ABSTRACT

Carbon, fire hazards, and forest regeneration dynamics following high severity wildfire in a mixed-conifer forest at Boggs Mountain Demonstration Forest

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We evaluate direct wildfire impacts on 1) tree mortality, fuel consumption and stored carbon, and 2) post-fire forest regeneration, understory vegetation recovery, and fuel and carbon dynamics following a high severity wildfire at Boggs Mountain Demonstration Forest (BMDF). This study uses two scales to address the following research question: What are the effects of various post-fire forest management strategies on carbon-storage, fire hazard, and other ecological variables? First, forest-wide observational data using pre- and post-fire data from the Forest's Continuous Forest Inventory (CFI) provides insight into tree mortality from the 2015 Valley Fire, carbon emissions and flux, and implications of post-fire harvest on stored or utilized carbon following stand-replacing fire. Second, a manipulative experiment exploring alternative post-fire management strategies on forest regeneration, carbon sequestration, and fuel hazards is being implemented to provide long-term insight into forest recovery. In the observational study, roughly 115 CFI plots were read following the fire, and inference regarding direct impacts on forest structure, tree mortality, and carbon stocks will be calculated. In the experiment, 20 replicate units of roughly 3 ha each have been established in a randomized block design, where 4 unique treatments are being applied: 1) no harvest/control; 2) harvest/no plant control; 3) harvest/pile burn/plant; and 4) harvest/pile burn/sub-surface rip/plant. Metrics being evaluated are natural and planted tree seedling establishment and growth, understory plant richness and cover, forest fuel characteristics and development, and the fate and trajectory of stored carbon. From these metrics we hope to infer the influence of both pre-existing stand conditions on post-fire forest and fuel structure, and in cases of high severity fire (where >90% of the basal area was killed), the implications of salvage logging and alternative site preparation treatments on long term forest carbon and fire hazard dynamics.

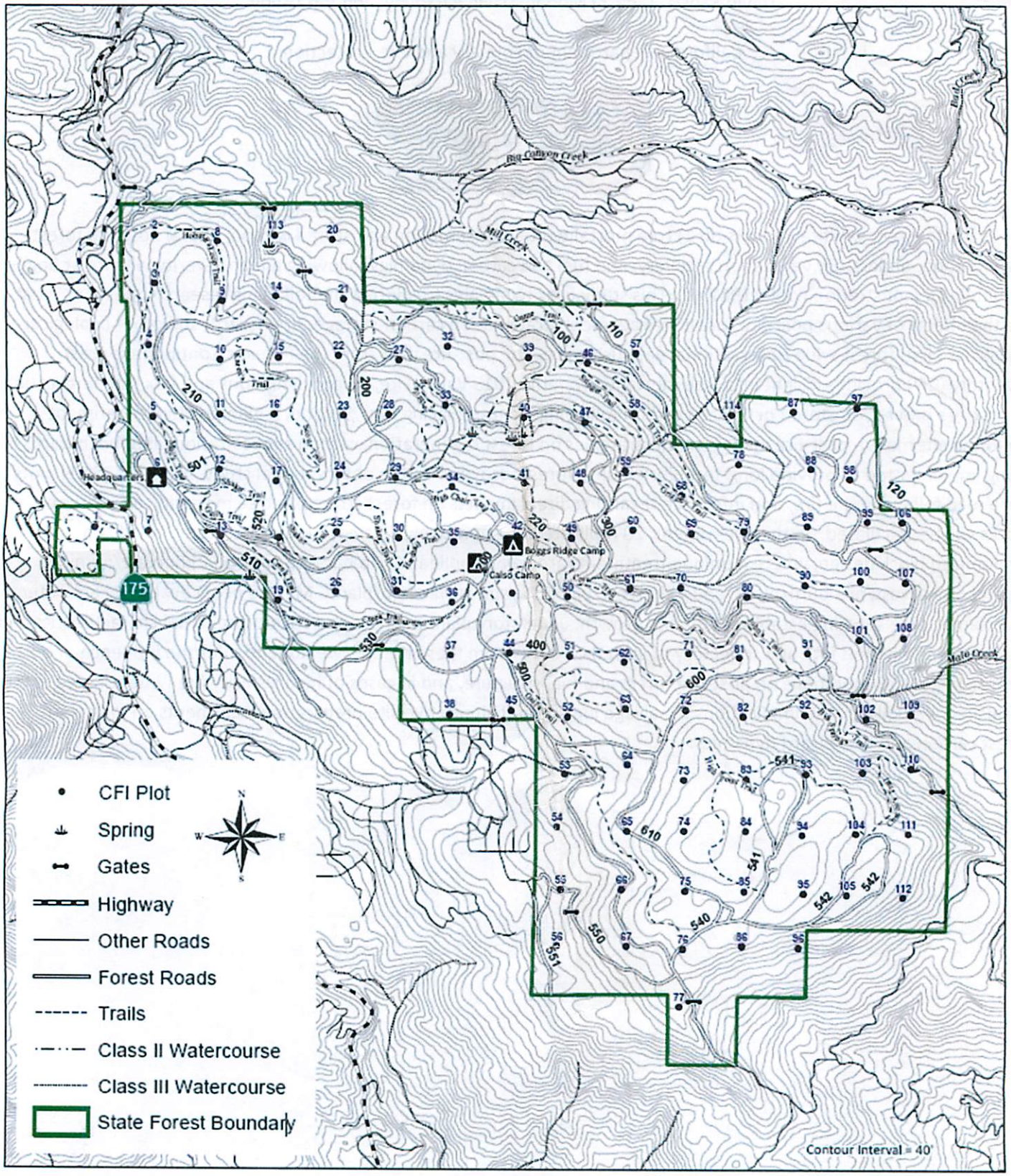
Boggs Mountain CFI Plots

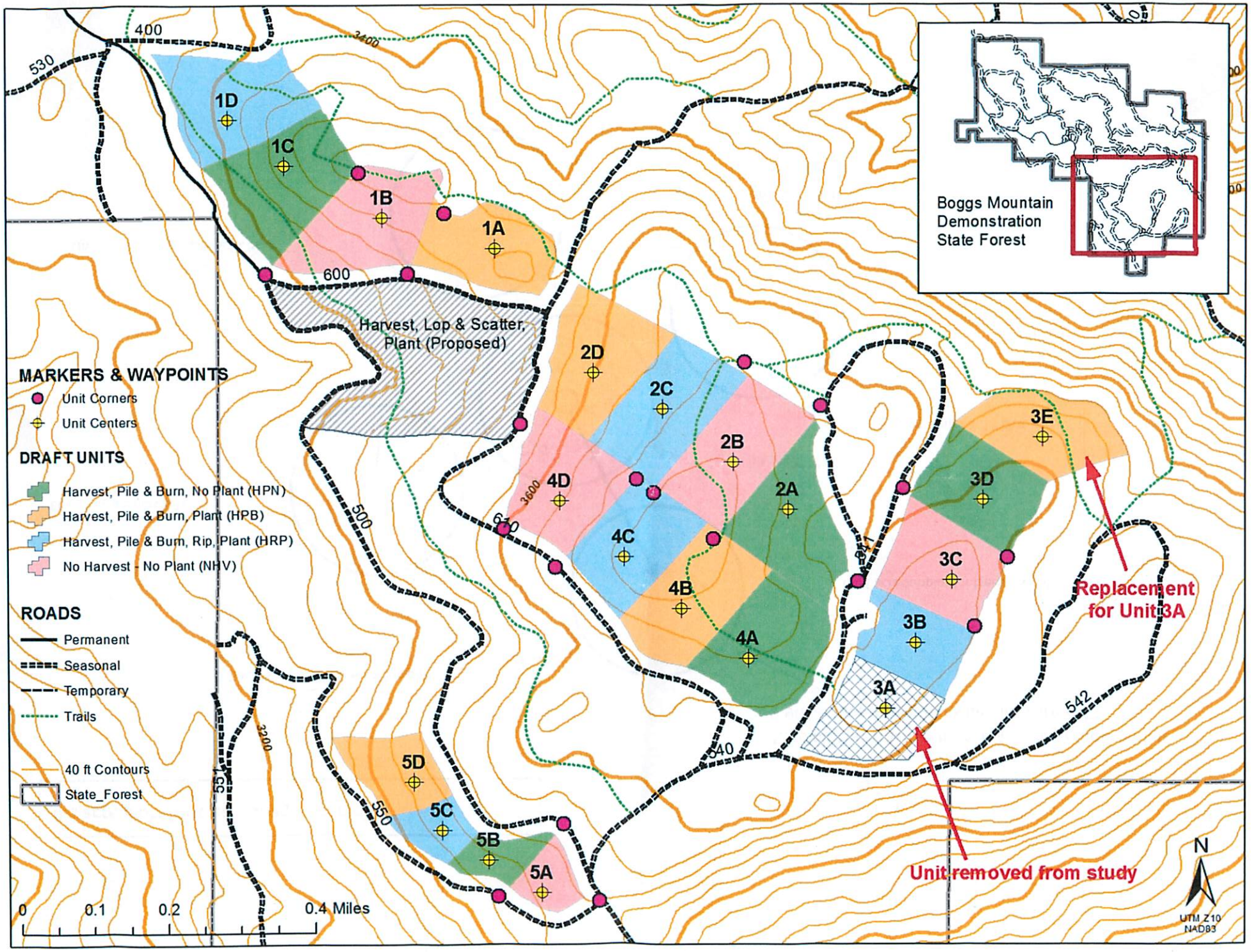
1 inch = 2,500 feet

0 0.25 0.5 1 Miles

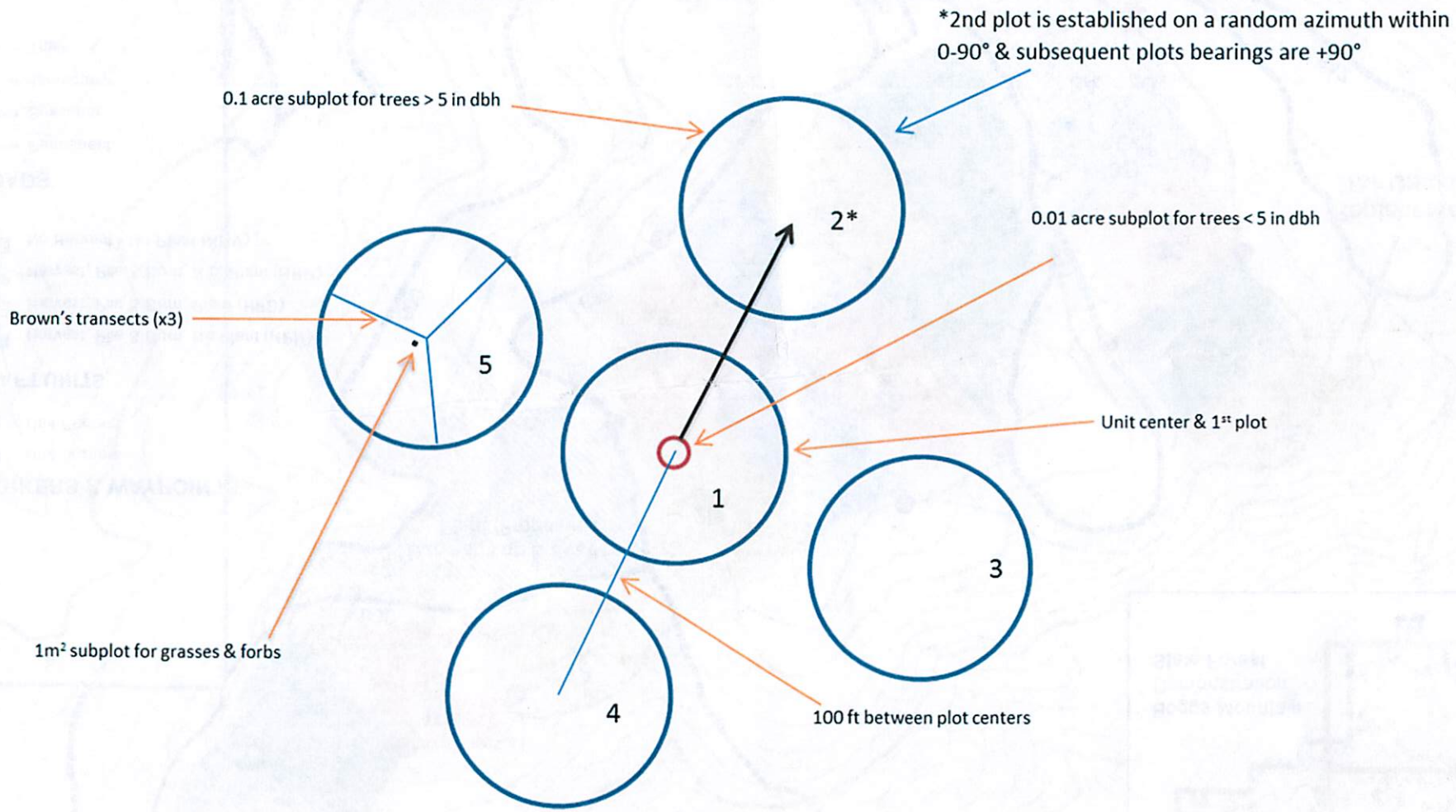
BOGGS MOUNTAIN DEMONSTRATION STATE FOREST

3/17/2015 Headley




Boggs Mountain Demonstration State Forest
MARKERS & WAYPOINTS
Unit Corners
Unit Centers
DRAFT UNITS
Harvest, Pile & Burn, No Plant (HPN)
Harvest, Pile & Burn, Plant (HPB)
Harvest, Pile & Burn, Rip, Plant (HRP)
No Harvest - No Plant (NHV)
ROADS
Permanent
Seasonal
Temporary
Trails
40 ft Contours
State_Forest
Harvest, Lop & Scatter, Plant (Proposed)
1A
1B
1C
1D
2A
2B
2C
2D
3A
3B
3C
3D
3E
4A
4B
4C
4D
5A
5B
5C
5D
Replacement for Unit 3A
Unit removed from study
0 0.1 0.2 0.4 Miles
N
UTM Z10 NAD83

0.1 acre plots for trees/ snags > 5 in dbh



Monitoring impacts of fire on watersheds at Boggs Mountain Demonstration State Forest

Site description

- Quaternary volcanics (andesitic flows and lahar deposits) capping Mesozoic sedimentary rocks from the Great Valley Sequence
- Annual precipitation: 67 in, rain dominated.
- 95% of forest was commercial mixed-conifer timberland
- September 2015 Valley Fire, mixed severity

Objectives

1. Quantify impacts of different burn severities on runoff and erosion
2. Assess impacts of post-fire salvage logging and site preparation on runoff, erosion, and soil properties
3. Assess processes that control post-fire and post-salvage erosion

Methods

Scale and design

- Burn severity impacts in small catchments ("channels"), installed Nov 2016
- Treatments in hillslope plots (1 treatment per hillslope "block"; 5 blocks)
  - High severity burned, untreated controls. Installed Nov 2015

  Planned summer 2016:
  - Salvage logged with ground-based methods following practices in larger sale units
  - Logged and contour subsoiled (ripped)
  - Logged and pre-emergent site preparation
  - Logged and delayed-application defoliant site preparation
  - Logged, ripped, and pre-emergent (space dependent)
- BMP Demonstration (pending on timing of 319(h) funding)

Soils

- Bulk density, infiltration, and water repellency along three transects per channel and in one location per plot

Cover

- Surface and canopy cover surveys
- Along transects in channels and in three quadrats per plot

Precipitation

- Three stand-alone tipping bucket rain gages across monitoring area (will increase to six in 2016)
- One USGS rain gage (USGS site number 385022122423601)

Sediment delivery

- Eroded soil collected in silt fences in each channel and plot
- Periodic sediment sampling to determine sediment production
- Monitoring of rill networks in each channel/plot

Runoff

- Silt fences in all channels and in one plot of each treatment include weirs and pressure tapes to determine runoff rates and volumes.

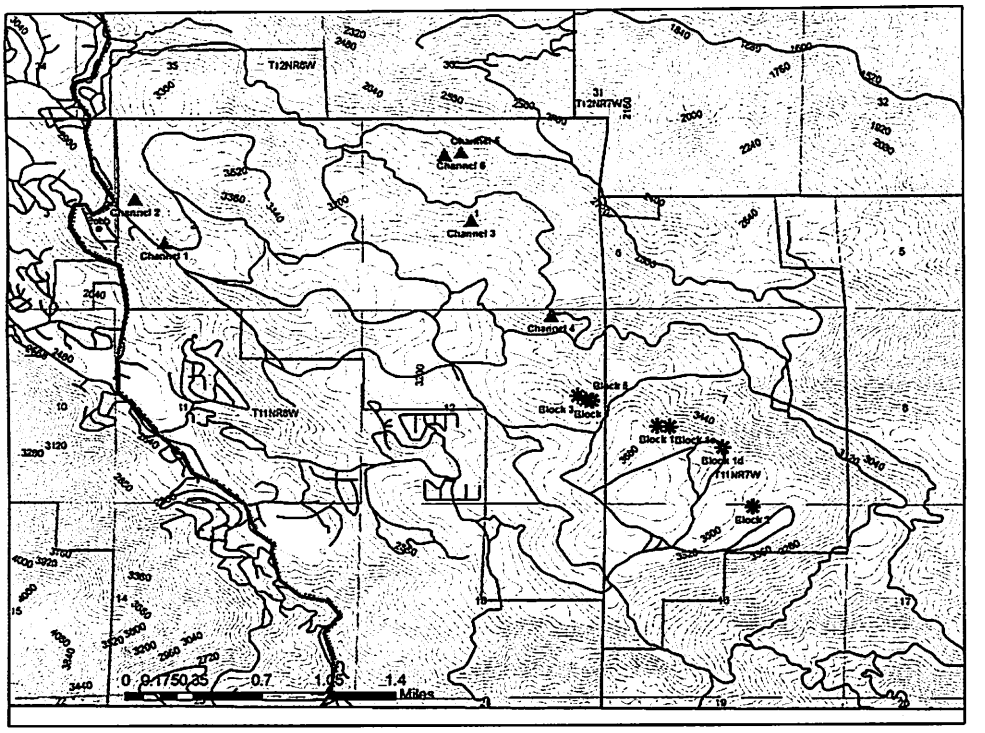


Figure 1. Map of study sites. Triangles indicate channels, stars indicate blocks of replicated plots

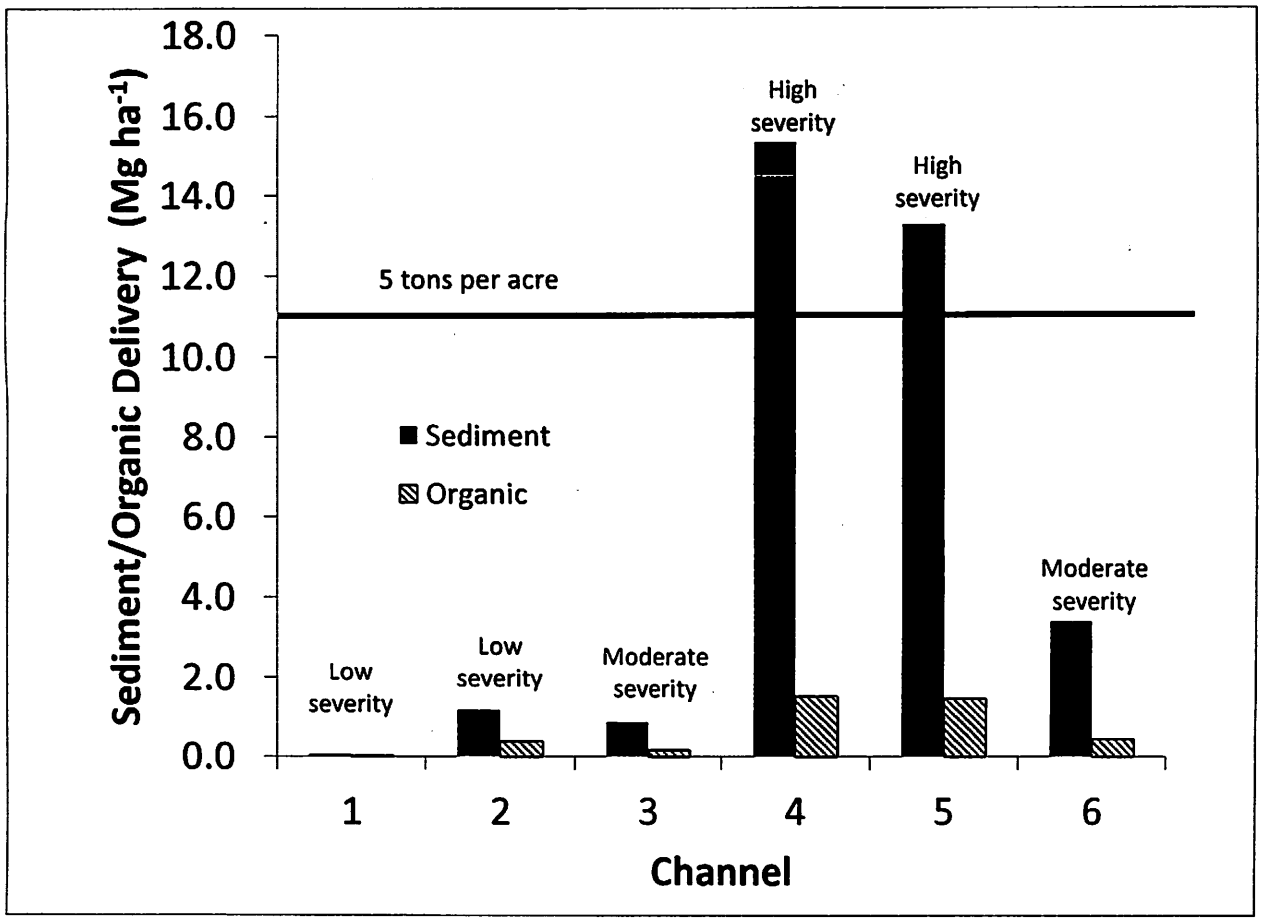


Figure 2. Sediment delivery results from monitored channels for the 2015/2016 wet season.

- Magnitude of sediment delivery from channels non-linearly correlated with ground cover; sediment delivery starts to increase rapidly when the percent of bare soils are greater than 55 percent.
- Dominant mechanism for high rates of sediment delivery is rill and channel incision; High soil burn severity catchments have much higher rill/channel densities than moderate or low soil burn severity sites.

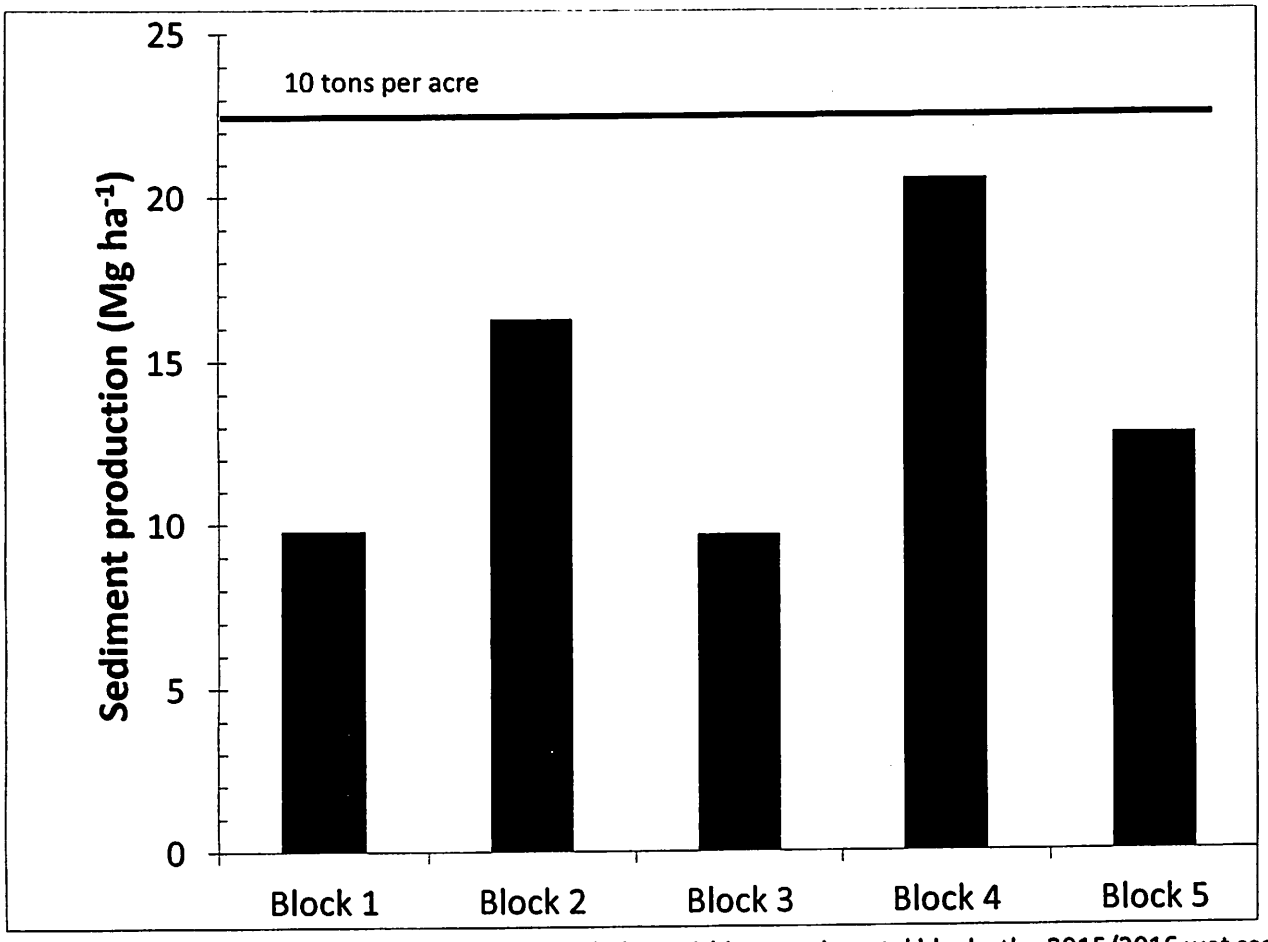


Figure 3. Sediment production results for control plots within experimental blocks the 2015/2016 wet season.

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