

CAL FIRE Fuel Treatment and Fire Effects Monitoring

Program Plan

California Department of Forestry and Fire Protection
Fire and Resource Assessment Program



June 10, 2019

Introduction

Background

The large and unprecedented increase in prescribed fire anticipated in California forests over the next two decades represents a fundamental shift in forest management strategy and policy, especially for the State. While the use of prescribed fire as a management tool, and the reintroduction of fire back into fire-adapted forest ecosystems are both well supported, the implications of such a large change to forest management will nonetheless require scrutiny to ensure the best potential outcomes. It is therefore imperative that implementation be accompanied by monitoring, which will allow agencies and practitioners to document basic information about fires, fuels, and vegetation, and detect impacts and trends to ensure that fire and natural resource management objectives are being met while minimizing potentially harmful impacts. Effective monitoring leads to improved best management practices, prioritized investments and adaptive management strategies.

Prescribed Fire/Fuel Treatment Monitoring

Monitoring of prescribed fires and other fuel treatments consists of evaluating both near-term (direct) effects, as well as long-term (indirect) effects on a number of identified metrics and indicators. It can help us evaluate the success of an individual prescribed fire project or vegetation management program beyond just the number of “black” or “treated” acres. It will usually consist of pre-fire, day-of-fire/active-fire, and post-fire measurements, to varying levels of detail. Post fire measurements are often re-taken for several years after a burn to evaluate long-term effects and determine eventual needs for retreatment.

Fuel treatment and fire effects monitoring can help answer such questions as:

- How much smoke and greenhouse gas was put into the atmosphere?
- How much of that smoke reached nearby communities? How long were those communities impacted? How would this compare to a wildfire?
- Did we achieve our fuel consumption targets, and how long will the fuel and fire hazard take to return?
- To what extent was the likelihood of crown fire in forested ecosystems reduced?
- What changes to vegetation composition and structure occurred due to the fire? Are the project area and nearby areas now more resilient to future wildfire?
- Are we having undesirable impacts to the ecosystem, such as increased erosion or changes to biodiversity/species composition?
- Are the prescribed burns collectively helping to achieve strategic fire and resource management goals?
- How effective are different treatment types and arrangements in mediating fire behavior and meeting both fire- and land-management objectives?

Answers to these and other questions will help CAL FIRE communicate to the public, landowners, and the legislature the benefits of prescribed fire as a management tool, and how well we are meeting our fire and land management objectives, using real data from actual prescribed fires. Where we are not

meeting our objectives, or are having undesirable impacts, monitoring can help us adapt our management strategies and improve best management practices.

Goals and Objectives

This program is designed as a collaborative effort between California Department of Forestry and Fire Protection – Fire and Resource Assessment Program (CAL FIRE – FRAP), the California Air Resources Board (CARB), and the University of California Davis (UC Davis). Beginning in 2018, the Governor’s Office directed CAL FIRE to work directly with CARB to facilitate monitoring of smoke and air quality impacts related to prescribed fire. With additional funding provided to CAL FIRE-FRAP, the program expanded to also include monitoring of fire hazard reduction and ecological effects of prescribed fire. CAL FIRE-FRAP hired a Senior Environmental Scientist to coordinate monitoring efforts, and entered into a contract with UC Davis to develop a field sampling team and protocols, and to provide scientific support and analysis.

This interdisciplinary and interagency group seeks to evaluate how fuel and vegetation monitoring data can interface with smoke monitoring data to understand the complex relationships between treatment application, smoke production and transport, and ultimately, treatment effectiveness as related to quantifiable objectives. While the program emphasizes evaluation of broadcast prescribed fire treatments, it will also include monitoring of alternative or multi-step projects involving other fuel treatment methods, including hand piling and pile burning, mastication and chipping, herbivory, and other treatments. The group meets weekly to coordinate upcoming monitoring efforts and develop program documents and strategy.

The collective mission, goals and objectives of the Fuel Treatment and Fire Effects Monitoring Program are as follows.

Mission

To provide information to state, federal and local agencies, land managers and practitioners about the near- and long-term effects of California’s increasing use of prescribed fire and related fuel management actions, in order to improve best management practices, minimize potentially harmful impacts, prioritize investments, and achieve resource management objectives.

Goals

- In conjunction with the California Air Resource Board and UC Davis, determine ways to increase the pace and scale of prescribed burning while protecting the people, property, and environment of California.
- Characterize the efficacy of reducing wildfire hazard with mechanical and prescribed fire treatments.
- Characterize the ecological and public health effects of prescribed burning.
- Share reports with all audiences (public, agencies, Legislature, Gov. Office, etc.) and provide recommendations for policy and program improvements.

Objectives

- Monitor smoke and air quality in communities and sensitive populations close to prescribed fires, as measured by PM2.5 concentrations and other metrics.
- Monitor prescribed fire and fuel treatment effectiveness on fire hazard reduction over time, as measured by reduced rate of spread, flame length, crown fire potential, and other metrics.
- Monitor prescribed fire and fuel treatment effects on ecosystems over time as measured by changes in aboveground carbon, tree mortality and damage, soil surface conditions, understory plant species diversity and cover, and other variables.
- Share data between organizations and work closely to pair information on fuel hazard, emissions, and ecological effects with air quality measurements.
- Analyze monitoring data to quantify and characterize impacts and effects of prescribed burning across multiple scales, including detecting trends over time.
- Provide information to the California Forest Management Task Force, CAL FIRE and CARB Executives, prescribed fire program managers, unit staff, and field practitioners.
- Support public information and awareness efforts regarding the benefits of prescribed fire, especially through departmental communications branches.

Program Structure

This document serves to outline the program structure, mission, goals, objectives, and timeline of the CAL FIRE Prescribed Fire Monitoring Program. Additional guiding documents and approaches are described in the sections that follow.

Monitoring Scoping Plan

CAL FIRE, CARB and UC Davis will collaboratively develop a monitoring scoping plan to identify key management issues and treatment effects which will guide selection of monitoring projects. Monitoring scoping plan will be updated annually.

Monitoring Advisory Committee

CAL FIRE, CARB and UC Davis will convene a monitoring program advisory team, composed of CAL FIRE, CARB, USFS, UCD staff, and other groups as needed. Advisory team will meet quarterly to discuss monitoring priorities and resolve any team issues.

Monitoring Program Team

The Prescribed Fire Monitoring Program team will consist of project leads, field staff and others from CAL FIRE, CARB and UC Davis as follows.

CAL FIRE

- Program Coordinator - Senior Environmental Scientist – Forest Health Monitoring
- FRAP Scientific Staff (as needed)

- Vegetation Management Crews – Forestry Assistant II, with assistance from crews
- Possible future expansion – 2-4 FRAP seasonal field crew members

CARB

- Program Coordinator – Air Pollution Specialist – Air Quality Planning and Science
- Project Scientist – Air Pollution Specialist - Incident Air Monitoring
- Project Staff – Rapid Incident Response team

UC Davis

- Project Director and Principal Investigator
- Project Scientist and Technical Coordinator
- Field Crew Chief (Ph.D. student)
- 3-4 Seasonal field crew members
- 2 Summer interns
- Outreach Coordinator (Postdoctoral scholar)

Monitoring Approach

The program will take a multi-tiered approach to field measures and analysis:

- Tier 1 – Detailed field measurements taken by CAL FIRE, CARB and UC Davis at burn unit-level
- Tier 2 – Limited field measurements taken by CAL FIRE Vegetation Management crews
- Tier 3 – Evaluation of annual statewide data on Rx burn projects

Tier 1 measurements and analysis are the most detailed. These will include field measurements taken at or near the physical prescribed burn area by CAL FIRE, CARB and UC Davis prior to, during and following prescribed fire. At minimum, these measurements will involve the deployment of air quality monitoring units, installation of semi-permanent fuels and vegetation monitoring plots, and fire environment observations taken the day of the prescribed fire. Plots will be re-measured for up to 6 years after a prescribed burn.

Tier 2 measurements are limited in scope, to be taken at or near the physical prescribed burn location by Vegetation Management Crews prior to, during, and immediately after a prescribed fire. This tier leverages the skill of the Forestry Assistant II on each of CAL FIRE’s Vegetation Management Crews to obtain data for a broader selection of prescribed burns than would otherwise be possible. As their priority is treatment implementation, Vegetation Management Crews have limited capacity for detailed measurements or revisits to burn units. Tier 2 measurements will include, but are not limited to, photo documentation of pre- and post-burn conditions, rapid assessment of fuel loading, and basic fire environment observations.

Tier 3 measures will be derived from records of prescribed fires implemented across the state. Data will come from sources such as CalMAPPER (CAL FIRE’s activity tracking database), FACTS (the US Forest Service activity tracking database), and others. Prescribed fire activity across the state will be evaluated against agency priority areas, goals and objectives.

Annual Work Timeline

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Weekly Coordination	■	■	■	■	■	■	■	■	■	■	■	■
Advisory Group Call/Meeting	■			■			■			■		
Training		■	■	■								
Field Planning			■	■	■							
Field Sampling					■	■	■	■	■	■		
Data QA/QC											■	■
Data Analysis and Report	■	■	■									
Report Submission				■								
Presentations and Workshops					■	■						

Project Selection and Sampling Protocols

Selection of Tier 1 monitoring sites will be guided by the monitoring scoping plan and advisory team recommendations. Sites will be chosen to maximize the potential long-term benefits to project goals while considering logistical and cost constraints. Sites will be considered first from those included in the Community Wildfire Prevention and Mitigation Report (45 Day Report), followed by state forests, state parks, and those with good neighbor agreements or other collaborations. Additional monitoring may occur on various jurisdictions where permission can be obtained, including National Forests, National Parks, and Bureau of Land Management lands, university research facilities, and private and corporate lands.

Tier 2 monitoring will occur on as many prescribed fires as possible, to be performed by the Vegetation Management Crews.

As much as possible, Tier 1 and 2 fuels and vegetation monitoring will occur coincident with CARB air quality monitoring and other similar monitoring efforts. This will be coordinated on weekly Monitoring Program Team calls and meetings.

Sampling of units that are undergoing maintenance treatments will be evaluated to examine key criteria regarding effectiveness duration and ecosystem impacts. Linked treatments designed as sequential operations targeted at final outcomes (e.g., mechanical treatment followed by broadcast prescribed fire) will also be examined.

Where possible, the monitoring program will examine the interaction of wildfires on previously installed treatments, as well as effects of wildland fires managed for resource benefit.

Prescribed Fire Project Tracking and Monitoring Scheduling

A database of potential prescribed fire projects and possible monitoring opportunities will be maintained throughout the year, to include active VMP's and other upcoming fuel management projects.

An annual burn calendar will be maintained throughout the year through coordination with key personnel at each burn unit to align crew availability with as many prescribed fires as possible during each burn season.

Prescribed Fire Monitoring Program personnel will work with prescribed fire project implementers, air quality management district personnel, and others to perform measurements before, during and after a prescribed fire. This may include some, or all, of the following. The data gathered will be used to inform prescribed fire and air quality managers of fuel conditions before and after burns, and air quality impacts during burns. This will help inform future projects so that effectiveness can be optimized.

Table 1: Prescribed Fire Monitoring Program measurements

Activity	Timing
Installation and reading of semi-permanent fuels and ecosystem measurement plots. Typical plots in forested systems are 1/10 th acre, circular plots with a durable monument at plot-center.	Pre-burn fuel measurement is usually done days to weeks in advance of a prescribed fire. Post- burn measurements are usually up to one month after the burn, then annually or biennially thereafter for up to 5 years.
Photo-documentation of pre- and post-burn conditions at fixed locations. Photo points are recorded by GPS, and detailed photo information is recorded to accurately recreate photos after the burn.	Usually done 1-2 days before the burn, or the day of the burn, prior to ignition. Photos are recreated 1-7 days after fire is declared out.
Deployment of portable air quality monitoring units at locations near the prescribed fire, typically in nearby communities or in locations with sensitive populations that may be impacted by smoke. The portable units require a standard 120V outlet, and sit on a tripod with a relatively small footprint.	Deployed by local air districts with support from CARB 1-3 days prior to the burn.

<p>Fire environment and behavior measurements immediately prior to and during the prescribed fire (day-of-fire). This may include deployment of fuel moisture measurement equipment, fuel sample collection for precise fuel moisture measurement, periodic weather observations during burn operations, and observations of fire behavior (rate of spread, flame length, torching).</p>	<p>On the day of burn.</p>
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Detailed Field Sampling Protocols – Tier 1

Air Quality

- Deployment of portable air quality monitoring units at locations near the prescribed fire, typically in nearby communities or locations with sensitive populations that may be impacted by smoke.
- E-BAM (portable AQ units) require a standard 120V outlet, and sit on a tripod with a relatively small footprint.
- Usually deployed by CARB 1-3 days prior to burn, left in place up to two weeks.

Vegetation and Fuels Plots

- Semi-permanent fuels and ecosystem measurement plots.
- Pre-burn measurement is usually done days to weeks in advance of a prescribed fire. Post-burn measurements are usually up to one month after burn, then annually or biennially thereafter for up to 6 years.
- 400 sq m (1/10 acre; a standard monitoring plot size for agency and university researchers; data generally expanded to per acre or per hectare for analysis)
- Sufficient plots installed for reasonable power, precision and accuracy, stratified by treatments if appropriate, ≥ 5 control plots
- Sampled before and after prescribed burn whenever possible, then monitored for at least 3 years.

Plot-level information:

- Overall cover (trees and all vegetation), landscape variables (GPS location, slope, aspect, horizontal and vertical shape)

Fuel measurements

- 1-1000 hr fuels, via Brown's Transects (≥ 2 transects per plot), litter and duff depths, coarse woody debris (diameters, length, decay class)
- Different fuel sizes subsampled along transects

Tree measurements

- Height, dbh, height to live crown, crown width, tree health, tree status (live/dead), tree position (e.g., emergent, dominant, codominant, suppressed, etc.)
- Growth increment, dominant trees
- For snags, measure dbh, height, and decay class

Shrub and understory measurements

- Modal height, cover of lifeform classes, identification and cover of every plant species present (all lifeforms; we may ask a collaborator to do lichens as well)

Ground cover measurements

- Standard components: litter (cover and depth), bare soil, bedrock

For pre- vs. post-treatment monitoring projects

- Leave litter pins to measure litter/duff consumption
- Measure tree-level fire severity by:
 - Bole char height (average and maximum)
 - Scorch and torch percentage
 - Scorch and torch height
 - Mortality
- Shrub fire severity measured by postfire twig diameter (using calipers)
- If crews are on-site during burn, we can also measure flame heights and other real-time measures
- Aboveground Carbon (measured using standard allometry and formulas)

Fire Environment (Day-of-Burn) measurements

- Pre-burn fuel moistures (destructive sample of 1, 10, 100 hr fuels, duff and litter)
- Hourly weather (temperature, RH, wind, SOW)
- Hourly 10-hour fuel moisture
- Fire behavior (flame length, rate of spread, torching)

Detailed Field Sampling Protocols – Tier 2

For all prescribed fire projects

- Repeatable photo-documentation of pre- and post-burn conditions at fixed locations.
- Photo points are recorded by GPS, and detailed photo information is recorded in order to accurately recreate photos after the burn.
- Usually done 1-2 days before burn, or day of burn prior to ignition. Photos are recreated 1-7 days after fire is declared out.
- Rapid fuel characteristic measures (TBD)

Data Acquisition – Tier 3

- [TBD]

Data Management

UC Davis and CAL FIRE will maintain a joint database of fuel and vegetation measurements from prescribed fire monitoring projects. UC Davis project scientist will submit database and an annual report

to CAL FIRE-FRAP by April 30 each year, and work with CAL FIRE personnel to integrate findings into department monitoring reports.

CAL FIRE Vegetation Management Crews will submit photos and rapid assessment data from previous years burns to FRAP by February 30th each year.

CARB will maintain a database of air quality measurements made near prescribed fires. CARB will submit air quality data from prescribed fires monitored the prior year to FRAP by April 30 each year.

Reporting Metrics and Analytics

Field measurements will support the following reporting metrics and analytics, to be synthesized in annual reporting.

Tier 1 Metrics (based on quantitative field plot measures)

- Pre/post burn fuel loading (tons per acre)
- Fuel consumption (tons per acre) and estimated GHG and pollutant emissions from Rx burn
- Pre/post burn expected wildfire behavior
- Pre/post burn expected tree mortality, within treatment boundary
- Pre/post burn overstory stand structure and composition
- Pre/post burn understory composition and diversity
- Pre/post burn expected wildfire behavior, outside treatment boundary (“shadow effect”)
- Smoke and criteria pollutant emissions at burn unit (e.g. PM_{2.5}, PM₁₀)
- Smoke and criteria pollutant emissions in nearby communities and sensitive populations
- Hourly and daily air quality before, during and immediately after burn
- Carbon/GHG stock and flux

Tier 2 Metrics (based on photo interpretation and rapid measurement protocols)

- Pre/post burn fuel loading (tons per acre)
- Pre/post burn expected wildfire behavior

Tier 3 Metrics (based on statewide records of prescribed burning)

- Annual acres burned, by complexity (and possibly some measure of strategic value)

Synthesis and Annual Report

CAL FIRE-FRAP will produce an annual report by April 30 each year that summarizes results from all tiers investigated the previous year, as well as examining trends from multiple years. Annual report will be reviewed and approved by CAL FIRE executives, and presented to the Board of Forestry and Fire Protection. Additional presentations may be made to the California Air Resources Board, California Forest Management Task Force, and other relevant policy organizations.

Presentations, Outreach and Program Feedback

Findings summarized in CAL FIRE's annual report will be shared with all audiences via a strategic media effort (including internet, regional workshops, media outreach, etc).

Findings from CAL FIRE's annual report will be presented annually to the Board of Forestry and other policy organizations such as the Forest Management Task Force.

In partnership with UC Davis, CAL FIRE will partially fund a science outreach specialist (co-funded by California Fire Science Consortium) to coordinate science translation and delivery, including a statewide annual prescribed fire monitoring workshop to dispense summary information and findings related to the monitoring efforts.

CALFIRE, CARB and UC Davis will work to publish other reports and peer-reviewed papers as appropriate.

CAL FIRE and UC Davis will coordinate field and office workshops with fire and vegetation managers and the Forest Management Task Force commissioned by the governor.

Staff and Personnel Practices and Expectations

General Program Expectations

The following are general expectations for both Monitoring Program personnel and Unit or prescribed fire project operational staff.

- Monitoring Program personnel will work with Unit or project staff and AQ management district personnel to ensure adequate communication at all times.
- Monitoring Program personnel will not impede successful prescribed fire planning or operations.
- Monitoring Program personnel present on the day of the burn will operate under the direction of the Incident Commander, Burn Boss, or other designated project leader, and will follow all safety precautions as directed.
- If requested, Unit or project staff will provide Monitoring Program personnel with burn plans or other relevant information in advance of burn, to assist with monitoring planning.
- Unit or project staff will assist Monitoring Program personnel in obtaining access to burn unit or air quality monitoring locations prior to and after burn operations.
- Once complete, Monitoring Program personnel will provide data and analysis results to unit or project staff if requested.

Field Safety Plan

[TBD]

Training

CAL FIRE Annual 40-hour fireline safety training (all) -or- Federal FF2 training (Red Card)

CAL FIRE Radio Use (all)

First aid and CPR (all field crew leads)

Defensive Driver Training (all)

Contacts and Project Administration

Program Leads

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Program Staff and Advisors

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Hugh Safford UC Davis (Science Advisor)

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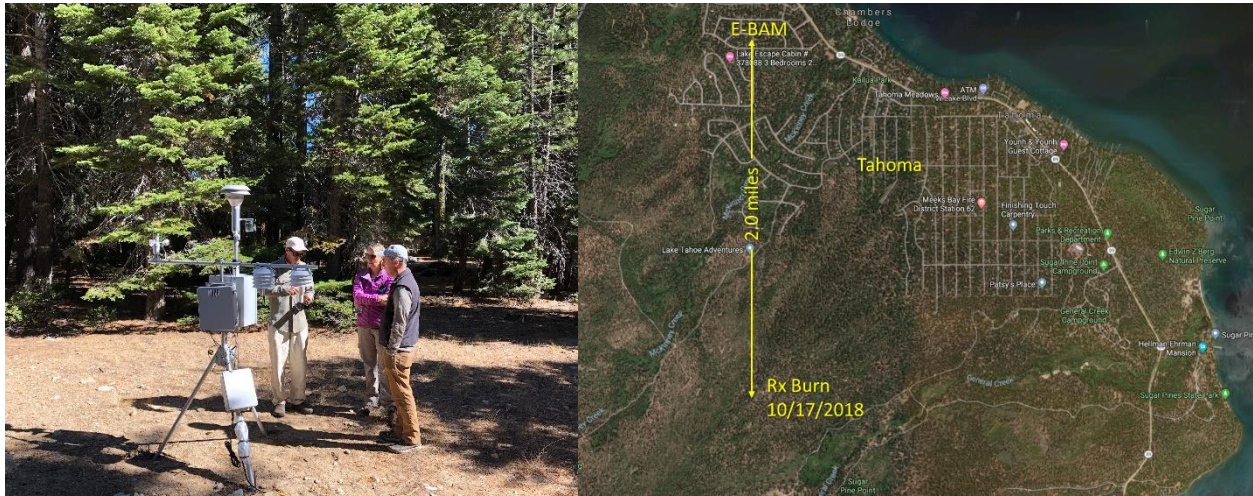
Chris Keithley CAL FIRE-FRAP (Program Administration)

John Melvin CAL FIRE (Program Administration)

David Passovoy CAL FIRE-FRAP (Rx burn Specialist)

Tadashi Moody CAL FIRE-FRAP (Science Advisor)

Appendix 1: Monitoring Examples



E-BAM air quality monitoring unit deployed near Sugar Pine Point State Park, October 2018



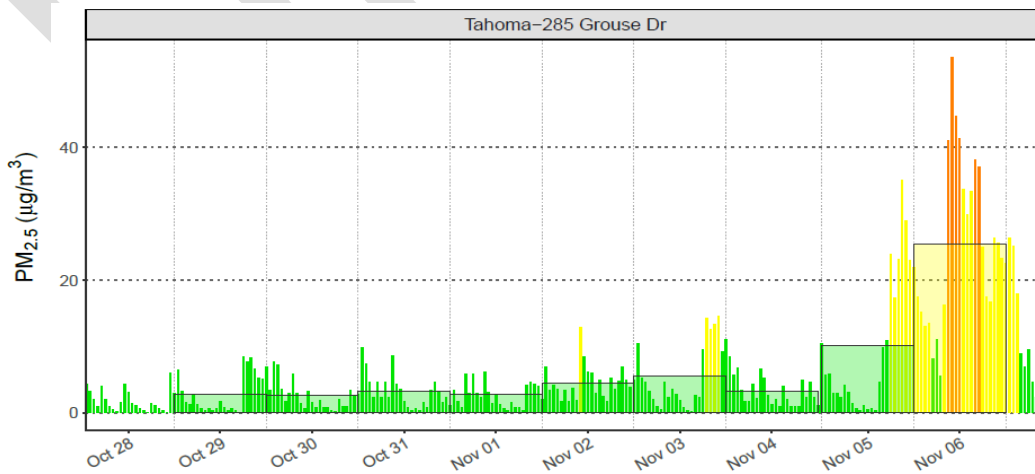
Pre- and post-fire measurements of fuels at Sugar Pine Point State Park, October 2018



Rate of Spread measurements during prescribed fire, Doaks Ridge, July 2018.

Daily (AQI) and Hourly (NowCast) PM_{2.5} Levels

Daily Air Quality Index (24hr AQI)	Hourly NowCast (actions to protect yourself)
■ Hazardous	Everyone should avoid any outdoor activity.
■ Very Unhealthy	Everyone should avoid prolonged or heavy exertion.
■ Unhealthy	People within Sensitive Groups should avoid all physical outdoor activity.
■ USG	People within Sensitive Groups should reduce prolonged or heavy outdoor exertion.
■ Moderate	Unusually sensitive individuals should consider limiting prolonged or heavy exertion.
■ Good	None.



Air quality measurements from E-BAM unit near Sugar Pine Point State Park, Oct/Nov 2018

Appendix 2: Vehicles, Supplies and Equipment List

Vehicles

FRAP will provide a field vehicle for State employee use, and all necessary field equipment for FRAP participation in field studies. Any additional field equipment required by CAL FIRE Vegetation Management Crews for field measurement will be provided to them by FRAP. Via contract with FRAP, UC Davis will provide field vehicles and equipment for UC Davis crews. CARB will provide vehicles and equipment for air quality monitoring via their Rapid Incident Response program.

Sample Field Equipment List – Tier 1

- Clipboard
- Pencils/Pens
- Data sheets – Fuels, Overstory, Understory, Weather, Fire Behavior
- Compass
- Clinometer
- GPS and Tablet
- First Aid Kit
- Radio
- Maps
- Flagging and stick flags
- For fixed area plots
 - Rebar
 - Rebar caps
 - Distance tape
 - Aluminum tree tags and nails
 - Diameter tape
 - Hypsometer
 - Sight tube
- For Brown's transects
 - Go no go gauges
 - Trowel
 - Duff Pins
 - Meter stick and ruler
- For weather and fuel moisture
 - Kestrel, tripod and wind vane
 - Temp/RH loggers
 - 10hr fuel sticks with racks
 - Fuel stick scale
 - Garden clippers and bags
 - Hand saw
 - Collection tins and paper bags
- For photo points
 - Camera (or use one on tablet/phone)
 - White board

- Dry Erase Markers
- For fire behavior
 - ROS poles with heat-resistant paint – 0.5m marks
 - Level for pole installation
- For pre/post burn sampling days
 - Clothing and footwear appropriate for weather
 - Helmet and field vest
 - Food and water for day
 - Sunscreen
- Personal gear for pre/post burn sampling days
 - Clothing and footwear appropriate for weather
 - Helmet and field vest
 - Food and water for day
 - Sunscreen
- Additional personal gear for burn days
 - Fireline approved helmet and Nomex

DRAFT

Appendix 3: Relationship to other CAL FIRE Research and Monitoring Programs

The Climate Change Research Plan for California lays out a Forest Research Agenda for California in which the “fundamental focus is to enhance monitoring and develop a better understanding of forest and woodland dynamics”. The Research Plan underlines the importance of assessing the effectiveness of strategies to reduce risk while also sequestering carbon, and identifying best management practices to minimize losses to forest capacity to sequester carbon. CAL FIRE has several existing and new monitoring programs, and recent legislation such as AB 1492 require development and tracking of ecological performance measures across multiple land management agencies.

Current CAL FIRE Resource Management Monitoring Programs and Projects

CAL FIRE has several existing and new monitoring programs, including the following. Effort will be made to align, coordinate and integrate findings from the Prescribed Fire Monitoring Program with other department monitoring programs.

CCI Forest Health Grant Program

- Forest Health Project Monitoring
- Forest Health Research Grants

Watershed Protection Program

- Exemption and Emergency Notice Monitoring
- Forest Practice Rules Effectiveness Monitoring (FORPRIEM 2.0)

Fire and Resource Assessment Program

- California Forest and Rangeland Assessment
- Forest Ecosystem and Harvested Wood Product Carbon Accounting
- Forest Ecosystem Research Projects

Demonstration State Forests

- Continuous Forest Inventory
- Caspar Creek
- Individual State Forest research projects (internal and externally led)

Appendix 4: Links to background documents

In 2017 the California Air Resources Board (CARB) and the California Department of Forestry and Fire Protection (CAL FIRE) established a Joint Prescribed Fire Monitoring Program. The program pre-dates, but is required by Public Resources Code (PRC) Section 4495 and is in line with Governor Jerry Brown's Executive Order B-52-18 as well as with goals F-1.1, F-1.3, F-1.6, and F-1.9 as described in the Safeguarding California Report and goals for Non-Federal Forest Lands the California Forest Carbon Plan. Please see links below:

- PRC 4495: <https://leginfo.legislature.ca.gov/faces/codes.xhtml>
- Executive Order B-52-18: <https://www.gov.ca.gov/wp-content/uploads/2018/05/5.10.18-Forest-EO.pdf>
- Safeguarding California Report: <http://resources.ca.gov/climate/safeguarding/>
- California Forest Carbon Plan: <https://www.fire.ca.gov/fcat/>