

**Arborist Report
Butte Fire Incident
15-CA-AEU-0024918**

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On Thursday morning, September 10, 2015, I received a telephone call from CAL FIRE Battalion Chief Christopher Van Cor. He requested my participation in investigating a tree/power line contact incident on a PG&E easement in Amador County. The utility's electrical equipment extends through private property located east of Jackson, California. The ongoing investigation was concentrating on tree/line contact found to have ignited the Butte Fire at 2:26pm on September 9, 2015 (Butte Fire General Information - State of California [cdfdata.fire.ca.gov/...](http://cdfdata.fire.ca.gov/)). In downtown Jackson winds were gusting to the south at 12 km/h at the time of ignition, (Weather Underground reporting station – see attached).

I traveled from Springville, California and arrived on the afternoon of September 10th at a staging location at 17501 Butte Mountain Road just outside of Jackson. There, I was met by Chief Van Cor and directed to the investigation site identified by CAL FIRE cause and origin experts as the origin vicinity. I remained at what I later learned was the Charamuga Ranch location and departed the vicinity sometime after 4pm. During the extent of my site visit I was in the presence of Chief Van Cor and CAL FIRE cause and origin investigator Captain Gianni Muschetto, and a CAL FIRE LIDAR survey team.



MTM_EOS7D_IMG8335 (cropped)

My assignment was to gather information and establish initial observations relating to arboricultural forensics study. Though details of my assignment are not firm at the onset it is my belief that I was to begin to consider and question pertinent site features and arboricultural attributes for recent and historic impact from possible contact(s) with overhead electrical power lines.

Attention was directed to the ongoing inspection of a Gray pine (*Pinus sabiniana*) observed with the length of its slender stem lying horizontal, just above the ground with the base of the tree still firmly upright and rooted (previous page - image 8335). The tree was one of several Gray pines growing along the north flank of an east-west powerline corridor; several pines and other trees and shrubs had been cut earlier in the season and stems and shrubbery were left lying alongside their stumps. The sight of the recumbent tree was compelling. My first inclination was to document the immediate scene and begin to establish an arboricultural context.



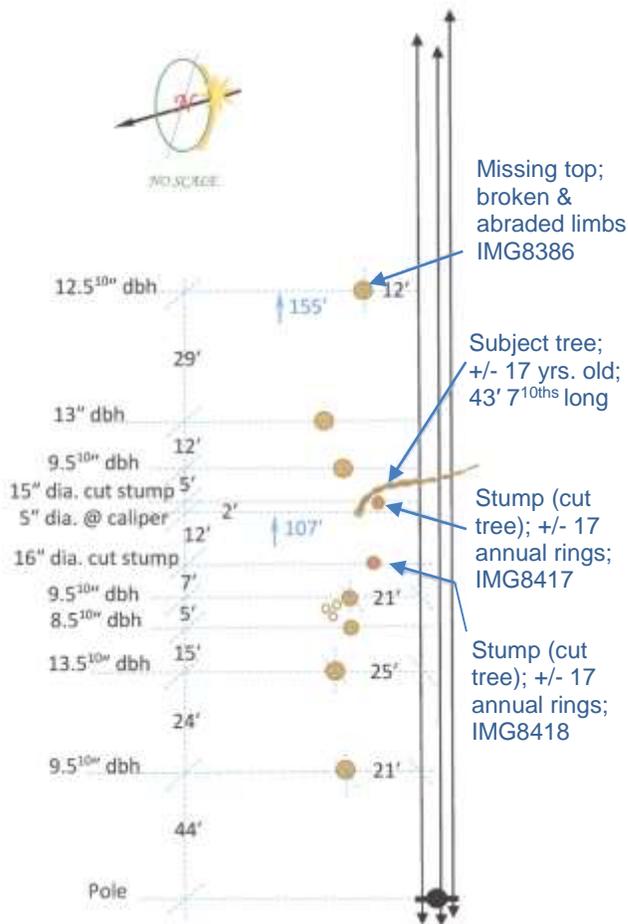
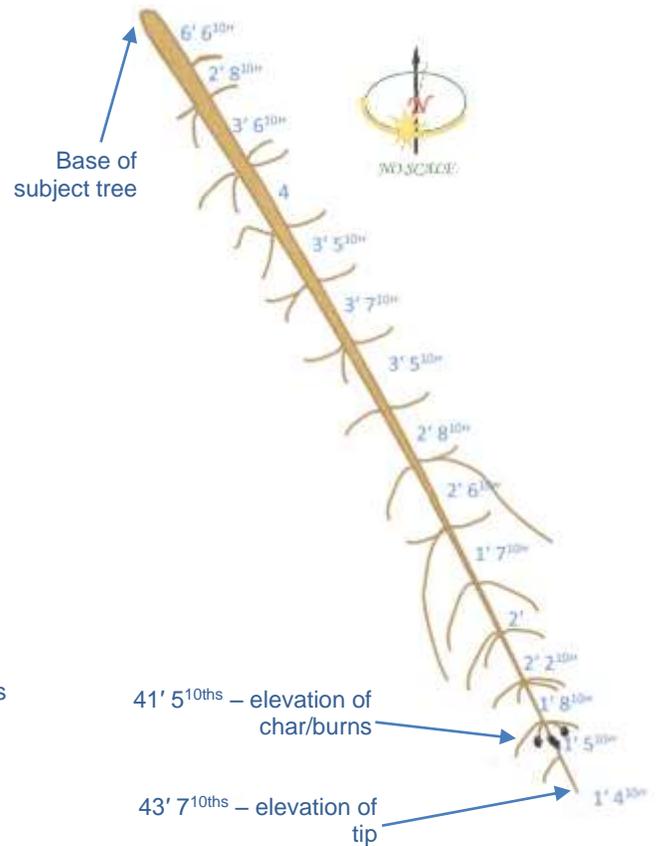
The surface grade is sloping in this locale, descending from the proximity of a power pole situated at the top of a rise. The 3-phase conductor span extends easterly over tree canopy and open-space to power poles in the distance. Images of the scene are shown on pages 2 and 3; a stand of Gray pines encompass the subject tree (seen here, left) with a red arrow indicating the subject tree extending out of the image, bottom right. A stand is a group of forest trees sufficiently similar in age, size and type to be considered a unit. Trees that are captured, and that develop within a closed stand, have narrow growth rings and poor stem taper. When the stand is altered and captured interior trees are exposed to open spaces, whether for right-of-way clearance or other reasons, they are prone to failure.

Two larger pines were situated on the south side at the edge of the stand; one of the remaining stumps is also visible here (shorter blue arrow). It is apparent that the act of cutting larger pines that previously contained the stand exposed interior trees.

During discussions with CAL FIRE investigators on-scene it was conveyed that local property owners observed line clearance workers cutting trees in the vicinity, thought to have occurred in the springtime. Tree debris remaining in the vicinity appears to be a result of that action. Adjacent to the subject stand of pines another Gray pine is missing its top; (the stem is situated 45 to 50 feet east of the subject tree and 12 feet north of the conductors); several of its branches are broken, abraded, or missing.



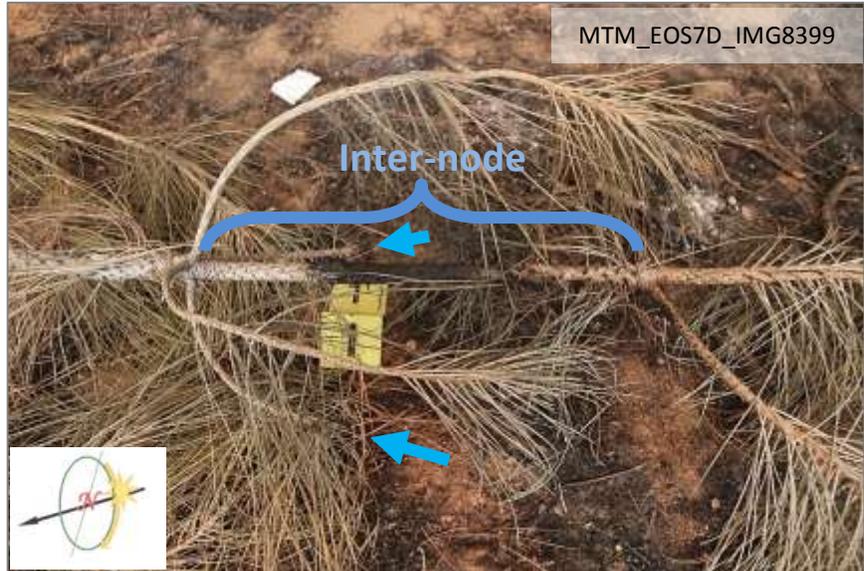
The sketch of the subject tree (right) focuses on inter-nodal dimensions; that is, the distance between lateral branching at nodes and corresponding loosely to annual growth increments. Of interest here is the over-all length of the stem, also representing the height of the tree. The subject tree sketch points to the proximity of charring – an indication of contact with an energized conductor, and its location in relation to the tree’s overall height.



The site sketch (left) focuses on certain trees in the stand along the edge of the utility right-of-way; the subject tree and adjacent stumps; and a proximity with the tri-phase conductors south of the stand. Additional trees can be found beyond specific locations documented here.

Both the site sketch and the sketch of the subject tree are referenced with a compass rose and an indication of the path of the sun. It is well understood that trees and other green plants have a physical orientation toward the path of the sun and this can have significant consequences for maintaining safety.

The top elevation of the subject tree is 43'7^{10th} and charring is found just two feet below at 41'5^{10th}. The burned section is the second increment beneath the top or tip of growth. These burn marks are characteristic of contact with energized electrical equipment. The image, right, shows a top view of the limb and clearly demonstrates an inter-node.



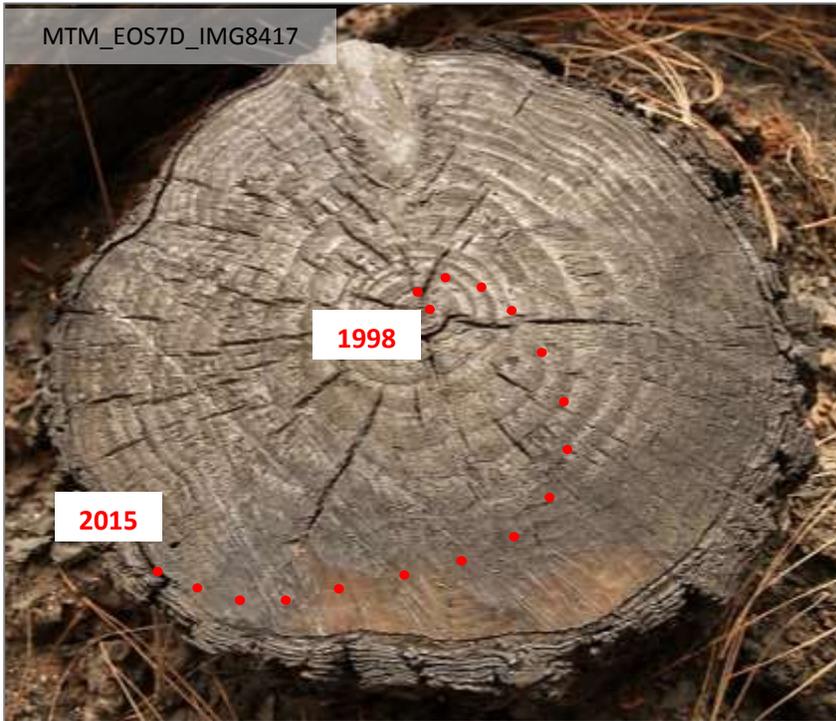
Viewed to the left is the side of the stem that came to rest on the energized conductor.



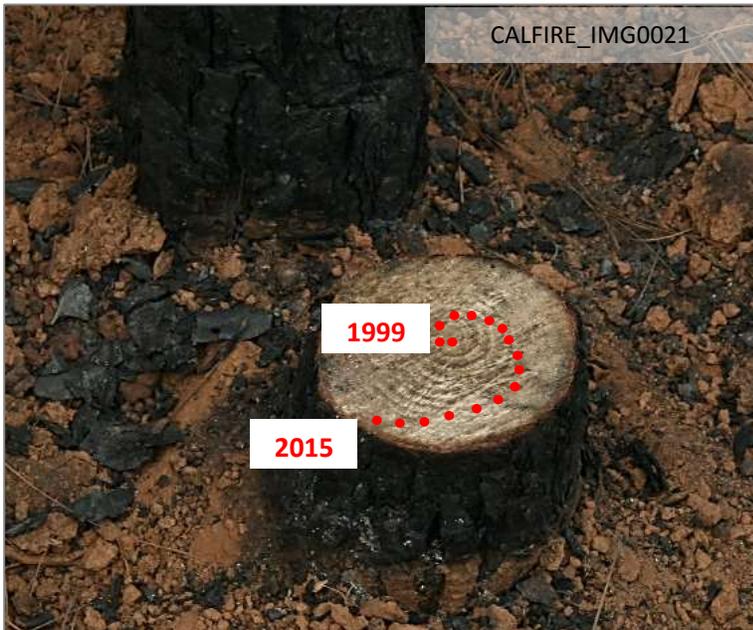
Blue arrows indicate the main stem - intact even though it was severely charred, and two lateral limbs whose tips caught fire, were burned-off, and fell onto the easement below. The top view shows less charring on the two lateral branches, an indication that the lateral limbs rested on the conductor very briefly, whereas the larger main stem is charred on top and bottom.

There are significant growth and development implications for the captured tree released in the 2015 growing season. The subject tree was already tall enough to reach the conductor and when it was allowed greater solar exposure tip extension was fortified. It's important to note that secondary growth origination occurs at a fixed elevation – it does not cause existing crotches and limbs to move higher in the canopy elevation.

A 'ring count' focusing on cut surfaces of stumps provides specific historic information.



Slash and other pieces of wood cut prior to the fire suggest the trees were alive when cut, so the outer growth ring can demonstrate a specific point in time. Further, the stage of ring development also suggests a particular time in relation to the growing season. Latewood is abrupt and laid down at the end of a growing season; earlywood is expanding and corresponds to the time when the tree begins to grow and is actively growing thru summer. Other ring characteristics are apparent, but a comparison of the annual increment number and the last growing stage before the stump was cut is revealing.



It is apparent from this tree ring study that the larger trees cut in line clearance activities occurred prior to the onset of the 2015 growing season, whereas the subject tree (cut in September 2015) occurred near the end of the growing season. A great discrepancy exists in the character of these trees. Furthermore, annual growth rings indicate they are close to the same age.

My work at the Charamuga Ranch site progressed over a period of

2 hours on September 10, 2015. During that time I conducted observations, took photographs, and made basic measurements of some attributes and their proximate locations. Subsequently, on September 12th I processed and annotated my site notes and sketches and prepared a 3-page DRAFT document entitled ARBOTIST'S SITE SKETHES – 09/10/2015; ANNOTATED 09/12/2015. That document was provided to CAL FIRE on Monday, September 14th and included a preliminary 'ring count'.

The following arboricultural hypotheses are provided based upon field work and follow-up analysis:

- **Factors other than the subject tree were considered among arboricultural characteristics of the site and were eliminated as a basis for initiating the fire.**
 - Inspection of trees in the vicinity of the adjacent power pole and its tri-phase attachment provide no relevant arboricultural data.
 - Inspection of the land-form surrounding the apparent ignition site and its relationship with trees and the tri-phase conductor provide no relevant arboricultural data.
 - Other trees in the immediate vicinity exhibit evidence of recent tree maintenance, however, they were ruled-out as relevant to ignition.
- **Existence of compelling initial findings upon arriving at the site.**
 - The unusual appearance of the subject tree was immediately apparent.
 - Burn marks on the tree top corresponded with likely tree/line contact.
- **The subject tree was defective and prone to failure.**
 - Site inspection undertaken 9/10/2015 and photographic evidence demonstrate that the tree lacked reaction wood and was unable to stand on its own.
 - Recent tree/line maintenance activities caused the tree to fail.
- **The fallen tree was growing in a homogenous stand of Gray pines.**
 - While the trees were homogenous in terms of age, height, and type those pines situated on the outer edge of the stand were significantly more stable.
 - Trees that are captured within the confines of a dense stand do not develop reaction wood, have poor trunk taper, and are inherently unstable.
 - Stable trees were removed exposing the weak interior trees to the elements.
- **The fallen pine tree was tall enough to reach the conductor at least 1 year prior to the incident.**
 - Visual inspection of burns & contact points and the series of nodes and inter-nodes that correspond to annual growth increments demonstrate that the tree was sufficiently tall to reach the conductor in the 2014 growing season, before adjacent larger trees were removed.
 - Stable trees were removed from the stand edge and they exposed weak interior trees to physical properties of the natural elements.
- **Orientation of the stand of Gray pines and its proximity to energized conductors guaranteed the failure would result in tree/line contact.**
 - Prevailing winds are to the south in the Jackson CA vicinity predisposing the unstable Gray pine to fall toward the conductors.
 - Secondary growth developing in the subject tree's canopy and other recently exposed tree canopies would be most prolific on their southern side - facing the energized conductors.
 - Gravitational leverage resulting from new foliage and tip growth causes the tree to fall to the south.

My work thru the date of this report is concluded. I will continue to ponder the investigation and will follow up and respond to any new tree evidence submitted for my consideration.

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Attached and included here are the following additional items:

- Draft – Arborist’s Site Sketches (3 pages)
- Historic Wind Records from Weather Underground (2 pages)
- Curriculum Vitae of MT Mahoney
- Fee Schedule of MT Mahoney