NCWAP Working Hypotheses for the Gualala River

The primary purpose of these working hypotheses is to elucidate in a succinct format the judgment of the Gualala NCWAP Team regarding watershed conditions relative to anadromous salmonids. They are called "working" hypotheses because, in general, they are not being "proved" in a rigorous scientific or statistical sense, but are proposed because of relationships in the data evaluated.

The working hypotheses are presented by subbasin because of differences in geology, climate, and land use. The hypotheses are responsive to the NCWAP assessment questions. The findings supporting the hypothesis are presented, along with recommendations for watershed improvements, and to further investigate the hypotheses. As such, they are not intended to be the final word, but are the best judgment based on the information at hand.

Recommendations for watershed improvements and further study are presented at the end of the section, as single recommendations apply in many cases to more than one hypothesis. References in the text to section numbers, figures, and tables refer to the NCWAP Gualala Watershed Assessment Report, which is available on CD and via the Internet at http://www.ncwatershed.ca.gov/gualala/synth_report.html.

Estuary Subbasin

No hypotheses have been developed. This section will be revised upon completion of the estuary study.

North Fork Subbasin

Working Hypothesis 1
Stream conditions in the North Fork Subbasin provide suitable habitat for salmonids.

Supporting Findings

- Young-of-the-year coho salmon were observed in tributaries of both the Little North Fork and North Fork.
- Young-of-the-year, year-old and older steelhead trout were observed in all surveys throughout the subbasin in 2002.
- MWATs from 2001 were fully suitable on Dry Creek, the Little North Fork and Robinson Creek.
- Water temperatures for the period of record (1994-2001) were suitable in the tributaries and the mainstem North Fork downstream of the Little North Fork confluence.
- Canopy cover target values (from Flosi et al 1998) were met on Log Cabin Creek. The North Fork, McGann Gulch, Little North Fork, and Doty Creek nearly

met the target values. Canopy cover has improved since the aerial photos of the 1960s. Embeddedness target values were met on Dry Creek, Little North Fork, Log Cabin, North Fork, and Robinson Creek (Section 5.2.8).

- Canopy cover EMDS scores were fully suitable on Doty Creek, the Little North Fork, and Log Cabin Creek. McGann Gulch and the North Fork were moderately suitable. Embeddedness was moderately suitable on Dry Creek, the Little North Fork, and the North Fork. Log Cabin was somewhat suitable. Pool depth was suitable on the North Fork. Shelter was somewhat suitable on Robinson Creek (Table 5.2-10).
- Areas of potential refugia were identified on the Little North Fork and North Fork.

Contrary Findings

- Water temperatures for the period of record (1994-2001) ranged from undetermined to fully unsuitable in the mainstem North Fork upstream of the confluence with the Little North Fork. MWATs and seasonal maxima were higher in the upstream areas, decreasing as the North Fork mainstem flowed off the oak woodland into the coastal areas (Figure 5.2-16).
- Seasonal maximum water temperatures were above the 75 F lethal level at the three upstream most mainstem sites (nf216, nf272, nf214) for the period of record (Section 5.2.7).
- Canopy cover target values (from Flosi et al 1998) were not met on Dry and Robinson Creek. Embeddedness target values were not met on Doty Creek or McGann Gulch. Primary pool depth and frequency were not met on any of the streams surveyed. Pool shelter target values were not met on any of the streams surveyed (Section 5.2.8).
- Canopy cover EMDS scores were unsuitable on Dry Creek and Robinson Creek. Embeddedness was unsuitable on Dry Creek, McGann Gulch, and Robinson Creek. Pool depth was unsuitable fully unsuitable on Doty Creek, the Little North Fork, Log Cabin, McGann Gulch, and Robinson Creek. Pool shelter was unsuitable on all inventoried streams except Robinson Creek (Table 5.2-10).
- Canopy cover as interpreted from aerial photos has not recovered to 1942 levels (Section 5.2.4).
- A high proportion of road crossings, and roads are located low on the sideslope (EMDS Watershed model). The EMDS model indicates a higher level of concern for overall subbasin conditions with more than 50 percent of the middle subbasin reaches harvested during the most recent 10 year period as a land use index.

Limitations

- Only 81 percent of the subbasin was habitat inventory surveyed.
- Available temperature data did not span all sites in all years from 1994-2001, however three or more years' data were available for five of the ten mainstem sites. Only one year's data were available for four of the ten mainstem North Fork

sites (nf474, nf406, nf258, nf473). No temporal trends were apparent for the mainstem North Fork.

- Temperature data were limited to the lower half of the watershed (9 miles). No stream temperature data were available in the upper reaches of the main stem (Figure 5.2-16).

<u>Conclusions</u>

- The hypothesis is supported.
- Physical habitat conditions are suitable for salmonids in the North Fork Subbasin.
- Water temperatures are suitable for salmonids in the tributaries and in the mainstem North Fork below its confluence with the Little North Fork. Water temperatures were high in the upper mainstem North Fork.

Working Hypothesis 2

Depleted overstory shade canopy cover along the upper North Fork mainstem and tributaries from legacy harvests and other factors continues to contribute to elevated water temperatures.

<u>Supporting Findings</u>

- Canopy cover target values (from Flosi et al 1998) were not met on Dry and Robinson Creek as measured by habitat inventory surveys in 2001 (Section 5.2.8).
- Canopy cover EMDS scores were unsuitable on Dry Creek and Robinson Creek (Table 5.2-10).
- Three points emerged from the comparison of water temperature MWATs for the period of record to the LANDSAT vegetation layers: (1) water temperatures were higher in the upstream areas draining the northeastern portion of the subbasin, (2) vegetation in the area upstream of those high temperatures (Franciscan Complex mélange) is open oak grasslands with poor canopy, and 3) water temperatures in the mainstem North Fork decreased from upstream of Dry Creek to downstream of Robinson Creek (Figure 5.2-16).
- Timber harvesting prior to 1968 removed riparian canopy throughout the middle and upper mainstem North Fork (upstream from the confluence with Dry Creek) and higher tributaries in the subbasin (Section 5.2.4).
- Current riparian canopy in the middle subbasin reaches consists of mid sized 40 year old second growth coniferous stands. Riparian canopy stocking has not fully recovered to 1936 density and old growth conditions upstream from Dry Creek (Section 5.2.4)
- Linear regression of channel canopy measurements and MWATs for 11 sites in the Gualala River Watershed showed a significant relationship of water temperature to channel canopy (page 3-18).

Contrary Findings

- Canopy coverage as measured by bank-to-bank exposure has improved since 1968 aerial photos.

Limitations

- Only 81 percent of the subbasin was habitat inventory surveyed.
- A hydrothermal area is documented on the North Fork, one mile above the confluence of Stewart Creek approximately in line with two well-documented hydrothermal areas on the Tombs Creek Fault. The extent to which such areas may influence stream temperatures is unknown.
- The linear regression of canopy and MWAT did not account for the factors of stream flow, stream aspect, thermal reach length, air temperature, relative location in the watershed, contributions from tributaries and groundwater inflow, and differences among years.

Conclusion

- The hypothesis is supported.

Working Hypothesis 3

A lack of in stream large woody debris contributes to a simplified habitat structure (e.g., lack of large, deep pools).

Supporting Findings

- Shelter/cover did not meet Flosi, et al (1998) target values on any of the streams surveyed (Table 5.2-6).
- Pool shelter EMDS scores were somewhat to fully unsuitable for the streams surveyed (Table 5.2-10).
- Pool depth and pool shelter are rank 1 and 2 limiting factors throughout the subbasin (Table 5.2-7).
- LWD is low due to streamside road construction, timber harvesting, and salmonid migration barrier removal (Sections 5.2.4 and 5.2.8).
- Roads, landings, and skid trails built in or adjacent to streams between 1952 and 1968 buried, removed, and dispersed large woody debris. The reduction of LWD likely reduces pool formation and sediment storage in the tributaries (Section 5.2.4).
- Timber harvest up to the mid-1990s in the lower and middle reaches frequently selectively cut large conifer vegetation down to the stream bank, reducing the available recruitment supply of large woody debris (Section 5.2.4).
- Stream clearance projects in the 1970s and 1980s to clear log jam barriers to salmonid migration removed large amounts of woody debris throughout the North Fork Subbasin, except on the North Fork (Section 5.2.4).

- Stream buffers are regenerating since the mid-1990s under current land management practices and Forest Practice Rules, and large trees are present in the riparian zone in the alluvial flats. However, the dense stands of riparian zone conifers have not reestablished to levels seen before mid-20th-century logging (Section 5.2.4).
- The Watershed Cooperative Monitoring Program identified deficient large woody debris on the North Fork, Little North Fork, Robinson Creek, and Dry Creek (Table 5.2-8).
- Pool depth and pool shelter are rank 1 and 2 limiting factors throughout the subbasin (Table 5.2-7).
- Enhancement of instream structure is a priority 1 restoration priority (Table 5.2-12).

Contrary Findings

- Shelter was somewhat suitable on Robinson Creek.
- In the lower watershed woody debris large enough to function in the channels is abundant adjacent to Little North Fork, lower Doty Creek and lower Robinson Creek.

Limitations

- Only 81 percent of the subbasin was habitat inventory survey.

Conclusion

- The hypothesis is supported.

Working Hypothesis 4

Instream conditions are improving in the North Fork Subbasin.

Supporting Findings

- Overall levels of channel disturbance in the Robinson Creek PWS decreased from 1984 to 1999/2000, based on aerial photo interpretation. Approximately 75 percent of the main channel appeared disturbed with enlarged and numerous bars and lack of riparian vegetation in 1984. By 1999/2000 the main channel appeared to have improved with disturbance between 50 and 75 percent (Section 5.2.6).
- The Dry Creek channel was at least 80 percent disturbed in 1984 images. In the 1999/2000 images, the upper reach of Dry Creek improved to approximately 50 percent of the channel showing disturbance (Section 5.2.6).
- Overall conditions of the channels in the Doty Creek PWS improved from 1984 to 1999/2000, based on aerial photo interpretation (Section 5.2.6).

- At least 80 percent of the North Fork channel within the Stewart Creek PWS appeared disturbed from 1984 aerial photos. By 1999/2000, the channel appears to have improved to 50 to 70 percent disturbance (Section 5.2.6).
- Thalweg profiles from 1998 to 2001 at three sites (nf 204, lnf 203, dry 211) in the subbasin showed no significant changes in bed elevation in these response reaches (Appendix 4).
- Canopy coverage has increased since 1968 aerial photos as measured by bank-to-bank exposure (Section 5.2.4).

Contrary Findings

- Canopy coverage as measured by bank-to-bank exposure has not recovered to the extent observed in 1936 aerial photos (Section 5.2.4).

Limitations

- Canopy coverage (bank-to-bank exposure) and fluvial characteristics came from aerial photo interpretation. The direct linkage to fish habitat conditions has not been made.

Conclusions

- The hypothesis is supported.
- Overall levels of channel disturbance have improved since 1984.
- Canopy coverage as measured by bank-to-bank exposure has improved since 1968, but not to 1936 levels. More information on the improvement with regard to riparian composition over the period of photo records is needed to discuss improvement in the riparian zone beyond canopy coverage.

Subbasin Recommendations

1. Maintain and enhance riparian zones to achieve target canopy density and diversity including large conifers for LWD recruitment.
    a) Ensure that adequate streamside protection zones are used to reduce solar radiation and moderate air temperatures in order to reduce heat inputs to the North Fork and its tributaries.
    b) Maintain or enhance existing riparian cover. Where current canopy density and diversity are inadequate and site conditions are appropriate, initiate tree planting, thinning, and other vegetation management to hasten the development of a denser, more extensive and diverse riparian canopy. Dry Creek, Robinson Creek, the central and higher reaches of the mainstem, and the lower reaches of Bear and Stewart Creeks are high priority areas for riparian improvements. Areas with persistent bank exposure include: (1) the central and higher reaches of the mainstem, (2) the lower reaches of Bear and Stewart Creeks, and (3) the upper reaches of Dry Creek.

c) Land managers in this subbasin should be encouraged to add more large organic debris and shelter structures in order to meter sediment inputs, improve channel structure, channel function, habitat complexity, and habitat diversity for salmonids. Pool shelter has the lowest suitability for salmonids in the whole subbasin. The natural large woody debris recruitment process should be enhanced by developing large riparian conifers with tree protection, planting, thinning from below, and other vegetation management techniques. Instream enhancement is the top tributary recommendation.

2. Address existing and potential sediment sources. Refer to Plate 3, *Potential Restoration Sites and Habitat Limiting Factors for the Gualala River Watershed* for more specifics.

   a) Continue efforts such as road erosion proofing, improvements, and decommissioning throughout the subbasin to reduce sediment delivery to the North Fork and its tributaries. Road sediment inventory and control is second of the top three tributary recommendations. Activities to reduce road-related sediment inputs are suggested for the Little North Fork and tributaries (Doty Creek, Log Cabin Creek, Tributary #1), Robinson Creek, Stewart Creek, McGann Gulch, and the mainstem North Fork.

   b) At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. Bank stabilization is the third priority of tributary recommendations. Bank stabilization is a restoration priority 2 for McGann Gulch, and priority 3 for Log Cabin Creek.

   c) Decommission and revegetate streamside roads: i) Focus on the instream and near-stream roads where channel braiding and/or aggradation are still persistent today, as noted in Stewart and Dry Creeks, upper Billings Creek, and upper Robinson Creek tributary to Billings Creek. ii) Concentrate on those tributaries in the lower and central subbasin reaches containing the best historical anadromous habitats where mid-20th-century operations caused the worst damage: Doty, Log Cabin, Dry, Robinson, and Stewart Creeks, and McGann Gulch. A waterfall upstream of the confluence of Stewart Creek and the mainstem blocks anadromous fish passage.

   d) Concentrate modern road upgrade/ repairs starting with those associated with historically active landsliding and/ or eroding streambanks on: i) The main timber haul route following the North Fork between Dry Creek and Stewart Creek, and 2 upslope roads crossing unnamed tributaries in this area ii) Dry and Stewart Creeks, and the upper reaches of Robinson Creek tributary to Billings Creek.

   e) In the timber dominant lower and central subbasin reaches: i) Incorporate mitigation elements into Timber Harvest Plans and pursue cost sharing grants to decommission legacy streamside roads and upgrade existing road drainage facilities. ii) Encourage the use of cable or helicopter yarding on steep and unstable slopes to reduce soil compaction, surface disturbance, surface flow interference, and the resultant sediment yield. iii) Evaluate the possibility of spreading timber harvesting operations over time and space to avoid concentrated road use by heavy equipment and resultant mobilization of road surface fines into watercourses.

f) Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 56 percent of the subbasin.

g) Pursue cost sharing grants such as those organized by the Sotoyome RCD to upgrade roads in upland areas underlain by the mélange.

h) Evaluate the fish rescue activities and fish holding facilities on Doty Creek to determine if it is causing a migration barrier and/or habitat degradation due to water diversion.

3. Encourage the continuation and expansion of stream monitoring using the protocols developed by the GRWC.
4. Encourage more habitat inventory surveys and biological surveys of tributaries, as only 81 percent has been completed.

Rockpile Subbasin

Working Hypothesis 1
Stream conditions in the Rockpile Subbasin provide unsuitable habitat for salmonids.

<u>Supporting Findings</u>

- Water temperatures from 1994 to 2001 in the lower 11 miles of the mainstem and in Horsethief Canyon range from somewhat to fully unsuitable for summertime rearing of salmonids (Table 5.3-4, Figure 5.3-11).
- Canopy cover, pool frequency/depth and pool shelter/cover target values were not met on Rockpile Creek, the only tributary habitat inventory surveyed by CDFG in the Rockpile Subbasin.
- Canopy cover, pool shelter and pool quality EMDS scores were moderately unsuitable on Rockpile Creek. Embeddedness was somewhat unsuitable. Rockpile Creek is a second order stream and the pool depth was fully unsuitable. The Maximum Weekly Average Temperature at the only site sampled in 2001 on Rockpile Creek was somewhat unsuitable (Table 5.3.8).
- The Watershed Cooperative Monitoring Program found large woody debris to be deficient at the one monitored site in lower Rockpile (#221) in 1998 and 1999 (Table 5.3-7).
- Approximately 16 miles of historic logging and ranchland roads built in or along the streambed simplified pool structure and complexity throughout the major tributary streams of the Rockpile Subbasin. The residual effects of channel aggradation from streamside road system failures are noted in timber harvest plan records (see Land Use Section), particularly in many of the unnamed tributaries of the central Rockpile PWS. where the channel continues to downcut to pre-logging levels in many areas (Section 5.3.4 and 5.3.5).

- At least 80 per cent of the channel along the mainstem Rockpile Creek in the Middle Rockpile PWS contained sediment accumulations indicative of channel disturbance in 1984 aerial images. In Horsethief Canyon, where streamside roads and landings were densely concentrated, 75 percent of the channels were disturbed in 1984 (Appendix 2).

Contrary Findings

- Embeddedness target values were reached on Rockpile Creek indicating that some good spawning substrate conditions exist in the 8.5 miles surveyed.
- Water temperatures were fully suitable for the two years sampled in a tributary about one and a half miles from the mouth.
- By 1999/2000 the main channel appeared to have shown some improvement with 50 percent of the channel reach appearing disturbed. In-channel disturbance in Horsethief Canyon improved to 25 percent in 1999/2000 (Table 5.3-3).

Limitations

- Water temperature data were limited to the lower 11 miles of the mainstem.
- Habitat inventory surveys were conducted only on 39 percent of stream miles in the Rockpile Subbasin.

Conclusion

- The hypothesis is supported.

Working Hypothesis 2

Depleted shade canopy cover along the mainstem of Rockpile Creek and tributaries from past timber harvest activities continues to contribute to elevated water temperatures that are unsuitable for salmonids.

Supporting Findings

- Temperatures in the lower 11 miles of mainstem Rockpile Creek were unsuitable for summer rearing of salmonids (Table 5.3-4, Figure 5.3-11).
- The CDFG canopy cover target value was not met on Rockpile Creek, the only tributary surveyed in the Rockpile Subbasin. (Table 5.3-6, Figure 5.3-13).
- Canopy cover EMDS scores were moderately unsuitable on Rockpile Creek (Table 5.3-8)
- Post World War II construction of roads, landings, and skid trails in riparian zones by crawler tractors eliminated overstory shade canopy cover over most of the blue line streams in the middle subbasin reaches. Twenty-five percent of the blue line streams still had exposed banks in 2000 photos compared with five percent in the 1942 pre-harvest photos (Figure 5.3-8 and discussion).

Contrary Findings

- Stream bank canopy cover has improved on Red Rock Creek, Horsethief Canyon, and unnamed tributaries downstream of Rockpile Peak, and has increased overall from 70 percent exposure in 1968 photos (Section 5.3.4).

Limitations

- Water temperature data were available for the lower 11 miles of the subbasin.
- Only 39 percent of the subbasin was habitat inventory surveyed.

Conclusion

- The hypothesis is supported.

Working Hypothesis 3

A lack of instream large woody debris contributes to simplified riparian habitat structure (e.g., lack of large, deep pools).

Supporting Findings

- The pool frequency/depth and pool shelter/cover CDFG target values were not met on Rockpile Creek, the only tributary surveyed in the Rockpile Subbasin. Large woody debris is important as a pool-forming component (Table 5.3-6).
- Pool shelter and pool quality EMDS scores were moderately unsuitable on Rockpile Creek. Pool depth was fully unsuitable in this second order stream (Table 5.3-8).
- Construction of roads, landings, and skid trails in or adjacent to streams between 1952 and 1968 buried, removed, or dispersed LWD in the subbasin. Review of 1961 and 1963 aerial photos showed riparian areas entirely cleared of vegetation and remnant downed logs (Section 5.3.4).
- Historic and recent timber harvest in the lower and middle reaches frequently removed large conifer vegetation down to the stream bank, severely reducing the available recruitment supply of large woody debris. Dense buffers of conifers large enough to function, upon recruitment, as LWD in channel formation processes have not reestablished (Section 5.3.4).
- The Watershed Cooperative Monitoring Program found large woody debris to be deficient at the one monitored site in lower Rockpile (#221) in 1998 and 1999 (Table 5.3-7).

Contrary Findings

- In the central subbasin reaches, riparian areas are re-growing under current land management practices.

Limitations

- Habitat inventory surveys were conducted on only 39 percent of the mainstem Rockpile Creek (the lower 8.5 miles).

Conclusion

- The hypothesis is supported.

Working Hypothesis 4

Instream and near stream conditions are improving in the Rockpile Subbasin.

Supporting Findings

- Overall levels of sediment accumulations indicating channel disturbance were less in the Lower Rockpile PWS 1999/2000 photos compared to 1984. Along the mainstem Rockpile Creek, approximately 80 percent of the main channel appeared disturbed with enlarged and numerous bars and lack of riparian vegetation in 1984. By 1999/2000 the main channel appeared to have shown some improvement with 50 percent of the channel reach disturbed (Table 5.3-3).
- At least 80 percent of the channel along the mainstem Rockpile Creek in the Middle Rockpile PWS was disturbed in 1984 images. In the 1999/2000 images, there were some improvements to 50 to 75 percent disturbance (Table 5.3-3).
- In Horsethief Canyon, where streamside roads and landings were densely concentrated, 75 percent of the channels were disturbed in 1984 compared with 25 percent in 1999/2000 (Table 5.3-3).
- Visual examination of GIS layers for dominant substrate, embeddedness, adverse fluvial, and landslide potential resulted in three conclusions: (1) 70 percent of adverse fluvial characteristics in the Gualala Basin abutted high and very high landslide potential ratings, (2) adverse fluvial declined from 1984 to1999, and (3) larger streambed particles were observed in upstream compared to downstream areas.
- Stream bank canopy cover has improved on Red Rock Creek, Horsethief Canyon, and unnamed tributaries downstream of Rockpile Peak, and has increased overall from 70 percent exposure in 1968 photos (Section 5.3.4).

Contrary Findings

- No change in channel disturbance at 50 percent was observed in the Upper Rockpile PWS between 1984 and 1999/2000.

Limitations

- None noted.

Conclusion

- The hypothesis is supported.

Working Hypothesis 5

Land management activities, especially past road building adjacent to stream channels or across debris slide slopes and/or steep terrain have contributed sediment to streams.

Supporting Findings

- Approximately 16 miles of historic logging and ranchland roads built in or along the streambed impacted pool structure and complexity throughout the major tributary streams of the Rockpile Subbasin (Section 5.3.4).
- A high density of road debris slides into streams in the Red Rock and Central Rockpile PWSs was visible in the1963 and 1981 air photos (Section 5.3.4).
- Mid-20th-century roads and landings built in or near the main channel may still be contributing excess sediment, especially where channel braiding and/or aggradation are persistent as noted along the mainstem, Red Rock Creek, and Horsethief Canyon (Section 5.3.4).
- The residual effects of heavy channel aggradation from failure of streamside road systems built in the 1950s and 1960s are noted in timber harvest plan records (Section 5.3.4), particularly in many of the unnamed tributaries of the central Rockpile PWS, where the channel continues to downcut.
- Modern road segments within 60 meters of historically active landslides are numerous in the upper stream reaches and may be contributing excess sediment to streams. Debris slides and debris flows are more numerous in the central and upper reaches of the subbasin. Modern road failures were generally more numerous in high or very high potential landslide areas (105 miles, or 62 percent, of current roads in the Rockpile) (Section 5.3.4).
- Many undersized culverts and substandard road drainage facilities failed during the 1986 and 1996 storms, representing a portion of contemporary sediment pulses in the subbasin (Section 5.3.4).
- Large portions of the upper subbasin are underlain with the mélange of the Central Belt of the Franciscan Assemblage and vegetated with prairie and sparse oaks. Landsliding is especially prevalent in the mélange, and active earthflow complexes are very numerous and unavoidably crossed by many roads.

Contrary Findings

- Approximately one and a half miles of modern roads (out of 168 miles total) are located within 50 feet of blue line streams in the subbasin. Of these roads, less than a half mile total length are in areas that may be affected by historically active landsliding and stream bank erosion.
- Distributions of debris slides and debris flows are more numerous in the central and upper reaches of the subbasin. Major earth flows are common in the Central Belt of the Franciscan Complex mélange in the east subbasin (Plate 1 and Appendix 2, and Synthesis Graphics), potentially high in natural background sources.

Limitations

- Although roads are located in erosion-prone areas, the performance of those roads was not evaluated in this assessment.

- Evaluation of the relationship of site-specific road failures to regional geologic conditions is beyond the scope of this assessment.

<u>Conclusions</u>

- Sediment contributions from earlier timber harvest and road-building activities persist, while sources associated with existing unimproved timber and ranchland roads may still exist.

Rockpile Subbasin Recommendations

Target restoration and land use activities to the three highest priorities for restoration in the Rockpile Subbasin: (1) fish habitat improvement structures including large wood placement, (2) riparian canopy development, and (3) bank stabilization. Cost sharing grants should be pursued to off set the costs of watershed improvements.

1. Install fish habitat improvement structures including large woody debris placement
   a) Promote installation of fish habitat improvement structures as appropriate to the stream channel type and hydrologic conditions.
   b) Land managers in this subbasin should be encouraged to add more large organic debris and shelter structures in order to improve sediment metering, channel structure, channel function, habitat complexity, and habitat diversity for salmonids. Pool shelter is the most limiting factor in Rockpile Creek, the stream surveyed in the subbasin. The natural large woody debris recruitment process should be enhanced by developing large riparian conifers with tree protection, planting, thinning from below, and other vegetation management techniques. Instream structure enhancement is the first of the top three recommendations.
2. Improve or enhance riparian zones to achieve target canopy density and increase the density and diversity of the riparian zone, including large conifers for LWD recruitment.
   a) Maintain and enhance existing riparian cover. Where current canopy is inadequate and site conditions are appropriate, initiate tree planting and other vegetation management to hasten the development of denser and more extensive riparian canopy. Riparian canopy development is the second priority recommendation. The mainstem, Red Rock Creek and Horsethief Canyon are the primary areas needing attention.
3. Address bank stabilization issues where indicated on the restoration map in Chapter 4.
   a) Encourage cooperative efforts to reduce sediment yield to streams at stream bank erosion sites. Grazing is an issue in the upper subbasin. Bank stabilization is the third of the top three recommendations.
   b) Continue efforts such as road erosion proofing, improvements, and decommissioning throughout the subbasin to reduce sediment delivery to central Rockpile Creek and Rockpile Creek tributaries. Focus efforts on areas adjacent

to the streams, abandoning and vegetating historic streamside roads were feasible. Channel characteristics improved the least in the Middle and Upper Rockpile Creek PWSs.

c) Encourage the use of cable or helicopter yarding on steep and unstable slopes to reduce soil compaction, surface disturbance, and resultant sediment yield.

d) Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 60 percent of the subbasin.

4. Expand existing monitoring efforts to both better understand relationships in the subbasin and to assist in targeting restoration activities.

   a) Expand continuous temperature monitoring efforts into the upper subbasin and tributaries.

   b) Investigate the availability and quality of other temperature and canopy data for the eastern area, and reevaluate the relationship of canopy to actual stream temperatures.

   c) Collect data to evaluate and possibly model the relationship among water temperature, canopy levels, and other factors where canopy is still recovering to establish reasonable recovery targets.

   d) Encourage more stream habitat inventories and biological surveys of tributaries, as only 39 percent has been completed.

   e) Survey for salmonids, using consistent methods, to estimate population numbers for comparison with recovery targets to be set by NMFS.

   f) Conduct both instream and hillslope monitoring to determine whether land use practices are allowing for recovery and protection of the salmonid habitat in the subbasin. Use GRWC methods for instream monitoring.

Buckeye Subbasin

Working Hypothesis 1
Stream conditions in the Buckeye Subbasin provide unsuitable habitat for salmonids.

<u>Supporting Findings</u>

- Coho salmon were last observed from a bank observation taken during a stream survey on the mainstem of Buckeye in 1964 and in Franchini Creek in 1970.
- Temperatures on the Buckeye Creek mainstem and 3 of the 4 sampled tributaries ranged from fully unsuitable to undetermined (between suitable and unsuitable) (Table 5.4-3), with 7 of 10 seasonal maximum temperatures above the lethal temperature for salmonids.
- CDFG habitat inventory target values for canopy cover, pool frequency/depth and pool shelter/cover were not met on Buckeye Creek, the only stream surveyed in the Buckeye Subbasin (Table 5.4-7).

- Canopy cover, pool shelter and pool quality EMDS scores were somewhat unsuitable on Buckeye Creek. Embeddedness was somewhat unsuitable on the lower reach. Pool depth was fully unsuitable on this second order stream. The Maximum Weekly Average Temperatures at four sites sampled in 2001 on Buckeye Creek were in the somewhat unsuitable range (Table 5.4-10).
- The Gualala River Watershed Council's Cooperative Monitoring Program identified a lack of large woody debris (LWD) at two sample sites on Buckeye Creek (Table 5.4-8).
- Twenty-seven miles of historic logging and ranchland roads built in or along the streambed eliminated pool structure and complexity throughout the major tributary streams of the Buckeye Subbasin (Figure 5.4-6). Early 1960s air photos showed a high density of road debris slides accessing streams in the Little Creek, Grasshopper, and Flat Ridge Creek PWSs (Appendix 2).
- Mid-20th-century roads and landings built in or near the main channel may still be contributing excess sediment (this may be true where channel braiding and/or aggradation are persistent) along the mainstem and Flat Ridge, an unnamed tributary below Flat Ridge, Franchini, North Fork Buckeye, and lower Little creeks. The residual effects of channel aggradation from streamside road failures built in the 1950s and 1960s are noted in timber harvest plan records particularly in the Little Creek, Grasshopper, and Flat Ridge Creek Planning Watersheds (Section 5.4.4).
- The length of channels features indicative of "excess" stream sediment in the mainstem Buckeye Creek in the Grasshopper Creek PWS increased from about 25 to 50 percent of channel length from 1984 to 2000. The length of channels features indicative of "excess" stream sediment in Roy Creek increased from 10 percent to almost 25 percent (Appendix 2).

Contrary Findings

- Steelhead trout one year and older were observed on the mainstem of Buckeye and on Franchini creeks (Section 5.4.9).
- Water temperature MWATs on the lower tributary were fully suitable (Table 5.4-3).
- CDFG habitat inventory embeddedness target values were reached on Buckeye Creek, indicating good spawning substrate conditions.
- The embeddedness EMDS score was somewhat suitable on the upper reach.
- Little Creek PWS improved between 1984 and 1999/2000 from 80 percent of main channel disturbance to 50 to 75 percent disturbance. Little Creek itself improved from 80 percent disturbance and 14 delivering landslides to 25 percent channel disturbance and 6 delivering landslides.
- In the Grasshopper Creek PWS, channel disturbance in Franchini Creek decreased from 90 to approximately 50 percent from 1984 to 1999/ 2000, and in

lower reach of Grasshopper Creek disturbance decreased from 50-75 percent to 25 percent. Channel disturbance in the mainstem Buckeye Creek below Flat Ridge Creek decreased from up to 75 percent in 1984 to 20 percent in 1999/2000.

- Bank-to-bank exposure has decreased from 58 percent of the blue line streams in 1968 to approximately 22 percent in 2000.

Limitations

- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.
- Water temperatures were available for the period of record (1994-2001) only in the lower 13.5 miles of the mainstem and in Flat Ridge, Franchini, Grasshopper, and Soda Springs creeks, and a small tributary near the mouth.

Conclusion

- The hypothesis is supported.

Working Hypothesis 2

Depleted overstory shade canopy cover along the mainstem of Buckeye Creek and tributaries from past harvests continues to contribute to elevated water temperatures that are unsuitable for salmonids.

Supporting Findings

- Temperatures on the Buckeye Creek mainstem and 3 of the 4 sampled tributaries ranged from fully unsuitable to undetermined (between suitable and unsuitable), (Table 5.4-3) with 7 of 10 seasonal maximum temperatures above the lethal temperature for salmonids. Temperatures in open areas, such as those in the upper, eastern subbasin, were fully unsuitable (Figures 5.4-12 and 5.4-13).
- The Maximum Weekly Average Temperatures at four sites sampled in 2001 on Buckeye Creek were somewhat unsuitable.
- The CDFG habitat inventory canopy cover target value was not met on Buckeye Creek, the only tributary surveyed in the Buckeye Subbasin (Table 5.4-7).
- The EMDS scores for canopy cover were somewhat unsuitable on Buckeye Creek (Table 5.4-10).
- Post World War II construction of roads, landings, and skid trails in riparian zones by crawler tractors eliminated overstory shade canopy cover throughout long sections of Buckeye Creek and tributaries. There was near entire canopy elimination in the Buckeye Subbasin, with operations especially pronounced during the late 1950s to 1964 (Figures 5.4-6 and 5.4-9).
- Twenty-five percent of the blue line streams still had bank-to-bank exposure (open canopy) in 1999 photos (Figure 5.4-9) compared with 2 percent in 1942 pre-harvest photos.

- Contrary Findings
- Bank-to-bank canopy cover has improved on upper Buckeye, Osser, Little and Flat Ridge creeks (Figure 5.4-9), and has decreased overall in the subbasin from 60 percent exposure in 1968 photos.

<u>Limitations</u>

- Water temperatures were available for the period of record (1994-2001) only in the lower 13.5 miles of the mainstem and in Flat Ridge, Franchini, Grasshopper, and Soda Springs creeks, and a small tributary near the mouth.
- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.

<u>Conclusion</u>

- The hypothesis is supported.

Working Hypothesis 3

A lack of in stream large woody debris contributes to a simplified habitat structure (e.g., lack of large, deep pools).

<u>Supporting Findings</u>

- CDFG habitat inventory targets for pool frequency/depth and pool shelter/cover target value were not met on Buckeye Creek, the only stream surveyed in the Subbasin (Table 5.4-7).
- The EMDS scores for pool shelter and pool quality were somewhat unsuitable on Buckeye Creek. Pool depth was fully unsuitable on this second order stream.
- The Gualala River Watershed Council's Cooperative Monitoring Program identified a lack of large woody debris (LWD) at two sample sites on Buckeye Creek (Table 5.4-8).
- Historic and recent timber harvest has reduced the available recruitment supply of large woody debris (see findings in Hypothesis 2, above).
- Dense buffers of conifers large enough to function, upon recruitment, as LWD in channel formation processes have not been fully reestablished (Section 5.4.4).

<u>Contrary Findings</u>

- None noted.

<u>Limitations</u>

- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.

<u>Conclusion</u>

- The hypothesis is supported.

Working Hypothesis 4

Instream and near stream conditions are improving.

<u>Supporting Findings</u>

- Little Creek improved between 1984 and 1999/2000 from 80 percent of main channel disturbance and 14 delivering landslides to 25 percent channel disturbance and 6 delivering landslides.
- In the Grasshopper Creek PWS, channel disturbance in Franchini Creek decreased from 90 to approximately 50 percent from 1984 to 1999/ 2000, and lower reach Grasshopper Creek disturbance decreased from 50-75 percent to 25 percent.
- Channel disturbance in the mainstem Buckeye Creek below Flat Ridge Creek decreased from up to 75 percent in 1984 to 20 percent in 1999/2000.
- Bank-to-bank canopy cover has improved on upper Buckeye, Osser, Little and Flat Ridge creeks (Figure 5.4-9), and has decreased overall in the subbasin from 60 percent exposure in 1968 to 25 percent exposure in 1999/2000 photos.

<u>Contrary Findings</u>

- Above the Flat Ridge Creek junction, similar channel disturbance levels were observed in 1999/2000 compared to 1984.
- Twenty-five percent of the blue line streams still had bank-to-bank exposure (open canopy) in 1999 photos (Figure 5.4-9) compared with 2 percent in 1942 pre-harvest photos.

<u>Limitations</u>

- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.

<u>Conclusion</u>

- The hypothesis is supported.
- Overall levels of channel disturbance have improved since 1984.
- Canopy coverage as measured by bank-to-bank exposure has improved since 1968, but not to 1942 levels. More information on the improvement with regard to riparian composition over the period of photo records is needed to discuss improvement in the riparian zone beyond canopy coverage.

Buckeye Subbasin Recommendations

Target restoration and land use activities to the three highest priorities for restoration in the Buckeye Subbasin: large wood placement, road repair or removal, and riparian canopy development.

1. Enhance instream structure, including large woody debris:

a) Land managers in this subbasin should be encouraged to add more large organic debris and shelter structures in order to improve sediment metering, channel structure, channel function, habitat complexity, and habitat diversity for salmonids. Pool shelter is the most limiting factor in the Buckeye Creek, the stream surveyed in the subbasin. Instream structure enhancement is the first of the top three recommendations.

b) Enhance large woody debris through short and long-term efforts through (1) ongoing large wood placement efforts, and (2) enhancement of the natural large woody debris recruitment process by developing large riparian conifers with tree protection, planting, thinning from below, and other vegetation management techniques.

c) Support ongoing large wood placement efforts.

2. Address road issues.

a) Landowners should develop erosion control plans for decommissioning old roads, maintaining existing roads, and constructing new roads. Decommission and revegetate streamside roads where feasible, focusing on those associated with unsuitable fish habitat conditions such as Little, Franchini, Grasshopper, and Osser creeks.

b) Size culverts in steep terrain to accommodate flashy, debris-laden flows and maintain trash racks to prevent culvert plugging. Critical dips should be required to minimize the potential for culvert failure.

c) Evaluate the possibility of spreading timber-harvesting operations over time and space to avoid concentrated road use by heavy equipment and resultant mobilization of road surface fines into watercourses.

d) Incorporate mitigation elements into Timber Harvest Plans and pursue cost share grants for decommissioning legacy streamside roads and upgrading road drainage facilities.

e) Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 53 percent of the subbasin.

3. Address riparian canopy issues.

a) Ensure that adequate streamside protection zones are used on Buckeye Creek to reduce solar radiation and moderate air temperatures, particularly on mainstem.

b) Maintain and enhance riparian zones to achieve target canopy density and diversity, including large conifers for LWD recruitment. Ensure that adequate streamside protection zones are used on Buckeye Creek to reduce solar radiation and moderate air temperatures, particularly on mainstem and upper tributaries. Retain, plant, and protect trees to achieve denser riparian canopy where current canopy is inadequate, particularly on the mainstem and Franchini, Grasshopper, and Soda Springs creeks.

c) Collect data to evaluate and possibly model relationship between water temperature and canopy levels where canopy is still recovering to establish reasonable recovery targets.

4. Monitor instream and hillslope conditions.

a) Conduct both instream and hillslope monitoring to determine whether current timber harvest practices are allowing for recovery and protection of the salmonid habitat in the subbasin. Use GRWC protocols for instream monitoring activities. Improve baseline information on habitat conditions by conducting inventory surveys in Buckeye Creek major tributaries.

b) Expand continuous temperature monitoring efforts into the upper subbasin and tributaries. Consider looking at canopy composition and monitoring air temperatures to examine canopy, temperature, and other microclimate effects on water temperatures.

c) Encourage more habitat inventory surveys and biological surveys of tributaries as only 37 percent of the mainstem Buckeye has been completed.

d) Survey for salmonids, using consistent methods to estimate population numbers, for comparison with recovery targets to be set by NMFS.

Wheatfield Subbasin

Working Hypothesis 1
Stream conditions in all three of the Super Planning Watersheds in the Wheatfield Fork Subbasin provide unsuitable habitat for salmonids.

<u>*Supporting Findings*</u>

Lower Wheatfield Super Planning Watershed

- Coho salmon were not observed in the Wheatfield Fork during electrofishing surveys in October of 2001.
- Water temperatures expressed as MWAT ranged from undetermined to fully unsuitable at 13 of 17 sites in the Wheatfield Fork (Table 5.5-4).
- Canopy cover, primary pool depth/frequency, and shelter/cover on the mainstem of Wheatfield Fork did not meet CDFG habitat inventory target values (Table 5.5-7).
- Canopy cover, embeddedness, primary pool depth/frequency and shelter/cover on Fuller Creek and the North and South Forks of Fuller Creek did not meet target values (Table 5.5-7).
- Canopy cover, pool depth and pool Quality EMDS scores were moderately unsuitable for the mainstem of Wheatfield Fork. Embeddedness was somewhat unsuitable. Pool Shelter was fully unsuitable (Table 5.5-10).

- Embeddedness may be naturally high due to the geology coupled with Tombs Fault (page 5.5–1).

Walter's Ridge Super Planning Watershed

- Coho salmon were not observed in Tombs Creek during electrofishing surveys in October of 2001.
- Canopy cover, pool depth and shelter cover did not meet CDFG habitat inventory target values in Tombs Creek (Table 5.5-7).
- The EMDS scores for canopy cover, embeddedness, pool depth and pool shelter were moderately unsuitable for the mainstem of Tombs Creek. Pool depth was fully unsuitable (Table 5.5-10).

Hedgepeth Lake Super Planning Watershed

- Coho salmon were not observed in House and Pepperwood Creeks during electrofishing surveys in October of 2001.
- Canopy cover, primary pool depth/frequency, and shelter/cover did not meet target values on House, Pepperwood and Danfield Creeks.
- The EMDS scores on House, Pepperwood and Danfield Creeks for canopy cover, pool depth were fully unsuitable. Embeddedness was moderately unsuitable on Danfield Creek. Pool Shelter was fully unsuitable on Danfield and Pepperwood Creeks and undetermined on House Creek.

<u>Contrary Findings</u>

Lower Wheatfield Super Planning Watershed

- Steelhead trout (young-of-the-year, one year, two-year and three year olds) were observed in the Wheatfield Fork during electrofishing surveys in October of 2001.
- Steelhead trout (young-of-the-year, one-year, two-year and three-year olds) were observed in Tombs Creek during electrofishing surveys in October of 2001.
- Water temperatures expressed as MWAT ranged from somewhat to fully suitable at 4 of 17 sites in the SPWS (Table 5.5-4).
- The EMDS score for embeddedness was somewhat suitable on the Wheatfield Fork.
- Macroinvertebrate sampling at one site in the lower Wheatfield Fork indicated a good biotic condition.

Walter's Ridge Super Planning Watershed

- Embeddedness may be naturally high due to the geology, coupled with the Tombs Fault.

Hedgepeth Lake Super Planning Watershed

- Steelhead trout (young-of-the-year, one year, two-year and three year olds) were observed in House, and Pepperwood Creeks during electrofishing surveys in October of 2001.
- Embeddedness met the target values on House and Pepperwood Creeks.
- The EMDS scores for House and Pepperwood Creeks for embeddedness were moderately suitable and somewhat suitable, respectively. (Table 5.5-10).

<u>Limitations</u>

- Only 62 percent of the Lower Wheatfield Super Planning Watershed was habitat inventory surveyed.
- Only 32 percent of the Walter's Ridge Super Planning Watershed was habitat inventory surveyed.
- Only 42 percent of the Hedgepeth Lake Super Planning Watershed was habitat inventory surveyed.
- The modified ten pool protocol (electrofishing methodology) used was designed to indicate coho salmon presence/not detected status only, and can not be used to indicate species composition, species density or estimate populations.

<u>Conclusions</u>

- The hypothesis is supported.

Working Hypothesis 2

Depleted overstory shade canopy cover along Wheatfield Fork and tributaries from legacy harvests and other factors continues to contribute to elevated water temperatures.

<u>Supporting Findings</u>

Lower Wheatfield Super Planning Watershed

- Canopy cover did not meet CDFG habitat inventory target values on the mainstem of Wheatfield Fork Fuller Creek and the North and South Forks of Fuller Creek.
- The EMDS score for canopy cover was moderately unsuitable on the Wheatfield Fork.
- Canopy density is known to be naturally low in grasslands and oak woodlands, which appeared to occur naturally in some areas on the 22 of 36 miles of the Wheatfield Fork that were habitat inventoried.
- Timber harvest operations, including road building in riparian zones, shortly after WW II eliminated overstory shade canopy cover throughout long sections of the Wheatfield Fork and tributaries. There was near entire canopy elimination along

the lower main stem and main tributaries, especially pronounced during the mid to late 1950s (Figures 5.5-5 and 5.5-10).

- Water temperatures expressed as MWAT ranged from undetermined to fully unsuitable at 13 of 17 sites in the SPWS (Table 5.5-4). Some evidence of mainstem cooling by Fuller Creek was observed (from site WF620 to WF612) (Figures 5.5-13 and 5.5-14).

Walter's Ridge Super Planning Watershed

- Canopy cover did not meet CDFG habitat inventory target values on Tombs Creek. The EMDS score for canopy cover was somewhat unsuitable on Tombs Creek.
- Timber harvest operations, including road building in riparian zones, shortly after WW II eliminated overstory shade canopy cover throughout long sections of the main stem Wheatfield Fork, Tombs and Wolf Creeks, and tributaries (Figures 5.5-5 and 5.5-10).
- Bank-to-bank exposure increased substantially from 1942 to 1999 (Figures 5.5-5 and 5.5-10).
- Prolonged ranchland operations with intent of conversion to pastureland prevented timely reestablishment of vegetative cover over streams.
- Some of the recent vineyard development has encroached into riparian areas that were once covered in 1942 (Section 5.5.4).

Hedgepeth Lake Super Planning Watershed

- Canopy cover did not meet CDFG habitat inventory target values on House, Pepperwood and Danfield Creeks (Table 5.5-7).
- The EMDS scores for canopy cover were fully unsuitable on House, Pepperwood and Danfield Creeks (Table 5.5-10).
- Timber harvest operations, including road building in riparian zones, shortly after WW II eliminated overstory shade canopy cover throughout long sections of House and Pepperwood Creek watersheds (Figure 5.5-6).
- Prolonged ranchland operations with intent of conversion to pastureland prevented timely reestablishment of vegetative cover over streams. This caused longer term warming, and development of algal blooms currently noted in many of these stream reaches.
- Some of the recent vineyard development has encroached into riparian areas that were once covered in 1942.

Contrary Findings

Lower Wheatfield Super Planning Watershed

- Water temperatures expressed as MWAT ranged from somewhat to fully suitable at 4 of 17 sites in the SPWS (Table 5.5-4).
- Photos from 1942 show some bank-to-bank exposure along the lower main stem Wheatfield Fork, where old growth timber occurs along the edge of an alluvial channel (Figures 5.5-5 and 5.5-10).
- Advanced conifer hardwood regeneration since 1968 has reinstated canopy cover throughout many of the highest tributary reaches (Figures 5.5-5 and 5.5-10).
- Bank-to-bank exposure decreased from over 50 percent of the blue line streams in 1968 in the Lower Wheatfield SPW to approximately 20 percent in 1999 (Figure 5.5-10).

Walter's Ridge Super Planning Watershed

- Advanced conifer hardwood regeneration since 1968 has reinstated canopy cover throughout many of the highest tributary reaches.
- Bank-to-bank exposure improved in some areas by 1999 (Figure 5.5-10).

Hedgepeth Lake Super Planning Watershed

- Advanced conifer hardwood regeneration since 1968 has reinstated canopy cover throughout many of the highest tributary reaches.

Limitations

- Only 62 percent of the Lower Wheatfield Super Planning Watershed was habitat inventory surveyed.
- Only 32 percent of the Walter's Ridge Super Planning Watershed was habitat inventory surveyed.
- Only 42 percent of the Hedgepeth Lake Super Planning Watershed was habitat inventory surveyed.

Conclusions

- The hypothesis is supported.

Working Hypothesis 3
A lack of instream large woody debris contributes to simplified riparian habitat structure (e.g., lack of large, deep pools).

Supporting Findings

Lower Wheatfield Super Planning Watershed

- Shelter/cover did not meet CDFG habitat inventory target values on the mainstem of Wheatfield Fork, Fuller Creek, and the North and South Forks of Fuller Creek (Table 5.5-7).
- The EMDS score for pool shelter was fully unsuitable on the Wheatfield Fork (Table 5.5-10).
- Heavy tractors building roads, landings, and skid trails in or adjacent to streams between 1952 and 1968 buried, removed, or dispersed LWD in the SPWS. Aerial photos from 1961 and 1965 show riparian areas entirely cleared of vegetation and remnant downed logs in the Fuller Creek, Tobacco, and Annapolis Planning watersheds (Section 5.5.4).
- The LP SYP describes LWD as not abundant in any of the survey reaches (Appendix 3).
- While the literature suggests about 130 pieces over 8 inches in diameter per 1,000 feet of stream may be desirable (Beechie and Sibley 1997, Martin 1999) the Watershed Cooperative Monitoring Program (1998-2001) identified 15 pieces per 1000 feet of stream channel (Table 5.5-8).

Walter's Ridge Super Planning Watershed

- Shelter/cover did not meet CDFG habitat inventory target values on Tombs Creek.
- The EMDS score for pool shelter on Tombs Creek was somewhat unsuitable.

Hedgepeth Lake Super Planning Watershed

- Shelter/cover did not meet CDFG habitat inventory target values on House, Pepperwood and Danfield Creeks.
- The EMDS scores for pool shelter on Pepperwood and Danfield Creeks were fully unsuitable. House Creek was moderately unsuitable

Contrary Findings

- None noted.

Limitations

- Only 62 percent of the Lower Wheatfield Super Planning Watershed was habitat inventory surveyed.
- Only 32 percent of the Walter's Ridge Super Planning Watershed was habitat inventory surveyed.

- Only 42 percent of the Hedgepeth Lake Super Planning Watershed was habitat inventory surveyed.

<u>Conclusion</u>
- The hypothesis is supported.

Working Hypothesis 4
Land management activities in the Wheatfield Fork Subbasin, especially past road building adjacent to stream channels or across debris slide slopes and/or steep terrain, have contributed sediment to streams.

<u>Supporting Findings</u>
- Approximately 13 miles of historic logging roads built in or along the streambed in the Lower Wheatfield SPW eliminated pool structure and complexity throughout Fuller, Sullivan, Haupt, and Tobacco Creeks (Section 5.55).
- Most of the lower reaches of the Wheatfield Fork Subbasin were clear-cut and roaded between 1952 and 1961 in or along the major tributaries (Figure 5.5-6). This left large areas of disturbed ground prone to erosion.
- Both historic and modern aerial photos showed that numerous debris flows and debris slides involved roads and that numerous failures occur along instream and near-stream roads and landings. These resulted in increased sedimentation in the streams (Section 5.5.5).
- Modern road segments within 60 meters of historically active landslides are numerous in the upper stream reaches of Haupt Creek and may be contributing excess sediment.
- Analysis of 1942 photos of Fuller Creek in an undisturbed old growth condition found fewer overall landslides compared to 1965 and 1984 photos.
- Embeddedness was somewhat to fully unsuitable on the 22 of the 36 miles of the Wheatfield Fork and on the North and South Forks of Fuller Creeks.
- Four large debris slides are apparent in the 1965 photos. These originate from areas of dense skid trail networks. Active landsliding is most abundant along the South Fork Fuller. By1968, a massive debris slide starting from Fuller Mountain Ridge breached two road contours and continued down into the South Fork Fuller Creek.
- Photos from 1965 showed an approximate one-quarter mile section of streamside road collapsed into the North Fork Fuller Creek by 1965.
- Photos from 1965 showed sinuous meandering channel patterns in the North and South Forks upper mainstem Fuller Creek from multiple road debris slides entering streams.
- Figure 87 shows two slides that cut through two road contours in the Annapolis PWS.

- Many undersized culverts and substandard road drainage facilities failed during the 1986 and 1996 storms, representing a portion of contemporary sediment pulses in the subbasin. These failures were generally more numerous where the road network crosses high or very high potential landslide areas.

Contrary Findings

- Most of the historic streamside roads are now abandoned and vegetated throughout Fuller, Haupt, Sullivan, and Tobacco Creeks.
- Successional analysis of air photos since 1942 indicates downcutting of the stream channel in the lower Wheatfield suggesting sediment transport was exceeding supply. Bed elevations have lowered since 1942 and perhaps since 1921 (Appendix 2).
- The active program to decommission streamside roads and landings in the Fuller Creek PWS appears to have reduced sediment sources. The graveled stream substrate observed today compares favorably with the aggraded channel infill of silt and sand deposits observed in the 1965 photos in the same stream reaches.
- There is a declining association of the historic instream roads with channel aggradation indicators between 1984 and 1999. This further indicates net outflow of material and gradual recovery of the streambed. The geofluvial analysis indicates that there are fewer areas in the major tributaries of the SPW that may still now be contributing excess sediment from the mid-20th-century instream roads.
- There is no difference in overall landslide mapping over the entire SPWS between 1984 imagery (76 slides accessing watercourses) and 1999/2000 photos (75 slides).

Limitations

- Only 62 percent of the SPWS was habitat inventory surveyed.
- Analysis of sediment sources and changes in fluvial characteristics was from aerial photo interpretation with little ground-truthing.

Conclusions

- The hypothesis is supported.
- Past logging practices, specifically tractor operations on steep slopes and adjacent to streams, accelerated erosion and added excess sediment to stream channels. Modern logging operations are far less intense than those practiced from 1950-1968.
- Indications from the aerial photo analysis of fluvial characteristics, lower river downcutting, and data from the Fuller Creek roads improvement program all point towards reduction of sediment sources and improvement in the stream

channel with regard to sediment. Positive responses by the salmonid habitat should be realized in the future.

Working Hypothesis 5
Instream and near stream conditions have improved.

<u>*Supporting Findings*</u>

- Aerial photo interpretation of the Fuller Creek PWS found overall levels of channel disturbance improved in the 1999/2000 photos compared to 1984. Within the planning watershed, approximately 80 percent of the main channel appeared disturbed with enlarged and numerous bars and lack of riparian vegetation in 1984. By 1999/2000 the main channel appeared to have improved with disturbance at less than 30 percent (Table 5.5-3).
- At least 80 per cent of the South Fork Fuller Creek channel was disturbed in 1984 images, compared to 50 per cent in 1999/2000 images (Table 5.5-3).
- The Wheatfield Fork in the Tobacco Creek PWS showed improvement in channel conditions from at least 75 per cent disturbed in 1984 to less than 50 percent in the 1999/2000 photos. Tobacco Creek had approximately 30 percent channel disturbance in the 1984 imagery compared to less than 20 percent disturbed by 1999/ 2000 (Table 5.5-3).
- Bank-to-bank exposure decreased from over 50 percent of the blue line streams in 1968 in the Lower Wheatfield SPW compared to approximately 20 percent in 1999 (Figure 5.5-10).

<u>*Contrary Findings*</u>

- There is no substantial difference in overall landslide mapping between 1984 imagery (76 slides accessing watercourses) and 1999/2000 photos (75 slides) at the scale of 1:24000. There is considerable variation between PWSs.

<u>*Limitations*</u>

- Analysis was limited by a lack of comparable historic stream surveys in this SPW with which to indicate comparative trends.
- Analysis of sediment sources and changes in fluvial characteristics was from aerial photo interpretation with little ground-truthing.
- The extent to which recent and current land use practices may individually or cumulatively affect the rate of improvement in the observed fluvial characteristics, other channel characteristics, and fish habitat is beyond the scope of this assessment and has not been determined.

<u>*Conclusions*</u>

- The hypothesis is supported.

- Overall levels of channel disturbance have improved since 1984. The streambed in the lower Wheatfield Fork has downcut since 1942 or before.
- Canopy coverage as measured by bank-to-bank exposure has improved since 1968, but not to 1942 levels. More information on the improvement with regard to riparian composition over the period of photo records is needed to discuss improvement in the riparian zone beyond canopy coverage.

Wheatfield Fork Subbasin Recommendations

Restoration and land use activities should be targeted on the three highest priorities for restoration in the Wheatfield Fork Subbasin: (1) riparian canopy development, (2) fish habitat improvement structures including large wood placement, (3) bank stabilization, (4) feral pig and livestock impacts, and (5) road repair or removal.

1. Address riparian canopy development:
    a) Ensure that adequate streamside protection zones are used to reduce solar radiation and moderate air temperatures in order to reduce heat inputs to Wheatfield Fork and its tributaries.
    b) Maintain and enhance existing riparian cover. Improvement of riparian canopy is a priority 1 restoration recommendation. Ensure that adequate streamside protection zones are used on the Wheatfield Fork and tributaries to reduce solar radiation and moderate air temperatures, particularly on the mainstem and upper tributaries. Retain, plant, and protect trees to achieve denser riparian canopy where current canopy is inadequate, particularly in the Lower Wheatfield SPWS: Fuller, Tobacco, and Haupt Creeks.
2. Install fish habitat improvement structures including large woody debris placement:
    a) The suitability of F4 channel types for fish habitat improvement structures include: good for bank placed boulders; fair for plunge weirs, single and opposing wing deflectors, channel constrictors and log cover; poor for boulder clusters.
    b) Land managers in the subbasin should be encouraged to add more large organic debris and shelter structures in order to improve sediment metering, channel structure, channel function, habitat complexity, and habitat diversity for salmonids. The natural large woody debris recruitment process should be enhanced by developing large riparian conifers with tree protection, planting, thinning from below, and other vegetation management techniques. Instream structure enhancement is a restoration priority 2.
3. Address stream bank stability issues:
    a) At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. Grazing is an issue in the subbasin. Bank stabilization is the third of the top three recommendations.
    b) Reduce livestock and feral pig access to the riparian zone to encourage stabilization of stream banks and revegetation of the riparian zone. Improvement of riparian canopy is a priority 1 restoration recommendation, and bank stabilization is a priority 3.

4. Address road-related sediment sources:
    a) Decommission and revegetate streamside roads, focusing on those where channel braiding and/ or aggradation are persistent today (from restoration map) i) Lower Wheatfield SPW: The lower reaches of Haupt and Tobacco Creeks ii) Walters Ridge SPWS: Lower to middle reaches of Tombs, Wolf, and Elk Creeks, and unnamed tributaries to the main stem Wheatfield Fork upstream from Tombs Creek, to Elk Creek, and flanked by Bear and Gibson ridges. iii) Hedgepeth Lake SPW: (a) Larger tributary watercourses to the lower reaches of House Creek, (b) Middle to higher reaches of House, and Pepperwood Creeks, Danfield and Cedar Creeks.
    b) Upgrade and maintain existing road systems to eliminate sediment sources to pools and spawning gravels. Carefully engineer new roads or repairs to reduce adverse sediment impacts. Use the Restoration Map to locate where ranch roads cross historically active landslides to target further field evaluation. These areas have been mapped in dense concentrations in the east subbasin reaches.
    c) Target road upgrade/repair starting with instream sediment indicators where fish habitat is less than suitable, such as (House, Danfield, and Tobacco Creeks).
    d) In the timber dominant Lower Wheatfield SPW: incorporate mitigation elements into Timber Harvest Plans and pursue cost sharing grants for decommissioning legacy streamside roads and upgrading road drainage facilities.
    e) In the ranchland dominated Walters Ridge and Hedgepeth Lake SPWs: pursue cost sharing grants organized by the Sotoyome RCD to upgrade ranchland roads.
    f) Landowners should develop erosion control plans for decommissioning old roads, maintaining existing roads, and constructing new roads. Target road upgrade and repair in the areas identified above.
    g) Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 60 percent of the subbasin.
5. Conduct both instream and hillslope monitoring to determine whether current timber harvesting, ranchland, and vineyard development practices are allowing for recovery and protection of the salmonid habitat in the subbasin.
6. Expand monitoring and analysis efforts:
    a) Conduct both instream and hillslope monitoring to determine whether current land use practices are allowing for recovery and protection of the salmonid habitat in the subbasin. Use GRWC protocols for instream and channel measurements. Improve baseline information on habitat conditions by conducting inventory surveys in more Wheatfield Fork tributaries.
    b) Expand continuous temperature monitoring efforts into the upper subbasin and tributaries. Consider looking at canopy composition and monitoring air temperatures to examine canopy, temperature, and other microclimate effects on water temperatures.

c) Encourage more habitat inventory surveys and biological surveys of tributaries, as only 45 percent of the subbasin has been completed.

d) Investigate the availability and quality of other temperature and canopy data for the eastern area, and reevaluate the relationship of canopy to actual stream temperatures. Spot temperature and canopy measurements from habitat inventory data may be useful in providing information from areas in the subbasin for which we have no other data.

e) Survey for salmonids using consistent methods to estimate population numbers for comparison.

Mainstem South Fork Subbasin

Working Hypothesis 1
Instream conditions are suitable for salmonids in the South Fork and tributaries upstream of the confluence with the Wheatfield Fork.

<u>Supporting Findings</u>

- Steelhead trout (young-of-the-year, one year and older) were detected on South Fork during electrofishing surveys in October of 2001.
- Water temperatures were fully suitable for salmonids the headwaters of the South Fork in 2001 and somewhat suitable in McKenzie Creek (Table 5.6-4)
- CDFG habitat inventory survey results met target values for canopy cover in Camper Creek, Carson Creek, Palmer Canyon Creek, and in the headwaters of the South Fork. Embeddedness target values were met on all seven of the streams surveyed (Table 5.6-7).
- The EMDS scores from Carson Creek and in the headwaters of the South Fork were fully suitable for canopy cover. Camper and Palmer Canyon Creeks were moderately suitable for canopy cover. McKenzie and Wild Hog Creeks were somewhat suitable for canopy cover (Table 5.6-10).
- Embeddedness was moderately suitable in the headwaters of the South Fork, and somewhat suitable on Marshall and Palmer Canyon Creeks (Figure 5.6-17).

<u>Contrary Findings</u>

- Coho salmon were not detected on the South Fork during electrofishing surveys in October of 2001.
- Water temperatures (MWAT) in 2001 were unsuitable for salmonids at one of two sites in the lower mainstem South Fork and undetermined at one of two sites in McKenzie Creek (Table 5.6-4).
- Water temperatures (MWAT) in 1995-98 and 2000-2001 were unsuitable for salmonids at five of seven sites in the mainstem, both sites in McKenzie Creek in 2000-2001, and the site in Palmer Canyon Creek in 2000 (Table 5.6-4).

- CDFG habitat inventory target values for canopy cover were not met on Marshall and McKenzie Creeks. The Marshall Creek EMDS score for canopy cover was moderately unsuitable (Table 5.6-7).
- Target values were not met on any of the seven streams surveyed for primary pool depth/frequency or shelter/cover. The EMDS scores ranged from somewhat to fully unsuitable on all of the seven streams surveyed for pool depth, pool shelter and pool quality (Table 5.6-10).

Limitations

- Only 31 percent (1.6 miles) of the SPWS was habitat inventory surveyed.
- The modified ten-pool protocol electrofishing methodology was used as designed to indicate coho salmon presence/not detected only. It cannot be used to for species composition, species density or population estimates.
- Water temperature data for the SPWS were restricted to eight sites for the period of 1995- 1998 and 2000-2001. Water temperature data were available for only four sites in 2001.

Conclusions

- The Hypothesis is supported within the limitations of the length of streams habitat inventory surveyed.

Working Hypothesis 2
Historically logged areas have contributed sediment to the streams.

Supporting Findings

- Most of the higher and east reaches of the South Fork were clear-cut between 1952 and 1961 building roads in or along the major tributaries streams (Figure 5.6-10). This left large areas of disturbed ground.
- Approximately 15 miles of historic logging roads built in or along the streambed simplified pool structure and complexity throughout the Marshall and McKenzie Creeks, and the upper mainstem tributaries (Section 5.6.4).
- Numerous debris flows and debris slides involved roads, and numerous failures occurred along instream and near-stream roads and landings during large storm events as observed in 1961 and 1965 aerial photos. This increased sedimentation in the streams (Section 5.6.4).
- Many undersized culverts and substandard road drainage facilities failed during the 1986 and 1996 storms, representing a portion of contemporary sediment pulses in the subbasin. These failures were generally more numerous where roads (mostly ranchland roads) cross high or very high potential landslide areas (105 miles) (Section 5.6.4).

- LWD recruitment has been limited due to streamside road construction, timber harvesting, and salmonid migration barrier removal. The reduction of LWD likely reduces pool formation and sediment storage in the tributaries.

Marshall Creek

- Streamside roads lined Wild Hog and Palmer Canyon creeks by 1959. Lack of erosion control facilities along streamside roads and landings created gully erosion observed in 1965 photos (Figure 5.6-10).
- Modern road segments within 60 meters of historically active landslides are numerous in the upper tributary stream reaches of Marshall Creek and may be contributing excess sediment to streams.

McKenzie Creek

- Streamside/instream roads and landings were densely concentrated in the central and higher reaches of McKenzie Creek (1961, 1965, and 1981 photos) (Figure 5.6-10).

<u>Contrary Findings</u>

- Embeddedness target values were met on all seven of the streams surveyed.
- Approximately 1.5 miles of modern roads (out of 116 miles total) are located within 50 feet of blue line streams in the subbasin.
- The northeast portion of the Upper South Fork watershed is underlain primarily by Central Belt Franciscan mélange. This may contribute relatively large amounts of fine grained sediment to streams.

<u>Limitations</u>

- Only 31 percent (1.6 miles) of the SPWS was habitat inventory surveyed.
- Observations of landuse and associated impacts are from aerial photo interpretations.

<u>Conclusions</u>

- The hypothesis is supported by the limited data available.

Working Hypothesis 3

Instream and near stream conditions are improving.

<u>Supporting Findings</u>

- Overstory shade canopy as observed from aerial photos has recovered in the middle to upper reaches as indicated by (1) comparison of 1981 bank-to-bank exposure with 2001 habitat inventory survey, and (2) canopy density ranged between approximately 50 to 75 percent between the years 1999, 2000, and 2001 in McKenzie, Carson, Camper, and Wild Hog creeks (Section 5.6.4).

- The McKenzie Creek channel in the Upper Marshall Creek PWS was more than 50 percent disturbed based on 1984 aerial photo interpretation, and improved to less than 25 percent disturbed per 1999/2000 photos (Table 5.6-3).
- Channel disturbance observed from aerial photos for the Upper South Fork PWS decreased from 39.2 percent disturbance in 1984 to 23.9 percent in 1999/2000 photos (Table 5.6-3).

Contrary Findings

- The levels of channel disturbance observed from aerial photos in the South Fork Gualala in the Middle South Fork PWS are similar between 1984 and 1999/2000 (31.5 percent and 27.2 percent, respectively) (Table 5.6-3).
- Channel disturbance was 50 to 75 percent in the lower reach of Marshall Creek downstream of McKenzie Creek (Lower Marshall Creek PWS) in 1984 and nearly the same in 1999/2000 observations with approximately 50 percent of the channel disturbed (Table 5.6-3).
- Riparian canopy has not recovered to 1942 levels observed from aerial photos (Figures 5.6-7 and 5.6-10).

Limitations

- Only 31 percent (1.6 miles) of the SPWS was habitat inventory surveyed. Analysis is limited by a comparable lack of historical stream surveys in this SPW with which to indicate comparative trends.

Conclusions

- The hypothesis is supported by the limited data available.
- Current riparian shade canopy cover has improved from 1968 when long portions of riparian zones had been cleared of all vegetation, but not to the 1942 levels.
- Improvements in the levels of channel disturbances from 1984 to 1999/2000 are generally positive, but mixed, with some areas improving and others staying the same.

Subbasin Recommendations

Target restoration and land use activities to the four highest priorities for restoration in the Gualala Mainstem/South Fork Subbasin: (1) large wood placement, (2) road repair or removal, (3) riparian canopy development, (4) barrier removal, (5) bank stabilization, and (6) livestock or feral pig exclusion.

1. Install fish habitat improvement structures including large woody debris placement.
   a) Land managers in the subbasin should be encouraged to add more large organic debris and shelter structures in order to improve sediment metering, channel structure, channel function, habitat complexity, and habitat diversity for salmonids. The natural large woody debris recruitment process should be enhanced by developing large riparian conifers with tree protection, planting,

thinning from below, and other vegetation management techniques. Instream structure enhancement is a restoration priority 1 in McKenzie and Wild Hog creeks, and the South Fork, priority 2 in Marshall Creek.

b) At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. Grazing is an issue in the subbasin. Bank stabilization is the third of the top three recommendations.

c) Reduce livestock and feral pig access to the riparian zone to encourage stabilization of stream banks and revegetation of the riparian zone.

2. Address road issues.

a) Decommission and revegetate streamside roads, focusing on those where channel braiding and/or aggradation are persistent today, such as the central and upper reaches of McKenzie Creek, and the lower reaches of Marshall Creek including Palmer Canyon and Wild Hog Creeks. Road repair and removal is a restoration priority 2. (from CGS restoration map).

b) Upgrade and maintain existing road systems to eliminate sediment sources to pools and spawning gravels. Carefully engineer new roads or repairs to reduce adverse sediment impacts. Use the CGS Restoration map to locate where ranch roads cross historically active landslides to target further field evaluation. These areas have been mapped in dense concentrations in the east subbasin reaches.

c) Target road upgrade/repair starting with instream sediment indicators where fish habitat is less than suitable, priority 1 in McKenzie, Wild Hog, and the South Fork, and priority 2 in Marshall Creek.

d) Incorporate mitigation elements into Timber Harvest Plans and pursue cost sharing grants for decommissioning legacy streamside roads and upgrading road drainage facilities in the timber-dominant lower subbasin, including Little and Big Pepperwood Creeks.

e) Pursue cost sharing grants organized by the Sotoyome RCD to upgrade ranchland roads in the ranchland upland areas.

f) Develop erosion control plans for decommissioning old roads, maintaining existing roads, and constructing new roads. Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 50 percent of the subbasin.

3. Address riparian zone issues.

a) Ensure that adequate streamside protection zones are used to reduce solar radiation and moderate air temperatures in order to reduce heat inputs to the Upper South Fork and its tributaries.

b) In the east subbasin reaches, retain, plant, and protect trees to achieve denser riparian canopy to enhance current canopy recovery from mid-20th-century block clearance logging and ranchland conversions. The following areas continue to show gaps on riparian shade cover compared to 1942: i. The central to upper reaches of the Upper South Fork, McKenzie Creek, and Wild Hog and Palmer

Canyon creeks . ii. Riparian canopy development is a restoration priority 1 for Marshall Creek and a priority 2 for the South Fork and Palmer Canyon and Wild Hog creeks.

   c) Reduce livestock and feral pig access to the riparian zone to encourage stabilization of stream banks and revegetation of the riparian zone.

4. Expand monitoring efforts in the subbasin.
   a) Conduct both instream and hillslope monitoring to determine whether current land use practices are allowing for recovery and protection of the salmonid habitat in the subbasin. Use GRWC protocols for instream measurements. Improve baseline information on habitat conditions by conducting inventory surveys in the South Fork and major tributaries upstream of the confluence with the Wheatfield Fork.
   b) Expand continuous temperature monitoring efforts into the upper subbasin and tributaries. Consider looking at canopy composition and monitoring air temperatures to examine canopy, temperature, and other microclimate effects on water temperatures.
   c) Investigate the availability and quality of other temperature and canopy data for the eastern area, and reevaluate the relationship of canopy to actual stream temperatures. Spot temperature and canopy measurements from habitat inventory data may be useful in providing information from areas in the subbasin for which we have no other data.
   d) Conduct habitat inventory surveys in the remainder of the SPWS to provide information for restoration priorities and as a baseline for future comparisons.
5. Remove fish migration barriers in Palmer Canyon Creek and McKenzie Creek.