EXECUTIVE SUMMARY

The Herger-Feinstein Quincy Library Group Project — Impacts of Vegetation Management on Water Yield

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In October 1998, the Herger-Feinstein Quincy Library Group Forest Recovery (HFQLG) Act was signed into law. The Act was developed to examine local forest management strategies for reducing forest fuels and the risk of wildfires, promoting forest health, and restoring economic stability to rural communities. The proposal was developed with a desired future condition of an all-age, multi-storied, fire resistant forest approximating pre European settlement conditions.

The HFQLG project proposed treatments to reduce forest density as a primary means of reducing the risk of wildfire and improving forest health. Proposed treatments, usually partial cuts or thinning, will change vegetation structure on 200,000 to 300,000 of almost 2.5 million acres. The project is mandated to address the timing of water releases, water quality changes, and water-yield changes on pilot areas. The preferred Sierra Conservation Framework alternative for the Plumas, Lassen, and Tahoe National Forests includes implementing the Quincy Library Group project for five years and the resulting water-yield changes on these forests are evaluated and discussed in this report.

The objective of the study reported on here was to model the hydrologic impacts, both on-site and off-site, of the fuels reduction treatments proposed for implementation on the HFQLG project area. The updated version of the WRENSS Hydrologic Model, an acronym for the procedural handbook Water Resources Evaluation of Non-Point Silvicultural Sources, was used in this analysis.

It was initially intended that the simulations would quantify the hydrologic impacts of the forest management activities on the majority of the 2.5 million acre HFQLG project area. However, it was quickly determined that the stand descriptions, or vegetation data, required for the hydrologic simulations were not readily available for the Lassen and Tahoe National Forests. Appropriate data was available for the Plumas National Forest so the study area for this effort was reduced to 5 HUC-5 Watersheds that occupy approximately 412,000 acres on the Plumas National Forest. Data describing current forest condition on those 5 watersheds was derived from the Vestra Resources PLAS Veg Map. The primary database was a GIS layer of the study area that depicted individual

stands, or polygons, of uniform cover. Uniform cover implies that the polygon, regardless of aerial extent, has a uniform Vegetation Class (forest, shrub, grass, non-forest), Vegetation Type (forest, grass, bare ground, water, rock, urban, etc.), Species Composition (18 tree species, 19 brush species), Size Class (0 – 6), Canopy Cover, Land Use, Wetland Type, and Large Tree Crown Characteristics.

The GIS layer for vegetation polygons was then intersected with a GIS topographic aspect map and the Oregon State Climate map of monthly precipitation. This overlay procedure created a new, composite GIS map depicting all the logical combinations of stand polygons each having a uniform vegetation cover, aspect, and seasonal precipitation. The resultant data set consisted of approximately 95,000 unique polygons that varied in size from less than 1-acre to approximately 95-acres in size. The land cover and spatial characterization of the forested environment as depicted in this study contrasted significantly from the coarse 1-km^2 grid used by Huff et al. (1999) in an earlier analysis. The data indicate that approximately 88-percent of the area in the 5 HUC-5 watersheds is forested while 12-percent is classed as non-forested. All non-forest polygons were dropped from analysis. This reduced the study area, or the area modeled, from approximately 412,000-acres in size to approximately 363,000-acres of forest land.

In addition to the data layer describing the vegetative land cover, a second layer depicting the occurrence, location, and nature of the fuel treatments was also provided. All of the treatments involved harvesting a percentage of the current basal area of the forest stand. In most all instances, the stand prescriptions called for leaving 80 to 90-percent of the initial basal area on-site and in no instance was more than 50-percent of the basal area proposed for removal. Simulating the changes in water yield that would result from the proposed treatments consisted of simulating the water yield for each forested polygon for both pre- and post-treatment condition with the difference representing the change in water yield that occurred as a result of the treatment. Although only the annual water yield and change was simulated, the analysis was still quite robust because of the spatial resolution attained.

The WRENSS Hydrologic Model separates the Central Sierra Region into two hydrologic zones based on precipitation form. Two variations of the model are used in simulation. A Snow Dominated Procedure (SDP) is used to model hydrologic response from areas at or above 4000 feet in elevation while a Rain Dominated Procedure (RDP) is used to simulate hydrologic response on those forested areas lying below 4000 feet elevation. On average, 87-percent of the approximately 363,000-acres of forested area lies at or above 4000-feet elevation while only 13-percent lies below 4000 feet. Within the two elevation zones, only 2-percent of the forest in the RDP area and 4-percent of the forest in the SDP area is proposed for treatment through the year 2005. Spatially, the greatest impact will occur in Spanish Creek and Nelson/Onion Valley while the least impact will occur in Lower Indian Creek and Lights Creek. Overall, however, the intensity of harvest is quite low and averages only 3.7 percent of the forested portion of the study area.

Simulated baseline, or pre-treatment, water yield from the 5 HUC-5 watersheds was estimated to be 28.8 inches. This yield was generated from an average of 47.0 inches of annual precipitation. Average evapotranspiration from the entire study area was simulated to be 18.2 inches.

There are no paired watershed case studies in the project area to which the simulation results can be compared. However, four USGS stream gauges were identified in the Sierras with long-term stream flow record that could be compared with the modeled results, at least for base line precipitation/water yield comparisons. Sagehen Creek (10343500), General Creek (10336645), Blackwood Creek (10336660), and Ward Creek (10336674) are all USGS stream gauges that lie at or above 6000 feet in elevation. The gauge history for each watershed indicates there are no diversions above any of the gauge sites. Based on the available streamflow record, water yield from the 4 watersheds averages 33.5 area inches. Using the GIS, the 30-year average precipitation for the watersheds is estimated to be 49.8 inches. Evapotranspiration (estimated as precipitation – water yield) averages approximately 16.5 inches for the four high elevation watersheds. The simulated water balance for SDP zone is very close to the water balance estimated for the 4 USGS high elevation watersheds. Precipitation on the USGS watersheds is estimated to be 49.8 inches while it is estimated as 47.4 inches for the higher elevations in the study watersheds. Average area weighted measured runoff on the USGS watersheds is estimated to be 33.5 inches while the simulated flow from snow zone of the HUC-5 study watersheds is estimated to be 31.7 inches. The estimate of average annual evapotranspiration for the 4 USGS watersheds is 16.5 inches while it is simulated to be 15.7 inches for the HUC-5 study watersheds. In general, the baseline simulations of water yield compare with the measured data quite well.

Once the baseline water yield was simulated, the effect of the proposed treatments on water yield was simulated. On average, water yield spread over the entire 363,000-acre forested area of the 5 HUC-5 watersheds will increase an average of 0.04 inches, or less than 1-percent, as a result of the proposed treatments. The percentage of forested area treated (3.7-percent) and the reduction in basal area (less than 20-percent of basal area removed) are relatively small, as is the simulated response.

In contrast, the on-site impacts of the proposed treatments present a somewhat different characterization of response. On average, the simulated increase in water yield averages 1.04 area inches when including only the treated portions of the forested area on the 5 watersheds. The largest increase of 1.33 inches will occur from Nelson/Onion Valley while the smallest unit area increase of 0.56 area inches will occur from Lights Creek The hydrologic models would indicate that even the 12-acre treatment in the rain dominated zone (RDP) of lower Indian Creek has the potential for altering water yield, at least on-site. Although quite variable between the 5 HUC-5 watersheds, the water yield increases represent an 1164 acre-foot increase in annual water yield as the net result of imposing fuels reduction treatments on 13,403 acres of forest land.

Even when expressed as an on-site impact, the proposed treatments are still unlikely to generate a measurable increase in water yield at that scale as less than 20-percent of the

basal area is proposed for removal in most cases. However, the increases, although not measurable, are likely to occur and be present be in the system. In some cases the increased water yield, such as from Nelson/Onion Valley, might be measurable on-site, but the capability to monitor the response is not in place. Initially, the HFQLG proposal was to treat 200,000 to 300,000 acres of forest. Such treatments if implemented at the scale of those proposed for the 5 HUC-5 watersheds would yield anywhere from 17,000 to 26,000 acre-feet of additional water yield on an annual basis. Such an increase, if perpetuated over time by additional management, would represent a sizeable amount of water.

In summary, the vegetation database and the GIS allowed a spatially robust application of the hydrologic models. Hydrologic response to treatment, particularly at the landscape level, was not particularly large. However, the proposed treated area was not extensive and the treatments were not particularly invasive so a large increase in water yield could not be expected. However, some increase in water yield will occur and little environmental damage should occur as a result of what is proposed. What is significant is the documentation that the proposed treatments will have an effect on water yield, at least at the project level. The hydrologic model used to simulate water yield and the effect of the treatments is defensible, as are the increases in water yield, measurable or not. The spatial capability of both the database and the model should be useful in planning the hydrologic outcome of future management alternatives.