Appendix A

Wildland Vegetative
Fuel Management Plan

WILDLAND VEGETATIVE FUEL MANAGEMENT PLAN

JULY, 2020

UNIVERSITY OF CALIFORNIA, BERKELEY

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1. EXECUTIVE SUMMARY

The Wildland Vegetative Fuel Management Plan (WVFMP or Plan) proposes treatments of vegetation and associated fuels within the 800-acre UC Berkeley Hill Campus (Plan Area or Hill Campus) to improve public safety and reduce losses/damage from wildland fire.

This Plan describes the wildland fire management objectives, provides context to regional planning by highlighting partnerships, and highlights both past and current vegetation treatments and the regional planning context in terms of partnerships and both past and current vegetation treatments.

The WVFMP then characterizes existing conditions, focusing on wildland fire aspects that influence both wildfire threats, response, and potential management, such as fire history, hazard ratings, access, topography, water resources, plant and wildlife resources, and vegetative fuel models. A detailed fire behavior analysis is presented that predicts flame lengths, fire spread rates, potential for crown fire, and spot fire distribution.

Vegetation treatments are proposed that address the existing conditions and are categorized as Evacuation Support Treatments, Fire Reduction Treatments, Fuel Break Treatments, and Creation of Roadside Temporary Refuge Areas. Each vegetation treatment type achieves different goals and objectives.

Treatments are conducted through a variety of activities, which are described in the Plan. These activities include manual vegetation treatment, mechanical vegetation treatment, prescribed burning, managed herbivory (livestock grazing), herbicide application, and biomass utilization and disposal. Any of the activities could be used singularly or in combination to implement any of the goals of the treatment types. Proposed projects have been designed and are described herein, including the location, goal, and vegetation treatment activity(ies) of each project.

A set of best practices and environmental protection measures are included in this Plan, along with a list of permits and approvals that could be required. A program that ensures ongoing maintenance, monitoring, and adaptation is also included.

The Plan will be reviewed by the UC Berkeley Fire Mitigation Committee. The Chancellor is the UC Berkeley decision-making body with discretionary authority to approve the Plan.

2. OVERVIEW OF THE PLAN

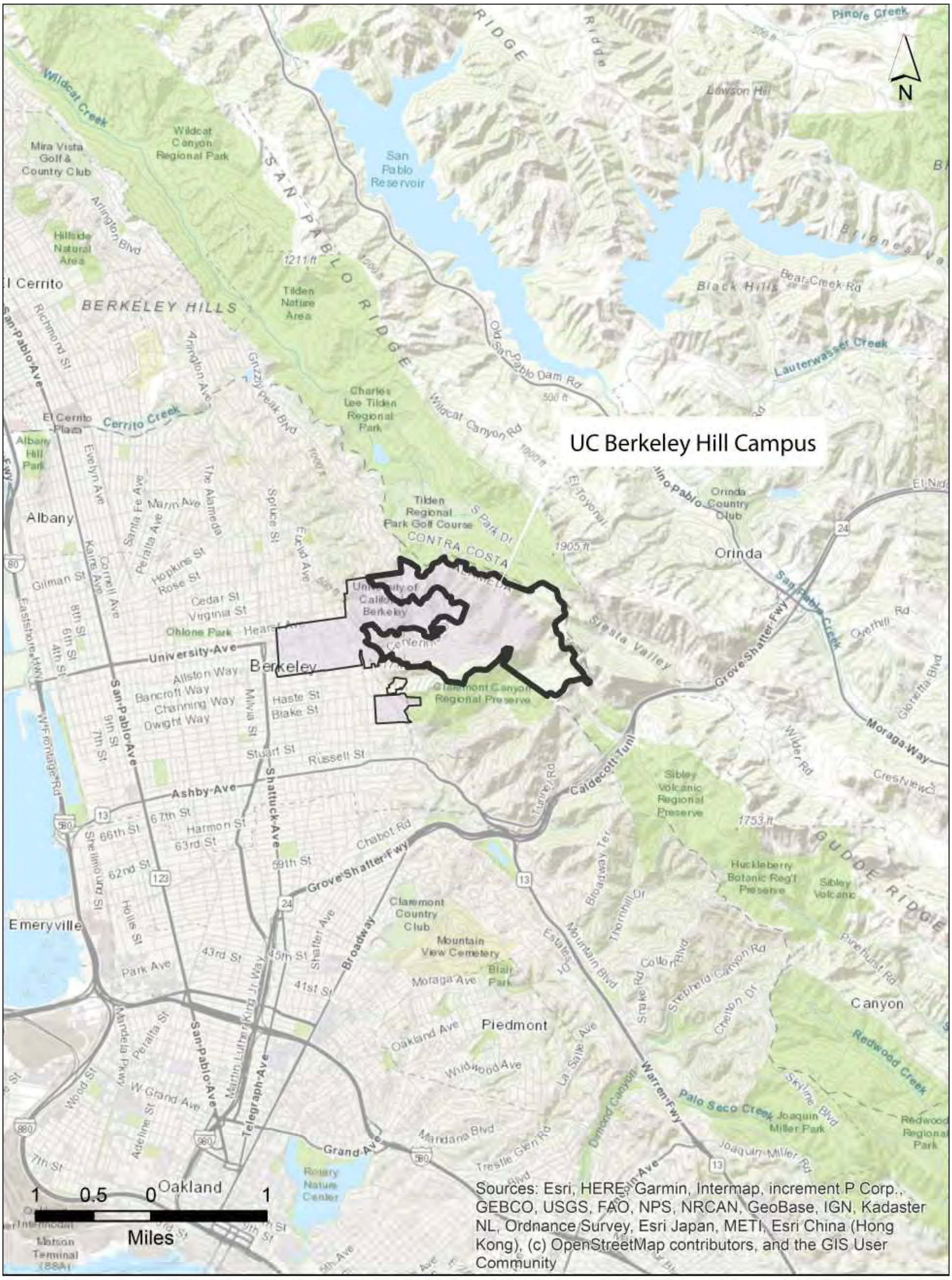
The Wildland Vegetative Fuel Management Plan (WVFMP or Plan) for the UC Berkeley Hill Campus (Plan Area or Hill Campus) is proposed by the University of California, Berkeley (UC Berkeley) to treat vegetative fuels within the Plan Area. The WVFMP covers vegetation management to improve public safety and reduce potential impacts of a wildland fire. The Plan serves as one component of UC Berkeley's range of actions to reduce wildfire risk and minimize the potential for harmful effects of wildfire on people, property, and natural resources within the 800-acre Plan Area, as shown in Figure 1. As part of the Plan, UC Berkeley would implement vegetation treatment activities on approximately 300 acres annually within the Plan Area.

The Plan will be reviewed by the UC Berkeley Fire Mitigation Committee, an interdepartmental body comprising UC Berkeley staff and faculty. The Chancellor is the UC Berkeley decision-making body with discretionary authority to approve the Plan.

The WVFMP presents a multifaceted approach to vegetation treatment. The Plan includes different vegetation treatment types, each achieving different goals and objectives. The vegetation treatment types are fire hazard reduction, evacuation support, temporary refuge areas, and fuel breaks. The Plan also describes vegetation treatment activities that would be implemented to achieve the goals of each treatment type. The vegetation treatment activities are manual treatment, mechanical treatment, prescribed burning, prescribed herbivory (livestock grazing), and targeted ground application of herbicides. Any of the activities could be used singularly or in combination to implement any of the goals of the treatment types. Proposed projects have been designed and are described herein, including the location, goal, and vegetation treatment activity(ies) of each project.

The WVFMP does not include other aspects of fire management, such as ignition detection (including installation of cameras or increased roving patrol), a program to enhance fire suppression capabilities (emergency response), nor the placement of water tanks in remote areas of the Hill Campus. This Plan focuses on fuel management through vegetation treatment only.

A fuel management plan focuses on vegetation management to alter fire behavior – potentially to decrease ignitability, reduce fire intensity and heat output so that fires can be contained and suppressed more easily, resulting in smaller, and less damaging wildfires. In contrast, a wildfire management plan typically includes all aspects of wildland fire management, including ignition detection, reporting (i.e., communications), response (encompassing water supply, designated authorities, communications), and post-fire recovery. A wildfire management plan is typically a large document that includes a detailed fire prevention plan that encompasses patrols, education and public outreach, property closure triggers, and operations plan. A wildfire management plan also includes details on wildfire response, such as hydrant locations, engine response times, landowner responsibilities during a wildfire (including evacuation support), and post-wildfire actions including maintenance.



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Vicinity Map UC Berkeley Hill Campus Wildland Fuel Management Plan

Figure 1. Map of the Hill Campus vicinity

2.1 PLAN OBJECTIVES

The objectives of the Plan guide its implementation and will help UC Berkeley to plan, budget for, execute, and monitor the results of its actions. The objectives of the Plan are to:

- Increase the Plan Area's resistance to catastrophic wildfire to reduce the potential for loss of human life and property damage from wildfire.
- Provide a range of vegetation treatment and maintenance activities in a manner that mitigates adverse environmental effects.
- Thin vegetation to reduce the likelihood in a wildfire event of ember production starting new fires (known as ember cast).
- Increase the pace and scale of vegetation treatment and maintenance activities to reduce the overall fuel volume available to burn, thereby increasing the probability of containment of a future fire.
- Manage highly flammable invasive plant species and promote fire-resistant native plant species to reduce wildfire risks and enhance biodiversity.
- Maintain the visual character of the Plan Area for recreational users and neighboring communities.
- Enable UC Berkeley staff to make informed and adaptive management decisions that are cost-effective and environmentally sustainable.
- Maintain an active role in regional efforts to reduce wildfire hazard in the East Bay hills.

2.2 REGIONAL WILDFIRE RISK REDUCTION PLANNING

The Plan is consistent with local and state codes and ordinances that pertain to wildfire risk reduction. More than twenty reports and plans address wildfire hazard in the Oakland/Berkeley Hills, and the Plan is consistent with or considers information in the following campus, regional, and statewide vegetative fuel management documents:

- **UC Berkeley, *2020 Long Range Development Plan* (2005)** – includes policies to manage vegetation in the Plan Area to reduce fuel load focusing on high-hazard introduced species.

- **CAL FIRE Santa Clara Unit Plan, *Strategic Fire Plan* (2018)** – identifies the 16,200 acre Oakland-Berkeley Hills as a Priority Area, and specifically mentions the 1991 Oakland Tunnel Fire, which destroyed 3,000 homes for a loss of 1.8 billion dollars, and identifies the "Berkeley upper Strawberry Canyon fuel reduction project" as a priority vegetation reduction project in Claremont Canyon; the Plan Area encompasses both canyons.

- **CAL FIRE, *California Strategic Fire Plan* (2018)** – provides a roadmap for reducing the risk of wildfire in the state by focusing on fire prevention and suppression activities and natural resource management to maintain the state's forests as resilient.

- ***2018 State of California State Hazard Mitigation Plan*** – represents the state's primary hazard mitigation guidance document that includes discussions on wildfire and structural fire hazards and provides a mitigation plan for an effective wildfire suppression plan.

- ***Alameda County Community Wildfire Protection Plan* (2015)** – provides a comprehensive analysis of wildfire hazards and risks, and identifies proposed projects to reduce the risk of wildfire in the wildland-urban interface areas of Alameda County. The Plan prioritizes vegetation treatment projects in the Plan Area.

- **East Bay Regional Park District, *Wildfire Hazard Reduction and Resource Management Plan* (2009)** – identifies a framework for undertaking ongoing vegetation management activities on park lands in the East Bay hills in Alameda and Contra Costa counties adjacent to the Plan Area.

- **East Bay Municipal Utility District, *East Bay Watershed Fire Management Plan* (2000)** – guides the implementation of fire protection and preparedness activities that meet key watershed management objectives adjacent to the Plan Area.

- **Lawrence Berkeley National Laboratory, *Federal Wildland Fire Management Plan* (2015) –** provides a comprehensive wildland fire management plan to be implemented by LBNL on LBNL-managed property in the Hill Campus.

- **City of Oakland**, ***Draft Vegetation Management Plan* (2019) –** includes a framework for managing fuel loads and high hazard vegetation management activities to reduce fired hazard on approximately 1,300 acres within the City of Oakland, including Claremont Avenue and Garber Park, located immediately south of the Plan Area.

- **City of Berkeley Wildfire Evacuation Plan (Draft) (2019)** – The City of Berkeley's Fire and Rescue Department recognizes the threat wildfire poses to its approximately two thousand residents in neighborhoods north and south of the Plan Area and establishes a High Fire Hazard District. Centennial Drive has been identified as one of only three evacuation routes in its newly revised evacuation plan.

2.3 PARTNERSHIPS

The proposed treatments included in this Plan are part of a regional effort to remove high hazard fuels and reduce risks from wildfires in high hazard areas by installing and maintaining major ridgetop fuel breaks and improve public safety within evacuation corridors for the communities of Oakland, Berkeley, and other East Bay municipalities. UC Berkeley works closely with internal and external fire management partnerships which have assisted in the development of the Plan, including Hills Emergency Forum (HEF), Diablo Firesafe Council, and various neighborhood groups, along with internal interdisciplinary planning teams. HEF has partnered with UC Berkeley as a technical advisor of the Plan; Diablo Firesafe Council has partnered with UC Berkeley for community outreach and liaison; and the Alameda County Resource Conservation Service for oak planting coordination. UC Berkeley maintains the following partnerships:

- **Hills Emergency Forum (HEF):** UC Berkeley participates regularly in HEF, an inter-agency organization of nine partner agencies in the East Bay hills aimed at regional wildfire prevention and protection. The nine members coordinate collection, assessment and sharing of information on East Bay hills fire hazards, and HEF provides a forum for building interagency consensus on developing fire safety standards and codes, incident response and management protocols, public education programs, multi-jurisdictional training, and vegetation reduction strategies.

- **Diablo Firesafe Council**: UC Berkeley supports and collaborates with the Diablo Firesafe Council, a non-profit organization that provides resources to coordinate public and private landowners in Alameda and Contra Costa counties to reduce the threat of wildfire. UC Berkeley staff has attended and participated in its Partners in Prevention event and will continue to do so. UC Berkeley also supports the local Diablo Firesafe Council in the development and implementation of the Alameda County Community Wildfire Protection Plan (2015).

- **Special Districts**: Open Space lands owned and managed by the **East Bay Municipal Utility District (EBMUD)** and **East Bay Regional Park District (EBRPD)** lie immediately to the east and south of the Plan Area. EBMUD owns and manages land and waterbodies and is responsible for management surrounding nearby reservoirs. EBRPD owns and manages Tilden Regional Park to the east and Claremont Canyon Regional Preserve to the south of the Plan Area. Both agencies continue to implement vegetation management activities on its open space lands. UC Berkeley and these special district partners actively manage open spaces by installing and maintaining regional ridgeline fuel breaks that increase fire safety for landowners.

- **Pacific Gas & Electric (PG&E):** PG&E provides electricity to UC Berkeley (and LBNL) from a substation in the Plan Area, and the Plan Area encompasses right-of-way for overhead transmission lines. UC Berkeley collaborates with PG&E to treat vegetation in the Hill Campus along PG&E's electric transmission line right-of-way to increase power reliability and reduce ignition potential, and resulting wildland fire hazard.

- **Lawrence Berkeley National Lab (LBNL):** UC Berkeley partners with LBNL to actively install and maintain regional ridgeline fuel breaks. LBNL manages its property to ensure safety for its facilities and employees. In addition, since 1996, LBNL has maintained about 75 acres of UC Berkeley property in the Hill Campus for fire safety, consistent with its LRDP, under a Letter of Cooperation.

- **Cities**: The **cities of Oakland and Berkeley** inspect homes for defensible space compliance where they are adjacent to the Plan Area and cooperatively maintain road rights-of-way on routes abutting the Plan Area. UC Berkeley and the cities of Oakland and Berkeley participate in inspection and maintenance of defensible space on UC Berkeley land (including within the Plan area) and adjacent private and public properties.

2.4 PAST AND ONGOING VEGETATION TREATMENTS

2.4.1 HISTORY OF FIRE AND FUEL MANAGEMENT PLANNING IN THE HILL CAMPUS

The first known recommendations for fire management planning in the UC Hill Campus were recorded seven days after the Berkeley Fire in 1923. Nelson et al (1923) reported that this fire not only devastated a portion of the residential section, but also spread along the Berkeley Hills south to Tunnel Road in less than four hours. The group recommended the eucalyptus and pine trees killed by fire be piled and burned, or utilized for firewood. They recommended the forested areas which were burned be planted with fire resistant species, such as Redwood, to provide greater shade. The group also recommended increased education, prevention, detection and suppression activities.

A Study of the Long Term Use Potential of Strawberry Canyon and the Undeveloped Hill Lands (chaired by Robert L. Cockrell) recommended in 1958 that access be improved on the north facing slope and that water supplies (mains and hydrants) be established along major roads traversing the south and head of the canyon (Cockrell, 1958).

Dr. Harold Biswell prepared a thorough report in 1974 of "The Wildfire Problem and Management Plan for the Reduction of Fire Hazards in the Hill Area of the University Campus.” He advocated controlled broadcast burning under the coniferous stands, in the briars, as well as in the grassland and chaparral. Additionally, Dr. Biswell recommended the eradication of eucalyptus sprouts and French broom. Lastly, he suggested more coast live oak be planted in lieu of the north coastal scrub on the north facing slopes of Strawberry Canyon, and in other locations (Biswell, 1974).

Garret Eckbo and Associates included fuel management recommendations as part of a campus-specific Vegetation Plan in "A Land Use and Vegetation Management Study” (1976). This study classified existing vegetation units. Desired vegetation was stated for each unit, and fuel management prescriptions were specified. This study called for conversion of a major portion of eucalyptus sprouts to grass, greatly increased conifer plantations, and oak/bay woodland. The fuel management techniques that were often suggested were to pile and burn large diameter fuels every 25 years, broadcast burning at 10 or 25 year intervals, hand clearing, piling and burning soft chaparral, and cutting sprouts (then two years old) then treating with the chemical 2,4,D, which is also known as 2,4-Dichlorophenoxyacetic acid. The study also recommended the use of goats and cattle to clear brush and maintain grassland.

As a start of implementing the Garrett Eckbo report, Mark Hamlin, a contractor who prepared a report for UC Berkeley’s Office of Environment, Health & Safety, recommended the creation of a fuel break in the conifers and brush north of Panoramic Hill. Reduction of fuels was to be accomplished using controlled broadcast burns.

The UC Berkeley Committee on Conservation and Environmental Quality submitted in 1978 a "Proposed Management Plan for Strawberry and Claremont Canyons” (McBride, 1978). This committee recommended that a fuel management zone 100 feet wide be established on UC boundaries where they are adjacent to residential property. The density of shrubs and trees were to be reduced in this strip, trees limbed, and mulch burned on a periodic basis. An experimental forest was proposed for the Claremont Canyon area.

A UC Berkeley/EBRPD Joint Agency Fuel Management Plan for the Dwight Derby Site/Berkeley Open Space Regional Park was issued in 1983 where the area behind the Clark Kerr Campus and at the base of Panoramic Hill was to be managed with hand crews, goats and broadcast burning to reduce the fire hazard in the area. In 1984, the Hill Area Task Force recommended vegetation management activities in limited areas of the Hill Campus. The group recommended that eucalyptus sprouts be removed. The establishment of a 100-foot wide buffer zone along UC/private property boundaries was proposed to reduce fire hazard. The Task Force endorsed clearing, pruning and prescribed burning to maintain discontinuous fuel distribution in the buffer zone. Roadsides were to be mowed each spring.

A 1986 Plan by C.L. Rice and R. Aronson proposed a suite of treatments in all vegetation types throughout the Hill Campus (Rice and Aronson, 1986). Eucalyptus sprouts (then 13 years old) were removed on approximately 50 acres, goats grazed 40 acres and five prescribed burns were conducted.[1] The understory of coniferous forests on the north-facing spurs below the Jordan Fire Trail were thinned. Oak trees were planted in the area south of the satellite dish, now encompassed by LBNL, and native grass seed was distributed on Chaparral Hill. The plan was implemented until 1991, just months before the Oakland Tunnel Fire.

The 2020 Hill Area Fire Fuel Management Program (2003) is currently being implemented by UC Berkeley in the Hill Campus to reduce fire risk to the campus, LBNL, neighboring residents, and recreational visitors to adjacent park and watershed lands. The program, which was prepared by Safe Solutions Group (2003), approaches fuel management by offering a broad set of priorities and decision criteria for treatments. The program prioritizes defensible space treatments both around structures and along property boundaries. The program does provide a process for larger-scale treatments, which allow for eucalyptus removal in Claremont Canyon and goat-grazing near MSRI. The program also recommends roadside and evacuation treatments that could extend to 100-feet from pavement edge, as funding allows. Ongoing vegetation management activities under this plan are largely funded and implemented by Facilities Services Department. While a baseline level of funding is provided to conduct treatments required by law, maintenance and larger treatments are undertaken as funding becomes available. This program would be replaced and superseded by this WVFMP.

2.4.2 PAST VEGETATION TREATMENTS

UC Berkeley has managed the Plan Area for fire hazard reduction for decades. The 1980s saw a combination of treatments in Strawberry Canyon that spanned prescribed burns, goat grazing, eucalyptus removal, and forest thinning with hand crews.[2] In the 2000s, efforts focused on eucalyptus removal in Claremont Canyon.[3]

More recently, UC Berkeley Facilities Services Department has planned for and undertaken regular vegetation treatment activities in the Plan Area. The vegetation treatments are reviewed and approved by the Fire Mitigation Committee, an inter-department committee headed by the Scott Stephens, Wildland Fire Science professor from the College of Natural Resources, with representation from the university’s Facilities Services, Environmental Health and Safety, Lawrence Berkeley National

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[1] Prescribed burns were conducted at the following locations: Lawrence Hall of Science (3 times), Botanical Garden 1988), Panoramic Hill, Tightwad Hill, Big C eucalyptus grove.

[2] Fire Prevention Committee meeting minutes, 1986-91.

[3] Fire Mitigation Committee meeting minutes 2000-2011.

Laboratory Protective Services, and UC Berkeley Police and Capital Projects departments. The treatments covered by the 2020 LRDP EIR that Facilities Services has implemented over the years in the Plan Area include:

- Remove dead trees and hazardous trees or limbs that pose an imminent public safety risk;
- Remove vegetation along 100 feet of either side of roadways and trails to maintain emergency evacuation access;
- Provide defensible space, by removing vegetation within 100 feet of all structures consistent with the California State Public Resources Code (PRC) 4291; and
- Remove vegetation along a 15-foot strip of land adjacent to roads and near property boundaries, and a 50-foot radius of designated turnouts along Grizzly Peak Boulevard and Claremont Avenue.

Typically, vegetation treatment activities carried out by Facilities Services is implemented by hand crews and hand-held tools, with occasional use of machinery to cut grass and shrubs and to chip woody material. Herbicide is applied by hand-held tools to roadside vegetation, however it is currently limited in its use. Removal of exotic plants occurs in areas previously treated. In recent years, Facilities Services has replaced hazardous Monterey pine trees with fire-resistant trees, shrubs, and grasses on an area known as Tightwad Hill. In addition, the Claremont Canyon Conservancy, UC Berkeley Forestry Club and a local non-profit, Take to The Hills, have participated in maintaining prior treatments in the Plan Area through removal of flammable exotic invasive species and planting less flammable species. The combined efforts typically exceed 500 volunteer-days annually. Additionally, UC Berkeley has participated in and will continue to participate in Wildfire Awareness events organized by the Berkeley City Council.

2.4.3 HISTORY OF EUCALYPTUS MANAGEMENT IN THE HILL CAMPUS

While certain eucalyptus stands in the Hill Campus have been actively managed, others have been neglected. Some eucalyptus stands have been treated three times through thinning, pruning, understory removal, overstory removal – often with herbicide application to the cut stumps. In some stands, trees have been cut and herbicide applied to the stumps. Most eucalyptus trees in the Hill Campus have been cut and treated with herbicide twice, whereas some small stands of eucalyptus have never been removed. In all areas of treatment tree trunks were removed.

In 1974 FEMA provided millions of dollars via a grant to create a multi-jurisdictional fuel break that covered the East Bay Hills. The fuel break project was aimed at removing eucalyptus trees that were top-killed from a freeze in 1973 and played an important role in determining current conditions of the fuels in the Hill Campus because the structure of the eucalyptus stands changed. Almost all of the eucalyptus trees that were cut resprouted, despite being treated with herbicide after cutting.

Approximately 50 acres of the then 12-15 year-old eucalyptus sprouts were cut between 1988 and 1991 in Strawberry Canyon and on top of Chaparral Hill. Again, most of the eucalyptus trees in Strawberry Canyon resprouted, despite being treated with herbicide after cutting.

UC Berkeley cut approximately 90 acres of 20-year old eucalyptus sprouts in Claremont Canyon between 2005-2006, and because of effective herbicide application did not experience any resprouting. Approximately 2 acres of 24-year old eucalyptus resprouts near signpost 18 were cut and left to sprout again.

Hazard trees throughout the Hill Campus were felled as necessary between 1974 and 2019. Most recently, hazardous trees around one building in the Field Station for the Study of Behavior, Ecology and Reproduction (FSSBER) were felled in 2019, and trees that might block evacuation and access along a swath 100-feet on both sides of Centennial Avenue, were removed in 2019-2020, as shown on Figure 5. This treatment did not target eucalyptus, however most of the trees removed were eucalyptus because they were adjacent to the road and were more likely to block access or egress.

2.4.4 ONGOING VEGETATION TREATMENTS

Using funding received by CAL FIRE California Climate Investments Forest Health Grant, Facilities Services expanded its ongoing vegetation treatment and maintenance activities in the Plan Area that are covered by the 2020 LRDP EIR to implement treatments to improve emergency access and evacuation support within 100 feet of either side of large portions of Centennial Drive, as shown on Figure 5. Total area of vegetation removed in the winter of 2019-2020 was 33.3 acres within the Plan Area, which comprises an area 100-feet from pavement edge along the UC Berkeley-managed length of Centennial Drive (see Figure 5). UC Berkeley proposes to conduct a similar evacuation treatments support project along upper portions of Claremont Avenue covering roughly 18 acres within the Plan Area (see Figure 5), and 89 acres along the Jordan Fire Trail. The Centennial Drive, Claremont Avenue and Jordan Fire Trail treatments are consistent with CAL FIRE guidelines as they appear in Protective Practices for CAL FIRE's 35 Emergency Fuels Reduction Projects dated April 5, 2019.[4]

Current vegetation treatments take the form of Defensible Space Creation and Maintenance, Roadside Treatments, Turnout and Signpost Treatments, Exotic Plant Removal and Maintenance, as well as Evacuation Support, Hazard Tree Removal, and Replanting with Fire-resistant Vegetation. The total acreage of these types of treatments is 308 acres, as shown on Figure 2. Generally, treatments occur annually, however the Evacuation Support Treatments have been limited by funding, and will take place in 2019-2021, and periodically thereafter.

Table 1. Approximate Acreage of Ongoing Vegetation Treatment Types

Total Defensible Space	68
Total Roadside Treatments	3
Total Turnout Treatments	2
Total Exotic Plant Removal	76
Total Evacuation Support Treatments	151
Hazard Tree Removal	5
Replanting	3
Total	*308*

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[4] http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC&sectionNum=4291; http://resources.ca.gov/wp-content/uploads/2019/04/Signed-North-Orinda-Waiver.pdf

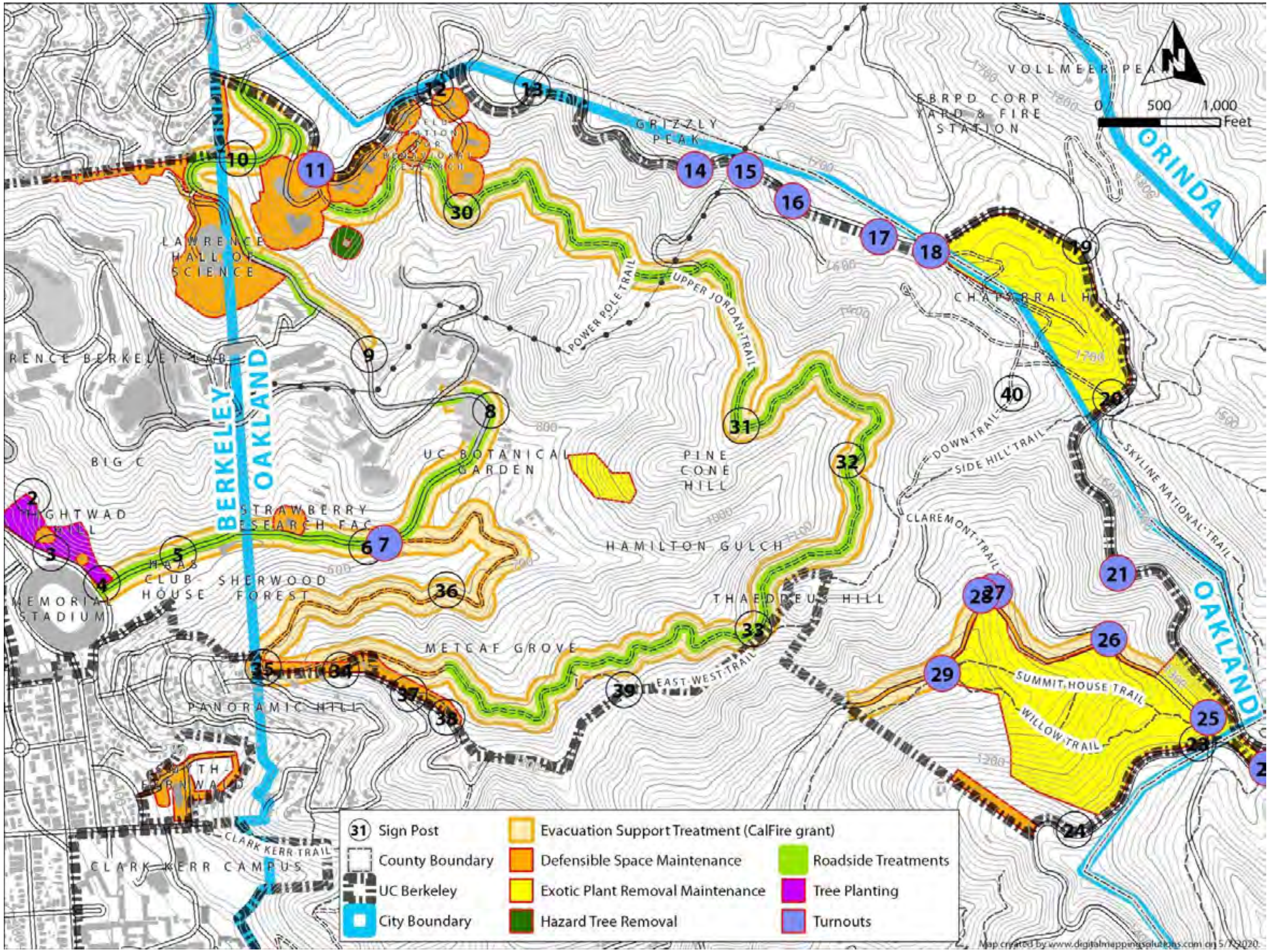

Figure 2. Ongoing vegetation treatments in the UC Hill Campus.

2.4.4.1 Defensible Space and Roadside Treatments

Since 2014, UC Berkeley has applied the set of standards below to direct initial treatments and maintenance activities in the Roadside Treatment and Defensible Space Maintenance areas in the Plan Area. The standards for the Roadside Treatments apply to the strip of land within 15 feet of the pavement edge from both sides of designated roadways. The Defensible Space Maintenance area applies to areas within 100 feet of any structure, unless specified otherwise. These distances are consistent with California State PRC 4291.

2.4.4.2 Standards for Defensible Space

- A minimum of five-foot wide zone (the Non-Combustible Zone) nearest the structure should be kept free of all woody plants and combustible materials.
- Keep the ground free of dead leaves, mulch, needles or other plant debris. The ground surface should be composed of inorganic, non-combustible, material such as decomposed granite, pebbles, or rock/flagstone.
- Vegetation in the non-combustible zone could include irrigated lawns and succulents, but would exclude woody plants.
- Dead material that drapes over ground cover will be removed. This includes leaves, bark, and branches.
- Cut and chip trees with a high fuel volume that are at risk of falling on buildings, structurally unsound, or are unhealthy. Large, “legacy trees” that are structurally sound, and with branches that are 30-40 feet above ground will be retained.
- Remove all dead plants and dry vegetation.
    - Cut grass and weeds within 15-feet of the pavement edge and within 30-feet of a structure to less than four inches in height.
    - Remove leaves, bark, and humus under trees and shrubs (including vines and semi-woody species) so that the buildup of leaves and humus will not exceed two inches in depth anywhere in a defensible space within a year. However, do not expose bare earth in over 50 percent of the site.
    - Remove dead material that drapes over ground cover (including leaves, bark, and branches).
    - From mature trees, remove all vines, loose papery bark, dead branches, and live branches smaller than three inches in diameter to a height of 8 feet above the ground.
    - Remove all dead branches from within live ground covers, vines, shrubs (including semi-woody species), and immature trees.
- Prune trees and large tree-form shrubs (e.g., elderberry or toyon) that are being retained.
    - All lower tree branches, under three inches in diameter, will be removed up to eight feet above the ground, or on the lower third of trees, whichever is less (see Figure 3, below). OR,
    - All lower tree branches, under three inches in diameter, will be removed to provide vertical clearance of three times the height of the understory plants, or eight feet above understory plants, whichever is greater. Retention of short understory shrubs provides aesthetic benefits and wildlife habitat without sacrificing fire safety; alternatively, trees will be pruned to a higher height in order to allow for screening from the understory shrubs.

  - In young trees, remove the branches on the lower one-third of the height of the tree. Example: if a tree is 10 feet tall, prune the lower three–four feet and keep the understory plant material to less than one feet in height. As the tree grows to 24 feet in height, it can achieve the eight-foot distance from the ground, and the understory plant material can reach 2.5 feet in height.

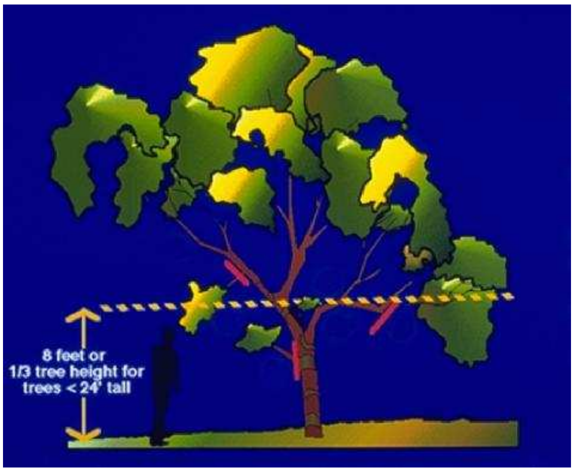

Figure 3*. Prune branches to a height of 8 feet above the ground. In young trees, prune branches on the lower one-third of the height of the tree. Do not disturb or thin the tree canopy. This promotes growth in the understory, which is more easily ignited.*

- All dead branches smaller than three inches in diameter will be removed. All dead limbs greater than three inches in diameter should be retained where they do not pose a public safety of fire risk.
  - Do not thin or prune the upper tree canopy, as this will promote more growth in the lower parts of the tree, and may result in increased risk that fire will spread to the tree canopy.
  - Sometimes small trees may need to be cut to the ground in order to achieve the separation of the ground level from another, larger, tree canopy, or because mowing equipment cannot avoid the small trees.
  - Maintain at least eight feet of vertical clearance between roof surfaces and overhanging portions of trees.
- Manage individual plants or shrub masses to maintain horizontal spacing, per Figure 4 below. Design distinct groupings of shrubs (including vines, semi-woody species, all types of brush, and all chaparral species). Make sure the plant groupings are small enough to provide adequate horizontal separation between groupings and to allow proper maintenance; groupings should measure no wider than two times the grouping height, or 120 square feet. The space between islands should be greater than three times the height of the shrubs (see Figure 4).
- Remove and safely dispose of all cut vegetation and hazardous refuse, using a gasifier or air-curtain type burner wherever possible.
- Chipped materials may remain on site, provided the mulch layer is no greater than three inches in depth.

Figure 4. *Shrub island spacing. Design groups of plants small enough to provide horizontal separation between groups. This allows proper maintenance and helps slow the spread of fire. Each shrub or group of plants should measure no wider than two times its height, or less than 120 square feet (or 6 feet x 20 feet). The space between groups should be greater than three times the height of the shrubs.*

2.4.4.3 Standards for Roadside Treatments

Within 10 feet of road pavement edge:

- Grassland vegetation and invasive weeds will be mowed to a 4-inch height or treated with herbicide annually. In unusual circumstances when rains occur after grass is mowed, grass may be allowed to regrow or need to be re-mowed.
- Understory shrubs will be removed under trees, or shortened to create a vertical distance between the top of the shrub and the bottom of the tree canopy of three times the shrub height.
- Trees will be pruned of lower branches (to eight feet in height, or the lower third of branches).
- All tree branches extending over roadway surfaces should be pruned to ensure at least 15 feet of vertical clearance.

2.4.4.4 Evacuation Support Treatments

Evacuation support treatment project areas are identified on Figure 5. In all areas, vegetation treatment for evacuation support focuses on removing highly flammable trees, understory shrubs and small trees that could enable torching, and trees that may block access/egress should they fall. The goal for evacuation support treatments is to improve public safety and reduce loss from wildfires by supporting the conversion of the existing fire-prone forest to vegetation with more favorable burning characteristics.

In areas located within 100 feet of Centennial Drive, Claremont Avenue, and Jordan Fire Trail (see Figure 5) vegetation treatments focus on achieving a two to four-foot predicted flame length immediately after treatment. Vegetation treatments aim to remove high-volume vegetation and create discontinuity in the fuel so that in the event of fire, the rate of spread is slowed, and flame lengths meet the treatment goal in treated areas. UC Berkeley treats and maintains the first 10 feet from the pavement edge for evacuation support treatments, as described above in Sections 1.4.4.3.

In the Plan Area, UC Berkeley removes all dead, unhealthy or trees leaning toward Centennial Drive, Rim Way, Claremont Avenue and Jordan Fire Trail. “Specimen” trees identified by the UC Berkeley landscape architect that are healthy and that do not pose a public hazard are retained, per the campus Specimen Tree Program (UC Berkeley, 1990) and all shrubs under them removed. Trees to be retained are protected during treatment periods. UC Berkeley applies practices consistent with those used by the International Society of Arboriculture and follows current California Forest Practice Rules.

In evacuation support treatment areas, UC Berkeley removes lower branches of all trees to a minimum height of 8 feet, and understory vegetation. Shrubs are removed or thinned to a minimum spacing of 6 feet. Surface vegetative fuels may include short shrubs with little dead material, leaf litter, annual and perennial grass. Taller shrubs may be present well away from a tree canopy. Grass is cut every fire season within 10 feet of the pavement edge of Centennial Drive, Rim Way, and Jordan Fire Trail. Branches hanging over roadbeds or fire trails are trimmed to a height of 15 feet above ground. Dead surface fuels smaller than six inches in diameter are removed. Leaf litter of less than six inches in depth is typically left and dead trees are removed. Chips will cover most surfaces within the area upon completion of the treatment; in this treatment area chip depth can be as deep as six inches.
See https://facilities.berkeley.edu/news/centennial-drive-evacuation-support-project for details of the prescription.

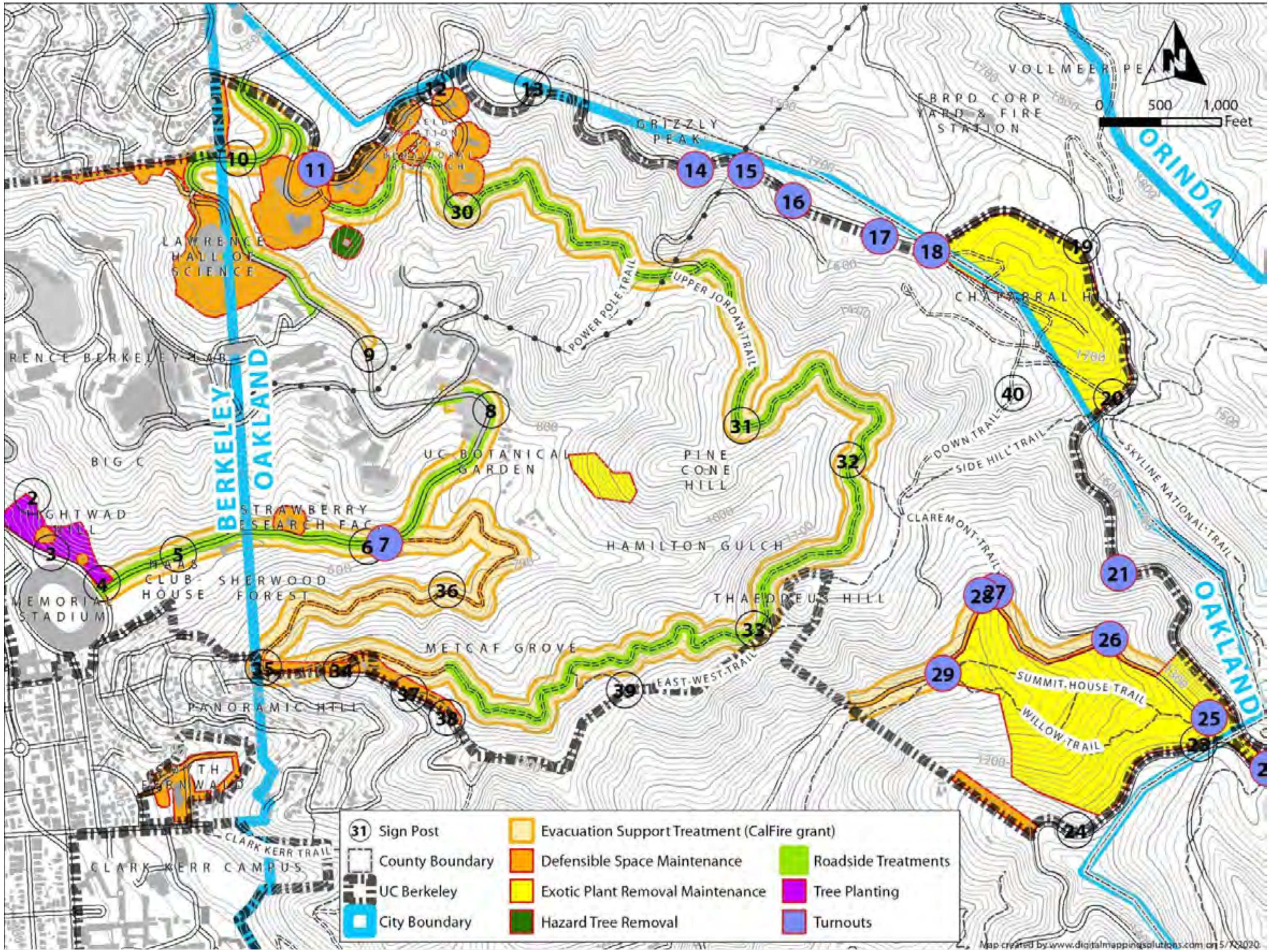

Figure 5. Map of ongoing vegetation treatment projects funded by CAL FIRE grant

2.4.4.5 Standards for Turnout Treatments

Vegetation at turnouts is treated annually and performed according to specified actions, depending on the location. Generally, treatments are to cut grass, and remove debris for a 50-foot radius from pavement edge. Refer to Figure 2 for the locations of treatments these turnouts. UC Berkeley performs the following activities annually at two expanded locations where an additional value at risk is present or where a staging area is possible. In addition, treatments are also applied to the Vista Parking Lot near the Lawrence Hall of Science:

Sign Post 24

- Cut flashy vegetative fuels (e.g. dry grass, which is easily ignited) from pavement edge to the incline of western slope, and approximately 300 feet east of the UC Berkeley property boundary; remove all Coyote Brush within 300 feet east of the UC Berkeley property boundary.
- Spread or haul away wood chips so that there is a three-inch maximum depth.
- Do not treat the first two feet near the fence (avoid succulents).
- Perform the following actions at the driveway entrance:
  - Clear vegetation along the east side of the driveway where cars may park
  - Clear vegetation 50 feet from west of roadside western slope

Sign Post 29

- Cut flashy fuels at the entrance where vehicles park between the gate and logs, and pavement edge from entrance for 50 feet east bound on Claremont Avenue.
- Cut flashy fuels for 10 feet on both sides of the road from the entrance along emergency access road to first marked trail, and beyond to eastern incline (areas also to be trimmed: redwoods and campus signs).
- Cut flashy fuels north of the emergency road to paved road.
- Spread wood chips (or haul away) so that there is a three-inch maximum depth.
- Cut flashy fuels along Willow Trail 30 south of emergency road.
- Cut flashy fuels from the emergency road north to the logs at pavement edge landing located north of the emergency access road, generally opposite the trail map.
- No trail maintenance.
- Stay away from creek bank and other water sources.

Vista Parking Lot

- At Vista Parking Lot: From the boundary of private yards 100 feet south on UC Berkeley land: continue weed whipping west to Campus Drive.
- Cut grass on 10 feet west of (below) Vista Parking Lot and parking to freight entry.
- Spread or haul away wood chips so that there is a three-inch maximum depth.

See also Appendix B “2018 SCU Ops Guide (1)” which is included in bid packages for Annual Work.

2.4.4.6 Exotic Plant Removal

The following work will take place in the area described as Exotic Plant Removal in the map entitled Annual Maintenance Activities (Figure 2).

Over the years, in specific areas, UC Berkeley has removed eucalyptus and acacia sprouts in the Plan Area. In these areas, occasional eucalyptus and acacia seedlings that are found will be removed. Eucalyptus seedlings smaller than two inches in diameter are pulled and Monterey pine trees smaller than four inches are cut or pulled, as is French broom plants. Eucalyptus, acacia, and French broom sprouts and seedlings that are cut are treated with herbicide according to the Pest Control Advisor (PCA) recommendation. Cut material is not expected to be of large volume and is left on site when it cannot be safely or feasibly chipped, in lengths no longer than two feet. The small volume of cut material should be no higher than 18 inches off the ground in an area no more than 1/10th acre, and further than 300 feet from existing structures.

2.4.4.7 Tree Planting

Tree planting is conducted under the supervision of the Facilities Services Fire Mitigation Program Manager and campus Landscape Architect, based on field conditions. Native trees, including oaks, maples, and buckeyes, are selected by staff, with volunteer labor planting the trees in openings on the slope during the late winter or spring. This activity has occurred on Tightwad Hill, in openings created from the removal of hazard trees (see Figure 5). Table 2 includes the annual acres of ongoing vegetation treatments in the Plan Area since 2014.

Table 2. Annual Acres of Ongoing Vegetation Treatments by UC Berkeley

Fiscal Year	Defensible Space Maintenance (acres)	Exotic Plant Removal (acres)	Roadside Treatment (acres)	Evacuation Support Treatment (acres)	Turnout Treatment (acres)	Tree Planting (acres)	Total (acres)
2014	70	76	3	0	2	0	151
2015	70	76	3	0	2	0	151
2016	69	76	3	0	2	5.3	155
2017	66	76	8	0	2	5.3	157
2018	66	76	4	0	2	5.3	153
2019	69	76	3	131	2	5.3	286

Source: Facilities Services

Treatments are aimed at maintaining the vegetation per the standards described in the previous sections. Facilities Services inspects sites annually in order to develop a work plan that addresses the needs of the area. In most cases, the area needs to be treated in some manner to reach the standards; however, in other locations, such as at the end of Mosswood or Canyon drives, work needs only to occur periodically. A full monitoring and maintenance plan appears in Section 7 of this Plan.

3. DESCRIPTION OF EXISTING CONDITIONS

3.1 PLAN AREA

The Plan Area comprises the roughly 800-acre UC Berkeley Hill Campus in the hills adjoining but east of the UC Berkeley Campus Park and California Memorial Stadium. The Plan Area is located primarily in Alameda County with a small area in unincorporated Contra Costa County (see Figure 1). Roughly 85 percent of the Plan Area is located within the City of Oakland; the lower or westernmost portion of the Plan Area lies within the City of Berkeley. The Plan Area is bounded on the east by Grizzly Peak Boulevard; to the west by Stadium Rim Way and private residences; to the south by Grizzly Peak Boulevard and the East Bay Regional Park District's Claremont Canyon Regional Reserve; and to the north by LBNL and private residences. LBNL manages approximately 200 acres in the Hill Campus, which is not included in the Plan Area. LBNL is a federally funded research and development center, operated and managed by the Regents of the University of California on behalf of the United States Department of Energy. The Plan Area is located within the wildland-urban interface (WUI), which is the area where humans and their development meet or mix with wildland fuel.

3.2 FIRE HISTORY

California has long been recognized as one of the most fire-prone natural landscapes in the world. Wildfire, particularly WUI fire, represents the third greatest source of hazard to California, behind flood and earthquake hazards, both in terms of recent state history as well as the probability of future destruction of greater magnitudes than previously recorded (State of California Hazard Mitigation Plan, September 2018). Wildfires in the state in 2017 and 2018 were by far the most destructive and deadly in recent history. In California in 2017, 10,280 structures were damaged or destroyed and 47 people lost their lives (https://www.fire.ca.gov/incidents/2017/). In 2018 24,226 structures were damaged or destroyed and 100 fatalities occurred in the state[5].

The East Bay hills' combination of hot dry summers, conducive topography, flammable vegetation, dense urban development, limited fire-fighting access, and Diablo winds (winds generally blown east to west and usually occurring during late summer and early fall) present significant risks to the public and structures and property along the wildland-urban interface.

Historic wildfire ignitions in the East Bay hills have not been well documented, but are often directly related to human activity. Records are in the form of newspaper articles and old fire planning studies but support the conclusion that wildfires pose a substantial risk to the Plan Area. As shown in Figure 6 below, between 1923 and 1998, 11 Diablo wind fires burned 9,840 acres of the East Bay hills, destroying 3,542 homes and killing 26 people, with more than 2 billion dollars in financial loss in current dollars. During the same period, three large west-wind fires burned 1,230 acres of grass, brush, trees, and four homes in the East Bay hills.[6]

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[5] https://www.fire.ca.gov/incidents/2018/

[6] EBRPD WHRRMP 2010.

The 1991 Oakland Tunnel Fire set a tragic record for loss of homes to California wildfire, which has now been surpassed by the 2003 Southern California fires, 2017 North Bay Fires, and the 2018 Camp Fire. Until 2017, the 1991 Tunnel Fire stood as the highest destruction of California homes per acre. For eight decades, the 1923 Berkeley Fire, which burned 130 acres north of the Plan Area, held the California record for the greatest number of structures destroyed by wildfire (584 structures). This fire also burned through the Plan Area and destroyed several structures on the north side of the UC Berkeley campus. Additional smaller fires have also ignited near the Plan Area including, most recently, the Grizzly Fire. In 2017, the Grizzly Fire burned 20 acres in the Plan Area and caused the evacuation of more than 1,000 youth campers, researchers, and other staff. The event prevented access by emergency responders along Centennial Drive and disrupted research, camps, and other UC Berkeley functions.

The 2017 Grizzly Fire brought to the foreground the need for increased fire safety in UC Berkeley's Hill Campus. This fire occurred Aug 2, 2017, during a hot, but generally windless day. Despite the moderate weather, the fire burned 20 acres and required involvement of 14 agencies in its suppression. The potential risk to public safety was illustrated by the required evacuation of four international laboratories (Mathematical Sciences Research Institute (MSRI), Space Sciences Laboratory (SSL), Lawrence Hall of Science (LHS), and LBNL), the public UC Botanical Garden, as well as seven children's summer camps. The potential for business disruptions and property damage was illustrated as it burned near PG&E transmission lines, which are critical infrastructure providing the sole source of power to LBNL and the UC Berkeley Campus Park.

3.3 HAZARD RANKING

The Plan Area directly abuts the residential area in Panoramic Hill. As mentioned before and demonstrated in part by the 2017 Grizzly Fire, access between and within the Plan Area and potentially fire-affected residential areas is poor or non-existent. Once one home ignites, house-to-house ignition is almost certain due to the combustible building characteristics, density of structures, and volume of vegetation between structures in this neighborhood that was developed in the 1900s.

The Plan Area is located within a Local Responsibility Area Very High Fire Hazard Severity Zone as identified by the most recent Fire and Resource Assessment Program map for the cities of Berkeley and Oakland.[7] It is also located in a State Responsibility Mutual Threat Zone. The Plan Area lies adjacent to the 1991 Tunnel Fire location; the current vegetation on the Hill Campus is the same as the vegetation that fueled the Tunnel Fire.

3.4 VEGETATIVE FIRE HAZARD

The expected intensity of a wildfire in the Plan Area is likely to prevent emergency access or evacuation, as well as be devastating to the environment. Hot winds during fire events can carry burning embers, potentially for miles. As noted in the textbook by Scott et al. (2015), the spotting potential of Eucalyptus forests is "unparalleled in terms of both density and distance as a result of the

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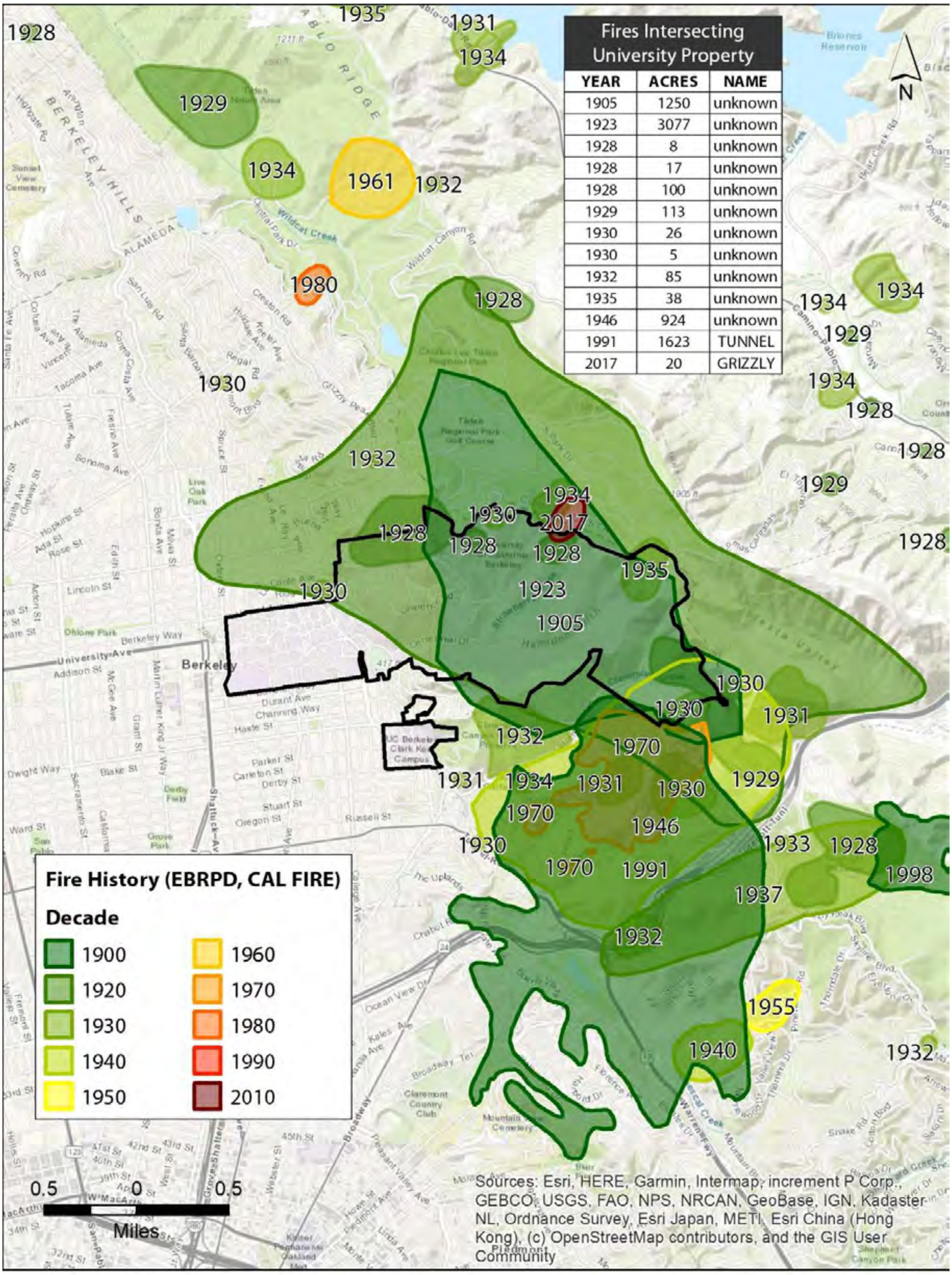
[7] https://osfm.fire.ca.gov/media/5604/berkeley.pdf;
https://osfm.fire.ca.gov/media/5606/oakland.pdf ;
https://osfm.fire.ca.gov/media/7271/fhszs_map1.pdf



Fires Intersecting University Property

YEAR	ACRES	NAME
1905	1250	unknown
1923	3077	unknown
1928	8	unknown
1928	17	unknown
1928	100	unknown
1929	113	unknown
1930	26	unknown
1930	5	unknown
1932	85	unknown
1935	38	unknown
1946	924	unknown
1991	1623	TUNNEL
2017	20	GRIZZLY

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Fire History Map UC Berkeley Hill Campus Wildland Fuel Management Plan

Figure 6. Fire history of the East Bay Hills

abundance and aerodynamic properties of the tree bark” (McArthur 1967). Eucalyptus spot fire distances of 30 - 41 kilometers were documented during one of the worst modern fire sieges on record, the Black fires in Victoria Australia on February 7, 2009, when 173 lives and over 2,000 structures were lost under hot and windy weather. Eucalyptus tree bark peels and remains draping, hanging and/or loosely attached and curled inward toward the tree bole, and it may act as a ladder fuel that enhances torching and ember production. McArthur (1967) shows a picture of *Eucalyptus obliqua* alight 60-70 feet above ground under “very mild” meteorological conditions. The bark eventually falls and creates a deep layer of combustible litter that decomposes very little, which may also contribute to crown fire under mild conditions. Crown fire is fire than has burned upward into the tree canopy. Spotting is the transfer of embers ahead of a fire front which can ignite smaller vegetation fires. Spotting has been identified as critical to the spread of some of the most destructive wildfires (Koo et al 2010).

The effects of spotting are sobering to those concerned with fire safety and damage. Secondary spot fires and roof ignitions from these firebrands substantially increase the extent of values at risk, potentially causing an urban conflagration involving far more than 2,200 structures currently considered at risk within and adjacent the Plan Area. A huge number of structures lie downwind of eucalyptus groves, many of which have not been retrofitted to meet modern building code requirements designed to withstand fire. With a high density of urban ignitions, a mass fire could occur, whereby the coalescence of the individual spot fires increases fire spread and intensity, such as occurred in 2017 in Coffey Park, Santa Rosa. These factors may help explain the devastating effects of the Diablo-wind-driven Tunnel Fire, and the 1923 Berkeley Fire. Prevention of crown fire in eucalyptus in the Berkeley/Oakland hills, and elsewhere in the East Bay is of paramount importance to the fire safety of a very large population, but is largely beyond the scope of the Plan.

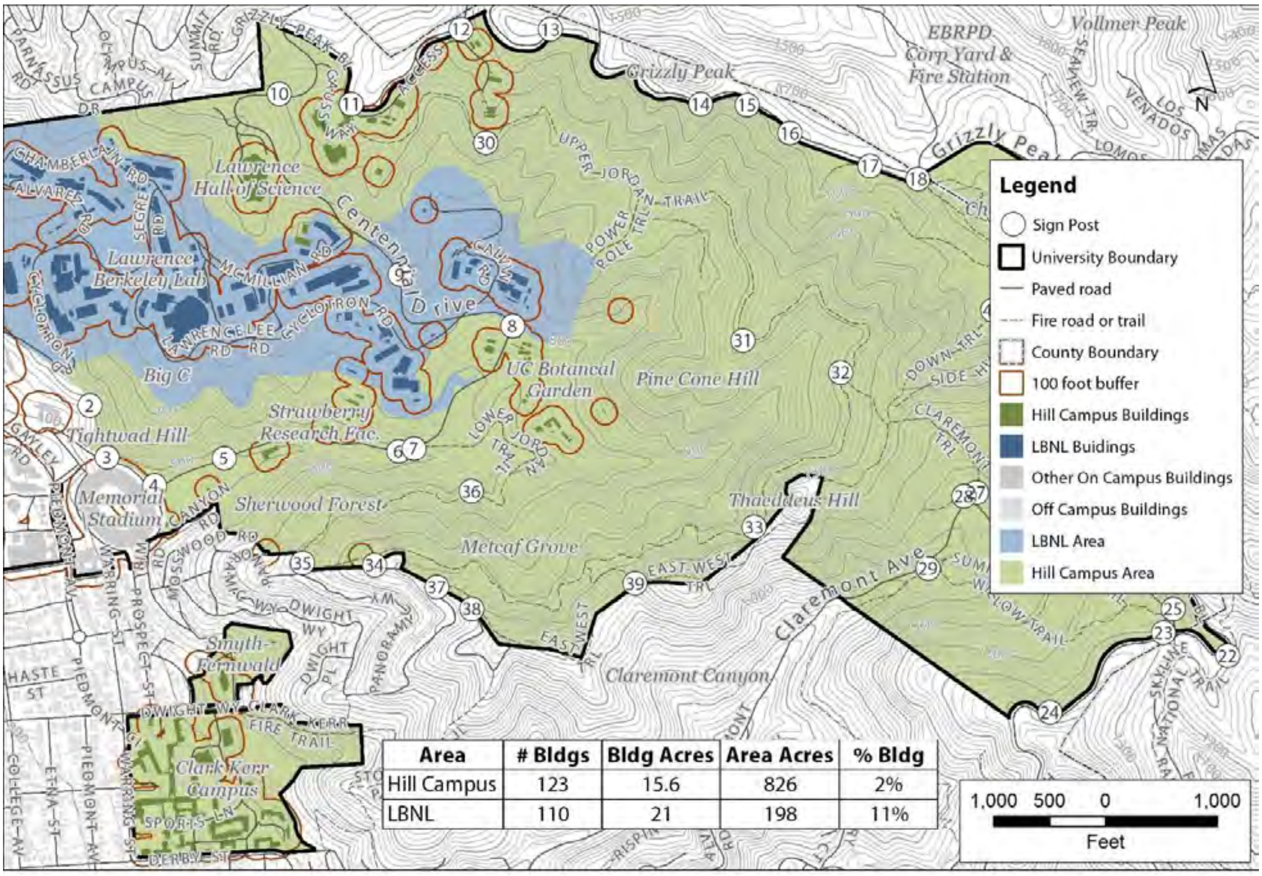
3.5 INFRASTRUCTURE

The Plan Area is heavily vegetated open space although it contains several UC Berkeley campus public and research facilities concentrated along Centennial Drive. Facilities include Lawrence Hall of Science, Mathematical Sciences Research Institute, Space Sciences Laboratory, Space Sciences Laboratory, Field Station for the Study of Behavior, Ecology and Reproduction, Botanical Garden, Facilities Services Strawberry Facility, and Strawberry Canyon Recreational Area (shown on Figure 7.) A Pacific Gas & Electric (PG&E) substation serving the Campus Park and LBNL is located in the Plan Area and included overhead transmission lines. The 2020 LRDP EIR reported that two Secondary Historical Resources are located in the Plan Area. These are Charter Hill and the Big C, and the Botanical Garden itself. In addition, a historic structure designed by Julia Morgan, built in 1911 and relocated to the Botanical Garden in 2014, is listed on both the California and national historic registries (LRDP EIR).

3.5.1 ACCESS AND ROADS

Paved public access roads within the Plan Area include Centennial Drive, Stadium Rim Way and Claremont Avenue. Grizzly Peak Boulevard defines the Plan Area’s eastern boundary. Centennial Drive, aligned east-west, serves as the primary emergency access to and a major evacuation route from the Plan Area to the west, as well as private residences and research institutes. Unimproved dirt fire trails provide emergency vehicle and maintenance access (EVMA), as well as recreational access within the

Plan Area. These fire trails include the East-West Trail and Upper and Lower Jordan Fire trails, which are heavily used for recreation and dog walking. Upper Jordan Fire Trails serve as the primary alternative emergency evacuation route for the Panoramic Hill neighborhood to the south, with 404 structures and a population of almost 1,000 residents. Centennial Drive is the primary emergency evacuation route for the 1,048 structures (day-time population 2,081) in the residential area to the north and has been designated by the Berkeley Fire Department as one of only three major evacuation routes for approximately 1,900 Berkeley residents. LBNL (with more than 3,000 employees) has two evacuation routes, one of which is through the Strawberry Gate on Centennial Dr.



Area	# Bldgs	Bldg Acres	Area Acres	% Bldg
Hill Campus	123	15.6	826	2%
LBNL	110	21	198	11%

Structures at Risk

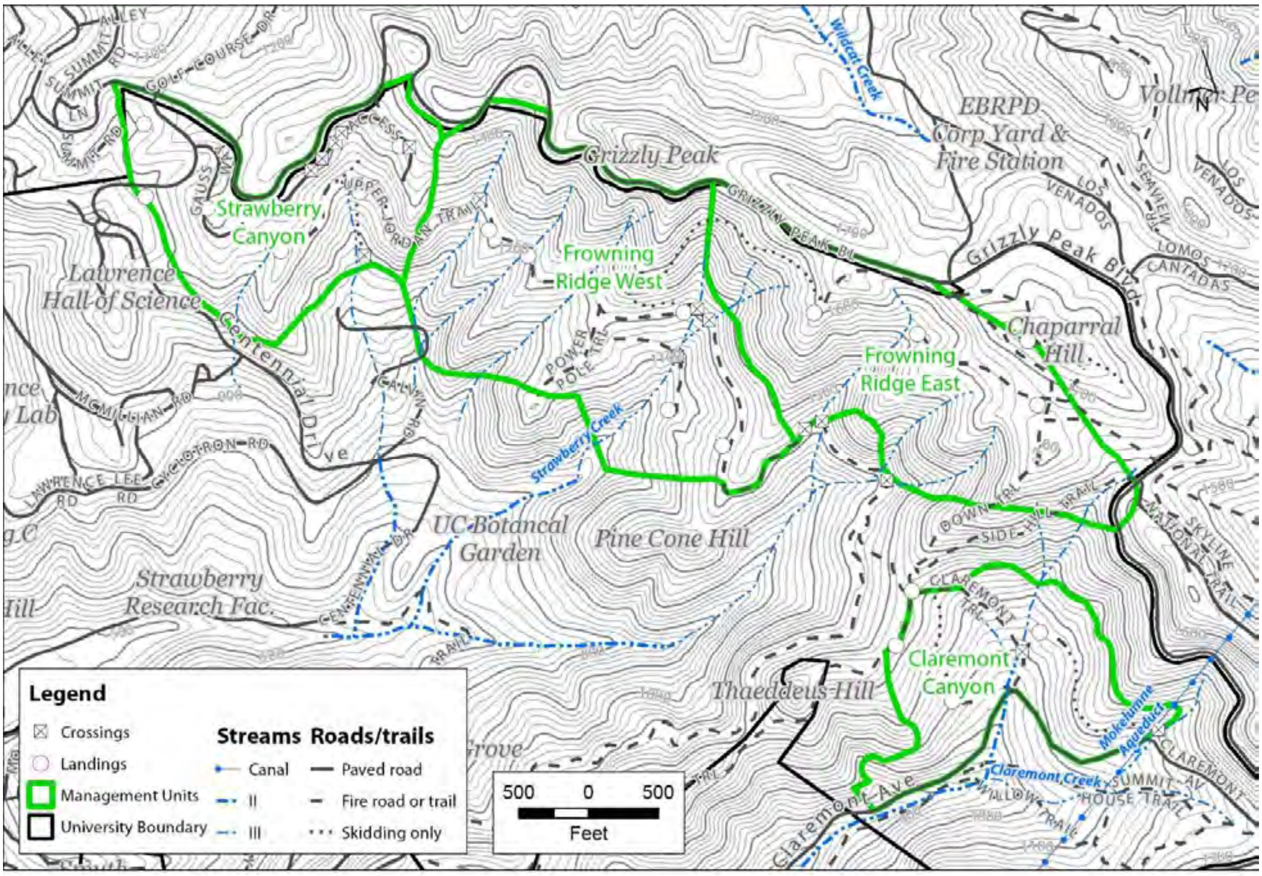
UC Berkeley Hill Campus Wildland Fuel Management Plan

Figure 7. Structures and facilities at risk in the Hill Campus

The current road network has been inspected and appears stable and sufficient to access proposed treatment areas. Many of these roads were successfully used in earlier tree-removal projects in the 1970s and late 1990s. UC Berkeley will inspect internal "appurtenant" roads before, during and after operations.

3.5.2 ROAD USE CLASSES

The Plan Area contains internal seasonal roads that represent "mainline" roads with native dirt and gravel surfaces, and moderate to low grades (Figure 8). Upper Jordan Fire Trail and the East-West Trail are in this class. These roads are behind locked gates and managed by UC Berkeley. These roads are not all-weather and vehicle use is restricted to dry summer months to avoid rutting and sediment movement into watercourses. Extended dry periods during the winter months between mid-November and mid-April occasionally occur, and ground conditions may be sufficiently dry for vehicle use, with prior approval by UC Berkeley Facilities Services.



Management Units Map UC Berkeley Hill Campus Wildland Fuel Management Plan

Figure 8. Road classes indicating routes suitable for skidding, hauling and public permanent roads

The Plan Area also contains trails that are generally too steep or have turns too tight to accommodate full-sized trucks, but can support 4WD pickups and may be used during treatments. Examples include Power Pole Trail, Down Trail, Claremont Trail, East Connector, and the newly built trail from Upper Jordan Fire Trail to Grizzly Peak at MP17 (i.e., “Botanical Experience Trail”).

UC Berkeley PDM Unit Operations Maps (Figure 8) show roads classified into appropriate uses as follows:

> “**Permanent/public**” – these are public paved roads used to access treatment areas: Claremont Avenue, Grizzly Peak Boulevard, and Centennial Drive.
>
> “**Suitable for hauling**” – these roads, shown in Figure 8 as *Fire road or trail*, were used for hauling and truck use in the past and are in good condition for use during treatment

"**Suitable for skidding only**" – these roads and trails, shown in Figure 8 as *Skidding only* are too steep or have inadequate turn radii to permit safe truck use – these skid roads lead to landings.

Appurtenant Road Class	Appropriate Use Class	Approximate Miles
Internal Seasonal	Suitable for Hauling	2.9
Internal Seasonal Jeep	Suitable for Skidding Only	1.6
Internal Permanent	Suitable for Hauling	0.3
Public Permanent	Suitable for Hauling	4.2

3.5.3 LANDINGS

The Plan Area contains 22 mapped (see Figure 9) landings that were either used previously or are located on flat areas suitable for construction and use with minimal ground disturbance. In some cases, landings may not be used for future projects, while in other cases existing landings may be required to facilitate operations. Due to limitations of the terrain, there a several locations where skid trails (routes used by tracked or wheeled skidders to move logs to a landing or road) meet landings on the haul roads near ephemeral watercourses. In these areas, UC Berkeley would take protective measures to prevent chip movement into watercourses or possibly block drainages.

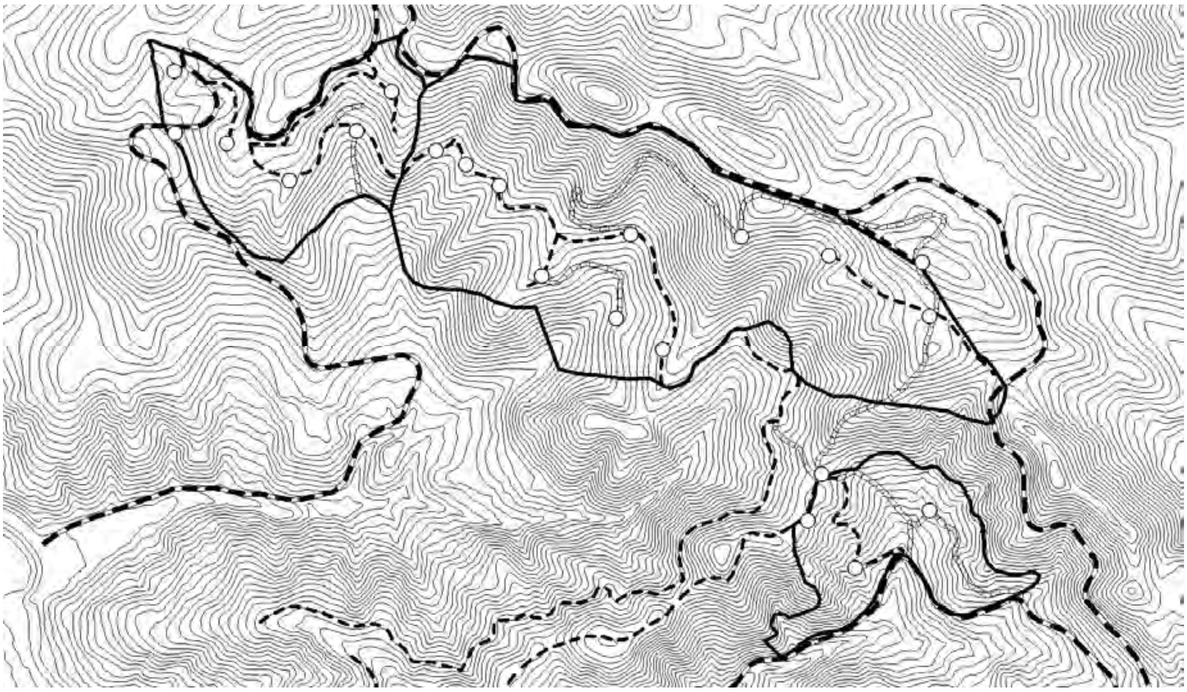


Figure 9. Map of existing landings in the Hill Campus

3.6 TOPOGRAPHY

Slopes in the Plan Area are steep, averaging more than 30 percent. Elevations in the Plan Area range from a low of about 400 feet above mean sea level at its western edge and rise to almost 1,800 feet above mean sea level at Chaparral Hill at its eastern edge.

3.7 WATER RESOURCES

The Plan Area lies within two watersheds: Strawberry Canyon and Claremont Canyon, which drop to the west, divided by a major east-west ridgeline. Grizzly Peak Boulevard forms a major ridgeline in the east. The Plan Area contains several drainages. Strawberry Creek, which flows year-round traverses the Plan Area. All other drainages are ephemeral except for an approximately 200-foot segment that drains the Claremont Unit where year-round water was found and is associated with a permanent wet area containing riparian vegetation. The remaining ephemeral watercourses drain surface water during winter months, but do not likely sustain habitat for riparian plants, fish or amphibians other than newts and tree frogs.

3.8 WILDLIFE

The Plan Area supports a diverse array of wildlife. Riparian corridors and adjacent oak-bay woodlands, scrub, and remnant grasslands are particularly valuable to some amphibians, birds, and small mammals. Mature trees, including blue gum and conifers, provide suitable nesting substrate for a number of bird species, particularly raptors such as red-tailed hawk and great horned owl.

The 2020 LRDP (UC Berkeley, 2004) states that the Hill Campus provides suitable habitat for the state and federally-threatened Alameda whipsnake, California red-legged frog, numerous bird species of concern, and several special-status plant species. Alameda whipsnake is found in chaparral, Diablan sage scrub, and northern coyote brush scrub, as well as adjacent riparian scrub, grasslands, and woodlands. Typical habitat characteristics for this species include open to partially open scrub/chaparral cover on east, southeast, and southwest-facing slopes with abundant rock outcrops, rodent burrows, and western fence lizard prey. The mosaic of native habitat also provides important foraging opportunities for a number of mammalian and avian predatory species, including mountain lion, bobcat, grey fox, coyote, striped and spotted skunk, great horned owl, red-tailed hawk, and other raptors.

3.9 PLANT RESOURCES

As shown in Figure 10, the LandFire 2016 (USGS 2020) dataset of vegetation indicates the majority of the Hill Campus is mapped as Central and Southern California Mixed Evergreen Woodland. Large patches of Southern California Coastal Scrub, and Dry/Mesic Chaparral are located on the higher elevations of the Hill Campus in Hamilton Gulch, and below Signposts 14-18. Vegetation mapped as Western Urban vegetation follows the roads. The western portion of the Hill Campus, near the Strawberry Canyon Recreation Area, are mapped as Warm Climate Ruderal Deciduous and Evergreen Forests.

🟪 Western Warm Temperate Urban Shrubland
🟪 Western Warm Temperate Urban Mixed Forest
🟪 Western Warm Temperate Urban Herbaceous
🟪 Western Warm Temperate Urban Evergreen Forest
🟪 Western Warm Temperate Urban Deciduous Forest
🟪 Western Cool Temperate Urban Shrubland
🟪 Western Cool Temperate Urban Mixed Forest
🟪 Western Cool Temperate Urban Herbaceous
🟪 Western Cool Temperate Urban Evergreen Forest
🟪 Western Cool Temperate Urban Deciduous Forest
🟩 Southern California Oak Woodland and Savanna
🟫 Southern California Dry-Mesic Chaparral
🟫 Southern California Coastal Scrub
🟦 Open Water
🟧 Northern California Coastal Scrub
🟫 Northern and Central California Dry-Mesic Chaparral
⬛ Mediterranean California Sparsely Vegetated Systems II
🟧 Introduced Upland Vegetation-Perennial Grassland and Forbland
🟧 Introduced Upland Vegetation-Annual Grassland
⬜ Developed-Roads
🟥 Developed-Medium Intensity
🟥 Developed-Low Intensity
🟥 Developed-High Intensity
🟩 Central and Southern California Mixed Evergreen Woodland
🟨 California Northern Coastal Grassland
🟫 California Montane Woodland and Chaparral
🟩 California Montane Riparian Systems
🟨 California Mesic Serpentine Grassland
🟫 California Mesic Chaparral
🟩 California Coastal Redwood Forest
🟩 California Coastal Live Oak Woodland and Savanna
🟦 California Central Valley Mixed Oak Savanna
🟨 California Central Valley and Southern Coastal Grassland
🟧 California Annual Grassland

Table 3. Vegetation types mapped through the LandFire mapping program (2016 refresh)

EXISTING VEGETATION TYPE	ACRES
Central and Southern California Mixed Evergreen Woodland	2.22
California Coastal Redwood Forest	114.76
Mediterranean California Mixed Oak Woodland	5.34
Mediterranean California Lower Montane Conifer Forest and Woodland	3.78
Mediterranean California Mixed Evergreen Forest	65.61
California Maritime Chaparral	0.22
Northern and Central California Dry-Mesic Chaparral	72.50
California Central Valley Mixed Oak Savanna	0.67
California Coastal Live Oak Woodland and Savanna	266.65
California Lower Montane Foothill Pine Woodland and Savanna	8.90
Northern California Coastal Scrub	8.23
California Northern Coastal Grassland	0.67
California Coastal Closed-Cone Conifer Forest and Woodland	0.22
Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland	4.00
California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna	9.79
Developed-Low Intensity	26.02

Developed-Medium Intensity	13.79
Developed-High Intensity	1.33
Developed-Roads	34.69
Temperate Pacific Freshwater Emergent Marsh	0.67
Western Warm Temperate Urban Deciduous Forest	37.14
Western Warm Temperate Urban Evergreen Forest	32.25
Western Warm Temperate Urban Mixed Forest	21.57
Western Warm Temperate Urban Herbaceous	15.35
Western Warm Temperate Urban Shrubland	44.48
Western Warm Temperate Developed Ruderal Deciduous Forest	12.01
Western Warm Temperate Developed Ruderal Evergreen Forest	5.12
Western Warm Temperate Developed Ruderal Mixed Forest	0.67
Western Warm Temperate Developed Ruderal Shrubland	0.44
Western Warm Temperate Developed Ruderal Grassland	3.56
Central California Coast Ranges Cliff and Canyon	0.22
Mediterranean California Foothill and Lower Montane Riparian Woodland	6.89
California Ruderal Grassland and Meadow	4.00
Californian Ruderal Forest	2.67

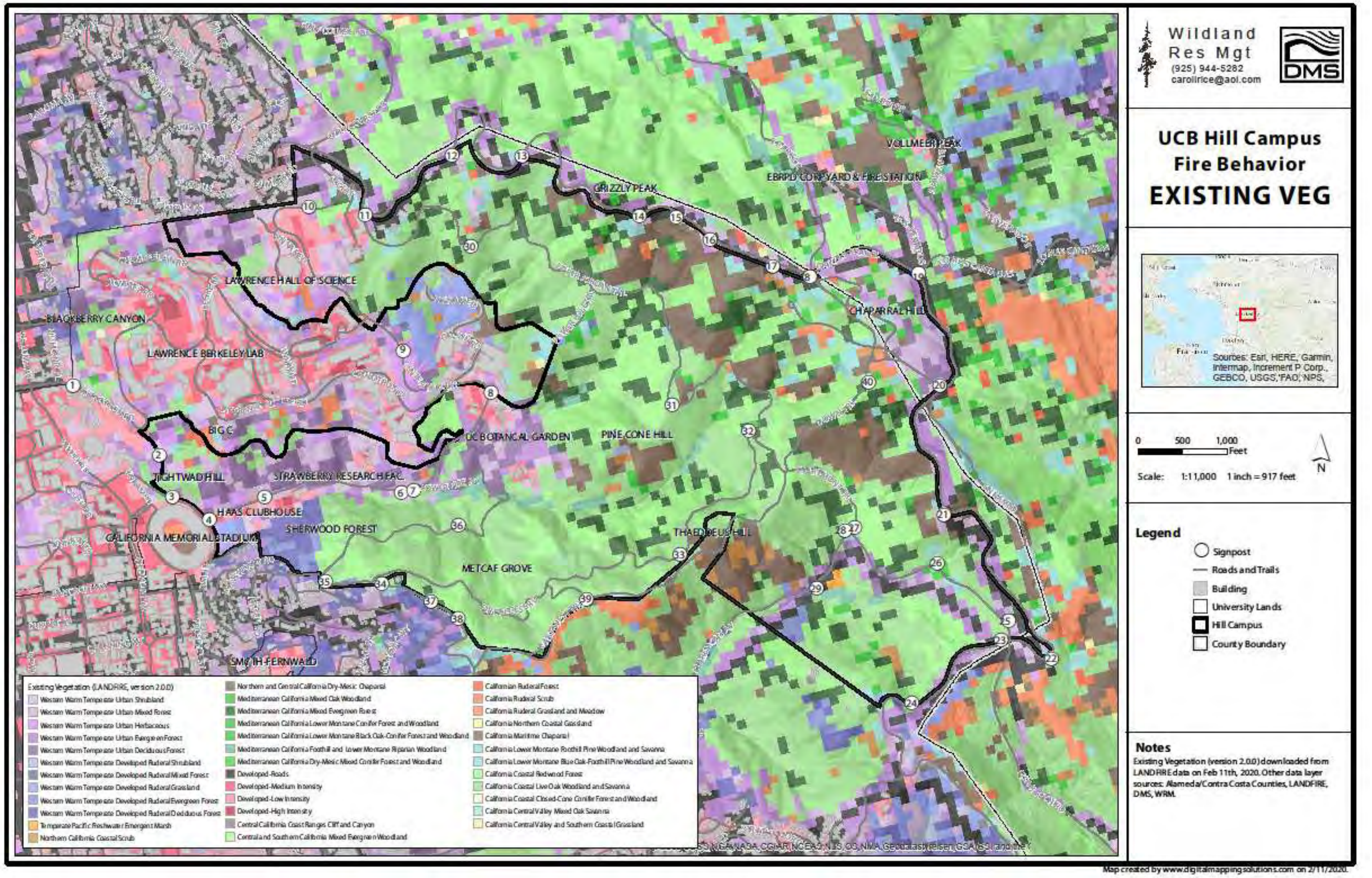


Figure 10. Current vegetation types, from 2016 LandFire data

3.10 VEGETATIVE FUEL MODELS

Fire managers in virtually all federal and state agencies, as well as in other countries where wildland fire hazards are significant, use fuel model systems for the various computerized fire behavior prediction systems (FBPS). Within the United States, information regarding fuel volumes and fire-behavior descriptions is based upon fuel models described in Rothermel (1983) and Scott and Burgan (2005). Each fuel model is given a number designation, which is interpreted consistently by fire managers across the continent.

Fuel models describe surface, grass, and shrub fuel characteristics with respect to potential fire behavior. A key significant factor is the amount and distribution of smaller-diameter fuels, because these materials generally spread wildland fires. Another important factor is the amount of dead biomass and the ratio of live-to-dead material in terrain with significant brush and numerous tree stands, since dead biomass contributes fine fuel litter as well as carries flames more readily. Fuel models include these considerations.

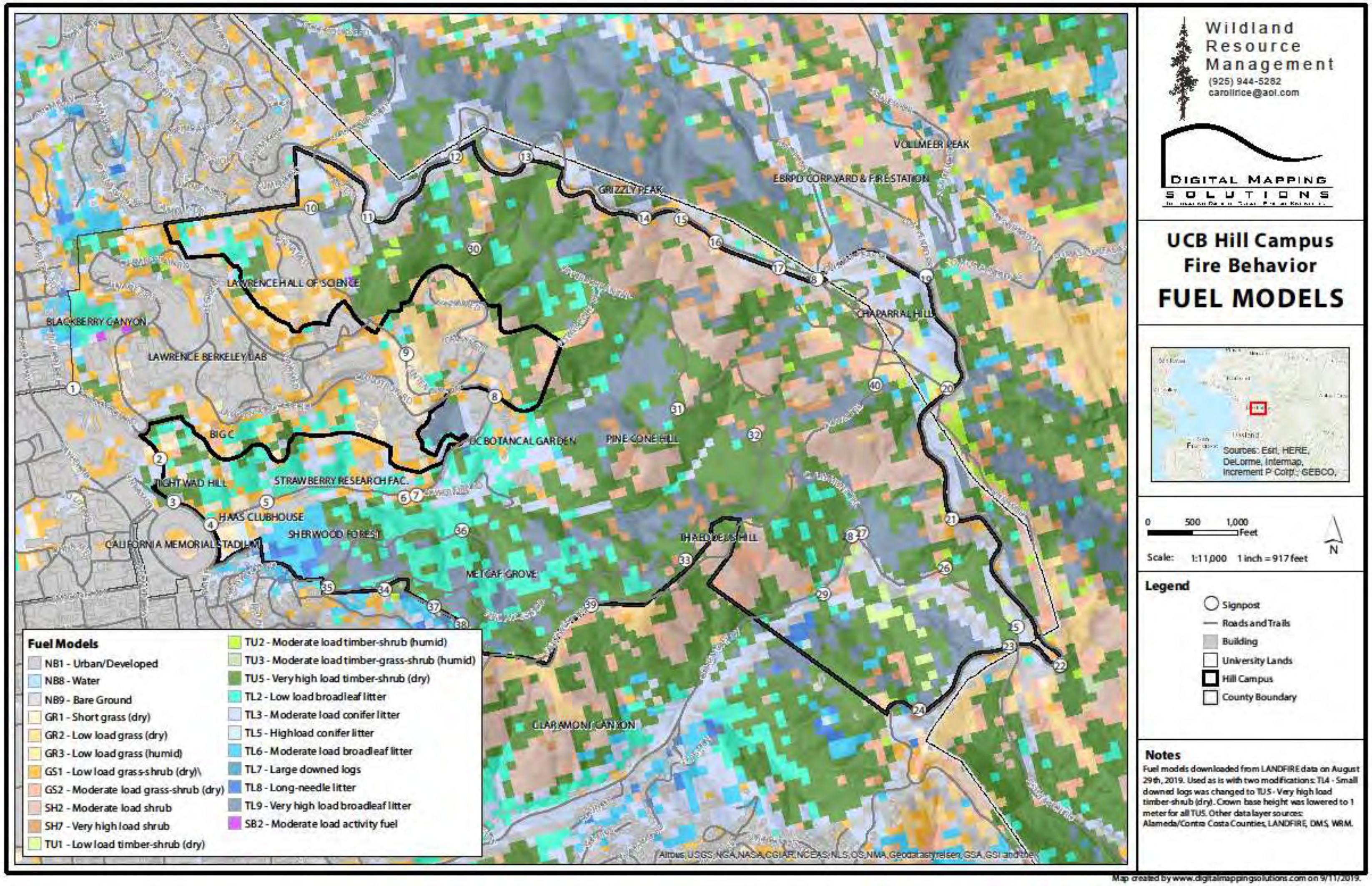
Fuel models may be categorized by several methods, including drawing polygons on maps from field surveys and samples, to defining spectral bands on satellite imagery. For the first approximation of fuels, UC Berkeley has used data from the Landscape Fire and Resource Management Planning Tools Project (LANDFIRE Version 1.40), a nationally-accepted and consistent mapping of fuel models and FBFM40 (the Scott and Burgan expanded 40 fuel models). Each of the fuel models present in the Plan Area are described below.

The most abundant surface fuel model (see Figure 11) in the Plan Area is Timber Understory (TU5), with 282.04 acres covered. This fuel model is abundant in the forest of the FSSBER, the Botanical Garden, and on the ridgeline dividing Strawberry and Claremont Canyons. The area mapped as TU5 also occurs in the area where treatments to remove eucalyptus occurred in 2005-6, south of Claremont Avenue and near the intersection of Grizzly Peak Boulevard and Claremont Avenue. Patches of TU5 tend to be large, and uniform.

The Timber Litter fuel model that has the greatest fuel volume is TL9, and is found in a stand north of Claremont Avenue above the Upper Jordan Fire Trail, and on the northern ridgeline defining Hamilton Gulch. Approximately 100 acres is split between other Timber Litter Fuel models TL 2,3,5,6, 7 and 8.

Shrub surface fuel models (97.33 acres) occur in the Plan Area bordering Claremont Canyon, the upper slopes of Claremont Canyon, and along Upper Jordan Fire Trail, and below Grizzly Peak Boulevard just east of the site of the 2017 Grizzly Fire. Shrubby surface fuel models appear as medium to large patches.

Grass covers only 21 acres of the Plan Area, located high along Grizzly Peak Boulevard, and in small patches throughout the upper canyon. The largest patch of grass is mapped near the Lawrence Hall of Science.



Notes

Fuel models downloaded from LANDFIRE data on August 29th, 2019. Used as is with two modifications: TL4 - Small downed logs was changed to TU5 - Very high load timber-shrub (dry). Crown base height was lowered to 1 meter for all TU5. Other data layer sources: Alameda/Contra Costa Counties, LANDFIRE, DMS, WRM.

Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 11. Fuel model distribution in the Hill Campus

Grass-shrub fuel models covers 54.88 acres in the Plan Area and is found near the Vista Parking Lot and the northern border of the Hill Campus.

Hill Campus	**768.72**
GR1	9.94
GR2	10.89
GS1	32.78
GS2	21.77
NB1	48.90
NB9	0.35
SB2	0.22
SH2	78.50
SH7	18.83
TU5	282.04
TL3	56.62
TL5	1.05
TL6	11.61
TL7	1.11
TL8	4.01
TL9	97.45
TU2	4.03
TU3	2.62

Table 4. Description of Fuel Models

Value	FBFM40	Description
91	NB1	Urban
98	NB8	Water
99	NB9	Barren
101	GR1	Short, sparse dry climate grass is short, naturally or heavy grazing, predicted rate of fire spread and flame length low
121	GS1	Low load, dry climate grass-shrub shrub about 1 foot high, grass load low, spread rate moderate and flame length low
122	GS2	Low load, dry climate grass-shrub shrub about 1 foot high, grass load low, spread rate moderate and flame length low
144	SH4	Moderate load, humid climate shrub, woody shrubs and shrub litter, possible pine overstory, fuelbed depth 2-3 feet, spread high and flame moderate
145	SH5	High load, humid climate grass-shrub combined, heavy load with depth greater than 2 feet, spread rate and flame very high
149	SH9	Very high load, humid climate shrub, woody shrubs and shrub litter, dense finely branched shrubs with fine dead fuel, 4-6 feet tall, herbaceous may be present, spread rate and flame high
161	TU1	Low load dry climate timber grass shrub, low load of grass and/or shrub with litter, spread rate and flame low

162	TU2	Moderate load, humid climate timber-shrub, moderate litter load with some shrub, spread rate moderate and flame low
163	TU3	Moderate load, humid climate timber grass shrub, moderate forest litter with some grass and shrub, spread rate high and flame moderate
165	TU5	Very high load, dry climate shrub, heavy forest litter with shrub or small tree understory, spread rate and flame moderate
181	TL1	Low load compact conifer litter, compact forest litter, light to moderate load, 1-2 inches deep, may represent a recent burn, spread rate and flame low
182	TL2	Low load broadleaf litter, broadleaf, hardwood litter, spread rate and flame low
183	TL3	Moderate load conifer litter, moderate load conifer litter, light load of coarse fuels, spread rate and flame low
186	TL6	Moderate load broadleaf litter, less compact than TL2. Spread rate is moderate, flame length low.
189	TL9	Very high load, fluffy broadleaf litter. Spread rate is moderate, flame length moderate

3.11 FIRE BEHAVIOR ANALYSIS

3.11.1 FIRE BEHAVIOR SUMMARY

One way of measuring potential damage and risk is to conduct a fire behavior analysis. Two analyses were performed, both using FlamMap 6.0, which predicts fire behavior across the landscape under the same conditions. Outputs from FlamMap are well-suited for landscape level comparisons of fuel treatment effectiveness because fuel is the only variable that changes. Outputs and comparisons can be used to identify combinations of hazardous fuel and topography, aiding in prioritizing fuel treatments (USFS, 2018).

One scenario focused on fire behavior resulting from winds blowing uphill, which is a fairly extreme set of weather conditions. The other scenario was based on an easterly (45 degrees) wind, which would facilitate fire spread toward the Campus Park. Other environmental inputs were the same.

For both scenarios, four types of burning characteristics were portrayed: flame length, crown fire potential, surface fire spread rate, and maximum spotting distance.

Flame Length

Flame length (measured in feet) is the length of the flame at the head of the fire measured from the middle of the combustion zone to the average position of the flame tip.[8] Flame length is often correlated to the ability to control a fire. A flame length of 8 feet is usually looked at as a cut-off point for strategic firefighting decisions on whether to attack the fire directly, or instead attempt control through indirect methods. Attacking the fire directly involves efforts to slow the flaming front at its

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[8] Andrews and Rothermel, 1982. Charts for Interpreting Wildland Fire Behavior Characteristics. USDA Forest Service, General Technical Report INT-131. September 1982.

head – where it is advancing fastest. Indirect attack involves fire control methods on the fire's flank or well ahead of the fire (using backfires or retardants).

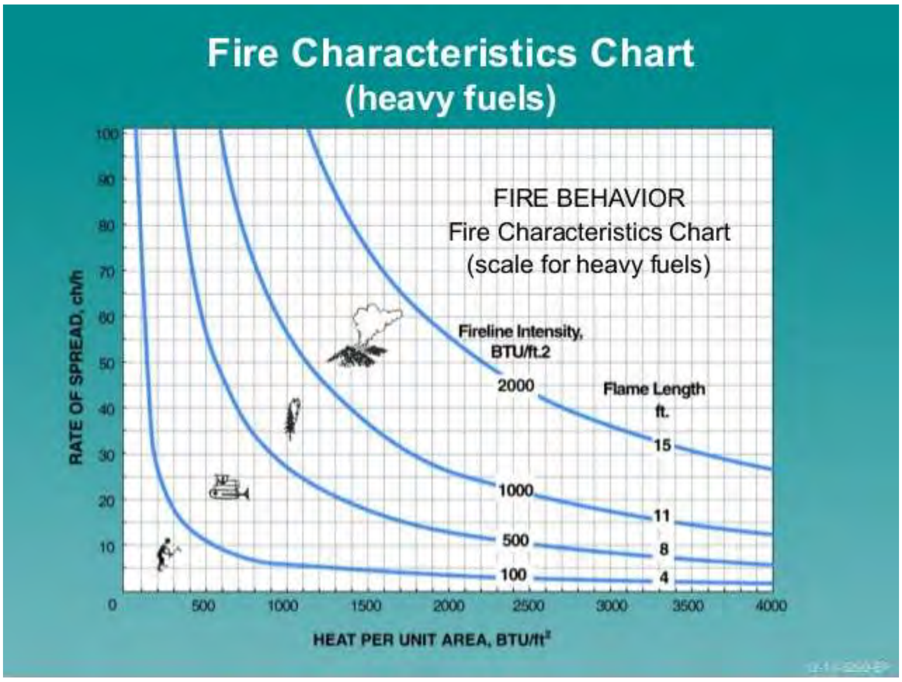


Figure 12. Limits to fire suppression based on flame length, rate of spread and heat per unit area

Rate of Spread

Rate of spread (measured in chains per hour, where one chain equals 66 feet, and 80 chains equals one mile) is the forward rate of spread at the head of a surface fire. While a fast rate of spread does not necessarily result in a problematic fire, a fast-moving fire coupled with high flame lengths cannot be suppressed with a hand-crew. High rates of fire spread is associated with both unmowed grasslands, and in stands of tall, dense shrubs.

A surface fire that makes the transition to some form of crown fire is modeled from canopy base height, stand height, canopy bulk density, and foliar moisture content. It is important to keep in mind that crown fire activity only pertains to treed fuel model types. Crown fires and torching can occur only where there are trees; shrub stands can burn intensely and still not torch.

Crown Fire Activity

Crowning activity indicates locations where fire is expected to travel into and possibly consume the crowns. When a fire burns through tree crowns, countless embers are produced and are distributed, sometimes at long distances. These embers can start new fires, which can each grow and confound the finest fire suppression forces.

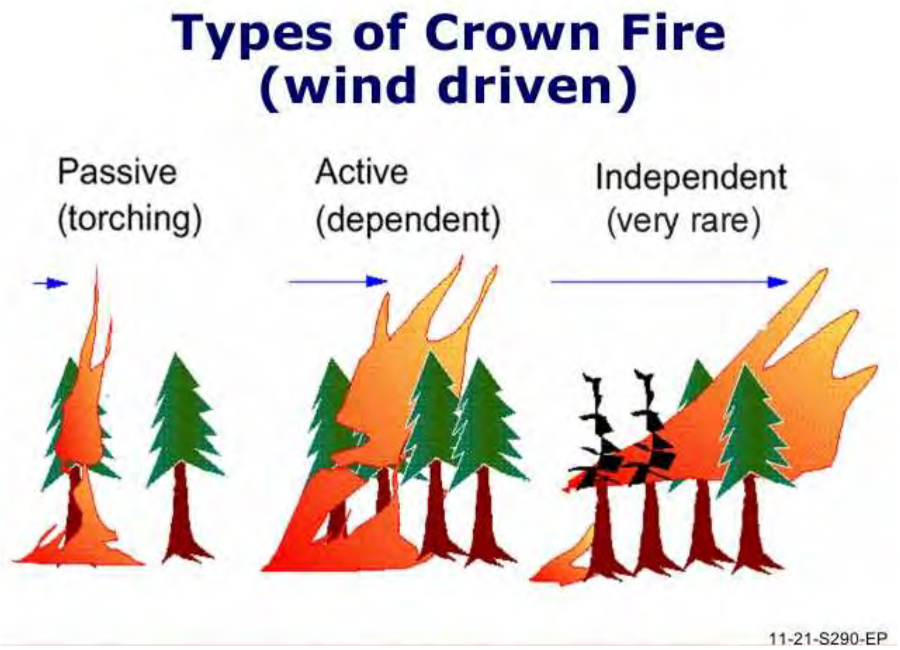


Figure 13. Types of crown fires

Maximum Spotting Distance

Wildfires can create embers that loft ahead of the flaming front that ignite new fires called “spot fires.” “Spotting potential” describe the propensity of vegetation to create and disburse embers that have the potential to start countless new fires well in advance of the main fire. Thus, it is useful to know the maximum distance embers can be expected to be cast from its source. Typically, this is influenced most by the position on the slope of the area generating embers, as well as the wind speed and type of material burning.

Fire Prediction Summary

Under dry conditions with a wind blowing uphill at a 20 mile per hour speed throughout the Hill Campus, and current fuels are expected to produce fire behavior that is daunting for containment and control and likely to produce substantial levels of damage.

Almost half of the area is expected to burn with flames longer than 8 feet in length. Rates of fire spread are not excessively fast, and a large percentage of the area (nearer to the mouth of Strawberry Canyon) has slow fire spread rates. Torching is expected to be widespread in the upper reaches of the Hill Campus, however, crown fire is predicted to be rare. Under weather where winds blow uphill, new spot fires could be distributed as far as 2000 feet, which would extend well into neighboring residential areas and within the LBNL.

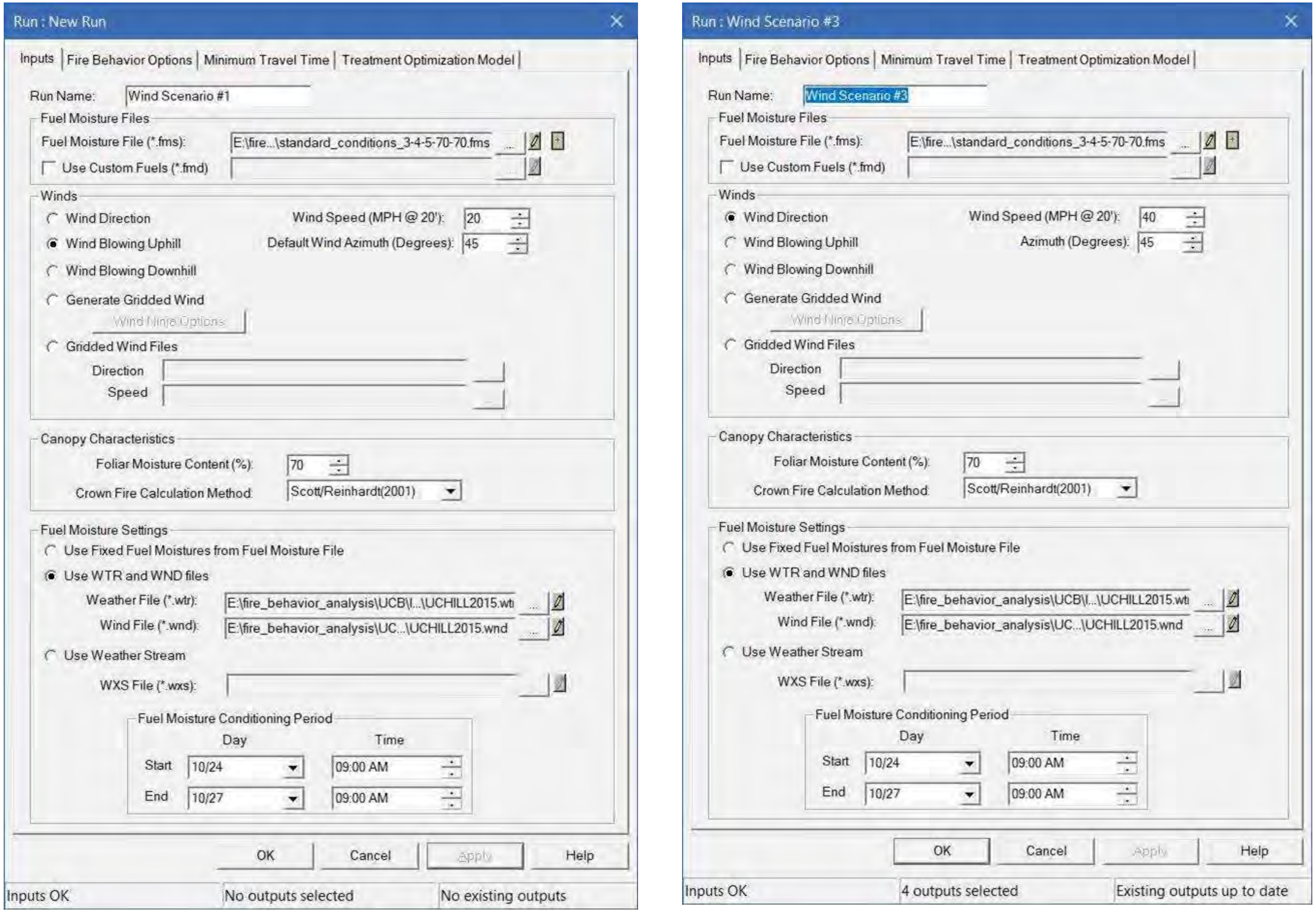
Using the same dry weather conditions and a strong wind (40 miles per hour) blowing from the northeast to the Campus Park and down Claremont Ave., the area is expected to burn with long flame lengths (greater than 8 feet in length) increases by a third, to more than half the Hill Campus.

In both wind scenarios, areas in the western portion of the Strawberry Canon, Botanical Garden and Chaparral Hill are expected to burn with short flame lengths and with slow fire spread rates.

With strong northeasterly winds, fire spread rates dramatically increase. Almost every area in the Hill Campus with trees is predicted to torch, with the exception of patches of the western portion of Strawberry Canyon. With strong winds blowing form the northeast a larger proportion of the Hill Campus is expected to spread new spot fires long distances (greater than 2000 ft).

3.11.2 WEATHER AND FUEL MOISTURE CONDITIONS

Two weather scenarios were selected for this analysis: one that portrays conditions with strong wind (20 miles per hour) that blows upslope in all locations. This is likely to portray conditions under which a wildfire burns with a westerly influence, and when fuels are a dominant influence. The second is under a Diablo Wind scenario, which is with a 40 mile per hour blowing from the northeast. The fuel moistures are the same CAL FIRE used to assess fire hazard severity statewide, and are almost the same as the 97th percentile of values for the nearest remote automatic weather stations.
The 97th percentile indicates that three percent of the days (roughly 10 days) are hotter, drier or windier than the weather selected for the simulation.



Run Name: Wind Scenario #1

Fuel Moisture Files

Fuel Moisture File (*.fms): E:\fire...\standard_conditions_3-4-5-70-70.fms

☐ Use Custom Fuels (*.fmd)

Winds

○ Wind Direction

● Wind Blowing Uphill

○ Wind Blowing Downhill

○ Generate Gridded Wind

○ Gridded Wind Files

Direction

Speed

Wind Speed (MPH @ 20'): 20

Default Wind Azimuth (Degrees): 45

Canopy Characteristics

Foliar Moisture Content (%): 70

Crown Fire Calculation Method: Scott/Reinhardt(2001)

Fuel Moisture Settings

○ Use Fixed Fuel Moistures from Fuel Moisture File

● Use WTR and WND files

Weather File (*.wtr): E:\fire_behavior_analysis\UCB\...\UCHILL2015.wt

Wind File (*.wnd): E:\fire_behavior_analysis\UC...\UCHILL2015.wnd

○ Use Weather Stream

WXS File (*.wxs):

Fuel Moisture Conditioning Period

	Day	Time
Start	10/24	09:00 AM
End	10/27	09:00 AM

Inputs OK | No outputs selected | No existing outputs

Run Name: Wind Scenario #3

Fuel Moisture Files

Fuel Moisture File (*.fms): E:\fire...\standard_conditions_3-4-5-70-70.fms

☐ Use Custom Fuels (*.fmd)

Winds

● Wind Direction

○ Wind Blowing Uphill

○ Wind Blowing Downhill

○ Generate Gridded Wind

○ Gridded Wind Files

Direction

Speed

Wind Speed (MPH @ 20'): 40

Azimuth (Degrees): 45

Canopy Characteristics

Foliar Moisture Content (%): 70

Crown Fire Calculation Method: Scott/Reinhardt(2001)

Fuel Moisture Settings

○ Use Fixed Fuel Moistures from Fuel Moisture File

● Use WTR and WND files

Weather File (*.wtr): E:\fire_behavior_analysis\UCB\...\UCHILL2015.wt

Wind File (*.wnd): E:\fire_behavior_analysis\UC...\UCHILL2015.wnd

○ Use Weather Stream

WXS File (*.wxs):

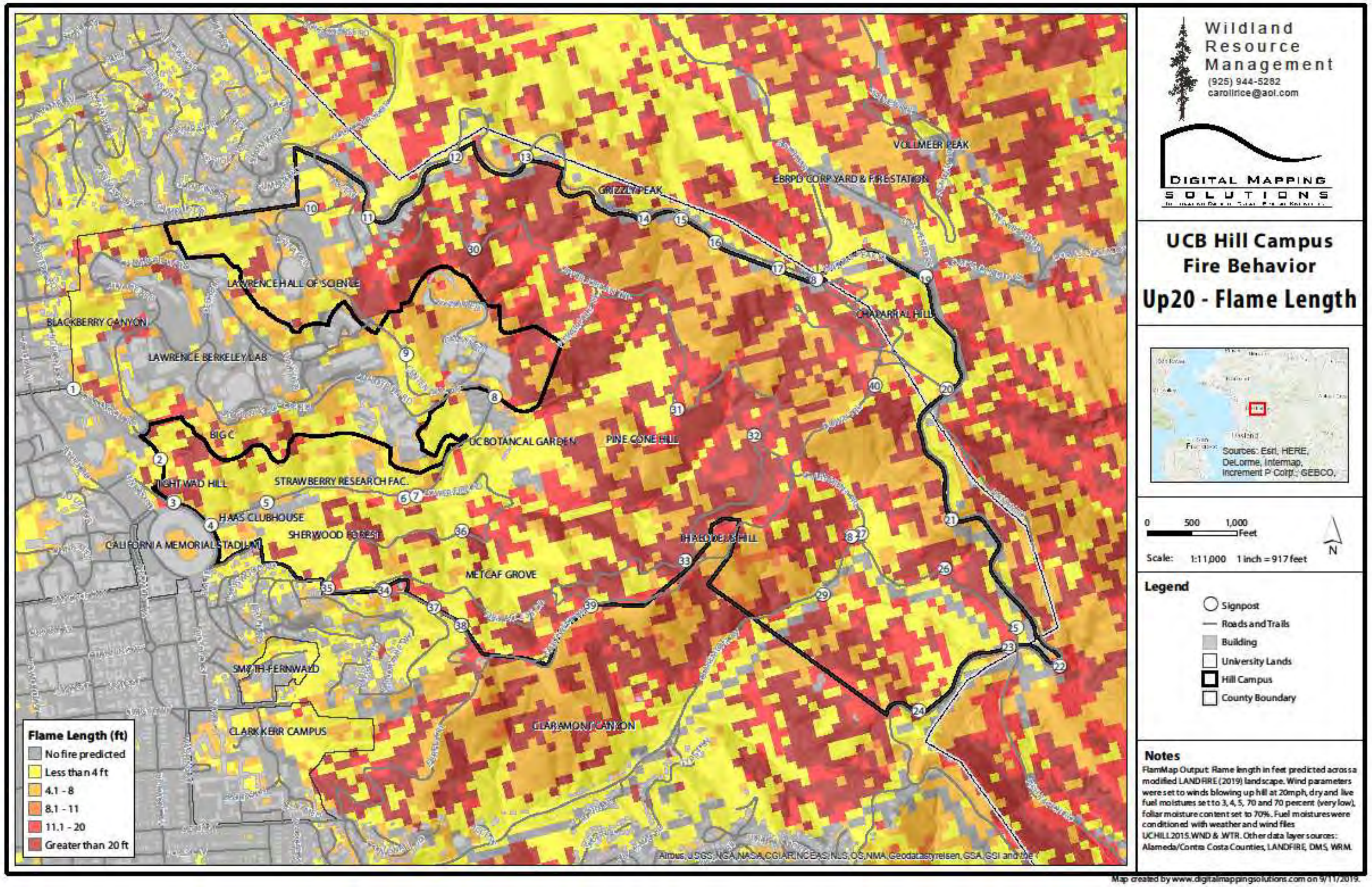
Fuel Moisture Conditioning Period

	Day	Time
Start	10/24	09:00 AM
End	10/27	09:00 AM

Inputs OK | 4 outputs selected | Existing outputs up to date

Figure 14. Inputs to fire behavior prediction software FlamMap

3.11.3 FIRE BEHAVIOR WITH UPSLOPE 20 MPH WINDS



Notes

FlamMap Output: Flame length in feet predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing up hill at 20mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources: Alameda/Contra Costa Counties, LANDFIRE, DMS, WRM.

Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 15. Predicted flame lengths with a 20 mile per hour wind blowing uphill in all directions

Flame Length (Figure 12)

As shown on Figure 12, almost half of the 800-acre Plan Area is expected to burn with flames longer than 8 feet (330.55 acres), indicating direct attack methods would not be appropriate, and that indirect suppression would be necessary. Land that is expected to burn with flames between 4-8 feet in length totals 219.72 acres, and the area that is expected to burn with low flames lengths, shorter than 4 feet, totals 36.97. In the Plan Area, 181.47 acres is not expected to carry fire, due to the lack of vegetative fuel.

Long flame lengths are associated with forested areas with a dense understory of shrubs and short trees, as well as in stands of thick, dense shrubs. The areas of longest flame length are located in the higher portion of the Hill Campus: northeast of LBNL, surrounding the Botanical Garden, throughout Hamilton Gulch, as well in in Claremont Canyon. Areas of shorter flame lengths are located in areas where a dense forest canopy overstory is present over a thin leaf litter of surface fuel. These areas are found in the western portion of the Plan Area, in lower Strawberry Canyon, in the Botanical Garden, on the southern side of Claremont Canyon, and atop Chaparral Hill.

Rate of Fire Spread (Figure 13)

Fast-moving fires are those where the rate of spread is greater than 20 chains[9] per hour (or a 1.4 mile per hour); a total of 282.29 acres in the Plan Area is expected to burn in this category of spread rates. The rate of fire spread in almost 300 acres is expected to be slow to moderate, or 1 to 20 chains/hr. Fire spread is not expected or barely moving in 189.21 acres. The slower spread rates in the Plan Area are found in lower Strawberry Canyon and south of Claremont Avenue, and on Chaparral Hill. Fast-moving fires are expected north of the Botanical Garden, north of Claremont Avenue, and on the west-facing slope of Frowning Ridge.

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[9] A chain is a unit of length equal to 66 feet, commonly used in surveying and forest operations. Conveniently, 80 chains is equivalent to a mile. Chain is abbreviated ch.

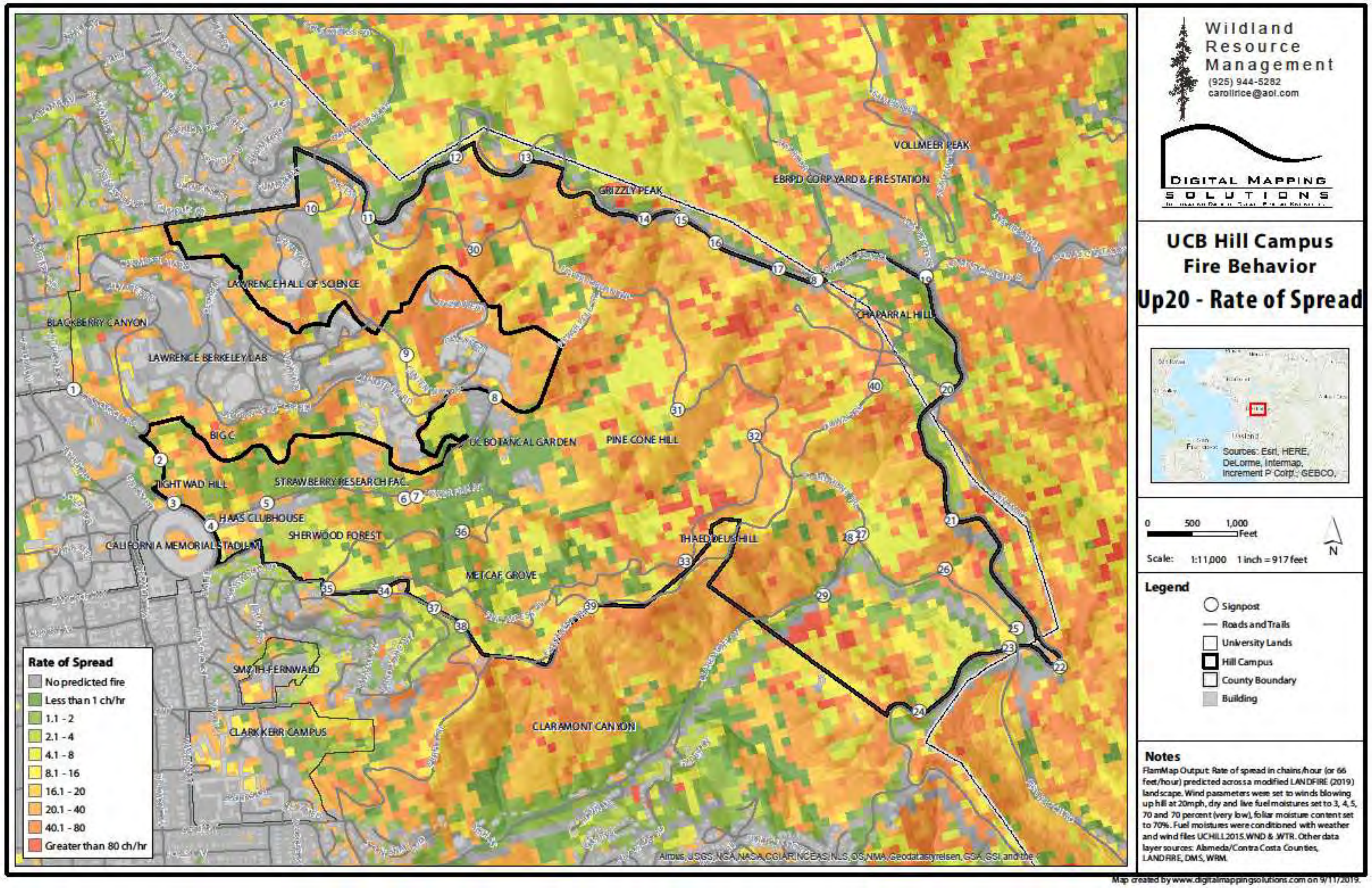
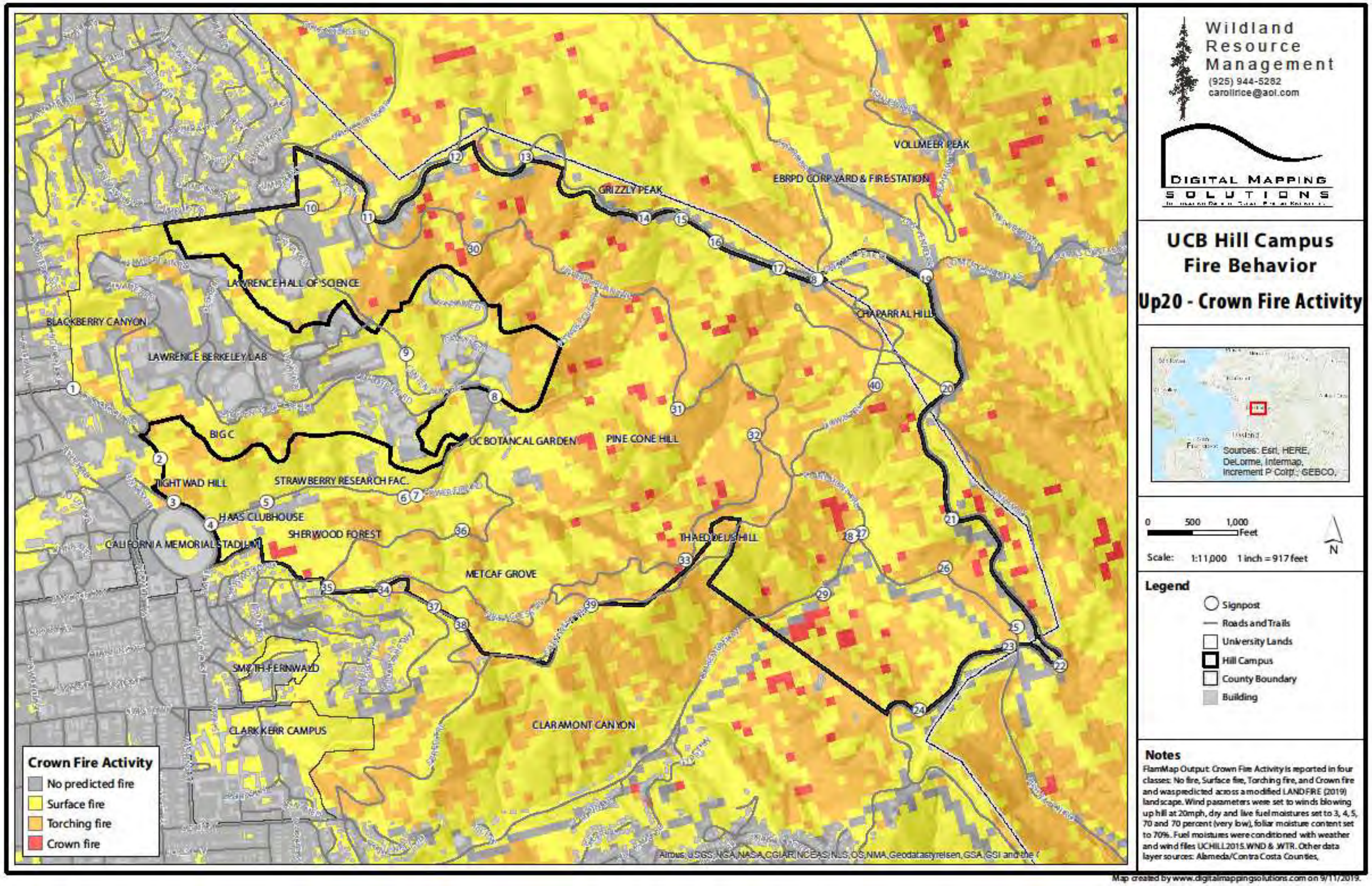


Figure 16. Predicted fire spread rates with a 20 mile per hour wind blowing uphill in all directions

Crown Fire Activity (Figure 14)

While only 21.61 acres in the Plan Area are expected to experience canopy-to canopy fire spread, more than 300 acres can be expected to torch, consuming the tree canopy and producing and distributing embers. Fires are expected to burn as a surface fire in 389.59 acres.

Surface fires are predicted in lower Strawberry Canyon, around Lawrence Hall of Science, the Botanical Garden and lands east, the shrubby slopes of Frowning Ridge, the northwestern portion of the Plan Area in Claremont Canyon, Chaparral, Hill, and on the north-facing slopes between the Lower and Upper Jordan Fire Trails. Areas without trees cannot torch or produce canopy fires. Torching can be expected northeast of LBNL to Grizzly Peak Boulevard, the upper slopes of Hamilton Gulch, and portions of Claremont Canyon. Minor ridgelines between Lower Jordan Fire Trail and the southern boundary of the Plan Area are also expected to experience torching. Canopy fire is rare and occurs in small patches sprinkled throughout the Hill Campus.

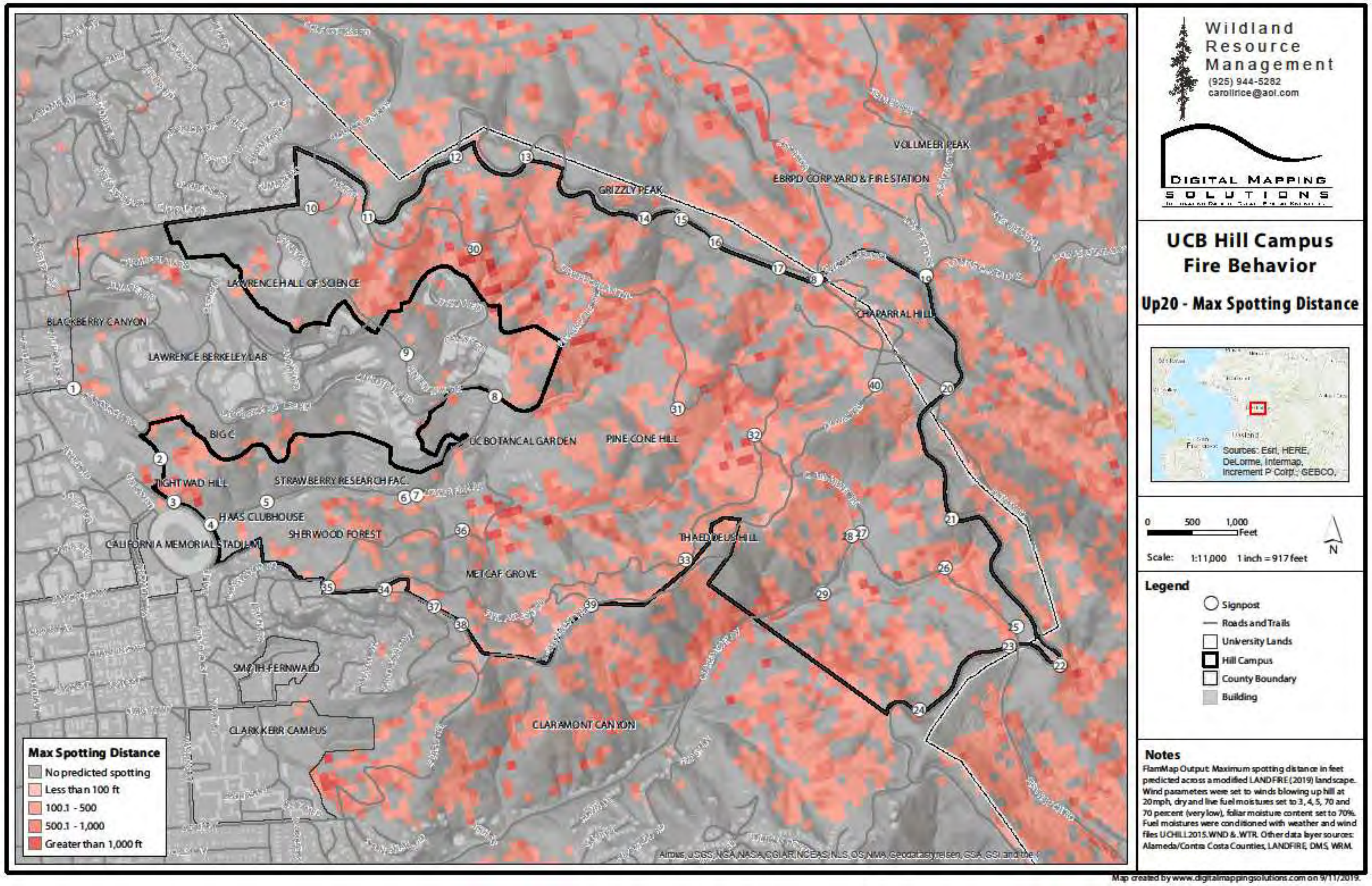


Notes

FlamMap Output: Crown Fire Activity is reported in four classes: No fire, Surface fire, Torching fire, and Crown fire and was predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing up hill at 20mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources: Alameda/Contra Costa Counties,

Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 17. Predicted crown fire activity with a 20 mile per hour wind blowing uphill in all directions



Notes

FlamMap Output: Maximum spotting distance in feet predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing up hill at 20mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources: Alameda/Contra Costa Counties, LANDFIRE, DMS, WRM.

Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 18. Predicted maximum spotting distance with a 20 mile per hour wind blowing uphill in all direction

Maximum Spotting Distance (Figure 15)

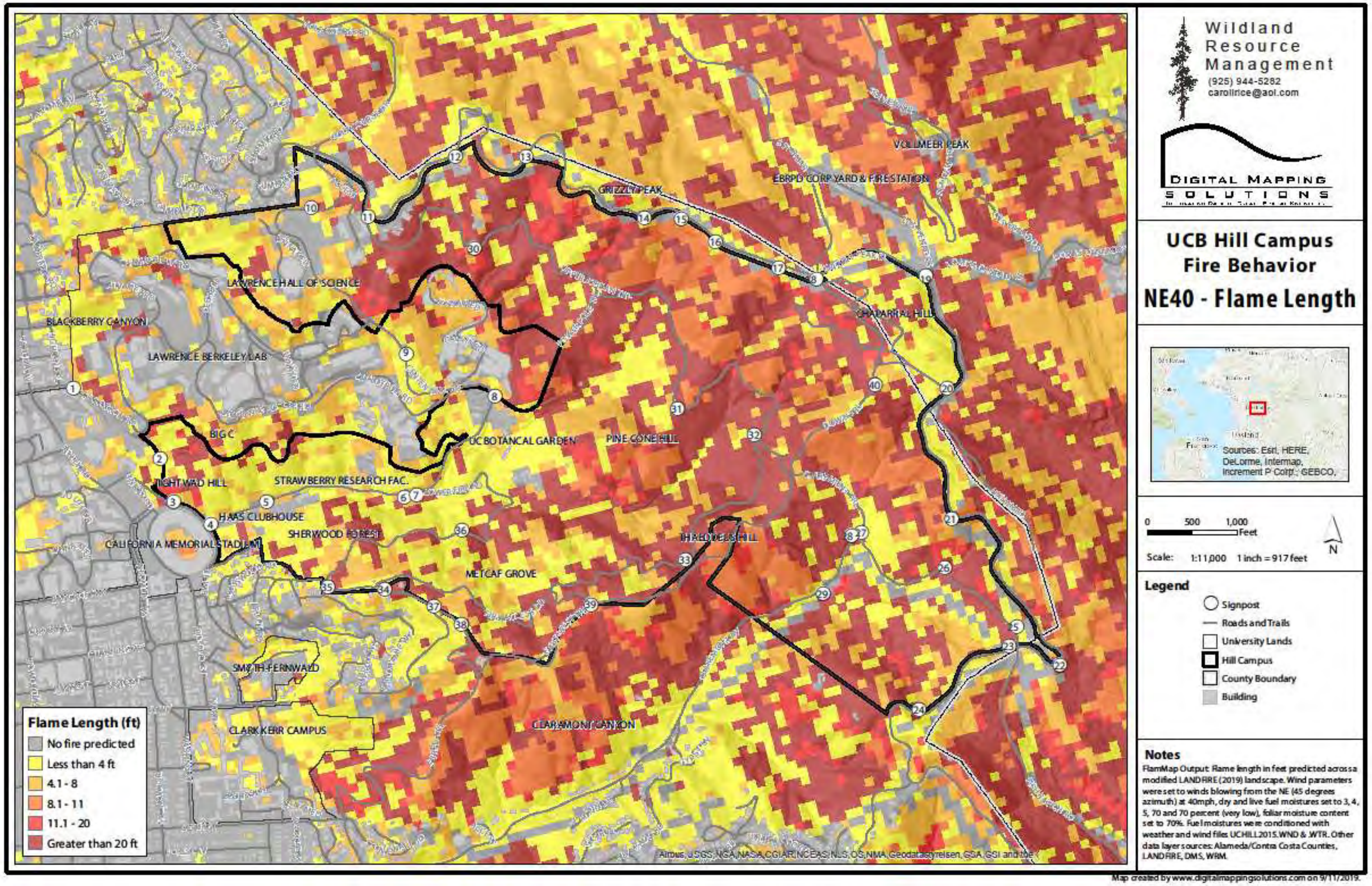
Under a scenario where fire runs uphill throughout the Plan Area, modeling shows that the longest maximum spotting distance would be between 1,000-2,000 feet, and is located above the eastern portion of LBNL. Long-distance spotting is also predicted to occur in Hamilton Gulch, south of the Botanical Garden, and along the southern boundary of the Plan Area in Claremont Canyon. A small patch of potential long-distance spotting is located on Rim Way, close to the Campus Park.

3.11.4 FIRE BEHAVIOR WITH NORTHEAST 40 MPH WINDS

Flame Length (Figure 16)

With a very strong wind (40 miles per hour) blowing from the northeast, more than half of the Hill Campus is expected to burn with flames longer than 8 feet (411.3 acres). This is almost a third more acreage than with a 20 mile per hour wind that blows uphill. Acreage that is expected to burn with shorter flame lengths, i.e. between 4-8 feet in length, totals 137.11 acres, and the area that is expected to burn with low flames lengths, shorter than 4 feet, totals 23.45 acres. Land in the Plan Area, not expected to carry fire, due to the lack of vegetative fuel totals 174.39 acres.

Projected flame lengths longer than 8 feet would be widespread in the upper reaches of the Plan Area, whereas flames less than 4 feet in length would be common in western portions of Strawberry Canyon, the Botanical Garden, Chaparral Hill, and in portions of Claremont Canyon. As with the other wind scenario, long flame lengths are associated with areas of trees with thick understory vegetation and in areas of shrubby vegetation. Areas of more benign fire behavior (in terms of flame lengths) in this wind scenario continue to be located in areas where a dense forest canopy is combined with a thin leaf litter.



Notes

FlamMap Output: Flame length in feet predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing from the NE (45 degrees azimuth) at 40mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources: Alameda/Contra Costa Counties, LANDFIRE, DMS, WRM.

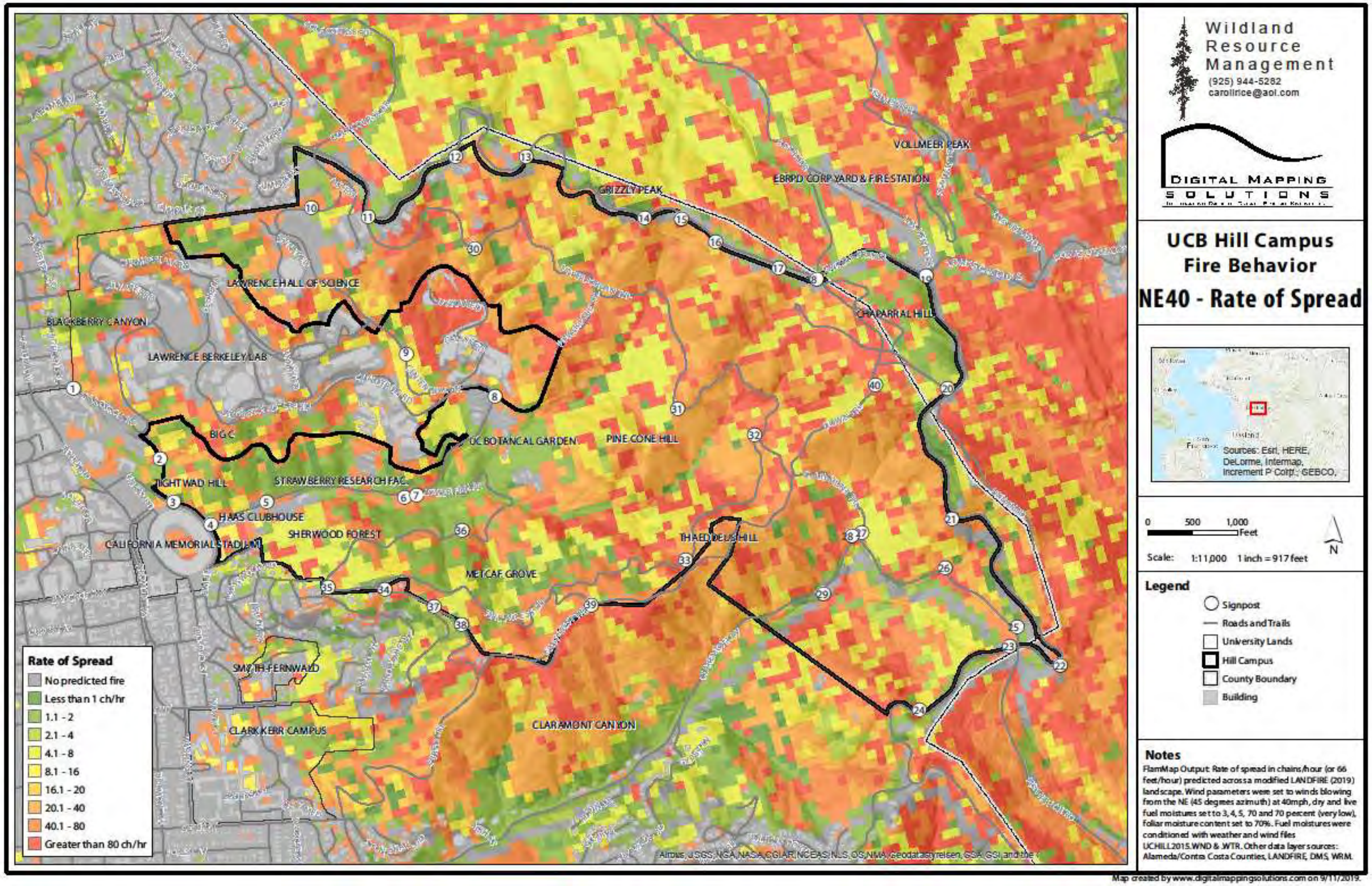
Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 19. Predicted flame lengths with a 40 mile per hour wind blowing from the northeast

Rate of Fire Spread (Figure 17)

High rates of fire spread are associated with both unmowed grasslands, and in stands of tall, dense shrubs. Acreage where a fire is expected to burn with a rate of spread greater than 20 miles per hour (or a 1/4 mile per hour) totals of 428.48 acres, or almost double that under a 20 miles per hour uphill wind scenario. Moderate spread rates, from 1 to 20 ch/hr, is predicted on 157.1 acres. Fire spread is not expected or barely moving in 182.72 acres, which is almost the same as under a 20 miles per hour uphill wind scenario.

The patterns of spread rates are similar to the 20 miles per hour uphill wind scenario, with slower spread rates found in lower Strawberry Canyon, at the Botanical Garden, and Chaparral Hill. Fast-moving fires are to be expected north of the Botanical Garden and Claremont Avenue, and on the west-facing slope of Frowning Ridge. Areas above Upper Jordan Fire Trail and in Claremont Canyon are anticipated to spread faster with a northeast wind.



Notes

FlamMap Output: Rate of spread in chains/hour (or 66 feet/hour) predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing from the NE (45 degrees azimuth) at 40mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources: Alameda/Contra Costa Counties, LANDFIRE, DMS, WRM.

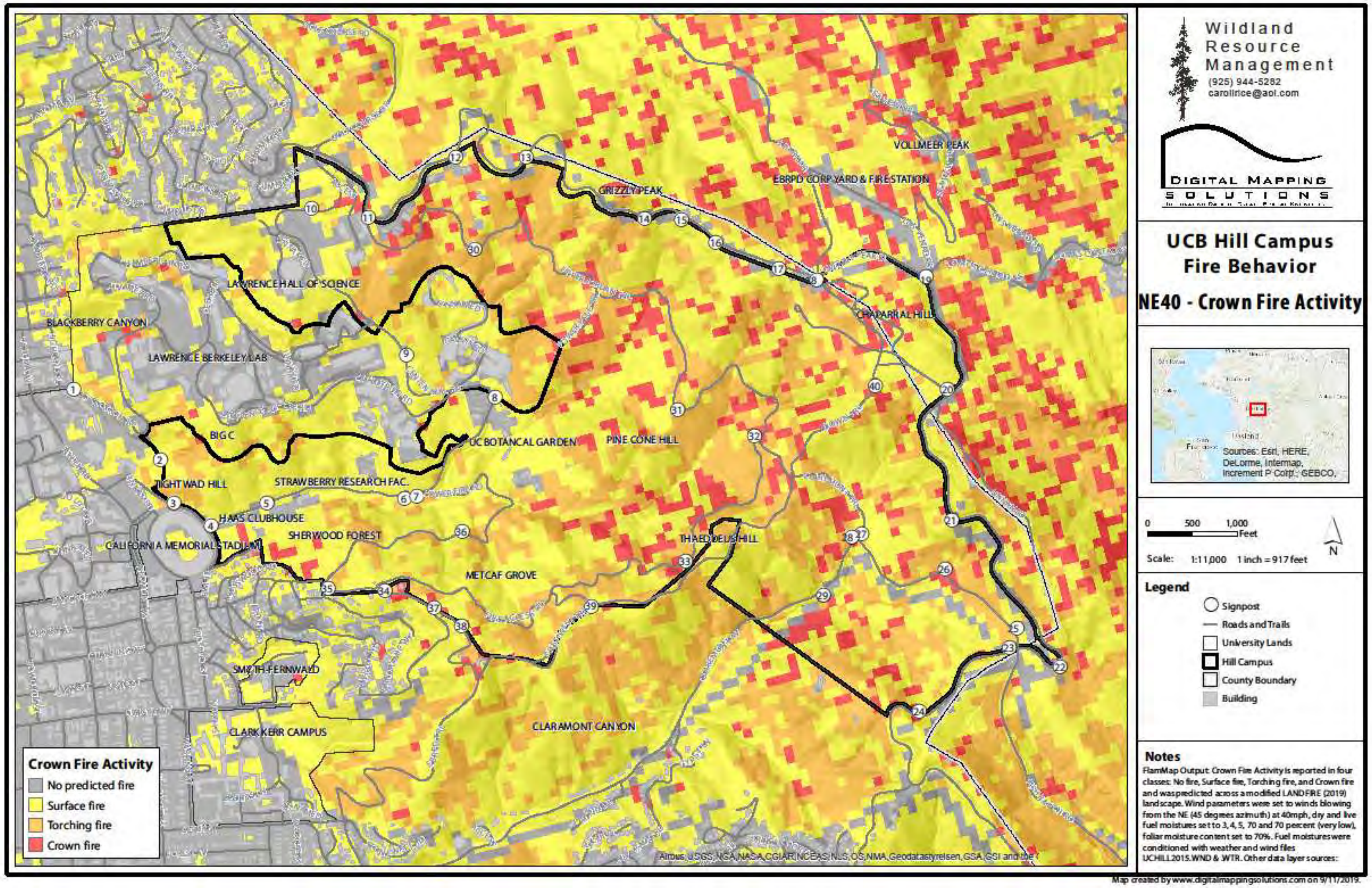
Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 20. Predicted rate of fire spread with a 40 mile per hour wind blowing from the northeast

Crown Fire Activity (Figure 18)

The acreage predicted to burn with canopy-to canopy fire spread under a stronger wind from the northeast quadrupled, compared to a 20 miles per hour uphill wind scenario, is 81.76 acres. Surprisingly, less area (251.21 acres) is expected to torch. The area where surface fires are expected is almost the same, at 386.5 acres). Thus, the greatest shift is from fires torching to spreading from canopy to canopy during a wildfire.

Surface fires continue to be predicted in the same locations as in the 20 miles per hour uphill wind scenario, likely because of a lack of trees. Torching can be expected northeast of LBNL's Strawberry gate to Grizzly Peak Boulevard, upper slopes of Hamilton Gulch, and portions throughout Claremont Canyon. Minor ridgelines between Lower Jordan Fire Trail and the southern boundary of the Plan Area are also expected to experience torching. Canopy fire still occurs in small patches, however the patches are larger, and located in FSSBER, northeast of the Botanical Garden, west of Thaddeus Hill, and in and in Claremont Canyon both north and south of Claremont Avenue.



Notes

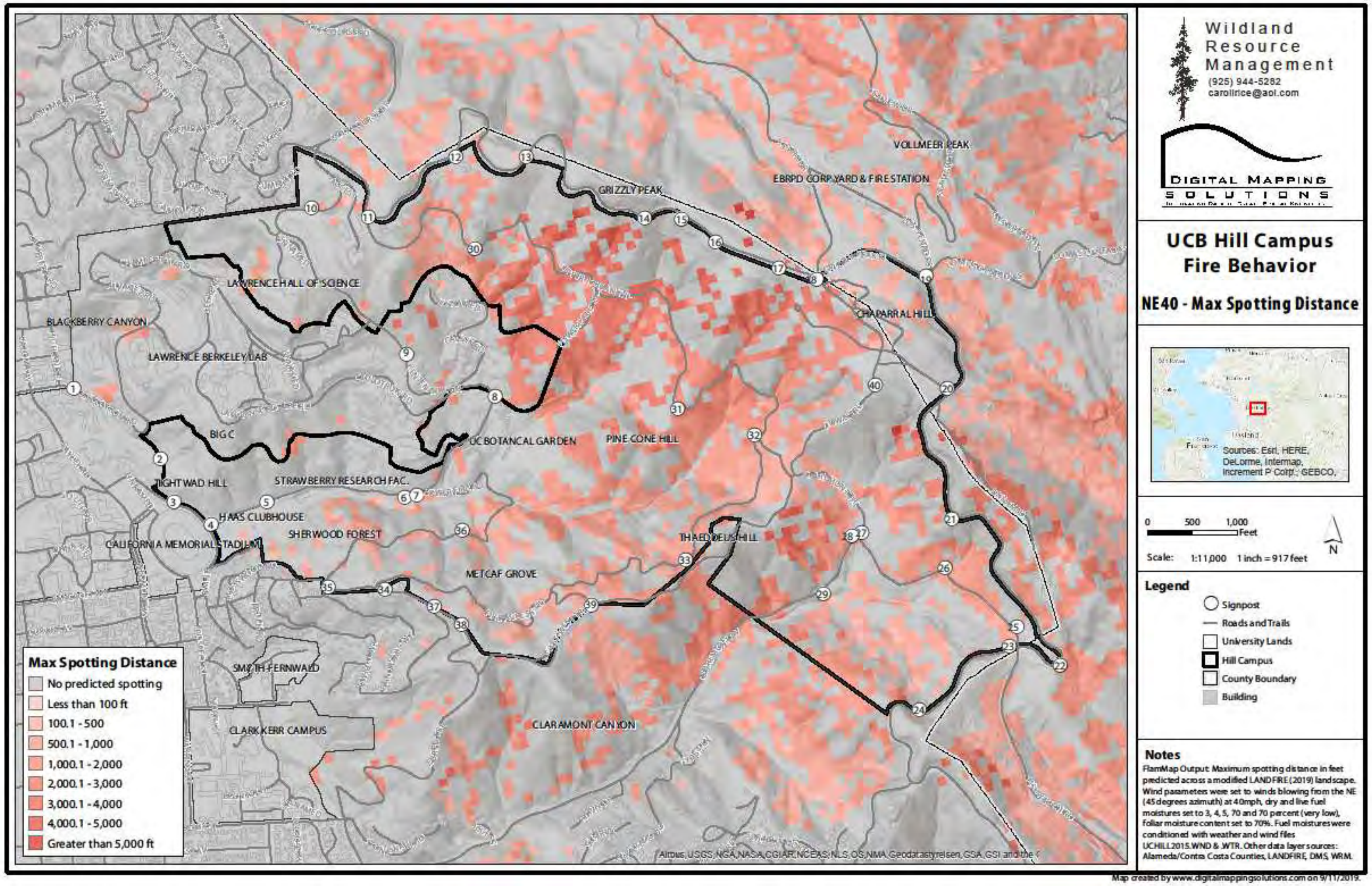
FlamMap Output: Crown Fire Activity is reported in four classes: No fire, Surface fire, Torching fire, and Crown fire and was predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing from the NE (45 degrees azimuth) at 40mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources:

Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 21. Predicted crown fire activity with a 40 mile per hour wind blowing from the northeast

Maximum Spotting Distance (Figure 19)

Not surprisingly, the scenario with faster windspeeds produced greater maximum spotting distances. The number of acres with 2,000 feet or more maximum spotting distance rose to 105 acres, or roughly an eighth of the Plan Area. However, areas of long-distance spotting potential change with a different wind direction. For example, there is no spotting predicted on Tightwad Hill. However, long-range spotting potential occurs above the Upper Jordan Fire Trail, northeast of the LBNL Strawberry Gate, and in Claremont Canyon northwest of signposts 27 and 28.



UCB Hill Campus Fire Behavior

NE40 - Max Spotting Distance

Notes

FlamMap Output: Maximum spotting distance in feet predicted across a modified LANDFIRE (2019) landscape. Wind parameters were set to winds blowing from the NE (45 degrees azimuth) at 40mph, dry and live fuel moistures set to 3, 4, 5, 70 and 70 percent (very low), foliar moisture content set to 70%. Fuel moistures were conditioned with weather and wind files UCHILL2015.WND & .WTR. Other data layer sources: Alameda/Contra Costa Counties, LANDFIRE, DMS, WRM.

Map created by www.digitalmappingsolutions.com on 9/11/2019.

Figure 22. Predicted maximum spotting distance with a 40 mile per hour wind blowing from the northeast

4. DESCRIPTION OF PROPOSED TREATMENTS

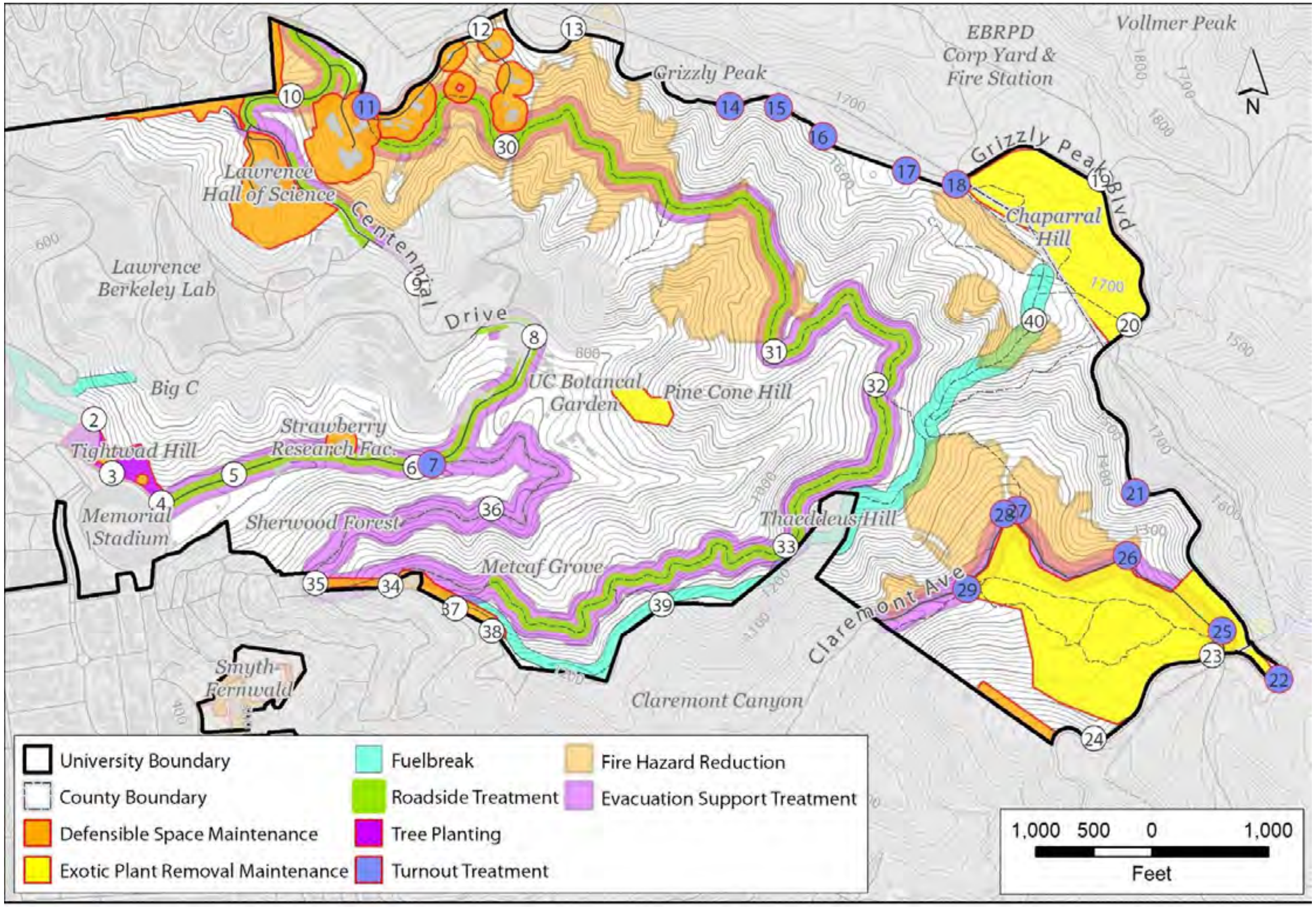
4.1 DESCRIPTION OF PROPOSED TREATMENTS

The Plan includes continuing with previously described (see section 2.4.4) current and ongoing vegetation treatments, and adding new vegetation treatments proposed for implementation throughout the Hill Campus. The treatment types include emergency evacuation support, fire hazard reduction, creation of fuel breaks, and creation of temporary refuge areas. As shown in Table 5, the combined acreage of the new treatment projects is 123.1 acres.

This section describes the four treatment types and the specific treatments that are proposed to be implemented in the Plan Area, which are shown in Figure 20 below.

Table 5. Acreages of Proposed Projects

Treatment Type	Acreage
Total Fire Hazard Reduction Fuel Treatment	98.4
Total Fuel breaks	23.2
Total Temporary Refuge Areas	1.54
Total	123.1



All Projects Considered

UC Berkeley Hill Campus Wildland Fuel Management Plan

Figure 23. Proposed areas of treatment

4.1.1 EVACUATION SUPPORT TREATMENTS

The treatment type of evacuation support is described in Section 1.4.4.4 Evacuation Support Treatments, as part of ongoing treatments undertaken by the university.

In addition to the treatments along Centennial Drive and Claremont Avenue, evacuation support treatments may be implemented along the Jordan Fire Trail (both Upper and Lower), the route along Grizzly Peak Boulevard and the route to LBNL from Hearst Avenue. The East Bay Regional Park District and East Bay Municipal Utility District both manage vegetation on the eastern side of Grizzly Peak Boulevard. UC Berkeley would conduct treatments along the western side of Grizzly Peak Boulevard similar to those proposed along Centennial Drive and Claremont Avenue.

Work associated with evacuation support treatments may involve complete closure of portions of Claremont Avenue, for a few hours at a time to allow cutting and skidding of trees growing close to the road. The Upper Jordan Fire Trail, an unimproved road on UC Berkeley land, would be closed to the public as necessary during tree removal activities. UC Berkeley will coordinate with local fire departments to permit emergency access or alternative access to the land served by the fire trail.

It is expected that the vast majority, if not all, of the work will be road-based with the use of a grapple saw and loader. The equipment will be positioned on the road and will reach into the vegetation. Hand crews will be used to apply herbicide as needed.

Figure 24. Example of a grapple saw

Completion of the proposed vegetation removal to support evacuation support treatments is expected to require 10 weeks spread over two years. In general, work could be conducted year-around but may be timed to minimize environmental effects (e.g., erosion, disturbance of special-status species). Skidding would not be performed after a heavy rain, per California Forest Practice Rules.

4.1.2 FIRE HAZARD REDUCTION TREATMENTS

Fire Hazard Reduction treatments, as shown on Figure 20, would be implemented in areas where treatments to remove eucalyptus were performed in the 1990s, but regrowth occurred because of ineffective herbicide application. In these locations a robust understory of California Bay and, to a lesser degree, Coast Live Oak, grew at the same time as the eucalyptus trees regrew. Currently these areas pose significant fire hazards in terms of flame lengths and ember production, and spotting distribution.

Treatments will consist of removing or pruning those trees most likely to torch and produce embers afar, potentially near the Campus Park or along the Jordan Fire Trail or near research and education facilities on campus.

The Fire Hazard Reduction Treatment involves the following activities:

- Evaluate trees and shrubs for both vertical and horizontal spacing and their corresponding potential to torch and produce embers; and
- Remove tall, unhealthy or structurally unsound trees, predominantly eucalyptus that are likely to torch and distribute embers; and remove short trees under tall trees.

Criteria for tree removal includes flammability/fire hazard, consideration of tree health, structure, height, potential for failure/falling, and competition with other trees (including for water, space, and light), and high fuel volume production of small diameter fuels. Criteria for retention of trees includes fuel characteristics (flammability, fuel volume amount of dead material), consideration of ability to slow spreading of invasive species and surface fuels, protection of understory, encouragement of nesting and improvement of flight patterns of raptors, prevention of erosion, and cost of removal.

Grouping of multiple trees that have torching potential because of their vertical connectedness will be thinned so that the canopies are separated vertically, with preference for retention being healthier trees that will allow for sustained growth. Tree health is measured in part by crown ratio (proportion of crown with foliage). Trees will be removed following a variable density thinning strategy to prevent crown fire spread by using gaps in tree canopy. Diagrams and pictures of variable density thinning appear as Appendix B. Canopy cover and tree density will be variable to help reduce canopy fire spread.

In a few locations of the Plan Area, in the denser stands where terrain is too steep to tractor yard, and cable yarding is infeasible, trees may be felled across slope and positioned against cut stumps so they remain stable over time. All tops and limbs must to be lopped and scattered or chipped as required. In these cases, stump heights may exceed six inches in order to safely hold log segments to be left on-site. All trees proposed for these alternative treatments must receive prior approval from project managers.

Otherwise, vegetation in specific areas identified as projects will be treated through the combination of the use of machinery and hand labor. Trees would be felled using hand tools or a mechanized feller-buncher or grapple saw. Road-based operations will be used wherever possible so disturbance off roads, skid trails and fire trails is minimized. To prevent resprouting, an herbicide will be applied by a licensed California Qualified Applicator to the cambium ring of eucalyptus and acacia stumps. See Section 4.5 for specific herbicides considered. Felled trees will be skidded by rubber-tired or tracked vehicles along skid trails to landings. Selected tree trunks will be left on the slope. At the landings, trees would be stored or chipped using a grapple-fed chipper or a tracked chipper. Whole trees will be fed into the chipper and pulled through the blades by a conveyor belt and feed wheel. Chips will be both spread on-site to depth of six inches or less, or transported to an air curtain or gasifier to supply electricity directly to the university. Along roads and buildings, lower limbs of trees will be pruned, understory vegetation shortened and grass mowed.

Wherever possible, trees will be removed with machinery that can be positioned on roads, skid trails, landings and fire trails. Use of equipment with articulated arms with attached saws or grapples will be preferred types of machinery. During tree removal operations tractors will be positioned on existing, stable roads adjacent to some of the steeper areas, and cut material is winched for chipping and or hauling. Trees on steeper slopes and within 50 feet of water courses will be felled using hand-held equipment only; no heavy equipment is used for cutting or chipping in steep areas. Trees on steeper slopes will be felled using hand-held equipment only; no heavy equipment is used for cutting or chipping. A crane (positioned on a road) may be used to reposition tree trunks after cutting.

In most cases felled trees are removed (skidded) by rubber-tired or tracked vehicles along paths to landings.

In some cases, landings may not be needed, while in other cases, because cut material is to be mostly chipped and broadcasted back into the treatment areas, the chippers may be stationed on roads and out into the cutting areas, which will reduce the need for many of these landings. The equipment available to the operator and the limits on chip depths will be determined by the need to avoid and minimize impacts to sensitive resources (e.g., special-status wildlife) if present.

4.1.2.1 Access for Treatment Areas

There is vehicle access into and out of the treatment areas, with alternatives to allow for phased operations and account for public safety. All internal roads will need to be kept passable during operations for fire and emergency vehicle access. Truck traffic will need to be limited to weekdays and non-holidays typically between 8AM and 6PM and internal roads will need to be posted and closed to public access during operations. Upper Jordan Fire Trail is heavily used by the public, and is the main internal road accessing treatment areas. These notifications will be made at least a week in advance and posted at all trailheads with an information contact.

Cut material will not be removed from UC Berkeley property so vehicle traffic will consist primarily of moving equipment into and around the project area, and road watering as needed to reduce any fugitive road dust. Equipment will include low-bed trucks hauling chippers, skidders and tractors, as well as water trucks and service and employee vehicles.

Project equipment and debris will be staged in areas adjacent to Upper Jordan Fire Trail and in previously disturbed areas. Where possible, the project will use staging areas, landings and skid trails from previous logging activities rather than constructing new ones. Equipment would be staged, fueled, and maintained at these landings while contractors are mobilized. Environmentally sensitive areas would be avoided. At the landings, trees would be stored temporarily, or chipped, or burned.

Most of the treatment area has slopes from 10-45 percent and is not too steep for travel by tractors and rubber-tired skidders. Tractors can also be positioned on existing and stable roads adjacent to some of the steeper areas, and cut material winched for chipping and or hauling. Some of these areas (less than 20 acres) could be ground-cable yarded from existing roads if desired. Grapple saws are types of equipment that can minimize ground disturbance. Because of a long reach from an articulated arm, trees can be cut and placed without traveling off the roadbed.

All of the area containing dense eucalyptus was removed in the past with tractors, however the pine stands on some of the steeper areas have not been removed. These stands will require more extensive “line pulling”, or “endlining” (i.e. an operator will pull their tractor winch cables up to 100 feet to cut trees and “whole tree yard” the trees to more gentle ground or a landing for chipping). In some isolated cases where the distances are too great, these trees will need to be bucked and left on site, and the tops lopped and scattered. This could occur in areas smaller than 1/10th of an acre, and no closer than 300 feet from a structure. Where flame lengths are predicted to already be greater than 12 feet, cut material can remain.

There are many places, depending on equipment capabilities, where a chipper could be walked out onto some of the gentler terrain to chip and broadcast material; other areas will require logs to be skidded to a roadside or landing for chipping.

Existing landings are located adjacent to fire trails and paved roads. Equipment would be staged, fueled, and maintained at existing landings while contractors are mobilized. At these landings, trees are stored, chipped using a grapple-fed chipper or a tracked chipper, or transported to an air-curtain burner for disposal.

4.1.2.2 Biomass Disposal for Fire Hazard Reduction Treatments

Vegetation removed during treatment activities is called biomass. The objective is to leave or use all downed material on UC Berkeley property. Projects would leave or use all downed material on UC Berkeley property. The potential to obtain funds from the sale of salvaged wood materials is not part of the current project. A small portion of chips will be staged at various locations for potential use by a gasifier or use on the Campus Park. A greater volume of the biomass generated will be burned with an air curtain type of burner on UC Berkeley property, either in the Plan Area or outside the area. Some logs will be used as barriers to vehicular traffic on the Hill Campus, and otherwise kept as logs onsite.

Selected tree trunks are left on the slope. The trunks of these trees are cut into 20-to 30-foot lengths. In these cases, downed trees are cut by chain saws such that all portions of the tree are within six inches of the ground. Where possible, tree trunks will be placed and anchored to prevent movement, to help control sediment and erosion or support wildlife habitat. Other logs will be positioned on UC Berkeley property as barriers to illegal vehicular access.

Whole trees are fed into the chipper and pulled through the blades by a conveyor belt and feed wheel. Alternatively, the tracked chipper is driven to downed trees on slopes less than three percent. Remaining wood chips are expected to be between one and four inches long and would be spread on up to 20 percent of the site to a maximum depth of six inches, except for in Evacuation Support Treatment areas, and Defensible Space treatment areas, where the maximum depth is three inches. UC Berkeley will use some of the wood chips to create sediment traps. The maximum depth of chips is used for the sediment trap to increase both the length of time the traps function and the amount of sediment that can be retained. Chips may also be spread to the maximum depth over uneven terrain and around stumps. Chips will be spread on skid paths to reduce disturbance of soil. UC Berkeley expects the chips to decompose in approximately five years, restoring the original contours of the portion of the site in which they would be spread and reducing the evidence of skid road creation. Chip decomposition in previous projects on the UC Hill Campus has been observed to be five inches per year.[10]

4.1.2.3 Fire Hazard Reduction Projects

Fire Hazard Reduction (FHR) projects were identified in six discrete areas (see Figure 20 *Proposed Areas of Treatment*) in the Plan Area. The six treatment areas fall within three broad treatment areas: Strawberry Canyon, Frowning Ridge, and Claremont Canyon. The Strawberry FHR Project covers 23.7-acres, the Claremont FHR Project includes a 25.5-acre area and the Frowning FHR Project covers a 49.2-acre area. In all three areas, the treatments would focus on removing high hazard vegetation. The projects in the Strawberry Canyon treatment area are near the MSRI, SSL, LBNL and LHS with treatments aimed at protecting those facilities, as well as downhill near the Campus Park. The projects in the Frowning Ridge treatment area are uphill of the Botanical Garden and LBNL, and are similarly aimed at protecting those facilities, as well as downhill near the Campus Park. Actions in the uphill portion near Grizzly Peak Boulevard of the Frowning Ridge treatment area will also minimize the ability of embers to spread downhill to the Campus Park. Projects in Claremont Canyon area are aimed at protecting nearby residential neighborhoods, EBMUD watershed lands, and bolstering efforts to keep a fire from spreading to Strawberry Canyon through Hamilton Gulch.

The total area to be treated in these three projects is approximately 98.4 acres. Most of the treatment area comprises dense pine and eucalyptus tree cover that will have the trees cut, stumps treated, and protection given to interspersed native oak, bay and other tree species as well as native brush vegetation.

Proposed projects are also located in smaller areas in which brush is abundant but trees are sparse (fewer than 3 trees per acre) that will also be treated, but yarding will be less feasible or desirable given the potential impacts to existing vegetation and soils. Trees cut in these areas will be mostly felled, bucked and the tops lopped and scattered to a height less than 24 inches on-site to accelerate decomposition and reduce fuel loading. Cut material is not expected to be of large volume and is left on site when it cannot be safely or feasibly chipped, in lengths no longer than two feet. Large trunk segments will be fallen across slopes to ensure stability over time, and not positioned in a way that could undesirably alter surface water flow. Some of these log segments may exceed 24 inches in height

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[10] Hazardous Fire Risk Reduction Environmental Impact Statement East Bay Hills, California, November 2014.

once on the ground, but will be limbed to minimize height. No cut material would be left within 20 feet of any watercourse or swale.

Strawberry Fire Hazard Reduction Project

Trees would be cut and moved, per Section 3.1.2. In addition, a cable system may also be used to move logs to landings without use of vehicles. UC Berkeley will use landings and skid trails from previous logging activities; six existing landings are adjacent to fire trails or paved roads in the Strawberry FHR treatment area. Equipment would be staged, fueled, and maintained at existing landings while contractors are mobilized. Any eucalyptus and acacia cut would be prevented from resprouting by application of herbicides to the stumps, as described in Section 3.2.

Completion of the Strawberry FHR treatment is expected to require 10 weeks spread over two years. In general, work could be conducted year-around but may be timed to minimize environmental effects (e.g., erosion and disturbance of special-status species). Skidding would not be performed after a heavy rain. Initial work contracts may be issued for several noncontiguous areas, for example, several five-acre areas adjacent to Grizzly Peak Boulevard. Subsequent work areas would be contiguous to those already completed, each with a clear path to the existing landing areas.

Claremont Fire Hazard Reduction Project

The Claremont FHR treatment involves similar activities as the Strawberry FHR treatment. Three roads to be used mainly follow existing dirt roads created during work done in 1974 and 1975 when trees were last cut on the site. Four existing landings are adjacent to existing fire trails or paved roads in the project area. Trees on steeper slopes and within 50 feet of water courses would be felled using hand-held equipment only; no heavy equipment would be used for cutting or chipping in these areas.

UC Berkeley anticipates that completion of the proposed work would extend over a period of two years, with 10 weeks of actual vegetation removal work. In general, work could be conducted year-around but may be timed to minimize environmental effects (e.g. erosion, disturbance of special-status species). Temporary closure of Claremont Avenue may be required during cutting and skidding of trees that are close to the roadway.

Frowning Fire Hazard Reduction Project

The same procedures described for the Strawberry FHR treatment area above would be used for tree removal, management of cut material, suppression of resprouting from stumps, and suppression of seedlings at Frowning Ridge.

In the Frowning FHR, temporary closure of Grizzly Peak Boulevard may be required during cutting and skidding of trees close to the roadway. The Upper Jordan Fire Trail, an unimproved road on UC Berkeley land, would be closed to the public as necessary during treatments. UC Berkeley would coordinate with local fire departments to permit emergency access or alternative access to the land served by the fire trail.

Eleven existing landings are located adjacent to fire trails or paved roads in the project area. Equipment would be staged, fueled, and maintained at these landings while contractors are mobilized. Environmentally sensitive areas would be avoided, through the use of exclusionary fencing or other types of protection and demarcation.

Completion of the proposed vegetation removal in the Frowning FHR is expected to require an estimated 10 weeks spread over two years. In general, work could be conducted year-around but may be timed to minimize environmental effects (e.g. erosion, disturbance of special-status species). Skidding would not be performed after a heavy rain. Initial work contracts may be issued for several noncontiguous areas, for example, eight acres of cutting adjacent to each of the two lower landings in the first year. Subsequent work areas would be contiguous to those already completed, each with a clear path to the existing landing areas.

A more specific type of fire hazard reduction treatments will occur along ridgelines in Frowning Ridge treatment areas FHR-FR-1, FHR-FR-3, FHR-FR-4, and FHR-FR-5, which are major spur ridgelines, and are crucial for fire containment. Treatments will be aimed at providing an anchor point for fire containment and reduce ember-casting potential. Fuel characteristics would produce a flame length less than 4 feet in areas with trees, and potentially offer backfire potential (i.e. with fuels that could ignite when managed) in areas of grass cover (based on post-treatment fuel conditions and weather condition noted in the fire behavior analysis (Appendix A). Post-treatment fuel characteristics will result in minimal torching or crown fire potential. The total width of treatment areas is approximately 200-feet along the ridges.

Treatment will remove small diameter trees and branches lower than 8 feet of the ground, per defensible space standards described in Section 5.3.1. All dead, unhealthy or leaning trees will be removed.

Grouping of multiple trees that have torching potential because of their vertical connectedness will be separated, with preference for retention being healthy trees that will allow for sustained growth. Health is measured in part by crown ratio (proportion of crown with foliage). Tree canopy cover and tree density will be of variable density to impede canopy fire spread.

4.1.3 FUEL BREAK TREATMENTS

Fuel breaks are strategically located linear strips where vegetation has been treated or removed to slow the spread of a fire or reduce the likelihood of crown fire transition, and as a defensive position for firefighting. Fuel breaks in the Plan Area are typically installed on ridgetops to limit spotting from trees between canyons and generally to help prevent fire spread from one canyon to another (see Figure 20).

There are two fuel break treatment projects, totaling approximately 23 acres in size. One is located along the ridgeline between Strawberry and Claremont Canyons, known as the East-West Fuel Break, and the other is located along Hearst Avenue as it approaches the LBNL entry gate, known as the Hearst Gate Fuel Break.

East-West Fuel Break Project

This fuel break project serves to help contain a wildfire spreading from Claremont Canyon to Strawberry Canyon and vice versa (see Figure 20). Because current vegetation in this treatment area is both forested and a mixture of brush and grass, the character of the fuel break will be a shaded fuel break in some segments and a non-shaded fuel break in other segments. In these locations, Monterey pines will be removed to prevent torching and ember production, and more importantly, ember distribution in the adjacent canyon. The material from the treatment within 50 feet of the fire trail will be chipped, and where the pines are located in scrub stands further than 100 from the fire trail, they will be lopped and scattered.

Part of the fuel break installation will require minor blading of the roadbed on the fire trail so that it is passible with 4WD vehicles, a Type III wildland engine, or small slip-on type engines after the project is complete. Machinery will also be used to cut brush and remove trees. Wherever possible, operations will be road-based to minimize disturbance. Hand labor will augment machinery to cut brush and move biomass. Herbicides will be applied via cut-stump method to eucalyptus and acacia trees. It is expected to take up to 8 weeks to implement using both manual and mechanical treatment methods.

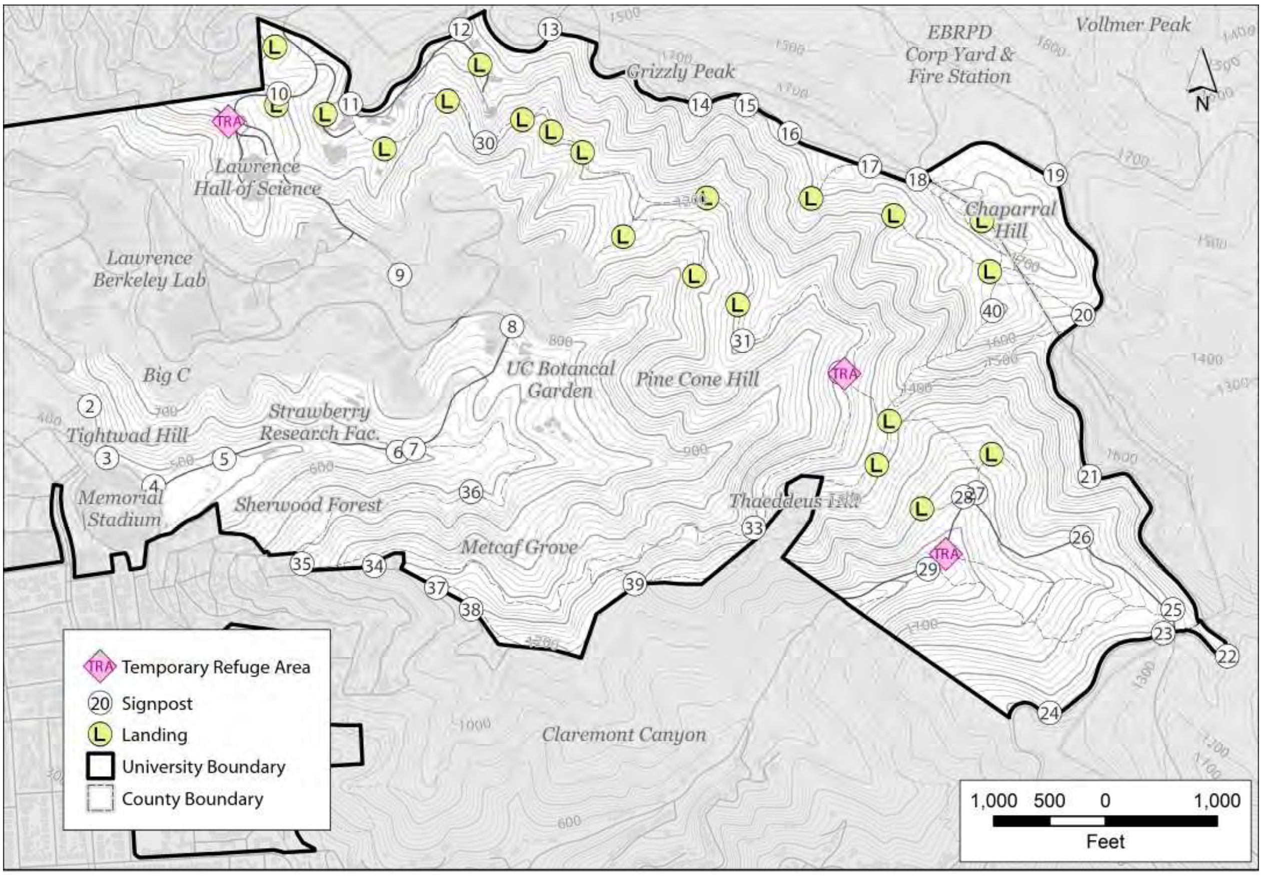
Hearst Gate Fuel Break Project

The Hearst Gate fuel break will aid containment of a fire between the LBNL's southern border and the Hill Campus. It is fairly short, covering approximately one acre. Because of its small size and lack of access, hand labor will be used to remove understory vegetation, thin and limb trees. The stumps of eucalyptus trees that were removed will have herbicide applied to prevent resprouting. Implementation of the Hearst Gate FB Project is expected to take up to 4 weeks to complete.

4.1.4 CREATION OF ROADSIDE TEMPORARY REFUGE AREAS

In selected locations, usually near intersections of roads and fire trails, all trees and shrubs will be removed in an approximately 200-foot diameter from the edge of pavement or fire trail to create an area of low-fuel volume for a firefighter and evacuee temporary refuge area. In order to provide an area where fire behavior would be survivable, the resulting fuel characteristics would consist of low volume, short fuels. This could be mowed grass, pavement, bare ground, or a thin layer of leaf litter. Temporary refuge areas can be constructed using a combination of machinery, hand labor and selective use of herbicides using cut-stump application methods. These places of refuge will be located in collaboration with local wildfire responding agencies, and sized to conform to previously published documents and guidelines.

Three temporary refuge areas are proposed. These locations include an area within the existing parking lot of the Lawrence Hall of Science, in an open area near Signpost 29 in Claremont Canyon, and adjacent to and within the Jordan Fire Trail.



Temporary Refuge Areas

UC Berkeley Hill Campus Wildland Fuel Management Plan

Figure 24. Map of temporary refuge areas

5. DESCRIPTION OF TREATMENT ACTIVITIES

Currently in the Plan Area, hand labor is used to create areas for defensible space. Occasionally, prescribed herbivory augments the hand labor; however, prescribed herbivory is a minor component of the total 154 acres currently treated with hand labor. Mechanical equipment is most often used for tree removal and cutting large areas of French broom. UC Berkeley anticipates using mechanical equipment to treat almost 284 acres of the Plan Area, primarily with a grapple saw and other types of equipment with articulated arms, which would result in most work being road-based. Prescribed burning is not currently conducted in the Hill Campus, but is included as a potential treatment activity. Herbicides are currently used sparingly, hand applied on stump cuts of trees and shrubs that sprout.

Table 6. Treatment Activities

Treatment Activities	Description	Method of Application
Manual Treatment	Use of hand tools and hand-operated power tools to cut, clear or prune herbaceous or woody species	Hand pull and grub, thin, prune, hand pile, lop and scatter, hand plant; often combined with pile burning
Mechanical Treatment	Use of motorized equipment to cut, uproot, crush/compact, or chop existing vegetation	Mastication, chipping, brush raking, grading, tilling, mowing, roller chopping, chaining, skidding and removal, piling; can be combined with pile burning
Prescribed Burning	Pile burning: Prescribed burning of piles of vegetative material to reduce fuel and/or remove biomass following treatment Broadcast burning: Prescribed burning to reduce fuels over a larger area or restore fire resiliency in target fire-adapted plant communities; would be conducted under specific conditions related to fuels, weather, and other variables	Pile burning: Place removed fuels in piles on site and burn fuel Broadcast burning: Burn understory within timber or oak forests, or broadcast treatment using fire with a control line along the perimeter
Prescribed Herbivory (managed livestock grazing)	Use of domestic livestock to reduce a target plant population thereby reducing fire fuels or competition of desired plant species	Grazing or browsing by cows, goats, or sheep
Herbicides	Chemical application designed to inhibit growth of target plant species	Ground-level application only, such as paint-on stems, backpack hand-applicator, hypo-hatchet tree injection, foliar spray with a hooded spray wand, or hand placement of pellets by a licensed applicator. No aerial spray is allowed.

5.1 MANUAL VEGETATION TREATMENT

Manual treatment involves the use of hand tools and hand-operated power tools to cut, clear, or prune herbaceous and woody species. Activities could include thinning trees; cutting undesired competing brush species; manually pulling, grubbing, or digging out root systems of undesired plants to prevent sprouting and regrowth; and placing mulch, such as wood chips from pruning operations, around desired vegetation to limit competitive growth and minimize erosion. This treatment allows for selective removal of targeted species.

Manual treatments are typically used in developed, sensitive or hard to access areas for small-scale projects. Consequently, ground disturbance associated with manual treatments is typically less than mechanical treatment within an equivalent area. Hand tools include, but are not limited to, shovels, Pulaski hoes, McLeod fire tools, weed whips and “weed wrenches” (tools that pull both shrub and root systems out), chain saws, hand saws, mechanized brush cutters, machetes, pruning shears, and loppers. Hand cutting can involve workers using chain saws and wedges to fell a tree in a direction that facilitates processing. Masticators, which is mechanical treatment method, and chippers are used occasionally to assist with manual treatments and process cut materials into mulch to remain on-site.

UC Berkeley has historically used hand labor for managing vegetation throughout the Plan Area, sometimes with the assistance of volunteer labor.

5.2 MECHANICAL VEGETATION TREATMENT

Mechanical treatment involves the use of heavy motorized equipment, such as tractors, masticators, or specially designed vehicles with attached implements designed to cut, tear uproot, crush/compact, or chop target vegetation. Mechanical treatment methods that may be used include mowing, masticating (mulching), grubbing, and chipping, among others. Grading by a tractor with an attached blade can maintain passable roadbeds. Mowing using a tractor reduces fuel height of vegetation and performed at the appropriate time can reduce the amount of manual work needed to maintain an area. Almost all of the eucalyptus stands in the Plan Area were removed using tracked mechanical equipment. Current best practices limit mechanical equipment to slopes less than 30 percent grade, which would constrain the area to be treated with tracked mechanical equipment.

Mechanical treatment is effective at removing dense stands of vegetation and is typically used in shrub and tree fuel types. Mechanical treatments are appropriate where a high level of control over vegetation removal is needed, such as near residential areas or in sensitive habitats. Unless followed with targeted application of herbicides, mechanical treatment has limited use for noxious weed control, as the machinery tends to spread seeds and may not kill root systems.

In certain instances, two or more pieces of heavy equipment are used in concert. For example, a feller-buncher or grapple saw may be responsible for cutting material, while another piece of equipment moves the cut material to a landing or staging area where it can then be further treated or transported. Feller-bunchers and grapple saws are used to quickly remove trees and may need to be supported by skidders to move trees and materials. Feller-bunchers are tracked vehicles with a self-leveling cab that mechanically grasps the standing tree, cuts it with a hydraulically powered chain saw, and arranges cut trees in bunches to facilitate dragging the tree out of the forest (skidding). Use of feller-bunchers is limited to slopes of less than approximately 45 percent. As the name implies, grapple saws have a saw at the end of an articulated arm and are restricted to flatter terrain, usually on a roadbed.

Landings are typically needed to sort, store, and chip trees into mulch and spread or remove the material. A flat landing area is typically used for yarding operations, temporary stacking, loading, and trucking logs or brush off the treated site. All of the ground containing dense eucalyptus in the Plan Area was logged in the past with tractors. The Plan Area contains numerous landings from previous vegetation treatment activities that would also be used for future treatments (see Figure 9 in Section 2.5.3).

Typically, mechanical treatments will not result in the hauling of cut material from UC Berkeley property. Cut material is chipped and looped and spread directly back onto treated areas to help mitigate erosion potential. As needed, some logs could be anchored and utilized on-site for erosion mitigation, as well as for wildlife habitat. Vegetation removed during mechanical treatments (i.e. biomass) is handled in the same methods as described above under Manual Methods, or it is piled on-site and burned.

5.2.1 MOWING

Mowing tools, including rotary mowers or straight-edged cutter bar mowers, or flails, is used to cut herbaceous and woody vegetation above the ground. Mowing results in shorter, more compacted fuels, which reduces potential flame length and fire spread rates. Timing of mowing has an impact on the type of vegetation promoted: mowing after annual grasses have dried enhances growing conditions for perennial native grasses, provided mowing does not occur during seed production. Mowing at the appropriate time to a height (approximately 4 inches) minimizes weed and brush encroachment and reduces the amount of manual work needed to maintain the site. Mowing of weeds is typically required annually.

5.2.2 THINNING

The term thinning has broad use in forestry and wildland management. Thinning spans the complete removal of overstory to allow for the understory to thrive, or removal of smaller diameter trees (everything from trees smaller than four inches to 24 inches in diameter), or the removal of large diameter trees (as in commercial forestry operations). Sometimes thinning is specified in terms of post-treatment desired condition, i.e. tree spacing (distance between trees) or number of trees left per acre, or species and size class distribution of remaining trees.

During forestry operations tractors are positioned on existing, stable roads adjacent to some of the steeper areas, and cut material is winched for chipping and or hauling. Trees on steeper slopes and within 50 feet of water courses are felled using hand-held equipment only; no heavy equipment is used for cutting or chipping in steep areas. Trees on steeper slopes are felled using hand-held equipment only; no heavy equipment is used for cutting or chipping. A crane (positioned on a road) may be used to reposition tree trunks after cutting.

Felled trees are dragged (skidded) by rubber-tired or tracked vehicles along paths to landings. Selected tree trunks are left on the slope. The trunks of these trees are cut into 20-to 30-foot lengths. In these cases, downed trees are cut by chain saws such that all portions of the tree are within six inches of the ground. Where possible, tree trunks are placed and anchored to prevent movement, to help control sediment and erosion or support wildlife habitat. Other logs are positioned on university property as barriers to illegal vehicular access.

A cable system may also be used to move logs to the landings without use of vehicles. As much as possible, UC Berkeley uses landings and skid trails from previous logging activities rather than constructing new ones.

5.2.3 YARDING

Yarding is the process of transporting entire or portions of cut trees from their cut location to a landing or staging area for subsequent treatment or transport. Tractor-based yarding involves the use of tractors to pull logs to a landing area where they can be reduced to debris and distributed, or relocated. Tractor-based yarding is best suited for flatter areas to minimize the potential for erosion. The use of a feller-buncher in combination with tractor yarding may be appropriate in larger treatment areas. Cable yarding involves the use of cables to move cut and felled trees to a landing or staging area. Equipment is set up on flat areas and cables strung up or down slopes to transport materials along skid trails. This technique results in less soil disturbance/compaction and therefore less potential for erosion and sedimentation.

5.3 PRESCRIBED BURNING

Prescribed burning is the intentional use of fire under specified conditions of fuels, weather, location, and other variables defined in a burn plan. Prescribed fire produces lower intensity surface fires that are intended to control vegetation by enhancing the growth, reproduction, or vigor of certain species, in addition to managing fuel loads and/or maintaining a targeted vegetation community. Surface fire burns along the surface without significant movement into understory or overstory vegetation, with low flame lengths. Typically, prescribed burning requires the construction of fire breaks using manual or mechanical treatments if roads and trails are not already in place; use of existing roads and trails is preferred. In some cases, larger vegetation may be trimmed or removed manually by hand crews or by mechanical equipment in advance of burning, or vegetation may be pretreated with herbicides to kill the aboveground portions and cause them to dry before burning. Prescribed burning may be used where other activities are not feasible because of rocky soils, steep slopes, or irregular terrain. Factors that are considered when designing and implementing a prescribed burn include risk to structures and property, land use, environmental impacts, weather conditions, soil stability, slope and aspect, soil type, vegetation types and density, fuel moisture content, time of year, fire return interval, and the efficacy of alternative activity methods. Burning may occur throughout the year, but it is usually conducted during late spring when the ground is still wet, or during the fall or winter when precipitation is imminent, and plants have completed their yearly growth cycle and their moisture content has declined.

UC Berkeley has carried out prescribed burns in the Plan Area in late winter when leaf litter is dry but annual grasses are moist and green, and in the summer when grasses are dry. No specific locations have been identified for prescribed burning, however, areas that have been treated under the CCI/CAL FIRE grant period are potential locations because fuels will have been reduced and a prescribed burn could be easier to control.

Prescribed burns typically last one day. Equipment used for a prescribed burn include fire engines, work crews, bulldozers, masticators, onsite water truck for fire suppression, and ignition devices such as drip torches. Prescribed burns in the Plan Area require a burn plan that includes a smoke management plan approved by the Bay Area Air Quality Management District.

5.4 PRESCRIBED HERBIVORY (MANAGED LIVESTOCK GRAZING)

Prescribed herbivory, also known as "managed livestock grazing," is the use of domestic livestock to accomplish specific and measurable vegetation management objectives. Objectives include removing biomass (fine fuel loads), reducing populations of specific plant species, slowing the reestablishment of shrubs on burned or mechanically thinned sites, preventing shrub encroachment into grasslands, and improving plant community structure for wildlife habitat values. Grazing is used both as an initial treatment to reduce the volume of hazardous fuels, and as a maintenance technique. See Section 7 of this Plan for more details about maintenance. Goats, sheets and cattle are most commonly used for this purpose because they are relatively common and easy to manage.[11] Grazing/browsing by these animals is best used for green herbaceous plants that produce fine fuels and smaller diameter woody species that produce highly flammable fire fuels.

Livestock are best selected according to site conditions and the types of vegetation that need to be managed. Goats are typically best suited to woody vegetation and in steep terrain; sheep eat both forbs and grasses and can be used in a variety of environments; and cattle are better suited to herbaceous plants, especially grasses. Successful herbivory treatments can enhance habitat for certain wildlife. For example, shrub species increase their vegetative output for winter browsing by deer and other wildlife. Managed grazing is most effective employing the proper combination of animals, stocking rates, timing, and rest.

Prescribed herbivory by domestic livestock should occur when the target plant species is (are) palatable and when feeding on the plants can damage them or reduce viable seeds. Additionally, prescribed herbivory should be restricted during critical growth stages of desirable plant species. When desirable species are present, the area needs a period without herbivory to allow the desirable species to recover. The frequency of moving the livestock is based on numerous site-specific factors, including slope, density and type of vegetation, stocking rate, type of livestock, and precipitation/moisture content of vegetation. Targeted grazing by livestock requires infrastructure that could include a herder,

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[11] Natural Resource Conservation Service, Grazing Lands Technology Institute, 2003. National Range and Pasture Handbook. Revision 1.

fencing, mineral block, supplemental food and/or a watering site to keep the animals within the desired area. In addition, portable electric fencing is typically used for prescribed herbivory.

Prescribed herbivory is not new to the Hill Campus; both Strawberry and Claremont canyons were dairy farms in the 1940s. Since the 1980s, goats were used to manage grasslands and shrublands in the Plan Area including below the Lawrence Hall of Science, Math Science Research Institute and FSSBER. Currently, a herd of goats is reducing fuel hazards in the 29-acre FSSBER managed by the Office of Laboratory Animal Care (OLAC); OLAC and Facilities Services have an agreement to graze four locations in the Hill Campus to evaluate the potential of this treatment.

5.5 HERBICIDE APPLICATION

Herbicides are chemicals that damage or kill plants and are categorized as selective or non-selective. Selective herbicides kill only a specific type of plant, such as broad-leaved plants, which allows the herbicide to be used to control weeds while maintaining grass species. Other herbicides, such as glyphosate (Roundup®), are non-selective and kill any type of plant. UC Berkeley could use Garlon 4[12] or Garlon 3A (triclopyr) and Stalker[13] (imazapyr) Transline, Glyphosate, Snapshot, and Surflan, using cut stump or basal bark application, which are described below. UC has a rigorous review procedure regarding the use of Tier 1 herbicides and prohibits all other herbicides.

To prevent resprouting of removed trees, an herbicide solution will be applied by a licensed California Qualified Applicator to the cambium ring of eucalyptus and acacia stumps within three minutes of felling. The herbicide mixture will likely consist of a combination of Garlon 14 or Garlon 3A (triclopyr) and Stalker[15] (imazapyr) in a solution of methylated seed oil, water, and marking dye. If application within 60 feet of running or standing water is necessary, Garlon 3A will be used, which is approved for use near aquatic areas. A typical tree requires 1 to 2 ounces of diluted solution. Foliar spray with a hooded spray wand is also considered.

Use of herbicides will be subject to the restrictions described on the product label, specified in the recommendation by the Pesticide Control Advisor, and by the 2014 Final Hazardous Fire Risk Reduction Environmental Impact Statement East Bay Hills, California.

5.5.1 CUT STUMP APPLICATION

To maximize the efficacy of treatment the tree must be cut leaving a stump not more than four inches in height above soil surface and the cut surface of the stump must be treated with an herbicide within minutes of the cut. The herbicides applied to the outer portion of the cut surface, including the cambium of the tree. The herbicide is translocated to the roots and disrupts the transportation of nutrients and water, causing the plant to die.

5.5.2 BASAL BARK APPLICATION

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[12] Garlon is a registered trademark of Dow AgroSciences.

[13] Stalker is a registered trademark of BASF.

[14] Garlon is a registered trademark of Dow AgroSciences.

[15] Stalker is a registered trademark of BASF.

This treatment consists of spraying at very low pressure a solution of the herbicide mixed with esterified vegetable oil to the lower 12 to 15 inches of the resprout. This application method permits the operator to selectively treat resprouts without injury to adjacent vegetation, and is particularly effective on resprouts less than six inches in diameter. Since pines do not resprout, stump treatments are not needed.

Herbicide application must comply with the U.S. Environmental Protection Agency (EPA) label directions, as well as California Environmental Protection Agency and Department of Pesticide Regulation (DPR) label standards. Only ground-level application occurs. UC Berkeley does not use aerial application.

5.6 BIOMASS UTILIZATION & DISPOSAL

Implementation of the Plan would result in the removal of trees and other vegetation. Biomass disposal and utilization is a significant component of treatments.

Biomass may be disposed of or utilized in the following ways:
- Retained as logs to perform as barriers and erosion control
- Chipped and kept on site for erosion control
- Burned as logs in an air curtain burner
- Cut into smaller pieces and distributed in small areas in remote locations of the Hill Campus

Vegetation removed during mechanical treatments (i.e. biomass) is either left on-site or disposed of by skidding to landings to be chipped and then spread on-site. Alternatively, biomass can be transferred to other locations on the campus, disposed of in an air-curtain burner, or piled on-site and burned. Some of the fuels removed during treatment will also be converted to biochar, a charcoal-like substance that can be used to fertilize the soil.

The Plan includes possible purchase and utilization of a gasifier and a wood-burning hydronic boiler, and/or the rental of an air curtain burner. Both the air curtain burner and gasifier will reduce the production of greenhouse gases. For example, by burning the biomass the production of methane during chip and log decomposition will be eliminated. The fuels that are removed during treatment can be converted to electricity, which would substitute for the use of fossil fuels. The feedstock, or energy, would come from removing overstocked locations dead, unhealthy and structurally unsound trees instead of fossil fuels. The electricity would be used directly by the university. Both the air curtain burner and the gasifier can produce biochar for distribution to campus facilities such as the Botanical Garden or the Campus Park.

In some remote locations biomass will be lopped and spread directly back onto the treated areas to help mitigate erosion potential. Contract specifications will ensure the volume of cut material left onsite will be kept low enough to prevent excessive fuel buildup and not interfere with access for monitoring or establishment of desirable revegetation.

Opportunities for the use of large logs for barriers for vehicular traffic will be used when possible, as it both provides long-term carbon storage and blocks unauthorized use of the Hill Campus. In addition, logs will be anchored and used for on-site erosion control, and as wildlife habitat.

There will be no hauling of cut material from UC Berkeley property. Chips may be used on the Campus Park; the use of these chips would supplant the purchase of chips from elsewhere, thereby further reducing greenhouse gasses from the creation of chips and transportation needed.

Chipping is performed following other treatment techniques to reduce the size of materials by passing them through a series of high-speed blades. The result is chips or mulch, which is deposited into a truck bed, or on the ground in a pile, or broadcast near the equipment. If retained on site, spreading and redistribution of chipped material is necessary. Spread chipped material on the ground surface results in a compacted fuel structure that is less likely to ignite and carry fire.

A significant amount of the material will be chipped. Chips are to be kept at average depths less than six inches as measured across any random 1/10 acre area. In general, chips are deposited back into the areas where trees are being removed. Additional areas, if needed, may be designated.

Chips could cover the majority of treated areas in the Plan Area. After approximately 3-5 years, chips are expected to decompose and native vegetation will cover treated areas. Past experience in Claremont Canyon demonstrated chips decomposed at a rate of five inches per year.[16] Eucalyptus chips were deposited in 2004 to a depth of 27 inches. As shown in the photo, in 2010 bare ground is exposed, indicating that decomposition occurred over 5 years, 5 months, at a rate of 5 inches per year (rate = 0.42 inches/month). Using this same rate a 24-inch depth of eucalyptus chips should be expected to decompose in 5 years, and the six-inch depth in a year.

The fire risk is anticipated to be low in areas mulched with chips because of the expected slow rate of spread, short flame lengths, and complete lack of spotting potential. Moreover, the size of the chipped materials is generally large and blocky, with a low surface area-to-volume ratio, and high packing ratio, which means they have much more fuel than air in the fuelbed which generally prevents ignition, and further limits spread since material adjacent to a burning particle is difficult to ignite. Dr. John Shelly, University of California Cooperative Extension Advisor, Forest Products and Biomass Utilization, visited the site in Claremont Canyon on August 25, 2006, specifically to assess the signs of decomposition. His opinion was that the chips would need to be 10 feet deep in order to produce anaerobic activity to the point of being an ignition concern. Chips maintain a higher moisture content than uncovered soil, which helps further prevent ignitions, even during dry conditions (Shelly, 2006). This provides a more favorable growing site for oak seedlings, but impedes the growth of eucalyptus seedlings or sprouts. In a fire event, areas where chips have been applied would facilitate containment.

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[16] Communication dated March 4, between FEMA and UC Berkeley. Photo by Tom Klatt, UCPD, UC Berkeley.

Slide 8

Chip Decomposition – 5 years
Claremont Canyon Phase 4
2004 -2010

Oct. 2004

Feb 2010

27” of eucalyptus globulus chip decomposition occurred over 5 years, 5 months (rate = 0.42 inches/month or 5 inches/year)

Photos by: Tom Klatt, UCB

Figure 25. Photographic documentation of chip decomposition

6. ENVIRONMENTAL PROTECTION MEASURES

6.1 BEST MANAGEMENT PRACTICES FOR FIRE MITIGATION

The following standards will be incorporated into the design on treatments in the Plan Area to minimize environmental impacts and comply with laws and regulations. Some of these standards have been applied to UC Berkeley wildland fuel treatments since 2014.

Projects funded by the CCI/CAL FIRE grant will comply with the Protective Practices for CAL FIRE's 35 Emergency Fuels Reduction Projects dated April 5, 2019.

- Treatment scheduling will be planned for times of the year which maximize effectiveness and minimize environmental impacts.
  - Large oak and pine trees should be pruned between November and April to avoid attracting pathogens.
  - Grasslands should be mowed to four inches in spring, but no later than June 15.
  - Desirable native annual wildflowers may remain unmowed until after they have set seed, provided they do not form a means of rapidly transmitting fire to any structure.
  - Treatments will not occur during extreme fire danger conditions. It is the contractor's responsibility to determine the fire danger prior to start of work every day.
  - Contractors will have spark arrestors on all machinery and comply with PRC 4442.
  - Ground-disturbing activities will not occur within one week following an inch of rain, or unless the ground is consistently firm and can support the weight of machinery without creating ruts.
- Diversity of native plant species should be retained to the greatest extent possible while still achieving fire safety goals. It is sometimes beneficial to selectively reduce the dominance of aggressive, flammable species such as French broom. Retain specimens of plants that are unusual or uncommon on the site. Invasive weeds in project areas should be removed as part of the vegetation management. Noxious weeds, such as French broom, yellow star thistle, stink-wort, and poison hemlock, should be targeted for removal. All eucalyptus and Monterey pine seedlings will be removed.
- Vegetation disposal should be conducted in a way that does not impact the natural vegetation or increase flammability. Generally, cut vegetation, such as grass and broadleafed herbs, can be left in place. Plant material can be left to decompose on site, removed to an offsite location, mowed, or chipped and spread to a depth of less than six inches. In no case may unprocessed plant material be left within 10 feet of the pavement edge or 100 feet of any structure.
- Bare soil will not be exposed in over 50 percent of the site, and no single bare patch will be larger than 15 square feet.
- Haul routes, if used for removal of vegetation debris, should be restored to natural conditions by the contractor upon completion of the project. Repair should ensure the ground is protected from erosion, rainfall runoff is dispersed, and native vegetation is restored before October 15.

- Herbicide application will be conducted per the label, and per the recommendation provided by the Licensed Pest Control Advisor. Notification signage will be posted at each pedestrian entry point, and the footpaths will be closed during herbicide application.

7. PERMITS AND APPROVALS

As UC Berkeley implements specific treatments activities in the Plan Area, regulatory permits and approvals may be required for individual project depending on circumstances. UC Berkeley may need permits and/or approvals from the following agencies:

7.1 FEDERAL

- **U.S Army Corps of Engineers**: Compliance with Section 404 of the Clean Water Act for discharge of fill Waters of the U.S.

- **U.S. Fish and Wildlife Service**: Compliance with Section 10 of the federal Endangered Species Act or potentially Section 7 of the act, if federal approval of the project is necessary.

7.2 STATE

- **California Department of Fish and Wildlife**: Compliance with the California Endangered Species Act, incidental take authorization permits under Section 2018 of the Fish and Game Code if take of listed species is likely to occur, and Section 1602 streambed alteration notification for activities that occur within the bed or bank of adjacent waterways.

- **San Francisco Regional Water Quality Control Board**: National Pollutant Discharge Elimination System construction stormwater permit for disturbance of more than 1 acre, discharge permit for stormwater, and Clean Water Act Section 401 water quality certification or waste discharge requirements.

7.3 LOCAL

- **Bay Area Air Quality Management District**: Open burn permit and review of smoke management plans for prescribed burns.

8. MAINTENANCE AND MONITORING

Treatment intervals and any ongoing maintenance activities that would occur after the initial treatments are based on results of a monitoring program described in this section. Maintenance is expected to be less burdensome after the treatments described herein are implemented. An example of the reduced maintenance needed has occurred in Claremont Canyon, where treatments similar to those proposed for fire hazard reduction projects were performed. After initial work to control French broom and Italian thistles, the area requires minimal follow-up treatments to be maintained in a relatively low fire hazard state. The importance of low maintenance needs cannot be under-estimated because university funding fluctuates, and funding for maintenance may not be consistently allocated

8.1 PURPOSE

Maintenance of treatments is needed in order to retain the benefits of initial treatments. While UC Berkeley has maintained defensible space around buildings and property boundaries, it has not maintained treatments completed in the 1970s, ‘80s, and ‘90s, which now need retreatment. UC Berkeley has maintained all areas treated since 2005. This has entailed retreating areas within 100 feet of property boundaries and buildings to maintain required defensible space, mowing roadside grass, and searching for and removing invasive flammable vegetation that was targeted for removal in initial treatment (i.e. Monterey pine, acacia and eucalyptus). Most maintenance actions have been conducted annually, however some treatments, such as the maintenance of a fuel break at the eastern end of Canyon and Moss roads on Panoramic Hill, have been conducted on a periodic basis (i.e., every 3-5 years).

Some treatments in the Plan Area conducted between 1988-1991 have not been retreated since and need treatment; these treatments are considered maintenance in forest management time-frames. These encompass areas in the Plan Area where eucalyptus resprouts from the 1974-1975 treatment were recut, but not killed. In other areas, such as in the FSSBER, maintenance of the tree stand has been sporadic. In the 1980s, trees smaller than eight inches in diameter were removed and killed. Goats were used to reduce surface fuels by grazing understory vegetation. In the 2000s most Monterey pines were cut and the large boles of the trees left to decompose. Maintenance of the areas within 100-feet of buildings continued through the defensible space treatments.

Monitoring is necessary to determine if the treatments are progressing towards and ultimately meeting the goals as defined in the 2020 LRDP, which are:

- Reducing fuel load by removing dead materials, reducing plant density and favoring species with lower fuel content;
- Reducing horizontal spread by reducing small-diameter fuel materials and by separating dense clusters of vegetation with areas of lower fuel load; and

- Reducing vertical fire spread by increasing separation of understory and crown fuels.

The monitoring program guides future maintenance requirements. It involves a set of protocols and methods, defining performance standards, establishing reporting standards, and scheduling and proposing remedial measures if performance standards are not met. Remedial measures to assist with obtaining specific performance standards will rely on maintenance actions. The maintenance actions may be used for routine site maintenance or prescribed as a remedial measure to meet a specific performance standard**.**

Permanent photographic points will be established within each treatment area in order to track changes in vegetation composition in the years following initial treatments.

8.2 FIELD INVESTIGATION (POST-TREATMENT)

Post-treatment monitoring will include data collection on the following environmental characteristics: erosion/soil stability, woody plant resprouting, resulting vegetation composition, and wood chip placement on a Post-treatment Assessment Form (Appendix E). This form and many elements of the monitoring program were informed by the EBRPD Wildfire hazard Reduction and Resource Management Plan (WHRRMP). Post-treatment monitoring will be conducted immediately following vegetation treatments. This data will also be evaluated on an annual basis, following treatment, to inform the ongoing management strategies. Year 0 post-treatment data will be compared to the results of subsequent post-treatment assessments during monitoring years 1-5, 7, 9, and 10 to track changes in vegetation following treatments.

Monitoring methods specific to post-treatment field assessments are presented below.

8.2.1 EXOTIC VEGETATION COMPOSITION

To measure exotic vegetation (and conversely native vegetation) composition within each treatment area, a biologist will walk through each separate vegetation community and determine the absolute vegetative cover of all woody plant species (native and exotic) based on a visual assessment in a way that is reproducible. This information will be used to establish baseline exotic woody plant cover percentages that will later be compared to post-treatment levels to determine if exotic woody plant performance standards are being met.

Additionally, stands of California Invasive Plant Council (Cal-IPC) rated exotic plant species known to be problematic in the Proposed Plan Area (Table 7) will be mapped in the field. These mapped areas will be targeted for treatment when vegetation management activities occur at the site.

Vegetation composition is linked to fuel characteristics and can therefore indicate whether the wildland fire related goals are being met.

Table 7. Exotic Plants Known to Occur in the Proposed Plan Area

Common Name	Scientific Name	Growth Form	Cal-IPC Rating[1]
Blackwood acacia	*Acacia melanoxylon*	Tree	Limited
Italian thistle	*Carduus pycnocephalus*	Annual herb	Moderate
Purple starthistle	*Centaurea calcitrapa*	Biennial herb	Moderate
Yellow starthistle	*Centaurea solstitialis*	Annual herb	High
Bull thistle	*Cirsium vulgare*	Biennial herb	Moderate
Poison hemlock	*Conium maculatum*	Biennial herb	Moderate
Pampas grass	*Cortaderia* spp.	Perennial herb	High
Artichoke thistle	*Cynara cardunculus*	Perennial herb	Moderate
Cape ivy	*Delairea odorata*	Perennial vine	High
Red gum	*Eucalyptus camaldulensis*	Tree	Limited
Blue gum	*Eucalyptus globulus*	Tree	Limited
Oblong spurge	*Euphorbia oblongata*	Perennial herb	Limited
French broom	*Genista monspessulana*	Shrub	High
Harding grass	*Phalaris aquatica*	Perennial herb	Moderate
Monterey pine	*Pinus radiata*	Tree	Not rated
Himalayan blackberry	*Rubus armeniacus*	Shrub/vine	High
Milk thistle	*Silybum marianum*	Annual/biennial herb	Limited

[1] Ratings from California Invasive Plant Inventory (Cal-IPC 2006), from http://www.cal-ipc.org/, accessed August, 2013.

8.2.2 HYDROLOGIC FEATURES

Hydrologic features, such as springs, creeks or dams, not previously identified in prior surveys should be mapped on an aerial photograph or with a handheld GPS unit, where accessible. The type of feature, type of underlying material (substrate), dominant vegetation growing within the feature, and general water quality (i.e. color, clarity [turbidity]) will be photographed and described.

8.2.3 PHOTOGRAPHIC POINTS

Photographs will be used in combination with other recorded data as a guide to track post-treatment conditions of an area. These photographs will also be used to inform the adaptive management strategy and develop or alter existing prescriptions for further action on the site.

The compass direction of each photograph will be noted and included in the annual report. Photographs will be taken during the both pre- and post-treatment site assessments, ideally during the spring or winter in order to show the full extent of each vegetation type. In years where individual sites do not require maintenance treatments, photographic documentation is not required.

Permanent photographic points will be established within each site determined to require initial and maintenance-type treatments prior to treatment during the first site assessment of each treatment area. The location of each photographic point will be established centrally within the treatment area or in a location that is representative of the site. Larger treatment areas may require multiple photographic points in order to track changes in vegetation. Once the location of the photographic point is determined, it will be recorded with a GPS unit or the coordinates will be recorded in latitude/longitude decimal degree format out to at least four decimal points, so that photographs can be taken from the same location during subsequent site visits.

Once a photographic point is established, at least one photograph facing north (recorded as 0°) will be taken from a height of 5 feet, with the horizontal angle of the photograph noted if not level. If additional photographs are required at the photographic point (to form a panorama), photographs will be taken in clockwise order with the azimuth/bearing rounded to the nearest 5 degrees.

8.2.4 EROSION/SOIL STABILITY

Within disturbed areas of bare soil (vehicle tracks, soil exposed during mechanical shrub removal, or other soil disturbances), signs of erosion, which include rills, large erosional features, and sloughed soil/seeding materials will be noted and mapped on aerial photographs or with a handheld GPS unit, where accessible. These areas will be addressed in the Stormwater Pollution Prevention Plan (SWPPP).

8.2.5 WOODY PLANT RESPROUTING

All trees found resprouting after being treated will be counted and their general location mapped on aerial photographs, or with a handheld GPS unit, where accessible, or sufficiently described so that additional maintenance treatments on the resprouts can be undertaken.

8.2.6 VEGETATION COMPOSITION

To measure exotic vegetation (and conversely native vegetation) composition within each treatment area, a technician with suitable expertise will walk through each separate vegetation community and determine the absolute vegetative cover of all woody plant species (native and exotic) based on a visual assessment in a way that is reproducible.

8.2.7 WOOD CHIP PLACEMENT AND DEPTH

All areas where wood chips were placed following tree/shrub removal will be mapped on aerial photographs or with a handheld GPS unit, where accessible. The depth of the wood chips will also be measured in ten random locations to the nearest inch to obtain an estimate of average depth.

8.3 ANNUAL REPORTING

A monitoring report detailing the status of each treatment area will be prepared annually. Annual reports for each treated area will be submitted to Facilities Services by March 31 each year following implementation of each treatment. The annual report will detail the monitoring activities and findings of the previous year. For each treatment area, the report will include the following:

- Table detailing the treated acreages of each vegetation community;
- A list of the maintenance treatments that took place over the previous year;
- Plant composition of each vegetation community based on aerial cover of woody species;
- Photographs obtained from each of the permanent photographic points;
- Wildlife observations;
- A description and photographs of any previously undocumented hydrologic features and archeological resources;
- A general description of the site, including general habitat quality;
- A description and photographs of any areas of surface erosion;
- Description of the location of applied wood chips and the average depth of the wood chips in these areas;
- A description of any sightings of special-status species and a completed California Natural Diversity Database (CNDDB) form for each observation;

Following initial treatment, annual reporting will be conducted every year for the first 5 years (Years 1 through 5), then every other year (Year 7 and Year 9), and will conclude with a final Year 10 monitoring report, assuming the WVFMP will be updated in that time. Table 8 includes a list of task items to be included in the annual report for each treatment area.

Table 8. Monitoring and Reporting Schedule

	Task Item	**Year 1-5, 7, 9, 10**
Post-treatment Field Investigations		
	Exotic Vegetation Composition	**X**
	Hydrologic Features	**X**
	Archeological Resources	**X**
	Photographic Points	**X**
	Erosion/Soil Stability	**X**
	Woody Plant Resprouting	**X**

	Task Item	**Year 1-5, 7, 9, 10**
	Vegetation Composition	**X**
	Wood Chip Placement	**X**
Annual Reporting		**X**

8.4 PERFORMANCE CRITERIA

This section defines specific performance criteria for each of the monitored site characteristics described in Section 3 necessary to trigger future treatments and/or remedial measures as part of the adaptive management framework. These provide interim and long-term success criteria for 10 years. Acreage criteria are established for both native and exotic vegetation within each vegetation community to be evaluated at the end.

8.4.1 EXOTIC SPECIES MANAGEMENT

Because significant levels of exotic woody plant recruitment are possible following the initial treatments, performance standards relating to reductions in exotic species plant cover focus on gradual reductions in exotic plant cover. It is anticipated that as exotic plants are removed, they will be replaced with native species through natural recruitment.

The overall vegetation recruitment and retention goal for native plants is 80 percent. Success will be achieved if the “native” metrics are attained or exceeded. Therefore, the overall goal is defined as achieving the projected “native/exotic” ratios. Non-native annual grasses are not considered in the performance standard of 20 percent cover.

To prevent the successful resprouting of treated exotic trees, all observed resprouts must be removed/treated within one year of the initial treatment (generally the cut-stump method) of exotic trees.

8.4.2 WOODY VEGETATION COMPOSITION

In each portion of the treatment area treated for woody species removal, using the methods described in the EBRPD WHRRMP, no more than 10 percent of the canopy coverage removed may return due to resprouts or seedlings. For example, if woody species comprised 80 percent of aerial cover prior to treatment within a portion of a treatment area where all woody plants were removed, the resprouts/seedlings of those plants could not comprise more than 8 percent of the aerial cover of that area.

8.4.3 WOOD CHIP PLACEMENT

These performance criteria focus on what proportion of a treatment area can be covered with wood chips, the depth of the applied wood chips, and the location of the distributed wood chips in relation to sensitive resources.

Within a treatment area, woodchip cover cannot exceed 20 percent of the treatment area if a tracked chipper is used or 10 percent of the treatment area if chipping is confined to roadways and landings. Additionally, the depth of applied wood chips cannot exceed six inches (USFWS 2013).

8.4.4 SOIL STABILITY AND EROSION

Unless noted during the initial site assessment, less than 5% of treatment area effected by vegetation treatment activities (e.g., vehicle tracks, upturned roots, and heavy equipment) or other disturbance shall have visual evidence of erosion (i.e. rills) that lead to a drainage feature or watercourse.

8.5 ADAPTIVE MANAGEMENT

In order to ensure that each treatment area is meeting or progressing towards meeting all applicable performance standards, remedial measures will be implemented as recommended in the annual report.

Should success criteria not be met, maintenance measures may be implemented more frequently or by use of different maintenance approaches, substituting new methods for those that do not demonstrate adequate efficacy. Coppiced (resprouted) eucalyptus stumps will be treated with differing methods until 100 percent mortality is achieved. The eucalyptus latent seed stock is expected to require between 5 and 10 years of continuous treatment to ensure that any naturally germinating exotic trees are removed. Seeds that are carried onto project areas from adjacent areas (typically upslope) would require treatment until all possible seed sources have been eliminated. In areas containing other exotic vegetation (e.g. broom) exceeding coverage of stated goals, the project manager would select from a suite of approaches to achieve annual metrics for each floral community. As unanticipated results are recorded (both positive and negative), these would further inform the project manager such that future maintenance either expands upon successful methods or discontinues those methods found to be unsuitable or ineffective. This process of adaptive management would be employed throughout the project life-cycle.

After UC Berkeley implements the maintenance treatments and remedial measures recommended in the annual report, through an adaptive management process, further monitoring on the resulting site conditions and subsequent treatments will ensure that the treated areas are meeting the goals of this WVFMP and the LRDP. New remedial measures not described may be employed as they are developed over the course of the current monitoring period of each treatment area.

8.5.1 EXOTIC SPECIES CONTROL

In areas more than 20 percent of the aerial cover consist of exotic species in Table 7, above8, additional maintenance actions will take place that year.

8.5.2 EROSION CONTROL

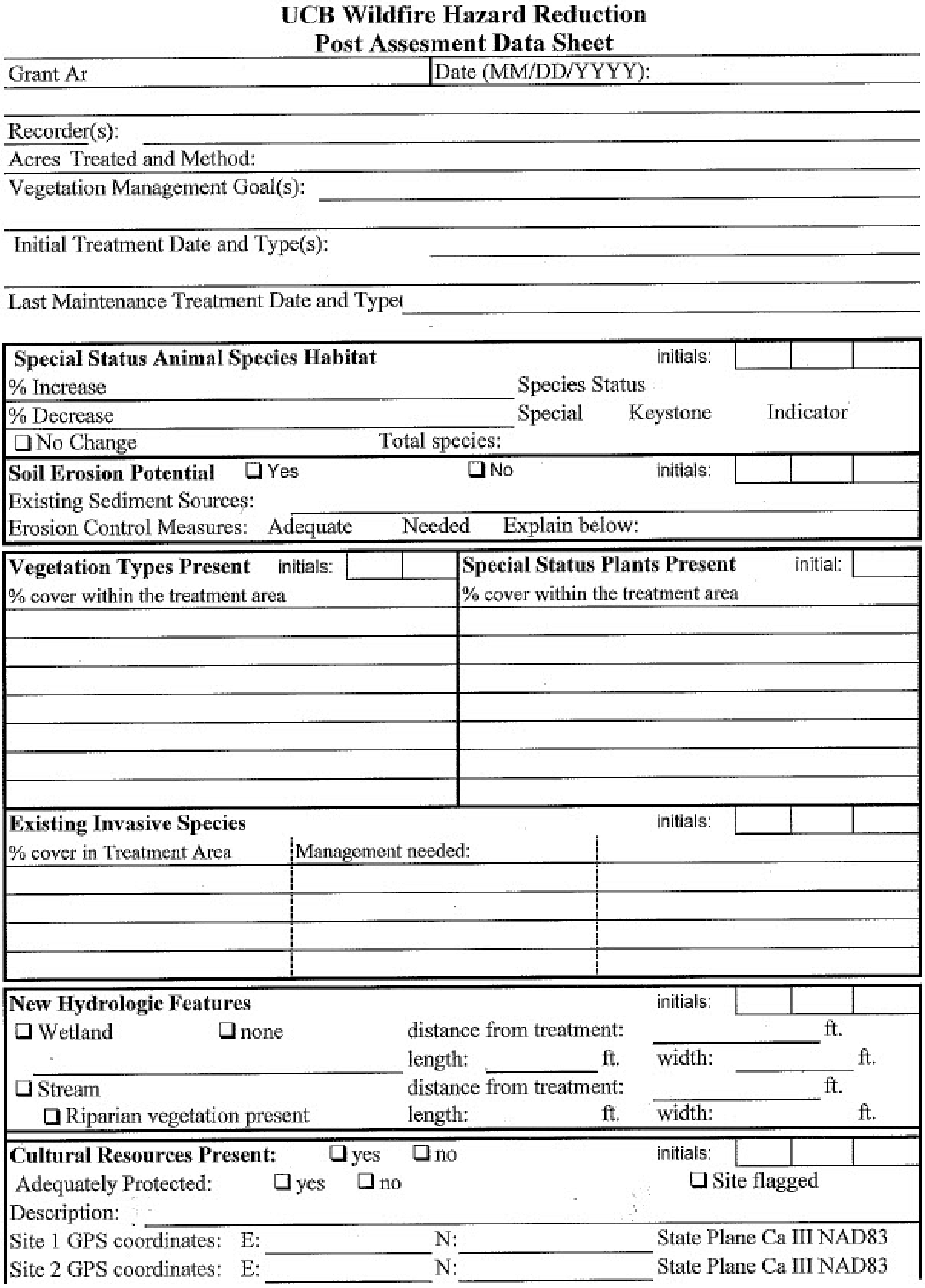
A native (locally sourced) erosion control seed mixture will be applied to all areas of accelerated erosion per the approved SWPPP.

If necessary, fencing, signs, maintenance, access control, jute fabric, sediment traps, mulch, straw wattles (without plastic monofilament netting), vegetation management, exotic species control, or any other commonly used erosion control technique may be used.

8.5.3 RELOCATE AND REDISTRIBUTE WOOD CHIPS

If the average depth of the wood chips exceeds six inches, wood chips in these areas will be redistributed to an average depth at or below six inches, as long as this does not result in an increase to the extent of the wood chips above 20 percent (when a track chipper is used) or 10 percent (if chipping was performed on a road or landing).

If wood chips cannot be distributed to the depth and extent permissible in the treatment area, the wood chips can be relocated and distributed to another treatment area where chipping has occurred, as long as the addition of wood chips will not prevent the receiving treatment area from meeting its performance criteria.



UCB Wildfire Hazard Reduction
Post Assesment Data Sheet

Grant Ar

Date (MM/DD/YYYY):

Recorder(s):

Acres Treated and Method:

Vegetation Management Goal(s):

Initial Treatment Date and Type(s):

Last Maintenance Treatment Date and Typet

Special Status Animal Species Habitat initials:

% Increase

% Decrease

☐ No Change

Species Status

Special Keystone Indicator

Total species:

Soil Erosion Potential ☐ Yes ☐ No initials:

Existing Sediment Sources:

Erosion Control Measures: Adequate Needed Explain below:

Vegetation Types Present initials:

% cover within the treatment area

Special Status Plants Present initial:

% cover within the treatment area

Existing Invasive Species initials:

% cover in Treatment Area

Management needed:

New Hydrologic Features initials:

☐ Wetland ☐ none

distance from treatment: ft.

length: ft. width: ft.

☐ Stream

☐ Riparian vegetation present

distance from treatment: ft.

length: ft. width: ft.

Cultural Resources Present: ☐ yes ☐ no initials:

Adequately Protected: ☐ yes ☐ no ☐ Site flagged

Description:

Site 1 GPS coordinates: E: N: State Plane Ca III NAD83

Site 2 GPS coordinates: E: N: State Plane Ca III NAD83

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Appendix B

Environmental Checklist for Later Vegetation Treatment Projects

1 INTRODUCTION

The Wildland Vegetative Fuel Management Plan (WVFMP) directs the treatment of vegetation that could become fire fuel within the UC Berkeley Hill Campus (or Plan Area). The WVFMP serves as one component of UC Berkeley's range of actions to reduce wildfire risk and minimize the potential for harmful effects of wildfire on people, property, and natural resources within the Plan Area. The Environmental Impact Report (EIR) for the WVFMP evaluates the environmental impacts of the WVFMP. The EIR includes both a project level and program level analysis; additional CEQA consideration is not required for project-level components. The discussion below focuses on the program level analysis and the reference to a Program EIR (PEIR) is intended to address those components of the overall project not covered at a project level.

The WVFMP is described in Chapter 2, "Project Description" of the EIR. The Program EIR has been prepared under the direction of CEQA lead agency, UC Regents, as delegated to UC Berkeley (the university), in accordance with the requirements of the California Environmental Quality Act (CEQA) (Public Resources Code [PRC] Section 21000 et seq.) and the State CEQA Guidelines. The document functions as a Program EIR in accordance with State CEQA Guidelines Section 15168 for streamlining of CEQA review of later activities consistent with the WVFMP.

Using this Environmental Checklist in reliance on the Program EIR, the university must evaluate the later activities associated with each future vegetation treatment project to determine whether such activities are within the scope of this EIR. Such evaluations must ascertain whether these future vegetation treatment projects are consistent with the activities contained in the WVFMP and would have effects that were analyzed in the EIR. If the UC Regents find that the impacts were analyzed in the EIR and no new or substantially more severe significant effects could occur or no new mitigation measures would be required for a later treatment project, the project can be found to be within the scope of this EIR. In this circumstance, no additional CEQA documentation would need to be prepared or publicly circulated (State CEQA Guidelines Section 15168[c][2] and [4]). The documentation used to substantiate the "within the scope" finding would provide the substantial evidence required to reach that conclusion. For the WVFMP, this documentation would be provided in the Environmental Checklist for Later Treatment Projects Under the WVFMP (see Appendix B of this EIR). The university may act on the proposed later treatment project using this documentation and the EIR for CEQA compliance purposes. If the later activity is approved, the university would file a Notice of Determination.

Under this CEQA compliance approach, the university must incorporate from the Program EIR into the later vegetation treatment project all environmental protection measures (EPMs) relevant to the later project and all feasible mitigation measures in response to significant impacts caused by the later project. If a later vegetation treatment project would have impacts that were not covered by the Program EIR (and therefore would not qualify for a within the scope finding), then additional documentation would need to be prepared that accompanies the Program EIR, and focused on those impacts not covered by the Program EIR, to demonstrate the project's CEQA compliance (State CEQA Guidelines Section 15168(c)(1)). If additional documentation is needed, it may be a Negative Declaration, Mitigated Negative Declaration, or an EIR, depending on the new or additional environmental impacts associated with the later activity. In this situation, the Checklist serves the same function as an initial study to identify which impacts were not covered by (and are therefore not within the scope of) the Program EIR and, therefore, must be addressed in a Negative Declaration, Mitigated Negative Declaration, or an EIR, as well as documenting those impacts which are within the scope of the PEIR.

1.1 Treatments Addressed in the Program EIR

Proposed treatment projects qualifying as within the scope of the Program EIR must be consistent with the treatments covered in the WVFMP, which are summarized in this section, and the geographic extent of the WVFMP, which is encompassed in the boundaries of the Plan Area. Refer to Program EIR Chapter 2, "Project Description" for a detailed description of the WVFMP.

TREATMENT TYPES

The WVFMP treatment types are:

- **Evacuation Support Treatments:** roadside treatments within up 100-200 feet along either side of emergency evacuation routes throughout the Hill Campus focused on removing all trees prone to torching that could potentially block access if they fall and removing understory shrubs and small trees that could enable torching.
- **Temporary Refuge Areas**: created in strategic locations to provide temporary refuge from wildfire for evacuees and firefighters and would be typically sited near the intersections of roads and fire trails.
- **Fuel Breaks:** strategically-located linear strips where vegetation has been treated or removed to aid in the containment of a fire and reduce the likelihood of crown fire transition.
- **Fire Hazard Reduction:** focused on reducing hazardous fire conditions in the Plan Area to help promote landscape resiliency and improve native habitat; these projects would be primarily implemented in areas where eucalyptus trees were previously removed but regrowth occurred because of ineffective follow-up treatments.

TREATMENT ACTIVITIES

The treatment types would be implemented using various treatment “activities” that may be applied singularly or in combination. The WVFMP treatment activities are:

- **Prescribed Burning**: Includes pile burning (prescribed burning of piles of vegetative material to reduce fuel and/or remove biomass following treatment) and broadcast burning (prescribed burning to reduce fuels over a larger area or restore fire resiliency in target fire-adapted plant communities; these activities would be conducted under specific conditions related to fuels, weather, and other variables).
- **Mechanical Treatment**: Use of motorized equipment to cut, uproot, crush/compact, or chop existing vegetation.
- **Manual Treatment**: Use of hand tools and hand-operated power tools to cut, clear, or prune herbaceous or woody species.
- **Prescribed Herbivory**: Use of domestic livestock to reduce a target plant population thereby reducing fire fuels or competition of desired plant species.
- **Herbicides**: Chemical application designed to inhibit growth of target plant species.

1.2 EVALUATION OF ENVIRONMENTAL IMPACTS

The Environmental Checklist provided herein is to be used to determine whether later vegetation treatment projects in the Hill Campus have been covered in the Program EIR to allow for approval without further environmental review and documentation (beyond what is needed to complete the Checklist), or whether additional CEQA documentation is required (i.e., a Negative Declaration, Mitigated Negative Declaration or EIR).

1.2.1 Determining Whether a Proposed Treatment is Within the Scope of the Program EIR

The purpose of the Environmental Checklist is to guide the university in its determination of whether a proposed vegetation treatment project is within the scope of the WVFMP Program EIR. A proposed vegetation treatment project is within the scope of the Program EIR when it meets all of the following qualifications:

- **Treatment Methods**. The proposed treatment methods are consistent with the treatment types and activities described in Chapter 2, "Project Description" of the Program EIR.
- **Geographic Area**. The proposed treatment site is within the Hill Campus (the geographic extent of the WVFMP).
- **Environmental Impacts**. The environmental effects of the proposed treatment have been covered in the Program EIR and none of the criteria for preparation of subsequent CEQA documentation are met (State CEQA Guidelines Sections 15168(c)(2), 15162).

1.2.2 Documenting Whether Impacts of a Proposed Treatment Projects are Within the Scope of the Program EIR

For the Checklist to adequately document the impacts that are within the scope of this Program EIR and do not require additional CEQA review and documentation, the Checklist must identify the following:

- **Relevant Program EIR analysis.** Identify the specific sections, impact numbers, and page numbers from this Program EIR that contain information relevant to the proposed treatment project.
- **Additional Studies Prepared and References Cited.** Attach to the Checklist any site-specific studies, reports, and survey results used in support of the within-the-scope finding. Include copies of references cited in the Checklist, which will be made available to the public by the university upon request.
- **Environmental Protection Measures.** Identify each EPM that is relevant to the treatment, which will demonstrate that the EPM will be integrated into treatment design.
- **Environmental Impacts.** Identify which impacts in the Program EIR would occur from implementation of the proposed vegetation treatment project. Because the intent of the Program EIR is to disclose potentially significant impacts that are reasonably foreseeable to occur from any of the treatments within the extent of the Hill Campus, it is expected that, due to site-specific conditions or for smaller treatment projects, proposed vegetation treatment projects may result in impacts less severe than those identified in the Program EIR. The university may rely on the significant impact determination in the Program EIR, and for significant impacts and impacts that were found to be reduced to less than significant, apply the relevant mitigation measures. Alternatively, if an impact identified as significant in the Program EIR would be less than significant for the later treatment project, the university may demonstrate with substantial evidence in the Checklist that the project impact is less than significant and mitigation measure(s) are not needed.
- **Mitigation Measures.** Identify each mitigation measure from the Program EIR that is relevant to the proposed treatment project. In the Checklist, explain any components of the mitigation measures that are not applicable to the treatment, and for any significance determination that is different than the Program EIR, describe how each measure will address site-specific conditions and reduce the impact of the proposed vegetation treatment project.

1.2.3 Providing Substantial Evidence

The impact determinations and within-the-scope findings in the Checklist must be based on substantial evidence (defined in the CEQA Guidelines as "facts, reasonable assumptions predicted upon facts, and expert opinion supported by facts"). Therefore, the Checklist will include analytical discussions of the conclusions reached. Portions of the Program EIR relied on for conclusions should be identified by section number and page number. Ancillary information (e.g., results of site-specific surveys) not included in the Program EIR but relied on for conclusions or required by Program EIR measures will be attached to the Checklist. A list of references cited in the Checklist will be included with the Checklist and copies of such references made available to the public by the university upon request.

1.2.4 Project-Specific Analysis

ENVIRONMENTAL PROTECTION MEASURES, MITIGATION MEASURES, AND MONITORING AND REPORTING

The analysis must consider the measures identified in the Program EIR that will avoid, reduce, or otherwise mitigate potential impacts of the later vegetation treatment project. These measures take the form of EPMs and mitigation measures. Some EPMs and mitigation measures apply to all projects, while others only apply to projects that include specific treatment types, treatment activities, locations, or resources. The project proponent must prepare a Mitigation Monitoring and Reporting Program for each later vegetation treatment project to verify that all applicable EPMs and mitigation measures will be implemented, identify the timing of implementation, and identify the entity responsible for implementing and verifying or enforcing each measure.

RESOURCE AREAS

The environmental resource areas in the Checklist are the same as those analyzed in Chapter 3, "Environmental Setting, Impacts, and Mitigation Measures", of the EIR. The university will review the environmental analysis in the Program EIR for each corresponding resource area in the Checklist. The university will consider whether required EPMs and mitigation measures would be effective in avoiding, reducing, or mitigating environmental impacts of the project considering the proposed activities and site-specific characteristics. EPMs are intended to be integrated into treatment design and implementation; therefore, the university will determine if it is necessary to implement the EPM during preparation of the Checklist, prior to treatment, or during treatment implementation.

Written explanations supporting all conclusions should be provided in the discussion following the checklist questions for each resource area.

CHECKLIST ANSWERS

After verifying that the proposed treatment activities, treatment types, and geographic location of the treatment project are consistent with the Program EIR, the primary functions of the checklist are to determine:

- whether any of the significant impacts of the later treatment project would be substantially more severe than those covered in the Program EIR;
- whether the later treatment project would result in any new impacts that were not covered in the Program EIR; and
- the type of CEQA document, if any, that is appropriate to examine impacts that are not within the scope of the Program EIR.

Accordingly, the checklist questions presented for each resource area identify, for each impact addressed in the Program EIR, whether the impact applies to the treatment project and if so, identify the EPMs and mitigation measures that are applicable to the treatment project. The checklist is also intended to identify whether the impact significance determination for the treatment project is different than the impact significance determination in the Program EIR; if it is different, the checklist will identify whether the difference constitutes a substantially more severe significant impact and is therefore not within the scope of the Program EIR. If it is determined that a substantially more severe significant impact that cannot be mitigated to the same level, or lower level than, as was identified in the Program EIR, an EIR must be prepared, unless one or more mitigation measures incorporated into the project would mitigate the effects to a point where no significant effect on the environment would occur, in which case an MND would be appropriate The MND or EIR may be limited to examining the impacts that are not within the scope of the PEIR.

In summary, when additional environmental documentation is needed to augment the Program EIR for CEQA compliance, the Checklist and accompanying analysis would serve the same function as an initial study that defines the topics to be addressed in the EIR, MND, or ND to cover the impacts that are not within the scope of the Program

EIR, as directed by State CEQA Guidelines Section 15168(d)(1). Pursuant to State CEQA Guidelines Section 15168(d), a later ND could be prepared, if the new impact would be less than significant, or MND, if the new impact or substantially more severe significant impact could be clearly mitigated to less than significant. The analysis of any new impact to support adoption of an ND or MND, along with the analysis of impacts that are within the scope, would be documented in the Checklist. If a later EIR is prepared, it could be limited in its scope to the new significant impact(s) or substantially more severe significant impact(s), with the remainder of the impacts that are within the scope of the Program EIR being documented in the Checklist.

PROJECT-SPECIFIC CEQA FINDINGS AND OVERRIDING CONSIDERATIONS

When the university approves a vegetation treatment project using a within the scope finding for all environmental impacts, it must adopt CEQA findings pursuant to Section 15091 of the State CEQA Guidelines, and if needed, a statement of overriding considerations, pursuant to Section 15093 of the State CEQA Guidelines.

ENVIRONMENTAL CHECKLIST

WVFMP VEGETATION TREATMENT PROJECT INFORMATION

1. **Project title:**
2. **Project location:**
3. **Lead agency's name and address:**
   The Regents of the University of California
   1111 Franklin Street
   Oakland, CA 94607
4. **Contact person:**
   Raphael Breines, Senior Planner
   Physical & Environmental Planning
   510-642-6796
5. **Project sponsor's name and address**
   University of California, Berkeley
   Capital Strategies – Physical & Environmental Planning
   300 A&E Building
   Berkeley, California 94720-1382
6. **Description of Project**: (Describe the whole action involved, including any phasing of initial treatments as well as planned treatment maintenance, including equipment to be used and planned duration of treatments.)

   [insert text here]

7. **Regional Setting and Surrounding Land Uses:** *[insert text here]*
   (Briefly describe the project's surroundings)

8. **Other Public Agencies Whose Approval is Required**: (e.g., permits)

[insert text here; note status of any required approvals (permits)]

9. **Native American Consultation**. *For treatment projects that are within the scope of the WVFMP PEIR, AB 52 consultation for AB 52 compliance has been completed. (**Note to reviewers of the Draft EIR**: AB 52 consultation is in process as of Draft EIR publication, but will conclude prior to EIR certification and use of this Checklist.) The UC Regents conducted consultation pursuant to Public Resources Code section 21080.3.1 during preparation of the Program EIR. For treatment projects with impacts not within the scope of the Program EIR, pursuant to PRC Sections 21080.3.1, 21080.3.2, and 21082.3, the university must notify any California Native American tribe who has submitted written request for notification of a project in the area of the treatment site if preparing a ND, MND or EIR.*

[insert text here]

DETERMINATION

On the basis of this Environmental Checklist and the substantial evidence supporting it:

☐ I find that all of the effects of the proposed project (a) have been covered in the WVFMP Program EIR, and (b) all applicable Environmental Protection Measures and mitigation measures identified in the WVFMP Program EIR will be implemented. The proposed project is, therefore, WITHIN THE SCOPE of the WVFMP Program EIR. **NO ADDITIONAL CEQA DOCUMENTATION** is required.

☐ I find that the proposed project will have effects that were not covered in the WVFMP Program EIR. These effects are less than significant without any mitigation beyond what is already required pursuant to the WVFMP Program EIR. A **NEGATIVE DECLARATION** will be prepared.

☐ I find that the proposed project will have effects that were not covered in the WVFMP Program EIR or will have effects that are substantially more severe than those covered in the WVFMP Program EIR. Although these effects may be significant in the absence of additional mitigation beyond the WVFMP Program EIR's measures, revisions to the proposed project or additional mitigation measures have been agreed to by the project proponent that would avoid or reduce the effects so that clearly no significant effects would occur. A **MITIGATED NEGATIVE DECLARATION** will be prepared.

☐ I find that the proposed project will have significant environmental effects that are (a) new and were not covered in the WVFMP Program EIR and/or (b) substantially more severe than those covered in the WVFMP Program EIR. Because one or more effects may be significant and cannot be clearly mitigated to less than significant, an **ENVIRONMENTAL IMPACT REPORT** will be prepared.

Signature Date

Printed Name Title

Agency

AESTHETICS AND VISUAL RESOURCES

Impact in the PEIR			Project-Specific Checklist					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact AES-1: Result in Short-Term, Substantial Degradation of a Scenic Vista or Visual Character or Quality of Public Views from Treatment Activities								
Impact AES-2: Result in Long-Term, Substantial Degradation of a Scenic Vista or Visual Character or Quality of Public Views from Implementation of the Treatment Types								
Impact AES-3: Create a New Source of Substantial Light or Glare, Which Would Adversely Affect Day or Nighttime Views of the Area								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Aesthetic and Visual Resource Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

AIR QUALITY

Impact in the PEIR			**Project-Specific Checklist**					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact AQ-1: Generate Emissions of Criteria Air Pollutants and Precursors during Treatment Activities that Would Contribute to the Exceedances of the NAAQS and CAAQS								
Impact AQ-2: Expose People to Toxic Air Contaminants Emitted by Prescribed Burns and the Related Health Risk								
Impact AQ-3: Expose People to Diesel Particulate Matter Emissions and Related Health Risk								
Impact AQ-4 Expose People to Objectionable Odors from Equipment Exhaust								
Impact AQ-5: Expose People to Objectionable Odors from Smoke During Prescribed Burning								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Air Quality Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

ARCHAEOLOGICAL, HISTORICAL, AND TRIBAL CULTURAL RESOURCES

Impact in the PEIR			**Project-Specific Checklist**					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact CUL-1: Cause a Substantial Adverse Change in the Significance of Unique Archaeological Resources or Subsurface Historical Resources								
Impact CUL-2: Cause a Substantial Adverse Change in the Significance of a Tribal Cultural Resource								
Impact CUL-3: Disturb Human Remains								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Archaeological, Historical, and Tribal Cultural Resources Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

BIOLOGICAL RESOURCES

Impact in the PEIR			Project-Specific Checklist					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact BIO-1: Substantially Affect Special-Status Plant Species Either Directly or Through Habitat Modifications								
Impact BIO-2: Substantially Affect Special-Status Wildlife Species Either Directly or Through Habitat Modifications								
Impact BIO-3: Result in Degradation or Loss of Riparian Habitat or Other Sensitive Natural Communities								
Impact BIO-4: Substantially Adversely Affect State or Federally Protected Wetlands								
Impact BIO-5: Substantially Interfere with Wildlife Movement Corridors or Impede Use of Nurseries								
Impact BIO-6: Conflict with Local Policies and Ordinances								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Biological Resources Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

GEOLOGY AND SOILS

Impact in the PEIR			**Project-Specific Checklist**					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact GEO-1: Result in Substantial Erosion or Loss of Topsoil								
Impact GEO-2: Result in Increased Risk of Landslide								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Geology and Soils Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

Impact in the PEIR			Project-Specific Checklist					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact GHG-1: Conflict with Applicable Plan, Policy, or Regulation of an Agency Adopted for the Purpose of Reducing the Emissions of GHGs								
Impact GHG-2: Generate GHG Emissions through Treatment Activities								

[1]NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Greenhouse Gas Emissions and Climate Change Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

HAZARDS AND HAZARDOUS MATERIALS

Impact in the PEIR			**Project-Specific Checklist**					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact HAZ-1: Create a Significant Health Hazard from the Use or Accidental Release of Hazardous Materials								
Impact HAZ-2: Create a Significant Health Hazard from the Use or Accidental Release of Herbicides								

[1]NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Hazards and Hazardous Materials Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

HYDROLOGY AND WATER QUALITY

Impact in the PEIR			Project-Specific Checklist					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact HYD-1: Substantially Degrade Surface or Ground Water Quality Through the Implementation of Prescribed Burning								
Impact HYD-2: Substantially Degrade Surface or Ground Water Quality Through the Implementation of Manual or Mechanical Treatment Activities								
Impact HYD-3: Substantially Degrade Surface or Ground Water Quality Through Managed Herbivory								
Impact HYD-4: Substantially Degrade Surface or Ground Water Quality Through the Application of Herbicides								
Impact HYD-5: Violate Water Quality Standards, Waste Discharge Requirements, or Conflict with the Water Quality Control Plan From WVFMP Implementation								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Hydrology and Water Quality Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

NOISE AND VIBRATION

Impact in the PEIR			**Project-Specific Checklist**					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact NOI-1: Temporarily Expose Residences to a Substantial Increase in Noise Generated by Treatment Activities								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Noise and Vibration Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

RECREATION

Impact in the PEIR			Project-Specific Checklist					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact REC-1: Directly or Indirectly Disrupt Recreational Activities Within Designated Recreation Areas								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Recreation Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

WILDFIRE

Impact in the PEIR			Project-Specific Checklist					
Environmental Impact Covered In the PEIR	Identify Impact Significance in the PEIR	Identify Location of Impact Analysis in the PEIR	Does the Impact Apply to the Treatment Project?	List EPMs Applicable to the Treatment Project[1]	List MMs Applicable to the Treatment Project[1]	Identify Impact Significance for Treatment Project	Would this be a Substantially More Severe Significant Impact than Identified in the PEIR?	Is this Impact Within the Scope of the PEIR?
Would the project:								
Impact WIL-1: Substantially Exacerbate Fire Risk and Expose People or Structures to Uncontrolled Spread of a Wildfire								
Impact WIL-2: Expose People or Structures to Substantial Risks Related to Post-Fire Flooding or Landslides								

[1] NA: not applicable; there are no EPMs and/or MMs identified in the PEIR for this impact. None: there are EPMs and/or MMs identified in the PEIR for this impact, but none are applicable to the treatment project.

Wildfire Impacts: Would the treatment result in other impacts to aesthetics and visual resources that are not evaluated in the WVFMP PEIR?	☐ Yes	☐ No	If yes, complete row(s) below and discussion

	Potentially Significant	Less Than Significant with Mitigation Incorporated	Less than Significant
[identify new impact here, if applicable; add rows as needed]	☐	☐	☐

Discussion

Appendix C

Notice of Preparation and Initial Study

UNIVERSITY OF CALIFORNIA, BERKELEY

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PHYSICAL & ENVIRONMENTAL PLANNING BERKELEY, CALIFORNIA 94720-1382
A & E BUILDING, # 1382

November 20, 2019

State of California
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814

NOTICE OF PREPARATION OF A ENVIRONMENTAL IMPACT REPORT

Project Title: Hill Campus Wildland Vegetative Fuel Management Plan

Lead Agency: The Regents of the University of California

Project Location: University of California, Berkeley Hill Campus, all or portions of the following Assessor's Parcel Numbers: Alameda County: 048H-7750-001-03, 048H-7753-039-01, 048H-7755-029-01, 048H-7800-002-01, 048H-7900-002-04, 048H-7900-002-06, 048H-7900-004-01 and 057 -2042-004-10; Contra Costa County: 265-160-005-4 and 265-160-006-2

Counties: Alameda and Contra Costa Counties

Description of the Project

The University of California, Berkeley (UC Berkeley) proposes to implement its Wildland Vegetative Fuel Management Plan (Plan) for the UC Berkeley Hill Campus to treat vegetation that could become fire fuel within the 800-acre Plan Area (see Attachment A for location map). The proposed Plan includes implementation of three vegetation treatment types within the Plan Area, including evacuation support treatments, fuel break treatments, and fire hazard reduction treatments. Five types of vegetation treatment activities are proposed to implement the three vegetation treatment types: manual treatment, mechanical treatment, prescribed burning, managed herbivory (livestock grazing), and targeted ground application of herbicides. Additionally, UC Berkeley proposes specific fuel break and fire hazard reduction treatment projects. The Plan includes two specific fuel break projects and three fire hazard reduction projects in designated locations within the Plan Area. Fuel break (FB) projects are proposed on Claremont Ridge (East-West FB) and between the Hill Campus and the Hearst Gate to the Lawrence Berkeley National Laboratory (Hearst Gate FB). The fire hazard reduction (FHR) projects include vegetation treatments in Strawberry Canyon (Strawberry FHR Project), Claremont Canyon (Claremont FHR Project), and on areas along Frowning Ridge (Frowning FHR Project).

Implementation of the various treatment types and activities will be reviewed for use throughout the Plan Area at a programmatic level in the Environmental Impact Report (EIR). The identified fuel break and fire hazard reduction treatment projects will be studied at a project level of detail in the EIR. The near-term implementation of the identified treatment projects along with the longer-term implementation of treatment types together comprise the proposed "project" as defined in State CEQA Guidelines Section 15378. The Plan includes the project as defined by CEQA for the purposes of review in this EIR as well as ongoing vegetation treatment maintenance actions described in the 2020 Hill Area Fire Fuel Management Program that have been approved under UC Berkeley's 2020 Long Range Development Plan EIR (SCH #2003082131). Maintenance activities included in the 2020 Hill Area Fire Fuel Management Program are not part of the proposed action that will be studied in the Draft EIR.

UC Berkeley has prepared an Initial Study to identify the appropriate document under the California Environmental Quality Act (CEQA), which is included as Attachment B, below. The Initial Study contains a full description of the proposed project including location, objectives, and a preliminary identification of potential environmental effects associated with implementation of the Plan. As documented in the Initial Study, UC Berkeley determined that it will prepare an EIR. The Initial Study also serves to focus the EIR on the effects determined to be potentially significant, pursuant to State CEQA Guidelines Section 15063(c)(3).

Purpose of Notice

The Regents of the University of California will serve as the Lead Agency pursuant to CEQA and has prepared this Notice of Preparation (NOP) to provide responsible and trustee agencies, property owners, and other interested parties with a description of the proposed project and information on potential environmental effects of the proposed project, pursuant to State CEQA Guidelines Section 15082(a). The NOP is available for public review on UC Berkeley's Capital Strategies website: https://capitalstrategies.berkeley.edu/resources-notices/public-notices.

Project Location and Setting

As shown in Attachment A, the Plan Area is the approximately 800-acre UC Berkeley Hill Campus, which is located in the hills adjoining and east of the UC Berkeley Campus Park and California Memorial Stadium, and is primarily in Alameda County with a small area in unincorporated Contra Costa County. The Plan Area is bounded on the east by Grizzly Peak Boulevard; to the west by Stadium Rim Way and private residences; to the south by Grizzly Peak Boulevard and Claremont Canyon Regional Preserve; and to the north by Lawrence Berkeley National Laboratory (LBNL) and private residences. LBNL manages approximately 200 acres adjacent to the Hill Campus, which are not included in the Plan Area.

Probable Environmental Effects

As described in Attachment B, potential environmental effects of the proposed project would occur to the following resource areas:

- Aesthetics
- Air Quality
- Biological Resources
- Cultural Resources
- Geology / Soils
- Greenhouse Gas Emissions
- Hazards / Hazardous Materials
- Hydrology / Water Quality
- Noise
- Recreation
- Tribal Cultural Resources
- Wildfire

Public Review and Comment Period

UC Berkeley invites comments on the scope and content of the Draft EIR and appreciates your prompt review of this NOP. Written comments should focus on the scope and content of the environmental information to be included in the Draft EIR for the Hill Campus Wildland Vegetative Fuel Management Plan germane to agencies having statutory responsibilities associated with the proposed project as well as public interest in the proposed project. All comments on environmental issues received during the public comment period will be considered in the Draft EIR.

Due to the time limits mandated by State law, this NOP will be circulated for a 30-day review period, which will extend from November 20, 2019, to December 20, 2019. **Responses to this NOP must be received by 5:00 PM on Friday, December 20, 2019**. Please send your written or electronic responses, with appropriate contact information, to the following address:

Raphael Breines, Senior Planner
Physical & Environmental Planning
University of California, Berkeley
300 A&E Building, Berkeley, CA 94720-1382
Email: planning@berkeley.edu

Please include a subject line indicating Scoping Comments: Wildland Vegetative Fuel Management Plan.

Public Scoping Meeting

UC Berkeley will hold a public scoping meeting to inform interested parties about the project, and to provide agencies and the public with an opportunity to provide oral and written comments on the scope and content of the EIR. The meeting time and location are as follows:

Monday, December 2, 2019
Time: 6:30 – 8:00 pm
Location: Julia Morgan Hall, UC Botanical Garden at Berkeley
Address: 200 Centennial Drive, Berkeley, CA 94720.

*Parking is available in a lot located across the street from the Garden entrance; the cost is $1 per hour.
**The meeting facility is accessible to persons with disabilities.

If you have questions concerning this NOP, scoping session, or about environmental review in general for the project, please contact Raphael Breines, Senior Planner, Physical & Environmental Planning, at (510) 642-6796 or rbreines@berkeley.edu.

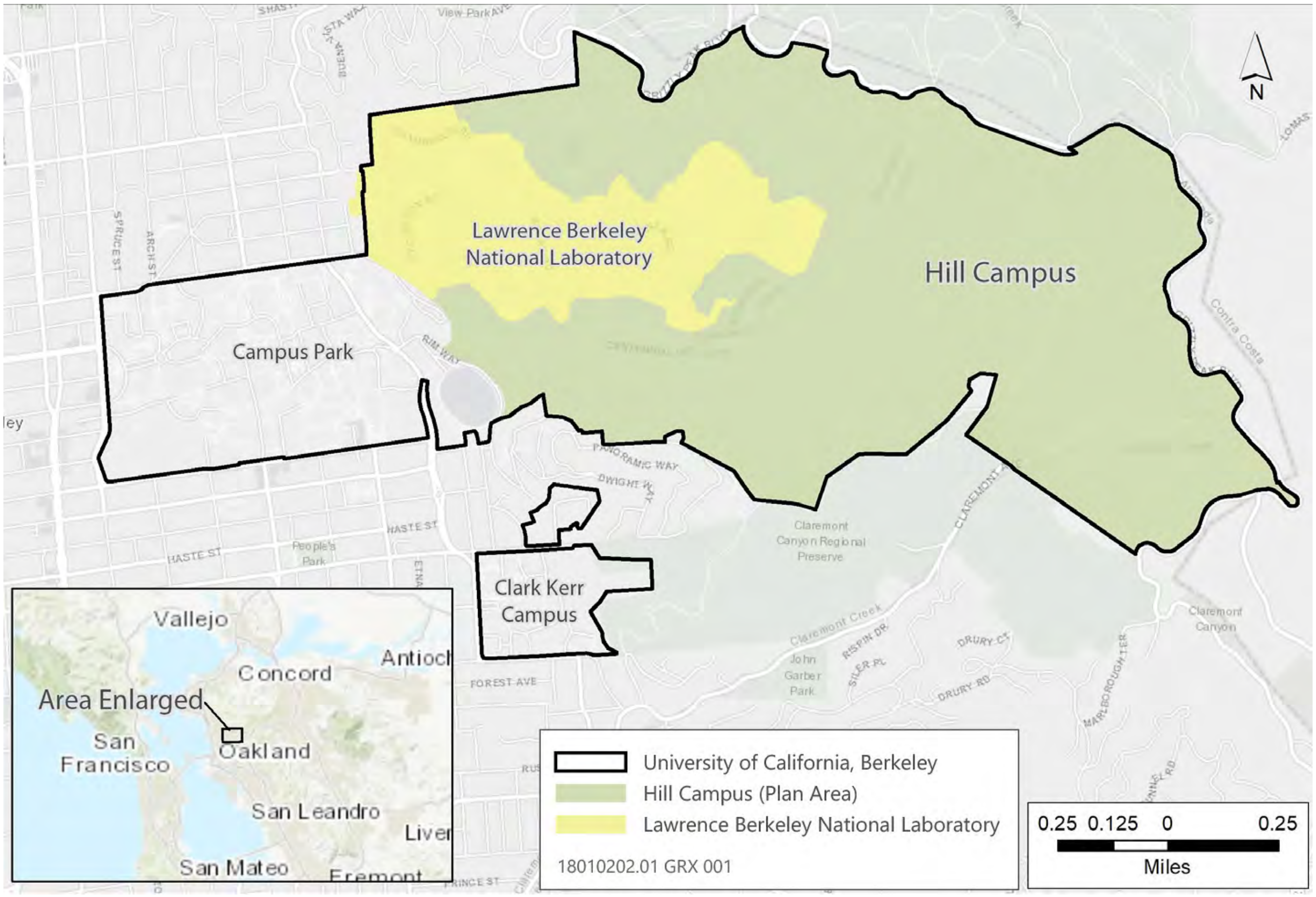
Sincerely,

Wendy Hillis
Campus Architect, Assistant Vice Chancellor
University of California, Berkeley

Attachments:

A) Location Map
B) Initial Study

Attachment A: Location Map (Plan Area)



Attachment B

Initial Study

Initial Study

for the

UC Berkeley Hill Campus
Wildland Vegetative Fuel Management Plan

Prepared for:

University of California, Berkeley
Capital Strategies – Physical & Environmental Planning
300 A&E Building
Berkeley, California 94720-1382
510-643-7384

Contact: Raphael Breines, Project Manager

Prepared By:

Ascent Environmental, Inc.
455 Capitol Mall, Suite 300
Sacramento, California 95814
916/444-7301

Contact: Heather Blair, Project Manager

November 2019

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Figures

Tables

ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACFD	Alameda County Fire Department
BAAQMD	Bay Area Air Quality Management District
BFD	Berkeley Fire Department
BUSD	Berkeley Unified School District
CAL FIRE	California Department of Forestry and Fire Protection
Caltrans	California Department of Transportation
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CO	carbon monoxide
CRHR	California Register of Historical Resources
dB	decibel
dBA	A-weighted decibel scale
DOC	California Department of Conservation
DPR	Department of Pesticide Regulation
DPR	Department of Pesticide Regulation
EBRPD	East Bay Regional Park District
EIR	environmental impact report
EPA	U.S. Environmental Protection Agency
EPM	Environmental protection measures
FB	Fuel break
FHR	fire hazard reduction
FHSZ	Fire Hazard Severity Zones
FMMP	Farmland Mapping and Monitoring Program
GHG	greenhouse gases
HCP	Habitat Conservation Plan
HSC	Health and Safety Code
HWHF	Hazardous Waste Handling Facility
I-80	Interstate 80
IEPR	Integrated Energy Policy Report
IS	Initial Study
LBNL	Lawrence Berkeley National Laboratory
LRDP	Long Range Development Plan
MRZ	Mineral Resources Zones
NAAQS	National Ambient Air Quality Standards
NCCP	Natural Community Conservation Plan
NO_2	nitrogen dioxide
NOP	notice of preparation
NRHP	National Register of Historic Places

O_3	ozone
OPR	Governor's Office of Planning and Research
OUSD	Oakland Unified School District
Pb	lead
PCA	Pesticide Control Advisor
PG&E	Pacific Gas & Electric
Plan Area or Hill Campus	UC Berkeley Hill Campus
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PRC	Public Resources Code
SB	Senate Bill
SFBAAB	San Francisco Bay Area Basin
SMP	smoke management plan
SO_2	sulfur dioxide
SPRP	Spill Prevention and Response Plan
SR-24	State Route 24
UC Berkeley	University of California, Berkeley
UCOP	University of California, Office of the President
UCPD	University of California Police Department
VdB	vibration decibels
VMT	vehicle miles traveled
Williamson Act	California Land Conservation Act
WVFMP or Plan	Wildland Vegetative Fuel Management Plan

1 INTRODUCTION

1.1 INTRODUCTION AND REGULATORY GUIDANCE

This Initial Study (IS) has been prepared by the University of California, Berkeley (UC Berkeley) to evaluate potential environmental effects resulting from implementation of the proposed Wildland Vegetative Fuel Management Plan (WVFMP or Plan) for the UC Berkeley Hill Campus (Plan Area or Hill Campus). The purpose of the Plan is to reduce wildfire risk and diminish or avoid the harmful effects of wildfire on people, property, and natural resources within the Hill Campus. Under the Plan, UC Berkeley proposes to implement three vegetation treatment types within the Hill Campus: 1) evacuation support treatments, 2) fire hazard reduction treatments, and 3) fuel break treatments.

Five types of vegetation treatment activities are proposed to implement the three vegetation treatment types; these include manual treatment, mechanical treatment, prescribed burning, managed herbivory (livestock grazing), and targeted ground application of herbicides. These proposed vegetation treatment types and activities would be reviewed for use throughout the entire 800-acre Plan Area. The specific locations where these vegetation treatments would be implemented would be dictated by the site-specific vegetative conditions and objectives of the treatment, local assets at risk, ecological conditions, and other factors.

UC Berkeley has developed five proposed treatment projects, consistent with the treatment types and activities described above. These are referred to as "Identified Treatment Projects," and comprise strategically placed fuel breaks and fire hazard reduction treatment types, using manual and mechanical treatment activities as well as targeted application of herbicides.

This document has been prepared in accordance with the California Environmental Quality Act (CEQA) (Public Resources Code Section 21000 et seq.) and the State CEQA Guidelines (California Code of Regulations Section 15000 et seq.). Under CEQA, an IS can be prepared by a lead agency to determine if a project may have a significant effect on the environment (CEQA Guidelines Section 15063[a]), which will determine the appropriate environmental document to prepare. The IS can also be used to focus the analysis of an EIR on only those topics for which there may be a significant environmental impact. In this circumstance, UC Berkeley has determined, based on the IS, that potentially significant physical environmental impacts may occur to some resources, and they require evaluation in and preparation of an environmental impact report (EIR).

Implementation of the various treatment types and activities will be reviewed for use throughout the Plan Area at a programmatic level in the EIR. The five identified treatment projects will be studied at a project level of detail in the EIR. The near-term implementation of the identified treatment projects along with the longer-term implementation of treatment types, together comprise the proposed "project," as defined in State CEQA Guidelines Section 15378. Under the existing 2020 Hill Area Fire Fuel Management Program (UC Berkeley 2003), UC Berkeley currently undertakes ongoing vegetation treatment maintenance actions that have been approved under the 2020 Long Range Development Plan EIR (UC Berkeley 2004), (refer to Section 2.3 for additional information). The existing 2020 Hill Area Fire Fuel Management Program will be incorporated into the Plan. These activities will be described in the Plan but have already been reviewed under CEQA and are therefore not part of the proposed action that will be studied in the EIR. The Plan will be reviewed by the UC Berkeley Fire Mitigation Committee. The UC Berkeley Chancellor is the decision-making body with discretionary authority to approve the Plan and certify the EIR.

1.2 PURPOSE OF THIS DOCUMENT

In accordance with provisions of CEQA, UC Berkeley is distributing a notice of preparation (NOP) of an EIR, along with this IS, to solicit comments on the scope of the EIR for proposed Plan implementation. The EIR will address the potentially significant environmental impacts of the proposed WVFMP, measures to mitigate these impacts, and alternatives that could reduce or avoid environmental impacts while attaining the basic objectives of the Plan. A Draft

EIR will be prepared and circulated for agency and public review, and a Final EIR will be prepared to address public comments on the Draft EIR.

As required by CEQA, this document is being made available for a 30-day public review period to responsible agencies, trustee agencies, interested parties and organizations, and individuals who could have an interest in the Plan. The public review period begins on November 20, 2019, and ends on December 20, 2019. During the 30-day review period, comments from the public, organizations, and agencies on environmental issues and alternatives that should be considered in the EIR may be submitted to UC Berkeley. Written comments may be provided by email or mail carrier and must be received by 5:00 p.m. on December 20, 2019. Comments should be sent to:

Raphael Breines, Senior Planner
Physical & Environmental Planning
University of California, Berkeley
300 A&E Building, Berkeley, CA 94720-1382

E-mail comments may be addressed to planning@berkeley.edu, please include "Wildland Vegetative Fuel Management Plan" in the subject line.

Digital copies of the NOP and IS are available on the internet at: https://capitalstrategies.berkeley.edu/resources-notices/public-notices. Printed copies of the NOP and IS are available for public review at the following locations:

A&E Building
Physical & Environmental Planning
Berkeley, CA 94720
Call 510-643-7384 to arrange a visit

1.3 DOCUMENT ORGANIZATION

This IS is organized as follows:

Chapter 1: Introduction. This chapter provides an introduction to the environmental review process and the regulatory guidance under which this document has been prepared. It also describes the purpose and organization of this document.

Chapter 2: Project Description. This chapter provides a detailed description of the Plan.

Chapter 3: Environmental Checklist. This chapter presents an analysis of the environmental issues identified in the CEQA Environmental Checklist (Appendix G of the State CEQA Guidelines) and a determination whether implementation of the Plan would result in no impact, a less-than-significant impact, or a potentially significant impact. If any impacts are determined to be potentially significant, further study of the impact will be conducted and disclosed in the EIR.

Chapter 4: References. This chapter lists the references used in preparation of this IS.

Chapter 5: **List of Preparers**. This chapter identifies report preparers.

2 PROJECT DESCRIPTION

2.1 PLAN OVERVIEW

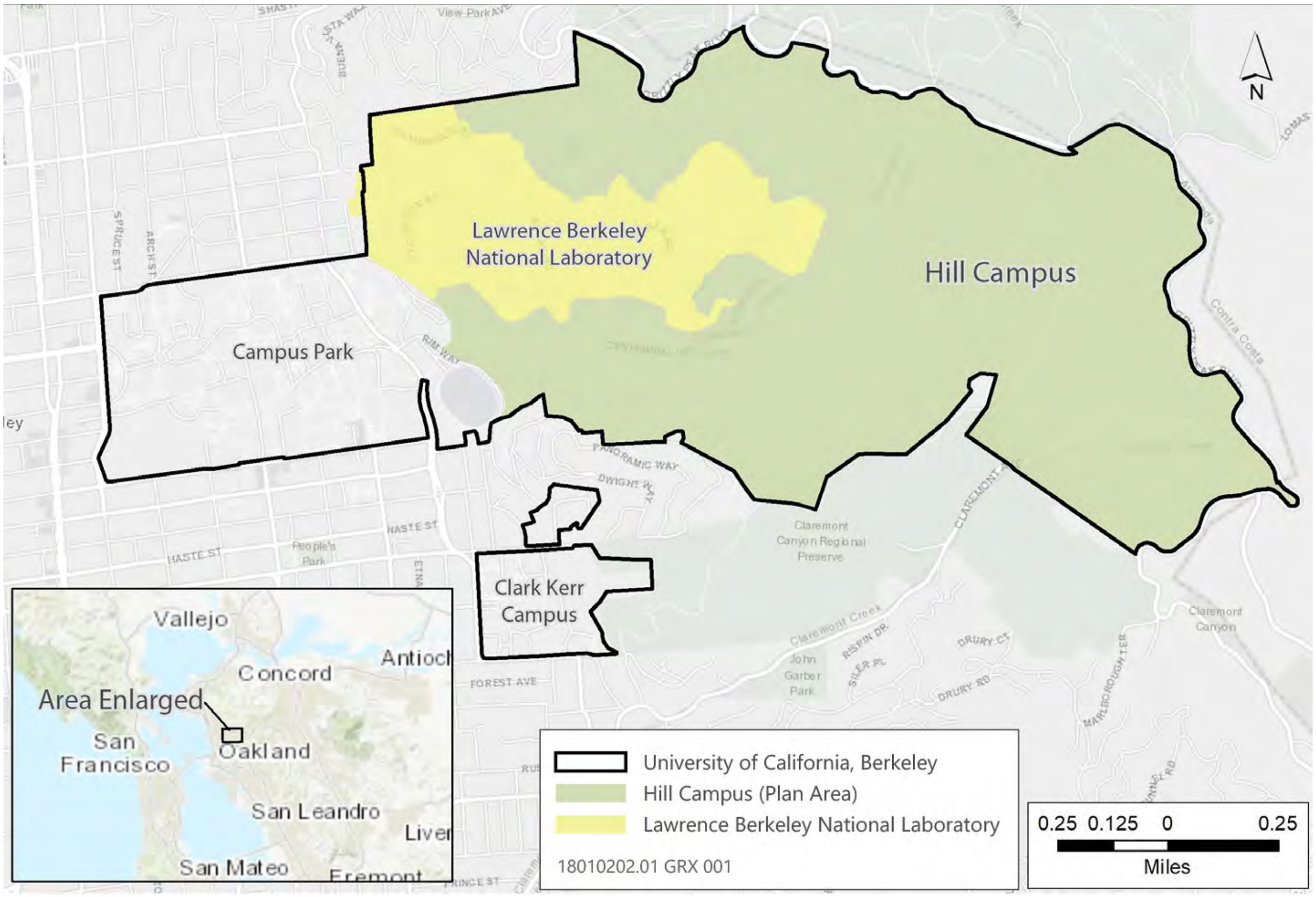
The Wildland Vegetative Fuel Management Plan (WVFMP or Plan) for the UC Berkeley Hill Campus (Plan Area or Hill Campus) is proposed by the University of California, Berkeley (UC Berkeley) to treat vegetation that could become fire fuel within the Plan Area. The proposed Plan includes implementation of three vegetation treatment types across the Hill Campus, which are referred to as evacuation support treatments, fuel break treatments, and fire hazard reduction treatments. Five types of vegetation treatment activities are proposed to implement the three vegetation treatment types; these include manual treatment, mechanical treatment, prescribed burning, managed herbivory (livestock grazing), and targeted ground application of herbicides. These vegetation treatment types and activities are reviewed for use throughout the entire 800-acre Plan Area.

The Plan also identifies two specific fuel break projects and three specific fire hazard reduction projects in designated locations (project areas) within the Plan Area. Fuel break (FB) projects are proposed on Claremont Ridge (East-West FB) and between the Hill Campus and the Hearst Gate to the Lawrence Berkeley National Laboratory (LBNL) (Hearst Gate FB). The fire hazard reduction (FHR) projects include vegetation treatments in Strawberry Canyon (Strawberry FHR Project), Claremont Canyon (Claremont FHR Project), and on areas along Frowning Ridge (Frowning FHR Project). These specific projects are collectively referred to as the "Identified Treatment Projects."

As described in Section 1, implementation of the various treatment types and activities will be reviewed for use throughout the Plan Area at a programmatic level in the EIR. The five Identified Treatment Projects will be studied at a project level of detail in the EIR. The near-term implementation of the five Identified Treatment Projects along with the longer-term implementation of treatment activities studied at a program level, together comprise the proposed "project," as defined in State CEQA Guidelines Section 15378. Under the existing 2020 Hill Area Fire Fuel Management Program, UC Berkeley currently undertakes ongoing vegetation treatment maintenance actions that have been approved under the 2020 Long Range Development Plan EIR (refer to Section 2.3 for additional information). The existing Hill Area Fire Fuel Management Program will be incorporated into the Plan to consolidate all of UC Berkeley's fuel management activities in one document, but will not be studied in the EIR.

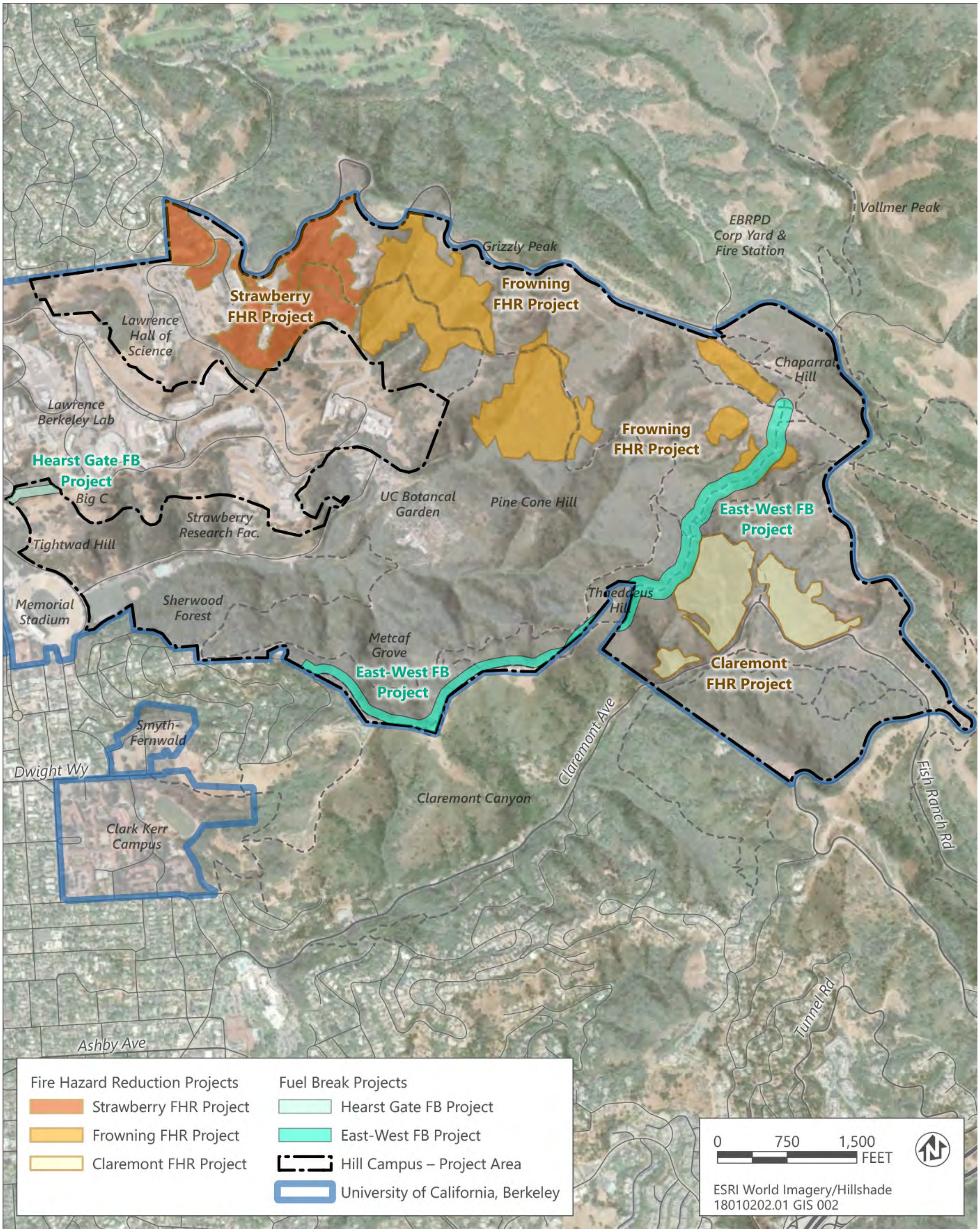
2.2 PLAN LOCATION

The Plan Area is the approximately 800-acre UC Berkeley Hill Campus, which is located in the hills adjoining and east of the UC Berkeley Campus Park and California Memorial Stadium, and is primarily in Alameda County with a small area in unincorporated Contra Costa County. Approximately 85 percent of the Plan Area is located within the City of Oakland; the lower or westernmost portion of the Plan Area lies within the City of Berkeley. The Plan Area is bounded on the east by Grizzly Peak Boulevard; to the west by Stadium Rim Way and private residences; to the south by Grizzly Peak Boulevard and the East Bay Regional Park District's (EBRPD's) Claremont Canyon Regional Preserve; and to the north by LBNL and private residences. LBNL manages approximately 200 acres adjacent to the Hill Campus, which are not included in the Plan Area. The Identified Treatment Projects are located within the boundary of the 800-acre Plan Area. Refer to Figure 2-1 and Figure 2-2 for a regional map of the Plan Area and a map of the Identified Treatment Projects, respectively.



Source: University of California, Berkeley 2019

Figure 2-1 Plan Area



Source: data downloaded from University of California, Berkeley in 2019

Figure 2-2 Identified Treatment Projects

2.3 PAST AND CURRENT VEGETATION TREATMENTS

Although not part of the proposed Project, UC Berkeley maintains an approved and ongoing program of vegetation treatment and maintenance activities in the Plan Area to reduce fire risk to the UC Berkeley campus, LBNL, neighboring residents, recreational visitors, and to adjacent park and watershed lands. Past, ongoing, and planned vegetation treatments described in the existing 2020 Hill Area Fire Fuel Management Program include defensible space and roadside treatments; roadside turnout and signpost treatments; exotic plant removal; hazard tree removal; and tree planting (i.e., replacing flammable vegetation with more fire-resistant vegetation). These ongoing activities have been addressed in either the UC Berkeley *2020 Long Range Development Plan EIR* (State Clearinghouse No. 2003082131) or are otherwise exempt from CEQA. These activities will be described in the Plan but have already been reviewed under CEQA and are therefore not part of the proposed project that will be studied in the EIR.

Ongoing defensible space treatments involve vegetation removal in areas within 100 feet of any structure, consistent with California State PRC 4291. Roadside treatments are implemented as emergency evacuation support measures along major roads and trails within and bounding the Plan Area. Roadside treatments involve vegetation removal and are conducted along the strip of land up to 100 feet of the edge of pavement from both sides of designated roadways and trails for brush vegetation and tree removal or pruning.

Roadside turnout and signpost treatments involve cutting grass and removing debris within a 50-foot radius of designated turnouts and around selected signposts. For exotic plant removal, UC Berkeley pulls or cuts eucalyptus, Monterey pine, and French broom seedlings, and applies herbicides to the cut exotic plants according to recommendations of a Pesticide Control Advisor (PCA). Hazard tree removal involves removing dead and hazardous trees or limbs that pose a public safety risk. Tree planting is conducted under the supervision of Facilities Services Fire Mitigation Program Manager. Native trees, including oaks, maples, and buckeyes are selected by staff, with volunteer labor planting the trees in the late winter or spring. This activity has occurred on Tightwad Hill, in openings created from the removal of hazard trees.

Typically, these vegetation treatment activities are carried out under contract by Facilities Services using hand crews and hand-held tools, with occasional use of machinery to cut grass and shrubs and to chip woody material. Herbicides are applied to roadside vegetation by hand-held tools; however, herbicide use is currently limited. Additional vegetation treatment activities are conducted by the Claremont Canyon Conservancy, UC Berkeley Forestry Club and a local non-profit, Take to The Hills, to assist in maintaining the Plan Area through removal of flammable exotic invasive species and planting less flammable species. The combined efforts of restoration work typically exceeds 500 volunteer-days annually.

Using a portion of the funding received by CAL FIRE California Climate Investments Fire Prevention Grant Program, Facilities Services anticipates that it will increase its implementation of defensible space and roadside treatments, roadside turnout treatments, exotic plant removal, hazard tree removal, signpost treatments, and selective tree planting throughout the Plan Area; these activities, which are included in the existing 2020 Hill Area Fire Fuel Management Program, are part of the ongoing treatment and maintenance activities approved in either the UC Berkeley *2020 Long Range Development Plan EIR* (State Clearinghouse No. 2003082131) or otherwise exempt from CEQA, as described above.

2.4 PLAN DESCRIPTION

2.4.1 Description of Vegetation Treatment Types

Three vegetation treatment types are proposed to be implemented within the 800-acre Plan Area to reduce wildfire risk and increase wildfire resiliency. These include evacuation support treatments, fuel breaks, and fire hazard reduction treatments. These treatment types would be implemented at various locations in the Plan Area based on the conditions and objectives of treatment at a given site, local assets at risk, ecological conditions, and other factors.

EVACUATION SUPPORT TREATMENTS

Evacuation support treatments are roadside treatments that are proposed along emergency evacuation routes throughout the Hill Campus including these major emergency access routes within and bounding the Plan Area: Stadium Rim Way, Centennial Drive, Grizzly Peak Boulevard, Claremont Avenue, and Jordan Trail. Roadside treatments involve vegetation removal, focusing on trees regardless of species, and are conducted along the strip of land up to 100 feet from the edge of pavement on both sides of designated roadways and trails. Vegetation treatment for evacuation support would focus on removing (including pruning) all trees prone to torching up to 100 feet from either side of major evacuation routes that could potentially block access were they to fall. The secondary focus of vegetation treatments would be to remove understory shrubs and small trees that could enable torching, and would also be implemented up to 100 feet on either side of identified emergency evacuation routes. The buffer for evacuation support treatments could increase to 200 feet in some instances (see below). Criteria for retention of trees includes consideration of whether its removal would facilitate the spreading of invasive plant species and surface fuels, improve habitat within the understory, encourage nesting and improve flight patterns of raptors, and prevent erosion. Treatment activities used to implement evacuation support treatments could include any of the proposed treatment activities identified in Table 2-1 below.

During active treatments, temporary closures of portions of roadways may be needed to allow cutting and skidding of trees close to the road. Typically, roads would be open before 9:00 am and after 3:00 pm on weekdays and no work would occur on weekends. In some cases, only one lane would need to be closed for a few hours at a time. Trails receiving treatments would also be closed to the public as necessary during treatments. UC Berkeley would coordinate with adjacent facilities and local fire departments to plan emergency access or alternative access to the areas served by the roads and trails during closures.

In a few selected locations, usually near intersections of roads and fire trails, all trees and shrubs would be removed in a minimum 200-foot diameter from the edge of pavement or fire trail to create a temporary refuge area for firefighters and evacuees. These places of refuge would be sited in collaboration with local wildfire response agencies. Completion of evacuation support treatments would typically take up to 10 weeks at a time (and would be periodically repeated in subsequent years) but could be longer depending on the size of the treatment area. The conditions of remaining trees would be monitored the year after initial treatment.

FUEL BREAK TREATMENTS

Fuel breaks are strategically-located linear strips where vegetation has been treated or removed to aid in the containment of a fire and reduce the likelihood of crown fire transition. To implement fuel break treatments under the Plan, UC Berkeley would either remove understory vegetation and select trees (i.e., shaded fuel breaks) or remove all tree and shrub vegetation in the fuel break area, leaving only some herbaceous vegetation (i.e., non-shaded fuel break) to minimize fire intensity if ignited by a wildland fire. Treatment would also alter the structure of the forest to inhibit torching and ember distribution. Fuel breaks serve the dual purpose of creating a non-burnable area to stop the spread of fire and as a defensive position to enable effective firefighting and fire-retardant application. Fuel break treatments in the Plan Area would could be up to 200 feet wide and installed on ridgelines or other areas naturally low in vegetation to limit the spread of fire from trees between canyons. Treatment activities used to implement fuel break treatments could include any of the proposed treatment activities included in Table 2-1 below. Completion of fuel break treatments would typically take up to 10 weeks at a time but could be longer depending on the size of the fuel break.

Fuel break treatments could be implemented in strategic locations throughout the Plan Area. Two specific fuel break treatment projects are proposed and described in more detail in Section 2.4.4, “Identified Treatment Projects.”

FIRE HAZARD REDUCTION TREATMENTS

Fire hazard reduction treatments would focus on reducing hazardous fire conditions in the Plan Area to help promote landscape resiliency and improve native habitat. Fire Hazard Reduction Treatments are less refined than the ongoing defensible space treatments (described in Section 2.3) in several ways: grasses are not mowed and there is no requirement to prune trees. Additionally, shrubs are retained in clumps. Treatments could involve a variety of activities, including manually and mechanically removing high fire hazard vegetation and trees, applying herbicides, and replacing fire-prone vegetation with fire-resistant trees and shrubs. In some limited cases, irrigation could be installed to support the new fire-resistant vegetation. UC Berkeley would evaluate trees and shrubs for vertical and horizontal spacing; remove tall, unhealthy, structurally unsound or highly flammable trees that are likely to torch and distribute embers; and remove short understory trees. Criteria for tree removal would include consideration of tree health, structure, height, potential for failure, flammability/fire hazard, high fuel volume production of small diameter fuels, and competition with other trees (including for water, space, and light). Criteria for retention of trees includes consideration of whether its removal would facilitate the spreading of invasive plant species and inhibit growth of surface fuels, improve habitat within the understory, encourage nesting and improve flight patterns of raptors, and prevent erosion.

Trees cut would be chipped and distributed throughout the treatment area, or kept as logs. In unusual circumstances where the added volume of the tree is insignificant (i.e. where trees are sparse and shrub cover is thick), trees would be bucked, (i.e., cutting a felled and delimbed tree into logs) and the tops cut into lengths no longer than 24 inches and placed beneath the shrub canopy to accelerate decomposition. Trees would be typically cut using a mechanized feller-buncher and hand tools.

To prevent resprouting, an herbicide would be applied to eucalyptus and acacia stumps within 3 minutes of cutting by a licensed California Qualified Applicator. Felled trees would be skidded by rubber-tired or tracked vehicles along skid trails to landings. At landings, trees would be stored or chipped using a grapple-fed chipper or a tracked chipper. Chips would be both spread on-site and transported to a gasifier to supply electricity directly to the campus. Refer to Section 2.7, “Biomass Utilization and Disposal,” for more information about the gasifier. Near roads, trails and buildings, lower limbs of trees would be pruned, understory vegetation shortened, and grass mowed. Completion of fire hazard reduction treatments would typically take up to 10 weeks at a time but could take longer depending on the size of a planned fire hazard reduction project.

Fire hazard reduction treatments could be implemented in various locations throughout the Plan Area. Three specific fire hazard reduction projects are proposed and described in more detail in Section 2.4.4, “Identified Treatment Projects.”

2.4.2 Description of Vegetation Treatment Activities

The vegetation treatment activities proposed to implement treatments in the Plan Area include manual treatment, mechanical treatment, prescribed burning, managed herbivory (livestock grazing), and targeted ground application of herbicides. Herbicide use involves only ground-level application, and UC Berkeley does not use aerial applications of herbicides.

Each of these vegetation treatment activities could be used to implement treatment types within the 800-acre Plan Area, and are described in more detail below. Several landings and skid roads exist in the Plan Area from previous logging activities, and no new landings or access roads would be created under the Plan. Some minor grading may be required to remove vegetation and reestablish landings for use during treatment activities.

The vegetation treatment types would be implemented using various combinations of the treatment activities. The treatment activity or activities selected would be those that are most likely to achieve the desired treatment objectives for the specific site, protect natural resource values, and meet the overall Plan objectives. During the planning phase for a vegetation treatment, the appropriate treatment activity or activities would be selected that best match the operational needs and treatment constraints on the landscape. Descriptions of the treatment activities proposed as part of the Plan are summarized in Table 2-1.

Table 2-1 Proposed Treatment Activities

Treatment Activity	Description	Equipment	Average Crew Size	Method of Application
Manual Treatment	Use of hand tools and hand-operated power tools to cut, clear or prune herbaceous or woody species	Shovels, Pulaski hoes, McLoed fire tools, machetes, pruning shears, weed whips, weed wrenches, hand saws, chainsaws, mechanized brush cutters, loppers	6-15	Hand pull and grub, thin, prune, hand pile, lop and scatter, hand plant; often combined with prescribed burning
Mechanical Treatment	Use of motorized equipment to cut, uproot, crush/compact, or chop existing vegetation	Feller buncher, yarder, skidder, masticator, tractor, mower	6-15	Mastication, chipping, brush raking, grading, tilling, mowing, roller chopping, skidding and removal, piling; can be combined with pile burning
Prescribed Burning	Pile burning: Prescribed burning of piles of vegetative material to reduce fuel and/or remove biomass following treatment Broadcast burning: Prescribed burning to reduce fuels over a larger area or restore fire resiliency in target fire-adapted plant communities; would be conducted under specific conditions related to fuels, weather, and other variables	1-2 fire trucks, water tender, drip torches, 1-2 hand crews	6-15	Pile burning: Place removed fuels in piles on-site and burn using fuel Broadcast burning: Install fire containment lines around the burn area, then ignite vegetation with a specific pattern of ignition with a control line along the perimeter
Managed Herbivory (livestock grazing)	Use of domestic livestock to reduce fire fuels or competition of desired plant species	Temporary or permanent fencing, water trough	1-2	Grazing or browsing by cows, goats, or sheep
Herbicides	Chemical application designed to prevent or inhibit growth of target plant species and include triclopyr, imazapyr and glyphosate-based herbicides. Pre-emergent herbicides, which kill germinating seedlings, may include Snapshot 2.5TG or Surflan AS.	Backpack with hand applicator	1-2	Ground-level application only, such as paint-on stems or stumps and hand-spray applicator. No aerial spray is allowed.

MANUAL VEGETATION TREATMENT

Manual vegetation treatment involves the use of hand tools and hand-operated power tools to cut, clear, or prune herbaceous and woody species. Activities could include thinning trees and shrubs; cutting undesired competing brush species; manually pulling, grubbing, or digging out root systems of undesired plants to prevent sprouting and regrowth; and placing mulch, such as wood chips from pruning operations, around desired vegetation to limit competitive growth and minimize erosion. This treatment allows for selective removal of targeted species. Historically, UC Berkeley has often used manual treatments to manage vegetation throughout the Plan Area.

Manual treatments are typically used in developed, sensitive or hard to access areas for small-scale projects. Consequently, ground disturbance associated with manual treatments is typically less than mechanical treatment within an equivalent area. Hand tools include, but are not limited to, shovels, Pulaski hoes, McLeod fire tools, weed whips and "weed wrenches" (tools that pull both shrub and root system out), chain saws, hand saws, mechanized brush cutters, machetes, pruning shears, and loppers. Hand cutting can involve workers using chain saws and wedges to fell a tree in a direction that facilitates processing. Masticators, which is a mechanical treatment method, and chippers are used occasionally to assist with manual treatments and process cut materials into mulch to remain on-site. Vegetation removed during manual treatments (i.e., biomass) is either left on-site or disposed of by skidding to landings to be chipped, placed as log barriers on campus and then spread on-site, placed in an on-site gasifier to generate energy for the campus, or piling on-site to be burned. Refer to Section 2.4.3, “Biomass Disposal and Utilization,” for more information on handling biomass under the Plan.

Manual treatment crews would typically consist of 6-15 personnel working up to 8 hours per day. As conditions allow, manual treatments would be conducted throughout the year.

MECHANICAL VEGETATION TREATMENT

Mechanical vegetation treatment involves the use of heavy motorized equipment, such as feller-bunchers and masticators, specially designed to cut, tear uproot, crush/compact, or chop target vegetation. Mechanical treatment methods that may be used include mowing, masticating (mulching), grubbing, and chipping, among others. Mowing using a tractor reduces fuel height of vegetation and performed at the appropriate time can reduce the amount of manual work needed to maintain an area. Mechanical treatment is effective for removing dense stands of vegetation and is typically used in shrub- and tree-dominated vegetation communities. Mechanical treatments are appropriate where a high level of control over vegetation removal is needed, such as near residential areas or in sensitive habitats. Unless followed with targeted application of herbicides, mechanical treatment has limited use for noxious weed control, as the machinery tends to spread seeds and may not kill root systems.

Depending on the intended purpose, two or more pieces of heavy equipment could be used together. For example, a feller-buncher may be used for cutting material, while another piece of equipment moves the cut material to a landing or staging area where it can then be further treated or transported on-site. Feller-bunchers are used to quickly remove trees and may need to be supported by skidders to move trees and materials. Feller-bunchers are tracked vehicles with a self-leveling cab that mechanically grasps the standing tree, cuts it with a hydraulically powered chain saw, and arranges cut trees in bunches to facilitate dragging the tree out of the forest (skidding). Use of feller-bunchers is limited to slopes of less than approximately 45 percent.

Landings are typically needed to sort, store, and chip cut trees into mulch and spread or remove the material. A flat landing area is typically used for yarding operations, temporary stacking, loading, and trucking logs or brush off the treated site. As previously described, several landings and skid roads exist in the Plan Area from previous logging activities, and no new landings or access roads would be created.

Mechanical treatment crews would typically consist of 6-15 personnel working up to 8 hours per day. As conditions allow, mechanical treatments would be conducted throughout the year.

PRESCRIBED BURNING

Prescribed burning is the intentional application of fire in a pre-defined, specific location under prescriptive conditions of fuels, weather, and other variables. Prescribed burning produces low-intensity surface fires that are intended to control vegetation by enhancing the growth, reproduction, or vigor of certain species, in addition to reducing fuel loads and/or maintaining a targeted vegetation community. Surface fire burns along the surface without significant movement into overstory vegetation, with short flame lengths. Typically, prescribed burning uses existing roads and trails as fire containment lines, otherwise fire containment lines are constructed using manual or mechanical treatments. In some cases, vegetation may be trimmed, thinned, or removed manually by prescribed herbivory, hand crews or by mechanical equipment in advance of burning, or vegetation may be pretreated with herbicides to kill the aboveground portions and cause them to dry before burning.

Prescribed burning may be used where other activities are not feasible because of rocky soils, steep slopes, or irregular terrain. Factors that are considered when designing and implementing a prescribed burn include risk to structures and property, land use, environmental impacts, weather conditions, soil stability, slope and aspect, soil type, vegetation types and density, fuel moisture content, time of year, fire return interval, and the efficacy of alternative treatment methods. Burning may occur throughout the year, but it is usually conducted during late spring when the ground is still moist before some plants have set seeds, or during the fall or winter when precipitation is imminent, and plants have completed their yearly growth cycle and their moisture content has declined.

In the past, UC Berkeley has implemented prescribed burns in the Plan Area in late winter when leaf litter is dry but annual grasses are moist and green. Prescribed burns would typically last one day. Equipment used for a prescribed burn would include 1-2 fire engines, an on-site water tender for fire suppression, and ignition devices such as drip torches. Crews implementing prescribed burns would typically consist of 6-15 personnel working up to 8 hours per day. Manual and mechanical treatment activities and associated equipment described above could also be used to prepare an area for a prescribed burn.

Prescribed burns in the Plan Area would require the preparation of a burn plan that includes a smoke management plan (SMP) approved by the Bay Area Air Quality Management District (BAAQMD).

MANAGED HERBIVORY (LIVESTOCK GRAZING)

Managed herbivory, also known as "livestock grazing," is the use of domestic livestock (e.g., goats, sheep, cattle) to accomplish specific and measurable vegetation management objectives. Objectives include removing biomass (fine fuel loads), reducing populations of specific plant species, slowing the re-establishment of shrubs on burned or mechanically thinned sites, and improving plant community structure for wildlife habitat values. Grazing/browsing is best used for green herbaceous plants that produce fine fuels and smaller diameter woody species that produce highly flammable fire fuels. Since the 1980's, UC Berkeley has used goats to manage grasslands and shrublands in the Plan Area including below the Lawrence Hall of Science, Math Science Research Institute, and Field Station for Animal Behavioral Research.

Livestock are selected according to site conditions and the types of vegetation that need to be managed. Goats are typically best suited to woody vegetation and in steep terrain; sheep eat both forbs and grasses and can be used in a variety of environments; and cattle are better suited to herbaceous plants, especially grasses.

Managed herbivory by domestic livestock could occur throughout the year. Livestock would be deployed in consideration of when the target plant species are palatable and when feeding on the plants can damage them or reduce viable seeds. Additionally, managed herbivory would be restricted during critical growth stages of desirable plant species. The frequency of moving livestock is based on numerous site-specific factors, including slope, density and type of vegetation, stocking rate, type of livestock, and precipitation/moisture content of vegetation. Targeted grazing by livestock requires staff and infrastructure, such as a herder, fencing, mineral block, and supplemental food and/or a watering site to keep the animals within the desired area.

HERBICIDE APPLICATION

Herbicides are chemicals that damage or kill plants and are categorized as selective or non-selective. Selective herbicides kill only a specific type of plant, such as broad-leaved plants, which allows the herbicide to be used to control weeds while maintaining grass species. Glyphosate-based herbicides are non-selective and kill any type of plant. Herbicides that may be applied under the proposed Plan include: triclopyr, imazapyr and glyphosate-based products.

To prevent resprouting of removed trees, an herbicide solution would be applied by a licensed California Qualified Applicator with the oversight of a Pesticide Control Advisor (PCA). Typically, 1 to 2 ounces of a diluted solution of herbicide would be applied to the cambium ring of eucalyptus and acacia stumps within 3 minutes of felling. The herbicide mixture would likely consist of a combination of triclopyr and imazapyr in a solution of methylated seed oil, water, and marking dye. Herbicides could also be used for invasive plant control (e.g., French broom) by foliar spraying of vegetation. Triclopyr is approved (see discussion below) for use in and around standing water sites; therefore, it is the only herbicide that would be used within 50 feet water.

UC Berkeley would use the following techniques to apply herbicides:

- *Cut Stump Application*: To maximize the efficacy of treatment, the tree must be cut leaving a stump not more than 4 inches in height above soil surface and the cut surface of the stump must be treated with an herbicide within minutes of the cut. The herbicide is applied to the surface of the stump and is translocated to the roots and disrupts the transportation of nutrients and water, causing the tree to die.
- *Basal Bark Application*: This treatment consists of very low pressure spraying of a solution of triclopyr mixed with esterified vegetable oil to the lower 12 to 15 inches of a resprout. This application method permits the operator to selectively treat resprouts without injury to adjacent vegetation, and is particularly effective on resprouts less than six inches in diameter.
- *Foliar Spray Application*: In foliar spraying, the herbicide is diluted with water at a specific rate, and sprayed over foliage until every leaf is wetted, but not dripping. This method is most suited to shrubs, grasses, and dense vines and would be used for invasive plant control. Foliar spray applications would only be conducted from the ground using hand held application devices.

Effective June 1, 2019, UC President Janet Napolitano issued a temporary suspension, with several exceptions, on the use of glyphosate-based herbicides at all UC locations. Exceptions for use of glyphosate-based herbicides include, among others, fuel-load management programs to reduce wildfire risk. Herbicide application would comply with the U.S. Environmental Protection Agency (EPA) label directions, as well as California Environmental Protection Agency and Department of Pesticide Regulation (DPR) label standards. Herbicide applicators would either possess a valid license or certificate from the California Department of Pesticide Regulation or receive appropriate training and/or direct supervision by a person licensed or certified.

Only ground-level herbicide application would occur; UC Berkeley does not use aerial applications. Limitations in the use of herbicides are addressed by requirements for application methodology, regulatory requirements (e.g., requirement to have a licensed PCA involved in the project), label restrictions, and project-specific guidelines. The limitations intended to be addressed by these requirements include the potential to damage or kill non-target plants; development of a resistance to a particular herbicide over time; or toxicity in humans, animals, birds, amphibians, reptiles, insects, and fish.

TREATMENT MAINTENANCE

In consideration of the dynamic nature of vegetation communities, treatment activities conducted for maintenance may change over time. The maintenance treatment could be different than the original treatment, such as a manual treatment using chainsaws to create shaded fuel breaks along roads followed by periodic prescribed burning to keep sprouting and fuel loads low. The condition of fuel breaks would be monitored yearly, and would be maintained every 3 to 7 years depending on shrub growth within the area of initial treatment. Areas of evacuation support would be maintained the following year, and then every 5-7 years thereafter. The treatment the following year is needed to evaluate and remove any trees made unstable from increased wind flow through the stand. Other treatment types could be maintained at different intervals depending on the vegetation type and objectives of the treatment. Areas of fire hazard reduction are expected to be maintained every 5-10 years, based on fuel volume and potential ember production and distribution.

2.4.3 Biomass Disposal and Utilization

Implementation of the Plan would include the removal of trees and other vegetation. The Plan includes the utilization of a gasifier and a wood-burning hydronic boiler that when used would reduce the generation of greenhouse gases relative to leaving material to decompose, and by replacing a portion of the use of fossil fuels for electricity generation. Accordingly, some of the vegetation removed during treatment activities would be converted to electricity, or hot water, which would substitute for the use of fossil fuels and produce biochar, a charcoal-like substance that can be used to fertilize the soil. The feedstock, or energy, comes from the biomass and the electricity generated would be used directly by the campus.

However, the majority of the biomass created through implementation of the Plan would be chipped and spread directly back onto the treated areas to reduce erosion potential. Chips spread on the hillside within 100 feet of roads and fire trails would have a maximum depth of six inches to prevent erosion and suppress invasive weeds. Some chips would be stockpiled in landings. In unusual circumstances chip depth would be 24 inches in remote locations. Chips are expected to decompose about five inches per year, based on previous treatments in the Hill Campus. A small portion of the biomass would be lopped and scattered. Biomass would also be eaten by livestock. An air curtain incinerator may also be used to dispose of woody biomass, which is similar to a gasifier except no electricity is generated. Whenever possible, biomass material would be fed into the gasifier and a wood-burning hydronic boiler. Some logs would be anchored and utilized on-site for erosion mitigation, wildlife habitat, or as a physical barrier to access by the public. Some minor earthmoving may be required to secure logs in place near slopes. The volume of cut vegetation left on-site would be kept low enough to prevent excessive fuel buildup, interfere with access for monitoring, and encourage establishment of desirable vegetation after treatment. There will be no hauling of cut material from the campus.

2.4.4 Identified Treatment Projects

The proposed Identified Treatment Projects comprise strategically placed fuel breaks and fire hazard reduction projects in the Plan Area, totaling approximately 155-acres of treatments (see Figure 2-2) in the 800-acre Hill Campus. Table 2-2 summarizes each of the Identified Treatment Projects, including the specific project names, treatment type, treatment activities, location in the Plan Area, and treatment acreage.

Table 2-2 Overview of Identified Treatment Projects

Project Name	Treatment Type	Treatment Activities	Location	Acres
East-West FB	Fuel Break	Manual, mechanical, herbicide use	Claremont Ridge between UC Berkeley property and Claremont Canyon Regional Preserve	26
Hearst Gate FB	Fuel Break	Manual, mechanical, herbicide use	between the Hill Campus and the Hearst Gate to LBNL	5
Strawberry FHR	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas in Strawberry Canyon near upper Centennial Drive and upper Jordan Fire Trail	40
Claremont FHR	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas in Claremont Canyon north of Claremont Avenue	30
Frowning FHR	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas along Frowning Ridge near the upper Jordan Fire Trail	54
			Total	**155**

Notes: FB = fuel break, FHR = fuel hazard reduction. Numbers are rounded to the nearest whole number.

FIRE HAZARD REDUCTION PROJECTS

As shown in Table 2-2, there are three fire hazard reduction projects proposed: the Strawberry FHR Project, the Claremont FHR Project, and the Frowning FHR Project. Together, they would be implemented on approximately 124 acres within the Plan Area. Treatment activities used to implement these projects would include a combination of manual and mechanical treatments to remove vegetation, followed by the use of herbicides to prevent resprouts. Up to 15 personnel would be required to implement each of the fire hazard reduction projects, working up to 8 hours per day, and each project would take up to 6 weeks to complete. These projects are anticipated to be implemented in 2020, 2021 and 2022, as conditions allow. General information regarding fire hazard reduction treatments is provided in Section 2.4.1, “Description of Vegetation Treatment Types,” described above. Biomass created by vegetation removal would primarily be chipped, and spread directly back onto the treated areas. Some logs would be strategically placed on-site to prevent runoff and erosion near slopes, or to act as physical barriers to access. Near slopes, some minor earth moving may be required to secure logs in place. A small portion of woody biomass would be lopped and scattered in the treatment area, or incinerated in an air curtain or fed in to the gasifier, as described above in Section 2.4.3, "Biomass Disposal."

Initial work contracts may be issued for several noncontiguous areas, for example, several 5-acre work areas could be treated simultaneously. Subsequent work areas would be contiguous to those already completed, each with a clear path to existing landing areas. Specific elements of each fire hazard reduction project are described below.

Following completion of these projects, UC Berkeley would apply herbicides annually (triclopyr or imazapyr) according to the regulations and label instructions described under "Herbicide Application" in Section 2.4.2, "Description of Vegetation Treatment Activities." Follow-up treatments annually would include a low-volume herbicide ground spray applied to resprouted foliage and selected seedlings. Follow-up treatments may also include a basal bark application or cutting the sprout and treating the cut surface with herbicide. On some resprouts and seedlings, a glyphosate-based solution may be applied to foliage in combination with imazapyr. Additional maintenance activities would occur every 5-7 years using any of the vegetation treatment activities described in section 2.4.2, "Description of Vegetation Treatment Activities," above.

Strawberry FHR Project

Strawberry FHR Project would be implemented on approximately 40 acres in the northwesternmost part of the Plan Area. Six existing landings are located adjacent to fire trails or paved roads in Strawberry Canyon and project-related equipment would be staged, fueled, and maintained at these landings during project implementation. The Strawberry FHR Project would require the use of three existing unpaved access roads. The roads are approximately 12 feet wide and follow existing logging roads created during work done in 1974 and 1975 and in 1989 and 1990 when trees were last cut in this area. Some minor grading may be required to reestablish existing landings and skid roads for use; however, no import or export of soil would occur.

Claremont FHR Project

The Claremont FHR Project would be implemented on approximately 30 acres in the southeastern portion of the Plan Area. Four existing landings that are adjacent to existing fire trails or paved roads in the Claremont Canyon FHR Project would be used for equipment staging, fueling, and maintenance during project implementation. Some minor grading may be required to reestablish existing landings for use; however, no import or export of soil would occur.

Temporary closure of Claremont Avenue may be required for a few hours to allow equipment to move and move off the site. UC Berkeley would coordinate with adjacent facilities and local fire departments to plan emergency access or alternative access to the areas served by the road.

Frowning FHR Project

The Frowning FHR Project would be implemented on approximately 54 acres spanning the northern portion of the Plan Area. Eleven landings exist adjacent to fire trails or paved roads in the vicinity of the Frowning FHR Project. Equipment would be staged, fueled, and maintained at these landings. Some minor grading may be required to reestablish existing landings for use; however, no import or export of soil would occur.

Temporary closure of Grizzly Peak Boulevard and the Upper Jordan Fire Trail may be required to allow equipment to move on and off the treatment site. UC Berkeley would coordinate with adjacent facilities and local fire departments to plan emergency access or alternative access to the areas served by the fire trail.

FUEL BREAK TREATMENT PROJECTS

As shown in Table 2-2, there are two fuel break treatment projects proposed, the East-West FB Project and the Hearst Gate FB Project; together they would be implemented on approximately 31 acres within the Plan Area. Treatment activities used to establish these fuel breaks would include a combination of manual and mechanical treatments to remove vegetation, followed by the use of herbicides to prevent resprouts. Up to 15 personnel would be required to implement each of the fuel break treatment projects, working up to 8 hours per day, and each would take up to 10 weeks to complete. They would be implemented over 2021 and 2022, as conditions allow. Biomass created by vegetation removal would primarily be chipped and spread directly back onto the treated areas. Some logs would be strategically placed on-site to prevent runoff and erosion near slopes, or to act as physical barriers to access. Near slopes, some minor earth moving may be required to secure logs in place. A small portion of woody biomass would be lopped and scattered in the treatment area or incinerated in an air curtain or fed in to the gasifier, as described above in Section 2.4.3, "Biomass Disposal."

The fuel break treatment projects would be maintained every 5 to 7 years using any of the vegetation treatment activities described in Section 2.4.2, "Description of Vegetation Treatment Activities," above.

East-West Fuelbreak Project

The East-West FB Project is proposed on Claremont Ridge between UC Berkeley property and Claremont Canyon Regional Preserve. It would be up to approximately 7,390 feet (1.4 miles) in length and 195 feet wide, covering a total of approximately 26 acres of the Plan Area. The East-West FB would be primarily a non-shaded fuel break, although some trees would remain. Therefore, any of the manual and mechanical equipment types could be used (Table 2-1). Cut-stump application of herbicides would occur after manual and mechanical treatments to prevent resprouting. Equipment staging would occur within three existing landings in the vicinity of the East-West FB shown on Figure 2-2. Some minor regrading may be required to clear the landings of vegetation however, no import or export of soil would occur.

Hearst Gate Fuelbreak Project

The Hearst Gate FB Project is proposed between the Hill Campus and the Hearst Gate to LBNL. It would be up to approximately 2,260 feet (0.4 miles) in length and 125 feet wide, covering a total of approximately 5 acres of the Plan Area. The Hearst Gate FB would be a shaded fuel break; understory vegetation would be removed, and many trees would remain, as appropriate to achieve the objectives of the treatment. Therefore, any of the manual and mechanical equipment types could be used (Table 2-1). Cut-stump application of herbicides would occur after manual and mechanical treatments to prevent resprouting. Equipment staging would occur within the Foothill Housing parking lot outside of the Plan Area. No grading would be necessary for this project.

2.5 ENVIRONMENTAL PROTECTION MEASURES

Environmental protection measures (EPMs) would be incorporated into the design of vegetation treatments in the Plan Area. Specific EPMs will be developed during preparation of the Draft EIR, such as public notifications before implementing certain activities, establishing buffers around sensitive species or habitats, and limiting ground disturbance during or after precipitation events. The EPMs are intended to minimize environmental impacts and comply with applicable laws and regulations and will be evaluated in the Draft EIR.

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3 ENVIRONMENTAL CHECKLIST

PROJECT INFORMATION

1. Project Title:	Hill Campus Wildland Vegetative Fuel Management Plan
2. Lead Agency Name and Address:	The Regents of the University of California University of California, Berkeley 300 A&E Building Berkeley, CA 94720
3. Contact Person and Phone Number:	Raphael Breines, (510) 642-6796
4. Project Location:	University of California, Berkeley
5. Project Sponsor's Name and Address:	Same as lead agency
6. General Plan Designation:	The Plan Area is designated as Open Space by the City of Berkeley General Plan, Resource Conservation Area by the City of Oakland General Plan, and Parks and Recreation by the Contra Costa General Plan; Alameda County has not assigned a land use designation to this area.
7. Zoning:	The land within the Plan Area is zoned for high-density (R-5) residential by the City of Berkeley, residential hillside (RH) by the City of Oakland, and Forestry Recreational (F-R) and General Agriculture (A-2) by Contra Costa County; Alameda County has not assigned a zoning district to this area.
8. Description of Project:	The Wildland Vegetative Fuel Management Plan for the UC Berkeley Hill Campus is proposed by the University of California, Berkeley to treat vegetation that could become fire fuel within the Plan Area. The proposed Plan includes implementation of three vegetation treatment types across the Hill Campus, which are evacuation support treatments, fuel break treatments, and fire hazard reduction treatments. Five types of vegetation treatment activities are proposed to implement the three vegetation treatment types; these are manual treatment, mechanical treatment, prescribed burning, managed herbivory (livestock grazing), and targeted ground application of herbicides. These vegetation treatment types and activities are reviewed for use throughout the entire 800-acre Plan Area; additionally, there are five specific Identified Treatment Projects proposed. Please refer to Chapter 2, "Project Description" for a detailed description of the project.
9. Surrounding Land Uses and Setting:	The Plan Area is bounded on the east by Grizzly Peak Boulevard, to the west by Stadium Rim Way and private residences, to the south by Grizzly Peak Boulevard and the East Bay Regional Park District's (EBRPD's) Claremont Canyon Regional Reserve, and to the north by Lawrence Berkeley National Laboratory (LBNL) and private residences.

10. Other public agencies whose approval is required:

Implementation of the Plan may require approval from the following agencies:

Federal

- **U.S Army Corps of Engineers**: Compliance with Section 404 of the Clean Water Act for discharge of fill into Waters of the U.S.
- **U.S. Fish and Wildlife Service**: Compliance with Section 7 or 10 of the federal Endangered Species Act.

State

- **California Department of Fish and Wildlife**: Compliance with the California Endangered Species Act, incidental take authorization permits under Section 2081 of the Fish and Game Code if take of listed species is likely to occur, and Section 1602 streambed alteration notification for activities that occur within the bed or bank of waterways.
- **San Francisco Regional Water Quality Control Board**: National Pollutant Discharge Elimination System construction stormwater permit for disturbance of more than 1 acre, discharge permit for stormwater, and Clean Water Act Section 401 water quality certification or waste discharge requirements.

Local

- **Bay Area Air Quality Management District:** Open burn permit and review of smoke management plans for prescribed burns.

11. Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

Three Native American tribes requested to be notified of UC Berkeley CEQA projects. In compliance with Public Resources Code (PRC) section 21080.3.1 consultation, UC Berkeley sent written notification describing the proposed Plan to the three Native American tribes on October 24, 2019. Consultation is ongoing.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages. Where checked below, the topic with a potentially significant impact will be addressed in an environmental impact report.

☒ Aesthetics
☒ Biological Resources
☒ Geology / Soils
☒ Hydrology / Water Quality
☒ Noise
☒ Recreation
☐ Utilities / Service Systems

☐ Agriculture and Forest Resources
☒ Cultural Resources
☒ Greenhouse Gas Emissions
☐ Land Use / Planning
☐ Population / Housing
☐ Transportation
☒ Wildfire

☐ None

☒ Air Quality
☐ Energy
☒ Hazards / Hazardous Materials
☐ Mineral Resources
☐ Public Services
☒ Tribal Cultural Resources
☒ Mandatory Findings of Significance
☐ None with Mitigation Incorporated

DETERMINATION (To be completed by the Lead Agency)

On the basis of this initial evaluation:

☐ I find that the proposed project could not have a significant effect on the environment, and a **NEGATIVE DECLARATION** will be prepared.

☐ I find that although the proposed project COULD have a significant effect on the environment, there WILL NOT be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A **MITIGATED NEGATIVE DECLARATION** will be prepared.

☒ I find that the proposed project **MAY** have a significant effect on the environment, and an **ENVIRONMENTAL IMPACT REPORT** is required.

☐ I find that the proposed project **MAY** have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An **ENVIRONMENTAL IMPACT REPORT** is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier **EIR** or **NEGATIVE DECLARATION** pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier **EIR** or **NEGATIVE DECLARATION**, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature

November 20, 2019
Date

Wendy Hillis
Printed Name

Campus Architect, Assistant Vice Chancellor
Title

UC Berkeley
Agency

3.1 AESTHETICS

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
I. Aesthetics.				
Except as provided in Public Resources Code section 21099 (where aesthetic impacts shall not be considered significant for qualifying residential, mixed-use residential, and employment centers), would the project:				
a) Have a substantial adverse effect on a scenic vista?	☒	☐	☐	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☒	☐	☐	☐
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage points.) If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☒	☐	☐	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

3.1.1 Environmental Setting

Aesthetic resources are generally defined as both the natural and built features of the landscape that contribute to the public's experience and appreciation of the environment. A scenic vista is defined as a viewpoint that provides expansive views of a highly valued landscape for the benefit of the general public.

The 800-acre Plan Area is located within the UC Berkeley Hill Campus in the hills adjoining and east of the UC Berkeley Campus Park and California Memorial Stadium. Existing development within the Plan Area includes several campus public and research facilities such as the Lawrence Hall of Science, Botanical Garden, Space Sciences Laboratory, and the Mathematical Sciences Research Institute.

Areas within the UC Botanical Garden and around the Lawrence Hall of Science support a wide variety of native and non-native trees, shrubs, groundcovers, and turf. Large tracts of eucalyptus and conifer also form a dominant part of the visual landscape within the Plan Area. Stands of blue gum eucalyptus are spread throughout the Strawberry and Claremont Canyon watersheds. The primary use of the Hill Campus is natural open space, including 300-acres, referred to as the Ecological Study Area, preserved by UC Berkeley for education and research. Native vegetation throughout the Plan Area includes areas of oak-bay woodland, north coastal scrub, remnants of oak savanna and native grasslands, and riparian scrub and woodland. The Plan Area also includes the developed Strawberry Canyon Recreation Area, and the adjacent Witter and Levine-Fricke sport fields.

As shown on Figure 2-2, the majority of the Plan Area remains undeveloped with slopes that range from moderate to steep, with rugged terrain. Site topography and vegetation contribute to the visual quality of the Plan Area. Long-range views of scenic features within the Plan Area, including the hillside, undeveloped open space, and a mosaic pattern of vegetation, can be seen from publicly accessibly viewpoints throughout the UC Berkeley campus. Long-range views to the west of the San Francisco Bay, San Francisco, Marin County and the Golden Gate Bridge can be seen from the Lawrence Hall of Science, Panoramic Hill and Grizzly Peak Boulevard, within the Plan Area. Viewer groups for the Plan Area include students, residents, motorists, and recreationists.

Regional access to UC Berkeley is provided via Interstates 80 (I-80) and 580 (I-580), and State Routes 24 (SR-24) and 13 (SR-13). None are located within the Plan Area, nor are they designated by the California Department of Transportation (Caltrans) as a state scenic highway (ArcGIS 2019a).

3.1.2 Discussion

a) Have a substantial adverse effect on a scenic vista?

Potentially significant. A scenic vista is defined as a viewpoint that provides expansive views of a highly valued landscape for the benefit of the general public. UC Berkeley proposes to implement vegetation treatments throughout the Plan Area to reduce wildfire risk. The vegetation treatment types, including the fuel break and fire hazard reduction projects, would be implemented using various combinations of the treatment activities as described in Chapter 2, "Project Description." Implementation of fuel break treatments and prescribed burning under the Plan, would result in removal of vegetation such that a substantial adverse effect on a scenic vista could result; implementation of other treatment types and activities may also result in a substantial adverse effect on a scenic vista, but potentially to a lesser degree. This impact could be ***potentially significant*** and will be analyzed further in the EIR.

b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?

Potentially significant. There are no state scenic highways located within the Plan Area; however, portions of the Plan Area may be visible from State Route 24, a state scenic highway. Implementation of proposed treatments would remove vegetation such that varying degrees of damage to scenic resources, including trees, within a state scenic highway could result. This impact could be ***potentially significant*** and will be analyzed further in the EIR.

c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage points.) If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?

Potentially significant. As discussed in Criterion (a), implementation of fuel break treatments and prescribed burning would require UC Berkeley to remove vegetation such that varying degrees of degradation to the existing visual character or quality of the Plan Area could result; implementation of other treatment types and activities may also result in degradation of existing visual character or quality, but potentially to a lesser degree. This impact could be ***potentially significant*** and will be analyzed further in the EIR.

d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?

No impact. Implementation of the Plan would not result in any new, permanent structures or lighting; therefore, no new sources of light or glare would be created. During treatment activities there would be equipment and vehicles at the designated treatment locations. Light reflected from vehicles and equipment could result in glare to nearby viewers; however, potential glare would be temporary, largely shielded by existing and remaining vegetation, and would be eliminated following conclusion of the treatment activity. Therefore, Plan implementation would have ***no impact*** with respect to light or glare and this issue will not be analyzed further in the EIR.

3.2 AGRICULTURE AND FOREST RESOURCES

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
II. Agriculture and Forest Resources. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use or a Williamson Act contract?	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☒	☐
e) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☒	☐

3.2.1 Environmental Setting

The California Department of Conservation (DOC) Farmland Mapping and Monitoring Program (FMMP) prepares maps and statistical data for analyzing land use impacts on California's agricultural resources. The FMMP categorizes agricultural production potential based on a combination of physical and chemical characteristics of the soil and climate that determine the degree of suitability of the land for crop production. Pursuant to the FMMP, portions of the Plan Area located in Alameda County are designated as Urban and Built-Up Land, and the small area in unincorporated Contra Costa County is designated as Other Land (DOC 2016a; DOC 2016b).

The California Land Conservation Act (Williamson Act) recognizes the importance of agricultural land and includes provisions to protect and ensure the orderly conservation of agricultural land. According to the DOC 2016 Status Report, approximately 138,165 acres of land enrolled under Williamson Act Contract are within Alameda County and 42,944 acres are within Contra Costa County (DOC 2016c:38). However, none are located within the Plan Area.

Pursuant to Forest Inventory and Analysis prepared by United States Department of Agriculture (USDA 2016:6), the land within Alameda County and Contra Costa County is classified as Nonforest. In addition, the Plan Area is zoned for residential use by the City of Berkeley and the City of Oakland. The Plan Area located within Contra Costa County is zoned for Forestry Recreational and General Agriculture (City of Berkeley 2014, City of Oakland 2018, ArcGIS 2019c).

Alameda County has approximately 106.2 acres of forest land, and Contra Costa County has approximately 43.2 acres (DOC 2016c: 82).

3.2.2 Discussion

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?

No impact. The Plan Area does not contain any lands designated as Prime Farmland, Unique Farmland, of Farmland of Statewide Importance. Therefore, Plan implementation would not result in the conversion of Prime Farmland, Unique Farmland, of Farmland of Statewide Importance to a non-agricultural use. As such, implementation of the Plan would have ***no impact*** to these types of agricultural resources, and this issue will not be analyzed further in the EIR.

b) Conflict with existing zoning for agricultural use or a Williamson Act contract?

No impact. The entirety of the Plan Area is zoned for residential use by both the City of Berkeley and the City of Oakland. In addition, there are no Williamson Act contracts in effect for land within the Plan Area. Therefore, Plan implementation would not conflict with any existing zoning for agricultural use or a Williamson Act contract. As such, the Plan would have ***no impact***, and this issue will not be analyzed further in the EIR.

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?

No impact. Land within the Plan Area is zoned for residential use by both the City of Berkeley and the City of Oakland, which does not include provisions for forest land or timberland. Plan implementation would not conflict with existing zoning for, or cause rezoning of, forest land, timberland, or timberland zoned Timberland Production. Therefore, Plan implementation would have ***no impact*** related to forest land or timberland zoning conflicts, and this issue will not be analyzed further in the EIR.

d) Result in the loss of forest land or conversion of forest land to non-forest use?

Less than significant. Pursuant to PRC Section 12220(g), forest land is defined as land that can support 10 percent native tree cover of any species under natural conditions. Treatment activities that could occur within forest land in the Plan Area include prescribed burning, mechanical treatment, manual treatment, prescribed herbivory, and herbicide application. The evacuation support, fire hazard reduction, and shaded fuel break treatment types would inherently retain some vegetation within treatment areas. Establishing a non-shaded fuel break would require complete removal of vegetation within the limited area of the fuel break (typically up to 200 feet wide) to achieve the strategic and functional objectives of the fuel break. Untreated vegetation surrounding the fuel break within forest land would remain intact. While treatment activities would alter forest land through vegetation removal, the area would generally continue to support 10 percent of native tree cover thereby maintaining consistency with the definition of forest land as defined by PRC Section 12220(g). Therefore, implementation of the Plan would not directly result in the loss of forest land or convert forest land to a non-forest use. This impact would be ***less than significant*** and will not be analyzed further in the EIR.

e) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?

Less than significant. The Plan Area does not include farmland; therefore, its implementation would not convert Farmland to non-agricultural use. As described under Criterion (d) above, within implementation of the Plan the area would generally continue to support 10 percent of native tree cover thereby maintaining consistency with the definition of forest land as defined by PRC Section 12220(g). As discussed in Chapter 2, "Project Description," the proposed Plan includes implementation of three vegetation treatment types to reduce wildfire risk within the Plan Area. Plan implementation would not involve other changes in the environment, such as those that induce growth that could result in development that converts forest land to non-forest use. Therefore, this impact would be ***less than significant*** and will not be analyzed further in the EIR.

3.3 AIR QUALITY

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
III. Air Quality.				
Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☒	☐	☐	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☒	☐	☐	☐
c) Expose sensitive receptors to substantial pollutant concentrations?	☒	☐	☐	☐
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?	☒	☐	☐	☐

3.3.1 Environmental Setting

The Plan Area is in the San Francisco Bay Area Basin (SFBAAB). Regional and local air quality in the SFBAAB is affected by topography, dominant airflows, location, and season. The Bay Area Air Quality Management District (BAAQMD) is the local agency that attains and maintains air quality conditions in the SFBAAB, including the Plan Area. It does so through a comprehensive program of monitoring, permitting, adopting rules and regulations, developing plans for the attainment of ambient-air quality standards, and implementing other programs and regulations required by the federal Clean Air Act and California Clean Air Act. On April 19, 2017, BAAQMD adopted the 2017 Clean Air Plan: Spare the Air, Cool the Climate (BAAQMD 2017a). The plan aims to lead the region in eliminating fossil fuel combustion, to continue progress toward attaining all state and federal air quality standards, and to eliminate health risk disparities from exposure to air pollution among communities within the SFBAAB. It includes a wide range of proposed "control measures"—actions to reduce combustion-related activities, decrease fossil fuel combustion, improve energy efficiency, and decrease emissions of potent greenhouse gases.

The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants, which are known to be harmful to human health and the environment. These pollutants are: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (this is broken down into particulate matter less than 10 microns in diameter [PM_{10}] and particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]), and sulfur dioxide (SO_2). For each of these six criteria pollutants there are federal and state standards; for several of these pollutants, California has set standards that are more stringent than the federal standards. The SFBAAB is currently designated nonattainment for the state ambient air quality standards for O_3, $PM_{2.5}$, and PM_{10}. With respect to NAAQS, the SFBAAB meets the NAAQS for CO, Pb, NO_2, and SO_2 (CARB 2019a).

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). Odor sources of concern include wastewater treatment plants, sanitary landfills, composting facilities, petroleum refineries, chemical manufacturing plants, painting/coating operations, rendering plants, and food processing facilities (BAAQMD 2017b).

Sensitive receptors are generally considered to include those land uses where exposure to pollutants could result in health-related risks to sensitive individuals, such as children or the elderly. Residential dwellings, schools, hospitals, playgrounds, and similar facilities are of primary concern because of the presence of individuals particularly sensitive to pollutants and/or the potential for increased and prolonged exposure of individuals to pollutants. As discussed in Chapter 2, "Project Description," private residences are located to the north and west of the Plan Area.

3.3.2 Discussion

a) Conflict with or obstruct implementation of the applicable air quality plan?

Potentially significant. Treatment activities implemented under the Plan could result in a net increase in criteria air pollutant emissions. These emission generating activities could exceed significance criteria established by BAQQMD to identify significant contributions to regional air pollution and thereby conflict with BAAQMD regulations and application air quality plans. This is a ***potentially significant*** impact that will be analyzed further in the EIR.

b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?

Potentially significant. Treatment activities could increase criteria air pollutant emissions. As discussed above, SFBAAB is currently designated nonattainment for the state ambient air quality standards for O_3, $PM_{2.5}$, and PM_{10}. Thus, implementation of the Plan, along with increases in criteria pollutant emission from other development in the region, could contribute to non-attainment status pursuant to federal or state ambient air quality standards. Because treatments implemented under the Plan may exceed BAAQMD's established significance criteria for criteria air pollutants (as noted above), the Plan's contribution may be cumulatively considerable. This could be a ***potentially significant*** impact that will be analyzed further in the EIR.

c) Expose sensitive receptors to substantial pollutant concentrations?

Potentially significant. Treatment activities, such as prescribed burning and the use of diesel equipment, could generate pollutants within close proximity to nearby private residences. The primary air pollutant of concern from smoke generated by prescribed burning is $PM_{2.5}$. $PM_{2.5}$ is a criteria air pollutant, subject to the health-based NAAQS and CAAQS. The potential for these anticipated emissions to affect residents could be a ***potentially significant*** impact that will be analyzed further in the EIR.

d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?

Potentially significant. Treatment activities, such as prescribed burning and the use of diesel equipment, conducted under the Plan could result in temporary odorous smoke emissions which could be perceived as objectionable depending on the frequency and intensity of the smoke, wind speed and direction, and the proximity and sensitivity of exposed individuals. This could be a ***potentially significant*** impact that will be analyzed further in the EIR.

3.4 BIOLOGICAL RESOURCES

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
IV. Biological Resources. Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service?	☒	☐	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service?	☒	☐	☐	☐
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☒	☐	☐	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

3.4.1 Environmental Setting

The 800-acre Plan Area is largely undeveloped and supports a mixture of cover types including ornamental landscaping and native and non-native vegetation. Areas within the UC Botanical Garden and around the Lawrence Hall of Science support a wide variety of native and non-native trees, shrubs, groundcovers, and turf. Large tracts of eucalyptus and conifer also form a dominant part of the visual landscape within the Plan Area. Stands of blue gum eucalyptus are spread throughout the Strawberry and Claremont Canyon watersheds. Native vegetation includes areas of oak-bay woodland, north coastal scrub, remnants of oak savanna and native grasslands, and riparian scrub and woodland. Biological resource studies are currently being conducted throughout the Plan Area in support of EIR preparation.

Undeveloped areas within the Plan Area support a diverse array of reptiles, amphibians, birds, and small mammals. The Plan Area also includes suitable habitat for the state and federally-threatened (under the Endangered Species Act) Alameda whipsnake, several other special-status wildlife species, special-status plant species, special-status bat species, and nesting birds, including raptors. Most of the Plan Area is located within designated critical habitat for the Alameda whipsnake.

Wetland resources within the Plan Area include the main channels of Strawberry and Claremont creeks, tributary drainages, scattered seeps, and springs. Wetlands include areas where emergent vegetation is present within the drainage, as well as active springs and seeps where surface water is sufficient to support hydrophytic vegetation.

The Plan Area is not located within an area covered under an adopted Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP), or other approved local, regional, or state conservation plan.

3.4.2 Discussion

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service?

Potentially significant. Several special-status species, including the federal and state-listed Alameda whipsnake, are known or have the potential to occur within the Plan Area, and much of the Plan Area is located within designated critical habitat for the Alameda whipsnake. Treatment activities implemented under the Plan could result in a substantial adverse direct and indirect effects to special-status species, including injury, mortality, habitat modification, and disturbance. This impact could be ***potentially significant*** and will be analyzed in the EIR.

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service?

Potentially significant. The Plan Area includes riparian habitat and other sensitive natural communities. Treatment activities that require vegetation removal could degrade or remove these habitats. This impact could be ***potentially significant*** and will be analyzed in the EIR.

c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?

Potentially significant. The Plan Area includes wetland resources. Treatment activities that require vegetation removal could disturb, fill, or hydrologically interrupt these areas. This impact could be ***potentially significant*** and will be analyzed in the EIR.

d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?

Potentially significant. Wildlife corridors are features that provide connections between two or more areas of habitat that would otherwise be isolated and unusable. Often drainages, creeks, or riparian areas are used by wildlife as movement corridors because these features can provide cover and access across a landscape. Nursery sites are locations where fish and wildlife concentrate for hatching and/or raising young, such as nesting rookeries for birds, spawning areas for native fish, fawning areas for deer, and maternal roosts for bats. The Plan Area contains habitat that could serve as nursery sites. Treatment activities could affect movement patterns of native resident or migratory wildlife species and impede the use of wildlife nursery sites during application, this impact could be ***potentially significant*** and will be further analyzed in the EIR.

e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?

No impact. There are no UC Berkeley policies or ordinances specially protecting biological resources. As a state agency, other local ordinances promulgated by counties and cities do not apply to UC Berkeley actions within its campus. Therefore, Plan implementation would have ***no impact*** and this issue will not be analyzed further in the EIR.

f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?

No impact. There are no adopted HCPs or other conservation plans that overlap the Plan Area. Therefore, Plan implementation would not conflict with the provisions of an adopted HCP, NCCP, or other approved local, regional, or state HCP. Implementation of the Plan would have ***no impact*** and this issue will not be analyzed further in the EIR.

3.5 CULTURAL RESOURCES

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
V. Cultural Resources.				
Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource pursuant to Section 15064.5?	☒	☐	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	☒	☐	☐	☐
c) Disturb any human remains, including those interred outside of dedicated cemeteries?	☒	☐	☐	☐

3.5.1 Environmental Setting

CEQA defines historic resources as those that are listed on, or determined to be eligible for listing on, the California Register of Historical Resources (CRHR) or a local register, or are otherwise determined to be historical pursuant to CEQA (PRC Section 21084.1) or CEQA Guidelines (CCR Title 14, Section 15064.5). The CRHR also includes properties formally determined eligible or listed in the National Register of Historic Places (NRHP) (PRC Section 5024.1). A historic resource may be an object, building, structure, site, area, place, record, or manuscript that is historically significant or significant in terms of California's architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural records (PRC Section 5020.1(j)). Typically, historic resources are more than 50 years old. The Charter Hill and the Big C, and Botanical Garden, located within the Plan Area are eligible for listing in the CRHR (UC Berkeley 2004:4.4-30).

Archaeological resources may be considered historic resources or, if not, they may be determined to be "unique" as defined by CEQA (PRC Section 21083.2(g)). A "unique archaeological resource" is an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria: (1) contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information; (2) has a special and particular quality such as being the oldest of its type or the best available example of its type; or (3) is directly associated with a scientifically recognized important prehistoric or historic event or person. The Plan Area was historically used for grazing, dairying, agricultural, and research activities. During the 19th century, water systems and scattered structures were constructed. Areas with physical remnants of these facilities remain. Two prehistoric petroglyph sites were identified within the Plan Area, and remnants of property line markers have also been recorded (UC Berkeley 2004:4.4-51).

Cultural resource studies are currently being conducted throughout the Plan Area in support of EIR preparation.

3.5.2 Discussion

a) Cause a substantial adverse change in the significance of a historical resource pursuant to Section 15064.5?

Potentially significant. The Plan Area encompasses the following known historical resources:

- The Big "C" on Charter Hill, located on the hillside above California Memorial Stadium.

- The Botanical Garden, constructed in 1920 through 1926 by John W. Gregg, Landscape Architect with Thomas Harper Goodspeed.
- Julia Morgan Senior Women's Hall, formerly Girton Hall, was designed by Julia Morgan and built in 1911.
- The Lawrence Hall of Science, built in 1968 and designed by Anshen & Allen.
- Former Poultry Husbandry Area (H-31) consists of a series of level terraces accessed by a winding, unsurfaced, single lane road above the Strawberry Canyon Recreation Area and is adjacent to Chicken Creek and Centennial Drive.
- Claremont Canyon/Summit House Site (H-32) is located at the top of Claremont Canyon near the present-day intersection of Grizzly Peak Boulevard and Fish Ranch Road.
- The Strawberry Canyon Corporation Yard/Dump Area, located on the lower reach of Strawberry Canyon above the present-day Memorial Stadium.
- The remnants of historic fencing (Ala-579H/P-01-002183) located below the East-West Trail in Claremont Canyon; this fencing appears located on adjacent public property.
- A cadastral or property monument (P-01-002184) located below the East-West Trail in Claremont Canyon; this resource appears located on adjacent public property.

Implementation of the Plan would not affect these resources. However, treatment activities implemented under the Plan could result in the removal of existing subsurface materials during grading and vegetation removal. These activities could unearth previously undiscovered historical resources. If a treatment implemented under the Plan causes a substantial adverse change in the significance of a historical resource, a significant impact would result. This ***potentially significant*** impact will be further analyzed in the EIR.

b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?

Potentially significant. The Plan Area encompasses the following known archaeological (prehistoric) resources:

- Single Stone Pestle (Ala-19)
- Petroglyph (Ala-19/P-01-000039)
- Projectile Point (P-01-010575)

Implementation of the Plan would not affect these archaeological resources because they have either have been previously removed or their locations are known and would be identified and avoided during treatment activities. However, treatment activities implemented under the Plan could result in the removal of existing subsurface materials during grading and vegetation removal. These activities could unearth previously undiscovered archaeological resources. If a treatment implemented under the Plan causes a substantial adverse change in the significance of a historical resource, a significant impact could result. This ***potentially significant*** impact will be further analyzed in the EIR.

c) Disturb any human remains, including those interred outside of formal cemeteries?

Potentially significant. The potential for human remains to occur within the Plan Area is unknown and none have been identified. Treatment activities implemented under the Plan would involve soil disturbance during grading and vegetation removal, which could result in impacts to any sub-surface human remains. This could be a ***potentially significant*** impact and will be further analyzed in the EIR.

3.6 ENERGY

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VI. Energy.				
Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☒	☐
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☒	☐

3.6.1 Environmental Setting

UC Berkeley maintains and operates a natural gas cogeneration plant on campus and procures both electricity and steam from the plant. Approximately 90 percent of energy used by UC Berkeley is delivered by the cogeneration plant, additional energy needs are delivered to UC Berkeley by Pacific Gas & Electric (PG&E) (UCOP 2018).

On-road vehicles use about 90 percent of the petroleum consumed in California. Pursuant to the California Department of Transportation (Caltrans) 2015 vehicle fuel consumption estimates, Alameda County consumed 927 million gallons of gasoline and diesel in 2015, and Contra Costa County consumed 533 million gallons in the same year (Caltrans 2008).

In 2016 UC Berkeley adopted the *2025 Carbon Neutrality Planning Framework*, which, among other provisions, includes a commitment to increase efficiency and alternative fuel use in its vehicle fleet (UC Berkeley 2016). To this end, in 2014, UC Berkeley reduced fuel use by commuters and the campus fleet to 25 percent below 1990 levels. UC Berkeley is currently on target to achieve climate neutrality from building and fleet use by 2025 (UC Berkeley 2019; UC Berkeley 2014). As of 2016, 35 percent of UC Berkeley's vehicle fleet are hybrid vehicles or powered by alternative fuels.

In addition to the *2025 Carbon Neutrality Planning Framework*, other applicable state plans and regulations for renewable energy or energy efficiency are:

- Reducing California's Petroleum Dependence, prepared by the California Energy Commission (CEC) and CARB in 2003, includes recommendations to increase the use of alternative fuels to 20 percent of on-road transportation fuel use by 2020 and 30 percent by 2030, significantly increase the efficiency of motor vehicles, and reduce per capita VMT (CEC and CARB 2003).
- California's 2017 Climate Change Scoping Plan prepared by CARB, outlines the main strategies California will implement to achieve the legislated GHG emission target for 2030 (i.e., 40 percent below 1990 levels) and "substantially advance toward our 2050 climate goals" (i.e., 80 percent below 1990 levels) (CARB 2017:1, 3, 5, 20, 25–26).
- 2017 Integrated Energy Policy Report (IEPR) is the most recent IEPR, which was adopted March 16, 2018. The 2017 IEPR provides a summary of priority energy issues currently facing the state, outlining strategies and recommendations to further the state's goal of ensuring reliable, affordable, and environmentally-responsible energy sources (CEC 2018).
- State Alternative Fuels Plan, prepared by CEC in partnership with CARB, presents strategies and actions California must take to increase the use of alternative non-petroleum fuels in a manner that minimizes the costs to California and maximizes the economic benefits of in-state production (CEC and CARB 2007).

- Executive Order S-06-06, signed on April 25, 2006, establishes numerical targets to increase the production and use of bioenergy within California, including ethanol and biodiesel fuels made from renewable resources. These targets entail the in-state production of a minimum of 20 percent of total biofuels consumed within California by 2010, 40 percent by 2020, and 75 percent by 2050.California 2030 Natural and Working Lands Climate Change Implementation Plan serves as a multi-disciplinary approach to conserve and maintain a resilient natural and working lands sector to provide the state with a natural carbon sink and improve air and water quality, wildlife habitat, recreation, and other benefits.
- Health and Safety Code (HSC) Section 43870 requires by January 1, 2024, that 10 percent of transportation fuels purchased by state agencies be very low carbon transportation fuels, which includes renewable diesel fuels.
- Senate Bill 100 requires that eligible renewable energy resources and zero-carbon resources supply 100 percent of retail sales of electricity to California end-use customers and 100 percent of electricity procured to serve all state agencies by December 31, 2045. Biomass is indicated as an eligible renewable energy source under the state's Renewal Portfolio Standard guidelines.

3.6.2 Discussion

a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?

Less than significant. Plan implementation would result in short-term consumption of energy in the form of fossil fuel (e.g., diesel and other petroleum fuels) combustion in the engines of vehicles and equipment, which would be used by workers accessing treatment areas and during implementation of treatment activities. The energy needs for Plan implementation would be temporary and would not require additional capacity or increase peak or base period demands for electricity or other forms of energy. In addition, the Plan includes the utilization of a gasifier and a wood-burning hydronic boiler that when used would convert some of the vegetation removed during treatment activities to electricity. Accordingly, utilization of a gasifier would help offset energy consumed during Plan implementation. Given the need for the project to increase public safety and improve habitat conditions in the Plan Area, this would not be an inefficient, wasteful, or unnecessary consumption of energy resources. Therefore, Plan implementation would have a ***less-than-significant*** impact and this issue will not be analyzed further in the EIR.

b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency

Less than significant. As discussed in Criterion (a), Plan implementation would result in short-term consumption of energy in the form of fossil fuel combustion in the engines of vehicles and equipment. The energy needs for Plan implementation would be temporary and would occur throughout the year during treatment implementation. Plan implementation would not result in any changes from baseline electricity use; proposed use of a gasifier to process a portion of the biomass would generate a small amount of renewable energy. Increases in vehicle fuel consumption attributable to Plan implementation would comply with UC Berkeley's *2025 Carbon Neutrality Planning Framework*. UC Berkeley's ongoing efforts to increase efficiency and alternative fuel use would include the incorporation of alternative fuels during application of treatment activities. Additionally, the utilization of a gasifier would help offset energy consumed during Plan implementation. For these reasons, Plan implementation would not conflict with state or local plans for renewable energy or energy efficiency. Therefore, Plan implementation would have a ***less-than-significant*** impact and this issue will not be analyzed further in the EIR.

3.7 GEOLOGY AND SOILS

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VII. Geology and Soils.				
Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to California Geological Survey Special Publication 42.)	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☒	☐	☐	☐
b) Result in substantial soil erosion or the loss of topsoil?	☒	☐	☐	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☒	☐	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994, as updated), creating substantial direct or indirect risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐

3.7.1 Environmental Setting

Local geology comprising the Plan Area is characterized by shales, sandstones and blue schists of the Cretaceous Franciscan assemblage, and claystones, shale, sandstones and siltstones from the late Cretaceous to Tertiary periods. Soils within the Plan Area include Xerorthent, Millsholm, Los Osos, Maymen, Tierra associations. Xerorthents-Millsholm soils, the type primarily found within the Plan Area, have low shrink-swell potential (UC Berkeley 2004).

Major fault lines within the San Francisco Bay Area include the San Andreas, Hayward, Calaveras and San Gregorio faults. The active Hayward fault passes in a north-south direction through the UC Berkeley campus under Memorial

Stadium and close to Bowles Hall, the Greek Theatre, and Donner Lab. The Strawberry Canyon fault, Lawrence Hall fault complex, and the Wildcat fault run through the Plan Area, but these are not active faults (UC Berkeley 2004). The Plan Area lies within the Alquist-Priolo Fault Zone, as well as a liquefaction zone and a landslide zone (DOC 2019).

The Plan Area is located within the western coastal margin of the Coast Range Geomorphic Province of northern California. The geologic units that underlie the area consist of Mesozoic strata and Franciscan complex whose geologic age ranges from 10,000 years to 206 million years. Paleontological resources are known to occur within these geologic units, and fossil localities have been identified in areas adjacent to the Plan Area (FEMA 2014).

3.7.2 Discussion

a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the state Geologist for the area or based on other substantial evidence of a known fault? (Refer to California Geological Survey Special Publication 42.)

No impact. The proposed Plan does not include excavation, installation of structures, or other subsurface activity that could exacerbate the risk of rupture of a known earthquake fault. Therefore, implementation of the Plan Area would not directly or indirectly cause substantial adverse effects related to this seismic hazard. *No impact* would occur, and this issue will not be analyzed further in the EIR.

ii) Strong seismic ground shaking?

No impact. The proposed Plan does not include excavation, installation of structures, or other subsurface activity that could exacerbate the risk of seismic ground shaking. Therefore, implementation of the Plan Area would not directly or indirectly cause substantial adverse effects related to this seismic hazard. *No impact* would occur, and this issue will not be analyzed further in the EIR.

iii) Seismic-related ground failure, including liquefaction?

No impact. The proposed Plan does not include excavation, installation of structures, or other subsurface activity that could exacerbate the risk of seismic-related ground failure, including liquefaction. Therefore, implementation of the Plan Area would not directly or indirectly cause substantial adverse effects related to this seismic hazard. *No impact* would occur, and this issue will not be analyzed further in the EIR.

iv) Landslides?

Potentially significant. The Plan Area lies within a designated landslide zone (DOC 2019) and the topography is generally steep. Removal of vegetation during treatment activities implemented under the Plan could affect the root structure in treated areas such that stability of slopes and soils could decrease. This is particularly true for mechanical treatment activities to construct fuel breaks, which could result in an increased risk of landslide.

Prescribed burning activities, including those that would be implemented under the Plan, would involve the application of fire to the landscape under conditions that result in a low-severity burn. Prescribed burns typically maintain soil cover, mineralize important nutrients from plant matter stored on the soil surface, reduce fuel loads leading to possible future high burn severity, and stimulate herbaceous vegetation helping to facilitate nutrient cycling. Prescribed burns implemented under the Plan would typically retain 70 percent of the vegetation in a treatment area. Therefore, any risk of landside from prescribed burning would be negligible. However, given the risk of landslide from other treatment activities and treatment types, a *potentially significant* impact could occur, and this issue will be analyzed in the EIR.

b) Result in substantial soil erosion or the loss of topsoil?

Potentially significant. Treatment activities implemented under the Plan would require grading, excavation, and vegetation removal which could disturb the ground surface and result in soil erosion or the loss of topsoil. UC Berkeley would integrate measures into treatment design to minimize erosion, such as suspending treatment activities during and after precipitation, limiting the amount of exposed bare soil, and restricting the use of heavy equipment where the erosion hazard is high. Nonetheless, this impact could be ***potentially significant*** and will be analyzed further in the EIR.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Potentially significant. The Plan Area is located within a seismically-active area and a landslide zone; additionally, the topography is generally steep. As described under Criterion (a)(iv) above, removing vegetation during mechanical treatment activities could potentially increase the risk of landslide by affecting the root structure in treated areas such that stability of slopes and soils could decrease. The proposed Plan does not include excavation, installation of structures, or other subsurface activity that could exacerbate the risk of lateral spreading, subsidence, liquefaction, or collapse. The impact related to the Plan's exacerbation of landslide risk could be ***potentially significant*** and will be analyzed further in the EIR.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994, as updated), creating substantial direct or indirect risks to life or property?

No impact. Although expansive soils exist within the Plan Area, Plan implementation would not create buildings or structures that could be affected by soil expansion. There would be ***no impact*** and this issue will not be analyzed further in the EIR.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

No impact. Plan implementation would not involve the installation of any septic system of other form of waste water disposal. There would be ***no impact*** and this issue will not be analyzed further in the EIR.

f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Less than significant. The fossil yielding potential of a particular area is highly dependent on the geologic age and origin of the underlying rocks, which vary in distribution and surface exposure throughout the state. All sedimentary rocks, some volcanic rocks, and some metamorphic rocks have potential for the presence of scientifically significant, nonrenewable paleontological resources. Treatment activities implemented under the Plan could result in the removal of existing subsurface materials during grading and vegetation removal. However, Plan implementation would not include excavation beyond the potential disturbance of the top inches of soil during minor grading activities and mechanical treatments. Therefore, the potential to disturb paleontological or unique geologic features is low. Accordingly, Plan implementation would not be expected to directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. This impact would be ***less than significant,*** and this issue will not be analyzed further in the EIR.

3.8 GREENHOUSE GAS EMISSIONS

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VIII. Greenhouse Gas Emissions.				
Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☒	☐	☐	☐
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☒	☐	☐	☐

3.8.1 Environmental Setting

Certain gases in the earth’s atmosphere, classified as greenhouse gases (GHGs), play a critical role in determining the earth’s surface temperature. Global climate change refers to any significant change in climate measurements, such as temperature, precipitation, or wind, lasting for an extended period (i.e., decades or longer). Climate change may result from:

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

Prominent GHGs contributing to climate change are CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. It is “extremely likely” that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropomorphic increase in GHG concentrations and other anthropomorphic forcing (IPCC 2014). Transportation, industry, and electricity generation are the largest sectors of anthropogenic GHG emissions (CARB 2019b).

Legislation and executive orders in California have established a statewide context and a process for developing an enforceable cap on GHG emissions. GHG emission targets established by the state legislature include reducing statewide GHG emissions to 1990 levels by 2020 (Assembly Bill [AB] 32 of 2006) and reducing to 40 percent below 1990 levels by 2030 (Senate Bill [SB] 32 of 2016). Executive Order S-3-05 calls for statewide GHG emissions to be reduced to 80 percent below 1990 levels by 2050. Executive Order B-55-18 calls for California to achieve carbon neutrality by 2045 and achieve and maintain net negative GHG emissions thereafter. In addition, the UC Carbon Neutrality Initiative commits the UC system to emitting net zero GHG emissions from its buildings and its vehicle fleet by 2025. To achieve carbon neutrality by 2025, the UC plans to expand energy efficiency efforts and increase the use of energy from renewable sources.

The emissions of GHGs adversely affect the environment because of their contribution, on a cumulative basis, to global climate change. Although the emissions of one single project will not cause global climate change, GHG emissions from multiple sources result in a cumulative impact with respect to global climate change. Therefore, impacts related to GHG emission are evaluated on a cumulative basis.

3.8.2 Discussion

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

Potentially significant. Treatment activities implemented under the Plan would result in GHG emissions primarily from the use of off-road equipment, on-road vehicles, machine-powered hand tools, and from combustion of vegetation. Worker commute trips and hauling of equipment and materials associated with all treatment activities would also directly generate GHG emissions. The load of sequestered carbon could also be affected by vegetation removal. The generation of GHG emissions and carbon sequestration implications resulting from Plan implementation could be a ***potentially significant*** impact and will be analyzed further in the EIR.

b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

Potentially significant. GHG emissions association with Plan implementation could conflict with local and regional plans for reduction of GHG emissions. This could be a ***potentially significant*** impact and will be analyzed further in the EIR.

3.9 HAZARDS AND HAZARDOUS MATERIALS

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
IX. Hazards and Hazardous Materials. Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☒	☐	☐	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials into the environment?	☒	☐	☐	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☒	☐	☐	☐
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☒	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☐	☐	☐	☒
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	☐	☐	☒	☐

3.9.1 Environmental Setting

This section describes the environmental setting and impacts related to hazards and hazardous materials. For the purposes of this analysis, the term “hazards” refers to risk associated with such issues as fires, explosions, exposure to hazardous materials, and interference with emergency response plans. The term “hazardous material” is defined in different ways for different regulatory programs. For this analysis, “hazardous material” is defined by the California Health and Safety Code, Section 25501: “because of their quantity, concentration, or physical or chemical characteristics, (they) pose a significant present or potential hazard to human health and safety or to the environment if release into the workplace or the environment.”

"Hazardous waste" is a subset of hazardous materials. For this analysis, "hazardous waste" is defined by the California Health and Safety Code, Section 25517, and in the California Code of Regulations, Title 22, Section 66261.2: "because of their quantity, concentration, or physical or chemical characteristics, may either cause, or significantly contribute to an increase in mortality or an increase in serious illness, or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed."

Operations at UC Berkeley, including within the Plan Area, require the use of hazardous materials including chemical agents, solvents, fuels, paints, cleansers, and pesticides. Other hazardous materials, including radioactive and biohazardous materials, are also used in laboratory research facilities in the Plan Area. The Plan Area does not contain known underground storage tanks (GeoTracker 2019). However, LBNL, which is outside of and adjacent to the Plan Area, is permitted to operate a Hazardous Waste Handling Facility (HWHF) where hazardous and mixed waste treatment and storage take place. LBNL is listed as cleanup site under corrective action and the DTSC Cleanup Program provides oversight of ongoing cleanup activities onsite (EnviroStor 2019a; 2019b). The Plan Area is part of the UC Berkeley campus and encompasses facilities used by students, as well as the public. Outside of the UC Berkeley campus, the nearest school to the Plan Area is, Berkeley Rose Waldorf School, located 0.5 mile east of the Plan Area.

There are no public airports or private airstrips within the Plan Area. The nearest airport is the Oakland International Airport located approximately 10 miles southeast of the Plan Area.

The California Department of Forestry and Fire Protection (CAL FIRE) has mapped Fire Hazard Severity Zones (FHSZs) for the entire state. FHSZs are based on an evaluation of fuels, fire history, terrain, housing density, and occurrence of severe fire weather and are intended to identify areas where urban fires could result in catastrophic losses. FHSZs are categorized as: Moderate, High, and Very High. According to CAL FIRE's Fire Resource Assessment Program FHSZ Geographic Information System data, the Plan Area is located within a Very High FHSZs (ArcGIS 2019b).

3.9.2 Discussion

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?

Potentially significant. Plan implementation would involve the routine use of hazardous materials such as fuels, oils and lubricants. These types of substances are considered household hazardous materials and can adversely impact human health or the environment if released in large quantities. Equipment may be fueled, lubricated, and serviced as needed on-site during treatments. Fuels would also be used during prescribed burns for fire ignition. UC Berkeley would integrate measures into treatment design to reduce the risk of release of hazardous materials and comply with applicable regulations. These may include operating all diesel- and gasoline-powered equipment per manufacturer's specifications and in compliance with all state and federal emissions requirements. Fuels used for prescribed burning would be completely consumed during the burning process such that no hazardous materials would persist.

To prevent resprouting of removed trees and control of invasive weeds, herbicides would be applied during treatment activities. Herbicide application would comply with the U.S. Environmental Protection Agency (EPA) label directions, as well as California Environmental Protection Agency and Department of Pesticide Regulation (DPR) label standards. In addition, measures incorporated into treatment design to provide protection to workers, the public, and the environment from accidental leaks or spills of herbicides, adjuvants, or other potential contaminants may include preparing a Spill Prevention and Response Plan (SPRP), adhering to label instructions and restrictions, employing techniques during herbicide application to minimize drift, and notifying the public. Measures such as these and compliance with regulatory requirements would minimize risk of exposure to hazardous materials. Nonetheless, this impact could be ***potentially significant*** and will be analyzed further in the EIR.

b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials into the environment?

Potentially significant. As discussed in Criterion (a) above, Plan implementation would involve the storage, transport, and handling of hazardous materials such as fuels, oils and lubricants, as well as herbicides. The improper handling of these substances could result in their accidental release into the environment should any leaks or spills occur. Therefore, this impact could be ***potentially significant*** and will be analyzed further in the EIR.

c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?

Potentially significant. Herbicide use in the Plan area would occur on the UC Berkeley campus in proximity to students and other users of the Plan Area. Emissions may occur through accidental release as described above (criteria (a) and (b)). This impact could be ***potentially significant*** and will be analyzed further in the EIR.

d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code §65962.5 and, as a result, would it create a significant hazard to the public or the environment?

Less than significant. Properties owned or acquired by UC Berkeley have the potential to contain soil and/or groundwater contamination from historic activities by UC Berkeley or previous owners. The Plan Area does not contain known underground storage tanks; however, LBNL is listed as a cleanup site under corrective action. As discussed in Chapter 2, "Project Description," LBNL manages approximately 200 acres in the Hill Campus, which are not included in the Plan Area. Plan implementation would not disrupt areas within LBNL or expose hazardous chemicals. Therefore, Plan implementation would have a ***less-than-significant*** impact, and this issue will not be analyzed further in the EIR.

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?

No impact. The Plan would not result in new or relocated residential land uses, other types of noise-sensitive receptors, or new places of permanent employment where residents or workers could be exposed to a safety hazard or excessive noise. The nearest airport, Oakland International Airport, is located approximately 10 miles southeast of the Plan Area. Therefore, the Plan would have ***no impact*** related to exposure of residents or workers to a safety hazard or excessive noise levels, and this issue will not be analyzed further in the EIR.

f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?

No impact. Transport of mechanical equipment and personnel to the Plan Area could occur along transportation routes also used for emergency response and evacuation. However, traffic associated with Plan implementation would be temporary and would not impair emergency access to or from the site because UC Berkeley would coordinate with adjacent facilities and local fire departments to plan emergency access or alternative access to the Plan Area during treatment activities, as discussed in Chapter 2, "Project Description." Implementation of the proposed evacuation support treatment type would improve emergency response and evacuation within the Plan Area. Therefore, implementation of the Plan would have ***no impact***; and this issue will not be analyzed further in the EIR.

g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?

Potentially significant. The Plan Area is located within a Very High FHSZ. Plan implementation would require the temporary and periodic use of off-road vehicles and mechanical equipment within vegetated areas. Heat or sparks from vehicles or equipment activity (e.g., chainsaws and chippers) could ignite dry vegetation and cause a fire, exposing people or structures in the vicinity to risk of wildland fires. UC Berkeley would integrate measures into treatment design to reduce the risk of uncontrolled spread of wildfire from treatment activities and comply with applicable regulations. These may include restricting vegetation treatment activities during extreme fire conditions, equipping all machine-powered tools with federal-or state-approved spark arrestors, requiring crews to carry one fire extinguisher per chainsaw, and restricting smoking areas (to minimize the risk of accidental wildfire ignition). To help prevent fire escape during prescribed burning, UC Berkeley would implement prescribed burns in late winter when leaf litter is dry but annual grasses are moist and green. During a prescribed burn, 1 or 2 fire engines and an on-site water tender for fire suppression would be located onsite at all times. In the event a prescribed burn goes beyond the perimeter of its planned area, hand crews and fire engines would be on-site to control the escape. Furthermore, one of the primary objectives of the Plan is to reduce wildfire risk. Nonetheless, this impact could be ***potentially significant*** and will be analyzed further in the EIR.

3.10 HYDROLOGY AND WATER QUALITY

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
X. Hydrology and Water Quality.				
Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?	☒	☐	☐	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☒	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:				
i) Result in substantial on- or offsite erosion or siltation;	☒	☐	☐	☐
ii) Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;	☐	☐	☐	☒
iii) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☐	☒
iv) Impede or redirect flood flows?	☐	☐	☐	☒
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☐	☒
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☒	☐	☐	☐

3.10.1 Environmental Setting

The Plan Area drains overland in natural drainage patterns along the western front of the Berkeley Hills. Surface water resources within the Plan Area include Strawberry Creek, Derby Creek, and Claremont Creek. The Plan Area is also characterized by ephemeral channels, ephemeral tributaries, and perennial streams. The East Bay Plain groundwater basin underlies the Plan Area; groundwater depths vary and are influenced by time of the year and geologic factors such as seepage barriers, faults, and formational contacts (UC Berkeley 2004).

Flooding hazards within the City of Berkeley as they relate to surface flow from the Plan Area are due to the potential for Strawberry Creek to overflow. There are no identified flooding hazards within the portion of the Plan Area located in the City of Oakland (City of Oakland 2016). The Plan Area is not located within a 100-year flood zone, tsunami, or seiche zones (FEMA 2019; CGS 2019).

3.10.2 Discussion

a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?

Potentially significant. Plan implementation could directly impact water quality during application of treatment activities. Prescribed burning, grading, and vegetation removal could result in increased erosion which could enter runoff and increase siltation in waterways. Measures would be integrated into treatment design to minimize erosion, in consideration of precipitation events and steep slopes with erosion potential, as well as minimizing exposure of bare soil.

To prevent resprouting of removed trees and control of invasive weeds, herbicides would be applied during treatment activities. Herbicide application would comply with the U.S. Environmental Protection Agency (EPA) label directions, as well as California Environmental Protection Agency and Department of Pesticide Regulation (DPR) label standards. In addition, measures would be integrated into treatment design minimize the potential for human exposure and potential health risk and comply with applicable laws and regulations, such as preparing a Spill Prevention and Response Plan (SPRP) prior to beginning any herbicide treatment activities, employing techniques during herbicide application to minimize drift, and notifying the public of application activities

Although measures would be implemented avoid and minimize the risk of water quality degradation, impacts could be ***potentially significant***. Therefore, this issue will be analyzed further in the EIR.

b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?

Less than significant. The Plan could require use of water for emergency use (if needed) during prescribed burns and pile burning, dust abatement during minor grading activities (as needed). However, the amount of water needed during treatments implemented under the Plan would be negligible and short-term. No new permanent demand for water would be created. In addition, Plan implementation would not create any impervious surfaces which would interfere with groundwater recharge. Therefore, no new or expanded resources would be needed. The impact would be ***less than significant,*** and this issue will not be analyzed further in the EIR.

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:

i) Result in substantial on- or offsite erosion or siltation;

Potentially significant. Plan implementation would not substantially alter the existing drainage pattern within the Plan Area; it would not alter the course of any stream or waterway or add any impervious surfaces. However, treatments would include ground disturbing activities that could affect existing surface drainage patterns and result in erosion or siltation. As described under Criterion (a) above, impacts could be ***potentially significant***. Therefore, this issue will be analyzed further in the EIR.

ii) Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;

No impact. Plan implementation would not substantially alter the existing drainage pattern within the Plan Area; it would not alter the course of any stream or waterway or add any impervious surfaces. Therefore, it could not substantially increase the rate or amount of surface runoff in a manner which would result in flooding. ***No impact*** would occur, and this issue will not be analyzed further in the EIR.

iii) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or

No impact. Plan implementation could require the use of water for emergency use (if needed) during prescribed burns, dust abatement during minor grading activities (as needed). However, the amount of water needed during treatments implemented under the Plan would be negligible and short-term. Plan implementation would not generate permanent water drainage flows. Plan implementation would not substantially alter the existing drainage pattern within the Plan Area; it would not alter the course of any stream or waterway or add any impervious surfaces. Therefore, the Plan could not create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. ***No impact*** would occur, and this issue will not be analyzed further in the EIR.

iv) Impede or redirect flood flows?

No impact. The Plan Area is not located within a flood hazard area, the only flooding hazard is due to the potential overflow of Strawberry Creek. Plan implementation would not place any structures in or adjacent to Strawberry Creek. Plan implementation would not substantially alter the existing drainage pattern within the Plan Area; it would not alter the course of any stream or waterway or add any impervious surfaces. Therefore, it could not impede or redirect flood flows. ***No impact*** would occur, and this issue will not be analyzed further in the EIR.

d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?

No impact. The Plan Area is not located within a flood hazard, tsunami, or seiche zone. Plan implementation would not result in construction of buildings or other facilities or store materials on site where they could be inundated by tsunami, floodwater, or seiche. There would be ***no impact*** related to the potential release of pollutants due to inundation and this issue will not be analyzed further in the EIR.

e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?

Potentially significant. As described under Criterion (a), Plan implementation could directly impact water quality during application of treatment activities through increased erosion or siltation or herbicide use. This impact could be ***potentially significant*** and will be analyzed further in the EIR.

3.11 LAND USE AND PLANNING

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XI. Land Use and Planning.				
Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒

3.11.1 Environmental Setting

The 800-acre Plan Area is located within the UC Berkeley Hill Campus subarea designated in the 2020 LRDP in the hills adjoining and east of the UC Berkeley Campus Park and California Memorial Stadium. Development within the Plan Area includes several campus public and research facilities such as the Lawrence Hall of Science, Botanical Garden, Space Sciences Laboratory, and the Mathematical Sciences Research Institute. However, the primary use of the Hill Campus is natural open space, including 300-acres, referred to as the Ecological Study Area, preserved by UC Berkeley for education and research.

The proposed Plan is consistent with the 2020 LRDP. The 2020 LRDP includes a number of policies and procedures for individual project review to support the Objectives of the 2020 LRDP. While all the 2020 LRDP Objectives bear either directly or indirectly on land use, the following are particularly relevant to the proposed Plan:

- Plan every new project as a model of resource conservation and environmental stewardship.
- Maintain and enhance the image and experience of the campus and preserve our historic legacy of landscape and architecture.
- Maintain the Hill Campus as a natural resource for research, education and recreation, with focused development on suitable sites.

The 2020 LRDP also includes the following policy that is directly relevant to the proposed Plan:

- Manage the Hill Campus landscape to reduce fire and flood risk and restore native vegetation and hydrology patterns.

The City of Berkeley General Plan land use diagram designates the land within the Plan Area as Open Space which allows parks, recreational facilities, schoolyards, community services, and facilities necessary for the maintenance of the areas (City of Berkeley 2009; City of Berkeley 2001). The portion of the Plan Area located within the City of Oakland is designated as Resource Conservation Area by the City of Oakland General Plan. This designation applies to city-owned and publicly-owned properties that provide important habitat for wildlife, areas for groundwater recharge, and fire break along the urban-wildland interface (City of Oakland 2015; City of Oakland 1996). The Contra Costa General Plan Land Use Element designates the land within the Plan Area as Parks and Recreation (Contra Costa County 2017). As a constitutionally-created state entity, the University of California, which includes UC Berkeley, is not subject to local governments' regulations, including city and county general plans and zoning ordinances.

3.11.2 Discussion

a) Physically divide an established community?

No impact. Treatment activities would be implemented throughout the Plan Area to reduce wildfire risk. However, implementation of the Plan would not result in construction of physical barriers that would change the connectivity between developed areas or physically divide an established community. There would be ***no impact,*** and this issue will not be analyzed further in the EIR.

b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?

No impact. Implementation of the proposed Plan would be consistent with the UC Berkeley's 2020 Long Range Development Plan (LRDP); specifically, the policy to "manage the Hill Campus landscape to reduce fire and flood risk and restore native vegetation and hydrology patterns" (UC Berkeley 2004). Therefore, there would be ***no impact*** and this issue will not be analyzed further in the EIR.

3.12 MINERAL RESOURCES

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XII. Mineral Resources. Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

3.12.1 Environmental Setting

The California Department of Conservation, Geological Survey classifies lands into Aggregate and Mineral Resources Zones (MRZs) based on guidelines adopted by the California State Mining and Geology Board. These MRZs identify whether known or inferred significant mineral resources are present in areas. The Mineral Land Classification of the San Francisco-Monterey Bay Area indicates that the City of Berkeley, including the land within the Plan Area, is classified Mineral Resource Zone 1 (MRZ-1; this classification indicates areas where no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence) and does not contain known mineral resources (DOC 1987; DOC 1983). A small portion of the Plan Area located in the City of Oakland is classified MRZ-2 and contains sand and gravel deposits. No mineral resource recovery sites are identified in the City of Berkeley General Plan and the City of Oakland General Plan land use maps, including those portions that encompass the Plan Area (City of Berkeley 2009; City of Oakland 2015).

3.12.2 Discussion

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?

No impact. The Plan Area is classified MRZ-1, this classification indicates areas where no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence. Therefore, Plan implementation would have ***no impact*** because there would not be any loss of known mineral resources. This issue will not be analyzed further in the EIR.

b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?

No impact. The Plan Area is not designated as a locally important mineral resources recovery site in the City of Berkeley General Plan or City of Oakland General Plan (City of Berkeley 2009; City of Oakland 2015). Therefore, Plan implementation would have ***no impact*** because there would not be any loss of availability of locally important mineral resources. This issue will not be analyzed further in the EIR.

3.13 NOISE

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIII.Noise. Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or in other applicable local, state, or federal standards?	☒	☐	☐	☐
b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

3.13.1 Environmental Setting

Sound is created when objects vibrate, resulting in air pressure variations characterized by their amplitude (loudness) and frequency (pitch). The standard unit of sound amplitude is the decibel (dB). The decibel scale is logarithmic; it describes the physical intensity of the pressure variations. The pitch of the sound is related to the frequency of the pressure variation. The human ear's sensitivity to sound is frequency-dependent. The A-weighted decibel scale (dBA) measures sound intensity while discriminating against frequencies in a manner approximating that of the human ear.

Groundborne vibration levels can vary from approximately 50 vibration decibels (VdB), which is the typical background vibration velocity level that is barely perceptible by humans, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings.

Noise-sensitive land uses generally include those where exposure to noise would result in adverse effects, as well as uses where quiet is an essential element of their intended purpose. Noise-sensitive land uses in the vicinity of the Plan Area include private residences to the north and west. Additional development within the Plan Area includes several campus public and research facilities such as the Lawrence Hall of Science, Botanical Garden, Space Sciences Laboratory, and the Mathematical Sciences Research Institute. The Plan Area also encompasses the Strawberry Canyon Recreation Area, which features two outdoor swimming pools, a fitness center and a clubhouse, as well as two athletic fields. However, the primary use of the Hill Campus is natural open space, including 300-acres, referred to as the Ecological Study Area, preserved by UC Berkeley for education and research.

Federal, state, and local governments have established noise standards and guidelines to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise. The City of Berkeley Municipal Code Chapter 13.40, "Community Noise," and City of Oakland Planning Code Chapter 17.120, "Performance Standards," establish various prohibitions and restrictions related to noise-generating activities, including hourly restrictions. Although UC Berkeley is exempt from these prohibitions and restrictions (see Section 3.11 "Land Use and Planning" above), it considers these local ordinances in its environmental analyses.

There are no public airport or private airstrips within the Plan Area. The nearest airport is the Oakland International Airport located approximately 10 miles southeast of the Plan Area.

3.13.2 Discussion

a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or in other applicable local, state, or federal standards?

Potentially significant. Treatment activities implemented under the Plan would require the use of noise generating heavy-duty off-road equipment, such as masticators and chippers, during mechanical treatment activities. The use of hand operated power tools would also temporarily increase noise levels. These temporary noise level increases could occur near sensitive receptors and may be considered substantial Therefore, this impact could be ***potentially significant,*** and will be analyzed further in the EIR.

b) Generation of excessive groundborne vibration or groundborne noise levels?

No impact. Treatment activities implemented under the Plan would not include activities that can result in excessive ground vibration, such as pile driving, drilling, boring, or rock blasting. Therefore, Plan implementation would not result in the exposure of sensitive receptors to levels of excessive vibration or groundborne noise levels. There would be ***no impact,*** and this issue will not be analyzed further in the EIR.

c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

No impact. The Plan would not result in new or relocated residential land uses, other types of noise-sensitive receptors, or new places of permanent employment where residents or workers could be adversely affected by aircraft noise, or changes in the levels of aircraft activity. In addition, the nearest airport, Oakland International Airport, is located approximately 10 miles southeast of the Plan Area. Therefore, the Plan would have ***no impact*** related to exposure of residents or workers to excessive noise levels, and this issue will not be analyzed further in the EIR.

3.14 POPULATION AND HOUSING

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIV. Population and Housing. Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

3.14.1 Environmental Setting

The Plan Area includes several public and research facilities; however, the majority of the area remains undeveloped. UC Berkeley enrollment for fall 2018 semester included 31,348 undergraduate students and 11,856 graduate students (UC Berkeley 2018). On-campus housing opportunities are available for approximately 22 percent of undergraduate students and 9 percent of graduate students (UC Berkeley 2017).

According to the 2013-2017 American Community Survey 5-year estimates, the City of Berkeley had a population of 120,179 in 2017, and a total of 49,137 housing units (U.S. Census Bureau 2019a). The City of Oakland had a population of 417,442 in 2017, and a total of 169,303 housing units (U.S. Census Bureau 2019b). In 2017, the unemployment rate was 4.2 percent in California, 2.5 percent in Alameda County, and 2.6 percent in Contra Costa County (EDD 2019).

3.14.2 Discussion

a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?

No impact. Plan implementation would not include construction of new housing or commercial development. Therefore, no direct population growth would result from Plan implementation. In addition, the Plan does not propose to extend roads or other permanent infrastructure to new areas that would induce growth in new locations; similarly, reducing wildfire risk along evacuation routes would not induce population growth. Employment needs for Plan implementation would be met by existing UC Berkeley staff or private contractors. The average crew size during treatment activities could include up to 15 personnel for the most labor-intensive vegetation treatment applications. The number of employees needed to implement treatment activities would be minimal and would not be considered to result in a substantial increase in employment nor would it result in employees permanently relocating to the area. Because implementation of the Plan would not induce any population growth, there would be ***no impact*** related to unplanned population growth, and this issue will not be analyzed further in the EIR.

b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?

No impact. No persons or homes would be displaced as a result of Plan implementation. Therefore, the Plan would have ***no impact*** related to displacement and the associated construction of replacement housing. This issue will not be analyzed further in the EIR.

3.15 PUBLIC SERVICES

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XV. Public Services.				
Would the project:				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

3.15.1 Environmental Setting

Fire protection services for the UC Berkeley Campus, including the Plan Area, are provided by the Berkeley Fire Department (BFD). BFD currently has seven fire stations, housing seven engine companies, two truck companies, and three ambulances. There are currently 130 sworn fire suppression personnel (BFD 2019). Station Number 2 provides primary response to the UC Berkeley Campus (UC Berkeley 2004). Alameda County Fire Department (ACFD) Station Number 19, provides fire protection services to LBNL and portions of the UC Berkeley campus. This fire station houses an engine company, a patrol and a HazMat unit (ACFD 2019).

The University of California Police Department (UCPD) provides police services to all UC Berkeley properties, including the Plan Area. UCPD operations consist of patrol, investigations, special events, and crime prevention. There are currently 63 sworn officers, 83 full-time civilian personnel, and 45 student employees (UCPD 2019).

The Plan Area is located within the Berkeley Unified School District (BUSD) and Oakland Unified School District (OUSD) service boundaries.

Park resources within the Plan Area include Strawberry Canyon Recreation Area which features two outdoor swimming pools, a fitness center, and a clubhouse. Two athletic fields, the Levine Fricke Field, and Witter Rugby Field, are also located within the Plan Area (UC Berkeley 2004). The Plan Area contains recreational trails and shares its southern border with the 208-acre Claremont Canyon Regional Preserve, managed by EBRPD.

3.15.2 Discussion

a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:

Fire protection?

No impact. The Plan does not include development of new residences nor the creation of permanent jobs requiring increased fire protection services. Implementation of treatment activities under the Plan is intended to reduce the threat of wildfire risk and facilitate emergency access. Therefore, Plan implementation would not increase demand for fire protection services such that the construction of new or expansion of existing fire protection facilities would be required. There would be ***no impact*** and this issue will not be analyzed further in the EIR.

Police protection?

No impact. The Plan does not include development of new residences nor the creation of permanent jobs requiring increased police protection services. Therefore, Plan implementation would not increase demand for police protection services such that the construction of new or expansion of existing police protection facilities would be required. There would be ***no impact*** and this issue will not be analyzed further in the EIR.

Schools?

No impact. The Plan does not include development of new residences that would generate new students in the community. Therefore, Plan implementation would have ***no impact*** on school services and facilities, and this issue will not be analyzed further in the EIR.

Parks?

No impact. The Plan does not include development of new residences that would generate new residents who would require new or expanded park facilities. Therefore, Plan implementation would have ***no impact*** on parks, and this issue will not be analyzed further in the EIR.

Other public facilities?

No impact. The Plan does not include development of new residences nor the creation of permanent jobs. Because Plan implementation would not induce population growth, the Plan would not result in an increase in demand for other public facilities, such as libraries and community centers. Therefore, Plan implementation would have ***no impact*** on other public facilities, and this issue will not be analyzed further in the EIR.

3.16 RECREATION

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVI. Recreation.				
Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☐	☒

3.16.1 Environmental Setting

Park resources within the Plan Area include Strawberry Canyon Recreation Area which features two outdoor swimming pools, a fitness center, and a clubhouse. Two athletic fields, the Levine Fricke Field, and Witter Rugby Field, are also located within the Plan Area (UC Berkeley 2004:4.11-24). The Plan Area also includes a well-used public trail network that connects to trails within Claremont Canyon Regional Preserve and Tilden Regional Park. Claremont Canyon Regional Preserve comprises 208 acres of open space. Tilden Regional Park, located northwest of the Plan Area, includes 2,077 acres of open space, facilities, and recreational facilities. Both Claremont Canyon and Tilden Regional Park are managed by EBRPD (UC Berkeley 2004).

3.16.2 Discussion

a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

No impact. Treatment activities would not increase the use of recreational facilities to the extent that substantial deterioration would occur. Typically, this impact occurs when a project induces population growth, such as a new housing development or a business that would necessitate a large number of new employees. Plan implementation would not include construction of new housing or commercial development. In addition, the number of employees needed to implement treatment activities would be minimal and would not substantially increase use of existing recreational facilities by employees. Therefore, Plan implementation would have ***no impact*** related to substantial physical deterioration of recreational facilities, and this issue will not be analyzed further in the EIR.

b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?

No impact. Plan implementation would not include development of residential communities or other similar types of development or induce population growth that would require construction or expansion of recreational facilities. Therefore, Plan implementation would have ***no impact*** related to the construction or expansion of recreational facilities and this issue will not be analyzed further in the EIR.

Directly or indirectly disrupt recreation activities within designated recreation areas?

Depending on the location and other site-specific considerations of the treatment, proposed treatment activities may temporarily restrict public access to surrounding areas for safety reasons, which would disrupt the recreation experience. Potential nuisance impacts that could also disrupt recreation may include degradation of scenic resources, decreased air quality, and traffic as a result of ingress/egress of heavy equipment. Although disruption of recreational activities would not result in a physical impact to the environment, this issue will be addressed in the EIR for informational purposes.

3.17 TRANSPORTATION

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVII. Transportation.				
Would the project:				
a) Conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities?	☐	☐	☒	☐
b) Conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☒	☐
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
d) Result in inadequate emergency access?	☐	☐	☐	☒

3.17.1 Environmental Setting

The Plan Area can be accessed via public local roadways including Piedmont Avenue, Prospect Street, Centennial Drive, and Grizzly Peak Boulevard. Bear Transit provides shuttle service to the Plan Area via the Hill Line. The Hill Line originates on the UC Berkeley Campus Park and travels along Centennial Drive (UC Berkeley 2018). UC Berkeley's bicycle and pedestrian facilities are concentrated on the Campus Park near existing classroom facilities. Given the open undeveloped nature of the Plan Area, bicycle and pedestrian transport facilities are limited (UC Berkeley 2006).

3.17.2 Discussion

a) Conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities?

Less than significant. Treatment activities implemented under the Plan would not result in long-term operational increases in vehicular traffic along roadways within the Plan Area. Treatment-related traffic would include heavy-vehicle trips to haul equipment and materials, and trips associated with the workers commuting to and from the treatment areas. The number of haul trips and workers trips to and from the treatment areas would vary based on the size of the area being treated, the type of treatment being implemented, and the duration of the vegetation treatments. As discussed in Chapter 2, "Project Description," the average crew size could include up to 15 personnel for the most labor-intensive vegetation treatment applications. This would result in a small number of worker related trips to and from the Plan Area. In addition, implementation of the Plan would not alter existing or planned public transit, bicycle, or pedestrian facilities within the Plan Area. Due to the temporary nature of treatment activities and the small crew size associated with treatment application, Plan implementation would not generate substantial pedestrian, bicycle, and transit demand. In addition, implementation of roadside treatments or equipment access could result in temporary road closures along Centennial Drive which could temporarily disrupt traffic operations. Any lane closures would be accompanied by traffic control signage and flaggers. Therefore, Plan implementation would not adversely affect the performance of the circulation system and would not conflict with any applicable transportation plans, ordinances, or policies. This impact would be ***less than significant*** and this issue will not be analyzed further in the EIR.

b) Conflict or be inconsistent with CEQA Guidelines section 15064.3(b), which pertains to vehicle miles traveled?

Less than significant. Senate Bill 743, passed in 2013, required the Governor's Office of Planning and Research (OPR) to develop new CEQA guidelines that address traffic metrics under CEQA. After several years of consideration and public input, the Office of Administrative Law approved (on December 28, 2018) comprehensive updates to the CEQA Guidelines (including at Section 15064.3(b)) that included removing Level-of-Service as a measure of transportation impacts under CEQA and replacing it with vehicle miles traveled (VMT). A "vehicle mile traveled" is defined as one vehicle traveling on a roadway for 1 mile. Pursuant to State CEQA Guidelines Section 15064.3(c), this change in analysis may be implemented now and is mandated to be addressed beginning July 1, 2020. According to OPR's Technical Advisory on evaluated transportation impacts in CEQA, projects that generate or attract fewer than 110 vehicle trips per day generally may be assumed to cause a less-than-significant transportation impact (OPR 2018). This analysis relies on OPR's Technical Advisory for VMT threshold.

The average crew size during treatment activities could include up to 15 personnel for the most labor-intensive vegetation treatment applications. This would result in a small number of worker-related trips to and from the Plan Area. In addition, worker related trips would be sporadic and occur at designated times throughout the year. Even if two treatment projects occurred simultaneously and each required the maximum of 15 personnel, this would generate a daily maximum of 60 vehicle trips (30 vehicles x 2 trips). Plan implementation would not approach 110 trips per day. Therefore, Plan implementation would not conflict or be inconsistent with CEQA Guidelines section 15064.3(b) and the impact would be ***less than significant***. This issue will not be analyzed further in the EIR.

c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?

No impact. Plan implementation would not require construction, re-design, or alteration of any public roadways and vegetation treatments would not occur within any road right-of-way. Therefore, Plan implementation would have ***no impact*** on hazards due to design features and incompatible vehicular use and this issue will not be analyzed further in the EIR.

d) Result in inadequate emergency access?

No impact. Implementation of the Plan would not locate any new development or land uses within the Plan Area that would require installation of emergency access routes or permanently alter any existing roadways/emergency access routes. Emergency fire suppression services to ensure safety during prescribed burning would be available onsite during this treatment activity. Additionally, Plan implementation would improve emergency access along major emergency access routes by clearing vegetation prone to torching including trees that could potentially block access were they to fall. Therefore, implementation of the Plan would not result in any reduction in the adequacy of emergency access. In addition, as discussed in Chapter 2, "Project Description," UC Berkeley would coordinate with adjacent facilities and local fire departments to plan emergency access or alternative access to the Plan Area during treatment activities, including for activities that could result in temporary road closures. Therefore, Plan implementation would have ***no impact*** on emergency access and this issue will not be analyzed further in the EIR.

3.18 TRIBAL CULTURAL RESOURCES

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVIII. Tribal Cultural Resources. Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?	☒	☐	☐	☐
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe?	☒	☐	☐	☐

3.18.1 Environmental Setting

AB 52, signed by the California Governor in September of 2014, established a new class of resources under CEQA: "tribal cultural resources," defined in PRC 21074. Pursuant to PRC Sections 21080.3.1, 21080.3.2, and 21082.3, lead agencies undertaking CEQA review must, upon written request of a California Native American tribe, begin consultation before the release of an environmental impact report, negative declaration, or mitigated negative declaration. Based on earlier tribal outreach conducted by UC Berkeley, three Native American Tribes requested further notification of UC Berkeley CEQA projects. UC Berkeley sent the three Native American Tribes notification of the project on October 24, 2019. Consultation is ongoing.

3.18.2 Discussion

Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:

a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?

b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe?

Potentially significant. Consultation with tribes has been initiated pursuant to PRC Sections 21080.3.1, 21080.3.2, and 21082.3 and is on-going. Until such time as consultation has concluded and potential resources (if any) have been identified, it is unclear whether tribal cultural resources could be affected by implementation of the project. Depending on the outcome of consultation, this impact could be ***potentially significant*** and will be further analyzed in the EIR.

3.19 UTILITIES AND SERVICE SYSTEMS

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIX. Utilities and Service Systems.				
Would the project:				
a) Require or result in the relocation or construction of construction of new or expanded water, wastewater treatment or stormwater drainage, electric power, natural gas, or telecommunication facilities, the construction or relocation of which could cause significant environmental effects?	☐	☐	☐	☒
b) Have insufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?	☐	☐	☒	☐
c) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has inadequate capacity to serve the project's projected demand, in addition to the provider's existing commitments?	☐	☐	☒	☐
d) Generate solid waste in excess of state or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☐	☒
e) Fail to comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☐	☒

3.19.1 Environmental Setting

UC Berkeley owns and maintains the water lines, sanitary sewer infrastructure, and stormwater utilities serving the Plan Area. Non-hazardous solid waste generated within the Plan Area is collected and hauled by UC Berkeley's Campus Recycling and Refuse Division (UC Berkeley 2004). UC Berkeley maintains and operates a natural gas cogeneration plant on-campus and procures both electricity and steam from the plant. Approximately 90 percent of energy used by UC Berkeley is delivered by the cogeneration plant, additional energy needs are delivered to UC Berkeley by Pacific Gas & Electric (PG&E) (UCOP 2018). A PG&E substation is located on LBNL property just outside of the Plan Area that serves the Plan Area and Campus Park; overheard power lines traverse the Plan Area.

3.19.2 Discussion

a) Require or result in the relocation or construction of construction of new or expanded water, wastewater treatment or stormwater drainage, electric power, natural gas, or telecommunication facilities, the construction or relocation of which could cause significant environmental effects?

No impact. Treatment activities would not involve development of residential communities or other similar types of development or induce population growth in an area that would require the expansion or construction of water infrastructure, wastewater treatment facilities, storm drainage facilities, electric power, natural gas, or telecommunications facilities. Therefore, implementation of the Plan would have *no impact*; and this issue will not be analyzed further in the EIR.

b) Have insufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?

Less than significant. Plan implementation would not involve development of residential communities or other similar types of development or induce population growth in an area that would increase demand for water. A minimal amount of water would be required for fire suppression during prescribed burning activities and for dust control during some vegetation removal and minor grading activities. Therefore, implementation of the Plan would not result in a physical impact associated with provision of sufficient water supplies, including related infrastructure needs. The impact would be *less than significant*, and this issue will not be analyzed further in the EIR.

c) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has inadequate capacity to serve the project's projected demand, in addition to the provider's existing commitments?

Less than significant. Plan implementation would not include construction of restroom facilities. Depending on the duration and location of treatment activities, UC Berkeley may supply portable restrooms for use by work crews. Portable restrooms are self-contained and would be cleaned periodically, and the waste would be hauled off-site to a wastewater treatment facility for disposal. This service is typically provided by an independent contractor permitted to handle, haul, and dispose of sanitary sewage. Pursuant to 40 CFR Part 403.5, hauled waste must be disposed of at a designated publicly owned treatment facility. Typically, publicly owned treatment facilities are responsible for implementing permit programs for hauled waste and ensure that adequate treatment capacity exists. Therefore, wastewater treatment demand would not exceed the capacity of any wastewater treatment provider. The impact would be *less than significant*, and this issue will not be analyzed further in the EIR.

d) Generate solid waste in excess of state or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?

No impact. Plan implementation would include the removal of trees and other vegetation. The Plan includes the utilization of a gasifier and a wood-burning hydronic boiler that when used would reduce the generation of greenhouse gases relative to leaving material to decompose, and by replacing a portion of the use of fossil fuels for electricity generation. Accordingly, some of the vegetation removed during treatment activities would be converted to electricity. However, the majority of the biomass created would be chipped and lopped, and spread directly back onto the treated areas to help mitigate erosion potential. The volume of cut vegetation left on-site would be kept low enough to prevent excessive fuel buildup, interfere with access for monitoring, and encourage establishment of desirable re-vegetation. There will be no hauling of cut material from the campus. All personal refuse generated by work crews during treatment activities would be disposed of in the nearest solid waste receptacle. Therefore, Plan implementation would not result in an increase in solid waste requiring disposal in a landfill. *No impact* would occur, and this issue will not be analyzed further in the EIR.

e) Fail to comply with federal, state, and local management and reduction statutes and regulations related to solid waste?

No impact. As discussed in Criterion (d), the majority of the biomass generated during Plan implementation would be chipped and lopped, and spread directly back onto the treated areas, and would not require hauling of cut material from the campus. Therefore, Plan implementation would not conflict with federal, state, and local statutes or regulations related to solid waste. Plan implementation would have *no impact,* and this issue not be analyzed further in the EIR.

3.20 WILDFIRE

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XX. Wildfire.				
Is the project located in or near state responsibility areas or lands classified as high fire hazard severity zones?	☒Yes	☐Yes	☐No	☐No
If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☒	☐	☐	☐
c) Require the installation of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☒	☐	☐	☐
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☒	☐	☐	☐

3.20.1 Environmental Setting

The California Department of Forestry and Fire Protection (CAL FIRE) has mapped Fire Hazard Severity Zones (FHSZs) for the entire state. FHSZs are based on an evaluation of fuels, fire history, terrain, housing density, and occurrence of severe fire weather and are intended to identify areas where urban fires could result in catastrophic losses. FHSZs are categorized as: Moderate, High, and Very High. According to CAL FIRE's Fire Resource Assessment Program FHSZ Geographic Information System data, the Plan Area is located within a Very High FHSZs (ArcGIS 2019b).

3.20.2 Discussion

a) Substantially impair an adopted emergency response plan or emergency evacuation plan?

No impact. Implementation of the Plan would not locate any new development or land uses within the Plan Area that would require installation of emergency access routes or alter any existing roadways/emergency access routes. Emergency fire suppression services to ensure safety during prescribed burning would be available onsite during this treatment activity. Additionally, Plan implementation would improve emergency access along major emergency access routes by clearing vegetation prone to torching including trees that could potentially block access were they to fall. Therefore, implementation of the Plan would not result in any reduction in the adequacy of emergency access. In addition, as discussed in Chapter 2, "Project Description," UC Berkeley would coordinate with local fire departments to plan emergency access or alternative access to the Plan Area during treatment activities.

Implementation of the proposed evacuation support treatment type would improve emergency response and evacuation within the Plan Area. Therefore, Plan implementation would have ***no impact*** on emergency response or evacuation and this issue will not be analyzed further in the EIR.

b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?

Potentially significant. The Plan Area is located within a Very High FHSZ. Plan implementation would require the temporary and periodic use of off-road vehicles and mechanical equipment within vegetated areas. Heat or sparks from vehicles or equipment activity (e.g., chainsaws and chippers) could ignite dry vegetation and cause a fire, exposing people or structures in the vicinity to risk of wildland fires. However, UC Berkeley would integrate measures into treatment design to reduce the risk of uncontrolled spread of wildfire from treatment activities and comply with applicable regulations. These may include restricting vegetation treatment activities during extreme fire conditions, equipping all machine-powered tools with federal-or state-approved spark arrestors, requiring crews to carry one fire extinguisher per chainsaw, and restricting smoking areas (to minimize the risk of accidental wildfire ignition). To help prevent fire escape during prescribed burning, UC Berkeley would continue to carry out prescribed burns in late winter when leaf litter is dry but annual grasses are moist and green. During a prescribed burn, 1 or 2 fire engines and an on-site water tender for fire suppression would be located onsite at all times. In the event a prescribed burn goes beyond the perimeter of its planned area, hand crews and fire engines are on-site to control the escape. Nonetheless, this impact could be ***potentially significant*** and will be analyzed further in the EIR.

c) Require the installation of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?

Potentially significant. The proposed Plan includes installation of strategically placed fuel breaks that would be maintained every 5 to 7 years. No other infrastructure (such as roads, emergency water sources, power lines, or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment are proposed under the Plan. Although the use of vehicles and heavy machinery during fuel break installation could increase the risk of an accidental wildfire ignition, measures implemented by UC Berkeley would reduce the risk of uncontrolled spread of wildfire from treatment activities. These may include restricting vegetation treatment activities during extreme fire conditions, equipping all machine-powered tools with federal-or state-approved spark arrestors, requiring crews to carry one fire extinguisher per chainsaw, and restricting smoking areas (to minimize the risk of accidental wildfire ignition). Furthermore, one of the primary objectives of the Plan is to reduce the frequency and severity of future uncontrolled wildfire. Nonetheless, this impact would be ***potentially significant*** and will be analyzed further in the EIR.

d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?

Potentially significant. The Plan Area lies within a designated landslide zone (DOC 2019) and the topography is generally steep. Removal of vegetation during treatment activities implemented under the Plan could affect the root structure in treated areas such that stability of slopes and soils could decrease. This is particularly true for mechanical treatment activities to construct fuel breaks, which could result in an increased risk of landslide.

Prescribed burning activities, including those that would be implemented under the Plan, would involve the application of fire to the landscape under conditions that result in a low-severity burn. Prescribed burns typically maintain soil cover, mineralize important nutrients from plant matter stored on the soil surface, reduce fuel loads leading to possible future high burn severity, and stimulate herbaceous vegetation helping to facilitate nutrient cycling. Prescribed burns implemented under the Plan would typically retain 70 percent of the vegetation in a treatment area. Therefore, any risk of landside or flooding from prescribed burning would be negligible. However, given the risk of landslide from other treatment activities and treatment types, a ***potentially significant*** impact could occur, and this issue will be analyzed in the EIR.

3.21 MANDATORY FINDINGS OF SIGNIFICANCE

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XX. Mandatory Findings of Significance.				
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒	☐	☐	☐
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐

3.21.1 Environmental Setting

3.21.2 Discussion

a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory?

b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)

c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?

Potentially significant. As discussed in various sections of the IS, Plan implementation could result in ***potentially significant*** impacts to aesthetics, air quality, biological resources, cultural resources, geology and soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, noise, recreation, tribal cultural resources, and wildfire. These issues will be analyzed in the EIR.

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3.20 Wildfire

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3.21 Mandatory Findings of Significance

No references cited in this section.

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Appendix D

Summary of Comments Received on the Notice of Preparation

Table D-1 NOP Comment Summary

Commenter/Date	Summary	EIR Section Where Considered
	Received by Email/Comment Card/Voicemail	
Steven Chainey January 17, 2020	▶ Fire Zone 3 - Panoramic Hill is not mentioned in the IS for the UC Berkeley Hill Campus WVFMP, although it shares a ¾-mile border with the UC Plan Area and includes the access entrance to the Upper Jordan Trail evacuation route. The densely vegetated WUI between UC's Sherwood Forest and private residences on Panoramic Hill should be addressed in the WVFMP, with measures added to reduce the risk of wildfire and airborne embers originating on UC's Plan Area. WVFMP projects and treatment areas described in the Initial Study document seem to overlook the importance of protecting Panoramic Hill and the wildfire egress route along Lower Jordan Fire Trail through Sherwood Forest.	2 Program Description, 3.11 Wildfire, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The following risk reduction measures are proposed ▪ IS Fig 2-2, Table 2-2, and Section 2.4.4: Extend the East-West Fuel Break (FB) Project along the border between Panoramic Hill neighborhood and UC's Sherwood Forest. The west end of the East-West FB should terminate at the densely forested east side of the UC softball stadium on Centennial Road. ▪ IS Fig 2-2, Table 2-2, and Section 2.4.4: Add a Sherwood Forest Fire Hazard Reduction (FHR) Project where it borders the Panoramic Hill neighborhood and UC sports facilities along the south side of Centennial Road. ▪ IS Fig 2-2, Table 2-2, and Section 2.4.4: Add a Lower Jordan Fire Trail Evacuation Route clearing project. Although the much longer Upper Jordan Trial is included in proposed Strawberry FHR and Frowning Ridge FHR projects, Lower Jordan Trail is much more heavily used and a more likely evacuation route connecting lower Centennial Road and the ridge tops of Panoramic Hill and Claremont Canyon. Lower Jordan Trail is also a likely access route for emergency vehicles and firefighting equipment if desperate evacuees in private vehicles are blocking upper Centennial Road and narrow Panoramic Way. ▪ IS Fig 2-2, and Section 2.4.1: Extend the proposed Centennial Evacuation Route clearing project downhill (west of) the UC Botanical Garden to UC Haas Clubhouse and pool facility. Both sides of lower Centennial Road are densely vegetated and would be a much safer evacuation route if a 100-foot buffer is created by limbing, thinning or removing tall trees and clearing brush ladder fuel.	2 Program Description, 3.11 Wildfire, Appendix A Wildland Vegetative Fuel Management Plan
	▶ Evacuation support treatments include creation of up to 100-foot strips of vegetation clearing or thinning. However, many eucalyptus trees exceed 100 feet in height or grow on steep side slopes above roads and trails where they could fall, toppling roadside power lines and blocking critical evacuation routes and access for first responders (a common occurrence in the recent Australian wildfires). Trees taller than the width of roadside buffer zones should also be evaluated for evacuation support treatments.	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan

Commenter/Date	Summary	EIR Section Where Considered
	▸ The WVFMP should describe and spatially map an intended future condition for the near-term and long-term of the 800-acre Plan Area landscape resulting from the completion of this and future vegetation management projects. What is the overall goal and desired cumulative effect of proposed treatments and projects?	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▸ I strongly urge UC to be resolute in defending the necessity of this plan if and when the Plan is opposed or misrepresented by some organizations or other members of the public. Make use of the UC Center for Fire Research and Outreach, Berkeley's Safe Passages Program, CalFire staff, and representatives of other local and state agencies with a depth of expertise in wildland vegetation management and their recent experience fighting wildfires and shepherding evacuees from harms way.	Not a CEQA issue
	▸ The selective use of limited quantities of targeted herbicide to prevent stump sprouting of eucalyptus and acacia trees removed for wildfire risk reduction is an essential tool for vegetation managers. I support the University's recent and future fire hazard mitigation maintenance projects and the WVFMP on the Hill Campus, and look forward to an aggressive initiation of the approved WVFMP starting in 2021.	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
Stuart M. Flashman Esq. (on behalf of the Claremont Canyon Conservancy) December 20, 2019	▸ Mitigation to prevent wildfire during implementation of treatment should include use of weather forecasts to avoid work when fire risk is high due to heat or high winds	3.11 Wildfire
	▸ Agrees with IS's conclusion that impacts to biological resources would be potentially significant and the Plan should identify measures to minimize such impacts	2 Program Description, 3.3 Biological Resources
	▸ Notes that protection of human health and safety should be the Plan's top priority, and some significant and unavoidable impacts to biological resources may occur, which would need to be justified by a statement of overriding considerations	2 Program Description, 3.3 Biological Resources
	▸ Recommends that the removal of vegetation should not be considered a significant impact and that the EIR needs to consider short-term, long-term, and temporary impacts of vegetation removal that considers the benefits of vegetation replacement, such as reduced fire risk and maintenance of wildlife habitat	3.2 Aesthetics, 3.3 Biological Resources, 3.11 Wildfire
	▸ EIR must evaluate the two different treatment types proposed (non-native tree removal vs. thinning projects) under normal conditions and under Diablo wind conditions	2 Program Description, 3.11 Wildfire
	▸ Under both conditions, EIR must consider speed of fire spread and fire fighter effectiveness, effectiveness of fuel breaks, likelihood of becoming a crown fire, likelihood of firebrands	2 Program Description, 3.11 Wildfire
	▸ The Plan's short-term and long-term goals should be identified and discussed, including associated benefits, impacts, and a reasonable range of alternatives	1 Introduction, 2 Program Description, 3 Environmental Setting, Impacts, and Mitigation Measures (all sections), 6 Alternatives
	▸ The EIR must include a stable and detailed project description explaining all of the treatments that would be used for different	2 Program Description, 6 Alternatives

Commenter/Date	Summary	EIR Section Where Considered
	project alternatives and cannot be vague and just analyze the worst case scenario (multiple court cases cited)	
	▶ The EIR needs to state clearly which parts of its analysis are project-level and programmatic, where each level of analysis would apply, and evaluate project and programmatic components accordingly	2 Program Description, 3 Environmental Setting, Impacts, and Mitigation Measures (all sections)
	▶ A preferred alternative must be chosen and a eucalyptus-pine removal approach should be chosen as the preferred treatment alternative (Joe McBride Plan summarized)	6 Alternatives
	▶ Impacts associated with each of the Alternatives must be compared, including feasibility and ability to avoid or substantially lessen potentially significant impacts	6 Alternatives
	▶ The EIR needs to consider how the effects of future climate change will interact with the Plan and its implementation	2 Program Description, 3.6 Air Quality and Greenhouse Gas Emissions
	▶ The EIR must consider the cumulative impact of the Project, in conjunction with other past, present, and reasonably foreseeable future projects, including projects on adjoining and nearby vegetated or developed areas of the East Bay Hills	4 Cumulative Impacts
	▶ The Plan should include coordination with surrounding land managers to jointly reduce wildfire risks, or evaluate the additional risk created by neighboring land management to minimize cumulative effects	4 Cumulative Impacts
Melissa Mandel December 20, 2019	▶ It's an environmentally destructive Plan that would lead to more fire, damage to the environment, wildlife deaths, and habitat destruction, and promotes nativism	2 Program Description, 3.3 Biological Resources, 3.11 Wildfire
	▶ No amount of pesticides are safe – they cause illness, kill animals, and pollute the environment	3.4 Hazardous Materials
	▶ Primarily causes of wildfire ignition are humans and the Plan would open the forest and allow for more arsonists	3.11 Wildfire
	▶ Forest should be left alone to allow overgrowth and maximum moisture retention to minimize fire risk	6 Alternatives
	▶ Thinning will lead to increased wind in the Plan Area, which increases dryness and fire spread	2 Program Description
	▶ Muir Woods is an example of a healthy, natural forest with lots of forest litter present	Not a CEQA issue
	▶ Another healthy forest example is on EBMUD's land in Moraga. Dead trees, poison oak, and Monterey Pines are allowed to remain and provide a wildlife sanctuary	Not a CEQA issue
	▶ Broom should not be targeted due to low combustibility and coverage of highly flammable grasslands	6 Alternatives
	▶ Plan is contradictory – healthy trees removed yet piles of dead branches often left onsite and use of heavy machinery also leaves extremely flammable shredded branches onsite	2 Program Description
	▶ California weather historically altered by European settlement through clearcutting and eliminating inland lakes. The Plan will do the same	Not a CEQA issue
	▶ Concerned with potential for machinery to cause wildfires and result in pollution	3.6 Air Quality and Greenhouse Gas Emissions, 3.11 Wildfire

Commenter/Date	Summary	EIR Section Where Considered
	▶ Plan ignores that various tree species are dying, thinning will weaken trees and dry out soils as trees rely on each other for survival	3.3 Biological Resources
	▶ Promote forest diversity and plant more disease resistant, drought tolerant trees rather than removing trees to prevent fires	6 Alternatives
	▶ Recommends reading Dave Maloney's report about fire prevention in the East Bay and David Theodoropoulos's report about the problems with nativist 'invasion biology' (links provided)	Not a CEQA issue
	▶ Highly flammable vegetation takes over in cut/thinned areas, and thinned areas never return to a healthy state causing negative visual impacts	2 Program Description, 3.2 Aesthetics, 3.3 Biological Resources
Isis Feral December 20, 2019	▶ Opposes the Plan and contends that the proposed actions do not accomplish the purpose the Plan by increasing fire danger, threatening public safety, and causing ecological devastation	1 Introduction, 2 Program Description
	▶ The IS does not address health and environmental hazards of removing trees and using pesticides or related cumulative effects	3.4 Hazardous Materials, 4 Cumulative Impacts
	▶ Would like to know precisely what pesticides are in use now and how the Plan would increase this use	2 Program Description, 3.4 Hazardous Materials
	▶ Grazing and herbicide use should not be combined to protect the grazing animals	2 Program Description
	▶ No discussion in IS of how herbicides affect flammability and how resulting fumes might endanger firefighter and the community when treated areas burn, as well as all modes of potential drift (air, water, soil)	3.4 Hazardous Materials, 3.6 Air Quality and Greenhouse Gas Emissions, 3.11 Wildfire
	▶ No discussion in IS of the effects of herbicides to top soil or watersheds and groundwater	3.5, Hydrology and Water Quality, 3.8 Geology and Soils
	▶ Pesticides are hazardous to human and ecological health (summaries are provided for several of the pesticides with associated links)	3.3 Biological Resources, 3.4 Hazardous Materials
	▶ Because chemical residues can persist in the environment for a long time, and herbicide products break down into various chemical components, subsequent applications of different herbicides can also combine into yet new, unintended mixtures. Synergism can exponentially increase chemical toxicity	3.4 Hazardous Materials, Appendix G Toxicity Evaluation
	▶ Environmental and health impacts are downplayed by claiming use of negligible quantities – endocrine disruption can occur at a nonmonotonic does	3.4 Hazardous Materials, Appendix G Toxicity Evaluation
	▶ Endocrine effects of pesticides in this program have not been adequately studied, and a large percentage of the ingredients are undisclosed	3.4 Hazardous Materials, Appendix G Toxicity Evaluation
	▶ Herbicide applications present severe health risks for certain people and consequently direct barriers to access. Obstacles to access to public spaces for people with disabilities are a violation of the Americans with Disabilities Act (ADA)	3.4 Hazardous Materials, 3.10 Recreation
	▶ The IS concludes that public services, schools, parks, and public facilities would not be impacted, but pesticides are an access barrier for people with disabilities, and therefore there would be an impact.	3.10 Recreation

Commenter/Date	Summary	EIR Section Where Considered
	▸ The Scoping Meeting was not accessible due to lack of transit	Not a CEQA issue
	▸ Would like to see physicians involved to evaluate toxic effects of pesticide use and related potential medical costs for those affected	3.4 Hazardous Materials; medical costs are not a CEQA issue
	▸ The EIR should use a precautionary approach instead of a risk assessment approach for pesticides	3.4 Hazardous Materials
	▸ UCB pesticide use is in conflict with current cities of Oakland and Berkeley pesticide policies. Berkeley does not use herbicides, and Oakland is prohibited from using them in the hills	1 Introduction; 3.4 Hazardous Materials
	▸ Assertation that non-native vegetation is more fire prone than native vegetation is incorrect and not based in science. Dense forests keep winds from spreading fires, and the moisture from many inches of annual fog drip keep fires from starting in the first place. Trees do not catch fire easily, unlike grasslands (links to a few articles and one presentation are included)	2 Program Description
	▸ It's important to understand that wildfires are a necessary part of the ecology in wildfire zones, where species evolved to be fire-dependent (e.g., Alameda whipsnake, Alameda pallid manzanita) and herbicides threaten special-status wildlife	3.3 Biological Resources
	▸ Monterey pines, which are targeted by the Plan, originated 80 miles away and are listed as endangered and should be preserved	3.3 Biological Resources
	▸ Eucalyptus trees contribute to keeping endangered species alive and provide nectar for bees and overwintering for monarch butterflies	3.3 Biological Resources
	▸ Forest impacts are hidden due to nativist definition of forests	3.1 Approach to the Environmental Analysis
	▸ Impacts related to land use and planning would occur because East Bay Hills Projects, and the LRDP, are about development and development would likely extend into the Plan Area	3.1 Approach to the Environmental Analysis
	▸ Should be focusing on reducing development in wildfire zones and making existing structures fire resistant	6 Alternatives
	▸ The Plan is likely to increase fire risk through clearcutting moisture-rich forests and turning them into dry, flammable grasslands more open to strong winds, leaving dead chipped vegetation onsite, and through the use of flammable herbicides	2 Program Description, 3.11 Wildfire
	▸ Pesticides proposed for use are known to produce toxic fumes when they burn and make vegetation more flammable	3.6 Air Quality and Greenhouse Gas Emissions, 3.11 Wildfire
	▸ When you cut down a lot of trees you create a new source of substantially brighter light in formerly shaded area, which adversely affect daytime views of the area. Removing trees also lets the glare from city lights be seen more widely in the area at night. the sunlight that would now saturate the denuded area would increase fire danger by removing the source of shade and moisture that inhibits fires	2 Program Description, 3.2 Aesthetics and Visual Resources
	▸ With increased fire risk under the Plan, firefighter lives are unnecessarily put in danger (another article is recommended about vegetation treatment to reduce wildfire)	2 Program Description, 3.11 Wildfire

Commenter/Date	Summary	EIR Section Where Considered
	▸ Supports the No Project option, and for diverting vegetation management funding earmarked for tree removal and pesticides to where it's most needed, for structurally securing homes and facilities, and for firefighting.	6 Alternatives
Elizabeth Stage December 20, 2019	▸ Concerns with lack of consideration for immediate neighbors of Plan Area (e.g., Berkeley lab, residents), lack of consideration of many people that visit the Plan area daily, and it's impossible to evaluate impacts when no Plan has been distributed to review	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▸ Consideration of evacuation plans, landslides, and ongoing maintenance of treated areas must be part of the environmental impact analysis. Lack of specificity in IS.	2 Program Description, 3.8 Geology and Soils, 3.11 Wildfire
	▸ Recommends consideration of the recommendations of Joe McBride and indicates that "thinning" is a forest management strategy that does not apply to the wildland urban interface	6 Alternatives
East Bay Pesticide Alert December 20, 2019	▸ The Scoping session held at the U.C. Botanical Gardens was at an inappropriate and obstructive location and kept concerned people from being able to attend (e-mail correspondence included)	Not a CEQA issue
	▸ There is a history of tall, mature trees that contribute to the campus's historical, cultural, and visual resources (links to historic photos included)	3.2 Aesthetics and Visual Resources, 3.7 Archaeological, Historic, and Tribal Cultural Resources
	▸ Eucalyptus trees provide many benefits, such as water and carbon storage, act as wind breaks, and provide beautification	3.2 Aesthetics and Visual Resources, 3.5 Hydrology and Water Quality, 3.6 Air Quality and Greenhouse Gas Emissions
	▸ Contends that removing trees and deforestation leads to increased fire risk (several articles and presentations are cited)	3.11 Wildfire
	▸ The university has ignored and continues to ignore expert information provided by EBPA	3.4 Hazardous Materials
	▸ Houses and other infrastructure start and spread fire, not trees and trees are often left in place and healthy	2 Program Description
	▸ Removing non-native trees for native plant restoration has negative impacts to wildlife through habitat removal	3.3 Biological Resources
	▸ Even with the best PPE, pesticides can still contact skin around the neck and wrists or mucus membranes	3.4 Hazardous Materials
	▸ There is no safe use of pesticides and agencies should review toxicology information for those proposed for use and review synergistic effects (information and links provided for pesticide compounds)	3.4 Hazardous Materials, Appendix G Toxicity Evaluation
	▸ Thinning 90 percent of tree cover and applying pesticides is deforestation may be to pave the way for new development and will harm the homeless	2 Program Description
	▸ Comments specific to UCB's LRDP are summarized intended to highlight conflicts between the Plan and the LRDP	1 Introduction
	▸ In the EIR, the EBPA would like to see: o Who is contracted by the university to conduct treatments o What has been spent on pesticides and what the university pays pesticide applicators	Not a CEQA issue or beyond the scope of this EIR

Commenter/Date	Summary	EIR Section Where Considered
	o Relationship between deforesting People's Park and the Plan o Responses to all current and previous FEMA NOP comments o Economic Relationship between Oakland and the university	
	▸ Triclopyr should not be used in and around water because it contaminates waters and can seep into soil	3.4 Hazardous Materials, Appendix G
	▸ Do not like use of "limited" in the IS, it's meaningless and meant to confuse	Not a CEQA issue
	▸ Fuel breaks would increase fire danger and create wind tunnels	2 Program Description, 3.11 Wildfire
	▸ What is called native is arbitrary and refuses to acknowledge species acclimation and the danger of destroying habitats formed over long time periods	2 Program Description
	▸ Determining conversion of forest land to non-forest uses as less than significant in the IS is dishonest	Appendix A
	▸ The discussion of odor in the IS doesn't take into consideration heightened sensitivity of people with Chemical Sensitivity	3.6 Air Quality and Greenhouse Gas Emissions
	▸ The air quality section should discuss pesticide drift and translocation	3.3 Biological Resources, 3.4 Hazardous Materials, 3.5 Hydrology and Water Quality
	▸ Evaluation of the Alameda pallid manzanita should be included	3.3 Biological Resources
	▸ Cultural evaluation needs to include evaluation of historic trees and vegetation	3.7 Archaeological, Historic, and Tribal Cultural Resources
	▸ Erosion has been caused by previous clearcutting by the UC which caused mudslides	3.8 Geology and Soils
	▸ Suggests that past and proposed deforestation and pesticide use result in increased fire danger and subsequently, erosion and drainage issues	3.11 Wildfire
	▸ The project has the potential to eliminate examples of CA history and cumulative effects to air quality, soil, water quality, specie habitats, and health	3.7 Archaeological, Historic, and Tribal Cultural Resources, 4 Cumulative Impacts
	▸ Summarizes comments from David Maloney on the Plan, including: ▪ The Plan ignores USFS analysis that recommends against removing eucalyptus trees ▪ It violates recommendations made by the Oakland/Berkeley Task Force in 1991/1992 ▪ It has no basis in fire science ▪ It violates principles of wildland fire prevention ▪ It creates the conditions for a fire storm	3.11 Wildfire (not all are CEQA issues)
	▸ Recommend no deforestation, no pesticide use, and replanting of previously removed eucalyptus trees (comments on FEMA EIS from 2013 are attached)	2 Program Description, 6 Alternatives
Anastasia Glikshtern December 20, 2019	▸ Opposes all use of herbicides due to health effects to humans, wildlife, and the environment and references the lawsuits related to glyphosate	3.4 Hazardous Materials, Appendix G Toxicity Evaluation

Commenter/Date	Summary	EIR Section Where Considered
	▸ Opposes replacing non-native vegetation with native vegetation due the terms being arbitrary and there being no indication that native vegetation is inherently less flammable	2 Program Description, 3.11 Wildfire
	▸ Opposes the use of oak trees in tree replacement due to sudden oak death and believes it will lead to more dead trees and fuel in the area	2 Program Description, 3.3 Biological Resources
	▸ Supports protection of existing mature trees as opposed to removing trees to combat climate change and maintain carbon sequestration	3.6 Air Quality and Greenhouse Gas Emissions
	▸ Fire danger will increase with tree removal by drying out the area and winds increasing, as well as leaving chips and logs onsite	2 Program Description, 3.11 Wildfire
Hills Conservation Network (HCN) December 20, 2019	▸ HCN believes that the new Plan is an improvement, but proposes an alternative plan to better reduce wildfire risk (and cite USFS AMSET report to support the alternative plan) and would like the identified treatment projects to be described in more detail, including specific locations, number of trees to be removed, where each treatment activity would be used, etc. to assess potential impacts	2 Program Description, 6 Alternatives
	▸ The following alternative priorities are proposed ▪ Highest priority should be to treat fine fuel, cured fuel, and areas near human activity ▪ 2nd priority should be fuel that spreads and increases intensity of fire ▪ 3rd should be creating/maintaining fire resistant environment through lowering temps, increasing moisture, reducing wind speed, discouraging succession of weeds, and avoiding creating of more fuel (chips, logs)	2 Program Description, 6 Alternatives
	▸ Potentially ambiguous language needs to be removed. The term “prone to torching” can be interpreted in different ways by different people and should be removed. In its place the species that are intended to be removed should be listed.	2 Program Description
	▸ Specifics regarding vegetation treatments to achieve evacuation routes, fuel breaks, and fire hazard reduction zones are proposed	2 Program Description, 6 Alternatives
	▸ There shall be no pesticide application to prevent regrowth of stumps. Regrowth shall be prevented using hand labor as has been effectively implemented by the East Bay Municipal Utilities District on adjacent properties	6 Alternatives
	▸ Since a primary objective of this plan is to reduce fuels, there shall be no new vegetation planted. Instead, the plan must reduce fuel, reduce ignition risk, and ensure that the post-treatment environment is “naturally” more fire safe. This will be accomplished by removing ground fuels, fire ladder components, while ensuring that existing shade canopy is maintained	6 Alternatives
	▸ The HCN alternative specifically calls for limiting vegetation removal activities to fuel breaks, evacuation routes, and adjacent to structures. As Jack Cohen has written extensively, removing vegetation more than several hundred feet from a roadway or structure is of negligible value in reducing fire risk (several links are included).	6 Alternatives

Commenter/Date	Summary	EIR Section Where Considered
	▸ Fire modeling must analyze the current condition and the *new equilibrium* condition of the project areas post-treatment.	2 Program Description, 3.11 Wildfire
	▸ The HCN alternative has many advantages over the initial study recommendation (several are listed, and AMSET comments on FEMA EIS are attached)	6 Alternatives
San Francisco Forest Alliance December 19, 2020	▸ Express opposition to deforestation and pesticide applications	2 Program Description
	▸ Mature trees flight climate change and reduce fire danger (link to Guardian article is included) because they sequester carbon and are not easily ignitable. Native trees are vulnerable to disease, such as SOD	2 Program Description
	▸ Opposed to herbicide use due to negative affects to human health and the environment and reference the outcome of the Monsanto case as well as an article on the harmful effects of herbicides	3.4 Hazardous Materials, Appendix G Toxicity Evaluation
East Bay Regional Park District December 20, 2019	▸ Express support for the plan and find it to be well thought out and indicate that it accounts for biological resource protection and diversity	Not a CEQA issue
	▸ The District believing addressing fuels is an urgent challenge and appreciates the need to proactively control wildland vegetation in fire-prone areas	Not a CEQA issue
Bev Von Dohre December 19, 2019	▸ Exact same letter as Melissa Mandel included above	See above
Wende Micco December 18, 2019	▸ Applauds UCB's current efforts but encourages UCB to consider the details of the Claremont Canyon Conservancy's Fuel Management Proposal specific to Strawberry and Claremont Canyons and urges retention of healthy native oaks along Centennial Drive and oak-bay woodlands in the Plan Area.	2 Program Description, 6 Alternatives
Jerry Kent on behalf of Claremont Canyon Conservancy (Board Member) December 18, 2019	▸ Feels that UCB was able to achieve important fire mitigation work through projects between 2000 and 2007 with limited funds, staffing, and w/o public opposition and expresses discontent with FEMA process that stalled. The CCC generally supports what is proposed but urges UCB to move carefully and deliberately	1 Introduction
	▸ Policies from the 2020 LRDP that the commenter thinks should guide the plan and EIR process are quoted	1 Introduction, 2 Program Description
	▸ Believes the NOP to be inadequate because there is no plan, no alternatives, and no site specificity	2 Program Description, 6 Alternatives
	▸ The final Hill Campus Wildland Vegetative Fuel Management Plan (Hill Campus FM Plan/EIR) must be based on verifiable wildland/urban fire mitigation science, natural resource management science, sustainable land management principles, and the requirements of law	2 Program Description
	▸ The Claremont Canyon Conservancy strongly recommends that UC planners base their Plan and EIR on the McBride Fuel Management and Wildfire Mitigation Proposal for the University of California Property in Strawberry and Claremont Canyons	2 Program Description, 6 Alternatives
	▸ The Plan and EIR need to:	Executive Summary, 2 Program Description, 6 Alternatives

Commenter/Date	Summary	EIR Section Where Considered
	▪ Identify/implement methods to decrease short-term and long-term liability from wildfires and provide short-term and long-term goals ▪ Incorporate adaptive management and allow for future revisions based on changing conditions ▪ Identify and rank area by wildfire risk ▪ Prioritize treatment methods to protect human health and safety, prevent harm to homes and biological resources, and protect scenic values ▪ Identify and evaluate mitigation measures and alternatives that mitigate or avoid significant project impacts and substantial evidence must be provided for measures or alternatives that are dismissed as infeasible ▪ Take into account future climate change, particularly in cumulative ▪ Make recommendations to inform policy makers about controversial issues, such as fire and resource management science, eucalyptus and pine trees, herbicides, and public desire to save trees (examples are provided)	
	▶ Believe that flammable eucalyptus and pine trees that are identified in the final Hill Campus FM Plan/EIR should be removed, as proposed in the UC 2020 Long Range Development Plan, to release safer understory native vegetation to be managed appropriately	2 Program Description
	▶ The final Hill Campus FM Plan/EIR must be separated from the Cal Fire award of a grant for partial work without a comprehensive plan. Care must be taken that a "cart before the horse" approach to justify the provisions in a grant does not interfere with a transparent and unbiased public process required by CEQA and NEPA laws	1 Introduction
	▶ Suggests that the Plan and EIR should be developed recognizing that Diablo wind fires have proven unstoppable in unmanaged wildland vegetation and the Plan needs to be comprehensive and incorporate home hardening and defensible space provisions to be administered by local agencies	2 Program Description, 6 Alternatives, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should describe why East Bay Hill fires are different than the fires in Southern California, the fires in forested areas of the Sierra, and why fire mitigation efforts must be site and vegetation specific to address this area's development and vegetation history that has contributed to recognized fire hazards in the East Bay Hills wildlands and residential areas	1 Introduction, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should describe how recommended fire projects in the Plan will address future fire risks associated with global warming, extreme weather, and the new normal for more fires often described by Cal Fire, in numerous scientific publications, and by the media.	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should include numbered polygons of project areas with cost projections for project work to facilitate grant requests and development of annual budget requirements	2 Program Description; economic considerations that do not result in physical environmental effects are beyond the scope of CEQA

Commenter/Date	Summary	EIR Section Where Considered
	▶ The final Hill Campus FM Plan/EIR should expand on the description of fire behavior to address the fact that the four most damaging fires in California history have all occurred under similar circumstances (Berkeley 1923, Oakland 1991, Tubbs 2017, and Camp 2018), and that the State of California has a history of siege fires that can make quick and adequate response problematic	1 Introduction, 2 Program Description, 3.11 Wildfire
	▶ The final Hill Campus FM Plan/EIR should describe the differences between forest fires and urban intermix fires. The UC Hills Plan and EIR must describe a viable model for fuel reduction that is understandable and based on native woodlands, shrubland, and grasslands that can be managed by University employees	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should upgrade the wildland and residential area data set and analysis that was developed for the 1995 East Bay Hills Vegetation Management Program that was largely the work or the UC Fire Science Lab, Campus Professors, and project consultants. Further, the 1995 wildland and residential hazard analysis should be used as a baseline for measuring improvements in fire safety projects that are included in the eventual UC Hills Campus Vegetation Management Plan	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should describe previous freeze events and their impact on high-ridge Campus, Tilden, and Claremont Canyon eucalyptus trees	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should include a detailed discussion of topography with over 75% of the Hill Campus having a slope over 40%, and over 90% has a slope over 20%. In our opinion, current fire modeling does not fully address slopes of this degree when combined with extreme weather conditions that are typical during Diablo winds	2 Program Description, 3.8 Geology and Soils, 3.11 Wildfire, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The UC Hill Campus Plan's vegetation fire hazard descriptions must be accurate and useful to a conflicted public and for university officials who must decide how to make the UC Hills reasonably fire safe	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should address and deal with the two opposing "views" that have been stated by individuals and groups for the East Bay Hills with one view claiming that planted "exotic" vegetation, including eucalyptus and pine are the only fire safe vegetation because SOD will kill all oaks while shrubs and grasslands can produce uncontrollable flames above 40 feet. The second "view" claims that native vegetation, including oaks and bays are the only fire safe vegetation, and that UC should learn to manage native trees, shrubs, and grasslands in intermix areas especially when near homes	2 Program Description, 6 Alternatives, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should address the fact that social media and blogging about vegetation fire hazards has created a political environment filled with strong views about native and exotic trees, clear-cuts, restoring natural landscapes, fake news about fire hazard myths, cherry picked facts, and media confusion about the role of vegetation fires at the urban/wildland interface and intermix as well as options for managing park and	Not a CEQA issue

Commenter/Date	Summary	EIR Section Where Considered
	residential vegetation in Very High Severity Fire Hazard Zones in the Oakland hills	
	▶ The final Hill Campus FM Plan/EIR should describe how the University will work with PG&E to coordinate and update standards for tree separation and limb clearance near powerlines in high-ridge locations with trees above flammable wildland vegetation that can be impacted by Diablo winds	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should include an area map showing the Cal Fire Very High Fire Hazard Severity Zone including and surrounding the Campus Hills between Tunnel Canyon in the South and the city of Berkeley in the North. Followed by an analysis of current, future, and cumulative impacts of fire hazard mitigation projects and responsibilities for agency wildland vegetation management.	3.11 Wildfire, 4 Cumulative Impacts, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should address the fact that fire behavior in the past has been based on standard modeling that assumes relative differences in vegetation with flame lengths at the fire front of 0-4', 4-8', 8-11', and above 20'. However, these flame lengths and descriptions do not correspond to what urban residents see on TV during every fire season	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▶ The final Hill Campus FM Plan/EIR should note that a comprehensive Environmental Impact Statement was prepared by FEMA also covered Strawberry Canyon, Chaparral Hill, and Claremont Canyon areas. It also should describe how the University proposes to deal with the FEMA/EIS and its USFWS Biological Opinion for these three project areas, and for obtaining required permits. The Plan should also state how long it will take the University to complete a Title 10 Habitat Conservation Plan with the USFWS and other resource agencies if required, to obtain permits	2 Program Description, 3.3 Biological Resources
	▶ The final Hill Campus FM Plan/EIR should either use or explain why it does not agree with the general concepts of the 3Rs advocated by the Sierra Club and other environmental groups (that seems to me to be consistent with UCs 2020 LRPD Plan policies) about the removal of high fire risk eucalyptus and pine trees, replacement naturally by lower growing and safer natives, and for required restoration of habitat for local native species, including listed species	6 Alternatives
	▶ The final Hill Campus FM Plan/EIR should propose the use of prescribed fire by Cal Fire at some future point in the Hill Campus while recognizing that current use is questionable given concerns about the possibility of losing control of a managed fire and given the operational difficulties of using prescribed fire within urban areas of the Bay Area's challenged air quality system	2 Program Description, 3.6 Air Quality, 3.11 Wildfire
	▶ The final Hill Campus FM Plan/EIR should include in its fire mitigation program and suppression planning a request for the location of an East Bay Hills Cal Fire Unit near the Campus	Outside of the scope of this EIR
	▶ The final Hill Campus FM Plan/EIR should recommend the adoption of specific updated IPM policies and updated University policies that will allow appropriate and safe use of herbicides by	2 Program Description, 3.4 Hazardous Materials

Commenter/Date	Summary	EIR Section Where Considered
	trained and licensed employees and by reliable and licensed contractors working on Hill Campus vegetation management projects to implement the final Plan/EIR	
	▸ Removal of highest-fire-risk trees in the Hills to reduce excessive vegetation fuel followed by treating eucalyptus stumps with an IPM approved herbicide is the only currently available economic and effective strategy in UC's Very High Fire Hazard Severity Zones	2 Program Description, 6 Alternatives
	▸ The final Hill Campus FM Plan/EIR should recommend removal of all second-growth eucalyptus trees, coppice suckers and seedlings for both fire hazard reduction and economic reasons to allow for the restoration of areas that were logged following the freeze of 1972	2 Program Description, 6 Alternatives, Appendix A Wildland Vegetative Fuel Management Plan
	▸ The final Hill Campus FM Plan/EIR should also document and include a discussion about the continued risks of retaining large blue gum eucalyptus trees on both the Campus Park area and the Hill Campus	2 Program Description, Appendix A Wildland Vegetative Fuel Management Plan
	▸ The final Plan/EIR should include a case study that will clarify the facts surrounding the recent UC Grizzly Peak Fire of August 2, 2017. And then provide appropriate science-based policies to address recommendations for vegetation management	2 Program Description
	▸ The University is clearly not a self-contained vegetation island. Its immediate neighbors, EBRPD and EBMUD, contain extensive wildlands with very substantial fuel loads of highly flammable and invasive vegetation. The EIR will need to address the "cumulative impacts" of fire safety for the campus and the major land ownerships of wildlands in the East Bay Hills. Diablo Winds come from the North East and LBL has modeled the potential for a 60 ft high wall of wildfire coming from Tilden blowing into the Hill Campus. The EIR will need to address how the University's fuel management plans interact with and have been coordinated among the major wildland ownerships in the East Bay Hills. The wildlands wildfire threats in the East Bay Hills are present at an areawide scale, and they must be addressed at this large scale	1 Introduction, 4 Cumulative Impacts, Appendix A Wildland Vegetative Fuel Management Plan
	▸ Additional information on previous fires in the area and wildfire risk is provided in links, figures, summaries, quotes, and a paper the author wrote in 2017 is provided	2 Program Description, 3.11 Wildfire
BAAQMD December 17, 2019	▸ Please be aware that any prescribed burning projects shall comply with the requirements of Regulation 5: Open Burning, and receive written approval of a smoke management plan by the APCO prior to any burn and comply with the smoke management plan during the burn	2 Program Description, 3.6 Air Quality, 3.11 Wildfire
Claremont Canyon Conservancy December 14, 2019	▸ As was noted at the scoping meeting, the study is too vague and nonspecific	2 Program Description
	▸ As UC and its consultant develop the full plan, we urge that the following points be given careful consideration. ▪ The plan prepared and submitted by Forestry Professor Emeritus Joe McBride should be the basis of the UC Plan. It is	2 Program Description, 3.3 Biological Resources, 3.4 Hazards Materials, 6 Alternatives

Commenter/Date	Summary	EIR Section Where Considered
	comprehensive, it takes into account conditions created by global warming and it has the specifics necessary to make the Hill Campus as firesafe as possible while respecting the natural environment ▪ UC's plan should not be limited to the five projects noted in the Initial Study. Other areas of the Hills Campus require attention as well. If other areas are covered under separate approved plans, then those areas should be noted in this plan ▪ UC's vegetation management plan must respect science and correctly apply it. It must avoid programs that respond to popular opinion but are not based on sound science. One such program is thinning. Thinning is a tool that foresters use in rural areas to ensure that trees grown for timber are given the room they require to grow straight and tall to maximize the harvest. The safest and most financially viable option is to completely remove the dense eucalyptus groves ▪ UC has successful experience with complete removal rather than thinning in the Hills Campus in the area southeast of Claremont Avenue at Signpost 29 ▪ Maintenance is critical. Once an initial treatment has been completed, ongoing work is necessary to prevent the land from returning to a state where fire-prone vegetation is again difficult to manage. A correctly designed treatment program, such as elimination and not mere thinning of eucalyptus, will enable a cost-effective and time-limited maintenance program ▪ Vegetation management along evacuation routes must be completed over a wide enough area to keep the routes safe in emergency situations. A hundred feet may be insufficient if trees beyond a 100-foot perimeter are tall enough to fall across a route ▪ The UC plan must include habitat for the threatened and likely to become endangered Alameda Whipsnake ▪ The Initial Study outlines the correct use of the herbicide triclopyr. However, the study also mentions but does not discuss using glyphosate. If this latter chemical is not going to be applied, then that should either be so stated or preferably no mention of it should be made	
William Boyd December 13, 2019	▸ The following are eucalyptus along the south side of South Park Drive, across from the golf course, that are capable of throwing embers to another big stand of eucalyptus on the ridge above the golf course. This latter stand extends from north of South Park Drive on a ridge that runs parallel to Grizzly Peak Rd that threatens the South side of the UC lands and Strawberry Canyon. As noted in my earlier materials in response to the UC Wildland land Fuel Management Plan, the huge areas of eucalyptus in Tilden are a clear and present threat to UC, already highlighted by LBL, and must be examined in the EIR Project Objectives, Existing Conditions and Cumulative Impacts section of the EIR	1 Introduction, 2 Program Description, 4 Cumulative Impacts
Maria Kiernik December 11, 2019	▸ I, along with my family and friends, STRONGLY OPPOSE any further clearcutting and ESPECIALLY OPPOSE ANY KIND OF HERBICIDE / PESTICIDE USE applications by the university. We do not need to add more chemicals (some of which have been	3.4 Hazardous Materials, Appendix G Toxicity Evaluation

Commenter/Date	Summary	EIR Section Where Considered
	declared as probable carcinogens by the World Health Organization) into our environment, especially one where young children play. Our dog recently died of lymphoma - we hiked with him almost daily in the hills.	
Blanche Sack (voicemail) December 11, 2019	▶ Supports UCB's Plan and appreciates the outreach that UCB has conducted (could not attend the meeting due to inability to drive at night)	Not a CEQA issue
Alex Jackson December 11, 2019	▶ I am writing in opposition to the use of pesticides (and herbicides) in the eradication effort for non-native trees in our local parks and open spaces. I hike daily in these areas, and I am concerned for the health of myself and all of the other users of our parks, and for the environmental impact that these chemicals WILL have on our lands. The rules in place about use of these chemicals are there for a reason, not to be set aside for expediency. it is absurd to think that we can actually eradicate these trees (eucalyptus, etc.) no matter what we do. Not realistic. Don't ruin our watershed, and parklands in the process. Building a wall against plants that have been here for over a hundred years is surely a losing proposition. We need to manage, of course, and adapt to our current ecosystem	2 Program Description, 3.4 Hazardous Materials
William Boyd December 3, 2019	▶ Provides photo essay and lessons learned from the Sonoma Valley wildfires	3.11 Wildfire
William Boyd December 3, 2019	▶ AB 38 sets forth Legislative Findings, in Section 1, regarding the need for wildfire mitigation programs and defines key State policies applicable to vegetation fuel management for wildfire protection purposes. As such, the Plan and associated EIR need to address the policies and fuel management standards set forth in the Findings provisions. ▶ Sections from AB 38 as well as legislative findings are provided	3.11 Wildfire
William Boyd December 3, 2019	▶ Provides an overview of their experience with CEQA, resource protection, and resource management	Not a CEQA issue
	▶ Forwards an email between Claremont Canyon Conservancy members providing information regarding Joe McBride's alternative plan and recommendations, including: ▪ The significance of UC Berkeley, along with its huge daytime population, warrant taking the most extensive wildfire fuel load reductions feasible, as specified pursuant to the recently enacted AB32. This goal should be incorporated into the Project Objectives for the EIR and then analyzed in the EIR. ▪ The University must address wildfire spread issues in the EIR. The issues associated with "wildfire movement" should be stated in the Project Objectives and examined in depth in the EIR. ▪ The "mitigation" and "alternatives" analyses of the EIR must be measured in relation to the likelihood of success of "reducing flammable wildfire fuel loads to the maximum extent feasible" ▪ Professor McBride recommends replacing eucalyptus with a restored, wildfire resistant landscape comprised of coast live oak and grasslands. His recommendations have been validated by the experience of the Sonoma Valley in 2017	1 Introduction, 2 Program Description, 3.11 Wildfire

Commenter/Date	Summary	EIR Section Where Considered
Joe McBride December 3, 2019	▶ Submits his comments from the scoping meeting and his entire alternative fuel management plan. Comments are summarized below:	Addressed below
	▶ There is a lack of specificity in the plan, which makes it hard to evaluate impacts	2 Program Description
	▶ No map of existing vegetation is presented in the plan. This is crucial information both as to the selection of the vegetation management activities and the evaluation of potential environmental impacts	3.3 Biological Resources
	▶ The Fuel break (Figure 2-2) does not extend along the University property and the housing area off of Panoramic Way. This is a crucial omission because of the potential for fire driven by a north wind to race up the north facing slope of strawberry Canyon and into the residential area	2 Program Description, 6 Alternatives
	▶ It is unclear if any vegetation type conversion (for example conversion of Monterey pine plantations to annual grasslands or oak-bay woodland). If so, such conversions should be spelled out in the plan. I believe it is crucial to convert existing eucalyptus plantations to either oak-bay woodland or annual grassland and to convert all conifer plantations along the ridges to annual grassland	2 Program Description, 3.3 Biological Resources
	▶ Table 2-2 identifies 155 acres for treatment in the plan. I think the plan should be expanded to a larger area. In particular, I am concerned about expanding treatments to the north facing slope of Strawberry canyon west of the Frowning FHR project.	2 Program Description, 6 Alternatives
	▶ The "Evacuation support treatment" proposes the treatment of a strip of land 100' from either side of major evacuation roads (page 2, paragraph 5). This strip should be widened to include any trees that could potentially fall onto the evacuation routes because of their height and lean	2 Program Description, 6 Alternatives
	▶ Treatment Maintenance (page 2-10). The objectives and "vegetation management activities" should be spelled out for each vegetation type in each of the Fire hazard reduction projects. This information is necessary to evaluate the long-term effectiveness of the plan and the environmental impacts of the maintenance program	2 Program Description
Marilyn Goldhaber December 2, 2019	▶ Include a summary of vegetation management already approved in the 2020 LRDP	1 Introduction, 2 Program Description, 4 Cumulative Impacts
Katherine Bond December 2, 2019	▶ What are herbicides?	2 Program Description, 3.4 Hazardous Materials
Jerry Kent December 2, 2019	▶ Follow policies for fuel management from the LRDP and LRDP EIR	2 Program Description
	▶ High fire risk vegetation (e.g., eucalyptus, Monterey pine) should be removed in VHFHSZs and replaced with less flammable native flora	2 Program Description
	▶ Thinning of second-growth eucalyptus is not safe or sustainable without regular use of prescribed fire every 5 years	2 Program Description, 6 Alternatives
	▶ The Plan and EIR must be separated from the grant to ensure a transparent and unbiased public process	Not a CEQA issue

Commenter/Date	Summary	EIR Section Where Considered
	▸ Vegetation management and home hardening with defensible space are needed to adequately reduce fire risk	3.11 Wildfire, 6 Alternatives
Robert Bahme November 27, 2019	▸ Endorses the plan and would like to see a specific fire break and tree removal zone added. Indicates that the pine trees are not native and create a large fire liability	2 Program Description, 6 Alternatives
SPRAWLDEF November 24, 2019	▸ Supports comments made by the Sierra Club	See Sierra Club comments below
Sierra Club November 24, 2019	▸ The Plan is inadequate because it does not include an alternative for the removal of blue gum eucalyptus. Instead, the plan reports that eucalyptus will be thinned. This is insufficient and inadequate for dealing the fire danger from the blue gum eucalyptus ▸ UC should put into its plan an alternative that the Sierra Club advocates which is the 3Rs. This plan calls for removal of blue gun eucalyptus and other fire dangerous trees which will allow for the restoration and recovery of native vegetation that is less fire dangerous and the reestablishment of the biodiversity that existed with the native habitat and also recovery of endangered or threatened species (2015 3 R's paper is attached)	6 Alternatives 6 Alternatives
Ian Monroe November 22, 2019	▸ Supports aggressive removal of eucalyptus trees	2 Program Description, 6 Alternatives
State Clearinghouse November 20, 2019	▸ Copy of NOP submitted to reviewing agencies	Outside of the scope of this EIR
NAHC November 20, 2019	▸ CEQA regulations related to cultural resources are summarized, including AB 52 and SB 18, and NAHC recommendations for cultural resource assessments are provided	3.7 Archaeological, Historic, and Tribal Cultural Resources
Max Ventura November 20, 2019	▸ Objects to the scoping meeting location and late noticing of the meeting ▸ Believes the plan is a nativist attack and will convert the area to grasslands, which is more dangerous for fire risk	Outside of the scope of this EIR 2 Program Description
Alfred Twu November 20, 2019	▸ Please get rid of all the eucalyptus trees and other flammable plants. The hills will still be beautiful without them and we'll all be much safer	2 Program Description, 6 Alternatives
	Verbal Comments Received at Public Scoping Meeting on December 2, 2019	
Joe McBride December 2, 2019	▸ The Plan is lacking specificity and no vegetation map is provided, environmental impacts will not be able to be evaluated ▸ The Plan fails to use appropriate techniques for assessing landsliding ▸ Concerned with only treating 100 feet on each side of evacuation routes ▸ Concerned with the schedule and that treatments are already underway without the EIR being approved	2 Program Description, 3.3 Biological Resources, 3.8 Geology and Soils, 3.11 Wildfire, 4 Cumulative Impacts, 6 Alternatives,
Dan Grassetti December 2, 2019	▸ Concerned with the schedule and that treatments are already underway without the EIR being approved ▸ Concerned with lack of specificity in the Plan ▸ Interested in the process and when the Plan will be released to the public	2 Program Description, 4 Cumulative Impacts

Commenter/Date	Summary	EIR Section Where Considered
Stuart Flashman Attorney for the CCC December 2, 2019	▶ It should be clear that the primary purpose of the project is to identify and implement methods of vegetation management to decrease the short-term and long-term risk of damage to people, property, and/or the environment ▶ The EIR needs to distinguish between short-term and long-term goals for the project; address the priority of different tasks; identify areas of highest wildfire risk; analyze the effectiveness of the methods of vegetation removal; assess all feasible mitigation measures and alternatives; consider the effects of future climate change on the effectiveness of the Plan and address cumulative affects; and should not assume native species are preferable ▶ Prioritization should be 1) protecting human health and safety, 2) protection structures and biological resources	1 Introduction, 2 Program Description, 4 Cumulative Impacts, 6 Alternatives
Elizabeth Starge December 2, 2019	▶ Upset with UCB for how the FEMA grant process and litigation went ▶ Believes the UC is prioritizing the safety and welfare of research labs on campus as opposed to other disciplines and Berkeley neighbors	Not a CEQA issue
Jerry Kent December 2, 2019	▶ Believes the UC should use the McBride Plan (submits written comments which are included above)	6 Alternatives
Jon Kaufman December 2, 2019	▶ Believes the UC should use the McBride Plan ▶ Believes thinning trees is not appropriate in the WUI and the UC should instead focus on removing trees that are a potential cause of wildfire	6 Alternatives
Michael Graf Attorney for CCC December 2, 2019	▶ The project description is too vague and general ▶ The EIR must consider how different treatment options exacerbate or reduce wildfire risk ▶ The EIR must go into greater detail on how each of the different treatments will affect biological resources and compare between alternatives	2 Program Description, 3.3 Biological Resources, 3.11 Wildfire, 6 Alternatives
Katherine Bond December 2, 2019	▶ The project description is too vague and does not provide information about the herbicides proposed for use ▶ The term thinning needs to be clearly defined	2 Program Description, 3.4 Hazardous Materials, Appendix G Toxicity Evaluation
Janice Thomas December 2, 2019	▶ The Plan is too vague and the figures were not helpful ▶ Concerned with removal of coastal live oaks that occur within EST and FB areas, as well as disturbance to native vegetation and wildlife	2 Program Description, 3.3 Biological Resources

Appendix E

Biological Resources Assessment

E1

Special Status Plant Species Survey Report

Special Status Plant Species Survey Report

UC Berkeley Hill Campus Fire Hazard Reduction

University of California, Berkeley

October 2019

Prepared for:

University of California, Berkeley, Facilities Services
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1.0 Introduction

On behalf of the University of California, Berkeley (UCB), Condor Country Consulting, Inc. (CCCI) performed focused rare plant surveys during three blooming season periods between March 4 and August 15, 2019 for the UC Berkeley Hill Campus Fire Hazard Reduction project. This survey and report was prepared in support of a California Environmental Quality Act (CEQA) document that UCB's Facilities Services is preparing for UC Berkeley Hill Campus Fire Hazard Reduction project. The botanical surveys found one species of plant, Western leatherwood (*Dirca occidentalis*) at 26 locations that is listed by the California Native Plant Society (CNPS) as rare in California and moderately threatened (CNPS 1B.2 ranking). No federally or State listed special status species were located. The term "special status species" includes species federally and State listed and proposed for listing as "Threatened or Endangered, Candidate, or Species of Concern". Nine vegetation communities were mapped within the Project Area.

1.1 Project Location and Description

The project is located in the East Bay Hills above the cities of Berkeley and Oakland, in the heavily vegetated 800-acre Hill Campus of the UCB. The project is primarily bounded by Grizzly Peak Road to the north and east, Centennial Drive to the west, and Claremont Avenue to the south. The UCB main campus and the Lawrence Berkeley National Lab (LBNL) are west of the Project Area (Figures 1 and 2).

The University of California Berkeley (UCB) proposes to treat vegetation in 250 acres of the Hill Campus to reduce wildfire hazard and potential damage to approximately 3,000 habitable structures and institutions of international importance as well as improved life safety for 3,000-plus residents and approximately 1,000 day-time users of the Hill Campus, and increasing the reliability of the 150 KV transmission line, the sole power source to the campus and Lawrence Berkeley National Laboratory. The campus will target areas forested with flammable eucalyptus and high fuel volume, and areas within 100 feet of roads, fire-trails and buildings. Area treatments will thin the forest to reduce fuel volume and fire hazard. Roadside treatments will both reduce fire intensity along the road and remove hazardous trees likely to block the road. Defensible space will be installed within 100 feet of buildings.

Vegetation will be treated through the combination of the use of machinery and hand labor. Trees would be cut using hand tools and a mechanized feller buncher. To prevent re-sprouting, an herbicide will be applied by a licensed California Qualified Applicator to the cambium ring of eucalyptus and acacia stumps. Felled trees will be skidded by rubber-tired or tracked vehicles along skid trails to landings. Selected tree trunks will be left on the slope. At the landings, trees would be stored or chipped using a grapple-fed chipper or a tracked chipper. Whole trees will be fed into the chipper and pulled through the blades by a conveyor belt and feed wheel. Chips will be both spread on-site and transported to a gasifier to supply electricity directly to the campus. Along roads and buildings, lower limbs of trees will be pruned, understory vegetation shortened and grass mowed.

2.0 Environmental Setting

The Project Area is located in the East Bay Hills located above the University of California, Berkeley (UCB) campus and the Lawrence Berkeley National Lab (LBNL). Initial vegetation and aquatic community surveys were conducted in 2010 as part of the Federal Emergency Management Agency (FEMA) East Bay Hills Hazardous Fire Risk Reduction Project. Follow-up plant and vegetation surveys were conducted during the late winter, spring, and summer of 2019 in support for a California Environmental Quality Act (CEQA) document in preparation of the next phase of the UC Berkeley Hill Campus Fire Hazard Reduction grant from the California Department of Forestry and Fire Protection (Cal Fire). A total of nine vegetation communities were identified inside the Project Area and named according to the conventions used in the original FEMA biological assessment (FEMA 2012), as well as those described in *A Manual of California Vegetation* (Sawyer et al. 2009), *California Vegetation* (Holland 1995), *USFWS National Wetlands Inventory* (USFWS 2019b) and Cowardin (Cowardin et al., 1979). The vegetation communities include: coastal scrub (xeric), coniferous forest/non-native coniferous forest, coyote brush scrub, developed/disturbed/landscaped, eucalyptus forest, oak-bay woodland, riparian woodland, riverine features, and successional grassland.

3.0 Methods

3.1 Literature and Data Review

CCCI biologist Ted Robertson conducted a literature search prior to field visits. The literature search included a review of the CDFW California Natural Diversity Database (CNDDB) for records of special status plants species within ten miles of the project sites (CDFW 2019) and aerial imagery of the project location (Google Earth Pro 2019). The Biological Assessment (BA) and the Biological Opinion (BO) for the Project Area was referenced to insure that the focused plant searches included two key federally listed species that were identified to occur at adjacent FEMA- and UC-funded project sites, the pallid manzanita (*Arctostaphylos pallida*) and the Presidio clarkia (*Clarkia franciscana*). Mr. Robertson evaluated all species identified in the CNDDB search for their potential to occur within the Project Area, based on habitat suitability. Mr. Robertson compiled a list of all special status species with potential to occur within ten miles of the Project Area using the January 2019 California Natural Diversity Data Base (CNDDB) data using search parameters that included their regulatory status, local distribution and bloom periods (Appendix A – Figures 3a and 3b, Appendix B, and Appendix C). In this report, "special- status" refers to species that meet one or more of the following criteria:

- species listed by the USFWS or CDFW as threatened or endangered, proposed for listing, or candidates for listing;
- plant species that qualify as rare, threatened, or endangered as defined in Section 15380 of the California Environmental Quality Act (CEQA) Guidelines; and
- plant species included on the CDFW Rare Plant Rank as 1A, 1B, or 2 (formerly the California Native Plant Society Rank).

3.2 Botanical Study Methods

CCCI botanist Ted Robertson conducted background literature research and led a team of biologists to perform field surveys of the entire Project Area (Table 1). Mr. Robertson holds a California Department of Fish and Wildlife (CDFW) Voucher Collecting Permit for special status plants (Permit Number 2081(a)-19-015-V). CCCI botanists conducted surveys in accordance with California Native Plant Society's Botanical Survey Guidelines (CNPS 2001), CDFW Protocol for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (CDFW 2009), and U.S. Fish and Wildlife Service (USFWS) Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants (USFWS 1996).

Field surveys were conducted on foot and covered all areas within the Project Area except for areas with dense stands of poison oak or steep areas with slopes greater than 45 degrees. These areas were visually searched using binoculars along the perimeters of these inaccessible portions. All habitats were mapped and checked for special-status plant species (Figure 4). Focused botanical surveys consisted of walking meandering transects, up to 50 feet apart depending on the topography or subject plant communities throughout the project sites, and documenting all plants observed (Appendix D). Plant species in bloom or otherwise recognizable were identified to a level necessary to determine their regulatory status.

Teams of two CCCI botanists conducted botanical and vegetation surveys between March 2018 and August 2019, for all federally listed special-status plant species with the potential to occur in the project sites based upon the CNDDB data search using a 10-mile buffer radius from the project boundaries (Table 1). The surveys were floristic in nature because CCCI botanists identified all species present, not only dominant or rare species, and also inventoried every plant observed to genus, species, subspecies, or variety (Baldwin et al. 2012, Erter and Naumovich 2013). Three sets of survey periods were required to capture all of the blooming and fruiting seasons of special status species with the potential to occur within the project site (Appendix C). Woody perennial species such as the pallid manzanita, a shrub with distinctive bark and leaves, can be identified year-round, outside of their winter blooming period.

Table 1. Survey Areas and Dates, Personnel

Survey Bloom Period	Area Surveyed	Date	CCCI Personnel
Late winter blooming period	Campus Hill Area, Claremont Canyon	March 4, 12-13, 2019	Ted Robertson Grayson Sandy
Mid-spring blooming period	Campus Hill Area, Claremont Canyon	May 6-8, 2019	Ted Robertson Steven Cochrane
Mid-summer blooming period	Campus Hill Area, Claremont Canyon, Lower Centennial Drive	August 13-15, 2019	Ted Robertson Steven Cochrane

3.3 Vegetation Community and Wildlife Habitat Classification

Plant identification was based upon the *Second Edition of The Jepson Manual* (Baldwin et al. 2012). Vegetation communities were identified using a combination of the characterizations in *A Manual of California Vegetation* (Sawyer et al. 2009) and the land cover types identified by *California Vegetation* (Holland 1995). Final vegetation community types were aligned with those described in the 2012 Biological Assessment for the Hazardous Fire Risk Reduction for the East Bay Hills (FEMA 2012). Land cover types were classified by disturbance, dominant species, overall species composition, and affinity for water or various substrates. The minimum mapping unit for this project was defined as an area of 200 square feet. Wetlands and other aquatic habitats were classified using the USFWS National Wetlands Inventory (NWI) Classification System for Wetland and Deepwater Habitats, or “Cowardin class” (Cowardin et al., 1979 and USFWS 2019b).

3.4 Limitations

Seasonal variations in temperature and rainfall can affect botanical surveys. These environmental factors affect annual and biennial plant species that may not grow or flower every season. If a plant species does not grow or flower in a particular year, at a particular site, the ability to detect or identify it is compromised; therefore, botanical survey results may under-represent the suite of species that actually occur there. Those areas that were inaccessible by foot because of steep terrain or thick patches of poison oak (*Toxicodendron diversilobum*) were thoroughly scanned using binoculars.

4.0 Habitats Within the Project Area

As shown on Figure 4 (Appendix A), terrestrial habitat types within the study area include:

- Coastal scrub
- Coniferous forest/non-native coniferous forest
- Coyote brush scrub
- Developed/disturbed/landscaped
- Eucalyptus forest
- Oak-bay woodland
- Riparian woodland
- Riverine features
- Successional grassland.

A general discussion of each habitat type is provided below.

Coastal Scrub

Northern coastal scrub communities are characterized by relatively open to dense woody shrub cover and an absence of trees. Saplings of oak species (*Quercus* spp.), California bay (*Umbellularia californica*), and Monterey pine (*Pinus radiata*) trees sometimes emerge from the shrub canopy cover. The Project Area is dominated by shrubs and forbs adapted to relatively xeric conditions. Coyote brush (*Baccharis pilularis*) is the dominant shrub in xeric coastal scrub communities in the Project Area. Other shrub species present include California sagebrush (*Artemisia californica*), toyon (*Heteromeles arbutifolia*), silver bush lupine (*Lupinus albifrons*), poison oak (*Toxicodendron diversilobum*), and sticky monkey-flower (*Diplacus aurantiacus*). Scattered coast live oak (*Quercus agrifolia*), California bay, and Monterey pine trees also occur in this community. Non-native invasive species commonly observed in coastal scrub include French broom (*Genista monspessulana*), poison hemlock, and fennel (*Foeniculum vulgare*). Coastal scrub communities dominated by species adapted to more mesic (i.e., moist) conditions are also present in the Project Area, although less common than xeric coastal scrub communities. The dominant plant species observed in mesic coastal scrub include California blackberry (*Rubus ursinus*), thimbleberry (*Rubus parviflorus*), blue elderberry (*Sambucus nigra* ssp. *caerulea*), and California hazelnut (*Corylus cornuta*). Non-native invasive species in this community include poison hemlock, Italian thistle, and Himalayan blackberry (*Rubus armeniacus*). Scattered coast live oak and California bay, as well as madrone (*Arbutus menziesii*) and bigleaf maple (*Acer macrophyllum*) are also occasionally present in this community.

Coniferous Forest/Non-native Coniferous Forest

The coniferous forest community in the Project Area is dominated by Monterey pine, which is native only to San Cruz, Monterey, and San Luis Obispo counties and was planted in the East Bay Hills in the early 1900s. Similar to other woodland and forest communities, the understory is typically sparse, and the ground is covered mostly by pine needles. In more open canopied Monterey pine forests, native shrubs species such as California blackberry, coyote brush, and poison oak are common. Non-native species commonly observed in Monterey pine forests include erect veldt grass (*Ehrharta erecta*) and poison hemlock. Mature groves of varying densities of Monterey pine occur throughout the Project Area, often with eucalyptus (*Eucalyptus globulus*), coast live oak, and California bay trees.

Coyote Brush Scrub

Coyote brush scrub is a successional stage from grassland to scrub and commonly occurs where grazing or fire has been discontinued or suppressed. Coyote brush scrub is distinct from coastal scrub by the density of coyote brush and low cover of other shrubs species, such as California sagebrush and poison oak. In areas of dense coyote brush, little or no understory is present; however, herbaceous grass and forb species such as wild oats, blue wild rye, and bracken fern (*Pteridium aquilinum* var. *pubescens*) are along edges or in open areas. Non-native invasive species such as Italian thistle and French broom are also commonly present in disturbed areas in this community.

Developed/Disturbed/Landscaped

Developed, disturbed, and landscaped areas consist of land developed for residential and urban use, including landscaped and maintained residential and parkland, as well as areas used for road and trail construction and maintenance. Vegetation in these areas is predominantly planted trees, shrubs, and non-native herbaceous species. A large variety of ornamental trees and shrubs were observed in this community.

The action area includes; large buildings, structures, and parking lots, such as the UCB Mathematical Sciences Research Institute Building, and public roads. Landscaped areas include maintained yards associated with private residences and planted or maintained areas associated with public or University buildings, and botanical gardens such as the UCB Botanical Garden. Disturbed vegetation includes areas created by natural or human disturbance that may support early succession stages of adjacent habitats. Disturbed areas are often susceptible to invasion by non-native species, including weeds such as French broom, fennel, poison hemlock, and Italian thistle. Disturbed areas were identified in a variety of locations, including areas near new development, along road shoulders, or on hillsides, such as the hillsides along portions of Grizzly Peak Blvd.

Eucalyptus Forest

Eucalyptus trees were introduced from Australia and were widely planted throughout the East Bay Hills in the early 1900s. Eucalyptus trees are capable of rapid growth and prolific reproduction. A rapid growth rate and the production of allelopathic oils, which inhibit establishment of other species, have helped eucalyptus forests invade large areas of the Project Area.

Eucalyptus stands in the Project Area range between young stands (i.e., less than 40 years old) of recently colonized saplings to mature stands (i.e., over 40 years old) including some stands that have never been logged. Blue-gum eucalyptus is the dominant species. The understory of these young stands usually supports a more diverse mix of native and non-native shrubs and herbaceous plants when compared to those in the mature stands. Native species in this community include California blackberry, poison oak, toyon, and coyote brush; non-native invasive species include cotoneaster (*Cotoneaster* sp.), French broom, erect veldtgrass, and the non-native oblong spurge (*Euphorbia oblongata*). Mature eucalyptus forests characterized by a closed-canopy and sparse shrub and forb understory. Scattered coast live oak and California bay trees are present in both young and mature eucalyptus stands. Additionally, redwood trees (*Sequoia sempervirens*) are occasionally present in stands of eucalyptus.

Oak-Bay Woodland

The oak-bay woodland community consists of a mix of predominantly coast live oak and California bay trees. Other native trees found in this vegetation community in the Project Area include California buckeye, bigleaf maple, and madrone. Understory species may contain poison oak, woodfern (*Dryopteris arguta*), Swordfern (*Polystichum* sp.), California blackberry, coyote brush, California hazelnut, toyon, and currants (*Ribes* spp.).

Riparian Woodland

Riparian woodland communities are located along streams and on the edges of seeps and ponds. Arroyo willow (*Salix lasiolepis*) is the dominant species in this community in the Project Area. Scattered California bay and coast live oak trees were also identified adjacent to riparian woodland communities. California blackberry, thimbleberry, sword fern, blue gum eucalyptus, and poison oak are commonly found in the understory. The most common non-native species identified in the action area's riparian woodland communities are English ivy (*Hedera helix*) and poison hemlock.

Riverine Features

Riverine features in the action area and vicinity include several unnamed intermittent drainages. There are two perennial creeks in the Project Area: Strawberry and Claremont Creeks. Strawberry and Claremont Creeks originate in the action area in Strawberry Canyon and Claremont Canyon Regional Preserve, respectively. These creeks run westward from the Project Area and become channelized and are diverted in culverts underground through the cities of Berkeley and Oakland before draining into San Francisco Bay.

Successional Grassland

The successional grassland community is characterized by grassland areas that appear to be in the process of transitioning into shrub-dominated communities. Vegetation consists primarily of non-native annual grasses and forb species found in California annual grasslands but with a higher cover of shrub species, typically coyote brush, than typically occurs in California annual grassland communities. In some areas, fire suppression and cessation of livestock grazing in the East Bay Hills have resulted in the succession of California annual grasslands into coyote brush scrub and coastal scrub communities (Stromberg et al. 2007). Vegetation management practices, including clearing eucalyptus stands, have also produced areas of successional grassland as shrubs have recolonized the area. Although coyote brush is the dominant shrub, other species such as sticky monkey-flower, poison oak, and occasional immature coast live oak, California bay, and other saplings were also observed. Successional grassland community present in the Project Area is found along the west side of Grizzly Peak Road.

5.0 Results

The following summarizes the results of CCCI's botanical surveys in the Project Area.

Floristic Survey
During the floristic surveys, 193 plant species were observed inside the Project Area (Appendix D).

Special Status Plants
Based on a literature review, available database resources, and familiarity of flora within the region, a total of 49 special status species (Appendix A, Figure 3a) are known to occur within 10 miles of the Project Area. Appendix B contains a table of the 49 special status plant species potentially occurring within a 10-mile radius of the CNDBB search area as shown in Figure 3a, in Appendix A.

Only one species of a CNPS listed plant was observed, the Western leatherwood. Twenty-six specimens of the western leather wood plants were located and mapped with a GPS unit. Twenty-five of the plants were located along the southeastern portion of the Upper Fire Road. A single western leatherwood was located along the access dirt road, opposite a site slated to be logged (Appendix A, Figure 5). All 26 of these specimens were not located under or near any eucalyptus, Monterey pine or acacia trees, the tree species targeted for removal. No federal or state listed endangered or threatened plant species were observed in any portion of the Project Area.

Critical Habitat
The Project Area is not located within any federally listed special status plant critical habitat units.

6.0 Recommendations

To prevent impacts to listed plant species, erect bright orange ESA fence along edges of the dirt road that borders known locations of Western leatherwood. Include mention of this plant in any environmental awareness material used for training future work/logging crews. If future brush clearance could occur along this portion of the fire road after all of the tree removal is complete, more permanent signage should be erected along the edge of the road bordering the leatherwood locations. Signage should include information for contacting the UCB office that will have primary jurisdiction for this section of the road shoulders. Any mulching of the felled trees should not cover native vegetation. During the past chipping operations, deep piles of mulch in the Frowning Ridge area have impacted stands of native plants such as annual hairgrass (*Deschampsia danthonioides*) and bull clover (*Trifolium fucatum*). As much as practicable, access routes to trees slated for removal should stay within or under non-native tree habitats.

7.0 References

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Appendix A

List of Figures

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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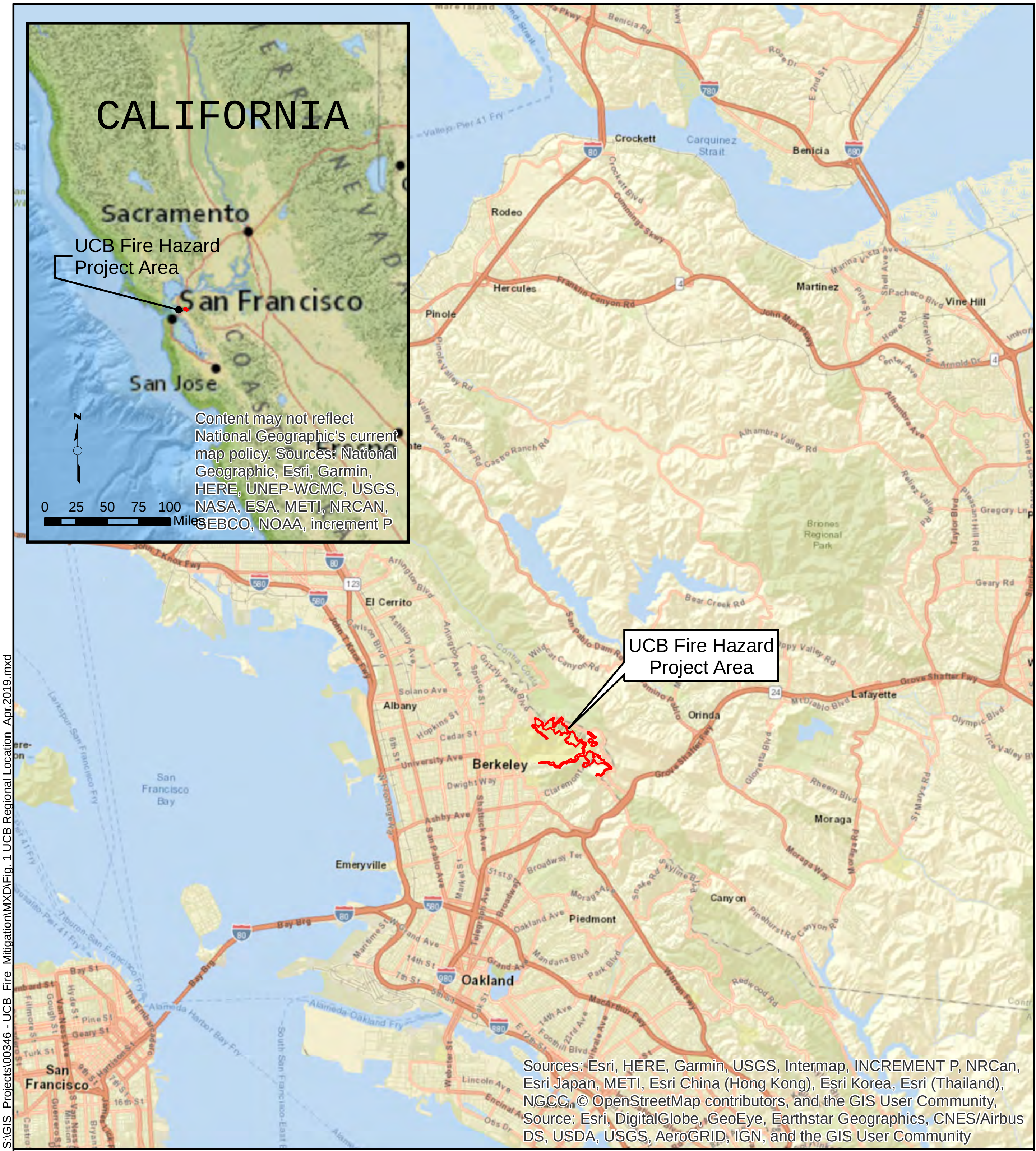

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S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 1 UCB Regional Location Apr.2019.mxd

Ted Robertson April 23, 2019

Regional Location of UC Berkeley Hill Campus Fire Hazard Reduction Project

FIGURE 1

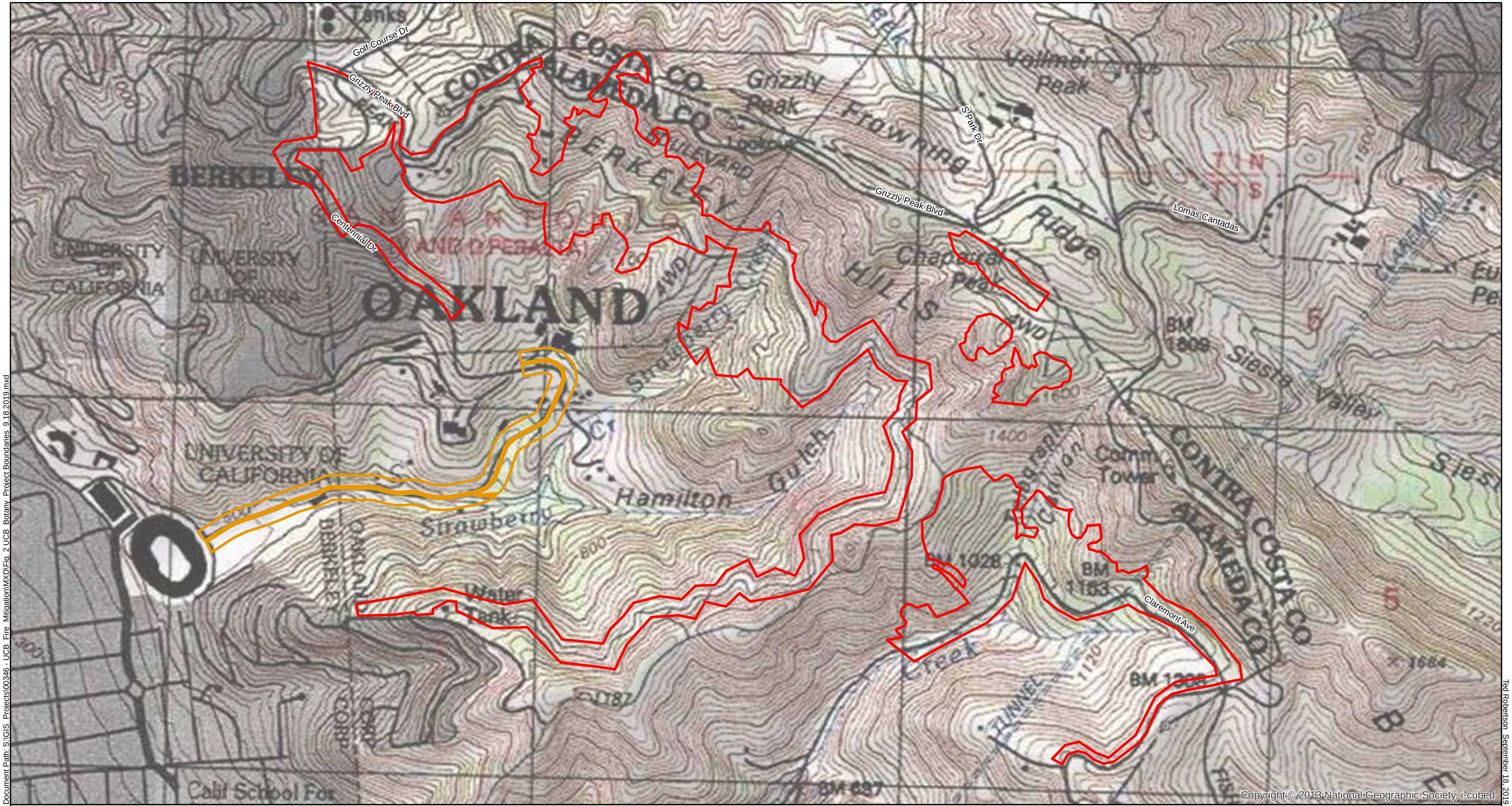
City of Berkeley, CA

N
W E
S

0 1 2 3 4 Miles

CONDOR COUNTRY CONSULTING, INC.

Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 2 UCB Botany Project Boundaries 9.18.2019.mxd



Ted Robertson, September 18, 2019

🟥 Project Area

🟧 Lower Centennial Drive Project Area

Project Boundaries

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa Counties, California

N
W E
S

0 0.1 0.2 0.3 0.4 Miles

FIGURE 2

CONDOR COUNTRY CONSULTING, INC.

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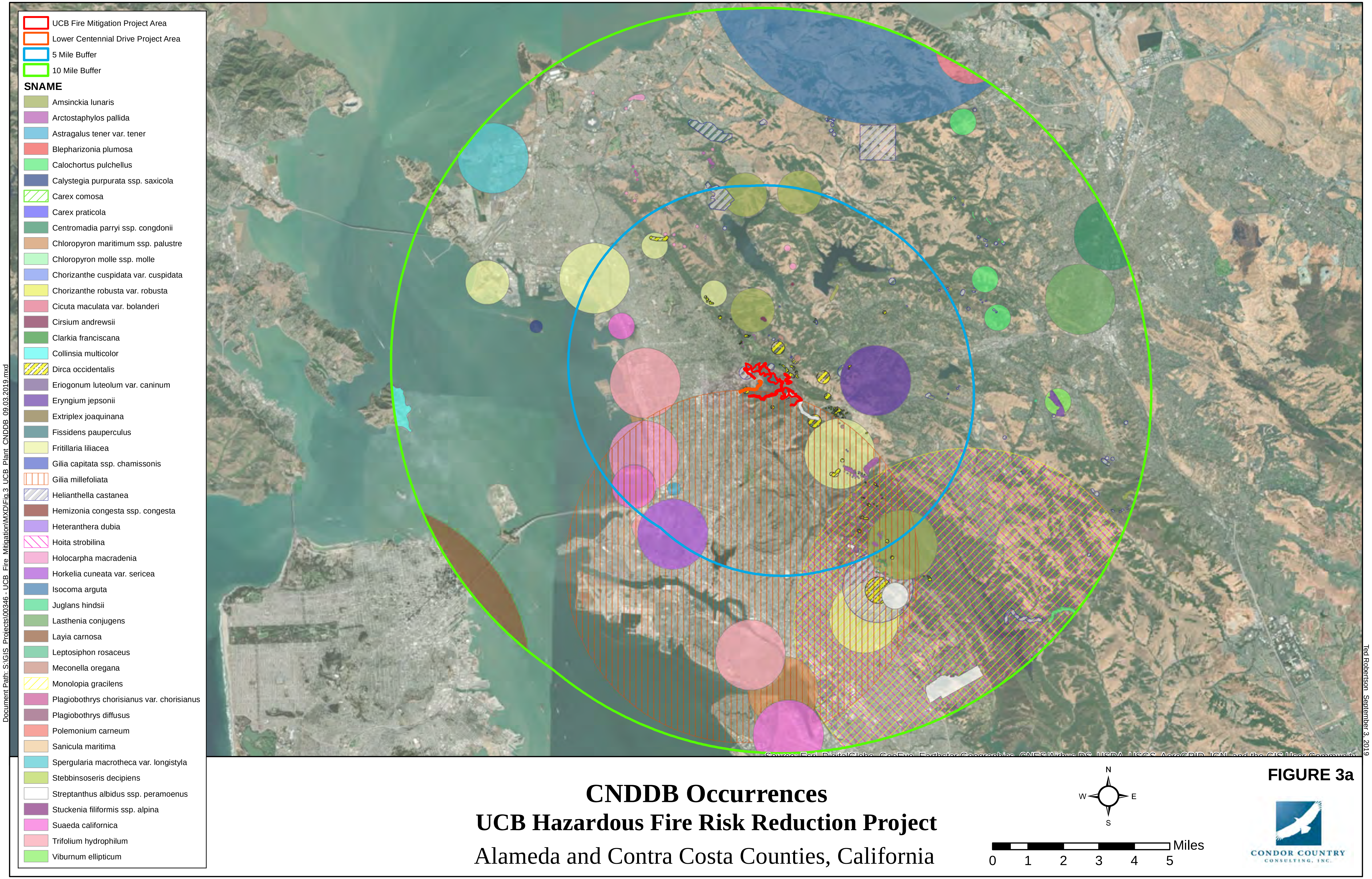

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Ted Robertson September 3, 2019

FIGURE 3a

CNDDB Occurrences
UCB Hazardous Fire Risk Reduction Project
Alameda and Contra Costa Counties, California

N
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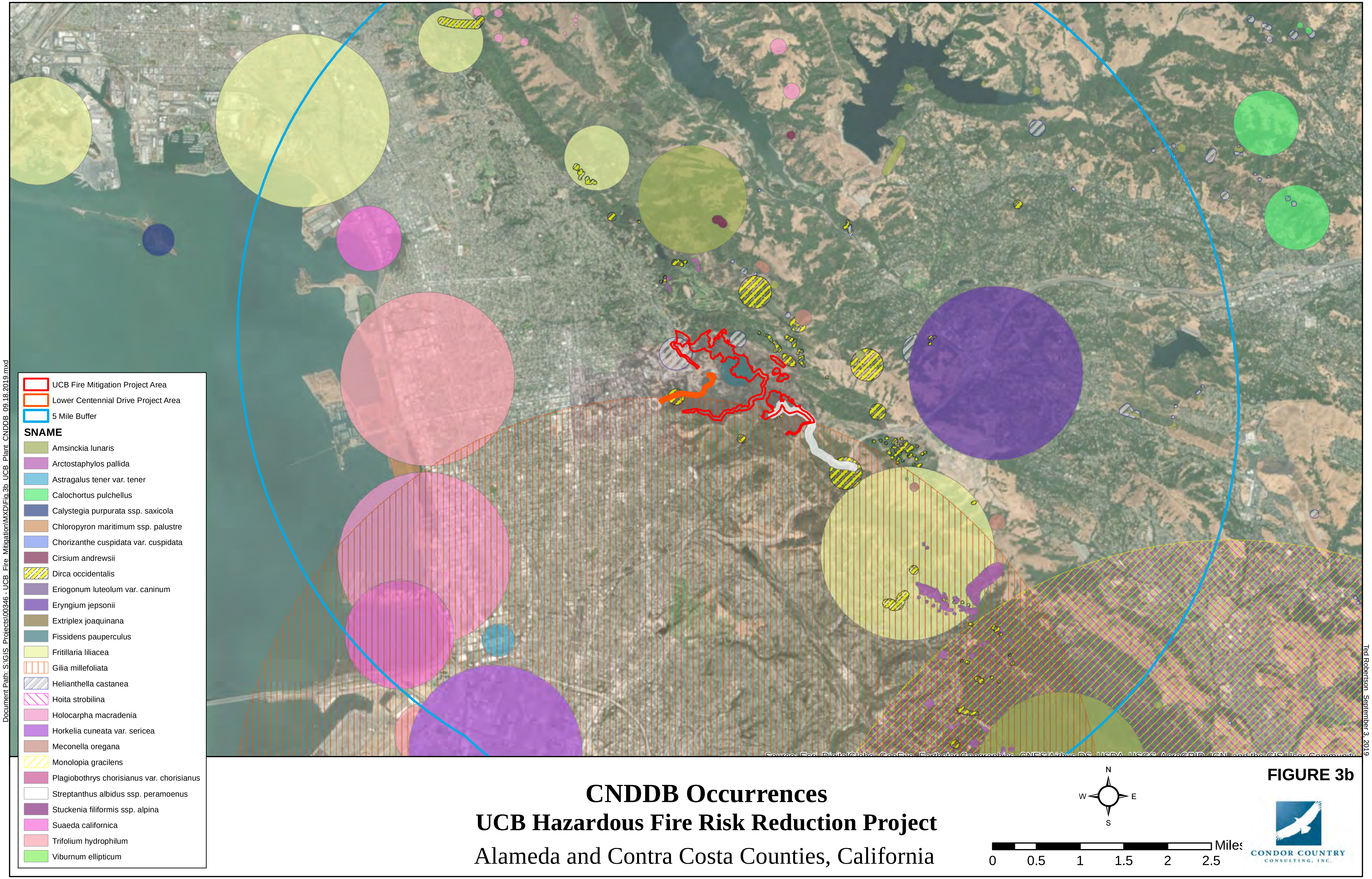
0 1 2 3 4 5 Miles

CONDOR COUNTRY
CONSULTING, INC.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

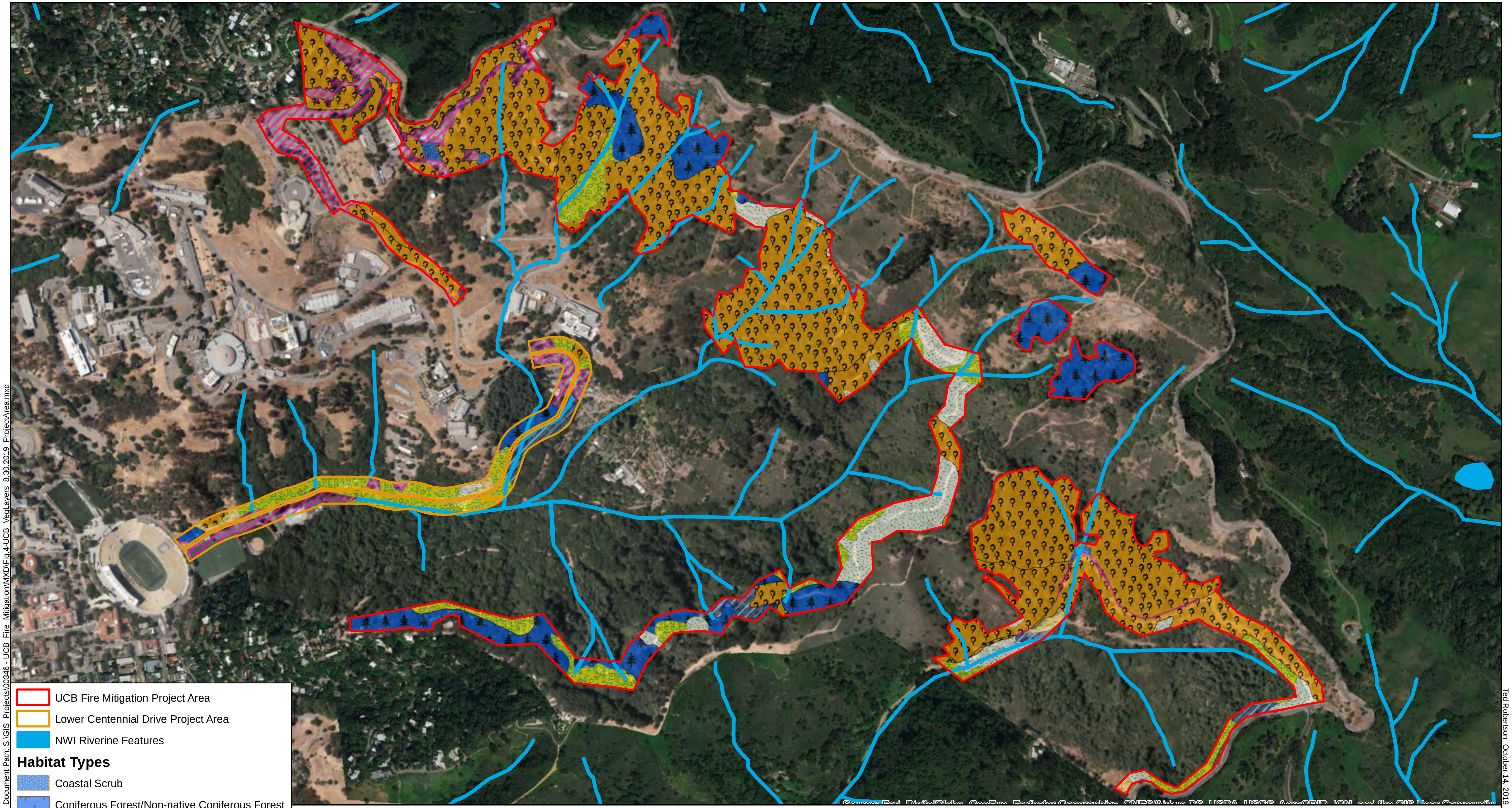
Document Path: S:\GIS_Projects\00346 - UCB_Fire_Mitigation\MXD\Fig.3b_UCB_Plant_CNDDB_09.18.2019.mxd

Ted Robertson September 3, 2019

FIGURE 3b

CNDDB Occurrences
UCB Hazardous Fire Risk Reduction Project
Alameda and Contra Costa Counties, California

CONDOR COUNTRY CONSULTING, INC.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

HABITATS

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa County, California

FIGURE 4

CONDOR COUNTRY CONSULTING, INC.

Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig.4-UCB VegLayers 8.30.2019 ProjectArea.mxd

Ted Robertson October 14, 2019

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig.5 UCB Fire Hazard Dirca Locations March 2019.mxd

Ted Robertson October 14, 2019

🟥 UCB Biological Sudy Area - 2019
🟧 Lower Centennial Drive Project Area
🟦 NWI Riverine Features

Rare Plants

● *Dirca occidentalis - Western leatherwood*

RARE PLANTS
UC Berkeley Hill Campus Fire Hazard Reduction Project
Alameda and Contra Costa County, California

Figure 5

N
W E
S

0 200 400 600 800 1,000 Feet

CONDOR COUNTRY CONSULTING, INC.

Appendix B

Appendix B: Special Status Plant Species Potentially Occurring within a 10-Mile Radius CNDDB Search Area

UC Berkeley Hill Campus Fire Hazard Reduction
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Appendix B: Special Status Plant Species within the CNDDB Search Area Potentially Occurring within 10 miles of the Project Boundaries.

Highlighted rows indicate required habitat not present withing the Project Area.

Scientific Name	Common Name	Fed/State/CNPS	General Habitat Description	Habitat Present?	Local Distribution Search Results
Amsinckia lunaris	bent-flowered fiddleneck	CNPS 1B.2	Damp rock and soil on outcrops and cliffs within broadleaved upland forest, lower montane coniferous forest and north coast coniferous forest; often on acidic substrates; from 100-1000 m (325-3280 ft) elevation; blooms March - June. Herbarium collections March - May.	Yes	26 occurrences exist within 10 miles of the project. Closest occurrence (Occ.# 8) is 0.2 mi east of the Claremont Canyon project area. It was sited in 2006 and is potentially extant.
Arctostaphylos pallida	pallid manzanita	FT/SE/ CNPS 1B.1	Occurs on siliceous shale, sandy or gravel within chaparral, cismontane woodland, coastal scrub, and broadleafed upland or closed-cone coniferous forest within the Diablo Range from 185 - 465 m (605-1525 ft) elevation; blooms December - March. Herbarium collections January - December.	Yes	9 occurrences within 10 miles of the project. Closest occurrence (Occ.# 2) is 0.46 mi north in Tilden Regional Park.
Astragalus tener var. *tener*	alkali milk-vetch	CNPS 1B.2	Occurs on alkaline substrates in playas, valley and foothill grassland on adobe clay, and vernal pools between 1-60 m (3-195 ft) elevation; blooms March - June. Herbarium collections March - mid-June.	Possible	4 occurrences within 10 miles of the project. Nearest occurrence (Occ.# 67, yr: 1900) is 4 mi northwest, and possibly extirpated.
Blepharizonia plumosa	big tarplant	CNPS 1B.1	Occurs on clay substrates in valley and foothill grassland between 30-505 m (100-1650 ft) elevation; blooms July - October. Herbarium collections mid-July - October.	Yes	Only 1 occurrence within 10 miles of the project. Occurs 7.5 miles east (Occ.#10, yr: 1937), presumed extant.
Calochortus pulchellus	Mt. Diablo fairy-lantern	CNPS 1B.2	Found on north-facing wooded slopes, rarely within chaparral, riparian woodland, and valley and foothill grassland; between 30-840 m (100-2755 ft) elevation; blooms April - June. Herbarium collections April - June.	Yes	7 occurrences within 10 miles of the project. Closest is 5.6 miles to the east (Occ.#22, yr: 1970), Presumed extant.
Calystegia purpurata ssp. saxicola	coastal bluff morning-glory	CNPS 1B.2	Coastal dunes and coastal scrub from 15-105 m (50-345 ft) elevation; blooms May - September. Herbarium collections May - mid-August.	No	Only 1 occurrence within 10 miles of the project on Brooks Island, 5.8 miles west (Occ.#31, yr: 1893).
Carex comosa	bristly sedge	CNPS 2B.1	Coastal prairies, marshes and swamps (lake margins), valley and foothill grassland from 0-425 m (0-1400 ft) elevation; blooms July - September, perennial herb. Herbarium collections May - Sept.	Yes	Only 1 occurrence within 10 miles of the project in a San Francisco swamp, 8.7 miles southwest (Occ.#10, yr: 1866). Possibly extirpated.
Carex praticola	northern meadow sedge	CNPS 2B.2	Occurs in meadows and seeps (mesic); between 0-3200 m (0-10,500 ft) elevation; blooms May-July; perennial herb. Herbarium collections May - Aug.	Possible	Only 1 occurrence within 10 miles of the project on Angel Island, 9.6 miles west (Occ.#16, yr: 1967).
Centromadia parryi ssp. *congdonii*	Congdon's tarplant	CNPS 1B.1	Occurs in alkaline valley and foothill grassland between 1-230 m (3-750 ft) of elevation; blooms May - October. Herbarium collections June - mid-Nov.	Possible	Only 1 occurrence within 10 miles of the project, 8.8 miles northeast (Occ.#2, yr: 1933).
Chloropyron maritimum ssp. *palustre*	Point Reyes salty bird's-beak	CNPS 1B.2	Coastal salt marshes and swamps from 0-10 m (0-30 ft) elevation; blooms from May - October. Herbarium collections mid-May - Oct. 15.	No	3 occurrences within 10 miles of the project. Nearest occurrence (Occ.# 21, yr: 1990) is 3 mi west along Berkeley shoreline.
Chloropyron molle ssp. *molle*	soft salty bird's-beak	FE/SR/CNPS 1B.2	Coastal saline or brackish marsh and swamp from 0-3 m (0-10 ft) elevation; blooms July - November. Herbarium collections mid-June - mid-Oct.	No	Only 1 occurrence within 10 miles of the project, 9.9 miles northwest (Occ.#1, yr: 2009). Presumed extant.
Chorizanthe cuspidata var. cuspidata	San Francisco Bay spineflower	CNPS 1B.2	Occurs on coastal bluff scrub, coastal dunes, coastal prairie, on sandy soils; between 3-215 m (10-705 ft) elevation; blooms April-July. Herbarium collections Apr. - July.	Not likely	Only 1 occurrence within 10 miles of the project, from an Oakland location west of Lake Merritt, 3.6 miles southwest (Occ.#16, yr: 1881). Presumed extirpated.
Chorizanthe robusta var. *robusta*	robust spineflower	FE/CNPS 1B.1	Occurs on sandy or gravelly substrates within maritime chaparral, openings in cismontane woodland, coastal dunes and coastal scrub from 3-300 m (10-985 ft) elevation; blooms May - September. Herbarium collections May - mid-Sept.	Not likely	One occurrence, possible extirpated, dated 1894 in the city of Alameda (Occ.# 1), 6.2 miles south of the project site.

Scientific Name	**Common Name**	**Fed/State/CNPS**	**General Habitat Description**	**Habitat Present?**	**Local Distribution Search Results**
Cicuta maculata var. *bolanderi*	Bolander's water-hemlock	CNPS 2B.1	Occurs in coastal, brackish or fresh marshes and swamps between 0-200 m (0-655 ft) elevation; blooms July - September. Herbarium collections June - Sept.	No	Three occurrences within 10 miles of the project, all northeast of the project area. Closest (Occ.#4, yr: 1900) is 9.6 miles to the northeast near Martinez, presumed extant.
Cirsium andrewsii	Franciscan thistle	CNPS 1B.2	Occurs in mesic, and sometimes serpentine, substrate within broadleafed upland forest, coastal bluff scrub, coastal prairie and coastal scrub from 0-150 m (0-490 ft) elevation; blooms May - Sept. Herbarium collections mid-May - July.	Yes	2 occurrences within 10 miles of the project. Nearest occurrence (Occ.# 14, yr: 2006) is 1.2 mi north in Tilden Regional Park.
Clarkia franciscana	Presidio clarkia	FE/SE/ CNPS 1B.1	Occurs within coastal scrub and valley and foothill grassland on serpentine soils between 25 - 335 m (80-1100 ft) elevation; blooms May - June. Herbarium collections May - June.	Not likely. No serpentine soils present.	One occurrence (Occ.#4, yr: 2010), 4.8 miles southeast of the project area in Oakland Hills, presumed extant.
Collinsia multicolor	San Francisco collinsia	CNPS 1B.2	Closed-cone coniferous forest, coastal scrub, occasionally on serpentine soils, between 30-250 m (100-820 ft) elevation; blooms March - May. Annual herb. Herbarium collections Mar. - May.	Yes	Only 1 occurrence within 10 miles of the project on Angel Island, 9.5 miles west (Occ.#26, yr: 1993).
Dirca occidentalis	western leatherwood	CNPS 1B.2	Occurs in broadleafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, North Coast coniferous forest, riparian forest, and riparian woodland, often on brushy slopes and mesic sites between 50-400 m (165-1310 ft) elevation; blooms Nov. - March. Herbarium collections Jan. - Apr.	Yes. Species present.	26 occurrences within 10 miles of the project. This shrub is known to exist within the project area (Occ.#22, yr: 2017) New occurrence locations were found during the early spring surveys.
Eriogonum luteolum var. *caninum*	Tiburon buckwheat	CNPS 1B.2	Occurs on sandy to gravelly serpentine soils in chaparral, valley and foothill woodland, cismontane woodland and coastal prairie, at elevations from 0-700 m (0-2300 ft) elevation; blooms May - Oct. Herbarium collections mid-May - mid-Oct.	Not likely. No serpentine soils present.	3 occurrences within 10 miles of the project. Nearest occurrence (Occ.# 20, yr: 2009) is 4 mi south in Oakland hills.
Eryngium jepsonii	Jepson's coyote-thistle	CNPS 1B.2	Occurs in wetlands below 500 m (1,640 ft) elevation on moist clay soil; blooms April - August. Herbarium April - July. Perennial herb.	Not likely.	3 occurrences within 10 miles of the project. Nearest occurrence (Occ.# 20, yr: 2009) is 4 mi south in Oakland hills.
Extriplex (Atriplex) joaquinana	San Joaquin spearscale	CNPS 1B.2	Occurs in chenopod scrub, meadows and seeps, playas, and valley and foothill grassland on alkaline substrates between 1-835 m (3-2750 ft) elevation; blooms April - Sept. Herbarium collections Apr. - Sept.	Not likely. Alkaline soils not present.	Only 1 old occurrence within 10 miles of the project, 2 miles east (Occ.#7, yr: 1895). Presumed extant.
Fissidens pauperculus	minute pocket moss	CNPS 1B.2	Occurs in coniferous forest on damp coastal soil between 10-100 m (33 - 330 ft) elevation. Moss.	Yes	One known occurrence along Strawberry Canyon, about 1/2 mile above the UCB Botanical Garden, at 985 ft elevation (Occ.#15, yr: 1994).
Fritillaria liliacea	fragrant fritillary	CNPS 1B.2	Occurs often on serpentine soils in cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland between 3-410 m (10-1345 ft) elevation; blooms February - April. Herbarium collections Feb. - Apr.	Not likely. No serpentine soils present.	Four occurrences in surrounding quads, two in Mt. Diablo State Park and two in the Oakland Area. Closest (Occ.#74) is ~6.5 miles to the south, presumed extant.
Gilia capitata ssp. chamissonis	blue coast gilia	CNPS 1B.1	Coastal dunes and coastal scrub from 2-200 m (7-656 ft) elevation; blooms April - July. Annual herb. Herbarium collections mid-Apr. - July.	No. No habitat or low elevation present.	One occurrence (Occ.#3, yr: 1996) 8 miles southwest of the project area on Treasure Island.
Gilia millefoliata	dark-eyed gilia	CNPS 1B.2	Coastal dunes from 2-20 m (7-66 ft) elevation; blooms Mar.-July. Annual herb. Herbarium collections Apr. - July.	No. No habitat or low elevation present.	Only 1 old occurrence within 10 miles of the project (Occ.#43, year: 1863), 4 to 8 miles southwest of the project area from the coastal area of Oakland. Extirpated
Helianthella castanea	Diablo helianthella	CNPS 1B.2	Occurs in broadleaved upland forest, chaparral cismontane woodland, coastal scrub, riparian woodland, and valley and foothill grassland between 60-1300 m (195-4265 ft) elevation; blooms Apr. - June. Herbarium collections mid-Mar. - mid-June.	Yes	More than 43 occurrences occur spread out throughout the 10 mile project buffer. The two closest occurrences are just west of project area (Occ.#84, yr: 2001) on hill west of the Lawrence Hall of Science parking lot (observed by author between 1990 and 2009), and an occurrence (Occ.#6, yr: 2003) just east of the project area near Grizzly Peak Blvd. Presumed extant.

Scientific Name	**Common Name**	**Fed/State/CNPS**	**General Habitat Description**	**Habitat Present?**	**Local Distribution Search Results**
Hemizonia congesta ssp. congesta	congested-headed hayfield tarplant	CNPS 1B.2	Grasslands and along edges of marshes, between 0- 100 m (0 - 330 ft) elevation; blooms May -November. Annual herb. Herbarium: May - early Nov.	No. Low elevation not present.	Only 1 old occurrence within 10 miles of the project (Occ.#2), from an old botanical collection from San Francisco sometime in the 1890s. Greater than 10 miles southwest of the project area. Presumed extirpated.
Heteranthera dubia	water star-grass	CNPS 2B.2	Occurs in wetlands and generally submersed, between 0 - 1500 m (0-4,920 ft) elevation; blooms July - August. Perennial herb. Herbarium collections between May - Nov.	No. Habitat not present.	Only 1 old occurrence within 10 miles of the project (Occ.#1, yr: 1879), from an old botanical collection from San Francisco, over 10 miles southwest of the project area. Presumed extirpated.
Hoita strobilina	Loma Prieta hoita	CNPS 1B.1	Usually found on serpentinite substrates within mesic chaparral, cismontane woodland and riparian woodland between 30 - 860 m (100-2820 ft) elevation; blooms June - Aug. Herbarium collections mid-May - mid-Aug.	Not likely. No serpentine soils present.	Two occurrences within 10 miles of the project. Nearest (Occ.#15, yr: 2004) in the Richmond Hills. ~6 miles northwest, presumed extant.
Holocarpha macradenia	Santa Cruz tarplant	FT/SE/ CNPS 1B.1	Occurs in coastal prairie, coastal scrub and valley and foothill grasslands, in areas with light sandy soil, or sandy clay, often with non-natives, between 10 - 220 m (30-720 ft) elevation; blooms June - Nov. Herbarium collections June - Nov.	No. Low elevation not present.	14 occurrences within 10 miles of the project, many in the Richmond hills. All possibly extirpated. All extant Contra Costa County occurrences are introduced; nearly half have failed. Last remaining natural population in the S.F. Bay Area extirpated by development in 1993.
Horkelia cuneata var. *sericea*	Kellogg's horkelia	CNPS 1B.1	Found on sandy or gravelly openings in closed-cone coniferous forest, chaparral, coastal dunes and coastal scrub between 10 - 200 m (30-650 ft) elevation; blooms April - September. Herbarium collections Apr. - Aug.	Not likely. Low elevation not present.	One occurrence (Occ.#35, yr: 1863) in Oakland, ~5 miles southwest of the project. Nearest occurrences (Alameda County) are presumed extirpated.
Isocoma arguta	Carquinez goldenbush	CNPS 1B.1	Generally found in wetlands within valley and foothill grassland between 1 - 20 m (3-65 ft) elevation; blooms August - December; often within alkali flats or other mineral-rich soils of the Suisun Slough. Herbarium collections mid-Aug - mid-Nov.	No. Habitat and low elevation not present.	One occurrence (Occ.#14) near Carquinez Strait. ~10 miles northeast of the project, presumed extant. Mentioned in an old flora (Munz) from 1968.
Juglans hindsii	Northern California black walnut	CNPS 1B.1	Occurs in riparian forest and woodlands in areas with deep alluvial soils associated with creeks or streams. Found between 0-440 m (0-1445 ft) elevation; blooms April - May. Herbarium collections Apr - Nov.	Yes	One occurrence (Occ.#2, yr: 2011) located near Moraga ~7 miles east of the project area.
Lasthenia conjugens	Contra Costa goldfields	FE/ CNPS 1B.1	Occurs in vernal pools, alkaline playas, mesic valley and foothill grassland, between 0-470 m (0-1540 ft) elevation; blooms March - June. Herbarium collections mid-Mar - May.	Not likely. Preferred habitat not present.	Two occurrences within 10 miles of project area. Only extant species is near Hercules (Occ.#23, yr: 2017) ~9 miles north of the project.
Layia carnosa	beach layia	FE/SE/ CNPS 1B.1	Occurs in coastal dunes and coastal scrub with sandy soils, between 0-60 m (0-200 ft) elevation; blooms March-July. Herbarium collections between mid-March - July.	No. No habitat or low elevation present.	Only 1 old occurrence within 10 miles of the project (Occ.#6, yr: 1904), from an old botanical collection from San Francisco sand dunes, over 10 miles southwest of the project area. Presumed extirpated.
Leptosiphon rosaceus	rose leptosiphon	1B.1	Occurs on open, grassy slopes along coastal bluffs, between 0 - 70 m (0-230 ft) elevation; blooms April - June. Annual herb. Herbarium collections May - June.	No. No habitat or low elevation present.	Only 1 old occurrence within 10 miles of the project (Occ.#6, yr: 1885), from an old field collection from San Francisco, over 10 miles southwest of the project area. Presumed extirpated.
Meconella oregana	Oregon meconella	CNPS 1B.1	Found in coastal prairie and scrub between 250 - 620 m (820-2035 ft) elevation; blooms March - May; known in CA only from five occurrences. Herbarium collections Mar - Apr.	Possible	Four occurrences, all in the Oakland/Berkeley hills, all presumed extant. Closest occurrence (Occ.#5, yr: 1994) is ~5 miles to the east.
Monolopia gracilens	woodland woollythreads	CNPS 1B.2	Serpentine grassy openings of mixed evergreen forest, redwood forest, broadleaf upland forest, oak woodland and chaparral between 100 – 1200 m (325-3935 ft) elevation; blooms March - July. Herbarium collections mid-Mar. - mid-July.	Not likely. Serpentine soils not present.	Only 1 occurrence within 10 miles of the project. The closest (Occ.#45, yr: 1888) is ~6-8 miles southeast and presumed extant.

Scientific Name	Common Name	Fed/State/CNPS	General Habitat Description	Habitat Present?	Local Distribution Search Results
Plagiobothrys chorisianus var. chorisianus	Choris' popcornflower	CNPS 1B.2	Chaparral, coastal prairie, coastal scrub, in mesic conditions between 15-100 m (50-330 ft) elevation; blooms March-June. Herbarium collections Apr. - June.	Not likely. Low elevation not present.	Only 1 old occurrence within 10 miles of the project (Occ.#11, yr: 1890), ~5 miles southwest of the project area. Presumed extirpated.
Plagiobothrys diffusus	San Francisco popcornflower	SE/ CNPS 1B.1	Found in seeps and moist places within coastal prairie and valley and foothill grassland between 60 - 360 m (195-1180 ft) elevation; blooms Apr. - June. Herbarium collections Apr. - June.	Possible.	One occurrence (Occ.#13, yr: 1997) ~5.5 miles east in the Oakland hills, presumed extant.
Polemonium carneum	Oregon polemonium	CNPS 2B.2	Occurs in coastal scrub, coastal prairie and yellow pine forest, in open habitat, between 0 - 1,800 m (0-5,910 ft) elevation; blooms April - June. Perennial herb. Herbarium collections April-June, mostly in May.	Possible.	Only 1 occurrence within 10 miles of the project on Angel Island, ~10 miles west (Occ.#3). Location mentioned in Howell's Marin Flora from 1949.
Sanicula maritima	adobe sanicle	SR/ CNPS 1B.1	Found on clay and serpentinite soils within chaparral, coastal prairie, meadows and seeps, and valley and foothill grassland between 30 - 240 m (100-785 ft) elevation; blooms February - May; apparently extirpated from the San Francisco Bay Area. Herbarium collections mid-Mar. - mid-May.	Not likely. Site just above known elevation range.	One occurrence (Occ. #6, yr: 1936) in Alameda ~7 miles south of the project, extirpated.
Spergularia macrotheca var. longistyla	long-styled sand-spurrey	CNPS 1B.2	Occurs in alkaline marshes, mud flats, meadows, and hot springs between 0 - 200 m (0-670 ft) elevation; blooms February - May. Perennial herb. Herbarium collections March - mid-June.	No. Habitat not present.	Three occurrences within 10 miles of the project. Closest occurrence (Occ.#15, yr: 1989) is ~9 miles to the northwest in a Richmond salt marsh. Presumed extant.
Stebbinsoseris decipiens	Santa Cruz microseris	CNPS 1B.2	Occurs in broadleaved upland forest, closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub, valley and foothill grasslands, between 10 - 500 m (33-1,640 ft) elevation; blooms April - May. Annual herb. Herbarium collections Apr. - May.	Yes.	Only 1 occurrence within 10 miles of the project on Angel Island, ~10 miles west (Occ.#18, yr: 1968). From a botanical field collection. Presumed extant.
Streptanthus albidus ssp. *peramoenus*	most beautiful jewelflower	CNPS 1B.2	Ultramafic substrate within chaparral, cismontane woodland, valley and foothill grassland between 95 - 1000 m (310-3280 ft) elevation; blooms Apr. - Sept. No herbarium collection info.	Yes.	Five occurrences exist in the Oakland Hills. The closest (Occ.#65, yr: 1893), is from an old botanical collection made along Claremont Canyon Road and Grizzly Peak Blvd.
Stuckenia filiformis ssp. *alpina*	slender-leaved pondweed	CNPS 2B.2	Occurs in assorted shallow freshwater systems such as marsh, swamp and slow drainages between 300 – 2150 m (980-7050 ft) elevation; blooms May - July. Herbarium collections July only.	No. Habitat not present.	Only one nearby occurrence, 1.8 mi southeast in a quarry pond east of Round Top (Occ. #7, yr: 1992).
Suaeda californica	California sea blite	FE/CNPS 1B.1	A perennial evergreen shrub found within coastal salt marsh and swamp habitat, between 0 - 15 m (0-50 ft) elevation; blooms July - October. Herbarium collections Jan. - Dec.	No	Three occurrences introduced in an Emeryville marsh. Nearest (Occ.#23, yr: 2008) ~4 miles southwest.
Trifolium hydrophilum	saline clover	CNPS 1B.2	Salt marsh and swamp, vernal pool or other wetlands within valley and foothill grassland on alkaline soils between 0 - 300 m (0-985 ft) elevation; blooms April - June. Herbarium collections mid-Mar. - mid-June.	No	Four occurrences within 10 miles of the project. Nearest extent occurrence (Occ.#31, 1900) ~ 7-8 miles northwest in in Point Richmond.
Viburnum ellipticum	oval-leaved viburnum	CNPS 2B.3	Generally on north-facing slopes within chaparral, cismontane woodland and lower montane coniferous forest between 215 - 1400 m (705-4595 ft) elevation; blooms June - Aug. Herbarium collections May - Aug.	Yes.	Three occurrences within 10 miles of the project. Closest (Occ.#28, yr: 2002) ~7.8 miles east of the project, presumed extant.

FE = Federally Endangered
FT = Federally Threatened
SE = State Endangered
ST = State Threatened

CNPS = California Native Plant Society
1 = Rare in California and elsewhere
2 = Rare in California, but not elsewhe
A = Presumed extirpated or extinct
B = Rare, threatened, or endangered

0.1 = Seriously threatened in California
0.2 = Moderately threatened in California
0.3 = Not very threatened in California

Appendix C

Bloom Periods and Herbarium Collecting Dates

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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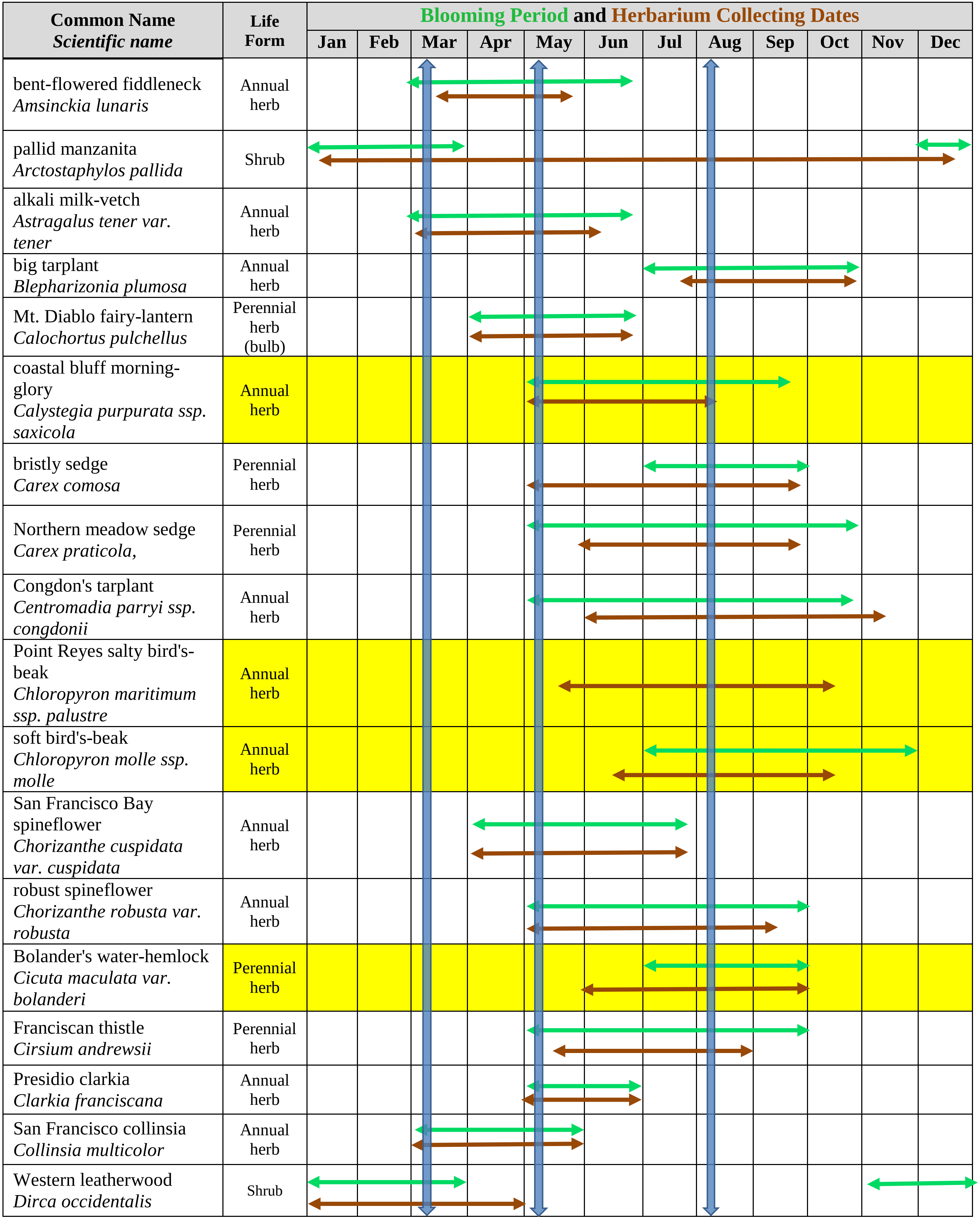
Appendix C

UCB Hill Campus Fire Hazard Reduction Project - Bloom Periods and Herbarium Collecting Dates

Yellow = No habitat present; Blue = Survey Dates; Green = Blooming Period; Brown = Herbarium collecting dates

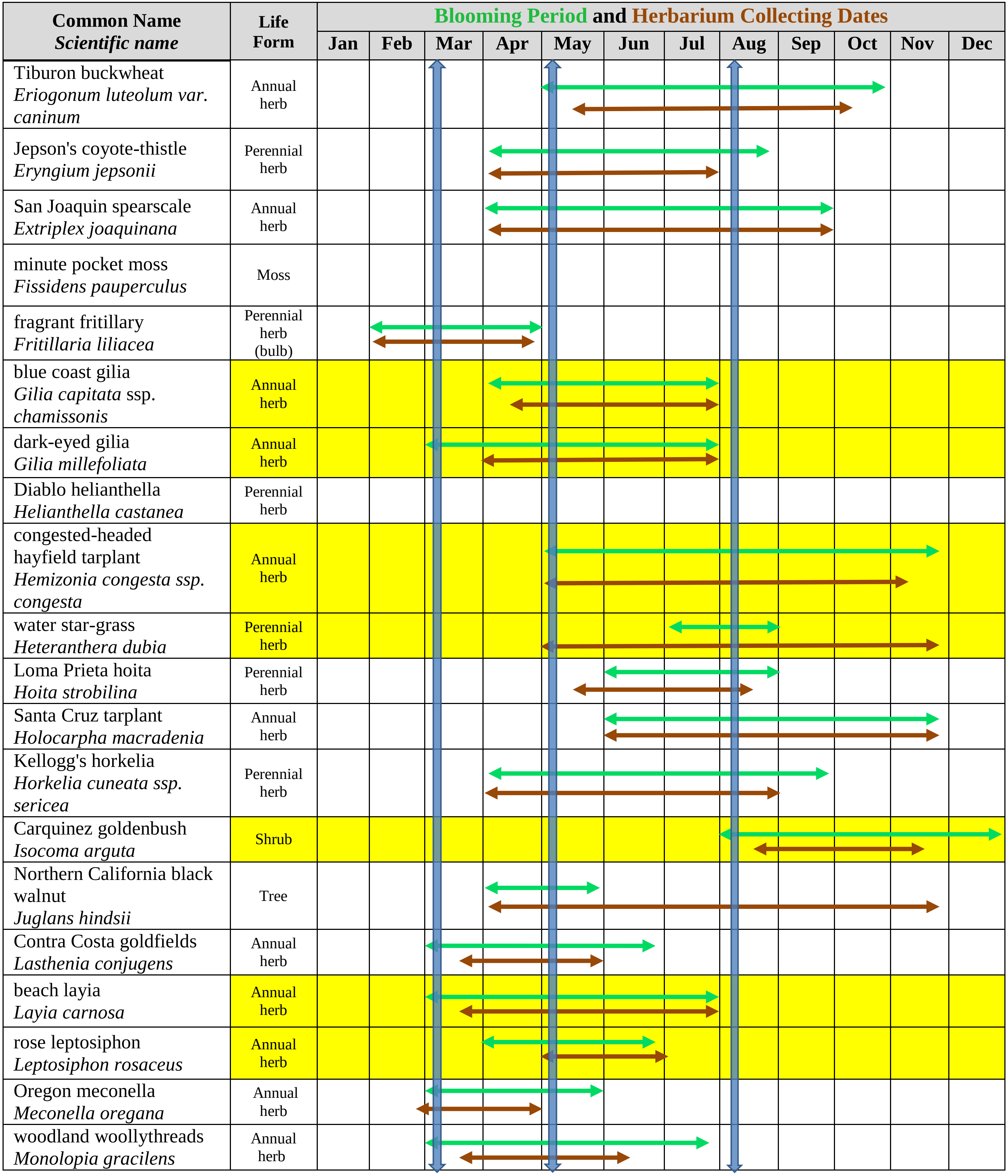


Common Name *Scientific name*	Life Form
bent-flowered fiddleneck *Amsinckia lunaris*	Annual herb
pallid manzanita *Arctostaphylos pallida*	Shrub
alkali milk-vetch *Astragalus tener var. tener*	Annual herb
big tarplant *Blepharizonia plumosa*	Annual herb
Mt. Diablo fairy-lantern *Calochortus pulchellus*	Perennial herb (bulb)
coastal bluff morning-glory *Calystegia purpurata ssp. saxicola*	Annual herb
bristly sedge *Carex comosa*	Perennial herb
Northern meadow sedge *Carex praticola,*	Perennial herb
Congdon's tarplant *Centromadia parryi ssp. congdonii*	Annual herb
Point Reyes salty bird's-beak *Chloropyron maritimum ssp. palustre*	Annual herb
soft bird's-beak *Chloropyron molle ssp. molle*	Annual herb
San Francisco Bay spineflower *Chorizanthe cuspidata var. cuspidata*	Annual herb
robust spineflower *Chorizanthe robusta var. robusta*	Annual herb
Bolander's water-hemlock *Cicuta maculata var. bolanderi*	Perennial herb
Franciscan thistle *Cirsium andrewsii*	Perennial herb
Presidio clarkia *Clarkia franciscana*	Annual herb
San Francisco collinsia *Collinsia multicolor*	Annual herb
Western leatherwood *Dirca occidentalis*	Shrub

Appendix C

UCB Hill Campus Fire Hazard Reduction Project - Bloom Periods and Herbarium Collecting Dates

Yellow = No habitat present; Blue = Survey Dates; Green = Blooming Period; Brown = Herbarium collecting dates

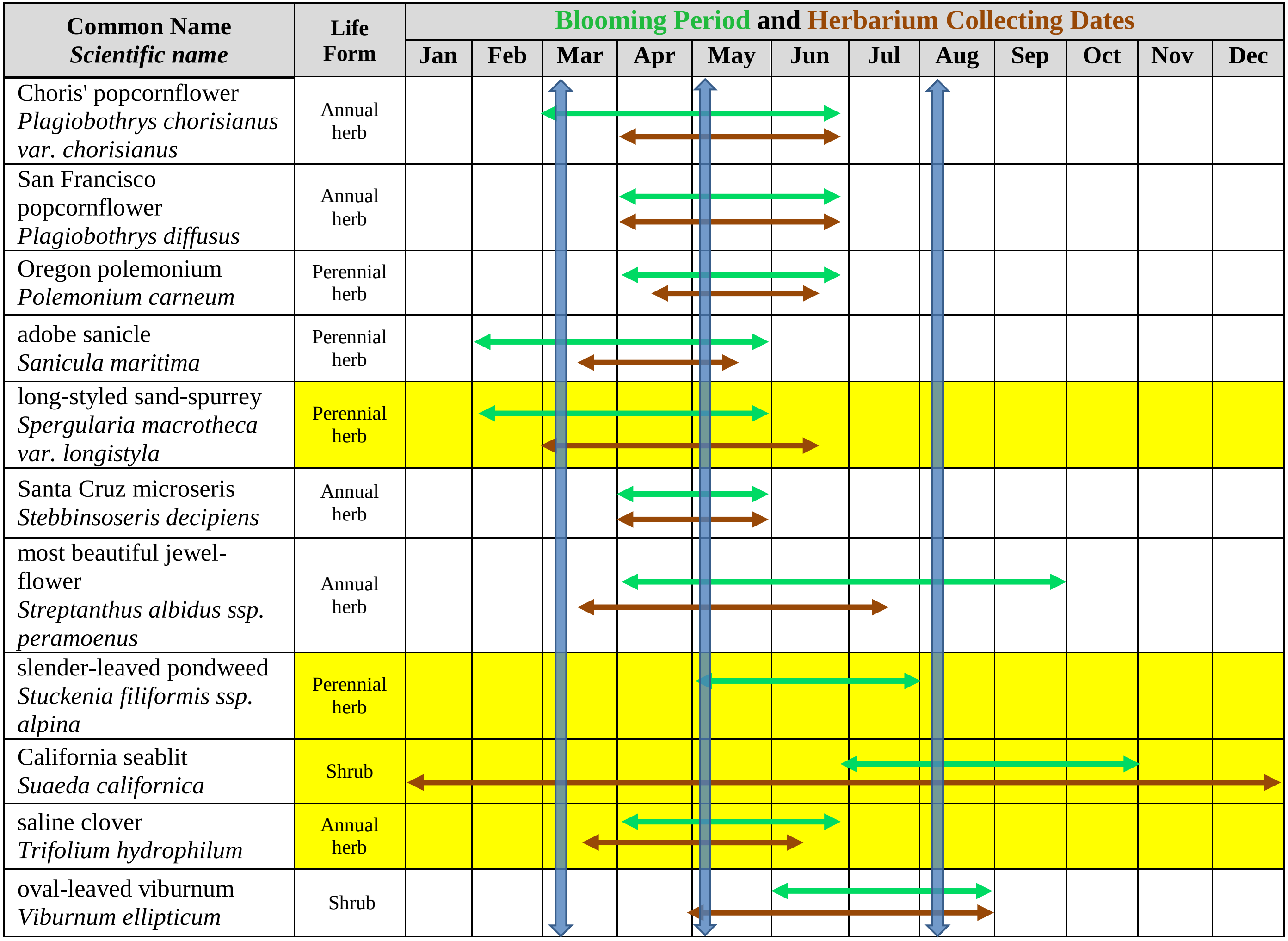


Common Name ***Scientific name***	**Life Form**	**Blooming Period and Herbarium Collecting Dates**											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Tiburon buckwheat *Eriogonum luteolum var. caninum*	Annual herb												
Jepson's coyote-thistle *Eryngium jepsonii*	Perennial herb												
San Joaquin spearscale *Extriplex joaquinana*	Annual herb												
minute pocket moss *Fissidens pauperculus*	Moss												
fragrant fritillary *Fritillaria liliacea*	Perennial herb (bulb)												
blue coast gilia *Gilia capitata* ssp. *chamissonis*	Annual herb												
dark-eyed gilia *Gilia millefoliata*	Annual herb												
Diablo helianthella *Helianthella castanea*	Perennial herb												
congested-headed hayfield tarplant *Hemizonia congesta ssp. congesta*	Annual herb												
water star-grass *Heteranthera dubia*	Perennial herb												
Loma Prieta hoita *Hoita strobilina*	Perennial herb												
Santa Cruz tarplant *Holocarpha macradenia*	Annual herb												
Kellogg's horkelia *Horkelia cuneata ssp. sericea*	Perennial herb												
Carquinez goldenbush *Isocoma arguta*	Shrub												
Northern California black walnut *Juglans hindsii*	Tree												
Contra Costa goldfields *Lasthenia conjugens*	Annual herb												
beach layia *Layia carnosa*	Annual herb												
rose leptosiphon *Leptosiphon rosaceus*	Annual herb												
Oregon meconella *Meconella oregana*	Annual herb												
woodland woollythreads *Monolopia gracilens*	Annual herb												

Appendix C

UCB Hill Campus Fire Hazard Reduction Project - Bloom Periods and Herbarium Collecting Dates

Yellow = No habitat present; Blue = Survey Dates; Green = Blooming Period; Brown = Herbarium collecting dates



Common Name ***Scientific name***	**Life Form**	**Blooming Period and Herbarium Collecting Dates**											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Choris' popcornflower *Plagiobothrys chorisianus var. chorisianus*	Annual herb												
San Francisco popcornflower *Plagiobothrys diffusus*	Annual herb												
Oregon polemonium *Polemonium carneum*	Perennial herb												
adobe sanicle *Sanicula maritima*	Perennial herb												
long-styled sand-spurrey *Spergularia macrotheca var. longistyla*	Perennial herb												
Santa Cruz microseris *Stebbinsoseris decipiens*	Annual herb												
most beautiful jewel-flower *Streptanthus albidus ssp. peramoenus*	Annual herb												
slender-leaved pondweed *Stuckenia filiformis ssp. alpina*	Perennial herb												
California seablit *Suaeda californica*	Shrub												
saline clover *Trifolium hydrophilum*	Annual herb												
oval-leaved viburnum *Viburnum ellipticum*	Shrub												

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Appendix D

List of Observed Species

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Appendix D. Plant Species Observed within the Project Area.

Scientific Name	Common Name	Native (Y/N)
Abies grandis	lowland grand fir	Y*
Acacia melanoxylon	blackwood acacia	N
Acer macrophyllum	big leaf maple	Y
Achillea millefolium	yarrow	Y
Aesculus californica	California buckeye	Y
Agave sp.	agave	--*
Aira caryophyllea	silver hairgrass	N
Allium triquetrum	three-corner leek	N
Amaryllis belladonna	naked lady	N
Amsinckia intermedia	common fiddleneck	Y
Anagallis arvensis	scarlet pimpernel	N
Anthemis cotula	mayweed	N
Aquilegia formosa	western columbine	Y
Arbutus menziesii	Pacific madrone	Y
Arnica discoidea	rayless arnica	Y
Artemisia californica	California sagebrush	Y
Artemisia douglasiana	Douglas' mugwort	Y
Athyrium filix-femina var. cyclosorum	western lady fern	Y
Avena barbata	slender wild oat	N
Avena fatua	common wild oat	N
Baccharis pilularis	common coyote brush	Y
Bellardia trixago	Mediterranean lineseed	N
Berberis pinnata subsp. pinnata	Oregon grape	N
Brassica nigra	black mustard	N
Briza maxima	rattlesnake grass	N
Briza minor	little rattlesnake grass	N
Brodiaea elegans	harvest brodiaea	Y
Bromus carinatus	California brome	Y
Bromus diandrus	ripgut brome	N
Bromus hordeaceus	soft brome	N
Calocedrus decurrens	incense cedar	Y*
Calystegia purpurata	morning glory	Y
Capsella bursa-pastoris	shepherd’s purse	N
Cardamine californica	milk maids	Y
Carduus pycnocephalus ssp. *pycnocephalus*	Italian thistle	N
Castilleja foliolosa	woolly indian paintbrush	Y
Ceanothus cuneatus	buck brush	Y
Centaurea solstitialis	yellow star-thistle	N
Chlorogalum parviflorum	soap root	Y
Cirsium vulgare	bull thistle	N
Claytonia perfoliata	miner’s lettuce	Y
Clinopodium douglasii	yerba buena	Y
Conium maculatum	common poison hemlock	N
Convolvulus arvensis	field morning glory	N
Cortaderia jubata	pampas-grass	N
Corylus cornuta	hazelnut	Y
Cotoneaster lacteus	milkflower cotoneaster	N

Scientific Name	**Common Name**	**Native (Y/N)**
Cotoneaster sp.	cotoneaster	N
Crataegus monogyna	single seed hawthorne	N
Croton setigerus	dove weed	Y
Cynara cardunculus ssp. *cardunculus*	artichoke thistle	N
Cynoglossum grande	hounds tongue	Y
Cynosurus echinatus	dogtail grass	N
Delairea odorata	German-ivy	N
Dichelostemma capitatum	blue dicks	Y
Dipsacus sativus	Fuller's teasel	N
Dirca occidentalis	Western leatherwood	Y
Dittrichia graveolens	Mediterranean stinkwort	N
Drymocallis glandulosa	sticky cinquefoil	Y
Echium candicans	pride of madeira	N
Ehrharta calycina	veldt grass	N
Elymus glaucus	blue wild rye	Y
Epilobium canum	California fuchsia	Y
Epipactis helleborine	helleborine orchid	N
Equisetum telmateia braunii	giant horsetail	Y
Eriogonum nudum	naked buckwheat	Y
Eriophyllum lanatum	wooly sunflower	Y
Erodium cicutarium	red-stemmed filaree	N
Eschscholzia californica	common California poppy	Y
Eucalyptus globulus	bluegum eucalyptus	N
Euphorbia oblongata	oblong spurge	N
Festuca californica	California fescue	Y
Festuca (*Vulpia*) *myuros*	rattail grass	N
Festuca perennis	perennial rye-grass	N
Foeniculum vulgare	common fennel	N
Fragaria vesca	wood strawberry	Y
Frangula californica	California coffee-berry	Y
Fritillaria sp.	checker lily	Y
Galium aparine	annual bedstraw	N
Galium murale	tiny bedstraw	N
Genista monspessulana	French broom	N
Geranium dissectum	dissected geranium	N
Geranium molle	dove's-foot crane's-bill	N
Geranium purpureum	little robin	N
Hedera helix	English ivy	N
Helminthotheca echioides	bristly ox-tongue	N
Heracleum maximum	cow parsnip	Y
Hesperocyparis macrocarpa	Monterey cypress	Y*
Heteromeles arbutifolia	toyon	Y
Hirschfeldia incana	summer mustard	N
Holodiscus discolor	oceanspray	Y
Hordeum murinum	mouse barley	N
Hypochaeris radicata`	hairy cat's ear	N
Juncus patens	spreading rush	Y
Lactuca serriola	common prickly lettuce	N

Scientific Name	**Common Name**	**Native (Y/N)**
Lathyrus latifolius	perennial sweet-pea	N
Lepidium latifolium	broad-leaved peppergrass	N
Lithophragma affine	woodland star	Y
Lobularia maritima	sweet alyssum	N
Lonicera hispidula	California honeysuckle	Y
Lotus corniculatus	birdfoot trefoil	N
Lupinus albifrons	silver bush-lupine	Y
Lupinus albifrons.	silver bush lupine	Y
Lupinus succulentus	arroyo lupine	Y
Madia sativa	coast tarweed	N
Maianathemum stellatum	false Solomon’s seal	Y
Malva parviflora	small-flowered mallow	N
Marah fabacea	manroot	Y
Marrubium vulgare	horehound	N
Matricaria discoidea	pineapple weed	N
Medicago polymorpha	burclover	N
Melilotus albus	white sweetclover	N
Melica californica	California melic	Y
Melica torreyanna	Torrey’s melic	Y
Mentha sp.	mint	--
Mimulus aurantiacus	Sticky monkeyflower	Y
Myosotis latifolia	forget me not	N
Monardella villosa	coyote mint	Y
Nasturtium officinale	watercress	Y
Oemleria cerasiformis	oso berry	Y
Oxalis pes-caprae	Bermuda buttercup	N
Pellaea andromedifolia	coffee fern	Y
Pentagramma triangularis	goldback fern	Y
Phacelia californica	California phacelia	Y
Phacelia malvifolia	stinging phacelia	Y
Phalaris aquatica	Harding grass	N
Phalaris canariensis.	canary grass	N
Physocarpus capitatus	ninebark	Y
Pinus radiata	Monterey pine	Y*
Pinus sp.	ornamental pine	N
Plantago lanceolata	English plantain	N
Poa secunda	one-sided blue grass	Y
Polypodium sp	polypody fern	Y
Polystichum munitum	Western sword fern	Y
Prunus sp.	plum	N
Prunus dulcis	domestic almond	N
Psuedognaphalium sp.	cudweed	--
Pteridium aquilinum var. pubescens	bracken fern	Y
Quercus agrifolia var. *agrifolia*	coast live oak	Y
Raphanus sativus	cultivated radish	N
Ranunculus californicus	California buttercup	Y
Ranunculus repens	creeping buttercup	N
Ribes menziesii	canyon gooseberry	Y

Scientific Name	**Common Name**	**Native (Y/N)**
Ribes sanguineum var. glutinosum	red-flowering current	Y
Rosa gymnocarpa.	wood rose	Y
Rubus armeniacus	Himalayan blackberry	N
Rubus parviflorus	thimbleberry	N
Rubus ursinus	California blackberry	Y
Rumex acetosella	sheep sorrel	N
Rumex crispus	curly dock	N
Rumex pulcher	fiddle dock	N
Salix lasiolepis	arroyo willow	Y
Salix sp.	willow	Y
Sambucus nirga ssp. *caerula*	blue elderberry	Y
Sanicula crassicaulis	Pacific sanicle	Y
Scrophularia californica	California bee plant	Y
Senecio vulgaris	common groundsel	N
Sequoia sempervirens	coast redwood	Y
Silybum marianum	blessed milkthistle	N
Sisyrinchium bellum	blue-eyed-grass	Y
Solanum furcatum	forked nightshade	N
Solidago velutina ssp. californica	California goldenrod	Y
Sonchus oleraceus	common sow-thistle	N
Stachys rigida	hedge nettle	Y
Stellaria neglecta	common chickweed	N
Stipa lepida	foothill needle grass	Y
Stipa pulchra	purple needle grass	Y
Symphoricarpos albus	common snowberry	Y
Symphoricarpos mollis	creeping snowberry	Y
Symphyotrichum chilense	Pacific aster	Y
Tiarella trifoliata var. unifoliata	sugar scoop	Y
Torilis arvensis	field hedge parsley	N
Toxicodendron diversilobum	poison oak	Y
Trientalis latifolia	star flower	Y
Trifolium hirtum	rose clover	N
Trifolium willdenovii	tomcat clover	Y
Trillium chloropetalum	giant wakerobin	Y
Turritis glabra	tower rockcress	Y
Typha angustifolia	narrow cattail	N
Ulmus sp.	ornamental elm	N
Umbellularia californica	California bay	Y
Urtica dioica ssp. *holoserica*	perennial stinging nettle	Y
Vaccinium ovatum	huckleberry	Y
Vicia gigantean	giant vetch	Y
Vicia sativa	spring vetch	N
Vicia villosa	hairy vetch	N
Vinca major	periwinkle	N
Wyethia angustifolia	narrow leaved mule ears	Y
Wyethia helenioides	wooly mule ears	Y
Wyethia glabra	smooth mule ears	Y
Xanthium strumarium	common cocklebur	N

Scientific Name	**Common Name**	**Native (Y/N)**
Yucca sp.	ornamental yucca	N
Zantedeschia aethiopica	callalily	N

*= Native plant not naturally occurring in the project area

E2

California Red-legged Frog
Habitat Assessment

California Red-legged Frog Habitat Assessment

UC Berkeley Hill Campus Fire Hazard Reduction

University of California, Berkeley

April 2019

Prepared for:

University of California, Berkeley, Facilities Services
2000 Carleton Street
Berkeley, CA 94720

Prepared by:
Condor Country Consulting, Inc.
815 Estudillo Street
Martinez, CA 94553

Table of Contents

List of Appendices

1.0 Introduction

On behalf of the University of California, Berkeley (UCB), Condor Country Consulting, Inc. (CCCI) has prepared this habitat assessment in accordance with the *Revised Guidance on Site Assessment and Field Surveys for the California Red-legged Frog* (USFWS, 2005) for the UC Berkeley Hill Campus Fire Hazard Reduction project. This site assessment was prepared in support of a California Environmental Quality Act (CEQA) document that UCB's Facilities Services is preparing for UC Berkeley Hill Campus Fire Hazard Reduction project. The purpose of this site assessment is to determine the likelihood of California red-legged frog (CRLF) presence in the Proposed Project site and surrounding vicinity.

1.1 Project Location and Description

The project is located in the East Bay Hills above the cities of Berkeley and Oakland, in the heavily vegetated 800-acre Hill Campus of the UCB. The project is primarily bounded by Grizzly Peak Road to the north and east, Centennial Drive to the west, and Claremont Avenue to the south. The UCB main campus is west of the project area (Figures 1 and 2).

The University of California Berkeley (UCB) proposes to treat vegetation in 242 acres in the Hill Campus to reduce wildfire hazard and potential damage to approximately 3,000 habitable structures and institutions of international importance as well as improved life safety for 3000-plus residents and approximately 1000 day-time users of the Hill Campus, and increasing the reliability of the 150 KV transmission line, the sole power source to the campus and Lawrence Berkeley National Laboratory. The campus will target areas forested with flammable eucalyptus and high fuel volume, and areas within 100 feet of roads, fire-trails, ridge tops, and buildings. Area treatments will thin the forest to reduce fuel volume and fire hazard. Roadside treatments will both reduce fire intensity along the road and remove hazardous trees likely to block the road. Defensible space will be installed within 100 feet of buildings.

Vegetation will be treated through the combination of the use of machinery, and hand labor. Trees would be cut using hand tools and a mechanized fellerbuncher. To prevent re-sprouting, an herbicide will be applied by a licensed California Qualified Applicator to the cambium ring of eucalyptus and acacia stumps. Felled trees will be skidded by rubber-tired or tracked vehicles along skid trails to landings. Selected tree trunks will be left on the slope. At the landings, trees would be stored or chipped using a grapple-fed chipper or a tracked chipper. Whole trees will be fed into the chipper and pulled through the blades by a conveyor belt and feed wheel. Chips will be both spread on-site and transported to a gasifier to supply electricity directly to the campus. Along roads and buildings, lower limbs of trees will be pruned, understory vegetation shortened and grass mowed.

1.2 California Red-legged Frog Background

CRLF are nearly endemic to California. They can be locally common to abundant in some areas. This species is listed as threatened under the federal Endangered Species Act (FESA; USFWS 1973), and is a California species of special concern (CDFG 2019). CRLF occur from extreme northern Baja California, Mexico north to Mendocino and Shasta Counties, and west from the Sierra Nevada foothills to the Pacific Coast (Jennings and Hayes 1994, Stebbins 2003). CRLF are most abundant along the Inner Coast Ranges from Point Reyes to southern Santa Barbara County, and within eastern Contra Costa and Alameda Counties (Jennings and Hayes 1994). Over the years these populations have become fragmented or extirpated.

Although CRLF uses an array of habitat types (including aquatic, riparian, and upland), typical habitat for this species is perennial and long-lived ephemeral ponds and slow moving creeks. CRLF optimal habitat includes upland habitat (grasslands, oak woodlands/savannah, scrub, and riparian woodlands) with fossorial mammal burrows (especially those of California ground squirrel (*Otospermophilus beecheyi*) and pocket gopher (*Thomomys bottae*)) surrounding aquatic breeding sites (Zeiner et al. 1988, Jennings and Hayes 1994, USFWS 2002, Stebbins 2003). Rocks, downed trees, leaf litter, and man-made debris (water troughs, hay stacks) are often used as shelter for this species (USFWS 2010). Creek banks and riparian woodland corridors are also important CRLF habitat (USFWS 2010). These upland and riparian sites are used for foraging, cover, aestivation, dispersal (USFWS 2002, USFWS 2010).

CRLF reproduction occurs in aquatic environments from November through April. During heavy rains, adult CRLF migrate to nearby breeding habitats. Egg masses are attached to aquatic vegetation just below the water surface, and hatch after approximately 4 weeks (California Herps 2019). Water must be present at the breeding site for at least 11-20 weeks to allow for tadpoles to metamorphose; however, if water is perennial, tadpoles can overwinter and metamorphose the following summer (USFWS 2010, California Herps 2019).

Primary threats for this species include habitat conversion to urban development and exotic predator invasions and introductions such as bullfrogs (Jennings and Hayes 1994, USFWS 2002). Habitat protection for critical populations is an important management goal for the USFWS (2002). Reduction in exotic species introductions and removal of exotic species sympatric with CRLF may also increase habitat suitability (Zeiner et al. 1988, Jennings and Hayes 1994, USFWS 2002, Stebbins 2003).

2.0 Environmental Setting

The Project Area is located in the East Bay Hills located above the University of California, Berkeley, (UCB) campus and the Lawrence Berkeley National Lab (LBNL). Initial vegetation and aquatic community surveys were conducted in 2010 as part of the Federal Emergency Management Agency (FEMA) East Bay Hills Hazardous Fire Risk Reduction Project. Follow-up surveys were conducted during the winter and early spring of 2019 in support for a California Environmental Quality Act (CEQA) document in preparation of the next phase of the UC Berkeley Hill Campus Fire Hazard Reduction grant from the California Department of Forestry and Fire Protection (Cal Fire). A total of eleven vegetation communities were identified in the Project area and named according to the conventions used in the original FEMA biological assessment (FEMA 2012), as well as those described in *A Manual of California Vegetation* (Sawyer et al. 2009), *California Vegetation* (Holland 1995), *USFWS National Wetlands Inventory* (USFWS 2019b) and Cowardin (Cowardin et al., 1979). The vegetation communities include: California annual grassland, coastal scrub (xeric), coniferous forest/non-native coniferous forest, coyote brush scrub, developed/disturbed/landscaped, eucalyptus forest, oak-bay woodland, redwood forest, riparian woodland, riverine and lacustrine features, and successional grassland.

3.0 Methods

3.1 Preliminary Data Gathering and Literature Review

The methods used for this CRLF site assessment are based on the U.S. Fish and Wildlife Service (USFWS) *Revised Guidance on Site Assessment and Field Surveys for the California Red-legged Frog* (USFWS 2005). The site assessment included a review of available resources to provide an overview of the upland and aquatic habitats present within the study area and surrounding vicinity. The California Department of Fish and Wildlife (CDFW) California Natural Diversity Data Base (CNDDB) (CDFW, February 2019) and the USFWS Recovery Plan for the California Red-legged Frog (*Rana draytonii*) (USFWS, 2002) were reviewed for information regarding known existing and historic populations of CRLF in the vicinity of the study area. A listing of other information sources reviewed prior to conducting the field assessment included:

- USGS “Briones Valley, Oakland East, and Richmond, CA” 7.5-minute topographic quadrangles,
- Aerial photography of the project area and vicinity, (Google Earth Pro, 2019),
- California’s Wildlife Volume 1, Amphibians and Reptiles (Zeiner, D.C., et al., 1988),
- Amphibians and Reptiles of Special Concern (Jennings and Hayes, 1994),
- USFWS online species information for CRLF (USFWS, 2007),
- National Wetlands Inventory database shapefiles (USFWS 2019b).

3.2 Habitat Assessment

Three criteria were used to assess the likelihood of CRLF presence in or within the vicinity of the Project Area:

1. The location of the Project Area with respect to the current and historic range of CRLF.
2. The presence of absence of known record of CRLF within a one-mile radius of the Project Area.
3. The habitat types occurring within and adjacent to the Project Area.

CCCI biologists conducted biological reconnaissance surveys of the Project Area during nine visits spanning between February 27 and April 16, 2019 (Feb. 27, 28; Mar. 1, 4, 12-14, 19; and Apr 16). During the surveys, the habitat types on-site were classified, 39 stream and pond habitat locations were assessed, and protocol level surveys were conducted at ten (10) pond and stream pool locations (Figures 3 and 4).

3.3 Vegetation Community and Wildlife Habitat Classification

Plant identification was based upon the *Second Edition of The Jepson Manual* (Baldwin et al. 2012). Vegetation communities were identified using a combination of the characterizations in *A Manual of California Vegetation* (Sawyer et al. 2009) and the land cover types identified by

California Vegetation (Holland 1995). Final vegetation community types were aligned with those described in the 2012 Biological Assessment for the Hazardous Fire Risk Reduction for the East Bay Hills (FEMA 2012). Land cover types were classified by disturbance, dominant species, overall species composition, and affinity for water or various substrates. The minimum mapping unit for this project was defined as an area of 200 square feet. Wetlands and other aquatic habitats were classified using the USFWS National Wetlands Inventory (NWI) Classification System for Wetland and Deepwater Habitats, or “Cowardin class” (Cowardin et al., 1979 and USFWS 2019b).

4.0 Results

4.1 Current and Historic Range of the CRLF in Relation to the Project Area

The study area is within the historic range of the CRLF according to California’s Wildlife Volume 1, Amphibians and Reptiles revised map (Zeiner et al., 1988 and Wright & Thomson 2014). Its current range is much reduced, with most remaining populations found in central California along the coast from Marin County south to Ventura County. No USFWS critical recovery areas were identified within, or in the vicinity of the Project Area. The nearest CRLF critical recovery unit is located in Contra Costa County, four miles northeast of the Project Area (USFWS 2019a).

4.2 Assessment of CRLF Records within One Mile of the Study Area

There were two non-CNDDB documented occurrences within 1 mile of the site documented by the East Bay Regional Park District (EBRPD) biologists (Figure 5). On March 5th, 2019, a Fisheries database search came up with two records, a 2008 record (confirmed by park stewardship manager Joe DiDonato) of an adult CRLF found in Lake Anza which intersects the 1-mile Project Area buffer to the north. Steve Edwards, the former director of the Tilden Botanical Garden, remembers seeing a few CRLF adults after the botanical garden pond was rebuilt in 2001. Soon after the pond was rebuilt, members of the public started to release bullfrogs into the pond. The pond became infested with bullfrogs, and subsequently, no CRLF sightings have occurred at this site, located 0.7 miles north of the Project Area.

The nearest documented CNDDB occurrence of CRLF is 1.7 miles northeast of the Project Area and is located in Contra Costa County (CNDDB occurrence #960); two adult and 40-60 tadpoles CRLF were observed in the Wagner Ranch Nature area pond in 2007 (Figure 5). Personal communication with wildlife biologist Dr. Reg Barrett, a volunteer caretaker for this nature area in January 2019, personally observed that CRLF are still present in this pond. This pond is separated from the project area by two major watersheds and ridgelines, and a heavily used commuter highway (San Pablo Dam Road). The next closest CNDDB occurrence was 1.9 miles east of the Project Area (CNDDB occurrence # 226) in 1997, were two adult CRLF in a culvert outlet pool in a seasonal tributary to Brookside Creek. This area has been extensively developed since that sighting and the SR-24 eight-lane highway creates a major dispersal barrier for this population. The third CNDDB record (occurrence #8), located 2 miles southeast of the Project Area, is from a UCB Museum of Vertebrate Zoology (MVZ) collection of egg masses and 3 adults from 1931.

4.3 Habitats Within the Project Area

As shown on Figures 6 and 7, terrestrial habitat types within the study area include California annual grassland, coastal scrub (xeric), coniferous forest/non-native coniferous forest, coyote brush scrub, developed/disturbed/landscaped, eucalyptus forest, oak-bay woodland, redwood forest, riparian woodland, riverine and lacustrine features, and successional grassland. Aquatic habitats within the study area include man-made lakes, man-made ponds, and stream courses. A general discussion of each habitat type is provided below.

4.3.1 Terrestrial Habitats Within the Project Area

California Annual Grassland

California annual grassland, also known as non-native annual grassland, is a predominantly herbaceous community, typically composed of a dense cover of introduced annual grasses and non-native and native forbs adapted to colonizing and persisting in disturbed upland habitats. Native grasses and perennial forb may also occur sporadically in the California annual grassland community. Dominant non-native invasive grasses include wild oats (*Avena* spp.), ripgut brome (*Bromus diandrus*), foxtail barley (*Hordeum murinum*), and annual fescues (*Festuca* spp.). Common non-native forbs observed include burclover (*Medicago polymorpha*), rose clover (*Trifolium hirtum*), and filarees (*Erodium* spp.). Nonnative invasive forbs, such as poison hemlock (*Conium maculatum*) and Italian thistle (*Carduus pycnocephalus*) are present in California annual grassland communities where soils have been disturbed. Scattered native grasses, including purple needlegrass (*Stipa pulchra*), blue wild rye (*Elymus glaucus*), and creeping wild rye (*Elymus triticoides*), occur sparingly in this community in the project area. Native forbs present include California poppy (*Eschscholzia californica*), yarrow (*Achillea millefolium*), clovers (*Trifolium* spp.), and blue-eyed grass (*Sisyrinchium bellum*). California annual grasslands within the action area may provide suitable dispersal, upland refugia, and aestivation habitat for California red-legged frogs.

Coastal Scrub (xeric)

Northern coastal scrub communities are characterized by relatively open to dense woody shrub cover and an absence of trees. Saplings of oak species (*Quercus* spp.), California bay (*Umbellularia californica*), and Monterey pine (*Pinus radiata*) trees sometimes emerge from the shrub canopy cover. The project area is dominated by shrubs and forbs adapted to relatively xeric conditions. Coyote brush (*Baccharis pilularis*) is the dominant shrub in xeric coastal scrub communities in the project area. Other shrub species present include California sagebrush (*Artemisia californica*), toyon (*Heteromeles arbutifolia*), silver bush lupine (*Lupinus albifrons*), poison oak (*Toxicodendron diversilobum*), and sticky monkey-flower (*Diplacus aurantiacus*). Scattered coast live oak (*Quercus agrifolia*), California bay, and Monterey pine trees also occur in this community. Non-native invasive species commonly observed in coastal scrub include French broom (*Genista monspessulana*), poison hemlock, and fennel (*Foeniculum vulgare*). Coastal scrub communities dominated by species adapted to more mesic (i.e., moist) conditions are also present in the project area, although less common than xeric coastal scrub communities. The dominant plant species observed in mesic coastal scrub include California blackberry (*Rubus ursinus*), thimbleberry (*Rubus parviflorus*), blue elderberry (*Sambucus nigra* ssp. *caerulea*), and California hazelnut (*Corylus cornuta*). Non-native invasive species in this community include poison hemlock, Italian thistle, and Himalayan blackberry (*Rubus armeniacus*). Scattered coast live oak and California bay, as well as madrone (*Arbutus menziesii*) and bigleaf maple (*Acer* *macrophyllum*) are also occasionally present in this community. Coastal scrub communities within the action area may provide suitable dispersal habitat for CRLF.

Coniferous Forest/Non-native Coniferous Forest

The coniferous forest community in the project area is dominated by Monterey pine, which is native only to San Mateo, Monterey, and San Luis Obispo counties and was planted in the East Bay Hills in the early 1900s. Similar to other woodland and forest communities, the understory is typically sparse, and the ground is covered mostly by pine needles. In more open canopied Monterey pine forests, native shrubs species such as California blackberry, coyote brush, and poison oak are common. Non-native species commonly observed in Monterey pine forests include erect veldt grass (*Ehrharta erecta*) and poison hemlock. Mature groves of varying densities of Monterey pine occur throughout the project area, often with eucalyptus (*Eucalyptus globulus*), coast live oak, and California bay trees.

Coyote Brush Scrub

Coyote brush scrub is a successional stage from grassland to scrub and commonly occurs where grazing or fire has been discontinued or suppressed. Coyote brush scrub is distinct from coastal scrub by the density of coyote brush and low cover of other shrubs species, such as California sagebrush and poison oak. In areas of dense coyote brush, little or no understory is present; however, herbaceous grass and forb species such as wild oats, blue wild rye, and bracken fern (*Pteridium aquilinum* var. *pubescens*) are along edges or in open areas. Non-native invasive species such as Italian thistle and French broom are also commonly present in disturbed areas in this community.

Developed/Disturbed/Landscaped

Developed, disturbed, and landscaped areas consist of land developed for residential and urban use, including landscaped and maintained residential and parkland, as well as areas used for road and trail construction and maintenance. Vegetation in these areas is predominantly planted trees, shrubs, and non-native herbaceous species. A large variety of ornamental trees and shrubs were observed in this community.

The action area includes; large buildings, structures, and parking lots, such as the UCB Mathematical Sciences Research Institute Building, and public roads. Landscaped areas include maintained yards associated with private residences and planted or maintained areas associated with public or University buildings, and botanical gardens such as the UCB Botanical Garden. Disturbed vegetation includes areas created by natural or human disturbance that may support early succession stages of adjacent habitats. Disturbed areas are often susceptible to invasion by non-native species, including weeds such as French broom, fennel, poison hemlock, and Italian thistle. Disturbed areas were identified in a variety of locations, including areas near new development, along road shoulders, or on hillsides, such as the hillsides along portions of Grizzly Peak Blvd. Developed, disturbed, and landscaped areas do not provide suitable habitat for CRLF, but they may occasionally disperse through these areas to access more suitable habitat.

Eucalyptus Forest

Eucalyptus trees were introduced from Australia and were widely planted throughout the East Bay Hills in the early 1900s. Eucalyptus trees are capable of rapid growth and prolific reproduction. A rapid growth rate and the production of allelopathic oils, which inhibit establishment of other species, have helped eucalyptus forests invade large areas of the project area.

Eucalyptus stands in the project area range between young stands (i.e., less than 40 years old) of recently colonized saplings to mature stands (i.e., over 40 years old) including some stands that have never been logged. Blue-gum eucalyptus is the dominant species. The understory of these young stands usually supports a more diverse mix of native and non-native shrubs and herbaceous plants when compared to those in the mature stands. Native species in this community include California blackberry, poison oak, toyon, and coyote brush; non-native invasive species include cotoneaster (*Cotoneaster* sp.), French broom, erect veldtgrass, and the non-native oblong spurge (*Euphorbia oblongata*). Mature eucalyptus forests characterized by a closed-canopy and sparse shrub and forb understory. Scattered coast live oak and California bay trees are present in both young and mature eucalyptus stands. Additionally, redwood trees (*Sequoia sempervirens*) are occasionally present in stands of eucalyptus.

Eucalyptus forests within the action area provide low quality dispersal habitat for CRLF. Eucalyptus trees within the action area degrade the aquatic habitat for CRLF by altering hydrology and water chemistry. The high rates of transpiration by eucalyptus trees reduce the availability of surface water within the action area. The allelopathic oils released from the litter of eucalyptus trees impair water quality within the action area and reduce the availability of suitable invertebrate prey species for the CRLF.

Oak-Bay Woodland

The oak-bay woodland community consists of a mix of predominantly coast live oak and California bay trees. Other native trees found in this vegetation community in the project area include California buckeye, bigleaf maple, and madrone. Understory species may contain poison oak, woodfern (*Dryopteris arguta*), Swordfern (*Polystichum* sp.), California blackberry, coyote brush, California hazelnut, toyon, and currants (*Ribes* spp.). Oak-bay woodland within the action area may provide suitable dispersal habitat for CRLF.

Redwood Forest

Coast redwood trees tend to be on shallow soils on north and east-facing slopes or in valley or canyon bottoms. In the project area, redwood forest exists in small patches in Strawberry Creek, the UC Botanical gardens and in Claremont Canyon. Shrubs and herbaceous species are relatively sparse in the understory of closed canopy redwood forests. Understory plants may include poison oak, ocean spray (*Holodiscus discolor*), and California hazelnut. Redwood forests within the action area may provide suitable dispersal habitat for California red-legged frogs.

Riparian Woodland

Riparian woodland communities are located along streams and on the edges of seeps and ponds. Arroyo willow (*Salix lasiolepis*) is the dominant species in this community in the project area. Scattered California bay and coast live oak trees were also identified adjacent to riparian woodland communities. California blackberry, thimbleberry, sword fern, blue gum eucalyptus, and poison oak are commonly found in the understory. The most common non-native species identified in the action area's riparian woodland communities are English ivy (*Hedera helix*) and poison hemlock. Riparian woodlands within the action area may provide suitable dispersal, foraging, and non-breeding aquatic habitat for CRLF.

Riverine and Lacustrine Features

Riverine features in the action area and vicinity include several unnamed intermittent drainages. There are two perennial creeks in the project area: Strawberry and Claremont Creeks. Strawberry and Claremont Creeks originate in the action area in Strawberry Canyon and Claremont Canyon Regional Preserve, respectively. These creeks run westward from the project area and become channelized and are diverted in culverts underground through the cities of Berkeley and Oakland before draining into San Francisco Bay.

There are limited lacustrine features in the action area, a small ephemeral pond west of the Lawrence Hall Science staff parking lot, and a shallow, perennial pond inside the UCB botanical garden. Streams, ponds, and lacustrine features within the action area provide suitable dispersal and non-breeding aquatic habitat for California red-legged frogs. There is only one pond near the action area (UCB Botanical Garden pond) that has suitable depths and hydroperiods that could provide suitable breeding habitat for CRLF.

Successional Grassland

The successional grassland community is characterized by grassland areas that appear to be in the process of transitioning into shrub-dominated communities. Vegetation consists primarily of non-native annual grasses and forb species found in California annual grasslands but with a higher cover of shrub species, typically coyote brush, than typically occurs in California annual grassland communities. In some areas, fire suppression and cessation of livestock grazing in the East Bay Hills have resulted in the succession of California annual grasslands into coyote brush scrub and coastal scrub communities (Stromberg et al. 2007). Vegetation management practices, including clearing eucalyptus stands, have also produced areas of successional grassland as shrubs have recolonized the area. Although coyote brush is the dominant shrub, other species such as sticky monkey-flower, poison oak, and occasional immature coast live oak, California bay, and other saplings were also observed. Successional grassland community present in the project area is found along the west side of Grizzly Peak Road. Successional grassland within the action area provides suitable dispersal, upland refugia, and aestivation habitat for CRLF.

4.3.2 Aquatic Habitats within the Study Area

Streams Intersecting Project Area

Claremont Creek (and Telegraph Canyon Tributary)

The portion of Claremont Creek that intersect the project area are intermittent and are accessible by Claremont Avenue. The creek contains no suitable pools or emergent vegetation that could be used by breeding CRLF. The tributaries could be used as dispersal corridors by CRLF, but ridgelines, an eight-lane freeway (SR-24), and adjacent tributaries that flow into long culverts that are not day lighted for well over 1 mile create insurmountable barriers for CRLF to access the Claremont watershed.

Strawberry Creek (and Hamilton Gulch Tributary)

The tributary portions of Strawberry Creek that intersect the project area are intermittent to ephemeral and are accessible by a gated fire road. The lower perennial portions of Strawberry Creek are below the project area impact zones. Only the perennial portion of the creek contains a few pools, but these pools have strong currents and no emergent vegetation, thus there is no suitable breeding habitat for CRLF in this drainage. There is a potential that CRLF could use the tributaries as dispersal corridors, but the watershed is separated from other watersheds by a ridgeline and Grizzly Peak Boulevard.

Streams within One Mile of Project Area

Round Top Creek

Round Top Creek is an intermittent stream located southeast of the project area that flows into a miles long culvert. The creek watershed is isolated from the project area by the eight-lane SR-24 highway and adjoining tributaries that disappear into culverts. The creek contains no breeding habitat for CRLF and the previously mentioned dispersal barriers prevent CRLF from entering into the project area.

San Pablo Creek

San Pablo Creek flows from the City of Orinda northwest into San Pablo Reservoir. The perennial portion of the creek is over 1.5 miles from the project area. A few intermittent and ephemeral tributaries enter the 1-mile project area buffer and are northeast of the Wildcat Creek and Siesta Valley Creek watersheds. There are 2 long ridgelines that separate this watershed from the project area watersheds. There is a known CRLF breeding pond that is inside this watershed, but this breeding pond is outside of the 1-mile dispersal buffer. The tributaries could provide potential CRLF dispersal habitat.

Siesta Valley Creek

Siesta Valley Creek is an intermittent creek within a small water shed less than one square mile in size. The creek and its tributaries drain into a culvert over 1-mile long underneath Highway 24. This watershed is east of the Claremont Creek watershed and south of the Wildcat Creek watershed. The creek does not contain any CRLF breeding habitat (no pools with emergent vegetation), but could provide dispersal habitat.

Wildcat Creek

Wildcat Creek flows perennially (except during drought years) in a northwest direction through the middle of Tilden Regional Park. On the north edge of the 1-mile project buffer, the creek flows through Lake Anza, a lake that has contained CRLF. The portion of Wildcat Creek above lake Anza contains CLFR dispersal habitat.

Lakes and Ponds

Lake Anza

Lake Anza is a 10-acre lake that is used for recreational swimming along one shore during the summer. The Tilden Park Fisheries Database has a 2011 record of a sub-adult CRLF observation on the north end of the lake that was confirmed by the East Bay Regional Park Stewardship Manager, Joe DiDonato.

Lawrence Hall of Science Pond
This pond is located just west of the Lawrence Hall of Science staff parking lot. This report's principal author, Ted Robertson, was responsible for caretaking this pond for 20 years until leaving employment in 2010. In 2010 and prior years, this pond was regularly sampled several times a month and contained predominantly bullfrog tadpoles, crayfish, and aquatic insects. Summer water levels were maintained using a filtered water source. No native amphibians were observed in this pond. Between 2011 and 2019, the maintenance of this pond was neglected and a large crack developed that caused the pond to dry up each year, approximately one month after the last major rainfall. Cattails no longer survive in this pond. This pond is fed by ephemeral run-off and has no direct tributary link to Strawberry Creek. The uphill portion of the pond has a migration barrier consisting of a tall, 15 foot concrete wall, asphalt, and a large building. Three protocol level surveys were conducted at this pond at the end of the breeding season, twice during the day and once at night. No amphibians were observed or heard.

UCB Botanical Gardens Pond
This artificial and perennial pond is fed by a tributary of Strawberry Creek. It has become a well-established breeding site for California and rough-skinned newts (*Taricha torosa* and *T. granulosa*). The pond is concrete lined and contains emergent vegetation. This pond provides potential CRLF breeding habitat but there are no CRLF records for this pond since it was rebuilt in 1963 (A flood destroyed the original 1939 pond in October 1962). Three protocol level surveys were conducted at this pond at the end of the breeding season, twice during the day and once at night. No CRLF were detected, but there was observations of California newt and Sierra treefrog breeding at this pond.

Tilden Park Botanical Garden Pond
This artificial pond with a concrete base currently contains California newts and Sierran treefrogs. In 2001, an adult CRLF was spotted in this pond (Edward Culver, EBRPD fisheries biologist, personal communication 2019). CRLF have not been observed in subsequent years. About ten years ago, this pond became infested with bullfrogs until it was drained around 2015 and all bullfrogs were removed. A March 2019 amphibian survey by the author found California newts and Sierran treefrogs inhabiting the pond.

Sibley Park Northern Ponds
These adjacent perennial 3/4 acre ponds are separated by a 12 to 16-foot wide dike. These ponds are heavily infested with bullfrogs. On a recent survey, 85 individual bullfrogs were counted within 5-feet of the shoreline. Hundreds more are presumably hiding within the tules (*Schoenoplectus* sp.) that cover over 85% of the pond. The bullfrogs have captured the pond site, preventing CRLF from using this pond for reproduction or refugia.

Siesta Valley Wetland
This wetland was a cattle pond several years in the past but has now become a seasonal wetland. The seasonal wetland is well sloped allowing for drainage that prevents any pools from

developing. There is no CRLF breeding habitat at this pond, but is could serve as part of the dispersal corridor.

5.0 Summary

CCCI biologists conducted a CRLF site assessment for the Project Area and surrounding vicinity. Literature reviews, personal communications with resource managers, and CNDDB searches were conducted to assess the current and historic distribution of CRLF in relation to the Project Area. Aquatic and upland features within the Project Area and within one-mile radius were assessed for potential CRLF breeding and dispersal habitats.

There are no documented records of CRLF within the Project Area, an area that has been well traversed by herpetologists from the local University for over 130 years. The Strawberry Creek and Claremont Creek watersheds contain no adequate pools or emergent vegetation that would provide suitable CRLF breeding habitat. The few pools that are located along the lower reaches of Strawberry Creek are shallow, have strong currents running through them, and contain no emergent vegetation for egg attachment. The nearest ponds to the project area is the former Lawrence Hall of Science (LHS) pond, which is 500 feet from the urbanized portion of the Project area. Due to a breach, this pond does not hold water for more than one month after a major rain event and it is contaminated with pollutants. The UC Berkeley Botanical Garden pond could be a potential breeding location and is approximately 800 feet away from the nearest edge of the Project Area. This pond was built in 1963 and there has been no record of CRLF at this pond, although it does support a healthy breeding population of California newts and Sierran treefrogs.

The nearest confirmed sightings for CRLF are from Lake Anza, a lake that is exactly one mile from the edge of the nearest Project Boundary. There is documentation of CRLF dispersing upstream along Wildcat Creek to the Tilden Park Botanical garden, a location 0.7 miles from the nearest edge of the Project Area. There is a large golf course between the Wildcat Creek dispersal corridor and the Project Area. There is a small potential that CRLF could disperse over the ridgeline that separates Wildcat Creek into the Strawberry Creek watershed and into the Project area. Dispersal could only occur during the winter and spring months when there is adequate moisture in the habitats. By mid-May, the habitat becomes too arid for safe dispersal of CRLF. The cutting, removal and chipping of the non-native trees in the Project Area will occur between mid-August to mid-October, ending before the start of the winter rainy season. It is highly unlikely that CRLF are within the Project Area or estivating in underground burrows.

Due to the reasons outline above combined with the lack of documented historic population use in the Project Area, it is determined that the Project Area would not support a breeding population of CRLF and that CRLF would not be dispersing through the area during the summer and early fall dates scheduled for the tree removal. It is CCCI’s recommendation that no additional CRLF study is warranted. Additional day and nighttime surveys that are specified in the CRLF protocol could be performed at the UC Berkeley botanical garden this summer if the USFWS feels they are still warranted.

6.0 References

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Appendix A

List of Figures

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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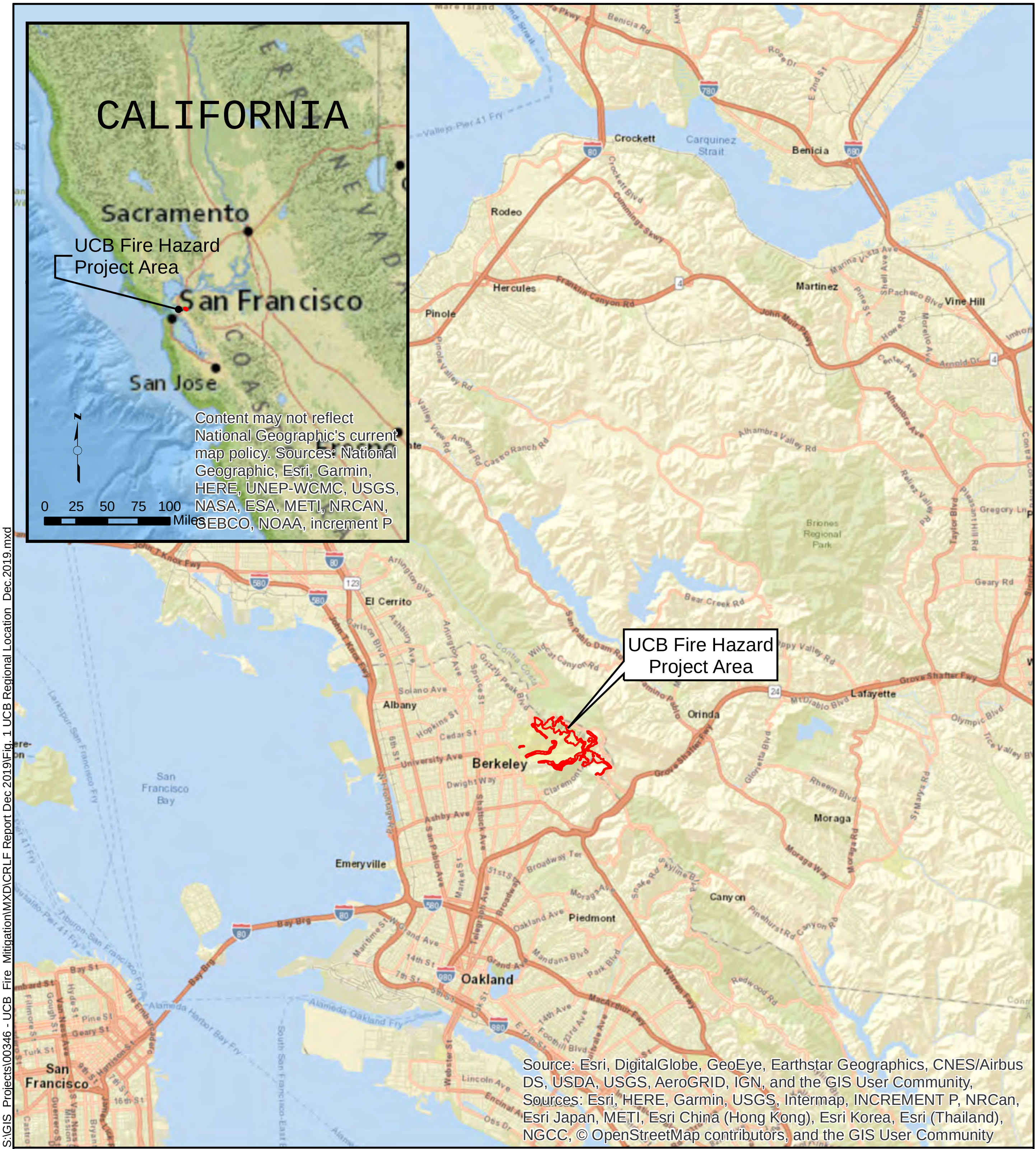
S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\CRLF Report Dec 2019\Fig. 1 UCB Regional Location Dec.2019.mxd



Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Ted Robertson Dec 9, 2019

FIGURE 1

Regional Location of
UC Berkeley Hill Campus Fire Hazard Reduction Project

City of Berkeley, CA

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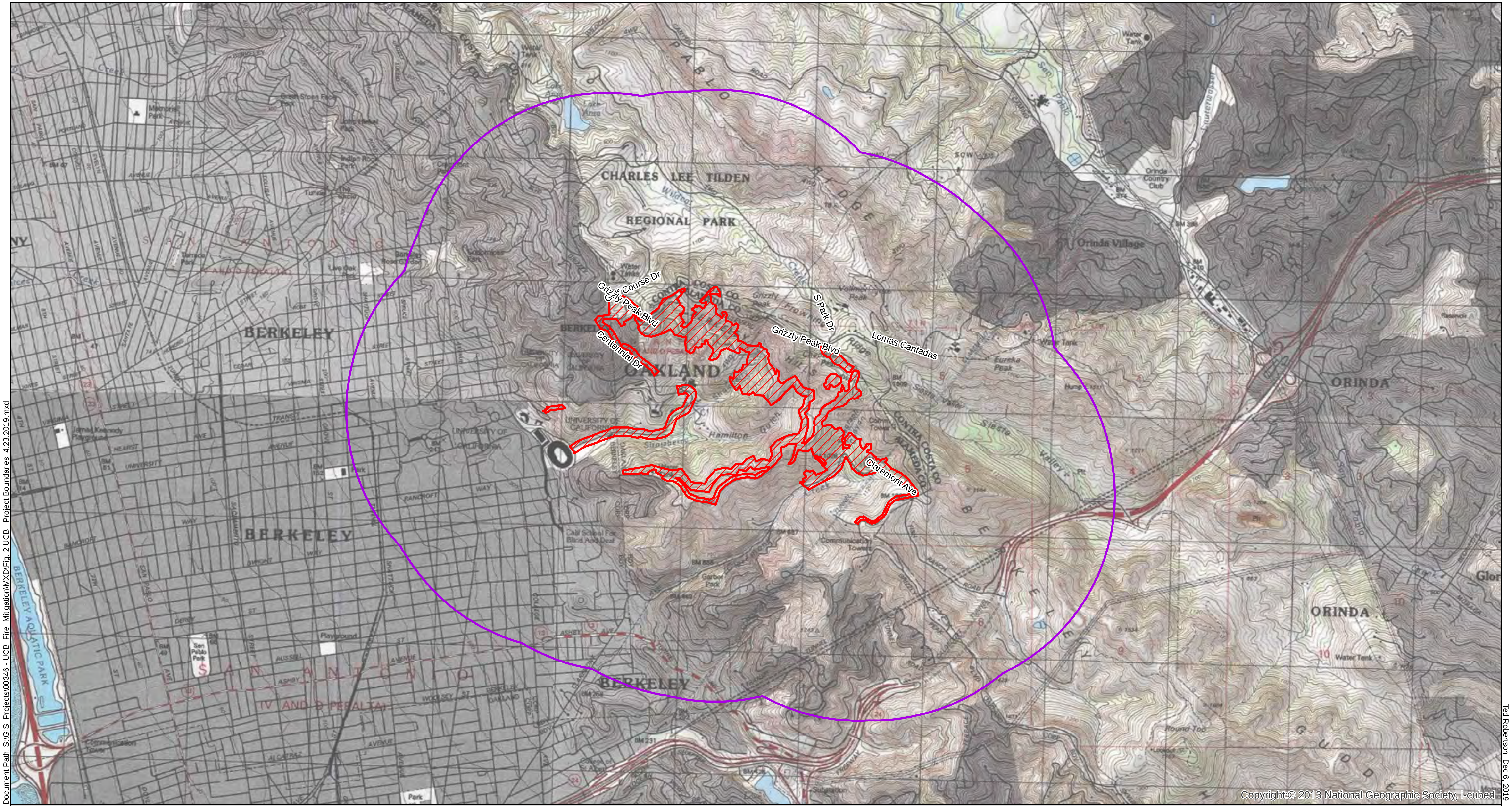
Miles

CONDOR COUNTRY
CONSULTING, INC.



Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 2 UCB Project Boundaries 4.23.2019.mxd

Ted Robertson Dec 6, 2019

▨ Project Area
☐ 1 Mile Buffer

Project Boundaries
UC Berkeley Hill Camus Fire Hazard Reduction Project
Alameda and Contra Costa Counties, California

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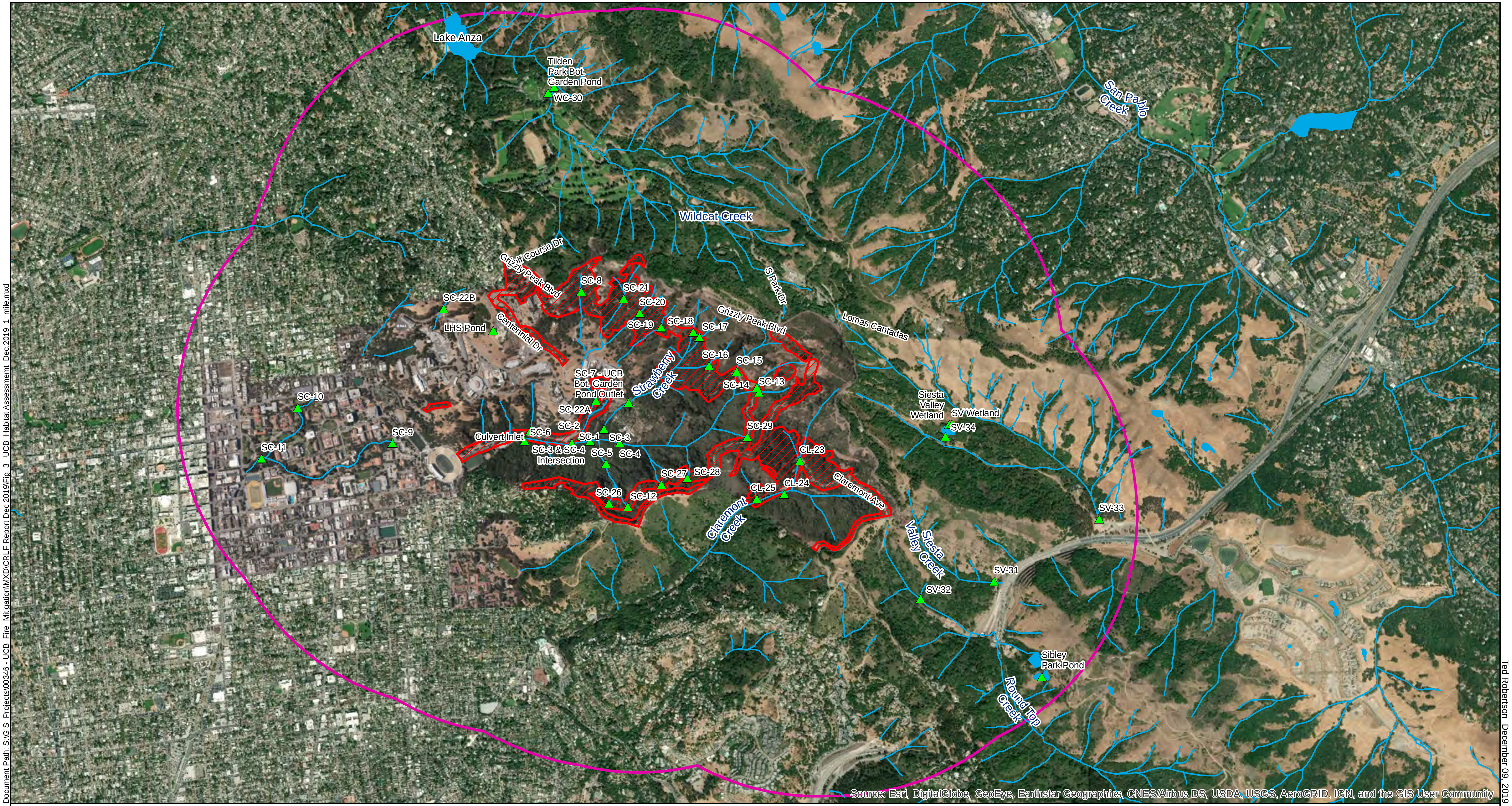
FIGURE 2

CONDOR COUNTRY
CONSULTING, INC.



Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\CRLF Report Dec 2019\Fig. 3 UCB Habitat Assessmemt Dec.2019 1 mile.mxd

Ted Robertson December 09, 2019

▲	CRLF Habitat Assessment Sites
▨	UCB Fire Mitigation Project Area
☐	1-mile Project Buffer
🟦	NWI Riverine Data

SC = Strawberry Cr. Watershed
C = Claremont Cr. Watershed
SV = Siesta Valley Watershed
W = Wildcat Cr. Watershed

Frog Habitat Assessment Locations within 1 mile of the Project Boundaries

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa Counties, California

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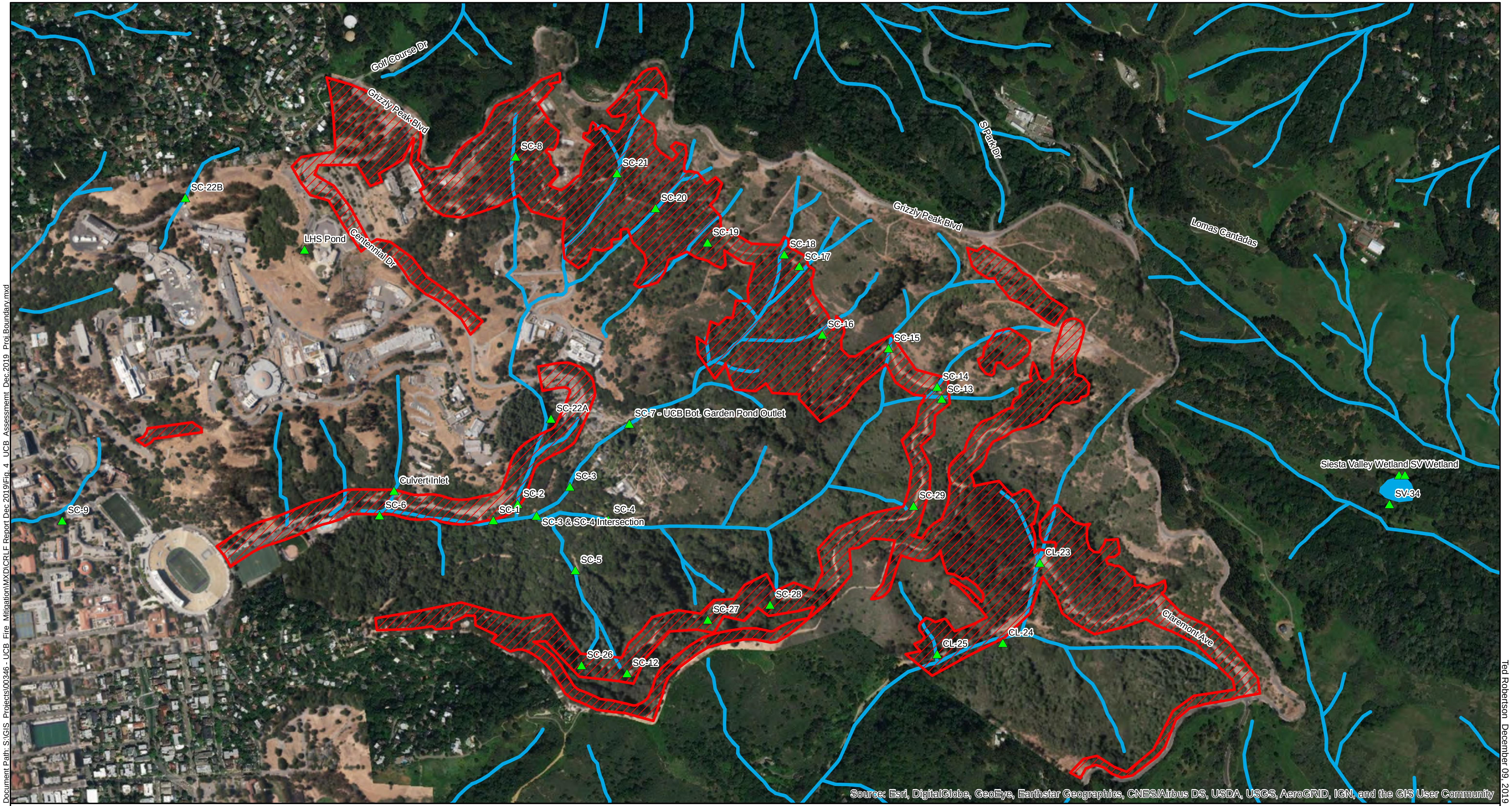
FIGURE 3

CONDOR COUNTRY CONSULTING, INC.



Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\CRLF Report Dec 2019\Fig. 4 UCB Assessmemt Dec.2019 Proj.Boundary.mxd

Ted Robertson December 09, 2019

- ▲ CRLF Habitat Assessment Sites
- ▨ UCB Fire Mitigation Project Project Area
- 🟦 NWI Riverine Data

SC = Strawberry Cr. Watershed C = Claremont Cr. Watershed
SV = Siesta Valley Watershed W = Wildcat Cr. Watershed

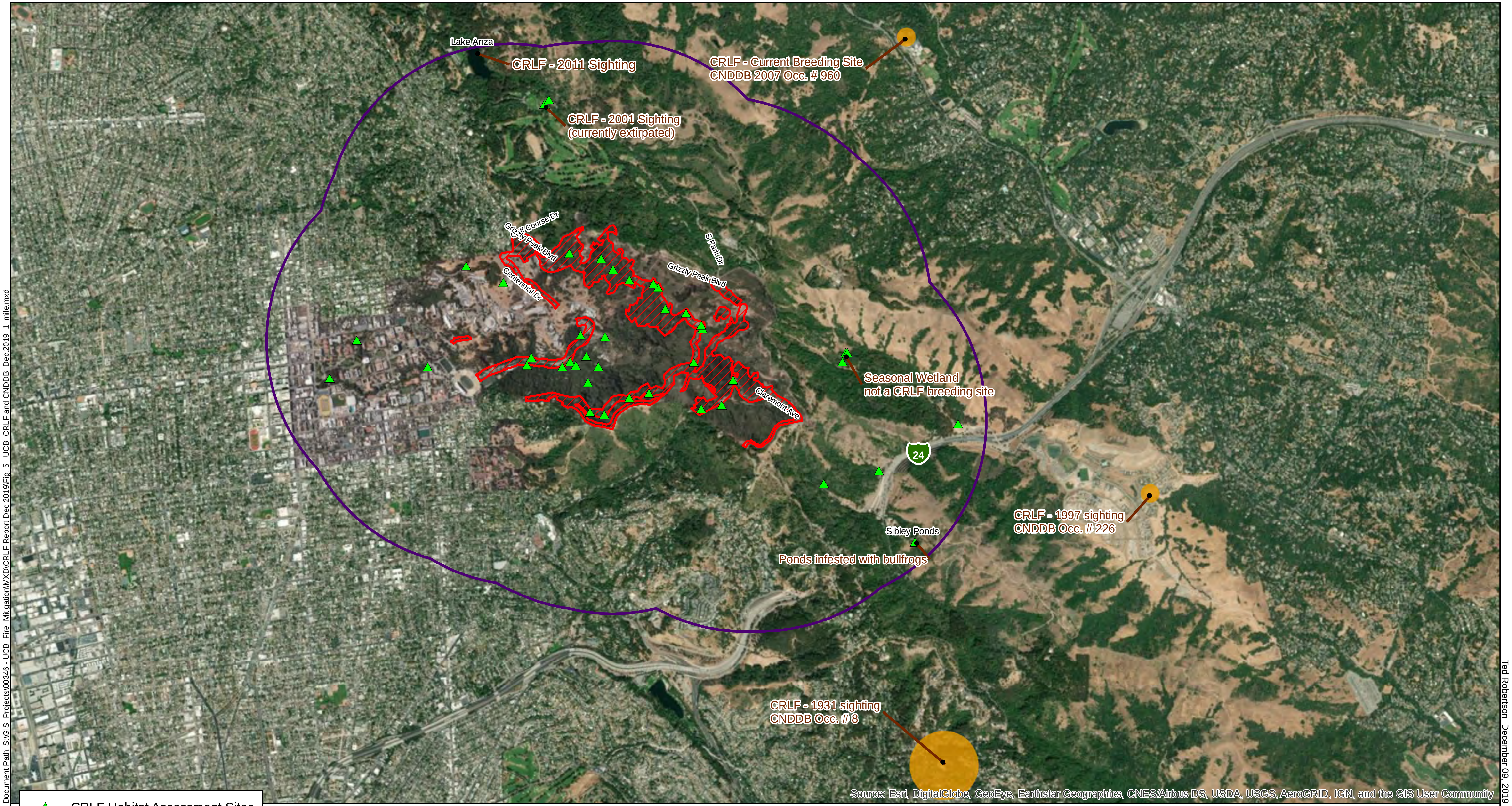
Frog Habitat Assessment Locations within the Project Boundaries

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa Counties, California

FIGURE 4

CONDOR COUNTRY CONSULTING, INC.



Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\CRLF Report Dec 2019\Fig. 5 UCB CRLF and CNDDB Dec.2019 1 mile.mxd

Ted Robertson December 09, 2019

▲ CRLF Habitat Assessment Sites

▨ UCB Fire Mitigation Project Area

☐ 1-mile Project Buffer

CNDDB Records

🟧 California red-legged frog

SC = Strawberry Cr. Watershed
C = Claremont Cr. Watershed
SV = Siesta Valley Watershed
W = Wildcat Cr. Watershed

CRLF Sightings and CNDDB Records

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa Counties, California

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FIGURE 5

CONDOR COUNTRY
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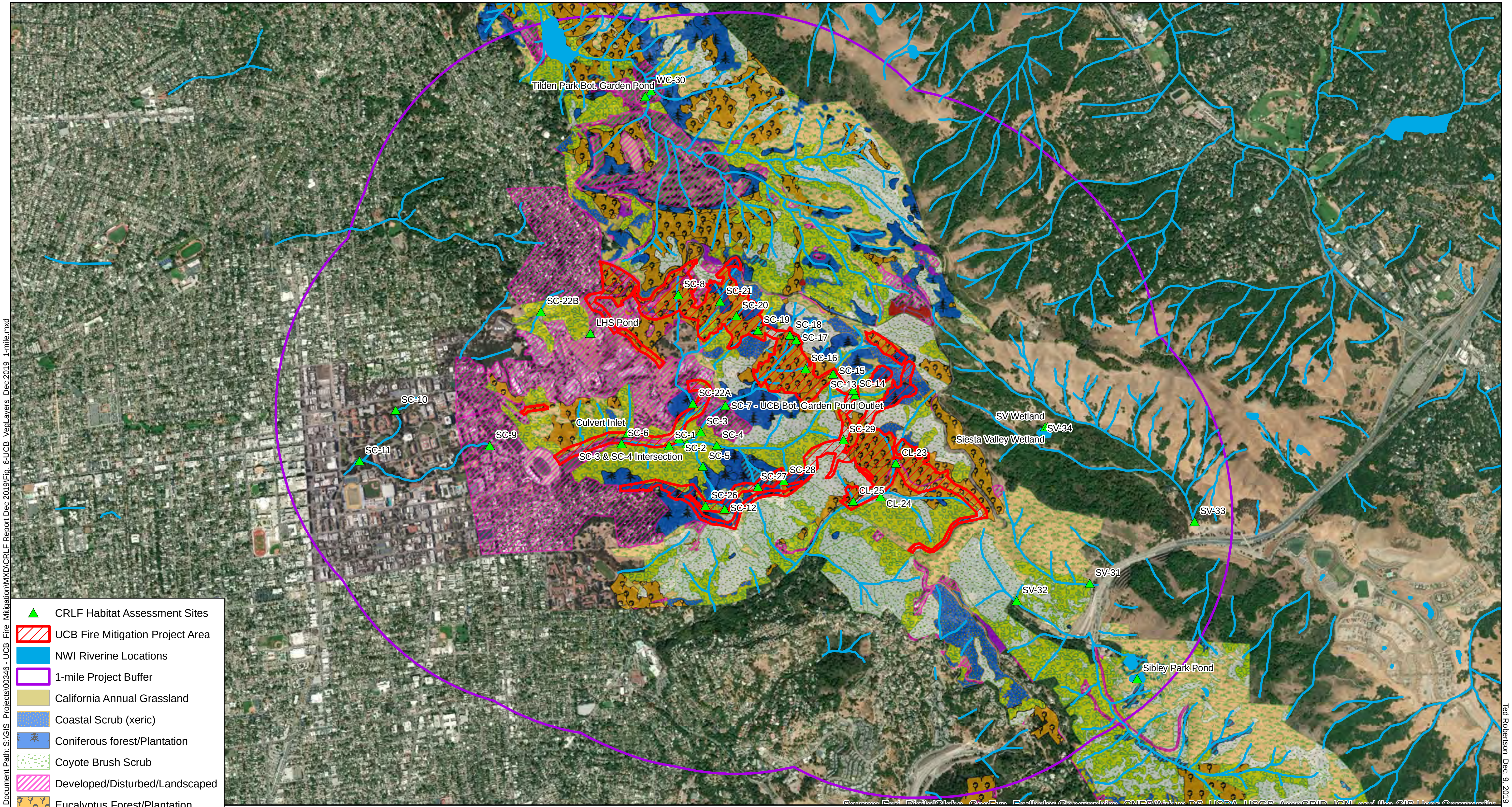

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- ▲ CRLF Habitat Assessment Sites
- ▨ UCB Fire Mitigation Project Area
- ■ NWI Riverine Locations
- ☐ 1-mile Project Buffer
- ■ California Annual Grassland
- ▨ Coastal Scrub (xeric)
- ▨ Coniferous forest/Plantation
- ▨ Coyote Brush Scrub
- ▨ Developed/Disturbed/Landscaped
- ▨ Eucalyptus Forest/Plantation
- ■ Non-native Coniferous Forest
- ■ Northern Maritime Chaparral
- ▨ Oak-Bay Woodland/Forest
- ■ Redwood Forest
- ▨ Riparian Woodland
- ▨ Successional grassland

HABITATS

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa County, California

SC = Strawberry Cr. Watershed
C = Claremont Cr. Watershed
SV = Siesta Valley Watershed
W = Wildcat Cr. Watershed

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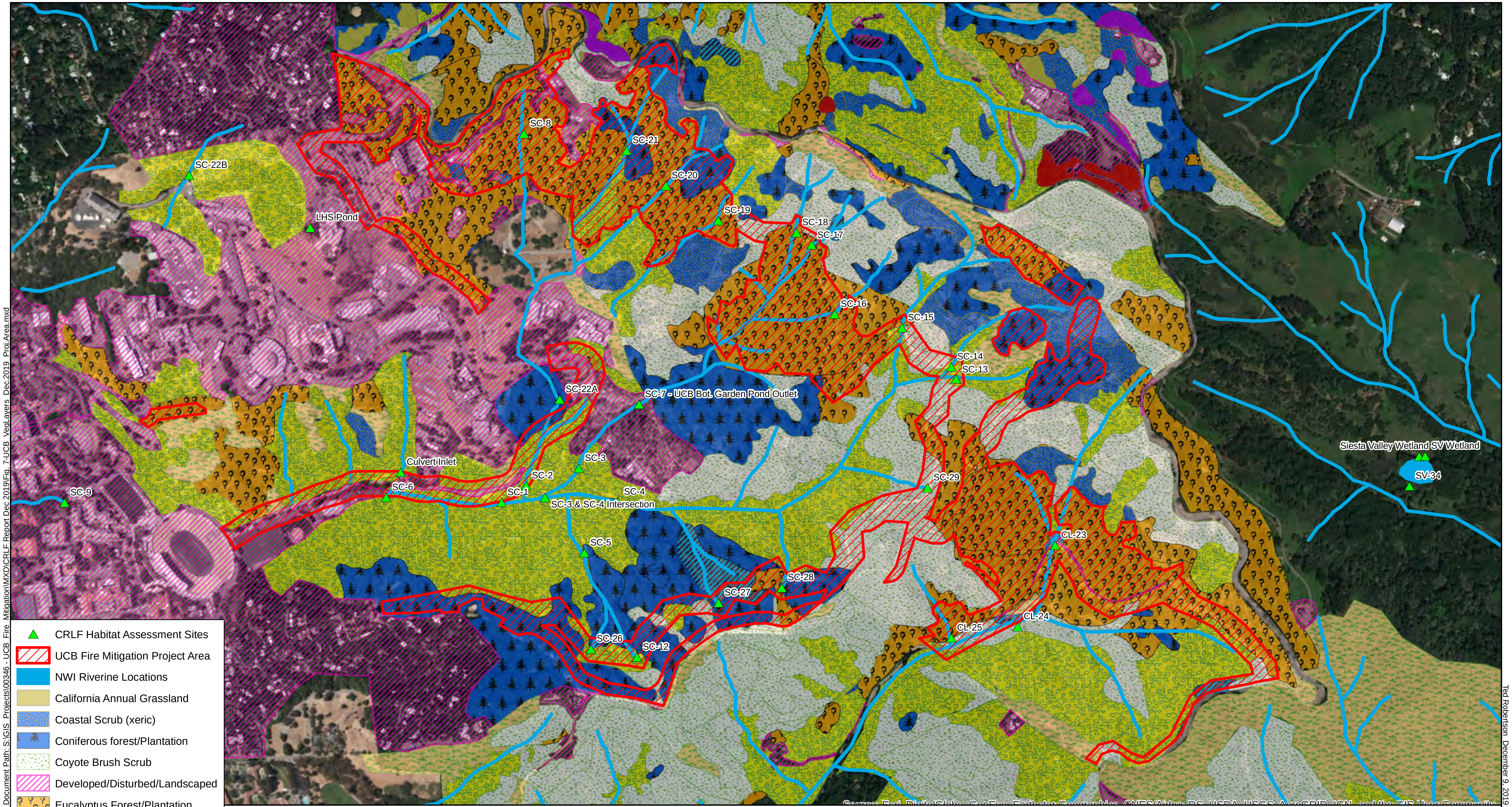
0 0.2 0.4 0.6 0.8 1 Miles

FIGURE 6

CONDOR COUNTRY
CONSULTING, INC.

Document Path: S:\GIS_Projects\00346 - UCB_Fire_Mitigation\MXD\CRLF Report Dec 2019\Fig. 6-UCB_VegLayers_Dec2019_1-mile.mxd

Ted Robertson Dec. 9, 2019



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

▲ CRLF Habitat Assessment Sites
▨ UCB Fire Mitigation Project Area
🟦 NWI Riverine Locations
🟨 California Annual Grassland
▨ Coastal Scrub (xeric)
▨ Coniferous forest/Plantation
▨ Coyote Brush Scrub
▨ Developed/Disturbed/Landscaped
▨ Eucalyptus Forest/Plantation
🟪 Non-native Coniferous Forest
🟩 Northern Maritime Chaparral
▨ Oak-Bay Woodland/Forest
🟥 Redwood Forest
▨ Riparian Woodland
▨ Successional grassland

SC = Strawberry Cr. Watershed
C = Claremont Cr. Watershed
SV = Siesta Valley Watershed
W = Wildcat Cr. Watershed

HABITATS

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa County, California

FIGURE 7

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CONDOR COUNTRY CONSULTING, INC.

Document Path: S:\GIS_Projects\00346 - UCB_Fire_Mitigation\MXD\CRLF Report Dec 2019\Fig. 7-UCB_VegLayers_Dec2019_ProjArea.mxd

Ted Robertson December 9, 2019

Appendix B

Site Photographs

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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S.C. (Strawberry Creek) - 01: Alameda County, U.C. Berkeley

- Steep banks, fast-moving stream with no pools, no emergent vegetation and rocky substrate.
- Not characteristic of adequate CRLF breeding habitat.

S.C. - 02: Alameda County, U.C. Berkeley

- Steep banks with concrete features and substrate, no emergent vegetation.
- Fast-moving water, few legitimate pools – stream segment does not represent adequate CRLF breeding habitat.

S.C. - 03: Alameda County, U.C. Berkeley

- Fast-moving stream with some small pools, very steep banks with rocky substrate.
- Main pool occurs at base of culvert, shallow depth and lack of emergent (or submerged) vegetation represent poor CRLF breeding habitat.

S.C. - 04: Alameda County, U.C. Berkeley

- Fast-moving stream, small bank width, steep banks, banks choked with blackberry and other overhanging vegetation.
- No emergent vegetation present, substrate is rocky, stream segment does not represent adequate CRLF habitat.

Photo 1. S.C. - 04 Terminating into culvert.

Photo 2. S.C. - 04 emptying from culvert.

S.C. - 05: Alameda County, U.C. Berkeley

- Small, fast-moving stream with steep banks, sandy/silty substrate, and large amounts of overhanging vegetation dominating banks.
- No pooling areas or emergent vegetation in stream segment, does not represent adequate CRLF habitat.

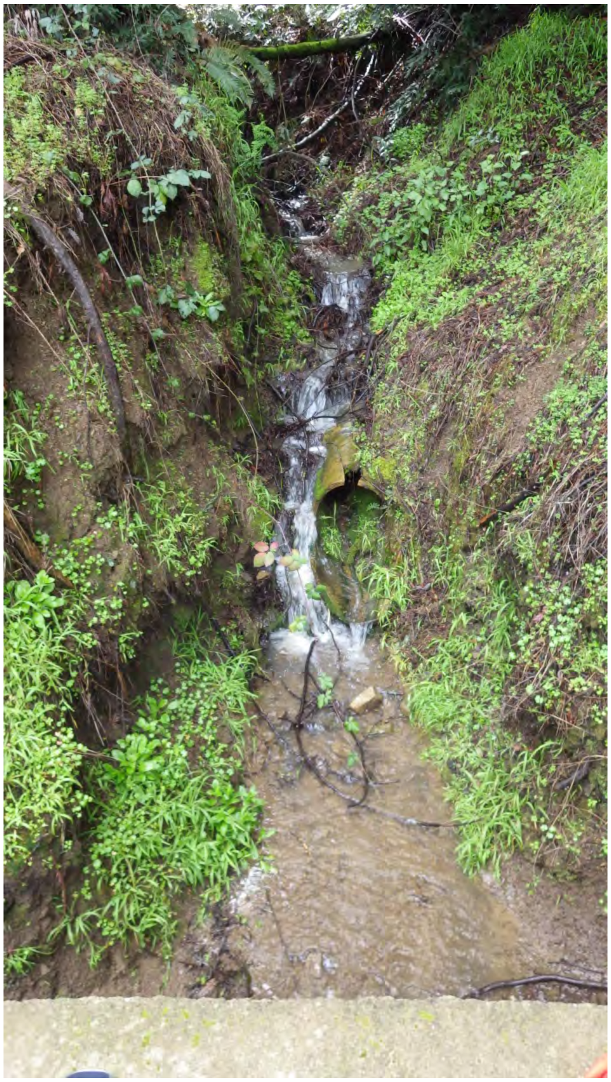

Photo 1. S.C. - 05 terminating into culvert at **Photo 2.** S.C. - 05 emptying into
blackberry thicket.
base of photo.

S.C. - 06: Alameda County, U.C. Berkeley

- Small, slow-flowing glide, silty/mud substrate with steep slopes and no pooling areas.
- Stream segment is 1-2 inches deep with no emergent vegetation, does not represent adequate CRLF habitat.

S.C. - 07: Alameda County, U.C. Berkeley

- Small fast-moving stream with steep banks, rocky substrate, narrow width and no emergent vegetation.
- Stream flows out of U.C. Berkeley Botanical Garden pond, represents potential (though unlikely) CRLF habitat.

S.C. - 08: Alameda County, U.C. Berkeley

- Small riffle, slow-moving with no pooling areas, no emergent vegetation and rocky/silty substrate.
- Lack of pools and emergent vegetation, does not represent adequate CRLF habitat.

S.C. - 09: Alameda County, U.C. Berkeley

- Shallow, fast-moving stream with one pool beneath culvert exit. Rocky/concrete substrate, steep banks and no emergent vegetation.
- Located within U.C. Berkeley campus in urban setting, lack of pooling and emergent vegetation does not represent adequate CRLF habitat.

Photo 1. S.C. - 09 emptying from culvert and flowing downstream.

Photo 2. S.C. 09 downstream from culvert, depicting rocky substrate, urban setting and lack of emergent vegetation.

S.C. - 10: Alameda County, U.C. Berkeley

- Large, fast-moving stream, relatively wide with large, deep pooling areas. Substrate is rocky/muddy/silty with no emergent vegetation, steep banks, and extensive bank coverage by invasive English ivy (*Hedera helix*).
- Stream segment represents appropriate CRLF habitat, though lack of emergent vegetation, steep banks, and presence of extensive vegetation covering banks means their presence is unlikely.

S.C. - 11: Alameda County, U.C. Berkeley

- Fast-moving stream with wide, steep banks, no emergent vegetation and large pools.
- Substrate is rocky, banks are covered in scattered annual grasses, duff, English ivy (*Hedera helix*), and *Cornus* sp.
- Stream segment represents appropriate CRLF habitat, though a lack of species records in the area makes their presence unlikely.

S.C. - 12: Alameda County, U.C. Berkeley

- Fast-moving stream with rock/gravel/silt substrate, emptying from a culvert into steep, narrow canal.
- Banks are steep and choked with vegetation, with no pooling areas and no emergent vegetation.
- Stream segment does not represent adequate CRLF habitat.

Photo 1. S.C. - 12, yellow arrow shows location of culvert, the stream itself was not visible or safely accessible.

S.C. - 13: Alameda County, U.C. Berkeley

- Narrow, fast-moving stream with low water levels during survey, rocky substrate, and steep banks.
- Banks dominated by accumulated duff and organic matter. No emergent vegetation present, no pooling areas and clear ephemeral conditions.
- Does not represent adequate CRLF habitat.

S.C. - 14: Alameda County, U.C. Berkeley

- Fast-flowing stream with no pools, no emergent vegetation and a rocky/silty substrate.
- Stream segment is ephemeral with steep banks and does not represent adequate CRLF habitat.

S.C. - 15: Alameda County, U.C. Berkeley

- Fast-moving stream segment with steep banks, a steep grade with sharp drops no pooling areas, and a rocky/silty substrate.
- Stream segment has no emergent vegetation and no pooling areas, meaning it does not represent adequate CRLF habitat.

S.C. - 16: Alameda County, U.C. Berkeley

- Segment is not an actual creek, merely an ephemeral water collection point along a fire road. Not classified as CRLF habitat.

S.C. - 17: Alameda County, U.C. Berkeley

- Fast-flowing stream with steep banks, no emergent vegetation and rocky/silty substrate.
- Stream is too small with no pooling areas to support CRLF. Not adequate CRLF habitat.

S.C. - 18: Alameda County, U.C. Berkeley

- Fast-flowing, shallow, steep-banks with no emergent vegetation and no pooling areas.
- Does not represent adequate CRLF habitat.

S.C. - 19: Alameda County, U.C. Berkeley

- Stream segment is not currently running, and does not appear to have been running for some time.
- Does not represent adequate CRLF habitat.

S.C. - 20: Alameda County, U.C. Berkeley

- Stream segment not currently running, and looks to not have been running for some time.
- Does not represent adequate CRLF habitat.

S.C. - 21: Alameda County, U.C. Berkeley

- Stream segment is not currently running. The amount of vegetation filling the former segment suggests that water has not run through it significantly in some time.
- Segment does not represent adequate CRLF habitat.

S.C. - 22A: Alameda County, U.C. Berkeley

- Large, fast-flowing stream with rocky substrate and no emergent vegetation.
- Pooling areas are present along with steep, rocky banks and large rocks throughout.
- Stream segment represents potentially adequate CRLF habitat. No animals seen in the area.

S.C. - 22B: Alameda County, U.C. Berkeley

- Stream segment is fast-flowing, very shallow, with a rocky substrate and no emergent vegetation or pooling areas.
- Does not represent adequate CRLF habitat.

C - 23: Alameda County, U.C. Berkeley

- Stream segment is fast-flowing, very shallow, with a rocky substrate and no emergent vegetation or pooling areas.
- Does not represent adequate CRLF habitat.

C - 24: Alameda County, U.C. Berkeley

- Stream segment is fast-flowing, has a large pooling area, though the water moves fast through it, no emergent vegetation with a rocky, sandy substrate.
- Represents potentially suitable CRLF habitat, though not suitable breeding habitat.

The pooling area is large enough for CRLF to live in, but the water moves too quickly for this area to act as a breeding site for CRLF.

C - 25: Alameda County, U.C. Berkeley

- There was no water in this stream three days after a rain event. It is therefore likely to dry up too quickly to support amphibian populations.
- Does not represent adequate CRLF habitat.

S.C. - 26: Alameda County, U.C. Berkeley

- Small, fast-moving stream with steep banks, shallow depth and no emergent vegetation.
- Rocky to sandy substrate, no emergent vegetation, and no pooling areas makes this inadequate CRLF habitat.

S.C. - 27: Alameda County, U.C. Berkeley

- No running water, no emergent vegetation, no substrate other than silt and leafy debris.
- Not adequate CRLF habitat.

Photo 1. Depicting culvert and drainage paths leading under road.

Photo 2. Culvert terminating on other side of road into dense blackberry thicket (arrow points to culvert).

S.C. - 28: Alameda County, U.C. Berkeley

- No water present at time of survey. Stream is simple drainage ditch with no vegetation, no pooling areas, and no adequate CRLF habitat.

Photo 1. Drainage moves into culvert and beneath road.

Photo 2. Stream terminates in culvert and empties into area dominated by blackberry thicket.

S.C. - 29: Alameda County, U.C. Berkeley

- No water at time of survey. No emergent vegetation, minimal banks, likely does not hold water more than a few days after a rain event. Does not represent adequate CRLF habitat.

Photo 1. Drainage moves into culvert and beneath road.

Photo 2. Stream terminates in culvert and empties into area dominated by blackberry thicket.

W.C. (Wildcat Creek) - 30: Alameda County, U.C. Berkeley

- This stream is shallow (within 2 days of a rain event), concrete-lined, fast-flowing and has no emergent vegetation.
- Does not represent adequate CRLF habitat.

S.V. (Siesta Valley) 31: Contra Costa County, Siesta Valley

- Fast-flowing stream with small pooling areas, split into north fork and south fork.
- Both forks have steep banks dominated by invasive Himalayan blackberry, and no emergent vegetation. Stream does not represent adequate CRLF habitat.

Photo 1. S.V. 31 – South fork.

Photo 2. S.V. 31 – North fork.

S.V. 32: Contra Costa County, Siesta Valley

- Large, fast-moving stream with no large pooling areas and no emergent vegetation.
- Represents low quality CRLF habitat.

S.V. 33: Contra Costa County, Siesta Valley

- Large, fast moving stream with no emergent vegetation, dense canopy, no large pooling areas and banks dominated by invasive vegetation (Himalayan blackberry).

Photo 1. Downstream portion of S.V. 33, tree in photo is *Salix sp.*

Photo 2. Upstream portion of S.V. - 33.

<u>Sibley Park Pond: Contra Costa County</u>

- Diked pond with tules (*Schoenoplectus* sp.) throughout.
- Site is currently a breeding pond for large numbers of bullfrogs (*Lithobates catesbeianus*).
- Bullfrogs have captured the site, preventing other amphibians such as CRLF from using this pond for breeding or dispersal.

Tilden Park Botanical Garden Pond: Contra Costa County

- Concrete-lined pond, filled artificially, no emergent vegetation.
- Site is currently a breeding pond for California newts (*Taricha torosa*) and Sierran tree frogs (*Pseudacris sierra*).
- Represents adequate CRLF habitat, though no frogs were seen during initial survey.

Photo 1. Tilden Regional Park Botanical Garden Pond.

Photo 2. Sierran tree frog (*Pseudacris sierra*).

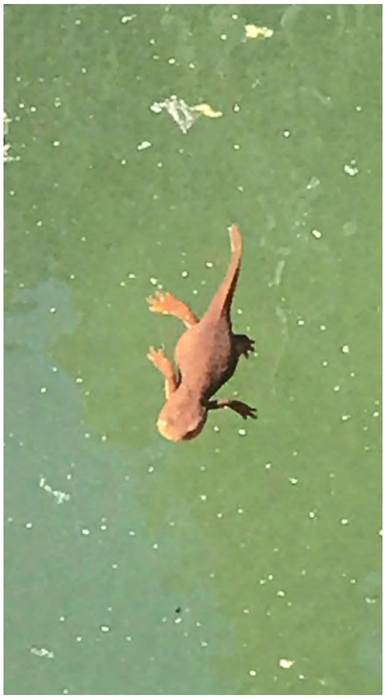

Photo 3. California newt (*Taricha torosa*)

U.C. Berkeley Botanical Garden Pond: Alameda County

- Large pond, estimated depth of three feet, with water lily and *Iris laevigata* throughout.
- Breeding habitat for rough-skinned (*Taricha granulosa*) and California newts (*Taricha torosa*) and Sierran tree frogs (*Pseudacris sierra*), 200+ adult newts and 100+ newt egg masses.
- Strawberry Creek runs into and out of this pond, meaning it is potential dispersal habitat for amphibians. The pond represents good CRLF habitat, though none were seen during initial survey, and none have been reported occurring in the pond.

Photo 1. Rough-skinned newt adult.

Photo 2. Newt egg masses.

Lawrence Hall of Science (LHS) Pond: Alameda County

- Pond is small with emergent vegetation (*Typha latifolia*) and silty/rocky substrate.
- Pond is ephemeral in nature, losing all water within one month of the last rain events.
- According to LHS stewards, the pond has not housed any visible wildlife for at least the past two years.
- Pond is poor CRLF habitat, due to the past presence of bullfrogs and crayfish and current ephemeral nature.

Appendix C

Correspondence Letters

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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From: Devin L. WOOLRIDGE
To: Ted Robertson
Cc: Carol Rice
Subject: Fwd: FW: CRLF habitat assessment
Date: Friday, March 08, 2019 10:20:10 AM
Attachments: image001.png

Hi Ted,

This is what we have received from EBRP so far. I don't quite understand it, so I'm not sure if it's what you requested or if it's through enough, etc. Take a look at it and let me know what might be the next steps.

Devin

---------- Forwarded message ---------
From: **Brad Gallup** <bgallup@ebparks.org>
Date: Thu, Mar 7, 2019 at 1:24 PM
Subject: FW: CRLF habitat assessment
To: Devin L. WOOLRIDGE <woolridg@berkeley.edu>

Devin – Kristen sent this to me before and I forgot to forward to you. Sorry about that.

If you have questions, feel free to contact Kristen directly.

Thank you

Brad Gallup
Assistant Fire Chief | Fire Department
East Bay Regional Park District
17930 Lake Chabot Road, Castro Valley, CA 94546
T: 510-690-6606| F: 510-881-4942
bgallup@ebparks.org | www.ebparks.org

From: Kristen Van Dam <KVanDam@ebparks.org>
Sent: Tuesday, March 5, 2019 10:06 AM
To: Brad Gallup <bgallup@ebparks.org>
Subject: FW: CRLF habitat assessment

Here is what we have.

Kristen

Kristen Van Dam
Resource Analyst / Ecologist | Stewardship
East Bay Regional Park District
2950 Peralta Oaks Court, Oakland, CA 94605
T: 510-544-2324| F: 510-635-3478
KVanDam@ebparks.org | www.ebparks.org

From: Edward Culver
Sent: Tuesday, March 5, 2019 9:49 AM
To: Tammy Lim <TLim@ebparks.org>; Steven Bobzien <sbobzien@ebparks.org>; Kristen Van Dam <KVanDam@ebparks.org>
Cc: Doug Bell <DBell@ebparks.org>; Joe Sullivan <JSullivan@ebparks.org>
Subject: RE: CRLF habitat assessment

Here are the instances of CRLF that I show in Tilden Park in the Fisheries Database.

Description	Species	Long	Lat
CRLF sub-adult 2011 – Brook Base	California Red-legged Frog	-122.26326915000	37.90742164750
CRLF egg mass – 2013 – EEC Ponds	California Red-legged Frog	-122.26717905900	37.91111489500
CRLF – 2008 – Pond Survey	California Red-legged Frog	-122.26717905900	37.91111489500
Adult CRLF 2001 – Bot Garden	California Red-legged Frog	-122.24366836000	37.89304090500

The CRLF in red is well within the 1-mile buffer. This was an adult observed in the larger of the Botanic Garden ponds in 2001.

The CRLF in yellow is just on the edge of the 1-mile buffer (at the north end of Lake Anza). This was a sub-adult observed during Fisheries surveys of Wildcat Creek. It was confirmed by Joe DiDonato.

The other two instances occurred in the Environmental Education Center ponds in 2008 and 2013. I believe that the 2008 occurrence was observed by Steve during his pond surveys, so he might be able to provide more insight into this particular observation.

I hope this helps.

Ed

Edward Culver
Resource Analyst I - Fisheries Biologist | Fisheries Management Unit
East Bay Regional Park District
2950 Peralta Oaks Court, Oakland, CA 94605
T: 510-544-2342
ECulver@ebparks.org | www.ebparks.org

From: Tammy Lim <TLim@ebparks.org>
Sent: Monday, March 04, 2019 2:11 PM
To: Edward Culver <ECulver@ebparks.org>; Steven Bobzien <sbobzien@ebparks.org>; Kristen Van Dam <KVanDam@ebparks.org>
Cc: Doug Bell <DBell@ebparks.org>
Subject: FW: CRLF habitat assessment

Hi Kristen,

I asked Doug about this and unfortunately, we are a dead end!

Ed and Steve might have a better idea what/where stream CRLF frog habitat occurs (items 1-3). I've cc'd both of them.

In regards to the fourth item, is that Nate Luna? I'm not sure who deals with site access that's not a research project.

Requests from Condor Country:

1. Their report and data sheets for each body of water they assessed.
2. Are there any unreported CNDDB CRLF locations (I only have 2 CNDDB locations and they are just outside of the 1-mile project buffer).
3. We will need to get a GIS layer of all of ponds (and stock ponds) within 1 mile of the UCB properties.
4. Who we need to contact to get permission for a site visit.

Tammy Lim
Resource Analyst | Acquisition, Stewardship & Development

From: stephen edwards
To: Ted Robertson
Subject: Re: Hi and a pond question
Date: Wednesday, March 27, 2019 11:12:49 AM

Hi Ted,
The pond was built in 1980. I had seen one or two red legged frogs under the garden's creek dogwood patch--close to Wildcat Creek-- in each of 1970 and 71. Then I was away from the garden until 1978 I think. Never saw any red leggeds from then on until we rebuilt the pond somewhere around 2000. I forget the year. There were a couple, as I vaguely recall, hopping about in the vegetation near the pond. This was strange, as, during the life of the first pond, I looked for these frogs every day, and never saw one.

Where did these come from? Anyway, soon after we rebuilt the pond, kids started sneaking bullfrogs into it, and these were a recurrent problem, and probably still are today. We never saw a red legged frog in the garden again (I can speak for my time there which ended in late 2013).

Steve

> On March 27, 2019 at 8:23 AM Ted Robertson <Ted@condorcountry.com> wrote:
>
> Hi Steve,
>
> I have a quick question regarding the Tilden botanical garden pond. Do you know what year it was first created? I'm writing a red-legged frog habitat assessment and the history of the pond's creation would help me with that effort. Also, any history of red-legged frogs or bullfrog occupancy would be helpful too.
>
> Hope all is well,
>
> Ted Robertson
>
> *Biologist II*
> Condor Country Consulting, Inc.
> 815 Estudillo Street
> Martinez, CA 94553
> url: condorcountry.com

Appendix D

CRLF Habitat Site Assessment Data Sheets

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 02/28/2019 (mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name), Ted (first name) ______ (Last name) ______ (first name)

Sandy (Last name), Grayson (first name) ______ (Last name) ______ (first name)

Site Location: S.C. #1, Alameda Co., UC Berkeley, 37.87239593, -122.2413249
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: S.C #1

Bank full width: 8 ft.

Depth at bank full: 1 ft.

Stream gradient: 3-5°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ________

Maximum depth of stream pools: ________

Characterize non-pool habitat: run, [✓ riffle], glide, other: ________

Vegetation: emergent, [✓ overhanging], dominant species:
Quercus agrifolia, Prunus spp
No Emergent veg.

Substrate: Rocky

Bank description: Sandy, gravel, 45° bank Slope

[✓ Perennial] or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry: ________

Other aquatic habitat characteristics, species observations, drawings, or comments:

stream enters culvert. R.SHA Nest

SIDE-VIEW

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs – 4995-4996
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 02/28/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted (Last name) (first name) ______ (Last name) (first name)

Sandy, Grayson (Last name) (first name) ______ (Last name) (first name)

Site Location: SC-2: Alameda County, UC Berkeley, 37.8728122, -122,2405816
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (I mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-02

Bank full width: 12 ft then 6 ft.

Depth at bank full: 3 ft

Stream gradient: 0 to 10°

Are there pools (circle one)? [✓ YES] NO Just 1 below culverts

If yes,

Size of stream pools: 12 x 15 ft.

Maximum depth of stream pools: ______

Characterize non-pool habitat: run, riffle, glide, other:
Riffle w/ 1-pool

Vegetation: emergent, overhanging, dominant species:
Calif. Buckeye Umbellularia californica
Quercus agrifolia, no emergent veg.

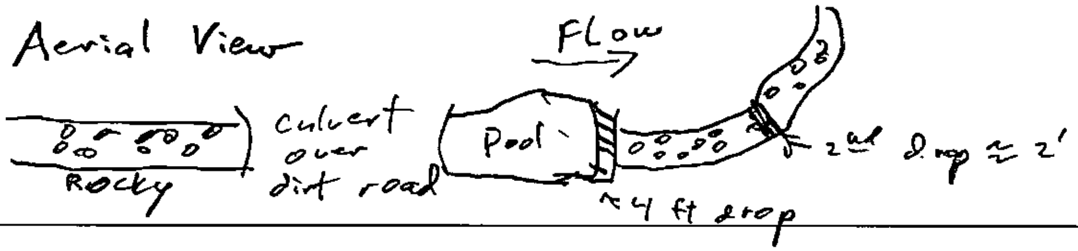
Substrate: Rocky

Bank description: Steep, rocky, 45+ bank gradient.

Perennial or [✓ Ephemeral] *(circle one).* If ephemeral, date it goes dry: Late Summer.

Other aquatic habitat characteristics, species observations, drawings, or comments:

*37.872823, -122.240578 → GPS



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 4997 - 5001
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (Biologist)

Date of Site Assessment: 02/28/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ______ (Last name) ______ (first name)

Sandy (Last name) Grayson (first name) ______ (Last name) ______ (first name)

Site Location: SC-3; Alameda County, U.C. Berkeley, 37.87325769, -122.2389745
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D. SC - 3

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-3

Bank full width: 4-8ft

Depth at bank full: 1ft

Stream gradient: 4°

Are there pools (circle one)? [✓ YES] NO → Just one @ culvert.

If yes,

Size of stream pools: 8×8 ft

Maximum depth of stream pools:

Characterize non-pool habitat: run, [✓ riffle], glide, other:

Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica

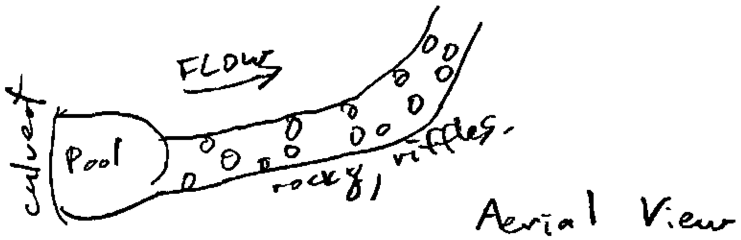
No emergent veg.

Substrate: Rocky

Bank description: steep (>45°), rocky

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Late Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs – 5002
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 02/28/2019 (mm/dd/yyyy)

Site Assessment Biologists:

Robertson	Ted		
(Last name)	(first name)	(Last name)	(first name)
Sandy	Grayson		
(Last name)	(first name)	(Last name)	(first name)

Site Location: SC-04; Alameda County; UC Berkeley, 37.8724617, -122.2377652
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-4

Bank full width: 2-5 ft

Depth at bank full: 1 ft

Stream gradient: 6°

Are there pools (circle one)? [✓ YES] NO

If yes,

Size of stream pools: 4-3 ft

Maximum depth of stream pools: 3 ft

Characterize non-pool habitat: run, [✓ riffle], glide, other:

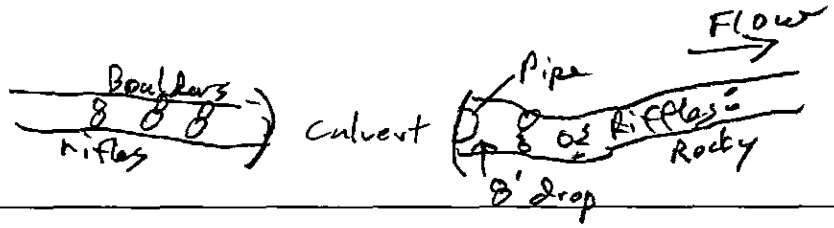
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia, californica
Salix (Arroyo willow)
No emergent veg.

Substrate: Rocky

Bank description: steep (45-60°), rocky

[✓ Perennial] or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry:

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 2/28/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted ______
(Last name) (first name) (Last name) (first name)

Sandy Grayson ______
(Last name) (first name) (Last name) (first name)

Site Location: SC-05: Alameda Co., UC Berkeley, 37.87120848, -1222387581
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-05

Bank full width: 1 ft

Depth at bank full: 6-8 in

Stream gradient: 20°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools:

Maximum depth of stream pools:

Characterize non-pool habitat: run, [✓ riffle], glide, other:

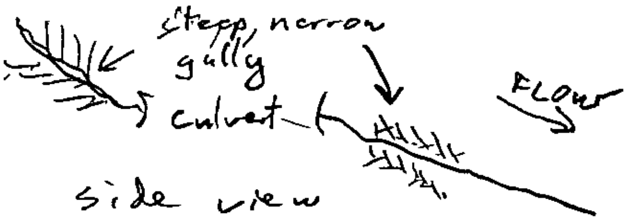
Vegetation: emergent, [✓ overhanging,] dominant species: Umbellularia californica Sequoia sempervirens, Rubus armeniacus, no emergent veg.

Substrate: Rocky

Bank description: Sandy, gravelly, (steep 45 - 75° slope).

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: late spring

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 005 - 5006
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 02/28/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ______ (Last name) ______ (first name)

Sandy (Last name) Grayson (first name) ______ (Last name) ______ (first name)

Site Location: SC-06: Alameda Co., UC Berkeley, 37.87246517, -122.2448556
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB 14111 Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-06

Bank full width: 10-15 ft

Depth at bank full: 1-2 ft

Stream gradient: 2-3°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: __________

Maximum depth of stream pools: __________

Characterize non-pool habitat: run, riffle, [✓ glide], other: __________

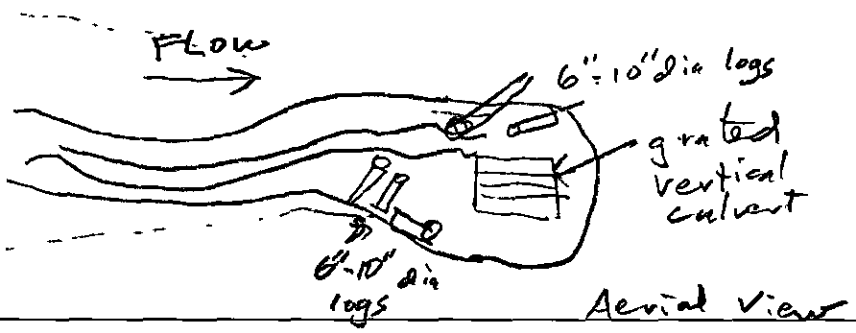
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica, Prunus spp., Rubus armeniacus., Annual grasses. No Emergent veg.

Substrate: silts, mud.

Bank description: Steep slopes, (30°- 45° slopes)

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: __________

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs -5007
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 02/28/2019
(mm/dd/yyyy)

Site Assessment Biologists:

Robertson	Ted		
(Last name)	(first name)	(Last name)	(first name)
Sandy	Grayson		
(Last name)	(first name)	(Last name)	(first name)

Site Location: SC-7: Alameda Co., UC Berkeley, 37.87438189, -122.2371679
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-07

Bank full width: 3 - 4 ft.
Depth at bank full: 6 in - 1 ft.
Stream gradient: 10°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools:
Maximum depth of stream pools:

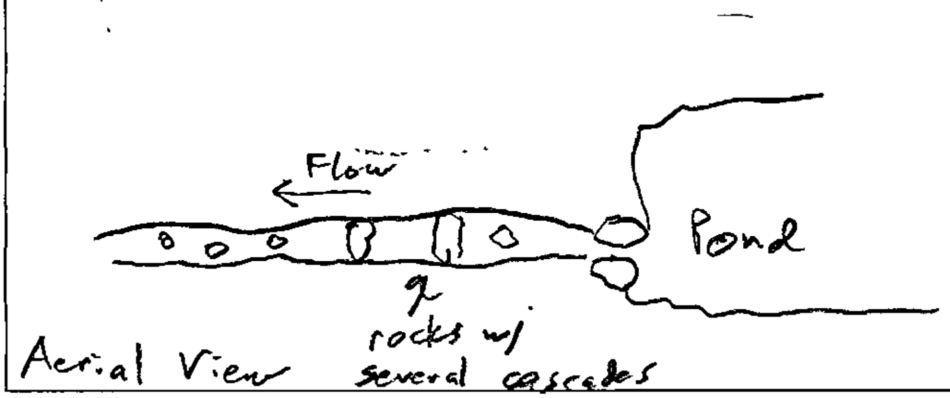
Characterize non-pool habitat: run, [✓ riffle], glide, other: small cascades

Vegetation: emergent, [✓ overhanging], dominant species:
Variety of ornamental trees (Botanical Garden)
No emergent veg.
Substrate: Rocky

Bank description: steep (30-60°), gravel, rocks, covered with scattered ferns

Perennial or Ephemeral *(circle one)*. If [✓ ephemeral], date it goes dry: Late Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs - 5010
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 02/28/2019
(mm/dd/yyyy)

Site Assessment Biologists:
Robertson (Last name) Ted (first name) ______ (Last name) ______ (first name)
Sandy (Last name) Grayson (first name) ______ (Last name) ______ (first name)

Site Location: SC-8: Alameda Co., UC Berkeley, 37.88134315, -122.2408431
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-8
Bank full width: 2-3 ft
Depth at bank full: 2-4in
Stream gradient: 20°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools:
Maximum depth of stream pools:

Characterize non-pool habitat: run, [✓ riffle], glide, other:

Vegetation: emergent, [✓ overhanging], dominant species: Eucalyptus globulus Umbellularia californica, No emergent or bank vegetation

Substrate: rock, silt

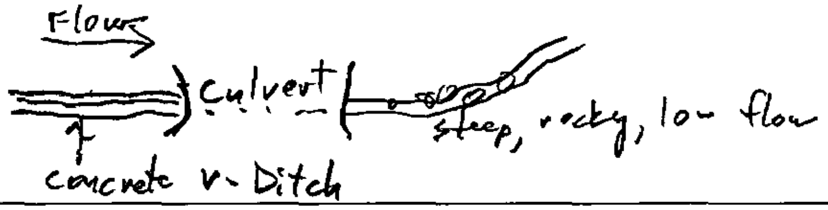
Bank description: rocky, gravel, silt, steep slope (30-50°)

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: 2-4 wks after last storm.

Other aquatic habitat characteristics, species observations, drawings, or comments:

Flow low, 24 hrs. after last storm.

Aerial view



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs - 5013 ⊕ 5014
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________ (FWS Field Office) ____________ (date) ____________ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ____________ (Last name) ____________ (first name)

Sandy (Last name) Grayson (first name) ____________ (Last name) ____________ (first name)

Site Location: SC - 09: Alameda Co., UCBerkeley, 37.87219253, -122.2546923
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-09

Bank full width: 3-4'

Depth at bank full: 2-4"

Stream gradient: 1°

Are there pools (circle one)? [✓ YES] NO

If yes,

Size of stream pools: 8x10' - sandy rocky substrate, No vegetation

Maximum depth of stream pools: 1,5 ft.

Characterize non-pool habitat: run, [✓ riffle], [✓ glide] other:

Vegetation: emergent, [✓ overhanging], dominant species: Sequoia sempervirens Umbellularia californica no emergent or bank vegetation

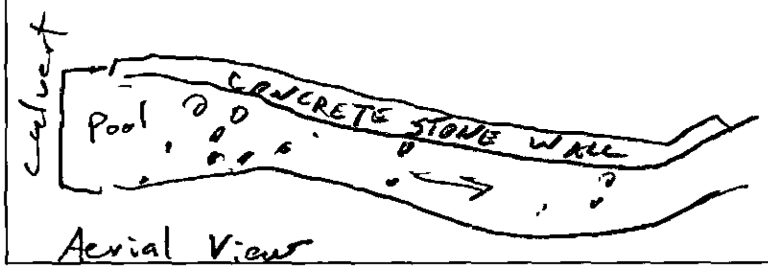
Substrate: rock

Bank description: rocky / duff & debris. SW = Rock Wall NE = Redwood leaf duff over loamy soils, on 10° slope.

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:

* GPS point at culvert



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs - 5015 - 5016
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted ______
(Last name) (first name) (Last name) (first name)

Sand Grayson ______
(Last name) (first name) (Last name) (first name)

Site Location: SC-10: Alameda Co, UCBerkeley, 37.87418055, -122.2617777
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ______

Appendix D. - SC-10

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-10

Bank full width: 5-10'

Depth at bank full: 6" - 2ft

Stream gradient: 2°

Are there pools (circle one)? [✓ YES] NO

If yes,

Size of stream pools: 10'x 20', 3'x 20', 4' x 20'

Maximum depth of stream pools: 3', 1', 2' respectively.

Characterize non-pool habitat: [✓ run], [✓ riffle], glide, other:

Vegetation: emergent, [✓ overhanging], dominant species: No Emergent

Hedera helix on banks

Overhang = Sequoia sempervirens, Umbellularia californica

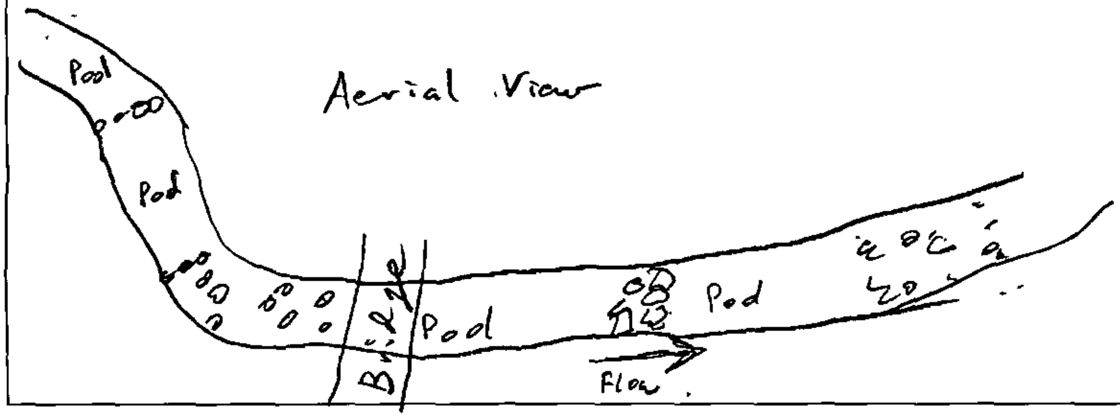
Substrate: Rocky & silty

Bank description: 35° slope w/ English Ivy or redwood leaf duff.

Undercut in a few spots

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: Mid-summer.

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5017 - 5018
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019 (mm/dd/yyyy)

Site Assessment Biologists:

(Last name)	(first name)	(Last name)	(first name)
Robertson	Ted		
Sandy	Grayson		

Site Location: SC-11; Alameda Co., UC Berkeley, 37.87115526, -122.2644041
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** **(include habitat types, important features, and species locations)****

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-11

Bank full width: 20ft

Depth at bank full: 6 in to 12 in.

Stream gradient: 1°

Are there pools (circle one)? [✓ YES] NO

If yes,

Size of stream pools: 15'x20'

Maximum depth of stream pools: 1.5 to 2 ft

Characterize non-pool habitat: run, [✓ riffle] glide, other:

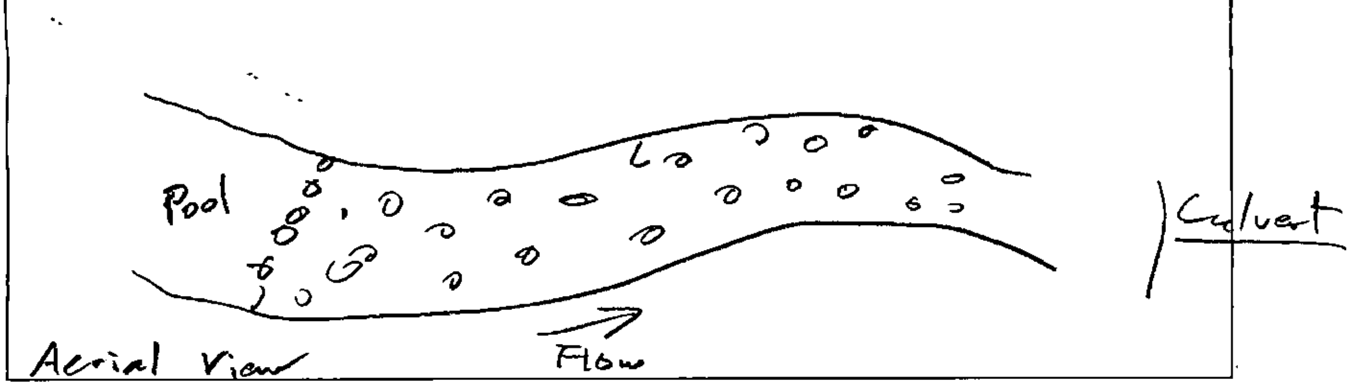
Vegetation: emergent, [✓ overhanging] dominant species:
No emergent.
Eucalyptus, Sequoia sempervirens, Umbellularia californica

Substrate: Rocky

Bank description: Steep, 80° to 30° slope.
Mostly Bare with scattered annual grasses & English ivy
& Cornus

[✓ **Perennial**] or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry:

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species location

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______________ (FWS Field Office) ______ (date) ______________ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted (Last name) (first name) ______________ (Last name) (first name)

Sandy Grayson (Last name) (first name) ______________ (Last name) (first name)

Site Location: SC-12: Alameda Co., UC Berkeley, 37.86870547, -122.237093
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______________ Maximum depth: ______________

Vegetation: emergent, overhanging, dominant species: ______________

Substrate: ______________

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ______________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-12

Bank full width: 20 ft.

Depth at bank full: 1 To 2 inches,

Stream gradient: 25°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools:

Maximum depth of stream pools:

Characterize non-pool habitat: run, [✓ riffle], glide, other:

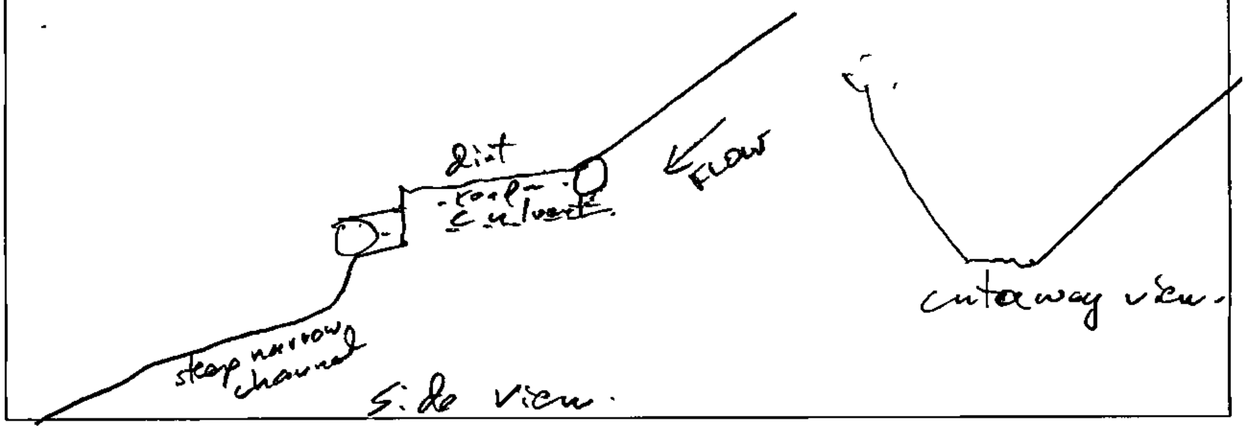
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica
no emergent Veg.

Substrate: Rocky

Bank description: Rocky, gravel, silt

Perennial or [✓ **Ephemeral**] *(circle one)*. If [✓ ephemeral], date it goes dry: Late spring.

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs - 5021
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________________
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists:

(Last name)	(first name)	(Last name)	(first name)
Robertson	Ted		
Sandy	Grayson		

Site Location: SC-13: Alameda Co., UC Berkeley, 37.87558983, -122.2274892
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-13

Bank full width: 2-4 ft

Depth at bank full: 1-2 in

Stream gradient: 18°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: —

Maximum depth of stream pools: —

Characterize non-pool habitat: run, [✓ riffle], glide, other:

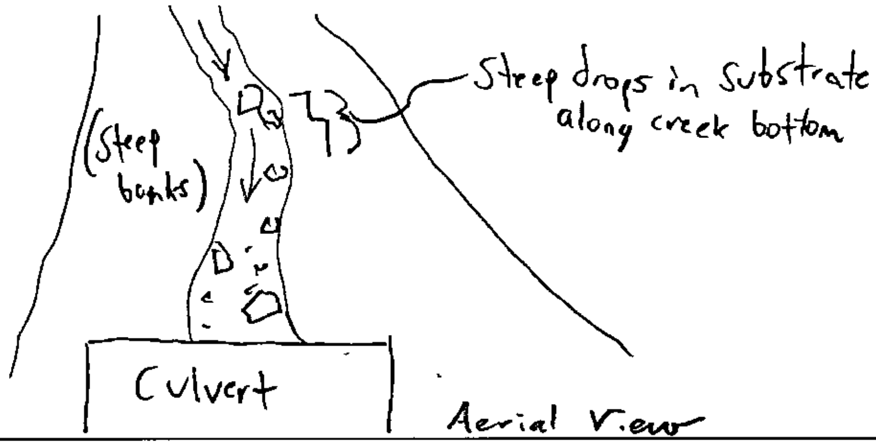
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica
NO EMERGENT VEG.

Substrate: rocky, silty

Bank description: rocky, silt, duff + organic matter

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5022-5023
3. Maps with important habitat features and species location

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019 (mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ______ (Last name) ______ (first name)

Sandy (Last name) Grayson (first name) ______ (Last name) ______ (first name)

Site Location: SC-14: Alameda Co., UC Berkeley, 37.87588235, -122.2276435 (County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D. SC-14
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-14

Bank full width: 1-2 ft

Depth at bank full: 1-2 in

Stream gradient: 27°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ____

Maximum depth of stream pools: ____

Characterize non-pool habitat: run, [✓ riffle], glide, other: fast-flowing, no pools

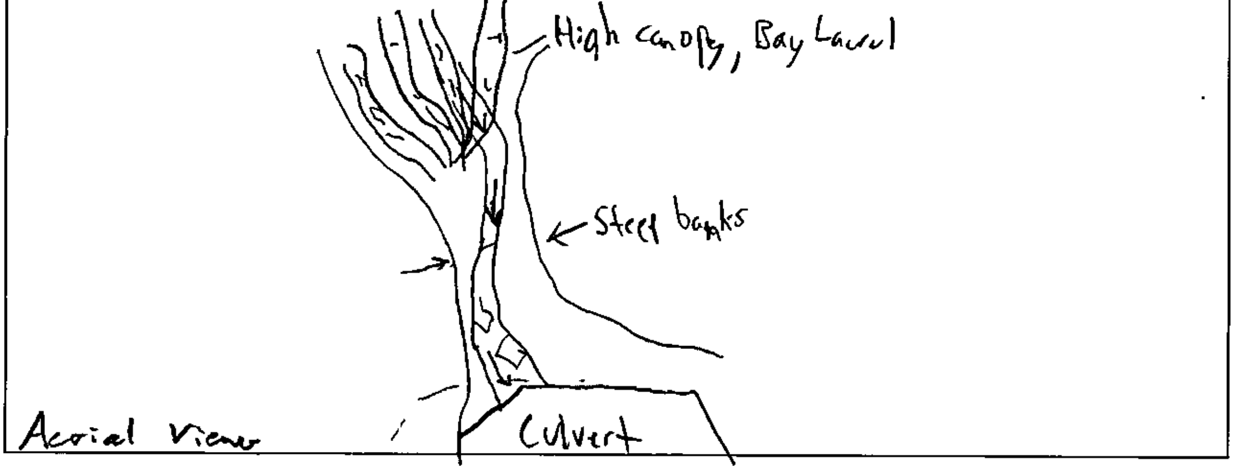
Vegetation: emergent, [✓ overhanging] dominant species: Umbellularia californica -No emergent veg.

Substrate: Rocks, silt

Bank description: silty, rocky, duff

Perennial or [✓ Ephemeral] *(circle one).* If ephemeral, date it goes dry: Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5026-5027
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________ (FWS Field Office) ____________ (date) ____________ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted
(Last name) (first name) ____________ (Last name) (first name)

Sandy Grayson
(Last name) (first name) ____________ (Last name) (first name)

Site Location: SC-15: Alameda Co, UC Berkeley, 37.87680673, -122.2291724
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ____________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-15

Bank full width: 1-2 ft

Depth at bank full: 3-5in

Stream gradient: 25°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ______

Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: steep banks, rocky substrate, no pools

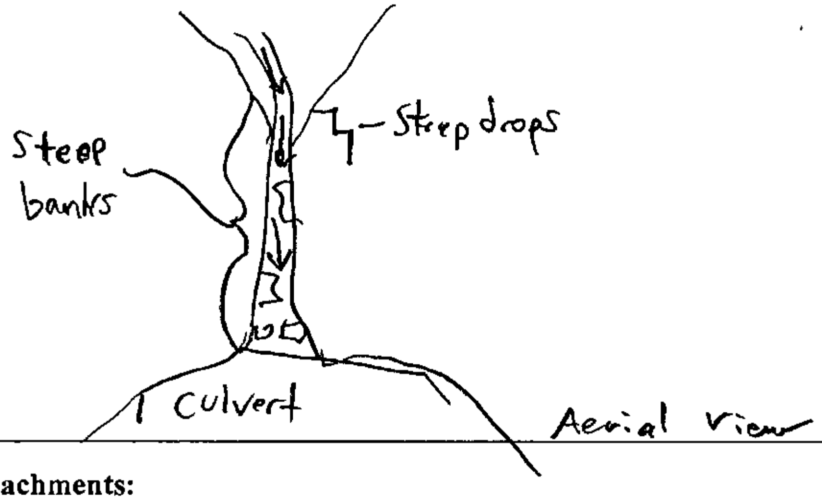
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica No emergent veg.

Substrate: rock, silt, duff

Bank description: rocky, silty

Perennial or [✓ **Ephemeral**] *(circle one).* If ephemeral, date it goes dry: Late spring

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5029 + 5030
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ________ (FWS Field Office) ________ (date) ________ (biologist)

Date of Site Assessment: 03/01/2019 (mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ________ (Last name) ________ (first name)

Sandy (Last name) Grayson (first name) ________ (Last name) ________ (first name)

Site Location: SC-16: Alameda Co., UCBerkeley, 37.87710955, -122.2312365
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ________ Maximum depth: ________

Vegetation: emergent, overhanging, dominant species: ________

Substrate: ________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-16

Bank full width: 1-2ft

Depth at bank full: <1 inch

Stream gradient: 2°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools:

Maximum depth of stream pools:

Characterize non-pool habitat: run, riffle, glide, other: ephemeral water collection point

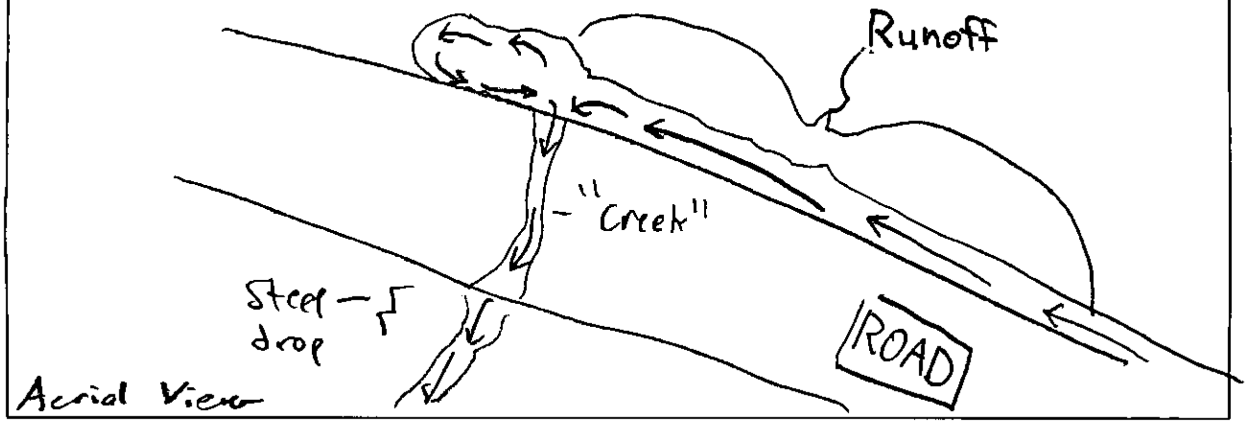
Vegetation: emergent, [✓ overhanging] dominant species: Coyote brush: Baccharis sp. No Emergent Veg.

Substrate: rock & mud

Bank description: no banks water pooling along road and flowing across.

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: 1 week post-rain event

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5031-5032
3. Maps with important habitat features and species location

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ______ (Last name) ______ (first name)

Sandy. (Last name) Grayson (first name) ______ (Last name) ______ (first name)

Site Location: SC-17; Alameda Co., UC Berkeley, 37.87878473, -122.2319843
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-17
Bank full width: 1-5 ft
Depth at bank full: 1-2 in
Stream gradient: 26°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools: ______
Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: Steep banks, fast-flowing

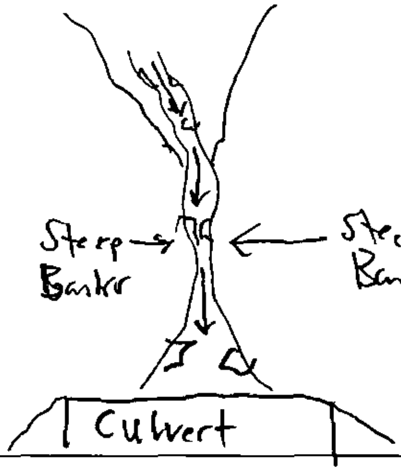
Vegetation: emergent, [✓ overhanging] dominant species: Umbellularia californica, Eucalyptus globulus
No EMERGENT VEG.

Substrate: rock, silt, duff

Bank description: rocky & silty w/ eucalyptus leaves intermittent

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: Late Spring/Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Aerial view

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5033 & 5034
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted (Last name) (first name) ______ (Last name) (first name)

Sandy Grayson (Last name) (first name) ______ (Last name) (first name)

Site Location: SC-18: Alameda, UC Berkeley, 37.87906565, -122.2324586
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-18
Bank full width: 1-2 ft
Depth at bank full: 2-6 in
Stream gradient: 27°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools: ______
Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: fast-flow, shallow stream, no emergent veg.

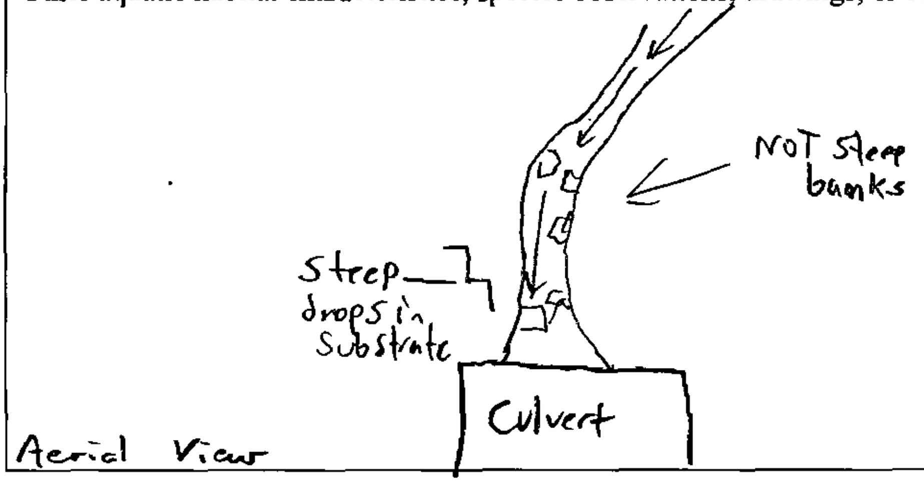
Vegetation: emergent, [✓ overhanging], dominant species: Eucalyptus globulus

Substrate: rock, silt, duff

Bank description: rocky + silty, clogged with eucalyptus leaves

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5035 + 5036
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted (Last name) (first name) ______ (Last name) (first name)

Sandy Grayson (Last name) (first name) ______ (Last name) (first name)

Site Location: SC-19: Alameda Co, UC Berkeley, 37.87932294, -122.2348484
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-19
Bank full width: 1-2 ft
Depth at bank full: No water
Stream gradient: 28°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools: ______
Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: rocky, choked w/eucalyptus

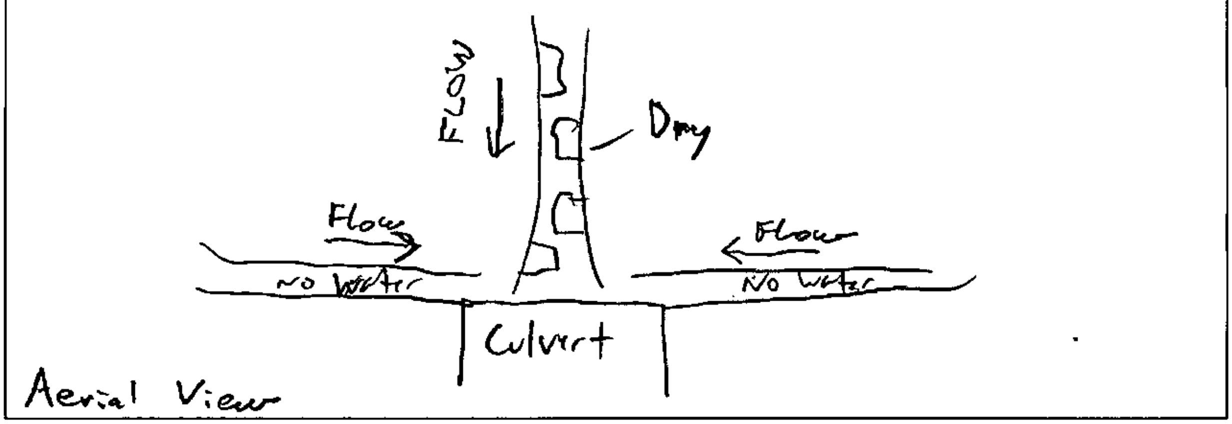
Vegetation: emergent, [✓ overhanging], dominant species: Eucalyptus globulus, Umbellularia californica, no emergent veg.

Substrate: rocks, eucalyptus duff

Bank description: heavily inundated w/eucalyptus leaves

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: 1-2 days after rain event

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5037 & 5038
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ________________
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted
(Last name) (first name) (Last name) (first name)

Sand Grayson
(Last name) (first name) (Last name) (first name)

Site Location: SC-20; Alameda Co., UC Berkeley, 37.88014419, -122.2364756
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ________________ Maximum depth: ________________

Vegetation: emergent, overhanging, dominant species: ________________

Substrate: ________________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ________________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-20
Bank full width: 6-10 m
Depth at bank full: No water
Stream gradient: 20°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools:
Maximum depth of stream pools:

Characterize non-pool habitat: run, [✓ riffle], glide, other: Creek not running

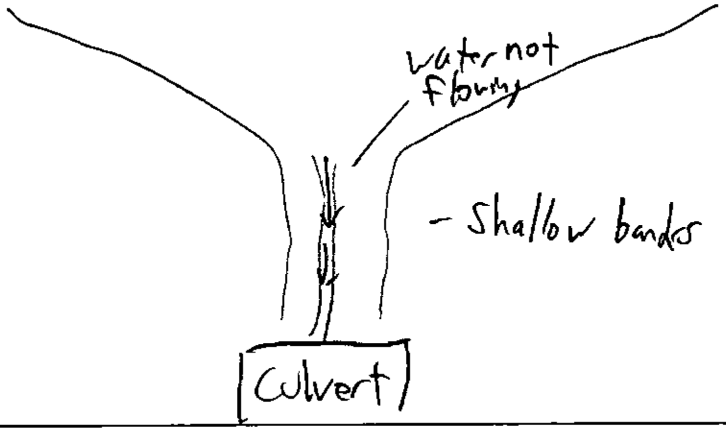
Vegetation: emergent, [✓ overhanging], dominant species: Eucalyptus globulus
No emergent veg.

Substrate: rocks, duff, silt

Bank description: rocky, covered in non-native veg, filled w/eucalyptus leaves

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: 1-2 days post-rain event

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5039 & 5040
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson (Last name) Ted (first name) ______ (Last name) ______ (first name)

Sandy (Last name) Grayson (first name) ______ (Last name) ______ (first name)

Site Location: SC-21; Alameda Co., UC Berkeley, 37.88098341, -122.2376942
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-21

Bank full width: 2-4 ft

Depth at bank full: No water

Stream gradient: 30°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ______

Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: No water

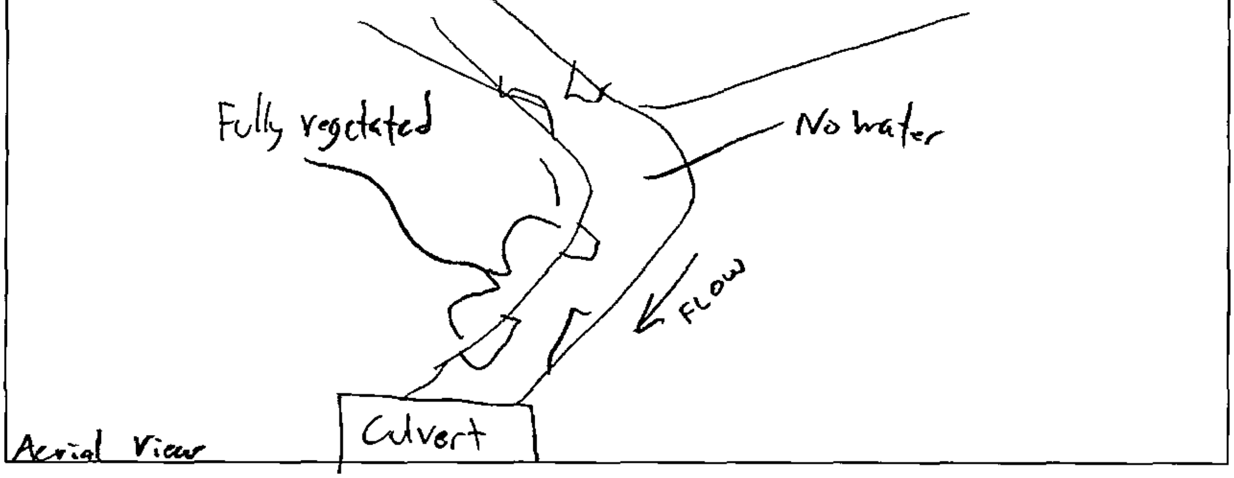
Vegetation: emergent, [✓ overhanging], dominant species: Eucalyptus globulus, Umbellularia californica, Coast live oak: Quercus agrifolia No emergent vege

Substrate: rock, silt, organic matter

Bank description: fully vegetated w/ non-native annuals

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: 1-2 days post-rain event

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5041 & 5042
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______________________ ______________ ______________________
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/01/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted
(Last name) (first name) (Last name) (first name)

Sandy Grayson
(Last name) (first name) (Last name) (first name)

Site Location: SC-22A ; Alameda Co., UC Berkeley, 37.87491932, -122.2396007
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ bridges.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______________________ Maximum depth: ______________

Vegetation: emergent, overhanging, dominant species: ______________________

Substrate: ______________________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-22A

Bank full width: 2-3ft
Depth at bank full: 4-8in
Stream gradient: ______

Are there pools (circle one)? YES NO
If yes,
Size of stream pools: ______
Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: fast-flowing stream, rocky substrate w/large rocks

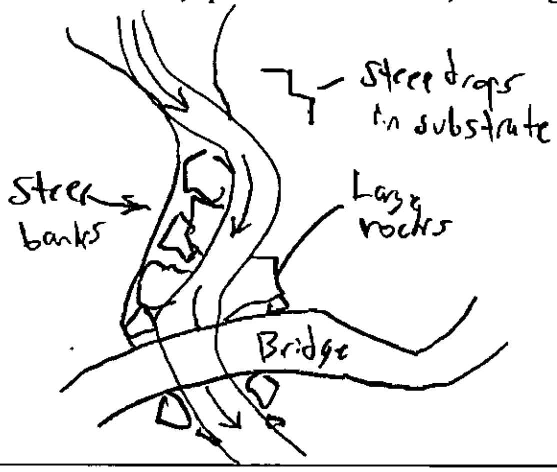
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica Sequoia sempervirens, no emergent veg.

Substrate: Large rocks

Bank description: large rocks, no emergent veg.

[✓ **Perennial**] or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry: ______

Other aquatic habitat characteristics, species observations, drawings, or comments:



Aerial View

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5043-5044
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by____
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted
(Last name) (first name) (Last name) (first name)

(Last name) (first name) (Last name) (first name)

Site Location: SC-22B; Alameda Co., UC Berkeley, 37.8801823, -122.2510639
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** **(include habitat types, important features, and species locations)****

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________________

Substrate: ____________________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D. ↳ SC-22

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-22B

Bank full width: 2 ft.

Depth at bank full: 2 - 4 inches

Stream gradient: 25° slope

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ______

Maximum depth of stream pools: ______

Characterize non-pool habitat: run, [✓ riffle], glide, other: ______

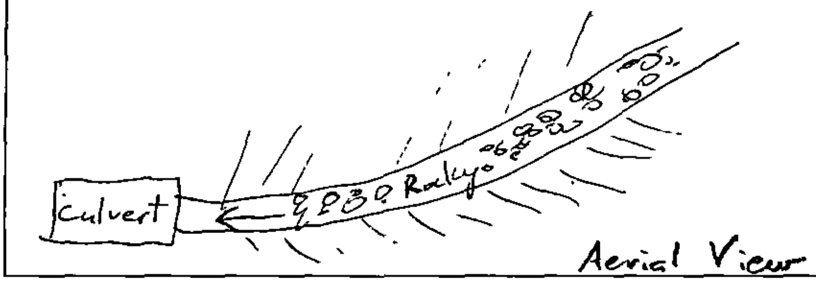
Vegetation: emergent, [✓ overhanging], dominant species:
Bay Laurel - Umbellularia californica
Quercus agrifolia, no emergent veg.

Substrate: Rocky

Bank description: 30- 35° slope, Rocky, gravel, S.H, clay
with non-native annual vegetation

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: 2 weeks after last rain event.

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5045 - 5046
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted
(Last name) (first name) ______ (Last name) (first name)

______ (Last name) (first name) ______ (Last name) (first name)

Site Location: C-23; Alameda Co., UC Berkeley, 37.87160403, -122.243632
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus + non-native trees near roads + buildings

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: C-23

Bank full width: 2 to 4 ft
Depth at bank full: 2 to 4 inches
Stream gradient: 20° slope

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools:
Maximum depth of stream pools:

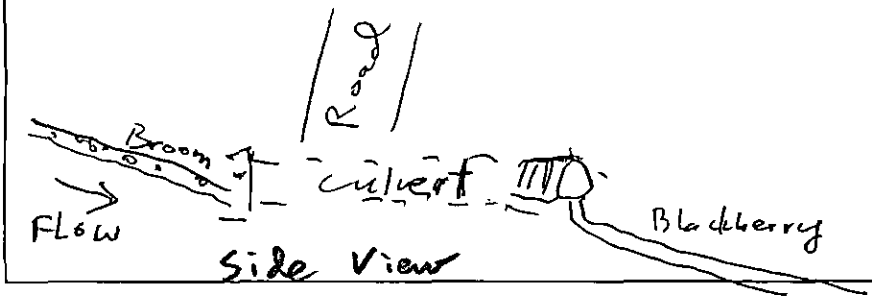
Characterize non-pool habitat: run, [✓ riffle], glide, other:

Vegetation: emergent, [✓ overhanging], dominant species:
Bay laurel - Umbellularia californica, Genista monspessulana
Himalayan Blackberry - Rubus Emergent ⇒ Watercress, Tropaeolum
Substrate: Rocky, gravel, silt

Bank description: 30° - 40° slopes, rocky to gravel to silt.

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: late spring

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5047 & 5048
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________ (FWS Field Office) ____________ (date) ____________ (biologist)

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted ____________
(Last name) (first name) (Last name) (first name)

____________ ____________
(Last name) (first name) (Last name) (first name)

Site Location: C-24; Alameda Co., UC Berkeley; 37.8696163, -122.2254625
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & bridges.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: C-24

Bank full width: 6 ft
Depth at bank full: 0.5 - 1 ft.
Stream gradient: 5 - 8° slope

Are there pools (circle one)? [✓ YES] NO (One pool)
If yes,
Size of stream pools: 15 X 15 ft.
Maximum depth of stream pools: 2 ft.
Strong current through Pool, No emergent vegetation.

Characterize non-pool habitat: run, [✓ riffle], glide, other:

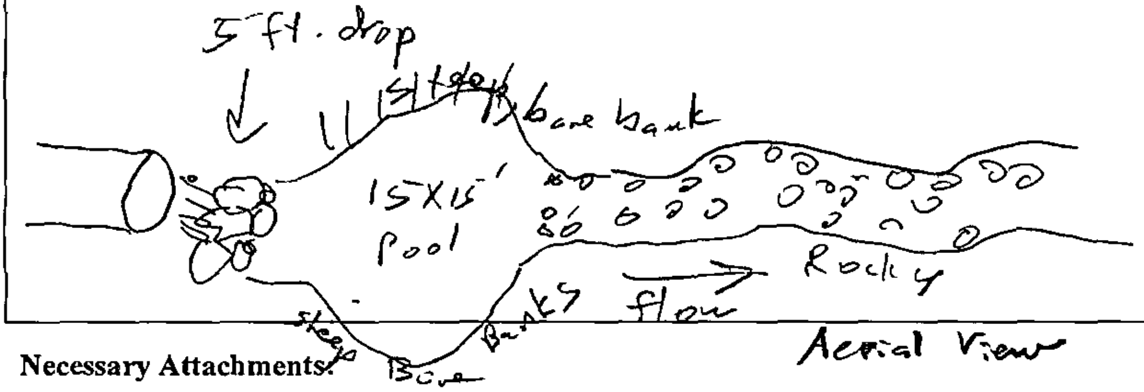
Vegetation: ~~emergent~~, [✓ overhanging], dominant species:
: Bay laurel - Umbellularia californica
& No emergent veg.

Substrate: Rocky, gravel, sand.

Bank description: 3 → 8' foot vertical incision followed by 25°-45° slope. Mostly rocky, gravel, sand, silt with scattered sword ferns.

Perennial or **Ephemeral** *(circle one)*. If [✓ ephemeral] date it goes dry: -mid-summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5049 & 5050 ≈ 200 ft. downstream
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________ (FWS Field Office) ________ (date) ____________ (biologist)

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Tod
(Last name) (first name) ____ (Last name) (first name)

____ (Last name) (first name) ____ (Last name) (first name)

Site Location: #C-25: Alameda Co. UC Berkeley; 37.8693125, 122.2274894
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

* → chang file from 24 to 25

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

#C-25 (24 [illegible] file)

STREAM:

Bank full width: 3 ft.
Depth at bank full: < 1 inch (no water)
Stream gradient: 18°

Are there pools (circle one)? YES [✓ NO]
If yes,
Size of stream pools: ____
Maximum depth of stream pools: ____

Characterize non-pool habitat: [✓ run,] riffle, glide, other:
No Water 3 days after large storm (2" rainfall)

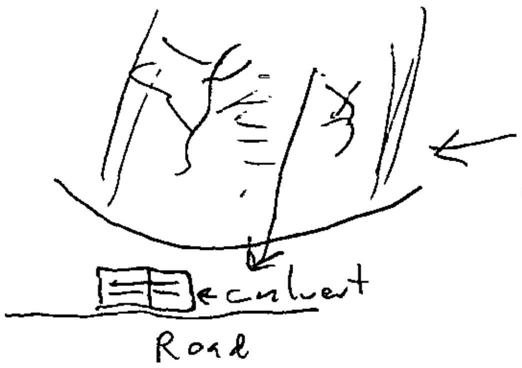
Vegetation: emergent, [✓ overhanging] dominant species:
willow - Salix spp. & poison oak - Toxicodendron diversilobum

Substrate: silty loam

Bank description: 25°-30° bank slope

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: 1-2 days after heavy rain

Other aquatic habitat characteristics, species observations, drawings, or comments:



overgrown with vegetation. No flow.

Aerial VIEW

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs - 5051
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted
(Last name) (first name) (Last name) (first name)

(Last name) (first name) (Last name) (first name)

Site Location: SC-26: Alameda Co, UC Berkeley; 37.86888037 -122.2585072
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-26

Bank full width: 1 ft.

Depth at bank full: 1-2 inches

Stream gradient: 18-20° slope

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools:

Maximum depth of stream pools:

Characterize non-pool habitat: run, [✓ riffle] glide, other:

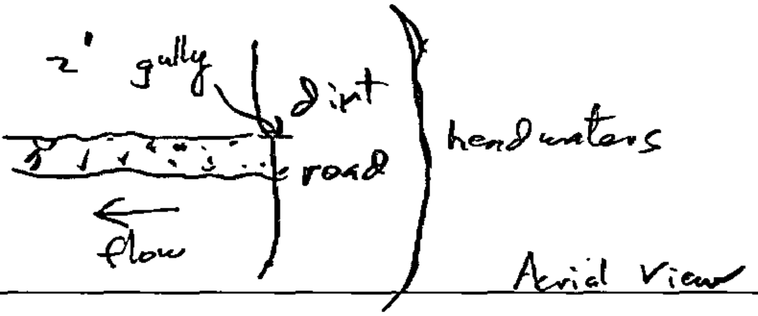
Vegetation: emergent, no [✓ overhanging,] dominant species:
Salix spp, Sequoia sempervirens, Bay laurel: Umbellularia californica

Substrate: Rocky to sandy

Bank description: Steep 30° slopes, bare with patches of moss

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: 1-2 weeks after heavy rain event

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5052
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/04/2019 (mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted (Last name) (first name) ______ (Last name) (first name)

______ (Last name) (first name) ______ (Last name) (first name)

Site Location: #SC-27: Alameda Co., UC Berkeley, 37.87005556, -122.2346231
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-27

Bank full width: 1 ft.

Depth at bank full: 1-2 inch.

Stream gradient: 30° slope

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools:

Maximum depth of stream pools:

Characterize non-pool habitat: [✓ run,] riffle, glide, other:

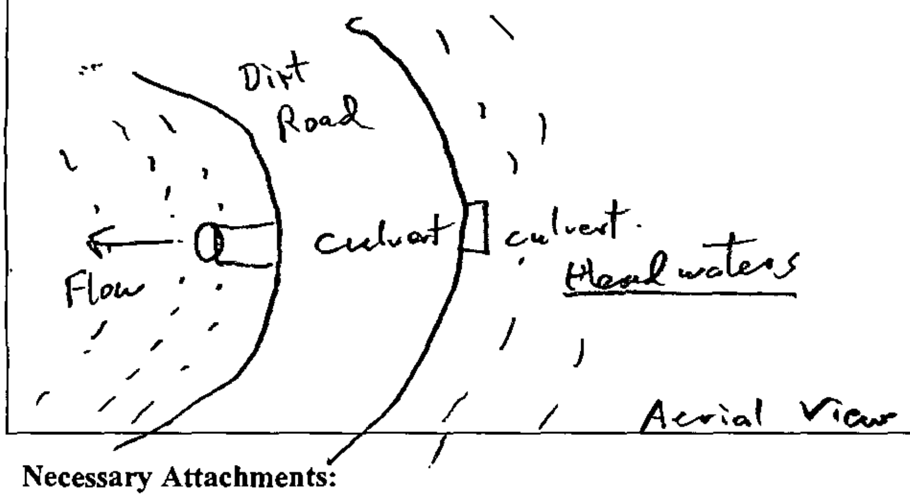
Vegetation: emergent, [✓ overhanging], dominant species: Sambucus nigra, Bay laurel - Umbellularia californica Ribes sanguineum, NO EMERGENT VEG.

Substrate: Rocky to Silt.

Bank description: Bowl shaped in X-section.

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: 1-day after storm

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5053 - 5054
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted (Last name) (first name) ______ (Last name) (first name)

______ (Last name) (first name) ______ (Last name) (first name)

Site Location: # SC 28: Alameda Co., UC Berkeley; 37.87045472, -122.2326991
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SC-28

Bank full width: 2 ft.

Depth at bank full: 1 to 2 in

Stream gradient: ______

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ______

Maximum depth of stream pools: ______

Characterize non-pool habitat: [✓ run], riffle, glide, other: ______

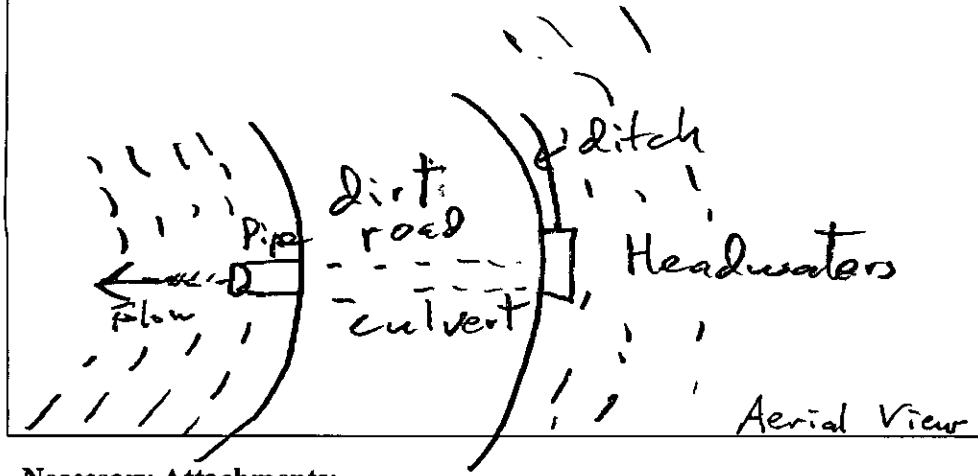
Vegetation: ~~emergent~~, [✓ overhanging] dominant species:
Bay laurel – U. californica, Sequoia sempervirens
Rubus ursinus

Substrate: Rocky, gravel, silt

Bank description: Bowl shaped

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: 4-6 days after heavy rain event.

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5055, 5056
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____
(FWS Field Office) **(date)** **(biologist)**

Date of Site Assessment: 03/04/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Tad ____________________
(Last name) **(first name)** **(Last name)** **(first name)**

____________________ ____________________
(Last name) **(first name)** **(Last name)** **(first name)**

Site Location: SC - 29: Alameda Co., UC Berkeley; 37.87294451, -122.2283017
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES [✓ NO]

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES [✓ NO]
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________________ Maximum depth: ________________

Vegetation: emergent, overhanging, dominant species: ____________________

Substrate: ____

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ________________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: #SC-29

Bank full width: 1-2 ft

Depth at bank full: 1-2 inches

Stream gradient:

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools:

Maximum depth of stream pools:

Characterize non-pool habitat: [✓ run] riffle, glide, other:

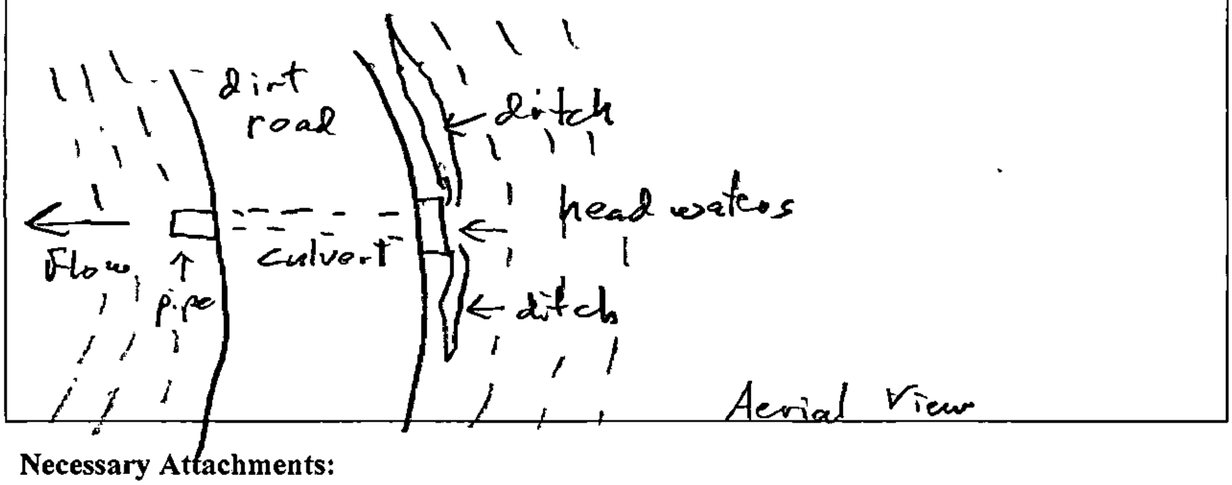
Vegetation: ~~emergent~~, [✓ overhanging] dominant species:
Coyote Brush- Baccharis pilularis
No emergent veg.

Substrate: gravel, silty

Bank description: - Minimal bank, mostly continuation of contours.

Perennial or Ephemeral *(circle one)*. If [✓ ephemeral] date it goes dry: 4-6 days after last rain event

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5058, 5059
3. Maps with important habitat features and species location

5057 = Headwaters of Strawberry Cr.

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________ (FWS Field Office) ____________ (date) ____________ (biologist)

Date of Site Assessment: 03/12/19
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted (Last name) (first name) ____________ (Last name) (first name)

Sandy, Grayson (Last name) (first name) ____________ (Last name) (first name)

Site Location: Wildcat Creek (WC) - 30: Contra Costa Co.; 37.89338298, -122.2431595
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin non-native trees near roads & buildings

1) Is this site within the current or historic range of the CRF (circle one)? [✓ YES] NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? [✓ YES] NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ____________ Maximum depth: ____________

Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: WC-30

Bank full width: 12 ft

Depth at bank full: 3-4 in

Stream gradient: 45°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ______

Maximum depth of stream pools: ______

Characterize non-pool habitat: [✓ run], [✓ riffle], glide, other: fast-moving Stream.

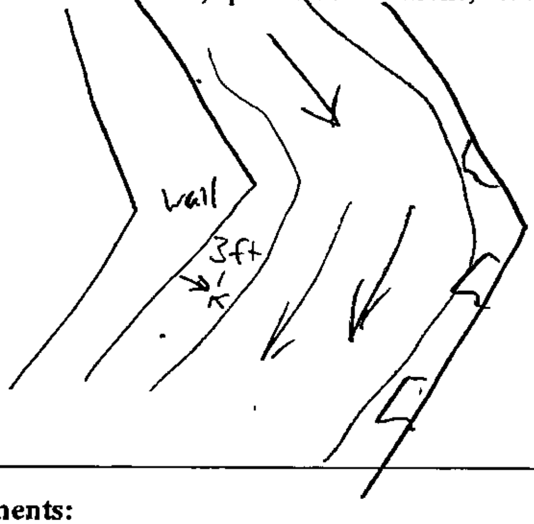
Vegetation: emergent, [✓ overhanging], dominant species: Salix, Ribes, Cornus, Sequoia, Pinus, Alnus,

Substrate: Concrete

Bank description: Sloped, Steep walls

[✓ Perennial] or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5074-5076
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ________ (FWS Field Office) ________ (date) ________ (biologist)

Date of Site Assessment: 03/13/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted (Last name) (first name) ________ (Last name) (first name)

Sandy Grayson (Last name) (first name) ________ (Last name) (first name)

Site Location: SV-31: Contra Costa Co., Siesta Valley, 37.86470665, -122.2097347
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus & non-native trees near roads & buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ________ Maximum depth: ________

Vegetation: emergent, overhanging, dominant species: ________

Substrate: ________

Perennial or Ephemeral *(circle one).* If ephemeral, date it goes dry: ________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SV-31

Bank full width: 3ft

Depth at bank full: 6-8 in

Stream gradient: N. Fork: 18° S. Fork: 20°

Are there pools (circle one)? [✓ YES] NO

If yes,

Size of stream pools: 2ft X 3ft

Maximum depth of stream pools: 4-6 in

Characterize non-pool habitat: [✓ run], [✓ riffle], glide, other: fast-moving stream with small pooling areas. Stream is forked @ survey area: North Fork and South Fork.

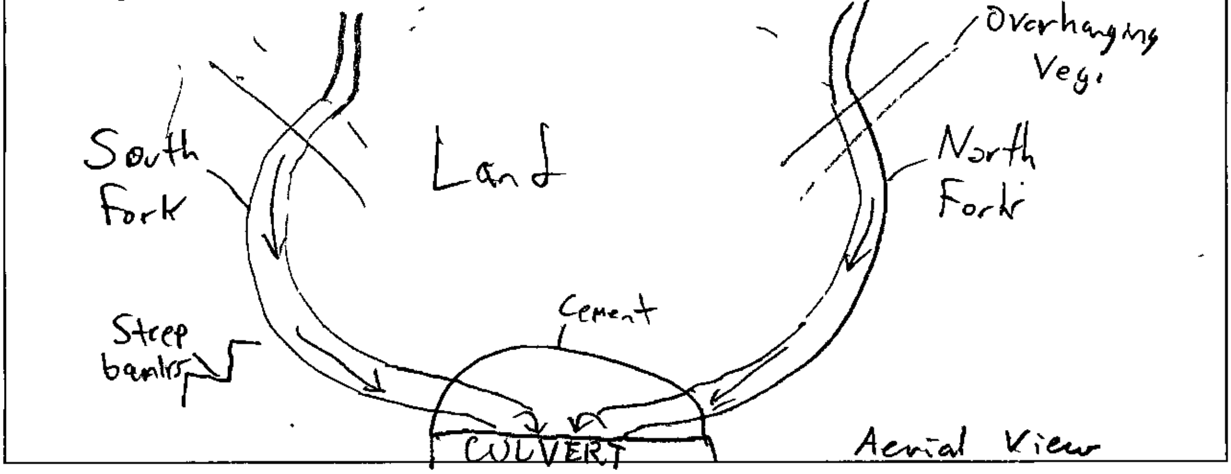
Vegetation: emergent, [✓ overhanging], dominant species: U. californica - Bay laurel Q. agrifolia - coast live oak No emergent vegetation

Substrate: rock, silt, concrete

Bank description: Steep ⊕ rocky

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: Late spring to early summer.

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs N-Fork-5077 S-Fork-5078
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Site Assessment: 03/13/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted (Last name) (first name) ______ (Last name) (first name)

Sandy Grayson (Last name) (first name) ______ (Last name) (first name)

Site Location: SV-32: Contra Costa Co.; Siesta Valley Watershed: 37.86360879, -122.2151719
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SV-32

Bank full width: 2-5ft

Depth at bank full: 4in

Stream gradient: 2°

Are there pools (circle one)? [✓ YES] NO

If yes,

Size of stream pools: 4 X 6 ft

Maximum depth of stream pools: 8in

Characterize non-pool habitat: [✓ run], [✓ riffle], glide, other:

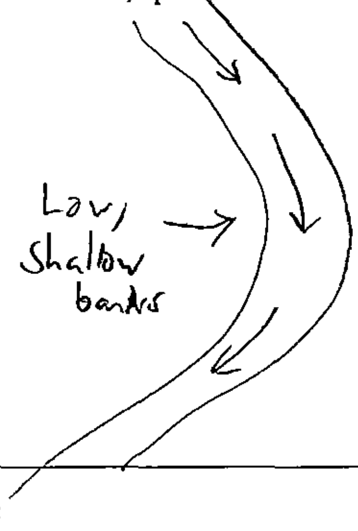
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica Quercus agrifolia, Ribes sp., Salix sp.
No emergent veg.

Substrate: rock, silt

Bank description: low, shallow, muddy & silty

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: Late Spring

Other aquatic habitat characteristics, species observations, drawings, or comments:



Aerial View

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5679- 5680
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ ______ ______
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/13/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted ______ ______
(Last name) (first name) (Last name) (first name)

Sandy Grayson ______ ______
(Last name) (first name) (Last name) (first name)

Site Location: SV-33 ' Contra Costa Co; Siesta Valley Watershed ; 37.86849384, -122.2019835
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: ______ Maximum depth: ______

Vegetation: emergent, overhanging, dominant species: ______

Substrate: ______

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM: SV-33

Bank full width: 8

Depth at bank full: 6-12 in

Stream gradient: 12°

Are there pools (circle one)? YES [✓ NO]

If yes,

Size of stream pools: ______

Maximum depth of stream pools: ______

Characterize non-pool habitat: [✓ run, riffle], glide, other: fast-moving large stream

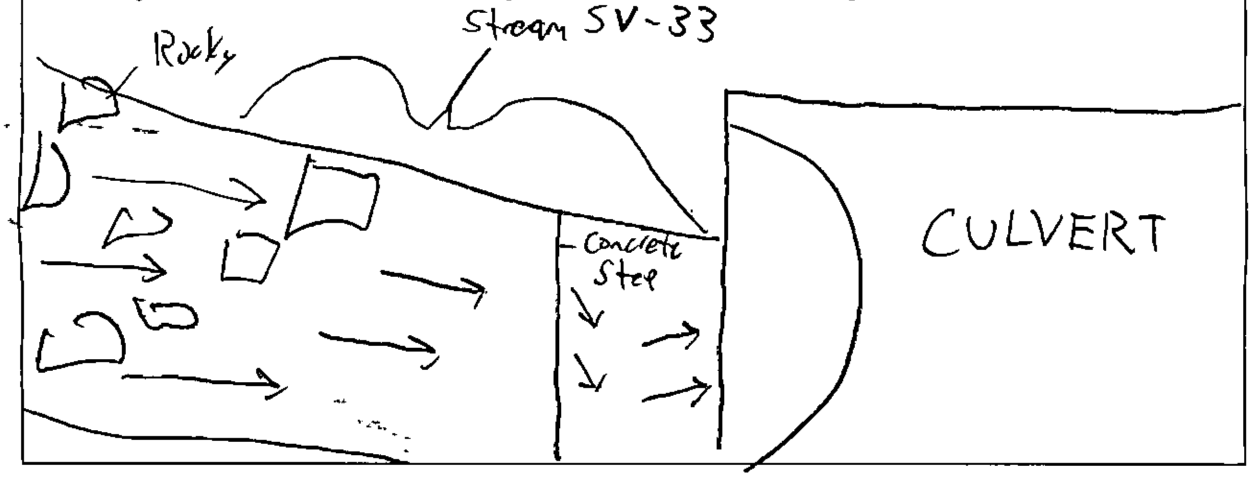
Vegetation: emergent, [✓ overhanging], dominant species: Umbellularia californica Eucalyptus globulus, Quercus agrifolia, Salix sp. No emergent veg.

Substrate: Rock, concrete

Bank description: Shallow, rock,

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Late summer

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5083-5084
3. Maps with important habitat features and species location

Appendix D.

California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ________ (FWS Field Office) ________ (date) ________ (biologist)

Date of Site Assessment: 03/19/2018
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted (Last name) (first name) ________ (Last name) (first name)

Dexter, Sean. (Last name) (first name) ________ (Last name) (first name)

Site Location: Siesta Valley Creek - SV-34, Siesta Valley Wetland, Contra Costa Co, 37.873203, -122.213553 37.873924, -122.213274
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
East Bay Municipal Utility District, (EBMUD).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction.
Brief description of proposed action:
Thin Eucalyptus & non-native trees near roads & buildings

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: 20x40 ft (filled in) Maximum depth: 2 - 3 inches.

Vegetation: [✓ emergent] overhanging, dominant species: Overhanging: Quercus agrifolia Juncus sp.

Substrate: Silt, clay, sand

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: Late Spring

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: 2 ft
Depth at bank full: 6 in.
Stream gradient: 10°

Are there pools (circle one)? [✓ YES] NO
If yes,
Size of stream pools: 18 in X 7 ft.
Maximum depth of stream pools: 6 inches.

Characterize non-pool habitat: run [✓ riffle] glide, other:

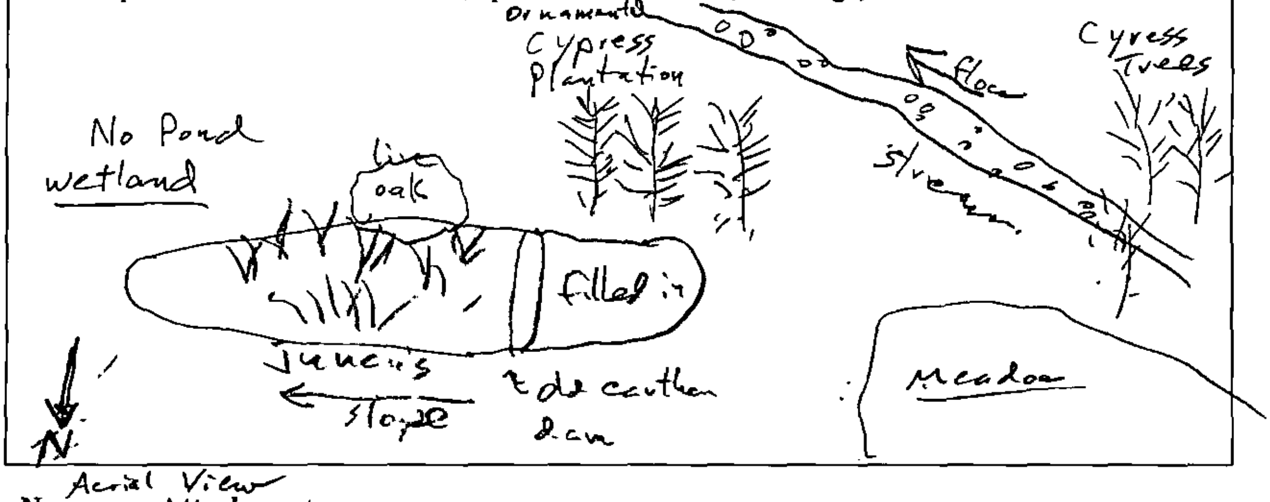
Vegetation: emergent, overhanging, dominant species:
Cypress sp. overhanging.
NO emergent.

Substrate: Rocky & sandy.

Bank description: Vertical erosion ≈ 1 ft.

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Late spring

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5092 - 5096 Stream 5097 - 5098
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____ (FWS Field Office) ____ (date) ____ (biologist)

Date of Site Assessment: 02/27/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted
(Last name) (first name) (Last name) (first name)

(Last name) (first name) (Last name) (first name)

Site Location: Alameda Co., LHS Pond; UCBerkeley; 37.87896606, -122.2473361
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION
(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND: LHS Pond

Size: 30X60 ft. Maximum depth: ____

Vegetation: [✓ emergent], [✓ overhanging], dominant species:
Typha latifolia ↳ Acer macrophyllum, Salix spp, cotoneaster spp,
↳ Quercus agrifolia.

Substrate: silt & clay

Perennial or [✓ Ephemeral] *(circle one)*. If ephemeral, date it goes dry: Dry 8-9 months of year.

D

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: ______________

Depth at bank full: ______________

Stream gradient: ______________

Are there pools (circle one)? YES NO

If yes,

Size of stream pools: ______________

Maximum depth of stream pools: ______________

Characterize non-pool habitat: run, riffle, glide, other: ______________

Vegetation: emergent, overhanging, dominant species: ______________

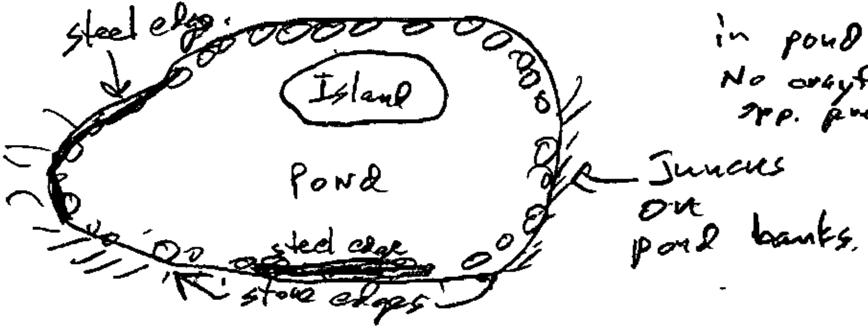
Substrate: ______________

Bank description: ______________

Perennial or [✓ **Ephemeral**] *(circle one)*. If ephemeral, date it goes dry: Mid-spring, 1 month after last rain.

Other aquatic habitat characteristics, species observations, drawings, or comments:

Talked w/ BioLab Manager. Deena Sampson- "No animals in pond for at least 2+ yrs. No crayfish no bullfrog tadpoles, spp. present in 2009."



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5007 - 5012
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ______ ______ ______
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/12/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted (Last name) (first name) Sandy, Grayson (Last name) (first name)

(Last name) (first name) (Last name) (first name)

Site Location: Tilden Park Botanical Garden Pond: Contra Costa Co.; 37.89302565 -122.2435934
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)****

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? [✓ YES] NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? [✓ YES] NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND: Tilden Park Botanical Garden Pond
Size: 30 x 40 ft. Maximum depth: 5 ft.

Vegetation: emergent, overhanging, dominant species:
Duckweed (floating)
Overhanging - Aspen - Populus tremuloides, willows - Salix prolixa

Substrate: Concrete.

[✓ Perennial] or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ______

Filled artificially

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: ____________

Depth at bank full: ____________

Stream gradient: ____________

Are there pools (circle one)? YES NO

If yes,

Size of stream pools: ____________

Maximum depth of stream pools: ____________

Characterize non-pool habitat: run, riffle, glide, other: ____________

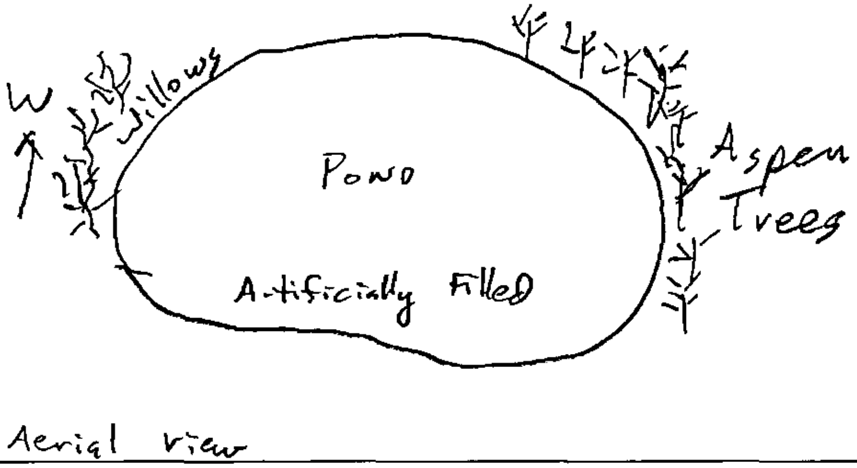
Vegetation: emergent, overhanging, dominant species: ____________

Substrate: ____________

Bank description: ____________

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: ____________

Other aquatic habitat characteristics, species observations, drawings, or comments:



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs 5073
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by ____________
(FWS Field Office) (date) (biologist)

Date of Site Assessment: 02/27/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson Ted
(Last name) (first name) (Last name) (first name)

(Last name) (first name) (Last name) (first name)

Site Location: Alameda Co., UCB Botanical Garden Pond: 37.87483189, -122.2371679
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)****

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin eucalyptus ⊕ non-native trees near roads ⊕ buildings.

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND: UCB Botanical Garden Pond
Size: 36 x 66 ft
Maximum depth: 3' ft

Vegetation: [✓ emergent] overhanging, dominant species:
1° = Nymphaea sp - water lily & Iris laevigata

Substrate: Concrete overlain with silt & clay

[✓ Perennial] or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry: ____________

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width:
Depth at bank full:
Stream gradient:

Are there pools (circle one)? YES NO
If yes,
Size of stream pools:
Maximum depth of stream pools:

Characterize non-pool habitat: run, riffle, glide, other:

Vegetation: emergent, overhanging, dominant species:

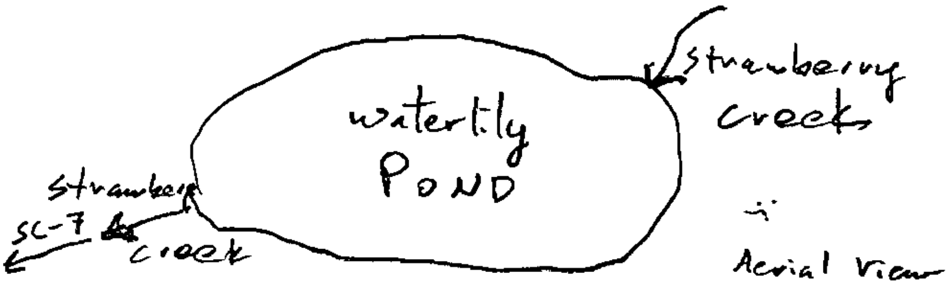
Substrate:

Bank description:

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry:

Other aquatic habitat characteristics, species observations, drawings, or comments:

* CA Newts - breeding (amplexus), 100+ egg masses
↳ 200+ individuals



Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs - 5008 - 5009
3. Maps with important habitat features and species location

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

Site Assessment reviewed by: (FWS Field Office) (date) (biologist)

Date of Site Assessment: 03/19/2019
(mm/dd/yyyy)

Site Assessment Biologists: Robertson, Ted
(Last name) (first name) (Last name) (first name)

Dexter, Sean
(Last name) (first name) (Last name) (first name)

Site Location: Sibley Park Pond Contra Costa County, 37.859132, -122.206052
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
East Bay Regional Park District.

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction.
Brief description of proposed action:
Thin Eucalyptus & non-native trees near roads & bridges

1) Is this site within the current or historic range of the CRF (circle one)? YES NO

2) Are there known records of CRF within 1.6 km (1 mi) of the site (circle one)? YES NO
If yes, attach a list of all known CRF records with a map showing all locations.

GENERAL AQUATIC HABITAT CHARACTERIZATION

(if multiple ponds or streams are within the proposed action area, fill out one data sheet for each)

POND:

Size: 180 ft. X 150 ft
& 150 ft X 60 ft.

Maximum depth: >6 ft.

Vegetation: emergent, overhanging, dominant species:
Emergent - Schoenoplectus Typha latifolia.
Overhanging: Salix sp. (inc. S. lasiolepis), Quercus agrifolia.

Substrate: Silt, sand, clay.

[✓ **Perennial**] or **Ephemeral** *(circle one)*. If ephemeral, date it goes dry:

Appendix D.
California Red-legged Frog Habitat Site Assessment Data Sheet

STREAM:

Bank full width: _______________
Depth at bank full: ______________
Stream gradient: _______________

Are there pools (circle one)? YES NO
If yes,
Size of stream pools: _______________________
Maximum depth of stream pools: ______________

Characterize non-pool habitat: run, riffle, glide, other: __________________________

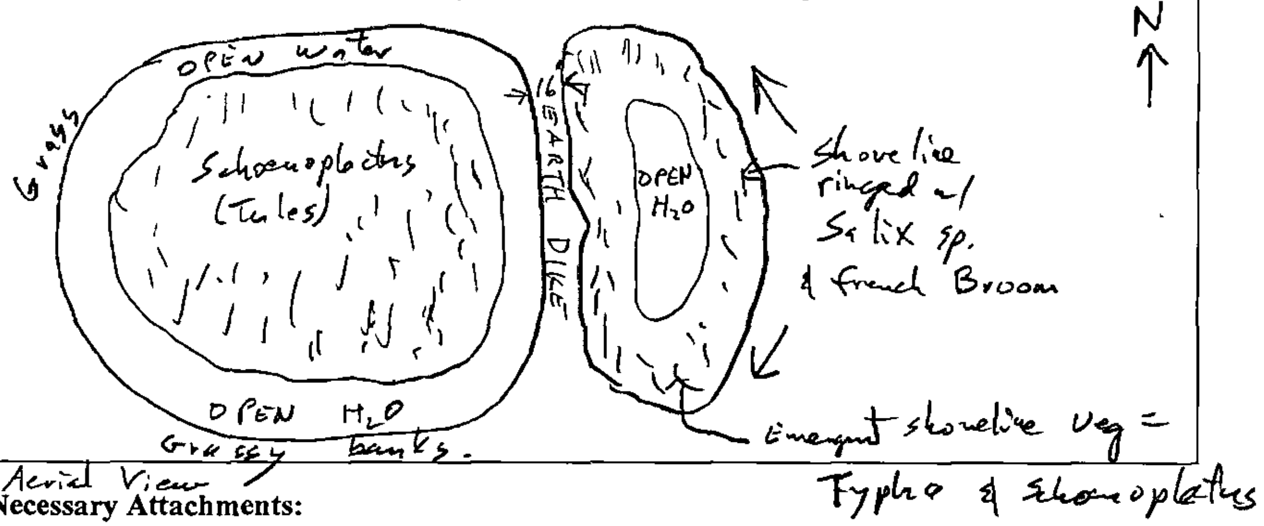
Vegetation: emergent, overhanging, dominant species: __________________________

Substrate: ____

Bank description: ____

Perennial or Ephemeral *(circle one)*. If ephemeral, date it goes dry: __________________

Other aquatic habitat characteristics, species observations, drawings, or comments:



Aerial View

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species location

Appendix E

CRLF Survey Data Sheets

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/14/2018 (mm/dd/yyyy) **Survey Biologist:** Robertson, Ted (Last name) (first name)

Survey Biologist: Dexter, Sean (Last name) (first name)

Site Location: SC-2, Alameda County, 37.8728122, -122.2405816
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
SC = Strawberry Creek

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin non-native trees near roads ⊕ buildings.

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 4:21 PM **End Time:** 4:50

Cloud cover: 0% **Precipitation:** 0

Air Temperature: 11°C **Water Temperature:** 11°C

Wind Speed: 0 **Visibility Conditions:** Clear

Moon phase: N/A **Humidity:** 55%

Description of weather conditions: Sunny, calm

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ YES] NO
Brand, model, and power of binoculars: Swarovski EL 8.5 X 42

Appendix E.
California Red-legged Frog Survey Data Sheet

5.6-2

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None observed					
or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Strong current through pool & no emergent vegetation
Domestic dogs

Other notes, observations, comments, *etc.*

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by________ (FWS Field Office) ________ (date) ________ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson (Last name), Ted (first name)

Survey Biologist: ~~G~~ Sandy (Last name), Grayson (first name)

Site Location: SC - 2, Alameda County; 37.8728122, -122.2405816
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings.

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): **1** [✓ **2**] **3** **4** **5** **6** **7** **8**

Begin Time: 5:04 PM

End Time: 5:14 PM

Cloud cover: 70%

Precipitation: 0

Air Temperature: 15°C

Water Temperature: 12°C

Wind Speed: 1-3 mph.

Visibility Conditions: water = 2+ ft Air > 10 mile

Moon phase: N/A

Humidity: 66%

Description of weather conditions: Hazy, light breeze

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**

Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

SC-2

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None observed or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Dogs, raccoons, skunk

Other notes, observations, comments, *etc.*

strong current through pool.
No vegetation in creek or within 6 to 12" of water on bank.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ________ (FWS Field Office) ________ (date) ________ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: ~~G~~ Sandy, Grayson (Last name) (first name)

Site Location: SC-2, Alameda Co., 37, 8728122, -122.2905816
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): **DAY** [✓ **NIGHT**] **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): 1 2 [✓ 3] 4 5 6 7 8

Begin Time: 9:23 PM

End Time: 9:30 PM.

Cloud cover: 20%

Precipitation: 0

Air Temperature: 9°C

Water Temperature: 10°C

Wind Speed: 0-1 mph

Visibility Conditions: Air > 10 mi. H_2O > 2 ft clear.

Moon phase: 3/4 waxing

Humidity: 68%

Description of weather conditions: Calm & clear.

Brand name and model of light used to conduct surveys: Mag-Lite. LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Swavorski 8.5X42 EL.

Appendix E.
California Red-legged Frog Survey Data Sheet

SC-2

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None heard or observed					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______

Other notes, observations, comments, *etc.*

No animals observed

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/14/2018 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: Dexter, Sean (Last name) (first name)

Site Location: SC-3 Alameda Co, 37.87325769, -122.2389745
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin non-native trees near roads + buildings

Type of Survey (circle one): [✓ DAY] NIGHT BREEDING [✓ NON-BREEDING]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 4:52 PM

End Time: 4:58

Cloud cover: 0%

Precipitation: 0

Air Temperature: 11°C

Water Temperature: 11°C

Wind Speed: 0-1 mph

Visibility Conditions: clear water

Moon phase: N/A

Humidity: 55%

Description of weather conditions: Sunny, calm, dry

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ YES] NO
Brand, model, and power of binoculars: Swarovski EL 8.5 x 42

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-3

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Dogs in creek, racoons. Swift water through small pools. No emergent vegetation for CRLF egg.

Other notes, observations, comments, *etc.*

No animals observed.

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ____ (FWS Field Office) ____ (date) ____ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: & Sandy, Grayson (Last name) (first name)

Site Location: SC-3; Alameda County; 37.87325769, -122.2389745
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ DAY] NIGHT BREEDING [✓ NON-BREEDING]

Survey number (circle one): 1 [✓ 2] 3 4 5 6 7 8

Begin Time: 5:28 PM.

End Time: 5:33 PM.

Cloud cover: 40%

Precipitation: 0

Air Temperature: 15°C

Water Temperature: 12°C

Wind Speed: 0-1 mph.

Visibility Conditions: Air > 10 mi. H_2O ~ 2 ft. to bottom of pool.

Moon phase: N/A.

Humidity: 66%

Description of weather conditions: Mostly Sunny, no breeze.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ YES] NO
Brand, model, and power of binoculars: Swarovski 8.5X42 EL.

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-3

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
None observed or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Raccoons, people, dogs, skunks.

Other notes, observations, comments, *etc.*

No vegetation in creek.
strong current through Pool.
most of bank lacks vegetation near pool.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy) **Survey Biologist:** Robertson, Ted (Last name) (first name)

Survey Biologist: ~~G~~ Sandy, Grayson (Last name) (first name)

Site Location: SC-3: Alameda Co., 37.87325769, -122.2389745
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): DAY [✓ NIGHT] **BREEDING** [✓ NON-BREEDING]

Survey number (circle one): 1 2 [✓ 3] 4 5 6 7 8

Begin Time: 9:04 pm. **End Time:** 9:11 pm.

Cloud cover: ______ **Precipitation:** 0

Air Temperature: 9°C **Water Temperature:** 10°C

Wind Speed: 0 mph. **Visibility Conditions:** Air > 10 mi. H_2O > 2 ft. - clear.

Moon phase: Waxing gibbous **Humidity:** 68%

Description of weather conditions: clear & calm.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ YES] NO
Brand, model, and power of binoculars: Swarovski 8.5X42 EL.

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-3

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
None heard or observed					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______________________________

____

____

____

____

Other notes, observations, comments, *etc.*

No animals observed

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/14/2019 (mm/dd/yyyy) **Survey Biologist:** Robertson (Last name), Ted (first name)

Survey Biologist: Dexter (Last name), Sean (first name)

Site Location: SC 3 & 4 intersection, Alameda Co., 37.872590, -122.239338
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
Pool @ downstream intersection of SC-3 & SC-4

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction.
Brief description of proposed action:

Thin non-native trees near roads & buildings.

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** **NON-BREEDING**

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 5:10 PM **End Time:** 5:18 PM.

Cloud cover: 0% **Precipitation:** 0

Air Temperature: 11°C **Water Temperature:** 11°C

Wind Speed: 0 - 2 mph. **Visibility Conditions:** clear

Moon phase: N/A **Humidity:** 55%

Description of weather conditions: Sunny & calm

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Swarovski EL 8.5 X 42

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C. 3+4

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None observed.					
or heard					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: domestic dogs raccoons
No emergent Vegetation. strong current through Pod

Other notes, observations, comments, *etc.*
Water striders, mosquitoes

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs 5088-5089
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: Sandy, Grayson (Last name) (first name)

Site Location: SC3 & SC4 junction; Alameda Co.; 37.872590; -122.239338
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): 1 [✓ 2] 3 4 5 6 7 8

Begin Time: 5:17 PM

End Time: 5:26 PM.

Cloud cover: 40%

Precipitation: 0

Air Temperature: 15°C

Water Temperature: 12°C

Wind Speed: 0-1 mph

Visibility Conditions: Air > 10 miles. H2O ≈ 2 ft. to bottom of pond

Moon phase: N/A

Humidity: 66%

Description of weather conditions: Partly cloudy & slight breeze.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**

Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C. 3+4

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
No observed or heard					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Raccoons, people, dogs, skunks

Other notes, observations, comments, *etc.*

No vegetation in creek or on banks within 6 to 24 inches of H_2O.
Strong currents in pools.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)
Survey Biologist: Robertson, Ted (Last name) (first name)
Survey Biologist: Sandy, Grayson (Last name) (first name)

Site Location: SC 3 & SC 4 intersection, Alameda Co.; 37.872590, -122.239338
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): **DAY [✓ NIGHT]**   **BREEDING [✓ NON-BREEDING]**

Survey number (circle one): **1 2 [✓ 3] 4 5 6 7 8**

Begin Time: 9:13 PM.   **End Time:** 9:20 PM.

Cloud cover: 20%   **Precipitation:** 0

Air Temperature: 9°C   **Water Temperature:** 10°C

Wind Speed: 0-1 mph.   **Visibility Conditions:** Air >10 mi H_2O > 2ft - clear

Moon phase: Waxing gibbous   **Humidity:** 68%

Description of weather conditions: clear & calm

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? **[✓ YES] NO**
Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

SC 3+4

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None heard or observed					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______________________

____

____

____

____

Other notes, observations, comments, *etc.*

No animals observed

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______________ (FWS Field Office) ______________ (date) ______________ (biologist)

Date of Survey: 03/14/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: Dexter, Sean (Last name) (first name)

Site Location: SC-4, Alameda Co. 37.8724617, -122.2377652
(County, General location name, UTM Coordinates or Lat/Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:

Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 5:00 **End Time:** 5:08

Cloud cover: 0% **Precipitation:** 0

Air Temperature: 11°C **Water Temperature:** 11°C

Wind Speed: 0-1 mph. **Visibility Conditions:** Clear

Moon phase: N/A **Humidity:** 55%

Description of weather conditions: Sunny & mild

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Swarovski EL 8.5x42

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-4

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ____________________

Other notes, observations, comments, *etc.*
No pools

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: & Sandy, Grayson (Last name) (first name)

Site Location: SC-4 Alameda Co.; 37.8724617, -122.2377652

(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ DAY] NIGHT BREEDING [✓ NON-BREEDING]

Survey number (circle one): 1 [✓ 2] 3 4 5 6 7 8

Begin Time: 5:35

End Time: 5:42

Cloud cover: 40%

Precipitation: 0

Air Temperature: 15°C

Water Temperature: 12°C.

Wind Speed: 1-2 mph

Air

Visibility Conditions: H_2O ~2 ft, could see base of pool.

Moon phase: N/A.

Humidity: 66%

Description of weather conditions: Mostly sunny, light breeze.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ YES] NO

Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-4

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
None observed or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______

Other notes, observations, comments, *etc.*

No emergent Vegetation.

Equisetum (Horse tails), 2 - 12 inches from edge of pools.

Strong current through pools upstream of culvert.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: Sandy, Grayson (Last name) (first name)

Site Location: SC-4: Alameda Co.; 37.8724617, -122.2377652
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): DAY [✓ NIGHT] **BREEDING** [✓ NON-BREEDING]

Survey number (circle one): 1 2 [✓ 3] 4 5 6 7 8

Begin Time: 8:55

End Time: 9:02 P.M.

Cloud cover: 20%

Precipitation: 0

Air Temperature: 9°C

Water Temperature: 10°C

Wind Speed: 0-1

Visibility Conditions: Air > 100'; H₂O clear, > 2ft.

Moon phase: Waxing gibbous

Humidity: 68%

Description of weather conditions: Clear & calm

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ YES] NO

Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-4

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
None observed or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______________________

Other notes, observations, comments, *etc.*

No animals observed

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: (FWS Field Office) (date) (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: ~~G~~ Sandy, Grayson (Last name) (first name)

Site Location: SC-5: Alameda Co.; 37.87120848 -122.2387581
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): [✓ **1**] **2 3 4 5 6 7 8**

Begin Time: 5:45

End Time: 5:51

Cloud cover: 40%

Precipitation: 0

Air Temperature: 15°C

Water Temperature: 12°C -

Wind Speed: 1-2 mph.

Visibility Conditions: Air > 10 miles, H_2O - clear - No pool.

Moon phase: N/A

Humidity: 66%

Description of weather conditions: Mostly Sunny & light breeze.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**

Brand, model, and power of binoculars: Swarovski 8,5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-05

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None observed or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______

Other notes, observations, comments, *etc.*

No pool. All ripples.
No emergent vegetation
Bank vegetation annual herbs above (2-6") water's edge.

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist).

Date of Survey: 04/16/2019 (mm/dd/yyyy) Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: ~~G~~ Sandy, Grayson (Last name) (first name)

Site Location: SC-5, Alameda Co., 37.87120848, -122.238581 (County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings

Type of Survey (circle one): DAY [✓ NIGHT] BREEDING [✓ NON-BREEDING]

Survey number (circle one): 1 [✓ 2] 3 4 5 6 7 8

Begin Time: 8:45 PM. End Time: 9:52 PM.

Cloud cover: 25% Precipitation: 0

Air Temperature: 10°C Water Temperature: 10°C

Wind Speed: 0-1 Visibility Conditions: Air > 10 miles H₂O > 1 ft.

Moon phase: Waxing gibbous Humidity: 65% CRLF Pool, ≤ 3" depth.

Description of weather conditions: Clear, cool, no breeze.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ YES] NO

Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

S.C.-5

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
None observed or heard					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______________________________

____

____

____

____

Other notes, observations, comments, *etc.*

No animals observed

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______________ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/14/2019 (mm/dd/yyyy)

Survey Biologist: Robertson (Last name), Ted (first name)

Survey Biologist: Dexter (Last name), Sean (first name)

Site Location: LHS PoND, Alameda County, 37.87896606 -122.2473361
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ DAY] NIGHT   BREEDING [✓ NON-BREEDING]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 4:12 PM

End Time: 4:32 PM

Cloud cover: 2%

Precipitation: NONE

Air Temperature: 16° C

Water Temperature: 8° C

Wind Speed: 0-1 mph

Visibility Conditions: clear to base of Pond, Rusty tint to water

Moon phase: N/A

Humidity: 55%

Description of weather conditions: Sunny, mild to no wind.

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ YES] NO

Brand, model, and power of binoculars: Swarovski EL 8.5 X 42

Appendix E.
California Red-legged Frog Survey Data Sheet

L.H.S Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None observed					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Raccoon scat, high iron content from rusty guard rails used to shore up pond edges.

Other notes, observations, comments, *etc.*

Mosquito larvae.

Cattails (Typha latifolia) dead. No emergent shoots

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs 5085-5087
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) (date) (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy) **Survey Biologist:** Robertson, Ted (Last name) (first name)

Survey Biologist: Sandy, Grayson (Last name) (first name)

Site Location: LHS Pond: Alameda; 37.87876606, -122.2473361
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): 1 [✓ 2] 3 4 5 6 7 8

Begin Time: 6:09 PM. **End Time:** 6:22 PM.

Cloud cover: 25% **Precipitation:** 0

Air Temperature: 13°C **Water Temperature:** 14°C

Wind Speed: 2-4 mph. **Visibility Conditions:** Air > 10 mi! H2O ≈ 6" to base of puddle.

Moon phase: N/A **Humidity:** 65%

Description of weather conditions: Mostly sunny w/ light breeze

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Swarovski 8.5X42 EL.

Appendix E.

California Red-legged Frog Survey Data Sheet

LHS Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None observed or heard.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Pond quickly "dries up" do to crack in pond liner.
People, dogs, raccoons, skunks,
Water pollutants.

Other notes, observations, comments, *etc.*

No insect life in pond. Pollution? Oily sheen on water surface

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ____ (FWS Field Office) ____ (date) ____ (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: ~~G~~ Sandy, Grayson (Last name) (first name)

Site Location: LHS POND, UC Berkeley, 37.87896606, -122.2473361
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): **DAY [✓ NIGHT]** **BREEDING [✓ NON-BREEDING]**

Survey number (circle one): **1 2 [✓ 3] 4 5 6 7 8**

Begin Time: 10:09 PM.

End Time: 10:20 PM.

Cloud cover: 20%

Precipitation: 0

Air Temperature: 9°C

Water Temperature: 10°C

Wind Speed: 3-5 mph.

Visibility Conditions: Air > 10 mi Water ±

Moon phase: 3/4 WAXING

Humidity: 68%

Description of weather conditions: clear, light breeze

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

LHS Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
None heard or Observed					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______________________________

Other notes, observations, comments, *etc.*

Thousands & thousands of copepods in remnant water

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/19/2018 (mm/dd/yyyy)

Survey Biologist: Robertson (Last name) Ted (first name)

Survey Biologist: Dexter (Last name) Sean (first name)

Site Location: Sibley Pond, Contra Costa Co, 37.859132, -122.206052
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).
EB Regional Park Dist.

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin Eucalyptus & non-native trees near roads & buildings

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 4:15 PM. **End Time:** 4:45 PM.

Cloud cover: 100% **Precipitation:** 0

Air Temperature: 20° C **Water Temperature:** 12 °C

Wind Speed: 0 - 1 mph **Visibility Conditions:** Air > 5 mile. water ≈ 1 ft.

Moon phase: N/A (full) **Humidity:** 57%

Description of weather conditions: Cloudy, no wind.

Brand name and model of light used to conduct surveys: ______

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Zeiss terra 8X42
Swarovski WB 8X30

Appendix E.
California Red-legged Frog Survey Data Sheet

Sibley Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
Bullfrogs	85	O & H	Adult	4 - 6"	100%

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Bullfrogs, raccoons, skunks

Other notes, observations, comments, *etc.*

Almost 100 bullfrogs spotted within 5 ft. of shore. Estimate over 200+ additional bullfrogs hidden in reeds in center of pond. Very heavy bullfrog infestation. Tree frogs heard in ditches 1/4 mile south of pond; non observed or heard in or near pond due to bullfrogs.

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/12/2019 (mm/dd/yyyy) **Survey Biologist:** Robertson, Ted (Last name) (first name)

Survey Biologist: Sandy, Grayson (Last name) (first name)

Site Location: Tilden Park Botanical Garden Pond, 37.893026, -122.243593
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction.

Brief description of proposed action:

Thin Eucalyptus & non-native trees near roads & buildings.

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 3:50PM **End Time:** 4:14 PM.

Cloud cover: 3% **Precipitation:** 0

Air Temperature: 58°F **Water Temperature:** 50°F

Wind Speed: 1-4 mph **Visibility Conditions:** >10 miles

Moon phase: N/A **Humidity:** 60%

Description of weather conditions: Sunny, light breeze

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**

Brand, model, and power of binoculars: Nikon Monarch 8X42
Zeiss Terra 8X42

Appendix E.

California Red-legged Frog Survey Data Sheet

Tilden Park Botanical Garden Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
CA Newt (Taricha torosa)	5-10	O	Adult	Adult	100%
Sierra tree frog (Pseudacris sierra)	2	O/H	Adult	Adult	100%

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Past history of bullfrogs. Last C.R.L.F. spotted in 2001 by EB Park Resource staff.

Other notes, observations, comments, *etc.*

Adult newts + tree frogs, no egg masses

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs 5073
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by ______ (FWS Field Office) ______ (date) ______ (biologist)

Date of Survey: 03/14/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Tee (Last name) (first name)

Survey Biologist: Dexter, Sean (Last name) (first name)

Site Location: UCB Botanical Garden Pond, Alameda Co., 37,87483189 -122.2371679
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

****ATTACH A MAP** (include habitat types, important features, and species locations)******

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings.

Type of Survey (circle one) [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): [✓ 1] 2 3 4 5 6 7 8

Begin Time: 5:45 PM **End Time:** 6:03

Cloud cover: 10% **Precipitation:** 0

Air Temperature: 11°C **Water Temperature:** 12°C

Wind Speed: 0-2 mph **Visibility Conditions:** clear to base of Pond.

Moon phase: N/A. **Humidity:** 55%

Description of weather conditions: Sunny clear.

Brand name and model of light used to conduct surveys: N/A

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**

Brand, model, and power of binoculars: Swarovski EL 8.5 x 42

Appendix E.
California Red-legged Frog Survey Data Sheet

UCB Botanical Garden Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life Stages	Size Class	Certainty of Identification
Taricha torosa	300	O	EGG masses	4-5 cm	100%
" "	18	O	Adult	2 dm	100%
Pseudacris sierra	~10	H	Adult		100%
↳ in small artificial pond 100 yds from main pond.					

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: Raccoon.
Water lilies = Emergent Vegetation.

Other notes, observations, comments, *etc.*

Necessary Attachments:

4. All field notes and other supporting documents
5. Site photographs
6. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: (FWS Field Office) (date) (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy) **Survey Biologist:** Robertson, Ted (Last name) (first name)

Survey Biologist: & Sandy, Grayson (Last name) (first name)

Site Location: UCB Botanical Garden Pond: 37.87483189, -122.2371679
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction
Brief description of proposed action:
Thin non-native trees near roads & buildings

Type of Survey (circle one): [✓ **DAY**] **NIGHT** **BREEDING** [✓ **NON-BREEDING**]

Survey number (circle one): 1 [✓ 2] 3 4 5 6 7 8

Begin Time: 4:34 PM **End Time:** 4:52 pm

Cloud cover: 70% **Precipitation:** 0

Air Temperature: 15°C **Water Temperature:** 13°C

Wind Speed: 2-4 mph **Visibility Conditions:** >10 miles = air. 3+ ft = water

Moon phase: N/A **Humidity:** 66%

Description of weather conditions: Partly cloudy with light breeze.

Brand name and model of light used to conduct surveys: Mag-Lite LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ **YES**] **NO**
Brand, model, and power of binoculars: Swarovski 8.5X42 EL

Appendix E.
California Red-legged Frog Survey Data Sheet

UCB Botanical Garden Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
Taricha torosa	30 20	O O	Larvae Adult	2-3"=TL 6"-8"=TL	100%

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: striped skunk (signs of foraging along bank), raccoon, people, water striders

Other notes, observations, comments, *etc.*

No newt egg masses
Most larvae newts w/ external gills.
↳ 90%

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

Appendix E.
California Red-legged Frog Survey Data Sheet

Survey results reviewed by: (FWS Field Office) (date) (biologist)

Date of Survey: 04/16/2019 (mm/dd/yyyy)

Survey Biologist: Robertson, Ted (Last name) (first name)

Survey Biologist: & Sandy, Grayson (Last name) (first name)

Site Location: UCB Botanical Garden Pond; Alameda Co., 37.87483188, -122.2371679
(County, General location name, UTM Coordinates or Lat./Long. or T-R-S).

ATTACH A MAP (include habitat types, important features, and species locations)**

Proposed project name: UCB Hill Campus Fire Hazard Reduction

Brief description of proposed action:

Thin non-native trees near roads & buildings

Type of Survey (circle one): DAY [✓ NIGHT] **BREEDING [✓ NON-BREEDING]**

Survey number (circle one): 1 2 [✓ 3] 4 5 6 7 8

Begin Time: 9:45 PM.

End Time: 10:01 PM

Cloud cover: 20%

Precipitation: 0

Air Temperature: 9° C

Water Temperature: 13° C

Wind Speed: 0-1 mph

Air > 10 mi.

Visibility Conditions: H_2O ≈ 2.5 ft - clear

Moon phase: 3/4 Waxing

Air > 10 mi.

Humidity: water ≈ 2-3 ft. - clear.

↳ 66%

Description of weather conditions: clear & calm

Brand name and model of light used to conduct surveys: Mag-Lite. LED - 3-D cells

Were binoculars used for the surveys (circle one)? [✓ YES] NO

Brand, model, and power of binoculars: Swarovski 8.5X42 EL.

Appendix E.

California Red-legged Frog Survey Data Sheet

UCB Bot. Garden Pond

AMPHIBIAN OBSERVATIONS

Species	# of indiv.	Observed (O) Heard (H)	Life.Stages	Size Class	Certainty of Identification
Taricha terosa	30+ 10	O O	Larvas Adult	5-6 cm 1.5-2 dm	100%
Pseudacris sierra	10+	O & H	Adult	3-4 cm	100%
Taricha terosa	3	O	EGG sac	3 cm	100%

Describe potential threats to California red-legged frogs observed, including non-native and native predators such as fish, bullfrogs, and raccoons: ______________________________

Other notes, observations, comments, *etc.*

No animals observed

Necessary Attachments:

1. All field notes and other supporting documents
2. Site photographs
3. Maps with important habitat features and species locations

E3

Woodrat Nest Survey Report

Woodrat Nest Survey Report
UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

October 2019

Prepared for:

University of California, Berkeley, Facilities Services
2000 Carleton Street
Berkeley, CA 94720

Prepared by:
Condor Country Consulting, Inc.
815 Estudillo Street
Martinez, CA   94553

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1.0 Introduction

On behalf of the University of California, Berkeley (UCB), Condor Country Consulting, Inc. (CCCI) performed San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) nest surveys between May 6 and August 15, 2019 for the UC Berkeley Hill Campus Fire Hazard Reduction project. This survey and report was prepared in support of a California Environmental Quality Act (CEQA) document that UCB's Facilities Services is preparing for UC Berkeley Hill Campus Fire Hazard Reduction project. A total of 75 woodrat nest were located and mapped. Most of the nests were located under eucalyptus trees (*Eucalyptus globulus*, 28 nests) and bay trees (*Umbellularia californica*, 25 nests).

1.1 Project Location and Description

The project is located in the East Bay Hills above the cities of Berkeley and Oakland, in the heavily vegetated 800-acre Hill Campus of the UCB. The project is primarily bounded by Grizzly Peak Road to the north and east, Centennial Drive to the west, and Claremont Avenue to the south. The UCB main campus and the Lawrence Berkeley National Lab (LBNL) are west of the Project Area (Figures 1 and 2).

The University of California Berkeley (UCB) proposes to treat vegetation in 250 acres of the Hill Campus to reduce wildfire hazard and potential damage to approximately 3,000 habitable structures and institutions of international importance as well as improved life safety for 3,000-plus residents and approximately 1,000 day-time users of the Hill Campus, and increasing the reliability of the 150 KV transmission line, the sole power source to the campus and Lawrence Berkeley National Laboratory. The campus will target areas forested with flammable eucalyptus and high fuel volume, and areas within 100 feet of roads, fire-trails and buildings. Area treatments will thin the forest to reduce fuel volume and fire hazard. Roadside treatments will both reduce fire intensity along the road and remove hazardous trees likely to block the road. Defensible space will be installed within 100 feet of buildings.

Vegetation will be treated through the combination of the use of machinery and hand labor. Trees would be cut using hand tools and a mechanized feller buncher. To prevent re-sprouting, an herbicide will be applied by a licensed California Qualified Applicator to the cambium ring of eucalyptus and acacia stumps. Felled trees will be skidded by rubber-tired or tracked vehicles along skid trails to landings. Selected tree trunks will be left on the slope. At the landings, trees would be stored or chipped using a grapple-fed chipper or a tracked chipper. Whole trees will be fed into the chipper and pulled through the blades by a conveyor belt and feed wheel. Chips will be both spread on-site and transported to a gasifier to supply electricity directly to the campus.

Along roads and buildings, lower limbs of trees will be pruned, understory vegetation shortened and grass mowed.

2.0 Environmental Setting

The Project Area is located in the East Bay Hills located above the University of California, Berkeley (UCB) campus and the Lawrence Berkeley National Lab (LBNL). Initial vegetation and aquatic community surveys were conducted in 2010 as part of the Federal Emergency Management Agency (FEMA) East Bay Hills Hazardous Fire Risk Reduction Project. Follow-up plant and vegetation surveys were conducted during the late winter, spring, and summer of 2019 in support for a California Environmental Quality Act (CEQA) document in preparation of the next phase of the UC Berkeley Hill Campus Fire Hazard Reduction grant from the California Department of Forestry and Fire Protection (Cal Fire). A total of nine vegetation communities were identified inside the Project Area including: coastal scrub, coniferous forest/non-native coniferous forest, coyote brush scrub, developed/disturbed/landscaped, eucalyptus forest, oak-bay woodland, riparian woodland, riverine features, and successional grassland.

3.0 Background Information

The San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) is one of 11 subspecies of woodrat that live in California and the arid west. This subspecies is designated by California Department of Fish and Wildlife (CDFW) as a species of special concern in California.

The San Francisco dusky-footed woodrat prefers forest habitats with moderate canopy, year-round greenery, a brushy understory, and suitable nest-building materials (Zeiner et al. 1990). They build large, complex nests made of sticks, leaves and debris, often at the base of, or in a tree, around a shrub, or at the base of a hill (Jameson and Peeters 2004). Woodrats live in loose associations at times, in networks of 15 or more midens. The dusky-footed woodrat defends its nest against competitors year-round (Zeiner et al. 1990). Forage for woodrats consists of leaves, flowers, fungi, fruits and nuts; however, they favor poison oak, coffeeberry, blackberry and roses (Jameson and Peeters 2004). Woodrats typically breed from December through September, producing up to 5 litters of one to three young (Zeiner et al. 1990, Jameson and Peeters 2004).

Threats to the San Francisco dusky-footed woodrat include cover reducing activities such as cattle grazing, wildfire, habitat fragmentation, urbanization, and human disturbance as well as predation pressure from domestic/feral cats and dogs. The availability of suitably-sized sticks may limit the number of woodrat middens in an area (Zeiner et al. 1990).

4.0 Methods

CCCI biologists Ted Robertson and Steven Cochrane conducted field surveys on foot and covered all areas within the Project Area except for areas with dense stands of poison oak or steep areas with slopes greater than 45 degrees. These areas were visually searched using binoculars along the perimeters of these inaccessible portions. All nest locations were mapped using a handheld Global Navigation Satellite System (GNSS) device. Accuracy varied between 2 feet in open accessible areas to approximately 20 feet in areas with thick tree canopy or steep canyons that interfered with the reception of satellite Global Positioning System (GPS) transmission data. Several nest locations were mapped using offset point location procedures using range finders for distance and compass for direction to the nest locations. Table 1 lists the dates nest surveys were performed.

Table 1. Survey Areas and Dates, Personnel

Area Surveyed	Date	CCCI Personnel
Campus Hill Area, Claremont Canyon	May 6-8, 2019	Ted Robertson Steven Cochrane
Campus Hill Area, Claremont Canyon, Lower Centennial Drive	August 13-15, 2019	Ted Robertson Steven Cochrane

5.0 Results

Nine terrestrial habitat types occurred within the study area including:

- Coastal scrub
- Coniferous forest/non-native coniferous forest
- Coyote brush scrub
- Developed/disturbed/landscaped
- Eucalyptus forest
- Oak-bay woodland
- Riparian woodland
- Riverine features
- Successional grassland.

A general discussion and map location for each habitat type can be found in the following report; *Special Status Plant Species Survey Report, UC Berkeley Hill Campus Fire Hazard Reduction, University of California, Berkeley, October 2019* (CCCI 2019).

Seventy-five (75) woodrat nests were located and mapped inside the Project Area (Figure 3). Woodrat nests were located within or under the following 13 plants or habitats:

- Bay trees (25 nests)
- Coyote brush (1 nest)
- Currant bush (1 nest)
- Elderberry tree (1 nest)
- Eucalyptus trees (28 nests)
- French broom shrub (1 nest)
- Ground with no overstory cover (1 nest)
- Hazelnut shrub (1 nest)
- Live oak trees (7 nests)
- Madrone tree (1 nest)
- Poison oak (4 nests)
- Stumps (4 nests)
- Willow (1 nest)

A table of latitude and longitude coordinates along with the name of the host plant or habitat for each woodrat nest is located in Appendix A.

6.0 Recommendations

Because a nest may become inactive or a new nest built between the time period of the current nest surveys and the actual removal of vegetation, the following recommendations are suggested:

1. Get pre-approval from CDFW for any actions that may impact the woodrat nests.
2. Have a qualified biologist survey the plot of land no more than 7 days prior to the start of any logging activities for the presence or absence of any woodrat nest.
3. If a nest is found, the following actions can be taken;
    - If the nest will not be disturbed, mark the perimeter of the next with ESA fencing to prevent accidental encroachment by machinery. If there is a probability of woodchips covering the nest from logging or chipping activities, temporarily cover the nest with a tarp. A nest should not be covered for more than a 4 hour period of time.
    - If there is a danger of the nest being damaged or destroyed by the logging activities, move the nest to nearby adjacent habitat out of harm's way.
    - If a nest is located at the very base of the tree, cut the tree at least 2 feet above the top of the nest. Using a mechanized feller buncher or similar piece of equipment will greatly decrease the likelihood of the felled tree from damaging the nest. Prior to cutting, temporarily protect the nest with a trap to prevent wood chips from covering the nest.

7.0 References

Condor Country Consulting, Inc. (CCCI). 2019. Special Status Plant Species Survey Report, UC Berkeley Hill Campus Fire Hazard Reduction, University of California, Berkeley, October 2019.

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U.S. Fish and Wildlife Service. 2013. Biological Opinion for the Proposed Federal Emergency Management Agency (FEMA) Hazardous Fire Risk Reduction in the East Bay Hills of Alameda and Contra Costa Counties, California (HMGP 1731-16-34, PDM-PJ-09-CA-2005-003, PDM-PJ-09-CA-2005-011, PDM-PJ-09-CA-2006-004).

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White, editors. 1990. California's wildlife. Volume III: mammals. California Statewide Wildlife Habitat Relationships System, California Department of Fish and Game, Sacramento, USA.

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Figures

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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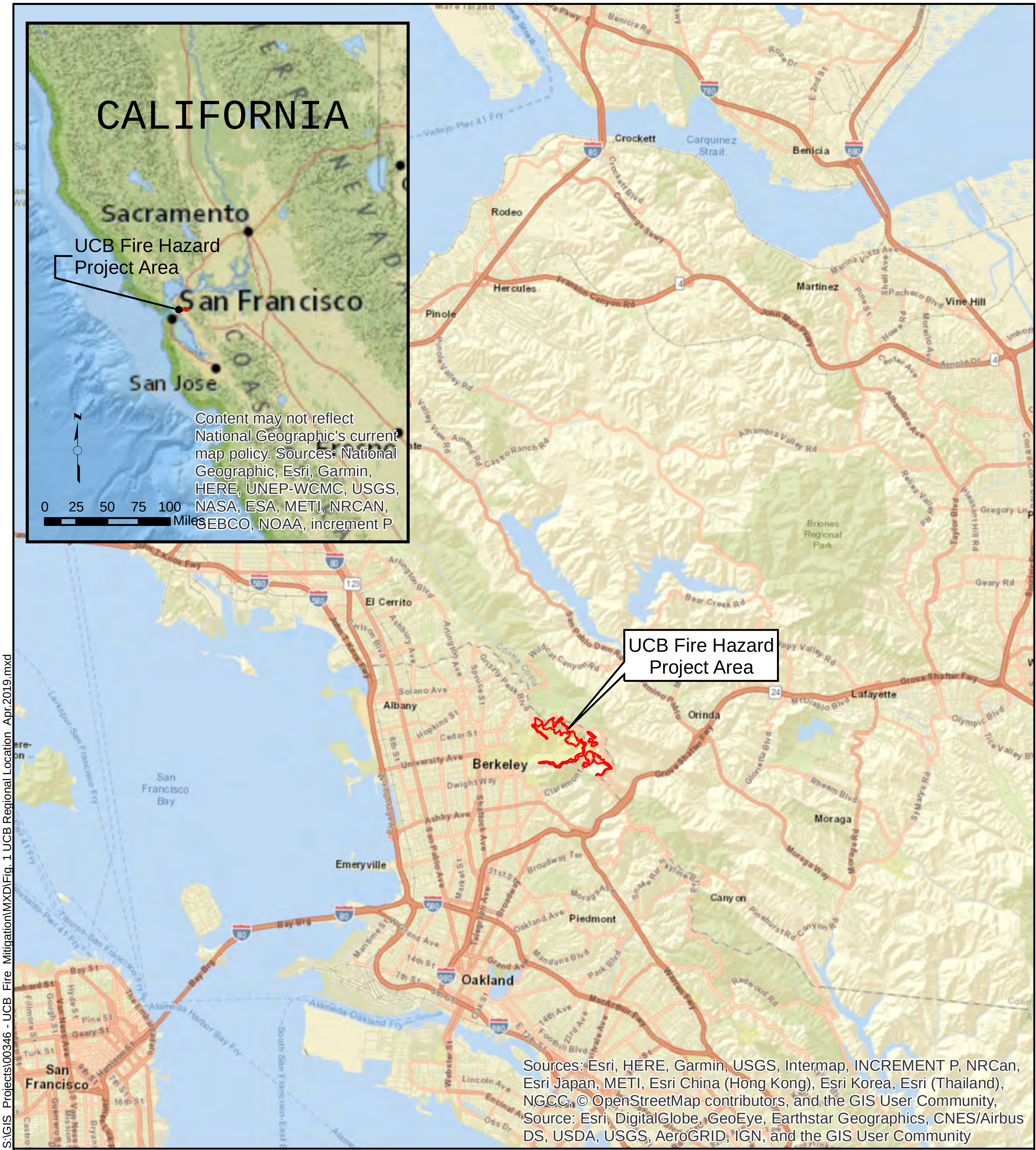

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S:\GIS_Projects\00346 - UCB_Fire_Mitigation\MXD\Fig. 1 UCB Regional Location_Apr.2019.mxd

Ted Robertson April 23, 2019

FIGURE 1

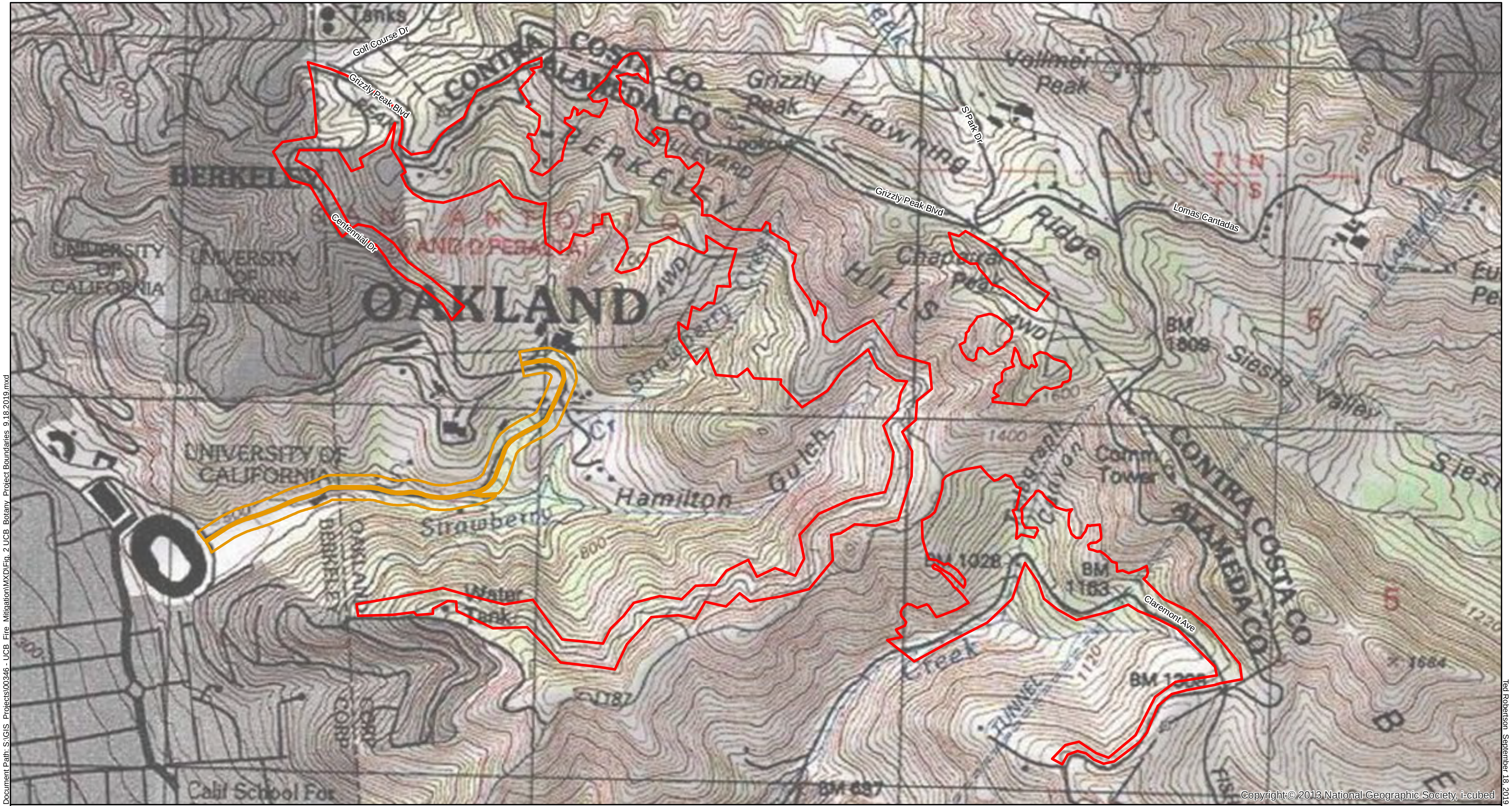
Regional Location of UC Berkeley Hill Campus Fire Hazard Reduction Project

City of Berkeley, CA

N
W E
S

0 1 2 3 4
Miles

CONDOR COUNTRY
CONSULTING, INC.



Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 2 UCB Botany Project Boundaries 9.18.2019.mxd

Ted Robertson, September 18, 2019

🟥 Project Area

🟧 Lower Centennial Drive Project Area

Project Boundaries

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa Counties, California

N
W E
S

0 0.1 0.2 0.3 0.4 Miles

FIGURE 2

CONDOR COUNTRY
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Ted Robertson October 17, 2019

Woodrat Nest Locations

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa County, California

N
W E
S

0 500 1,000 1,500 2,000 Feet

FIGURE 3

CONDOR COUNTRY CONSULTING, INC.

Appendix A

Appendix A: Woodrat Nest Location Coordinates

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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Table 1. Woodrat Nest Coordinates

Item Number	Latitude	Longitude	Host Plant
0	37.87248054	-122.2245644	Bay tree
1	37.87253805	-122.2243749	Bay tree
2	37.87300373	-122.2245717	Bay tree
3	37.87311874	-122.2246101	Bay tree
4	37.86963684	-122.2405018	Live oak
5	37.87271330	-122.2283087	Willow
6	37.87916506	-122.2369480	Eucalyptus
7	37.87916014	-122.2368885	Eucalyptus
8	37.87924038	-122.2369079	Eucalyptus
9	37.87926254	-122.2367589	Eucalyptus
10	37.87925583	-122.2365765	Eucalyptus
11	37.87944591	-122.2366741	Eucalyptus
12	37.87806990	-122.2320940	Eucalyptus
13	37.87810850	-122.2322931	Eucalyptus
14	37.87125664	-122.2219596	Bay tree
15	37.87317533	-122.2247609	Bay tree
16	37.87323889	-122.2247733	Bay tree
17	37.87295001	-122.2245138	Bay tree
18	37.87842365	-122.2251101	Bay tree
19	37.87839420	-122.2251041	Bay tree
20	37.87803944	-122.2246939	Stump
21	37.87782313	-122.2243376	Stump
22	37.86880272	-122.2386641	Currant
23	37.86871617	-122.2374933	Madrone
24	37.86984081	-122.2354944	Live oak
25	37.87019222	-122.2344194	Live oak
26	37.87074211	-122.2318917	Hazelnut
27	37.87342138	-122.2280385	Coyote brush
28	37.87375690	-122.2280243	Stump
29	37.87379911	-122.2279514	Ground
30	37.87393300	-122.2281715	Bay tree
31	37.87429010	-122.2281311	Bay tree
32	37.87418793	-122.2283835	Eucalyptus
33	37.87433502	-122.2284687	Bay tree
34	37.87440408	-122.2282643	Bay tree
35	37.87472313	-122.2282691	Elderberry
36	37.87544418	-122.2274702	Bay tree
37	37.87670738	-122.2296576	French broom
38	37.87637290	-122.2297112	Eucalyptus
39	37.87628737	-122.2297815	Eucalyptus
40	37.87613407	-122.2299803	Eucalyptus

Item Number	Latitude	Longitude	Host Plant
41	37.87617271	-122.2302757	Bay tree
42	37.87577878	-122.2304761	Bay tree
43	37.87570129	-122.2304869	Bay tree
44	37.87549104	-122.2306105	Bay tree
45	37.87539758	-122.2306083	Bay tree
46	37.88006468	-122.2403313	Eucalyptus
47	37.88001591	-122.2399894	Eucalyptus
48	37.87995554	-122.2398616	Eucalyptus
49	37.87989674	-122.2396991	Eucalyptus
50	37.87982533	-122.2393180	Eucalyptus
51	37.87991654	-122.2393575	Eucalyptus
52	37.87988942	-122.2392650	Eucalyptus
53	37.88003162	-122.2390660	Eucalyptus
54	37.87933715	-122.2361614	Eucalyptus
55	37.87966308	-122.2353617	Bay tree
56	37.87900920	-122.2345922	Eucalyptus
57	37.87900468	-122.2345291	Eucalyptus
58	37.87892152	-122.2333012	Bay tree
59	37.87659414	-122.2309744	Poison Oak
60	37.87632206	-122.2315699	Eucalyptus
61	37.87936234	-122.2352096	Eucalyptus
62	37.87870839	-122.2344482	Eucalyptus
63	37.87302937	-122.2244450	Bay tree
64	37.87213026	-122.2260063	Eucalyptus
65	37.87956241	-122.2351247	Bay tree
66	37.87850641	-122.2249448	Stump
67	37.87853071	-122.2249702	Poison Oak
68	37.87857371	-122.2249988	Poison Oak
69	37.87846963	-122.2249910	Poison Oak
70	37.87346184	-122.2256804	Eucalyptus
71	37.87681858	-122.2249396	Bay tree
72	37.87675792	-122.2251476	Live oak
73	37.87661085	-122.2254203	Live oak
74	37.87659553	-122.2252434	Live oak

E4

Sensitive Plant Communities
Survey Report

Sensitive Plant Communities Survey Report

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

July 2020

Prepared for:

University of California, Berkeley, Facilities Services
2000 Carleton Street
Berkeley, CA 94720

Prepared by:
Condor Country Consulting, Inc.
815 Estudillo Street
Martinez, CA   94553

Table of Contents

List of Figures

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1.0 Introduction

On behalf of the University of California, Berkeley (UCB), Condor Country Consulting, Inc. (CCCI) performed sensitive plant community surveys between May 5 and May 15, 2020 for the UC Berkeley Hill Campus Fire Hazard Reduction project. This survey and report was prepared in support of a California Environmental Quality Act (CEQA) document that UCB's Facilities Services is preparing for UC Berkeley Hill Campus Fire Hazard Reduction project. Eight sensitive plant communities totaling 29 acres were mapped within the Project Area; bigleaf maple forest, bush monkeyflower scrub, California bay forest, California buckeye grove, hazelnut scrub, madrone forest, ocean spray brush, and redwood forest (planted). The most abundant sensitive community was the California bay forest, occupying 24 acres withing the project area.

1.1 Project Location and Description

The project is located in the East Bay Hills above the cities of Berkeley and Oakland, in the heavily vegetated 800-acre Hill Campus of the UCB. The project is primarily bounded by Grizzly Peak Road to the north and east, Centennial Drive to the west, and Claremont Avenue to the south. The UCB main campus and the Lawrence Berkeley National Lab (LBNL) are west of the Project Area (Figures 1 and 2).

The University of California Berkeley (UCB) proposes to treat vegetation in 279 acres of the Hill Campus to reduce wildfire hazard and potential damage to approximately 3,000 habitable structures and institutions of international importance as well as improved life safety for 3,000-plus residents and approximately 1,000 day-time users of the Hill Campus, and increasing the reliability of the 150 KV transmission line, the sole power source to the campus and Lawrence Berkeley National Laboratory. The campus will target areas forested with flammable eucalyptus and high fuel volume, and areas within 100 feet of roads, fire-trails and buildings. Area treatments will thin the forest to reduce fuel volume and fire hazard. Roadside treatments will both reduce fire intensity along the road and remove hazardous trees likely to block the road. Defensible space will be installed within 100 feet of buildings.

Vegetation will be treated through the combination of the use of machinery and hand labor. Trees would be cut using hand tools and a mechanized feller buncher. To prevent re-sprouting, an herbicide will be applied by a licensed California Qualified Applicator to the cambium ring of eucalyptus and acacia stumps. Felled trees will be skidded by rubber-tired or tracked vehicles along skid trails to landings. Selected tree trunks will be left on the slope. At the landings, trees would be stored or chipped using a grapple-fed chipper or a tracked chipper. Whole trees will be fed into the chipper and pulled through the blades by a conveyor belt and feed wheel. Chips will be both spread on-site and transported to a gasifier to supply electricity directly to the campus.

Along roads and buildings, lower limbs of trees will be pruned, understory vegetation shortened, and grass mowed.

2.0 Environmental Setting

The Project Area is located in the East Bay Hills located above the University of California, Berkeley (UCB) campus and the Lawrence Berkeley National Lab (LBNL). Initial vegetation and aquatic community surveys were conducted in 2010 as part of the Federal Emergency Management Agency (FEMA) East Bay Hills Hazardous Fire Risk Reduction Project. Follow-up plant and vegetation surveys were conducted during the late winter, spring, and summer of 2019 and 2020 in support for a California Environmental Quality Act (CEQA) document in preparation of the next phase of the UC Berkeley Hill Campus Fire Hazard Reduction grant from the California Department of Forestry and Fire Protection (Cal Fire). A total of nine vegetation communities were identified inside the Project Area and named according to the conventions used in the original FEMA biological assessment (FEMA 2012), as well as those described in *A Manual of California Vegetation* (Sawyer et al. 2009), *California Vegetation* (Holland 1995), *USFWS National Wetlands Inventory* (USFWS 2020), and Cowardin (Cowardin et al., 1979). The vegetation communities include coastal scrub (xeric), coniferous forest/non-native coniferous forest, coyote brush scrub, developed/disturbed/landscaped, eucalyptus forest, oak-bay woodland, riparian woodland, riverine features, and successional grassland. During 2020, eight sensitive community habitats were mapped throughout the expanded Project Area including bigleaf maple forest, bush monkeyflower scrub, California bay forest, California buckeye grove, hazelnut scrub, madrone forest, ocean spray brush, and redwood forest.

3.0 Methods

3.1 Literature and Data Review

CCCI biologist Ted Robertson conducted a literature search prior to field visits. The literature search included a review of the CDFW list of California Sensitive Natural Communities (CDFW 2019b) and aerial imagery of the project location (Google Earth Pro 2020). The Biological Assessment (BA) and the Biological Opinion (BO) for the Project Area was referenced for a list of major habitats previously mapped in areas inside and adjacent to the Project Area. A list of potential sensitive natural communities was compiled based upon the previous floristic studies that had cataloged every species observed by Mr. Robertson when he conducted surveys for sensitive plant species inside the expanded Project Area in 2019 and 2020.

3.2 Sensitive Plant Community Study Methods

CCCI botanist Ted Robertson conducted background literature research and led a team of botanists and biologists to perform field surveys of the entire Project Area (Table 1). Mr. Robertson holds a California Department of Fish and Wildlife (CDFW) Voucher Collecting

Permit for special status plants (Permit Number 2081(a)-19-015-V). CCCI botanists conducted surveys in accordance with California Native Plant Society's Botanical Survey Guidelines (CNPS 2001), CDFW Protocol for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (CDFW 2009), and U.S. Fish and Wildlife Service (USFWS) Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants (USFWS 1996).

Table 1. Survey Areas, Dates, and Personnel

Area Surveyed	**Date**	**Total Survey Person Hours**	**CCCI Personnel**
East/West Ridge Fuel Breaks Landing Areas Hearst Gate Fuel Break	May 5, 2020	24 hours	Ted Robertson Steven Cochrane Rachel McCracken
Centennial Drive Lower Jordan EST Strawberry FHR	May 6, 2020	16 hours	Ted Robertson Steven Cochrane
Upper Jordan EST	May 14, 2020	16 hours	Ted Robertson Rachel McCracken
Frowning FHR Claremont FHR	May 15, 2020	16 hours	Ted Robertson Rachel McCracken

Field surveys were conducted on foot and covered all areas within the Project Area except for areas with dense stands of poison oak or steep areas with slopes greater than 45 degrees. These areas were visually searched using binoculars along the perimeters of these inaccessible portions. All habitats withing the Project Area were investigated, and all sensitive plant communities were mapped (Figure 3).

3.3 Sensitive Plant Community Classification

Plant identification was based upon the *Second Edition of The Jepson Manual* (Baldwin et al. 2012). Plant communities were identified using the characterizations in *A Manual of California Vegetation* (Sawyer et al. 2009). Sensitive plant community types were classified using the California Sensitive Natural Communities list (CDFW 2019b). Vegetation community types were aligned with those described in the 2019 Biological Assessment for the Hazardous Fire Risk Reduction for the East Bay Hills (FEMA 2012). The minimum mapping unit for this project was defined as an area of 800 square feet.

4.0 Sensitive Plant Communities Within the Project Area

As shown in Figure 3, sensitive plant communities within the study area include:

- Bigleaf maple forest
- Bush monkeyflower scrub
- California bay forest
- California buckeye grove
- Hazelnut scrub
- Madrone forest
- Ocean spray brush
- Redwood forest (planted)

A general discussion of each habitat type is provided below.

Bigleaf Maple Forest

Bigleaf maples (*Acer macropyhyllum*) are mostly associated with riparian environments, and the best developed stands are scattered near river terraces and adjacent side drainages. There were five stands in the project area, most averaging 0.17 acres in size. Four of the stands are associated with the lower reaches of the Strawberry Creek drainage. Bigleaf maples have a moderate to long fire interval and will vigorously sprout from the root crown if the top branches are killed by a moderate intensity fire or by major pruning. This forest was mapped in 0.9 acres in the Project Area.

Bush Monkeyflower Scrub

Only one small linear strand of bush monkey flower (*Diplacus aurantiacus*) 0.1 acres in size was found along the edge of the eastern fire break portion of the project area. There were many scattered individuals of this bush commonly found in the coastal and coyote brush scrub habitats inside the Project Area. This plant is a drought-deciduous shrub with surface feeder roots less than 6 feet deep. This plant is a low growing shrub, rarely exceeding 5 feet in height. After a fire, this shrub will grow back fast and flower quickly. This plant will also sprout from its roots after light fires. It is adapted to medium fire intervals of 20 to 50 years and will burn with moderate to high intensity.

California Bay Forest

The California bay forest community was the most common sensitive community in the Project Area, ninety-one stands were mapped, each averaging 0.25 acres in size. California bay (*Umbelullaria californica*) was also the most common understory tree found under Eucalyptus stands, although these understory stands were not mapped. Once the overstory eucalyptus trees are removed, the California bay forest will become the most abundant forest type. California bays are an evergreen broadleaf tree that have very aromatic leaves and can grow up to 80 feet tall. Other native trees found adjacent to this vegetation community in the Project Area include California buckeye (*Aesculus californica*), bigleaf maple, and madrone (*Arbutus menziesii*). Understory species may contain poison oak (*Toxicodendron diversilobum*), Swordfern (*Polystichum munitum*), California blackberry (*Rubus ursinus*), coyote brush (*Baccharis pilularis*), California hazelnut (*Corylus cornuta*), toyon (*Heteromeles arbutifolia*), and currants (*Ribes* spp.). In many cases, mature stands of bay trees can become the only tree present with very few shrubs or herbs present underneath the crown. They will spread into adjacent habitat becoming the dominant species. The tree's ability to sprout after fire allows it to grow in areas with frequent fire, but its typical fire interval is moderate, 30 – 100+ years. This forest was mapped in 24 acres in the Project Area.

California Buckeye Grove

There were six small buckeye groves in the project area, most were under 0.1 acres in size. Most of the small groves were in the Claremont Canyon area. They are frequently found adjacent to California bay trees, coast live oaks (*Quercus agrifolia*), and toyon shrubs. California buckeyes are a small, tree, growing up to 24 feet tall. California buckeyes are summer deciduous in areas away from the immediate coast, losing their leaves when the soil becomes dry. Because of this growth habit of not having leaves during the fire season, they are not prone to burning. Damaged trees can sprout from stumps or root crowns. They produce very large, round seeds annually. Buckeye groves were mapped in 0.4 acres of the Project Area.

Hazelnut Scrub

Hazelnut is a multi-stemmed shrub that grows up to 12 feet in height. This shrub was found growing in mostly north-facing slopes in well-drained soils. Hazelnut scrub was found in seven locations, in patches averaging 0.05 acres in size. Six of the patches were found along the Upper Jordan firebreak area, and a single patch along the Lower Jordan firebreak. Hazelnut scrub was found adjacent to coyote brush scrub and next to bay/oak woodland habitat. The above ground stems of hazelnut are killed by fire, but this plant will abundantly sprout from their root crowns, increasing the number of post-fire stems. Hazelnut adds low intensity and severity to fires.

Madrone forest

Madrone is an evergreen hardwood tree with thin, reddish peeling bark that is susceptible to top kill by a fire. The leaves are broad and thick. After a fire, new growth will sprout from the root crown. The tree will attain a height of 120 feet. It closely associates with California bay and coast live oak forests but tend to grow in slightly more drier conditions. Only a single 0.3-acre patch of madrone forest along the Lower Jordan Trail was found within the Project Area.

Ocean Spray Brush

Ocean spray is a deciduous shrub with small, strongly veined leaves, and a reddish-grey shredding bark. It grows up to 18 feet tall but is typically half this size in height. In burns with low to moderate intensity, it will sprout from root crowns if the branches become damaged mechanically or by fire. Ocean spray brush was found in seven small patches along the Upper Jordan Trail, mostly along the edges of coyote brush scrub habitat. Ocean spray brush was mapped in 0.5 acres of the Project Area.

Redwood Forest (planted)

Coast redwood trees (*Sequoia sempervirens*) tend to be found on north and east-facing slopes on shallow soils, in valley and canyon bottoms, in areas with abundant summer fog. These evergreen trees can attain maximum heights close to 400 feet. In the Project Area, six redwood patches were located along lower Centennial Road and Lower Jordan Fire Trail. All the redwood patches inside the Project Area have been planted. Redwoods are well adapted to small ground fires, mature trees have a thick, fire resistant bark. If the above ground portion of the tree becomes severely damaged by fire, they can sprout from stumps and roots. Most fires are fueled by the redwood leaf duff in the understory. Understory plants are sparse but can include sword fern, poison oak, and ocean spray. Redwood forests were mapped in 2.4 acres of the Project Area.

5.0 Habitats Within the Project Area

As shown on Figure 4, terrestrial habitat types within the study area include:

- Coastal scrub
- Coniferous forest/non-native coniferous forest
- Coyote brush scrub
- Developed/disturbed/landscaped
- Eucalyptus forest
- Oak-bay woodland
- Riparian woodland
- Riverine features
- Successional grassland

A general discussion of each habitat type is provided in the *Special Status Plant Species Survey Report*, UC Berkeley Hill Campus Fire Hazard Reduction, University of California, Berkeley, 2020 (UCB 2020).

6.0 Results

The following summarizes the results of CCCI's sensitive plant community surveys in the Project Area.

Sensitive Plant Communities

During the vegetation surveys, eight sensitive plant communities were observed inside the Project Area. A total of 130 plots were mapped for a total combined acreage of 28.8 acres. Table 2 describes the number of locations and total acreages for each of the sensitive plant communities.

Table 2: Sensitive Plant Community Statistics.

Sensitive Community Name	Number of Plots	Total Acreage
Bigleaf maple forest	5	0.9
Bush monkeyflower scrub	1	0.1
California bay forest	97	23.9
California buckeye grove	6	0.4
Hazelnut scrub	7	0.3
Madrone forest	1	0.3
Ocean spray brush	7	0.5
Redwood forest (planted)	6	2.4
TOTALS	**130**	**28.8**

Critical Habitat

The Project Area is not located within any federally listed special status plant critical habitat units.

7.0 Recommendations

To prevent impacts to sensitive plant communities, implementing different avoidance measures geared to each specific sensitive community is suggested. The sensitive plant communities have been grouped into five categories, shrubby sensitive species (monkeyflower scrub, hazelnut scrub, and ocean spray brush), deciduous trees (buckeyes and bigleaf maples), madrones, redwoods, and California bays. Clues for proper identification of sensitive vegetation to be protected along with avoidance and impact minimization precautions should be part of environmental awareness material used for training future work/logging crews.

Shrubby Sensitive Communities

The three shrubby sensitive communities (15 locations totaling 0.9 acres, bush monkeyflower scrub, hazelnut scrub, and ocean spray brush) are the most difficult sensitive plant communities to identify and should be surrounded with bright orange ESA fence. Locations away from logging operations can be marked with ESA fence along edges of the dirt road that borders these three shrubby sensitive communities. The biologist or forester assigned to monitoring the logging portion of this project should be familiar with identifying these three shrubs during the fall, non-flowering season, a time when they are more difficult to identify. Any mulching of the felled trees should not cover the sensitive community vegetation.

Deciduous Tree Sensitive Communities

The two sensitive communities composed of deciduous trees (11 locations totaling 1.3 acres, bigleaf maples and buckeyes), should have the boundaries of their driplines well marked by a qualified botanist, forester, or biologist who is familiar with the identification of these two species, especially when they become harder to identify after they lose their leaves in the late summer and fall. California buckeyes are summer deciduous, losing their leaves early during drought conditions to prevent water loss. A few of these trees had been heavily pruned prior to the surveys, creating a disadvantage for these species to successfully compete with adjacent vegetation.

Madrone Forest

There is a single 0.3-acre plot located along the Lower Jordan trail. The madrone forest dripline boundaries should be marked to keep logging equipment from entering the area to prevent damaging the trees and compacting the soil above the tree roots.

Redwood forest (planted)

There are 6 locations of redwood forests totaling 2.4 acres. All the patches are small (less than 0.2 acres) except for a 2-acre patch along the eastern edge of the UC Botanical Garden. All the groves have been planted in areas that are not part of their recent historical range, hence their status as a natural sensitive plant community is not well established for these UCB locations. None the less, logging equipment should avoid soil compaction around the root zone by not driving under the drip line zone surrounding these trees.

California Bay Forest

California bay forests are the most dominant and widespread sensitive plant community in the Project Area, mapped in 97 locations totaling 24 acres. In addition, bay trees are the most abundant understory tree found underneath the eucalyptus canopy (these understory bay tree locations were not mapped). To minimize impacts, heavy logging equipment should avoid traveling under the driplines of bay trees. In locations where the bay tree is part of the understory of trees to be removed, logging equipment and tree felling should occur using methods that avoid damaging the bay trees.

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List of Figures

UC Berkeley Hill Campus Fire Hazard Reduction
University of California, Berkeley

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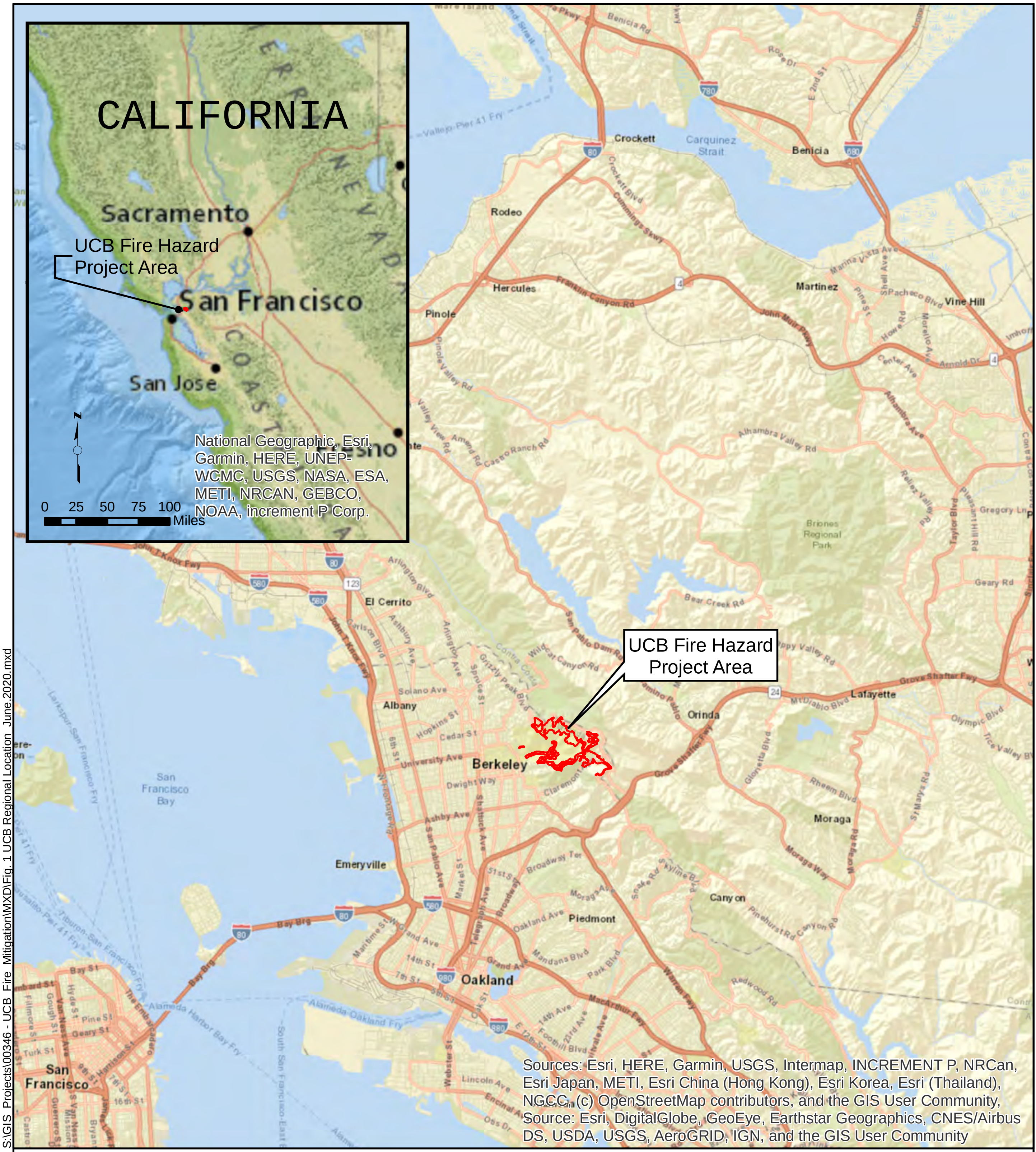

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Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 1 UCB Regional Location June.2020.mxd

Ted Robertson June 15, 2020

Regional Location of UC Berkeley Hill Campus Fire Hazard Reduction Project

City of Berkeley, CA

FIGURE 1

N
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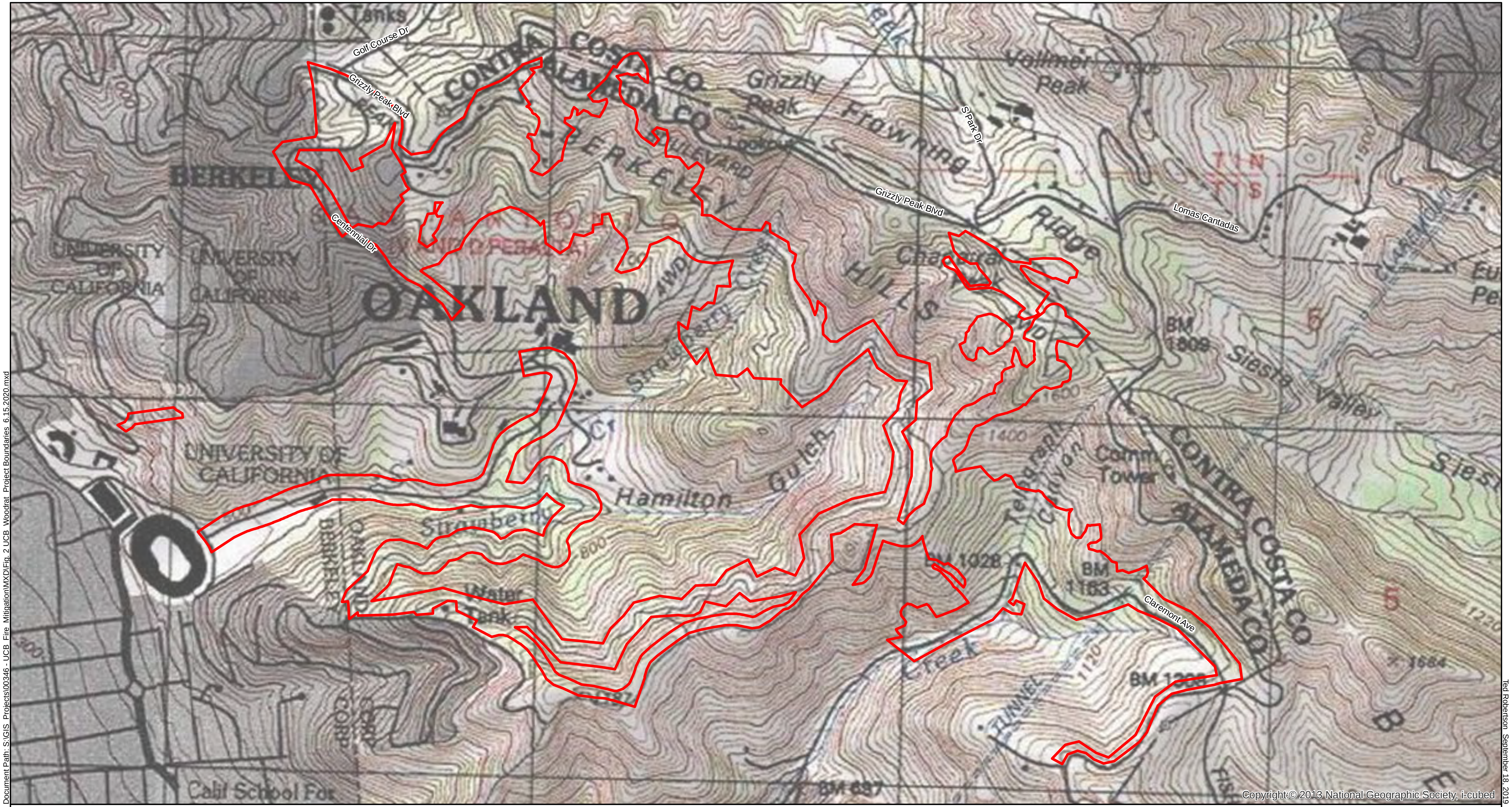
CONDOR COUNTRY
CONSULTING, INC.



Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 2 UCB Woodrat Project Boundaries 6.15.2020.mxd

Ted Robertson, September 18, 2019

Project Boundaries

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa Counties, California

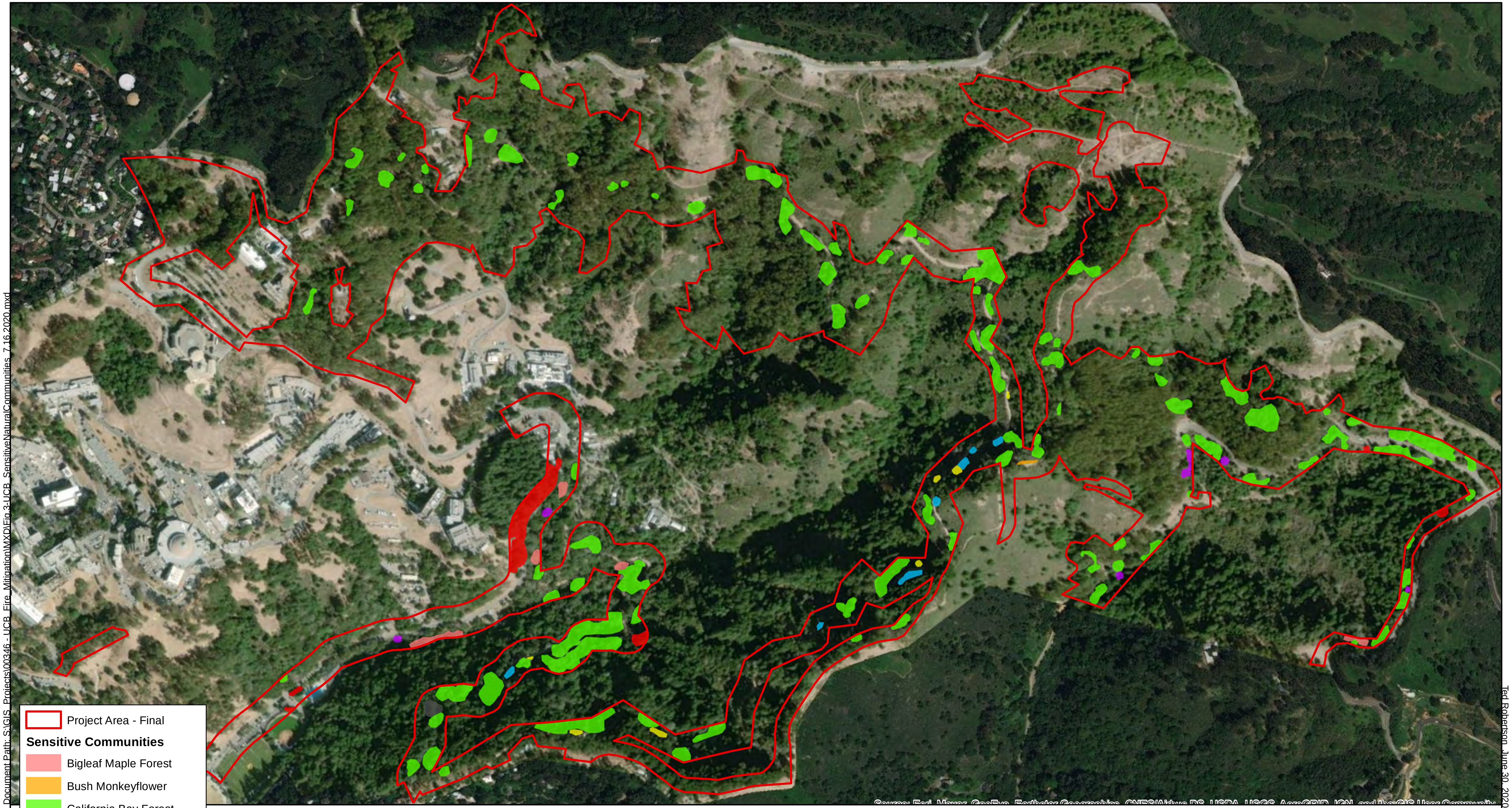
🟥 Project Area

N
W E
S

0 0.1 0.2 0.3 0.4 Miles

FIGURE 2

CONDOR COUNTRY
CONSULTING, INC.



🟥 Project Area - Final

Sensitive Communities

🟥	Bigleaf Maple Forest
🟧	Bush Monkeyflower
🟩	California Bay Forest
🟪	California Buckeye Forest
🟨	Hazelnut Scrub
⬛	Madrone Forest
🟦	Ocean Spray Brush
🟥	Redwood Forest (planted)

Sensitive Communities

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa County, California

N E S W

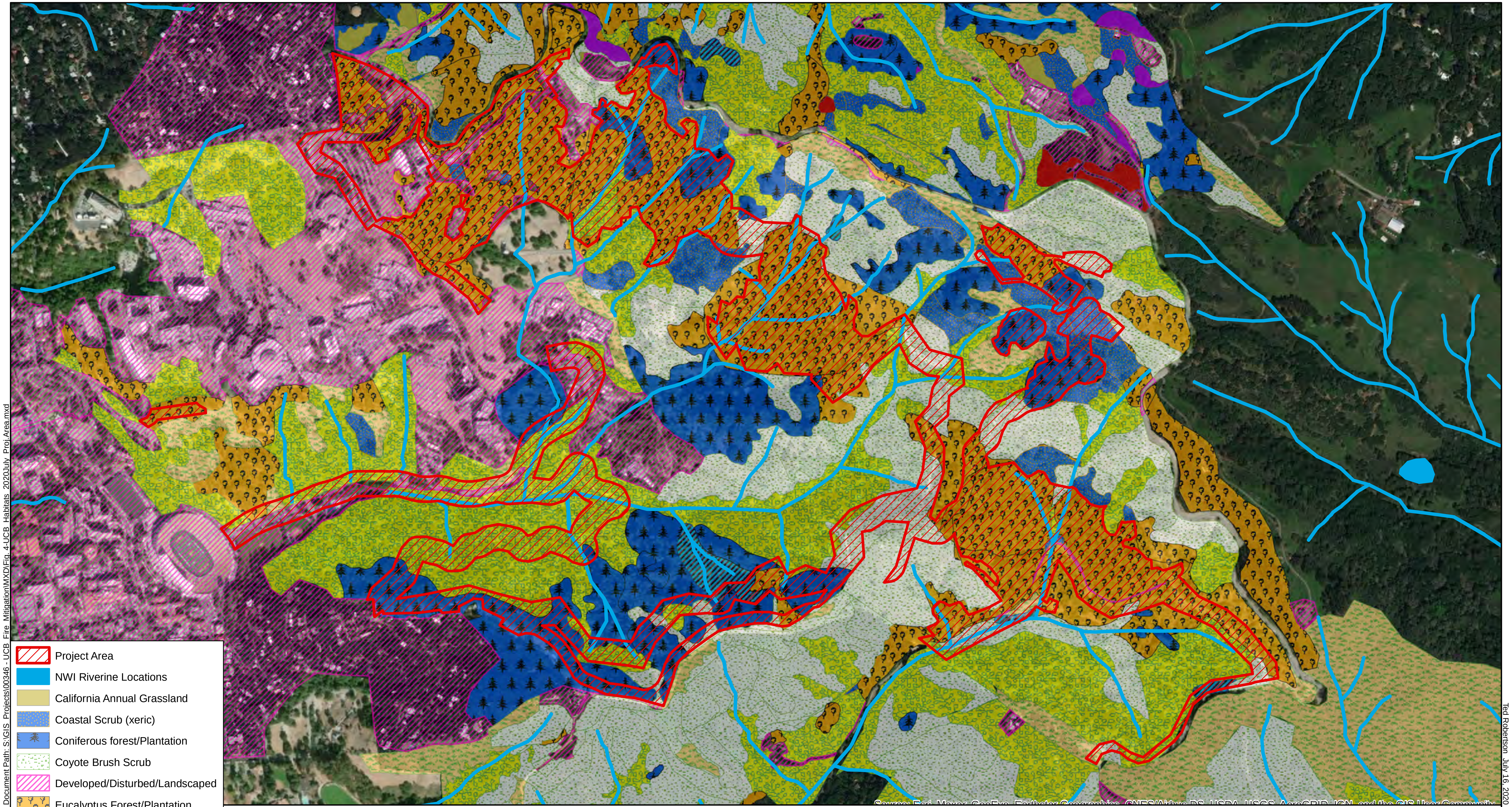
0 0.1 0.2 0.3 Miles

FIGURE 3

CONDOR COUNTRY CONSULTING, INC.

Document Path: S:\GIS_Projects\00346 - UCB_Fire_Mitigation\MXD\Fig 3-UCB_SensitiveNaturalCommunities_7.16.2020.mxd

Ted Robertson, June 30, 2020



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

▨	Project Area
🟦	NWI Riverine Locations
🟨	California Annual Grassland
▦	Coastal Scrub (xeric)
🟦	Coniferous forest/Plantation
⬚	Coyote Brush Scrub
▨	Developed/Disturbed/Landscaped
🟧	Eucalyptus Forest/Plantation
🟪	Non-native Coniferous Forest
🟩	Northern Maritime Chaparral
🟨	Oak-Bay Woodland/Forest
🟥	Redwood Forest
▨	Riparian Woodland
▦	Successional grassland

HABITATS

UC Berkeley Hill Campus Fire Hazard Reduction Project

Alameda and Contra Costa County, California

FIGURE 4

CONDOR COUNTRY CONSULTING, INC.

Document Path: S:\GIS Projects\00346 - UCB Fire Mitigation\MXD\Fig. 4-UCB Habitats 2020July Proj.Area.mxd

Ted Robertson July 16, 2020

Appendix F

Air Quality and Greenhouse Gases Emissions Modeling Data

Output from EMFAC2017 Model Run

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: ALAMEDA
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN

Region	Calendar Y	Vehicle Cat	Model Yea	Speed	Fuel	Population	VMT	Trips	Fuel Consumption (1000 gal/day)	Fuel Consumption (gal/day)	gal/mile	miles/gal	ROG_RUNE	ROG_IDLE	ROG_STRE	ROG_HOTS	ROG_RUNL	ROG_REST	ROG_DIUR	TOG_RUNE	TOG_IDLE	TOG_STRE	TOG_HOTS	TOG_RUNL	TOG_RESTI	TOG_DIUR	CO_RUNE	CO_IDLEX	CO_STREX	NOx_RUNE	NOx_IDLE	NOx_STRE	CO2_RUNE	CO2_IDLEX	CO2_STRE	CH4_RUNE	CH4_IDLEX	CH4_STRE	PM10_RU	PM10_IDL	PM10_STR	PM10_PM	PM10_PM	PM2_5_RUNEX	PM2_5_IDLEX	PM2_5_STREX	PM2_5_PMTW	PM2_5_PMBW	SOx_RUNE	SOx_IDLEX	SOx_STRE	N2O_RUNE	N2O_IDLE	N2O_STREX
ALAMEDA	2021	LDA	Aggregate	Aggregate	GAS	643846.3	23456819	3010602	759.1663212	759,166.32	0.03236	30.898	0.011591	0	0.290414	0.119683	0.246102	0.209404	0.217333	0.016904	0	0.317965	0.119683	0.246102	0.209404	0.217333	0.693193	0	2.478666	0.047127	0	0.224251	270.7509	0	57.71532	0.002905	0	0.062188	0.001543	0	0.00199	0.008	0.03675	0.001419203	0	0.001829576	0.002000001	0.015750005	0.002679	0	0.000571	0.005018	0	0.028556
ALAMEDA	2021	LDA	Aggregate	Aggregate	DSL	7140.126	264939.3	33233.8	5.637479255	5,637.48	0.02128	46.996	0.019581	0	0	0	0	0	0	0.022291	0	0	0	0	0	0	0.25599	0	0	0.113991	0	0	216.593	0	0	0.000909	0	0	0.010575	0	0	0.008	0.03675	0.010117339	0	0	0.002000001	0.015750005	0.002048	0	0	0.034045	0	0
ALAMEDA	2021	LDA	Aggregate	Aggregate	ELEC	17125.1	649064.6	84207.95					0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.008	0.03675	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
ALAMEDA	2021	LDT1	Aggregate	Aggregate	GAS	66399	2359125	304135.2	88.60449258	88,604.49	0.03756	26.625	0.025406	0	0.427661	0.210919	0.766547	0.392514	0.450308	0.037042	0	0.468232	0.210919	0.766547	0.392514	0.450308	1.172104	0	2.646624	0.106817	0	0.296974	314.1232	0	67.2804	0.005778	0	0.083878	0.002072	0	0.002686	0.008	0.03675	0.001905156	0	0.002469748	0.002000001	0.015750005	0.003109	0	0.000666	0.008208	0	0.031586
ALAMEDA	2021	LDT1	Aggregate	Aggregate	DSL	46.09621	741.565	149.5479	0.030880027	30.88	0.04164	24.014	0.21664	0	0	0	0	0	0	0.24663	0	0	0	0	0	0	1.244688	0	0	1.203378	0	0	423.8716	0	0	0.010063	0	0	0.179628	0	0	0.008	0.03675	0.171857493	0	0	0.002000001	0.015750005	0.004007	0	0	0.066627	0	0
ALAMEDA	2021	LDT1	Aggregate	Aggregate	ELEC	321.7501	12861.12	1605.904					0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.008	0.03675	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
ALAMEDA	2021	LDT2	Aggregate	Aggregate	GAS	212628.3	7710663	988229.3	316.4944952	316,494.50	0.04105	24.363	0.016513	0	0.381832	0.138609	0.468688	0.292836	0.283896	0.024085	0	0.418057	0.138609	0.468688	0.292836	0.283896	0.890638	0	3.103874	0.085751	0	0.340973	343.2474	0	74.34634	0.004051	0	0.080284	0.001527	0	0.001906	0.008	0.03675	0.001403934	0	0.001752519	0.002000001	0.015750005	0.003397	0	0.000736	0.00707	0	0.036305
ALAMEDA	2021	LDT2	Aggregate	Aggregate	DSL	1221.379	52545.3	5987.178	1.500472498	1,500.47	0.02856	35.019	0.016179	0	0	0	0	0	0	0.018419	0	0	0	0	0	0	0.13753	0	0	0.049421	0	0	290.6699	0	0	0.000751	0	0	0.005673	0	0	0.008	0.03675	0.005428017	0	0	0.002000001	0.015750005	0.002748	0	0	0.045689	0	0
ALAMEDA	2021	LDT2	Aggregate	Aggregate	ELEC	1502.599	49387.55	7579.032					0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.008	0.03675	0	0	0	0.002000001	0.015750005	0	0	0	0	0	0
ALAMEDA	2021	T6 instate (	Aggregate	Aggregate	DSL	438.3492	29828.91	1981.76	3.711821675	3,711.82	0.12444	8.036	0.408367	0.07429	0	0	0	0	0	0.464895	0.084574	0	0	0	0	0	0.909939	1.899405	0	4.759191	5.082113	1.90878	1256.94	660.5245	0	0.018968	0.003451	0	0.121984	0.011811	0	0.012	0.13034	0.116707365	0.011299657	0	0.003000001	0.055860016	0.011875	0.00624	0	0.197574	0.103825	0

Source:
California Air Resources Board. 2017. EMFAC2017 computer program, Version 1.0.2 (web-based). Sacramento, CA. Available: https://www.arb.ca.gov/emfac/2017/. AccessedJanuary 2, 2020.

Model run by Ascent Environmental on January 2, 2020.

Project Assumptions

Treatment Activity	Equipment Used	Offroad Equip Category	Crew Avg	Crew Max	Acres/Day	Hours/Day
Mechanical Treatment	Chainsaw	Chain Saw (25 hp)	1	2	3	8.0
	Feller/Buncher	Feller/Buncher (300 hp)	1	1	3	8.0
	Skidder	Skidder (300 hp)	1	1	3	8.0
	Yarder	Loader (300 hp)	1	1	3	8.0
	Masticator	Masticator (175 hp)	1	1	5	8.0
	Mower	Mower (25 hp)	1	1	3	8.0
	Crane (ES)	On road only	1	1	N/A	6.0
	Tractor (grader)	Tractor (175 hp)	1	1	2	8.0
Manual Treatment	Shovels	--	6	15	<1	8.0
	Pulaski hoes	--	6	15	<1	8.0
	McLeod fire tools	--	6	15	1	8.0
	Machetes	--	6	15	1	8.0
	Pruning shears	--	6	15	1	8.0
	Weed whips	--	6	15	4	8.0
	Weed wrenches	--	6	15	1	8.0
	Hand saws	--	6	15	1	8.0
	Loppers	--	6	15	1	8.0
	Chainsaws	Chain Saw (25 hp)	3	5	3	8.0
	Brush cutters	Other Offroad Ag Equip (50 hp)	3	6	4	8.0
Prescribed Burn	3-4 Fire trucks	--	4	4	25 (max)	8.0
	Water tender	--	2	2	25	8.0
	Drip torches	--	3	4	20	8.0
	1-2 Hand crews	--	6	15		8.0
Prescribed Herbivory (goats)	Fencing	--	2	2	<1	8.0
	Water trough	--				
			Number of Goats/Truck:		100	2 decks of 50
Herbicide Application	Backpack	--	2	2	2.5	8.0
	Hand Applicator	-- None	-	-	-	-

*Assumptions for crew size, acres/day, and hours/day apply to each treatment activity, as opposed to specific equipment

Acreages of Identified Treatment Projects

Treatment Type	Acreage
Fire Hazard Reduction (FHR) Treatment	98.4
Fuelbreaks (FBs)	23.2
Temp Refuge Areas (TRAs)	1.54
Total	**123.14**

Emissions Per Acre Treated

Treatment/Fuel Type	Criteria Air Pollutants and Precursors					Greenhouse Gases			
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	source
Non-burning Activities	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
Mechanical Treatment	**6.9**	**7.1**	**0.35**	**0.30**	**2,101**	**--**	**--**	**0.9528**	wksht: Mechanical Treatment
Manual Treatment	**29**	**7.6**	**0.28**	**0.21**	**3,244**	**--**	**--**	**1.47**	wksht: Manual Treatment
Herbicide Treatment	**0.0008**	**0.0036**	**0.0001**	**0.0001**	**17**	**--**	**--**	**0.01**	wksht: Herbicide Appl
Prescribed Herbivory	**0.0060**	**0.026**	**0.0007**	**0.0007**	**237**	**--**	**--**	**0.11**	wksht: Presc Herbivory_Goats
	lb/day	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
Biomass Hauling Off Site	**0.032**	**0.38**	**0.021**	**0.014**	**99.8**	**--**	**--**	**0.045**	3 trips/day
lb/acre (based on 2.5 acres/day)	**0.013**	**0.151**	**0.008**	**0.006**				**0.018**	MT/acre (based on 2.5 acres/day)
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	
Prescribed Burning	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
Shrub/Chapparal	252	81	222	201	33,725	91	--	16.3	wksht: Prescribed Burn
Maximum Daily (25 acres):	6,296	2,015	5,540	5,037	843,121	2,266	--	408	
Worker Trips	0.0010	0.0045	0.0001	0.0001	21	--	--	0.010	
Biomass Disposal - per acre treated	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*MT/acre tx*	
Air Curtain (60%)	**2.8**	**3.1**	**4.0**	**4.0**	**5,269**	**15.4**	**0.49**	**2.6**	60% of biomass waste from each acre (= emissions/acre * 0.6)
Pile Burning (5%)	**0.77**	**0.51**	**3.3**	**2.7**	**439**	**1.29**	**0.04**	**0.22**	5 % of the biomass waste from each acre (= emissions/acre * 0.05)
Biomass Disposal - per day (2.5 acres)									
Air Curtain (60%)	**6.9**	**7.7**	**10.0**	**10.0**	**13,172**	**38.6**	**1.2**	**6.6**	
Pile Burning (5%)	**1.9**	**1.3**	**8.4**	**6.8**	**1,098**	**3.2**	**0.1**	**0.5**	

GHG Emissions - 200 Acres Treated per Year				+ air curtain & pile burning
		CO2eq	CO2eq	CO2eq
acres	treatment	MT/acre	Total MT	MT/acre
90	mechanical	0.95	85.75	3.80
90	manual	1.47	132.45	4.32
20	prescribed burn	16.3	326.51	
180	air curtain[1] - 60% biomass	2.63	473.67	
180	pile burning[2] - 5% biomass	0.22	39.47	
180	hauling offsite to air curtain[3]	0.018	3.26	**600 acres**
		Grand Total	**1061.1**	**3183.3**

1: 60% of biomass generated by manual or mechanical treatment activities will be burned off site in air curtain
2: 5% of biomass generated by manual or mechanical treatment activities will be burned on site in piles
3: truck emissions - hauling 60% of biomass off site

Notes

1 Emissions estimates do not include emissions generated by trucks hauling equipment and livestock to and from treatment sites at the beginning and end of each treatment.

2 These emission estimates do not account for changes in carbon sequestration or reduced probability and intensity of wildfire over the long term.

3 These emission estimates do not account for any emissions associated with the removal of vegetative biomass from treatments sites and any processing activity that may occur thereafter, including chipping and mulching applications.

4 Approximately 65% of biomass generated by treatments will be disposed of by pile burning (5%) or burning in an air curtain (60%), thus values listed for biomass disposal are based on acres treated (not acres burned)

5 The emissions estimates do not include fugitive PM10 and PM2.5 emissions associated with ground disturbance and other activity by off-road equipment. SPR AQ-4, AQ-5, and AQ-6 would limit vehicle speeds on unpaved

	value	units	source
global warming potential of nitrous oxide	298	unitless	wksht: Unit Conversions
global warming potential of methane	25	unitless	wksht: Unit Conversions
mass conversion factor	2,204.62	lb/MT	wksht: Unit Conversions

GHG Emissions - 200 Acres Treated per Year									
		ROG	ROG	NOx	NOx	PM10	PM10	PM2.5	PM2.5
acres	treatment	lb/acre	tons/year	lb/acre	tons/year	lb/acre	tons/year	lb/acre	tons/year
90	mechanical	6.9	0.31	7.1	0.32	0.35	0.02	0.30	0.01
90	manual	29.4	1.32	7.6	0.34	0.28	0.01	0.21	0.01
20	prescribed burn	252	2.52	81	0.81	222	2.22	201	2.01
180	air curtain[1] - 60% biomass	2.8	0.25	3.1	0.28	4.0	0.36	4.0	0.36
180	pile burning[2] - 5% biomass	0.77	0.07	0.51	0.05	3.3	0.30	2.7	0.25
180	hauling offsite to air curtain[3]	0.013	0.001	0.15	0.01	0.008	0.0008	0.006	0.0005
		Annual	**4.5**	**Annual**	**1.8**	**Annual**	**2.9**	**Annual**	**2.6**

1: 60% of biomass generated by manual or mechanical treatment activities will be burned off site in air curtain
2: 5% of biomass generated by manual or mechanical treatment activities will be burned on site in piles
3: truck emissions - hauling 60% of biomass off site

	ROG	NOx	PM10	PM2.5
180 acres Non-Burning	2.0	1.0	0.7	0.6
20 acres Prescribed Burning	2.5	0.8	2.2	2.0
TOTAL	**4.5**	**1.8**	**2.9**	**2.6**

Emissions Per Day

Treatment/Fuel Type	Criteria Air Pollutants and Precursors					Greenhouse Gases						
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	source			
Non-burning Activities	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*				
Mechanical Treatment	**20.7**	**21.8**	**1.1**	**0.9**	**6,302**	--	--	**2.86**	wksht: Mechanical Treatment			
Manual Treatment	**29.4**	**7.9**	**0.3**	**0.2**	**3,244**	--	--	**1.5**	wksht: Manual Treatment			
Herbicide Treatment	**0.0020**	**0.0090**	**0.0002**	**0.0002**	**43**	--	--	**0.019**	wksht: Herbicide Appl			
Prescribed Herbivory	**0.0020**	**0.0090**	**0.0002**	**0.0002**	**237**	--	--	**0.108**	wksht: Presc Herbivory_Goats			
	lb/day	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*				
Biomass Hauling Off Site	**0.032**	**0.38**	**0.021**	**0.014**	**99.8**	--	--	**0.045**	3 trips/day			
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq				
Prescribed Burning	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*				
Chaparral Shrub	252	81	222	201	33,725	91	--	16.3	wksht: Prescribed Burn			
20 Acres	5,037	1,612	4,432	4,029								
Biomass Disposal - per acre treated	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*MT/acre tx*				
Air Curtain (60%)	**2.8**	**3.1**	**4.0**	**4.0**	**5,269**	**15.4**	**0.49**	**2.6**	60% of biomass waste from each acre (= emissions/acre * 0.6)			
Pile Burning (5%)	**0.77**	**0.51**	**3.3**	**2.7**	**439**	**1.29**	**0.041**	**0.22**	5 % of the biomass waste from each acre (= emissions/acre * 0.05)			
Biomass Disposal - per day (2.5 acres)	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	2.9			
Air Curtain (60%)	**6.9**	**7.7**	**10.0**	**10.0**	**13,172**	**38.6**	**1.2**	**6.6**	60% of biomass waste from each acre (= emissions/acre * 0.6)			
Pile Burning (5%)	**1.9**	**1.3**	**8.4**	**6.8**	**1,098**	**3.2**	**0.10**	**0.55**	5 % of the biomass waste from each acre (= emissions/acre * 0.05)			
Non-burning Activities	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	East-West FB	0.50	0.50	28.62	18.83	8.06	7.31
Mechanical Treatment	**24**	**26**	**8.4**	**7.7**	**5.8**	Hearst Gate FB	1.0	0.0	32.97	11.91	7.67	6.97
Manual Treatment	**33**	**12**	**7.7**	**7.0**	**4.4**	Frowning FHR	0.50	0.50	26.84	17.04	4.38	3.94
								TOTAL	**88.43**	**47.77**	**20.11**	**18.23**

	Prescribed Burn Emissions			
	ROG	NOx	PM10	PM2.5
	lb/day	lb/day	lb/day	lb/day
20 acres:	5,037	1,612	4,432	4,029
tons:	**2.5**	**0.8**	**2.2**	**2.0**

Emissions estimates do not include emissions generated by trucks hauling equipment and livestock to and from treatment sites at

Not More than one type of treatment may be performed on the same land in the same year. For example, manual

1 These emission estimates do not account for changes in carbon sequestration or reduced probability and intensity of wildfire over the long term.

2 Approximately 65% of biomass generated by treatments will be disposed of by pile burning (5%) or burning in an air curtain (60%), thus values listed for biomass disposal are based on acres treated (not acres burned)

3 The emissions estimates do not include fugitive PM10 and PM2.5 emissions associated with ground disturbance and other activity by off-road equipment. SPR AQ-4, AQ-5, and AQ-6 would limit vehicle speeds on unpaved roads, require

	value	units	source
global warming potential of methane	25	unitless	wksht: Unit Conversions
mass conversion factor	2,204.62	lb/MT	wksht: Unit Conversions

Identified Treatment Projects GHG Emissions

	Project Name	Treatment Type	Treatment Activities	Location	Acreage of Impacts	ITP Duration (weeks)	ITP Duration (workdays)
Fuel Break (typically, up to 8 weeks)	East-West FB	Fuel Break	Manual, mechanical, herbicide use	Claremont Ridge between UC Berkeley property and Claremont Canyon Regional Preserve	22.0	8 weeks	40 (over 2 years)
	Hearst Gate FB	Fuel Break	Manual, herbicide use	Between the Hill Campus and the Hearst Gate to LBNL	1.2	4 weeks	20 (over 2 years)
Evacuation Support Treament	~~Jordan EST~~	Evacuation Support	Manual, mechanical, herbicide use	Along upper and lower Jordan Fire Trail	~~86.8~~	Not in Plan	Not in Plan
Temporary Refuge Area (typically 4 weeks)	TRA 1	Temporary Refuge Area	Manual, mechanical, herbicide use	On the southeast side of Claremont Avenue at Signpost 29	0.1	4 weeks	20 (over 2 years)
	TRA 2	Temporary Refuge Area	Manual, mechanical, herbicide use	Along the Upper Jordan Fire Trail at Signpost 32	0.7	4 weeks	20 (over 2 years)
	TRA 3	Temporary Refuge Area	Manual, mechanical, herbicide use	South of and adjacent to the Upper Jordan Fire Trail	0.7	4 weeks	20 (over 2 years)
	TRA 4	Temporary Refuge Area	Manual, mechanical, herbicide use	Entirely within the existing paved Lawrence Hall of Science parking lot	0.0	0 weeks (existing parking lot)	0
Fire hazard Reduction (typically, up to 10 weeks)	Strawberry FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Strawberry Canyon near upper Centennial Drive and upper Jordan Fire Trail	23.7	not specified, assume 10 weeks	50 (over 2 years)
	Claremont FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Claremont Canyon north of Claremont Avenue	25.5	not specified, assume 10 weeks	50 (over 2 years)
	Frowning FHR Project	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas along Frowning Ridge near the upper Jordan Fire Trail	49.2	not specified, assume 10 weeks	50 (over 2 years)
				Total	123.1		

** Herbicide treatment will follow up other treatments, to prevent regrowth

Biomass Disposal

- ▸Incinerated using an air curtain at Richmond Field Station – 60 percent
- ▸Chipped or masticated and spread onsite – 20 percent
- ▸Chipped or masticated and hauled to other UC Berkeley properties – 10 percent
- ▸Burned onsite in piles – 5 percent
- ▸Left onsite as logs – 5 percent
- ▸Processed using a gasifier – negligible, used rarely

It is estimated that up to **600 haul truck trips** could be required to transport biomass from the Hill Campus to the Richmond Field Station and other locations over the course of implementation. As described below for each of the Identified Treatment Projects, implementation is expected to occur **over two years (2021 and 2022)**; however, implementation may be accelerated if required by the CCI Grant Program in coordination with CAL FIRE. Conservatively assuming these 600 haul truck trips would occur **over a total of 8 months** (although the implementation period will likely be greater), fewer than **3 haul trips per day** would be required to dispose of the biomass created.

TOTAL ANNUAL GHG EMISSIONS

Project	Acres Manual	Acres Mechanical	Acres Herbicide	Total Acres	GHGs (total ITP, 2 yrs) MT-CO2e	GHGs (1 year) MT-CO2e		
East-West FB	11.0	11.0	22.0	22.0	90.0	44.98		
Hearst Gate FB	1.20	0.00	1.2	1.2	5.22	2.61		
TRA 1	0.05	0.05	0.1	0.1	0.41	0.20		
TRA 2	0.35	0.35	0.7	0.7	2.9	1.43		
TRA 3	0.35	0.35	0.7	0.7	2.9	1.43		
TRA 4	0.0	0.0	0.0	0.0	0.00	0.00		
Strawberry FHR	0.0	23.7	23.7	23.7	90.76	45.38		
Claremont FHR	0.0	25.5	25.5	25.5	97.651	48.83		
Frowning FHR	24.6	24.6	49.2	49.2	201.17	100.59		
			TOTAL ITPs:	123.1	490.89	245.44	MT-CO2e/year	ITPs
ITPs (treatments + worker trips + hauling (60%) and burning (65%) of biomass):					**490.89**	**245.4**	MT-CO2e/year	ITPs + Pile Burning/Air Curtain
			Total max acres treated per year:	**300**	(x 490.9/123.1) =	**1196.3**	MT-CO2e/year	Possible under WVFMP in 1 year
			Total max acres treated per year:	**200**	(x 490.9/123.1) =	**797.5**	MT-CO2e/year	Possible under WVFMP in 1 year

Emission Rates

	CO2eq *MT/acre*	
Non-burning Activities		
Mechanical Treatment	0.95	
Manual Treatment	1.5	
Herbicide Treatment	0.0078	
Hauling Off Site (3 trips/day)	0.0452	MTCO2eq/day
2.5 acres/day	0.0181	MTCO2eq/acre
Pile Burning/Air Curtain	4.39	

Identified Treatment Projects Criteria Emissions

	Project Name	Treatment Type	Treatment Activities	Location	Acreage of Impacts	ITP Duration (weeks)	ITP Duration (workdays)
Fuel Break (typically, up to 8 weeks)	East-West FB	Fuel Break	Manual, mechanical, herbicide use	Claremont Ridge between UC Berkeley property and Claremont Canyon Regional Preserve	22.0	8 weeks	40 (over 2 years)
	Hearst Gate FB	Fuel Break	Manual, herbicide use	Between the Hill Campus and the Hearst Gate to LBNL	1.2	4 weeks	20 (over 2 years)
Evacuation Support Treament	~~Jordan EST~~	Evacuation Support	Manual, mechanical, herbicide use	Along upper and lower Jordan Fire Trail	~~86.8~~	Not in Plan	Not in Plan
Temporary Refuge Area (typically 4 weeks)	TRA 1	Temporary Refuge Area	Manual, mechanical, herbicide use	On the southeast side of Claremont Avenue at Signpost 29	0.1	4 weeks	20 (over 2 years)
	TRA 2	Temporary Refuge Area	Manual, mechanical, herbicide use	Along the Upper Jordan Fire Trail at Signpost 32	0.7	4 weeks	20 (over 2 years)
	TRA 3	Temporary Refuge Area	Manual, mechanical, herbicide use	South of and adjacent to the Upper Jordan Fire Trail	0.7	4 weeks	20 (over 2 years)
	TRA 4	Temporary Refuge Area	Manual, mechanical, herbicide use	Entirely within the existing paved Lawrence Hall of Science parking lot	0.0	0 weeks (existing parking lot)	0
Fire hazard Reduction (typically, up to 10 weeks)	Strawberry FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Strawberry Canyon near upper Centennial Drive and upper Jordan Fire Trail	23.7	not specified, assume 10 weeks	50 (over 2 years)
	Claremont FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Claremont Canyon north of Claremont Avenue	25.5	not specified, assume 10 weeks	50 (over 2 years)
	Frowning FHR Project	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas along Frowning Ridge near the upper Jordan Fire Trail	49.2	not specified, assume 10 weeks	99 (over 2 years)
				Total	**123.1**		

Biomass Disposal

- ▸Incinerated using an air curtain at Richmond Field Station – **60 percent**
- ▸Chipped or masticated and spread onsite – **20 percent**
- ▸Chipped or masticated and hauled to other UC Berkeley properties – **10 percent**
- ▸Burned onsite in piles – **5 percent**
- ▸Left onsite as logs – **5 percent**
- ▸Processed using a gasifier – negligible, used rarely

It is estimated that up to **600 haul truck trips** could be required to transport biomass from the Hill Campus to the Richmond Field Station and other locations over the course of implementation. As described below for each of the Identified Treatment Projects, implementation is expected to occur **over two years (2021 and 2022)**; however, implementation may be accelerated if required by the CCI Grant Program in coordination with CAL FIRE. Conservatively assuming these 600 haul truck trips would occur **over a total of 8 months** (although the implementation period will likely be greater), fewer than **3 haul trips per day** would be required to dispose of the biomass created.

** Herbicide treatment will follow up other treatments, to prevent regrowth

**Assume maximum of 3 treatments per day over 2.5 acres (assumes 2 FB and 1 FHR).

TOTAL PROJECT EMISSIONS						ROG	NOx	PM10	PM2.5	ROG	NOx	PM10	PM2.5
Project	Acres Manual	Acres Mechanical	Acres Herbicide	Total Acres	Project Days	*lb/project*	*lb/project*	*lb/project*	*lb/project*	*avg lb/day*	*avg lb/day*	*avg lb/day*	*avg lb/day*
East-West FB	11.0	11.0	22.0	22.0	40	629.2	409.6	177.0	160.7	15.7	10.2	4.4	4.0
Hearst Gate FB	1.20	0.00	1.2	1.2	20	39.5	14.0	9.2	8.4	2.0	0.7	0.46	0.42
TRA 1	0.05	0.05	0.1	0.1	20	2.9	1.9	0.8	0.7	0.14	0.09	0.040	0.037
TRA 2	0.35	0.35	0.7	0.7	20	20.0	13.0	5.6	5.1	1.0	0.65	0.28	0.26
TRA 3	0.35	0.35	0.7	0.7	20	20.0	13.0	5.6	5.1	1.0	0.65	0.28	0.26
TRA 4	0.0	0.0	0.0	0.0	0	--	--	--	--	--	--	--	--
Strawberry FHR	0.0	23.7	23.7	23.7	50	574.6	605.4	199.8	181.1	11.5	12.1	4.0	3.6
Claremont FHR	0.0	25.5	25.5	25.5	50	618.2	651.4	215.0	194.9	12.4	13.0	4.3	3.9
Frowning FHR	24.6	24.6	49.2	49.2	100	1407.1	915.9	395.9	359.4	14.1	9.2	4.0	3.6
	37.6	85.6	**TOTAL ITPs:**	**123.1**		**3312**	**2624**	**1009**	**915**	ITPs (incl worker trips) + Hauling + Pile Burning & Air Curtain			
			Assume 60% of biomass will be burned in off site air curtain:	73.9		341.8	379.7	493.7	493.7				
			Assume 5% of biomass will be burned by on site pile burning:	6.2		94.9	63.3	411.4	335.4				
			All ITPs + 65% Burning of Waste Biomass:			**437**	**443**	**905**	**829**				

2,000 lb/ton

		ROG	NOx	PM10	PM2.5
Worker Trips	Worker Commute (1 worker)	*lb/day/wrkr* 1.02E-03	*lb/day/wrkr* 4.49E-03	*lb/day/wrkr* 1.23E-04	*lb/day/wrkr* 1.13E-04

Daily Emissions - Maximum Treatments per Day (2 Fuel Breaks + 1 Fire Hazard Reduction)

Project	Acres/Day Manual	Acres/Day Mechanical	Acres/Day Herbicide	Max Acres/Day
East-West FB	0.50	0.50	1.0	1.0
Hearst Gate FB	1.0	0.0	1.0	1.0
Frowning FHR	0.25	0.25	0.50	0.50

Total Max Daily (assume max of 3 concurrent treatments over total of 2.5 acres, i.e. 2 FB and 1 FHR):

MAXIMUM DAILY EMISSIONS (2 FB + 1 FHR)	ROG	NOx	PM10	PM2.5
Project	*lb/day*	*lb/day*	*lb/day*	*lb/day*
East-West FB	25.1	15.0	0.7	0.6
Hearst Gate FB	29.4	8.1	0.3	0.2
Frowning FHR	25.0	14.9	0.7	0.6
Biomass Hauling	0.0	0.4	0.0	0.0
TOTAL:	**79.5**	**38.0**	**1.7**	**1.4**
Threshold:	**54**	**54**	**82**	**54**

Daily Emissions - Project Treatments

Project	Acres/Day Manual	Acres/Day Mechanical	Acres/Day Herbicide	Max Acres/Day
TRA 1	0.05	0.05	0.1	0.1
TRA 2	0.25	0.25	0.5	0.5
TRA 3	0.25	0.25	0.5	0.5
TRA 4	0.0	0.0	0.0	0.0
Strawberry FHR	0.0	0.5	0.5	0.5
Claremont FHR	0.0	0.5	0.5	0.5

	ROG	NOx	PM10	PM2.5
Project	*lb/day*	*lb/day*	*lb/day*	*lb/day*
TRA 1	25.0	1.5	0.07	0.06
TRA 2	12.5	7.5	0.3	0.3
TRA 3	12.5	7.5	0.3	0.3
TRA 4	0.0	0.0	0.0	0.0
Strawberry FHR	10.3	11.0	0.5	0.5
Claremont FHR	10.3	11.0	0.5	0.5
Biomass Hauling	0.0	0.4	0.0	0.0

***Doesn't include air curtain or pile burning, includes hauling**

ITP Emissions (over 2 years)								
Project	Project Acres	Max Acres/Day	^{1}Extra Days Worker Trips	Days Equip Use	ROG *tons*	NOx *tons*	PM10 *tons*	PM2.5 *tons*
East-West FB	22.0	1	18	22	0.28	0.17	0.01	0.01
Hearst Gate FB	1.2	1	18	2	0.03	0.01	0.00	0.00
Frowning FHR	49.2	0.5	0	99	1.24	0.74	0.03	0.03
^{2}TRA 1	0.1	0.5	17	3	0.0376	0.0023	0.0001	0.0001
^{2}TRA 2	0.7	0.5	17	3	0.019	0.011	0.001	0.000
^{2}TRA 3	0.7	0.5	17	3	0.019	0.011	0.001	0.000
^{2}TRA 4	0.0	0.5	20	0	1E-05	4E-05	1E-06	1E-06
Strawberry FHR	23.7	0.5	2	48	0.25	0.26	0.01	0.01
Claremont FHR	25.5	0.5	0	51	0.26	0.28	0.01	0.01
Biomass Hauling	123.1	2.5	--	231	0.004	0.044	0.002	0.002
ITP TOTAL	123.1	2.5			**2.14**	**1.52**	**0.07**	**0.06**
			BAAQMD Threshold:		**10**	**10**	**15**	**10**

EMISSION RATES					
	Non-burning Activities	ROG *lb/day*	NOx *lb/day*	PM10 *lb/day*	PM2.5 *lb/day*
Treatment Activity	Mechanical Treatment	20.7	21.79	1.1	0.90
	Manual Treatment	29.4	7.9	0.3	0.2
	Herbicide Treatment	0.0020	0.0090	0.0002	0.0002
Biomass Disposal	Biomass Disposal	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*
	Air Curtain (60% acres treated)	4.6	5.14	6.68	6.68
	Pile Burning (5% acres treated)	15.4	10.28	66.84	54.50
Biomass Hauling	Biomass Hauling Off Site	*lb/day*	*lb/day*	*lb/day*	*lb/day*
	Hauling Off Site, 3 trips/day (lb/day)	0.0324	0.3778	0.0210	0.0139
		lb/acre	*lb/acre*	*lb/acre*	*lb/acre*
	Max 2.5 acres/day (lb/acre)	0.0130	0.1511	0.0084	0.0056
Worker Trips	Worker Commute (1 worker)	lb/day/wrkr 1.02E-03	lb/day/wrkr 4.49E-03	lb/day/wrkr 1.23E-04	lb/day/wrkr 1.13E-04

Manual Treatment

Crew Parameters	value	units	source
Crew size, average	6	workers	
Crew size, max	15	workers	
Area treated per day, average	1.0	acres	
Daily treatment activity duration	8.0	hr/day	

Non-Mechanized Equipment
Shovels
Pulaski hoes
McLeod fire tools
Machetes
Pruning shears
Weed wrenches
Hand saws
Loppers

Equipment List

	Mechanized Equipment	Comparable Equipment Type in OFFROAD2017 -ORION	Engine Size (hp)	source/notes
3	Chain Saw (25 hp) x3	OFF - Logging - Chainsaws	25	See Notes 1, 2, and 3
6	Brush Cutter (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	50	See Notes 1, 2, and 3
6	Weed Whip (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	50	See Notes 1, 2, and 3

Notes

1. The Comparable Equipment Type in OFFROAD2017 -ORION identifies how the equipment type is listed in CARB's web-based OFFROAD2017-ORION model.
2. It is assumed that all equipment would be operated for approximately 8 hours per day (9am-5pm).
3. Additional equipment and vehicles may include a fire engine present on site in the event that treatment activity ignites a fire. Emissions generated by these equipment types are not included and expected to be nominal.

Sources

1. California Air Resources Board. 2017. OFFROAD2017-ORION. Available at https://www.arb.ca.gov/orion/. Accessed December 23, 2019.

Off-road Equipment Emission Rates

	Mechanized Equipment	Comparable Equipment Type in OFFROAD2017 -ORION	ROG lb/day	NOx lb/day	PM10 lb/day	PM2.5 lb/day	CO2 MT/day	Fuel Usage gal/day
3	Chain Saw (25 hp) x3	OFF - Logging - Chainsaws	25.67	0.55	0.09	0.07	0.08	19.76
6	Brush Cutter (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	1.84	3.46	0.09	0.07	0.62	79.04
6	Weed Whip (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	1.84	3.46	0.09	0.07	0.62	79.04

Source: wksht Off-road Equip Emiss Rts

Off-road Equipment Emissions

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	*gal/day*	
Total Daily Emissions by One Treatment Crew	29.3	7.5	0.28	0.21	1.33	177.85	summation

Equipment Daily Emissions for One Treatment Crew

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***MT/crew/day***	***gal/crew/day***	
	29	**7.5**	**0.28**	**0.21**	**1.3**	**178**	summation
w/ Worker Trip Emissions:	**29**	**7.6**	**0.28**	**0.21**	**1.5**		

Emissions of One Treatment Crew Per Acre Treated

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/acre***	***lb/acre***	***lb/acre***	***lb/acre***	***MT/acre***	***gal/acre***	
	29.3	**7.48**	**0.28**	**0.21**	**1.33**	**178**	calculation
w/ Worker Trip Emissions:	**29**	**7.55**	**0.28**	**0.21**	**1.47**		

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (max = 15 workers)

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	1.53E-02	6.74E-02	1.84E-03	1.70E-03	1.46E-01	calculation

Worker Trip Emissions of One Treatment Crew Per Acre Treated

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	1.53E-02	6.74E-02	1.84E-03	1.70E-03	1.46E-01	calculation

Mechanical Treatment

Crew Parameters	value	units	source	
Crew size, average	8	workers	UCB (RB)	
Crew size, max	9	workers	UCB (RB)	
Area treated per day, average	3.0	acres	UCB (RB)	
Daily treatment activity duration	8.0	hr/day	UCB (RB)	
Daily treatment activity duration	6.0	hr/day	UCB (RB)	crane only

Representative Equipment List

Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	Engine Size (hp)	source/notes
Chain Saw (25 hp) x2	OFF - Logging - Chainsaws	25	See Notes 1, 2
Feller/Buncher (175 hp)	OFF - Logging - Fellers/Bunchers	175	See Notes 1, 2
Feller/Buncher (300 hp)	OFF - Logging - Fellers/Bunchers	300	See Notes 1, 2
Skidder (175 hp)	OFF - Logging - Skidders	175	See Notes 1, 2
Skidder (300 hp)	OFF - Logging - Skidders	300	See Notes 1, 2
Loader (300 hp)	ConstMin - Rubber Tired Loaders	300	See Notes 1, 2
Masticator (175 hp)	ConstMin - Excavators	175	See Notes 1, 2
Crane (300 hp)	ConstMin - Cranes	300	See Notes 1, 2
Tractor (175 hp)	OFF - Agricultural - Agricultural Tractors	175	See Notes 1, 2
Mower (25 hp)	OFF - Agricultural - Agricultural Mowers	25	See Notes 1, 2

Notes

1 The Comparable Equipment Type in OFFROAD2017 -ORION identifies how the equipment type is listed in CARB's web-based OFFROAD2017-ORION model.

2 It is assumed that all equipment other than the crane would be operated for approximately 8 hours per day (9am-5pm). The crane will be operated for 6 hours per day.

3 Additional equipment and vehicles may include a fire engine present on site in the event that treatment activity ignites a fire. Emissions generated by this equipment are not included and expected to be nominal.

Sources

1 California Air Resources Board. 2017. OFFROAD2017-ORION. Available at https://www.arb.ca.gov/orion/. Accessed December 23, 2019.

Off-road Equipment Emission Rates (Actual Equipment Used)

	Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	ROG *lb/day*	NOx *lb/day*	PM10 *lb/day*	PM2.5 *lb/day*	CO2 *MT/day*	Fuel Usage *gal/day*
2	Chain Saw (25 hp) x2	OFF - Logging - Chainsaws	17.12	0.37	0.06	0.04	0.05	13.18
1	Feller/Buncher (300 hp)	OFF - Logging - Fellers/Bunchers	0.49	2.53	0.08	0.07	0.71	70.50
1	Skidder (300 hp)	OFF - Logging - Skidders	0.55	2.75	0.09	0.08	0.76	76.14
1	Loader (300 hp)	ConstMin - Rubber Tired Loaders	0.37	4.32	0.14	0.13	0.32	31.44
1	Masticator (175 hp)	ConstMin - Excavators	0.23	2.25	0.11	0.10	0.24	23.09
1	*Crane (300 hp)	ConstMin - Cranes	0.32	3.82	0.16	0.14	0.20	19.87
1	Tractor (175 hp)	OFF - Agricultural - Agricultural Tractors	0.95	4.83	0.07	0.06	0.47	57.04
1	Mower (25 hp)	OFF - Agricultural - Agricultural Mowers	0.61	0.50	0.34	0.26	0.021	4.79

*Crane emissions based on 6 hrs/day operation

Source: wksht Off-road Equip Emiss Rts

Off-road Equipment Emissions	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source

units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	*gal/day*	
Daily Off-road Emissions by One Treatment Crew	20.6	21.4	1.05	0.89	2.8	296	summation

Equipment Daily Emissions for One Treatment Crew

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***MT/crew/day***	***gal/crew/day***	
	21	**21**	**1.0**	**0.89**	**2.8**	**296**	summation
w/ Worker Trip Emissions:	**20.6**	**21.4**	**1.0**	**0.89**	**2.9**		

Emissions of One Treatment Crew Per Acre Treated

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/acre***	***lb/acre***	***lb/acre***	***lb/acre***	***MT/acre***	***gal/acre***	
	6.880	**7.123**	**0.349**	**0.295**	**0.924**	**98.7**	calculation
w/ Worker Trip Emissions:	**6.883**	**7.136**	**0.350**	**0.296**	**0.953**		

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates

	lb/crew/day	lb/crew/day	lb/crew/day	lb/crew/day	MT/crew/day	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (max = 9 workers)

	lb/crew/day	lb/crew/day	lb/crew/day	lb/crew/day	MT/crew/day	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	9.17E-03	4.04E-02	1.11E-03	1.02E-03	8.77E-02	calculation

Worker Trip Emissions of One Treatment Crew Per Acre Treated

units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	3.06E-03	1.35E-02	3.69E-04	3.40E-04	2.92E-02	calculation

Off-Road Equipment Exhaust Emission Rates

Output from OFFROAD2017

OFFROAD2017 (v1.0.1) Emissions Inventory

Region Type: Statewide

Region: California

Calendar Year: 2020

Model Year: Aggregate

Scenario: All Adopted Rules - Exhaust

Vehicle Classification: OFFROAD2017 Equipment Types

VehClass	HP Bin	Fuel Type	ROG (tons/day)	NOx (tons/day)	PM10 (tons/day)	PM2.5 (tons/day)	CO2 (tons/day)	Annual Activity (hr/year)	Fuel Usage (gal/hr)
OFF - Logging - Chainsaws	25	Gasoline	1.183974572	0.02552499	0.004040885	0.003053113	7.712523258	807982.25	0.823508685
OFF - Logging - Fellers/Bunchers	175	Diesel	0.05307901	0.330474559	0.013646889	0.012555138	145.540412	785768.35	6.152927132
OFF - Logging - Fellers/Bunchers	300	Diesel	0.040395319	0.207844263	0.006442462	0.005927065	127.9385994	479398.3	8.812032709
OFF - Logging - Skidders	175	Diesel	0.038472065	0.231356875	0.009543865	0.008780356	101.3390411	528432.4	6.371732884
OFF - Logging - Skidders	300	Diesel	0.018403251	0.091388252	0.002838928	0.002611813	56.03461827	194413.6	9.51802343
ConstMin - Rubber Tired Loaders	300	Diesel	0.215713077	2.508087642	0.083264026	0.076602904	410.4821603	3388731.793	3.929978068
ConstMin - Excavators	175	Diesel	0.073428465	0.72197501	0.03509013	0.03228292	166.4622268	1871529.053	2.885706537
ConstMin - Cranes	300	Diesel	0.041169462	0.494114741	0.020202206	0.018586029	57.90677848	567252.29	3.311968392
OFF - ConstMin - Crushing/Proc. Equipment	25	Gasoline	0.002738475	0.002244552	0.001550291	0.001171331	0.20548052	15727.85	0.996518914
OFF - ConstMin - Crushing/Proc. Equipment	100	Gasoline	0.001292353	0.004485861	9.23473E-05	6.97735E-05	1.324499833	6599.2	8.006637168
OFF - Agricultural - Agricultural Mowers	25	Gasoline	0.0406493	0.03304239	0.02270675	0.017156211	3.009625667	386743.05	0.599337467
OFF - Agricultural - Agricultural Tractors	175	Gasoline	0.005482774	0.027987315	0.000429935	0.000324839	5.997188891	33817.25	7.130167296
ConstMin - Tractors/Loaders/Backhoes	175	Diesel	0.06678754	0.656892718	0.033096747	0.030449007	142.2627484	1698591.506	2.717285575
ConstMin - Crawler Tractors	300	Diesel	0.061739809	0.766138971	0.030743122	0.028283673	78.22487497	553582.907	4.58453447
ConstMin - Excavators	175	Diesel	0.073428465	0.72197501	0.03509013	0.03228292	166.4622268	1871529.053	2.885706537
Agricultural - Sprayers/Spray rigs	50	Diesel	0.020769762	0.064307446	0.00505936	0.004654611	0.964854499	242929.7419	0.92020828
ConstMin - Off-Highway Trucks	25	Diesel	0.000397361	0.000977343	0.000101019	0.000092937	0.106877717	6318.77412	0.548766227
Agricultural - Combine Harvesters	300	Diesel	0.089238701	0.989567915	0.036368474	0.033458996	17.64369847	752536.5261	5.432091062
ConstMin - Rubber Tired Dozers	300	Diesel	0.008868161	0.094461534	0.004600388	0.004232357	6.945496914	50470.09062	4.464802728
OFF - Agricultural - Other Agricultural Equipment	50	Gasoline	0.000319456	0.00060276	1.65202E-05	0.000012482	0.239635187	6095.5	1.646706587
Agricultural - Sprayers/Spray rigs	50	Diesel	0.020769762	0.064307446	0.00505936	0.004654611	0.964854499	242929.7419	0.92020828
ConstMin - Graders	300	Diesel	0.139600375	1.74555588	0.057891833	0.053260486	214.6264786	1518857.616	4.584577023
ConstMin - Excavators	300	Diesel	0.071885027	0.821343499	0.025046186	0.023042491	211.7060725	1591024.607	4.317073627

Chippers = OFF - ConstMin - Crushing/Proc. Equipment
Masticators = ConstMin - Excavators
Harvesters = harvesters
Dozers = dozers

Dozer Transports = on-road, ‘T7 Utility’ in EMFAC
Forwarders = on-road, ‘T7 Tractor Construction’ in EMFAC

Source: wksht raw OFFROAD2017 output

Note: These equipment may be used in one or more types of treatments

	value	units	source		
time conversion rate	365	days/year	Earth		
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions	2204.62	lb/MT
mass conversion rate	1.1023	ton/MT	wksht: Unit Conversions		
daily equipment use	8	hr/day	assumption		
daily equipment use - chainsaw	8	hr/day	assumption		
daily equipment use - crane only	6	hr/day	assumption		

Exhaust Emission Rates, hourly

			ROG	**NOx**	**PM10**	**PM2.5**	**CO2**	**Fuel Usage**	
units:	HP Bin		*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*MT/hr*	*gal/hr*	
OFF - Logging - Chainsaws	25		1.07	0.02	0.004	0.003	0.003	0.824	Gasoline
OFF - Logging - Fellers/Bunchers	175		0.05	0.31	0.013	0.012	0.061	6.153	Diesel
OFF - Logging - Fellers/Bunchers	300		0.06	0.32	0.010	0.009	0.088	8.812	Diesel
OFF - Logging - Skidders	175		0.05	0.32	0.013	0.012	0.064	6.372	Diesel
OFF - Logging - Skidders	300		0.07	0.34	0.011	0.010	0.095	9.518	Diesel
ConstMin - Rubber Tired Loaders	300		0.05	0.54	0.018	0.017	0.040	3.930	Diesel
ConstMin - Excavators	300		0.03	0.28	0.014	0.013	0.029	2.886	Diesel
ConstMin - Cranes*	300		0.05	0.64	0.026	0.024	0.034	3.312	Diesel
OFF - ConstMin - Crushing/Proc. Equipment	25		0.13	0.10	0.072	0.054	0.004	0.997	Gasoline
OFF - ConstMin - Crushing/Proc. Equipment	100		0.14	0.50	0.010	0.008	0.066	8.007	Gasoline
OFF - Agricultural - Agricultural Mowers	25		0.08	0.06	0.043	0.032	0.003	0.599	Gasoline
ConstMin - Tractors/Loaders/Backhoes	175		0.03	0.28	0.014	0.013	0.028	2.717	Diesel
ConstMin - Crawler Tractors	300		0.08	1.01	0.041	0.037	0.047	4.585	Diesel
ConstMin - Excavators	175		0.03	0.28	0.014	0.013	0.029	2.886	Diesel
Agricultural - Sprayers/Spray rigs	50		0.06	0.19	0.015	0.014	0.001	0.920	Diesel
ConstMin - Off-Highway Trucks	25		0.05	0.11	0.012	0.011	0.006	0.549	Diesel
Agricultural - Combine Harvesters	300		0.09	0.96	0.035	0.032	0.008	5.432	Diesel
ConstMin - Rubber Tired Dozers	300		0.13	1.37	0.067	0.061	0.046	4.465	Diesel
OFF - Agricultural - Agricultural Mowers	25		0.08	0.062	0.043	0.032	0.003	0.599	Gasoline
OFF - Agricultural - Agricultural Tractors	175		0.12	0.604	0.0093	0.0070	0.059	7.130	Gasoline
OFF - Agricultural - Other Agricultural Equipment	50		0.038	0.072	0.0020	0.0015	0.013	1.647	Gasoline
Agricultural - Sprayers/Spray rigs	50		0.062	0.193	0.0152	0.0140	0.001	0.920	Diesel
ConstMin - Graders	300		0.067	0.839	0.0278	0.0256	0.047	4.585	Diesel
ConstMin - Excavators	300		0.033	0.377	0.0115	0.0106	0.044	4.317	Diesel

Source: Calculations using values in the above table.

Exhaust Emission Rates, daily

			ROG	**NOx**	**PM10**	**PM2.5**	**CO2**	**Fuel Usage**	
units:	HP Bin		*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	*gal/day*	
OFF - Logging - Chainsaws	25	8 hrs/day	8.56	0.184	0.029	0.022	0.025	6.59	Gasoline
OFF - Logging - Fellers/Bunchers	175		0.39	2.46	0.10	0.09	0.5	49.2	Diesel
OFF - Logging - Fellers/Bunchers	300		0.49	2.53	0.08	0.07	0.7	70.5	Diesel
OFF - Logging - Skidders	175		0.43	2.56	0.11	0.10	0.5	51.0	Diesel
OFF - Logging - Skidders	300		0.55	2.75	0.09	0.08	0.8	76.1	Diesel
ConstMin - Rubber Tired Loaders	300		0.37	4.32	0.14	0.13	0.3	31.4	Diesel

ConstMin - Excavators	175		0.23	2.25	0.11	0.10	0.2	23.1	Diesel
ConstMin - Cranes*	300	6 hrs/day	0.32	3.82	0.16	0.14	0.20	19.87	Diesel
OFF - ConstMin - Crushing/Proc. Equipment	25		1.02	0.83	0.58	0.43	0.0	8.0	Gasoline
OFF - ConstMin - Crushing/Proc. Equipment	100		1.14	3.97	0.08	0.06	0.5	64.1	Gasoline
OFF - Agricultural - Agricultural Mowers	25		0.61	0.50	0.34	0.26	0.0	4.8	Gasoline
ConstMin - Tractors/Loaders/Backhoes	175		0.23	2.26	0.11	0.10	0.2	21.7	Diesel
ConstMin - Crawler Tractors	300		0.65	8.08	0.32	0.30	0.4	36.7	Diesel
ConstMin - Excavators	175		0.23	2.25	0.11	0.10	0.2	23.1	Diesel
Agricultural - Sprayers/Spray rigs	50		0.50	1.55	0.12	0.11	0.01	7.36	Diesel
ConstMin - Off-Highway Trucks	25		0.37	0.90	0.09	0.09	0.04	4.39	Diesel
Agricultural - Combine Harvesters	300		0.69	7.68	0.28	0.26	0.06	43.46	Diesel
ConstMin - Rubber Tired Dozers	300		1.03	10.93	0.53	0.49	0.36	35.72	Diesel
OFF - Agricultural - Agricultural Mowers	25		0.61	0.50	0.34	0.26	0.02	4.79	Gasoline
OFF - Agricultural - Agricultural Tractors	175		0.95	4.83	0.074	0.056	0.47	57.04	Gasoline
OFF - Agricultural - Other Agricultural Equipment	50		0.31	0.58	0.016	0.012	0.10	13.17	Gasoline
Agricultural - Sprayers/Spray rigs	50		0.50	1.55	0.122	0.112	0.01	7.36	Diesel
ConstMin - Graders	300		0.54	6.71	0.223	0.205	0.37	36.68	Diesel
ConstMin - Excavators	300		0.26	3.01	0.092	0.085	0.35	34.54	Diesel

Source: Calculations using the above table.

*Crane only operated 6 hrs/day

Truck Hauling Activity and Exhaust Emissions

Haul Truck Emission Rates (running exhaust, running loss, brake wear, tire wear)

	ROG	NOx	PM10	PM2.5	CO2	units	Fuel Use	units
T6 instate construction heavy	0.408	4.760	0.264	0.176	1,257	g/mile	0.12444	gal/mile
	Source: wksht: On-Rd Veh Emiss Rates						Source: wksht: raw EMFAC2017-ALAMEDA	

	value	units	source
mass conversion rate	453.59	g/lb	wksht: Unit Conversions
mass conversion rate	1,000,000	g/MT	wksht: Unit Conversions

Destination of chipped biomass (energy)	Hill Campus to the Richmond Field Station (6 miles 1-way)		
Trip distance (1-way)	6	miles/trip	Prog Desc
Trucks per day	3	haul trucks	
VMT associated with chipped biomass			
Daily VMT	36	VMT/day	calculation

					MT-CO2	Gallons		
Haul Truck Emissions (exhaust, loss, wear)	ROG	NOx	PM10	PM2.5	CO2	Fuel use		
	lb/day	lb/day	lb/day	lb/day	MT/day	gal/day		
Daily CO2					0.045			CO2 lb/day
Annual CO2					4.52			99.75885
Daily (per each 1-way trip)	0.005	0.06	0.003	0.002	0.008	0.75		
1 day = 3 roundtrips	0.032	0.378	0.021	0.014		4.48	per day	
	lb/year	lb/year	lb/year	lb/year	MT/year	gal/year		
1 year = 300 round trips	3.24	37.78	2.10	1.39		448	per year	
Annual TOTAL	**3.2**	**37.8**	**2.1**	**1.4**	**4.5**	**448**	per year	

Running Exhaust Emission Rates for On-Road Vehicles

Source: These emission rates were provided by the California Air Resources Board's Mobile Source Emissions Inventory (EMFAC2017), which is available at http://www.arb.ca.gov/emfac/2017/.

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County Model Year: Aggregated
Region: ALAMEDA Speed: Aggregated
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN

						1.0002					1.0002										1.0009						1.0009			
Vehicle Category	**Fuel**	**Population**	**VMT**	**Trips**	**ROG_RUNEX**	**SAFE_CORR**	**ROG_IDLEX**	**ROG_STREX**	**ROG_RUNLOSS**	**NOx_RUNEX**	**SAFE_CORR**	**NOx_IDLEX**	**NOx_STREX**	**CO2_RUNEX**	**CO2_IDLEX**	**CO2_STREX**	**CH4_RUNEX**	**CH4_IDLEX**	**CH4_STREX**	**PM10_RUNEX**	**SAFE_CORR**	**PM10_IDLEX**	**PM10_STREX**	**PM10_PMTW**	**PM10_PMBW**	**PM2_5_RUNEX**	**SAFE_CORR**	**PM2_5_IDLEX**	**PM2_5_PMTW**	**PM2_5_PMBW**
			VMT/day	trips/day	g/mile	g/mile	g/veh/day	g/trip	g/mile	g/mile	g/mile	g/veh/day	g/trip	g/mile	g/veh/day	g/trip	g/mile	g/veh/day	g/trip	g/mile	g/mile	g/mile	g/mile	g/veh/day	g/trip	g/mile	g/mile	g/mile	g/mile	g/mile
LDA	GAS	643,846	23,456,819	3,010,602	0.012	0.012	0.000	0.290	0.246	0.047	0.047	0.000	0.224	270.751	0.000	57.715	0.003	0.000	0.062	0.002	0.002	0.000	0.002	0.008	0.037	0.001	0.001	0.000	0.002	0.016
LDA	DSL	7,140	264,939	33,234	0.020	0.020	0.000	0.000	0.000	0.114	0.114	0.000	0.000	216.593	0.000	0.000	0.001	0.000	0.000	0.011	0.011	0.000	0.000	0.008	0.037	0.010	0.010	0.000	0.002	0.016
LDT1	GAS	66,399	2,359,125	304,135	0.025	0.025	0.000	0.428	0.767	0.107	0.107	0.000	0.297	314.123	0.000	67.280	0.006	0.000	0.084	0.002	0.002	0.000	0.003	0.008	0.037	0.002	0.002	0.000	0.002	0.016
LDT1	DSL	46	742	150	0.217	0.217	0.000	0.000	0.000	1.203	1.204	0.000	0.000	423.872	0.000	0.000	0.010	0.000	0.000	0.180	0.180	0.000	0.000	0.008	0.037	0.172	0.172	0.000	0.002	0.016
LDT2	GAS	212,628	7,710,663	988,229	0.017	0.017	0.000	0.382	0.469	0.086	0.086	0.000	0.341	343.247	0.000	74.346	0.004	0.000	0.080	0.002	0.002	0.000	0.002	0.008	0.037	0.001	0.001	0.000	0.002	0.016
LDT2	DSL	1,221	52,545	5,987	0.016	0.016	0.000	0.000	0.000	0.049	0.049	0.000	0.000	290.670	0.000	0.000	0.001	0.000	0.000	0.006	0.006	0.000	0.000	0.008	0.037	0.005	0.005	0.000	0.002	0.016
T6 instate construction heavy	DSL	438	29,829	1,982	0.408	0.408	0.074	0.000	0.000	4.759	4.760	5.082	1.909	1256.940	660.524	0.000	0.019	0.003	0.000	0.122	0.122	0.012	0.000	0.012	0.130	0.117	0.117	0.011	0.003	0.056

Exhaust Emissions of ROG, PM, and NOx corrected for changes due to Federal SAFE Rule Part 1. see: https://ww3.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf

Source: wksht: raw EMFAC2017-ALAMEDA

Prescribed Burn

Crew Parameters	value	units	source
Crew size, average	15	workers	
Crew size, max	25	workers	
Area treated per day, max	25	acres/day	
Daily treatment activity duration	8.0	hr/day	

Equipment/Personnel	Avg	Max
Fire truck personnel	4	4
Water tender	2	2
Drip torches	3	4
Hand crew personnel	6	15
Total:	15	25

Method

Total emissions from a fire are estimated by multiplying an emission factor by the biomass consumed and an accurate assessment of the total acreage burned. For instance, assume that 10 tons/acre of fuel is consumed during a 200-acre landscape prescribed fire in a ponderosa stand in the western U.S. After the fire, ground surveys and aerial reconnaissance indicate a mosaic fire pattern and only 100 acres of the 200 acres within the fire perimeter actually burned (i.e., "black acres"). Because the emission factor for $PM_{2.5}$ for pine fuels is approximately 46 lb/ton, then total emission production would calculated using the following equation:

Fuel consumed (kg/acre) x $PM_{2.5}$ emission factor (lb/ton) x area burned (acres) x consumption factor = total emissions $PM_{2.5}$ (lb)

10,000 kg/acre x 11 g/kg x 10 acres x 0.53 = 583 kg or 1,286 lbs of $PM_{2.5}$ emissions

Table A. Calculated Prescribed Burn Emissions (Per Acre)[1]

Prescribed Burn Vegetation Type	Total Fuel Loading (kg/acre)	Percent Composition (1 acre)	Size (acres)	Fuel Consumption Factor[2]	Pollutant Emissions (lb/acre burned)										
					CO_2	CO	CH_4	NMOC[3]	$PM_{2.5}$	PM_{10}	NOx	N_2O	SO_2	CO_2e	CO_2e (MT/acre)
Chaparral	11,433	100%	1	0.80	33,725	2,035	90.66	251.83	201.46	221.61	80.59	N/A	N/A	35,991	16.33
TOTAL (1 acre)		**100%**			**33,725**	**2,035**	**91**	**252**	**201**	**222**	**81**	**0.0**	**0.0**	**35,991**	**16.3**
Pile (Mixed)	5,693		1	0.41	8,781	190.23	25.71	15.42	54.50	66.84	10.28	0.82	N/A	9,669	4.39
Air Curtain (Mixed)	5,693		1	0.41	8,781	190.23	25.71	4.63	6.68	6.68	5.14	0.82	N/A	9,669	4.39
Daily Emissions (assumes 2.5 acres/day)					lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Pile (Mixed)					21,953	476	64	39	136	167	26	N/A	N/A	24,173	11
Air Curtain (Mixed)					21,953	476	64	12	16.7	16.7	13	2.1	N/A	24,173	11

Notes:

1: These values are calculated based on Emissions Factors in Table B. Results do not include emissions generated bytransport of equipment, or the use of drip torches or Heli torches. The level of emissions from these sources would be nominal compared to the level of emissions generated by the burning of vegetative fuels.

2: From NWCG 2018: National Wildfire Coordinating Group. 2018. NWCG Smoke Management Guide for Prescribed Fire, Table 4.2.4. See: https://www.nwcg.gov/publications/420-2

3: It is assumed that the estimate for NMOC is approximately equivalent to ROG.

Table B. Fire Average Emissions Factors

Prescribed Burn Vegetation Type	[1]Fuel Loading (kg/acre)	[2]Pollutant Emission Factors (g of emissions/kg of fuel consumed)							
		[3]CO_2	CO	[3]ROG	[4]$PM_{2.5}$	[4]PM_{10}	NOx	CH_4	[7]N_2O	SO_2
Piled (Mixed)[5]	5,693	1,708	37	3.0	10.6	13	2	5.0	0.16	NA
Chaparral	11,433	1,674	101	12.5	10	11	4	4.5	N/A	NA
Air Curtain Incinerator (Mixed)[6]	5,693	1,708	37	0.9	1.3	1.3	1	5.0	0.16	NA

Sources:

(1) FEMA (2014). East Bay Hills EIS https://www.fema.gov/media-library/assets/documents/100411
(2) USEPA (1996). "Miscellaneous Sources - Wildfires and Prescribed Burning." In Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources (AP-42), 5th Ed.
(3) Urbanski (2014). "Wildland fire emissions, carbon, and climate: Emission factors." See: http://dx.doi.org/10.1016/j.foreco.2013.05.045 (CO_2 all; ROG for pile/air curtain)
(4) USDA Forest Service (2005). "The Use of Air Curtain Destructors for Fuel Reduction and Disposal" https://www.fs.fed.us/t-d/pubs/pdf/hi_res/05511303hi.pdf
(5) ROG, NOx, PM2.5, CO2, CH4 EFs from Springsteen et al. (2015): https://www.fs.usda.gov/treesearch/pubs/52990 PM10 EF from Springsteen et al. (2011): https://doi.org/10.3155/1047-3289.61.1.63
(6) ROG, PM, and NOx EFs from SJVAPCD Internal Memo: Clerico & Villegas (2017) "Air Curtain Incinerator Emissions Factors Determination."
https://www.valleyair.org/busind/pto/emission_factors/Criteria/Criteria/Air-Curtain-Incinerators/EF-Determination-Analysis.pdf
(6) CO2 and CH4 EFs from Springsteen et al. (2015) (Table 6). https://www.fs.usda.gov/treesearch/pubs/52990
(7) N2O values from Urbanski 2014, Table 1, for prescribed burning of NW conifer http://dx.doi.org/10.1016/j.foreco.2013.05.045

	value	units	source
global warming potential of nitrous oxide	298	unitless	wksht: Unit Conversions
global warming potential of methane	25	unitless	wksht: Unit Conversions
mass conversion factor	2,204.62	lb/MT lb/1000kg	wksht: Unit Conversions

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (max = 25 workers)

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	2.55E-02	1.12E-01	3.07E-03	2.83E-03	2.44E-01	calculation

Worker Trip Emissions of One Average Treatment Crew Per Acre Treated

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	calculation

Prescribed Herbivory - goats

Crew Parameters	value	units	source
Crew size	2	workers	
Area treated per day, average (goats)	0.3	acres/day	
Daily treatment activity duration	8.0	hr/day	

Livestock Emissions (goats)	value	units	source
type of livestock used for grazing in tree dominated landscape	goats	n/a	assumption
proxy livestock	sheep	n/a	assumption
weight of goat, avg.	60	lb/head	assumption
number of trucks used to transport herd	1	truck/herd	assumption
livestock double-decker trailer dimensions (Featherlite model 8261)			
length	53	ft	Source 1
width	8.5	ft	Source 1
area of trailer (each deck)	450.5	sq. ft.	calculation
number of 60-lb goats per running foot of truck floor	3.6	head/run ft.	Source 2
number of goats total	50	head	Project Description
grazing rate of goats			
goats	7	goats	Source 3
days	21	days	Source 3
acre	1.0	acre	Source 3
grazing rate	147	goats/acre-day	calculation
Area grazed by one truckload of goats	**0.34**	**acres/day**	**calculation**
methane emission rate of goats (enteric fermentation)	5	kg/head/year	Source 4
time conversion rate	365	days/year	Earth
mass conversion rate	1,000	kg/MT	wksht: Unit Conversions
methane emission rate of goats	1.37E-05	MT/day/goat	conversion calculation
methane emissions of goats, daily	6.85E-04	MT/day	calculation
methane emissions of goats, per area	0.0020	MT/acre	calculation
global warming potential of methane	25	unitless	wksht: Unit Conversions
CO2-e emissions of goats, per area	0.050	MT/acre	calculation

Total Daily Emissions by One Treatment Herd	CO2-eq	CO2-eq	
units:	*MT/day*	*MT/acre*	
	0.017	**0.050**	calculation
w/ Worker Trip Emissions	0.037	**0.108**	calculation

Sources

1 Featherlite Trailers. 2019. Model 8261 Double-decker Livestock Trailer. Available: https://www.fthr.com/products/livestock-trailers/semi/8261-livestock-trailer. Accessed January 27, 2020.

2 National Institute for Animal Agriculture. 2001. Livestock Trucking Guide. Available: https://www.stopliveexports.org/images/documents/Resources/Reports/Livestock_Trucking_Guide.pdf. Accessed May 2, 2019.

3 Nader, G., Henkin, Z., Smith, E., Ingram, R., and Narvaez, N. 2007. *Planned Herbivory in the Management of Wildfire Fuels* . Society for Range Management. Available: https://journals.uair.arizona.edu/index.php/rangelands/article/view/12320. Accessed May 2, 2019.

4 Intergovernmental Panel on Climate Change. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Prepared by the National Greenhouse Gas Inventories Programme, Eggleston HAS., Biennia L., Miwa K., Negara T. and Tanabe K. (eds). Vol.4, Chap. 10: Livestock and Manure Management. Published: IGES, Japan. Available: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf.

Notes

1 Livestock do not emit criteria air pollutants or precursors (e.g., ROG, NOx, PM10, or PM2.5).

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (2 workers)	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	2.04E-03	**8.99E-03**	**2.46E-04**	**2.27E-04**	**1.95E-02**	calculation

Worker Trip Emissions of One Treatment Crew Per Acre Treated						
units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	5.99E-03	**2.64E-02**	**7.23E-04**	**6.66E-04**	5.73E-02	calculation

Herbicide Application

Crew Parameters

	value	units	source
Workers per crew, average	2	workers	
Area treated per day, average	2.5	acres	
Daily equipment use	8.0	hr/day	

Herbicide treatment activities will entail each crew member applying herbicide via a hand applicator from herbicide stock carried in backpack.
Therefore no emissions would be generated other than worker trip emissions.

Equipment List (if a vehicle spray rig is ever used)

Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	Engine Size (hp)	source/notes
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs	50	See Notes 1 and 2
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs	50	See Notes 1 and 2

Notes

1 The Comparable Equipment Type in OFFROAD2017 -ORION identifies how the equipment type is listed in CARB's web-based OFFROAD2017-ORION model.

2 It is assumed that all equipment is used for approximately 8 hours per day.

Sources

1 California Air Resources Board. 2017. OFFROAD2017-ORION. Available at https://www.arb.ca.gov/orion/. Accessed December 24, 2019.

2 Application of herbicides would also result in off-gas emissions of ROG. The level of emissions would be a function of the type of herbicide used, the application rate (gallons/acre), and the number of applications.

Off-road Equip Emission Rates

(not used for backpack sprayer rig)

Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION		ROG	NOx	PM10	PM2.5	CO2
		units:	lb/day	lb/day	lb/day	lb/day	MT/day
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs		0.50	1.55	0.12	0.11	0.01
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs		0.50	1.55	0.12	0.11	0.01

Source: wksht Off-road Equip Emiss Rts

Off-road Equip Emissions

(not used for backpack sprayer rig)

	ROG	NOx	PM10	PM2.5	CO2	source	
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*		
Total Daily Emissions by One Treatment Crew	1.0	3.1	0.2	0.2	0.02	summation	(not included in total)

On road Vehicle Emission Rates

	ROG	NOx	PM10	PM2.5	CO2	source	(Worker Trips)
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*		
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts	

On road Vehicle Emissions (2 workers)

	ROG	NOx	PM10	PM2.5	CO2	source	(Worker Trips)
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*		
	2.04E-03	8.99E-03	2.46E-04	2.27E-04	1.95E-02	calculation	

Total Daily Emissions by One Treatment Crew

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	2.04E-03	**8.99E-03**	**2.46E-04**	**2.27E-04**	**1.95E-02**	summation

Total Emissions of One Treatment Crew Per Acre Treated

units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	8.15E-04	**3.59E-03**	**9.83E-05**	**9.06E-05**	**7.79E-03**	calculation

Worker Trip Exhaust Emissions

Commute Trips by Workers

	value	units	source
Trip rate for crew workers	2	trips/day	assumption
Avg. worker commute trip length	16.8	miles/trip	Source 1, CARB 2017:D-86 (default worker trip length in CalEEMod V2016.3.2 for home-to-work trips, Alameda county)
Daily VMT by a single crew worker	33.6	VMT/day	calculation

Mix of passenger vehicles used in employee commutes

breakdown of passenger car VMT in Alameda County	value	units	source
light duty autos - gasoline	23,456,819	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty autos - diesel	264,939	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - gasoline	2,359,125	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - diesel	742	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - gasoline	7,710,663	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - diesel	52,545	VMT/day	wksht: On-Rd Veh Emiss Rates
Total, all passenger vehicle types	33,844,832	VMT/day	summation

relative portion of passenger car VMT by veh type	value	units	source
light duty autos - gasoline	69.3%	%	calculation
light duty autos - diesel	0.8%	%	calculation
light duty trucks 1 - gasoline	7.0%	%	calculation
light duty trucks 1 - diesel	0.00%	%	calculation
light duty trucks 2 - gasoline	22.8%	%	calculation
light duty trucks 2 - diesel	0.16%	%	calculation
Total, all passenger vehicle types	100.0%	%	summation

Emission Rates (running exhaust only; not including running loss, brake ware, and tire wear)

Emission rates are corrected to reflect the recent "post-SAFE" adjustments to EMFAC.

	ROG	NOx	PM10	PM2.5	CO2	units	source
light duty autos - gasoline	0.012	0.047	0.002	0.001	270.751	g/mile	wksht: On-Rd Veh Emiss Rates
light duty autos - diesel	0.020	0.114	0.011	0.010	216.593	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - gasoline	0.025	0.107	0.002	0.002	314.123	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - diesel	0.217	1.204	0.180	0.172	423.872	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - gasoline	0.017	0.086	0.002	0.001	343.247	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - diesel	0.016	0.049	0.006	0.005	290.670	g/mile	wksht: On-Rd Veh Emiss Rates
Composite emiss rates - all pass vehicles	**0.014**	**0.061**	**0.0017**	**0.0015**	**289.901**	**g/mile**	**Sumproduct calculation**

	value	units	source
mass conversion rate	453.59	g/lb	wksht: Unit Conversions
mass conversion rate	1,000,000	g/MT	wksht: Unit Conversions

Commute Emissions *of a Single Worker* (exhaust only, round trip)

ROG	NOx	PM10	PM2.5	CO2
lb/day/wrkr	lb/day/wrkr	lb/day/wrkr	lb/day/wrkr	MT/day/wrkr
1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03

Source: calculations

Sources

1 California Air Pollution Control Officers Association. 2017 (November). *California Emissions Estimator Model Version 2016.3.2 User's Guide* . Available http://www.caleemod.com/. Accessed December 24, 2019.

Output from OFFROAD2017 Model Run

OFFROAD2017 (v1.0.1) Emissions Inventory
Region Type: Statewide
Region: California
Calendar Year: 2020
Scenario: All Adopted Rules - Exhaust
Vehicle Classification: OFFROAD2017 Equipment Types
Units: Emissions: tons/day, Fuel Consumption: gallons/year, Activity: hours/year, HP-Hours: HP-hours/year

Source: California Air Resources Board. 2017. OFFROAD2017-ORION computer program, Version 1.0.1 (web-based). Sacramento, CA. Available: https://www.arb.ca.gov/orion/?bay Accessed December 23, 2019.

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	50	Diesel	1.174893524	1.421621164	1.691846674	3.661714451	3.297612359	45.01836351	0.315889953	0.290618757	0.315889953	0.000383762	0.000369898	10430249.63	9311653.087	25996.44037	379403510.8	1.1201
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	75	Diesel	1.079248722	1.305890953	1.554118159	4.211739898	7.997859024	80.1763049	0.62658175	0.57645521	0.62658175	0.000713864	0.000658777	18575950.11	10514434.3	28229.09296	663170144.2	1.7667
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	100	Diesel	1.552987137	1.879114436	2.236301478	9.749911448	13.09971466	214.0655554	1.049749589	0.965769622	1.049749589	0.001945828	0.001758893	49596586.94	20709267.73	34749.80848	1775062239	2.3949
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	175	Diesel	1.214506651	1.469553047	1.748889577	7.09577752	11.50062471	150.5682992	0.659165283	0.606432061	0.659165283	0.001364981	0.001237161	34884985.25	11107977.14	17144.87696	1351017012	3.1405
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	300	Diesel	1.000148894	1.210180161	1.440214407	3.665666301	10.92254709	161.5721221	0.465994799	0.428715215	0.465994799	0.00147383	0.001327575	37434447.53	6783003.223	8568.806453	1469895813	5.5189
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	600	Diesel	0.443596919	0.536752272	0.638779564	1.881081794	4.445913926	113.278701	0.196122145	0.180432373	0.196122145	0.001041035	0.000930767	26245403.82	2864401.43	2568.188081	1051843155	9.1626
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	50	Diesel	0.001280879	0.001549864	0.001844466	0.007552208	0.008084587	0.129773362	0.000477471	0.000439273	0.000477471	1.16944E-06	1.0663E-06	30067.03177	29477.48265	45.99841127	1031711.893	1.0200
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	100	Diesel	0.006560775	0.007938538	0.009447516	0.057290535	0.061315729	1.322500137	0.005042412	0.004639019	0.005042412	1.21124E-05	1.08665E-05	306408.4406	125841.9494	202.113679	10512139.25	2.4349
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	175	Diesel	0.013974716	0.016909406	0.020123591	0.134192004	0.142509049	3.223286484	0.008548642	0.00786475	0.008548642	2.95815E-05	2.64845E-05	746799.3068	223195.2816	357.2412699	28767296.71	3.3459
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	300	Diesel	0.003159606	0.003823123	0.004549833	0.013323921	0.038042555	0.884978234	0.001489216	0.001370079	0.001489216	8.14216E-06	7.27152E-06	205039.5257	40430.10859	64.99637194	7821670.77	5.0715
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	50	Diesel	0.012135549	0.014684014	0.017475191	0.052390648	0.059443602	0.937897158	0.004014391	0.003693239	0.004014391	8.36542E-06	7.70634E-06	217300.2465	161225.8946	495.018737	7405267.781	1.3478
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	75	Diesel	0.005420175	0.006558412	0.007805052	0.03575526	0.051386362	0.831645955	0.003380635	0.003110185	0.003380635	7.57795E-06	6.83331E-06	192683.0351	102365.0354	312.6240517	6634925.959	1.8823
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	100	Diesel	0.001114069	0.001348023	0.001604259	0.007394109	0.010283976	0.171982558	0.000751879	0.000691728	0.000751879	1.56731E-06	1.41311E-06	39846.42878	17276.7729	52.92957485	1370138.623	2.3064
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	175	Diesel	0.000753353	0.000911558	0.001084829	0.005943969	0.008531708	0.145369193	0.000438413	0.00040334	0.000438413	1.33042E-06	1.19444E-06	33680.41059	12233.94059	37.53435701	1294385.771	2.7530
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	75	Diesel	0.000942918	0.00114093	0.001357801	0.005275969	0.007967445	0.118305486	0.000600252	0.000552232	0.000600252	1.07284E-06	9.7207E-07	27410.05356	17201.92587	47.58589721	1059811.742	1.5934
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	100	Diesel	0.006153571	0.007445821	0.008861142	0.034434148	0.05172082	0.77103328	0.004133207	0.00380255	0.004133207	6.99179E-06	6.33528E-06	178639.7584	79702.18414	219.5106039	6803396.683	2.2413
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	175	Diesel	0.011474849	0.013884568	0.016523783	0.077026534	0.121267114	1.853103126	0.006434778	0.005919995	0.006434778	1.69035E-05	1.52262E-05	429343.1989	134334.8843	375.7215474	18960379.34	3.1961
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	300	Diesel	0.073750993	0.089238701	0.10620143	0.309101165	0.989567915	17.64369847	0.036368474	0.033458996	0.036368474	0.000162006	0.000144971	4087846.937	752536.5261	1991.546359	174193814	5.4321
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	600	Diesel	0.013794052	0.016690802	0.019863434	0.092097337	0.196622527	5.808809338	0.008049066	0.00740514	0.008049066	5.36517E-05	4.77287E-05	1345835.937	168488.9641	371.6783816	55719673.04	7.9877
Statewide	2020	Agricultural - Construction Equipment	Aggregated	50	Diesel	0.086376509	0.104515576	0.124382173	0.294010359	0.276092987	3.933342189	0.024322656	0.022376844	0.024322656	3.40183E-05	3.23187E-05	911311.2454	880706.311	2240.908598	39030804.98	1.0348
Statewide	2020	Agricultural - Construction Equipment	Aggregated	75	Diesel	0.066867336	0.080909476	0.096288963	0.33053801	0.544563319	6.976563868	0.040015831	0.036814564	0.040015831	6.29284E-05	5.73237E-05	1616391.557	1094030.325	2961.909142	68917836.31	1.4775
Statewide	2020	Agricultural - Construction Equipment	Aggregated	100	Diesel	0.136193947	0.164794676	0.196119284	0.785566705	1.124540772	17.06770141	0.090796724	0.083532986	0.090796724	0.000154772	0.000140239	3954394.883	2008315.44	4133.845005	169330747.3	1.9690
Statewide	2020	Agricultural - Construction Equipment	Aggregated	175	Diesel	0.276514086	0.334582045	0.398180284	1.807885066	2.61704323	39.81744342	0.152887353	0.140656365	0.152887353	0.000362306	0.000327164	9225254.81	3588935.805	5656.753706	440247153.2	2.5705
Statewide	2020	Agricultural - Construction Equipment	Aggregated	300	Diesel	0.149053671	0.180354942	0.214637286	0.564713831	1.68835929	26.1642193	0.071291521	0.0655882	0.071291521	0.000239052	0.000214981	6061955.999	1463040.451	2592.486263	288027841.4	4.1434
Statewide	2020	Agricultural - Construction Equipment	Aggregated	600	Diesel	0.016139423	0.019528702	0.023240769	0.077557327	0.164771411	2.467394483	0.007074227	0.006508289	0.007074227	2.24811E-05	2.02736E-05	571667.6128	77922.83876	88.23845202	27583416.28	7.3363
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	100	Diesel	0.002600208	0.003146252	0.003744299	0.028156738	0.028969588	0.690589845	0.002147071	0.001975305	0.002147071	6.34967E-06	5.67431E-06	160001.9173	68738.73276	151.3886273	6186485.948	2.3277
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	175	Diesel	0.006091979	0.007371295	0.00877245	0.072430701	0.073464649	1.841407513	0.00406068	0.003735826	0.00406068	1.69562E-05	1.51301E-05	426633.4566	148222.0575	323.4112343	18059011.99	2.8783
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	300	Diesel	0.005751112	0.006958846	0.008281601	0.029182301	0.082215699	2.112641924	0.003050704	0.002806648	0.003050704	1.94909E-05	1.73588E-05	489475.4259	85211.59418	184.4273816	21041047.12	5.7442
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	600	Diesel	0.010983765	0.013290356	0.015816622	0.056786035	0.153503628	4.194095088	0.005938874	0.005463764	0.005938874	3.87071E-05	3.44612E-05	971724.7658	128515.6876	279.0569565	41667093.81	7.5611
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	100	Diesel	0.000511384	0.000618774	0.000736393	0.002863871	0.004303163	0.064217904	0.000343783	0.00031628	0.000343783	5.82367E-07	5.27654E-07	14878.56782	7191.011533	19.65344989	575280.9226	2.0691
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	300	Diesel	0.000486145	0.000588235	0.000700048	0.001906018	0.006454342	0.102686461	0.000232798	0.000214174	0.000232798	9.41171E-07	8.43735E-07	23791.30057	4648.45272	13.03639854	1022659.598	5.1181
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	600	Diesel	0.004588234	0.005551764	0.006607058	0.024674789	0.06222317	1.358697771	0.002385712	0.002194855	0.002385712	1.25084E-05	1.11639E-05	314795.0264	32280.22896	80.02855839	13654963.56	9.7519
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	750	Diesel	0.007015226	0.008488423	0.010101925	0.04571679	0.09974861	2.855559642	0.004040475	0.003717237	0.004040475	2.63677E-05	2.3463E-05	661601.124	46769.8976	102.7193726	28296191.93	14.1459
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	9999	Diesel	0.004512897	0.005460605	0.006498571	0.028469851	0.099466418	1.748995728	0.002554836	0.002350449	0.002554836	1.61434E-05	1.43708E-05	405222.683	20253.8793	44.20985052	17418336.2	20.0072
Statewide	2020	Agricultural - Forklifts	Aggregated	50	Diesel	0.008329891	0.010079168	0.011995043	0.031867773	0.030535396	0.452964823	0.002431376	0.002236866	0.002431376	3.96608E-06	3.72184E-06	104946.8663	135899.0676	225.4047962	4501397.564	0.7722
Statewide	2020	Agricultural - Forklifts	Aggregated	75	Diesel	0.000666551	0.000806527	0.000959834	0.00354922	0.005395457	0.073054736	0.000399008	0.000367087	0.000399008	6.59961E-07	6.00262E-07	16925.96242	11169.0931	13.2753232	725991.0514	1.5154
Statewide	2020	Agricultural - Forklifts	Aggregated	100	Diesel	0.000263394	0.000318706	0.000379287	0.001410587	0.002074989	0.029034574	0.00016858	0.000155093	0.00016858	2.62338E-07	2.38566E-07	6726.985008	3723.031021	4.425107956	288534.9041	1.8069
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	75	Diesel	0.000531814	0.000643495	0.000765812	0.002199643	0.003820446	0.041842827	0.000321954	0.000296198	0.000321954	3.73498E-07	3.43806E-07	9694.513367	6368.002594	10.74298747	396017.7104	1.5224
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	100	Diesel	0.001004006	0.001214848	0.001445769	0.004157604	0.007168695	0.079088231	0.000627793	0.00057757	0.000627793	7.05994E-07	6.49837E-07	18323.85556	9658.368091	16.27728793	748523.5271	1.8972
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	175	Diesel	0.015199372	0.01839124	0.021887095	0.075544853	0.138259771	1.543674826	0.008030367	0.007387938	0.008030367	1.39118E-05	1.26838E-05	357652.134	124287.7548	209.3339196	15074359.51	2.8776
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	300	Diesel	0.024397354	0.029520799	0.03513219	0.08426145	0.258801586	2.984410247	0.01128455	0.010381786	0.01128455	2.70455E-05	2.45217E-05	691454.3633	132445.404	222.3550252	31340564.87	5.2207
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	600	Diesel	0.007667018	0.009277092	0.011040506	0.042594817	0.08158357	1.026575728	0.003481478	0.00320296	0.003481478	9.32485E-06	8.43497E-06	237846.0759	33226.44267	56.11435245	10553090.83	7.1583
Statewide	2020	Agricultural - Nut Harvester	Aggregated	50	Diesel	0.017305079	0.020939146	0.024919314	0.157761395	0.209073841	3.71735182	0.008638253	0.007947193	0.008638253	3.40801E-05	3.0544E-05	861268.7006	832557.5467	2163.103518	33509011.04	1.0345
Statewide	2020	Agricultural - Nut Harvester	Aggregated	75	Diesel	0.010312822	0.012478514	0.014850463	0.149440562	0.153348011	3.820401958	0.007558222	0.006953564	0.007558222	3.5249E-05	3.13908E-05	885144.2612	527876.168	1348.947913	34535547.25	1.6768
Statewide	2020	Agricultural - Nut Harvester	Aggregated	100	Diesel	0.027294515	0.033026363	0.039304102	0.589897109	0.444740956	15.22567759	0.029471864	0.027114115	0.029471864	0.000140894	0.000125103	3527618.636	1667859.599	2823.777412	137161562.2	2.1151
Statewide	2020	Agricultural - Nut Harvester	Aggregated	175	Diesel	0.031761944	0.038431952	0.0457372	0.509912831	0.428611524	13.22005895	0.023689457	0.0217943	0.023689457	0.000122093	0.000108624	3062939.303	1037802.558	2109.200003	128907069.1	2.9514
Statewide	2020	Agricultural - Nut Harvester	Aggregated	300	Diesel	0.002332642	0.002822496	0.003359004	0.014208802	0.03357186	1.046182667	0.001366857	0.001257508	0.001366857	9.66738E-06	8.59608E-06	242388.7837	53181.30936	108.8019435	10467046.06	4.5578
Statewide	2020	Agricultural - Nut Harvester	Aggregated	600	Diesel	0.008608325	0.010416073	0.012395988	0.060497762	0.135094993	4.72433151	0.005560745	0.005115886	0.005560745	4.37135E-05	3.8818E-05	1094574.594	144768.7803	337.87967	47049853.59	7.5608
Statewide	2020	Agricultural - Other Harvesters	Aggregated	50	Diesel	0.008901878	0.010771273	0.012818705	0.046736982	0.045268574	0.692941894	0.002945745	0.002710085	0.002945745	6.18251E-06	5.69363E-06	160546.8607	154901.7971	133.1627547	6207556.238	1.0364
Statewide	2020	Agricultural - Other Harvesters	Aggregated	75	Diesel	0.014621926	0.01769253	0.021055573	0.123885121	0.132694241	2.744770158	0.009127393	0.008397202	0.009127393	2.51083E-05	2.25527E-05	635932.4438	369540.8109	263.2945955	24762844.07	1.7209
Statewide	2020	Agricultural - Other Harvesters	Aggregated	100	Diesel	0.049694107	0.06012987	0.071559515	0.391511955	0.415455767	8.577962576	0.035647552	0.032795748	0.035647552	7.83486E-05	7.04818E-05	1987417.667	897927.2792	728.0142055	76854316.19	2.2133
Statewide	2020	Agricultural - Other Harvesters	Aggregated	175	Diesel	0.036362418	0.043998525	0.052361881	0.255609466	0.353819437	5.838406939	0.020627698	0.018977482	0.020627698	5.32502E-05	4.79719E-05	1352693.369	445588.1728	663.9394256	59265853.24	3.0357
Statewide	2020	Agricultural - Other Harvesters	Aggregated	300	Diesel	0.032301318	0.039084595	0.046513898	0.123726373	0.37282827	6.466930268	0.015175035	0.013961032	0.015175035	5.9222E-05	5.31362E-05	1498315.171	298092.6387	442.4863288	63801635.35	5.0263
Statewide	2020	Agricultural - Other Harvesters	Aggregated	600	Diesel	0.010914517	0.013206565	0.015716904	0.056758814	0.123821091	2.172559079	0.005121368	0.004711658	0.005121368	1.98937E-05	1.78511E-05	503357.5583	56429.40441	89.39338039	21803055.22	8.9201
Statewide	2020	Agricultural - Others	Aggregated	50	Diesel	0.007216495	0.008731958	0.010391752	0.02821355	0.027917677	0.41976328	0.002160271	0.001987449	0.002160271	3.69046E-06	3.44903E-06	97254.4413	92698.95177	176.6132793	4171452.829	1.0491
Statewide	2020	Agricultural - Others	Aggregated	75	Diesel	0.001337765	0.001618696	0.001926382	0.007889627	0.011546726	0.173077661	0.00083155	0.000765026	0.00083155	1.57079E-06	1.42211E-06	40100.15172	26461.26219	53.59573027	1719982.042	1.5154
Statewide	2020	Agricultural - Others	Aggregated	100	Diesel	0.005496992	0.00665136	0.007915668	0.032498939	0.046241476	0.711832216	0.003662778	0.003369756	0.003662778	6.46048E-06	5.84885E-06	164923.5364	81245.30659	162.9997393	7073926.22	2.0299
Statewide	2020	Agricultural - Others	Aggregated	175	Diesel	0.015262451	0.018467566	0.02197793	0.106028118	0.1564544	2.444667833	0.008692531	0.007997128	0.008692531	2.22959E-05	2.00869E-05	566402.1028	211832.3884	428.9349416	27008273.82	2.6738
Statewide	2020	Agricultural - Others	Aggregated	300	Diesel	0.01700882	0.020580672	0.024492701	0.067854726	0.200173165	3.201848319	0.008451068	0.007774982	0.008451068	2.9291E-05	2.63083E-05	741832.3245	162490.6026	325.9994739	35373474.45	4.5654
Statewide	2020	Agricultural - Others	Aggregated	600	Diesel	0.078411721	0.094878183	0.112912879	0.474977419	0.93850505	16.19982113	0.03888639	0.035775479	0.03888639	0.000148428	0.000133108	3753316.763	479025.0518	970.2369863	178972862	7.8353
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	50	Diesel	0.017165093	0.020769762	0.024717733	0.065126272	0.064307446	0.964854499	0.00505936	0.004654611	0.00505936	8.46544E-06	7.92783E-06	223545.9598	242929.7419	434.4094685	9044828.946	0.9202
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	75	Diesel	0.004381862	0.005302053	0.006309881	0.024824585	0.037378562	0.538168393	0.002694745	0.002479166	0.002694745	4.87755E-06	4.42192E-06	124687.5773	83592.54841	150.2923314	5091603.773	1.4916
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	100	Diesel	0.011570721	0.014000572	0.016661838	0.065787102	0.096219498	1.42451368	0.007593029	0.006985586	0.007593029	1.29116E-05	1.17047E-05	330043.8338	152082.0676	271.0194729	13583842.64	2.1702
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	175	Diesel	0.020506221	0.024812528	0.029528959	0.138982468	0.210374338	3.164818588	0.011611399	0.010682487	0.011611399	2.88414E-05	2.60041E-05	733252.9513	272895.5592	487.7741085	32488666.15	2.6869
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	300	Diesel	0.007966703	0.009639711	0.011472053	0.032125117	0.093112435	1.435968724	0.003988839	0.003669731	0.003988839	1.31263E-05	1.17988E-05	332697.839	69197.91037	124.3552539	15073452.24	4.8079

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	600	Diesel	0.000340093	0.000411513	0.000489735	0.002186725	0.004051508	0.06710771	0.000169421	0.000155867	0.000169421	6.14403E-07	5.51398E-07	15548.10326	2139.666774	3.899239564	706090.0353	7.2666
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	50	Diesel	0.002799549	0.003387455	0.004031351	0.018070582	0.02141278	0.359424445	0.001121074	0.001031388	0.001121074	3.26136E-06	2.95325E-06	83274.61038	68258.248	155.6780386	3068369.734	1.2200
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	75	Diesel	0.00734329	0.008885381	0.010574337	0.079952853	0.087273349	1.957237432	0.005039152	0.00463602	0.005039152	1.79967E-05	1.60819E-05	453469.949	251507.5948	542.4676691	16257667.43	1.8030
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	100	Diesel	0.019483973	0.023575607	0.028056921	0.218680291	0.218527399	5.358985839	0.016002635	0.014722424	0.016002635	4.92943E-05	4.40327E-05	1241616.881	524383.8308	1125.106689	45111844.94	2.3678
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	175	Diesel	0.01084632	0.013124047	0.0156187	0.139764686	0.132595605	3.554092233	0.007378318	0.006788052	0.007378318	3.27544E-05	2.92026E-05	823443.2864	268213.8182	559.6251258	31729199.79	3.0701
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	300	Diesel	0.004020866	0.004865248	0.005790047	0.021459819	0.055526141	1.522164875	0.002177628	0.002003417	0.002177628	1.40469E-05	1.2507E-05	352668.5198	67932.1257	140.9577005	13960122.68	5.1915
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	50	Diesel	0.00064228	0.000777159	0.000924884	0.002712933	0.002358094	0.235701714	0.000248051	0.000228207	0.000248051	2.15991E-06	1.92377E-06	7647.082518	5757.097511	18.36037232	248356.0876	1.3283
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	75	Diesel	9.41909E-06	1.13971E-05	1.35635E-05	0.000245996	0.000212722	0.039438976	1.43687E-05	1.32192E-05	1.43687E-05	3.6435E-07	3.21896E-07	1279.554132	803.5642712	2.448049643	46204.94559	1.5923
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	100	Diesel	0.001779819	0.002153581	0.002562939	0.01502912	0.019601336	2.179009713	0.001345811	0.001238146	0.001345811	2.00926E-05	1.77848E-05	70695.5704	29060.46138	89.35381196	2552900.998	2.4327
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	175	Diesel	0.003681667	0.004454818	0.005301601	0.042122761	0.048299337	6.969571229	0.002990235	0.002751016	0.002990235	6.43267E-05	5.68847E-05	226120.0629	62138.74411	190.9478721	8165021.899	3.6390
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	300	Diesel	0.001288727	0.00155936	0.001855768	0.007808017	0.024277368	3.609180697	0.000731142	0.000672651	0.000731142	3.333E-05	2.94576E-05	117095.8929	18883.76037	57.52916661	4228355.195	6.2009
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	750	Diesel	0.000285558	0.000345526	0.000411204	0.001424951	0.003921137	0.24006333	0.000178056	0.000163812	0.000178056	2.21094E-06	1.95936E-06	7788.590369	401.7821356	1.224024821	281247.4949	19.3851
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	50	Diesel	1.31441E-05	1.59044E-05	1.89276E-05	0.000303016	0.000253335	0.051197509	9.8678E-07	9.07838E-07	9.8678E-07	4.72952E-07	4.17867E-07	1661.046784	1110.519052	2.789968158	53860.17402	1.4957
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	75	Diesel	0.0001231	0.000148951	0.000177264	0.00075579	0.001294717	0.090206243	9.08359E-05	8.3569E-05	9.08359E-05	8.30308E-07	7.36251E-07	2926.642214	1665.778578	4.184952238	105499.3099	1.7569
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	100	Diesel	0.000186108	0.000225191	0.000267996	0.001706014	0.002622855	0.244981166	0.000166148	0.000152856	0.000166148	2.25939E-06	1.9995E-06	7948.144118	3331.557156	8.369904475	286513.9154	2.3857
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	175	Diesel	0.000702311	0.000849797	0.001011328	0.005607219	0.008895763	0.923427068	0.00051459	0.000473423	0.00051459	8.51647E-06	7.53689E-06	29959.57424	7218.373838	18.13479303	1079979.778	4.1505
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	300	Diesel	0.002272305	0.00274949	0.00327212	0.016903826	0.036316359	8.469873291	0.001188836	0.001093729	0.001188836	7.824E-05	6.913E-05	274795.711	40838.19719	103.2288219	9905837.551	6.7289
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	600	Diesel	0.001725955	0.002088406	0.002485375	0.010527904	0.033622302	3.771082193	0.001039424	0.00095627	0.001039424	3.48137E-05	3.07791E-05	122348.6086	11713.69411	30.68964974	4410510.084	10.4449
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	750	Diesel	0.00018226	0.000220535	0.000262455	0.000659573	0.004157083	0.327667092	0.000105489	9.70496E-05	0.000105489	3.02398E-06	2.67437E-06	10630.79793	608.5035902	2.789968158	383357.2618	17.4704
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	50	Diesel	0.001854171	0.002243547	0.002670006	0.007383921	0.005544894	0.517251724	0.000706055	0.00064957	0.000706055	4.72662E-06	4.22174E-06	16781.66252	17613.46935	24.58456825	795095.3243	0.9528
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	75	Diesel	0.002874197	0.003477779	0.004138844	0.022049788	0.028636371	2.948583786	0.002570321	0.002364695	0.002570321	2.71749E-05	2.40659E-05	95663.55364	80941.39159	110.9457439	5014227.23	1.1819
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	100	Diesel	0.003516599	0.004255085	0.005063902	0.033749466	0.04118686	4.476142567	0.002233302	0.002054638	0.002233302	4.12787E-05	3.65337E-05	145223.516	84573.11271	117.2494794	7618613.066	1.7171
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	175	Diesel	4.87689E-05	5.90103E-05	7.02272E-05	0.000227711	0.000535305	0.03380473	3.64256E-05	3.35115E-05	3.64256E-05	3.11078E-07	2.7591E-07	1096.757242	459.8942704	0.630373545	57486.7838	2.3848
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	300	Diesel	0.000132117	0.000159862	0.000190249	0.000446793	0.002793201	0.194715246	7.24309E-05	6.66364E-05	7.24309E-05	1.79628E-06	1.58924E-06	6317.321711	1839.577082	2.52149418	331123.8747	3.4341
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	25	Diesel	1.05411E-05	1.27547E-05	1.51791E-05	8.35062E-05	7.90918E-05	0.011167246	5.39381E-06	4.96231E-06	5.39381E-06	1.0293E-07	9.11456E-08	362.3089908	751.441548	1.472364875	18786.0387	0.4822
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	50	Diesel	0.000694593	0.000840458	0.001000215	0.003371506	0.002698535	0.320946644	0.000251607	0.000231479	0.000251607	2.94647E-06	2.61952E-06	10412.7604	11647.34399	22.82165557	539910.7522	0.8940
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	75	Diesel	0.001559955	0.001887545	0.002246335	0.012775209	0.017722169	1.796657117	0.001305208	0.001200791	0.001305208	1.65642E-05	1.46641E-05	58290.56151	54479.51223	106.7464535	3360070.882	1.0700
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	100	Diesel	0.001520062	0.001839275	0.00218889	0.013707368	0.016137925	1.927702635	0.001404098	0.00129177	0.001404098	1.7777E-05	1.57336E-05	62542.189	42026.13478	83.18861546	3605175.701	1.4882
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	175	Diesel	0.000124762	0.000150962	0.000179657	0.000793724	0.001414035	0.120249028	6.61183E-05	6.08288E-05	6.61183E-05	1.10802E-06	9.81456E-07	3901.347268	1663.447529	3.680912189	224902.6018	2.3453
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	300	Diesel	2.25747E-05	2.73154E-05	3.25076E-05	0.000197509	0.000289856	0.105874796	1.28627E-05	1.18337E-05	1.28627E-05	9.78188E-07	8.64136E-07	3434.991157	751.441548	1.472364875	198004.8479	4.5712
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	600	Diesel	3.29004E-05	3.98095E-05	4.73765E-05	0.000179931	0.000436308	0.091409928	2.02752E-05	1.86532E-05	2.02752E-05	8.44143E-07	7.46076E-07	2965.694452	375.720774	0.736182438	170952.9522	7.8933
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	750	Diesel	9.33342E-05	0.000112934	0.000134401	0.001440072	0.001245979	0.0536091	6.33924E-05	5.8321E-05	6.33924E-05	4.92843E-07	4.3755E-07	1739.288215	160.5644333	0.736182438	100352.7708	10.8323
Statewide	2020	AirGrSupp - Bobtail	Aggregated	25	Diesel	3.51068E-06	4.24792E-06	5.05537E-06	7.29738E-05	9.51251E-05	0.011372948	3.39219E-06	3.12081E-06	3.39219E-06	1.05043E-07	9.28245E-08	368.9827583	695.8579192	1.515669725	17396.44798	0.5303
Statewide	2020	AirGrSupp - Bobtail	Aggregated	50	Diesel	5.00383E-05	6.05464E-05	7.20552E-05	0.000462245	0.00040533	0.071756777	1.50729E-05	1.38671E-05	1.50729E-05	6.61926E-07	5.85669E-07	2328.069614	2418.147591	6.062678899	109773.6528	0.9627
Statewide	2020	AirGrSupp - Bobtail	Aggregated	75	Diesel	1.49167E-05	1.80492E-05	2.148E-05	0.000206959	0.000297969	0.03028103	1.61136E-05	1.48245E-05	1.61136E-05	2.79516E-07	2.4715E-07	982.4346813	695.8579192	1.515669725	51493.48602	1.4118
Statewide	2020	AirGrSupp - Bobtail	Aggregated	100	Diesel	3.63956E-05	4.40387E-05	5.24097E-05	0.000888602	0.00069439	0.139538262	3.13307E-05	2.88242E-05	3.13307E-05	1.28901E-06	1.13889E-06	4527.165221	2783.431677	6.062678899	237287.5504	1.6265
Statewide	2020	AirGrSupp - Bobtail	Aggregated	175	Diesel	0.000119913	0.000145095	0.000172675	0.001413166	0.001362285	0.222815364	8.649E-05	7.95708E-05	8.649E-05	2.05644E-06	1.81859E-06	7228.999096	3114.00551	7.578348624	378935.1323	2.3214
Statewide	2020	AirGrSupp - Bobtail	Aggregated	300	Diesel	0.000517042	0.00062562	0.00074454	0.003302979	0.007441613	1.218417846	0.000293666	0.000270172	0.000293666	1.12494E-05	9.94456E-06	39530.22518	10072.5847	22.73504587	2071995.466	3.9245
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	25	Diesel	9.37969E-05	0.000113494	0.000135068	0.000473894	0.000418277	0.047609844	4.14352E-05	3.81204E-05	4.14352E-05	4.37363E-07	3.88585E-07	1544.648957	3208.612593	6.748339012	80215.31482	0.4814
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	50	Diesel	0.000171718	0.000207779	0.000247274	0.001022668	0.000926824	0.106246019	6.86774E-05	6.31832E-05	6.86774E-05	9.77146E-07	8.67166E-07	3447.035088	4786.425758	10.79734242	178999.3711	0.7202
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	100	Diesel	0.001616494	0.001955957	0.002327751	0.03194249	0.026086007	4.972286738	0.001132629	0.001042019	0.001132629	4.59228E-05	4.05831E-05	161320.3672	108186.1743	234.8421976	9310042.006	1.4911
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	175	Diesel	0.001239266	0.001499512	0.001784543	0.039372242	0.018093128	7.000357159	0.000581766	0.000535224	0.000581766	6.46846E-05	5.7136E-05	227118.8785	98477.91347	207.8488416	13112157.26	2.3063
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	300	Diesel	0.000191672	0.000231923	0.000276007	0.001505329	0.003033246	0.780495782	9.23655E-05	8.49762E-05	9.23655E-05	7.21032E-06	6.3703E-06	25322.32607	6711.593313	14.84634583	1463975.123	3.7729
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	600	Diesel	4.68859E-05	5.67319E-05	6.75157E-05	0.000995322	0.000275363	0.560500425	9.37294E-06	8.6231E-06	9.37294E-06	5.1807E-06	4.57473E-06	18184.81901	3208.612593	6.748339012	1049858.04	5.6675
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	750	Diesel	0.000133031	0.000160968	0.000191565	0.001333609	0.001375931	0.713987094	6.06092E-05	5.57604E-05	6.06092E-05	6.59717E-06	5.82747E-06	23164.52495	1925.167556	4.049003407	1337349.729	12.0325
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	25	Diesel	0.000331431	0.000401031	0.00047726	0.001394045	0.001010937	0.117836014	0.000112375	0.000103385	0.000112375	1.07951E-06	9.61762E-07	3823.059695	7353.894977	10.70392288	183847.3744	0.5199
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	50	Diesel	0.000301638	0.000364982	0.000434359	0.001716431	0.001407456	0.172986257	0.000118665	0.000109172	0.000118665	1.59029E-06	1.41189E-06	5612.348613	6816.943915	12.84470745	269864.5999	0.8233
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	75	Diesel	0.005728636	0.00693165	0.008249236	0.037932359	0.052548367	5.045915357	0.004822375	0.004436585	0.004822375	4.64801E-05	4.11841E-05	163709.1667	137447.799	204.444927	8755724.561	1.1911
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	100	Diesel	0.00198038	0.002396259	0.002851747	0.009032667	0.016672056	1.065976473	0.001789686	0.001646511	0.001789686	9.79607E-06	8.70036E-06	34584.4327	21524.73387	34.25255321	1823977.525	1.6067
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	175	Diesel	0.000635922	0.000769466	0.000915728	0.007852121	0.007542599	1.300040499	0.000429768	0.000395387	0.000429768	1.20004E-05	1.06108E-05	42178.38227	15676.63643	23.54863033	2249369.708	2.6905
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	300	Diesel	0.001243443	0.001504566	0.001790558	0.006096427	0.020554833	2.026299968	0.000732463	0.000673866	0.000732463	1.86968E-05	1.65384E-05	65741.07088	15910.09342	24.61902262	3514543.138	4.1320
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	600	Diesel	0.000600445	0.000726538	0.00086464	0.003656308	0.007816233	1.842187012	0.000252579	0.000232373	0.000252579	1.70139E-05	1.50357E-05	59767.72878	8089.284474	11.77431517	3195267.367	7.3885
Statewide	2020	AirGrSupp - Forklift	Aggregated	25	Diesel	1.39391E-05	1.68663E-05	2.00723E-05	6.871E-05	5.88833E-05	0.007859744	4.97605E-06	4.57796E-06	4.97605E-06	7.22491E-08	6.41502E-08	255.0007476	881.4522734	2.264105625	22036.30684	0.2893
Statewide	2020	AirGrSupp - Forklift	Aggregated	50	Diesel	0.000371072	0.000448998	0.000534344	0.001779052	0.001590173	0.172270232	0.000153406	0.000141134	0.000153406	1.58159E-06	1.40605E-06	5589.117942	12393.41649	32.82953156	483006.2172	0.4510
Statewide	2020	AirGrSupp - Forklift	Aggregated	75	Diesel	0.00017849	0.000215972	0.000257025	0.000774727	0.001730119	0.081295247	0.000133694	0.000122999	0.000133694	7.4626E-07	6.63521E-07	2637.534773	3825.799153	11.32052812	253824.9225	0.6894
Statewide	2020	AirGrSupp - Forklift	Aggregated	100	Diesel	0.001742264	0.00210814	0.002508861	0.013880363	0.018587457	1.979684221	0.001484234	0.001365495	0.001484234	1.82509E-05	1.61579E-05	64228.6743	70500.13302	189.0528197	6162192.063	0.9110
Statewide	2020	AirGrSupp - Forklift	Aggregated	175	Diesel	0.000864481	0.001046022	0.001244852	0.007827064	0.011570415	1.242295029	0.000604031	0.000555709	0.000604031	1.14597E-05	1.01394E-05	40304.89406	30322.45202	80.37574967	3872935.04	1.3292
Statewide	2020	AirGrSupp - Forklift	Aggregated	300	Diesel	0.000453253	0.000548436	0.000652684	0.003181856	0.008029185	0.940055573	0.000251465	0.000231347	0.000251465	8.67768E-06	7.67261E-06	30499.06777	12393.41649	32.82953156	2930162.165	2.4609
Statewide	2020	AirGrSupp - Forklift	Aggregated	600	Diesel	8.84406E-05	0.000107013	0.000127354	0.000317646	0.001998495	0.155820972	5.15605E-05	4.74356E-05	5.15605E-05	1.43799E-06	1.27179E-06	5055.439822	1322.17841	3.396158437	485680.2026	3.8236
Statewide	2020	AirGrSupp - Lift	Aggregated	25	Diesel	4.88685E-06	5.91308E-06	7.03706E-06	9.83612E-05	0.000125576	0.014900529	4.40458E-06	4.05221E-06	4.40458E-06	1.37616E-07	1.21616E-07	483.4312687	1002.469221	2.419098477	25061.73052	0.4822
Statewide	2020	AirGrSupp - Lift	Aggregated	50	Diesel	0.000215816	0.000261137	0.000310775	0.002397387	0.002448741	0.354251241	0.000111709	0.000102772	0.000111709	3.26875E-06	2.89135E-06	11493.29138	13295.90756	32.65782944	595836.0479	0.8644
Statewide	2020	AirGrSupp - Lift	Aggregated	75	Diesel	3.41763E-05	4.13534E-05	4.92139E-05	0.001060564	0.000669664	0.171560606	1.8829E-05	1.73227E-05	1.8829E-05	1.58514E-06	1.40025E-06	5566.094922	4511.111493	10.88594315	320790.1506	1.2339
Statewide	2020	AirGrSupp - Lift	Aggregated	100	Diesel	0.001275015	0.001542768	0.001836021	0.015084247	0.015012984	2.283296004	0.001033488	0.000950809	0.001033488	2.1072E-05	1.8636E-05	74079.02424	50651.07641	123.3740223	4265977.619	1.4625
Statewide	2020	AirGrSupp - Lift	Aggregated	175	Diesel	0.000235286	0.000284696	0.000338812	0.003177587	0.002415277	0.528889181	0.000175738	0.000161679	0.000175738	4.88278E-06	4.31672E-06	17159.227	8019.753766	19.35278782	988935.8862	2.1396
Statewide	2020	AirGrSupp - Lift	Aggregated	300	Diesel	0.000256084	0.000309862	0.000368761	0.00299638	0.003792947	1.05073302	0.00011166	0.000102727	0.00011166	9.70687E-06	8.57594E-06	34089.87566	8784.796066	21.77188629	1964786.911	3.8806
Statewide	2020	AirGrSupp - Other GSE	Aggregated	25	Diesel	1.07875E-05	1.30528E-05	1.5534E-05	0.000229114	0.000182777	0.036358228	7.52352E-07	6.92164E-07	7.52352E-07	3.35826E-07	2.96751E-07	1179.602657	2446.457884	5.064074836	61161.44709	0.4822
Statewide	2020	AirGrSupp - Other GSE	Aggregated	50	Diesel	0.005159914	0.006243496	0.007430276	0.035750505	0.03341217	4.350949372	0.002282327	0.002099741	0.002282327	4.00719E-05	3.55119E-05	141161.7607	212366.9027	450.7026604	7317562.623	0.6647
Statewide	2020	AirGrSupp - Other GSE	Aggregated	75	Diesel	0.001373029	0.001661365	0.001977162	0.018756384	0.020776594	2.793480117	0.001201194	0.001105099	0.001201194	2.57859E-05	2.28E-05	90631.38592	76825.95677	164.5824322	5224283.794	1.1797
Statewide	2020	AirGrSupp - Other GSE	Aggregated	100	Diesel	0.001138434	0.001377505	0.001639345	0.017355892	0.013303751	2.68706233	0.000836975	0.000770017	0.000836975	2.48091E-05	2.19314E-05	87178.77804	56820.77915	119.0057586	5015103.361	1.5343
Statewide	2020	AirGrSupp - Other GSE	Aggregated	175	Diesel	0.002461745	0.002978712	0.003544913	0.044826063	0.030778759	7.930722401	0.001464889	0.001347698	0.001464889	7.32496E-05	6.47295E-05	257303.5542	92175.68518	194.9668812	14831645.4	2.7914
Statewide	2020	AirGrSupp - Other GSE	Aggregated	300	Diesel	0.002493698	0.003017375	0.003590925	0.01808838	0.039810848	8.454256844	0.001288767	0.001185665	0.001288767	7.8089E-05	6.90025E-05	274289.0526	70157.56423	149.3902077	15810794.6	3.9096
Statewide	2020	AirGrSupp - Other GSE	Aggregated	600	Diesel	0.001596267	0.001931483	0.002298624	0.01255279	0.024715008	5.27351571	0.00088242	0.000811826	0.00088242	4.87084E-05	4.30417E-05	171093.4095	27463.28455	58.23686061	9862281.963	6.2299
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	50	Diesel	2.64942E-05	3.2058E-05	3.81516E-05	0.000241588	0.000307019	0.044164914	1.62294E-05	1.4931E-05	1.62294E-05	4.07532E-07	3.60468E-07	1432.881989	1465.513722	26.1078274	63358.74356	0.9777

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	75	Diesel	5.42478E-06	6.56398E-06	7.81168E-06	0.000274043	0.000167298	0.047192028	1.93119E-06	1.77669E-06	1.93119E-06	4.36151E-07	3.85175E-07	1531.09338	1375.604905	37.10059683	75607.32143	1.1130
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	100	Diesel	6.59421E-06	7.979E-06	9.49567E-06	2.98353E-05	7.48561E-05	0.003180056	3.96356E-06	3.64647E-06	3.96356E-06	2.92034E-08	2.59552E-08	103.1734083	50.94832981	1.374096179	5094.832981	2.0251
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	175	Diesel	1.35748E-05	1.64255E-05	1.95477E-05	0.000129046	0.000212625	0.020780925	1.27927E-05	1.17692E-05	1.27927E-05	1.91723E-07	1.69611E-07	674.2142209	299.6960577	1.374096179	32966.56635	2.2497
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	300	Diesel	4.75184E-06	5.74972E-06	6.84264E-06	3.05178E-05	0.000118979	0.017331304	2.1709E-06	1.99723E-06	2.1709E-06	1.60094E-07	1.41456E-07	562.2950755	101.8966596	2.748192358	27766.83975	5.5183
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	600	Diesel	1.3913E-06	1.68347E-06	2.00347E-06	3.42008E-05	9.50489E-06	0.019557343	3.17767E-07	2.92345E-07	3.17767E-07	1.80776E-07	1.59624E-07	634.5164613	101.8966596	2.748192358	31333.22283	6.2271
Statewide	2020	CHC - AE Barge and Dredge	Aggregated		Diesel	0.02257465	0.027315327	0.032507496	0.266567482	0.705648592	19.69613688	0.018247773	0.016787951	0.018247773	0.000181423	0.001140353	4532969.278	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Charter Fishing	Aggregated		Diesel	0.076949104	0.093108416	0.110806709	0.322445275	0.454030184	5.750192825	0.024989527	0.022990364	0.024989527	5.08549E-05	0.00033292	1323378.67	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Commercial Fishing	Aggregated		Diesel	0.20144494	0.243748378	0.290080714	0.93885434	1.852903494	16.47006912	0.10219769	0.094021874	0.10219769	0.000146231	0.000953572	3790505.609	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Crew and Supply	Aggregated		Diesel	0.0130744	0.015820023	0.018827135	0.062915083	0.078482952	1.319856567	0.002833607	0.002606919	0.002833607	1.18105E-05	7.64161E-05	303758.514	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Ferry and Excursion	Aggregated		Diesel	0.063576891	0.076928038	0.091550723	0.366475909	0.434020539	7.641041054	0.01491097	0.013718093	0.01491097	6.87379E-05	0.000442395	1758548.113	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Others	Aggregated		Diesel	0.005014868	0.006067991	0.00722141	0.021152241	0.031519902	0.361586465	0.001777965	0.001635728	0.001777965	3.1926E-06	2.09349E-05	83217.35117	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Pilot Vessels	Aggregated		Diesel	0.000250556	0.000303172	0.0003608	0.000825237	0.00089486	0.012714408	5.68303E-05	5.22839E-05	5.68303E-05	1.10034E-07	7.3613E-07	2926.158675	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Tow Boats	Aggregated		Diesel	0.013487176	0.016319483	0.019421534	0.078308061	0.101883326	1.664656158	0.004043669	0.003720175	0.004043669	1.4986E-05	9.63791E-05	383112.4483	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Tug Boats	Aggregated		Diesel	0.029874508	0.036148155	0.043019292	0.18026341	0.225616346	3.829414996	0.008174401	0.007520449	0.008174401	3.45086E-05	0.000221713	881321.0752	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Work Boats	Aggregated		Diesel	0.002790761	0.003376821	0.004018696	0.016432183	0.026673147	0.313645564	0.001052375	0.000968185	0.001052375	2.81609E-06	1.81592E-05	72183.98786	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Barge and Dredge	Aggregated		Diesel	0.003303354	0.003997059	0.00475683	0.0305789	0.124870042	2.354634984	0.0033769	0.003106748	0.0033769	2.16707E-05	0.000136327	541907.6902	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Charter Fishing	Aggregated		Diesel	0.64857278	0.784773064	0.933944804	4.00448483	9.078221831	96.18142221	0.383271879	0.352610128	0.383271879	0.000869788	0.005568642	22135682.48	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Commercial Fishing	Aggregated		Diesel	0.571784986	0.691859833	0.82337038	2.669592658	10.35940246	64.72790108	0.449495887	0.413536216	0.449495887	0.000581288	0.003747569	14896808.89	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Crew and Supply	Aggregated		Diesel	0.106146495	0.128437259	0.152850953	0.769352849	0.912683787	16.18869791	0.02488534	0.022894513	0.02488534	0.000146488	0.000937281	3725749.406	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Ferry and Excursion	Aggregated		Diesel	1.011381845	1.223772032	1.456389857	9.184965823	9.983174319	191.9487631	0.250148104	0.230136256	0.250148104	0.00174432	0.01111331	44176066.17	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Others	Aggregated		Diesel	0.085540095	0.103503515	0.123177737	0.479783099	1.27727512	11.80802422	0.057405206	0.05281279	0.057405206	0.000106605	0.000683652	2717558.847	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Pilot Vessels	Aggregated		Diesel	0.018810559	0.022760776	0.027087205	0.119595164	0.247204129	3.00757675	0.01044731	0.009611526	0.01044731	2.72422E-05	0.00017413	692179.0344	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Tow Boats	Aggregated		Diesel	0.118770124	0.14371185	0.171028979	1.07934156	1.190578791	23.02506997	0.028110997	0.025862118	0.028110997	0.000209315	0.001333089	5299106.899	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Tug Boats	Aggregated		Diesel	0.510994755	0.618303654	0.735832447	4.559303147	5.545477653	95.75923789	0.162091718	0.149124381	0.162091718	0.000870012	0.005544199	22038518.83	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Work Boats	Aggregated		Diesel	0.018447665	0.022321675	0.026564638	0.120367844	0.236202116	2.754128184	0.009676381	0.008902271	0.009676381	2.49099E-05	0.000159457	633849.0905	0	0	0	#DIV/0!
Statewide	2020	CHE - Port Construction Equipment	Aggregated	50	Diesel	0.000542269	0.000656146	0.000780867	0.00511397	0.003818492	0.514078991	6.56216E-05	6.03719E-05	6.56216E-05	4.73665E-06	4.19584E-06	16678.7267	12619.48542	7.066599102	527240.4534	1.3217
Statewide	2020	CHE - Port Construction Equipment	Aggregated	75	Diesel	0.001849127	0.002237443	0.002662742	0.018352492	0.01999527	2.691731209	0.000394831	0.000363245	0.000394831	2.48309E-05	2.19695E-05	87330.25468	42130.37035	15.08132497	2759810.108	2.0729
Statewide	2020	CHE - Port Construction Equipment	Aggregated	100	Diesel	0.001392187	0.001684546	0.002004749	0.020668793	0.009382631	3.11866589	0.000187994	0.000172955	0.000187994	2.87918E-05	2.54541E-05	101181.6802	36898.08675	17.24836224	3190778.729	2.7422
Statewide	2020	CHE - Port Construction Equipment	Aggregated	175	Diesel	0.004276066	0.005174039	0.006157534	0.053988103	0.044652034	8.213087488	0.000671113	0.000617424	0.000671113	7.58058E-05	6.70341E-05	266464.5785	66520.41921	38.9723763	9388658.028	4.0058
Statewide	2020	CHE - Port Construction Equipment	Aggregated	300	Diesel	0.007954712	0.009625202	0.011454785	0.048078386	0.083275892	17.26331203	0.001080379	0.000993949	0.001080379	0.000159369	0.000140901	560089.1468	79259.80227	35.6523426	19744522.48	7.0665
Statewide	2020	CHE - Port Construction Equipment	Aggregated	600	Diesel	0.021443738	0.025946923	0.030878983	0.140052222	0.211357755	56.0804647	0.002248687	0.002068792	0.002248687	0.000517848	0.000457721	1819468.916	163696.688	68.86037089	63603859.84	11.1149
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	100	Diesel	0.000149504	0.000180899	0.000215285	0.002147892	0.00093272	0.332894833	2.06749E-05	1.90209E-05	2.06749E-05	3.07329E-06	2.71704E-06	10800.40623	3744.360676	2.169897236	318270.6574	2.8844
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	175	Diesel	0.008288802	0.010029451	0.011935875	0.116322812	0.076864037	18.19616644	0.000883941	0.000813226	0.000883941	0.000167984	0.000148515	590354.5807	126210.8895	57.27861481	19306936.92	4.6775
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	300	Diesel	0.047242226	0.057163093	0.068028805	0.313280138	0.450238706	139.7101671	0.004220621	0.003882972	0.004220621	0.001290273	0.001140296	4532742.51	590407.6455	271.0869885	148741733.2	7.6773
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	600	Diesel	0.044905427	0.054335566	0.064663815	0.297900631	0.35879455	144.1113598	0.003796553	0.003492829	0.003796553	0.001331034	0.001176218	4675534.359	459409.9137	205.782881	153271805.7	10.1773
Statewide	2020	CHE - Port Forklift	Aggregated	50	Diesel	0.000269161	0.000325685	0.000387593	0.003492328	0.003050223	0.45613548	6.57194E-05	6.04619E-05	6.57194E-05	4.20912E-06	3.72292E-06	14798.81331	20388.59665	28.35097008	853093.9608	0.7258
Statewide	2020	CHE - Port Forklift	Aggregated	75	Diesel	0.000902893	0.001092501	0.001300167	0.01217573	0.012900026	1.964806709	0.000385038	0.000354235	0.000385038	1.81385E-05	1.60365E-05	63745.98981	54167.24329	54.43960301	3687519.239	1.1768
Statewide	2020	CHE - Port Forklift	Aggregated	100	Diesel	0.001729596	0.002092811	0.002490618	0.044930051	0.008785549	7.533056603	0.000333273	0.000306611	0.000333273	6.9595E-05	6.14838E-05	244401.7253	165542.7299	173.9256025	14154286.04	1.4764
Statewide	2020	CHE - Port Forklift	Aggregated	175	Diesel	0.005023324	0.006078221	0.007233586	0.106456376	0.051503905	18.00726825	0.001078454	0.000992178	0.001078454	0.000166335	0.000146973	584225.9869	261296.5569	276.84586	37632746.93	2.2359
Statewide	2020	CHE - Port Forklift	Aggregated	300	Diesel	0.002120673	0.002566014	0.003053769	0.019090543	0.019015584	9.269338665	0.000285031	0.000262228	0.000285031	8.5636E-05	7.56551E-05	300733.4846	90874.19599	96.99237179	19395607.98	3.3093
Statewide	2020	CHE - Port Forklift	Aggregated	600	Diesel	0.000255455	0.0003091	0.000367855	0.003105226	0.001865388	1.653364124	3.27375E-05	3.01185E-05	3.27375E-05	1.52785E-05	1.34945E-05	53641.57816	10753.23352	11.99778219	3466451.46	4.9884
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	50	Diesel	0.001681516	0.002034634	0.002421383	0.013361663	0.010289677	1.35524277	0.000208442	0.000191767	0.000208442	1.24794E-05	1.10613E-05	43969.35915	38964.71663	30.33851143	1496732.988	1.1284
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	75	Diesel	0.000760364	0.00092004	0.001094924	0.007858743	0.008684238	1.195483536	0.000164283	0.00015114	0.000164283	1.103E-05	9.75738E-06	38786.14674	20492.55045	12.54167499	1313739.551	1.8927
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	100	Diesel	0.001308461	0.001583238	0.001884184	0.016230528	0.008845347	2.474844357	0.000193609	0.00017812	0.000193609	2.28419E-05	2.01993E-05	80293.59962	32880.40484	16.94674819	2747743.95	2.4420
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	175	Diesel	0.002683564	0.003247112	0.003864332	0.033301002	0.028681312	5.237980359	0.000417304	0.00038392	0.000417304	4.83472E-05	4.27517E-05	169940.5041	47684.46616	30.83577898	6349966.729	3.5639
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	300	Diesel	0.001907426	0.002307985	0.002746693	0.011788394	0.019991166	4.458841465	0.000227512	0.000209311	0.000227512	4.1167E-05	3.63925E-05	144662.2008	24799.65197	13.62292095	5610744.392	5.8332
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	600	Diesel	0.006372783	0.007711067	0.009176808	0.057453072	0.06935476	12.89765384	0.000875196	0.00080518	0.000875196	0.000119054	0.000105269	418450.1745	36164.91317	22.96895853	15808798.08	11.5706
Statewide	2020	CHE - Port RTG Crane	Aggregated	100	Diesel	1.14165E-06	1.38139E-06	1.64397E-06	1.53555E-05	1.23218E-05	0.002763825	1.46882E-07	1.35131E-07	1.46882E-07	2.55187E-08	2.2558E-08	89.66925099	77.95106778	0.666284979	7795.106778	1.1503
Statewide	2020	CHE - Port RTG Crane	Aggregated	300	Diesel	0.000983143	0.001189603	0.001415725	0.006452236	0.009289483	2.188214111	0.000115394	0.000106163	0.000115394	2.02016E-05	1.78599E-05	70994.19694	29218.22564	17.89212337	6859878.864	2.4298
Statewide	2020	CHE - Port RTG Crane	Aggregated	600	Diesel	0.011842604	0.01432955	0.017053349	0.078326921	0.105578242	34.70560124	0.001081435	0.00099492	0.001081435	0.000320515	0.000283262	1125985.011	219871.8689	122.0494924	108888877	5.1211
Statewide	2020	CHE - Port RTG Crane	Aggregated	750	Diesel	0.011203591	0.013556345	0.016133171	0.071784276	0.091720235	34.73081975	0.000927486	0.000853287	0.000927486	0.000320768	0.000283468	1126803.197	165398.3077	88.58768449	108884702	6.8127
Statewide	2020	CHE - Port RTG Crane	Aggregated	9999	Diesel	0.008869743	0.010732389	0.012772429	0.047112114	0.141927452	22.85171416	0.001883931	0.001733217	0.001883931	0.000211009	0.000186513	741398.6993	74065.3293	42.43194385	71651361.15	10.0101
Statewide	2020	CHE - Port Yard Tractor	Aggregated	175	Diesel	0.027182171	0.032890427	0.039142326	1.89648495	0.174865554	303.0082303	0.005982498	0.005503898	0.005982498	0.002800646	0.002473112	9830768.329	2815123.921	1340.279089	487197961.6	3.4921
Statewide	2020	CHE - Port Yard Tractor	Aggregated	300	Diesel	0.022918125	0.027730931	0.0330021	0.595407404	0.11778007	276.3307261	0.00406302	0.003737978	0.00406302	0.002554127	0.002255374	8965246.084	2023444.516	930.9952148	443860036.1	4.4307
Statewide	2020	CHE - Port Yard Tractor	Aggregated	600	Diesel	0.000156449	0.000189304	0.000225287	0.003970638	0.001083388	1.950405561	2.84268E-05	2.61526E-05	2.84268E-05	1.80278E-05	1.59189E-05	63278.76045	9800.449585	4.569733955	3136143.867	6.4567
Statewide	2020	CHE - Rail Construction Equipment	Aggregated	75	Diesel	1.59316E-05	1.92772E-05	2.29415E-05	0.000158849	0.000226299	0.026608276	5.59306E-06	5.14561E-06	5.59306E-06	2.45529E-07	2.17173E-07	863.2762125	440.4772024	2.426301725	27289.50177	1.9599
Statewide	2020	CHE - Rail Container Handling Equipment	Aggregated	175	Diesel	0.002399606	0.002903523	0.003455433	0.030234845	0.024859929	4.746638347	0.000309688	0.000284913	0.000309688	4.3813E-05	3.87414E-05	153999.4537	33740.47568	20.01050965	5058269.33	4.5642
Statewide	2020	CHE - Rail Container Handling Equipment	Aggregated	300	Diesel	0.005657836	0.006845982	0.008147284	0.033044593	0.057218492	13.13805273	0.000617076	0.000567709	0.000617076	0.000121298	0.000107231	426249.6518	61824.38048	19.46666725	13960835.09	6.8945
Statewide	2020	CHE - Rail Container Handling Equipment	Aggregated	600	Diesel	0.001686692	0.002040897	0.002428837	0.01079412	0.015876321	3.996691022	0.000193372	0.000177902	0.000193372	3.69008E-05	3.26205E-05	129668.2386	12446.55353	5.319777627	4231590.213	10.4180
Statewide	2020	CHE - Rail Forklift	Aggregated	75	Diesel	4.00963E-05	4.85166E-05	5.77387E-05	0.000535701	0.000574329	0.086265474	1.84499E-05	1.69739E-05	1.84499E-05	7.96364E-07	7.04087E-07	2798.788285	2555.452115	2.99077878	162202.4145	1.0952
Statewide	2020	CHE - Rail Forklift	Aggregated	100	Diesel	0.000395217	0.000478212	0.000569112	0.008167473	0.001358494	1.234445711	4.34839E-05	4.00052E-05	4.34839E-05	1.14012E-05	1.00754E-05	40050.2316	25633.42413	9.615962301	2308928.894	1.5624
Statewide	2020	CHE - Rail Forklift	Aggregated	175	Diesel	0.000488982	0.000591668	0.000704134	0.009441921	0.003558866	1.454080503	4.70199E-05	4.32583E-05	4.70199E-05	1.3429E-05	1.1868E-05	47176.04053	18731.54646	7.748147424	3026139.177	2.5185
Statewide	2020	CHE - Rail Forklift	Aggregated	300	Diesel	9.00285E-05	0.000108934	0.000129641	0.0006414	0.000776422	0.290354717	1.14169E-05	1.05035E-05	1.14169E-05	2.68177E-06	2.36984E-06	9420.23901	2636.376732	1.569599203	606936.5449	3.5732
Statewide	2020	CHE - Rail Other General Industrial Equipment	Aggregated	50	Diesel	0.000625947	0.000757396	0.000901364	0.004397775	0.00321071	0.386326935	8.60147E-05	7.91336E-05	8.60147E-05	3.55301E-06	3.15315E-06	12533.95195	9156.291078	2.531897856	427293.5836	1.3689
Statewide	2020	CHE - Rail Other General Industrial Equipment	Aggregated	175	Diesel	5.13531E-05	6.21372E-05	7.39484E-05	0.000680368	0.000673228	0.118333778	1.11933E-05	1.02979E-05	1.11933E-05	1.09251E-06	9.65824E-07	3839.209112	1066.186696	1.673043329	145503.7588	3.6009
Statewide	2020	CHE - Rail Other General Industrial Equipment	Aggregated	300	Diesel	0.000446806	0.000540635	0.0006434	0.002812222	0.005462943	1.138260807	5.16127E-05	4.74837E-05	5.16127E-05	1.05104E-05	9.29033E-06	36929.61833	6645.763365	8.21843519	1484434.109	5.5569
Statewide	2020	CHE - Rail RTG Crane	Aggregated	300	Diesel	0.009264601	0.011210167	0.013341025	0.054376439	0.091506668	22.01372865	0.000821159	0.000755466	0.000821159	0.00020325	0.000179673	714211.1823	257751.5527	61.72067707	69007235.82	2.7709
Statewide	2020	CHE - Rail RTG Crane	Aggregated	600	Diesel	0.003368147	0.004075458	0.004850131	0.019385374	0.030943268	9.025109796	0.000269767	0.000248186	0.000269767	8.33406E-05	7.36617E-05	292809.748	84865.04303	23.66772597	28334508.08	3.4503
Statewide	2020	CHE - Rail Yard Tractor	Aggregated	175	Diesel	0.015952915	0.019303027	0.022972198	1.030841802	0.073397868	165.3785595	0.002852656	0.002624443	0.002852656	0.001528528	0.001349798	5365525.229	1670647.101	436.2745175	265460478.2	3.2116
Statewide	2020	CHE - Rail Yard Tractor	Aggregated	300	Diesel	0.005774725	0.006987417	0.008315603	0.138976662	0.026881721	66.86425965	0.001008188	0.000927533	0.001008188	0.00061802	0.000545737	2169337.267	539423.8956	156.2472059	107514017.6	4.0216
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	50	Diesel	0.001495888	0.001810025	0.002154079	0.011405124	0.01174645	1.514136427	0.000743729	0.000684231	0.000743729	1.39541E-05	1.23582E-05	49124.48884	42522.51868	122.3304779	1668165.487	1.1553
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	75	Diesel	0.001174982	0.001421728	0.001691974	0.017390834	0.020870058	2.637724936	0.001097161	0.001009388	0.001097161	2.43518E-05	2.15288E-05	85578.0806	45392.30393	103.0151393	3332730.383	1.8853
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	100	Diesel	0.002486302	0.003008425	0.003580274	0.042931038	0.034516172	6.778656541	0.001757383	0.001616792	0.001757383	6.25975E-05	5.53265E-05	219926.0461	100341.9407	270.4147407	8597536.478	2.1918
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	175	Diesel	0.002986989	0.003614257	0.004301264	0.060883948	0.038690168	10.94695749	0.001714332	0.001577186	0.001714332	0.00010112	8.93476E-05	355161.9799	91149.43542	294.8808362	13626504.14	3.8965
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	300	Diesel	0.003536796	0.004279523	0.005092986	0.031824449	0.054235399	15.4586558	0.001576028	0.001449946	0.001576028	0.000142817	0.000126171	501539.0627	93993.36675	294.8808362	19431673.65	5.3359
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	600	Diesel	0.005395464	0.006528512	0.007769468	0.055806179	0.074612077	29.57645281	0.002350151	0.002162138	0.002350151	0.000273287	0.000241399	959575.4387	89020.79591	254.9624698	37287362.52	10.7792

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	750	Diesel	0.001932467	0.002338285	0.002782753	0.020618331	0.025770517	11.16299281	0.000902503	0.000830303	0.000902503	0.000103149	9.11108E-05	362171.0079	21361.0842	48.93219117	13799363.72	16.9547
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	9999	Diesel	0.002318229	0.002805058	0.00333825	0.015465638	0.062367801	8.186127037	0.001513912	0.001392799	0.001513912	7.56153E-05	6.68141E-05	265589.8763	5502.576223	7.726135448	10236953.45	48.2665
Statewide	2020	ConstMin - Cranes	Aggregated	25	Diesel	4.49523E-05	5.43923E-05	6.47313E-05	0.00025483	0.000233064	0.028955934	1.74891E-05	1.609E-05	1.74891E-05	2.66363E-07	2.36334E-07	939.443405	2269.319433	4.851693954	56732.98581	0.4140
Statewide	2020	ConstMin - Cranes	Aggregated	50	Diesel	0.001435642	0.001737127	0.002067325	0.006087655	0.004912904	0.469185571	0.000518825	0.000477319	0.000518825	4.29478E-06	3.82943E-06	15222.20914	22074.45302	51.75140217	910142.1269	0.6896
Statewide	2020	ConstMin - Cranes	Aggregated	75	Diesel	0.00043368	0.000524753	0.000624499	0.001811052	0.003964213	0.210937977	0.00036797	0.000338532	0.00036797	1.93722E-06	1.72165E-06	6843.650344	6513.920883	17.7895445	456156.6568	1.0506
Statewide	2020	ConstMin - Cranes	Aggregated	100	Diesel	0.012597576	0.015243067	0.01814051	0.086842618	0.133633515	10.8890318	0.009424005	0.008670084	0.009424005	0.000100297	8.88748E-05	353282.6445	269506.0354	624.2512887	23791638.92	1.3109
Statewide	2020	ConstMin - Cranes	Aggregated	175	Diesel	0.026864534	0.032506087	0.038684929	0.216157927	0.335790452	32.15110942	0.01804766	0.016603847	0.01804766	0.000296447	0.000262413	1043107.337	475979.8295	1064.138207	69919131.79	2.1915
Statewide	2020	ConstMin - Cranes	Aggregated	300	Diesel	0.034024349	0.041169462	0.048995062	0.193263142	0.494114741	57.90677848	0.020202206	0.018586029	0.020202206	0.000534356	0.000472627	1878721.655	567252.29	1224.244108	126123714.6	3.3120
Statewide	2020	ConstMin - Cranes	Aggregated	600	Diesel	0.045032523	0.054489353	0.064846834	0.438377577	0.662716832	96.14363758	0.026117992	0.024028552	0.026117992	0.000887545	0.000784711	3119274.438	566718.3325	1177.344399	209774775.3	5.5041
Statewide	2020	ConstMin - Cranes	Aggregated	750	Diesel	0.001543157	0.00186722	0.002222146	0.015197021	0.019899029	1.540245862	0.001026016	0.000943935	0.001026016	1.4194E-05	1.25713E-05	49971.58072	5220.517041	12.93785054	3341532.276	9.5722
Statewide	2020	ConstMin - Cranes	Aggregated	9999	Diesel	0.006454718	0.007810209	0.009294794	0.066670163	0.089339789	5.391574529	0.004263014	0.003921973	0.004263014	4.96541E-05	4.40053E-05	174923.6978	12520.94291	25.87570109	11747745.37	13.9705
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	50	Diesel	0.004464928	0.005402563	0.006429496	0.019211729	0.014850301	1.518041588	0.0015558	0.001431336	0.0015558	1.39011E-05	1.23901E-05	49251.18751	47825.65411	143.5336636	2009939.674	1.0298
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	75	Diesel	0.001529901	0.001851181	0.002203058	0.006001087	0.014660302	0.501061461	0.001074866	0.000988877	0.001074866	4.58666E-06	4.0896E-06	16256.38729	10064.00849	48.80144561	726705.5659	1.6153
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	100	Diesel	0.072674107	0.087935669	0.104650713	0.502870306	0.74032847	66.60047706	0.061834272	0.05688753	0.061834272	0.000613574	0.000543584	2160779.131	1110692.86	2412.800884	97212253.54	1.9454
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	175	Diesel	0.054882035	0.066407262	0.07903013	0.464453863	0.678747961	73.17609328	0.037970883	0.034933212	0.037970883	0.000674903	0.000597253	2374117.757	718031.6236	1624.801071	107051310.4	3.3064
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	300	Diesel	0.051024636	0.061739809	0.073475476	0.324519919	0.766138971	78.22487497	0.030743122	0.028283673	0.030743122	0.000721697	0.000638461	2537919.919	553582.907	1293.238309	114494896	4.5845
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	600	Diesel	0.110619984	0.133850181	0.159292777	0.83902517	1.620152223	264.7779805	0.06089731	0.056025525	0.06089731	0.002444685	0.002161082	8590429.977	1005715.613	2145.82827	387108544.1	8.5416
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	750	Diesel	0.003355136	0.004059714	0.004831396	0.020939202	0.064385614	5.688886556	0.001886486	0.001735567	0.001886486	5.24959E-05	4.64319E-05	184569.6591	13437.35655	30.14206935	8339590.964	13.7356
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	9999	Diesel	0.01026947	0.012426059	0.014788037	0.052402357	0.201317043	15.59589712	0.005708065	0.00525142	0.005708065	0.000143884	0.000127292	505991.7063	23275.6213	43.06009907	22769424.83	21.7391
Statewide	2020	ConstMin - Excavators	Aggregated	25	Diesel	4.19918E-05	5.08101E-05	6.04682E-05	0.000142684	9.69173E-05	0.007507832	1.35074E-05	1.24268E-05	1.35074E-05	6.81539E-08	6.12779E-08	243.5833332	444.3691972	1.438206773	11109.22993	0.5482
Statewide	2020	ConstMin - Excavators	Aggregated	50	Diesel	0.050649871	0.061286343	0.072935814	0.465188062	0.416738031	60.75592299	0.0229584	0.021121728	0.0229584	0.000560199	0.000495882	1971159.011	2508180.171	3512.10094	89707497.39	0.7859
Statewide	2020	ConstMin - Excavators	Aggregated	75	Diesel	0.001084086	0.001311744	0.001561083	0.013697868	0.019382637	1.918646714	0.001121245	0.001031546	0.001121245	1.77063E-05	1.56597E-05	62248.37961	42879.22119	63.28109802	3146750.119	1.4517
Statewide	2020	ConstMin - Excavators	Aggregated	100	Diesel	0.035778846	0.043292404	0.051521539	0.513919181	0.442672884	77.02209764	0.026454767	0.024338386	0.026454767	0.000711034	0.000628644	2498897.133	1556634.923	2466.524616	127079786.3	1.6053
Statewide	2020	ConstMin - Excavators	Aggregated	175	Diesel	0.060684682	0.073428465	0.087385942	0.973384051	0.72197501	166.4622268	0.03509013	0.03228292	0.03509013	0.001537205	0.001358642	5400683.623	1871529.053	3240.27986	273257506.9	2.8857
Statewide	2020	ConstMin - Excavators	Aggregated	300	Diesel	0.059409113	0.071885027	0.085549123	0.454866236	0.821343499	211.7060725	0.025046186	0.023042491	0.025046186	0.001955545	0.001727917	6868570.371	1591024.607	2787.244726	347501309.9	4.3171
Statewide	2020	ConstMin - Excavators	Aggregated	600	Diesel	0.089532496	0.10833432	0.128926794	0.778734813	1.104904583	375.3528977	0.036370556	0.033460912	0.036370556	0.003467638	0.00306358	12177911.39	1829484.027	2923.87437	617798738.6	6.6565
Statewide	2020	ConstMin - Excavators	Aggregated	750	Diesel	0.00273005	0.003303361	0.003931272	0.017538357	0.041989192	6.657783456	0.001376443	0.001266328	0.001376443	6.14726E-05	5.43399E-05	216004.452	17490.82078	31.64054901	10957049.47	12.3496
Statewide	2020	ConstMin - Excavators	Aggregated	9999	Diesel	0.002576325	0.003117354	0.003709908	0.023196396	0.065063725	10.49153725	0.001219913	0.00112232	0.001219913	9.69222E-05	8.56305E-05	340386.3717	14298.42113	21.5731016	17213439.75	23.8059
Statewide	2020	ConstMin - Graders	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Graders	Aggregated	50	Diesel	0.001444012	0.001747255	0.002079378	0.00561789	0.004028677	0.377837502	0.000495033	0.000455431	0.000495033	3.44997E-06	3.08386E-06	12258.52165	14410.43829	41.91248418	521715.6862	0.8507
Statewide	2020	ConstMin - Graders	Aggregated	75	Diesel	0.000630401	0.000762785	0.000907778	0.004785471	0.005855066	0.622699245	0.00041414	0.000381009	0.00041414	5.73825E-06	5.08239E-06	20202.79122	13301.323	36.13145188	955754.3045	1.5189
Statewide	2020	ConstMin - Graders	Aggregated	100	Diesel	0.015100674	0.018271815	0.02174497	0.076668461	0.14199413	8.388855137	0.011736812	0.010797867	0.011736812	7.71061E-05	6.84687E-05	272167.1662	144663.7768	401.7817449	12994841.45	1.8814
Statewide	2020	ConstMin - Graders	Aggregated	175	Diesel	0.088387797	0.106949234	0.127278428	0.688809182	1.043941422	101.6533407	0.058274995	0.053612995	0.058274995	0.000937184	0.000829681	3298030.688	1048194.55	2273.390952	155787854.3	3.1464
Statewide	2020	ConstMin - Graders	Aggregated	300	Diesel	0.115372211	0.139600375	0.166135984	0.561828527	1.74555588	214.6264786	0.057891833	0.053260486	0.057891833	0.001980867	0.001751752	6963319.729	1518857.616	2046.485435	329199174.5	4.5846
Statewide	2020	ConstMin - Graders	Aggregated	600	Diesel	0.005008834	0.00606069	0.007212721	0.021702012	0.080172221	9.360577776	0.002480916	0.002282443	0.002480916	8.63929E-05	7.63998E-05	303693.6371	40748.70216	56.36506493	14294847.41	7.4528
Statewide	2020	ConstMin - Graders	Aggregated	9999	Diesel	0.005666585	0.006856568	0.008159883	0.028964461	0.094892625	7.276127989	0.002975645	0.002737594	0.002975645	6.71014E-05	5.93868E-05	236065.9594	6171.065866	8.671548451	11165444.24	38.2537
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	50	Diesel	0.035938508	0.043485595	0.051751451	0.237249149	0.200509801	25.19652336	0.014935095	0.013740287	0.014935095	0.000231876	0.000205651	817473.4513	866657.063	1346.691992	32698705.29	0.9432
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	75	Diesel	0.009090084	0.010999002	0.013089722	0.118194828	0.105457376	17.30682026	0.006355099	0.005846691	0.006355099	0.000159737	0.000141256	561500.7234	351483.9269	559.1113223	24924680.88	1.5975
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	100	Diesel	0.01325036	0.016032936	0.019080519	0.110405016	0.146991519	14.70000529	0.012172738	0.011198919	0.012172738	0.000135511	0.000119979	476925.4824	264684.1516	420.0430239	21096186.91	1.8019
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	175	Diesel	0.011587824	0.014021267	0.016686467	0.166349385	0.149544753	27.36974784	0.007255224	0.006674806	0.007255224	0.000252699	0.000223388	887981.3263	249070.734	371.7948387	39435716.95	3.5652
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	300	Diesel	0.009283468	0.011232997	0.013368194	0.059749162	0.134592609	24.4826313	0.004558947	0.004194231	0.004558947	0.000226076	0.000199824	794312.0096	162851.8716	259.6887614	35337860.58	4.8775
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	600	Diesel	0.018820494	0.022772798	0.027101512	0.151370925	0.223329638	74.89357252	0.007556584	0.006952057	0.007556584	0.000691864	0.000611271	2429839.48	302636.5964	447.005245	108182856	8.0289
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	750	Diesel	0.001623268	0.001964154	0.002337506	0.008804188	0.0195751	4.360698559	0.000794496	0.000730936	0.000794496	4.02681E-05	3.55914E-05	141478.0623	9975.239051	14.1906427	6360560.439	14.1829
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	9999	Diesel	0.001583725	0.001916307	0.002280564	0.010218012	0.028875052	4.256810676	0.000759947	0.000699152	0.000759947	3.93088E-05	3.47435E-05	138107.5343	3752.981877	7.095321349	6134447.528	36.7994
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	25	Diesel	0.000328398	0.000397361	0.000472893	0.001487585	0.000977343	0.106877717	0.000101019	9.29375E-05	0.000101019	9.78286E-07	8.72322E-07	3467.529831	6318.77412	4.218071819	157969.353	0.5488
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	50	Diesel	0.002655821	0.003213544	0.003824382	0.022227393	0.018664155	2.31583599	0.001298578	0.001194692	0.001298578	2.13314E-05	1.89015E-05	75134.74824	119589.348	75.92529274	3442295.349	0.6283
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	75	Diesel	0.000345536	0.000418099	0.000497572	0.00541061	0.003174861	0.729463906	0.000127972	0.000117734	0.000127972	6.73389E-06	5.95379E-06	23666.65308	16864.17923	11.24819152	1199626.35	1.4034
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	100	Diesel	0.00124835	0.001510503	0.001797623	0.012752808	0.012836151	1.688953929	0.001035963	0.000953086	0.001035963	1.55778E-05	1.3785E-05	54796.25018	31549.95755	25.30843091	2777073.78	1.7368
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	175	Diesel	0.028477158	0.034457362	0.041007108	0.367192702	0.291878483	57.64658755	0.015297306	0.014073521	0.015297306	0.000532117	0.000470504	1870280.047	601262.175	438.6794692	94855263.35	3.1106
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	300	Diesel	0.050706505	0.061354871	0.073017367	0.310612744	0.559852045	117.4322756	0.0218129	0.020067868	0.0218129	0.001084198	0.000958466	3809960.854	918146.5799	736.7565444	193820759	4.1496
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	600	Diesel	0.194657599	0.235535695	0.280306943	1.364376461	2.259521419	503.8763347	0.082494644	0.075895073	0.082494644	0.004652747	0.004112571	16347712.76	2200801.267	1656.296201	828404939.5	7.4281
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	750	Diesel	0.082022299	0.099246982	0.118112111	0.637076972	0.959549718	169.6949914	0.037533657	0.034530965	0.037533657	0.001566454	0.001385028	5505567.109	421206.1266	354.3180328	279310439.7	13.0710
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	9999	Diesel	0.133106491	0.161058854	0.191673347	0.794672886	2.452901733	301.3982779	0.061998209	0.057038353	0.061998209	0.002782583	0.002459972	9778535.197	390385.4393	282.6108119	493432682.7	25.0484
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	50	Diesel	0.020391525	0.024673746	0.029363797	0.124366619	0.115893726	13.58995378	0.009324623	0.008578653	0.009324623	0.000125034	0.000110919	440911.0837	482844.2201	1039.670839	18398450.7	0.9132
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	75	Diesel	0.002632177	0.003184935	0.003790335	0.014005844	0.026837846	1.523929068	0.001998365	0.001838496	0.001998365	1.40105E-05	1.24381E-05	49442.20029	31803.05419	103.5472976	2323012.137	1.5546
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	100	Diesel	0.031960991	0.038672799	0.046023828	0.287259616	0.357997203	41.13313473	0.026532266	0.024409685	0.026532266	0.000379337	0.000335723	1334519.256	757944.697	1729.519727	62159657.6	1.7607
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	175	Diesel	0.014212675	0.017197337	0.020466252	0.143046351	0.18214476	23.22135551	0.009625171	0.008855157	0.009625171	0.000214267	0.00018953	753391.3058	231062.2371	572.3087123	35193843.11	3.2606
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	300	Diesel	0.015026776	0.018182399	0.021638557	0.096749312	0.227524335	31.03155986	0.008659152	0.00796642	0.008659152	0.000286451	0.000253275	1006784.785	212490.1649	538.725805	46629610.12	4.7380
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	600	Diesel	0.040031982	0.048438698	0.057646054	0.339639009	0.585638556	118.2681818	0.020690541	0.019035297	0.020690541	0.001092247	0.000965289	3837080.908	467000.443	1071.854459	178930147.1	8.2164
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	750	Diesel	0.006137212	0.007426026	0.008837585	0.046049418	0.088632069	21.63001924	0.002896614	0.002664885	0.002896614	0.000199796	0.000176541	701762.1529	52928.61065	102.1480098	32768275.43	13.2587
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	9999	Diesel	0.002295618	0.002777697	0.00330569	0.015628691	0.053502784	7.463848972	0.001253352	0.001153084	0.001253352	6.89381E-05	6.09189E-05	242156.3599	12364.73279	26.5864683	11280212.9	19.5844
Statewide	2020	ConstMin - Pavers	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Pavers	Aggregated	50	Diesel	0.003080373	0.003727251	0.004435737	0.015618218	0.0134708	1.664334572	0.00113714	0.001046169	0.00113714	1.52952E-05	1.35841E-05	53997.50226	58350.50373	168.4225778	2258429.409	0.9254
Statewide	2020	ConstMin - Pavers	Aggregated	75	Diesel	0.004303553	0.0052073	0.006197117	0.021043522	0.039124298	2.725983038	0.003736442	0.003437527	0.003736442	2.5074E-05	2.22491E-05	88441.51754	57160.69951	162.8084919	4134182.505	1.5472
Statewide	2020	ConstMin - Pavers	Aggregated	100	Diesel	0.007336686	0.00887739	0.010564827	0.088447865	0.09411725	13.28064834	0.006019525	0.005537963	0.006019525	0.000122566	0.000108395	430876.0095	248553.2323	648.4269245	20134078.43	1.7335
Statewide	2020	ConstMin - Pavers	Aggregated	175	Diesel	0.009626348	0.011647881	0.013861941	0.125985279	0.123716534	22.06304059	0.006101825	0.005613679	0.006101825	0.000203695	0.000180076	715811.0539	210825.4799	560.0050711	33254619.24	3.3953
Statewide	2020	ConstMin - Pavers	Aggregated	300	Diesel	0.00478518	0.005790068	0.006890659	0.033386315	0.089245661	17.20929957	0.002566216	0.002360918	0.002566216	0.000158965	0.00014046	558336.772	117500.9942	268.072603	26019209.33	4.7518
Statewide	2020	ConstMin - Pavers	Aggregated	600	Diesel	0.000717679	0.000868392	0.001033458	0.005839192	0.011019316	3.114077396	0.000377592	0.000347384	0.000377592	2.87697E-05	2.54167E-05	101032.8116	12777.8711	29.47395111	4691493.532	7.9069
Statewide	2020	ConstMin - Pavers	Aggregated	750	Diesel	0.000116714	0.000141224	0.000168068	0.001181165	0.001449849	0.644546303	6.36481E-05	5.85563E-05	6.36481E-05	5.95565E-06	5.2607E-06	20911.59496	1297.825917	2.807042963	973369.4381	16.1128
Statewide	2020	ConstMin - Paving Equipment	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Paving Equipment	Aggregated	50	Diesel	0.001829621	0.002213841	0.002634654	0.015046074	0.014079459	2.072750296	0.000772774	0.000710952	0.000772774	1.91087E-05	1.69175E-05	67248.10061	95418.89377	207.3871312	3309861.667	0.7048
Statewide	2020	ConstMin - Paving Equipment	Aggregated	75	Diesel	0.000334333	0.000404543	0.000481439	0.002116375	0.003476355	0.252782756	0.000267473	0.000246075	0.000267473	2.32707E-06	2.06318E-06	8201.258116	6666.255765	18.2164372	447477.4329	1.2303
Statewide	2020	ConstMin - Paving Equipment	Aggregated	100	Diesel	0.004895972	0.005924126	0.0070502	0.057661923	0.057861374	8.66317553	0.003796383	0.003492672	0.003796383	7.99485E-05	7.07077E-05	281067.1893	171853.4165	381.1439169	15276974.01	1.6355
Statewide	2020	ConstMin - Paving Equipment	Aggregated	175	Diesel	0.004062846	0.004916043	0.005850498	0.054944804	0.049016652	9.383803885	0.002641735	0.002430396	0.002641735	8.6636E-05	7.65893E-05	304447.1826	114703.3636	255.0301208	16605984.79	2.6542

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	ConstMin - Paving Equipment	Aggregated	300	Diesel	0.002405721	0.002910922	0.003464238	0.014906492	0.038062173	6.655835604	0.00134908	0.001241154	0.00134908	6.14643E-05	5.4324E-05	215941.2561	50233.71489	109.2986232	11743440.66	4.2987
Statewide	2020	ConstMin - Paving Equipment	Aggregated	600	Diesel	0.002227096	0.002694786	0.003207018	0.014734119	0.035743147	6.857098949	0.001097556	0.001009751	0.001097556	6.33305E-05	5.59667E-05	222471.0236	29298.70207	64.45816241	12059120.7	7.5932
Statewide	2020	ConstMin - Paving Equipment	Aggregated	750	Diesel	0.000283535	0.000343077	0.00040829	0.001595349	0.004809248	0.817888947	0.000122656	0.000112843	0.000122656	7.55328E-06	6.6755E-06	26535.50613	2113.195262	4.203793201	1444303.315	12.5571
Statewide	2020	ConstMin - Paving Equipment	Aggregated	9999	Diesel	8.53571E-05	0.000103282	0.000122914	0.001118791	0.002670434	0.608922351	4.30099E-05	3.95691E-05	4.30099E-05	5.62723E-06	4.96994E-06	19755.81508	1275.419626	2.8025288	1075197.501	15.4897
Statewide	2020	ConstMin - Rollers	Aggregated	25	Diesel	2.92477E-05	3.53897E-05	4.21167E-05	9.76398E-05	6.92508E-05	0.005350783	9.29179E-06	8.54845E-06	9.29179E-06	4.85932E-08	4.36724E-08	173.6002689	322.0686501	1.443695522	8051.716253	0.5390
Statewide	2020	ConstMin - Rollers	Aggregated	50	Diesel	0.044475631	0.053815514	0.064044909	0.274664432	0.263598979	34.20033288	0.019113971	0.017584853	0.019113971	0.000314865	0.000279139	1109592.135	1439402.094	4257.458093	51416740.46	0.7709
Statewide	2020	ConstMin - Rollers	Aggregated	75	Diesel	0.000885514	0.001071472	0.001275141	0.003542794	0.008689253	0.307840672	0.000610446	0.00056161	0.000610446	2.81957E-06	2.51255E-06	9987.551586	7418.851355	33.204997	514092.0986	1.3462
Statewide	2020	ConstMin - Rollers	Aggregated	100	Diesel	0.031464132	0.038071599	0.04530835	0.352520401	0.382682206	53.13589533	0.024340591	0.022393344	0.024340591	0.000490324	0.000433688	1723935.605	1017975.265	3142.925151	88807912.43	1.6935
Statewide	2020	ConstMin - Rollers	Aggregated	175	Diesel	0.018620416	0.022530704	0.026813399	0.307082413	0.256668429	55.26132785	0.011790179	0.010846965	0.011790179	0.00051036	0.000451036	1792892.923	643140.4977	1836.380704	92480565.84	2.7877
Statewide	2020	ConstMin - Rollers	Aggregated	300	Diesel	0.003461853	0.004188842	0.004985068	0.027196651	0.053535842	9.150214605	0.001881251	0.001730751	0.001881251	8.44944E-05	7.46828E-05	296868.6357	70756.87209	235.32237	15292261.14	4.1956
Statewide	2020	ConstMin - Rollers	Aggregated	600	Diesel	0.001414331	0.00171134	0.002036636	0.015725152	0.021297743	5.368596267	0.000720405	0.000662773	0.000720405	4.95929E-05	4.38178E-05	174178.1934	25541.6543	85.17803578	8929542.643	6.8194
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	25	Diesel	2.60151E-06	3.14783E-06	3.74618E-06	5.68926E-05	7.64759E-05	0.009242248	2.50461E-06	2.30424E-06	2.50461E-06	8.53711E-08	7.5434E-08	299.8545496	518.4860232	1.666057562	12962.15058	0.5783
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	50	Diesel	0.002139944	0.002589333	0.00308152	0.012293703	0.011607696	1.553576823	0.000779734	0.000717355	0.000779734	1.42994E-05	1.26801E-05	50404.08907	46059.77091	171.6039289	2179518.165	1.0943
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	75	Diesel	0.000482495	0.000583819	0.000694792	0.002265431	0.0034265	0.245156422	0.000276564	0.000254439	0.000276564	2.25212E-06	2.00093E-06	7953.830128	6511.738441	26.656921	354421.4351	1.2215
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	100	Diesel	0.031614064	0.038253018	0.045524253	0.818762645	0.567507591	134.3205905	0.018859399	0.017350647	0.018859399	0.001240912	0.001096307	4357883.631	2177934.92	7873.78804	209372159.1	2.0009
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	175	Diesel	0.015442307	0.018685191	0.022236922	0.182747618	0.172199771	31.67373493	0.011553481	0.010629203	0.011553481	0.000292376	0.000258517	1027619.447	398643.2753	1507.782094	49413312.49	2.5778
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	300	Diesel	0.000377056	0.000456238	0.000542961	0.004063785	0.006485722	2.197243319	0.000148026	0.000136184	0.000148026	2.03033E-05	1.79336E-05	71287.13966	16307.2217	66.6423025	3428951.563	4.3715
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	600	Diesel	0.00011803	0.000142816	0.000169963	0.001474037	0.002196923	0.815341659	4.68756E-05	4.31256E-05	4.68756E-05	7.5347E-06	6.65471E-06	26452.86219	3330.204134	13.3284605	1280233.051	7.9433
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	750	Diesel	2.24673E-05	2.71854E-05	3.23529E-05	0.000257403	0.000354597	0.140557685	2.48747E-06	2.28847E-06	2.48747E-06	1.29885E-06	1.14721E-06	4560.239293	351.2324673	1.666057562	219520.2921	12.9835
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	50	Diesel	0.0026373	0.003191132	0.003797711	0.015472419	0.011668467	1.517735925	0.000964971	0.000887774	0.000964971	1.39531E-05	1.23876E-05	49241.27061	52215.1405	56.3151351	2165433.778	0.9430
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	75	Diesel	0.002439927	0.002952312	0.003513495	0.011500167	0.023225987	1.182614908	0.001853048	0.001704804	0.001853048	1.08607E-05	9.65234E-06	38368.63828	26518.93627	39.83265654	1863020.387	1.4468
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	100	Diesel	0.00770373	0.009321513	0.011093371	0.047018532	0.073075632	5.779817303	0.006414844	0.005901657	0.006414844	5.32062E-05	4.71741E-05	187519.8071	108105.7636	123.6185892	9084257.978	1.7346
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	175	Diesel	0.007097595	0.00858809	0.010220537	0.046102239	0.084374702	6.217326312	0.004860586	0.004471739	0.004860586	5.72693E-05	5.0745E-05	201714.305	66699.51415	90.65363212	9868829.447	3.0242
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	300	Diesel	0.007329059	0.008868161	0.010553844	0.046607973	0.094461534	6.945496914	0.004600388	0.004232357	0.004600388	6.39947E-05	5.66882E-05	225338.9983	50470.09062	75.54469343	11027703.67	4.4648
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	600	Diesel	0.062914875	0.076126998	0.090597419	0.60735736	0.817804455	77.19726779	0.036801478	0.03385736	0.036801478	0.00071184	0.000630074	2504580.336	329652.0262	462.8829397	121808749.3	7.5976
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	750	Diesel	0.000824286	0.000997386	0.001186971	0.004445176	0.015006498	2.192950277	0.000419943	0.000386348	0.000419943	2.02502E-05	1.78986E-05	71147.85664	5350.056355	5.494159522	3479957.332	13.2985
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	50	Diesel	0.009911013	0.011992326	0.014271859	0.054821622	0.042555963	4.754064869	0.003840635	0.003533384	0.003840635	4.36564E-05	3.8802E-05	154240.399	177805.3911	211.8834193	7398726.533	0.8675
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	100	Diesel	0.101776897	0.123150046	0.146558732	0.875574833	1.038950847	115.5201928	0.081362509	0.074853508	0.081362509	0.001064988	0.00094286	3747925.431	2356215.261	2632.794649	202325606.8	1.5907
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	175	Diesel	0.163093075	0.197342621	0.234854028	1.754681418	1.832763086	274.5781094	0.100881434	0.09281092	0.100881434	0.002533718	0.00224107	8908384.366	3178707.319	3453.127077	477004959.1	2.8025
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	300	Diesel	0.178275271	0.215713077	0.25671639	0.989675296	2.508087642	410.4821603	0.083264026	0.076602904	0.083264026	0.003789763	0.0033503	13317641.63	3388731.793	3221.200631	713348539.7	3.9300
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	600	Diesel	0.24211208	0.292955617	0.348641395	1.568445503	3.056900662	509.9835402	0.114984501	0.105785741	0.114984501	0.004707787	0.004162417	16545854.32	2669471.427	2833.224911	889193027.1	6.1982
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	750	Diesel	0.016380647	0.019820583	0.023588132	0.130350484	0.212409337	37.76895249	0.007536951	0.006933995	0.007536951	0.000348701	0.000308265	1225372.069	99348.02768	115.9632227	65694433.7	12.3341
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	9999	Diesel	0.015864327	0.019195836	0.022844631	0.078340048	0.332239748	35.42701466	0.008400019	0.007728018	0.008400019	0.000327064	0.000289151	1149390.475	64296.04164	55.83414428	61451252.16	17.8765
Statewide	2020	ConstMin - Scrapers	Aggregated	25	Diesel	6.79648E-05	8.22374E-05	9.78693E-05	0.000230938	0.000156863	0.012151601	2.1862E-05	2.0113E-05	2.1862E-05	1.10309E-07	9.91797E-08	394.2453239	568.4132631	1.415529271	14210.33158	0.6936
Statewide	2020	ConstMin - Scrapers	Aggregated	50	Diesel	0.000456032	0.000551799	0.000656686	0.001557197	0.001118632	0.096717427	0.000154246	0.000141907	0.000154246	8.8052E-07	7.89395E-07	3137.890409	2969.9593	8.493175623	115026.3184	1.0565
Statewide	2020	ConstMin - Scrapers	Aggregated	75	Diesel	0.00150758	0.001824172	0.002170915	0.007120988	0.013949672	0.822651815	0.001219041	0.001121518	0.001219041	7.5606E-06	6.71437E-06	26690.03214	15786.09946	38.21929031	1067750.631	1.6907
Statewide	2020	ConstMin - Scrapers	Aggregated	100	Diesel	0.003790631	0.004586663	0.005458509	0.030769645	0.046994449	4.041348006	0.003457421	0.003180827	0.003457421	3.72505E-05	3.29849E-05	131117.0853	57815.52349	101.9181075	5237587.598	2.2679
Statewide	2020	ConstMin - Scrapers	Aggregated	175	Diesel	0.038683324	0.046806822	0.055703987	0.343555704	0.477184028	52.53748818	0.025664644	0.023611472	0.025664644	0.000484575	0.000428804	1704520.944	405907.0691	921.5095551	68072923.91	4.1993
Statewide	2020	ConstMin - Scrapers	Aggregated	300	Diesel	0.042396716	0.051300027	0.061051271	0.237371821	0.58506787	60.31098149	0.025662935	0.0236099	0.025662935	0.000556333	0.00049225	1956723.374	350924.1383	891.7834405	78702794.56	5.5759
Statewide	2020	ConstMin - Scrapers	Aggregated	600	Diesel	0.349695724	0.423131826	0.503561842	3.036536132	4.988937799	756.4652033	0.190228219	0.175009962	0.190228219	0.006983405	0.006174167	24542680.42	2328560.195	4969.923269	982307934.1	10.5399
Statewide	2020	ConstMin - Scrapers	Aggregated	750	Diesel	0.013104902	0.015856932	0.018871059	0.149426646	0.217447818	12.21045143	0.008854982	0.008146583	0.008854982	0.000112499	9.96601E-05	396154.6491	25398.59931	66.52987572	15803547.64	15.5975
Statewide	2020	ConstMin - Scrapers	Aggregated	9999	Diesel	0.01913936	0.023158626	0.027560679	0.231996676	0.29312723	17.51522205	0.012248722	0.011268824	0.012248722	0.000161363	0.000142957	568262.0899	14265.59398	36.80376103	22785161.44	39.8344
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	50	Diesel	0.015920132	0.019263359	0.02292499	0.165060776	0.16186651	25.88768669	0.0063456	0.005837952	0.0063456	0.000238867	0.000211292	839897.4845	906264.7269	2947.821223	39493188.26	0.9268
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	75	Diesel	0.039621835	0.04794242	0.057055442	0.834212927	0.635045573	134.479181	0.027136221	0.024965323	0.027136221	0.001242138	0.001097601	4363028.924	3249223.61	9324.293208	228948335.6	1.3428
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	100	Diesel	0.000870417	0.001053205	0.001253401	0.018145706	0.016388374	2.814340787	0.00106335	0.000978282	0.00106335	2.59939E-05	2.29703E-05	91308.18739	63474.68849	188.5319473	4844953.425	1.4385
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	175	Diesel	0.000224906	0.000272137	0.000323865	0.005004044	0.003009961	0.927973366	0.000126601	0.000116473	0.000126601	8.57283E-06	7.57399E-06	30107.0739	10407.12976	39.46017502	1584227.12	2.8929
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	300	Diesel	0.000130991	0.000158499	0.000188627	0.001583676	0.002001096	0.861923497	5.67509E-05	5.22108E-05	5.67509E-05	7.96498E-06	7.0349E-06	27964.15863	7159.792276	24.84529538	1467622.111	3.9057
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	600	Diesel	5.98759E-05	7.24498E-05	8.62213E-05	0.000465292	0.000976704	0.249345997	4.19371E-05	3.85821E-05	4.19371E-05	2.30353E-06	2.03513E-06	8089.756266	896.604224	2.922975927	423914.4771	9.0227
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	9999	Diesel	0.000152967	0.000185091	0.000220273	0.001059199	0.002813587	0.337524192	9.23231E-05	8.49372E-05	9.23231E-05	3.11599E-06	2.75483E-06	10950.6007	575.4568928	2.922975927	575456.8928	19.0294
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	50	Diesel	0.000177038	0.000214215	0.000254934	0.001573252	0.001695436	0.239582108	8.65572E-05	7.96326E-05	8.65572E-05	2.20974E-06	1.95544E-06	7772.977639	12311.99952	51.70899614	443326.0419	0.6313
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	75	Diesel	0.000150011	0.000181513	0.000216016	0.001280175	0.002132844	0.182555115	0.000133179	0.000122524	0.000133179	1.68331E-06	1.48999E-06	5922.799655	5695.316534	22.53981883	378713.6544	1.0399
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	100	Diesel	0.000666841	0.000806877	0.000960251	0.008908445	0.008766224	1.375634811	0.000494937	0.000455342	0.000494937	1.26984E-05	1.12277E-05	44630.95644	31855.91227	120.6543243	2860734.059	1.4010
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	175	Diesel	0.000617295	0.000746927	0.000888905	0.007405065	0.008672256	1.287695993	0.000424719	0.000390741	0.000424719	1.18869E-05	1.051E-05	41777.87834	19776.10301	78.22643006	2682800.273	2.1125
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	300	Diesel	0.000903761	0.00109355	0.001301415	0.006883489	0.016518921	2.54471874	0.000533426	0.000490751	0.000533426	2.35001E-05	2.07697E-05	82560.59701	23213.11044	96.7886338	5293091.003	3.5566
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	600	Diesel	0.001619375	0.001959444	0.002331901	0.016583157	0.02450803	8.067857812	0.000881605	0.000811076	0.000881605	7.45428E-05	6.58488E-05	261752.7615	41338.74001	147.1717582	16796739.23	6.3319
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	750	Diesel	0.000981861	0.001188052	0.00141388	0.007705713	0.01808233	3.978241043	0.000637577	0.000586571	0.000637577	3.67514E-05	3.24699E-05	129069.6494	13015.9649	46.40550936	8278275.315	9.9163
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	9999	Diesel	0.000505895	0.000612133	0.000728489	0.002878121	0.011987598	1.320483681	0.000286198	0.000263302	0.000286198	1.21933E-05	1.07776E-05	42841.63877	3136.786904	11.93284526	2748189.142	13.6578
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	25	Diesel	0.000237378	0.000287227	0.000341824	0.000789279	0.000543482	0.041530669	7.4718E-05	6.87406E-05	7.4718E-05	3.7685E-07	3.38968E-07	1347.416818	2056.743446	2.810822586	51418.58615	0.6551
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	50	Diesel	0.029569539	0.035779143	0.042580137	0.164419253	0.136208389	15.72977518	0.012350603	0.011362555	0.012350603	0.000144542	0.000128384	510335.2323	546090.4671	791.246558	19486917.9	0.9345
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	75	Diesel	0.004617445	0.005587108	0.006649121	0.032517286	0.046009036	4.277624505	0.003706885	0.003410335	0.003706885	3.94102E-05	3.49134E-05	138782.8161	80990.54374	141.9465406	5867918.043	1.7136
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	100	Diesel	0.01513231	0.018310095	0.021790526	0.143403993	0.159997947	20.0974517	0.012842707	0.011815291	0.012842707	0.000185357	0.000164033	652039.687	349884.6671	504.5426542	27681655.61	1.8636
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	175	Diesel	0.004382431	0.005302742	0.006310701	0.038592191	0.052941873	6.080117665	0.002723712	0.002505815	0.002723712	5.60822E-05	4.96251E-05	197262.7216	52359.17004	74.48679853	8368688.424	3.7675
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	300	Diesel	0.001274988	0.001542735	0.001835982	0.007869851	0.019119549	3.651387337	0.000613954	0.000564838	0.000613954	3.37206E-05	2.98021E-05	118465.2409	23966.07759	33.72987103	5025778.021	4.9430
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	600	Diesel	0.000396902	0.000480252	0.000571539	0.006534145	0.005511097	0.49311562	0.000278206	0.00025595	0.000278206	4.54719E-06	4.02474E-06	15998.59322	2056.743446	2.810822586	678725.3372	7.7786
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	9999	Diesel	0.000242249	0.000293122	0.000348839	0.001261503	0.005076096	0.633578857	0.000144036	0.000132513	0.000144036	5.85048E-06	5.17119E-06	20555.76826	1028.371723	1.405411293	872059.2211	19.9887
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	50	Diesel	0.06085539	0.073635022	0.087631762	0.446913798	0.390365356	51.21964268	0.025550236	0.023506217	0.025550236	0.000471725	0.000418048	1661764.898	2082552.055	4125.566636	78947502.12	0.7979
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	75	Diesel	0.020475255	0.024775058	0.029484367	0.082516154	0.194526332	8.131785809	0.015601786	0.014353643	0.015601786	7.45681E-05	6.63705E-05	263826.835	192162.2615	876.8625951	13843240.74	1.3729
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	100	Diesel	0.402585733	0.487128737	0.579723455	5.487769855	4.949256444	813.9091572	0.309667118	0.284893748	0.309667118	0.007512916	0.006643017	26406386.24	16624965.05	27135.30362	1382156794	1.5884
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	175	Diesel	0.055196314	0.06678754	0.079482692	0.844739989	0.656892718	142.2627484	0.033096747	0.030449007	0.033096747	0.001313634	0.001161129	4615558.197	1698591.506	3133.705668	243546419.3	2.7173
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	300	Diesel	0.031409595	0.038005609	0.045229816	0.207032642	0.459755618	87.9874849	0.015348441	0.014120566	0.015348441	0.000812546	0.000718142	2854657.047	722813.9707	1312.418933	150058023.1	3.9494
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	600	Diesel	0.037433898	0.045295016	0.053904813	0.307968488	0.49386773	117.0486578	0.017449315	0.016053369	0.017449315	0.00108105	0.000955335	3797514.797	597446.5584	1135.608935	201110160	6.3562
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	750	Diesel	0.000851632	0.001030475	0.00122635	0.007958243	0.009484404	3.95885188	0.00026154	0.000240617	0.00026154	3.6576E-05	3.23116E-05	128440.5894	10739.63943	15.8122763	6821630.138	11.9595

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	9999	Diesel	0.01099895	0.01330873	0.015838488	0.078463875	0.257715659	40.00296966	0.0052307	0.004812244	0.0052307	0.000369517	0.000326499	1297852.295	36783.82624	60.37414589	68063277.29	35.2832
Statewide	2020	ConstMin - Trenchers	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Trenchers	Aggregated	50	Diesel	0.022975092	0.027799862	0.033084133	0.148479062	0.143668282	18.11296988	0.010938957	0.010063841	0.010938957	0.000166774	0.000147836	587655.3598	508954.7474	1352.812285	20305230.58	1.1546
Statewide	2020	ConstMin - Trenchers	Aggregated	75	Diesel	0.001793235	0.002169814	0.002582258	0.010291984	0.018142744	1.208868994	0.001245078	0.001145471	0.001245078	1.11228E-05	9.86663E-06	39220.42317	21300.4726	81.47619444	1503731.401	1.8413
Statewide	2020	ConstMin - Trenchers	Aggregated	100	Diesel	0.01066196	0.012900971	0.015353222	0.084363764	0.118171442	11.91643494	0.008960658	0.008243805	0.008960658	0.000109853	9.72603E-05	386615.608	177032.957	545.7367741	14852157.79	2.1839
Statewide	2020	ConstMin - Trenchers	Aggregated	175	Diesel	0.001781208	0.002155261	0.002564939	0.017056663	0.022849009	2.680105026	0.001168279	0.001074816	0.001168279	2.47255E-05	2.18747E-05	86953.05596	23462.75693	83.01348113	3357365.676	3.7060
Statewide	2020	ConstMin - Trenchers	Aggregated	300	Diesel	0.00355295	0.004299069	0.005116248	0.020265029	0.052688133	6.506927643	0.002122855	0.001953026	0.002122855	6.00532E-05	5.31087E-05	211110.1013	35399.04656	115.2965016	8100461.158	5.9637
Statewide	2020	ConstMin - Trenchers	Aggregated	600	Diesel	0.003000085	0.003630103	0.004320123	0.03062122	0.042562034	8.734460827	0.001599965	0.001471968	0.001599965	8.06644E-05	7.12895E-05	283379.9622	27962.22884	78.40162107	10862905.92	10.1344
Statewide	2020	ConstMin - Trenchers	Aggregated	750	Diesel	0.000329972	0.000399266	0.000475159	0.005141095	0.003361716	2.851120914	4.90496E-05	4.51256E-05	4.90496E-05	2.63501E-05	2.32705E-05	92501.47811	5499.164033	12.2982935	3556381.571	16.8210
Statewide	2020	ConstMin - Trenchers	Aggregated	9999	Diesel	0.000428643	0.000518658	0.000617246	0.006156318	0.005951064	0.236334198	0.00027479	0.000252807	0.00027479	2.17217E-06	1.92893E-06	7667.602785	342.9475543	1.537286688	294934.8967	22.3579
Statewide	2020	Industrial - Aerial Lifts	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	Industrial - Aerial Lifts	Aggregated	50	Diesel	0.006631471	0.00802408	0.009549318	0.14839722	0.141475929	28.12072439	0.001478661	0.001360368	0.001478661	0.000259791	0.000229518	912345.9335	1115896.104	3776.21971	51474842.25	0.8176
Statewide	2020	Industrial - Aerial Lifts	Aggregated	75	Diesel	0.005933368	0.007179375	0.00854405	0.195412108	0.110950646	32.47154514	0.003045698	0.002802042	0.003045698	0.000300038	0.000265028	1053503.521	914847.6755	3106.159016	66076940.38	1.1516
Statewide	2020	Industrial - Aerial Lifts	Aggregated	100	Diesel	0.00289212	0.003499465	0.004164652	0.099759846	0.062668835	16.59579282	0.000817197	0.000751821	0.000817197	0.00015335	0.000135453	538432.2209	433976.934	1468.430883	33772334.83	1.2407
Statewide	2020	Industrial - Aerial Lifts	Aggregated	175	Diesel	0.000457502	0.000553578	0.000658803	0.016131763	0.005592237	2.998798403	0.000181856	0.000167308	0.000181856	2.77117E-05	2.44758E-05	97292.7116	46796.40613	158.604792	6105215.543	2.0791
Statewide	2020	Industrial - Aerial Lifts	Aggregated	300	Diesel	1.90191E-05	2.30131E-05	2.73875E-05	0.00032074	0.000229273	0.179201548	3.02606E-06	2.78397E-06	3.02606E-06	1.65624E-06	1.46262E-06	5813.996865	1586.251469	5.346228943	364837.838	3.6652
Statewide	2020	Industrial - Aerial Lifts	Aggregated	600	Diesel	1.08353E-05	1.31107E-05	1.56029E-05	0.000226394	6.26001E-05	0.12725907	2.13529E-06	1.96447E-06	2.13529E-06	1.17625E-06	1.03867E-06	4128.780382	528.7504898	1.782076314	259087.74	7.8086
Statewide	2020	Industrial - Forklifts	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	Industrial - Forklifts	Aggregated	50	Diesel	0.02990517	0.036185255	0.043063444	0.183717863	0.150877513	18.92637709	0.011596138	0.010668447	0.011596138	0.000174087	0.000154475	614045.4611	1251643.346	1750.570951	53069676.95	0.4906
Statewide	2020	Industrial - Forklifts	Aggregated	75	Diesel	0.004325367	0.005233695	0.006228529	0.017534128	0.040923212	1.792114521	0.00338422	0.003113482	0.00338422	1.64392E-05	1.4627E-05	58143.18196	76265.99005	150.4622966	5609780.669	0.7624
Statewide	2020	Industrial - Forklifts	Aggregated	100	Diesel	0.159533666	0.193035735	0.229728478	1.607608837	1.745471727	226.2102927	0.12970248	0.119326281	0.12970248	0.00208664	0.001846298	7339143.82	8575792.671	11536.40724	707022296	0.8558
Statewide	2020	Industrial - Forklifts	Aggregated	175	Diesel	0.038128317	0.046135263	0.054904776	0.443072844	0.452907689	72.00842602	0.024522443	0.022560648	0.024522443	0.00066461	0.000587723	2336234.079	1591160.943	2170.129277	224859967.1	1.4683
Statewide	2020	Industrial - Forklifts	Aggregated	300	Diesel	0.007380963	0.008930966	0.010628587	0.044757395	0.098685845	15.70674114	0.003880797	0.003570333	0.003880797	0.000144995	0.000128196	509587.9183	233106.692	318.2856274	48924440.58	2.1861
Statewide	2020	Industrial - Forklifts	Aggregated	600	Diesel	0.001314935	0.001591071	0.001893506	0.009073146	0.01492497	3.951566344	0.000546373	0.000502663	0.000546373	3.64947E-05	3.22522E-05	128204.2181	34695.70008	49.18959696	12256785.9	3.6951
Statewide	2020	Industrial - Forklifts	Aggregated	9999	Diesel	3.86624E-05	4.67815E-05	5.56738E-05	0.000584127	0.001388073	0.313844315	1.18743E-05	1.09244E-05	1.18743E-05	2.90049E-06	2.56156E-06	10182.33318	1113.48991	1.446752852	979871.1205	9.1445
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	25	Diesel	2.47057E-05	2.98939E-05	3.55762E-05	8.21461E-05	5.65642E-05	0.004322404	7.77646E-06	7.15434E-06	7.77646E-06	3.92216E-08	3.52789E-08	140.2356465	285.4183923	1.279408147	7135.459808	0.4913
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	50	Diesel	0.054045322	0.065394839	0.077825263	0.380551489	0.319596878	40.69836148	0.023088917	0.021241804	0.023088917	0.000374655	0.000332175	1320413.517	1908290.246	2333.64046	66996559.08	0.6919
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	75	Diesel	0.014029463	0.01697565	0.020202426	0.184314334	0.171677979	26.51624948	0.010992484	0.010113085	0.010992484	0.000244735	0.000216422	860290.5119	679472.7331	822.6594384	48607288.63	1.2661
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	100	Diesel	0.008594887	0.010399814	0.012376638	0.050011725	0.078238157	6.253837828	0.007213898	0.006636786	0.007213898	5.7562E-05	5.1043E-05	202898.881	146773.5541	194.4700383	11493117.53	1.3824
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	175	Diesel	0.006829495	0.008263689	0.009834473	0.094628742	0.07839234	15.32387737	0.004200144	0.003864132	0.004200144	0.000141472	0.000125071	497166.325	189260.936	232.8522827	28104281.54	2.6269
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	300	Diesel	0.006921922	0.008375526	0.009967568	0.042058916	0.105437028	16.47658213	0.003428345	0.003154078	0.003428345	0.000152127	0.00013448	534564.5614	138168.1895	173.999508	30185562.18	3.8689
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	600	Diesel	0.014169877	0.017145551	0.020404622	0.114342418	0.159529616	47.63169453	0.005622382	0.005172591	0.005622382	0.000439954	0.000388763	1545357.872	228565.9028	275.0727516	87334202.02	6.7611
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	750	Diesel	0.002122101	0.002567743	0.003055826	0.027467105	0.020573945	8.004955737	0.000980141	0.00090173	0.000980141	7.39461E-05	6.53354E-05	259711.973	23241.61969	28.14697923	14654062.41	11.1744
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	9999	Diesel	0.000780678	0.000944621	0.001124176	0.005389888	0.019699677	2.773616928	0.000396857	0.000365109	0.000396857	2.562E-05	2.26379E-05	89986.94663	4372.60977	5.117632587	5088624.62	20.5797
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	25	Diesel	3.1914E-05	3.86159E-05	4.59561E-05	0.000108441	7.36576E-05	0.005705987	1.02657E-05	9.44441E-06	1.02657E-05	5.17973E-08	4.65715E-08	185.12447	325.6908272	1.459932187	8142.270681	0.5684
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	50	Diesel	0.003311879	0.004007374	0.004769106	0.01993057	0.016625515	1.89776363	0.001416966	0.001303608	0.001416966	1.74464E-05	1.54893E-05	61570.85097	75846.87985	102.1952531	2692013.274	0.8118
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	75	Diesel	0.000461156	0.000557999	0.000664065	0.003943325	0.004973178	0.516399102	0.000400053	0.000368049	0.000400053	4.76053E-06	4.21478E-06	16754.00016	11368.23832	17.51918624	823166.6299	1.4738
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	100	Diesel	0.00770601	0.009324272	0.011096654	0.137932272	0.106129967	20.82314028	0.004868272	0.004478811	0.004868272	0.000192289	0.000169956	675583.8538	354218.0868	465.7183677	33008646.91	1.9073
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	175	Diesel	0.007840414	0.009486901	0.011290197	0.090243116	0.080556008	14.37212952	0.005482746	0.005044126	0.005482746	0.000132642	0.000117303	466287.9143	164187.2598	230.6692855	22773224.17	2.8400
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	300	Diesel	0.011719418	0.014180496	0.016875963	0.063578075	0.162421164	25.24625318	0.005937622	0.005462612	0.005937622	0.000233063	0.000206057	819086.8806	167028.9123	224.8295568	40054926.8	4.9039
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	600	Diesel	0.012114817	0.014658929	0.017445337	0.085620243	0.173785355	29.54699108	0.005978827	0.005500521	0.005978827	0.000272813	0.000241159	958619.5856	127122.0152	172.2719981	46764698.45	7.5409
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	750	Diesel	0.000590067	0.000713981	0.000849697	0.00277939	0.00666162	1.360424215	0.00032652	0.000300398	0.00032652	1.25601E-05	1.11036E-05	44137.46542	3463.721948	4.379796561	2159053.347	12.7428
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	9999	Diesel	0.000570488	0.000690291	0.000821503	0.004303439	0.013455656	2.199231231	0.000252718	0.000232501	0.000252718	2.03159E-05	1.79498E-05	71351.63527	3463.721948	4.379796561	3490277.149	20.5997
Statewide	2020	Locomotive - Line haul	Aggregated	9999	Diesel	1.515021523	1.833176042	2.181630993	17.68582119	52.33907175	6782.160964	0.775796242	0.70863681	0.775796242	0.068994099	0.055334619	219957237.6	0	0	0	#DIV/0!
Statewide	2020	Locomotive - Passenger	Aggregated	9999	Diesel	0.244261151	0.000250929	0.000298626	1.395551619	5.915809063	0	0.107664804	0.099051619	0.107664804	0.004845019	0.004862486	0	0	0	0	#DIV/0!
Statewide	2020	Locomotive - Short line	Aggregated	9999	Diesel	0.060713538	1.01993E-05	1.2138E-05	0.234723818	1.73494679	0	0.029154344	0.026821996	0.029154344	0.000997524	0.000894056	0	0	0	0	#DIV/0!
Statewide	2020	Locomotive - Switcher	Aggregated	9999	Diesel	0.297612364	0.000470095	0.000559451	0.799512681	4.616170039	0	0.097504642	0.089704271	0.097504642	0.002662034	0.002394284	0	0	0	0	#DIV/0!
Statewide	2020	Ocean Going Vessels	Aggregated		Diesel	9.937150594	12.90660493	15.42066482	15.860394	213.4639362	9045.801951	2.384881002	2.194090522	2.384881002	6.760104932	0.219338097	285620623.9	0	0	6248901685	#DIV/0!
Statewide	2020	OFF - Agricultural - 2-Wheel Tractors	Aggregated	25	Gasoline	0.055398103	0.050955175	0.060962233	2.012661384	0.040738984	3.565416188	0.02265358	0.017116038	0.025170644	0.000104704	9.21891E-05	263154.05	633483.05	2494	4433844.8	0.4154
Statewide	2020	OFF - Agricultural - Agricultural Mowers	Aggregated	25	Gasoline	0.044193629	0.0406493	0.048632393	1.868776706	0.03304239	3.009625667	0.02270675	0.017156211	0.025229722	7.9635E-05	8.12014E-05	231789.6	386743.05	2145.62	4833461.4	0.5993
Statewide	2020	OFF - Agricultural - Agricultural Tractors	Aggregated	25	Diesel	0.299910254	0.356917988	0.431870766	1.703430954	2.721963913	361.762241	0.103004538	0.094764175	0.103004538	0.004899056	0.003028289	12037627	16660034.45	31269.93	301117002.8	0.7225
Statewide	2020	OFF - Agricultural - Agricultural Tractors	Aggregated	100	Gasoline	0.045616886	0.041958412	0.050198601	1.666383955	0.11950358	29.51690203	0.002057989	0.001554925	0.002286655	0.000285174	0.000428334	1222680.65	248006.55	450.36	20336537.1	4.9300
Statewide	2020	OFF - Agricultural - Agricultural Tractors	Aggregated	175	Gasoline	0.005960832	0.005482774	0.006559533	0.226761441	0.027987315	5.997188891	0.000429935	0.000324839	0.000477705	5.95758E-05	8.4471E-05	241122.65	33817.25	61.14	4227156.25	7.1302
Statewide	2020	OFF - Agricultural - Balers	Aggregated	50	Gasoline	0.007917825	0.007282815	0.008713083	0.400218994	0.015123238	5.102187349	0.00035174	0.000265759	0.000390822	6.20333E-05	7.6327E-05	217875.8	111934.55	1645.01	3917709.25	1.9465
Statewide	2020	OFF - Agricultural - Balers	Aggregated	100	Gasoline	0.003768779	0.003466523	0.004147312	0.110184175	0.014547944	4.717954209	0.000328947	0.000248538	0.000365497	4.5582E-05	6.49954E-05	185529.5	57264.85	841.19	3664950.4	3.2398
Statewide	2020	OFF - Agricultural - Combines	Aggregated	100	Gasoline	0.001029014	0.000946487	0.001132368	0.047388071	0.002672444	2.51970946	0.00017568	0.000132736	0.0001952	2.43439E-05	3.4417E-05	98243.4	13983.15	112.62	1440264.45	7.0258
Statewide	2020	OFF - Agricultural - Combines	Aggregated	175	Gasoline	0.000655059	0.000602523	0.000720853	0.070056074	0.002546912	2.167715648	0.000155402	0.000117415	0.000172669	2.1534E-05	3.0205E-05	86220.3	7690.55	62.39	1261250.2	11.2112
Statewide	2020	OFF - Agricultural - Combines	Aggregated	300	Gasoline	0.000119591	0.00011	0.000131603	0.0152993	0.001394847	0.460044685	3.39377E-05	2.56418E-05	3.77086E-05	4.70273E-06	6.38573E-06	18228.1	1160.7	11.05	225175.8	15.7044
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	25	Gasoline	0.04329973	0.039827092	0.047648712	1.682733975	0.032182649	2.803849285	0.019909	0.015042356	0.022121111	7.7247E-05	7.45867E-05	212908.15	392977.25	1013.66	3860878.75	0.5418
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	25	Diesel	0.002032262	0.00241856	0.002926458	0.010760889	0.018468917	2.438522027	0.000694258	0.000638718	0.000694258	3.19807E-05	2.03938E-05	81066.5	176554.15	216.46	2959047.7	0.4592
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	50	Gasoline	0.000428576	0.000394204	0.000471621	0.034207182	0.000663908	0.350264764	2.41469E-05	1.82444E-05	2.68299E-05	4.25858E-06	5.35128E-06	15275.25	6865.65	15.19	260894.7	2.2249
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	100	Gasoline	3.24146E-05	2.98149E-05	3.56703E-05	0.001598961	8.1583E-05	0.075190005	5.24243E-06	3.96095E-06	5.82492E-06	7.2644E-07	1.01016E-06	2883.5	817.6	1.64	53961.6	3.5268
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	25	Gasoline	0.005699259	0.005242178	0.006271686	0.201701681	0.003935571	0.356879628	0.002127345	0.001607328	0.002363717	1.03008E-05	9.12211E-06	26039.1	56936.35	393.78	493644.25	0.4573
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	25	Diesel	0.004721536	0.005619018	0.006799011	0.025092891	0.043008136	5.643501679	0.001691153	0.001555861	0.001691153	7.42622E-05	4.7194E-05	187599.05	332956.65	745.32	6444921.8	0.5634
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	50	Gasoline	0.000347311	0.000319456	0.000382194	0.02034269	0.00060276	0.239635187	1.65202E-05	1.2482E-05	1.83558E-05	2.91353E-06	3.51637E-06	10037.5	6095.5	50.7	176769.5	1.6467
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	100	Gasoline	0.002200705	0.002024209	0.002421742	0.07617579	0.007125402	3.170904929	0.000221083	0.000167041	0.000245648	3.06354E-05	4.369E-05	124713.2	36602.2	295.81	2452347.4	3.4073
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	175	Gasoline	0.000327802	0.000301513	0.000360726	0.023308093	0.001800945	0.713665514	5.11622E-05	3.86559E-05	5.68469E-05	7.08952E-06	9.93024E-06	28345.9	3836.15	32.91	521716.4	7.3892
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	300	Gasoline	0.000178332	0.000164029	0.000196243	0.015659513	0.001805099	0.465948748	3.43733E-05	2.59709E-05	3.81925E-05	4.76308E-06	6.45862E-06	18436.15	1208.15	11.49	297204.9	15.2598
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	25	Gasoline	0.096299109	0.08857592	0.105971295	3.355575568	0.058707649	5.660279386	0.034364491	0.025964282	0.038182768	0.000155896	0.000150118	428513.65	929629.45	9474.69	8725602.4	0.4610
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	25	Diesel	0.000492822	0.000586499	0.000709663	0.00226985	0.004141381	0.517747481	0.000196608	0.00018088	0.000196608	6.56923E-06	4.27618E-06	16998.05	31495.85	287.88	598421.15	0.5397
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	50	Gasoline	0.001534448	0.001411385	0.001688567	0.078456818	0.002899733	0.968659892	6.67785E-05	5.04549E-05	7.41984E-05	1.17771E-05	1.45066E-05	41409.25	24604.65	309.35	811953.45	1.6830
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	100	Gasoline	0.002718688	0.002500649	0.00299175	0.080413743	0.010336107	3.326226493	0.000231912	0.000175223	0.000257681	3.2136E-05	4.58599E-05	130907.25	41635.55	521.76	2831217.4	3.1441
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	175	Gasoline	0.000778601	0.000716157	0.000856803	0.048552218	0.005276019	1.501935305	0.000107673	8.13527E-05	0.000119636	1.49202E-05	2.09192E-05	59714	9154.2	117.16	1281588	6.5231
Statewide	2020	OFF - Agricultural - Swathers	Aggregated	100	Gasoline	0.014437167	0.013279306	0.015887222	0.43289218	0.05388927	17.17657903	0.001197592	0.000904848	0.001330658	0.00016595	0.000237383	677611.55	160402.9	1686.23	14115455.2	4.2244
Statewide	2020	OFF - Agricultural - Swathers	Aggregated	175	Gasoline	0.01001574	0.009212477	0.01102171	0.610095184	0.066633316	18.77261688	0.001345797	0.001016824	0.00149533	0.000186486	0.000261988	747844.85	122924.7	1292.89	15857286.3	6.0838
Statewide	2020	OFF - Agricultural - Tillers	Aggregated	25	Gasoline	0.785988294	0.722952032	0.864932172	42.5227535	0.555863833	69.84141646	0.031956647	0.024145022	0.035507386	0.001991368	0.001854423	5293456.3	10835313.35	152386.39	75847193.45	0.4885
Statewide	2020	OFF - AirGrSupp - A/C Tug Narrow Body	Aggregated	175	Gasoline	0.009429301	0.008673071	0.01037637	0.476131493	0.059992314	11.82106911	0.000847445	0.000640292	0.000941605	0.00011743	0.000167034	476799.5	49822.5	68.22	6476925	9.5700

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	OFF - AirGrSupp - A/C Tug Wide Body	Aggregated	600	Gasoline	0.004215937	0.003877818	0.004639381	0.447496819	0.039569344	12.52331616	0.000923851	0.000698021	0.001026501	0.000128018	0.000175495	500951.55	14107.25	27.24	7053625	35.5102
Statewide	2020	OFF - AirGrSupp - Air Conditioner	Aggregated	175	Gasoline	2.47893E-06	2.28012E-06	2.72791E-06	0.00021803	2.67009E-05	0.006728205	4.82341E-07	3.64435E-07	5.35934E-07	6.68377E-08	5.11472E-08	146	0	1.23	0	#DIV/0!
Statewide	2020	OFF - AirGrSupp - Air Conditioner	Aggregated	175	Nat Gas	0	0	1.18983E-06	0.000892136	0.000121051	0.036157318	0	0	3.2156E-06	0	0	1821.35	58.4	7.97	7592	31.1875
Statewide	2020	OFF - AirGrSupp - Air Start Unit	Aggregated	175	Gasoline	0.00025515	0.000234687	0.000280777	0.02101566	0.002576095	0.636439245	4.56259E-05	3.44729E-05	5.06955E-05	6.32236E-06	8.81523E-06	25163.1	2248.4	31.13	292292	11.1916
Statewide	2020	OFF - AirGrSupp - Baggage Tug	Aggregated	100	Gasoline	0.064395159	0.059230667	0.070862944	4.825277071	0.376913423	114.3931857	0.007975767	0.006026135	0.008861964	0.001105198	0.001619742	4623560.85	889202.05	1013.18	88920205	5.1997
Statewide	2020	OFF - AirGrSupp - Baggage Tug	Aggregated	100	Nat Gas	0	0	0.002577949	0.841744641	0.105745803	18.79023581	0	0	0.001671085	0	0	1046378.35	167673.7	201.37	16767370	6.2406
Statewide	2020	OFF - AirGrSupp - Belt Loader	Aggregated	100	Gasoline	0.015629052	0.014375602	0.017198819	1.190068744	0.090684305	27.2061064	0.001896875	0.001433194	0.002107639	0.000262849	0.000386127	1102201.45	387721.25	477.63	23263275	2.8428
Statewide	2020	OFF - AirGrSupp - Belt Loader	Aggregated	100	Nat Gas	0	0	0.000186381	0.071494321	0.008774045	1.806682577	0	0	0.000160675	0	0	99593.9	29393.45	53.12	1763607	3.3883
Statewide	2020	OFF - AirGrSupp - Bobtail	Aggregated	100	Gasoline	0.009265385	0.008522301	0.010195991	0.694431483	0.054197951	16.43710025	0.001146034	0.000865892	0.001273371	0.000158805	0.000232763	664424.1	127746.35	145.61	12774635	5.2011
Statewide	2020	OFF - AirGrSupp - Bobtail	Aggregated	100	Nat Gas	0	0	2.15718E-05	0.01460726	0.001328351	0.405232386	0	0	3.60388E-05	0	0	22159.15	3577	4.02	357700	6.1949
Statewide	2020	OFF - AirGrSupp - Cargo Loader	Aggregated	100	Gasoline	0.004935245	0.004539439	0.005430936	0.373976734	0.028591271	8.57822957	0.000598095	0.000451894	0.00066455	8.28777E-05	0.000121701	347396.05	104765.95	145.35	7333616.5	3.3159
Statewide	2020	OFF - AirGrSupp - Cargo Loader	Aggregated	100	Nat Gas	0	0	0.000295524	0.088577151	0.011288281	1.82075857	0	0	0.000161927	0	0	101875.15	25356.55	24.44	1774958.5	4.0177
Statewide	2020	OFF - AirGrSupp - Cargo Tractor	Aggregated	100	Gasoline	0.159662176	0.146857269	0.175698485	13.1627006	0.695119075	145.7475033	0.010161866	0.007677854	0.011290962	0.001203306	0.00221408	6320099.1	1214614.15	898.74	115388344.3	5.2034
Statewide	2020	OFF - AirGrSupp - Cargo Tractor	Aggregated	175	Nat Gas	0	0	0.000106986	0.068379289	0.009200643	2.600337527	0	0	0.000231258	0	0	140320.6	15019.75	96.99	2337073.1	9.3424
Statewide	2020	OFF - AirGrSupp - Cart	Aggregated	25	Gasoline	0.000325131	0.000299055	0.000357787	0.020579381	0.000253377	0.033773062	1.53327E-05	1.15847E-05	1.70363E-05	9.62962E-07	8.74618E-07	2496.6	4277.8	28.72	51333.6	0.5836
Statewide	2020	OFF - AirGrSupp - Catering Truck	Aggregated	300	Gasoline	0.022990682	0.021146829	0.025299843	1.029474246	0.129642368	22.89372562	0.001688881	0.001276044	0.001876535	0.000199987	0.000326036	930669.7	97520.7	95.6	19884470.73	9.5433
Statewide	2020	OFF - AirGrSupp - Catering Truck	Aggregated	300	Nat Gas	0	0	0.000103422	0.052383238	0.006900381	1.753257777	0	0	0.000155924	0	0	95053.3	7967.95	17.48	1633429.75	11.9295
Statewide	2020	OFF - AirGrSupp - Deicer	Aggregated	100	Gasoline	0.000120394	0.000110739	0.000132486	0.003901922	0.000745819	0.206613742	1.44056E-05	1.08842E-05	1.60062E-05	1.99618E-06	2.7888E-06	7960.65	934.4	44.92	86899.2	8.5195
Statewide	2020	OFF - AirGrSupp - Forklift	Aggregated	50	Gasoline	0.00512521	0.004714168	0.00563998	0.481938517	0.011332305	3.541866611	0.000244173	0.000184486	0.000271303	4.30626E-05	5.72325E-05	163370.35	99765.45	137.09	4988272.5	1.6375
Statewide	2020	OFF - AirGrSupp - Forklift	Aggregated	50	Nat Gas	0	0	0.00033165	0.088600738	0.023949598	7.138465977	0	0	0.00063485	0	0	377446.5	233545.25	321.06	11677262.5	1.6162
Statewide	2020	OFF - AirGrSupp - Fuel Truck	Aggregated	175	Gasoline	5.26185E-05	4.83985E-05	5.79035E-05	0.004484352	0.00056867	0.14087616	1.00993E-05	7.6306E-06	1.12215E-05	1.39946E-06	1.92697E-06	5500.55	1806.75	86	234877.5	3.0444
Statewide	2020	OFF - AirGrSupp - Fuel Truck	Aggregated	175	Nat Gas	0	0	2.91357E-05	0.013829749	0.00180957	0.442593254	0	0	3.93615E-05	0	0	23936.7	6117.4	10.59	856436	3.9129
Statewide	2020	OFF - AirGrSupp - Generator	Aggregated	100	Gasoline	0.001988111	0.001828665	0.002187795	0.100080737	0.006614571	1.207823154	8.42123E-05	6.36271E-05	9.35693E-05	9.97191E-06	1.81368E-05	51771.6	6069.95	6.54	649484.65	8.5292
Statewide	2020	OFF - AirGrSupp - Ground Power Unit	Aggregated	175	Gasoline	0.007925055	0.007289466	0.00872104	0.809300865	0.071273206	22.96373813	0.001646255	0.001243837	0.001829173	0.000228121	0.00032156	917894.7	89691.45	112.5	13453717.5	10.2339
Statewide	2020	OFF - AirGrSupp - Hydrant truck	Aggregated	175	Gasoline	0.02627801	0.024170514	0.028917347	1.019872273	0.127584377	20.32562116	0.00145713	0.001100943	0.001619034	0.000172544	0.000292006	833532.25	104944.8	68.26	12750793.2	7.9426
Statewide	2020	OFF - AirGrSupp - Lav Cart	Aggregated	25	Gasoline	7.61519E-05	7.00445E-05	8.38005E-05	0.00479217	5.97315E-05	0.008014965	3.64361E-06	2.75295E-06	4.04845E-06	2.28528E-07	2.08425E-07	594.95	978.2	6.77	11738.4	0.6082
Statewide	2020	OFF - AirGrSupp - Lav Truck	Aggregated	175	Gasoline	0.005764898	0.005302553	0.006343918	0.411522303	0.036002113	10.10742501	0.000724595	0.000547472	0.000805105	0.000100407	0.000142795	407610.1	136641.4	112.28	17763382	2.9831
Statewide	2020	OFF - AirGrSupp - Lav Truck	Aggregated	175	Nat Gas	0	0	1.1599E-05	0.006138311	0.000811632	0.211127981	0	0	1.87764E-05	0	0	11355.15	3044.1	7.88	395733	3.7302
Statewide	2020	OFF - AirGrSupp - Lift	Aggregated	100	Gasoline	0.009793067	0.009007663	0.010776672	0.429891214	0.042277287	9.676115169	0.000674642	0.00050973	0.000749602	9.34848E-05	0.000137659	392948.05	82570.3	219.18	8257030	4.7590
Statewide	2020	OFF - AirGrSupp - Lift	Aggregated	100	Nat Gas	0	0	2.21938E-05	0.010204637	0.001224453	0.286404714	0	0	2.5471E-05	0	0	15527.1	2682.75	7.95	268275	5.7878
Statewide	2020	OFF - AirGrSupp - Maint. Truck	Aggregated	175	Gasoline	0.004861416	0.00447153	0.005349691	0.36707071	0.038340167	10.13540982	0.000726601	0.000548987	0.000807334	0.000100685	0.000142173	405832.55	68415.6	151.97	8894028	5.9319
Statewide	2020	OFF - AirGrSupp - Other	Aggregated	50	Nat Gas	0	0	0.00037719	0.041631933	0.014827521	2.421913171	0	0	0.00021539	0	0	129403.45	47355.1	46.22	2367755	2.7326
Statewide	2020	OFF - AirGrSupp - Other GSE	Aggregated	50	Gasoline	0.004380087	0.004028804	0.004820019	0.281634697	0.008981778	2.678445181	0.00018465	0.000139513	0.000205166	3.2565E-05	4.15597E-05	118632.3	45088.45	246.56	2254422.5	2.6311
Statewide	2020	OFF - AirGrSupp - Passenger Stand	Aggregated	175	Gasoline	0.00169584	0.001559834	0.001866169	0.121332249	0.015331495	3.592682369	0.000257557	0.000194599	0.000286175	3.17961E-05	5.02113E-05	143328.2	21232.05	113.4	2656129.455	6.7506
Statewide	2020	OFF - AirGrSupp - Passenger Stand	Aggregated	175	Nat Gas	0	0	3.18816E-07	0.000241101	3.28399E-05	0.009817806	0	0	8.73134E-07	0	0	408.8	0	3.99	0	#DIV/0!
Statewide	2020	OFF - AirGrSupp - Service Truck	Aggregated	300	Gasoline	0.028497032	0.02621157	0.031359245	1.364736495	0.172276075	31.90304178	0.002353503	0.001778202	0.002615004	0.000326124	0.000452708	1292256.95	400751.75	476.16	72135315	3.2246
Statewide	2020	OFF - AirGrSupp - Service Truck	Aggregated	300	Nat Gas	0	0	0.000310293	0.158486993	0.015071748	4.454324907	0	0	0.00039614	0	0	244031.7	60575.4	46.32	10903572	4.0286
Statewide	2020	OFF - AirGrSupp - Sweeper	Aggregated	50	Nat Gas	0	0	2.91381E-06	0.000646049	0.000218088	0.053619741	0	0	4.7686E-06	0	0	2726.55	1135.15	3.9	51081.75	2.4019
Statewide	2020	OFF - AirGrSupp - Sweeper	Aggregated	100	Gasoline	0.000251055	0.000230921	0.000276271	0.010971359	0.001096542	0.252957948	1.76368E-05	1.33256E-05	1.95965E-05	2.08845E-06	3.55601E-06	10150.65	3828.85	10.59	204077.705	2.6511
Statewide	2020	OFF - AirGrSupp - Water Truck	Aggregated	175	Gasoline	0.000413152	0.000380017	0.000454649	0.026707813	0.003366893	0.756713418	5.42483E-05	4.09876E-05	6.02759E-05	7.51716E-06	1.05491E-05	30112.5	10986.5	35.35	1647975	2.7409
Statewide	2020	OFF - ConstMin - Asphalt Pavers	Aggregated	25	Gasoline	0.018586094	0.017095489	0.020452863	0.782310714	0.013512634	1.244788688	0.009391568	0.007095852	0.010435076	3.231E-05	3.37955E-05	96469.5	84519.4	213.11	1454156.35	1.1414
Statewide	2020	OFF - ConstMin - Asphalt Pavers	Aggregated	50	Gasoline	0.002978905	0.002739997	0.003278103	0.192540529	0.004321699	1.380675913	9.51826E-05	7.19157E-05	0.000105758	1.67865E-05	2.23871E-05	63904.2	27385.95	69.79	876350.4	2.3335
Statewide	2020	OFF - ConstMin - Asphalt Pavers	Aggregated	100	Gasoline	0.001585503	0.001458346	0.00174475	0.059937968	0.004323819	1.429457174	9.96652E-05	7.53026E-05	0.000110739	1.38106E-05	2.02147E-05	57702.85	14859.15	37.8	906408.15	3.8833
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	25	Gasoline	0.006616635	0.006085981	0.007281203	0.291278774	0.004753185	0.461481621	0.003481745	0.002630651	0.003868605	1.18431E-05	1.24326E-05	35488.95	26688.8	217.31	445913.2	1.3297
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	25	Diesel	0.000749203	0.000891614	0.001078853	0.004022797	0.006806925	0.899889828	0.000256224	0.000235726	0.000256224	1.18766E-05	7.48445E-06	29751.15	44957.05	55.11	696905.45	0.6618
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	50	Gasoline	0.000231048	0.000212518	0.000254254	0.012138359	0.000423731	0.139777391	9.63613E-06	7.28063E-06	1.07068E-05	1.69944E-06	1.97684E-06	5642.9	1967.35	20.87	62955.2	2.8683
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	100	Gasoline	0.001491925	0.001372272	0.001641772	0.045365768	0.005445931	1.744864154	0.000121656	9.19179E-05	0.000135173	1.68578E-05	2.40571E-05	68671.1	10449.95	99.5	919595.6	6.5714
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	175	Gasoline	0.000327049	0.00030082	0.000359897	0.019682172	0.002124893	0.601431053	4.31162E-05	3.25767E-05	4.79069E-05	5.97459E-06	8.28841E-06	23659.3	2273.95	23.79	286517.7	10.4045
Statewide	2020	OFF - ConstMin - Cement and Mortar Mixers	Aggregated	25	Gasoline	0.265197951	0.243929075	0.291834168	9.029593262	0.173922495	16.04607909	0.08993971	0.067954447	0.099933011	0.000482813	0.000415211	1185220.7	3023663.65	32841.64	20960522.85	0.3920
Statewide	2020	OFF - ConstMin - Cement and Mortar Mixers	Aggregated	25	Diesel	0.001897829	0.002258574	0.002732874	0.013202551	0.017044032	2.304714368	0.00067734	0.000623153	0.00067734	3.4539E-05	1.92148E-05	76379.9	231921	772.75	2388516.2	0.3293
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	25	Gasoline	0.202804537	0.186539613	0.223174022	8.426981833	0.154227678	13.88493716	0.102201829	0.07721916	0.113557588	0.000382094	0.000370667	1058069.3	1313675.15	4622.58	13726160.8	0.8054
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	25	Diesel	6.22035E-05	7.40273E-05	8.95731E-05	0.000305725	0.00056603	0.07424934	2.11499E-05	1.94579E-05	2.11499E-05	9.42083E-07	5.91337E-07	2350.6	3160.9	5.21	56896.2	0.7436
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	50	Gasoline	0.003615697	0.003325718	0.003978853	0.269383832	0.005802272	3.207448853	0.000221119	0.000167067	0.000245687	3.89967E-05	4.83111E-05	137904.3	49661.9	81.27	1738166.5	2.7769
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	50	Diesel	0.001138259	0.001354622	0.001639092	0.009348131	0.008617129	1.166939581	0.000435381	0.00040055	0.000435381	1.50856E-05	9.75614E-06	38781.25	27838.55	47.72	918672.15	1.3931
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	100	Gasoline	0.001485918	0.001366748	0.001635163	0.073423193	0.003714093	3.427779809	0.000238993	0.000180573	0.000265548	3.31171E-05	4.70171E-05	134210.5	28437.15	46.55	1876851.9	4.7195
Statewide	2020	OFF - ConstMin - Cranes	Aggregated	50	Gasoline	0.001050844	0.000966566	0.00115639	0.064717025	0.001603723	0.423780602	2.92151E-05	2.20736E-05	3.24612E-05	5.1524E-06	6.92789E-06	19775.7	9906.1	23.79	366525.7	1.9963
Statewide	2020	OFF - ConstMin - Cranes	Aggregated	100	Gasoline	0.00222805	0.00204936	0.002451833	0.079045077	0.006258725	1.676078509	0.00011686	8.82944E-05	0.000129845	1.61933E-05	2.38794E-05	68163.75	20330.5	48.77	1504457	3.3528
Statewide	2020	OFF - ConstMin - Cranes	Aggregated	175	Gasoline	9.42309E-05	8.66736E-05	0.000103695	0.004000089	0.000471753	0.110141343	7.89596E-06	5.96584E-06	8.77329E-06	1.09414E-06	1.45898E-06	4164.65	569.4	1.35	71175	7.3141
Statewide	2020	OFF - ConstMin - Crushing/Proc. Equipment	Aggregated	25	Gasoline	0.002977251	0.002738475	0.003276283	0.126967271	0.002244552	0.20548052	0.001550291	0.001171331	0.001722545	5.50855E-06	5.49066E-06	15673.1	15727.85	54.49	185036.75	0.9965
Statewide	2020	OFF - ConstMin - Crushing/Proc. Equipment	Aggregated	100	Gasoline	0.001405037	0.001292353	0.001546157	0.046595076	0.004485861	1.324499833	9.23473E-05	6.97735E-05	0.000102608	1.27965E-05	1.85102E-05	52837.4	6599.2	27.83	633523.2	8.0066
Statewide	2020	OFF - ConstMin - Dumpers/Tenders	Aggregated	25	Gasoline	0.024378161	0.022423032	0.026826679	0.88181565	0.016897349	1.510490574	0.009969125	0.007532228	0.011076805	4.30823E-05	3.95918E-05	113014.95	326145.75	2188.01	2837254.5	0.3465
Statewide	2020	OFF - ConstMin - Dumpers/Tenders	Aggregated	25	Diesel	0.000193201	0.000229925	0.000278209	0.000949132	0.001759004	0.23050924	6.70304E-05	6.1668E-05	6.70304E-05	2.92473E-06	1.87869E-06	7467.9	21936.5	32.66	350984	0.3404
Statewide	2020	OFF - ConstMin - Dumpers/Tenders	Aggregated	100	Gasoline	0.000127251	0.000117046	0.000140032	0.003932067	0.000454093	0.143664915	1.00167E-05	7.56815E-06	1.11296E-05	1.388E-06	1.85025E-06	5281.55	1919.9	16.91	126713.4	2.7510
Statewide	2020	OFF - ConstMin - Excavators	Aggregated	25	Diesel	0.001353716	0.001611034	0.001949352	0.006653399	0.012318342	1.615866006	0.000460279	0.000423456	0.000460279	2.05023E-05	1.35025E-05	53673.25	71722.5	51.16	1649617.5	0.7483
Statewide	2020	OFF - ConstMin - Other Construction Equipment	Aggregated	25	Diesel	0.004365066	0.005194789	0.006285695	0.030822859	0.039430027	5.364497474	0.001527931	0.001405696	0.001527931	8.06844E-05	4.49407E-05	178641.95	371121.05	537.26	5038930.85	0.4814
Statewide	2020	OFF - ConstMin - Other Construction Equipment	Aggregated	175	Gasoline	0.001386602	0.001275397	0.001525871	0.118384817	0.004553206	3.547710106	0.000254333	0.000192163	0.000282592	3.52428E-05	4.95387E-05	141408.3	25652.2	69.1	3232177.2	5.5125
Statewide	2020	OFF - ConstMin - Pavers	Aggregated	25	Diesel	0.000366851	0.000436582	0.000528265	0.001800491	0.003343746	0.437273213	0.000129073	0.000118747	0.000129073	5.54817E-06	3.60036E-06	14311.65	16881.25	20.14	405150	0.8478
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	25	Gasoline	0.428308308	0.393957982	0.471327167	15.65724576	0.313351565	27.70661489	0.176730981	0.133530075	0.196367757	0.000813376	0.000716858	2046273.95	4416930.7	23349.27	36207299.2	0.4633
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	25	Diesel	0.000433906	0.000516383	0.000624824	0.002132608	0.003948387	0.51793214	0.000147456	0.00013566	0.000147456	6.57158E-06	4.30464E-06	17111.2	29864.3	35.82	567421.7	0.5730
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	50	Gasoline	0.00222317	0.002044871	0.002446463	0.155528302	0.00364504	1.74079196	0.000120009	9.06732E-05	0.000133343	2.11649E-05	2.63702E-05	75273.95	33503.35	192.09	1239623.95	2.2468
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	100	Gasoline	0.0004281	0.000393766	0.000471098	0.018847092	0.0012091	0.791317343	5.51725E-05	4.16859E-05	6.13028E-05	7.64523E-06	1.08215E-05	30889.95	8446.1	48.91	557442.6	3.6573
Statewide	2020	OFF - ConstMin - Plate Compactors	Aggregated	25	Gasoline	0.180543385	0.166063805	0.198676982	5.844921923	0.123676045	10.94543204	0.0597934	0.045177235	0.066437111	0.000333207	0.000276726	789914.75	2499253.55	12893.45	15344497.8	0.3161
Statewide	2020	OFF - ConstMin - Plate Compactors	Aggregated	25	Diesel	0.00128201	0.001525698	0.001846094	0.009683512	0.011560942	1.585919361	0.000451748	0.000415609	0.000451748	2.46783E-05	1.3284E-05	52804.55	268614.45	447.4	2148915.6	0.1966
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	25	Gasoline	0.092236197	0.084838854	0.101500308	3.819204897	0.067888236	6.226301343	0.045326577	0.034246747	0.050362864	0.00016773	0.000167134	477084.2	629062.9	2526.13	7742453	0.7584
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	25	Diesel	0.007827978	0.009315941	0.011272288	0.049259545	0.070897374	9.521315654	0.002711481	0.002494563	0.002711481	0.000135335	7.97424E-05	316980.6	829130.35	1191.72	9907162.15	0.3823
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	50	Gasoline	0.005077683	0.004670453	0.005587681	0.329571968	0.007176732	1.673048038	0.000115338	8.71446E-05	0.000128154	2.03412E-05	2.9246E-05	83482.8	30532.25	48.77	1129693.25	2.7342
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	100	Gasoline	0.010388127	0.009554999	0.0114315	0.38695891	0.026135203	6.304041982	0.000439533	0.000332092	0.00048837	6.09058E-05	9.21034E-05	262909.5	57746.65	92.41	4330998.75	4.5528

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	OFF - ConstMin - Rough Terrain Forklifts	Aggregated	50	Gasoline	0.000710711	0.000653712	0.000782094	0.043741567	0.00108559	0.287237956	1.98019E-05	1.49615E-05	2.20021E-05	3.49229E-06	4.65184E-06	13278.7	3792.35	8.99	178240.45	3.5014
Statewide	2020	OFF - ConstMin - Rough Terrain Forklifts	Aggregated	100	Gasoline	0.009673035	0.008897257	0.010644585	0.342965853	0.027206336	7.293644254	0.00050853	0.000384223	0.000565034	7.04668E-05	0.000104297	297715.9	58009.45	140.16	4930803.25	5.1322
Statewide	2020	OFF - ConstMin - Rough Terrain Forklifts	Aggregated	175	Gasoline	0.000356141	0.000327579	0.000391912	0.015144256	0.001785173	0.417266327	2.99136E-05	2.26013E-05	3.32373E-05	4.1451E-06	5.74639E-06	16403.1	1700.9	3.96	241527.8	9.6438
Statewide	2020	OFF - ConstMin - Rubber Tired Loaders	Aggregated	25	Diesel	0.000361586	0.000430317	0.000520684	0.001777164	0.003290305	0.431607824	0.000122943	0.000113108	0.000122943	5.47628E-06	3.5921E-06	14278.8	18545.65	19.1	463641.25	0.7699
Statewide	2020	OFF - ConstMin - Rubber Tired Loaders	Aggregated	50	Gasoline	0.001674619	0.001540315	0.001842816	0.107989492	0.002363845	0.649407285	4.47696E-05	3.38259E-05	4.97439E-05	7.89561E-06	1.08522E-05	30977.55	12402.7	23.9	496108	2.4976
Statewide	2020	OFF - ConstMin - Rubber Tired Loaders	Aggregated	100	Gasoline	0.010511052	0.009668066	0.011566772	0.392080896	0.027367528	7.674516144	0.000535086	0.000404287	0.00059454	7.41465E-05	0.000110386	315097.2	84194.55	164.33	6062007.6	3.7425
Statewide	2020	OFF - ConstMin - Signal Boards	Aggregated	25	Gasoline	0.004608225	0.004238645	0.005071071	0.190239505	0.003646774	0.321756496	0.002337403	0.001766038	0.002597114	9.24899E-06	8.4393E-06	24090	41642.85	157.18	325685.85	0.5785
Statewide	2020	OFF - ConstMin - Signal Boards	Aggregated	25	Diesel	0.020036899	0.023845566	0.028853134	0.151346408	0.180689288	24.78679134	0.007060506	0.006495666	0.007060506	0.000385704	0.000207912	826462.2	2935377.45	3910.37	17612264.7	0.2816
Statewide	2020	OFF - ConstMin - Signal Boards	Aggregated	50	Diesel	0.000497165	0.000591667	0.000715917	0.004037368	0.003750498	0.515814625	0.000186993	0.000172033	0.000186993	6.6682E-06	4.24312E-06	16866.65	10026.55	18.6	370982.35	1.6822
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	25	Gasoline	0.303309154	0.27898376	0.333773222	12.7233652	0.215248553	20.05287803	0.151293128	0.114310363	0.168103475	0.000508925	0.000547446	1562685.45	1408494.85	4411.49	26658015.9	1.1095
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	25	Diesel	0.036219536	0.043104241	0.052156132	0.175105475	0.325965746	42.03155838	0.013257854	0.012197225	0.013257854	0.000533301	0.000351587	1397577.7	2226237.2	2666.85	44524744	0.6278
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	50	Gasoline	0.011076143	0.010187836	0.01218862	0.870550605	0.017217182	9.216741459	0.000635394	0.000480075	0.000705993	0.000112059	0.000140842	402032.9	209889.6	676.54	6716467.2	1.9154
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	100	Gasoline	0.006366644	0.005856039	0.007006103	0.334993164	0.015972421	13.62970731	0.000950296	0.000718001	0.001055884	0.000131682	0.000187914	536400.35	125476.05	404.51	10038084	4.2749
Statewide	2020	OFF - ConstMin - Surfacing Equipment	Aggregated	25	Gasoline	0.206302698	0.189757222	0.227023535	7.775117115	0.159008528	13.33242657	0.093345732	0.070527887	0.10371748	0.000384927	0.000349983	999026.9	2696079.8	6301.39	20978772.85	0.3705
Statewide	2020	OFF - ConstMin - Tampers/Rammers	Aggregated	25	Gasoline	0.022621402	0.020807166	0.024893474	1.055152784	0.019135855	1.989022664	0.015006598	0.011338318	0.016673997	7.94503E-05	4.95399E-05	141411.95	659106.05	3618.44	2787552.45	0.2146
Statewide	2020	OFF - ConstMin - Tractors/Loaders/Backhoes	Aggregated	25	Diesel	0.006717821	0.007994763	0.009673663	0.033017507	0.061129803	8.018739189	0.002301024	0.002116942	0.002301024	0.000101743	6.70571E-05	266555.85	369314.3	391.47	8494228.9	0.7218
Statewide	2020	OFF - ConstMin - Tractors/Loaders/Backhoes	Aggregated	100	Gasoline	0.00478102	0.004397582	0.005261221	0.311366088	0.012197246	5.376880444	0.000374889	0.000283249	0.000416543	5.19482E-05	7.79522E-05	222514.95	75901.75	86.9	4781810.25	2.9316
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	25	Gasoline	0.186926294	0.171934805	0.205700984	7.751731041	0.139333336	12.46643066	0.094055593	0.071064226	0.104506214	0.000330991	0.000336962	961858.95	983890.35	2265.03	14563715.35	0.9776
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	25	Diesel	0.003165524	0.003767235	0.004558355	0.017150602	0.028755775	3.804728941	0.001083775	0.000997073	0.001083775	5.04195E-05	3.18156E-05	126468.85	132243.15	213.57	2952860.95	0.9563
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	50	Gasoline	0.020795298	0.019127515	0.022883957	1.275287113	0.031920021	8.50660108	0.000586437	0.000443086	0.000651597	0.000103425	0.000140371	400689.7	181459.75	451.05	5443792.5	2.2081
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	100	Gasoline	0.008039786	0.007394996	0.008847295	0.284097856	0.022771451	6.140978828	0.000428164	0.000323502	0.000475738	5.93304E-05	8.76498E-05	250196.55	60155.65	149.21	3970272.9	4.1592
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	25	Gasoline	0.054119779	0.049779373	0.059555515	2.246683385	0.038359551	3.541784569	0.026721735	0.020189756	0.029690817	8.99424E-05	9.66721E-05	275950.95	314673.8	838.29	5935703	0.8769
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	25	Diesel	0.005853037	0.006965598	0.008428373	0.033122609	0.052459486	6.882136648	0.002119701	0.001950125	0.002119701	9.37653E-05	5.75433E-05	228738.2	498509.7	1248.23	8714411.5	0.4588
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	25	Nat Gas	0	0	0.004337447	1.155747383	0.031804795	6.800198702	0	0	0.003495189	0	0	454574.65	384611.45	1024.6	7255057.55	1.1819
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	50	Gasoline	0.016764212	0.015419722	0.018447993	1.385361219	0.025354563	12.99174398	0.000895639	0.000676705	0.000995155	0.000157956	0.000201909	576349.6	361674.85	1001.1	11935270.05	1.5936
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	100	Gasoline	0.01322626	0.012165514	0.014554693	0.736452515	0.03345952	26.08084056	0.001818419	0.001373917	0.002020465	0.000251977	0.000361646	1032318.55	361674.85	1001.1	24232214.95	2.8543
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	25	Gasoline	0.001596002	0.001468003	0.001756303	0.098918648	0.001336785	0.154870849	7.7897E-05	5.88555E-05	8.65523E-05	3.92515E-06	4.18257E-06	11939.15	17275.45	19.09	397335.35	0.6911
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	25	Nat Gas	0	0	0.000209549	0.033166358	0.00092607	0.172901049	0	0	0.000113813	0	0	12037.7	12253.05	9.65	281820.15	0.9824
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	50	Gasoline	0.424132765	0.390117317	0.466732236	50.24905923	0.983844126	175.0611849	0.012068562	0.009118469	0.013409513	0.002128425	0.003389343	9674890.75	6016524.95	3339.53	246677522.9	1.6081
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	50	Nat Gas	0	0	0.029045008	4.824438772	1.261758667	300.639046	0	0	0.026736938	0	0	16015188.95	11996184.9	6658.92	491843580.9	1.3350
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	100	Gasoline	0.895261944	0.823461936	0.985181158	85.46009534	4.439823594	1037.095264	0.072308766	0.05463329	0.080343074	0.010019787	0.015570514	44446090.15	21113782.7	11719.79	1477964789	2.1051
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	100	Nat Gas	0	0	0.172290927	81.32940586	8.156117586	1801.474267	0	0	0.160211743	0	0	100227317.3	42102987.25	23370.34	2947209108	2.3805
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	175	Gasoline	0.0467453	0.042996327	0.051440351	3.272767747	0.274430403	76.886773	0.005511962	0.004164594	0.006124402	0.00076379	0.001089475	3109909.5	771661.1	428.09	112662520.6	4.0301
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	175	Nat Gas	0	0	0.007903639	4.764547021	0.405799968	137.5005502	0	0	0.012228431	0	0	7522405.45	1540701.5	855.01	224942419	4.8825
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	25	Gasoline	0.044684645	0.041100936	0.049172726	2.744803972	0.036019226	4.493076452	0.002165608	0.001636237	0.002406231	0.000124544	0.00011913	340055.9	607349.05	1565.15	6415006.4	0.5599
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	25	Diesel	0.007043318	0.00838213	0.010142378	0.039910619	0.06561047	8.696761966	0.002477269	0.002279087	0.002477269	0.000116271	7.27537E-05	289200.45	551420.1	386.3	9935219.7	0.5245
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	50	Gasoline	0.013165069	0.01210923	0.014487355	1.270837209	0.029268563	8.746730345	0.000602992	0.000455594	0.000669991	0.000106344	0.000143075	408409.45	228165.15	319.63	6844954.5	1.7900
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	100	Gasoline	0.004072513	0.003745898	0.004481553	0.298239812	0.024126534	7.484131406	0.000521812	0.000394258	0.000579791	7.23071E-05	0.000105565	301336.7	74887.05	104.84	5916076.95	4.0239
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	175	Gasoline	0.000571578	0.000525738	0.000628987	0.055341532	0.004856784	1.551460971	0.000111223	8.40353E-05	0.000123581	1.54121E-05	2.16839E-05	61896.7	7146.7	9.59	1243525.8	8.6609
Statewide	2020	OFF - Industrial - Other Material Handling Equipment	Aggregated	50	Gasoline	0.000197157	0.000181345	0.00021696	0.013680971	0.000383429	0.089776306	6.1891E-06	4.67621E-06	6.87678E-06	1.09152E-06	1.3618E-06	3887.25	1423.5	3.7	58363.5	2.7308
Statewide	2020	OFF - Industrial - Other Material Handling Equipment	Aggregated	100	Gasoline	0.005660064	0.005206127	0.006228556	0.234277247	0.023538579	5.173425999	0.000360704	0.000272532	0.000400782	4.99825E-05	7.36431E-05	210214.45	77033.25	199.52	4159795.5	2.7289
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	25	Gasoline	0.034102588	0.031367561	0.037527818	2.207465047	0.027711664	3.54397539	0.001655336	0.001250698	0.001839262	9.33346E-05	9.47899E-05	270578.15	297431.2	1100.79	3848063.6	0.9097
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	25	Diesel	0.001402674	0.001669298	0.002019851	0.008611	0.013256476	1.768206607	0.000503673	0.000463379	0.000503673	2.43572E-05	1.47586E-05	58666.45	81763.65	125.54	1512019.8	0.7175
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	50	Gasoline	0.036476979	0.033551525	0.04014069	3.171484464	0.079356612	28.27209721	0.001949053	0.001472618	0.002165615	0.000343737	0.000442673	1263611.75	480913.05	931.26	16831956.75	2.6275
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	100	Gasoline	0.021288584	0.01958124	0.023426788	1.355830344	0.1348998	45.34750953	0.003161737	0.002388868	0.003513041	0.00043812	0.000630268	1799103.25	401525.55	777.31	27303737.4	4.4807
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	175	Gasoline	0.000164843	0.000151623	0.0001814	0.018017151	0.001599158	0.527912364	3.78457E-05	2.85945E-05	4.20508E-05	5.24426E-06	7.34219E-06	20958.3	2157.15	4.12	302001	9.7157
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	25	Gasoline	0.482489572	0.443793908	0.530950342	11.17903371	0.287807906	24.16902901	0.092049781	0.069548724	0.102277535	0.000754925	0.000579763	1654935.55	5399269.8	11169.15	33277159.5	0.3065
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	25	Diesel	0.002176052	0.002589682	0.003133515	0.011066936	0.018678256	2.338378713	0.000885701	0.000814845	0.000885701	3.10235E-05	1.94315E-05	77241.3	141572.55	172.7	2829173.4	0.5456
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	50	Gasoline	0.027245696	0.025060592	0.029982227	1.755401485	0.038725236	10.3725634	0.000715075	0.000540279	0.000794528	0.000126111	0.000175503	500973.45	223507.75	462.12	7822771.25	2.2414
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	50	Diesel	0.032008484	0.038092742	0.046092217	0.237693104	0.202409862	26.15721278	0.01154862	0.01062473	0.01154862	0.000338147	0.000220953	878299.5	858009.15	1053.83	31746338.55	1.0236
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	100	Gasoline	0.093098743	0.085632224	0.102449488	3.461855161	0.244705757	66.51338834	0.004637473	0.003503869	0.005152748	0.000642612	0.000958521	2736102.05	725273.25	1500.52	50769127.5	3.7725
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	175	Gasoline	0.007603512	0.006993711	0.008367202	0.310111764	0.034956706	8.33035881	0.000597198	0.000451216	0.000663553	8.27534E-05	0.000117196	334537.1	48482.95	100.12	6496715.3	6.9001
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	50	Nat Gas	0	0	0.001542249	0.273206051	0.056002952	18.60702082	0	0	0.001425279	0	0	988657.25	289156.65	34.02	9253012.8	3.4191
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	100	Nat Gas	0	0	0.008410083	4.368995669	0.331376649	104.5618583	0	0	0.008100337	0	0	5785742.75	597647.35	70.32	52592966.8	9.6809
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	175	Nat Gas	0	0	0.002345504	0.888797716	0.088674835	27.21256615	0	0	0.002167612	0	0	1485852.95	96334.45	11.3	14064829.7	15.4239
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	300	Nat Gas	0	0	0.001804495	1.022726196	0.085800371	28.04605006	0	0	0.002494239	0	0	1538880.15	77091.65	9.04	16189246.5	19.9617
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	600	Nat Gas	0	0	0.002541331	1.440339272	0.120835517	39.49818789	0	0	0.00351272	0	0	2167249.55	67499.45	7.94	22814814.1	32.1077
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	25	Gasoline	3.708143451	3.410750346	4.080585671	193.2412513	2.559672098	318.8602664	0.210877042	0.15932932	0.234307824	0.008734233	0.008453741	24131234.05	33706472.5	293368.03	361547822.7	0.7159
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	25	Diesel	0.051405914	0.061177286	0.074024516	0.31715031	0.48729975	61.14857664	0.022477934	0.020679699	0.022477934	0.000853473	0.000512248	2036214.55	3348207.05	9918	48145773.95	0.6082
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	50	Gasoline	0.137865166	0.12680838	0.151712205	8.063319767	0.286997605	90.03841889	0.006207168	0.00468986	0.006896853	0.001094703	0.001368579	3906613.25	1749167.6	15229.17	55973363.2	2.2334
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	50	Diesel	0.061166471	0.072793155	0.088079718	0.508999305	0.519204943	72.39692633	0.024812576	0.02282757	0.024812576	0.000935912	0.000608299	2418026.45	1727293.15	5116.86	57000673.95	1.3999
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	100	Gasoline	0.033280493	0.030611398	0.036623153	1.16584009	0.178330119	44.59695099	0.003109406	0.002349329	0.003454896	0.000430869	0.000617015	1761271	337723.55	2940.96	28031054.65	5.2151
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	100	Nat Gas	0	0	0.000152911	0.090811105	0.011033174	2.891501831	0	0	0.000257152	0	0	157117.9	24783.5	218.35	2057030.5	6.3396
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	175	Gasoline	0.003281329	0.003018167	0.003610903	0.236910253	0.031481944	7.208770952	0.000516792	0.000390465	0.000574213	7.16116E-05	0.000100586	287123.6	31605.35	277.5	4614381.1	9.0847
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	175	Nat Gas	0	0	0.000172944	0.108840663	0.015403318	4.21658549	0	0	0.000374996	0	0	227413.25	20458.25	181.1	2986904.5	11.1160
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	25	Gasoline	0.391626711	0.360218249	0.430961306	14.09686287	0.199663452	26.85756755	0.0371589	0.028075614	0.041287667	0.000804473	0.000670955	1915242.6	3518329.9	30625.39	24357523.1	0.5444
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	25	Diesel	0.000280775	0.000334145	0.000404316	0.001990014	0.002748719	0.345432369	0.000128323	0.000118057	0.000128323	5.1231E-06	2.65E-06	10533.9	46668.9	326.12	657722.7	0.2257
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	50	Gasoline	0.001237305	0.001138074	0.001361579	0.075754132	0.002129439	0.91163404	6.28472E-05	4.74846E-05	6.98303E-05	1.10838E-05	1.3687E-05	39069.6	15267.95	135.55	442770.55	2.5589
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	50	Diesel	0.000212382	0.000252752	0.00030583	0.002077118	0.002398054	0.34786794	9.86329E-05	9.07423E-05	9.86329E-05	4.49706E-06	2.80701E-06	11158.05	17301	122.06	657438	0.6449
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	25	Gasoline	1.198922608	1.102769015	1.319341196	40.56345167	0.816445522	74.18607958	0.461665175	0.348813688	0.512961305	0.002262043	0.001893861	5406033.25	14939993.85	67694.1	82893700.95	0.3618
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	25	Diesel	0.028697898	0.034152871	0.041324974	0.169852741	0.250829964	31.39175694	0.012195939	0.011220264	0.012195939	0.00044885	0.000263154	1046053.5	2249005.9	5587.23	24715474.95	0.4651
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	50	Gasoline	0.021285079	0.019578016	0.023422931	1.42143483	0.033934224	13.59337471	0.000937115	0.000708042	0.001041239	0.000165271	0.000210881	601961.65	268563.35	1216.97	8325463.85	2.2414
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	50	Diesel	0.039134054	0.046572759	0.056353038	0.313005339	0.307846472	42.37291257	0.015364949	0.014135753	0.015364949	0.000547776	0.000356362	1416561.35	901648.55	2239.96	33360996.35	1.5711
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	100	Gasoline	0.037416327	0.034415538	0.041174386	1.509224132	0.109534808	51.10707497	0.003563308	0.002692277	0.003959231	0.000493766	0.000710664	2028593.35	340304.1	1542.64	31648281.3	5.9611
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	175	Gasoline	0.00120198	0.001105581	0.001322706	0.078605515	0.005549292	2.320188369	0.000166333	0.000125674	0.000184814	2.30486E-05	3.23992E-05	92483.7	9796.6	45.48	1410710.4	9.4404
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	25	Gasoline	1.171832234	1.077851289	1.289529892	48.92144766	0.843997951	77.33857051	0.583496997	0.440864398	0.648329997	0.001997318	0.002108426	6018510.55	7447624.25	35850.19	116926308.3	0.8081
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	25	Diesel	0.025449221	0.030286676	0.036646878	0.140142215	0.220461694	27.595552	0.010589338	0.009742191	0.010589338	0.000380623	0.000231222	919121.1	2348512.2	3656.54	35728119.9	0.3914

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	50	Gasoline	0.051473775	0.047345578	0.056643749	2.965131466	0.08547186	27.27455705	0.001880284	0.001420659	0.002089204	0.000331609	0.000425948	1215869.75	502283.8	2417.92	22602771	2.4207
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	50	Diesel	0.137667113	0.163835242	0.198240643	1.023926146	0.910476852	120.2144209	0.050549683	0.046505708	0.050549683	0.001554072	0.001014139	4031260.75	3383633.95	5268.83	155647161.7	1.1914
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	100	Gasoline	0.041924232	0.038561909	0.04613506	1.399587415	0.13394278	42.81621189	0.002985249	0.002255521	0.003316943	0.000413664	0.000598774	1709203.75	512675.35	2467.81	35887274.5	3.3339
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	175	Gasoline	0.003361258	0.003091685	0.00369886	0.180969618	0.018898031	5.330937793	0.000382171	0.000288752	0.000424635	5.29573E-05	7.45292E-05	212743.9	35069.2	169.73	4558996	6.0664
Statewide	2020	OFF - Logging - Chainsaws	Aggregated	25	Gasoline	1.287208711	1.183974572	1.416494666	2.853403505	0.02552499	7.712523258	0.004040885	0.003053113	0.004489872	0.00031764	0.000233098	665380.4	807982.25	3918.89	6463858	0.8235
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	100	Diesel	0.028998336	0.034510417	0.041757604	0.509312093	0.305593529	79.73469308	0.010774719	0.009912742	0.010774719	0.000935329	0.000667348	2652747	635289.8	497.49	65434849.4	4.1756
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	175	Diesel	0.044601113	0.05307901	0.064225602	0.820846652	0.330474559	145.540412	0.013646889	0.012555138	0.013646889	0.001637579	0.001216278	4834775.4	785768.35	615.31	119436789.2	6.1529
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	300	Diesel	0.033943289	0.040395319	0.048878336	0.245823166	0.207844263	127.9385994	0.006442462	0.005927065	0.006442462	0.001439529	0.001062745	4224473.5	479398.3	375.34	104988227.7	8.8120
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	600	Diesel	0.014930806	0.017768893	0.021500361	0.104182757	0.086892206	56.4533594	0.002816939	0.002591584	0.002816939	0.000554108	0.000468879	1863821.4	140817	110.21	46328793	13.2358
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	750	Diesel	0.002263268	0.002693476	0.003259106	0.0157849	0.013248411	8.553341107	0.000427877	0.000393647	0.000427877	8.60015E-05	7.10293E-05	282345.75	10687.2	8.21	6978741.6	26.4191
Statewide	2020	OFF - Logging - Shredders	Aggregated	25	Gasoline	0.182642969	0.167995003	0.200987447	8.04568257	0.1475683	12.36101215	0.093260236	0.07046329	0.103622485	0.000352446	0.000341446	974659.5	1489221.9	6148.49	11913775.2	0.6545
Statewide	2020	OFF - Logging - Shredders	Aggregated	175	Diesel	2.4511E-06	2.91701E-06	3.52958E-06	4.75248E-05	3.77925E-05	0.009715896	1.48086E-06	1.36239E-06	1.48086E-06	1.09321E-07	3.6729E-08	146	0	0.34	0	#DIV/0!
Statewide	2020	OFF - Logging - Skidders	Aggregated	100	Diesel	0.016242943	0.019330445	0.023389838	0.276752684	0.165013435	42.80353983	0.005827698	0.005361483	0.005827698	0.000502107	0.000358327	1424372.35	330398	228.86	33700596	4.3111
Statewide	2020	OFF - Logging - Skidders	Aggregated	175	Diesel	0.032327221	0.038472065	0.046551198	0.578524761	0.231356875	101.3390411	0.009543865	0.008780356	0.009543865	0.001140238	0.000847039	3367030.1	528432.4	366.15	79793292.4	6.3717
Statewide	2020	OFF - Logging - Skidders	Aggregated	300	Diesel	0.015463843	0.018403251	0.022267934	0.108978076	0.091388252	56.03461827	0.002838928	0.002611813	0.002838928	0.000630486	0.000465511	1850433.2	194413.6	134.54	44131887.2	9.5180
Statewide	2020	OFF - Logging - Skidders	Aggregated	600	Diesel	0.001031506	0.001227577	0.001485368	0.006984434	0.005794278	3.749012297	0.000188225	0.000173167	0.000188225	3.67978E-05	3.11278E-05	123735	10836.85	7.34	2925949.5	11.4180
Statewide	2020	OFF - Military - A/C unit	Aggregated	100	Diesel	0.001380566	0.001642987	0.001988014	0.018996961	0.018014804	3.219810457	0.001002674	0.00092246	0.001002674	3.777E-05	2.69361E-05	107072.75	30882.65	102.9	3119147.65	3.4671
Statewide	2020	OFF - Military - A/C unit	Aggregated	300	Diesel	0.00066255	0.000788489	0.000954072	0.005017352	0.009956478	2.768238479	0.000291642	0.000268311	0.000291642	3.11474E-05	2.29841E-05	91363.15	12910.05	42.96	2685290.4	7.0769
Statewide	2020	OFF - Military - A/C unit	Aggregated	600	Diesel	0.000376912	0.000448556	0.000542753	0.002947066	0.005387395	1.65741461	0.000168562	0.000155077	0.000168562	1.62681E-05	1.37532E-05	54669.7	4996.85	16.75	1574007.75	10.9408
Statewide	2020	OFF - Military - Aircraft Support	Aggregated	100	Diesel	0.000252677	0.000300706	0.000363855	0.003476902	0.003297144	0.589302975	0.000183514	0.000168833	0.000183514	6.91283E-06	4.9171E-06	19545.75	8365.8	27.9	568874.4	2.3364
Statewide	2020	OFF - Military - Aircraft Support	Aggregated	175	Diesel	0.000546717	0.000650638	0.000787272	0.008868288	0.007268811	1.733244	0.000318845	0.000293337	0.000318845	1.9502E-05	1.44648E-05	57498.45	12012.15	39.95	1681701	4.7867
Statewide	2020	OFF - Military - Cart	Aggregated	100	Diesel	0.000128993	0.000153512	0.000185749	0.001774973	0.001683206	0.300841647	9.36845E-05	8.61897E-05	9.36845E-05	3.52903E-06	2.51043E-06	9979.1	3500.35	11.62	283528.35	2.8509
Statewide	2020	OFF - Military - Cart	Aggregated	175	Diesel	4.48113E-05	5.33291E-05	6.45282E-05	0.000726883	0.000595783	0.142064111	2.61339E-05	2.40432E-05	2.61339E-05	1.59846E-06	1.15696E-06	4599	824.9	2.75	126209.7	5.5752
Statewide	2020	OFF - Military - Cart	Aggregated	300	Diesel	0.000145933	0.000173672	0.000210143	0.001105119	0.002193008	0.609730493	6.4237E-05	5.9098E-05	6.4237E-05	6.86051E-06	5.05299E-06	20085.95	2930.95	9.69	577397.15	6.8531
Statewide	2020	OFF - Military - Communications	Aggregated	50	Diesel	3.95383E-05	4.70538E-05	5.69351E-05	0.000339001	0.000356307	0.049521258	1.6716E-05	1.53788E-05	1.6716E-05	6.40186E-07	3.90246E-07	1551.25	1102.3	3.67	44092	1.4073
Statewide	2020	OFF - Military - Communications	Aggregated	100	Diesel	6.37E-05	7.58083E-05	9.1728E-05	0.00087653	0.000831213	0.148563774	4.62639E-05	4.25628E-05	4.62639E-05	1.74273E-06	1.21298E-06	4821.65	1737.4	5.93	138992	2.7752
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	50	Diesel	4.84344E-05	5.76409E-05	6.97455E-05	0.000415276	0.000436477	0.06066354	2.04772E-05	1.8839E-05	2.04772E-05	7.84228E-07	4.98596E-07	1981.95	1102.3	3.67	54012.7	1.7980
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	100	Diesel	0.001422767	0.00169321	0.002048784	0.019577663	0.018565482	3.31823386	0.001033324	0.000950658	0.001033324	3.89246E-05	2.77506E-05	110310.3	45358.55	150.93	3220457.05	2.4320
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	175	Diesel	6.52155E-05	7.76119E-05	9.39103E-05	0.00105786	0.000867065	0.20675125	3.80336E-05	3.49909E-05	3.80336E-05	2.32631E-06	1.70698E-06	6785.35	1102.3	3.67	184084.1	6.1556
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	300	Diesel	0.000132154	0.000157275	0.000190302	0.001000778	0.001985952	0.552162006	5.8172E-05	5.35182E-05	5.8172E-05	6.21277E-06	4.57552E-06	18187.95	2376.15	7.79	529881.45	7.6544
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	600	Diesel	0.000735101	0.000874831	0.001058545	0.005747742	0.01050718	3.232499991	0.000328752	0.000302452	0.000328752	3.1728E-05	2.68296E-05	106649.35	8365.8	27.9	3120443.4	12.7483
Statewide	2020	OFF - Military - Crane	Aggregated	100	Diesel	9.249E-05	0.000110071	0.000133186	0.002919164	0.001736392	0.519973241	3.66503E-05	3.37182E-05	3.66503E-05	6.09955E-06	4.32943E-06	17209.75	4785.15	15.95	502440.75	3.5965
Statewide	2020	OFF - Military - Crane	Aggregated	175	Diesel	1.9264E-05	2.29257E-05	2.77401E-05	0.000649983	0.000246781	0.130921825	6.11522E-06	5.626E-06	6.11522E-06	1.4731E-06	1.08718E-06	4321.6	839.5	2.91	118369.5	5.1478
Statewide	2020	OFF - Military - Crane	Aggregated	300	Diesel	1.69389E-05	2.01587E-05	2.4392E-05	0.000224082	0.000165689	0.132469362	4.1657E-06	3.83245E-06	4.1657E-06	1.49051E-06	1.09269E-06	4343.5	551.15	1.82	117946.1	7.8808
Statewide	2020	OFF - Military - Deicer	Aggregated	100	Diesel	5.83917E-05	6.94909E-05	8.4084E-05	0.000803486	0.000761945	0.136183461	4.24086E-05	3.90159E-05	4.24086E-05	1.5975E-06	1.10646E-06	4398.25	1102.3	3.67	121253	3.9901
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	50	Diesel	0.000253539	0.000301733	0.000365096	0.002173843	0.002284821	0.317555064	0.000107192	9.86163E-05	0.000107192	4.10519E-06	2.66194E-06	10581.35	8062.85	26.91	306388.3	1.3124
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	100	Diesel	0.007401944	0.008808925	0.010658799	0.101852787	0.096586918	17.26311041	0.00537587	0.0049458	0.00537587	0.000202505	0.000144434	574134.05	201965.45	672.1	16763132.35	2.8427
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	175	Diesel	0.007764063	0.009239877	0.011180251	0.125940771	0.10322619	24.61423259	0.004527992	0.004165753	0.004527992	0.000276952	0.000205545	817052.5	162581.95	541.01	23899546.65	5.0255
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	300	Diesel	0.002362261	0.002811285	0.003401655	0.017888903	0.035498895	9.86989595	0.001039824	0.000956638	0.001039824	0.000111053	8.19718E-05	325842.8	42956.85	142.9	9579377.55	7.5854
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	600	Diesel	0.001420651	0.001690692	0.002045738	0.011108047	0.020306101	6.247106504	0.000635343	0.000584516	0.000635343	6.13174E-05	5.18604E-05	206148.35	17406.85	57.91	6057583.8	11.8429
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	750	Diesel	7.62514E-05	9.07455E-05	0.000109802	0.000587686	0.001097802	0.330511718	3.39561E-05	3.12396E-05	3.39561E-05	3.3232E-06	2.74182E-06	10898.9	481.8	1.77	257763	22.6212
Statewide	2020	OFF - Military - Hydraulic unit	Aggregated	100	Diesel	0.000844689	0.00100525	0.001216352	0.011623153	0.011022227	1.970017591	0.000613479	0.000564401	0.000613479	2.31093E-05	1.64702E-05	65470.05	20096.9	66.9	1909205.5	3.2577
Statewide	2020	OFF - Military - Lift (Military)	Aggregated	100	Diesel	2.52146E-05	3.00075E-05	3.6309E-05	0.00034696	0.000329022	0.058806498	1.83128E-05	1.68478E-05	1.83128E-05	6.8983E-07	4.78395E-07	1901.65	481.8	1.77	45771	3.9470
Statewide	2020	OFF - Military - Light	Aggregated	50	Diesel	6.17785E-05	7.35216E-05	8.89611E-05	0.000529689	0.00055673	0.077376966	2.61188E-05	2.40293E-05	2.61188E-05	1.00029E-06	6.42758E-07	2555	1387	4.85	69350	1.8421
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	50	Diesel	1.23557E-05	1.47043E-05	1.77922E-05	0.000105938	0.000111346	0.015475393	5.22376E-06	4.80586E-06	5.22376E-06	2.00058E-07	1.01005E-07	401.5	189.8	0.78	9490	2.1154
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	100	Diesel	0.000167743	0.000199629	0.000241551	0.002308196	0.00218886	0.391217931	0.000121828	0.000112082	0.000121828	4.58919E-06	3.27164E-06	13004.95	4686.6	15.66	370241.4	2.7749
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	175	Diesel	0.000231183	0.000275127	0.000332904	0.003750019	0.003073669	0.732914613	0.000134826	0.00012404	0.000134826	8.24655E-06	6.10987E-06	24287.1	4686.6	15.66	693616.8	5.1822
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	300	Diesel	9.68935E-05	0.000115311	0.000139527	0.000733754	0.001456068	0.40483628	4.26508E-05	3.92387E-05	4.26508E-05	4.5551E-06	3.35979E-06	13355.35	1737.4	5.93	378753.2	7.6870
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	600	Diesel	3.80079E-05	4.52325E-05	5.47314E-05	0.000297183	0.000543267	0.167134251	1.69979E-05	1.56381E-05	1.69979E-05	1.64048E-06	1.35989E-06	5405.65	481.8	1.77	130086	11.2197
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	750	Diesel	4.47E-05	5.31967E-05	6.4368E-05	0.000344512	0.000643552	0.193751922	1.99056E-05	1.83132E-05	1.99056E-05	1.94812E-06	1.58578E-06	6303.55	189.8	0.78	118814.8	33.2115
Statewide	2020	OFF - Military - Pressure Washers	Aggregated	175	Diesel	4.45184E-05	5.29805E-05	6.41065E-05	0.000722132	0.000591889	0.141135587	2.59631E-05	2.3886E-05	2.59631E-05	1.58802E-06	1.14595E-06	4555.2	824.9	2.75	125384.8	5.5221
Statewide	2020	OFF - Military - Pump (Military)	Aggregated	50	Diesel	0.000558972	0.000665223	0.00080492	0.004792624	0.005037296	0.700106787	0.000236323	0.000217417	0.000236323	9.05063E-06	5.87205E-06	23341.75	17406.85	57.91	678867.15	1.3410
Statewide	2020	OFF - Military - Pump (Military)	Aggregated	100	Diesel	0.000597188	0.000710703	0.00085995	0.008217469	0.007792619	1.392785362	0.000433724	0.000399026	0.000433724	1.63381E-05	1.16431E-05	46282	13519.6	44.92	1351960	3.4233
Statewide	2020	OFF - Military - Start Cart	Aggregated	100	Diesel	1.32708E-05	1.57934E-05	1.911E-05	0.00018261	0.000173169	0.030950786	9.63832E-06	8.86725E-06	9.63832E-06	3.63069E-07	2.35984E-07	938.05	189.8	0.78	18980	4.9423
Statewide	2020	OFF - Military - Start Cart	Aggregated	600	Diesel	1.9919E-05	2.37052E-05	2.86833E-05	0.000155746	0.000284712	0.087590727	8.90815E-06	8.1955E-06	8.90815E-06	8.59732E-07	7.07952E-07	2814.15	189.8	0.78	53713.4	14.8269
Statewide	2020	OFF - Military - Test Stand	Aggregated	100	Diesel	0.000402903	0.000479488	0.00058018	0.005544052	0.005257421	0.939665855	0.000292619	0.00026921	0.000292619	1.10228E-05	7.84164E-06	31171	9906.1	32.99	911361.2	3.1466
Statewide	2020	OFF - Military - Test Stand	Aggregated	175	Diesel	2.77264E-05	3.29967E-05	3.9926E-05	0.000449749	0.000368633	0.087900233	1.617E-05	1.48764E-05	1.617E-05	9.89028E-07	7.14379E-07	2839.7	481.8	1.77	68415.6	5.8939
Statewide	2020	OFF - Military - Test Stand	Aggregated	300	Diesel	0.000452392	0.000538384	0.000651444	0.003425869	0.006798324	1.890164507	0.000199135	0.000183204	0.000199135	2.12676E-05	1.5698E-05	62400.4	9281.95	31	1828544.15	6.7228
Statewide	2020	OFF - Military - Test Stand	Aggregated	600	Diesel	0.000289705	0.000344773	0.000417175	0.002265196	0.004140899	1.273934344	0.000129562	0.000119197	0.000129562	1.25041E-05	1.05679E-05	42007.85	3500.35	11.62	1200620.05	12.0010
Statewide	2020	OFF - Military - Welder	Aggregated	50	Diesel	0.000181629	0.000216153	0.000261546	0.001557285	0.001636787	0.22748827	7.67893E-05	7.06462E-05	7.67893E-05	2.94086E-06	1.89981E-06	7551.85	6226.9	20.85	217941.5	1.2128
Statewide	2020	OFF - Military - Welder	Aggregated	100	Diesel	0.000477219	0.000567931	0.000687196	0.00656667	0.006227169	1.112990251	0.000346594	0.000318866	0.000346594	1.30559E-05	9.3053E-06	36989.1	17406.85	57.91	1079224.7	2.1250
Statewide	2020	OFF - Oil Drilling - Compressors (Workover)	Aggregated	25	Diesel	5.72952E-05	6.8186E-05	8.25051E-05	0.000280893	0.000514725	0.064511204	2.34589E-05	2.15821E-05	2.34589E-05	8.18525E-07	4.80232E-07	1908.95	3197.4	3.61	76737.6	0.5970
Statewide	2020	OFF - Oil Drilling - Generator (Drilling)	Aggregated	50	Diesel	5.52678E-05	6.57733E-05	7.95857E-05	0.00041605	0.000336735	0.041826722	1.94872E-05	1.79282E-05	1.94872E-05	5.40715E-07	3.19542E-07	1270.2	1113.25	0.59	36737.25	1.1410
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	25	Diesel	1.1073E-05	1.33983E-05	1.59451E-05	0.000235017	0.000187408	0.037273938	7.71792E-07	7.10049E-07	7.71792E-07	3.44284E-07	3.04225E-07	1209.311854	1673.244571	1.049714286	41831.11429	0.7227
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	50	Diesel	0.001682842	0.002036238	0.002423292	0.006078079	0.004294334	0.361909803	0.000564792	0.000519609	0.000564792	3.29555E-06	2.95386E-06	11741.765	9629.029143	8.397714286	406184.8434	1.2194
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	75	Diesel	0.0001142	0.000138182	0.000164449	0.001541311	0.001437063	0.215740258	8.64706E-05	7.9553E-05	8.64706E-05	1.9912E-06	1.76084E-06	6999.455066	3846.153143	4.198857143	269262.2114	1.8199
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	100	Diesel	0.001164372	0.00140889	0.001676695	0.009335964	0.012806104	1.190137139	0.000978956	0.000900639	0.000978956	1.09685E-05	9.71374E-06	38612.68878	16542.44743	12.59657143	1471894.151	2.3342
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	175	Diesel	0.005581457	0.006753563	0.008037298	0.057440843	0.0561008	8.769476705	0.003486482	0.003207564	0.003486482	8.09107E-05	7.15753E-05	284516.0139	75436.66743	62.98285714	10901186.46	3.7716
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	300	Diesel	0.00468877	0.005673412	0.006751829	0.023804064	0.066298077	10.19594214	0.001965722	0.001808464	0.001965722	9.41259E-05	8.32179E-05	330796.1139	56711.864	45.13771429	12689337.3	5.8329
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	600	Diesel	0.007373498	0.008921933	0.010617838	0.039666338	0.106182654	18.40919707	0.00334006	0.003072855	0.00334006	0.000169981	0.000150253	597266.1248	55740.87829	39.88914286	22925813.89	10.7150
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	750	Diesel	0.002006899	0.002428348	0.002889935	0.009544083	0.024911382	4.507752114	0.000913558	0.000840473	0.000913558	4.16162E-05	3.67917E-05	146249.053	8839.644	6.298285714	5609469.498	16.5447
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	9999	Diesel	0.001329566	0.001608775	0.001914575	0.006557851	0.028022016	3.22590371	0.000706518	0.000649997	0.000706518	2.97852E-05	2.63294E-05	104660.8932	5233.875429	3.149142857	4025248.046	19.9968
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	75	Diesel	1.11369E-05	1.34757E-05	1.60372E-05	0.000101572	0.000144868	0.012955971	1.06862E-05	9.83135E-06	1.06862E-05	1.1945E-07	1.05745E-07	420.3421992	218.4931507	1.092465753	16168.49315	1.9238
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	175	Diesel	0.000165833	0.000200658	0.0002388	0.002010734	0.001657281	0.298502641	0.000119628	0.000110058	0.000119628	2.75483E-06	2.43634E-06	9684.589446	2194.763699	2.184931507	372536.2842	4.4126
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	300	Diesel	0.001989989	0.002407886	0.002865584	0.011416591	0.019780203	4.245325816	0.000747345	0.000687558	0.000747345	3.91904E-05	3.46498E-05	137734.9207	24150.04795	43.69863014	5234422.12	5.7033
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	600	Diesel	0.090762945	0.109823164	0.130698641	0.533204508	1.022417074	258.5363165	0.033652739	0.030960519	0.033652739	0.002387574	0.002110139	8387926.062	822681.3356	588.8390411	322927522.8	10.1958

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	750	Diesel	0.000668996	0.000809485	0.000963354	0.004104062	0.005818624	2.071075271	0.000297073	0.000273307	0.000297073	1.9128E-05	1.69038E-05	67193.75628	3790.856164	2.184931507	2585003.39	17.7252
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	50	Diesel	0.000298091	0.000360691	0.000429252	0.002790143	0.002675769	0.366358625	0.000121496	0.000111776	0.000121496	3.37822E-06	2.99017E-06	11886.10211	15262.95938	38.7646857	705886.2397	0.7788
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	75	Diesel	0.002355471	0.00285012	0.003391879	0.0412691	0.03877251	6.275079026	0.001645281	0.001513658	0.001645281	5.79456E-05	5.12164E-05	203588.0282	199765.2037	507.3613276	13441309.9	1.0191
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	100	Diesel	0.003431454	0.004152059	0.004941293	0.098679204	0.053973907	14.7144911	0.003692129	0.003396759	0.003692129	0.00013594	0.000120098	477395.4588	365413.2041	928.0721813	31518652.45	1.3065
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	175	Diesel	0.003958643	0.004789959	0.005700447	0.111593902	0.067053433	19.89397777	0.002601145	0.002393054	0.002601145	0.000183811	0.000162372	645438.1995	303014.6348	769.593025	42613187.7	2.1301
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	300	Diesel	0.003098975	0.00374976	0.004462524	0.028090862	0.046487	14.21429561	0.00164517	0.001513556	0.00164517	0.000131325	0.000116015	461167.1667	106840.7157	271.3527999	30447226.47	4.3164
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	600	Diesel	0.005449158	0.006593481	0.007846787	0.046188272	0.08198596	24.14741483	0.002985502	0.002746662	0.002985502	0.000223091	0.000197088	783436.2805	104596.1628	265.6521109	51724111.3	7.4901
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	750	Diesel	0.001016917	0.00123047	0.001464361	0.008342905	0.01868328	4.399456862	0.000623119	0.000573269	0.000623119	4.06447E-05	3.59078E-05	142735.5328	13467.3171	34.20413444	9423700.136	10.5987
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	9999	Diesel	0.002805571	0.003394741	0.004040022	0.029531273	0.032851936	2.451712455	0.001447746	0.001331927	0.001447746	2.25831E-05	2.00105E-05	79543.11051	2693.463421	6.840826889	5251603.485	29.5319
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	50	Diesel	0.001534453	0.001856688	0.002209612	0.020201768	0.012180267	1.97702751	0.000330626	0.000304175	0.000330626	1.82326E-05	1.61362E-05	64142.48027	74884.09384	57.00689074	3809263.439	0.8566
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	75	Diesel	0.016726746	0.020239363	0.024086515	0.242540758	0.195499232	33.13797651	0.008088741	0.007441642	0.008088741	0.000305875	0.000270468	1075125.153	1049874.996	799.2366082	70982024.26	1.0241
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	100	Diesel	0.019444187	0.023527466	0.027999629	0.361275971	0.232785309	48.80112874	0.018257774	0.016797152	0.018257774	0.000450607	0.000398308	1583298.877	1066349.496	811.7781241	104532722.6	1.4848
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	175	Diesel	0.038649706	0.046766145	0.055655577	0.672493384	0.405985935	104.8385805	0.020740147	0.019080935	0.020740147	0.000968125	0.000855678	3401372.286	1544110.015	1175.482087	224565753.5	2.2028
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	300	Diesel	0.038196798	0.046218126	0.05500339	0.231404774	0.337418029	101.3018591	0.014478958	0.013320641	0.014478958	0.00093544	0.000826812	3286627.254	855176.3517	651.0186923	216990045.2	3.8432
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	600	Diesel	0.085972832	0.104027126	0.123800878	0.498533774	0.838093503	234.2809555	0.034335749	0.031588889	0.034335749	0.002163464	0.00191217	7600987.586	1180173.319	898.4285981	501833190.1	6.4406
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	750	Diesel	0.033610134	0.040668262	0.048398592	0.172559444	0.325191372	80.93739202	0.014849273	0.013661331	0.014849273	0.000747298	0.0006606	2625924.548	245619.8278	186.9826016	173369062.6	10.6910
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	9999	Diesel	0.214799677	0.25990761	0.309311535	1.052123626	3.353595134	490.7165795	0.108004671	0.099364297	0.108004671	0.004530474	0.004005163	15920758.99	718887.3009	547.2661511	1051122000	22.1464
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	50	Diesel	0.000213749	0.000258637	0.000307799	0.001861769	0.001805594	0.260012418	8.65404E-05	7.96172E-05	8.65404E-05	2.39753E-06	2.12219E-06	8435.816543	10840.2139	35.34427226	500982.3038	0.7782
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	75	Diesel	0.002179791	0.002637548	0.0031389	0.050398921	0.043456652	8.056974321	0.001418801	0.001305297	0.001418801	7.44253E-05	6.57599E-05	261399.6587	243030.602	792.3957813	17258155.36	1.0756
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	100	Diesel	0.004374031	0.005292578	0.006298605	0.122978284	0.088059477	19.37345448	0.005532364	0.005089775	0.005532364	0.000178986	0.000158124	628550.3947	450393.4034	1468.497505	41498219.3	1.3956
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	175	Diesel	0.012104073	0.014645928	0.017429865	0.328232145	0.220104592	59.06661584	0.008866532	0.008157209	0.008866532	0.000545737	0.000482094	1916351.301	890296.2773	2902.790877	126521544.2	2.1525
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	300	Diesel	0.005618573	0.006798473	0.008090745	0.050700073	0.081255215	25.2521814	0.002912593	0.002679585	0.002912593	0.0002333	0.000206105	819279.2152	219951.4369	717.1466855	54090537.25	3.7248
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	600	Diesel	0.009009882	0.010901958	0.012974231	0.079642315	0.14655659	41.30891237	0.005025284	0.004623261	0.005025284	0.000381651	0.000337158	1340222.168	188130.1639	613.3941444	88484286.88	7.1239
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	750	Diesel	0.004191512	0.00507173	0.006035778	0.036764386	0.075030996	19.57069123	0.002623517	0.002413636	0.002623517	0.000180815	0.000159733	634949.5239	58746.96566	191.5431529	41920703.27	10.8082
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	9999	Diesel	0.085905911	0.103946152	0.123704512	0.771185129	1.319038774	126.9051676	0.047442841	0.043647414	0.047442841	0.001170724	0.001035783	4117298.402	109451.192	356.863136	271832701.8	37.6177
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	50	Diesel	3.61605E-05	4.37542E-05	5.20711E-05	0.000680481	0.000683855	0.106114647	2.32394E-05	2.13802E-05	2.32394E-05	9.79998E-07	8.66093E-07	3442.772852	4205.182469	13.68165378	204457.7743	0.8187
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	75	Diesel	0.001727583	0.002090376	0.00248772	0.039062474	0.033989567	6.211601506	0.001142734	0.001051315	0.001142734	5.73775E-05	5.06983E-05	201528.57	186079.3243	605.4131797	13305340.13	1.0830
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	100	Diesel	0.002388731	0.002890364	0.003439772	0.064591223	0.047984982	10.19248676	0.002902803	0.002670578	0.002902803	9.41629E-05	8.31897E-05	330684.0079	234789.3545	763.8923359	21832453.84	1.4084
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	175	Diesel	0.003977645	0.004812951	0.005727809	0.104010949	0.074524022	18.71137333	0.003086637	0.002839706	0.003086637	0.000172877	0.00015272	607069.9007	282448.0892	918.9510787	40080031.9	2.1493
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	300	Diesel	0.003603947	0.004360776	0.005189684	0.034519921	0.054015097	17.41420758	0.001973087	0.00181524	0.001973087	0.000160895	0.000142132	564984.7868	148583.1139	483.4184335	37301484.14	3.8025
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	600	Diesel	0.009608736	0.01162657	0.01383658	0.090746253	0.171658525	49.07627721	0.006395923	0.005884249	0.006395923	0.000453446	0.000400554	1592225.766	225327.694	733.1086149	105122094.5	7.0663
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	750	Diesel	0.004409491	0.005335484	0.006349667	0.043803844	0.085610072	23.74949717	0.003442824	0.003167398	0.003442824	0.000219444	0.00019384	770526.2803	71838.53384	233.728252	50871765.93	10.7258
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	9999	Diesel	0.013012245	0.015744817	0.018737633	0.103580264	0.369007781	56.1703256	0.009576213	0.008810116	0.009576213	0.000518932	0.000458455	1822384.354	61325.57767	199.5241176	120317648.6	29.7165
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	50	Diesel	7.38828E-05	8.93982E-05	0.000106391	0.001524154	0.001313631	0.235993636	3.39026E-05	3.11903E-05	3.39026E-05	2.17966E-06	1.92615E-06	7656.553622	8823.655742	17.10206722	454703.804	0.8677
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	75	Diesel	0.000566558	0.000685536	0.000815844	0.011443739	0.009577718	1.752316136	0.00030443	0.000280076	0.00030443	1.6184E-05	1.43022E-05	56851.9672	55883.15304	108.3130924	3753486.47	1.0173
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	100	Diesel	0.000443753	0.000536941	0.000639004	0.01283264	0.007275286	1.9302812	0.00048262	0.00044401	0.00048262	1.78331E-05	1.57547E-05	62625.8477	45883.00986	88.93074956	4134690.207	1.3649
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	175	Diesel	0.004256856	0.005150796	0.006129873	0.135198491	0.076105212	24.52370212	0.002510238	0.002309419	0.002510238	0.000226606	0.000200159	795644.5074	375299.4909	727.4079259	52530124.12	2.1200
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	300	Diesel	0.003080514	0.003727423	0.004435941	0.037303011	0.036521998	19.68026078	0.001284054	0.001181329	0.001284054	0.000181861	0.000160628	638504.387	147649.1728	286.1745915	42155402.81	4.3245
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	600	Diesel	0.023982743	0.029019119	0.03453515	0.268073727	0.26324913	141.7724368	0.010996422	0.010116708	0.010996422	0.001310037	0.001157128	4599650.578	538831.244	1044.366238	303678607.1	8.5363
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	750	Diesel	0.002381541	0.002881664	0.003429418	0.023906739	0.022852226	12.24614826	0.001168418	0.001074945	0.001168418	0.00011315	9.99514E-05	397312.7937	38235.84155	74.10895796	26231426.44	10.3911
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	9999	Diesel	0.001478152	0.001788564	0.002128539	0.013186763	0.03480069	6.969135166	0.000834641	0.00076787	0.000834641	6.43888E-05	5.68811E-05	226105.9153	14117.84919	27.36330756	14927988.18	16.0156
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	50	Diesel	0.000152296	0.000184278	0.000219306	0.002325295	0.002020356	0.2503595	9.09877E-05	8.37087E-05	9.09877E-05	2.31013E-06	2.0434E-06	8122.638247	11228.54904	7.980964704	482383.4185	0.7234
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	75	Diesel	0.019004612	0.02299558	0.027366641	0.294442867	0.236840381	41.06901797	0.009406843	0.008654295	0.009406843	0.000379133	0.0003352	1332439.059	1272034.198	904.1292871	87970429.61	1.0475
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	100	Diesel	0.032970304	0.039894068	0.047477238	0.64660258	0.429091177	88.89802547	0.031698004	0.029162164	0.031698004	0.000820917	0.000725574	2884198.533	1902437.023	1352.203448	190420854.4	1.5161
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	175	Diesel	0.049258565	0.059602864	0.070932334	0.987186813	0.550107935	157.7817241	0.02250152	0.020701398	0.02250152	0.001457293	0.001287793	5119054.275	2250522.043	1599.613354	337970731.8	2.2746
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	300	Diesel	0.076454302	0.092509705	0.110094195	0.490385739	0.676469518	222.5618515	0.027110745	0.024941885	0.027110745	0.002055401	0.00181652	7220774.163	1865543.219	1325.980279	476730700.1	3.8706
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	600	Diesel	0.132607793	0.16045543	0.190955222	0.898913123	1.170971791	439.3969411	0.049750537	0.045770494	0.049750537	0.004058464	0.003586299	14255749.85	2160693.651	1535.765637	941194593.7	6.5978
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	750	Diesel	0.025742767	0.031148748	0.037069584	0.168039637	0.273499703	81.55362394	0.011111023	0.010222142	0.011111023	0.000753231	0.00066563	2645917.513	248632.1573	176.7213613	174689040.3	10.6419
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	9999	Diesel	0.288590583	0.349194606	0.41557044	1.755141757	4.763137489	855.8931787	0.14114734	0.129855553	0.14114734	0.007904499	0.006985685	27768511.58	1310532.081	931.4925947	1833335550	21.1887
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	50	Diesel	0.000237189	0.000286998	0.000341552	0.002288833	0.001542155	0.243975643	6.02171E-05	5.53997E-05	6.02171E-05	2.24856E-06	1.9913E-06	7915.521032	11098.55259	9.121102519	470083.2387	0.7132
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	75	Diesel	0.005763117	0.006973371	0.008298888	0.107098174	0.08149049	15.75506161	0.001830282	0.001683859	0.001830282	0.00014549	0.000128591	511155.6229	464751.8895	381.946168	33747569.51	1.0998
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	100	Diesel	0.003362602	0.004068748	0.004842146	0.075082657	0.040319361	10.08548888	0.003149994	0.002897995	0.003149994	9.31445E-05	8.23164E-05	327212.5796	235844.2425	193.8234285	21603262.84	1.3874
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	175	Diesel	0.011769697	0.014241333	0.016948363	0.254417323	0.127995613	41.4269034	0.005552216	0.005108039	0.005552216	0.000382659	0.000338121	1344050.257	621518.9448	510.781741	88737025.37	2.1625
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	300	Diesel	0.010393499	0.012576134	0.014966639	0.064452265	0.089133001	28.29711388	0.0036494	0.003357448	0.0036494	0.000261309	0.000230957	918068.6962	241393.5188	198.3839798	60612826.6	3.8032
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	600	Diesel	0.009121249	0.011036711	0.013134598	0.057461306	0.083969399	27.84036592	0.003483179	0.003204524	0.003483179	0.000257124	0.000227229	903250.0114	138731.9073	114.0137815	59634465.86	6.5108
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	750	Diesel	0.004501418	0.005446716	0.006482042	0.031040245	0.041778855	15.15840886	0.002150201	0.001978185	0.002150201	0.000140012	0.000123721	491797.8816	45781.52942	37.62454789	32469530.71	10.7423
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	9999	Diesel	0.091010247	0.110122399	0.131054756	0.845518432	1.145650043	114.1074379	0.046149662	0.042457689	0.046149662	0.00105225	0.00093133	3702090.157	99886.97328	82.08992267	244419780	37.0628
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	50	Diesel	0.000439871	0.000532244	0.000633414	0.005208092	0.004635148	0.563261834	0.000283098	0.00026045	0.000283098	5.19444E-06	4.59727E-06	18274.40989	20563.34738	21.66261848	1085272.057	0.8887
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	75	Diesel	0.005044797	0.006104204	0.007264507	0.108902757	0.088095977	16.74277055	0.00281104	0.002586157	0.00281104	0.000154644	0.000136652	543200.7517	472956.9897	498.2402251	35863256.32	1.1485
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	100	Diesel	0.009296095	0.011248274	0.013386376	0.177916961	0.128462612	24.75248545	0.009005322	0.008284897	0.009005322	0.00022857	0.000202026	803067.1304	570362.3193	600.8526284	53020181.31	1.4080
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	175	Diesel	0.01789788	0.021656435	0.025772947	0.398535659	0.223070015	66.30284803	0.009381422	0.008630908	0.009381422	0.000612466	0.000541155	2151122.885	931844.3206	981.6586586	142021658	2.3085
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	300	Diesel	0.026607945	0.032195614	0.038315441	0.214018085	0.283446795	104.4494429	0.010436578	0.009601651	0.010436578	0.000964889	0.000852502	3388747.145	905869.566	954.295351	223732215.2	3.7409
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	600	Diesel	0.024009606	0.029051623	0.034573833	0.179859207	0.246328738	90.95528561	0.010564831	0.009719644	0.010564831	0.000840206	0.000742365	2950944.072	458887.3309	483.4184335	194827535.4	6.4307
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	750	Diesel	0.001793916	0.002170638	0.002583239	0.011179572	0.02313256	5.610706039	0.001106445	0.001017929	0.001106445	5.18199E-05	4.57938E-05	182033.1783	17316.50305	18.24220504	12018213.37	10.5121
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	9999	Diesel	0.000241361	0.000292047	0.00034756	0.004361647	0.013482074	2.407569102	0.000278278	0.000256016	0.000278278	2.22519E-05	1.96503E-05	78110.92806	1082.281441	1.140137815	5157047.787	72.1725
Statewide	2020	TRU - Instate Genset TRU	Aggregated	50	Diesel	0.027953832	0.033824137	0.040253518	0.569462579	0.442498605	12.37506767	0.0018784	0.001728128	0.0018784	0.000114342	0.000101681	7855.244678	4732231.312	6061.362925	149065286.3	0.0017
Statewide	2020	TRU - Instate Trailer TRU	Aggregated	50	Diesel	0.55893336	0.676309365	0.804864038	8.663635237	6.199066511	147.5054518	0.118946807	0.109431062	0.118946807	0.00135614	0.001211995	93631.11745	37489892.85	28296.75798	1274656357	0.0025
Statewide	2020	TRU - Instate Truck TRU	Aggregated	25	Diesel	0.085734206	0.103738389	0.123457256	0.835697541	1.006758848	20.03943787	0.04179778	0.038453958	0.04179778	0.000183945	0.000164656	12720.30924	10088376.25	7412.473368	142246105.2	0.0013
Statewide	2020	TRU - Instate Van TRU	Aggregated	25	Diesel	0.001984807	0.002401616	0.002858122	0.019346983	0.023307172	0.463927015	0.000967648	0.000890236	0.000967648	4.25846E-06	3.81191E-06	294.4840636	365899.6569	268.8461843	3293096.912	0.0008
Statewide	2020	TRU - Out-of-State Genset TRU	Aggregated	50	Diesel	0.017533384	0.021215395	0.025248073	0.357943725	0.278676851	7.797867027	0.001190055	0.001094851	0.001190055	7.20527E-05	6.4072E-05	4949.803514	2981907.775	24116.89677	93930094.91	0.0017
Statewide	2020	TRU - Out-of-State Trailer TRU	Aggregated	50	Diesel	0.292687487	0.354151859	0.421469981	5.010861418	3.586090988	90.94566571	0.036660988	0.033728109	0.036660988	0.000837697	0.000747265	57729.01413	23114693.2	110162.4303	785899568.9	0.0025
Statewide	2020	TRU - Railcar TRU	Aggregated	50	Diesel	0.030296925	0.03665928	0.043627572	0.518688708	0.371206614	9.414047986	0.003794884	0.003491294	0.003794884	8.67124E-05	7.73516E-05	5975.696641	2392668.516	7420.737883	81350729.53	0.0025

Unit Conversion Rates

Global Warming Potential (rates)

	CO_2	CH_4	N_2O	units
global warming potential	1	25	298	unitless

Source: Intergovernmental Panel on Climate Change. *Climate Change 2007—The Physical Science Basis* . Working Group I Contribution to the Fourth Assessment Report. Available: https://www.ipcc.ch/report/ar4/wg1/. Accessed May 2, 2019.

Mass Conversion Rates

value	units	source
1,000	kg/MT	onlineconversion.com/weight_common.htm
1,000,000	g/MT	onlineconversion.com/weight_common.htm
2,000	lb/ton	onlineconversion.com/weight_common.htm
2,204.62	lb/MT	onlineconversion.com/weight_common.htm
453.59	g/lb	onlineconversion.com/weight_common.htm
1.1023	ton/MT	onlineconversion.com/weight_common.htm
2,204.62	lb/MT	onlineconversion.com/weight_common.htm
1,000,000	MT/MMT	million

Project Assumptions

Treatment Activity	Equipment Used	Offroad Equip Category	Crew Avg	Crew Max	Acres/Day	Hours/Day
Mechanical Treatment	Chainsaw	Chain Saw (25 hp)	1	2	3	8.0
	Feller/Buncher	Feller/Buncher (300 hp)	1	1	3	8.0
	Skidder	Skidder (300 hp)	1	1	3	8.0
	Yarder	Loader (300 hp)	1	1	3	8.0
	Masticator	Masticator (175 hp)	1	1	5	8.0
	Mower	Mower (25 hp)	1	1	3	8.0
	Crane (ES)	On road only	1	1	N/A	6.0
	Tractor (grader)	Tractor (175 hp)	1	1	2	8.0
Manual Treatment	Shovels	--	6	15	<1	8.0
	Pulaski hoes	--	6	15	<1	8.0
	McLeod fire tools	--	6	15	1	8.0
	Machetes	--	6	15	1	8.0
	Pruning shears	--	6	15	1	8.0
	Weed whips	--	6	15	4	8.0
	Weed wrenches	--	6	15	1	8.0
	Hand saws	--	6	15	1	8.0
	Loppers	--	6	15	1	8.0
	Chainsaws	Chain Saw (25 hp)	3	5	3	8.0
	Brush cutters	Other Offroad Ag Equip (50 hp)	3	6	4	8.0
Prescribed Burn	3-4 Fire trucks	--	4	4	25 (max)	8.0
	Water tender	--	2	2	25	8.0
	Drip torches	--	3	4	20	8.0
	1-2 Hand crews	--	6	15		8.0
Prescribed Herbivory (goats)	Fencing	--	2	2	<1	8.0
	Water trough	--				
			Number of Goats/Truck:		100	2 decks of 50
Herbicide Application	Backpack	--	2	2	2.5	8.0
	Hand Applicator	-- None	-	-	-	-

*Assumptions for crew size, acres/day, and hours/day apply to each treatment activity, as opposed to specific equipment

Acreages of Identified Treatment Projects	
Treatment Type	Acreage
Fire Hazard Reduction (FHR) Treatment	98.4
Fuelbreaks (FBs)	23.2
Temp Refuge Areas (TRAs)	1.54
Total	**123.14**

Emissions Per Acre Treated

Treatment/Fuel Type	Criteria Air Pollutants and Precursors					Greenhouse Gases			
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	source
Non-burning Activities	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
Mechanical Treatment	**6.9**	**7.1**	**0.35**	**0.30**	**2,101**	**--**	**--**	**0.9528**	wksht: Mechanical Treatment
Manual Treatment	**29**	**7.6**	**0.28**	**0.21**	**3,244**	**--**	**--**	**1.47**	wksht: Manual Treatment
Herbicide Treatment	**0.0008**	**0.0036**	**0.0001**	**0.0001**	**17**	**--**	**--**	**0.01**	wksht: Herbicide Appl
Prescribed Herbivory	**0.0060**	**0.026**	**0.0007**	**0.0007**	**237**	**--**	**--**	**0.11**	wksht: Presc Herbivory_Goats
	lb/day	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
Biomass Hauling Off Site	**0.032**	**0.38**	**0.021**	**0.014**	**99.8**	**--**	**--**	**0.045**	3 trips/day
lb/acre (based on 2.5 acres/day)	**0.013**	**0.151**	**0.008**	**0.006**				**0.018**	MT/acre (based on 2.5 acres/day)
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	
Prescribed Burning	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
Shrub/Chapparal	252	81	222	201	33,725	91	--	16.3	wksht: Prescribed Burn
Maximum Daily (25 acres):	6,296	2,015	5,540	5,037	843,121	2,266	--	408	
Worker Trips	0.0010	0.0045	0.0001	0.0001	21	--	--	0.010	
Biomass Disposal - per acre treated	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*MT/acre tx*	
Air Curtain (60%)	**2.8**	**3.1**	**4.0**	**4.0**	**5,269**	**15.4**	**0.49**	**2.6**	60% of biomass waste from each acre (= emissions/acre * 0.6)
Pile Burning (5%)	**0.77**	**0.51**	**3.3**	**2.7**	**439**	**1.29**	**0.04**	**0.22**	5 % of the biomass waste from each acre (= emissions/acre * 0.05)
Biomass Disposal - per day (2.5 acres)									
Air Curtain (60%)	**6.9**	**7.7**	**10.0**	**10.0**	**13,172**	**38.6**	**1.2**	**6.6**	
Pile Burning (5%)	**1.9**	**1.3**	**8.4**	**6.8**	**1,098**	**3.2**	**0.1**	**0.5**	

GHG Emissions - 200 Acres Treated per Year				+ air curtain & pile burning
		CO2eq	CO2eq	CO2eq
acres	treatment	MT/acre	Total MT	MT/acre
90	mechanical	0.95	85.75	3.80
90	manual	1.47	132.45	4.32
20	prescribed burn	16.3	326.51	
180	air curtain[1] - 60% biomass	2.63	473.67	
180	pile burning[2] - 5% biomass	0.22	39.47	
180	hauling offsite to air curtain[3]	0.018	3.26	**600 acres**
		Grand Total	**1061.1**	**3183.3**

1: 60% of biomass generated by manual or mechanical treatment activities will be burned off site in air curtain
2: 5% of biomass generated by manual or mechanical treatment activities will be burned on site in piles
3: truck emissions - hauling 60% of biomass off site

GHG Emissions - 200 Acres Treated per Year									
		ROG	ROG	NOx	NOx	PM10	PM10	PM2.5	PM2.5
acres	treatment	lb/acre	tons/year	lb/acre	tons/year	lb/acre	tons/year	lb/acre	tons/year
90	mechanical	6.9	0.31	7.1	0.32	0.35	0.02	0.30	0.01
90	manual	29.4	1.32	7.6	0.34	0.28	0.01	0.21	0.01
20	prescribed burn	252	2.52	81	0.81	222	2.22	201	2.01
180	air curtain[1] - 60% biomass	2.8	0.25	3.1	0.28	4.0	0.36	4.0	0.36
180	pile burning[2] - 5% biomass	0.77	0.07	0.51	0.05	3.3	0.30	2.7	0.25
180	hauling offsite to air curtain[3]	0.013	0.001	0.15	0.01	0.008	0.0008	0.006	0.0005
		Total	**4.5**	**Total**	**1.8**	**Total**	**2.9**	**Total**	**2.6**

1: 60% of biomass generated by manual or mechanical treatment activities will be burned off site in air curtain
2: 5% of biomass generated by manual or mechanical treatment activities will be burned on site in piles
3: truck emissions - hauling 60% of biomass off site

	ROG	NOx	PM10	PM2.5
180 acres Non-Burning	2.0	1.0	0.7	0.6
20 acres Prescribed Burning	2.5	0.8	2.2	2.0
TOTAL	**4.5**	**1.8**	**2.9**	**2.6**

Notes

1 Emissions estimates do not include emissions generated by trucks hauling equipment and livestock to and from treatment sites at the beginning and end of each treatment.

2 These emission estimates do not account for changes in carbon sequestration or reduced probability and intensity of wildfire over the long term.

3 These emission estimates do not account for any emissions associated with the removal of vegetative biomass from treatments sites and any processing activity that may occur thereafter, including chipping and mulching applications.

4 Approximately 65% of biomass generated by treatments will be disposed of by pile burning (5%) or burning in an air curtain (60%), thus values listed for biomass disposal are based on acres treated (not acres burned)

5 The emissions estimates do not include fugitive PM10 and PM2.5 emissions associated with ground disturbance and other activity by off-road equipment. SPR AQ-4, AQ-5, and AQ-6 would limit vehicle speeds on unpaved

	value	units	source
global warming potential of nitrous oxide	298	unitless	wksht: Unit Conversions
global warming potential of methane	25	unitless	wksht: Unit Conversions
mass conversion factor	2,204.62	lb/MT	wksht: Unit Conversions

Emissions Per Day

Treatment/Fuel Type	Criteria Air Pollutants and Precursors					Greenhouse Gases			
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	source
Non-burning Activities	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
Mechanical Treatment	**20.7**	**21.8**	**1.1**	**0.9**	**6,302**	**--**	**--**	**2.86**	wksht: Mechanical Treatment
Manual Treatment	**29.4**	**7.9**	**0.3**	**0.2**	**3,244**	**--**	**--**	**1.5**	wksht: Manual Treatment
Herbicide Treatment	**0.0020**	**0.0090**	**0.0002**	**0.0002**	**43**	**--**	**--**	**0.019**	wksht: Herbicide Appl
Prescribed Herbivory	**0.0020**	**0.0090**	**0.0002**	**0.0002**	**237**	**--**	**--**	**0.108**	wksht: Presc Herbivory_Goats
	lb/day	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
Biomass Hauling Off Site	**0.032**	**0.38**	**0.021**	**0.014**	**99.8**	**--**	**--**	**0.045**	3 trips/day
	ROG	NOx	PM10	PM2.5	CO2	CH4	N2O	CO2eq	
Prescribed Burning	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
Chaparral Shrub	252	81	222	201	33,725	91	--	16.3	wksht: Prescribed Burn
20 Acres	5,037	1,612	4,432	4,029					
Biomass Disposal - per acre treated	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*lb/acre tx*	*MT/acre tx*	
Air Curtain (60%)	**2.8**	**3.1**	**4.0**	**4.0**	**5,269**	**15.4**	**0.49**	**2.6**	60% of biomass waste from each acre (= emissions/acre * 0.6)
Pile Burning (5%)	**0.77**	**0.51**	**3.3**	**2.7**	**439**	**1.29**	**0.041**	**0.22**	5 % of the biomass waste from each acre (= emissions/acre * 0.05)
Biomass Disposal - per day (2.5 acres)	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	2.9
Air Curtain (60%)	**6.9**	**7.7**	**10.0**	**10.0**	**13,172**	**38.6**	**1.2**	**6.6**	60% of biomass waste from each acre (= emissions/acre * 0.6)
Pile Burning (5%)	**1.9**	**1.3**	**8.4**	**6.8**	**1,098**	**3.2**	**0.10**	**0.55**	5 % of the biomass waste from each acre (= emissions/acre * 0.05)
Non-burning Activities	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*				
Mechanical Treatment	**24**	**26**	**8.4**	**7.7**	**5.8**				
Manual Treatment	**33**	**12**	**7.7**	**7.0**	**4.4**				

Prescribed Burn Emissions				
	ROG	NOx	PM10	PM2.5
	lb/day	lb/day	lb/day	lb/day
20 acres:	5,037	1,612	4,432	4,029
tons:	**2.5**	**0.8**	**2.2**	**2.0**

East-West FB	0.50	0.50	28.62	18.83	8.06	7.31
Hearst Gate FB	1.0	0.0	32.97	11.91	7.67	6.97
Frowning FHR	0.50	0.50	26.84	17.04	4.38	3.94
		TOTAL	**88.43**	**47.77**	**20.11**	**18.23**

Emissions estimates do not include emissions generated by trucks hauling equipment and livestock to and from treatment sites at

Not More than one type of treatment may be performed on the same land in the same year. For example, manual

1 These emission estimates do not account for changes in carbon sequestration or reduced probability and intensity of wildfire over the long term.

2 Approximately 65% of biomass generated by treatments will be disposed of by pile burning (5%) or burning in an air curtain (60%), thus values listed for biomass disposal are based on acres treated (not acres burned)

3 The emissions estimates do not include fugitive PM10 and PM2.5 emissions associated with ground disturbance and other activity by off-road equipment. SPR AQ-4, AQ-5, and AQ-6 would limit vehicle speeds on unpaved roads, require

	value	units	source
global warming potential of methane	25	unitless	wksht: Unit Conversions
mass conversion factor	2,204.62	lb/MT	wksht: Unit Conversions

Identified Treatment Projects GHG Emissions

	Project Name	Treatment Type	Treatment Activities	Location	Acreage of Impacts	ITP Duration (weeks)	ITP Duration (workdays)
Fuel Break (typically, up to 8 weeks)	East-West FB	Fuel Break	Manual, mechanical, herbicide use	Claremont Ridge between UC Berkeley property and Claremont Canyon Regional Preserve	22.0	8 weeks	40 (over 2 years)
	Hearst Gate FB	Fuel Break	Manual, herbicide use	Between the Hill Campus and the Hearst Gate to LBNL	1.2	4 weeks	20 (over 2 years)
Evacuation Support Treament	~~Jordan EST~~	Evacuation Support	Manual, mechanical, herbicide use	Along upper and lower Jordan Fire Trail	~~86.8~~	Not in Plan	Not in Plan
Temporary Refuge Area (typically 4 weeks)	TRA 1	Temporary Refuge Area	Manual, mechanical, herbicide use	On the southeast side of Claremont Avenue at Signpost 29	0.1	4 weeks	20 (over 2 years)
	TRA 2	Temporary Refuge Area	Manual, mechanical, herbicide use	Along the Upper Jordan Fire Trail at Signpost 32	0.7	4 weeks	20 (over 2 years)
	TRA 3	Temporary Refuge Area	Manual, mechanical, herbicide use	South of and adjacent to the Upper Jordan Fire Trail	0.7	4 weeks	20 (over 2 years)
	TRA 4	Temporary Refuge Area	Manual, mechanical, herbicide use	Entirely within the existing paved Lawrence Hall of Science parking lot	0.0	0 weeks (existing parking lot)	0
Fire hazard Reduction (typically, up to 10 weeks)	Strawberry FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Strawberry Canyon near upper Centennial Drive and upper Jordan Fire Trail	23.7	not specified, assume 10 weeks	50 (over 2 years)
	Claremont FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Claremont Canyon north of Claremont Avenue	25.5	not specified, assume 10 weeks	50 (over 2 years)
	Frowning FHR Project	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas along Frowning Ridge near the upper Jordan Fire Trail	49.2	not specified, assume 10 weeks	50 (over 2 years)
				Total	123.1		

** Herbicide treatment will follow up other treatments, to prevent regrowth

Biomass Disposal

- ▸Incinerated using an air curtain at Richmond Field Station – 60 percent
- ▸Chipped or masticated and spread onsite – 20 percent
- ▸Chipped or masticated and hauled to other UC Berkeley properties – 10 percent
- ▸Burned onsite in piles – 5 percent
- ▸Left onsite as logs – 5 percent
- ▸Processed using a gasifier – negligible, used rarely

It is estimated that up to **600 haul truck trips** could be required to transport biomass from the Hill Campus to the Richmond Field Station and other locations over the course of implementation. As described below for each of the Identified Treatment Projects, implementation is expected to occur **over two years (2021 and 2022)**; however, implementation may be accelerated if required by the CCI Grant Program in coordination with CAL FIRE. Conservatively assuming these 600 haul truck trips would occur **over a total of 8 months** (although the implementation period will likely be greater), fewer than **3 haul trips per day** would be required to dispose of the biomass created.

TOTAL ANNUAL GHG EMISSIONS

Project	Acres Manual	Acres Mechanical	Acres Herbicide	Total Acres	GHGs (total ITP, 2 yrs) MT-CO2e	GHGs (1 year) MT-CO2e		
East-West FB	11.0	11.0	22.0	22.0	90.0	44.98		
Hearst Gate FB	1.20	0.00	1.2	1.2	5.22	2.61		
TRA 1	0.05	0.05	0.1	0.1	0.41	0.20		
TRA 2	0.35	0.35	0.7	0.7	2.9	1.43		
TRA 3	0.35	0.35	0.7	0.7	2.9	1.43		
TRA 4	0.0	0.0	0.0	0.0	0.00	0.00		
Strawberry FHR	0.0	23.7	23.7	23.7	90.76	45.38		
Claremont FHR	0.0	25.5	25.5	25.5	97.651	48.83		
Frowning FHR	24.6	24.6	49.2	49.2	201.17	100.59		
			TOTAL ITPs:	123.1	490.89	245.44	MT-CO2e/year	ITPs
ITPs (treatments + worker trips + hauling (60%) and burning (65%) of biomass):					**490.89**	**245.4**	MT-CO2e/year	ITPs + Pile Burning/Air Curtain
			Total max acres treated per year:	**300**	(x 490.9/123.1) =	**1196.3**	MT-CO2e/year	Possible under WVFMP in 1 year
			Total max acres treated per year:	**200**	(x 490.9/123.1) =	**797.5**	MT-CO2e/year	Possible under WVFMP in 1 year

Emission Rates

	CO2eq *MT/acre*	
Non-burning Activities		
Mechanical Treatment	0.95	
Manual Treatment	1.5	
Herbicide Treatment	0.0078	
Hauling Off Site (3 trips/day)	0.0452	MTCO2eq/day
2.5 acres/day	0.0181	MTCO2eq/acre
Pile Burning/Air Curtain	4.39	

Identified Treatment Projects Criteria Emissions

	Project Name	Treatment Type	Treatment Activities	Location	Acreage of Impacts	ITP Duration (weeks)	ITP Duration (workdays)
Fuel Break (typically, up to 8 weeks)	East-West FB	Fuel Break	Manual, mechanical, herbicide use	Claremont Ridge between UC Berkeley property and Claremont Canyon Regional Preserve	22.0	8 weeks	40 (over 2 years)
	Hearst Gate FB	Fuel Break	Manual, herbicide use	Between the Hill Campus and the Hearst Gate to LBNL	1.2	4 weeks	20 (over 2 years)
Evacuation Support Treament	~~Jordan EST~~	Evacuation Support	Manual, mechanical, herbicide use	Along upper and lower Jordan Fire Trail	~~86.8~~	Not in Plan	Not in Plan
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	TRA 2	Temporary Refuge Area	Manual, mechanical, herbicide use	Along the Upper Jordan Fire Trail at Signpost 32	0.7	4 weeks	20 (over 2 years)
	TRA 3	Temporary Refuge Area	Manual, mechanical, herbicide use	South of and adjacent to the Upper Jordan Fire Trail	0.7	4 weeks	20 (over 2 years)
	TRA 4	Temporary Refuge Area	Manual, mechanical, herbicide use	Entirely within the existing paved Lawrence Hall of Science parking lot	0.0	0 weeks (existing parking lot)	0
Fire hazard Reduction (typically, up to 10 weeks)	Strawberry FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Strawberry Canyon near upper Centennial Drive and upper Jordan Fire Trail	23.7	not specified, assume 10 weeks	50 (over 2 years)
	Claremont FHR Project	Fire Hazard Reduction	Mechanical, herbicide use	Areas in Claremont Canyon north of Claremont Avenue	25.5	not specified, assume 10 weeks	50 (over 2 years)
	Frowning FHR Project	Fire Hazard Reduction	Manual, mechanical, herbicide use	Areas along Frowning Ridge near the upper Jordan Fire Trail	49.2	not specified, assume 10 weeks	99 (over 2 years)
				Total	123.1		

Biomass Disposal

- ▸Incinerated using an air curtain at Richmond Field Station – 60 percent
- ▸Chipped or masticated and spread onsite – 20 percent
- ▸Chipped or masticated and hauled to other UC Berkeley properties – 10 percent
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It is estimated that up to **600 haul truck trips** could be required to transport biomass from the Hill Campus to the Richmond Field Station and other locations over the course of implementation. As described below for each of the Identified Treatment Projects, implementation is expected to occur **over two years (2021 and 2022)**; however, implementation may be accelerated if required by the CCI Grant Program in coordination with CAL FIRE. Conservatively assuming these 600 haul truck trips would occur **over a total of 8 months** (although the implementation period will likely be greater), fewer than **3 haul trips per day** would be required to dispose of the biomass created.

** Herbicide treatment will follow up other treatments, to prevent regrowth

**Assume maximum of 3 treatments per day over 2.5 acres (assumes 2 FB and 1 FHR).

TOTAL PROJECT EMISSIONS

Project	Acres Manual	Acres Mechanical	Acres Herbicide	Total Acres	Project Days	ROG *lb/project*	NOx *lb/project*	PM10 *lb/project*	PM2.5 *lb/project*	ROG *avg lb/day*	NOx *avg lb/day*	PM10 *avg lb/day*	PM2.5 *avg lb/day*	
East-West FB	11.0	11.0	22.0	22.0	40	629.2	409.6	177.0	160.7	15.7	10.2	4.4	4.0	
Hearst Gate FB	1.20	0.00	1.2	1.2	20	39.5	14.0	9.2	8.4	2.0	0.7	0.46	0.42	
TRA 1	0.05	0.05	0.1	0.1	20	2.9	1.9	0.8	0.7	0.14	0.09	0.040	0.037	
TRA 2	0.35	0.35	0.7	0.7	20	20.0	13.0	5.6	5.1	1.0	0.65	0.28	0.26	
TRA 3	0.35	0.35	0.7	0.7	20	20.0	13.0	5.6	5.1	1.0	0.65	0.28	0.26	
TRA 4	0.0	0.0	0.0	0.0	0	--	--	--	--	--	--	--	--	
Strawberry FHR	0.0	23.7	23.7	23.7	50	574.6	605.4	199.8	181.1	11.5	12.1	4.0	3.6	
Claremont FHR	0.0	25.5	25.5	25.5	50	618.2	651.4	215.0	194.9	12.4	13.0	4.3	3.9	
Frowning FHR	24.6	24.6	49.2	49.2	100	1407.1	915.9	395.9	359.4	14.1	9.2	4.0	3.6	
	37.6	85.6	**TOTAL ITPs:**	**123.1**		**3312**	**2624**	**1009**	**915**	ITPs (incl worker trips) + Hauling + Pile Burning & Air Curtain				
			Assume 60% of biomass will be burned in off site air curtain:	73.9		341.8	379.7	493.7	493.7					
			Assume 5% of biomass will be burned by on site pile burning:	6.2		94.9	63.3	411.4	335.4					
			All ITPs + 65% Burning of Waste Biomass:			**437**	**443**	**905**	**829**					

2,000 lb/ton

		ROG	NOx	PM10	PM2.5
Worker Trips	Worker Commute (1 worker)	*lb/day/wrkr* 1.02E-03	*lb/day/wrkr* 4.49E-03	*lb/day/wrkr* 1.23E-04	*lb/day/wrkr* 1.13E-04

Daily Emissions - Maximum Treatments per Day (2 Fuel Breaks + 1 Fire Hazard Reduction)

Project	Acres/Day Manual	Acres/Day Mechanical	Acres/Day Herbicide	Max Acres/Day
East-West FB	0.50	0.50	1.0	1.0
Hearst Gate FB	1.0	0.0	1.0	1.0
Frowning FHR	0.25	0.25	0.50	0.50

Total Max Daily (assume max of 3 concurrent treatments over total of 2.5 acres, i.e. 2 FB and 1 FHR):

Daily Emissions - Project Treatments

Project	Acres/Day Manual	Acres/Day Mechanical	Acres/Day Herbicide	Max Acres/Day
TRA 1	0.05	0.05	0.1	0.1
TRA 2	0.25	0.25	0.5	0.5
TRA 3	0.25	0.25	0.5	0.5
TRA 4	0.0	0.0	0.0	0.0
Strawberry FHR	0.0	0.5	0.5	0.5
Claremont FHR	0.0	0.5	0.5	0.5

MAXIMUM DAILY EMISSIONS (2 FB + 1 FHR)

Project	ROG *lb/day*	NOx *lb/day*	PM10 *lb/day*	PM2.5 *lb/day*
East-West FB	25.1	15.0	0.7	0.6
Hearst Gate FB	29.4	8.1	0.3	0.2
Frowning FHR	25.0	14.9	0.7	0.6
Biomass Hauling	0.0	0.4	0.0	0.0
TOTAL:	**79.5**	**38.0**	**1.7**	**1.4**
Threshold:	**54**	**54**	**82**	**54**

Project	ROG *lb/day*	NOx *lb/day*	PM10 *lb/day*	PM2.5 *lb/day*
TRA 1	25.0	1.5	0.07	0.06
TRA 2	12.5	7.5	0.3	0.3
TRA 3	12.5	7.5	0.3	0.3
TRA 4	0.0	0.0	0.0	0.0
Strawberry FHR	10.3	11.0	0.5	0.5
Claremont FHR	10.3	11.0	0.5	0.5
Biomass Hauling	0.0	0.4	0.0	0.0

*Doesn't include air curtain or pile burning, includes hauling

ITP Emissions (over 2 years)

Project	Project Acres	Max Acres/Day	[1]Extra Days Worker Trips	Days Equip Use	ROG *tons*	NOx *tons*	PM10 *tons*	PM2.5 *tons*
East-West FB	22.0	1	18	22	0.28	0.17	0.01	0.01
Hearst Gate FB	1.2	1	18	2	0.03	0.01	0.00	0.00
Frowning FHR	49.2	0.5	0	99	1.24	0.74	0.03	0.03
[2]TRA 1	0.1	0.5	17	3	0.0376	0.0023	0.0001	0.0001
[2]TRA 2	0.7	0.5	17	3	0.019	0.011	0.001	0.000
[2]TRA 3	0.7	0.5	17	3	0.019	0.011	0.001	0.000
[2]TRA 4	0.0	0.5	20	0	1E-05	4E-05	1E-06	1E-06
Strawberry FHR	23.7	0.5	2	48	0.25	0.26	0.01	0.01
Claremont FHR	25.5	0.5	0	51	0.26	0.28	0.01	0.01
Biomass Hauling	123.1	2.5	--	231	0.004	0.044	0.002	0.002
ITP TOTAL	123.1	2.5			**2.14**	**1.52**	**0.07**	**0.06**
				BAAQMD Threshold:	**10**	**10**	**15**	**10**

EMISSION RATES

	Non-burning Activities	ROG *lb/day*	NOx *lb/day*	PM10 *lb/day*	PM2.5 *lb/day*
Treatment Activity	Mechanical Treatment	20.7	21.79	1.1	0.90
	Manual Treatment	29.4	7.9	0.3	0.2
	Herbicide Treatment	0.0020	0.0090	0.0002	0.0002
Biomass Disposal	Biomass Disposal	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*
	Air Curtain (60% acres treated)	4.6	5.14	6.68	6.68
	Pile Burning (5% acres treated)	15.4	10.28	66.84	54.50
Biomass Hauling	Biomass Hauling Off Site	*lb/day*	*lb/day*	*lb/day*	*lb/day*
	Hauling Off Site, 3 trips/day (lb/day)	0.0324	0.3778	0.0210	0.0139
		lb/acre	*lb/acre*	*lb/acre*	*lb/acre*
	Max 2.5 acres/day (lb/acre)	0.0130	0.1511	0.0084	0.0056
Worker Trips	Worker Commute (1 worker)	lb/day/wrkr 1.02E-03	lb/day/wrkr 4.49E-03	lb/day/wrkr 1.23E-04	lb/day/wrkr 1.13E-04

Manual Treatment

Crew Parameters	value	units	source
Crew size, average	6	workers	
Crew size, max	15	workers	
Area treated per day, average	1.0	acres	
Daily treatment activity duration	8.0	hr/day	

Non-Mechanized Equipment
Shovels
Pulaski hoes
McLeod fire tools
Machetes
Pruning shears
Weed wrenches
Hand saws
Loppers

Equipment List

	Mechanized Equipment	Comparable Equipment Type in OFFROAD2017 -ORION	Engine Size (hp)	source/notes
3	Chain Saw (25 hp) x3	OFF - Logging - Chainsaws	25	See Notes 1, 2, and 3
6	Brush Cutter (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	50	See Notes 1, 2, and 3
6	Weed Whip (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	50	See Notes 1, 2, and 3

Notes

1 The Comparable Equipment Type in OFFROAD2017 -ORION identifies how the equipment type is listed in CARB's web-based OFFROAD2017-ORION model.

2 It is assumed that all equipment would be operated for approximately 8 hours per day (9am-5pm).

3 Additional equipment and vehicles may include a fire engine present on site in the event that treatment activity ignites a fire. Emissions generated by these equipment types are not included and expected to be nominal.

Sources

1 California Air Resources Board. 2017. OFFROAD2017-ORION. Available at https://www.arb.ca.gov/orion/. Accessed December 23, 2019.

Off-road Equipment Emission Rates

	Mechanized Equipment	Comparable Equipment Type in OFFROAD2017 -ORION	ROG lb/day	NOx lb/day	PM10 lb/day	PM2.5 lb/day	CO2 MT/day	Fuel Usage gal/day
3	Chain Saw (25 hp) x3	OFF - Logging - Chainsaws	25.67	0.55	0.09	0.07	0.08	19.76
6	Brush Cutter (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	1.84	3.46	0.09	0.07	0.62	79.04
6	Weed Whip (50 hp) x6	OFF - Agricultural - Other Agricultural Equipment	1.84	3.46	0.09	0.07	0.62	79.04

Source: wksht Off-road Equip Emiss Rts

Off-road Equipment Emissions	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	*gal/day*	
Total Daily Emissions by One Treatment Crew	29.3	7.5	0.28	0.21	1.33	177.85	summation

Equipment Daily Emissions for One Treatment Crew	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***MT/crew/day***	***gal/crew/day***	
	29	**7.5**	**0.28**	**0.21**	**1.3**	**178**	summation
w/ Worker Trip Emissions:	**29**	**7.6**	**0.28**	**0.21**	**1.5**		

Emissions of One Treatment Crew Per Acre Treated	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/acre***	***lb/acre***	***lb/acre***	***lb/acre***	***MT/acre***	***gal/acre***	
	29.3	**7.48**	**0.28**	**0.21**	**1.33**	**178**	calculation
w/ Worker Trip Emissions:	**29**	**7.55**	**0.28**	**0.21**	**1.47**		

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (max = 15 workers)	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	1.53E-02	6.74E-02	1.84E-03	1.70E-03	1.46E-01	calculation

Worker Trip Emissions of One Treatment Crew Per Acre Treated	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	1.53E-02	6.74E-02	1.84E-03	1.70E-03	1.46E-01	calculation

Mechanical Treatment

Crew Parameters	value	units	source	
Crew size, average	8	workers	UCB (RB)	
Crew size, max	9	workers	UCB (RB)	
Area treated per day, average	3.0	acres	UCB (RB)	
Daily treatment activity duration	8.0	hr/day	UCB (RB)	
Daily treatment activity duration	6.0	hr/day	UCB (RB)	crane only

Representative Equipment List

Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	Engine Size (hp)	source/notes
Chain Saw (25 hp) x2	OFF - Logging - Chainsaws	25	See Notes 1, 2
Feller/Buncher (175 hp)	OFF - Logging - Fellers/Bunchers	175	See Notes 1, 2
Feller/Buncher (300 hp)	OFF - Logging - Fellers/Bunchers	300	See Notes 1, 2
Skidder (175 hp)	OFF - Logging - Skidders	175	See Notes 1, 2
Skidder (300 hp)	OFF - Logging - Skidders	300	See Notes 1, 2
Loader (300 hp)	ConstMin - Rubber Tired Loaders	300	See Notes 1, 2
Masticator (175 hp)	ConstMin - Excavators	175	See Notes 1, 2
Crane (300 hp)	ConstMin - Cranes	300	See Notes 1, 2
Tractor (175 hp)	OFF - Agricultural - Agricultural Tractors	175	See Notes 1, 2
Mower (25 hp)	OFF - Agricultural - Agricultural Mowers	25	See Notes 1, 2

Notes

1. The Comparable Equipment Type in OFFROAD2017 -ORION identifies how the equipment type is listed in CARB's web-based OFFROAD2017-ORION model.
2. It is assumed that all equipment other than the crane would be operated for approximately 8 hours per day (9am-5pm). The crane will be operated for 6 hours per day.
3. Additional equipment and vehicles may include a fire engine present on site in the event that treatment activity ignites a fire. Emissions generated by this equipment are not included and expected to be nominal.

Sources

1. California Air Resources Board. 2017. OFFROAD2017-ORION. Available at https://www.arb.ca.gov/orion/. Accessed December 23, 2019.

Off-road Equipment Emission Rates (Actual Equipment Used)

	Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	ROG *lb/day*	NOx *lb/day*	PM10 *lb/day*	PM2.5 *lb/day*	CO2 *MT/day*	Fuel Usage *gal/day*
2	Chain Saw (25 hp) x2	OFF - Logging - Chainsaws	17.12	0.37	0.06	0.04	0.05	13.18
1	Feller/Buncher (300 hp)	OFF - Logging - Fellers/Bunchers	0.49	2.53	0.08	0.07	0.71	70.50
1	Skidder (300 hp)	OFF - Logging - Skidders	0.55	2.75	0.09	0.08	0.76	76.14
1	Loader (300 hp)	ConstMin - Rubber Tired Loaders	0.37	4.32	0.14	0.13	0.32	31.44
1	Masticator (175 hp)	ConstMin - Excavators	0.23	2.25	0.11	0.10	0.24	23.09
1	*Crane (300 hp)	ConstMin - Cranes	0.32	3.82	0.16	0.14	0.20	19.87
1	Tractor (175 hp)	OFF - Agricultural - Agricultural Tractors	0.95	4.83	0.07	0.06	0.47	57.04
1	Mower (25 hp)	OFF - Agricultural - Agricultural Mowers	0.61	0.50	0.34	0.26	0.021	4.79

*Crane emissions based on 6 hrs/day operation

Source: wksht Off-road Equip Emiss Rts

Off-road Equipment Emissions

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	*gal/day*	
Daily Off-road Emissions by One Treatment Crew	20.6	21.4	1.05	0.89	2.8	296	summation

Equipment Daily Emissions for One Treatment Crew

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***lb/crew/day***	***MT/crew/day***	***gal/crew/day***	
	21	**21**	**1.0**	**0.89**	**2.8**	**296**	summation
w/ Worker Trip Emissions:	**20.6**	**21.4**	**1.0**	**0.89**	**2.9**		

Emissions of One Treatment Crew Per Acre Treated

	ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	source
units:	***lb/acre***	***lb/acre***	***lb/acre***	***lb/acre***	***MT/acre***	***gal/acre***	
	6.880	**7.123**	**0.349**	**0.295**	**0.924**	**98.7**	calculation
w/ Worker Trip Emissions:	**6.883**	**7.136**	**0.350**	**0.296**	**0.953**		

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates

	lb/crew/day	lb/crew/day	lb/crew/day	lb/crew/day	MT/crew/day	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (max = 9 workers)

	lb/crew/day	lb/crew/day	lb/crew/day	lb/crew/day	MT/crew/day	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	9.17E-03	4.04E-02	1.11E-03	1.02E-03	8.77E-02	calculation

Worker Trip Emissions of One Treatment Crew Per Acre Treated

units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	3.06E-03	1.35E-02	3.69E-04	3.40E-04	2.92E-02	calculation

Off-Road Equipment Exhaust Emission Rates

Output from OFFROAD2017

OFFROAD2017 (v1.0.1) Emissions Inventory
Region Type: Statewide
Region: California
Calendar Year: 2020

Model Year: Aggregate
Scenario: All Adopted Rules - Exhaust
Vehicle Classification: OFFROAD2017 Equipment Types

VehClass	HP Bin	Fuel Type	ROG (tons/day)	NOx (tons/day)	PM10 (tons/day)	PM2.5 (tons/day)	CO2 (tons/day)	Annual Activity (hr/year)	Fuel Usage (gal/hr)
OFF - Logging - Chainsaws	25	Gasoline	1.183974572	0.02552499	0.004040885	0.003053113	7.712523258	807982.25	0.823508685
OFF - Logging - Fellers/Bunchers	175	Diesel	0.05307901	0.330474559	0.013646889	0.012555138	145.540412	785768.35	6.152927132
OFF - Logging - Fellers/Bunchers	300	Diesel	0.040395319	0.207844263	0.006442462	0.005927065	127.9385994	479398.3	8.812032709
OFF - Logging - Skidders	175	Diesel	0.038472065	0.231356875	0.009543865	0.008780356	101.3390411	528432.4	6.371732884
OFF - Logging - Skidders	300	Diesel	0.018403251	0.091388252	0.002838928	0.002611813	56.03461827	194413.6	9.51802343
ConstMin - Rubber Tired Loaders	300	Diesel	0.215713077	2.508087642	0.083264026	0.076602904	410.4821603	3388731.793	3.929978068
ConstMin - Excavators	175	Diesel	0.073428465	0.72197501	0.03509013	0.03228292	166.4622268	1871529.053	2.885706537
ConstMin - Cranes	300	Diesel	0.041169462	0.494114741	0.020202206	0.018586029	57.90677848	567252.29	3.311968392
OFF - ConstMin - Crushing/Proc. Equipment	25	Gasoline	0.002738475	0.002244552	0.001550291	0.001171331	0.20548052	15727.85	0.996518914
OFF - ConstMin - Crushing/Proc. Equipment	100	Gasoline	0.001292353	0.004485861	9.23473E-05	6.97735E-05	1.324499833	6599.2	8.006637168
OFF - Agricultural - Agricultural Mowers	25	Gasoline	0.0406493	0.03304239	0.02270675	0.017156211	3.009625667	386743.05	0.599337467
OFF - Agricultural - Agricultural Tractors	175	Gasoline	0.005482774	0.027987315	0.000429935	0.000324839	5.997188891	33817.25	7.130167296
ConstMin - Tractors/Loaders/Backhoes	175	Diesel	0.06678754	0.656892718	0.033096747	0.030449007	142.2627484	1698591.506	2.717285575
ConstMin - Crawler Tractors	300	Diesel	0.061739809	0.766138971	0.030743122	0.028283673	78.22487497	553582.907	4.58453447
ConstMin - Excavators	175	Diesel	0.073428465	0.72197501	0.03509013	0.03228292	166.4622268	1871529.053	2.885706537
Agricultural - Sprayers/Spray rigs	50	Diesel	0.020769762	0.064307446	0.00505936	0.004654611	0.964854499	242929.7419	0.92020828
ConstMin - Off-Highway Trucks	25	Diesel	0.000397361	0.000977343	0.000101019	0.000092937	0.106877717	6318.77412	0.548766227
Agricultural - Combine Harvesters	300	Diesel	0.089238701	0.989567915	0.036368474	0.033458996	17.64369847	752536.5261	5.432091062
ConstMin - Rubber Tired Dozers	300	Diesel	0.008868161	0.094461534	0.004600388	0.004232357	6.945496914	50470.09062	4.464802728
OFF - Agricultural - Other Agricultural Equipment	50	Gasoline	0.000319456	0.00060276	1.65202E-05	0.000012482	0.239635187	6095.5	1.646706587
Agricultural - Sprayers/Spray rigs	50	Diesel	0.020769762	0.064307446	0.00505936	0.004654611	0.964854499	242929.7419	0.92020828
ConstMin - Graders	300	Diesel	0.139600375	1.74555588	0.057891833	0.053260486	214.6264786	1518857.616	4.584577023
ConstMin - Excavators	300	Diesel	0.071885027	0.821343499	0.025046186	0.023042491	211.7060725	1591024.607	4.317073627

Chippers = OFF - ConstMin - Crushing/Proc. Equipment
Masticators = ConstMin - Excavators
Harvesters = harvesters
Dozers = dozers

Dozer Transports = on-road, ‘T7 Utility’ in EMFAC
Forwarders = on-road, ‘T7 Tractor Construction’ in EMFAC

Source: wksht raw OFFROAD2017 output

Note: These equipment may be used in one or more types of treatments

	value	units	source	
time conversion rate	365	days/year	Earth	
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions	2204.62 lb/MT
mass conversion rate	1.1023	ton/MT	wksht: Unit Conversions	
daily equipment use	8	hr/day	assumption	
daily equipment use - chainsaw	8	hr/day	assumption	
daily equipment use - crane only	6	hr/day	assumption	

Exhaust Emission Rates, hourly

		ROG	**NOx**	**PM10**	**PM2.5**	**CO2**	**Fuel Usage**	
units:	HP Bin	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*MT/hr*	*gal/hr*	
OFF - Logging - Chainsaws	25	1.07	0.02	0.004	0.003	0.003	0.824	Gasoline
OFF - Logging - Fellers/Bunchers	175	0.05	0.31	0.013	0.012	0.061	6.153	Diesel
OFF - Logging - Fellers/Bunchers	300	0.06	0.32	0.010	0.009	0.088	8.812	Diesel
OFF - Logging - Skidders	175	0.05	0.32	0.013	0.012	0.064	6.372	Diesel
OFF - Logging - Skidders	300	0.07	0.34	0.011	0.010	0.095	9.518	Diesel
ConstMin - Rubber Tired Loaders	300	0.05	0.54	0.018	0.017	0.040	3.930	Diesel
ConstMin - Excavators	300	0.03	0.28	0.014	0.013	0.029	2.886	Diesel
ConstMin - Cranes*	300	0.05	0.64	0.026	0.024	0.034	3.312	Diesel
OFF - ConstMin - Crushing/Proc. Equipment	25	0.13	0.10	0.072	0.054	0.004	0.997	Gasoline
OFF - ConstMin - Crushing/Proc. Equipment	100	0.14	0.50	0.010	0.008	0.066	8.007	Gasoline
OFF - Agricultural - Agricultural Mowers	25	0.08	0.06	0.043	0.032	0.003	0.599	Gasoline
ConstMin - Tractors/Loaders/Backhoes	175	0.03	0.28	0.014	0.013	0.028	2.717	Diesel
ConstMin - Crawler Tractors	300	0.08	1.01	0.041	0.037	0.047	4.585	Diesel
ConstMin - Excavators	175	0.03	0.28	0.014	0.013	0.029	2.886	Diesel
Agricultural - Sprayers/Spray rigs	50	0.06	0.19	0.015	0.014	0.001	0.920	Diesel
ConstMin - Off-Highway Trucks	25	0.05	0.11	0.012	0.011	0.006	0.549	Diesel
Agricultural - Combine Harvesters	300	0.09	0.96	0.035	0.032	0.008	5.432	Diesel
ConstMin - Rubber Tired Dozers	300	0.13	1.37	0.067	0.061	0.046	4.465	Diesel
OFF - Agricultural - Agricultural Mowers	25	0.08	0.062	0.043	0.032	0.003	0.599	Gasoline
OFF - Agricultural - Agricultural Tractors	175	0.12	0.604	0.0093	0.0070	0.059	7.130	Gasoline
OFF - Agricultural - Other Agricultural Equipment	50	0.038	0.072	0.0020	0.0015	0.013	1.647	Gasoline
Agricultural - Sprayers/Spray rigs	50	0.062	0.193	0.0152	0.0140	0.001	0.920	Diesel
ConstMin - Graders	300	0.067	0.839	0.0278	0.0256	0.047	4.585	Diesel
ConstMin - Excavators	300	0.033	0.377	0.0115	0.0106	0.044	4.317	Diesel

Source: Calculations using values in the above table.

Exhaust Emission Rates, daily

			ROG	NOx	PM10	PM2.5	CO2	Fuel Usage	
units:	HP Bin		*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	*gal/day*	
OFF - Logging - Chainsaws	25	8 hrs/day	8.56	0.184	0.029	0.022	0.025	6.59	Gasoline
OFF - Logging - Fellers/Bunchers	175		0.39	2.46	0.10	0.09	0.5	49.2	Diesel
OFF - Logging - Fellers/Bunchers	300		0.49	2.53	0.08	0.07	0.7	70.5	Diesel
OFF - Logging - Skidders	175		0.43	2.56	0.11	0.10	0.5	51.0	Diesel
OFF - Logging - Skidders	300		0.55	2.75	0.09	0.08	0.8	76.1	Diesel
ConstMin - Rubber Tired Loaders	300		0.37	4.32	0.14	0.13	0.3	31.4	Diesel
ConstMin - Excavators	175		0.23	2.25	0.11	0.10	0.2	23.1	Diesel
ConstMin - Cranes*	300	6 hrs/day	0.32	3.82	0.16	0.14	0.20	19.87	Diesel
OFF - ConstMin - Crushing/Proc. Equipment	25		1.02	0.83	0.58	0.43	0.0	8.0	Gasoline
OFF - ConstMin - Crushing/Proc. Equipment	100		1.14	3.97	0.08	0.06	0.5	64.1	Gasoline
OFF - Agricultural - Agricultural Mowers	25		0.61	0.50	0.34	0.26	0.0	4.8	Gasoline
ConstMin - Tractors/Loaders/Backhoes	175		0.23	2.26	0.11	0.10	0.2	21.7	Diesel
ConstMin - Crawler Tractors	300		0.65	8.08	0.32	0.30	0.4	36.7	Diesel
ConstMin - Excavators	175		0.23	2.25	0.11	0.10	0.2	23.1	Diesel
Agricultural - Sprayers/Spray rigs	50		0.50	1.55	0.12	0.11	0.01	7.36	Diesel
ConstMin - Off-Highway Trucks	25		0.37	0.90	0.09	0.09	0.04	4.39	Diesel
Agricultural - Combine Harvesters	300		0.69	7.68	0.28	0.26	0.06	43.46	Diesel
ConstMin - Rubber Tired Dozers	300		1.03	10.93	0.53	0.49	0.36	35.72	Diesel
OFF - Agricultural - Agricultural Mowers	25		0.61	0.50	0.34	0.26	0.02	4.79	Gasoline
OFF - Agricultural - Agricultural Tractors	175		0.95	4.83	0.074	0.056	0.47	57.04	Gasoline
OFF - Agricultural - Other Agricultural Equipment	50		0.31	0.58	0.016	0.012	0.10	13.17	Gasoline
Agricultural - Sprayers/Spray rigs	50		0.50	1.55	0.122	0.112	0.01	7.36	Diesel
ConstMin - Graders	300		0.54	6.71	0.223	0.205	0.37	36.68	Diesel
ConstMin - Excavators	300		0.26	3.01	0.092	0.085	0.35	34.54	Diesel

<u>Source:</u> Calculations using the above table.

*Crane only operated 6 hrs/day

Truck Hauling Activity and Exhaust Emissions

Haul Truck Emission Rates (running exhaust, running loss, brake wear, tire wear)

	ROG	NOx	PM10	PM2.5	CO2	units	Fuel Use	units
T6 instate construction heavy	0.408	4.760	0.264	0.176	1,257	g/mile	0.12444	gal/mile
	Source: wksht: On-Rd Veh Emiss Rates						Source: wksht: raw EMFAC2017-ALAMEDA	

	value	units	source
mass conversion rate	453.59	g/lb	wksht: Unit Conversions
mass conversion rate	1,000,000	g/MT	wksht: Unit Conversions

Destination of chipped biomass (energy)	Hill Campus to the Richmond Field Station (6 miles 1-way)							
Trip distance (1-way)	6	miles/trip	Prog Desc					
Trucks per day	3	haul trucks						
VMT associated with chipped biomass								
Daily VMT	36	VMT/day	calculation					
					MT-CO2	Gallons		
Haul Truck Emissions (exhaust, loss, wear)	ROG	NOx	PM10	PM2.5	CO2	Fuel use		
	lb/day	lb/day	lb/day	lb/day	MT/day	gal/day		
Daily CO2					0.045			CO2 lb/day
Annual CO2					4.52			99.75885
Daily (per each 1-way trip)	0.005	0.06	0.003	0.002	0.008	0.75		
1 day = 3 roundtrips	0.032	0.378	0.021	0.014		4.48	per day	
	lb/year	lb/year	lb/year	lb/year	MT/year	gal/year		
1 year = 300 round trips	3.24	37.78	2.10	1.39		448	per year	
Annual TOTAL	**3.2**	**37.8**	**2.1**	**1.4**	**4.5**	**448**	per year	

Running Exhaust Emission Rates for On-Road Vehicles

Source: These emission rates were provided by the California Air Resources Board's Mobile Source Emissions Inventory (EMFAC2017), which is availal

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Model Year: Aggregated
Region: ALAMEDA
Speed: Aggregated
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL

						1.0002	
Vehicle Category	**Fuel**	**Population**	**VMT**	**Trips**	**ROG_RUNEX**	**SAFE_CORR**	**ROG_IDLEX**
			VMT/day	trips/day	g/mile	g/mile	g/veh/day
LDA	GAS	643,846	23,456,819	3,010,602	0.012	0.012	0.000
LDA	DSL	7,140	264,939	33,234	0.020	0.020	0.000
LDT1	GAS	66,399	2,359,125	304,135	0.025	0.025	0.000
LDT1	DSL	46	742	150	0.217	0.217	0.000
LDT2	GAS	212,628	7,710,663	988,229	0.017	0.017	0.000
LDT2	DSL	1,221	52,545	5,987	0.016	0.016	0.000
T6 instate construction heavy	DSL	438	29,829	1,982	0.408	0.408	0.074

Exhaust Emissions of ROG, PM, and NOx corrected for changes due to Federal SAFE Rule Part 1. see: https://ww3.arb.ca.gov/msei/emfac_off_mod

Source: wksht: raw EMFAC2017-ALAMEDA

ble at http://www.arb.ca.gov/emfac/2017/.

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			1.0002					
ROG_STREX	**ROG_RUNLOSS**	**NOx_RUNEX**	**SAFE_CORR**	**NOx_IDLEX**	**NOx_STREX**	**CO2_RUNEX**	**CO2_IDLEX**	**CO2_STREX**
g/trip	g/mile	g/mile	g/mile	g/veh/day	g/trip	g/mile	g/veh/day	g/trip
0.290	0.246	0.047	0.047	0.000	0.224	270.751	0.000	57.715
0.000	0.000	0.114	0.114	0.000	0.000	216.593	0.000	0.000
0.428	0.767	0.107	0.107	0.000	0.297	314.123	0.000	67.280
0.000	0.000	1.203	1.204	0.000	0.000	423.872	0.000	0.000
0.382	0.469	0.086	0.086	0.000	0.341	343.247	0.000	74.346
0.000	0.000	0.049	0.049	0.000	0.000	290.670	0.000	0.000
0.000	0.000	4.759	4.760	5.082	1.909	1256.940	660.524	0.000

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				1.0009				
CH4_RUNEX	**CH4_IDLEX**	**CH4_STREX**	**PM10_RUNEX**	**SAFE_CORR**	**PM10_IDLEX**	**PM10_STREX**	**PM10_PMTW**	**PM10_PMBW**
g/mile	g/veh/day	g/trip	g/mile	g/mile	g/mile	g/mile	g/veh/day	g/trip
0.003	0.000	0.062	0.002	0.002	0.000	0.002	0.008	0.037
0.001	0.000	0.000	0.011	0.011	0.000	0.000	0.008	0.037
0.006	0.000	0.084	0.002	0.002	0.000	0.003	0.008	0.037
0.010	0.000	0.000	0.180	0.180	0.000	0.000	0.008	0.037
0.004	0.000	0.080	0.002	0.002	0.000	0.002	0.008	0.037
0.001	0.000	0.000	0.006	0.006	0.000	0.000	0.008	0.037
0.019	0.003	0.000	0.122	0.122	0.012	0.000	0.012	0.130

	1.0009			
PM2_5_RUNEX	**SAFE_CORR**	**PM2_5_IDLEX**	**PM2_5_PMTW**	**PM2_5_PMBW**
g/mile	g/mile	g/mile	g/mile	g/mile
0.001	0.001	0.000	0.002	0.016
0.010	0.010	0.000	0.002	0.016
0.002	0.002	0.000	0.002	0.016
0.172	0.172	0.000	0.002	0.016
0.001	0.001	0.000	0.002	0.016
0.005	0.005	0.000	0.002	0.016
0.117	0.117	0.011	0.003	0.056

Prescribed Burn

Equipment/Personnel	Avg	Max
Fire truck personnel	4	4
Water tender	2	2
Drip torches	3	4
Hand crew personnel	6	15
Total:	15	25

Crew Parameters	value	units	source
Crew size, average	15	workers	
Crew size, max	25	workers	
Area treated per day, max	25	acres/day	
Daily treatment activity duration	8.0	hr/day	

Method

Total emissions from a fire are estimated by multiplying an emission factor by the biomass consumed and an accurate assessment of the total acreage burned. For instance, assume that 10 tons/acre of fuel is consumed during a 200-acre landscape prescribed fire in a ponderosa stand in the western U.S. After the fire, ground surveys and aerial reconnaissance indicate a mosaic fire pattern and only 100 acres of the 200 acres within the fire perimeter actually burned (i.e., "black acres"). Because the emission factor for $PM_{2.5}$ for pine fuels is approximately 46 lb/ton, then total emission production would calculated using the following equation:

Fuel consumed (kg/acre) x $PM_{2.5}$ *emission factor (lb/ton) x area burned (acres) x consumption factor = total emissions* $PM_{2.5}$ *(lb)*

10,000 kg/acre x 11 g/kg x 10 acres x 0.53 = 583 kg or 1,286 lbs of $PM_{2.5}$ *emissions*

Table A. Calculated Prescribed Burn Emissions (Per Acre)[1]

Prescribed Burn Vegetation Type	Total Fuel Loading (kg/acre)	Percent Composition (1 acre)	Size (acres)	Fuel Consumption Factor[2]	Pollutant Emissions (lb/acre burned)										
					CO_2	CO	CH_4	NMOC[3]	$PM_{2.5}$	PM_{10}	NOx	N_2O	SO_2	CO_2e	CO_2e (MT/acre)
Chaparral	11,433	100%	1	0.80	33,725	2,035	90.66	251.83	201.46	221.61	80.59	N/A	N/A	35,991	16.33
TOTAL (1 acre)		**100%**			**33,725**	**2,035**	**91**	**252**	**201**	**222**	**81**	**0.0**	**0.0**	**35,991**	**16.3**
Pile (Mixed)	5,693		1	0.41	8,781	190.23	25.71	15.42	54.50	66.84	10.28	0.82	N/A	9,669	4.39
Air Curtain (Mixed)	5,693		1	0.41	8,781	190.23	25.71	4.63	6.68	6.68	5.14	0.82	N/A	9,669	4.39
Daily Emissions (assumes 2.5 acres/day)					**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**	**lb/day**
Pile (Mixed)					21,953	476	64	39	136	167	26	N/A	N/A	24,173	11
Air Curtain (Mixed)					21,953	476	64	12	16.7	16.7	13	2.1	N/A	24,173	11

Notes:

1: These values are calculated based on Emissions Factors in Table B. Results do not include emissions generated bytransport of equipment, or the use of drip torches or Heli torches. The level of emissions from these sources would be nominal compared to the level of emissions generated by the burning of vegetative fuels.

2: From NWCG 2018: National Wildfire Coordinating Group. 2018. NWCG Smoke Management Guide for Prescribed Fire, Table 4.2.4. See: https://www.nwcg.gov/publications/420-2

3: It is assumed that the estimate for NMOC is approximately equivalent to ROG.

Table B. Fire Average Emissions Factors

Prescribed Burn Vegetation Type	[1]Fuel Loading (kg/acre)	[2]Pollutant Emission Factors (g of emissions/kg of fuel consumed)								
		[3]CO_2	CO	[3]ROG	[4]$PM_{2.5}$	[4]PM_{10}	NOx	CH_4	[7]N_2O	SO_2
Piled (Mixed)[5]	5,693	1,708	37	3.0	10.6	13	2	5.0	0.16	NA
Chaparral	11,433	1,674	101	12.5	10	11	4	4.5	N/A	NA
Air Curtain Incinerator (Mixed)[6]	5,693	1,708	37	0.9	1.3	1.3	1	5.0	0.16	NA

Sources:

(1) FEMA (2014). East Bay Hills EIS https://www.fema.gov/media-library/assets/documents/100411

(2) USEPA (1996). "Miscellaneous Sources - Wildfires and Prescribed Burning." In Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources (AP-42), 5th Ed.

(3) Urbanski (2014). "Wildland fire emissions, carbon, and climate: Emission factors." See: http://dx.doi.org/10.1016/j.foreco.2013.05.045 (CO_2 all; ROG for pile/air curtain)

(4) USDA Forest Service (2005). "The Use of Air Curtain Destructors for Fuel Reduction and Disposal" https://www.fs.fed.us/t-d/pubs/pdf/hi_res/05511303hi.pdf

(5) ROG, NOx, PM2.5, CO2, CH4 EFs from Springsteen et al. (2015): https://www.fs.usda.gov/treesearch/pubs/52990 PM10 EF from Springsteen et al. (2011): https://doi.org/10.3155/1047-3289.61.1.63

(6) ROG, PM, and NOx EFs from SJVAPCD Internal Memo: Clerico & Villegas (2017) "Air Curtain Incinerator Emissions Factors Determination."
https://www.valleyair.org/busind/pto/emission_factors/Criteria/Criteria/Air-Curtain-Incinerators/EF-Determination-Analysis.pdf

(6) CO2 and CH4 EFs from Springsteen et al. (2015) (Table 6). https://www.fs.usda.gov/treesearch/pubs/52990

(7) N2O values from Urbanski 2014, Table 1, for prescribed burning of NW conifer http://dx.doi.org/10.1016/j.foreco.2013.05.045

	value	units	source
global warming potential of nitrous oxide	298	unitless	wksht: Unit Conversions
global warming potential of methane	25	unitless	wksht: Unit Conversions
mass conversion factor	2,204.62	lb/MT lb/1000kg	wksht: Unit Conversions

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (max = 25 workers)

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	2.55E-02	1.12E-01	3.07E-03	2.83E-03	2.44E-01	calculation

Worker Trip Emissions of One Average Treatment Crew Per Acre Treated

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	calculation

Prescribed Herbivory - goats

Crew Parameters	value	units	source
Crew size	2	workers	
Area treated per day, average (goats)	0.3	acres/day	
Daily treatment activity duration	8.0	hr/day	

Livestock Emissions (goats)	value	units	source
type of livestock used for grazing in tree dominated landscape	goats	n/a	assumption
proxy livestock	sheep	n/a	assumption
weight of goat, avg.	60	lb/head	assumption
number of trucks used to transport herd	1	truck/herd	assumption
livestock double-decker trailer dimensions (Featherlite model 8261)			
length	53	ft	Source 1
width	8.5	ft	Source 1
area of trailer (each deck)	450.5	sq. ft.	calculation
number of 60-lb goats per running foot of truck floor	3.6	head/run ft.	Source 2
number of goats total	50	head	Project Description
grazing rate of goats			
goats	7	goats	Source 3
days	21	days	Source 3
acre	1.0	acre	Source 3
grazing rate	147	goats/acre-day	calculation
Area grazed by one truckload of goats	**0.34**	**acres/day**	**calculation**
methane emission rate of goats (enteric fermentation)	5	kg/head/year	Source 4
time conversion rate	365	days/year	Earth
mass conversion rate	1,000	kg/MT	wksht: Unit Conversions
methane emission rate of goats	1.37E-05	MT/day/goat	conversion calculation
methane emissions of goats, daily	6.85E-04	MT/day	calculation
methane emissions of goats, per area	0.0020	MT/acre	calculation
global warming potential of methane	25	unitless	wksht: Unit Conversions
CO2-e emissions of goats, per area	0.050	MT/acre	calculation

Total Daily Emissions by One Treatment Herd	CO2-eq	CO2-eq	
units:	*MT/day*	*MT/acre*	
	0.017	**0.050**	calculation
w/ Worker Trip Emissions	0.037	**0.108**	calculation

Sources

1 Featherlite Trailers. 2019. Model 8261 Double-decker Livestock Trailer. Available: https://www.fthr.com/products/livestock-trailers/semi/8261-livestock-trailer. Accessed January 27, 2020.

2 National Institute for Animal Agriculture. 2001. Livestock Trucking Guide. Available: https://www.stopliveexports.org/images/documents/Resources/Reports/Livestock_Trucking_Guide.pdf. Accessed May 2, 2019.

3 Nader, G., Henkin, Z., Smith, E., Ingram, R., and Narvaez, N. 2007. *Planned Herbivory in the Management of Wildfire Fuels*. Society for Range Management. Available: https://journals.uair.arizona.edu/index.php/rangelands/article/view/12320. Accessed May 2, 2019.

4 Intergovernmental Panel on Climate Change. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Prepared by the National Greenhouse Gas Inventories Programme, Eggleston HAS., Biennia L., Miwa K., Negara T. and Tanabe K. (eds). Vol.4, Chap. 10: Livestock and Manure Management. Published: IGES, Japan. Available: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf.

Notes

1 Livestock do not emit criteria air pollutants or precursors (e.g., ROG, NOx, PM10, or PM2.5).

WORKER TRIP EMISSIONS

On road Vehicle Emission Rates

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*	
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts

On road Vehicle Emissions (2 workers)

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	2.04E-03	**8.99E-03**	**2.46E-04**	**2.27E-04**	**1.95E-02**	calculation

Worker Trip Emissions of One Treatment Crew Per Acre Treated

units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	5.99E-03	**2.64E-02**	**7.23E-04**	**6.66E-04**	5.73E-02	calculation

Herbicide Application

Crew Parameters

	value	units	source
Workers per crew, average	2	workers	
Area treated per day, average	2.5	acres	
Daily equipment use	8.0	hr/day	

Herbicide treatment activities will entail each crew member applying herbicide via a hand applicator from herbicide stock carried in backpack.
Therefore no emissions would be generated other than worker trip emissions.

Equipment List (if a vehicle spray rig is ever used)

Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	Engine Size (hp)	source/notes
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs	50	See Notes 1 and 2
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs	50	See Notes 1 and 2

Notes

1 The Comparable Equipment Type in OFFROAD2017 -ORION identifies how the equipment type is listed in CARB's web-based OFFROAD2017-ORION model.

2 It is assumed that all equipment is used for approximately 8 hours per day.

Sources

1 California Air Resources Board. 2017. OFFROAD2017-ORION. Available at https://www.arb.ca.gov/orion/. Accessed December 24, 2019.

2 Application of herbicides would also result in off-gas emissions of ROG. The level of emissions would be a function of the type of herbicide used, the application rate (gallons/acre), and the number of applications.

Off-road Equip Emission Rates

(not used for backpack sprayer rig)

Equipment Type	Comparable Equipment Type in OFFROAD2017 -ORION	ROG	NOx	PM10	PM2.5	CO2
	units:	lb/day	lb/day	lb/day	lb/day	MT/day
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs	0.50	1.55	0.12	0.11	0.01
Vehicle with spray rig	Agricultural - Sprayers/Spray rigs	0.50	1.55	0.12	0.11	0.01

Source: wksht Off-road Equip Emiss Rts

Off-road Equip Emissions

(not used for backpack sprayer rig)

	ROG	NOx	PM10	PM2.5	CO2	source	
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*		
Total Daily Emissions by One Treatment Crew	1.0	3.1	0.2	0.2	0.02	summation	(not included in total)

On road Vehicle Emission Rates

	ROG	NOx	PM10	PM2.5	CO2	source	(Worker Trips)
units:	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*lb/day/wrkr*	*MT/day/wrkr*		
Exhaust Emissions	1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03	wksht: Worker Trip Exh Emiss Rts	

On road Vehicle Emissions (2 workers)

	ROG	NOx	PM10	PM2.5	CO2	source	(Worker Trips)
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*		
	2.04E-03	8.99E-03	2.46E-04	2.27E-04	1.95E-02	calculation	

Total Daily Emissions by One Treatment Crew

	ROG	NOx	PM10	PM2.5	CO2	source
units:	*lb/day*	*lb/day*	*lb/day*	*lb/day*	*MT/day*	
	2.04E-03	**8.99E-03**	**2.46E-04**	**2.27E-04**	**1.95E-02**	summation

Total Emissions of One Treatment Crew Per Acre Treated

units:	*lb/acre*	*lb/acre*	*lb/acre*	*lb/acre*	*MT/acre*	
	8.15E-04	**3.59E-03**	**9.83E-05**	**9.06E-05**	**7.79E-03**	calculation

Worker Trip Exhaust Emissions

Commute Trips by Workers

	value	units	source
Trip rate for crew workers	2	trips/day	assumption
Avg. worker commute trip length	16.8	miles/trip	Source 1, CARB 2017:D-86 (default worker trip length in CalEEMod V2016.3.2 for home-to-work trips, Alameda county)
Daily VMT by a single crew worker	33.6	VMT/day	calculation

Mix of passenger vehicles used in employee commutes

breakdown of passenger car VMT in Alameda County	value	units	source
light duty autos - gasoline	23,456,819	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty autos - diesel	264,939	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - gasoline	2,359,125	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - diesel	742	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - gasoline	7,710,663	VMT/day	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - diesel	52,545	VMT/day	wksht: On-Rd Veh Emiss Rates
Total, all passenger vehicle types	33,844,832	VMT/day	summation

relative portion of passenger car VMT by veh type	value	units	source
light duty autos - gasoline	69.3%	%	calculation
light duty autos - diesel	0.8%	%	calculation
light duty trucks 1 - gasoline	7.0%	%	calculation
light duty trucks 1 - diesel	0.00%	%	calculation
light duty trucks 2 - gasoline	22.8%	%	calculation
light duty trucks 2 - diesel	0.16%	%	calculation
Total, all passenger vehicle types	100.0%	%	summation

Emission Rates (running exhaust only; not including running loss, brake ware, and tire wear) Emission rates are corrected to reflect the recent "post-SAFE" adjustments to EMFAC.

	ROG	NOx	PM10	PM2.5	CO2	units	source
light duty autos - gasoline	0.012	0.047	0.002	0.001	270.751	g/mile	wksht: On-Rd Veh Emiss Rates
light duty autos - diesel	0.020	0.114	0.011	0.010	216.593	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - gasoline	0.025	0.107	0.002	0.002	314.123	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 1 - diesel	0.217	1.204	0.180	0.172	423.872	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - gasoline	0.017	0.086	0.002	0.001	343.247	g/mile	wksht: On-Rd Veh Emiss Rates
light duty trucks 2 - diesel	0.016	0.049	0.006	0.005	290.670	g/mile	wksht: On-Rd Veh Emiss Rates
Composite emiss rates - all pass vehicles	**0.014**	**0.061**	**0.0017**	**0.0015**	**289.901**	**g/mile**	**Sumproduct calculation**

	value	units	source
mass conversion rate	453.59	g/lb	wksht: Unit Conversions
mass conversion rate	1,000,000	g/MT	wksht: Unit Conversions

Commute Emissions *of a Single Worker* (exhaust only, round trip)

ROG	NOx	PM10	PM2.5	CO2
lb/day/wrkr	lb/day/wrkr	lb/day/wrkr	lb/day/wrkr	MT/day/wrkr
1.02E-03	4.49E-03	1.23E-04	1.13E-04	9.74E-03

Source: calculations

Sources

1 California Air Pollution Control Officers Association. 2017 (November). *California Emissions Estimator Model Version 2016.3.2 User's Guide* . Available http://www.caleemod.com/. Accessed December 24, 2019.

Output from OFFROAD2017 Model Run

OFFROAD2017 (v1.0.1) Emissions Inventory
Region Type: Statewide
Region: California
Calendar Year: 2020
Scenario: All Adopted Rules - Exhaust
Vehicle Classification: OFFROAD2017 Equipment Types
Units: Emissions: tons/day, Fuel Consumption: gallons/year, Activity: hours/year, HP-Hours: HP-hours/year

Source: California Air Resources Board. 2017. OFFROAD2017-ORION computer program, Version 1.0.1 (web-based). Sacramento, CA. Available: https://www.arb.ca.gov/orion/?bay Accessed December 23, 2019.

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	50	Diesel	1.174893524	1.421621164	1.691846674	3.661714451	3.297612359	45.01836351	0.315889953	0.290618757	0.315889953	0.000383762	0.000369898	10430249.63	9311653.087	25996.44037	379403510.8	1.1201
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	75	Diesel	1.079248722	1.305890953	1.554118159	4.211739898	7.997859024	80.1763049	0.62658175	0.57645521	0.62658175	0.000713864	0.000658777	18575950.11	10514434.3	28229.09296	663170144.2	1.7667
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	100	Diesel	1.552987137	1.879114436	2.236301478	9.749911448	13.09971466	214.0655554	1.049749589	0.965769622	1.049749589	0.001945828	0.001758893	49596586.94	20709267.73	34749.80848	1775062239	2.3949
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	175	Diesel	1.214506651	1.469553047	1.748889577	7.09577752	11.50062471	150.5682992	0.659165283	0.606432061	0.659165283	0.001364981	0.001237161	34884985.25	11107977.14	17144.87696	1351017012	3.1405
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	300	Diesel	1.000148894	1.210180161	1.440214407	3.665666301	10.92254709	161.5721221	0.465994799	0.428715215	0.465994799	0.00147383	0.001327575	37434447.53	6783003.223	8568.806453	1469895813	5.5189
Statewide	2020	Agricultural - Agricultural Tractors	Aggregated	600	Diesel	0.443596919	0.536752272	0.638779564	1.881081794	4.445913926	113.278701	0.196122145	0.180432373	0.196122145	0.001041035	0.000930767	26245403.82	2864401.43	2568.188081	1051843155	9.1626
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	50	Diesel	0.001280879	0.001549864	0.001844466	0.007552208	0.008084587	0.129773362	0.000477471	0.000439273	0.000477471	1.16944E-06	1.0663E-06	30067.03177	29477.48265	45.99841127	1031711.893	1.0200
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	100	Diesel	0.006560775	0.007938538	0.009447516	0.057290535	0.061315729	1.322500137	0.005042412	0.004639019	0.005042412	1.21124E-05	1.08665E-05	306408.4406	125841.9494	202.113679	10512139.25	2.4349
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	175	Diesel	0.013974716	0.016909406	0.020123591	0.134192004	0.142509049	3.223286484	0.008548642	0.00786475	0.008548642	2.95815E-05	2.64845E-05	746799.3068	223195.2816	357.2412699	28767296.71	3.3459
Statewide	2020	Agricultural - Bale Wagons (Self Propelled)	Aggregated	300	Diesel	0.003159606	0.003823123	0.004549833	0.013323921	0.038042555	0.884978234	0.001489216	0.001370079	0.001489216	8.14216E-06	7.27152E-06	205039.5257	40430.10859	64.99637194	7821670.77	5.0715
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	50	Diesel	0.012135549	0.014684014	0.017475191	0.052390648	0.059443602	0.937897158	0.004014391	0.003693239	0.004014391	8.36542E-06	7.70634E-06	217300.2465	161225.8946	495.018737	7405267.781	1.3478
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	75	Diesel	0.005420175	0.006558412	0.007805052	0.03575526	0.051386362	0.831645955	0.003380635	0.003110185	0.003380635	7.57795E-06	6.83331E-06	192683.0351	102365.0354	312.6240517	6634925.959	1.8823
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	100	Diesel	0.001114069	0.001348023	0.001604259	0.007394109	0.010283976	0.171982558	0.000751879	0.000691728	0.000751879	1.56731E-06	1.41311E-06	39846.42878	17276.7729	52.92957485	1370138.623	2.3064
Statewide	2020	Agricultural - Balers (Self Propelled)	Aggregated	175	Diesel	0.000753353	0.000911558	0.001084829	0.005943969	0.008531708	0.145369193	0.000438413	0.00040334	0.000438413	1.33042E-06	1.19444E-06	33680.41059	12233.94059	37.53435701	1294385.771	2.7530
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	75	Diesel	0.000942918	0.00114093	0.001357801	0.005275969	0.007967445	0.118305486	0.000600252	0.000552232	0.000600252	1.07284E-06	9.7207E-07	27410.05356	17201.92587	47.58589721	1059811.742	1.5934
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	100	Diesel	0.006153571	0.007445821	0.008861142	0.034434148	0.05172082	0.77103328	0.004133207	0.00380255	0.004133207	6.99179E-06	6.33528E-06	178639.7584	79702.18414	219.5106039	6803396.683	2.2413
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	175	Diesel	0.011474849	0.013884568	0.016523783	0.077026534	0.121267114	1.853103126	0.006434778	0.005919995	0.006434778	1.69035E-05	1.52262E-05	429343.1989	134334.8843	375.7215474	18960379.34	3.1961
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	300	Diesel	0.073750993	0.089238701	0.10620143	0.309101165	0.989567915	17.64369847	0.036368474	0.033458996	0.036368474	0.000162006	0.000144971	4087846.937	752536.5261	1991.546359	174193814	5.4321
Statewide	2020	Agricultural - Combine Harvesters	Aggregated	600	Diesel	0.013794052	0.016690802	0.019863434	0.092097337	0.196622527	5.808809338	0.008049066	0.00740514	0.008049066	5.36517E-05	4.77287E-05	1345835.937	168488.9641	371.6783816	55719673.04	7.9877
Statewide	2020	Agricultural - Construction Equipment	Aggregated	50	Diesel	0.086376509	0.104515576	0.124382173	0.294010359	0.276092987	3.933342189	0.024322656	0.022376844	0.024322656	3.40183E-05	3.23187E-05	911311.2454	880706.311	2240.908598	39030804.98	1.0348
Statewide	2020	Agricultural - Construction Equipment	Aggregated	75	Diesel	0.066867336	0.080909476	0.096288963	0.33053801	0.544563319	6.976563868	0.040015831	0.036814564	0.040015831	6.29284E-05	5.73237E-05	1616391.557	1094030.325	2961.909142	68917836.31	1.4775
Statewide	2020	Agricultural - Construction Equipment	Aggregated	100	Diesel	0.136193947	0.164794676	0.196119284	0.785566705	1.124540772	17.06770141	0.090796724	0.083532986	0.090796724	0.000154772	0.000140239	3954394.883	2008315.44	4133.845005	169330747.3	1.9690
Statewide	2020	Agricultural - Construction Equipment	Aggregated	175	Diesel	0.276514086	0.334582045	0.398180284	1.807885066	2.61704323	39.81744342	0.152887353	0.140656365	0.152887353	0.000362306	0.000327164	9225254.81	3588935.805	5656.753706	440247153.2	2.5705
Statewide	2020	Agricultural - Construction Equipment	Aggregated	300	Diesel	0.149053671	0.180354942	0.214637286	0.564713831	1.68835929	26.1642193	0.071291521	0.0655882	0.071291521	0.000239052	0.000214981	6061955.999	1463040.451	2592.486263	288027841.4	4.1434
Statewide	2020	Agricultural - Construction Equipment	Aggregated	600	Diesel	0.016139423	0.019528702	0.023240769	0.077557327	0.164771411	2.467394483	0.007074227	0.006508289	0.007074227	2.24811E-05	2.02736E-05	571667.6128	77922.83876	88.23845202	27583416.28	7.3363
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	100	Diesel	0.002600208	0.003146252	0.003744299	0.028156738	0.028969588	0.690589845	0.002147071	0.001975305	0.002147071	6.34967E-06	5.67431E-06	160001.9173	68738.73276	151.3886273	6186485.948	2.3277
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	175	Diesel	0.006091979	0.007371295	0.00877245	0.072430701	0.073464649	1.841407513	0.00406068	0.003735826	0.00406068	1.69562E-05	1.51301E-05	426633.4566	148222.0575	323.4112343	18059011.99	2.8783
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	300	Diesel	0.005751112	0.006958846	0.008281601	0.029182301	0.082215699	2.112641924	0.003050704	0.002806648	0.003050704	1.94909E-05	1.73588E-05	489475.4259	85211.59418	184.4273816	21041047.12	5.7442
Statewide	2020	Agricultural - Cotton Pickers	Aggregated	600	Diesel	0.010983765	0.013290356	0.015816622	0.056786035	0.153503628	4.194095088	0.005938874	0.005463764	0.005938874	3.87071E-05	3.44612E-05	971724.7658	128515.6876	279.0569565	41667093.81	7.5611
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	100	Diesel	0.000511384	0.000618774	0.000736393	0.002863871	0.004303163	0.064217904	0.000343783	0.00031628	0.000343783	5.82367E-07	5.27654E-07	14878.56782	7191.011533	19.65344989	575280.9226	2.0691
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	300	Diesel	0.000486145	0.000588235	0.000700048	0.001906018	0.006454342	0.102686461	0.000232798	0.000214174	0.000232798	9.41171E-07	8.43735E-07	23791.30057	4648.45272	13.03639854	1022659.598	5.1181
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	600	Diesel	0.004588234	0.005551764	0.006607058	0.024674789	0.06222317	1.358697771	0.002385712	0.002194855	0.002385712	1.25084E-05	1.11639E-05	314795.0264	32280.22896	80.02855839	13654963.56	9.7519
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	750	Diesel	0.007015226	0.008488423	0.010101925	0.04571679	0.09974861	2.855559642	0.004040475	0.003717237	0.004040475	2.63677E-05	2.3463E-05	661601.124	46769.8976	102.7193726	28296191.93	14.1459
Statewide	2020	Agricultural - Forage & Silage Harvesters	Aggregated	9999	Diesel	0.004512897	0.005460605	0.006498571	0.028469851	0.099466418	1.748995728	0.002554836	0.002350449	0.002554836	1.61434E-05	1.43708E-05	405222.683	20253.8793	44.20985052	17418336.2	20.0072
Statewide	2020	Agricultural - Forklifts	Aggregated	50	Diesel	0.008329891	0.010079168	0.011995043	0.031867773	0.030535396	0.452964823	0.002431376	0.002236866	0.002431376	3.96608E-06	3.72184E-06	104946.8663	135899.0676	225.4047962	4501397.564	0.7722
Statewide	2020	Agricultural - Forklifts	Aggregated	75	Diesel	0.000666551	0.000806527	0.000959834	0.00354922	0.005395457	0.073054736	0.000399008	0.000367087	0.000399008	6.59961E-07	6.00262E-07	16925.96242	11169.0931	13.2753232	725991.0514	1.5154
Statewide	2020	Agricultural - Forklifts	Aggregated	100	Diesel	0.000263394	0.000318706	0.000379287	0.001410587	0.002074989	0.029034574	0.00016858	0.000155093	0.00016858	2.62338E-07	2.38566E-07	6726.985008	3723.031021	4.425107956	288534.9041	1.8069
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	75	Diesel	0.000531814	0.000643495	0.000765812	0.002199643	0.003820446	0.041842827	0.000321954	0.000296198	0.000321954	3.73498E-07	3.43806E-07	9694.513367	6368.002594	10.74298747	396017.7104	1.5224
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	100	Diesel	0.001004006	0.001214848	0.001445769	0.004157604	0.007168695	0.079088231	0.000627793	0.00057757	0.000627793	7.05994E-07	6.49837E-07	18323.85556	9658.368091	16.27728793	748523.5271	1.8972
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	175	Diesel	0.015199372	0.01839124	0.021887095	0.075544853	0.138259771	1.543674826	0.008030367	0.007387938	0.008030367	1.39118E-05	1.26838E-05	357652.134	124287.7548	209.3339196	15074359.51	2.8776
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	300	Diesel	0.024397354	0.029520799	0.03513219	0.08426145	0.258801586	2.984410247	0.01128455	0.010381786	0.01128455	2.70455E-05	2.45217E-05	691454.3633	132445.404	222.3550252	31340564.87	5.2207
Statewide	2020	Agricultural - Hay Squeeze/Stack retriever	Aggregated	600	Diesel	0.007667018	0.009277092	0.011040506	0.042594817	0.08158357	1.026575728	0.003481478	0.00320296	0.003481478	9.32485E-06	8.43497E-06	237846.0759	33226.44267	56.11435245	10553090.83	7.1583
Statewide	2020	Agricultural - Nut Harvester	Aggregated	50	Diesel	0.017305079	0.020939146	0.024919314	0.157761395	0.209073841	3.71735182	0.008638253	0.007947193	0.008638253	3.40801E-05	3.0544E-05	861268.7006	832557.5467	2163.103518	33509011.04	1.0345
Statewide	2020	Agricultural - Nut Harvester	Aggregated	75	Diesel	0.010312822	0.012478514	0.014850463	0.149440562	0.153348011	3.820401958	0.007558222	0.006953564	0.007558222	3.5249E-05	3.13908E-05	885144.2612	527876.168	1348.947913	34535547.25	1.6768
Statewide	2020	Agricultural - Nut Harvester	Aggregated	100	Diesel	0.027294515	0.033026363	0.039304102	0.589897109	0.444740956	15.22567759	0.029471864	0.027114115	0.029471864	0.000140894	0.000125103	3527618.636	1667859.599	2823.777412	137161562.2	2.1151
Statewide	2020	Agricultural - Nut Harvester	Aggregated	175	Diesel	0.031761944	0.038431952	0.0457372	0.509912831	0.428611524	13.22005895	0.023689457	0.0217943	0.023689457	0.000122093	0.000108624	3062939.303	1037802.558	2109.200003	128907069.1	2.9514
Statewide	2020	Agricultural - Nut Harvester	Aggregated	300	Diesel	0.002332642	0.002822496	0.003359004	0.014208802	0.03357186	1.046182667	0.001366857	0.001257508	0.001366857	9.66738E-06	8.59608E-06	242388.7837	53181.30936	108.8019435	10467046.06	4.5578
Statewide	2020	Agricultural - Nut Harvester	Aggregated	600	Diesel	0.008608325	0.010416073	0.012395988	0.060497762	0.135094993	4.72433151	0.005560745	0.005115886	0.005560745	4.37135E-05	3.8818E-05	1094574.594	144768.7803	337.87967	47049853.59	7.5608
Statewide	2020	Agricultural - Other Harvesters	Aggregated	50	Diesel	0.008901878	0.010771273	0.012818705	0.046736982	0.045268574	0.692941894	0.002945745	0.002710085	0.002945745	6.18251E-06	5.69363E-06	160546.8607	154901.7971	133.1627547	6207556.238	1.0364
Statewide	2020	Agricultural - Other Harvesters	Aggregated	75	Diesel	0.014621926	0.01769253	0.021055573	0.123885121	0.132694241	2.744770158	0.009127393	0.008397202	0.009127393	2.51083E-05	2.25527E-05	635932.4438	369540.8109	263.2945955	24762844.07	1.7209
Statewide	2020	Agricultural - Other Harvesters	Aggregated	100	Diesel	0.049694107	0.06012987	0.071559515	0.391511955	0.415455767	8.577962576	0.035647552	0.032795748	0.035647552	7.83486E-05	7.04818E-05	1987417.667	897927.2792	728.0142055	76854316.19	2.2133
Statewide	2020	Agricultural - Other Harvesters	Aggregated	175	Diesel	0.036362418	0.043998525	0.052361881	0.255609466	0.353819437	5.838406939	0.020627698	0.018977482	0.020627698	5.32502E-05	4.79719E-05	1352693.369	445588.1728	663.9394256	59265853.24	3.0357
Statewide	2020	Agricultural - Other Harvesters	Aggregated	300	Diesel	0.032301318	0.039084595	0.046513898	0.123726373	0.37282827	6.466930268	0.015175035	0.013961032	0.015175035	5.9222E-05	5.31362E-05	1498315.171	298092.6387	442.4863288	63801635.35	5.0263
Statewide	2020	Agricultural - Other Harvesters	Aggregated	600	Diesel	0.010914517	0.013206565	0.015716904	0.056758814	0.123821091	2.172559079	0.005121368	0.004711658	0.005121368	1.98937E-05	1.78511E-05	503357.5583	56429.40441	89.39338039	21803055.22	8.9201
Statewide	2020	Agricultural - Others	Aggregated	50	Diesel	0.007216495	0.008731958	0.010391752	0.02821355	0.027917677	0.41976328	0.002160271	0.001987449	0.002160271	3.69046E-06	3.44903E-06	97254.4413	92698.95177	176.6132793	4171452.829	1.0491
Statewide	2020	Agricultural - Others	Aggregated	75	Diesel	0.001337765	0.001618696	0.001926382	0.007889627	0.011546726	0.173077661	0.00083155	0.000765026	0.00083155	1.57079E-06	1.42211E-06	40100.15172	26461.26219	53.59573027	1719982.042	1.5154
Statewide	2020	Agricultural - Others	Aggregated	100	Diesel	0.005496992	0.00665136	0.007915668	0.032498939	0.046241476	0.711832216	0.003662778	0.003369756	0.003662778	6.46048E-06	5.84885E-06	164923.5364	81245.30659	162.9997393	7073926.22	2.0299
Statewide	2020	Agricultural - Others	Aggregated	175	Diesel	0.015262451	0.018467566	0.02197793	0.106028118	0.1564544	2.444667833	0.008692531	0.007997128	0.008692531	2.22959E-05	2.00869E-05	566402.1028	211832.3884	428.9349416	27008273.82	2.6738
Statewide	2020	Agricultural - Others	Aggregated	300	Diesel	0.01700882	0.020580672	0.024492701	0.067854726	0.200173165	3.201848319	0.008451068	0.007774982	0.008451068	2.9291E-05	2.63083E-05	741832.3245	162490.6026	325.9994739	35373474.45	4.5654
Statewide	2020	Agricultural - Others	Aggregated	600	Diesel	0.078411721	0.094878183	0.112912879	0.474977419	0.93850505	16.19982113	0.03888639	0.035775479	0.03888639	0.000148428	0.000133108	3753316.763	479025.0518	970.2369863	178972862	7.8353
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	50	Diesel	0.017165093	0.020769762	0.024717733	0.065126272	0.064307446	0.964854499	0.00505936	0.004654611	0.00505936	8.46544E-06	7.92783E-06	223545.9598	242929.7419	434.4094685	9044828.946	0.9202
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	75	Diesel	0.004381862	0.005302053	0.006309881	0.024824585	0.037378562	0.538168393	0.002694745	0.002479166	0.002694745	4.87755E-06	4.42192E-06	124687.5773	83592.54841	150.2923314	5091603.773	1.4916
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	100	Diesel	0.011570721	0.014000572	0.016661838	0.065787102	0.096219498	1.42451368	0.007593029	0.006985586	0.007593029	1.29116E-05	1.17047E-05	330043.8338	152082.0676	271.0194729	13583842.64	2.1702
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	175	Diesel	0.020506221	0.024812528	0.029528959	0.138982468	0.210374338	3.164818588	0.011611399	0.010682487	0.011611399	2.88414E-05	2.60041E-05	733252.9513	272895.5592	487.7741085	32488666.15	2.6869
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	300	Diesel	0.007966703	0.009639711	0.011472053	0.032125117	0.093112435	1.435968724	0.003988839	0.003669731	0.003988839	1.31263E-05	1.17988E-05	332697.839	69197.91037	124.3552539	15073452.24	4.8079
Statewide	2020	Agricultural - Sprayers/Spray rigs	Aggregated	600	Diesel	0.000340093	0.000411513	0.000489735	0.002186725	0.004051508	0.06710771	0.000169421	0.000155867	0.000169421	6.14403E-07	5.51398E-07	15548.10326	2139.666774	3.899239564	706090.0353	7.2666
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	50	Diesel	0.002799549	0.003387455	0.004031351	0.018070582	0.02141278	0.359424445	0.001121074	0.001031388	0.001121074	3.26136E-06	2.95325E-06	83274.61038	68258.248	155.6780386	3068369.734	1.2200
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	75	Diesel	0.00734329	0.008885381	0.010574337	0.079952853	0.087273349	1.957237432	0.005039152	0.00463602	0.005039152	1.79967E-05	1.60819E-05	453469.949	251507.5948	542.4676691	16257667.43	1.8030
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	100	Diesel	0.019483973	0.023575607	0.028056921	0.218680291	0.218527399	5.358985839	0.016002635	0.014722424	0.016002635	4.92943E-05	4.40327E-05	1241616.881	524383.8308	1125.106689	45111844.94	2.3678
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	175	Diesel	0.01084632	0.013124047	0.0156187	0.139764686	0.132595605	3.554092233	0.007378318	0.006788052	0.007378318	3.27544E-05	2.92026E-05	823443.2864	268213.8182	559.6251258	31729199.79	3.0701
Statewide	2020	Agricultural - Swathers/Windrowers/Hay Conditioners	Aggregated	300	Diesel	0.004020866	0.004865248	0.005790047	0.021459819	0.055526141	1.522164875	0.002177628	0.002003417	0.002177628	1.40469E-05	1.2507E-05	352668.5198	67932.1257	140.9577005	13960122.68	5.1915
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	50	Diesel	0.00064228	0.000777159	0.000924884	0.002712933	0.002358094	0.235701714	0.000248051	0.000228207	0.000248051	2.15991E-06	1.92377E-06	7647.082518	5757.097511	18.36037232	248356.0876	1.3283
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	75	Diesel	9.41909E-06	1.13971E-05	1.35635E-05	0.000245996	0.000212722	0.039438976	1.43687E-05	1.32192E-05	1.43687E-05	3.6435E-07	3.21896E-07	1279.554132	803.5642712	2.448049643	46204.94559	1.5923
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	100	Diesel	0.001779819	0.002153581	0.002562939	0.01502912	0.019601336	2.179009713	0.001345811	0.001238146	0.001345811	2.00926E-05	1.77848E-05	70695.5704	29060.46138	89.35381196	2552900.998	2.4327
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	175	Diesel	0.003681667	0.004454818	0.005301601	0.042122761	0.048299337	6.969571229	0.002990235	0.002751016	0.002990235	6.43267E-05	5.68847E-05	226120.0629	62138.74411	190.9478721	8165021.899	3.6390

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	300	Diesel	0.001288727	0.00155936	0.001855768	0.007808017	0.024277368	3.609180697	0.000731142	0.000672651	0.000731142	3.333E-05	2.94576E-05	117095.8929	18883.76037	57.52916661	4228355.195	6.2009
Statewide	2020	AirGrSupp - A/C Tug Narrow Body	Aggregated	750	Diesel	0.000285558	0.000345526	0.000411204	0.001424951	0.003921137	0.24006333	0.000178056	0.000163812	0.000178056	2.21094E-06	1.95936E-06	7788.590369	401.7821356	1.224024821	281247.4949	19.3851
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	50	Diesel	1.31441E-05	1.59044E-05	1.89276E-05	0.000303016	0.000253335	0.051197509	9.8678E-07	9.07838E-07	9.8678E-07	4.72952E-07	4.17867E-07	1661.046784	1110.519052	2.789968158	53860.17402	1.4957
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	75	Diesel	0.0001231	0.000148951	0.000177264	0.00075579	0.001294717	0.090206243	9.08359E-05	8.3569E-05	9.08359E-05	8.30308E-07	7.36251E-07	2926.642214	1665.778578	4.184952238	105499.3099	1.7569
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	100	Diesel	0.000186108	0.000225191	0.000267996	0.001706014	0.002622855	0.244981166	0.000166148	0.000152856	0.000166148	2.25939E-06	1.9995E-06	7948.144118	3331.557156	8.369904475	286513.9154	2.3857
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	175	Diesel	0.000702311	0.000849797	0.001011328	0.005607219	0.008895763	0.923427068	0.00051459	0.000473423	0.00051459	8.51647E-06	7.53689E-06	29959.57424	7218.373838	18.13479303	1079979.778	4.1505
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	300	Diesel	0.002272305	0.00274949	0.00327212	0.016903826	0.036316359	8.469873291	0.001188836	0.001093729	0.001188836	7.824E-05	6.913E-05	274795.711	40838.19719	103.2288219	9905837.551	6.7289
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	600	Diesel	0.001725955	0.002088406	0.002485375	0.010527904	0.033622302	3.771082193	0.001039424	0.00095627	0.001039424	3.48137E-05	3.07791E-05	122348.6086	11713.69411	30.68964974	4410510.084	10.4449
Statewide	2020	AirGrSupp - A/C Tug Wide Body	Aggregated	750	Diesel	0.00018226	0.000220535	0.000262455	0.000659573	0.004157083	0.327667092	0.000105489	9.70496E-05	0.000105489	3.02398E-06	2.67437E-06	10630.79793	608.5035902	2.789968158	383357.2618	17.4704
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	50	Diesel	0.001854171	0.002243547	0.002670006	0.007383921	0.005544894	0.517251724	0.000706055	0.00064957	0.000706055	4.72662E-06	4.22174E-06	16781.66252	17613.46935	24.58456825	795095.3243	0.9528
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	75	Diesel	0.002874197	0.003477779	0.004138844	0.022049788	0.028636371	2.948583786	0.002570321	0.002364695	0.002570321	2.71749E-05	2.40659E-05	95663.55364	80941.39159	110.9457439	5014227.23	1.1819
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	100	Diesel	0.003516599	0.004255085	0.005063902	0.033749466	0.04118686	4.476142567	0.002233302	0.002054638	0.002233302	4.12787E-05	3.65337E-05	145223.516	84573.11271	117.2494794	7618613.066	1.7171
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	175	Diesel	4.87689E-05	5.90103E-05	7.02272E-05	0.000227711	0.000535305	0.03380473	3.64256E-05	3.35115E-05	3.64256E-05	3.11078E-07	2.7591E-07	1096.757242	459.8942704	0.630373545	57486.7838	2.3848
Statewide	2020	AirGrSupp - Baggage Tug	Aggregated	300	Diesel	0.000132117	0.000159862	0.000190249	0.000446793	0.002793201	0.194715246	7.24309E-05	6.66364E-05	7.24309E-05	1.79628E-06	1.58924E-06	6317.321711	1839.577082	2.52149418	331123.8747	3.4341
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	25	Diesel	1.05411E-05	1.27547E-05	1.51791E-05	8.35062E-05	7.90918E-05	0.011167246	5.39381E-06	4.96231E-06	5.39381E-06	1.0293E-07	9.11456E-08	362.3089908	751.441548	1.472364875	18786.0387	0.4822
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	50	Diesel	0.000694593	0.000840458	0.001000215	0.003371506	0.002698535	0.320946644	0.000251607	0.000231479	0.000251607	2.94647E-06	2.61952E-06	10412.7604	11647.34399	22.82165557	539910.7522	0.8940
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	75	Diesel	0.001559955	0.001887545	0.002246335	0.012775209	0.017722169	1.796657117	0.001305208	0.001200791	0.001305208	1.65642E-05	1.46641E-05	58290.56151	54479.51223	106.7464535	3360070.882	1.0700
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	100	Diesel	0.001520062	0.001839275	0.00218889	0.013707368	0.016137925	1.927702635	0.001404098	0.00129177	0.001404098	1.7777E-05	1.57336E-05	62542.189	42026.13478	83.18861546	3605175.701	1.4882
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	175	Diesel	0.000124762	0.000150962	0.000179657	0.000793724	0.001414035	0.120249028	6.61183E-05	6.08288E-05	6.61183E-05	1.10802E-06	9.81456E-07	3901.347268	1663.447529	3.680912189	224902.6018	2.3453
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	300	Diesel	2.25747E-05	2.73154E-05	3.25076E-05	0.000197509	0.000289856	0.105874796	1.28627E-05	1.18337E-05	1.28627E-05	9.78188E-07	8.64136E-07	3434.991157	751.441548	1.472364875	198004.8479	4.5712
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	600	Diesel	3.29004E-05	3.98095E-05	4.73765E-05	0.000179931	0.000436308	0.091409928	2.02752E-05	1.86532E-05	2.02752E-05	8.44143E-07	7.46076E-07	2965.694452	375.720774	0.736182438	170952.9522	7.8933
Statewide	2020	AirGrSupp - Belt Loader	Aggregated	750	Diesel	9.33342E-05	0.000112934	0.000134401	0.001440072	0.001245979	0.0536091	6.33924E-05	5.8321E-05	6.33924E-05	4.92843E-07	4.3755E-07	1739.288215	160.5644333	0.736182438	100352.7708	10.8323
Statewide	2020	AirGrSupp - Bobtail	Aggregated	25	Diesel	3.51068E-06	4.24792E-06	5.05537E-06	7.29738E-05	9.51251E-05	0.011372948	3.39219E-06	3.12081E-06	3.39219E-06	1.05043E-07	9.28245E-08	368.9827583	695.8579192	1.515669725	17396.44798	0.5303
Statewide	2020	AirGrSupp - Bobtail	Aggregated	50	Diesel	5.00383E-05	6.05464E-05	7.20552E-05	0.000462245	0.00040533	0.071756777	1.50729E-05	1.38671E-05	1.50729E-05	6.61926E-07	5.85669E-07	2328.069614	2418.147591	6.062678899	109773.6528	0.9627
Statewide	2020	AirGrSupp - Bobtail	Aggregated	75	Diesel	1.49167E-05	1.80492E-05	2.148E-05	0.000206959	0.000297969	0.03028103	1.61136E-05	1.48245E-05	1.61136E-05	2.79516E-07	2.4715E-07	982.4346813	695.8579192	1.515669725	51493.48602	1.4118
Statewide	2020	AirGrSupp - Bobtail	Aggregated	100	Diesel	3.63956E-05	4.40387E-05	5.24097E-05	0.000888602	0.00069439	0.139538262	3.13307E-05	2.88242E-05	3.13307E-05	1.28901E-06	1.13889E-06	4527.165221	2783.431677	6.062678899	237287.5504	1.6265
Statewide	2020	AirGrSupp - Bobtail	Aggregated	175	Diesel	0.000119913	0.000145095	0.000172675	0.001413166	0.001362285	0.222815364	8.649E-05	7.95708E-05	8.649E-05	2.05644E-06	1.81859E-06	7228.999096	3114.00551	7.578348624	378935.1323	2.3214
Statewide	2020	AirGrSupp - Bobtail	Aggregated	300	Diesel	0.000517042	0.00062562	0.00074454	0.003302979	0.007441613	1.218417846	0.000293666	0.000270172	0.000293666	1.12494E-05	9.94456E-06	39530.22518	10072.5847	22.73504587	2071995.466	3.9245
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	25	Diesel	9.37969E-05	0.000113494	0.000135068	0.000473894	0.000418277	0.047609844	4.14352E-05	3.81204E-05	4.14352E-05	4.37363E-07	3.88585E-07	1544.648957	3208.612593	6.748339012	80215.31482	0.4814
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	50	Diesel	0.000171718	0.000207779	0.000247274	0.001022668	0.000926824	0.106246019	6.86774E-05	6.31832E-05	6.86774E-05	9.77146E-07	8.67166E-07	3447.035088	4786.425758	10.79734242	178999.3711	0.7202
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	100	Diesel	0.001616494	0.001955957	0.002327751	0.03194249	0.026086007	4.972286738	0.001132629	0.001042019	0.001132629	4.59228E-05	4.05831E-05	161320.3672	108186.1743	234.8421976	9310042.006	1.4911
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	175	Diesel	0.001239266	0.001499512	0.001784543	0.039372242	0.018093128	7.000357159	0.000581766	0.000535224	0.000581766	6.46846E-05	5.7136E-05	227118.8785	98477.91347	207.8488416	13112157.26	2.3063
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	300	Diesel	0.000191672	0.000231923	0.000276007	0.001505329	0.003033246	0.780495782	9.23655E-05	8.49762E-05	9.23655E-05	7.21032E-06	6.3703E-06	25322.32607	6711.593313	14.84634583	1463975.123	3.7729
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	600	Diesel	4.68859E-05	5.67319E-05	6.75157E-05	0.000995322	0.000275363	0.560500425	9.37294E-06	8.6231E-06	9.37294E-06	5.1807E-06	4.57473E-06	18184.81901	3208.612593	6.748339012	1049858.04	5.6675
Statewide	2020	AirGrSupp - Cargo Loader	Aggregated	750	Diesel	0.000133031	0.000160968	0.000191565	0.001333609	0.001375931	0.713987094	6.06092E-05	5.57604E-05	6.06092E-05	6.59717E-06	5.82747E-06	23164.52495	1925.167556	4.049003407	1337349.729	12.0325
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	25	Diesel	0.000331431	0.000401031	0.00047726	0.001394045	0.001010937	0.117836014	0.000112375	0.000103385	0.000112375	1.07951E-06	9.61762E-07	3823.059695	7353.894977	10.70392288	183847.3744	0.5199
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	50	Diesel	0.000301638	0.000364982	0.000434359	0.001716431	0.001407456	0.172986257	0.000118665	0.000109172	0.000118665	1.59029E-06	1.41189E-06	5612.348613	6816.943915	12.84470745	269864.5999	0.8233
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	75	Diesel	0.005728636	0.00693165	0.008249236	0.037932359	0.052548367	5.045915357	0.004822375	0.004436585	0.004822375	4.64801E-05	4.11841E-05	163709.1667	137447.799	204.444927	8755724.561	1.1911
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	100	Diesel	0.00198038	0.002396259	0.002851747	0.009032667	0.016672056	1.065976473	0.001789686	0.001646511	0.001789686	9.79607E-06	8.70036E-06	34584.4327	21524.73387	34.25255321	1823977.525	1.6067
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	175	Diesel	0.000635922	0.000769466	0.000915728	0.007852121	0.007542599	1.300040499	0.000429768	0.000395387	0.000429768	1.20004E-05	1.06108E-05	42178.38227	15676.63643	23.54863033	2249369.708	2.6905
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	300	Diesel	0.001243443	0.001504566	0.001790558	0.006096427	0.020554833	2.026299968	0.000732463	0.000673866	0.000732463	1.86968E-05	1.65384E-05	65741.07088	15910.09342	24.61902262	3514543.138	4.1320
Statewide	2020	AirGrSupp - Cargo Tractor	Aggregated	600	Diesel	0.000600445	0.000726538	0.00086464	0.003656308	0.007816233	1.842187012	0.000252579	0.000232373	0.000252579	1.70139E-05	1.50357E-05	59767.72878	8089.284474	11.77431517	3195267.367	7.3885
Statewide	2020	AirGrSupp - Forklift	Aggregated	25	Diesel	1.39391E-05	1.68663E-05	2.00723E-05	6.871E-05	5.88833E-05	0.007859744	4.97605E-06	4.57796E-06	4.97605E-06	7.22491E-08	6.41502E-08	255.0007476	881.4522734	2.264105625	22036.30684	0.2893
Statewide	2020	AirGrSupp - Forklift	Aggregated	50	Diesel	0.000371072	0.000448998	0.000534344	0.001779052	0.001590173	0.172270232	0.000153406	0.000141134	0.000153406	1.58159E-06	1.40605E-06	5589.117942	12393.41649	32.82953156	483006.2172	0.4510
Statewide	2020	AirGrSupp - Forklift	Aggregated	75	Diesel	0.00017849	0.000215972	0.000257025	0.000774727	0.001730119	0.081295247	0.000133694	0.000122999	0.000133694	7.4626E-07	6.63521E-07	2637.534773	3825.799153	11.32052812	253824.9225	0.6894
Statewide	2020	AirGrSupp - Forklift	Aggregated	100	Diesel	0.001742264	0.00210814	0.002508861	0.013880363	0.018587457	1.979684221	0.001484234	0.001365495	0.001484234	1.82509E-05	1.61579E-05	64228.6743	70500.13302	189.0528197	6162192.063	0.9110
Statewide	2020	AirGrSupp - Forklift	Aggregated	175	Diesel	0.000864481	0.001046022	0.001244852	0.007827064	0.011570415	1.242295029	0.000604031	0.000555709	0.000604031	1.14597E-05	1.01394E-05	40304.89406	30322.45202	80.37574967	3872935.04	1.3292
Statewide	2020	AirGrSupp - Forklift	Aggregated	300	Diesel	0.000453253	0.000548436	0.000652684	0.003181856	0.008029185	0.940055573	0.000251465	0.000231347	0.000251465	8.67768E-06	7.67261E-06	30499.06777	12393.41649	32.82953156	2930162.165	2.4609
Statewide	2020	AirGrSupp - Forklift	Aggregated	600	Diesel	8.84406E-05	0.000107013	0.000127354	0.000317646	0.001998495	0.155820972	5.15605E-05	4.74356E-05	5.15605E-05	1.43799E-06	1.27179E-06	5055.439822	1322.17841	3.396158437	485680.2026	3.8236
Statewide	2020	AirGrSupp - Lift	Aggregated	25	Diesel	4.88685E-06	5.91308E-06	7.03706E-06	9.83612E-05	0.000125576	0.014900529	4.40458E-06	4.05221E-06	4.40458E-06	1.37616E-07	1.21616E-07	483.4312687	1002.469221	2.419098477	25061.73052	0.4822
Statewide	2020	AirGrSupp - Lift	Aggregated	50	Diesel	0.000215816	0.000261137	0.000310775	0.002397387	0.002448741	0.354251241	0.000111709	0.000102772	0.000111709	3.26875E-06	2.89135E-06	11493.29138	13295.90756	32.65782944	595836.0479	0.8644
Statewide	2020	AirGrSupp - Lift	Aggregated	75	Diesel	3.41763E-05	4.13534E-05	4.92139E-05	0.001060564	0.000669664	0.171560606	1.8829E-05	1.73227E-05	1.8829E-05	1.58514E-06	1.40025E-06	5566.094922	4511.111493	10.88594315	320790.1506	1.2339
Statewide	2020	AirGrSupp - Lift	Aggregated	100	Diesel	0.001275015	0.001542768	0.001836021	0.015084247	0.015012984	2.283296004	0.001033488	0.000950809	0.001033488	2.1072E-05	1.8636E-05	74079.02424	50651.07641	123.3740223	4265977.619	1.4625
Statewide	2020	AirGrSupp - Lift	Aggregated	175	Diesel	0.000235286	0.000284696	0.000338812	0.003177587	0.002415277	0.528889181	0.000175738	0.000161679	0.000175738	4.88278E-06	4.31672E-06	17159.227	8019.753766	19.35278782	988935.8862	2.1396
Statewide	2020	AirGrSupp - Lift	Aggregated	300	Diesel	0.000256084	0.000309862	0.000368761	0.00299638	0.003792947	1.05073302	0.00011166	0.000102727	0.00011166	9.70687E-06	8.57594E-06	34089.87566	8784.796066	21.77188629	1964786.911	3.8806
Statewide	2020	AirGrSupp - Other GSE	Aggregated	25	Diesel	1.07875E-05	1.30528E-05	1.5534E-05	0.000229114	0.000182777	0.036358228	7.52352E-07	6.92164E-07	7.52352E-07	3.35826E-07	2.96751E-07	1179.602657	2446.457884	5.064074836	61161.44709	0.4822
Statewide	2020	AirGrSupp - Other GSE	Aggregated	50	Diesel	0.005159914	0.006243496	0.007430276	0.035750505	0.03341217	4.350949372	0.002282327	0.002099741	0.002282327	4.00719E-05	3.55119E-05	141161.7607	212366.9027	450.7026604	7317562.623	0.6647
Statewide	2020	AirGrSupp - Other GSE	Aggregated	75	Diesel	0.001373029	0.001661365	0.001977162	0.018756384	0.020776594	2.793480117	0.001201194	0.001105099	0.001201194	2.57859E-05	2.28E-05	90631.38592	76825.95677	164.5824322	5224283.794	1.1797
Statewide	2020	AirGrSupp - Other GSE	Aggregated	100	Diesel	0.001138434	0.001377505	0.001639345	0.017355892	0.013303751	2.68706233	0.000836975	0.000770017	0.000836975	2.48091E-05	2.19314E-05	87178.77804	56820.77915	119.0057586	5015103.361	1.5343
Statewide	2020	AirGrSupp - Other GSE	Aggregated	175	Diesel	0.002461745	0.002978712	0.003544913	0.044826063	0.030778759	7.930722401	0.001464889	0.001347698	0.001464889	7.32496E-05	6.47295E-05	257303.5542	92175.68518	194.9668812	14831645.4	2.7914
Statewide	2020	AirGrSupp - Other GSE	Aggregated	300	Diesel	0.002493698	0.003017375	0.003590925	0.01808838	0.039810848	8.454256844	0.001288767	0.001185665	0.001288767	7.8089E-05	6.90025E-05	274289.0526	70157.56423	149.3902077	15810794.6	3.9096
Statewide	2020	AirGrSupp - Other GSE	Aggregated	600	Diesel	0.001596267	0.001931483	0.002298624	0.01255279	0.024715008	5.27351571	0.00088242	0.000811826	0.00088242	4.87084E-05	4.30417E-05	171093.4095	27463.28455	58.23686061	9862281.963	6.2299
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	50	Diesel	2.64942E-05	3.2058E-05	3.81516E-05	0.000241588	0.000307019	0.044164914	1.62294E-05	1.4931E-05	1.62294E-05	4.07532E-07	3.60468E-07	1432.881989	1465.513722	26.1078274	63358.74356	0.9777
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	75	Diesel	5.42478E-06	6.56398E-06	7.81168E-06	0.000274043	0.000167298	0.047192028	1.93119E-06	1.77669E-06	1.93119E-06	4.36151E-07	3.85175E-07	1531.09338	1375.604905	37.10059683	75607.32143	1.1130
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	100	Diesel	6.59421E-06	7.979E-06	9.49567E-06	2.98353E-05	7.48561E-05	0.003180056	3.96356E-06	3.64647E-06	3.96356E-06	2.92034E-08	2.59552E-08	103.1734083	50.94832981	1.374096179	5094.832981	2.0251
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	175	Diesel	1.35748E-05	1.64255E-05	1.95477E-05	0.000129046	0.000212625	0.020780925	1.27927E-05	1.17692E-05	1.27927E-05	1.91723E-07	1.69611E-07	674.2142209	299.6960577	1.374096179	32966.56635	2.2497
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	300	Diesel	4.75184E-06	5.74972E-06	6.84264E-06	3.05178E-05	0.000118979	0.017331304	2.1709E-06	1.99723E-06	2.1709E-06	1.60094E-07	1.41456E-07	562.2950755	101.8966596	2.748192358	27766.83975	5.5183
Statewide	2020	AirGrSupp - Passenger Stand	Aggregated	600	Diesel	1.3913E-06	1.68347E-06	2.00347E-06	3.42008E-05	9.50489E-06	0.019557343	3.17767E-07	2.92345E-07	3.17767E-07	1.80776E-07	1.59624E-07	634.5164613	101.8966596	2.748192358	31333.22283	6.2271
Statewide	2020	CHC - AE Barge and Dredge	Aggregated		Diesel	0.02257465	0.027315327	0.032507496	0.266567482	0.705648592	19.69613688	0.018247773	0.016787951	0.018247773	0.000181423	0.001140353	4532969.278	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Charter Fishing	Aggregated		Diesel	0.076949104	0.093108416	0.110806709	0.322445275	0.454030184	5.750192825	0.024989527	0.022990364	0.024989527	5.08549E-05	0.00033292	1323378.67	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Commercial Fishing	Aggregated		Diesel	0.20144494	0.243748378	0.290080714	0.93885434	1.852903494	16.47006912	0.10219769	0.094021874	0.10219769	0.000146231	0.000953572	3790505.609	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Crew and Supply	Aggregated		Diesel	0.0130744	0.015820023	0.018827135	0.062915083	0.078482952	1.319856567	0.002833607	0.002606919	0.002833607	1.18105E-05	7.64161E-05	303758.514	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Ferry and Excursion	Aggregated		Diesel	0.063576891	0.076928038	0.091550723	0.366475909	0.434020539	7.641041054	0.01491097	0.013718093	0.01491097	6.87379E-05	0.000442395	1758548.113	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Others	Aggregated		Diesel	0.005014868	0.006067991	0.00722141	0.021152241	0.031519902	0.361586465	0.001777965	0.001635728	0.001777965	3.1926E-06	2.09349E-05	83217.35117	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Pilot Vessels	Aggregated		Diesel	0.000250556	0.000303172	0.0003608	0.000825237	0.00089486	0.012714408	5.68303E-05	5.22839E-05	5.68303E-05	1.10034E-07	7.3613E-07	2926.158675	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Tow Boats	Aggregated		Diesel	0.013487176	0.016319483	0.019421534	0.078308061	0.101883326	1.664656158	0.004043669	0.003720175	0.004043669	1.4986E-05	9.63791E-05	383112.4483	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Tug Boats	Aggregated		Diesel	0.029874508	0.036148155	0.043019292	0.18026341	0.225616346	3.829414996	0.008174401	0.007520449	0.008174401	3.45086E-05	0.000221713	881321.0752	0	0	0	#DIV/0!
Statewide	2020	CHC - AE Work Boats	Aggregated		Diesel	0.002790761	0.003376821	0.004018696	0.016432183	0.026673147	0.313645564	0.001052375	0.000968185	0.001052375	2.81609E-06	1.81592E-05	72183.98786	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Barge and Dredge	Aggregated		Diesel	0.003303354	0.003997059	0.00475683	0.0305789	0.124870042	2.354634984	0.0033769	0.003106748	0.0033769	2.16707E-05	0.000136327	541907.6902	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Charter Fishing	Aggregated		Diesel	0.64857278	0.784773064	0.933944804	4.00448483	9.078221831	96.18142221	0.383271879	0.352610128	0.383271879	0.000869788	0.005568642	22135682.48	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Commercial Fishing	Aggregated		Diesel	0.571784986	0.691859833	0.82337038	2.669592658	10.35940246	64.72790108	0.449495887	0.413536216	0.449495887	0.000581288	0.003747569	14896808.89	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Crew and Supply	Aggregated		Diesel	0.106146495	0.128437259	0.152850953	0.769352849	0.912683787	16.18869791	0.02488534	0.022894513	0.02488534	0.000146488	0.000937281	3725749.406	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Ferry and Excursion	Aggregated		Diesel	1.011381845	1.223772032	1.456389857	9.184965823	9.983174319	191.9487631	0.250148104	0.230136256	0.250148104	0.00174432	0.01111331	44176066.17	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Others	Aggregated		Diesel	0.085540095	0.103503515	0.123177737	0.479783099	1.27727512	11.80802422	0.057405206	0.05281279	0.057405206	0.000106605	0.000683652	2717558.847	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Pilot Vessels	Aggregated		Diesel	0.018810559	0.022760776	0.027087205	0.119595164	0.247204129	3.00757675	0.01044731	0.009611526	0.01044731	2.72422E-05	0.00017413	692179.0344	0	0	0	#DIV/0!

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	CHC - ME Tow Boats	Aggregated		Diesel	0.118770124	0.14371185	0.171028979	1.07934156	1.190578791	23.02506997	0.028110997	0.025862118	0.028110997	0.000209315	0.001333089	5299106.899	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Tug Boats	Aggregated		Diesel	0.510994755	0.618303654	0.735832447	4.559303147	5.545477653	95.75923789	0.162091718	0.149124381	0.162091718	0.000870012	0.005544199	22038518.83	0	0	0	#DIV/0!
Statewide	2020	CHC - ME Work Boats	Aggregated		Diesel	0.018447665	0.022321675	0.026564638	0.120367844	0.236202116	2.754128184	0.009676381	0.008902271	0.009676381	2.49099E-05	0.000159457	633849.0905	0	0	0	#DIV/0!
Statewide	2020	CHE - Port Construction Equipment	Aggregated	50	Diesel	0.000542269	0.000656146	0.000780867	0.00511397	0.003818492	0.514078991	6.56216E-05	6.03719E-05	6.56216E-05	4.73665E-06	4.19584E-06	16678.7267	12619.48542	7.066599102	527240.4534	1.3217
Statewide	2020	CHE - Port Construction Equipment	Aggregated	75	Diesel	0.001849127	0.002237443	0.002662742	0.018352492	0.01999527	2.691731209	0.000394831	0.000363245	0.000394831	2.48309E-05	2.19695E-05	87330.25468	42130.37035	15.08132497	2759810.108	2.0729
Statewide	2020	CHE - Port Construction Equipment	Aggregated	100	Diesel	0.001392187	0.001684546	0.002004749	0.020668793	0.009382631	3.11866589	0.000187994	0.000172955	0.000187994	2.87918E-05	2.54541E-05	101181.6802	36898.08675	17.24836224	3190778.729	2.7422
Statewide	2020	CHE - Port Construction Equipment	Aggregated	175	Diesel	0.004276066	0.005174039	0.006157534	0.053988103	0.044652034	8.213087488	0.000671113	0.000617424	0.000671113	7.58058E-05	6.70341E-05	266464.5785	66520.41921	38.9723763	9388658.028	4.0058
Statewide	2020	CHE - Port Construction Equipment	Aggregated	300	Diesel	0.007954712	0.009625202	0.011454785	0.048078386	0.083275892	17.26331203	0.001080379	0.000993949	0.001080379	0.000159369	0.000140901	560089.1468	79259.80227	35.6523426	19744522.48	7.0665
Statewide	2020	CHE - Port Construction Equipment	Aggregated	600	Diesel	0.021443738	0.025946923	0.030878983	0.140052222	0.211357755	56.0804647	0.002248687	0.002068792	0.002248687	0.000517848	0.000457721	1819468.916	163696.688	68.86037089	63603859.84	11.1149
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	100	Diesel	0.000149504	0.000180899	0.000215285	0.002147892	0.00093272	0.332894833	2.06749E-05	1.90209E-05	2.06749E-05	3.07329E-06	2.71704E-06	10800.40623	3744.360676	2.169897236	318270.6574	2.8844
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	175	Diesel	0.008288802	0.010029451	0.011935875	0.116322812	0.076864037	18.19616644	0.000883941	0.000813226	0.000883941	0.000167984	0.000148515	590354.5807	126210.8895	57.27861481	19306936.92	4.6775
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	300	Diesel	0.047242226	0.057163093	0.068028805	0.313280138	0.450238706	139.7101671	0.004220621	0.003882972	0.004220621	0.001290273	0.001140296	4532742.51	590407.6455	271.0869885	148741733.2	7.6773
Statewide	2020	CHE - Port Container Handling Equipment	Aggregated	600	Diesel	0.044905427	0.054335566	0.064663815	0.297900631	0.35879455	144.1113598	0.003796553	0.003492829	0.003796553	0.001331034	0.001176218	4675534.359	459409.9137	205.782881	153271805.7	10.1773
Statewide	2020	CHE - Port Forklift	Aggregated	50	Diesel	0.000269161	0.000325685	0.000387593	0.003492328	0.003050223	0.45613548	6.57194E-05	6.04619E-05	6.57194E-05	4.20912E-06	3.72292E-06	14798.81331	20388.59665	28.35097008	853093.9608	0.7258
Statewide	2020	CHE - Port Forklift	Aggregated	75	Diesel	0.000902893	0.001092501	0.001300167	0.01217573	0.012900026	1.964806709	0.000385038	0.000354235	0.000385038	1.81385E-05	1.60365E-05	63745.98981	54167.24329	54.43960301	3687519.239	1.1768
Statewide	2020	CHE - Port Forklift	Aggregated	100	Diesel	0.001729596	0.002092811	0.002490618	0.044930051	0.008785549	7.533056603	0.000333273	0.000306611	0.000333273	6.9595E-05	6.14838E-05	244401.7253	165542.7299	173.9256025	14154286.04	1.4764
Statewide	2020	CHE - Port Forklift	Aggregated	175	Diesel	0.005023324	0.006078221	0.007233586	0.106456376	0.051503905	18.00726825	0.001078454	0.000992178	0.001078454	0.000166335	0.000146973	584225.9869	261296.5569	276.84586	37632746.93	2.2359
Statewide	2020	CHE - Port Forklift	Aggregated	300	Diesel	0.002120673	0.002566014	0.003053769	0.019090543	0.019015584	9.269338665	0.000285031	0.000262228	0.000285031	8.5636E-05	7.56551E-05	300733.4846	90874.19599	96.99237179	19395607.98	3.3093
Statewide	2020	CHE - Port Forklift	Aggregated	600	Diesel	0.000255455	0.0003091	0.000367855	0.003105226	0.001865388	1.653364124	3.27375E-05	3.01185E-05	3.27375E-05	1.52785E-05	1.34945E-05	53641.57816	10753.23352	11.99778219	3466451.46	4.9884
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	50	Diesel	0.001681516	0.002034634	0.002421383	0.013361663	0.010289677	1.35524277	0.000208442	0.000191767	0.000208442	1.24794E-05	1.10613E-05	43969.35915	38964.71663	30.33851143	1496732.988	1.1284
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	75	Diesel	0.000760364	0.00092004	0.001094924	0.007858743	0.008684238	1.195483536	0.000164283	0.00015114	0.000164283	1.103E-05	9.75738E-06	38786.14674	20492.55045	12.54167499	1313739.551	1.8927
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	100	Diesel	0.001308461	0.001583238	0.001884184	0.016230528	0.008845347	2.474844357	0.000193609	0.00017812	0.000193609	2.28419E-05	2.01993E-05	80293.59962	32880.40484	16.94674819	2747743.95	2.4420
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	175	Diesel	0.002683564	0.003247112	0.003864332	0.033301002	0.028681312	5.237980359	0.000417304	0.00038392	0.000417304	4.83472E-05	4.27517E-05	169940.5041	47684.46616	30.83577898	6349966.729	3.5639
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	300	Diesel	0.001907426	0.002307985	0.002746693	0.011788394	0.019991166	4.458841465	0.000227512	0.000209311	0.000227512	4.1167E-05	3.63925E-05	144662.2008	24799.65197	13.62292095	5610744.392	5.8332
Statewide	2020	CHE - Port Other General Industrial Equipment	Aggregated	600	Diesel	0.006372783	0.007711067	0.009176808	0.057453072	0.06935476	12.89765384	0.000875196	0.00080518	0.000875196	0.000119054	0.000105269	418450.1745	36164.91317	22.96895853	15808798.08	11.5706
Statewide	2020	CHE - Port RTG Crane	Aggregated	100	Diesel	1.14165E-06	1.38139E-06	1.64397E-06	1.53555E-05	1.23218E-05	0.002763825	1.46882E-07	1.35131E-07	1.46882E-07	2.55187E-08	2.2558E-08	89.66925099	77.95106778	0.666284979	7795.106778	1.1503
Statewide	2020	CHE - Port RTG Crane	Aggregated	300	Diesel	0.000983143	0.001189603	0.001415725	0.006452236	0.009289483	2.188214111	0.000115394	0.000106163	0.000115394	2.02016E-05	1.78599E-05	70994.19694	29218.22564	17.89212337	6859878.864	2.4298
Statewide	2020	CHE - Port RTG Crane	Aggregated	600	Diesel	0.011842604	0.01432955	0.017053349	0.078326921	0.105578242	34.70560124	0.001081435	0.00099492	0.001081435	0.000320515	0.000283262	1125985.011	219871.8689	122.0494924	108888877	5.1211
Statewide	2020	CHE - Port RTG Crane	Aggregated	750	Diesel	0.011203591	0.013556345	0.016133171	0.071784276	0.091720235	34.73081975	0.000927486	0.000853287	0.000927486	0.000320768	0.000283468	1126803.197	165398.3077	88.58768449	108884702	6.8127
Statewide	2020	CHE - Port RTG Crane	Aggregated	9999	Diesel	0.008869743	0.010732389	0.012772429	0.047112114	0.141927452	22.85171416	0.001883931	0.001733217	0.001883931	0.000211009	0.000186513	741398.6993	74065.3293	42.43194385	71651361.15	10.0101
Statewide	2020	CHE - Port Yard Tractor	Aggregated	175	Diesel	0.027182171	0.032890427	0.039142326	1.89648495	0.174865554	303.0082303	0.005982498	0.005503898	0.005982498	0.002800646	0.002473112	9830768.329	2815123.921	1340.279089	487197961.6	3.4921
Statewide	2020	CHE - Port Yard Tractor	Aggregated	300	Diesel	0.022918125	0.027730931	0.0330021	0.595407404	0.11778007	276.3307261	0.00406302	0.003737978	0.00406302	0.002554127	0.002255374	8965246.084	2023444.516	930.9952148	443860036.1	4.4307
Statewide	2020	CHE - Port Yard Tractor	Aggregated	600	Diesel	0.000156449	0.000189304	0.000225287	0.003970638	0.001083388	1.950405561	2.84268E-05	2.61526E-05	2.84268E-05	1.80278E-05	1.59189E-05	63278.76045	9800.449585	4.569733955	3136143.867	6.4567
Statewide	2020	CHE - Rail Construction Equipment	Aggregated	75	Diesel	1.59316E-05	1.92772E-05	2.29415E-05	0.000158849	0.000226299	0.026608276	5.59306E-06	5.14561E-06	5.59306E-06	2.45529E-07	2.17173E-07	863.2762125	440.4772024	2.426301725	27289.50177	1.9599
Statewide	2020	CHE - Rail Container Handling Equipment	Aggregated	175	Diesel	0.002399606	0.002903523	0.003455433	0.030234845	0.024859929	4.746638347	0.000309688	0.000284913	0.000309688	4.3813E-05	3.87414E-05	153999.4537	33740.47568	20.01050965	5058269.33	4.5642
Statewide	2020	CHE - Rail Container Handling Equipment	Aggregated	300	Diesel	0.005657836	0.006845982	0.008147284	0.033044593	0.057218492	13.13805273	0.000617076	0.000567709	0.000617076	0.000121298	0.000107231	426249.6518	61824.38048	19.46666725	13960835.09	6.8945
Statewide	2020	CHE - Rail Container Handling Equipment	Aggregated	600	Diesel	0.001686692	0.002040897	0.002428837	0.01079412	0.015876321	3.996691022	0.000193372	0.000177902	0.000193372	3.69008E-05	3.26205E-05	129668.2386	12446.55353	5.319777627	4231590.213	10.4180
Statewide	2020	CHE - Rail Forklift	Aggregated	75	Diesel	4.00963E-05	4.85166E-05	5.77387E-05	0.000535701	0.000574329	0.086265474	1.84499E-05	1.69739E-05	1.84499E-05	7.96364E-07	7.04087E-07	2798.788285	2555.452115	2.99077878	162202.4145	1.0952
Statewide	2020	CHE - Rail Forklift	Aggregated	100	Diesel	0.000395217	0.000478212	0.000569112	0.008167473	0.001358494	1.234445711	4.34839E-05	4.00052E-05	4.34839E-05	1.14012E-05	1.00754E-05	40050.2316	25633.42413	9.615962301	2308928.894	1.5624
Statewide	2020	CHE - Rail Forklift	Aggregated	175	Diesel	0.000488982	0.000591668	0.000704134	0.009441921	0.003558866	1.454080503	4.70199E-05	4.32583E-05	4.70199E-05	1.3429E-05	1.1868E-05	47176.04053	18731.54646	7.748147424	3026139.177	2.5185
Statewide	2020	CHE - Rail Forklift	Aggregated	300	Diesel	9.00285E-05	0.000108934	0.000129641	0.0006414	0.000776422	0.290354717	1.14169E-05	1.05035E-05	1.14169E-05	2.68177E-06	2.36984E-06	9420.23901	2636.376732	1.569599203	606936.5449	3.5732
Statewide	2020	CHE - Rail Other General Industrial Equipment	Aggregated	50	Diesel	0.000625947	0.000757396	0.000901364	0.004397775	0.00321071	0.386326935	8.60147E-05	7.91336E-05	8.60147E-05	3.55301E-06	3.15315E-06	12533.95195	9156.291078	2.531897856	427293.5836	1.3689
Statewide	2020	CHE - Rail Other General Industrial Equipment	Aggregated	175	Diesel	5.13531E-05	6.21372E-05	7.39484E-05	0.000680368	0.000673228	0.118333778	1.11933E-05	1.02979E-05	1.11933E-05	1.09251E-06	9.65824E-07	3839.209112	1066.186696	1.673043329	145503.7588	3.6009
Statewide	2020	CHE - Rail Other General Industrial Equipment	Aggregated	300	Diesel	0.000446806	0.000540635	0.0006434	0.002812222	0.005462943	1.138260807	5.16127E-05	4.74837E-05	5.16127E-05	1.05104E-05	9.29033E-06	36929.61833	6645.763365	8.21843519	1484434.109	5.5569
Statewide	2020	CHE - Rail RTG Crane	Aggregated	300	Diesel	0.009264601	0.011210167	0.013341025	0.054376439	0.091506668	22.01372865	0.000821159	0.000755466	0.000821159	0.00020325	0.000179673	714211.1823	257751.5527	61.72067707	69007235.82	2.7709
Statewide	2020	CHE - Rail RTG Crane	Aggregated	600	Diesel	0.003368147	0.004075458	0.004850131	0.019385374	0.030943268	9.025109796	0.000269767	0.000248186	0.000269767	8.33406E-05	7.36617E-05	292809.748	84865.04303	23.66772597	28334508.08	3.4503
Statewide	2020	CHE - Rail Yard Tractor	Aggregated	175	Diesel	0.015952915	0.019303027	0.022972198	1.030841802	0.073397868	165.3785595	0.002852656	0.002624443	0.002852656	0.001528528	0.001349798	5365525.229	1670647.101	436.2745175	265460478.2	3.2116
Statewide	2020	CHE - Rail Yard Tractor	Aggregated	300	Diesel	0.005774725	0.006987417	0.008315603	0.138976662	0.026881721	66.86425965	0.001008188	0.000927533	0.001008188	0.00061802	0.000545737	2169337.267	539423.8956	156.2472059	107514017.6	4.0216
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	50	Diesel	0.001495888	0.001810025	0.002154079	0.011405124	0.01174645	1.514136427	0.000743729	0.000684231	0.000743729	1.39541E-05	1.23582E-05	49124.48884	42522.51868	122.3304779	1668165.487	1.1553
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	75	Diesel	0.001174982	0.001421728	0.001691974	0.017390834	0.020870058	2.637724936	0.001097161	0.001009388	0.001097161	2.43518E-05	2.15288E-05	85578.0806	45392.30393	103.0151393	3332730.383	1.8853
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	100	Diesel	0.002486302	0.003008425	0.003580274	0.042931038	0.034516172	6.778656541	0.001757383	0.001616792	0.001757383	6.25975E-05	5.53265E-05	219926.0461	100341.9407	270.4147407	8597536.478	2.1918
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	175	Diesel	0.002986989	0.003614257	0.004301264	0.060883948	0.038690168	10.94695749	0.001714332	0.001577186	0.001714332	0.00010112	8.93476E-05	355161.9799	91149.43542	294.8808362	13626504.14	3.8965
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	300	Diesel	0.003536796	0.004279523	0.005092986	0.031824449	0.054235399	15.4586558	0.001576028	0.001449946	0.001576028	0.000142817	0.000126171	501539.0627	93993.36675	294.8808362	19431673.65	5.3359
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	600	Diesel	0.005395464	0.006528512	0.007769468	0.055806179	0.074612077	29.57645281	0.002350151	0.002162138	0.002350151	0.000273287	0.000241399	959575.4387	89020.79591	254.9624698	37287362.52	10.7792
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	750	Diesel	0.001932467	0.002338285	0.002782753	0.020618331	0.025770517	11.16299281	0.000902503	0.000830303	0.000902503	0.000103149	9.11108E-05	362171.0079	21361.0842	48.93219117	13799363.72	16.9547
Statewide	2020	ConstMin - Bore/Drill Rigs	Aggregated	9999	Diesel	0.002318229	0.002805058	0.00333825	0.015465638	0.062367801	8.186127037	0.001513912	0.001392799	0.001513912	7.56153E-05	6.68141E-05	265589.8763	5502.576223	7.726135448	10236953.45	48.2665
Statewide	2020	ConstMin - Cranes	Aggregated	25	Diesel	4.49523E-05	5.43923E-05	6.47313E-05	0.00025483	0.000233064	0.028955934	1.74891E-05	1.609E-05	1.74891E-05	2.66363E-07	2.36334E-07	939.443405	2269.319433	4.851693954	56732.98581	0.4140
Statewide	2020	ConstMin - Cranes	Aggregated	50	Diesel	0.001435642	0.001737127	0.002067325	0.006087655	0.004912904	0.469185571	0.000518825	0.000477319	0.000518825	4.29478E-06	3.82943E-06	15222.20914	22074.45302	51.75140217	910142.1269	0.6896
Statewide	2020	ConstMin - Cranes	Aggregated	75	Diesel	0.00043368	0.000524753	0.000624499	0.001811052	0.003964213	0.210937977	0.00036797	0.000338532	0.00036797	1.93722E-06	1.72165E-06	6843.650344	6513.920883	17.7895445	456156.6568	1.0506
Statewide	2020	ConstMin - Cranes	Aggregated	100	Diesel	0.012597576	0.015243067	0.01814051	0.086842618	0.133633515	10.8890318	0.009424005	0.008670084	0.009424005	0.000100297	8.88748E-05	353282.6445	269506.0354	624.2512887	23791638.92	1.3109
Statewide	2020	ConstMin - Cranes	Aggregated	175	Diesel	0.026864534	0.032506087	0.038684929	0.216157927	0.335790452	32.15110942	0.01804766	0.016603847	0.01804766	0.000296447	0.000262413	1043107.337	475979.8295	1064.138207	69919131.79	2.1915
Statewide	2020	ConstMin - Cranes	Aggregated	300	Diesel	0.034024349	0.041169462	0.048995062	0.193263142	0.494114741	57.90677848	0.020202206	0.018586029	0.020202206	0.000534356	0.000472627	1878721.655	567252.29	1224.244108	126123714.6	3.3120
Statewide	2020	ConstMin - Cranes	Aggregated	600	Diesel	0.045032523	0.054489353	0.064846834	0.438377577	0.662716832	96.14363758	0.026117992	0.024028552	0.026117992	0.000887545	0.000784711	3119274.438	566718.3325	1177.344399	209774775.3	5.5041
Statewide	2020	ConstMin - Cranes	Aggregated	750	Diesel	0.001543157	0.00186722	0.002222146	0.015197021	0.019899029	1.540245862	0.001026016	0.000943935	0.001026016	1.4194E-05	1.25713E-05	49971.58072	5220.517041	12.93785054	3341532.276	9.5722
Statewide	2020	ConstMin - Cranes	Aggregated	9999	Diesel	0.006454718	0.007810209	0.009294794	0.066670163	0.089339789	5.391574529	0.004263014	0.003921973	0.004263014	4.96541E-05	4.40053E-05	174923.6978	12520.94291	25.87570109	11747745.37	13.9705
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	50	Diesel	0.004464928	0.005402563	0.006429496	0.019211729	0.014850301	1.518041588	0.0015558	0.001431336	0.0015558	1.39011E-05	1.23901E-05	49251.18751	47825.65411	143.5336636	2009939.674	1.0298
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	75	Diesel	0.001529901	0.001851181	0.002203058	0.006001087	0.014660302	0.501061461	0.001074866	0.000988877	0.001074866	4.58666E-06	4.0896E-06	16256.38729	10064.00849	48.80144561	726705.5659	1.6153
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	100	Diesel	0.072674107	0.087935669	0.104650713	0.502870306	0.74032847	66.60047706	0.061834272	0.05688753	0.061834272	0.000613574	0.000543584	2160779.131	1110692.86	2412.800884	97212253.54	1.9454
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	175	Diesel	0.054882035	0.066407262	0.07903013	0.464453863	0.678747961	73.17609328	0.037970883	0.034933212	0.037970883	0.000674903	0.000597253	2374117.757	718031.6236	1624.801071	107051310.4	3.3064
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	300	Diesel	0.051024636	0.061739809	0.073475476	0.324519919	0.766138971	78.22487497	0.030743122	0.028283673	0.030743122	0.000721697	0.000638461	2537919.919	553582.907	1293.238309	114494896	4.5845
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	600	Diesel	0.110619984	0.133850181	0.159292777	0.83902517	1.620152223	264.7779805	0.06089731	0.056025525	0.06089731	0.002444685	0.002161082	8590429.977	1005715.613	2145.82827	387108544.1	8.5416
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	750	Diesel	0.003355136	0.004059714	0.004831396	0.020939202	0.064385614	5.688886556	0.001886486	0.001735567	0.001886486	5.24959E-05	4.64319E-05	184569.6591	13437.35655	30.14206935	8339590.964	13.7356
Statewide	2020	ConstMin - Crawler Tractors	Aggregated	9999	Diesel	0.01026947	0.012426059	0.014788037	0.052402357	0.201317043	15.59589712	0.005708065	0.00525142	0.005708065	0.000143884	0.000127292	505991.7063	23275.6213	43.06009907	22769424.83	21.7391
Statewide	2020	ConstMin - Excavators	Aggregated	25	Diesel	4.19918E-05	5.08101E-05	6.04682E-05	0.000142684	9.69173E-05	0.007507832	1.35074E-05	1.24268E-05	1.35074E-05	6.81539E-08	6.12779E-08	243.5833332	444.3691972	1.438206773	11109.22993	0.5482
Statewide	2020	ConstMin - Excavators	Aggregated	50	Diesel	0.050649871	0.061286343	0.072935814	0.465188062	0.416738031	60.75592299	0.0229584	0.021121728	0.0229584	0.000560199	0.000495882	1971159.011	2508180.171	3512.10094	89707497.39	0.7859
Statewide	2020	ConstMin - Excavators	Aggregated	75	Diesel	0.001084086	0.001311744	0.001561083	0.013697868	0.019382637	1.918646714	0.001121245	0.001031546	0.001121245	1.77063E-05	1.56597E-05	62248.37961	42879.22119	63.28109802	3146750.119	1.4517
Statewide	2020	ConstMin - Excavators	Aggregated	100	Diesel	0.035778846	0.043292404	0.051521539	0.513919181	0.442672884	77.02209764	0.026454767	0.024338386	0.026454767	0.000711034	0.000628644	2498897.133	1556634.923	2466.524616	127079786.3	1.6053
Statewide	2020	ConstMin - Excavators	Aggregated	175	Diesel	0.060684682	0.073428465	0.087385942	0.973384051	0.72197501	166.4622268	0.03509013	0.03228292	0.03509013	0.001537205	0.001358642	5400683.623	1871529.053	3240.27986	273257506.9	2.8857
Statewide	2020	ConstMin - Excavators	Aggregated	300	Diesel	0.059409113	0.071885027	0.085549123	0.454866236	0.821343499	211.7060725	0.025046186	0.023042491	0.025046186	0.001955545	0.001727917	6868570.371	1591024.607	2787.244726	347501309.9	4.3171
Statewide	2020	ConstMin - Excavators	Aggregated	600	Diesel	0.089532496	0.10833432	0.128926794	0.778734813	1.104904583	375.3528977	0.036370556	0.033460912	0.036370556	0.003467638	0.00306358	12177911.39	1829484.027	2923.87437	617798738.6	6.6565
Statewide	2020	ConstMin - Excavators	Aggregated	750	Diesel	0.00273005	0.003303361	0.003931272	0.017538357	0.041989192	6.657783456	0.001376443	0.001266328	0.001376443	6.14726E-05	5.43399E-05	216004.452	17490.82078	31.64054901	10957049.47	12.3496
Statewide	2020	ConstMin - Excavators	Aggregated	9999	Diesel	0.002576325	0.003117354	0.003709908	0.023196396	0.065063725	10.49153725	0.001219913	0.00112232	0.001219913	9.69222E-05	8.56305E-05	340386.3717	14298.42113	21.5731016	17213439.75	23.8059
Statewide	2020	ConstMin - Graders	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Graders	Aggregated	50	Diesel	0.001444012	0.001747255	0.002079378	0.00561789	0.004028677	0.377837502	0.000495033	0.000455431	0.000495033	3.44997E-06	3.08386E-06	12258.52165	14410.43829	41.91248418	521715.6862	0.8507
Statewide	2020	ConstMin - Graders	Aggregated	75	Diesel	0.000630401	0.000762785	0.000907778	0.004785471	0.005855066	0.622699245	0.00041414	0.000381009	0.00041414	5.73825E-06	5.08239E-06	20202.79122	13301.323	36.13145188	955754.3045	1.5189
Statewide	2020	ConstMin - Graders	Aggregated	100	Diesel	0.015100674	0.018271815	0.02174497	0.076668461	0.14199413	8.388855137	0.011736812	0.010797867	0.011736812	7.71061E-05	6.84687E-05	272167.1662	144663.7768	401.7817449	12994841.45	1.8814

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	ConstMin - Graders	Aggregated	175	Diesel	0.088387797	0.106949234	0.127278428	0.688809182	1.043941422	101.6533407	0.058274995	0.053612995	0.058274995	0.000937184	0.000829681	3298030.688	1048194.55	2273.390952	155787854.3	3.1464
Statewide	2020	ConstMin - Graders	Aggregated	300	Diesel	0.115372211	0.139600375	0.166135984	0.561828527	1.74555588	214.6264786	0.057891833	0.053260486	0.057891833	0.001980867	0.001751752	6963319.729	1518857.616	2046.485435	329199174.5	4.5846
Statewide	2020	ConstMin - Graders	Aggregated	600	Diesel	0.005008834	0.00606069	0.007212721	0.021702012	0.080172221	9.360577776	0.002480916	0.002282443	0.002480916	8.63929E-05	7.63998E-05	303693.6371	40748.70216	56.36506493	14294847.41	7.4528
Statewide	2020	ConstMin - Graders	Aggregated	9999	Diesel	0.005666585	0.006856568	0.008159883	0.028964461	0.094892625	7.276127989	0.002975645	0.002737594	0.002975645	6.71014E-05	5.93868E-05	236065.9594	6171.065866	8.671548451	11165444.24	38.2537
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	50	Diesel	0.035938508	0.043485595	0.051751451	0.237249149	0.200509801	25.19652336	0.014935095	0.013740287	0.014935095	0.000231876	0.000205651	817473.4513	866657.063	1346.691992	32698705.29	0.9432
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	75	Diesel	0.009090084	0.010999002	0.013089722	0.118194828	0.105457376	17.30682026	0.006355099	0.005846691	0.006355099	0.000159737	0.000141256	561500.7234	351483.9269	559.1113223	24924680.88	1.5975
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	100	Diesel	0.01325036	0.016032936	0.019080519	0.110405016	0.146991519	14.70000529	0.012172738	0.011198919	0.012172738	0.000135511	0.000119979	476925.4824	264684.1516	420.0430239	21096186.91	1.8019
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	175	Diesel	0.011587824	0.014021267	0.016686467	0.166349385	0.149544753	27.36974784	0.007255224	0.006674806	0.007255224	0.000252699	0.000223388	887981.3263	249070.734	371.7948387	39435716.95	3.5652
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	300	Diesel	0.009283468	0.011232997	0.013368194	0.059749162	0.134592609	24.4826313	0.004558947	0.004194231	0.004558947	0.000226076	0.000199824	794312.0096	162851.8716	259.6887614	35337860.58	4.8775
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	600	Diesel	0.018820494	0.022772798	0.027101512	0.151370925	0.223329638	74.89357252	0.007556584	0.006952057	0.007556584	0.000691864	0.000611271	2429839.48	302636.5964	447.005245	108182856	8.0289
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	750	Diesel	0.001623268	0.001964154	0.002337506	0.008804188	0.0195751	4.360698559	0.000794496	0.000730936	0.000794496	4.02681E-05	3.55914E-05	141478.0623	9975.239051	14.1906427	6360560.439	14.1829
Statewide	2020	ConstMin - Off-Highway Tractors	Aggregated	9999	Diesel	0.001583725	0.001916307	0.002280564	0.010218012	0.028875052	4.256810676	0.000759947	0.000699152	0.000759947	3.93088E-05	3.47435E-05	138107.5343	3752.981877	7.095321349	6134447.528	36.7994
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	25	Diesel	0.000328398	0.000397361	0.000472893	0.001487585	0.000977343	0.106877717	0.000101019	9.29375E-05	0.000101019	9.78286E-07	8.72322E-07	3467.529831	6318.77412	4.218071819	157969.353	0.5488
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	50	Diesel	0.002655821	0.003213544	0.003824382	0.022227393	0.018664155	2.31583599	0.001298578	0.001194692	0.001298578	2.13314E-05	1.89015E-05	75134.74824	119589.348	75.92529274	3442295.349	0.6283
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	75	Diesel	0.000345536	0.000418099	0.000497572	0.00541061	0.003174861	0.729463906	0.000127972	0.000117734	0.000127972	6.73389E-06	5.95379E-06	23666.65308	16864.17923	11.24819152	1199626.35	1.4034
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	100	Diesel	0.00124835	0.001510503	0.001797623	0.012752808	0.012836151	1.688953929	0.001035963	0.000953086	0.001035963	1.55778E-05	1.3785E-05	54796.25018	31549.95755	25.30843091	2777073.78	1.7368
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	175	Diesel	0.028477158	0.034457362	0.041007108	0.367192702	0.291878483	57.64658755	0.015297306	0.014073521	0.015297306	0.000532117	0.000470504	1870280.047	601262.175	438.6794692	94855263.35	3.1106
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	300	Diesel	0.050706505	0.061354871	0.073017367	0.310612744	0.559852045	117.4322756	0.0218129	0.020067868	0.0218129	0.001084198	0.000958466	3809960.854	918146.5799	736.7565444	193820759	4.1496
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	600	Diesel	0.194657599	0.235535695	0.280306943	1.364376461	2.259521419	503.8763347	0.082494644	0.075895073	0.082494644	0.004652747	0.004112571	16347712.76	2200801.267	1656.296201	828404939.5	7.4281
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	750	Diesel	0.082022299	0.099246982	0.118112111	0.637076972	0.959549718	169.6949914	0.037533657	0.034530965	0.037533657	0.001566454	0.001385028	5505567.109	421206.1266	354.3180328	279310439.7	13.0710
Statewide	2020	ConstMin - Off-Highway Trucks	Aggregated	9999	Diesel	0.133106491	0.161058854	0.191673347	0.794672886	2.452901733	301.3982779	0.061998209	0.057038353	0.061998209	0.002782583	0.002459972	9778535.197	390385.4393	282.6108119	493432682.7	25.0484
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	50	Diesel	0.020391525	0.024673746	0.029363797	0.124366619	0.115893726	13.58995378	0.009324623	0.008578653	0.009324623	0.000125034	0.000110919	440911.0837	482844.2201	1039.670839	18398450.7	0.9132
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	75	Diesel	0.002632177	0.003184935	0.003790335	0.014005844	0.026837846	1.523929068	0.001998365	0.001838496	0.001998365	1.40105E-05	1.24381E-05	49442.20029	31803.05419	103.5472976	2323012.137	1.5546
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	100	Diesel	0.031960991	0.038672799	0.046023828	0.287259616	0.357997203	41.13313473	0.026532266	0.024409685	0.026532266	0.000379337	0.000335723	1334519.256	757944.697	1729.519727	62159657.6	1.7607
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	175	Diesel	0.014212675	0.017197337	0.020466252	0.143046351	0.18214476	23.22135551	0.009625171	0.008855157	0.009625171	0.000214267	0.00018953	753391.3058	231062.2371	572.3087123	35193843.11	3.2606
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	300	Diesel	0.015026776	0.018182399	0.021638557	0.096749312	0.227524335	31.03155986	0.008659152	0.00796642	0.008659152	0.000286451	0.000253275	1006784.785	212490.1649	538.725805	46629610.12	4.7380
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	600	Diesel	0.040031982	0.048438698	0.057646054	0.339639009	0.585638556	118.2681818	0.020690541	0.019035297	0.020690541	0.001092247	0.000965289	3837080.908	467000.443	1071.854459	178930147.1	8.2164
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	750	Diesel	0.006137212	0.007426026	0.008837585	0.046049418	0.088632069	21.63001924	0.002896614	0.002664885	0.002896614	0.000199796	0.000176541	701762.1529	52928.61065	102.1480098	32768275.43	13.2587
Statewide	2020	ConstMin - Other Construction Equipment	Aggregated	9999	Diesel	0.002295618	0.002777697	0.00330569	0.015628691	0.053502784	7.463848972	0.001253352	0.001153084	0.001253352	6.89381E-05	6.09189E-05	242156.3599	12364.73279	26.5864683	11280212.9	19.5844
Statewide	2020	ConstMin - Pavers	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Pavers	Aggregated	50	Diesel	0.003080373	0.003727251	0.004435737	0.015618218	0.0134708	1.664334572	0.00113714	0.001046169	0.00113714	1.52952E-05	1.35841E-05	53997.50226	58350.50373	168.4225778	2258429.409	0.9254
Statewide	2020	ConstMin - Pavers	Aggregated	75	Diesel	0.004303553	0.0052073	0.006197117	0.021043522	0.039124298	2.725983038	0.003736442	0.003437527	0.003736442	2.5074E-05	2.22491E-05	88441.51754	57160.69951	162.8084919	4134182.505	1.5472
Statewide	2020	ConstMin - Pavers	Aggregated	100	Diesel	0.007336686	0.00887739	0.010564827	0.088447865	0.09411725	13.28064834	0.006019525	0.005537963	0.006019525	0.000122566	0.000108395	430876.0095	248553.2323	648.4269245	20134078.43	1.7335
Statewide	2020	ConstMin - Pavers	Aggregated	175	Diesel	0.009626348	0.011647881	0.013861941	0.125985279	0.123716534	22.06304059	0.006101825	0.005613679	0.006101825	0.000203695	0.000180076	715811.0539	210825.4799	560.0050711	33254619.24	3.3953
Statewide	2020	ConstMin - Pavers	Aggregated	300	Diesel	0.00478518	0.005790068	0.006890659	0.033386315	0.089245661	17.20929957	0.002566216	0.002360918	0.002566216	0.000158965	0.00014046	558336.772	117500.9942	268.072603	26019209.33	4.7518
Statewide	2020	ConstMin - Pavers	Aggregated	600	Diesel	0.000717679	0.000868392	0.001033458	0.005839192	0.011019316	3.114077396	0.000377592	0.000347384	0.000377592	2.87697E-05	2.54167E-05	101032.8116	12777.8711	29.47395111	4691493.532	7.9069
Statewide	2020	ConstMin - Pavers	Aggregated	750	Diesel	0.000116714	0.000141224	0.000168068	0.001181165	0.001449849	0.644546303	6.36481E-05	5.85563E-05	6.36481E-05	5.95565E-06	5.2607E-06	20911.59496	1297.825917	2.807042963	973369.4381	16.1128
Statewide	2020	ConstMin - Paving Equipment	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Paving Equipment	Aggregated	50	Diesel	0.001829621	0.002213841	0.002634654	0.015046074	0.014079459	2.072750296	0.000772774	0.000710952	0.000772774	1.91087E-05	1.69175E-05	67248.10061	95418.89377	207.3871312	3309861.667	0.7048
Statewide	2020	ConstMin - Paving Equipment	Aggregated	75	Diesel	0.000334333	0.000404543	0.000481439	0.002116375	0.003476355	0.252782756	0.000267473	0.000246075	0.000267473	2.32707E-06	2.06318E-06	8201.258116	6666.255765	18.2164372	447477.4329	1.2303
Statewide	2020	ConstMin - Paving Equipment	Aggregated	100	Diesel	0.004895972	0.005924126	0.0070502	0.057661923	0.057861374	8.66317553	0.003796383	0.003492672	0.003796383	7.99485E-05	7.07077E-05	281067.1893	171853.4165	381.1439169	15276974.01	1.6355
Statewide	2020	ConstMin - Paving Equipment	Aggregated	175	Diesel	0.004062846	0.004916043	0.005850498	0.054944804	0.049016652	9.383803885	0.002641735	0.002430396	0.002641735	8.6636E-05	7.65893E-05	304447.1826	114703.3636	255.0301208	16605984.79	2.6542
Statewide	2020	ConstMin - Paving Equipment	Aggregated	300	Diesel	0.002405721	0.002910922	0.003464238	0.014906492	0.038062173	6.655835604	0.00134908	0.001241154	0.00134908	6.14643E-05	5.4324E-05	215941.2561	50233.71489	109.2986232	11743440.66	4.2987
Statewide	2020	ConstMin - Paving Equipment	Aggregated	600	Diesel	0.002227096	0.002694786	0.003207018	0.014734119	0.035743147	6.857098949	0.001097556	0.001009751	0.001097556	6.33305E-05	5.59667E-05	222471.0236	29298.70207	64.45816241	12059120.7	7.5932
Statewide	2020	ConstMin - Paving Equipment	Aggregated	750	Diesel	0.000283535	0.000343077	0.00040829	0.001595349	0.004809248	0.817888947	0.000122656	0.000112843	0.000122656	7.55328E-06	6.6755E-06	26535.50613	2113.195262	4.203793201	1444303.315	12.5571
Statewide	2020	ConstMin - Paving Equipment	Aggregated	9999	Diesel	8.53571E-05	0.000103282	0.000122914	0.001118791	0.002670434	0.608922351	4.30099E-05	3.95691E-05	4.30099E-05	5.62723E-06	4.96994E-06	19755.81508	1275.419626	2.8025288	1075197.501	15.4897
Statewide	2020	ConstMin - Rollers	Aggregated	25	Diesel	2.92477E-05	3.53897E-05	4.21167E-05	9.76398E-05	6.92508E-05	0.005350783	9.29179E-06	8.54845E-06	9.29179E-06	4.85932E-08	4.36724E-08	173.6002689	322.0686501	1.443695522	8051.716253	0.5390
Statewide	2020	ConstMin - Rollers	Aggregated	50	Diesel	0.044475631	0.053815514	0.064044909	0.274664432	0.263598979	34.20033288	0.019113971	0.017584853	0.019113971	0.000314865	0.000279139	1109592.135	1439402.094	4257.458093	51416740.46	0.7709
Statewide	2020	ConstMin - Rollers	Aggregated	75	Diesel	0.000885514	0.001071472	0.001275141	0.003542794	0.008689253	0.307840672	0.000610446	0.00056161	0.000610446	2.81957E-06	2.51255E-06	9987.551586	7418.851355	33.204997	514092.0986	1.3462
Statewide	2020	ConstMin - Rollers	Aggregated	100	Diesel	0.031464132	0.038071599	0.04530835	0.352520401	0.382682206	53.13589533	0.024340591	0.022393344	0.024340591	0.000490324	0.000433688	1723935.605	1017975.265	3142.925151	88807912.43	1.6935
Statewide	2020	ConstMin - Rollers	Aggregated	175	Diesel	0.018620416	0.022530704	0.026813399	0.307082413	0.256668429	55.26132785	0.011790179	0.010846965	0.011790179	0.00051036	0.000451036	1792892.923	643140.4977	1836.380704	92480565.84	2.7877
Statewide	2020	ConstMin - Rollers	Aggregated	300	Diesel	0.003461853	0.004188842	0.004985068	0.027196651	0.053535842	9.150214605	0.001881251	0.001730751	0.001881251	8.44944E-05	7.46828E-05	296868.6357	70756.87209	235.32237	15292261.14	4.1956
Statewide	2020	ConstMin - Rollers	Aggregated	600	Diesel	0.001414331	0.00171134	0.002036636	0.015725152	0.021297743	5.368596267	0.000720405	0.000662773	0.000720405	4.95929E-05	4.38178E-05	174178.1934	25541.6543	85.17803578	8929542.643	6.8194
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	25	Diesel	2.60151E-06	3.14783E-06	3.74618E-06	5.68926E-05	7.64759E-05	0.009242248	2.50461E-06	2.30424E-06	2.50461E-06	8.53711E-08	7.5434E-08	299.8545496	518.4860232	1.666057562	12962.15058	0.5783
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	50	Diesel	0.002139944	0.002589333	0.00308152	0.012293703	0.011607696	1.553576823	0.000779734	0.000717355	0.000779734	1.42994E-05	1.26801E-05	50404.08907	46059.77091	171.6039289	2179518.165	1.0943
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	75	Diesel	0.000482495	0.000583819	0.000694792	0.002265431	0.0034265	0.245156422	0.000276564	0.000254439	0.000276564	2.25212E-06	2.00093E-06	7953.830128	6511.738441	26.656921	354421.4351	1.2215
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	100	Diesel	0.031614064	0.038253018	0.045524253	0.818762645	0.567507591	134.3205905	0.018859399	0.017350647	0.018859399	0.001240912	0.001096307	4357883.631	2177934.92	7873.78804	209372159.1	2.0009
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	175	Diesel	0.015442307	0.018685191	0.022236922	0.182747618	0.172199771	31.67373493	0.011553481	0.010629203	0.011553481	0.000292376	0.000258517	1027619.447	398643.2753	1507.782094	49413312.49	2.5778
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	300	Diesel	0.000377056	0.000456238	0.000542961	0.004063785	0.006485722	2.197243319	0.000148026	0.000136184	0.000148026	2.03033E-05	1.79336E-05	71287.13966	16307.2217	66.6423025	3428951.563	4.3715
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	600	Diesel	0.00011803	0.000142816	0.000169963	0.001474037	0.002196923	0.815341659	4.68756E-05	4.31256E-05	4.68756E-05	7.5347E-06	6.65471E-06	26452.86219	3330.204134	13.3284605	1280233.051	7.9433
Statewide	2020	ConstMin - Rough Terrain Forklifts	Aggregated	750	Diesel	2.24673E-05	2.71854E-05	3.23529E-05	0.000257403	0.000354597	0.140557685	2.48747E-06	2.28847E-06	2.48747E-06	1.29885E-06	1.14721E-06	4560.239293	351.2324673	1.666057562	219520.2921	12.9835
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	50	Diesel	0.0026373	0.003191132	0.003797711	0.015472419	0.011668467	1.517735925	0.000964971	0.000887774	0.000964971	1.39531E-05	1.23876E-05	49241.27061	52215.1405	56.3151351	2165433.778	0.9430
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	75	Diesel	0.002439927	0.002952312	0.003513495	0.011500167	0.023225987	1.182614908	0.001853048	0.001704804	0.001853048	1.08607E-05	9.65234E-06	38368.63828	26518.93627	39.83265654	1863020.387	1.4468
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	100	Diesel	0.00770373	0.009321513	0.011093371	0.047018532	0.073075632	5.779817303	0.006414844	0.005901657	0.006414844	5.32062E-05	4.71741E-05	187519.8071	108105.7636	123.6185892	9084257.978	1.7346
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	175	Diesel	0.007097595	0.00858809	0.010220537	0.046102239	0.084374702	6.217326312	0.004860586	0.004471739	0.004860586	5.72693E-05	5.0745E-05	201714.305	66699.51415	90.65363212	9868829.447	3.0242
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	300	Diesel	0.007329059	0.008868161	0.010553844	0.046607973	0.094461534	6.945496914	0.004600388	0.004232357	0.004600388	6.39947E-05	5.66882E-05	225338.9983	50470.09062	75.54469343	11027703.67	4.4648
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	600	Diesel	0.062914875	0.076126998	0.090597419	0.60735736	0.817804455	77.19726779	0.036801478	0.03385736	0.036801478	0.00071184	0.000630074	2504580.336	329652.0262	462.8829397	121808749.3	7.5976
Statewide	2020	ConstMin - Rubber Tired Dozers	Aggregated	750	Diesel	0.000824286	0.000997386	0.001186971	0.004445176	0.015006498	2.192950277	0.000419943	0.000386348	0.000419943	2.02502E-05	1.78986E-05	71147.85664	5350.056355	5.494159522	3479957.332	13.2985
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	50	Diesel	0.009911013	0.011992326	0.014271859	0.054821622	0.042555963	4.754064869	0.003840635	0.003533384	0.003840635	4.36564E-05	3.8802E-05	154240.399	177805.3911	211.8834193	7398726.533	0.8675
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	100	Diesel	0.101776897	0.123150046	0.146558732	0.875574833	1.038950847	115.5201928	0.081362509	0.074853508	0.081362509	0.001064988	0.00094286	3747925.431	2356215.261	2632.794649	202325606.8	1.5907
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	175	Diesel	0.163093075	0.197342621	0.234854028	1.754681418	1.832763086	274.5781094	0.100881434	0.09281092	0.100881434	0.002533718	0.00224107	8908384.366	3178707.319	3453.127077	477004959.1	2.8025
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	300	Diesel	0.178275271	0.215713077	0.25671639	0.989675296	2.508087642	410.4821603	0.083264026	0.076602904	0.083264026	0.003789763	0.0033503	13317641.63	3388731.793	3221.200631	713348539.7	3.9300
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	600	Diesel	0.24211208	0.292955617	0.348641395	1.568445503	3.056900662	509.9835402	0.114984501	0.105785741	0.114984501	0.004707787	0.004162417	16545854.32	2669471.427	2833.224911	889193027.1	6.1982
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	750	Diesel	0.016380647	0.019820583	0.023588132	0.130350484	0.212409337	37.76895249	0.007536951	0.006933995	0.007536951	0.000348701	0.000308265	1225372.069	99348.02768	115.9632227	65694433.7	12.3341
Statewide	2020	ConstMin - Rubber Tired Loaders	Aggregated	9999	Diesel	0.015864327	0.019195836	0.022844631	0.078340048	0.332239748	35.42701466	0.008400019	0.007728018	0.008400019	0.000327064	0.000289151	1149390.475	64296.04164	55.83414428	61451252.16	17.8765
Statewide	2020	ConstMin - Scrapers	Aggregated	25	Diesel	6.79648E-05	8.22374E-05	9.78693E-05	0.000230938	0.000156863	0.012151601	2.1862E-05	2.0113E-05	2.1862E-05	1.10309E-07	9.91797E-08	394.2453239	568.4132631	1.415529271	14210.33158	0.6936
Statewide	2020	ConstMin - Scrapers	Aggregated	50	Diesel	0.000456032	0.000551799	0.000656686	0.001557197	0.001118632	0.096717427	0.000154246	0.000141907	0.000154246	8.8052E-07	7.89395E-07	3137.890409	2969.9593	8.493175623	115026.3184	1.0565
Statewide	2020	ConstMin - Scrapers	Aggregated	75	Diesel	0.00150758	0.001824172	0.002170915	0.007120988	0.013949672	0.822651815	0.001219041	0.001121518	0.001219041	7.5606E-06	6.71437E-06	26690.03214	15786.09946	38.21929031	1067750.631	1.6907
Statewide	2020	ConstMin - Scrapers	Aggregated	100	Diesel	0.003790631	0.004586663	0.005458509	0.030769645	0.046994449	4.041348006	0.003457421	0.003180827	0.003457421	3.72505E-05	3.29849E-05	131117.0853	57815.52349	101.9181075	5237587.598	2.2679
Statewide	2020	ConstMin - Scrapers	Aggregated	175	Diesel	0.038683324	0.046806822	0.055703987	0.343555704	0.477184028	52.53748818	0.025664644	0.023611472	0.025664644	0.000484575	0.000428804	1704520.944	405907.0691	921.5095551	68072923.91	4.1993
Statewide	2020	ConstMin - Scrapers	Aggregated	300	Diesel	0.042396716	0.051300027	0.061051271	0.237371821	0.58506787	60.31098149	0.025662935	0.0236099	0.025662935	0.000556333	0.00049225	1956723.374	350924.1383	891.7834405	78702794.56	5.5759
Statewide	2020	ConstMin - Scrapers	Aggregated	600	Diesel	0.349695724	0.423131826	0.503561842	3.036536132	4.988937799	756.4652033	0.190228219	0.175009962	0.190228219	0.006983405	0.006174167	24542680.42	2328560.195	4969.923269	982307934.1	10.5399
Statewide	2020	ConstMin - Scrapers	Aggregated	750	Diesel	0.013104902	0.015856932	0.018871059	0.149426646	0.217447818	12.21045143	0.008854982	0.008146583	0.008854982	0.000112499	9.96601E-05	396154.6491	25398.59931	66.52987572	15803547.64	15.5975
Statewide	2020	ConstMin - Scrapers	Aggregated	9999	Diesel	0.01913936	0.023158626	0.027560679	0.231996676	0.29312723	17.51522205	0.012248722	0.011268824	0.012248722	0.000161363	0.000142957	568262.0899	14265.59398	36.80376103	22785161.44	39.8344

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	50	Diesel	0.015920132	0.019263359	0.02292499	0.165060776	0.16186651	25.88768669	0.0063456	0.005837952	0.0063456	0.000238867	0.000211292	839897.4845	906264.7269	2947.821223	39493188.26	0.9268
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	75	Diesel	0.039621835	0.04794242	0.057055442	0.834212927	0.635045573	134.479181	0.027136221	0.024965323	0.027136221	0.001242138	0.001097601	4363028.924	3249223.61	9324.293208	228948335.6	1.3428
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	100	Diesel	0.000870417	0.001053205	0.001253401	0.018145706	0.016388374	2.814340787	0.00106335	0.000978282	0.00106335	2.59939E-05	2.29703E-05	91308.18739	63474.68849	188.5319473	4844953.425	1.4385
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	175	Diesel	0.000224906	0.000272137	0.000323865	0.005004044	0.003009961	0.927973366	0.000126601	0.000116473	0.000126601	8.57283E-06	7.57399E-06	30107.0739	10407.12976	39.46017502	1584227.12	2.8929
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	300	Diesel	0.000130991	0.000158499	0.000188627	0.001583676	0.002001096	0.861923497	5.67509E-05	5.22108E-05	5.67509E-05	7.96498E-06	7.0349E-06	27964.15863	7159.792276	24.84529538	1467622.111	3.9057
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	600	Diesel	5.98759E-05	7.24498E-05	8.62213E-05	0.000465292	0.000976704	0.249345997	4.19371E-05	3.85821E-05	4.19371E-05	2.30353E-06	2.03513E-06	8089.756266	896.604224	2.922975927	423914.4771	9.0227
Statewide	2020	ConstMin - Skid Steer Loaders	Aggregated	9999	Diesel	0.000152967	0.000185091	0.000220273	0.001059199	0.002813587	0.337524192	9.23231E-05	8.49372E-05	9.23231E-05	3.11599E-06	2.75483E-06	10950.6007	575.4568928	2.922975927	575456.8928	19.0294
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	50	Diesel	0.000177038	0.000214215	0.000254934	0.001573252	0.001695436	0.239582108	8.65572E-05	7.96326E-05	8.65572E-05	2.20974E-06	1.95544E-06	7772.977639	12311.99952	51.70899614	443326.0419	0.6313
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	75	Diesel	0.000150011	0.000181513	0.000216016	0.001280175	0.002132844	0.182555115	0.000133179	0.000122524	0.000133179	1.68331E-06	1.48999E-06	5922.799655	5695.316534	22.53981883	378713.6544	1.0399
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	100	Diesel	0.000666841	0.000806877	0.000960251	0.008908445	0.008766224	1.375634811	0.000494937	0.000455342	0.000494937	1.26984E-05	1.12277E-05	44630.95644	31855.91227	120.6543243	2860734.059	1.4010
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	175	Diesel	0.000617295	0.000746927	0.000888905	0.007405065	0.008672256	1.287695993	0.000424719	0.000390741	0.000424719	1.18869E-05	1.051E-05	41777.87834	19776.10301	78.22643006	2682800.273	2.1125
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	300	Diesel	0.000903761	0.00109355	0.001301415	0.006883489	0.016518921	2.54471874	0.000533426	0.000490751	0.000533426	2.35001E-05	2.07697E-05	82560.59701	23213.11044	96.7886338	5293091.003	3.5566
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	600	Diesel	0.001619375	0.001959444	0.002331901	0.016583157	0.02450803	8.067857812	0.000881605	0.000811076	0.000881605	7.45428E-05	6.58488E-05	261752.7615	41338.74001	147.1717582	16796739.23	6.3319
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	750	Diesel	0.000981861	0.001188052	0.00141388	0.007705713	0.01808233	3.978241043	0.000637577	0.000586571	0.000637577	3.67514E-05	3.24699E-05	129069.6494	13015.9649	46.40550936	8278275.315	9.9163
Statewide	2020	ConstMin - Surfacing Equipment	Aggregated	9999	Diesel	0.000505895	0.000612133	0.000728489	0.002878121	0.011987598	1.320483681	0.000286198	0.000263302	0.000286198	1.21933E-05	1.07776E-05	42841.63877	3136.786904	11.93284526	2748189.142	13.6578
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	25	Diesel	0.000237378	0.000287227	0.000341824	0.000789279	0.000543482	0.041530669	7.4718E-05	6.87406E-05	7.4718E-05	3.7685E-07	3.38968E-07	1347.416818	2056.743446	2.810822586	51418.58615	0.6551
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	50	Diesel	0.029569539	0.035779143	0.042580137	0.164419253	0.136208389	15.72977518	0.012350603	0.011362555	0.012350603	0.000144542	0.000128384	510335.2323	546090.4671	791.246558	19486917.9	0.9345
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	75	Diesel	0.004617445	0.005587108	0.006649121	0.032517286	0.046009036	4.277624505	0.003706885	0.003410335	0.003706885	3.94102E-05	3.49134E-05	138782.8161	80990.54374	141.9465406	5867918.043	1.7136
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	100	Diesel	0.01513231	0.018310095	0.021790526	0.143403993	0.159997947	20.0974517	0.012842707	0.011815291	0.012842707	0.000185357	0.000164033	652039.687	349884.6671	504.5426542	27681655.61	1.8636
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	175	Diesel	0.004382431	0.005302742	0.006310701	0.038592191	0.052941873	6.080117665	0.002723712	0.002505815	0.002723712	5.60822E-05	4.96251E-05	197262.7216	52359.17004	74.48679853	8368688.424	3.7675
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	300	Diesel	0.001274988	0.001542735	0.001835982	0.007869851	0.019119549	3.651387337	0.000613954	0.000564838	0.000613954	3.37206E-05	2.98021E-05	118465.2409	23966.07759	33.72987103	5025778.021	4.9430
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	600	Diesel	0.000396902	0.000480252	0.000571539	0.006534145	0.005511097	0.49311562	0.000278206	0.00025595	0.000278206	4.54719E-06	4.02474E-06	15998.59322	2056.743446	2.810822586	678725.3372	7.7786
Statewide	2020	ConstMin - Sweepers/Scrubbers	Aggregated	9999	Diesel	0.000242249	0.000293122	0.000348839	0.001261503	0.005076096	0.633578857	0.000144036	0.000132513	0.000144036	5.85048E-06	5.17119E-06	20555.76826	1028.371723	1.405411293	872059.2211	19.9887
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	50	Diesel	0.06085539	0.073635022	0.087631762	0.446913798	0.390365356	51.21964268	0.025550236	0.023506217	0.025550236	0.000471725	0.000418048	1661764.898	2082552.055	4125.566636	78947502.12	0.7979
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	75	Diesel	0.020475255	0.024775058	0.029484367	0.082516154	0.194526332	8.131785809	0.015601786	0.014353643	0.015601786	7.45681E-05	6.63705E-05	263826.835	192162.2615	876.8625951	13843240.74	1.3729
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	100	Diesel	0.402585733	0.487128737	0.579723455	5.487769855	4.949256444	813.9091572	0.309667118	0.284893748	0.309667118	0.007512916	0.006643017	26406386.24	16624965.05	27135.30362	1382156794	1.5884
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	175	Diesel	0.055196314	0.06678754	0.079482692	0.844739989	0.656892718	142.2627484	0.033096747	0.030449007	0.033096747	0.001313634	0.001161129	4615558.197	1698591.506	3133.705668	243546419.3	2.7173
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	300	Diesel	0.031409595	0.038005609	0.045229816	0.207032642	0.459755618	87.9874849	0.015348441	0.014120566	0.015348441	0.000812546	0.000718142	2854657.047	722813.9707	1312.418933	150058023.1	3.9494
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	600	Diesel	0.037433898	0.045295016	0.053904813	0.307968488	0.49386773	117.0486578	0.017449315	0.016053369	0.017449315	0.00108105	0.000955335	3797514.797	597446.5584	1135.608935	201110160	6.3562
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	750	Diesel	0.000851632	0.001030475	0.00122635	0.007958243	0.009484404	3.95885188	0.00026154	0.000240617	0.00026154	3.6576E-05	3.23116E-05	128440.5894	10739.63943	15.8122763	6821630.138	11.9595
Statewide	2020	ConstMin - Tractors/Loaders/Backhoes	Aggregated	9999	Diesel	0.01099895	0.01330873	0.015838488	0.078463875	0.257715659	40.00296966	0.0052307	0.004812244	0.0052307	0.000369517	0.000326499	1297852.295	36783.82624	60.37414589	68063277.29	35.2832
Statewide	2020	ConstMin - Trenchers	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	ConstMin - Trenchers	Aggregated	50	Diesel	0.022975092	0.027799862	0.033084133	0.148479062	0.143668282	18.11296988	0.010938957	0.010063841	0.010938957	0.000166774	0.000147836	587655.3598	508954.7474	1352.812285	20305230.58	1.1546
Statewide	2020	ConstMin - Trenchers	Aggregated	75	Diesel	0.001793235	0.002169814	0.002582258	0.010291984	0.018142744	1.208868994	0.001245078	0.001145471	0.001245078	1.11228E-05	9.86663E-06	39220.42317	21300.4726	81.47619444	1503731.401	1.8413
Statewide	2020	ConstMin - Trenchers	Aggregated	100	Diesel	0.01066196	0.012900971	0.015353222	0.084363764	0.118171442	11.91643494	0.008960658	0.008243805	0.008960658	0.000109853	9.72603E-05	386615.608	177032.957	545.7367741	14852157.79	2.1839
Statewide	2020	ConstMin - Trenchers	Aggregated	175	Diesel	0.001781208	0.002155261	0.002564939	0.017056663	0.022849009	2.680105026	0.001168279	0.001074816	0.001168279	2.47255E-05	2.18747E-05	86953.05596	23462.75693	83.01348113	3357365.676	3.7060
Statewide	2020	ConstMin - Trenchers	Aggregated	300	Diesel	0.00355295	0.004299069	0.005116248	0.020265029	0.052688133	6.506927643	0.002122855	0.001953026	0.002122855	6.00532E-05	5.31087E-05	211110.1013	35399.04656	115.2965016	8100461.158	5.9637
Statewide	2020	ConstMin - Trenchers	Aggregated	600	Diesel	0.003000085	0.003630103	0.004320123	0.03062122	0.042562034	8.734460827	0.001599965	0.001471968	0.001599965	8.06644E-05	7.12895E-05	283379.9622	27962.22884	78.40162107	10862905.92	10.1344
Statewide	2020	ConstMin - Trenchers	Aggregated	750	Diesel	0.000329972	0.000399266	0.000475159	0.005141095	0.003361716	2.851120914	4.90496E-05	4.51256E-05	4.90496E-05	2.63501E-05	2.32705E-05	92501.47811	5499.164033	12.2982935	3556381.571	16.8210
Statewide	2020	ConstMin - Trenchers	Aggregated	9999	Diesel	0.000428643	0.000518658	0.000617246	0.006156318	0.005951064	0.236334198	0.00027479	0.000252807	0.00027479	2.17217E-06	1.92893E-06	7667.602785	342.9475543	1.537286688	294934.8967	22.3579
Statewide	2020	Industrial - Aerial Lifts	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	Industrial - Aerial Lifts	Aggregated	50	Diesel	0.006631471	0.00802408	0.009549318	0.14839722	0.141475929	28.12072439	0.001478661	0.001360368	0.001478661	0.000259791	0.000229518	912345.9335	1115896.104	3776.21971	51474842.25	0.8176
Statewide	2020	Industrial - Aerial Lifts	Aggregated	75	Diesel	0.005933368	0.007179375	0.00854405	0.195412108	0.110950646	32.47154514	0.003045698	0.002802042	0.003045698	0.000300038	0.000265028	1053503.521	914847.6755	3106.159016	66076940.38	1.1516
Statewide	2020	Industrial - Aerial Lifts	Aggregated	100	Diesel	0.00289212	0.003499465	0.004164652	0.099759846	0.062668835	16.59579282	0.000817197	0.000751821	0.000817197	0.00015335	0.000135453	538432.2209	433976.934	1468.430883	33772334.83	1.2407
Statewide	2020	Industrial - Aerial Lifts	Aggregated	175	Diesel	0.000457502	0.000553578	0.000658803	0.016131763	0.005592237	2.998798403	0.000181856	0.000167308	0.000181856	2.77117E-05	2.44758E-05	97292.7116	46796.40613	158.604792	6105215.543	2.0791
Statewide	2020	Industrial - Aerial Lifts	Aggregated	300	Diesel	1.90191E-05	2.30131E-05	2.73875E-05	0.00032074	0.000229273	0.179201548	3.02606E-06	2.78397E-06	3.02606E-06	1.65624E-06	1.46262E-06	5813.996865	1586.251469	5.346228943	364837.838	3.6652
Statewide	2020	Industrial - Aerial Lifts	Aggregated	600	Diesel	1.08353E-05	1.31107E-05	1.56029E-05	0.000226394	6.26001E-05	0.12725907	2.13529E-06	1.96447E-06	2.13529E-06	1.17625E-06	1.03867E-06	4128.780382	528.7504898	1.782076314	259087.74	7.8086
Statewide	2020	Industrial - Forklifts	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	Industrial - Forklifts	Aggregated	50	Diesel	0.02990517	0.036185255	0.043063444	0.183717863	0.150877513	18.92637709	0.011596138	0.010668447	0.011596138	0.000174087	0.000154475	614045.4611	1251643.346	1750.570951	53069676.95	0.4906
Statewide	2020	Industrial - Forklifts	Aggregated	75	Diesel	0.004325367	0.005233695	0.006228529	0.017534128	0.040923212	1.792114521	0.00338422	0.003113482	0.00338422	1.64392E-05	1.4627E-05	58143.18196	76265.99005	150.4622966	5609780.669	0.7624
Statewide	2020	Industrial - Forklifts	Aggregated	100	Diesel	0.159533666	0.193035735	0.229728478	1.607608837	1.745471727	226.2102927	0.12970248	0.119326281	0.12970248	0.00208664	0.001846298	7339143.82	8575792.671	11536.40724	707022296	0.8558
Statewide	2020	Industrial - Forklifts	Aggregated	175	Diesel	0.038128317	0.046135263	0.054904776	0.443072844	0.452907689	72.00842602	0.024522443	0.022560648	0.024522443	0.00066461	0.000587723	2336234.079	1591160.943	2170.129277	224859967.1	1.4683
Statewide	2020	Industrial - Forklifts	Aggregated	300	Diesel	0.007380963	0.008930966	0.010628587	0.044757395	0.098685845	15.70674114	0.003880797	0.003570333	0.003880797	0.000144995	0.000128196	509587.9183	233106.692	318.2856274	48924440.58	2.1861
Statewide	2020	Industrial - Forklifts	Aggregated	600	Diesel	0.001314935	0.001591071	0.001893506	0.009073146	0.01492497	3.951566344	0.000546373	0.000502663	0.000546373	3.64947E-05	3.22522E-05	128204.2181	34695.70008	49.18959696	12256785.9	3.6951
Statewide	2020	Industrial - Forklifts	Aggregated	9999	Diesel	3.86624E-05	4.67815E-05	5.56738E-05	0.000584127	0.001388073	0.313844315	1.18743E-05	1.09244E-05	1.18743E-05	2.90049E-06	2.56156E-06	10182.33318	1113.48991	1.446752852	979871.1205	9.1445
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	25	Diesel	2.47057E-05	2.98939E-05	3.55762E-05	8.21461E-05	5.65642E-05	0.004322404	7.77646E-06	7.15434E-06	7.77646E-06	3.92216E-08	3.52789E-08	140.2356465	285.4183923	1.279408147	7135.459808	0.4913
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	50	Diesel	0.054045322	0.065394839	0.077825263	0.380551489	0.319596878	40.69836148	0.023088917	0.021241804	0.023088917	0.000374655	0.000332175	1320413.517	1908290.246	2333.64046	66996559.08	0.6919
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	75	Diesel	0.014029463	0.01697565	0.020202426	0.184314334	0.171677979	26.51624948	0.010992484	0.010113085	0.010992484	0.000244735	0.000216422	860290.5119	679472.7331	822.6594384	48607288.63	1.2661
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	100	Diesel	0.008594887	0.010399814	0.012376638	0.050011725	0.078238157	6.253837828	0.007213898	0.006636786	0.007213898	5.7562E-05	5.1043E-05	202898.881	146773.5541	194.4700383	11493117.53	1.3824
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	175	Diesel	0.006829495	0.008263689	0.009834473	0.094628742	0.07839234	15.32387737	0.004200144	0.003864132	0.004200144	0.000141472	0.000125071	497166.325	189260.936	232.8522827	28104281.54	2.6269
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	300	Diesel	0.006921922	0.008375526	0.009967568	0.042058916	0.105437028	16.47658213	0.003428345	0.003154078	0.003428345	0.000152127	0.00013448	534564.5614	138168.1895	173.999508	30185562.18	3.8689
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	600	Diesel	0.014169877	0.017145551	0.020404622	0.114342418	0.159529616	47.63169453	0.005622382	0.005172591	0.005622382	0.000439954	0.000388763	1545357.872	228565.9028	275.0727516	87334202.02	6.7611
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	750	Diesel	0.002122101	0.002567743	0.003055826	0.027467105	0.020573945	8.004955737	0.000980141	0.00090173	0.000980141	7.39461E-05	6.53354E-05	259711.973	23241.61969	28.14697923	14654062.41	11.1744
Statewide	2020	Industrial - Other General Industrial Equipment	Aggregated	9999	Diesel	0.000780678	0.000944621	0.001124176	0.005389888	0.019699677	2.773616928	0.000396857	0.000365109	0.000396857	2.562E-05	2.26379E-05	89986.94663	4372.60977	5.117632587	5088624.62	20.5797
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	25	Diesel	3.1914E-05	3.86159E-05	4.59561E-05	0.000108441	7.36576E-05	0.005705987	1.02657E-05	9.44441E-06	1.02657E-05	5.17973E-08	4.65715E-08	185.12447	325.6908272	1.459932187	8142.270681	0.5684
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	50	Diesel	0.003311879	0.004007374	0.004769106	0.01993057	0.016625515	1.89776363	0.001416966	0.001303608	0.001416966	1.74464E-05	1.54893E-05	61570.85097	75846.87985	102.1952531	2692013.274	0.8118
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	75	Diesel	0.000461156	0.000557999	0.000664065	0.003943325	0.004973178	0.516399102	0.000400053	0.000368049	0.000400053	4.76053E-06	4.21478E-06	16754.00016	11368.23832	17.51918624	823166.6299	1.4738
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	100	Diesel	0.00770601	0.009324272	0.011096654	0.137932272	0.106129967	20.82314028	0.004868272	0.004478811	0.004868272	0.000192289	0.000169956	675583.8538	354218.0868	465.7183677	33008646.91	1.9073
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	175	Diesel	0.007840414	0.009486901	0.011290197	0.090243116	0.080556008	14.37212952	0.005482746	0.005044126	0.005482746	0.000132642	0.000117303	466287.9143	164187.2598	230.6692855	22773224.17	2.8400
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	300	Diesel	0.011719418	0.014180496	0.016875963	0.063578075	0.162421164	25.24625318	0.005937622	0.005462612	0.005937622	0.000233063	0.000206057	819086.8806	167028.9123	224.8295568	40054926.8	4.9039
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	600	Diesel	0.012114817	0.014658929	0.017445337	0.085620243	0.173785355	29.54699108	0.005978827	0.005500521	0.005978827	0.000272813	0.000241159	958619.5856	127122.0152	172.2719981	46764698.45	7.5409
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	750	Diesel	0.000590067	0.000713981	0.000849697	0.00277939	0.00666162	1.360424215	0.00032652	0.000300398	0.00032652	1.25601E-05	1.11036E-05	44137.46542	3463.721948	4.379796561	2159053.347	12.7428
Statewide	2020	Industrial - Other Material Handling Equipment	Aggregated	9999	Diesel	0.000570488	0.000690291	0.000821503	0.004303439	0.013455656	2.199231231	0.000252718	0.000232501	0.000252718	2.03159E-05	1.79498E-05	71351.63527	3463.721948	4.379796561	3490277.149	20.5997
Statewide	2020	Locomotive - Line haul	Aggregated	9999	Diesel	1.515021523	1.833176042	2.181630993	17.68582119	52.33907175	6782.160964	0.775796242	0.70863681	0.775796242	0.068994099	0.055334619	219957237.6	0	0	0	#DIV/0!
Statewide	2020	Locomotive - Passenger	Aggregated	9999	Diesel	0.244261151	0.000250929	0.000298626	1.395551619	5.915809063	0	0.107664804	0.099051619	0.107664804	0.004845019	0.004862486	0	0	0	0	#DIV/0!
Statewide	2020	Locomotive - Short line	Aggregated	9999	Diesel	0.060713538	1.01993E-05	1.2138E-05	0.234723818	1.73494679	0	0.029154344	0.026821996	0.029154344	0.000997524	0.000894056	0	0	0	0	#DIV/0!
Statewide	2020	Locomotive - Switcher	Aggregated	9999	Diesel	0.297612364	0.000470095	0.000559451	0.799512681	4.616170039	0	0.097504642	0.089704271	0.097504642	0.002662034	0.002394284	0	0	0	0	#DIV/0!
Statewide	2020	Ocean Going Vessels	Aggregated		Diesel	9.937150594	12.90660493	15.42066482	15.860394	213.4639362	9045.801951	2.384881002	2.194090522	2.384881002	6.760104932	0.219338097	285620623.9	0	0	6248901685	#DIV/0!
Statewide	2020	OFF - Agricultural - 2-Wheel Tractors	Aggregated	25	Gasoline	0.055398103	0.050955175	0.060962233	2.012661384	0.040738984	3.565416188	0.02265358	0.017116038	0.025170644	0.000104704	9.21891E-05	263154.05	633483.05	2494	4433844.8	0.4154
Statewide	2020	OFF - Agricultural - Agricultural Mowers	Aggregated	25	Gasoline	0.044193629	0.0406493	0.048632393	1.868776706	0.03304239	3.009625667	0.02270675	0.017156211	0.025229722	7.9635E-05	8.12014E-05	231789.6	386743.05	2145.62	4833461.4	0.5993
Statewide	2020	OFF - Agricultural - Agricultural Tractors	Aggregated	25	Diesel	0.299910254	0.356917988	0.431870766	1.703430954	2.721963913	361.762241	0.103004538	0.094764175	0.103004538	0.004899056	0.003028289	12037627	16660034.45	31269.93	301117002.8	0.7225
Statewide	2020	OFF - Agricultural - Agricultural Tractors	Aggregated	100	Gasoline	0.045616886	0.041958412	0.050198601	1.666383955	0.11950358	29.51690203	0.002057989	0.001554925	0.002286655	0.000285174	0.000428334	1222680.65	248006.55	450.36	20336537.1	4.9300
Statewide	2020	OFF - Agricultural - Agricultural Tractors	Aggregated	175	Gasoline	0.005960832	0.005482774	0.006559533	0.226761441	0.027987315	5.997188891	0.000429935	0.000324839	0.000477705	5.95758E-05	8.4471E-05	241122.65	33817.25	61.14	4227156.25	7.1302
Statewide	2020	OFF - Agricultural - Balers	Aggregated	50	Gasoline	0.007917825	0.007282815	0.008713083	0.400218994	0.015123238	5.102187349	0.00035174	0.000265759	0.000390822	6.20333E-05	7.6327E-05	217875.8	111934.55	1645.01	3917709.25	1.9465
Statewide	2020	OFF - Agricultural - Balers	Aggregated	100	Gasoline	0.003768779	0.003466523	0.004147312	0.110184175	0.014547944	4.717954209	0.000328947	0.000248538	0.000365497	4.5582E-05	6.49954E-05	185529.5	57264.85	841.19	3664950.4	3.2398

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	OFF - Agricultural - Combines	Aggregated	100	Gasoline	0.001029014	0.000946487	0.001132368	0.047388071	0.002672444	2.51970946	0.00017568	0.000132736	0.0001952	2.43439E-05	3.4417E-05	98243.4	13983.15	112.62	1440264.45	7.0258
Statewide	2020	OFF - Agricultural - Combines	Aggregated	175	Gasoline	0.000655059	0.000602523	0.000720853	0.070056074	0.002546912	2.167715648	0.000155402	0.000117415	0.000172669	2.1534E-05	3.0205E-05	86220.3	7690.55	62.39	1261250.2	11.2112
Statewide	2020	OFF - Agricultural - Combines	Aggregated	300	Gasoline	0.000119591	0.00011	0.000131603	0.0152993	0.001394847	0.460044685	3.39377E-05	2.56418E-05	3.77086E-05	4.70273E-06	6.38573E-06	18228.1	1160.7	11.05	225175.8	15.7044
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	25	Gasoline	0.04329973	0.039827092	0.047648712	1.682733975	0.032182649	2.803849285	0.019909	0.015042356	0.022121111	7.7247E-05	7.45867E-05	212908.15	392977.25	1013.66	3860878.75	0.5418
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	25	Diesel	0.002032262	0.00241856	0.002926458	0.010760889	0.018468917	2.438522027	0.000694258	0.000638718	0.000694258	3.19807E-05	2.03938E-05	81066.5	176554.15	216.46	2959047.7	0.4592
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	50	Gasoline	0.000428576	0.000394204	0.000471621	0.034207182	0.000663908	0.350264764	2.41469E-05	1.82444E-05	2.68299E-05	4.25858E-06	5.35128E-06	15275.25	6865.65	15.19	260894.7	2.2249
Statewide	2020	OFF - Agricultural - Hydro Power Units	Aggregated	100	Gasoline	3.24146E-05	2.98149E-05	3.56703E-05	0.001598961	8.1583E-05	0.075190005	5.24243E-06	3.96095E-06	5.82492E-06	7.2644E-07	1.01016E-06	2883.5	817.6	1.64	53961.6	3.5268
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	25	Gasoline	0.005699259	0.005242178	0.006271686	0.201701681	0.003935571	0.356879628	0.002127345	0.001607328	0.002363717	1.03008E-05	9.12211E-06	26039.1	56936.35	393.78	493644.25	0.4573
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	25	Diesel	0.004721536	0.005619018	0.006799011	0.025092891	0.043008136	5.643501679	0.001691153	0.001555861	0.001691153	7.42622E-05	4.7194E-05	187599.05	332956.65	745.32	6444921.8	0.5634
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	50	Gasoline	0.000347311	0.000319456	0.000382194	0.02034269	0.00060276	0.239635187	1.65202E-05	1.2482E-05	1.83558E-05	2.91353E-06	3.51637E-06	10037.5	6095.5	50.7	176769.5	1.6467
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	100	Gasoline	0.002200705	0.002024209	0.002421742	0.07617579	0.007125402	3.170904929	0.000221083	0.000167041	0.000245648	3.06354E-05	4.369E-05	124713.2	36602.2	295.81	2452347.4	3.4073
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	175	Gasoline	0.000327802	0.000301513	0.000360726	0.023308093	0.001800945	0.713665514	5.11622E-05	3.86559E-05	5.68469E-05	7.08952E-06	9.93024E-06	28345.9	3836.15	32.91	521716.4	7.3892
Statewide	2020	OFF - Agricultural - Other Agricultural Equipment	Aggregated	300	Gasoline	0.000178332	0.000164029	0.000196243	0.015659513	0.001805099	0.465948748	3.43733E-05	2.59709E-05	3.81925E-05	4.76308E-06	6.45862E-06	18436.15	1208.15	11.49	297204.9	15.2598
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	25	Gasoline	0.096299109	0.08857592	0.105971295	3.355575568	0.058707649	5.660279386	0.034364491	0.025964282	0.038182768	0.000155896	0.000150118	428513.65	929629.45	9474.69	8725602.4	0.4610
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	25	Diesel	0.000492822	0.000586499	0.000709663	0.00226985	0.004141381	0.517747481	0.000196608	0.00018088	0.000196608	6.56923E-06	4.27618E-06	16998.05	31495.85	287.88	598421.15	0.5397
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	50	Gasoline	0.001534448	0.001411385	0.001688567	0.078456818	0.002899733	0.968659892	6.67785E-05	5.04549E-05	7.41984E-05	1.17771E-05	1.45066E-05	41409.25	24604.65	309.35	811953.45	1.6830
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	100	Gasoline	0.002718688	0.002500649	0.00299175	0.080413743	0.010336107	3.326226493	0.000231912	0.000175223	0.000257681	3.2136E-05	4.58599E-05	130907.25	41635.55	521.76	2831217.4	3.1441
Statewide	2020	OFF - Agricultural - Sprayers	Aggregated	175	Gasoline	0.000778601	0.000716157	0.000856803	0.048552218	0.005276019	1.501935305	0.000107673	8.13527E-05	0.000119636	1.49202E-05	2.09192E-05	59714	9154.2	117.16	1281588	6.5231
Statewide	2020	OFF - Agricultural - Swathers	Aggregated	100	Gasoline	0.014437167	0.013279306	0.015887222	0.43289218	0.05388927	17.17657903	0.001197592	0.000904848	0.001330658	0.00016595	0.000237383	677611.55	160402.9	1686.23	14115455.2	4.2244
Statewide	2020	OFF - Agricultural - Swathers	Aggregated	175	Gasoline	0.01001574	0.009212477	0.01102171	0.610095184	0.066633316	18.77261688	0.001345797	0.001016824	0.00149533	0.000186486	0.000261988	747844.85	122924.7	1292.89	15857286.3	6.0838
Statewide	2020	OFF - Agricultural - Tillers	Aggregated	25	Gasoline	0.785988294	0.722952032	0.864932172	42.5227535	0.555863833	69.84141646	0.031956647	0.024145022	0.035507386	0.001991368	0.001854423	5293456.3	10835313.35	152386.39	75847193.45	0.4885
Statewide	2020	OFF - AirGrSupp - A/C Tug Narrow Body	Aggregated	175	Gasoline	0.009429301	0.008673071	0.01037637	0.476131493	0.059992314	11.82106911	0.000847445	0.000640292	0.000941605	0.00011743	0.000167034	476799.5	49822.5	68.22	6476925	9.5700
Statewide	2020	OFF - AirGrSupp - A/C Tug Wide Body	Aggregated	600	Gasoline	0.004215937	0.003877818	0.004639381	0.447496819	0.039569344	12.52331616	0.000923851	0.000698021	0.001026501	0.000128018	0.000175495	500951.55	14107.25	27.24	7053625	35.5102
Statewide	2020	OFF - AirGrSupp - Air Conditioner	Aggregated	175	Gasoline	2.47893E-06	2.28012E-06	2.72791E-06	0.00021803	2.67009E-05	0.006728205	4.82341E-07	3.64435E-07	5.35934E-07	6.68377E-08	5.11472E-08	146	0	1.23	0	#DIV/0!
Statewide	2020	OFF - AirGrSupp - Air Conditioner	Aggregated	175	Nat Gas	0	0	1.18983E-06	0.000892136	0.000121051	0.036157318	0	0	3.2156E-06	0	0	1821.35	58.4	7.97	7592	31.1875
Statewide	2020	OFF - AirGrSupp - Air Start Unit	Aggregated	175	Gasoline	0.00025515	0.000234687	0.000280777	0.02101566	0.002576095	0.636439245	4.56259E-05	3.44729E-05	5.06955E-05	6.32236E-06	8.81523E-06	25163.1	2248.4	31.13	292292	11.1916
Statewide	2020	OFF - AirGrSupp - Baggage Tug	Aggregated	100	Gasoline	0.064395159	0.059230667	0.070862944	4.825277071	0.376913423	114.3931857	0.007975767	0.006026135	0.008861964	0.001105198	0.001619742	4623560.85	889202.05	1013.18	88920205	5.1997
Statewide	2020	OFF - AirGrSupp - Baggage Tug	Aggregated	100	Nat Gas	0	0	0.002577949	0.841744641	0.105745803	18.79023581	0	0	0.001671085	0	0	1046378.35	167673.7	201.37	16767370	6.2406
Statewide	2020	OFF - AirGrSupp - Belt Loader	Aggregated	100	Gasoline	0.015629052	0.014375602	0.017198819	1.190068744	0.090684305	27.2061064	0.001896875	0.001433194	0.002107639	0.000262849	0.000386127	1102201.45	387721.25	477.63	23263275	2.8428
Statewide	2020	OFF - AirGrSupp - Belt Loader	Aggregated	100	Nat Gas	0	0	0.000186381	0.071494321	0.008774045	1.806682577	0	0	0.000160675	0	0	99593.9	29393.45	53.12	1763607	3.3883
Statewide	2020	OFF - AirGrSupp - Bobtail	Aggregated	100	Gasoline	0.009265385	0.008522301	0.010195991	0.694431483	0.054197951	16.43710025	0.001146034	0.000865892	0.001273371	0.000158805	0.000232763	664424.1	127746.35	145.61	12774635	5.2011
Statewide	2020	OFF - AirGrSupp - Bobtail	Aggregated	100	Nat Gas	0	0	2.15718E-05	0.01460726	0.001328351	0.405232386	0	0	3.60388E-05	0	0	22159.15	3577	4.02	357700	6.1949
Statewide	2020	OFF - AirGrSupp - Cargo Loader	Aggregated	100	Gasoline	0.004935245	0.004539439	0.005430936	0.373976734	0.028591271	8.57822957	0.000598095	0.000451894	0.00066455	8.28777E-05	0.000121701	347396.05	104765.95	145.35	7333616.5	3.3159
Statewide	2020	OFF - AirGrSupp - Cargo Loader	Aggregated	100	Nat Gas	0	0	0.000295524	0.088577151	0.011288281	1.82075857	0	0	0.000161927	0	0	101875.15	25356.55	24.44	1774958.5	4.0177
Statewide	2020	OFF - AirGrSupp - Cargo Tractor	Aggregated	100	Gasoline	0.159662176	0.146857269	0.175698485	13.1627006	0.695119075	145.7475033	0.010161866	0.007677854	0.011290962	0.001203306	0.00221408	6320099.1	1214614.15	898.74	115388344.3	5.2034
Statewide	2020	OFF - AirGrSupp - Cargo Tractor	Aggregated	175	Nat Gas	0	0	0.000106986	0.068379289	0.009200643	2.600337527	0	0	0.000231258	0	0	140320.6	15019.75	96.99	2337073.1	9.3424
Statewide	2020	OFF - AirGrSupp - Cart	Aggregated	25	Gasoline	0.000325131	0.000299055	0.000357787	0.020579381	0.000253377	0.033773062	1.53327E-05	1.15847E-05	1.70363E-05	9.62962E-07	8.74618E-07	2496.6	4277.8	28.72	51333.6	0.5836
Statewide	2020	OFF - AirGrSupp - Catering Truck	Aggregated	300	Gasoline	0.022990682	0.021146829	0.025299843	1.029474246	0.129642368	22.89372562	0.001688881	0.001276044	0.001876535	0.000199987	0.000326036	930669.7	97520.7	95.6	19884470.73	9.5433
Statewide	2020	OFF - AirGrSupp - Catering Truck	Aggregated	300	Nat Gas	0	0	0.000103422	0.052383238	0.006900381	1.753257777	0	0	0.000155924	0	0	95053.3	7967.95	17.48	1633429.75	11.9295
Statewide	2020	OFF - AirGrSupp - Deicer	Aggregated	100	Gasoline	0.000120394	0.000110739	0.000132486	0.003901922	0.000745819	0.206613742	1.44056E-05	1.08842E-05	1.60062E-05	1.99618E-06	2.7888E-06	7960.65	934.4	44.92	86899.2	8.5195
Statewide	2020	OFF - AirGrSupp - Forklift	Aggregated	50	Gasoline	0.00512521	0.004714168	0.00563998	0.481938517	0.011332305	3.541866611	0.000244173	0.000184486	0.000271303	4.30626E-05	5.72325E-05	163370.35	99765.45	137.09	4988272.5	1.6375
Statewide	2020	OFF - AirGrSupp - Forklift	Aggregated	50	Nat Gas	0	0	0.00033165	0.088600738	0.023949598	7.138465977	0	0	0.00063485	0	0	377446.5	233545.25	321.06	11677262.5	1.6162
Statewide	2020	OFF - AirGrSupp - Fuel Truck	Aggregated	175	Gasoline	5.26185E-05	4.83985E-05	5.79035E-05	0.004484352	0.00056867	0.14087616	1.00993E-05	7.6306E-06	1.12215E-05	1.39946E-06	1.92697E-06	5500.55	1806.75	86	234877.5	3.0444
Statewide	2020	OFF - AirGrSupp - Fuel Truck	Aggregated	175	Nat Gas	0	0	2.91357E-05	0.013829749	0.00180957	0.442593254	0	0	3.93615E-05	0	0	23936.7	6117.4	10.59	856436	3.9129
Statewide	2020	OFF - AirGrSupp - Generator	Aggregated	100	Gasoline	0.001988111	0.001828665	0.002187795	0.100080737	0.006614571	1.207823154	8.42123E-05	6.36271E-05	9.35693E-05	9.97191E-06	1.81368E-05	51771.6	6069.95	6.54	649484.65	8.5292
Statewide	2020	OFF - AirGrSupp - Ground Power Unit	Aggregated	175	Gasoline	0.007925055	0.007289466	0.00872104	0.809300865	0.071273206	22.96373813	0.001646255	0.001243837	0.001829173	0.000228121	0.00032156	917894.7	89691.45	112.5	13453717.5	10.2339
Statewide	2020	OFF - AirGrSupp - Hydrant truck	Aggregated	175	Gasoline	0.02627801	0.024170514	0.028917347	1.019872273	0.127584377	20.32562116	0.00145713	0.001100943	0.001619034	0.000172544	0.000292006	833532.25	104944.8	68.26	12750793.2	7.9426
Statewide	2020	OFF - AirGrSupp - Lav Cart	Aggregated	25	Gasoline	7.61519E-05	7.00445E-05	8.38005E-05	0.00479217	5.97315E-05	0.008014965	3.64361E-06	2.75295E-06	4.04845E-06	2.28528E-07	2.08425E-07	594.95	978.2	6.77	11738.4	0.6082
Statewide	2020	OFF - AirGrSupp - Lav Truck	Aggregated	175	Gasoline	0.005764898	0.005302553	0.006343918	0.411522303	0.036002113	10.10742501	0.000724595	0.000547472	0.000805105	0.000100407	0.000142795	407610.1	136641.4	112.28	17763382	2.9831
Statewide	2020	OFF - AirGrSupp - Lav Truck	Aggregated	175	Nat Gas	0	0	1.1599E-05	0.006138311	0.000811632	0.211127981	0	0	1.87764E-05	0	0	11355.15	3044.1	7.88	395733	3.7302
Statewide	2020	OFF - AirGrSupp - Lift	Aggregated	100	Gasoline	0.009793067	0.009007663	0.010776672	0.429891214	0.042277287	9.676115169	0.000674642	0.00050973	0.000749602	9.34848E-05	0.000137659	392948.05	82570.3	219.18	8257030	4.7590
Statewide	2020	OFF - AirGrSupp - Lift	Aggregated	100	Nat Gas	0	0	2.21938E-05	0.010204637	0.001224453	0.286404714	0	0	2.5471E-05	0	0	15527.1	2682.75	7.95	268275	5.7878
Statewide	2020	OFF - AirGrSupp - Maint. Truck	Aggregated	175	Gasoline	0.004861416	0.00447153	0.005349691	0.36707071	0.038340167	10.13540982	0.000726601	0.000548987	0.000807334	0.000100685	0.000142173	405832.55	68415.6	151.97	8894028	5.9319
Statewide	2020	OFF - AirGrSupp - Other	Aggregated	50	Nat Gas	0	0	0.00037719	0.041631933	0.014827521	2.421913171	0	0	0.00021539	0	0	129403.45	47355.1	46.22	2367755	2.7326
Statewide	2020	OFF - AirGrSupp - Other GSE	Aggregated	50	Gasoline	0.004380087	0.004028804	0.004820019	0.281634697	0.008981778	2.678445181	0.00018465	0.000139513	0.000205166	3.2565E-05	4.15597E-05	118632.3	45088.45	246.56	2254422.5	2.6311
Statewide	2020	OFF - AirGrSupp - Passenger Stand	Aggregated	175	Gasoline	0.00169584	0.001559834	0.001866169	0.121332249	0.015331495	3.592682369	0.000257557	0.000194599	0.000286175	3.17961E-05	5.02113E-05	143328.2	21232.05	113.4	2656129.455	6.7506
Statewide	2020	OFF - AirGrSupp - Passenger Stand	Aggregated	175	Nat Gas	0	0	3.18816E-07	0.000241101	3.28399E-05	0.009817806	0	0	8.73134E-07	0	0	408.8	0	3.99	0	#DIV/0!
Statewide	2020	OFF - AirGrSupp - Service Truck	Aggregated	300	Gasoline	0.028497032	0.02621157	0.031359245	1.364736495	0.172276075	31.90304178	0.002353503	0.001778202	0.002615004	0.000326124	0.000452708	1292256.95	400751.75	476.16	72135315	3.2246
Statewide	2020	OFF - AirGrSupp - Service Truck	Aggregated	300	Nat Gas	0	0	0.000310293	0.158486993	0.015071748	4.454324907	0	0	0.00039614	0	0	244031.7	60575.4	46.32	10903572	4.0286
Statewide	2020	OFF - AirGrSupp - Sweeper	Aggregated	50	Nat Gas	0	0	2.91381E-06	0.000646049	0.000218088	0.053619741	0	0	4.7686E-06	0	0	2726.55	1135.15	3.9	51081.75	2.4019
Statewide	2020	OFF - AirGrSupp - Sweeper	Aggregated	100	Gasoline	0.000251055	0.000230921	0.000276271	0.010971359	0.001096542	0.252957948	1.76368E-05	1.33256E-05	1.95965E-05	2.08845E-06	3.55601E-06	10150.65	3828.85	10.59	204077.705	2.6511
Statewide	2020	OFF - AirGrSupp - Water Truck	Aggregated	175	Gasoline	0.000413152	0.000380017	0.000454649	0.026707813	0.003366893	0.756713418	5.42483E-05	4.09876E-05	6.02759E-05	7.51716E-06	1.05491E-05	30112.5	10986.5	35.35	1647975	2.7409
Statewide	2020	OFF - ConstMin - Asphalt Pavers	Aggregated	25	Gasoline	0.018586094	0.017095489	0.020452863	0.782310714	0.013512634	1.244788688	0.009391568	0.007095852	0.010435076	3.231E-05	3.37955E-05	96469.5	84519.4	213.11	1454156.35	1.1414
Statewide	2020	OFF - ConstMin - Asphalt Pavers	Aggregated	50	Gasoline	0.002978905	0.002739997	0.003278103	0.192540529	0.004321699	1.380675913	9.51826E-05	7.19157E-05	0.000105758	1.67865E-05	2.23871E-05	63904.2	27385.95	69.79	876350.4	2.3335
Statewide	2020	OFF - ConstMin - Asphalt Pavers	Aggregated	100	Gasoline	0.001585503	0.001458346	0.00174475	0.059937968	0.004323819	1.429457174	9.96652E-05	7.53026E-05	0.000110739	1.38106E-05	2.02147E-05	57702.85	14859.15	37.8	906408.15	3.8833
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	25	Gasoline	0.006616635	0.006085981	0.007281203	0.291278774	0.004753185	0.461481621	0.003481745	0.002630651	0.003868605	1.18431E-05	1.24326E-05	35488.95	26688.8	217.31	445913.2	1.3297
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	25	Diesel	0.000749203	0.000891614	0.001078853	0.004022797	0.006806925	0.899889828	0.000256224	0.000235726	0.000256224	1.18766E-05	7.48445E-06	29751.15	44957.05	55.11	696905.45	0.6618
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	50	Gasoline	0.000231048	0.000212518	0.000254254	0.012138359	0.000423731	0.139777391	9.63613E-06	7.28063E-06	1.07068E-05	1.69944E-06	1.97684E-06	5642.9	1967.35	20.87	62955.2	2.8683
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	100	Gasoline	0.001491925	0.001372272	0.001641772	0.045365768	0.005445931	1.744864154	0.000121656	9.19179E-05	0.000135173	1.68578E-05	2.40571E-05	68671.1	10449.95	99.5	919595.6	6.5714
Statewide	2020	OFF - ConstMin - Bore/Drill Rigs	Aggregated	175	Gasoline	0.000327049	0.00030082	0.000359897	0.019682172	0.002124893	0.601431053	4.31162E-05	3.25767E-05	4.79069E-05	5.97459E-06	8.28841E-06	23659.3	2273.95	23.79	286517.7	10.4045
Statewide	2020	OFF - ConstMin - Cement and Mortar Mixers	Aggregated	25	Gasoline	0.265197951	0.243929075	0.291834168	9.029593262	0.173922495	16.04607909	0.08993971	0.067954447	0.099933011	0.000482813	0.000415211	1185220.7	3023663.65	32841.64	20960522.85	0.3920
Statewide	2020	OFF - ConstMin - Cement and Mortar Mixers	Aggregated	25	Diesel	0.001897829	0.002258574	0.002732874	0.013202551	0.017044032	2.304714368	0.00067734	0.000623153	0.00067734	3.4539E-05	1.92148E-05	76379.9	231921	772.75	2388516.2	0.3293
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	25	Gasoline	0.202804537	0.186539613	0.223174022	8.426981833	0.154227678	13.88493716	0.102201829	0.07721916	0.113557588	0.000382094	0.000370667	1058069.3	1313675.15	4622.58	13726160.8	0.8054
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	25	Diesel	6.22035E-05	7.40273E-05	8.95731E-05	0.000305725	0.00056603	0.07424934	2.11499E-05	1.94579E-05	2.11499E-05	9.42083E-07	5.91337E-07	2350.6	3160.9	5.21	56896.2	0.7436
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	50	Gasoline	0.003615697	0.003325718	0.003978853	0.269383832	0.005802272	3.207448853	0.000221119	0.000167067	0.000245687	3.89967E-05	4.83111E-05	137904.3	49661.9	81.27	1738166.5	2.7769
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	50	Diesel	0.001138259	0.001354622	0.001639092	0.009348131	0.008617129	1.166939581	0.000435381	0.00040055	0.000435381	1.50856E-05	9.75614E-06	38781.25	27838.55	47.72	918672.15	1.3931
Statewide	2020	OFF - ConstMin - Concrete/Industrial Saws	Aggregated	100	Gasoline	0.001485918	0.001366748	0.001635163	0.073423193	0.003714093	3.427779809	0.000238993	0.000180573	0.000265548	3.31171E-05	4.70171E-05	134210.5	28437.15	46.55	1876851.9	4.7195
Statewide	2020	OFF - ConstMin - Cranes	Aggregated	50	Gasoline	0.001050844	0.000966566	0.00115639	0.064717025	0.001603723	0.423780602	2.92151E-05	2.20736E-05	3.24612E-05	5.1524E-06	6.92789E-06	19775.7	9906.1	23.79	366525.7	1.9963
Statewide	2020	OFF - ConstMin - Cranes	Aggregated	100	Gasoline	0.00222805	0.00204936	0.002451833	0.079045077	0.006258725	1.676078509	0.00011686	8.82944E-05	0.000129845	1.61933E-05	2.38794E-05	68163.75	20330.5	48.77	1504457	3.3528
Statewide	2020	OFF - ConstMin - Cranes	Aggregated	175	Gasoline	9.42309E-05	8.66736E-05	0.000103695	0.004000089	0.000471753	0.110141343	7.89596E-06	5.96584E-06	8.77329E-06	1.09414E-06	1.45898E-06	4164.65	569.4	1.35	71175	7.3141
Statewide	2020	OFF - ConstMin - Crushing/Proc. Equipment	Aggregated	25	Gasoline	0.002977251	0.002738475	0.003276283	0.126967271	0.002244552	0.20548052	0.001550291	0.001171331	0.001722545	5.50855E-06	5.49066E-06	15673.1	15727.85	54.49	185036.75	0.9965
Statewide	2020	OFF - ConstMin - Crushing/Proc. Equipment	Aggregated	100	Gasoline	0.001405037	0.001292353	0.001546157	0.046595076	0.004485861	1.324499833	9.23473E-05	6.97735E-05	0.000102608	1.27965E-05	1.85102E-05	52837.4	6599.2	27.83	633523.2	8.0066
Statewide	2020	OFF - ConstMin - Dumpers/Tenders	Aggregated	25	Gasoline	0.024378161	0.022423032	0.026826679	0.88181565	0.016897349	1.510490574	0.009969125	0.007532228	0.011076805	4.30823E-05	3.95918E-05	113014.95	326145.75	2188.01	2837254.5	0.3465
Statewide	2020	OFF - ConstMin - Dumpers/Tenders	Aggregated	25	Diesel	0.000193201	0.000229925	0.000278209	0.000949132	0.001759004	0.23050924	6.70304E-05	6.1668E-05	6.70304E-05	2.92473E-06	1.87869E-06	7467.9	21936.5	32.66	350984	0.3404
Statewide	2020	OFF - ConstMin - Dumpers/Tenders	Aggregated	100	Gasoline	0.000127251	0.000117046	0.000140032	0.003932067	0.000454093	0.143664915	1.00167E-05	7.56815E-06	1.11296E-05	1.388E-06	1.85025E-06	5281.55	1919.9	16.91	126713.4	2.7510
Statewide	2020	OFF - ConstMin - Excavators	Aggregated	25	Diesel	0.001353716	0.001611034	0.001949352	0.006653399	0.012318342	1.615866006	0.000460279	0.000423456	0.000460279	2.05023E-05	1.35025E-05	53673.25	71722.5	51.16	1649617.5	0.7483
Statewide	2020	OFF - ConstMin - Other Construction Equipment	Aggregated	25	Diesel	0.004365066	0.005194789	0.006285695	0.030822859	0.039430027	5.364497474	0.001527931	0.001405696	0.001527931	8.06844E-05	4.49407E-05	178641.95	371121.05	537.26	5038930.85	0.4814
Statewide	2020	OFF - ConstMin - Other Construction Equipment	Aggregated	175	Gasoline	0.001386602	0.001275397	0.001525871	0.118384817	0.004553206	3.547710106	0.000254333	0.000192163	0.000282592	3.52428E-05	4.95387E-05	141408.3	25652.2	69.1	3232177.2	5.5125

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	OFF - ConstMin - Pavers	Aggregated	25	Diesel	0.000366851	0.000436582	0.000528265	0.001800491	0.003343746	0.437273213	0.000129073	0.000118747	0.000129073	5.54817E-06	3.60036E-06	14311.65	16881.25	20.14	405150	0.8478
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	25	Gasoline	0.428308308	0.393957982	0.471327167	15.65724576	0.313351565	27.70661489	0.176730981	0.133530075	0.196367757	0.000813376	0.000716858	2046273.95	4416930.7	23349.27	36207299.2	0.4633
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	25	Diesel	0.000433906	0.000516383	0.000624824	0.002132608	0.003948387	0.51793214	0.000147456	0.00013566	0.000147456	6.57158E-06	4.30464E-06	17111.2	29864.3	35.82	567421.7	0.5730
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	50	Gasoline	0.00222317	0.002044871	0.002446463	0.155528302	0.00364504	1.74079196	0.000120009	9.06732E-05	0.000133343	2.11649E-05	2.63702E-05	75273.95	33503.35	192.09	1239623.95	2.2468
Statewide	2020	OFF - ConstMin - Paving Equipment	Aggregated	100	Gasoline	0.0004281	0.000393766	0.000471098	0.018847092	0.0012091	0.791317343	5.51725E-05	4.16859E-05	6.13028E-05	7.64523E-06	1.08215E-05	30889.95	8446.1	48.91	557442.6	3.6573
Statewide	2020	OFF - ConstMin - Plate Compactors	Aggregated	25	Gasoline	0.180543385	0.166063805	0.198676982	5.844921923	0.123676045	10.94543204	0.0597934	0.045177235	0.066437111	0.000333207	0.000276726	789914.75	2499253.55	12893.45	15344497.8	0.3161
Statewide	2020	OFF - ConstMin - Plate Compactors	Aggregated	25	Diesel	0.00128201	0.001525698	0.001846094	0.009683512	0.011560942	1.585919361	0.000451748	0.000415609	0.000451748	2.46783E-05	1.3284E-05	52804.55	268614.45	447.4	2148915.6	0.1966
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	25	Gasoline	0.092236197	0.084838854	0.101500308	3.819204897	0.067888236	6.226301343	0.045326577	0.034246747	0.050362864	0.00016773	0.000167134	477084.2	629062.9	2526.13	7742453	0.7584
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	25	Diesel	0.007827978	0.009315941	0.011272288	0.049259545	0.070897374	9.521315654	0.002711481	0.002494563	0.002711481	0.000135335	7.97424E-05	316980.6	829130.35	1191.72	9907162.15	0.3823
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	50	Gasoline	0.005077683	0.004670453	0.005587681	0.329571968	0.007176732	1.673048038	0.000115338	8.71446E-05	0.000128154	2.03412E-05	2.9246E-05	83482.8	30532.25	48.77	1129693.25	2.7342
Statewide	2020	OFF - ConstMin - Rollers	Aggregated	100	Gasoline	0.010388127	0.009554999	0.0114315	0.38695891	0.026135203	6.304041982	0.000439533	0.000332092	0.00048837	6.09058E-05	9.21034E-05	262909.5	57746.65	92.41	4330998.75	4.5528
Statewide	2020	OFF - ConstMin - Rough Terrain Forklifts	Aggregated	50	Gasoline	0.000710711	0.000653712	0.000782094	0.043741567	0.00108559	0.287237956	1.98019E-05	1.49615E-05	2.20021E-05	3.49229E-06	4.65184E-06	13278.7	3792.35	8.99	178240.45	3.5014
Statewide	2020	OFF - ConstMin - Rough Terrain Forklifts	Aggregated	100	Gasoline	0.009673035	0.008897257	0.010644585	0.342965853	0.027206336	7.293644254	0.00050853	0.000384223	0.000565034	7.04668E-05	0.000104297	297715.9	58009.45	140.16	4930803.25	5.1322
Statewide	2020	OFF - ConstMin - Rough Terrain Forklifts	Aggregated	175	Gasoline	0.000356141	0.000327579	0.000391912	0.015144256	0.001785173	0.417266327	2.99136E-05	2.26013E-05	3.32373E-05	4.1451E-06	5.74639E-06	16403.1	1700.9	3.96	241527.8	9.6438
Statewide	2020	OFF - ConstMin - Rubber Tired Loaders	Aggregated	25	Diesel	0.000361586	0.000430317	0.000520684	0.001777164	0.003290305	0.431607824	0.000122943	0.000113108	0.000122943	5.47628E-06	3.5921E-06	14278.8	18545.65	19.1	463641.25	0.7699
Statewide	2020	OFF - ConstMin - Rubber Tired Loaders	Aggregated	50	Gasoline	0.001674619	0.001540315	0.001842816	0.107989492	0.002363845	0.649407285	4.47696E-05	3.38259E-05	4.97439E-05	7.89561E-06	1.08522E-05	30977.55	12402.7	23.9	496108	2.4976
Statewide	2020	OFF - ConstMin - Rubber Tired Loaders	Aggregated	100	Gasoline	0.010511052	0.009668066	0.011566772	0.392080896	0.027367528	7.674516144	0.000535086	0.000404287	0.00059454	7.41465E-05	0.000110386	315097.2	84194.55	164.33	6062007.6	3.7425
Statewide	2020	OFF - ConstMin - Signal Boards	Aggregated	25	Gasoline	0.004608225	0.004238645	0.005071071	0.190239505	0.003646774	0.321756496	0.002337403	0.001766038	0.002597114	9.24899E-06	8.4393E-06	24090	41642.85	157.18	325685.85	0.5785
Statewide	2020	OFF - ConstMin - Signal Boards	Aggregated	25	Diesel	0.020036899	0.023845566	0.028853134	0.151346408	0.180689288	24.78679134	0.007060506	0.006495666	0.007060506	0.000385704	0.000207912	826462.2	2935377.45	3910.37	17612264.7	0.2816
Statewide	2020	OFF - ConstMin - Signal Boards	Aggregated	50	Diesel	0.000497165	0.000591667	0.000715917	0.004037368	0.003750498	0.515814625	0.000186993	0.000172033	0.000186993	6.6682E-06	4.24312E-06	16866.65	10026.55	18.6	370982.35	1.6822
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	25	Gasoline	0.303309154	0.27898376	0.333773222	12.7233652	0.215248553	20.05287803	0.151293128	0.114310363	0.168103475	0.000508925	0.000547446	1562685.45	1408494.85	4411.49	26658015.9	1.1095
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	25	Diesel	0.036219536	0.043104241	0.052156132	0.175105475	0.325965746	42.03155838	0.013257854	0.012197225	0.013257854	0.000533301	0.000351587	1397577.7	2226237.2	2666.85	44524744	0.6278
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	50	Gasoline	0.011076143	0.010187836	0.01218862	0.870550605	0.017217182	9.216741459	0.000635394	0.000480075	0.000705993	0.000112059	0.000140842	402032.9	209889.6	676.54	6716467.2	1.9154
Statewide	2020	OFF - ConstMin - Skid Steer Loaders	Aggregated	100	Gasoline	0.006366644	0.005856039	0.007006103	0.334993164	0.015972421	13.62970731	0.000950296	0.000718001	0.001055884	0.000131682	0.000187914	536400.35	125476.05	404.51	10038084	4.2749
Statewide	2020	OFF - ConstMin - Surfacing Equipment	Aggregated	25	Gasoline	0.206302698	0.189757222	0.227023535	7.775117115	0.159008528	13.33242657	0.093345732	0.070527887	0.10371748	0.000384927	0.000349983	999026.9	2696079.8	6301.39	20978772.85	0.3705
Statewide	2020	OFF - ConstMin - Tampers/Rammers	Aggregated	25	Gasoline	0.022621402	0.020807166	0.024893474	1.055152784	0.019135855	1.989022664	0.015006598	0.011338318	0.016673997	7.94503E-05	4.95399E-05	141411.95	659106.05	3618.44	2787552.45	0.2146
Statewide	2020	OFF - ConstMin - Tractors/Loaders/Backhoes	Aggregated	25	Diesel	0.006717821	0.007994763	0.009673663	0.033017507	0.061129803	8.018739189	0.002301024	0.002116942	0.002301024	0.000101743	6.70571E-05	266555.85	369314.3	391.47	8494228.9	0.7218
Statewide	2020	OFF - ConstMin - Tractors/Loaders/Backhoes	Aggregated	100	Gasoline	0.00478102	0.004397582	0.005261221	0.311366088	0.012197246	5.376880444	0.000374889	0.000283249	0.000416543	5.19482E-05	7.79522E-05	222514.95	75901.75	86.9	4781810.25	2.9316
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	25	Gasoline	0.186926294	0.171934805	0.205700984	7.751731041	0.139333336	12.46643066	0.094055593	0.071064226	0.104506214	0.000330991	0.000336962	961858.95	983890.35	2265.03	14563715.35	0.9776
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	25	Diesel	0.003165524	0.003767235	0.004558355	0.017150602	0.028755775	3.804728941	0.001083775	0.000997073	0.001083775	5.04195E-05	3.18156E-05	126468.85	132243.15	213.57	2952860.95	0.9563
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	50	Gasoline	0.020795298	0.019127515	0.022883957	1.275287113	0.031920021	8.50660108	0.000586437	0.000443086	0.000651597	0.000103425	0.000140371	400689.7	181459.75	451.05	5443792.5	2.2081
Statewide	2020	OFF - ConstMin - Trenchers	Aggregated	100	Gasoline	0.008039786	0.007394996	0.008847295	0.284097856	0.022771451	6.140978828	0.000428164	0.000323502	0.000475738	5.93304E-05	8.76498E-05	250196.55	60155.65	149.21	3970272.9	4.1592
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	25	Gasoline	0.054119779	0.049779373	0.059555515	2.246683385	0.038359551	3.541784569	0.026721735	0.020189756	0.029690817	8.99424E-05	9.66721E-05	275950.95	314673.8	838.29	5935703	0.8769
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	25	Diesel	0.005853037	0.006965598	0.008428373	0.033122609	0.052459486	6.882136648	0.002119701	0.001950125	0.002119701	9.37653E-05	5.75433E-05	228738.2	498509.7	1248.23	8714411.5	0.4588
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	25	Nat Gas	0	0	0.004337447	1.155747383	0.031804795	6.800198702	0	0	0.003495189	0	0	454574.65	384611.45	1024.6	7255057.55	1.1819
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	50	Gasoline	0.016764212	0.015419722	0.018447993	1.385361219	0.025354563	12.99174398	0.000895639	0.000676705	0.000995155	0.000157956	0.000201909	576349.6	361674.85	1001.1	11935270.05	1.5936
Statewide	2020	OFF - Industrial - Aerial Lifts	Aggregated	100	Gasoline	0.01322626	0.012165514	0.014554693	0.736452515	0.03345952	26.08084056	0.001818419	0.001373917	0.002020465	0.000251977	0.000361646	1032318.55	361674.85	1001.1	24232214.95	2.8543
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	25	Gasoline	0.001596002	0.001468003	0.001756303	0.098918648	0.001336785	0.154870849	7.7897E-05	5.88555E-05	8.65523E-05	3.92515E-06	4.18257E-06	11939.15	17275.45	19.09	397335.35	0.6911
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	25	Nat Gas	0	0	0.000209549	0.033166358	0.00092607	0.172901049	0	0	0.000113813	0	0	12037.7	12253.05	9.65	281820.15	0.9824
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	50	Gasoline	0.424132765	0.390117317	0.466732236	50.24905923	0.983844126	175.0611849	0.012068562	0.009118469	0.013409513	0.002128425	0.003389343	9674890.75	6016524.95	3339.53	246677522.9	1.6081
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	50	Nat Gas	0	0	0.029045008	4.824438772	1.261758667	300.639046	0	0	0.026736938	0	0	16015188.95	11996184.9	6658.92	491843580.9	1.3350
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	100	Gasoline	0.895261944	0.823461936	0.985181158	85.46009534	4.439823594	1037.095264	0.072308766	0.05463329	0.080343074	0.010019787	0.015570514	44446090.15	21113782.7	11719.79	1477964789	2.1051
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	100	Nat Gas	0	0	0.172290927	81.32940586	8.156117586	1801.474267	0	0	0.160211743	0	0	100227317.3	42102987.25	23370.34	2947209108	2.3805
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	175	Gasoline	0.0467453	0.042996327	0.051440351	3.272767747	0.274430403	76.886773	0.005511962	0.004164594	0.006124402	0.00076379	0.001089475	3109909.5	771661.1	428.09	112662520.6	4.0301
Statewide	2020	OFF - Industrial - Forklifts	Aggregated	175	Nat Gas	0	0	0.007903639	4.764547021	0.405799968	137.5005502	0	0	0.012228431	0	0	7522405.45	1540701.5	855.01	224942419	4.8825
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	25	Gasoline	0.044684645	0.041100936	0.049172726	2.744803972	0.036019226	4.493076452	0.002165608	0.001636237	0.002406231	0.000124544	0.00011913	340055.9	607349.05	1565.15	6415006.4	0.5599
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	25	Diesel	0.007043318	0.00838213	0.010142378	0.039910619	0.06561047	8.696761966	0.002477269	0.002279087	0.002477269	0.000116271	7.27537E-05	289200.45	551420.1	386.3	9935219.7	0.5245
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	50	Gasoline	0.013165069	0.01210923	0.014487355	1.270837209	0.029268563	8.746730345	0.000602992	0.000455594	0.000669991	0.000106344	0.000143075	408409.45	228165.15	319.63	6844954.5	1.7900
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	100	Gasoline	0.004072513	0.003745898	0.004481553	0.298239812	0.024126534	7.484131406	0.000521812	0.000394258	0.000579791	7.23071E-05	0.000105565	301336.7	74887.05	104.84	5916076.95	4.0239
Statewide	2020	OFF - Industrial - Other General Industrial Equipment	Aggregated	175	Gasoline	0.000571578	0.000525738	0.000628987	0.055341532	0.004856784	1.551460971	0.000111223	8.40353E-05	0.000123581	1.54121E-05	2.16839E-05	61896.7	7146.7	9.59	1243525.8	8.6609
Statewide	2020	OFF - Industrial - Other Material Handling Equipment	Aggregated	50	Gasoline	0.000197157	0.000181345	0.00021696	0.013680971	0.000383429	0.089776306	6.1891E-06	4.67621E-06	6.87678E-06	1.09152E-06	1.3618E-06	3887.25	1423.5	3.7	58363.5	2.7308
Statewide	2020	OFF - Industrial - Other Material Handling Equipment	Aggregated	100	Gasoline	0.005660064	0.005206127	0.006228556	0.234277247	0.023538579	5.173425999	0.000360704	0.000272532	0.000400782	4.99825E-05	7.36431E-05	210214.45	77033.25	199.52	4159795.5	2.7289
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	25	Gasoline	0.034102588	0.031367561	0.037527818	2.207465047	0.027711664	3.54397539	0.001655336	0.001250698	0.001839262	9.33346E-05	9.47899E-05	270578.15	297431.2	1100.79	3848063.6	0.9097
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	25	Diesel	0.001402674	0.001669298	0.002019851	0.008611	0.013256476	1.768206607	0.000503673	0.000463379	0.000503673	2.43572E-05	1.47586E-05	58666.45	81763.65	125.54	1512019.8	0.7175
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	50	Gasoline	0.036476979	0.033551525	0.04014069	3.171484464	0.079356612	28.27209721	0.001949053	0.001472618	0.002165615	0.000343737	0.000442673	1263611.75	480913.05	931.26	16831956.75	2.6275
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	100	Gasoline	0.021288584	0.01958124	0.023426788	1.355830344	0.1348998	45.34750953	0.003161737	0.002388868	0.003513041	0.00043812	0.000630268	1799103.25	401525.55	777.31	27303737.4	4.4807
Statewide	2020	OFF - Industrial - Sweepers/Scrubbers	Aggregated	175	Gasoline	0.000164843	0.000151623	0.0001814	0.018017151	0.001599158	0.527912364	3.78457E-05	2.85945E-05	4.20508E-05	5.24426E-06	7.34219E-06	20958.3	2157.15	4.12	302001	9.7157
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	25	Gasoline	0.482489572	0.443793908	0.530950342	11.17903371	0.287807906	24.16902901	0.092049781	0.069548724	0.102277535	0.000754925	0.000579763	1654935.55	5399269.8	11169.15	33277159.5	0.3065
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	25	Diesel	0.002176052	0.002589682	0.003133515	0.011066936	0.018678256	2.338378713	0.000885701	0.000814845	0.000885701	3.10235E-05	1.94315E-05	77241.3	141572.55	172.7	2829173.4	0.5456
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	50	Gasoline	0.027245696	0.025060592	0.029982227	1.755401485	0.038725236	10.3725634	0.000715075	0.000540279	0.000794528	0.000126111	0.000175503	500973.45	223507.75	462.12	7822771.25	2.2414
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	50	Diesel	0.032008484	0.038092742	0.046092217	0.237693104	0.202409862	26.15721278	0.01154862	0.01062473	0.01154862	0.000338147	0.000220953	878299.5	858009.15	1053.83	31746338.55	1.0236
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	100	Gasoline	0.093098743	0.085632224	0.102449488	3.461855161	0.244705757	66.51338834	0.004637473	0.003503869	0.005152748	0.000642612	0.000958521	2736102.05	725273.25	1500.52	50769127.5	3.7725
Statewide	2020	OFF - Light Commercial - Air Compressors	Aggregated	175	Gasoline	0.007603512	0.006993711	0.008367202	0.310111764	0.034956706	8.33035881	0.000597198	0.000451216	0.000663553	8.27534E-05	0.000117196	334537.1	48482.95	100.12	6496715.3	6.9001
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	50	Nat Gas	0	0	0.001542249	0.273206051	0.056002952	18.60702082	0	0	0.001425279	0	0	988657.25	289156.65	34.02	9253012.8	3.4191
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	100	Nat Gas	0	0	0.008410083	4.368995669	0.331376649	104.5618583	0	0	0.008100337	0	0	5785742.75	597647.35	70.32	52592966.8	9.6809
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	175	Nat Gas	0	0	0.002345504	0.888797716	0.088674835	27.21256615	0	0	0.002167612	0	0	1485852.95	96334.45	11.3	14064829.7	15.4239
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	300	Nat Gas	0	0	0.001804495	1.022726196	0.085800371	28.04605006	0	0	0.002494239	0	0	1538880.15	77091.65	9.04	16189246.5	19.9617
Statewide	2020	OFF - Light Commercial - Gas Compressors	Aggregated	600	Nat Gas	0	0	0.002541331	1.440339272	0.120835517	39.49818789	0	0	0.00351272	0	0	2167249.55	67499.45	7.94	22814814.1	32.1077
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	25	Gasoline	3.708143451	3.410750346	4.080585671	193.2412513	2.559672098	318.8602664	0.210877042	0.15932932	0.234307824	0.008734233	0.008453741	24131234.05	33706472.5	293368.03	361547822.7	0.7159
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	25	Diesel	0.051405914	0.061177286	0.074024516	0.31715031	0.48729975	61.14857664	0.022477934	0.020679699	0.022477934	0.000853473	0.000512248	2036214.55	3348207.05	9918	48145773.95	0.6082
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	50	Gasoline	0.137865166	0.12680838	0.151712205	8.063319767	0.286997605	90.03841889	0.006207168	0.00468986	0.006896853	0.001094703	0.001368579	3906613.25	1749167.6	15229.17	55973363.2	2.2334
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	50	Diesel	0.061166471	0.072793155	0.088079718	0.508999305	0.519204943	72.39692633	0.024812576	0.02282757	0.024812576	0.000935912	0.000608299	2418026.45	1727293.15	5116.86	57000673.95	1.3999
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	100	Gasoline	0.033280493	0.030611398	0.036623153	1.16584009	0.178330119	44.59695099	0.003109406	0.002349329	0.003454896	0.000430869	0.000617015	1761271	337723.55	2940.96	28031054.65	5.2151
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	100	Nat Gas	0	0	0.000152911	0.090811105	0.011033174	2.891501831	0	0	0.000257152	0	0	157117.9	24783.5	218.35	2057030.5	6.3396
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	175	Gasoline	0.003281329	0.003018167	0.003610903	0.236910253	0.031481944	7.208770952	0.000516792	0.000390465	0.000574213	7.16116E-05	0.000100586	287123.6	31605.35	277.5	4614381.1	9.0847
Statewide	2020	OFF - Light Commercial - Generator Sets	Aggregated	175	Nat Gas	0	0	0.000172944	0.108840663	0.015403318	4.21658549	0	0	0.000374996	0	0	227413.25	20458.25	181.1	2986904.5	11.1160
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	25	Gasoline	0.391626711	0.360218249	0.430961306	14.09686287	0.199663452	26.85756755	0.0371589	0.028075614	0.041287667	0.000804473	0.000670955	1915242.6	3518329.9	30625.39	24357523.1	0.5444
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	25	Diesel	0.000280775	0.000334145	0.000404316	0.001990014	0.002748719	0.345432369	0.000128323	0.000118057	0.000128323	5.1231E-06	2.65E-06	10533.9	46668.9	326.12	657722.7	0.2257
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	50	Gasoline	0.001237305	0.001138074	0.001361579	0.075754132	0.002129439	0.91163404	6.28472E-05	4.74846E-05	6.98303E-05	1.10838E-05	1.3687E-05	39069.6	15267.95	135.55	442770.55	2.5589
Statewide	2020	OFF - Light Commercial - Pressure Washers	Aggregated	50	Diesel	0.000212382	0.000252752	0.00030583	0.002077118	0.002398054	0.34786794	9.86329E-05	9.07423E-05	9.86329E-05	4.49706E-06	2.80701E-06	11158.05	17301	122.06	657438	0.6449
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	25	Gasoline	1.198922608	1.102769015	1.319341196	40.56345167	0.816445522	74.18607958	0.461665175	0.348813688	0.512961305	0.002262043	0.001893861	5406033.25	14939993.85	67694.1	82893700.95	0.3618
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	25	Diesel	0.028697898	0.034152871	0.041324974	0.169852741	0.250829964	31.39175694	0.012195939	0.011220264	0.012195939	0.00044885	0.000263154	1046053.5	2249005.9	5587.23	24715474.95	0.4651
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	50	Gasoline	0.021285079	0.019578016	0.023422931	1.42143483	0.033934224	13.59337471	0.000937115	0.000708042	0.001041239	0.000165271	0.000210881	601961.65	268563.35	1216.97	8325463.85	2.2414
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	50	Diesel	0.039134054	0.046572759	0.056353038	0.313005339	0.307846472	42.37291257	0.015364949	0.014135753	0.015364949	0.000547776	0.000356362	1416561.35	901648.55	2239.96	33360996.35	1.5711
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	100	Gasoline	0.037416327	0.034415538	0.041174386	1.509224132	0.109534808	51.10707497	0.003563308	0.002692277	0.003959231	0.000493766	0.000710664	2028593.35	340304.1	1542.64	31648281.3	5.9611
Statewide	2020	OFF - Light Commercial - Pumps	Aggregated	175	Gasoline	0.00120198	0.001105581	0.001322706	0.078605515	0.005549292	2.320188369	0.000166333	0.000125674	0.000184814	2.30486E-05	3.23992E-05	92483.7	9796.6	45.48	1410710.4	9.4404
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	25	Gasoline	1.171832234	1.077851289	1.289529892	48.92144766	0.843997951	77.33857051	0.583496997	0.440864398	0.648329997	0.001997318	0.002108426	6018510.55	7447624.25	35850.19	116926308.3	0.8081
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	25	Diesel	0.025449221	0.030286676	0.036646878	0.140142215	0.220461694	27.595552	0.010589338	0.009742191	0.010589338	0.000380623	0.000231222	919121.1	2348512.2	3656.54	35728119.9	0.3914

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	50	Gasoline	0.051473775	0.047345578	0.056643749	2.965131466	0.08547186	27.27455705	0.001880284	0.001420659	0.002089204	0.000331609	0.000425948	1215869.75	502283.8	2417.92	22602771	2.4207
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	50	Diesel	0.137667113	0.163835242	0.198240643	1.023926146	0.910476852	120.2144209	0.050549683	0.046505708	0.050549683	0.001554072	0.001014139	4031260.75	3383633.95	5268.83	155647161.7	1.1914
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	100	Gasoline	0.041924232	0.038561909	0.04613506	1.399587415	0.13394278	42.81621189	0.002985249	0.002255521	0.003316943	0.000413664	0.000598774	1709203.75	512675.35	2467.81	35887274.5	3.3339
Statewide	2020	OFF - Light Commercial - Welders	Aggregated	175	Gasoline	0.003361258	0.003091685	0.00369886	0.180969618	0.018898031	5.330937793	0.000382171	0.000288752	0.000424635	5.29573E-05	7.45292E-05	212743.9	35069.2	169.73	4558996	6.0664
Statewide	2020	OFF - Logging - Chainsaws	Aggregated	25	Gasoline	1.287208711	1.183974572	1.416494666	2.853403505	0.02552499	7.712523258	0.004040885	0.003053113	0.004489872	0.00031764	0.000233098	665380.4	807982.25	3918.89	6463858	0.8235
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	100	Diesel	0.028998336	0.034510417	0.041757604	0.509312093	0.305593529	79.73469308	0.010774719	0.009912742	0.010774719	0.000935329	0.000667348	2652747	635289.8	497.49	65434849.4	4.1756
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	175	Diesel	0.044601113	0.05307901	0.064225602	0.820846652	0.330474559	145.540412	0.013646889	0.012555138	0.013646889	0.001637579	0.001216278	4834775.4	785768.35	615.31	119436789.2	6.1529
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	300	Diesel	0.033943289	0.040395319	0.048878336	0.245823166	0.207844263	127.9385994	0.006442462	0.005927065	0.006442462	0.001439529	0.001062745	4224473.5	479398.3	375.34	104988227.7	8.8120
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	600	Diesel	0.014930806	0.017768893	0.021500361	0.104182757	0.086892206	56.4533594	0.002816939	0.002591584	0.002816939	0.000554108	0.000468879	1863821.4	140817	110.21	46328793	13.2358
Statewide	2020	OFF - Logging - Fellers/Bunchers	Aggregated	750	Diesel	0.002263268	0.002693476	0.003259106	0.0157849	0.013248411	8.553341107	0.000427877	0.000393647	0.000427877	8.60015E-05	7.10293E-05	282345.75	10687.2	8.21	6978741.6	26.4191
Statewide	2020	OFF - Logging - Shredders	Aggregated	25	Gasoline	0.182642969	0.167995003	0.200987447	8.04568257	0.1475683	12.36101215	0.093260236	0.07046329	0.103622485	0.000352446	0.000341446	974659.5	1489221.9	6148.49	11913775.2	0.6545
Statewide	2020	OFF - Logging - Shredders	Aggregated	175	Diesel	2.4511E-06	2.91701E-06	3.52958E-06	4.75248E-05	3.77925E-05	0.009715896	1.48086E-06	1.36239E-06	1.48086E-06	1.09321E-07	3.6729E-08	146	0	0.34	0	#DIV/0!
Statewide	2020	OFF - Logging - Skidders	Aggregated	100	Diesel	0.016242943	0.019330445	0.023389838	0.276752684	0.165013435	42.80353983	0.005827698	0.005361483	0.005827698	0.000502107	0.000358327	1424372.35	330398	228.86	33700596	4.3111
Statewide	2020	OFF - Logging - Skidders	Aggregated	175	Diesel	0.032327221	0.038472065	0.046551198	0.578524761	0.231356875	101.3390411	0.009543865	0.008780356	0.009543865	0.001140238	0.000847039	3367030.1	528432.4	366.15	79793292.4	6.3717
Statewide	2020	OFF - Logging - Skidders	Aggregated	300	Diesel	0.015463843	0.018403251	0.022267934	0.108978076	0.091388252	56.03461827	0.002838928	0.002611813	0.002838928	0.000630486	0.000465511	1850433.2	194413.6	134.54	44131887.2	9.5180
Statewide	2020	OFF - Logging - Skidders	Aggregated	600	Diesel	0.001031506	0.001227577	0.001485368	0.006984434	0.005794278	3.749012297	0.000188225	0.000173167	0.000188225	3.67978E-05	3.11278E-05	123735	10836.85	7.34	2925949.5	11.4180
Statewide	2020	OFF - Military - A/C unit	Aggregated	100	Diesel	0.001380566	0.001642987	0.001988014	0.018996961	0.018014804	3.219810457	0.001002674	0.00092246	0.001002674	3.777E-05	2.69361E-05	107072.75	30882.65	102.9	3119147.65	3.4671
Statewide	2020	OFF - Military - A/C unit	Aggregated	300	Diesel	0.00066255	0.000788489	0.000954072	0.005017352	0.009956478	2.768238479	0.000291642	0.000268311	0.000291642	3.11474E-05	2.29841E-05	91363.15	12910.05	42.96	2685290.4	7.0769
Statewide	2020	OFF - Military - A/C unit	Aggregated	600	Diesel	0.000376912	0.000448556	0.000542753	0.002947066	0.005387395	1.65741461	0.000168562	0.000155077	0.000168562	1.62681E-05	1.37532E-05	54669.7	4996.85	16.75	1574007.75	10.9408
Statewide	2020	OFF - Military - Aircraft Support	Aggregated	100	Diesel	0.000252677	0.000300706	0.000363855	0.003476902	0.003297144	0.589302975	0.000183514	0.000168833	0.000183514	6.91283E-06	4.9171E-06	19545.75	8365.8	27.9	568874.4	2.3364
Statewide	2020	OFF - Military - Aircraft Support	Aggregated	175	Diesel	0.000546717	0.000650638	0.000787272	0.008868288	0.007268811	1.733244	0.000318845	0.000293337	0.000318845	1.9502E-05	1.44648E-05	57498.45	12012.15	39.95	1681701	4.7867
Statewide	2020	OFF - Military - Cart	Aggregated	100	Diesel	0.000128993	0.000153512	0.000185749	0.001774973	0.001683206	0.300841647	9.36845E-05	8.61897E-05	9.36845E-05	3.52903E-06	2.51043E-06	9979.1	3500.35	11.62	283528.35	2.8509
Statewide	2020	OFF - Military - Cart	Aggregated	175	Diesel	4.48113E-05	5.33291E-05	6.45282E-05	0.000726883	0.000595783	0.142064111	2.61339E-05	2.40432E-05	2.61339E-05	1.59846E-06	1.15696E-06	4599	824.9	2.75	126209.7	5.5752
Statewide	2020	OFF - Military - Cart	Aggregated	300	Diesel	0.000145933	0.000173672	0.000210143	0.001105119	0.002193008	0.609730493	6.4237E-05	5.9098E-05	6.4237E-05	6.86051E-06	5.05299E-06	20085.95	2930.95	9.69	577397.15	6.8531
Statewide	2020	OFF - Military - Communications	Aggregated	50	Diesel	3.95383E-05	4.70538E-05	5.69351E-05	0.000339001	0.000356307	0.049521258	1.6716E-05	1.53788E-05	1.6716E-05	6.40186E-07	3.90246E-07	1551.25	1102.3	3.67	44092	1.4073
Statewide	2020	OFF - Military - Communications	Aggregated	100	Diesel	6.37E-05	7.58083E-05	9.1728E-05	0.00087653	0.000831213	0.148563774	4.62639E-05	4.25628E-05	4.62639E-05	1.74273E-06	1.21298E-06	4821.65	1737.4	5.93	138992	2.7752
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	50	Diesel	4.84344E-05	5.76409E-05	6.97455E-05	0.000415276	0.000436477	0.06066354	2.04772E-05	1.8839E-05	2.04772E-05	7.84228E-07	4.98596E-07	1981.95	1102.3	3.67	54012.7	1.7980
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	100	Diesel	0.001422767	0.00169321	0.002048784	0.019577663	0.018565482	3.31823386	0.001033324	0.000950658	0.001033324	3.89246E-05	2.77506E-05	110310.3	45358.55	150.93	3220457.05	2.4320
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	175	Diesel	6.52155E-05	7.76119E-05	9.39103E-05	0.00105786	0.000867065	0.20675125	3.80336E-05	3.49909E-05	3.80336E-05	2.32631E-06	1.70698E-06	6785.35	1102.3	3.67	184084.1	6.1556
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	300	Diesel	0.000132154	0.000157275	0.000190302	0.001000778	0.001985952	0.552162006	5.8172E-05	5.35182E-05	5.8172E-05	6.21277E-06	4.57552E-06	18187.95	2376.15	7.79	529881.45	7.6544
Statewide	2020	OFF - Military - Compressor (Military)	Aggregated	600	Diesel	0.000735101	0.000874831	0.001058545	0.005747742	0.01050718	3.232499991	0.000328752	0.000302452	0.000328752	3.1728E-05	2.68296E-05	106649.35	8365.8	27.9	3120443.4	12.7483
Statewide	2020	OFF - Military - Crane	Aggregated	100	Diesel	9.249E-05	0.000110071	0.000133186	0.002919164	0.001736392	0.519973241	3.66503E-05	3.37182E-05	3.66503E-05	6.09955E-06	4.32943E-06	17209.75	4785.15	15.95	502440.75	3.5965
Statewide	2020	OFF - Military - Crane	Aggregated	175	Diesel	1.9264E-05	2.29257E-05	2.77401E-05	0.000649983	0.000246781	0.130921825	6.11522E-06	5.626E-06	6.11522E-06	1.4731E-06	1.08718E-06	4321.6	839.5	2.91	118369.5	5.1478
Statewide	2020	OFF - Military - Crane	Aggregated	300	Diesel	1.69389E-05	2.01587E-05	2.4392E-05	0.000224082	0.000165689	0.132469362	4.1657E-06	3.83245E-06	4.1657E-06	1.49051E-06	1.09269E-06	4343.5	551.15	1.82	117946.1	7.8808
Statewide	2020	OFF - Military - Deicer	Aggregated	100	Diesel	5.83917E-05	6.94909E-05	8.4084E-05	0.000803486	0.000761945	0.136183461	4.24086E-05	3.90159E-05	4.24086E-05	1.5975E-06	1.10646E-06	4398.25	1102.3	3.67	121253	3.9901
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	50	Diesel	0.000253539	0.000301733	0.000365096	0.002173843	0.002284821	0.317555064	0.000107192	9.86163E-05	0.000107192	4.10519E-06	2.66194E-06	10581.35	8062.85	26.91	306388.3	1.3124
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	100	Diesel	0.007401944	0.008808925	0.010658799	0.101852787	0.096586918	17.26311041	0.00537587	0.0049458	0.00537587	0.000202505	0.000144434	574134.05	201965.45	672.1	16763132.35	2.8427
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	175	Diesel	0.007764063	0.009239877	0.011180251	0.125940771	0.10322619	24.61423259	0.004527992	0.004165753	0.004527992	0.000276952	0.000205545	817052.5	162581.95	541.01	23899546.65	5.0255
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	300	Diesel	0.002362261	0.002811285	0.003401655	0.017888903	0.035498895	9.86989595	0.001039824	0.000956638	0.001039824	0.000111053	8.19718E-05	325842.8	42956.85	142.9	9579377.55	7.5854
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	600	Diesel	0.001420651	0.001690692	0.002045738	0.011108047	0.020306101	6.247106504	0.000635343	0.000584516	0.000635343	6.13174E-05	5.18604E-05	206148.35	17406.85	57.91	6057583.8	11.8429
Statewide	2020	OFF - Military - Generator (Military)	Aggregated	750	Diesel	7.62514E-05	9.07455E-05	0.000109802	0.000587686	0.001097802	0.330511718	3.39561E-05	3.12396E-05	3.39561E-05	3.3232E-06	2.74182E-06	10898.9	481.8	1.77	257763	22.6212
Statewide	2020	OFF - Military - Hydraulic unit	Aggregated	100	Diesel	0.000844689	0.00100525	0.001216352	0.011623153	0.011022227	1.970017591	0.000613479	0.000564401	0.000613479	2.31093E-05	1.64702E-05	65470.05	20096.9	66.9	1909205.5	3.2577
Statewide	2020	OFF - Military - Lift (Military)	Aggregated	100	Diesel	2.52146E-05	3.00075E-05	3.6309E-05	0.00034696	0.000329022	0.058806498	1.83128E-05	1.68478E-05	1.83128E-05	6.8983E-07	4.78395E-07	1901.65	481.8	1.77	45771	3.9470
Statewide	2020	OFF - Military - Light	Aggregated	50	Diesel	6.17785E-05	7.35216E-05	8.89611E-05	0.000529689	0.00055673	0.077376966	2.61188E-05	2.40293E-05	2.61188E-05	1.00029E-06	6.42758E-07	2555	1387	4.85	69350	1.8421
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	50	Diesel	1.23557E-05	1.47043E-05	1.77922E-05	0.000105938	0.000111346	0.015475393	5.22376E-06	4.80586E-06	5.22376E-06	2.00058E-07	1.01005E-07	401.5	189.8	0.78	9490	2.1154
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	100	Diesel	0.000167743	0.000199629	0.000241551	0.002308196	0.00218886	0.391217931	0.000121828	0.000112082	0.000121828	4.58919E-06	3.27164E-06	13004.95	4686.6	15.66	370241.4	2.7749
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	175	Diesel	0.000231183	0.000275127	0.000332904	0.003750019	0.003073669	0.732914613	0.000134826	0.00012404	0.000134826	8.24655E-06	6.10987E-06	24287.1	4686.6	15.66	693616.8	5.1822
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	300	Diesel	9.68935E-05	0.000115311	0.000139527	0.000733754	0.001456068	0.40483628	4.26508E-05	3.92387E-05	4.26508E-05	4.5551E-06	3.35979E-06	13355.35	1737.4	5.93	378753.2	7.6870
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	600	Diesel	3.80079E-05	4.52325E-05	5.47314E-05	0.000297183	0.000543267	0.167134251	1.69979E-05	1.56381E-05	1.69979E-05	1.64048E-06	1.35989E-06	5405.65	481.8	1.77	130086	11.2197
Statewide	2020	OFF - Military - Other tactical support equipment	Aggregated	750	Diesel	4.47E-05	5.31967E-05	6.4368E-05	0.000344512	0.000643552	0.193751922	1.99056E-05	1.83132E-05	1.99056E-05	1.94812E-06	1.58578E-06	6303.55	189.8	0.78	118814.8	33.2115
Statewide	2020	OFF - Military - Pressure Washers	Aggregated	175	Diesel	4.45184E-05	5.29805E-05	6.41065E-05	0.000722132	0.000591889	0.141135587	2.59631E-05	2.3886E-05	2.59631E-05	1.58802E-06	1.14595E-06	4555.2	824.9	2.75	125384.8	5.5221
Statewide	2020	OFF - Military - Pump (Military)	Aggregated	50	Diesel	0.000558972	0.000665223	0.00080492	0.004792624	0.005037296	0.700106787	0.000236323	0.000217417	0.000236323	9.05063E-06	5.87205E-06	23341.75	17406.85	57.91	678867.15	1.3410
Statewide	2020	OFF - Military - Pump (Military)	Aggregated	100	Diesel	0.000597188	0.000710703	0.00085995	0.008217469	0.007792619	1.392785362	0.000433724	0.000399026	0.000433724	1.63381E-05	1.16431E-05	46282	13519.6	44.92	1351960	3.4233
Statewide	2020	OFF - Military - Start Cart	Aggregated	100	Diesel	1.32708E-05	1.57934E-05	1.911E-05	0.00018261	0.000173169	0.030950786	9.63832E-06	8.86725E-06	9.63832E-06	3.63069E-07	2.35984E-07	938.05	189.8	0.78	18980	4.9423
Statewide	2020	OFF - Military - Start Cart	Aggregated	600	Diesel	1.9919E-05	2.37052E-05	2.86833E-05	0.000155746	0.000284712	0.087590727	8.90815E-06	8.1955E-06	8.90815E-06	8.59732E-07	7.07952E-07	2814.15	189.8	0.78	53713.4	14.8269
Statewide	2020	OFF - Military - Test Stand	Aggregated	100	Diesel	0.000402903	0.000479488	0.00058018	0.005544052	0.005257421	0.939665855	0.000292619	0.00026921	0.000292619	1.10228E-05	7.84164E-06	31171	9906.1	32.99	911361.2	3.1466
Statewide	2020	OFF - Military - Test Stand	Aggregated	175	Diesel	2.77264E-05	3.29967E-05	3.9926E-05	0.000449749	0.000368633	0.087900233	1.617E-05	1.48764E-05	1.617E-05	9.89028E-07	7.14379E-07	2839.7	481.8	1.77	68415.6	5.8939
Statewide	2020	OFF - Military - Test Stand	Aggregated	300	Diesel	0.000452392	0.000538384	0.000651444	0.003425869	0.006798324	1.890164507	0.000199135	0.000183204	0.000199135	2.12676E-05	1.5698E-05	62400.4	9281.95	31	1828544.15	6.7228
Statewide	2020	OFF - Military - Test Stand	Aggregated	600	Diesel	0.000289705	0.000344773	0.000417175	0.002265196	0.004140899	1.273934344	0.000129562	0.000119197	0.000129562	1.25041E-05	1.05679E-05	42007.85	3500.35	11.62	1200620.05	12.0010
Statewide	2020	OFF - Military - Welder	Aggregated	50	Diesel	0.000181629	0.000216153	0.000261546	0.001557285	0.001636787	0.22748827	7.67893E-05	7.06462E-05	7.67893E-05	2.94086E-06	1.89981E-06	7551.85	6226.9	20.85	217941.5	1.2128
Statewide	2020	OFF - Military - Welder	Aggregated	100	Diesel	0.000477219	0.000567931	0.000687196	0.00656667	0.006227169	1.112990251	0.000346594	0.000318866	0.000346594	1.30559E-05	9.3053E-06	36989.1	17406.85	57.91	1079224.7	2.1250
Statewide	2020	OFF - Oil Drilling - Compressors (Workover)	Aggregated	25	Diesel	5.72952E-05	6.8186E-05	8.25051E-05	0.000280893	0.000514725	0.064511204	2.34589E-05	2.15821E-05	2.34589E-05	8.18525E-07	4.80232E-07	1908.95	3197.4	3.61	76737.6	0.5970
Statewide	2020	OFF - Oil Drilling - Generator (Drilling)	Aggregated	50	Diesel	5.52678E-05	6.57733E-05	7.95857E-05	0.00041605	0.000336735	0.041826722	1.94872E-05	1.79282E-05	1.94872E-05	5.40715E-07	3.19542E-07	1270.2	1113.25	0.59	36737.25	1.1410
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	25	Diesel	1.1073E-05	1.33983E-05	1.59451E-05	0.000235017	0.000187408	0.037273938	7.71792E-07	7.10049E-07	7.71792E-07	3.44284E-07	3.04225E-07	1209.311854	1673.244571	1.049714286	41831.11429	0.7227
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	50	Diesel	0.001682842	0.002036238	0.002423292	0.006078079	0.004294334	0.361909803	0.000564792	0.000519609	0.000564792	3.29555E-06	2.95386E-06	11741.765	9629.029143	8.397714286	406184.8434	1.2194
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	75	Diesel	0.0001142	0.000138182	0.000164449	0.001541311	0.001437063	0.215740258	8.64706E-05	7.9553E-05	8.64706E-05	1.9912E-06	1.76084E-06	6999.455066	3846.153143	4.198857143	269262.2114	1.8199
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	100	Diesel	0.001164372	0.00140889	0.001676695	0.009335964	0.012806104	1.190137139	0.000978956	0.000900639	0.000978956	1.09685E-05	9.71374E-06	38612.68878	16542.44743	12.59657143	1471894.151	2.3342
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	175	Diesel	0.005581457	0.006753563	0.008037298	0.057440843	0.0561008	8.769476705	0.003486482	0.003207564	0.003486482	8.09107E-05	7.15753E-05	284516.0139	75436.66743	62.98285714	10901186.46	3.7716
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	300	Diesel	0.00468877	0.005673412	0.006751829	0.023804064	0.066298077	10.19594214	0.001965722	0.001808464	0.001965722	9.41259E-05	8.32179E-05	330796.1139	56711.864	45.13771429	12689337.3	5.8329
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	600	Diesel	0.007373498	0.008921933	0.010617838	0.039666338	0.106182654	18.40919707	0.00334006	0.003072855	0.00334006	0.000169981	0.000150253	597266.1248	55740.87829	39.88914286	22925813.89	10.7150
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	750	Diesel	0.002006899	0.002428348	0.002889935	0.009544083	0.024911382	4.507752114	0.000913558	0.000840473	0.000913558	4.16162E-05	3.67917E-05	146249.053	8839.644	6.298285714	5609469.498	16.5447
Statewide	2020	Oil Drilling - Drill Rig (Mobile)	Aggregated	9999	Diesel	0.001329566	0.001608775	0.001914575	0.006557851	0.028022016	3.22590371	0.000706518	0.000649997	0.000706518	2.97852E-05	2.63294E-05	104660.8932	5233.875429	3.149142857	4025248.046	19.9968
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	25	Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	75	Diesel	1.11369E-05	1.34757E-05	1.60372E-05	0.000101572	0.000144868	0.012955971	1.06862E-05	9.83135E-06	1.06862E-05	1.1945E-07	1.05745E-07	420.3421992	218.4931507	1.092465753	16168.49315	1.9238
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	175	Diesel	0.000165833	0.000200658	0.0002388	0.002010734	0.001657281	0.298502641	0.000119628	0.000110058	0.000119628	2.75483E-06	2.43634E-06	9684.589446	2194.763699	2.184931507	372536.2842	4.4126
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	300	Diesel	0.001989989	0.002407886	0.002865584	0.011416591	0.019780203	4.245325816	0.000747345	0.000687558	0.000747345	3.91904E-05	3.46498E-05	137734.9207	24150.04795	43.69863014	5234422.12	5.7033
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	600	Diesel	0.090762945	0.109823164	0.130698641	0.533204508	1.022417074	258.5363165	0.033652739	0.030960519	0.033652739	0.002387574	0.002110139	8387926.062	822681.3356	588.8390411	322927522.8	10.1958
Statewide	2020	Oil Drilling - Workover Rig (Mobile)	Aggregated	750	Diesel	0.000668996	0.000809485	0.000963354	0.004104062	0.005818624	2.071075271	0.000297073	0.000273307	0.000297073	1.9128E-05	1.69038E-05	67193.75628	3790.856164	2.184931507	2585003.39	17.7252
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	50	Diesel	0.000298091	0.000360691	0.000429252	0.002790143	0.002675769	0.366358625	0.000121496	0.000111776	0.000121496	3.37822E-06	2.99017E-06	11886.10211	15262.95938	38.7646857	705886.2397	0.7788
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	75	Diesel	0.002355471	0.00285012	0.003391879	0.0412691	0.03877251	6.275079026	0.001645281	0.001513658	0.001645281	5.79456E-05	5.12164E-05	203588.0282	199765.2037	507.3613276	13441309.9	1.0191
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	100	Diesel	0.003431454	0.004152059	0.004941293	0.098679204	0.053973907	14.7144911	0.003692129	0.003396759	0.003692129	0.00013594	0.000120098	477395.4588	365413.2041	928.0721813	31518652.45	1.3065
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	175	Diesel	0.003958643	0.004789959	0.005700447	0.111593902	0.067053433	19.89397777	0.002601145	0.002393054	0.002601145	0.000183811	0.000162372	645438.1995	303014.6348	769.593025	42613187.7	2.1301
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	300	Diesel	0.003098975	0.00374976	0.004462524	0.028090862	0.046487	14.21429561	0.00164517	0.001513556	0.00164517	0.000131325	0.000116015	461167.1667	106840.7157	271.3527999	30447226.47	4.3164
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	600	Diesel	0.005449158	0.006593481	0.007846787	0.046188272	0.08198596	24.14741483	0.002985502	0.002746662	0.002985502	0.000223091	0.000197088	783436.2805	104596.1628	265.6521109	51724111.3	7.4901
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	750	Diesel	0.001016917	0.00123047	0.001464361	0.008342905	0.01868328	4.399456862	0.000623119	0.000573269	0.000623119	4.06447E-05	3.59078E-05	142735.5328	13467.3171	34.20413444	9423700.136	10.5987
Statewide	2020	Portable Equipment - Non-Rental Compressor	Aggregated	9999	Diesel	0.002805571	0.003394741	0.004040022	0.029531273	0.032851936	2.451712455	0.001447746	0.001331927	0.001447746	2.25831E-05	2.00105E-05	79543.11051	2693.463421	6.840826889	5251603.485	29.5319
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	50	Diesel	0.001534453	0.001856688	0.002209612	0.020201768	0.012180267	1.97702751	0.000330626	0.000304175	0.000330626	1.82326E-05	1.61362E-05	64142.48027	74884.09384	57.00689074	3809263.439	0.8566
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	75	Diesel	0.016726746	0.020239363	0.024086515	0.242540758	0.195499232	33.13797651	0.008088741	0.007441642	0.008088741	0.000305875	0.000270468	1075125.153	1049874.996	799.2366082	70982024.26	1.0241

Region	CalYr	VehClass	MdlYr	HP_Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2_5_tpd	PM_tpd	SOx_tpd	NH3_tpd	Fuel_gpy	Total_Activity_hpy	Total_Population	Horsepower_Hours_hhpy	Fuel Use gph
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	100	Diesel	0.019444187	0.023527466	0.027999629	0.361275971	0.232785309	48.80112874	0.018257774	0.016797152	0.018257774	0.000450607	0.000398308	1583298.877	1066349.496	811.7781241	104532722.6	1.4848
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	175	Diesel	0.038649706	0.046766145	0.055655577	0.672493384	0.405985935	104.8385805	0.020740147	0.019080935	0.020740147	0.000968125	0.000855678	3401372.286	1544110.015	1175.482087	224565753.5	2.2028
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	300	Diesel	0.038196798	0.046218126	0.05500339	0.231404774	0.337418029	101.3018591	0.014478958	0.013320641	0.014478958	0.00093544	0.000826812	3286627.254	855176.3517	651.0186923	216990045.2	3.8432
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	600	Diesel	0.085972832	0.104027126	0.123800878	0.498533774	0.838093503	234.2809555	0.034335749	0.031588889	0.034335749	0.002163464	0.00191217	7600987.586	1180173.319	898.4285981	501833190.1	6.4406
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	750	Diesel	0.033610134	0.040668262	0.048398592	0.172559444	0.325191372	80.93739202	0.014849273	0.013661331	0.014849273	0.000747298	0.0006606	2625924.548	245619.8278	186.9826016	173369062.6	10.6910
Statewide	2020	Portable Equipment - Non-Rental Generator	Aggregated	9999	Diesel	0.214799677	0.25990761	0.309311535	1.052123626	3.353595134	490.7165795	0.108004671	0.099364297	0.108004671	0.004530474	0.004005163	15920758.99	718887.3009	547.2661511	1051122000	22.1464
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	50	Diesel	0.000213749	0.000258637	0.000307799	0.001861769	0.001805594	0.260012418	8.65404E-05	7.96172E-05	8.65404E-05	2.39753E-06	2.12219E-06	8435.816543	10840.2139	35.34427226	500982.3038	0.7782
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	75	Diesel	0.002179791	0.002637548	0.0031389	0.050398921	0.043456652	8.056974321	0.001418801	0.001305297	0.001418801	7.44253E-05	6.57599E-05	261399.6587	243030.602	792.3957813	17258155.36	1.0756
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	100	Diesel	0.004374031	0.005292578	0.006298605	0.122978284	0.088059477	19.37345448	0.005532364	0.005089775	0.005532364	0.000178986	0.000158124	628550.3947	450393.4034	1468.497505	41498219.3	1.3956
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	175	Diesel	0.012104073	0.014645928	0.017429865	0.328232145	0.220104592	59.06661584	0.008866532	0.008157209	0.008866532	0.000545737	0.000482094	1916351.301	890296.2773	2902.790877	126521544.2	2.1525
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	300	Diesel	0.005618573	0.006798473	0.008090745	0.050700073	0.081255215	25.2521814	0.002912593	0.002679585	0.002912593	0.0002333	0.000206105	819279.2152	219951.4369	717.1466855	54090537.25	3.7248
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	600	Diesel	0.009009882	0.010901958	0.012974231	0.079642315	0.14655659	41.30891237	0.005025284	0.004623261	0.005025284	0.000381651	0.000337158	1340222.168	188130.1639	613.3941444	88484286.88	7.1239
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	750	Diesel	0.004191512	0.00507173	0.006035778	0.036764386	0.075030996	19.57069123	0.002623517	0.002413636	0.002623517	0.000180815	0.000159733	634949.5239	58746.96566	191.5431529	41920703.27	10.8082
Statewide	2020	Portable Equipment - Non-Rental Other Portable Equipment	Aggregated	9999	Diesel	0.085905911	0.103946152	0.123704512	0.771185129	1.319038774	126.9051676	0.047442841	0.043647414	0.047442841	0.001170724	0.001035783	4117298.402	109451.192	356.863136	271832701.8	37.6177
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	50	Diesel	3.61605E-05	4.37542E-05	5.20711E-05	0.000680481	0.000683855	0.106114647	2.32394E-05	2.13802E-05	2.32394E-05	9.79998E-07	8.66093E-07	3442.772852	4205.182469	13.68165378	204457.7743	0.8187
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	75	Diesel	0.001727583	0.002090376	0.00248772	0.039062474	0.033989567	6.211601506	0.001142734	0.001051315	0.001142734	5.73775E-05	5.06983E-05	201528.57	186079.3243	605.4131797	13305340.13	1.0830
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	100	Diesel	0.002388731	0.002890364	0.003439772	0.064591223	0.047984982	10.19248676	0.002902803	0.002670578	0.002902803	9.41629E-05	8.31897E-05	330684.0079	234789.3545	763.8923359	21832453.84	1.4084
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	175	Diesel	0.003977645	0.004812951	0.005727809	0.104010949	0.074524022	18.71137333	0.003086637	0.002839706	0.003086637	0.000172877	0.00015272	607069.9007	282448.0892	918.9510787	40080031.9	2.1493
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	300	Diesel	0.003603947	0.004360776	0.005189684	0.034519921	0.054015097	17.41420758	0.001973087	0.00181524	0.001973087	0.000160895	0.000142132	564984.7868	148583.1139	483.4184335	37301484.14	3.8025
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	600	Diesel	0.009608736	0.01162657	0.01383658	0.090746253	0.171658525	49.07627721	0.006395923	0.005884249	0.006395923	0.000453446	0.000400554	1592225.766	225327.694	733.1086149	105122094.5	7.0663
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	750	Diesel	0.004409491	0.005335484	0.006349667	0.043803844	0.085610072	23.74949717	0.003442824	0.003167398	0.003442824	0.000219444	0.00019384	770526.2803	71838.53384	233.728252	50871765.93	10.7258
Statewide	2020	Portable Equipment - Non-Rental Pump	Aggregated	9999	Diesel	0.013012245	0.015744817	0.018737633	0.103580264	0.369007781	56.1703256	0.009576213	0.008810116	0.009576213	0.000518932	0.000458455	1822384.354	61325.57767	199.5241176	120317648.6	29.7165
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	50	Diesel	7.38828E-05	8.93982E-05	0.000106391	0.001524154	0.001313631	0.235993636	3.39026E-05	3.11903E-05	3.39026E-05	2.17966E-06	1.92615E-06	7656.553622	8823.655742	17.10206722	454703.804	0.8677
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	75	Diesel	0.000566558	0.000685536	0.000815844	0.011443739	0.009577718	1.752316136	0.00030443	0.000280076	0.00030443	1.6184E-05	1.43022E-05	56851.9672	55883.15304	108.3130924	3753486.47	1.0173
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	100	Diesel	0.000443753	0.000536941	0.000639004	0.01283264	0.007275286	1.9302812	0.00048262	0.00044401	0.00048262	1.78331E-05	1.57547E-05	62625.8477	45883.00986	88.93074956	4134690.207	1.3649
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	175	Diesel	0.004256856	0.005150796	0.006129873	0.135198491	0.076105212	24.52370212	0.002510238	0.002309419	0.002510238	0.000226606	0.000200159	795644.5074	375299.4909	727.4079259	52530124.12	2.1200
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	300	Diesel	0.003080514	0.003727423	0.004435941	0.037303011	0.036521998	19.68026078	0.001284054	0.001181329	0.001284054	0.000181861	0.000160628	638504.387	147649.1728	286.1745915	42155402.81	4.3245
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	600	Diesel	0.023982743	0.029019119	0.03453515	0.268073727	0.26324913	141.7724368	0.010996422	0.010116708	0.010996422	0.001310037	0.001157128	4599650.578	538831.244	1044.366238	303678607.1	8.5363
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	750	Diesel	0.002381541	0.002881664	0.003429418	0.023906739	0.022852226	12.24614826	0.001168418	0.001074945	0.001168418	0.00011315	9.99514E-05	397312.7937	38235.84155	74.10895796	26231426.44	10.3911
Statewide	2020	Portable Equipment - Rental Compressor	Aggregated	9999	Diesel	0.001478152	0.001788564	0.002128539	0.013186763	0.03480069	6.969135166	0.000834641	0.00076787	0.000834641	6.43888E-05	5.68811E-05	226105.9153	14117.84919	27.36330756	14927988.18	16.0156
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	50	Diesel	0.000152296	0.000184278	0.000219306	0.002325295	0.002020356	0.2503595	9.09877E-05	8.37087E-05	9.09877E-05	2.31013E-06	2.0434E-06	8122.638247	11228.54904	7.980964704	482383.4185	0.7234
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	75	Diesel	0.019004612	0.02299558	0.027366641	0.294442867	0.236840381	41.06901797	0.009406843	0.008654295	0.009406843	0.000379133	0.0003352	1332439.059	1272034.198	904.1292871	87970429.61	1.0475
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	100	Diesel	0.032970304	0.039894068	0.047477238	0.64660258	0.429091177	88.89802547	0.031698004	0.029162164	0.031698004	0.000820917	0.000725574	2884198.533	1902437.023	1352.203448	190420854.4	1.5161
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	175	Diesel	0.049258565	0.059602864	0.070932334	0.987186813	0.550107935	157.7817241	0.02250152	0.020701398	0.02250152	0.001457293	0.001287793	5119054.275	2250522.043	1599.613354	337970731.8	2.2746
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	300	Diesel	0.076454302	0.092509705	0.110094195	0.490385739	0.676469518	222.5618515	0.027110745	0.024941885	0.027110745	0.002055401	0.00181652	7220774.163	1865543.219	1325.980279	476730700.1	3.8706
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	600	Diesel	0.132607793	0.16045543	0.190955222	0.898913123	1.170971791	439.3969411	0.049750537	0.045770494	0.049750537	0.004058464	0.003586299	14255749.85	2160693.651	1535.765637	941194593.7	6.5978
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	750	Diesel	0.025742767	0.031148748	0.037069584	0.168039637	0.273499703	81.55362394	0.011111023	0.010222142	0.011111023	0.000753231	0.00066563	2645917.513	248632.1573	176.7213613	174689040.3	10.6419
Statewide	2020	Portable Equipment - Rental Generator	Aggregated	9999	Diesel	0.288590583	0.349194606	0.41557044	1.755141757	4.763137489	855.8931787	0.14114734	0.129855553	0.14114734	0.007904499	0.006985685	27768511.58	1310532.081	931.4925947	1833335550	21.1887
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	50	Diesel	0.000237189	0.000286998	0.000341552	0.002288833	0.001542155	0.243975643	6.02171E-05	5.53997E-05	6.02171E-05	2.24856E-06	1.9913E-06	7915.521032	11098.55259	9.121102519	470083.2387	0.7132
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	75	Diesel	0.005763117	0.006973371	0.008298888	0.107098174	0.08149049	15.75506161	0.001830282	0.001683859	0.001830282	0.00014549	0.000128591	511155.6229	464751.8895	381.946168	33747569.51	1.0998
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	100	Diesel	0.003362602	0.004068748	0.004842146	0.075082657	0.040319361	10.08548888	0.003149994	0.002897995	0.003149994	9.31445E-05	8.23164E-05	327212.5796	235844.2425	193.8234285	21603262.84	1.3874
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	175	Diesel	0.011769697	0.014241333	0.016948363	0.254417323	0.127995613	41.4269034	0.005552216	0.005108039	0.005552216	0.000382659	0.000338121	1344050.257	621518.9448	510.781741	88737025.37	2.1625
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	300	Diesel	0.010393499	0.012576134	0.014966639	0.064452265	0.089133001	28.29711388	0.0036494	0.003357448	0.0036494	0.000261309	0.000230957	918068.6962	241393.5188	198.3839798	60612826.6	3.8032
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	600	Diesel	0.009121249	0.011036711	0.013134598	0.057461306	0.083969399	27.84036592	0.003483179	0.003204524	0.003483179	0.000257124	0.000227229	903250.0114	138731.9073	114.0137815	59634465.86	6.5108
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	750	Diesel	0.004501418	0.005446716	0.006482042	0.031040245	0.041778855	15.15840886	0.002150201	0.001978185	0.002150201	0.000140012	0.000123721	491797.8816	45781.52942	37.62454789	32469530.71	10.7423
Statewide	2020	Portable Equipment - Rental Other Portable Equipment	Aggregated	9999	Diesel	0.091010247	0.110122399	0.131054756	0.845518432	1.145650043	114.1074379	0.046149662	0.042457689	0.046149662	0.00105225	0.00093133	3702090.157	99886.97328	82.08992267	244419780	37.0628
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	50	Diesel	0.000439871	0.000532244	0.000633414	0.005208092	0.004635148	0.563261834	0.000283098	0.00026045	0.000283098	5.19444E-06	4.59727E-06	18274.40989	20563.34738	21.66261848	1085272.057	0.8887
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	75	Diesel	0.005044797	0.006104204	0.007264507	0.108902757	0.088095977	16.74277055	0.00281104	0.002586157	0.00281104	0.000154644	0.000136652	543200.7517	472956.9897	498.2402251	35863256.32	1.1485
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	100	Diesel	0.009296095	0.011248274	0.013386376	0.177916961	0.128462612	24.75248545	0.009005322	0.008284897	0.009005322	0.00022857	0.000202026	803067.1304	570362.3193	600.8526284	53020181.31	1.4080
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	175	Diesel	0.01789788	0.021656435	0.025772947	0.398535659	0.223070015	66.30284803	0.009381422	0.008630908	0.009381422	0.000612466	0.000541155	2151122.885	931844.3206	981.6586586	142021658	2.3085
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	300	Diesel	0.026607945	0.032195614	0.038315441	0.214018085	0.283446795	104.4494429	0.010436578	0.009601651	0.010436578	0.000964889	0.000852502	3388747.145	905869.566	954.295351	223732215.2	3.7409
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	600	Diesel	0.024009606	0.029051623	0.034573833	0.179859207	0.246328738	90.95528561	0.010564831	0.009719644	0.010564831	0.000840206	0.000742365	2950944.072	458887.3309	483.4184335	194827535.4	6.4307
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	750	Diesel	0.001793916	0.002170638	0.002583239	0.011179572	0.02313256	5.610706039	0.001106445	0.001017929	0.001106445	5.18199E-05	4.57938E-05	182033.1783	17316.50305	18.24220504	12018213.37	10.5121
Statewide	2020	Portable Equipment - Rental Pump	Aggregated	9999	Diesel	0.000241361	0.000292047	0.00034756	0.004361647	0.013482074	2.407569102	0.000278278	0.000256016	0.000278278	2.22519E-05	1.96503E-05	78110.92806	1082.281441	1.140137815	5157047.787	72.1725
Statewide	2020	TRU - Instate Genset TRU	Aggregated	50	Diesel	0.027953832	0.033824137	0.040253518	0.569462579	0.442498605	12.37506767	0.0018784	0.001728128	0.0018784	0.000114342	0.000101681	7855.244678	4732231.312	6061.362925	149065286.3	0.0017
Statewide	2020	TRU - Instate Trailer TRU	Aggregated	50	Diesel	0.55893336	0.676309365	0.804864038	8.663635237	6.199066511	147.5054518	0.118946807	0.109431062	0.118946807	0.00135614	0.001211995	93631.11745	37489892.85	28296.75798	1274656357	0.0025
Statewide	2020	TRU - Instate Truck TRU	Aggregated	25	Diesel	0.085734206	0.103738389	0.123457256	0.835697541	1.006758848	20.03943787	0.04179778	0.038453958	0.04179778	0.000183945	0.000164656	12720.30924	10088376.25	7412.473368	142246105.2	0.0013
Statewide	2020	TRU - Instate Van TRU	Aggregated	25	Diesel	0.001984807	0.002401616	0.002858122	0.019346983	0.023307172	0.463927015	0.000967648	0.000890236	0.000967648	4.25846E-06	3.81191E-06	294.4840636	365899.6569	268.8461843	3293096.912	0.0008
Statewide	2020	TRU - Out-of-State Genset TRU	Aggregated	50	Diesel	0.017533384	0.021215395	0.025248073	0.357943725	0.278676851	7.797867027	0.001190055	0.001094851	0.001190055	7.20527E-05	6.4072E-05	4949.803514	2981907.775	24116.89677	93930094.91	0.0017
Statewide	2020	TRU - Out-of-State Trailer TRU	Aggregated	50	Diesel	0.292687487	0.354151859	0.421469981	5.010861418	3.586090988	90.94566571	0.036660988	0.033728109	0.036660988	0.000837697	0.000747265	57729.01413	23114693.2	110162.4303	785899568.9	0.0025
Statewide	2020	TRU - Railcar TRU	Aggregated	50	Diesel	0.030296925	0.03665928	0.043627572	0.518688708	0.371206614	9.414047986	0.003794884	0.003491294	0.003794884	8.67124E-05	7.73516E-05	5975.696641	2392668.516	7420.737883	81350729.53	0.0025

Unit Conversion Rates

Global Warming Potential (rates)

	CO_2	CH_4	N_2O	units
global warming potential	1	25	298	unitless

Source: Intergovernmental Panel on Climate Change. *Climate Change 2007—The Physical Science Basis* . Working Group I Contribution to the Fourth Assessment Report. Available: https://www.ipcc.ch/report/ar4/wg1/. Accessed May 2, 2019.

Mass Conversion Rates

value	units	source
1,000	kg/MT	onlineconversion.com/weight_common.htm
1,000,000	g/MT	onlineconversion.com/weight_common.htm
2,000	lb/ton	onlineconversion.com/weight_common.htm
2,204.62	lb/MT	onlineconversion.com/weight_common.htm
453.59	g/lb	onlineconversion.com/weight_common.htm
1.1023	ton/MT	onlineconversion.com/weight_common.htm
2,204.62	lb/MT	onlineconversion.com/weight_common.htm
1,000,000	MT/MMT	million

Output from EMFAC2017 Model Run

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: ALAMEDA
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, R

Region	Calendar Y	Vehicle Cat	Model Yea	Speed	Fuel	Population	VMT	Trips	Fuel Consumption (1000 gal/day)	Fuel Consumption (gal/day)
ALAMEDA	2021	LDA	Aggregatec	Aggregatec	GAS	643846.3	23456819	3010602	759.1663212	759,166.32
ALAMEDA	2021	LDA	Aggregatec	Aggregatec	DSL	7140.126	264939.3	33233.8	5.637479255	5,637.48
ALAMEDA	2021	LDA	Aggregatec	Aggregatec	ELEC	17125.1	649064.6	84207.95		
ALAMEDA	2021	LDT1	Aggregatec	Aggregatec	GAS	66399	2359125	304135.2	88.60449258	88,604.49
ALAMEDA	2021	LDT1	Aggregatec	Aggregatec	DSL	46.09621	741.565	149.5479	0.030880027	30.88
ALAMEDA	2021	LDT1	Aggregatec	Aggregatec	ELEC	321.7501	12861.12	1605.904		
ALAMEDA	2021	LDT2	Aggregatec	Aggregatec	GAS	212628.3	7710663	988229.3	316.4944952	316,494.50
ALAMEDA	2021	LDT2	Aggregatec	Aggregatec	DSL	1221.379	52545.3	5987.178	1.500472498	1,500.47
ALAMEDA	2021	LDT2	Aggregatec	Aggregatec	ELEC	1502.599	49387.55	7579.032		
ALAMEDA	2021	T6 instate	Aggregatec	Aggregatec	DSL	438.3492	29828.91	1981.76	3.711821675	3,711.82

Source:
California Air Resources Board. 2017. EMFAC2017 computer program, Version 1.0.2 (web-based). Sacramento, CA. Available: https://www.arb.c

Model run by Ascent Environmental on January 2, 2020.

ESTL and DIURN

gal/mile	miles/gal	ROG_RUN	ROG_IDLE	ROG_STRE	ROG_HOTS	ROG_RUNL	ROG_REST	ROG_DIUR	TOG_RUN	TOG_IDLE	TOG_STRE	TOG_HOTS
0.03236	30.898	0.011591	0	0.290414	0.119683	0.246102	0.209404	0.217333	0.016904	0	0.317965	0.119683
0.02128	46.996	0.019581	0	0	0	0	0	0	0.022291	0	0	0
		0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0.004888
0.03756	26.625	0.025406	0	0.427661	0.210919	0.766547	0.392514	0.450308	0.037042	0	0.468232	0.210919
0.04164	24.014	0.21664	0	0	0	0	0	0	0.24663	0	0	0
		0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0.004888
0.04105	24.363	0.016513	0	0.381832	0.138609	0.468688	0.292836	0.283896	0.024085	0	0.418057	0.138609
0.02856	35.019	0.016179	0	0	0	0	0	0	0.018419	0	0	0
		0	0	0	0.004888	0	0.004021	0.014405	0	0	0	0.004888
0.12444	8.036	0.408367	0.07429	0	0	0	0	0	0.464895	0.084574	0	0

a.gov/emfac/2017/. AccessedJanuary 2, 2020.

TOG_RUNI	TOG_RESTI	TOG_DIURI	CO_RUNEX	CO_IDLEX	CO_STREX	NOx_RUNE	NOx_IDLEX	NOx_STRE	CO2_RUNE	CO2_IDLEX	CO2_STRE	CH4_RUNE
0.246102	0.209404	0.217333	0.693193	0	2.478666	0.047127	0	0.224251	270.7509	0	57.71532	0.002905
0	0	0	0.25599	0	0	0.113991	0	0	216.593	0	0	0.000909
0	0.004021	0.014405	0	0	0	0	0	0	0	0	0	0
0.766547	0.392514	0.450308	1.172104	0	2.646624	0.106817	0	0.296974	314.1232	0	67.2804	0.005778
0	0	0	1.244688	0	0	1.203378	0	0	423.8716	0	0	0.010063
0	0.004021	0.014405	0	0	0	0	0	0	0	0	0	0
0.468688	0.292836	0.283896	0.890638	0	3.103874	0.085751	0	0.340973	343.2474	0	74.34634	0.004051
0	0	0	0.13753	0	0	0.049421	0	0	290.6699	0	0	0.000751
0	0.004021	0.014405	0	0	0	0	0	0	0	0	0	0
0	0	0	0.909939	1.899405	0	4.759191	5.082113	1.90878	1256.94	660.5245	0	0.018968

CH4_IDLEX	CH4_STRE	PM10_RU	PM10_IDL	PM10_STR	PM10_PM	PM10_PM	PM2_5_RUNEX	PM2_5_IDLEX	PM2_5_STREX
0	0.062188	0.001543	0	0.00199	0.008	0.03675	0.001419203	0	0.001829576
0	0	0.010575	0	0	0.008	0.03675	0.010117339	0	0
0	0	0	0	0	0.008	0.03675	0	0	0
0	0.083878	0.002072	0	0.002686	0.008	0.03675	0.001905156	0	0.002469748
0	0	0.179628	0	0	0.008	0.03675	0.171857493	0	0
0	0	0	0	0	0.008	0.03675	0	0	0
0	0.080284	0.001527	0	0.001906	0.008	0.03675	0.001403934	0	0.001752519
0	0	0.005673	0	0	0.008	0.03675	0.005428017	0	0
0	0	0	0	0	0.008	0.03675	0	0	0
0.003451	0	0.121984	0.011811	0	0.012	0.13034	0.116707365	0.011299657	0

PM2_5_PMTW	PM2_5_PMBW	SOx_RUNE	SOx_IDLEX	SOx_STREX	N2O_RUNE	N2O_IDLEX	N2O_STREX
0.002000001	0.015750005	0.002679	0	0.000571	0.005018	0	0.028556
0.002000001	0.015750005	0.002048	0	0	0.034045	0	0
0.002000001	0.015750005	0	0	0	0	0	0
0.002000001	0.015750005	0.003109	0	0.000666	0.008208	0	0.031586
0.002000001	0.015750005	0.004007	0	0	0.066627	0	0
0.002000001	0.015750005	0	0	0	0	0	0
0.002000001	0.015750005	0.003397	0	0.000736	0.00707	0	0.036305
0.002000001	0.015750005	0.002748	0	0	0.045689	0	0
0.002000001	0.015750005	0	0	0	0	0	0
0.003000001	0.055860016	0.011875	0.00624	0	0.197574	0.103825	0

Appendix G

Toxicity Evaluation for the
UC Berkeley Hill Campus Wildland
Vegetative Fuel Management Plan

Toxicity Evaluation for the UC Berkeley Hill Campus Wildland Vegetative Fuel Management Plan

Prepared for Ascent Environmental, Inc.
March 2020

Bill A. Williams, PhD

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Tables

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Introduction – Herbicide Overview

This document has been prepared to evaluate the herbicides proposed for use by University of California, Berkeley in the Wildland Vegetative Fuel Management Plan (WVFMP or Plan) by analyzing the potential for direct and indirect effects from herbicide use to human health, wildlife, and the environment. Because of UC Berkeley's careful use of the chemicals listed in this document, it is expected that exposures will be relatively low and not result in adverse effects to applicators or the public.

Throughout this document, the evaluation of risks presented are based on the relationship between documented toxicity of an active ingredient (a.i.) and estimates of possible exposure associated with herbicide application. This is a standard method used to provide an estimated risk of chemicals to human applicators, selected target vegetation and non-target biota.

Risk = Fn (exposure x toxicity)

HQ = exposure/acceptable level of toxicity (where 1.0 is the initial point of concern)

As the exposure level decreases, the margin of safety increases. This approach is typically used in U.S. Environmental Protection Agency (USEPA) risk assessments. A hazard quotient (HQ) is the ratio of a projected level of exposure divided by some index of an acceptable exposure or an exposure associated with a defined risk. As the level of projected exposure decreases, the HQ decreases. Because the parameters used to develop risk estimates generally have a large range of potential values and uncertainties, the use of the HQ of 1.0 is very conservative and usually includes large internal safety factors. As a result, the HQ may be considerably larger than 1.0 and the risk estimates used to determine adverse effects to receptors of concern may not be realistic. In the following evaluations of chemicals used or proposed by UC Berkeley, the values included for HQ and/or toxicity are usually based on laboratory test data that are not particularly realistic when the actual field application scenarios are considered. For this reason, the narratives provided for the herbicides proposed for use under the WVFMP should be considered worst case scenarios.

Even highly hazardous chemicals can have little risk if the potential exposure is minimal. This is the basis for the information on the label provided for a chemical and reflects the ways to minimize potential exposure. The evaluations of toxicity in this document address the potential hazard of each chemical but the potential risk is clearly modified by the careful adherence to the restrictions and recommendations provided on the label and Material Safety Data Sheets (MSDS) provided by the chemical company. Generally, regulators and others tracking potential issues of exposure to toxic chemicals use a concept of the Level of Concern (LOC) which is included in many of the evaluations in this document. This value is a comparison of the expected exposure of a chemical to levels that remain at safe levels. Similar to the HQ, the LOC provides a quick look at the potential risk of an activity that includes the chemical.

This document is intended to provide descriptions and characteristics of the herbicides proposed for use under the WVFMP, as well as quickly accessible tables and definitions with succinct information about the relative hazards of each of the pesticide products proposed for use. This document includes the latest information needed to evaluate the safety of the base chemical, including active ingredients and current formulations. In many cases the formulations of herbicides being evaluated herein have additives such as surfactants and emollients used to increase the effectiveness of the herbicide. The list of herbicides proposed for use under the WVFMP are included in the columns below.

Herbicides

- Stalker (imazapyr)
- Roundup Pro (glyphosate)
- Transline (clopyralid)
- Surflan AS (oryzalin)
- Snapshot 2.5 T (isoxaben + trifluralin)
- Garlon® 4 Ultra (triclopyr)

Herbicides Proposed for Use in the WVFMP

Chemical control of annual and biennial weeds includes two strategies to treat different life stages: 1) post-emergent (i.e., direct application of herbicide to eliminate the plant), and 2) pre-emergent (i.e., treatment to prevent the germination of seeds). Herbicides are also classified as either selective or non-selective. Selective herbicides control plants in specific plant families or life stages, while allowing other plants to survive uninjured. Utilizing selective herbicides can be a powerful tool in balancing active management with protecting desirable, native vegetation types. Non-selective herbicides and application methods injure all plant species that are directly exposed to treatment, so should be directed only to the target species. Selectivity may be based on either the chemistry of the herbicide but can also reduce non-target exposures with the timing of the application. All of the herbicides listed above could be used to control invasive plants on natural lands. Application methods would include cut-stump, basal bark, and foliar spray by hand. No aerial or ground broadcast spray applications are proposed under the WVFMP. When herbicides are needed for vegetation control, best management practices recommend direct application to the plant or tree either by hand painting the herbicide directly on to the cambium of the freshly cut tree or plant stump or bottle spritzing, no further than 6 inches away. In order to apply an herbicide to a stump or grass, all of the plant or tree's foliage (leaves, branches, and trunks) must be hand or mechanically cut away until nothing is left but a stump or clump. When glyphosate and triclopyr are applied in this manner, the herbicide is absorbed within the plant or tree's system and does not migrate into the surrounding soil.

Approach

Descriptions of the chemicals in this document include information currently known about the toxicity, ingredients, and additives associated with each of the chemicals and the potential impact to humans and wildlife. The hazard discussions are based on reports and guidance in USEPA toxicity tables included in chemical regulatory documents and appropriate studies provided in support of chemical registration. Wildlife data published as toxicity estimates are in USEPA registrant files (USEPA 2016) and exposure and toxicity tables in the Wildlife Exposure Handbooks, Volume 1 and 2. Additional documents, including "*Herbicide Use and Wood Chip Application Literature Review*" and "*Screening Level Human Health and Ecological Risk Assessment*" were reviewed and are incorporated herein by reference.

Extensive searches on the chemical properties and toxicity of each of the herbicides proposed for use under the WVFMP were conducted to obtain recent information on potential toxicity and adverse effects to human health and wildlife, including aquatic life. Where recent, relevant information has been identified in in the Agency for Toxic Substances and Disease Registry (ATSDR ToxFAQs chemical fact sheets) and new registration information from USEPA, it is included where appropriate. Examples of some of the available databases and search engines that were considered and queried or referenced are listed below:

- CCRIS (Chemical Carcinogenesis Research Info System);
- CHEMFATE (environmental fate);
- Environmental Peer Reviewed Journals and Publications
- ECOTOX (toxicity to fish and aquatic life);
- EXTOXNET (Extension Toxicology Network's pesticide information project).
- HSDB (Hazardous Substances Data Bank);
- IRIS (Integrated Risk Information System; toxicity to human health);
- Material Safety Data Sheet (MSDS) for each chemical
- National library of Medicine (PubChem); and
- Syracuse Environmental Research Associates (SERA) for Chemicals
- USEPA RED and chemical review databases;
- USEPA Wildlife Exposures Handbook V1 &v2.

All herbicides proposed for control of unwanted vegetation must be evaluated to determine their inherent toxicity and the potential adverse impacts to humans and wildlife. Thousands of studies have been conducted by the manufacturers, research scientists, and regulatory agencies on the current suite of chemicals developed as herbicides. These studies and the reports generated provide the basic information used in this document.

The degree of toxicity of a pesticide determines what precautions must appear on the pesticide label. These should always be considered and followed by the users and include, for example, the signal words (*caution, warning, danger*). As a general rule, most pesticides receive the category "caution" which provides a basic level of care when handling any chemical. Highly toxic chemicals are categorized as "danger" to indicate the level of concern needed when handling such chemicals.

> ***CAUTION*** Products with the signal word CAUTION are lower in toxicity. A "CAUTION" label means the product is slightly toxic if eaten, absorbed through the skin, inhaled, or it causes slight eye or skin irritation.
>
> ***WARNING*** *indicates the pesticide product is moderately toxic if eaten, absorbed through the skin, inhaled, or it causes moderate eye or skin irritation.*
>
> ***DANGER*** *means that the pesticide product is highly toxic by at least one route of exposure. It may be corrosive, causing irreversible damage to the skin or eyes, it may be highly toxic if eaten, absorbed through the skin, or inhaled. Then the word "POISON" must also be included in red letters on the front panel of the product label.*

The label also includes first aid recommendations. The use and type of protective clothing and whether the pesticide may be used only by specially trained and certified applicators (restricted use pesticides).

The potential toxicity characteristics to humans for the chemicals proposed for use under the WVFMP are provided in the table below and as an additional information sheet for use in the field. Because it is neither ethical nor practical to conduct toxicity evaluations using humans, the historic approach has been to substitute rats, rabbits, dogs, and other animals as surrogate test animals. Nearly all data provided in the open literature characterizing chemical effects to humans are based on those surrogate animal studies. In rare cases, accidental and occupational exposures have provided information relating to actual adverse effects on humans. Using these surrogate studies, the USEPA provides an overview of metrics to prioritize potential toxic effects (refer to Table 1).

An important consideration in the hazard characterizations associated with the herbicides proposed for use by the WVFMP is the level of potential risk of handling during applications. At the end of each chemical characterization in this document a discussion is included about the basic parameters that lead to the possible adverse effects (risks) of handling. Although not comprehensive risk evaluations, the discussions provide a general overview of the potential for adverse effects of exposures. To develop the risk characterizations the information in the chemical specific Syracuse Environmental Research Associates (SERA) series was combined with USEPA acute and chronic data to synthesize an overview of the potential adverse effects of exposures. The SERA series are some of the most comprehensive hazard and risk assessments that have been conducted and reported. These assessments are all based on realistic estimates of exposure, with likely dose incorporated into the risk equations. These risk assessments were conducted and reported by SERA and are focused on dozens of chemicals that are used in actual field operations. Much of the information and data used in the following chemical characterizations incorporates basic SERA toxicology and risk data and has been updated and modified to be appropriate for the herbicides proposed for use under the WVFMP.

Table 1. USEPA Categorizations of Acute Chemical Toxicity

Toxicity Study	Category I High Toxicity	Category II Moderate Toxicity	Category III Low Toxicity	Category IV Very Low Toxicity
Acute Oral	Up to and including 50 mg/kg	> 50 thru 500 mg/kg	> 500 thru 5000 mg/kg	> 5000 mg/kg
Acute Dermal	Up to and including 200 mg/kg	> 200 thru 2000 mg/kg	> 2000 thru 5000 mg/kg	> 5000 mg/kg
Acute Inhalation	Up to and including 0.05 mg/liter	> 0.05 thru 0.5 mg/liter	> 0.5 thru 2 mg/liter	> 2 mg/liter
Eye Irritation	Corrosive (Irreversible destruction of ocular tissue) or corneal involvement more than 21 days	Corneal involvement or irritation clearing in 8-21 days	Corneal involvement or irritation clearing in 7 days or less	Minimal effects clearing in less than 24 hours
Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hour (moderate erythema)	Mild or Slight irritation (no irritation or slight erythema)

Source: USEPA 1998

Many commercially available pesticide products contain additives (surfactants, etc.) so the specific products listed in this appendix are evaluated in the formulations that would likely be used under the WVFMP. In some cases, formulations of chemicals contain additives and/or surfactants which will be identified due to potential toxicological concerns of these additives. Although not directly proposed under the WVFMP, additives will be identified when used as a surfactant and addressed as appropriate.

Potential risk must also include chronic or long-term exposure and potential development of cancer. In many cases, the studies used to evaluate the potential linkages to cancer are based on demographic, epidemiological studies in which the linkage is weak or not statically valid. However, to provide a conservative evaluation of chemicals of concern, these linkages are included in the determination of the cancer classification. Potential toxicity of the chemicals proposed for use under the WVFMP are included in Table 2 and cancer classification are provided in Table 3 below.

Table 2. Potential Human Toxicity of Chemicals Proposed for Use Under the WVFMP

All data reported for estimates of human toxicity are generally based on extrapolations of laboratory animal studies that include conservative safety factors to assure that adverse effects are not underestimated.

Product Names	Toxicity Overview
GARLON 4 Ultra **Triclopyr** triclopyr amine CAS No 55335-06-3	Garlon 4 Ultra is categorized as a Category III (low toxicity) chemical and has very low toxicity to humans if ingested, but may cause skin irritation, serious eye irritation, and may cause respiratory irritation at high doses and exposures. Prolonged skin contact is unlikely to result in absorption of harmful amounts. No adverse effects are anticipated from single ingestion exposure (USEPA 1998).
Round Up **Glyphosate** (Roundup Pro)/(RoundupProMax) Isopropylamine salt, potassium salt, dimethylamine salt & diammonium salt CAS No 40465-66-5	Decades of research has indicated that glyphosate has low toxicity (Category III) if ingested. Skin and eye irritation from exposure is possible. There is no evidence of neurotoxicity, immunotoxicity, or acute toxicity. Reproductive toxicity may occur at very high doses. Recent claims of carcinogenicity (class 2A) were based on animal studies. Substantial evidence finds human carcinogenicity unlikely. Some studies suggest that glyphosate may be a possible endocrine-disruptor (USEPA 2017a).[1]
Snapshot 2.5 TG **Isoxaben** Benzamide, N-[3-1-ethyl- 1-methy propyl)-5- isoxazoly l]-2,6-dimethoxy CAS No:82558-50-7	Oral toxicity of Snapshot 2.5TG is categorized as very low (Category IV). No adverse effects have been reported for inhalation, but Snapshot 2.5 TG has the potential for minor skin irritation from dust exposure. There are no reports of eye irritation or contact allergy (IRIS 1988).
Snapshot 2.5 TG **Trifluralin** 2,6-Dinitro-N,N-dipropyl-4-(trifluoromethyl)aniline CAS No 1582-09-8	Oral toxicity of Snapshot 2.5TG is categorized as very low (Category IV). No adverse effects have been reported for inhalation, but Snapshot 2.5 TG has the potential for minor skin irritation from dust exposure. There are no reports of eye irritation or contact allergy (IRIS 1988).
Stalker **Imazapyr** 2-[4,5- dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol- 2-yl]-3-pyridinecarboxylic acid CAS No: 81510-83-0	Stalker is practically non-toxic (Category III and IV) after ingestion. There are no reports of effects on mammalian reproduction. The chronic estimated level of concern for mammals was not exceeded for any of the registered uses. The chronic risk for mammals is low following all exposure routes to imazapyr. There is no evidence of carcinogenicity, neurotoxicity, or immunotoxicity after exposures to Imazapyr (USEPA 2006).
Surflan AS **Oryzalin** Benzenesulfonamide, 4-(Dipropylamino)-3,5-Dinitro CAS No 19044-88-3	Oryzalin generally is of moderate acute toxicity (Category III) but is carcinogenic in animal studies and has been classified as a Group C, possible human carcinogen. (USEPA 1994)
Transline **Clopyralid,** (Lontrel) (Cody (Alligare) (Confront) (Thistledown) Monoethanolamine salt 3,6-dichloro-pyridinecarboxylic acid CAS No 57754-85-5	Clopyralid has very low toxicity (Category III) if ingested. Clopyralid is classified by the USEPA as "not likely to be a human carcinogen." However, there are some indications of potential birth defects at very high doses. No birth defects were observed in animals given clopyralid at doses several times greater than those expected during normal exposure. Clopyralid is not listed as mutagenic (USDOE 2000, SERA 2004).

[1] There have been court cases involving Roundup in which the juries have awarded several million dollars to plaintiffs. Although glyphosate has been listed under Proposition 65 based on the International Agency for Research on Cancer's (IARC) classification of glyphosate as probably carcinogenic (based on one study in mice), decades of actual laboratory and field testing of glyphosate conclude that glyphosate is not likely to be carcinogenic to humans and no other meaningful risks to human health occur when the product is used according to the label. Recent expert panels have been convened to directly evaluate the claims of the IARC that glyphosate is carcinogenic to humans. Reports of these panels strongly counter that claim and indicate there is insufficient evidence that glyphosate is carcinogenic.

The toxicity data are derived from controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. Data are derived from each listed USEPA registration sites. Toxicity to other animals and humans based on specific exposure scenarios may be higher or lower, based on additional physical and exposure conditions.

Table 3. USEPA Cancer Classifications of Chemicals Proposed for Use Under the WVFMP

Chemical	Cas No.*	Products	Cancer Classification	USEPA Report Date
Triclopyr	55335-06-3	Garlon 4 Ultra	Group D--Not Classifiable as to Human Carcinogen.	5/9/1996
Glyphosate	1071-83-6	Roundup Roundup Pro	Not Likely to be Carcinogenic to Humans[1].	12/12/2017
Isoxaben	82558-50-7	Snapshot 2.5TG	Suggestive Evidence of Carcinogenic Potential.	10/7/2008
Trifluralin	1582-09-8	Snapshot 2.5 TG	Trifluralin is not classifiable as to its carcinogenicity to humans (Group 3).	4/1/1996
Imazapyr	81334-34-1	Stalker	No Evidence of Carcinogenicity.	12/16/2011
Oryzalin	19044-88-3	Surflan AS	Suggestive Evidence of Carcinogenic Potential in animals.	9/1/1994
Clopyralid	57754-85-5	Transline	Not Likely to be Carcinogenic to Humans.	5/22/2015

Source: USEPA OPP Annual Cancer Report 2018, USEPA RED series for Listed Chemicals, USEPA.gov.

[1] Although the USEPA has classified glyphosate as not likely to be carcinogenic to humans, it has been listed under Proposition 65 based on the IARC's classification of glyphosate as probably carcinogenic (based on one study in mice). However, decades of actual laboratory and field testing of glyphosate conclude that glyphosate is not likely to be carcinogenic to humans and no other meaningful risks to human health occur when the product is used according to the label. Recent expert panels have been convened to directly evaluate the claims of the IARC that glyphosate is carcinogenic to humans. Reports of these panels strongly counter that claim and indicate there is insufficient evidence that glyphosate is carcinogenic

Although this evaluation provides the documented potential hazards of the chemicals proposed for use by UC Berkeley staff and technicians, the important concept of risk associated with a chemical is the actual exposure (dose) taken in or contacted by the individual. That concept drives the development of best management practices (BMPs) for each herbicide as described on their label and guidance provided by USEPA and other regulatory agencies. Even the most potentially toxic herbicides proposed for use by UC Berkeley would not result in adverse effects or unacceptable risk because the application methods and BMPs that would be implemented would prevent human contact with or intake of the product. This principle is used as the primary operational approach by pesticide applicators during operations and applications.

Each of the herbicides proposed for use by UC Berkeley within the WVFMP area has an extensive series of reports and scientific studies used to determine the relative level of risk associated with exposure. These determinations are provided and supported by the USEPA, European scientific agencies (in a harmonization program) and other public and private groups responsible for the safe use of chemical products. One of the most informative elements of the chemical characterization is a calculated risk estimate where the level of safety is compared to a statistical level of effects, such as 1 in a million. Evaluations for each of the herbicides proposed for use in the WVFMP area are provided below. A simple calculated risk estimate is included in the evaluations using typical lower, central, and upper risk. Although the values are reasonable estimates of the likelihood of risk, they include parameters with large safety and uncertainty factors and are thus generally conservative and overly protective.

Hazard Evaluations

Garlon 4 Ultra CAUTION

Triclopyr

Several (over 200) retail herbicide products contain the active ingredient

Triclopyr

Triclopyr mimics auxin, a plant growth hormone, disrupting the normal growth and viability of plants
Cut-stump, basal bark, foliar spray
Crossbow/Stump Out/Confront/Remedy Ultra/Bonide/Battleship III/4-Speed XT
CAS No. 55335-06-3
3,5,6-trichloro-2-pyridinly)oxy]acetic acid
Light yellow to amber liquid, nonflammable, slight odor
Triclopyr is not flammable
Low human toxicity, eye irritation possible. No evidence of neurotoxicity, carcinogenicity, immunotoxicity or reproductive/developmental toxicity
Practically non-toxic to birds, fish, and aquatic invertebrates and bees

Mode of Action

Triclopyr is a selective systemic foliar herbicide that moves down to the roots of the vegetation, used primarily to control broadleaf, woody, and herbaceous weeds while leaving grasses and conifers unharmed.

As a selective herbicide, triclopyr affects actively growing plants by mimicking auxin, a plant growth hormone (SERA 1996). Plants rapidly absorb triclopyr through leaves and roots to produce an uncontrolled plant growth and plant death (NPIC 1998). After absorbing the herbicide, plants die slowly (within weeks).

Environmental Fate and Transport

Ester and salt forms of triclopyr rapidly turn into the triclopyr acid form in the environment, soluble in water, but the ester form is less soluble. Triclopyr has a low vapor pressure. Triclopyr in water breaks down faster with light. The half-life of triclopyr in water with light is around 1 day. Without light, it is stable in water with a half-life of 142 days (USEPA 1998a).

Triclopyr breaks down relatively quickly in soils. It is mainly broken down by microbes. The soil half-life ranges from 8 to 46 days. In deeper soils with less oxygen, the half-life is longer. Triclopyr is mobile in soils. However, movement studies show that triclopyr was not measured in soils deeper than 15 to 90 centimeters (about 6 to 35 inches). The half-life in plants can vary widely with the type of plant. Barley and wheat plants broke down 85% of triclopyr within 3 days of application. The half-life in grass was between 5 and 20 days. The half-life in plants ranges from 3 to 24 days (NPIC 1998).

Human Toxicology

Human toxicity estimates are extrapolated from animal studies. Triclopyr acid was found to be slightly toxic by oral and dermal routes and has been placed in Toxicity Category III for these effects. Acceptable studies for acute inhalation, primary eye irritation, primary dermal irritation and dermal sensitization were not available for the technical grade of triclopyr acid. Available data indicate that both Triclopyr triethylamine salt (TEA); and Triclopyr, butoxyethyl ester (BEE); are slightly toxic by oral (Toxicity Category III) and dermal (Toxicity Category III) routes of exposure, and practically non-toxic by inhalation (Toxicity Category IV) and do not cause dermal irritation (USEPA 2014). In a primary eye irritation study triclopyr TEA was found to be corrosive while BEE was found to be minimally irritating. Both TEA and BEE were found to cause dermal sensitization in test animals. The USEPA has classified triclopyr as a Group D chemical that is not classifiable as to human carcinogenicity (DeRoos 2003). Extensive evaluations of triclopyr toxicity suggest that it is low toxicity (USFS 2011).

Technical triclopyr acid was found to be slightly toxic by oral and dermal routes (Toxicity Category III). Acute effects include inhalation, primary eye irritation, primary dermal irritation and dermal sensitization while both BEE and TEA are slightly toxic by oral (Toxicity Category III) and dermal (Toxicity Category III) routes of exposure, and practically non-toxic by inhalation (Toxicity Category IV). They do not cause dermal irritation. These chemicals are classified a Group D chemical (not classifiable as to human carcinogenicity) (NPIC 2018). Triclopyr has not been shown to be an endocrine disruptor (USEPA 1998b; USFS 2011).

Ecological Toxicology

Triclopyr is practically non-toxic to slightly toxic to birds. Long-term exposures of weeks to months to birds (acid form) may affect eggshell thickness. While the salt form is practically non-toxic to slightly toxic to shellfish, the ester form is moderately to highly toxic. All forms of triclopyr can be toxic to algae.

For fish, the acid and salt forms are practically non-toxic, but the ester form is moderately to highly toxic. The ester form can bioaccumulate (build up) in fish. However, the ester form rapidly degrades to the acid form in the environment and fish are not likely to contact large amounts of the pesticide. A breakdown product of triclopyr is trichlorpropane (TCP) which is slightly to moderately toxic to fish and shellfish. Triclopyr is practically non-toxic to bees.

Typical Application Scenarios For Triclopyr/Garlon

For terrestrial applications of triclopyr, the main method of application (Table 4 below) is via directed foliar (backpack). Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates. Because of the sensitivity of each parameter used to estimate exposure, the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the estimates.

Table 4. Estimates of Potential Risk Synthesized from USEPA data and SERA 2011

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution.

Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters.

Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.0003, 0.003, 0.01	SERA 2011

Source: SERA 2011.

Special Issues Concerning Triclopyr/Garlon

In light of the various public concerns regarding the use of glyphosate-based products, the President of the University of California (UC), issued a temporary suspension of the use of glyphosate-based herbicides at UC campuses, with four explicit exceptions: 1) fuel-load management programs to reduce wildfire risk, 2) native habitat preservation or restoration activities, 3) agricultural operations, and 4) research activities. The temporary suspension became effective on June 1, 2019. In tandem with the temporary suspension, the UC President established a task force to review UC's current use of glyphosate-based herbicides for vegetation management purposes. The UC Task Force members include faculty and other expert individuals from across the UC system, including the following constituencies: faculty (toxicology, reproductive health, plant sciences, and environmental law); students; Agriculture and Natural Resources; facilities maintenance; groundskeeping; sustainability; environment, health and safety; and the Office of the General Counsel (UCOP 2019). The UC President charged the UC Task Force with several responsibilities, including the preparation of a report addressing the President's directive and providing recommendations for the use of herbicides at UC campuses.

Since convening, the UC Task Force has recommended that pesticides be grouped into three tiers based on hazard. For carcinogenicity, a pesticide is classified as Tier 1 (red-tier/most hazardous) if any one of five identified authoritative bodies identifies the pesticide as a carcinogen. The authoritative bodies include: USEPA, U.S. Food and Drug Administration (USFDA), National Institute for Occupational Safety and Health (NIOSH), the National Toxicology Program (NTP) of the US Department of Health and Human Services (USHHS), and the International Agency for Research on Cancer (IARC). There was not consensus across all members of the UC Task Force on this system of classifying hazard rankings. Two of the UC Task Force members felt that the California Department of Pesticide Regulation (DPR) and the USEPA should be used as the primary authoritative bodies for making hazard classifications. If DPR and USEPA were used, the hazard ranking for Garlon (and glyphosate) would likely change to Tier 2 (medium-tier/yellow) or Tier 3 (low-tier/green). However, because Triclopyr, the active ingredient in Garlon, has been identified as a possible carcinogen by the International Agency for Research on Cancer (IARC), it has been designated Tier 1 by the UC Task Force.

Per the UC President's directive, the Task Force has prepared a report with recommendations regarding the use of pesticides, including:

- The creation of a systemwide integrated pest management (IPM) policy, which requires each UC location to establish a local IPM committee (IPMC).

- All Tier 1 pesticides, including glyphosate and many other pesticides, will be prohibited from all applications except research, unless and until a local IPMC approves a specific use based on a strong justification of necessity and the unavailability of alternative solutions.

- UC will exceed State law with respect to requirements for training in safe pesticide application and licensure of relevant UC staff.

As of early 2020, the UC President accepted all of the Task Force recommendations and UC staff will proceed to implement them expeditiously (UCOP 2020). Therefore, after the UC Berkeley IPMC is established as recommended by the Task Force, UC Berkeley will permit the use of Tier 1 (high-red tier) pesticides, including Garlon, only after the local IPMC has reviewed and approved its specific use application following an IPM based assessment. In addition, regulations for any approved uses of Garlon on the UC Berkeley campus would be more stringent than what is currently required by state law.

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of personal protective equipment (PPE). Because Garlon would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to Garlon in excess of USEPA-defined safe levels.

Reasonable estimates of the HQs indicate that workers will not be subject to hazardous levels of triclopyr during applications (TEA at the application rate of 1 lb a.i./acre). For triclopyr BEE, the reasonable estimates of the HQs range from 0.7 to 1.2 based on the chronic reference dose (RfD), which is the dose assigned by USEPA that may result in an adverse effect. At the upper bounds of the estimated exposures for all application methods, the HQs for both triclopyr TEA (HQs = 1.6 to 3) and triclopyr BEE formulations (HQs = 6 to 12) exceed the level of concern (HQ=1), based on the chronic RfD. All of these HQs apply to an application rate of 1 lb a.i./acre and will scale proportionately to the application rate. Adverse developmental effects in experimental mammals have been observed, however, only at high doses that cause maternal toxicity. The available toxicity studies suggest, however, that concern for reproductive effects in humans is not warranted because the doses that elicited the responses were so high that they are not appropriate for human toxicity estimates. (USFS 2011).

Risk characterization estimates for ecological effects at an application rate of 1 lb a.i./acre are likely greater than that would result from typical WVFMP application techniques. Consumption of contaminated vegetation by mammals and birds would likely be considerably less. As with the human health risk assessment, the results suggest the potential for adverse effects, but not overt toxic effects, in large mammals from the consumption of treated vegetation. Because the WVFMP does not propose the use of a broadcast spraying of herbicides, the contamination will be considerably less and the risk to wildlife lower than calculations using 1 lb a.i./acre.

Roundup Pro CAUTION

Glyphosate

Several retail herbicide products (>750) contain the active ingredient glyphosate

Nonselective post-emergent broad-spectrum weed control
Spray application (backpack only) 41% a.i.
Roundup Pro/Roundup/Enforcer/Kleeraway/Zep WeedDefeat/Bonide/ Campaign/GroundClear/Killzall/ DuraZone/ Spectracide
CAS No 38641-94-0
Isopropylamine salt of N-(phosphonomethyl)glycine Isopropylamine salt of glyphosate
Amber-brown, liquid with slight odor. Stable
Roundup is not flammable
Glyphosate is of relatively low toxicity to mammals and shows no mutagenic or teratogenic potential. Possible link to some cancers with high exposure. It can be an eye and skin irritant, but is not a dermal sensitizer

Mode of Action

Glyphosate [N-(phosphonomethyl)glycine] is a nonselective, post-emergent, and systemic herbicide registered for use in agricultural and nonagricultural areas. It is the active ingredient in Aquamaster and Roundup ProMax and is applied to a variety of feed and food crops and agricultural drainage, sewage, and irrigation systems. There are several formulations of glyphosate, including an acid, monoammonium salt, diammonium salt, isopropylamine salt, potassium salt, sodium salt, and trimethylsulfonium or trimesium salt. Glyphosate is not effective on submerged or mostly submerged foliage and therefore is only applied to control emergent foliage (Schuette 1998; Siemering 2005).

Environmental Fate and Transport

Active ingredient Isopropylamine salt of N-(phosphonomethyl)glycine; {Isopropylamine salt of glyphosate} with the additive ethoxylated tallowamine. Identity of other components (37%) is withheld due to trade secret information of Monsanto Company (Monsanto 2017). Roundup products all contain the a.i. glyphosate, but in some formulations, additives are used to enhance the efficacy and usefulness of the applications.

Glyphosate is highly water-soluble. Glyphosate is broken down by microbial degradation to its metabolite aminiomethylphosphonic acid (AMPA) and carbon dioxide. The rate of degradation in water is generally slower than the rate in soil because there are fewer microorganisms in water than in most soils. For all aquatic systems, sediment appears to be the major sink for glyphosate residue. Even though glyphosate is highly water soluble it appears that parent glyphosate and AMPA have a low potential to move to groundwater due to their strong soil adsorptive characteristics (Schuette 1998; Siemering 2005; USEPA 1993). In the soil glyphosate is resistant to chemical degradation, is stable to sunlight, is relatively non leachable, and has a low tendency to runoff (except as adsorbed to colloidal matter and sediment). It is relatively immobile in most soil environments as a result of its strong adsorption to soil particles and does not move vertically below the 6 inch soil layer. Glyphosate’s primary route of decomposition in the environment is through microbial degradation in soil.

A Registration Evaluation Decision (R.E.D). was completed for glyphosate by the USEPA (1993), though toxicity and tolerances have been re-evaluated several times as a result of additional chemical uses, as well as new glyphosate salts being registered (FedReg 2007, 2011; USEPA 2006a, 2006b). Glyphosate is poorly biotransformed in rats and is excreted via feces and urine; neither the parent compound nor its major breakdown product bioaccumulates in animal tissue (Williams et al. 2000).

Human Toxicology

Human toxicity estimates are extrapolated from animal studies. Glyphosate has been studied for decades and mammalian toxicological data has illustrated the lack of mammalian toxicity. Rat, Oral LD50: > 5,000 mg/kg which is practically non-toxic. Acute dermal toxicity for the rat: LD50: > 5,000 mg/kg practically non-toxic. Skin and eye irritation for rabbits is moderate. Acute inhalation toxicity for rats is practically non-toxic. No skin sensitization for glyphosate acid and no evidence that it is genotoxic. Not carcinogenic in rats or mice. Developmental effects and reproductive effects in rats and rabbits reported only after extreme doses. Numerous recent studies challenge the claims of the IARC that glyphosate is carcinogenic and have revised the toxicity estimates as well (Tarazona et al. 2017). The decades of research with glyphosate support the USEPA regulatory information and continue to indicate that glyphosate is nontoxic to humans when used in compliance with label requirements, and no endocrine disruption is evident (NPIC 2019). Glyphosate products are effective, widely used, generally low risk products for weed control (Gertsberg 2011). Some ancillary reports in the press of sublethal effects on disease resistance, biological diversity, or enzyme activity as a result of ingestion/uptake of glyphosate are interesting but without clear mechanisms that can be related directly to glyphosate (Gertsberg 2011).

The USEPA has classified glyphosate as Category III for oral and dermal toxicity (USEPA 1993), and the isopropylamine and ammonium salts of glyphosate that are used as active ingredients in registered herbicide products exhibit low toxicity to mammals via the oral and dermal routes. Although no scientific evidence had unequivocally indicated that glyphosate is carcinogenic or mutagenic (USEPA 1993), a recent report by the WHO (WHO 2015) suggests that it “may probably be carcinogenic” although the WHO researchers fail to report a statistically significant finding. Use of the term “probably” generally indicates the linkage is not statistically defensible. The WHO report is a summary of discussions by a panel review convened specifically to update information on several chemicals, including the herbicides tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate, in order to evaluate and update the existing information about the potential for adverse effects.

Ecological Toxicity

Aquatic toxicity, fish Rainbow trout (Oncorhynchus mykiss): Acute toxicity, 96 hours, static, LC50: 5.4 mg/L, moderately toxic. Bluegill sunfish (*Lepomis macrochirus*): Acute toxicity, 96 hours, static, LC50: 7.3 mg/L, moderately toxic. Aquatic toxicity, invertebrates Water flea (*Daphnia magna*): Acute toxicity, 48 hours, static, EC50: 11 mg/L, slightly toxic. Mallard duck (*Anas platyrhynchos*): 5 days, LC50: > 5,620 mg/kg diet, practically non-toxic. Bobwhite quail (*Colinus virginianus*): 5 days, LC50: > 5,620 mg/kg diet, practically non-toxic. Honey bee (*Apis mellifera*): Oral/contact, 48 hours, LD50: > 100 µg/bee, practically non-toxic. Earthworm (*Eisenia foetida*): Acute toxicity, 14 days, LC50: > 1,250 mg/kg soil, practically non-toxic. Bioaccumulation Bluegill sunfish (*Lepomis macrochirus*): Fish: BCF: < 1 No significant bioaccumulation has been reported.

The shikimate acid pathway is a metabolic pathway found only in microorganisms and plants, never in animals. Since this pathway is specific to plants and some microorganisms; glyphosate has very low toxicity to mammals. The USEPA classifies glyphosate as Category III for oral and dermal toxicity (USEPA 1993). The oral LD50 for technical grade glyphosate for rats is 4,320 mg/kg. The dermal LD50 for technical grade glyphosate in rabbits is ≥ 2000 mg/kg (USEPA 1993). Technical grade glyphosate is nonvolatile and the LC50 for rats is ≥ 4.43 mg/L based on a 4-hr, nose-only inhalation study (Miller, et al. 2010; USEPA 1993).

The isopropylamine and ammonium salts exhibit low toxicity to mammals via the oral and dermal routes. The oral LD50 for the isopropylamine salt in rats is ≥ 5,000 mg/kg. The oral LD50 for the ammonium salt form in rats is 4,613 mg/kg. The dermal LD50 for rabbits is ≥ 5,000 mg/kg for both salts (Miller, et al. 2010). The salt formulations of glyphosate also exhibit low toxicity via the inhalation route. The 4-hr LC50 for rats exposed to the isopropylamine form is >1.3 mg/L air. The LC50 for rats exposed to the ammonium salt form was >1.9 mg/L in a whole-body exposure (Miller et al. 2010).

A one-year feeding study resulted in no chronic effects in beagle dogs at daily doses of 500 mg/kg. There is no scientific evidence indicating that glyphosate is carcinogenic or mutagenic (USEPA 1993). Experimental evidence has shown that neither glyphosate nor its major breakdown product (aminiomethylphosphonic acid [AMPA]) bioaccumulates in any animal tissue (Williams et al. 2000). Glyphosate is poorly biotransformed in rats and is excreted mostly unchanged in the feces and urine (Williams et al. 2000).

As previously described, glyphosate is practically nontoxic to birds, freshwater fish, and honeybees. Maximum bioconcentration factors were 0.52 times for whole fish (USEPA 1993). Technical grade glyphosate is slightly toxic to practically nontoxic to freshwater invertebratesLC50 values have also been obtained for several species of frogs and the American toad. The 24-hr LC50 for amphibians ranged from 6.6 to 18.1 mg/L. No significant acute toxicity to amphibians was observed with the technical material or the products (e.g., Roundup Original).

Special Issues Concerning Glyphosate/Roundup

Regardless of the decades of research indicating that glyphosate is relatively safe when used as designated by USEPA and other regulators, a recent, relevant issue has surfaced for glyphosate, the active ingredient in Roundup. Recent publications (Pahwa et al. 2019) suggest a possible linkage of extreme exposure to Roundup to onset of Non-Hodgkin's lymphoma. However, the preponderance of information and dozens of other studies refute that linkage (Williams et al. 2016; Andreotti et al. 2018). In response to this concern, registration of the glyphosate diammonium salt has been cancelled for two manufacturers (Nu Fam and Syngenta) by the USEPA, but others remain registered for use.

Of all the products proposed for use by UC Berkeley, the one likely to receive the most scrutiny and public concern is glyphosate (specifically as RoundUp) in its many commercial products. Several dozen reports have been reviewed for Roundup and glyphosate due in part to the public concern about the 2015 WHO designation as a Probable Carcinogen and the highly publicized court cases implicating Roundup exposure to the onset of Non-Hodgkins' Lymphoma (NHL). Because of the public concern about the use of Roundup by UC Berkeley, an extensive discussion is provided on the conditions and sequence of investigations on the potential hazards from exposure to Roundup.

Although the role of glyphosate and its hypothetical link to cancer has been the focus of numerous reports in the media and public forums, no clear, unambiguous connection exists between glyphosate exposure and cancer (De Roos 2003). Despite the apparent lack of toxicity to mammals, concerns have been raised by some groups about the possibility that glyphosate may have long-term cancer effects.

In response to the claims that RoundUp and specifically glyphosate "may be responsible for a substantial role in the onset of cancer," the USEPA announced in 2017 that it will not approve labels on products containing glyphosate that link the chemical to cancer. The move was directed at California. In 2017, the state declared the chemical, which is the main active ingredient in the weed killer Roundup, a carcinogen. Roundup producer Monsanto challenged the ruling in federal court, and a judge has temporarily blocked the state from requiring the labels as the lawsuit continues. The revised guidance from USEPA to companies registered to sell products containing glyphosate stipulates that California's labels would "constitute a false and misleading statement" and that the agency will no longer approve labels that contain the state's warning. "We will not allow California's flawed program to dictate federal policy," USEPA Administrator Andrew Wheeler said in a statement supporting the revised regulatory rule. USEPA said the move was based on its numerous internal and contracted studies that show that glyphosate does not pose a public risk when used as directed.

Regardless of the USEPA stance on the lack of correlation between approved uses and NHL cancer, there have been claims of causal connection of glyphosate exposure and this form of cancer. One such claim is the basis of a lawsuit (DeWayne Johnson v. Monsanto Company 2016) against Monsanto, the primary producer of glyphosate. During the trial, the plaintiff indicated that due to an accident during mixing, he was "drenched" with concentrated Roundup. The lawsuit contends that an individual contracted this form of cancer after his continued exposure to glyphosate products, as the person responsible for weed control in his workplace. During the trial, he indicated that he was inadvertently drenched with Roundup/Ranger Pro after an equipment malfunction and was exposed to windblown sprays, a possible misuse of the product based on label guidance. It can be argued that the information in the reports cited and exposures were not sufficient to establish that the individual's cancer was caused by glyphosate. The correlations presented by the prosecutors do not clearly provide causality.

A universal premise in science is "*correlation is not causation*." "Weak correlations between the sporadic exposure to glyphosate and onset of NHL are insufficient to assign a finding of reasonable certainty of the source of the cancer.” (National Association of Wheat Growers et al. v. Lauren Zeise (Director, California Office of Environmental Health Hazard Assessment [OEHHA] and Xavier Becerra [California State Attorney General]).

The juries in the RoundUp cases have awarded several million dollars to the plaintiffs based on little actual demographically supported exposures to the product but are based primarily on studies reported to support the claims of diseases linked to glyphosate exposure. Results that challenge the claims of a disease linkage to glyphosate exposure (Williams et al. 2016) suggest that the claims are not supported by the actual exposure and carcinogenicity data. Of the numerous studies that counter the claim of linkages to diseases, especially cancer, one example using a large multi-state and region evaluation of farm individuals and others, is provided by Koutros et al., 2019 and Mannetje et al 2016. Glyphosate was not statistically significantly associated with cancer at any site, and in this large, prospective cohort study, no association was apparent between glyphosate and any solid tumors or lymphoid malignancies overall, including NHL and its subtypes” (Andreotti et al. 2018).

The overall weight of evidence from the genetic toxicology data supports a conclusion that glyphosate “does not pose a genotoxic hazard and, therefore, should not be considered support for the classification of glyphosate as a genotoxic carcinogen” (Williams et al. 2016). The assessment of the epidemiological data found that the data do not support a causal relationship between glyphosate exposure and NHL. In fact, The American Cancer Society statistics list NHL as approximately 4 percent of all cancers and lists the following risk factors as contributing to development of this cancer: age, gender, ethnicity, geography, family history, as well as possible exposure to certain chemicals and drugs.

In response to the WHO declaration that glyphosate is a “probable carcinogen,” numerous scientists have called the designation into question (WHO 2015). It has been shown that the WHO panel ignored negative results available to them. One critical report on the WHO designation is provided by an independent study by four expert panels that did a comparison of the results presented by the WHO panel but included other reports with conflicting conclusions (Williams et al. 2016). The reports and data reviewed by WHO were supplemented by reports and data provided to WHO but not used in their report (reasons for rejection of those data by WHO were not supported by typical scientific discipline):

> “*We decided to remove it because … you couldn’t put it all in one paper*.” Aaron Blair, former epidemiologist at the US National Cancer Institute, explaining why new data on glyphosate and cancer were not reviewed or published by the WHO panel (from Williams et al 2016).

Substantial evidence, contrary to the IARC proclamation of carcinogenicity, supports the conclusion that impacts to human health from the use of glyphosate are not significant nor supported by all the data available to the IARC (Koutros et. al. 2019). Conflicting information, suggesting that glyphosate is not carcinogenic, has been reported by the three other WHO agencies, including the WHO International Programme on Chemical Safety, WHO Guidelines for Drinking Water Quality and the WHO Core Assessment Group. Further, a 2018 report by Tarone, who is an accredited statistician, was critical of the IARC findings of glyphosate being a probable carcinogen and indicated that a re-examination of the animal studies cited by IARC resulted in a contrary finding. (Tarone 2018) The author concluded that the data used was scientifically deficient and could not corroborate the finding by the WHO panel on glyphosate. Tarone, and others, including the European Chemicals Agency, reported that the IARC panel highlighted certain positive results from rodent studies, which they relied upon in the deliberations, but ignored contradictory negative results from the same studies, and an inappropriate statistical test was used. The author concluded that when all of the relevant data from the rodent carcinogenicity studies of glyphosate are evaluated together, it is clear that there is not sufficient evidence supporting the notions of glyphosate as an animal carcinogen. Even a conclusion that there are low levels of animal carcinogenicity would be difficult to support (Tarone 2018). The process of evaluation and registration of herbicides and pesticides used by all applicators, including UC Berkeley, is overseen by the USEPA, which released a draft risk assessment in December 2017 concluding that "glyphosate is not likely to be carcinogenic to humans" (USEPA 2017b).

Trial court cases, especially one decided by a jury, are not the same as scientific consensus. Jurists are not scientists and are dependent upon the information and material provided by the attorneys in court. The USEPA's current draft risk assessment for glyphosate states "The draft human health risk assessment concludes that glyphosate is not likely to be carcinogenic to humans. The Agency's assessment found no other meaningful risks to human health when the product is used according to the pesticide label. The Agency's scientific findings are consistent with the conclusions of science reviews by a number of other countries as well as the 2017 National Institute of Health Agricultural Health Survey" (USEPA 2017a).

Regardless of the disagreement among authoritative bodies on the risks and hazard rankings associated with glyphosate (refer to Table 5), because the IARC has designated glyphosate as a "probable carcinogen," it is considered a Tier 1 pesticide by the UC Task Force (see discussion under "Special Issues Concerning Garlon" above for more information). Therefore, prior to using any glyphosate-based products, UC Berkeley must establish a IPMC and the IPMC must review and approve the proposed uses of glyphosate, following an IPM based assessment. In addition, regulations for any approved uses of glyphosate-based herbicides on the UC Berkeley campus would be more stringent than what is currently required by state law (UCOP 2019, 2020).

Table 5. Differences of Cancer Classifications of Glyphosate

Agency	Carcinogenicity Classification	Classification Definition	Reference
HHS	No Data	The HHS provides no cancer classification for glyphosate	NTP 2016
USEPA	Group D	Group D (not carcinogenic)	IRIS1989
IARC	Group 2A	Group 2A (probable carcinogen}	IARC 2015, 2017

Source: WHO 2009. Criteria used to classify chemicals for carcinogenicity are often not the same across regulatory groups and result in differences in their classifications. The IARC has used outlier animal studies to suggest that glyphosate is "probably" carcinogenic so elevates the designation to 2A on the scale. Differences are due to specific criteria in each of the reporting agencies (Portier et al. 2016).

Typical Application Scenarios For Glyphosate/Roundup

For terrestrial applications of glyphosate, the main application method is directed foliar (backpack); associated risk estimates are shown in Table 6. Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates. Because of the sensitivity of each parameter used to estimate exposure, the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the estimates.

Table 6. Estimates of Potential Risk Synthesized from USEPA data and SERA 2011

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution.

Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters.

Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.0003, 0.003, 0.01	SERA 2011

Source: SERA 2011.
(calculations based on typical applicator exposure in an 8hr day).

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of PPE. Because Roundup would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to glyphosate in excess of USEPA-defined safe levels.

Despite the apparent lack of toxicity to mammals, concerns have been raised by some groups about the possible long-term safety of glyphosate. In an animal study, rats and mice were fed a diet containing glyphosate for 13 weeks. The two highest dose groups of male rats (25,000 and 50,000 mg/kg of 99 percent pure glyphosate) had significant reductions in sperm concentrations (Mahler 1992). Female rats in the 50,000 mg/kg group had slightly longer estrus cycles than the control group (Mahler 1992). Glyphosate is included in the final list of chemicals for screening under the USEPA Endocrine Disruptor Screening Program (USEPA 2009a, 2014), which focuses on pesticide active ingredients and inert ingredients with relatively greater potential for human exposure. In all of these studies above, the dose of chemical given to the test animals was far above any reasonably typical exposure in the field and not appropriate as a comparison to use under the WVFMP.

Snapshot 2.5 TG WARNING

Isoxaben (*Isoxaben and Trifluralin*)

Several retail herbicide products contain the active ingredient isoxaben.

Turf grasses, broadleaf weeds, grasses, vines, and around ornamental shrubs and trees.
Cut-stump, basal bark, foliar spray
Snapshot 2.5 TG/Gallery 75 DF/TO 2.5 G/Gemini Fortress
CAS No 82558-50-7
Isoxaben (N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl] -2,6-dimethoxybenzamide and isomers)
White, odorless, occurs as a suspension
Isoxaben has very low vapor pressure (1x10-9) and the flash point is not an issue
Very low toxicity to humans, non-irritating to eyes or skin. Slight increase in liver tumors possible birth defects in rabbits, no evidence of mutagenicity, or reproductive toxicity.
Very acutely toxic to fish, aquatic invertebrates

Mode of Action

Isoxaben disrupts the enzymes needed for protein synthesis, preventing growth of unwanted weeds. Isoxaben is a selective preemergent herbicide used primarily to control several broadleaf weeds and grasses in non-cropland areas. It has pre-emergent efficacy so that it will not control established weeds and must be applied before the unwanted weeds have emerged, during germination. Isoxaben is USEPA registered for use on turf grasses, broadleaf weeds, grasses, vines, and around ornamental shrubs and trees (USEPA 1988).

Environmental Fate and Transport

Bioconcentration potential is low (BCF < 100 or Log Pow < 3). Isoxaben biodegrades very slowly in the environment, dependent on the conditions in soil and/or water (Federal Register 2018). Biodegradability: very slow (in the environment). Biodegradation rate may increase in soil and/or water with acclimation.

Human Toxicity

Human toxicity estimates are extrapolated from animal studies. Isoxaben is a classified Category III chemical for low toxicity. Products containing isoxaben carry the signal word CAUTION which is associated with low but possible hazard. Isoxaben is classified as a non-carcinogen and very low toxicity if swallowed (IRIS 1998). Harmful effects have not been found from swallowing very small amounts. Acute dermal toxicity has been noted; however, prolonged skin contact is unlikely to result in absorption of harmful amounts. The rat LD50 is > 5,000 mg/kg. No adverse acute effects are anticipated from inhalation nor respiratory irritation (USFS 2000). The rat inhalation LC50 is > 5.71 mg/l. Brief contact is essentially nonirritating to skin and eyes. No evidence of mutagenicity, teratogenicity, or reproductive toxicology. In a standard-based calculation of risk, no adverse effect resulting from a single oral exposure was identified and no acute dietary endpoint was selected. Therefore, isoxaben is not expected to pose an acute risk.

Ecological Toxicity

Very highly acutely toxic to aquatic organisms (LC50/EC50 <0.1 mg/L in the most sensitive species). LC50, Oncorhynchus mykiss (rainbow trout), flow-through test, 96 Hour, > 200 mg/l. Acute toxicity to aquatic invertebrates EC50, *Daphnia magna* (Water flea), static test, 48 Hour, 544 mg/l, acute toxicity to algae/aquatic plants (green algae),chronic aquatic toxicity chronic toxicity to fish, chronic toxicity to aquatic invertebrates. Isoxaben is moderately toxic to *Daphnia magna* (Water flea), semi-static test, 0.69 mg/l; Contact LD50, *Apis mellifera* (bees), 100micrograms/bee; LC50, *Eisenia fetida* (earthworms), 14 d, mortality, > 1,000 mg/kg.

Typical Application Scenarios For Isoxaben/Snapshot

For terrestrial applications of isoxaben, the main application method is directed foliar (backpack); associated risk estimates are shown in Table 7. Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates. Because of the sensitivity of each parameter used to estimate exposure the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the estimates.

Table 7. Estimates of Potential Risk synthesized from USEPA data and SERA 2000

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution.

Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters

Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.003, 0.0003, 0.01	SERA 2000

Source: SERA 2000.
(calculations based on typical applicator exposure in an 8hr day).

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of PPE. Because Snapshot would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to Snapshot in excess of USEPA-defined safe levels.

Based on reasonable conservative estimates of the exposures associated with directed foliar applications, the estimated risk (using the hazard quotient) is well below the level of concern. The lack of an acute RfD or some other similar measure of 'acceptable' short-tern exposure makes it difficult to characterize risk. Accidental exposures for individuals also result in risks below the level of concern. Again, the lack of an acute RfD limits the characterization of risk. Under the conditions of use proposed by the WVFMP, there is no apparent risk in terms of systemic toxicity or reproductive effects for applicators and members of the general public.

Isoxaben is currently registered for uses that could result in short-term residential exposure and the USEPA has determined that it is appropriate to aggregate chronic exposure through food and water with short-term residential exposures to isoxaben. Using the standard USEPA exposure assumptions in risk estimates for short-term exposures, USEPA has concluded the combined short-term food, water, and residential exposures result in an aggregate Margin of Exposure (MOE) of 6,700, for females 13-49 years old. Because EPA's level of concern for isoxaben is a MOE of 100 or below, this MOE is not of concern. (Fed Reg CFR part 180, 2018).

Snapshot 2.5 TG WARNING

Trifluralin (*Isoxaben and Trifluralin*)

Several retail herbicide products contain the active ingredient trifluralin

Turf grasses, broadleaf weeds, grasses, vines, and around ornamental shrubs and trees.
Cut-stump, basal bark, foliar spray by hand
Snapshot 2.5 TG/Treflan/Flurene SE/Trust/Triflualina 600/Elancolan Trefanocide/Crisalin/ TR-10/Triflurex/Ipersan
Benzenamine, 2,6-Dinitro-N,N-dipropyl-4-(trifluoromethyl) aniline
CAS No 1582-09-8
Trifluralin is a yellow-orange crystalline solid not soluble in water. Melting point 48.5-49°C. Used as a selective pre-emergence herbicide. Stable
Trifluralin flammability rating is 1 in the index where 5 is high and 1 is low. The flashpoint is well above 185F.
Very low toxicity to humans, non-irritating to eyes or skin. Slight increase in liver tumors possible birth defects in rabbits, no evidence of mutagenicity, or reproductive toxicity
Very acutely toxic to fish, aquatic invertebrates

Mode of Action

Trifluralin's main mechanism of action is the inhibition of cell mitosis. This herbicide typically acts on the meristems and tissues of underground organs, such as roots, epicotyls, hypocotyls, plumules, rhizomes, bulbs and seeds

Environmental Fate and Transport

Trifluralin is strongly absorbed on soils (Koc = 7,000 g/ml) and nearly insoluble in water. Therefore, leaching and groundwater contamination by trifluralin is not expected to occur. Because adsorption is highest in soils high in organic matter or clay content and once adsorbed, the herbicide is inactive, higher application rates may be required for effective weed control on such soils (USDA 1990).

Trifluralin is subject to degradation by soil microorganisms. Trifluralin remaining on the soil surface after application may be decomposed by UV light or may volatilize. Recommended application rates give season long weed control but fall-seeded grain crops planted in soil treated with trifluralin during the preceding spring were not injured under warm, moist conditions. The half-life of trifluralin in the soil is 45 to 60 days. After six months to one year, 80- 90 percent of its activity will be gone (SERA 2011). Trifluralin is stable under normal temperatures and pressures, but it may pose a slight fire hazard if exposed to high heat or flame. Its flammability rating is 1 (slight) and will not burn spontaneously as its flashpoint is above 185F (NCBI 2017; MSDS, Safety Data Sheet, 2014).

Human Toxicology

Human toxicity estimates are extrapolated from animal studies. Trifluralin is not acutely toxic to test animals by oral, dermal or inhalation routes of exposure. Pesticide products containing trifluralin may be moderately toxic to relatively non-toxic, depending on the type of formulation. Nausea and severe gastrointestinal discomfort may occur after ingesting trifluralin (USEPA 1989). It may also induce skin allergies and, when inhaled, it may irritate the throat and the lungs.

Most cases of poisoning result from the carrier or solvent in formulated trifluralin products, rather than from the trifluralin itself (NRC Drinking Water and Health 1977). No evidence of mutagenicity was observed when trifluralin was tested in live animals, and in assays using bacterial and mammalian cell cultures.

USEPA considers trifluralin to be a possible human carcinogen (USEPA 1988, 1989). This classification is used when there is limited or uncertain information indicating that a chemical may cause cancer in animals receiving high doses of the chemical.

Ecological Toxicology

The oral LD50 for technical trifluralin in rats is greater than 10,000 mg/kg, in mice is greater than 5,000 mg/kg, and in dogs, rabbits and chickens is greater than 2,000 mg/kg. However, some formulated products which contain trifluralin may be more toxic than the technical material itself. For example, the oral LD50 for Treflan TR-10 in rats is >500 mg/kg. The dermal LD50 for technical trifluralin in rabbits is >2,000 mg/kg. The administration of 25 mg/kg to dogs for 2 years resulted in no toxicological effects. Studies in the rat and rabbit show no evidence that trifluralin is teratogenic. Meister conducted tests with animals and verified that trifluralin does not have any toxic effect on them when they are exposed to the product either through ingestion, inhalation, or when in contact with the skin. Nausea and severe gastrointestinal discomfort may occur after trifluralin ingestion. When placed in the rabbit eyes, it produced a mild irritation, which was reverted within 7 days.

Trifluralin is not hazardous to birds. The LD50 for bobwhite quail was greater than 2000 mg/kg. The 5-day LC50 in both quail and ducks was greater than 5,000 mg/kg. Trifluralin is toxic to fish and other aquatic organisms. However, its strong adsorption to soil and the usual practice of incorporating trifluralin into the soil at the time of application may prevent exposure of fish to this herbicide. Runoff from fields should be avoided. Trifluralin is toxic to Daphnia, a small freshwater crustacean (USEPA 1987, Fed Reg 1982).

At exposure levels well above label and permissible application rates (100 ppm), trifluralin has been shown to be toxic to earthworms. However, permitted application rates will result in soil residues of approximately 1 ppm trifluralin, a level that had no adverse effects on earthworms (WSSA 1989). In general, trifluralin is not very toxic to higher animals (except fish). It is non-toxic to bees. Trifluralin adsorbed to sediment may pose a risk for fish species that forage by feeding from sediment, particularly since it has a moderate tendency to bioaccumulate.

Typical Application Scenarios For Trifluralin/Snapshot

For terrestrial applications of trifluralin, the main type of application is directed foliar (backpack); associated risk estimates are shown in Table 8. Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates and are illustrated in the table below. Because of the sensitivity of each parameter used to estimate exposure, the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the risk estimates.

Table 8. Estimates of Potential Risk synthesized from USEPA data and SERA 2007

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution. Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters.

Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.003, 0.003, 0.03	SERA 2007a

Source: SERA 2007.
(calculations based on typical applicator exposure in an 8hr day).

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of PPE. Because Snapshot would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to Snapshot in excess of USEPA-defined safe levels. Non-accidental exposures which may occur during normal applications of trifluralin—the upper bound of HQs for systemic toxicity is 0.03, below the level of concern by a factor of over 30. For carcinogenicity, the HQ is 0.3, below the level of concern by a factor of about 3. An HQ of 1 for carcinogenicity would be associated with a risk of 1 in one million. Thus, an HQ of 3 would be associated with a risk of about 3 in 10 million. At the maximum likely application rate of 2 lbs a.i./acre, the risk would be about 0.6 in one million.

Stalker CAUTION

Imazapyr

Several retail herbicide products contain the active ingredient imazapyr

Nonselective pre-and post-emergent broad-spectrum weed control
Foliar spray by hand. Problem vegetation near roads, trails, parking lots, utilities
Stalker (BASF) Arsenal®, Habitat®, Chopper®, Polaris /Raptor/Eraser/Alligare
CAS No: 81510-83-0
2-[4,5- dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol- 2-yl]-3-pyridinecarboxylic acid
Imazapyr is stable, clear, slightly viscous, pale yellow to dark green aqueous liquid
Vapor Pressure is very low (0.0000002) and flash point is not relevant.
Imazapyr is of relatively low toxicity to mammals and shows no mutagenic or teratogenic potential. It can be an eye and skin irritant, but is not a dermal sensitizer
Practically nontoxic to fish, aquatic invertebrates, birds, terrestrial vertebrates

Mode of Action

Imazapyr is a non-selective herbicide used for the control of a broad range of weeds including terrestrial annual and perennial grasses and broadleaved herbs, woody species, and riparian and emergent aquatic species. Imazapyr is a pre-emergent and post-emergent bare ground herbicide for control of unwanted vegetation in non-cropland areas and aquatic sites. It will sterilize the soil where it is applied, and nothing will grow for up to 1 year. Imazapyr can also be used in pastures, rangelands and other listed areas. It controls plant growth by preventing the synthesis of branched-chain amino acids. Imazapyr is absorbed quickly through plant tissue and can be taken up by roots. It is translocated in the xylem and phloem to the tissues, where it inhibits the enzyme acetohydroxy acid synthase (AHAS), also known as acetolactate synthase (ALS). ALS catalyzes the production of three branched-chain aliphatic amino acids, valine, leucine, and isoleucine, required for protein synthesis and cell growth. Environmental pH determines its chemical structure, which in turn determines its environmental persistence and mobility. Below pH 5 the adsorption capacity of imazapyr increases and limits its movement in soil. Above pH 5, greater concentrations of imazapyr become negatively charged, fail to bind tightly with soils, and remain available (for plant uptake and/or microbial breakdown). In soils, imazapyr is degraded primarily by microbial metabolism. It is not, however, degraded significantly by photolysis or other chemical reactions (Dickens 1986)

Environmental Fate and Transport

Imazapyr is slowly degraded by microbial metabolism and can be relatively persistent in soils. It has an average half-life in soils that range from one to five months. At pH above 5, it does not bind strongly with soil particles and can remain available (for plant uptake) in the environment. In water, imazapyr can be rapidly degraded by photolysis with a half-life averaging two days (USEPA 2005). There have been a few reports from the field of unintended damage to desirable, native plants when imazapyr has either exuded out of the roots of treated plants into the surrounding soil, or when intertwined roots transfer the herbicide to non-target plants (Vizantinopoulos and Lolos 1994). In a laboratory study, the half-life of imazapyr ranged from 69-155 days, but factors affecting degradation rates were difficult to identify because the pH varied with temperature and organic content.

Human Toxicology

Human toxicity estimates are extrapolated from animal studies. Imazapyr is of relatively low toxicity to mammals and shows no mutagenic or teratogenic potential. It can be an eye and skin irritant but is not a dermal sensitizer (American Cyanamid 1986; Cyanamid Ltd. 1997). Imazapyr acid is categorized as practically non-toxic to small mammals. No mortality or clinical signs of toxicity were observed in acute oral studies. The acute risk to mammals following either broadcast granular application or spray application is expected to be low because the highest dose-based EECs are 0.03 (broadcast spray) to 0.1 (granular application) of the highest concentration tested in the acute study which produced no mortalities and no clinical signs of toxicity.

Chronic studies indicated no evidence of adverse reproductive effects. The chronic LOC for mammals was not exceeded for any of the studies registered with USEPA. The chronic risk for mammals is low following exposure to imazapyr. There is no evidence that imazapyr is carcinogenic or mutagenic. The USEPA has determined that the risk to humans of dietary and incidental exposure is below the level of concern (USEPA 2006).

Ecological Toxicology

There are no reported chronic risks of imazapyr to fish and invertebrates. Fish and invertebrates inhabiting surface waters adjacent to an imazapyr treated field would not be at risk for adverse acute and/or chronic effects on reproduction, growth, or survival when exposed to imazapyr directly or in residues in surface runoff and spray drift as a result of spray application. Risk to benthic organisms is also not likely based on the available toxicity data and because imazapyr is not expected to accumulate in benthic systems. Very Low toxicity to rats (Oral LD50 for rats >5,000 mg/kg), moderate toxicity for rabbits, dermal LD50 >2,000 mg/kg) and low toxicity to fish, LC50 for bluegill sunfish:>100 mg/LC.

Imazapyr is of relatively low toxicity to birds and mammals. The LD50 for rats is > 5,000 mg/kg, and for bobwhite quail and mallard ducks is >2,150 mg/kg. American Cyanamid reports that studies with rats indicate that imazapyr was excreted rapidly in the urine and feces with no residues accumulating in the liver, kidney, muscle, fat, or blood (Tu et al. 2004). Uncertainties remain about the potential toxic effects in animals due to the lack of toxicity data on reptiles and amphibians.

Imazapyr has not been found to cause mutations or birth defects in animals and is classified by the USEPA as a Group E compound, indicating that imazapyr shows no evidence of carcinogenicity. The LC50s for rainbow trout, bluegill sunfish, channel catfish, and the water flea (*Daphnia magna*) are all >100 mg/L. Imazapyr (tradename Habitat®) is registered for use in aquatic areas, including brackish and coastal waters, to control emerged, floating, and riparian/wetland species. A recent study from a tidal estuary in Washington showed that imazapyr, even when supplied at concentrations up to 1600 mg/L, did not affect the osmoregulatory capacity of Chinook salmon smolts. Washington State Department of Agriculture (2003) reported that the 96-hour LC50 for rainbow trout fry to be 77,716 mg/L (ppm). Limited information was found on the effects of imazapyr on other non-target organisms such as soil bacteria and fungi. The manufacturers report that Arsenal® is non-mutagenic to bacteria (American Cyanamid 1986).

Typical Application Scenarios For Imazapyr/Stalker

For terrestrial applications of imazapyr, the main application method is modeled: directed foliar (backpack); associated risk estimates are shown in Table 9. Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates. Because of the sensitivity of each parameter used to estimate exposure, the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the estimates.

Table 9. Estimates of Potential Risk synthesized from USEPA data and SERA 2011

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution.

Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters.

Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.003, 0.03, 0.01	SERA 2011

Source: SERA 2011.

(calculations based on typical applicator exposure in an 8hr day).

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of PPE. Because Stalker would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to Stalker in excess of USEPA-defined safe levels. There are numerous formulations of imazapyr but most of the toxicity data available is for Arsenal (BASF). The risk estimates are thus based on uses and application techniques of Arsenal.

The risk assessments used to evaluate imazapyr are based on the typical unit application rate of 1 lb a.i./acre, and up to the maximum labeled rate of 1.5 lbs a.i./acre. While imazapyr is an effective terrestrial herbicide, the exposure scenarios used to characterize used for terrestrial and aquatic plants result in a wide range of HQs. The variations are typical of all chemical applications and are impacted by different weather patterns and other site-specific variables.

Using typical exposure and risk estimates associated with typical applications of imazapyr, there is no indication that the applications will pose any substantial risk to humans or other species of animals. The USEPA/OPP classifies imazapyr as practically non-toxic to mammals, birds, honeybees, fish, and aquatic invertebrates. None of the expected (non-accidental) exposures to these groups of animals raise substantial concern.

Surflan AS CAUTION

Oryzalin (>38 Products)

Preemergence control of both grasses and broadleaved weeds
Cut-stump, basal bark, foliar spray by hand
Dirimal/EL-119/Rycelan/Ryzelon/Surflan
CAS No 19044-88-3
Bright orange, opaque liquid with slight aromatic odor. Biodegrades slowly.
3,5-dinitro-N4, N4-dipropylsulfanilamide
Low vapor pressure. Flash point >200F
practically nontoxic to birds, small mammals and honeybees
moderately toxic to freshwater fish, invertebrates

Mode of Action

Oryzalin acts by inhibiting cell division in plants. It is used to control annual grasses, broadleaf weeds, woody shrubs and vines in grapes, berries and orchard crops, including both fruits and nuts. It also is used on residential and commercial/industrial lawns and turf, golf course turf, ornamentals and shade trees, Christmas tree plantations, fencerows/hedgerows, nonagricultural rights-of-way, and uncultivated areas including patios, paths, paved areas and power stations.

Environmental Fate and Transport

Oryzalin biodegrades slowly with a half-life of approximately two months. It is not mobile under most field conditions and is not volatile. Up to 20 percent of the breakdown products of oryzalin have the potential to leach into the soil but the level of leaching varies according to the physiochemical environment (Elanco 1989).

Human Toxicology

Human toxicity estimates are extrapolated from animal studies. Oryzalin generally is of moderate acute toxicity but is carcinogenic in animal studies and has been classified as a Group C, possible human carcinogen. Several food-crop uses, including grapes and a variety of fruits and nuts, are registered and allowable and dietary exposure to oryzalin residues in foods is extremely low, as is the cancer risk posed by this herbicide to the general population (SERA 2014).

In acute toxicity studies using laboratory animals, oryzalin is practically non-toxic by the oral route and has been placed in Toxicity Category IV (the lowest of four categories) for this effect. It is of moderate dermal and inhalation toxicity and causes slight eye irritation and has been placed in Toxicity Category III for these effects. No skin sensitization occurred in tests on guinea pigs. In subchronic toxicity studies, oryzalin caused the accumulation of an iron-containing pigment in the kidneys of rats, an increase in the weights of several organs in mice, and blood, bone marrow and liver effects in beagle dogs (OHS 1992).

Oryzalin is carcinogenic in rats, based on an increase in mammary gland tumors in females and skin and thyroid tumors in both sexes. It has been classified as a Group C carcinogen--that is, a possible human carcinogen for which there is limited animal evidence. Another chronic toxicity study using beagle dogs showed effects to the blood, liver, kidneys and thyroid gland. In developmental toxicity studies using rats, oryzalin caused reduced maternal body weight as well as decreased fetal body weights, an increase in runts and bone development effects. In rabbits, it caused reduced maternal food consumption and weight gain, fetal effects and reduced litter size. Reproduction studies using rats showed increased liver and kidney weights, and decreased food consumption and body weight gain. Oryzalin was not mutagenic in several studies.

Ecological Toxicology

Oryzalin is moderately toxic to freshwater fish and invertebrates, and practically nontoxic to birds, small mammals and honeybees. Minor risks to birds are posed from acute and dietary exposure to oryzalin. Chronic risks are not posed at single application rates of 4 pounds active ingredient per acre (4 lb ai/A) or less. Oryzalin does not appear to pose a risk to nonendangered freshwater fish (USEPA 1994). However, a Daphnia life-cycle study is needed to determine the chronic risk to freshwater invertebrates. Oryzalin appears to pose a risk to endangered aquatic species in shallow water adjacent to treated areas. Oryzalin is moderately toxic to freshwater fish and invertebrates, and practically nontoxic to birds, small mammals and honeybees (Meister 1992)

Typical Application Scenarios For Oryzalin/Surflan

For terrestrial applications of oryzalin, the main type of application method would be foliar spray (backpack); associated risk estimates are shown in Table 10. Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates. Because of the sensitivity of each parameter used to estimate exposure, the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the estimates (SERA 2014, 2015).

Table 10. Estimates of Potential Risk Synthesized from USEPA data and SERA 2014

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution.

Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters.

Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.001, 0.0026, 0.062	SERA 2015

Source: SERA 2014.

(calculations based on typical applicator exposure in an 8hr day).

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of PPE. Because Surflan would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to Surflan in excess of USEPA-defined safe levels.

USEPA has developed risk parameters for oryzalin. The acute RfD for oryzalin is 0.05 mg/kg bw/day and the chronic RfD for oryzalin is 0.14 mg/kg bw/day (USEPA 1994). The RfDs are developed using an uncertainty factor of 100. The HQs for workers based on carcinogenicity are 0.001 (0.00002 to 0.06). These estimates of risk are associated with a single day's 8 hr. exposure, which represents a typical application event. Thus, based on this estimated exposure, an individual would need to apply oryzalin for 1,000 days to reach a cancer risk of 1-in-1-million.

USEPA (1994) estimates an exposure of 0.01 mg/kg 17 bw/day for individuals applying oryzalin by ground broadcast application (no broadcast spraying would occur under the WVFMP). Based on the cancer potency factor of 0.13 (mg/kg bw/day)-1, the risk [Dose x Potency] to individuals would be about

[0.13 (mg/kg bw/day)-19 x 0.01 mg/kg bw/day = 0.0013 or about 1 in 769]. The highest risk listed in the USEPA documents is 2.6x10-4 (USEPA 1994).

Transline CAUTION

Clopyralid (>16 Products)

Several retail herbicide products contain the active ingredient clopyralid

Used for thistles, knapweeds, locust, kudzu
Cut-stump, basal bark, foliar spray by hand
Transline/stinger/reclaim/Lontrel/clopyralid MEA
CAS No. 57754-85-5
Clopyralid 3,6-dichloroo-2-prridinecarboxylic acid.
Liquid red to brown with sweet odor
Nonvolatile and highly water soluble. Can be flammable as vapor
Very low toxicity to rats, no evidence of mutagenicity, carcinogenicity or reproductive toxicology
Low toxicity to fish, birds and aquatic invertebrates

Mode of Action

Clopyralid is a selective herbicide used for broadleaf noxious weed control, and it is the active ingredient in Transline. It is structurally similar to aminopyralid, which has an extra amino group, and it is also an auxin hormone mimic, causing abnormal growth that impairs proper nutrient transport throughout the plant. It is highly selective for terrestrial plants and appears to be relatively non-toxic to aquatic plants (SERA 2004).

Environmental Fate and Transport

Clopyralid is relatively nonvolatile and highly water soluble. It is stable to both hydrolysis and photolysis in aqueous systems but is degraded rapidly (Cox 1998). It is degraded in soil primarily through microbial activity (t ½ = 40 days), and carbon dioxide is the major breakdown product (USDOE 2000). It is very stable under anaerobic conditions. It is mobile and does not bind tightly to soil. Clopyralid is very stable in compost piles, and thus is no longer used for lawn and garden applications in California and Washington.

Human Toxicology

Human toxicity estimates are extrapolated from animal studies. Clopyralid is listed as a Category III compound for oral, dermal, and inhalation toxicity. The oral and dermal mammalian LD50s are both >5,000 mg/kg, and the mammalian inhalation LC50 is >1.3 mg/L. It is not metabolized extensively; 79-96% of parent clopyralid is excreted in rat urine (t ½ = 3 hr.) (SERA 2004). The No Observable Effect Level (NOEL), which is the highest dose that results in no effect, in dogs is 100 mg/kg/day. Clinical signs of acute clopyralid poisoning include neurotoxicity, manifested as ataxia, tremors, convulsions, and weakness. Chronic studies in rats, mice, and dogs have noted general decreases in body weight and increases in liver and kidney weight, which are commonly observed in chronic toxicity studies and can indicate either an adaptive or toxic response. The USEPA OPP has established an acute RfD of 0.75 mg/kg/day and a chronic RfD of 0.15 mg/kg/day for clopyralid.

The USEPA classifies clopyralid as a Group E human carcinogen (no evidence of carcinogenicity) because chronic studies in rats, mice, and dogs have shown no indication of carcinogenicity. However, technical grade clopyralid contains low levels of hexachlorobenzene (<2.5 ppm), which is classified as a potential human carcinogen (SERA 2004).

Recent panel reviews by the European Food Safety Authority (EFSA 2012) considered the status of clopyralid in Europe to consider the renewal of the registration of clopyralid as an herbicide on winter cereals and grassland. The panel's review of the available risk assessment information did not substantially alter the mammalian and toxicity information. The acute and long-term risk to birds and mammals from oral exposure via residues in food items and contaminated drinking water was assessed as low. No risk assessment for secondary poisoning was triggered based on the low Log Pow (< 3). Numerous recent publications refining the information about clopoyralid were identified but none that would substantially alter the basic information or characterization of the potential effects of clopyralid use by UC Berkeley.

Ecological Toxicology

Clopyralid is practically non-toxic to slightly toxic to birds. The oral LD50 in mallard duck is >1,645 mg/kg. The dietary LC50 for both pure clopyralid and the monoethanolamine salt of clopyralid is >4,460 ppm in both bobwhite quail and mallard ducks. Clopyralid is also practically non-toxic to fish and aquatic invertebrates (USEPA 2002). The 96-h LC50 in bluegill is 125 mg/L, and the LC50 in rainbow trout is 103 mg/L for technical grade clopyralid. The monoethanolamine salts are even less toxic to fish, with LC50s ranging from 700-1,645 mg a.i./L. There is no indication that clopyralid bioaccumulates in fish. The LC50 in *Daphnia* is 225 mg/L. In a chronic *Daphnia* reproduction study, the NOEL was found to be 23.1 mg a.i./L (SERA 2004). Clopyralid is also practically non-toxic to honeybees; the contact LD50 is >100 µg/bee. Clopyralid residues are highly toxic to non-target broadleaf plants.

Typical Application Scenarios For Clopyralid/Transline

For terrestrial applications of clopyralid, the main type of application method is directed foliar (backpack); associated risk estimates are shown in Table 11. Several standard exposure rates (mg/kg bw per lb/acre) are used to calculate risk estimates. Because of the sensitivity of each parameter used to estimate exposure the risk estimates generally extend across a large range of values. The most appropriate estimate generally represents a mid-point in the estimates.

Table 11. Estimates of Potential Risk synthesized from USEPA data and SERA 2004

Calculated risk estimates include the lower, central, and upper statistical values of the data distribution.

Calculated values are compared to the standard level of concern at 1x10-4 using USEPA risk parameters.

Application Method	Lower, Central and Upper risk estimates of risk per lb handled (mg/kg bw)	Reference
Directed foliar	0.0003, 0.003, 0.01	SERA 2004

Source: SERA 2004. TR 04-43-17-03c Clopyralid Human Health and Ecological Risk Assessment Final Report.
(calculations based on typical applicator exposure in an 8hr day).

Even using the upper bound estimate of exposure, which is very conservative, risks to applicators would be adequately addressed by ensuring proper handling and proper use of PPE. Because Transline would be applied according to label direction during implementation of the WVFMP, members of the general public would not be exposed to Transline in excess of USEPA-defined safe levels.

The USEPA OPP has established an acute RfD of 0.75 mg/kg/day and a chronic RfD of 0.15 mg/kg/day for clopyralid. Regardless of the low likelihood of substantial exposure to applied triclopyr, several highly conservative scenarios can be used to illustrate the potential risks of adverse effects. For terrestrial applications of clopyralid, as with many herbicides, the greatest exposures are actually associated with the acute and longer-term consumption of contaminated fruit and vegetation. This is typical of any pesticide exposure following foliar application. Exposures associated with dermal contact and the consumption of water (except for an accidental spill) are considerably lower.

Summary and Conclusions of WVFMP Herbicide Evaluations

Each of the herbicides proposed for use under the WVFMP were evaluated for toxicity and/or potential adverse human health and environmental effects; the results are summarized in Table 12. The hazard information, exposure assumptions, and potential toxicity associated with the listed active ingredients have been addressed. This review suggests that minimal to no substantial adverse environmental impacts are expected from herbicide use proposed under the WVFMP. Use of these products within the label restrictions and following regulatory guidance is not expected to result in any significant adverse impacts to human health or the environment.

Overall, the proposed uses of herbicides under the WVFMP should provide adequate and reasonable safe margins because they will be used according to label guidance and more restrictive environmental protection guidance. The herbicides reviewed, and the uses proposed, are considered reasonable with minimal to no potential adverse impacts. However, reports in the media have raised public concerns that should be noted regarding glyphosate. Most of those reports are based on equivocal correlations, not supported by defensible relevant studies illustrating causality. Instead, the primary body of research suggests these herbicides are safe to use according to label directions and restrictions.

Other Issues Related to Herbicides

Risks Related to Flammability and Accelerants

The flash point is the lowest temperature at which a liquid will form a vapor that will briefly ignite when exposed to an open flame. The flash point of liquids is one of the most dangerous characteristics of a chemical. The flash point is a general indication of the flammability or combustibility of a liquid. Below the flash point, insufficient vapor is available to support combustion. At some temperature above the flash point, the liquid will produce enough vapor to support combustion (the fire point). The determination of volatility (vapor pressure at which the liquid becomes a gas such as evaporation) is the condition under which a liquid is at an equilibrium as a vapor above its liquid (in a closed container). Vapor pressure and flash point is determined for every registered herbicide and is included in the MSDS.

Some comparisons illustrate the relative flash points of liquids: automotive gasoline, -45F, ethyl alcohol 55F, automotive diesel fuel 100F. Herbicides often contain some of these heavy petroleum constituents but not sufficient to result in a dangerous flash point. Most herbicides have flash points well above 150F and thus are safe to use without concern about flash point or flammability (NCBI 2017). Because the herbicides proposed by the WVFMP have high flash points, flammability during handling is not an issue. The retention of herbicide residue that could impact the flammability of target vegetation varies across plant species and physical conditions. Examples of residue times of several herbicides reported the dissipation rates at < 40 days under mild climatic conditions (Michael and Neary 1993).

Table 12. Toxicity Summary of Herbicide Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)A	Mammalian Dermal LD50 (mg/kg)B	Mammalian Inhalation LC50 (mg/L)A	USEPA Toxicity Rating	Carcinogenic	Reproductive or Developmental toxicity	Neurotoxic	Immunotoxic	Endocrine Disruption
Triclopyr Garlon 4 Ultra	>5,000	>5,000	>5.79	Oral, dermal, inhalation (IV)	No	No	No	No	No
Glyphosate RoundUp RoundUp Pro	>4,320 (technical); ≥5,000 (salts)	≥2,000 (tech); ≥5,000 (salts)	≥4.43 (tech); >1.3 (salts)	Oral, dermal, inhalation (III)	No	No	No	No	In human cell lines at very high doses
Isoxaben Snapshot 2.5	>5,000	>5,000	>5.71	Oral, dermal, inhalation (IV)	No	No	No	No	NA
Trifluralin Snapshot 2.5	>5,000	>5,000	>5.71	Oral, dermal, inhalation (IV)	No	No	No	No	NA
Imazapyr Stalker	>5,000	>2,000	>1.3	Oral, dermal, inhalation (IV)	No	No	No	No	No
Oryzalin Surflan AS	>5,000	>2,000	na	Oral, dermal, inhalation (IV)	No	No	No	No	No
Clopyralid Transline	>5,000	>5,000	>3.0	Oral, dermal, inhalation (III)	No (may contain hexachlorobenzene)	No	No	No	No

Source: Adapted by Infinity Solutions 2020. Toxicity data are derived from respective sections in this document and summarized for the categories used by USEPA and other regulators. Some data represent the most likely values within the typical range of effects in the literature

With the extensive use of herbicides in vegetation management, public concern has increased about the fate of pesticides in fires. Studies conducted on herbicides indicate that hot fires (>500 C) thermally degrade most pesticides. Smoldering fires (<500 C) have the potential to volatilize few herbicides. However, as described above for each herbicide proposed for use, herbicides break down over time, do not persist in the environment, and most post no risk of flammability such that a substantial risk related to fire would be created.

In some instances, the method of vegetation control may include prescribed burning by qualified fire personnel. This method sometimes incorporates chemical accelerants to assure a focused and complete ignition of the targeted vegetation.

The USFS has provided many reports addressing the potential impacts and risks of their use of fire accelerants to ignite prescribed burns. Table 13, Chemicals List, presents the fire accelerants, their chemical components, and the residues expected to remain following combustion. Because accelerants are used only for special focused and monitored uses, the likelihood of unintended adverse impacts is low.

Table 13. Comparison of Calculated/Estimated Risk Associated with Accelerants

Accelerant Used	Estimated HQ Risk	Comment
Aluminum oxide	1.92 E-01	Launcher Pistol
Gasoline+MTBE	1.09 E-02	Added 9.51E-03 + 1.35E-03
Gasoline + Diesel Fuel	1.17 E-02	Mixtures critical
Gelled Gasoline +MTBE+aluminum oxide	1.96 E-02	Concern about residual coating
Gelling agent + Aluminum oxide	8.71E-03	Concern about residual coating

Source: USFS. 2002.

The USFS has compiled an evaluation of the potential impacts to humans and wildlife from use of these chemicals. The compilation of relative "risks" from the use of accelerants is based on calculated exposure/target toxicity values similar to the HQs used in human and wildlife toxicology. Although each of the accelerants listed have been evaluated to generate risk estimates, the estimates are based on extended exposures in the laboratory and therefore are conservative and do not represent the likely effects after a typical application.

The HQs that may result in adverse effects to applicators/handlers are depicted by values nearest to unity. An HQ of 1.0 suggests that the exposure may be of concern (HQ of 1.0 E-0). The calculated estimated risk values provide a comparison of the potential for adverse effects to the applicator. These values are an extension of the hazard values extrapolated to a typical handling scenario. Given that all of the values are below 1.0 there is no substantial risk associated with the proper use of these accelerants.

Issues Related to the Potential Interactions of Herbicides

Synergism and Antagonism

Mixing chemicals in some cases can be problematic and the resulting impacts can be characterized as synergistic, antagonistic and/or additive. *Synergism* means an effect or effects arising between two or more active ingredients, or an active ingredient and one or more inert ingredients, that is greater than the sum of their individual effects. *Antagonistic* means the effects are less than the effects of the original chemical. *Additive effects* become the sum of the individual effects of the two chemicals.

Most commercially available herbicides are already a combination of active ingredients and can be safely used if the label recommendations and guidance are followed. Every product available to the public has been evaluated by both federal and private organizations to arrive at the recommended use rates and handling precautions. Over the past several years concern has developed in the public sector that in some cases the combinations of ingredients may cause synergistic effects because most pesticide product labels do not meaningfully limit tank mixtures and timing of applications. For this reason, USEPA has included, where appropriate, consideration of potential synergistic effects of pesticide products during its registration and registration review process (Zhou et al. 2005). Many of the registration reviews now include protective label restrictions to eliminate potential adverse, synergistic impacts (USEPA 2019).

Numerous studies and pesticide evaluations have been supported by the manufacturers and the scientific community to provide clear guidance on the potential synergistic and/or antagonistic effects of application of multiple pesticides on a site (Ma et al. 1992). Simplistic recommendations include extended time allotted between herbicide applications, care in the specific types of vegetation that is treated (many herbicides are toxic to specific types of vegetation) and physical separation often is sufficient to avoid interactions.

Zhang et al. (1995) developed a computer modelled synthetic data set by incorporating results from previously published papers on antagonistic and synergistic herbicide interactions between two herbicides. The comparisons considered herbicides applied as a tank mixture or sequentially, and then analyzed on the basis of various properties of the herbicides and target plants. Generally, interactions between herbicides were antagonistic more frequently than synergistic. This trend held regardless of whether the interacting herbicides were absorbed by the same or different parts of the plant, had the same or different translocating abilities, had the same or different modes of action, and regardless of whether the target plants were annual or perennial plants, or crops or weeds. Antagonistic interactions occurred much more frequently when the target plants were monocot than dicot, and in the Composite, Gramineae, or Leguminosae than in the Chenopodiaceae or Convolvulaceae families (Zhang et al. 1995).

Because herbicide applications proposed under the WVFMP would follow all herbicide label requirements, which take into account potential synergistic effects, the risk of synergism such that adverse effects to human health or the environment would occur are low.

Issues Related to the Safety of Treated Vegetation to Grazing Animals

There is no clear way to determine the residual herbicide on target vegetation without actual timed measurements of the plant tissue. As an alternative to actual residue measurements, it is useful to consider the half-life of an herbicide in soil and the time it takes to break down into a non-toxic form. The half-life is the time it takes for 50% of the chemical to degrade or break down. Soil half-lives are only an indication of potential residual because half-life varies substantially with soil type and other conditions. For all soil types, half-lives are affected by pH, temperature, moisture content, sunlight and concentration of active ingredient. Higher temperatures, greater soil moisture, high bacterial activity and high levels of organic matter tend to accelerate degradation; dry and cold conditions tend to lengthen degradation. Dry or drought conditions are the main factor in causing herbicide residues to persist longer than normal.(USEPA 2017).

The majority of residentially sold herbicides are required by law to break down in the soil within 14 days, if not sooner. As an example, the non-selective herbicide glyphosate generally breaks down within days to weeks depending on the specific product (USEPA 2017). Most herbicides are relatively non-toxic to mammals so that a substantial amount of treated vegetation would need to be consumed to approach or exceed the documented toxicity of the herbicide.

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Appendix H

Noise Modeling Calculations

Chainsaw Reference Noise Levels

Equipment	Distance in feet	Predicted dB L_{eq}
Chainsaw	50	86.0

Equipment	Reference Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Concrete Saw	90	0.4

Ground Type	soft
Source Height	15
Receiver Height	5
Ground Factor[2]	0.57

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Concrete Saw	86.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
86.0

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Table 4-26 from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 86).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 176 and 177).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2018: pg 86); and

D = Distance from source to receiver.

Chainsaw-Generated Noise Attenuation

Threshold	Distance Attenuated to Threshold in feet	Combined Predicted Noise Level (L_{eq} dBA)
Berkeley	214	75.0
Oakland	135	80.0

Equipment	Reference Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Concrete Saw	90	0.4
Concrete Saw	90	0.4
Concrete Saw	90	0.4

Ground Type	soft
Source Height	15
Receiver Height	5
Ground Factor[2]	0.57

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Concrete Saw	86.0
Concrete Saw	86.0
Concrete Saw	86.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
90.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Table 4-26 from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 86).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 176 and 177).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2018: pg 86); and

D = Distance from source to receiver.

Masticator-Generated Noise Attenuation

Threshold	Distance Attenuated to Threshold in feet	Combined Predicted Noise Level (L_{eq} dBA)
Berkeley	87	75.0
Oakland	55	80.0

Equipment	Reference Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Dozer	85	0.4

Ground Type	soft
Source Height	15
Receiver Height	5
Ground Factor[2]	0.57

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Dozer	81.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
81.0

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Table 4-26 from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 86).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 176 and 177).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2018: pg 86); and

D = Distance from source to receiver.

Water Tender-Generated Noise Attenuation

Threshold	Distance Attenuated to Threshold in feet	Combined Predicted Noise Level (L_{eq} dBA)
Berkeley	79	75.0
Oakland	50	80.0

Equipment	Reference Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Dump Truck	84	0.4

Ground Type	soft
Source Height	15
Receiver Height	5
Ground Factor[2]	0.57

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Dump Truck	80.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
80.0

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Table 4-26 from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 86).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2018 (pg 176 and 177).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2018: pg 86); and

D = Distance from source to receiver.

Equipment Description	Acoustical Usage Factor (%)	Spec 721.560 Lmax @ 50ft (dBA slow)	Actual Measured Lmax @ 50ft (dBA slow)	No. of Actual Data Samples (count)	Spec 721.560 LmaxCalc	Spec 721.560 Leq	Distance	Actual Measured LmaxCalc	Actual Measured Leq
Auger Drill Rig	20	85	84	36	79.0	72.0	100	78.0	71.0
Backhoe	40	80	78	372	74.0	70.0	100	72.0	68.0
Bar Bender	20	80	na	0	74.0	67.0	100		
Blasting	na	94	na	0	88.0		100		
Boring Jack Power Unit	50	80	83	1	74.0	71.0	100	77.0	74.0
Chain Saw	20	85	84	46	79.0	72.0	100	78.0	71.0
Clam Shovel (dropping)	20	93	87	4	87.0	80.0	100	81.0	74.0
Compactor (ground)	20	80	83	57	74.0	67.0	100	77.0	70.0
Compressor (air)	40	80	78	18	74.0	70.0	100	72.0	68.0
Concrete Batch Plant	15	83	na	0	77.0	68.7	100		
Concrete Mixer Truck	40	85	79	40	79.0	75.0	100	73.0	69.0
Concrete Pump Truck	20	82	81	30	76.0	69.0	100	75.0	68.0
Concrete Saw	20	90	90	55	84.0	77.0	100	84.0	77.0
Crane	16	85	81	405	79.0	71.0	100	75.0	67.0
Dozer	40	85	82	55	79.0	75.0	100	76.0	72.0
Drill Rig Truck	20	84	79	22	78.0	71.0	100	73.0	66.0
Drum Mixer	50	80	80	1	74.0	71.0	100	74.0	71.0
Dump Truck	40	84	76	31	78.0	74.0	100	70.0	66.0
Excavator	40	85	81	170	79.0	75.0	100	75.0	71.0
Flat Bed Truck	40	84	74	4	78.0	74.0	100	68.0	64.0
Front End Loader	40	80	79	96	74.0	70.0	100	73.0	69.0
Generator	50	82	81	19	76.0	73.0	100	75.0	72.0
Generator (<25KVA, VMS s	50	70	73	74	64.0	61.0	100	67.0	64.0
Gradall	40	85	83	70	79.0	75.0	100	77.0	73.0
Grader	40	85	na	0	79.0	75.0	100		
Grapple (on Backhoe)	40	85	87	1	79.0	75.0	100	81.0	77.0
Horizontal Boring Hydr. Jac	25	80	82	6	74.0	68.0	100	76.0	70.0
Hydra Break Ram	10	90	na	0	84.0	74.0	100		
Impact Pile Driver	20	95	101	11	89.0	82.0	100	95.0	88.0
Jackhammer	20	85	89	133	79.0	72.0	100	83.0	76.0
Man Lift	20	85	75	23	79.0	72.0	100	69.0	62.0
Mounted Impact Hammer (	20	90	90	212	84.0	77.0	100	84.0	77.0
Pavement Scarafier	20	85	90	2	79.0	72.0	100	84.0	77.0
Paver	50	85	77	9	79.0	76.0	100	71.0	68.0
Pickup Truck	40	55	75	1	49.0	45.0	100	69.0	65.0
Pneumatic Tools	50	85	85	90	79.0	76.0	100	79.0	76.0
Pumps	50	77	81	17	71.0	68.0	100	75.0	72.0
Refrigerator Unit	100	82	73	3	76.0	76.0	100	67.0	67.0
Rivit Buster/chipping gun	20	85	79	19	79.0	72.0	100	73.0	66.0
Rock Drill	20	85	81	3	79.0	72.0	100	75.0	68.0
Roller	20	85	80	16	79.0	72.0	100	74.0	67.0
Sand Blasting (Single Nozzl	20	85	96	9	79.0	72.0	100	90.0	83.0
Scraper	40	85	84	12	79.0	75.0	100	78.0	74.0
Shears (on backhoe)	40	85	96	5	79.0	75.0	100	90.0	86.0
Slurry Plant	100	78	78	1	72.0	72.0	100	72.0	72.0
Slurry Trenching Machine	50	82	80	75	76.0	73.0	100	74.0	71.0
Soil Mix Drill Rig	50	80	na	0	74.0	71.0	100		
Tractor	40	84	na	0	78.0	74.0	100		
Vacuum Excavator (Vac-tru	40	85	85	149	79.0	75.0	100	79.0	75.0
Vacuum Street Sweeper	10	80	82	19	74.0	64.0	100	76.0	66.0
Ventilation Fan	100	85	79	13	79.0	79.0	100	73.0	73.0
Vibrating Hopper	50	85	87	1	79.0	76.0	100	81.0	78.0
Vibratory Concrete Mixer	20	80	80	1	74.0	67.0	100	74.0	67.0
Vibratory Pile Driver	20	95	101	44	89.0	82.0	100	95.0	88.0

Equipment Description	Acoustical Usage Factor (%)	Spec 721.560 Lmax @ 50ft (dBA slow)	Actual Measured Lmax @ 50ft (dBA slow)	No. of Actual Data Samples (count)	Spec 721.560 LmaxCalc	Spec 721.560 Leq	Distance	Actual Measured LmaxCalc	Actual Measured Leq
Warning Horn	5	85	83	12	79.0	66.0	100	77.0	64.0
Welder / Torch	40	73	74	5	67.0	63.0	100	68.0	64.0

Source:
FHWA Roadway Construction Noise Model, January 2006. Table 9.1
U.S. Department of Transportation
CA/T Construction Spec. 721.560

Appendix I

Alternative A: The McBride Plan Alternative

Fuel management and wildfire mitigation proposal for the University of California property in Strawberry and Claremont canyons

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Introduction

Portions of the residential areas of Berkeley and Oakland adjacent to the University of California campus and the Lawrence Berkeley National Laboratory are in a very high fire hazard zone. This situation is due to the vegetation, topography and climatic conditions occurring in the area. These conditions were responsible for the rapid spread of the 1991 Oakland Tunnel Fire that killed 25 people and consumed 3,276 homes and apartments. Little can be done about the topography and climatic conditions of the area, but residential hardening of homes with defensible space in combination with agency fuel management can reduce the heat released by a fire, the rate of fire spread, and the production of embers. Fuel management can also provide space for firefighters to assemble and undertake fire suppression activities.

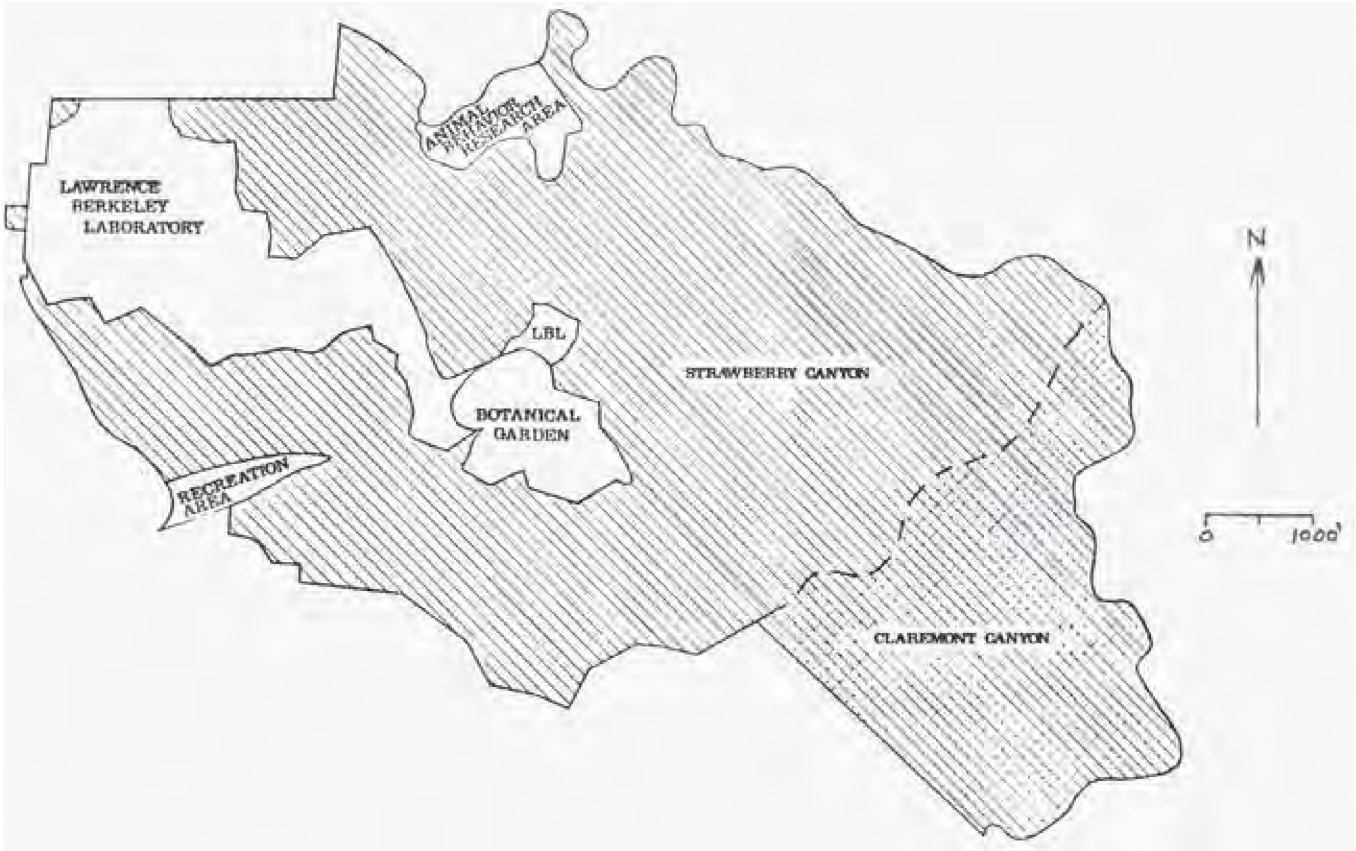
The purpose of this report is to present a fuel management plan for University of California property located in Strawberry and Claremont canyons. The plan will identify site-specific fuel reduction treatments to reduce the fire hazard present in naturally occurring vegetation types and to convert highly hazardous plantations of eucalyptus and conifer species to less hazardous naturally occurring vegetation types. The plan also will address the question of the safety of evacuation routes in the area during future fires. The following report presents cost estimates for the proposed management activities and evaluates the impact of the plan on rare and endangered species.

Characteristics of the study area

Climate

The study area occurs within a broad Mediterranean climate characterized by dry summers and wet winters (Russell, 1926). Current summer temperatures typically reach maxima around 90°F (32°C), while winter lows average just above freezing. A recent study by the Union of Concerned Scientists (Dahl, 2019) projected how many days in different areas will reach temperatures of 90 degrees, 100, 105, and what they call “off-the-chart” hot. For example, Oakland, which historically does not have any days over 100 degrees, will average 16 days of century heat per year by the end of the century.

The local Mediterranean climate is characterized by coastal summer fog. Fog usually persists until mid-morning from May through July in the higher elevations of the canyons. This summer fog tends to effect a higher fuel moisture level than is the case for locations further inland. Winds throughout most of



Map 1. University of California property in Strawberry and Claremont canyons

the year come from the west and southwest, but may blow from the east and northeast under atmospheric conditions that result in Diablo winds (SJSU, 2019). These winds can reach sustained velocities of 50 mph and are dry with relative humidity as low as 10%. Diablo winds, which blow down both Strawberry and Claremont canyons, can carry fire into the adjacent and downwind areas of Berkeley and Oakland.

The topography of the area results in a number of microclimates that can affect fuel moisture and fire behavior. South facing slopes are generally 5 to 10 degrees warmer than north facing slopes. Fuels dry out faster on these south facing slopes. Slope steepness influences flame length and the rate of fire movement during a fire, steeper slopes resulting in greater flame length and more rapid fire movement. The typical movements of winds are up slopes and up canyons during the afternoons, except in periods of Diablo winds. During Diablo winds the wind blows down slopes and down canyons.

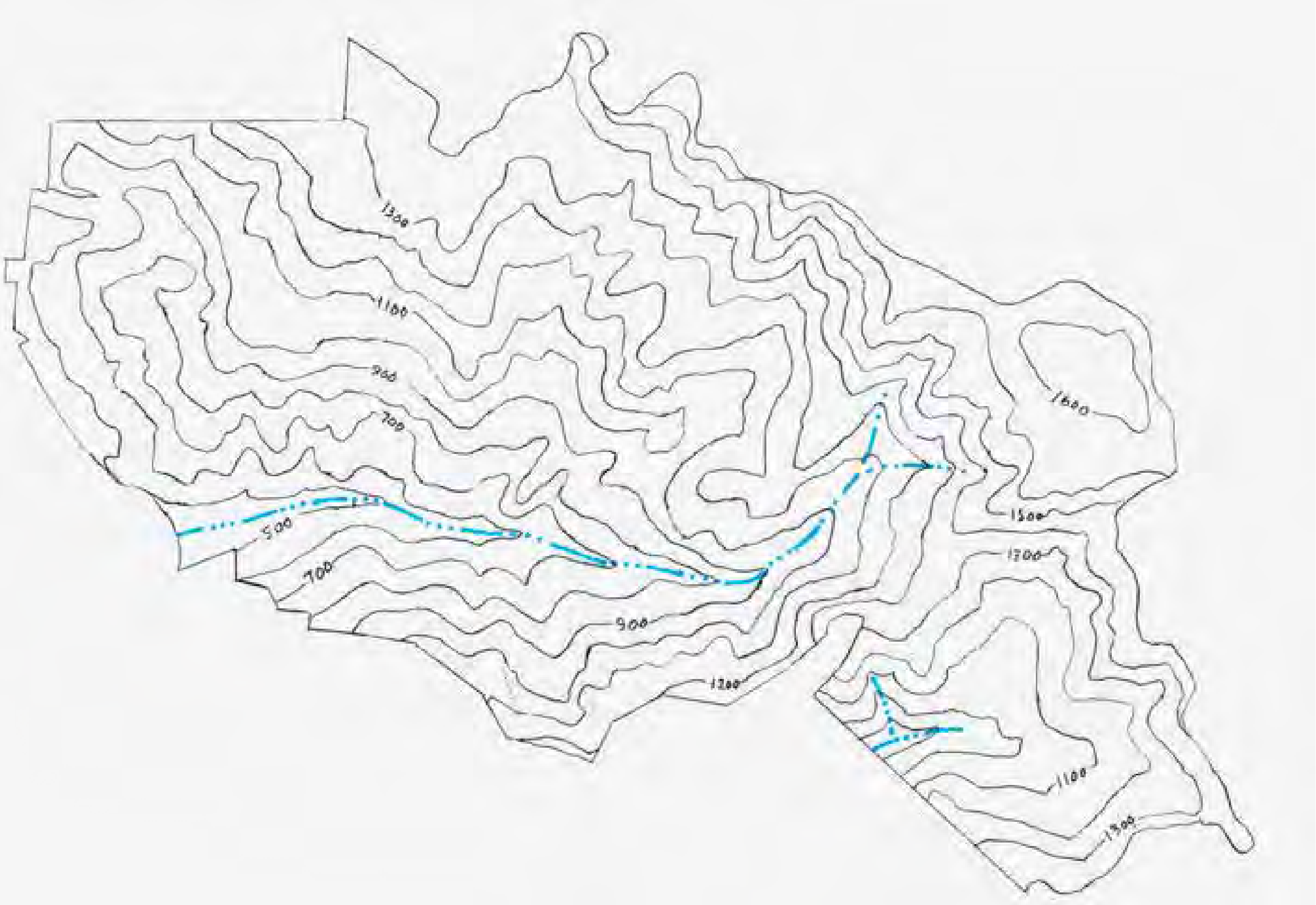
Topography

Strawberry and Claremont canyons are situated in the Oakland-Berkeley Hills (Map 1). They parallel each other in their orientation and topography (Map 2). The canyons are oriented along northeast to southwest axes. They extend from a ridge along their northeastern boundary paralleling Grizzly Peak Boulevard to the piedmont at the base of the hills. The highest elevations along this ridgeline approach 1,800 feet (550 meters) at the site of the AT&T towers. Both canyons narrow in width as they reach the piedmont below the hills. Stream elevation at the outlet of Strawberry Canyon is around 400 feet (137 meters) near California Memorial Stadium. The corresponding lower elevation in Claremont Canyon is around 450 feet (137 meters) near the Claremont Hotel and Spa. The side slopes of the canyons are generally oriented to the north and to the south. Slope steepness exceeds 50% over much of the north and south facing slopes in both canyons. The steep slopes of the canyons constrain the use of fire engines except on paved streets and unpaved fire roads and along the ridges where roads and fire trails exist. Slope steepness also limits the use of tractors (bulldozers) in firefighting. Slopes steeper than 50% are considered too steep for the use of tractors (California Department of Forestry and Fire Protection, 2019).

Vegetation

The principal vegetation types occurring in Claremont and Strawberry canyons are (1) annual grassland, (2) baccharis brushland, (3) oak woodland, (4) eucalyptus plantations, and (4) conifer plantations. The first three of these types will be referred to as naturally occurring types because they were not the result of planting of given species, as is the case of the eucalyptus and conifer plantations. Two of the naturally occurring types (baccharis brushland and oak woodland) are native types in that they were present when people came into the Bay Area. The annual grassland developed during the Spanish and Mexican periods in California as a result of the introduction of livestock and the inadvertent introduction of European annual grass seeds (Burcham, 1957). The distribution of these types in the study area is shown in Map 3 (*next page*). The approximate acreage of each vegetation type is shown in Table 1.

The annual grasslands are characterized by European annual grasses that include wild oat *(Avena fatua)*, soft chess *(Bromus hordeaceus)*, common barley *(Hordeum vulgare)* and ripgut grass *(Bromus diandrus)*. Typically, these grasses reach an average



Map 2. Topography of the study area in 100-foot elevations (University of California property in Strawberry and Claremont canyons)

Table 1. Area of vegetation types in the study area (University of California property in Strawberry and Claremont canyons, 2019)

Vegetation type	**Dominant species**	**Acres**
Annual grassland	*Avena fatua* *Bromus mollis* *Bromus diandrus* *Hordeum vulgare*	96
Baccharis brushland	*Baccharis pilularis* *Toxicodendron diversilobum* *Rubus ursinus*	252
Oak-bay woodland	*Quercus agrifolia* *Umbellularia californica*	159
Eucalyptus plantation	*Eucalyptus globulus*	116
Conifer plantation	Various species	75
Total		698

height of 2 to 3 feet depending on soil fertility and moisture. Grasslands also support a number of broadleaf herbaceous species including California poppy (*Eschscholzia californica*), soaproot (*Chlorogalum pomeridianum*) and exotic species like Italian thistle (*Carduus pycnocephalus*).

Baccharis brushland is dominated by baccharis *(Baccharis pilularis)* which forms a nearly continuous crown canopy from 4 to 6 feet in height. Associated with the baccharis one often finds poison oak *(Toxicodendron diversilobum)* and California blackberry *(Rubus ursinus)*. The former is an erect shrub or climbing vine and the latter an erect shrub or ground creeping vine. Small areas of chamise chaparral and coastal sagebrush occur within or adjacent to the general distribution of the baccharis brushland in Claremont Canyon. Chamise *(Adenostoma fasciculatum)* chaparral occurs on chert outcrops while coastal sagebrush, dominated by California sagebrush *(Artemisia californica)* occurs on shallow soils over basalt on south facing slopes. Some areas of baccharis brushland exhibit natural succession to oak woodland. Treatment of fuels in these areas should recognize the presence of coast live oak *(Quercus agrifolia)* and California bay *(Umbellularia californica)* and allow the trees to remain and succession to take place. They should not be removed except in the area designated as a preserve for the Alameda whipsnake, as required by the U.S. Fish and Wildlife Service.

The Oak woodland vegetation type is dominated by coast live oak and may support California bay on moist sites and madrone *(Arbutus menziesii)* on drier, rockier sites. Mature trees in this type typically reach 35 to 40 feet in height in the area. The understory of the oak woodland may support a variety of shrubs, grasses and forbs. Typical shrubs include poison oak *(Toxicodendron diversilobum)*, California coffeeberry *(Frangula californica)* and California hazelnut *(Corylus cornuta var. californica)*.

Eucalyptus plantations were first established toward the end of the 19th century in the East Bay Hills by Frank Havens and his realty syndicate, while more extensive plantations were planted in the early part of the 20th century (O'Brien, 2005). Blue gum *(Eucalyptus globulus)* was the most commonly planted species in both Strawberry and Claremont canyons. Tree density in these plantations varied with the spacing used in tree planting. Spacing varied from 6 x 6 feet to 12 x 12 feet resulting in stand densities approaching 1,000 trees per acre in some locations. Trees in these plantations reached heights of over 100 feet. Eucalyptus plantations in the two canyons have been subjected to unseasonable freezing, destructive fires, and various management treatments during the last century. The results of these events and management activities have ranged from the conversion of some plantations to other vegetation types (annual grassland, baccharis brushland, oak woodland), resprouting of some stands resulting in increased density of trees and sprouts, and reduction in tree density in other stands. The University of California has not continuously addressed the problem of fuel accumulation (leaves, bark, and branches) within the eucalyptus plantations.

Conifer plantations, primarily of Monterey pine *(Pinus radiata)*, were also established in Strawberry Canyon in the early part of the 20th century. The Monterey pine plantations typically grew to height of 50 to 75 feet with tree densities around 300 trees per acre. Understories beneath the trees are dominated by poison oak *(Toxicodendron diversilobum)*, but may also support understory species common to the oak woodland. Other conifer plantations occurring in Strawberry Canyon are dominated by redwood *(Sequoia sempervirens)*, Norway spruce *(Picea abies)*, Canary Island pine *(Pinus canariensis)*, bishop pine *(Pinus muricata)*, Italian stone pine *(Pinus pinea)*, high elevation pine species *(Pinus contorta ssp. murrayana, Pinus albicaulis, Pinus balfouriana)*, Monterey cypress *(Hesperocyparis macrocarpa)*, and western red cedar *(Thuja plicata)*. With the exception of redwood plantations, the plantations of other conifer species are relatively small in size. Most of these conifer plantations were established in the early part of the 20th century in Strawberry Canyon. A more recent redwood plantation was established in Claremont Canyon after the removal of eucalyptus trees in the latter part of the 20th century and early 21st century.

A limited area of riparian woodland/scrub also occurs along Strawberry and Claremont creeks in the two canyons. The dominant species in this type are arroyo willow *(Salix lasiolepis)* and California bay *(Umbellularia californica)*.

The potential for future fires in the wildlands of the University of California campus

A number of factors contribute to the potential for the ignition and spread of wildfires in Strawberry and Claremont canyons. These include the fire risk, fire hazard, fire characteristic of various fuels, continuity of fuels across the landscape, and the spread of fires by burning embers. These factors are discussed in the following paragraphs.

Fire risk

The term “fire risk” is used in reference to the probability of ignition of a fire (Brown, 1973). It is a function of ignition agents (lightning; people), climatic conditions, and the flammability of fuels. People are the primary source of ignition of fires in Strawberry and Claremont canyons. Accidents involving automobiles, unattended debris fires, improper use of gasoline powered tools, discarded cigarettes, power line failures (and contact of power lines with tree branches), and arson account for over 95% of the fires in the East Bay Hills (Keeley, 2005). A relatively few fires have been ignited in the area due to lightning strikes or the magnification of solar radiation through discarded bottles. The great majority of people-caused fires are ignited along roads, trails and power lines in the urban wildland interface zone. As a result, Strawberry and Claremont canyons have high fire risk areas adjacent to the roads, trails, and power lines. Such high fire risk calls for fuel management adjacent to these features, the objective being to reduce the accumulation of easily ignited fuels.

Climate also contributes to fire risk. In the Oakland-Berkeley Hills, fire risk is very low during the rainy season and the early summer months when hillsides are clothed with fog. Fire risk increases during the mid-summer and fall due to the absence of fog and the drying out of fuels.

Flammability of the vegetation in a given area varies with the fuel moisture content and the characteristics of the plant material. The flammability of the vegetation types in Strawberry and Claremont canyons can be ranked as follows (from high to low): annual grassland > eucalyptus > pine plantations > baccharis brushland > oak woodland (EBRPD Plan, 2010).

Table 2. Fuel loading (Russell and McBride, 2002, Agee et al, 1973)

Vegetation type	Fuel loading (tons/acre)
Annual grassland	1.51
Baccharis brushland	18.7
Oak-bay woodland	3.7
Eucalyptus plantation	60
Conifer plantation	40.7

Fire hazard

Fire hazard refers to the state of the fuel in a given area (Brown, 1973). It is generally defined by the amount of dead fuel on the ground within a vegetation type, the structural arrangement of the fuel, and potential flammability of living plant tissue. The term “fuel loading” is used in reference to the amount (tons/acre) of fuel. The structural arrangement of fuels may depend upon current or past management of vegetation, the developmental stage of a vegetation type, or the invasion of forest plantations by native and exotic species. The variation in fire hazard associated with flammability of living plant tissue is dependent on the percentage of live fuel moisture, the presence of leaf waxes, and aromatic compounds in the leaves and bark that are readably flammable when they evaporate from a plant.

Table 2 presents fuel loading for the major vegetation types in the study area based on the measurements made using the “Brown Method” (Russell and McBride, 2002; Cheney, 1981). Based on fuel loading alone, the Monterey pine and eucalyptus plantations have the highest fire hazard. The structural arrangement of fuels that is most critical in terms of fire hazard is the presence of fuel ladders. This term refers to live or dead plant material that allows a fire to climb from the ground into the tree canopy. Fuel ladders are present in eucalyptus and conifer plantations due to the establishment of native and exotic trees and shrub species in the understory. The presence of seedlings, saplings, and pole-sized trees in some Monterey pine and eucalyptus plantations also provides fuel ladders. A special type of fuel ladder exists in many eucalyptus plantations due to a build-up of dry leaves on the ground and strips of exfoliating bark that hang on tree branches. These highly flammable materials provide continuous fuel from the ground into the canopy of the trees. In mature oak woodland stands fuel ladders are uncommon.

Fire characteristics

Fire characteristics that contribute to fire intensity and the difficulty of suppressing wildfires include rate of spread (meters/minute), fire-line intensity (kW/meter) and flame length (meters). These characteristics are shown for the major vegetation types in Table 3 (Russell and McBride, 2002; Cheney, 1981). The figures shown are based on fires burning on level ground with wind speeds of zero mph. As the ground slope and/or the wind velocity increases these values will also increase. The rapid rate of spread of fires in annual grasslands and baccharis brushlands is especially critical in consideration of wildfires spreading from wildland areas into residential areas. The fire line intensity and flame lengths are important variables in terms of fire suppression. They determine the proximity to fires that firefighters can safely work during suppression activities.

Continuity of fuels across the landscape

The spread of a fire across a landscape will depend in part on the distribution and continuity of fuels. The rate of spread of a fire across a landscape will change as the fire encounters different fuels. Where continuous areas of annual grassland or baccharis brushland are present, fires can move very quickly. In contrast, when a landscape is composed of a mosaic of annual grassland (or baccharis brushland) units interspersed with units of oak woodland, the overall movement of a fire will be slowed.

Table 3. Fire characteristics (Russell and McBride, 2002, Chenny, 1981)

Vegetation type	Ease of ignition	Rate of spread (m/min)	Fire-line intensity (kW/m)	Average flame length (m)
Annual grassland	high	3.8	66	0.5
Baccharis brushland	moderate	1.6	197	0.8
Oak-Bay woodland	low	0.6	36	0.4
Eucalyptus plantation	high	0.6	250	1.0
Conifer plantation	high	0.6	158	0.7

Fire spread by ember production

Fires are spread by burning embers that are cast ahead of the flame front of a fire as well as by the flame front itself (Manzello et al., 2004; Cheney and Bary, 1969). The production and spread of embers is a function of fuel type, topographic location of the burning fuels, and wind velocity. Different vegetation fuel types, because of the aerodynamic characteristics of smaller pieces of the fuel, vary in their production of flying embers. Dried, fragmented pieces of grass leaves are easily carried aloft during a fire to spread burning embers. These can ignite spot fires ahead of the flame front of a fire in an annual grassland. The dried leaves of eucalyptus trees, because of their shape are easily carried aloft as burning embers. They can be blown from ¼ to 1 mile under high wind conditions. Heavier embers, known as firebrands, can be produced from exfoliated eucalyptus bark and Monterey pine cones during high wind velocity fires. These higher-density firebrands may not travel as far as lighter embers, but they have a greater potential for starting spot fires. Eucalyptus and conifer plantations occurring on ridges pose a considerable risk of torching and producing firebrands that can spread down canyons to ignite spot fires in wildland vegetation and urban areas.

Proposals for fuel management in Strawberry and Claremont canyons

Several fuel management prescriptions need to be applied on University of California and Lawrence Berkeley National Laboratory properties in Strawberry and Claremont canyons in order to reduce fire risk and fire hazard. These include (1) conversion of all eucalyptus plantations to naturally occurring vegetation types, (2) conversion of conifer plantations on ridges to naturally occurring vegetation types, (3) establishment of roadside fuelbreaks, (4) establishment of shaded fuelbreaks in areas adjacent to property boundaries and structures, (5) maintenance of conifer plantations, and (6) fuel maintenance along power lines. These fuel management prescriptions are based in part on a review of fire and fuel management in California and Australia (Husari et al., 2006, Gould et al. 2008). The prescriptions are discussed in the following paragraphs.

The cost of fuel management activities will vary with the fuel management prescription, topography, and size of plants to be removed. A best estimate of the costs of various treatments is incorporated in Table 4 and Table 5. These cost estimates are based on costs developed by the East Bay Regional Park

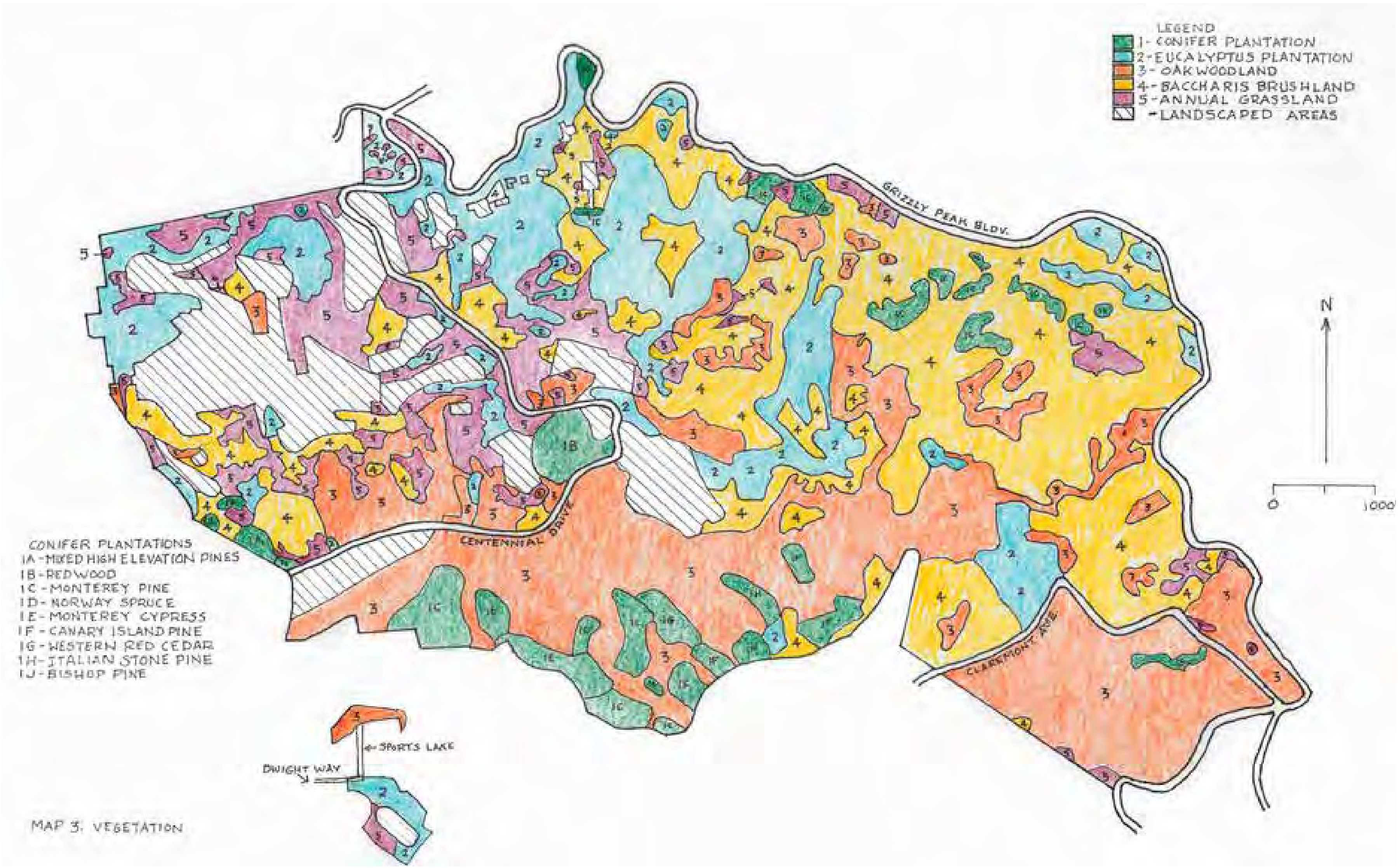
Continued on page 12

Table 4. Costs of initial vegetation treatments, UC property in Strawberry and Claremont canyons, 2019.

Management prescription	**Treatment**	**Acres**	**Cost/acre ($)**	**Total ($)**
Conversion of eucalyptus plantations	Tree removal	116	20,000	2,320,000
	Sprout control	116	2,000	232,000
	Conversion of understory oak and bay to shaded fuelbreak	29	3,000	87,000
	Conversion of poison oak understory to grassland	29	3,500	101,500
	Total			2,740,500
Conversion of conifer plantations on ridgetops	Tree Removal	23	5,000	115,000
	Conversion of understory oak and bays to shaded fuelbreak	6	3,000	18,000
	Conversion of understory without oak and bay trees to annual grassland	17.5	700	12,250
	Total			145,250
Roadside fuelbreak establishment	Tree removal	12	3,000	36,000
	Brush removal	40	2,000	80,000
	Total			116,000
Shaded fuelbreak establishment (adjacent to property boundaries and structures)	Tree thinning, pruning, and ground fuel removal	36	3,000	108,000
Ridgetop fuelbreak establishment	Conifer plantations (units previously treated in conifer plantation conversion)	23	0	0
	Eucalyptus plantations (units previously treated in eucalyptus conversion)	0.5	0	0
	Oak woodland	10	3,000	30,000
	Baccharis brushland	12	2,000	24,000
	Total			54,000
Clean-up of remaining conifer plantations	Removal of downed woody 10-hour fuels, pruning, elimination of fuel ladders	56	3,000	168,000
Alameda whipsnake reserve	Removal of existing trees and areas of broom	20	5,000	100,000
All initial treatments				3,431,750

Table 5. Costs of periodic maintenance, University of California property in Strawberry and Claremont canyons, 2019.

Management prescription	**Maintenance required**	**Frequency of treatment (yrs)**	**Acres**	**Cost/ acre ($)**	**Total cost/ treatment ($)**	**Prorated annual cost ($)**
Conversion of eucalyptus plantations	Locate and remove any stump sprouts or saplings	5	116	100	11,600	2,320
	Control resprouting of poison oak	5	29	700	20,300	4,060
	Total (annual)					6,380
Conversion of conifer plantations on ridgetops (maintenance of units converted to shaded fuelbreaks)	Tree thinning, pruning, and ground fuel removal	5	6	500	3,000	600
	Area converted to grassland grazed by goats	5	17.5	700	12,250	2,450
	Total (annual)					3,050
Roadside fuelbreak establishment	Grass mowing	1	80	500	40,000	40,000
Shaded fuelbreak establishment	Tree thinning, pruning, and ground fuel removal	5	36	500	18,000	3,600
Ridgetop fuelbreak establishment	Grassland and converted baccharis brushland units (mowing)	1	13.5	500	6,750	6,750
	Units converted to oak woodland shaded fuel breaks (tree thinning, pruning, and ground fuel removal)	5	34	500	17,000	3,400
	Oak woodland (tree thinning, pruning, and ground fuel removal)	5	10	500	5,000	1,000
	Total (annual)					11,150
Clean-up of conifer plantations	Tree thinning, pruning, and ground fuel removal	5	56	500	28,000	5,600
Alameda whipsnake preserve	Remove trees and broom	10	169	100	16,900	1,690
All treatments (prorated on an annual basis)						71,470



MAP 3: VEGETATION

District in 2010, Satomi (2016), and Kent (personal communication, 2019). Cost associated with the proposed management treatments are discussed in the following paragraphs.

1. Conversion of eucalyptus plantations to naturally occurring vegetation types

All areas of eucalyptus plantations in the study area should be converted to naturally occurring vegetation types to reduce the fire hazard and the potential for firebrand production (Map 4). This recommendation is based on studies of fire management in eucalyptus by Hodgson (1967), Cheney (2012), and the experience of the author. Thinning of eucalyptus plantations may eliminate fuel ladders but it does not stop the accumulation of eucalyptus litter (leaves, bark and small branches) both on the ground and hanging from tree branches. The University of California has not been able to properly manage their eucalyptus plantations in the past. Funding for maintenance operations to include removal of eucalyptus litter will be costly and will need to continue as long as there are thinned eucalyptus stands in Strawberry and Claremont canyons. Furthermore, eucalyptus canopies in thinned stands are still functionally continuous in Diablo winds and hanging leaves and bark can produce fire brands that can be carried by the wind. Conversion of eucalyptus plantations to naturally occurring vegetation types is the best solution for the fire hazard problem on the University of California property. Where plantations support understories of coast live oak and California bay this conversion can be easily accomplished by the removal of the eucalyptus trees and the control of stump sprouts and seedlings. In general, conversion is expected to occur naturally and will not require tree planting.

The eucalyptus plantations in Strawberry and Claremont canyons can be divided into two groups on the basis of previous management treatments. Some stands are the result of stump sprouting following tree removal after the freeze in 1972 (Hamilton et al., 1974) or later tree removal programs that did not succeed in preventing stump sprouting. Other stands survived the freeze in 1972 and were not subjected to fuel management activities. Eucalyptus tree size and densities vary between these two types of stands. Larger trees in plantations that have not been impacted by freezing or fuel management activities can range up to 3 to 5 feet in diameter and reach heights over 150 feet. The density of trees over 10 inches in diameters in these undisturbed plantations generally average 150/acre. In cut-over plantations, the density of trees, whose diameters typically range from 10 to 20 inches, average about 480 stems per acre. These cut-over stands support up to 1,000 stems per acre of trees and stump sprouts less than 10 inches in diameter. This distinction between unmanaged and cut-over plantations is important in estimating the per acre cost of removal of the eucalyptus. Estimated costs for removal of eucalyptus trees are shown in Table 4.

Eucalyptus stump sprouts resulting from the cutting of the eucalyptus trees must be controlled to prevent the regrowth of the eucalyptus trees. This can be accomplished most efficiently by the use of herbicides and is usually successful in one treatment (Boyd, 2019). Failure of the University to control stump sprouting of eucalyptus in the past has resulted in increased levels of fire hazard in Strawberry and Claremont canyons.

The conversion of eucalyptus stands supporting understories of coast live oak and California bay may require the elimination of fuel ladders extending from the ground into the canopies of the oaks and bays. Such fuel ladders are most likely to be due to poison oak vines extending from the ground surface into the tree canopies. These ladder fuels can be effectively eliminated by hand-cutting, as demonstrated by volunteers at Skyline Gardens on East Bay Municipal Utility District land northeast of Strawberry and Claremont canyons (https://www.skylinegardens.org/), or, if hand work is not possible, by goat grazing.

Some eucalyptus stands do not support understories of coast live oak and California bay, but may support shrub layers of poison oak. Dense poison oak brushfields will develop when the eucalyptus

MAP4 EUCALYPTUS PLANTATIONS

canopy is removed from these units. These emerging poison oak brushfields must be converted to annual grasslands because of the health danger of smoke from wildfires burning poison oak. Annual goat grazing will be required for a period of 3 to 5 years or longer following tree removal to accomplish this conversion.

Individual eucalyptus trees and small clumps of eucalyptus stump sprouts emerge occasionally in the naturally occurring vegetation types in the area. These trees and sprouts must also be cut down and subsequent eucalyptus sprouts controlled until the stumps are dead.

Approximately 116 acres of eucalyptus plantations occur in the study area (Table 1, Map 4). These plantations vary from units supporting large, 100-year-old trees to recently cut-over units supporting sprouts generally under 6 inches in diameter. Cost per acre of tree removal and conversion of site to naturally occurring vegetation types will range widely because of tree size and slope steepness. Using an average cost of $20,000 per acre the initial treatment of the 116 acres of eucalyptus plantations would amount to $2,320,000. Additional cost would be required to eliminate eucalyptus sprouting. These costs are expected to be $2,000 per acre for a single herbicide treatment. For the entire area of eucalyptus plantations, the cost to control eucalyptus sprouting with a single herbicide treatment would be $232,000 (Table 4).

Establishment of oak woodland/shaded fuelbreaks in the former understory of eucalyptus is estimated to cost $87,000, assuming 25% of the area of eucalyptus plantations supports oak and bay trees at a sufficient density to be converted into oak woodland/shaded fuelbreak and is adjacent to property structures.
The conversion of poison oak brushfields that may arise following the removal of the eucalyptus trees is estimated to cost a total of $101,500 with annual treatments following tree removal for as long as 5 years, assuming 25% of the eucalyptus plantations support dense stands of poison oak. After the 5 years of treatment, the areas would require goat grazing every 5 years at a cost of $20,300 per year of treatment.

2. Conversion of conifer plantations on ridges to oak woodlands or annual grasslands

Several units of conifer plantations occur along the ridges of Strawberry Canyon (Map 5). These present serious fire hazards because of fuel loading, stand structure, and the potential for firebrand production. Firebrands produced by conifer trees along ridges will be propelled by high wind velocities to rain down into the canyons. Many spot fires both in the interface vegetation and on structures are likely to be ignited. Because of this potential all portions of conifer plantation occurring within 200 feet of ridgetops should be converted either to oak woodland or grassland. Treatments similar to those prescribed for the conversion of eucalyptus plantations will be required to remove the conifer trees, eliminate fuel ladders and remove shrubs beneath the conifer canopies. Understories of oak woodland should be able to grow and thrive by removal of the overstory conifers. Following removal of the conifers the oak woodlands should be converted into shaded fuelbreaks by tree thinning, pruning, elimination of fuel ladders, and cleanup of accumulations of woody ground fuels. Shrub and herb dominated areas beneath the conifer canopies should be converted to annual grassland by goat grazing.

There are 14 units of conifer plantations occurring on or within 200 feet of the ridges above Strawberry Canyon. These are primarily located along the south ridge of Strawberry Canyon adjacent to the Hamilton Gulch development (Map 5). They cover an area of approximately 23.5 acres. Removal of trees from these units is anticipated to cost a total of $115,000 (Table 4). Treatments to convert the understories of these units to shaded fuelbreaks of oak woodlands is estimated to cost $18,000 assuming sufficient densities of oak and California bay trees occur under 25% (6 acres) of the conifer plantations to be cut down. It is estimated that 75% of the area under the conifers supports shrubs and herbaceous species. This area (17.5 acres) should be converted to annual grassland

Continued on page 15

MAP 5. CONIFER PLANTATION CONVERSION

Map 6. Roadside fuel breaks on University of California property in Strawberry and Claremont canyons, 2019)

by goat grazing following tree removal. The cost of this operation will be about $12,250.

Periodic maintenance of the units treated will be required following the removal of the conifer overstory. Maintenance of the oak woodland/shaded fuelbreak is estimated to cost $3,000 every 5 years. Maintenance of the area converted to annual grassland is estimated to cost $2,450 annually.

3. Establishment of roadside fuelbreaks

Roadside fuelbreaks should be established along all paved roads and unpaved fire roads within or adjacent to Strawberry and Claremont canyons. Shrubs within 20 feet of the edge of a road must be removed where a road goes through a baccharis brushland. Individual shrubs occurring in annual grasslands within the 20-foot-wide zone on each side of a road or street must also be removed. Shrubs occurring in the understories of oak woodlands and plantation types within the 20-foot-wide roadside fuelbreak also must be removed along with any vines. The design objective of the roadside fuelbreak is to maintain annual grass species and oak woodland forbs on the ground surface in this 20-foot-wide zone. These grasses and forbs must be mowed or goat grazed annually at the end of growing season (before they cure and dry). If mowing is used the clippings must be removed from the road fuelbreaks and not left on the ground where they could readily burn. In addition to the annual mowing and/or goat grazing of the roadside fuelbreaks, these fuelbreaks should be monitored annually to detect any accumulation of woody fuel that may have fallen onto the fuelbreaks from adjacent conifer plantations.

Approximately 57,500 linear feet of paved road (outside of landscaped and building site; e.g., Lawrence Berkeley National Laboratory, Botanical Garden) occur in the study area (Map 6). These paved roads are: Centennial Drive (18,027 feet), Grizzly Peak Boulevard (31,340 feet), and Claremont Avenue (8,154 feet). An additional 30,542 feet of unpaved fire roads occur in the study area. The establishment of a 20-foot-wide roadside fuelbreak on both sides of these roads will require the treatment of approximately 80 acres. It is anticipated that the cost of tree removal within the roadside fuelbreak, excluding areas where eucalyptus and conifer plantations are to be removed, will cost $36,000. Brush removal from the roadside fuelbreak is estimated to cost $80,000. Annual maintenance of the roadside fuelbreak will cost $40,000 (Table 5).

4. Establishment of shaded fuelbreaks

A system of shaded fuelbreaks (Agee et al., 2000; Dennis, 2019) in the oak woodland and remaining units of conifer plantations should be developed around all boundaries with private property in Strawberry and Claremont canyons (Map 7). Shaded fuelbreaks should also be established around all structures in special facilities (e.g., Botanical garden, Lawrence Hall of Science) on University of California property. The Lawrence Berkeley National Laboratory has done an exemplary job of fuel reduction on its property. However, there are some sites where the University of California property line is within 300 feet of Lawrence Berkeley National Laboratory structures or facilities (e.g., parking lots) as well as units of continuous tree cover adjacent to structures within the Lab where conversion to shaded fuelbreaks is advised. At these locations a shaded fuelbreak should be established to augment the fuel reduction measures taken by the Lawrence Berkeley National Laboratory.

Establishment of the shaded fuelbreak will entail thinning of trees to allow a minimum of 10 feet between adjacent tree canopies on 0 to 20% slopes, 20 feet on 21 to 40% slopes, and 30 feet for slopes over 40%. In thinning forests to establish shaded fuelbreaks, it is important to consider the future, full-mature size of the trees that will be left after thinning. One must consider future branch growth in creating the desired spacing between trees. In general, it is best to leave mature trees (providing desired spacing) in the shaded fuelbreak because they will have a minimum of lateral branch growth and cost more to be removed. The trees within a shaded fuelbreak must be pruned to a height of 15 feet or no more than 1/3 of their live crown.

All shrubs, saplings, and pole-sized trees should be removed to prevent flames from moving from the ground up into the forest canopy. Surface fuels (defined as ground plants over one foot in height, low shrubs, fallen tree branches, old logs, and excessive levels of forest leaf litter >3 inches) should be removed. Shaded fuelbreaks can be established by hand crews, machinery, or a combination of both. Once established, shaded fuelbreaks must be periodically maintained to prevent the accumulation of surface fuel and the reestablishment of fuel ladders.

Site condition primarily defined by slope steepness and rockiness of slopes will dictate where mechanical vs. hand labor can be used. The material removed in the establishment of the shaded fuelbreak should either be hauled to a central location or stacked in an appropriate opening (grass dominated opening at least 30 feet in diameter) where it later can be safely burned, gasified, or converted to biochar. This plan does not recommend chipping woody material produced during the establishment of shaded fuelbreaks and spreading the chips on the ground. Such chipped material presents a fire hazard for several years after it is spread and can have negative impacts on native plants and animals that inhabit the woodland and conifer ground surface.

Shaded fuelbreak establishment will only be required in the oak woodland vegetation type and where the understory of removed eucalyptus and conifer plantations results in the establishment of oak woodlands. Currently there are 7 units of oak woodland in the designated shaded fuelbreak zone (Map 7). These units amount to approximately 36 acres and would cost approximately $3,000 per acre to convert to a shaded fuelbreak, for a total cost of $108,000 (Table 4). It is not possible to calculate the additional cost of creating a shaded fuelbreak in the oak woodlands that will be released by the removal of the overstories of eucalyptus and conifers in the plantation within the proposed shaded fuelbreak. Periodic maintenance (every 5 years) of shaded fuelbreaks is estimated to cost $500 per acre for a total maintenance cost of $18,000 every five years plus the cost of annual mowing and treatments in the Alameda whipsnake preserve (Table 5).

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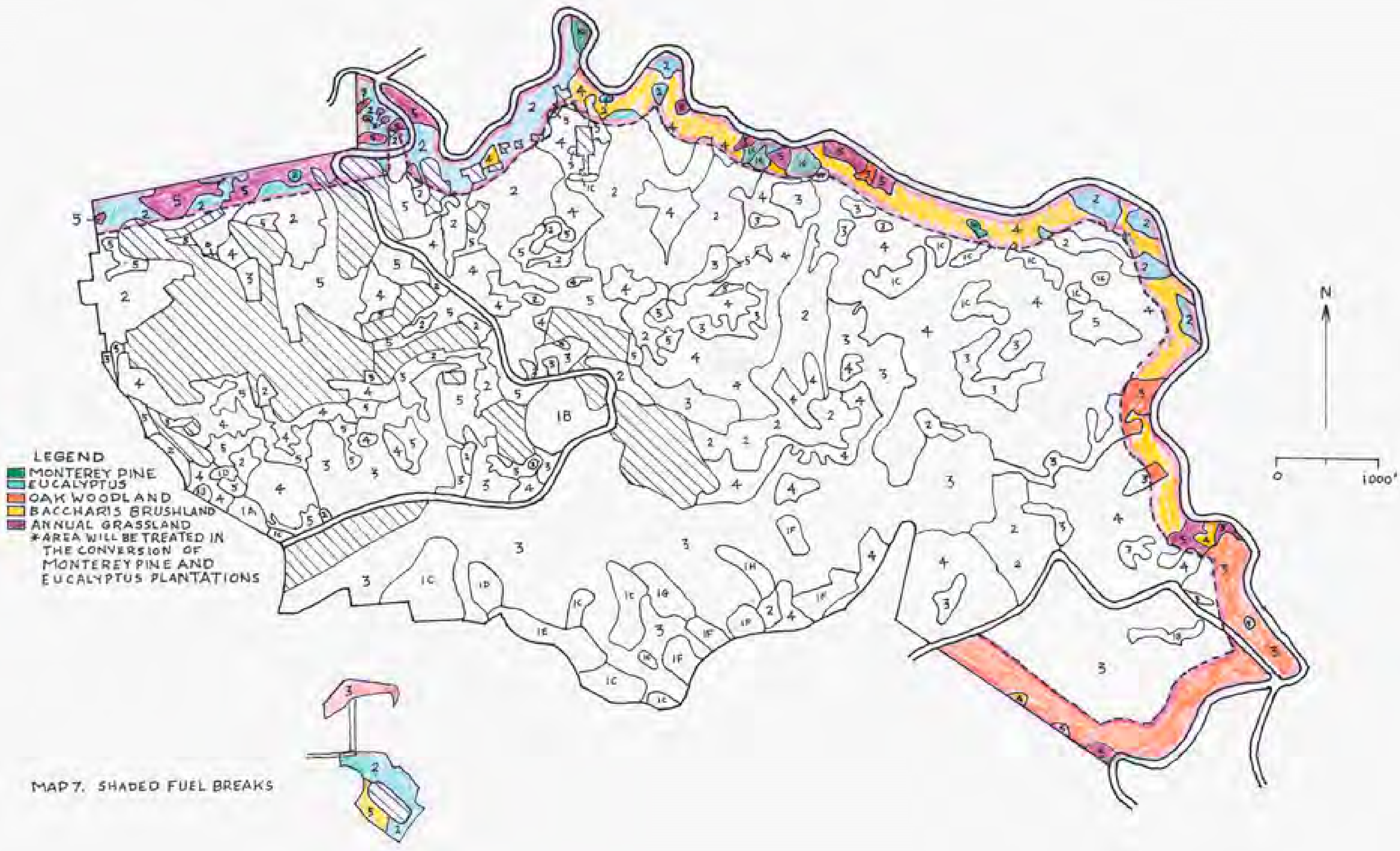

MAP 7. SHADED FUEL BREAKS

MAP 8. MAINTENANCE OF CONIFER PLANTATIONS

5. Maintenance of conifer plantations

Several conifer plantations occur within Strawberry Canyon which support species planted in the early part of the 20th century for the education of forestry students These plantations should be maintained, but in a fire safe condition. Fuel management of these plantations will involve the removal of any fuel ladders, dead standing trees and any accumulation of woody fuel under 4 inches in diameter on the ground surface. After the initial fuel cleanup these conifer plantations should be surveyed every 5 years to identify any local accumulations of fuel or the development of fuel ladders.

Some conifer plantations (e.g., Italian stone pine, Monterey pine) are past maturity and exhibiting tree mortality. Most of these over mature stands support understories of coast live oak and California bay. The over mature plantations should be managed to facilitate the natural succession of the plantation to native woodlands by periodic removal of the dead overstory conifer species.

After the conversion of the conifer plantations occurring along the ridges in the study area there will be approximately 56 acres of remaining conifer plantations (see Map 8). The initial treatment of these plantations to eliminate fuel ladders, dead standing trees and accumulations of woody fuel on the ground is estimated to cost to $3,000 per acre for a total of $168,000 (Table 4). Periodic maintenance (every 5 years) of these conifer plantations is anticipated to cost $500 per acre for a total $5,600 every 5 years.

6. Establishment of ridgetop fuelbreak

A fuelbreak along the ridgetop between Strawberry and Claremont canyons should be established to reduce the production of firebrands during a fire and to provide space for firefighters to suppress fire (Green, 1977). The fuelbreak should be 300 feet wide, going down slope 150 feet on each side of the ridge. Where non-University property occurs on one side of the ridgeline the fuelbreak should extend downslope 300 feet on University property. Twelve acres of baccharis brushland occurs within the proposed ridgetop fuelbreak (Map 9). This area of baccharis brushland must be converted to annual grassland and maintained as annual grassland. Approximately 12 acres of the baccharis brushland is within the area to be designated as an Alameda whipsnake preserve (see below). Removing 12 acres from the proposed 169-acre preserve will result in 157 acres for a preserve, an area slightly smaller than the 167 acres required by the U.S. Fish and Wildlife Service for a preserve. However, the Alameda whipsnake is known to use grassland areas adjacent to baccharis brushlands for both hunting and reproduction (EPA, 2010).

There are approximately 23.5 acres of conifer plantations within the proposed ridgetop fuelbreak. All of these will be converted to either grassland or oak woodland depending upon understory conditions during the conversion of conifer plantations on ridges (see 2 above). One- and one-half acres of annual grassland occur in the proposed ridgetop fuelbreak. No establishment technique is required for these acres. After the initial establishment of the ridgetop fuelbreak the grassland areas (existing prior to the establishment of the fuelbreak or established by removal of baccharis brushlands) are to be grazed by goats on an annual basis. Areas of oak woodland shaded fuelbreaks along the ridgetop are monitored and maintained every five years.

The overall cost for the establishment of the ridgetop fuelbreak, excluding costs associated with the conversion of eucalyptus and conifer plantations within the 300-foot-wide proposed ridgetop fuelbreak, is estimated to be $54,000 (Table 4). Annual maintenance cost for mowing grassland (both pre-existing and established) within the ridgetop fuelbreak will amount to $6,750 (Table 5). Monitoring and maintenance of the shaded fuelbreak within the ridgetop fuelbreak (exclusive of maintenance of shaded fuelbreaks established in the conversion of eucalyptus and conifer plantation will cost approximately $22,000 every five years (Table 5).

After the initial conversions, ongoing management should be provided by University staff, contractors, volunteers from local organizations, or by willing non-profit groups like the California Native Plant Society which handles the Skyline Garden Project for EBMUD.

7. Fuel maintenance along power lines

Power lines occur along the ridges and within Strawberry Canyon and along Grizzly Peak Boulevard, Fish Ranch Road, and along Claremont Avenue. Failure of power line equipment and contacts between power lines and tree branches have resulted in wildland fires. Pacific Gas and Electric Company (PG&E) recently revised its standards for the clearance of tree branches along power lines. The new, revised standards will require a clearance of 12 feet on each side of high voltage power lines (https://www.pge.com/en_US/safety/emergency-preparedness/natural-disaster/wildfires/vegetation-management.page) . Clearing vegetation along power lines is the responsibility of PG&E, who is also responsible for annual inspection of its power lines. The University of California and the Lawrence Berkeley National Laboratory should annually monitor electrical lines leading from the PG&E utility poles to structures and maintain clearance of tree branches around these lines.

Other fire management issues

Four additional fire management issues should be given consideration in Strawberry and Claremont canyons. These are (1) evacuation routes during a fire, (2) fire water supply, (3) purchase of fire trucks for wildland fire suppression and (4) improvements in fire detection. These issues are addressed in the following paragraphs.

1. Evacuation routes

Grizzly Peak Boulevard, Claremont Avenue and Centennial Drive will be used as evacuation routes in the event of a wildfire threatening the urban areas either north or south of Strawberry and Claremont canyons. The vegetation along these evacuation routes must be managed to minimize the possibility of trees and/or tree branches falling onto the road and blocking traffic. To minimize this potential any trees currently leaning over the roads should be removed. Any additional trees that lean toward the roads that are tall enough to fall onto the roads must also be removed. Periodic inspections (every 5 years) should be conducted to see if other trees within striking distance of the roads are exhibiting conditions (e.g., sudden oak death disease) that suggest they might likely fall onto the roads. Such trees should be removed. Tree removal must be augmented by the removal of all 1-hour and 10-hour fuels (terminology refers to the amount of time for a woody material to lose moisture based on size, usually under an inch in diameter for 10-hour fuels, (https://www.fws.gov/fire/downloads/monitor.pdf) resulting from the removal of individual trees.

The costs of establishing and maintaining roadside fuelbreaks along the evacuation routes is indicated above under “Establishment of roadside fuelbreaks.” An additional cost will be required for the removal of leaning trees that could fall onto the evacuation routes. There is no current estimate of the number of these trees along Grizzly Peak Boulevard, Claremont Avenue and Centennial Drive. Per tree cost of tree removal could range from $500 to $5,000.

2. Fire water supply

The water supply designated for firefighting should be increased in both Strawberry and Claremont canyons. Additional water tanks should be located along Grizzly Peak Boulevard to feed fireplugs along Grizzly Peak Boulevard, Claremont Avenue, and Centennial Drive. These storage tanks can also be used to fill tanker trucks engaged in fire suppression in the two canyons. Firefighting water storage facilities available to the Space Sciences Laboratory, Mathematical Sciences Research Institute, Lawrence Hall of Science, Botanical Garden, Landscape Maintenance Facility, Animal Behavior Research Center, Strawberry Canyon Recreation Area, and residence halls adjacent to wildland vegetation in Strawberry Canyon should be evaluated to see whether additional water storage for firefighting should be developed. Gravity feed systems need to be developed in view of PG&E's plan to turn off electricity during periods of extreme fire weather (https://www.pge.com/en_US/safety/emergency-preparedness/natural-disaster/wildfires/public-safety-power-shutoff-faq.page).

3. Purchase of fire trucks for wildland firefighting

The University of California and the Lawrence Berkeley National Laboratory should purchase fire trucks designed for fighting wildland fires. It would be of particular value to have tanker trucks capable of delivering water for firefighting in the two canyons. One Type 3 fire truck should be purchased by each agency (University of California; Lawrence Berkeley National Laboratory). A Type 3 fire engine is typically a four-wheel drive apparatus designed for rapid deployment, pick up, and relocation during wildfires. Technically, a Type 3 fire engine includes a pump operating at 120 gallons per minute, a large 500-gallon tank, 1000 feet of 1 ½ inch hose, and 800 feet of 1-inch fire hose. Type 3 fire engines can carry a minimum of four firefighters. Fire roads throughout both Strawberry and Claremont canyons should be modified, where necessary to accommodate the Type 3 fire engines purchased. Used fire engines are available and should be considered for purchase.

An alternative to the above would be for UC, LBL, EBRPD, and EBMUD to collaborate with the State to establish a Cal Fire unit station in the East Bay Hills, possibly with a temporary station at the service yard in Tilden Regional Park, and then by purchase of the abandoned property and structure on Fish Ranch Road near the Caldecott Tunnel and Highway 24 to construct a permanent Cal Fire unit station.

4. Improvements in fire detection

Early detection of wildland fires can be of great value in fire suppression. In the past fire lookout towers were used for surveillance of forest and wildland areas. A 40-foot-tall steel fire lookout tower was erected on Grizzly Peak in 1924 following the 1923 Berkeley Hills Fire. It was used for fire surveillance until 1960 when it was taken down. During the last 18 years of its operation 160 fires were spotted in the Berkeley Hills. More recent fire detection methods involve aerial patrols, ground observations from roads and fire trails and camera detection. PG&E has proposed the installation of several thousand cameras to detect and monitor the spread of wildfires in California (https://www.pge.com/pge_global/common/pdfs/safety/emergency-preparedness/natural-disaster/wildfires/Wildfire-Safety-Plan.pdf, p.91). The University, the LBNL, EBMUD, and EBRPD should make sites available for PG&E to install fire detection cameras on their property to monitor conditions in both Strawberry and Claremont canyons.

Impact of proposed fuel management on species of special interest and other species

The Alameda whipsnake (*Masticophis lateralis ssp euryxanthus*), a federally listed species, has been reported in Strawberry Canyon (U.S. Fish and Wildlife Service, 2002). It may also be present in Claremont Canyon. A second federally listed species, the pallid manzanita (Arctostaphylos pallida), has not been reported in either Claremont or Strawberry canyons but occurs nearby.

Although the Alameda whipsnake is associated with baccharis brushlands and coastal sage scrub, it moves into adjacent annual grasslands up to distances of 500 feet where it may stay for periods of a few hours to several weeks at a time (EPA, 2010). It utilizes grassland adjacent to brush dominated areas for mating, egg laying sites, and hunting for prey. It has also been reported in the margins of oak woodlands.

Many of the proposed fuel management techniques in this report could potentially negatively impact individual Alameda whipsnakes. In order to minimize that possibility the procedures outlined in the UC

Berkeley 2020 Hill Area Fire Fuel Management Program (Morales, M. and Morales, T., 2003) for the protection of the Alameda Whipsnake will be followed. These measures include:

- Installation of snake-proof drift fencing around the perimeter of all slash piles to be burned
- All vegetation treatment activity except hand clearing of brush will be limited to fall and winter months, when snakes are expected to be underground and less susceptible to harm
- A series of training sessions for contractors will be conducted to train personnel and develop an informational brochure to train personnel on identifying the Alameda whipsnake and methods to avoid disturbing it
- Stationary equipment will be checked for the presence of Alameda whipsnakes prior to being moved
- Potential Alameda whipsnake retreat habitats, (e.g., rock outcroppings) will be avoided by fuel management crews and vehicles
- Potential Alameda whipsnake retreat habitats will be protected from fire by construction of perimeter control lines
- Injured snakes will be captured and treated for injuries by the nearest cooperating wildlife rehabilitation center.

The U.S. Fish and Wildlife Service has required an area of 167 acres to be designated as a preserve for the Alameda Whipsnake. This area is to be maintained as baccharis brushland by the removal of tree species that emerge through the baccharis canopy. A contiguous area of 144 acres of Baccharis brushland occurs on the upper south facing slopes of Strawberry Canyon with 25 acres of non-contiguous baccharis brushland nearby (Map 10). This area should be set aside as the Alameda Whipsnake preserve and maintained as a baccharis brushland with the exception of those areas subject to ridgetop, roadside, and powerline fuelbreak establishment and maintenance. The area should be maintained as Baccharis brushland by the initial removal of trees that have emerged from the baccharis canopy and areas of broom *(Genista monspessulana)*. It is estimated that the initial removal of trees and broom will cost $100,000. Periodic maintenance to control the establishment of trees and broom within the preserve are estimated to cost $16,900 (every 10 years).

Several species of ground, tree and shrub nesting birds occur in the study area. Fuel management activities should be restricted to the non-nesting season of these birds to minimize impacts to these species.

Prioritization and costs of fuel management activities

The fuel management activities identified above can be prioritized on the basis of their importance in addressing the fire hazard presented by the vegetation in Strawberry and Claremont canyons. It is important from the standpoint of fire safety to initially address the most hazardous fuels before initiating fuel mitigation problems in less hazardous vegetation types. With that approach in mind the following priority of fuel management activities is proposed:

1. Conversion of eucalyptus plantations
2. Conversion of conifer plantations on ridges
3. Establishment of roadside fuelbreaks
4. Establishment of ridgetop fuelbreaks
5. Establishment of shaded fuelbreaks
6. Maintenance of conifer plantations

The initial cost for implementing this fuel management proposal is estimated to be $3,431,750. Periodic maintenance costs will amount to $71,460/ year. These costs are shown in Table 4 and Table 5.

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