-Review and Critique-

Report on San Jose Water Company Fire Hazard Assessment

Philip N. Omi, Ph.D.
Professor Emeritus, Forest Fire Science
Colorado State University

Omi Associates
P.O. Box 854
Sebastopol, CA 95473
10/1/2006

EXECUTIVE SUMMARY

The “Report on San Jose Water Company Fire Hazard Assessment” by TSS Consultants (dated May 2006) presents a systematic analysis of fire hazard in forested stands in the upper Los Gatos Creek watershed. The significant omission from consideration of chaparral-covered lands in the upper Los Gatos Creek watershed limits the usefulness of the report. A more meaningful analysis would consider all lands within the upper watershed (including lands managed by San Jose Water Company and Sierra Azul Open Space Preserve).

Specific shortcomings in the report include omission of ignition likelihood, incorrect application of fuel inventory information to represent treatment impacts, and incorrect interpretation of fire behavior outputs used in the FlamMap analysis. The composite hazard index presented in the report is poorly explained and may not be meaningful in terms of justifying the need for hazard reduction treatments within the NTMP. Further the report overlooks the possible increases to fire spread rates resulting from lop/scatter treatments, and apparently equates logging practices with wildfire hazard mitigation.

The fire behavior analysis in the TSS report is best viewed as a simulation exercise based in part on incomplete or uncertain information. Sole reliance on the report for making management decisions within the NTMP would not be prudent.

PURPOSE AND OVERVIEW TO THIS REPORT

The purpose of this report is to provide an overall review and critique of the "Report on San Jose Water Company Fire Hazard Assessment," by TSS Consultants (hereafter referred to as "the report." The report synopsis provides an overall summary of the TSS report. The critique considers two features: 1) overall report scope; and 2) analysis and inferences. Discussion and Conclusions provide an overall summary of this review and critique.

REPORT SYNOPSIS

The report by TSS Consultants (dated May 2006) presents synthetic results from fuel assessments, canopy cover estimates using LiDAR, and fire behavior simulations for the Upper Los Gatos Creek watershed. The report uses fire behavior estimates (rate of spread, flame length, fireline intensity, heat per unit area, etc.) from the FlamMap mapping and analysis program to evaluate treatments (various harvest alternatives) versus an untreated baseline within the NTMP (Non-Industrial Timber Management Plan) area. A composite hazard index is computed for treated and untreated areas, based on simulated heat per unit area, spread rate, and crowning estimates. Customized fuel models are developed to provide input to simulations for the NTMP area. Wildfire hazards outside the NTMP are simulated using fuel models incorporated in the California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP). Treatment impacts on NTMP fuel profiles are represented by field measurements sampled from harvest sites in Santa Cruz, Santa Clara, and San Mateo counties.

Three mitigation measures (paraphrased) result from the TSS Consultants analysis:

1. augmentation of lopping standards within the NTMP to restrict logging slash depth in all areas of operation to a maximum 12" residual standard;
2. augmentation of road safety zones so that all downed woody material 1-12 in will be removed/masticated and spread to a 1' fuel depth (within 100' of road edge);
3. augmentation of defensible space around habitable structures so that flammable materials 1-8 in dbh are removed or masticated (within 200 ft of permanent habitable structures in the NTMP).

The composite hazard index shows a net benefit of 18% across the NTMP resulting from adoption of these mitigation measures.

CRITIQUE

General assumptions

The report is correct in noting (§2.0) that fuel treatments do not stop fires and that proposed fuel treatments do not guarantee against wildfire damages. The assertion that reductions in fire behavior, growth, or severity are best achieved by fragmenting a

landscape repeatedly, provides intuitive appeal but has not been demonstrated empirically for actual landscapes. Theoretical justifications, i.e., such as Finney (1999), rely solely on computer simulations for hypothetical landscapes and also provide impetus for widespread interest in analyses (or similar variants) using FlamMap (or FARSITE). However, empirical evidence for reductions in fire growth or burned area at the landscape scale have not been demonstrated to date. Thus analyses such as the TSS report represent at best hypotheses yet to be tested or proven.

Additional commentary on the TSS report is provided below, by report section.

§2.2.4 Fire & Ignition History

The pre-settlement fire return interval information cited provides little insight to fire recurrence in the chaparral zones within the Los Gatos Creek Watershed. In fact, the fire potential and likelihood for watershed damages in the chaparral zones may be higher than in the forested areas of the NTMP.

No details are provided on how information on fire weather, ignition points, and burn footprints from the Lexington (1985) and Austrian Gulch (1951) fires was used to customize the fire behavior model to the site-specific conditions of the Upper Los Gatos Creek Watershed.

§3.1 FlamMap

The absence of fire probability calculations (though problematic) is a significant omission, especially for areas that don't burn often, e.g., coast Redwood stands. The low proportion of area burned by decade since the 1930s (§2.4) is further evidence that the redwood stands may comprise a low fire risk, irrespective of pre-settlement fire history. In redwood stands, wildfire risks and hazards are mitigated in part by characteristic fog belts and marine influences in the vicinity.

§3.3.1 Required Model Inputs

The field measurements in Brown (1974) were developed to develop biomass estimates for coarse woody debris in wilderness areas--not for providing inputs to fire behavior models as employed in the report. The estimators developed by Brown (1974) will likely lead to overestimates for loading and depth as employed in the fire behavior model. It is unclear how these field measurements allow for customization (and testing) of the fire model, as asserted in the report. It is also unclear how fuel models are customized to the NTMP area. Even the 95^{th} percentile depth measurement will likely overestimate the required fuelbed depth input for fire modeling (Albini and Brown 1978).

§3.3.2 Other Required Inputs

A crown bulk density estimate of .30 kg/m^3 used by other fire scientists may be at least 3 times too high, based on actual destructive field sampling of dense conifers elsewhere (as

yet unpublished). TSS plans to carry out this research for dominant tree species in Upper Los Gatos Creek Watershed (see footnote 4) may take longer than anticipated, and should not be relied upon if uninitiated at this time. Even if initiated, years could pass before study results would be available and verified (i.e., peer-reviewed). Further, the reliability of the .30 kg/m^3 crown bulk density estimate is questionable, even if "conservative" based on the extant literature cited.

§3.4.1 Standard Model Outputs

The discussion of outputs from fire behavior models is flawed and inaccurate. English units on fireline intensity should be Btu/ft-sec. The discussion on flame length overlooks its direct relationship to fireline intensity and suggests a non-existent relationship between flame length and risk. The asserted relationship between heat per unit area and amount of fuels burned is unjustified and not documented in the literature. The report over-generalizes the relationships between rate of spread, perimeter and area growth.

§3.4.2 Fire Hazard Index

Inclusion of "active" crown fire as the third component in the fire hazard index is misleading and confusing. It seems to presume that a fire actually will move into the canopy stratum and spread as an active crown fire. The ensuing discussion regarding "all five fire behavior outputs" and of weighting in the fire hazard index is confusing and raises doubts about the meaningfulness of the index.

§4.0 Treatment Design

The report acknowledges that additional analysis for the entire Upper Los Gatos Creek Watershed is needed. In fact, as noted previously with respect to §2.2.4, the chaparral zones probably represent a far greater fire hazard than the NTMP areas.

§4.2 Fuel Modification Recommendations

The aversion to pile and burning by San Jose Water Company is understandable yet unfortunate. Lopping and distributing fuels may increase fuelbed continuity and spread rate, depending on extent and quality of execution.

§4.3 Modeling Assumptions

The assumptions about crown bulk density reduction due to harvesting is questionable as noted above with reference to §3.3.2.

§4.4 Description of Surrogate Post-Harvesting Sites

It is questionable if surrogate sites were harvested with the objective of reducing wildfire severity. Thus the fuel profiles at surrogate sites may not be representative of NTMP sites after harvest, and any resemblance may be coincidental.

§4.6 Fuel Modification Treatment Modeling

The wording in the paragraph above Figure 11 implies that fire behavior would be "severe" in untreated NTMP sites and that the treatments carried out at surrogate sites (and proposed for the NTMP) would be successful in "reducing severe fire behavior." Notwithstanding the simulations described in the report, these are both untested hypotheses.

Reduction of canopy coverage (i.e., by 20%) may be a questionable strategy for reducing fire hazard. Arguably, thinning and removal of smaller diameter trees, removal of fuel ladders, and retention of large trees may be more effective in reducing wildfire hazard and ensuring the sustainability of the NTMP stands.

§4.7 Effectiveness of Treatments

The finding of net benefit in six measures of fire behavior is not especially meaningful, since flame length and fireline intensity are essentially duplicative measures. Also, fireline intensity depends on rate of spread and heat per unit area.

The use of heat per unit area to "scale the threat posed by crown fire" is unprecedented in the literature. Heat per unit area is unaffected by wind speed, so its correspondence to "areas that carry crown fire at low wind speeds" is probably coincidental. Tables 9 and 10 are either mislabeled or indecipherable if fire line intensity is cumulated (similar to Tables 6-7 in Appendix D).

The report omits mention that Table 11 indicates that most of the threat of active crown fire behavior is supported in areas that cannot be treated due to policy considerations ("Out", WLPZs, and other sensitive areas). Apparently, about 9% of the NTMP is susceptible to crown fire, approximately 2/3 of which is off-limits to management activities. Reducing the supposed crown fire threat on less than 3% of the total land area within the NTMP may not be meaningful or cost-effective.

The explanation relating heat per unit area increases and crown fuels does not make sense—heat per unit area is unaffected by crown fuels. Further, heat per unit area as a fire characteristic is descriptive of surface fires only.

The 18% net benefit across the NTMP attributable to reduction in fire hazard index may not be meaningful inasmuch as it is apparently calculated as a simple arithmetic average across the treatment types (Appendix D Table 7). Further, the focus on percent reduction in fire hazard index says nothing about whether the pre-treatment hazard is tolerable or not. Moreover, the interpretation of Table 12 mistakenly equates flame length with identifying the minimum height to live crown.

§5.0 Analysis and Conclusions

The report seems to lump harvesting with thinning treatments. While some overlap may exist in terms of tree cutting, harvest tends to focus on removal of larger trees while thinning removes the smaller and less commercially-sized trees. Thinning with slash disposal is more cost-effective in terms of reducing wildfire hazards and ensuring the sustainability of redwood stands.

Fuel loadings in Table 13 are not necessarily indicative of high fire hazard. In fact, the report acknowledges under *Modeling Discussion* that the "NTMP area appears to have a low hazard index." If so, then the changes due to treatment (i.e., 18%) may reduce hazards even lower but also may not be necessary. Further, the acknowledgement of low hazard index raises questions about study focus and the need for timber harvest.

The collaborative effort called for in conclusion makes good sense. Creation of community wildfire protection programs and fire-wise communities may provide the largest payoffs in terms of living with fire hazards in wildland areas. Public/private collaboration is especially important since socio-political concerns may override technological solutions to wildfire management problems.

DISCUSSION AND CONCLUSIONS

The limited scope of the report (i.e., forested stands within the NTMP versus all lands managed by San Jose Water Company and Sierra Azul Open Space Preserve) restricts its overall usefulness. The report relies on fire behavior predictions incorporated within the FlamMap simulation processor. Inferences are limited by the assumptions and limitations inherent to the underlying fire behavior prediction process.

The TSS report is reasonably-written but misguided and potentially misleading. It is misguided because it focuses on fire hazard in the redwood stands in the NTMP instead of the more flammable chaparral within the San Jose Creek watershed. The potential for long-term damage to watershed values is arguably much greater in the chaparral zones than in the redwood stands within the NTMP. Notwithstanding the commercial value of redwood stumpage, the fire risk analysis should focus instead on the vegetation types comprising the entire upper watershed rather than the trees within the NTMP. The report is misleading insofar as it builds an apparent rationale for timber harvest under the guise of wildfire hazard reduction.

The report creates the impression of high fire hazard in uncut redwood stands comprising the NTMP, relying on the FlamMap simulation processor. Yet the reliability of FlamMap estimates is questionable in timber/litter environments generally. The theoretical basis for the FlamMap processor (i.e., Rothermel's 1972 spread model) is most challenged in timber/litter fuel complexes, such as redwood stands, where the complexity of fuel and environmental influences presents a greater modeling challenge than in more uniform grass and shrub fuel beds. The analysis incorporates fuel measurements (i.e., loading and

depth) from field inventory techniques that are not intended for direct input to fire behavior calculations. Further, custom fuel modeling efforts within the report are likely to neglect site fuel characteristics such as surface area to volume ratio, heat content, and canopy base height, among others. As a result, fire characteristics are likely over-predicted for stands within the NTMP. Further, the fire hazard index (even though standardized) is poorly explained and may not be reliable or meaningful in terms of eventual fire behavior that will be experienced within treated and untreated stands of the NTMP. Lastly, anticipated reductions in wildfire hazard (i.e., by 18%), are purely speculative and not confirmed empirically nor in the literature.

The fuel models developed or relied upon for the analysis may be incapable of representing changes in fire behavior resulting from treatment alternatives. Thus, the fuel models developed may not represent the effects of lopping/scattering fuels uniformly, which, in fact, may increase rate of spread even if changes in fuelbed depth reduce fire spread predictions.

Fires can and will burn in stands dominated by coast redwood and associated forest types within the NTMP, and fuel hazard reduction is needed to create defensible spaces around structures. But the wisdom of logging to reduce fuel hazards needs to be balanced against environmental impacts (e.g., water quality) and the relatively-low probabilities of ignition in coast redwood stands due to inherent moisture regimes. Logging of merchantable timber may not reduce wildfire hazards and is counter-productive from a long-term, sustainability perspective. Strategically, removal of small-diameter trees that provide fuel ladders into tree crowns may make more sense, especially from a sustainability perspective. Also, removal of tree cover from steep slopes in the name of wildfire hazard reduction may produce unacceptable siltation and erosion especially near creeks and riparian zones.

The fire behavior analysis in the TSS report needs to be viewed as an exercise based on incomplete or uncertain information, using a simulation processor underlain with assumptions and limitations that accompany any computer-based analysis. Thus the report should not be relied upon as the sole basis for making management decisions affecting the NTMP. Further, a broader perspective that incorporates the chaparral zones in the upper watershed would provide a more meaningful assessment of overall fire hazard in the area.

Literature Cited

Albini, F.A. and J.K. Brown. 1978. Predicting slash depth for fire modeling. Ogden: USDA For. Serv., Res. Pap. INT-206, 28 p.

Brown, J.K.1974. Handbook for inventorying downed woody material. USDA For. Serv. Gen. Tech. Rep. INT-16.

Finney, M.A. 1999. Design of regular landscape fuel treatment patterns for modifying fire growth and behavior. For. Sci. 47(2):219-228.

Rothermel, R.C. 1972. A mathematical model for predicting fire spread in wildland fuels. USDA For Serv. Res. Pap. INT-115.