Staff Report
Supporting the Policy for the Implementation of the Water Quality Objectives for Temperature and Action Plan to Address Temperature Impairment in the Mattole River Watershed, Action Plan to Address Temperature Impairment in the Navarro River Watershed, and Action Plan to Address Temperature Impairment in the Eel River Watershed

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1.0 INTRODUCTION

This document presents the background information and rationale that supports the North Coast Regional Water Quality Control Board's proposed *Policy for the Implementation of the Water Quality Objectives for Temperature* and *Action Plan to Address Temperature Impairment in the Mattole River Watershed*, *Action Plan to Address Temperature Impairment in the Navarro River Watershed*, and *Action Plan to Address Temperature Impairment in the Eel River Watershed*. This Policy and those Action Plans are proposed as a single amendment to chapter 4, (Implementation Plans) of the *Water Quality Control Plan for the North Coast Region* (Basin Plan).

1.1 Background and Purpose

Approximately sixty-three percent of the area of the North Coast Region is listed as temperature impaired, per Section 303(d) of the Clean Water Act, because the water quality of those rivers and streams does not meet the temperature water quality objectives. Temperature impairments in the watersheds of the North Coast Region are predominantly associated with nonpoint sources of pollution, such as timber operations, agriculture, streambed alteration, land conversion and other construction activities. Temperature impairments are also associated with activities which do not generally involve waste discharge, such as vegetation alteration, water withdrawal, and hydromodification. Temperature Total Maximum Daily Load (TMDL) analyses of 13 watersheds in the north coast found the same factors to be responsible for elevated water temperatures: increased exposure to solar radiation due to loss of stream shade, physical stream channel alteration in response to elevated sediment loads, engineered stream channel alteration, and alteration of hydrology resulting from impoundments, water diversions, hydromodification, and landscape alteration. The widespread temperature impairments and common source factors within the North Coast Region point to the need for a region-wide approach for addressing temperature issues. The establishment and implementation of this Policy will provide a common approach to ensuring attainment of the water quality objectives for temperature. Similarly, the establishment and implementation of such a policy will ensure that high quality waters are also protected.

On January 19, 2012, the North Coast Regional Water Quality Control Board (Regional Water Board) adopted Resolution R1-2012-0013 titled "*Policy Statement for Implementation of the Water Quality Objective for Temperature in the North Coast Region"* (Policy Statement)[1]. The Policy Statement describes the water quality objectives for temperature, identifies common activities that have the potential to elevate water temperatures in excess of water quality objectives, and identifies the regulatory mechanisms at the disposal of the Regional Water Board used to control waste discharges and associated activities in a comprehensive and consistent

[1] Resolution R1-2012-0013 can be downloaded at: http://www.waterboards.ca.gov/northcoast/board_decisions/adopted_orders/pdf/2012/120127_12_0013_Resolution_Temperature.pdf

manner. The Policy Statement also provides direction to staff developing and implementing permits and evaluating the water quality impacts of proposed actions, provides clarification to the public regarding what is required to comply with the objective, and provides direction to staff to incorporate a Temperature Implementation Policy into the Basin Plan.

1.2 Document Organization

The remainder of this document is organized in the following manner:

- Chapter 2 presents the science of water temperatures in both a general sense, and as applied in north coast temperature TMDL analyses.
- Chapter 3 presents the water quality objectives for temperature contained in the Basin Plan.
- Chapter 4 discusses the interpretation of the water quality objectives for temperature and the manner in which they are implemented for activities and situations.
- Chapter 5 identifies and discusses the temperature factors this policy focuses on, as well as the actions to address the identified temperature factors.
- Chapter 6 discusses the Mattole, Navarro, and Eel River watershed Temperature TMDLs, and the actions identified to implement them.
- Chapter 7 provides a simple description of the monitoring strategy staff will use as the basis of a monitoring plan to be developed in the future.
- Chapter 8 describes the environmental setting and baseline condition for the environmental analysis.
- Chapter 9 presents the environmental analysis of alternatives and reasonable means of compliance.
- Chapter 10 presents an economic analysis of the impacts of this policy.
- Chapter 11 discusses the public process that has been conducted to date.
- Chapter 12 lists the references cited in the text of the report.

2.0 ANALYSIS OF TEMPERATURE

This section of the document presents an overview of temperature dynamics, drawing on the findings of temperature TMDL analyses and the body of scientific literature relevant to the topic of stream temperature. The discussion has undergone scientific peer review, as required by law. The three reviewers concurred with the scientific assumptions, assertions, and conclusions that this Policy reflects, although each had suggestions for strengthening the discussion. The discussion below reflects suggestions made by the reviewers. The peer reviewers' specific comments and Regional Water Board staff's response can be found in Appendix A of this document.

2.1 Identification of Drivers of Elevated Water Temperature

The sensitivity and response of stream temperatures to factors that drive them have been evaluated in temperature TMDL analyses completed in the North Coast Region. Figure 2.1 presents an example of such sensitivity analyses. Similar reach-scale sensitivity analyses were developed for the Mattole, Salmon, and Upper Lost River TMDLs. These sensitivity analyses were conducted using reach-scale temperature models and data representing site-specific conditions, represented as average values for the reach. The model calculates the temperature that results at the downstream end of the modeled reach based on the reach averaged inputs. The sensitivity of stream temperatures to driving factors over multiple reaches was also evaluated in both the Scott and Shasta River temperature analyses using deterministic temperature models that simulated temperature dynamics over many miles (NCRWQCB 2005, NCRWQCB 2006).

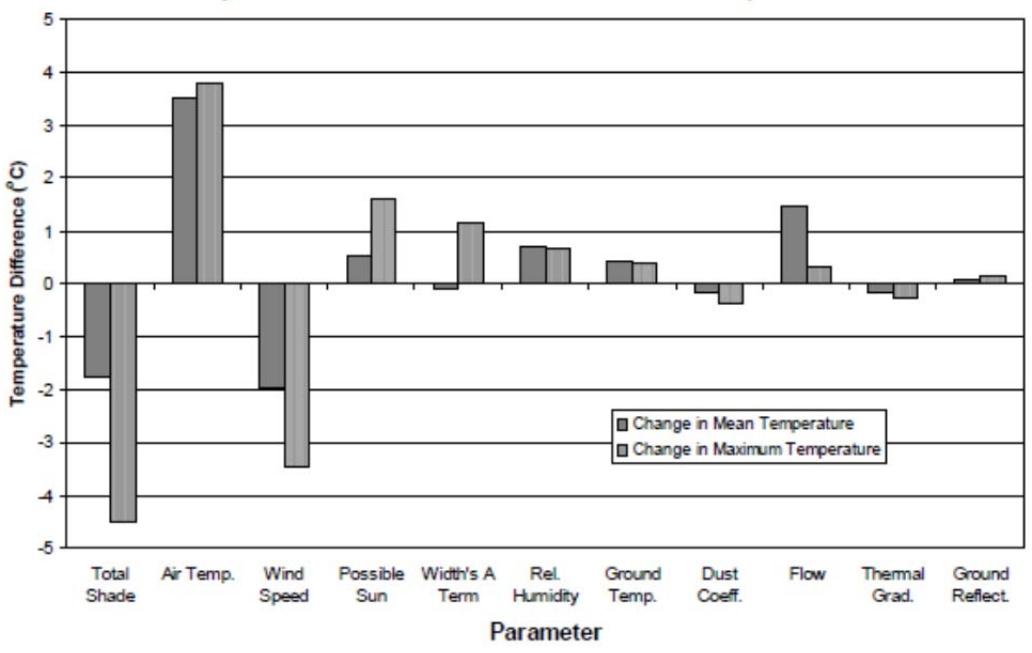


Figure 2.1: Results of a sensitivity analysis from the Navarro River temperature TMDL ranking temperature drivers (Source: NCRWQCB 2000)

The investigation of elevated stream temperatures in north coast streams points to a limited number of stream temperature factors that are directly affected by management activities. Figure 2.1 presents the results of an analysis examining the sensitivity of stream temperatures to the various factors acting to drive water temperature dynamics in the Navarro River watershed (NCRWQCB 2000). Of the factors that determine stream temperatures, shade and flow can be most directly affected by management activities. Air temperature, relative humidity, wind speed, ground temperature, width-to-depth ratio, channel roughness, and ground reflectivity can be indirectly affected by management activities, but generally do not cause temperature alteration of the same magnitude in response to changes in the values over the range that management actions most often create.

It should be noted that substantial changes in width-to-depth ratios and channel roughness can result in substantial temperature changes. Increased width-to-depth ratios primarily affect temperature through increased exposed surface area, which increases solar exposure. Increased channel roughness results in a deeper wetted channel, which often decreases width-to-depth ratios, thereby reducing solar exposure. Streams with greater depths are less sensitive to changes in temperature drivers than shallower streams (Herb and Stefan 2010). Increased channel roughness can also increase the time of travel through a reach, which may have a cooling or warming effect depending on the characteristics of the reach.

2.2 Interaction of Temperature Drivers

Sensitivity analyses such as those mentioned above evaluate the significance of changes in individual temperature drivers well. Evaluating the interaction of multiple drivers is more complex; however their interaction can be more easily understood when considered in the context of equilibrium temperature.

A stream is considered in equilibrium with its surroundings when the sum of the heat fluxes equals zero (i.e., heat inputs and outputs are balanced) (Bogan et al. 2003, Mohseni et al. 2002). Essentially, the equilibrium temperature is the temperature a stream (or any body of water) will reach if given enough time to come into balance with its surroundings. A simple example of this concept is a glass of cold water placed in a warm room: given enough time, the water will reach the temperature of the room, and that temperature is the equilibrium temperature. Headwater stream temperatures reflect the temperature of their sources, such as snow melt, groundwater, or lakes. As water travels downstream, its temperature changes in response to its surroundings, trending toward the local equilibrium temperature.

The strongest driver of equilibrium temperature is air temperature, while shading, wind sheltering, and groundwater inputs are the greatest modifiers of the relationship of air temperature to equilibrium temperature (Bogan et al. 2003, Morrill et al. 2005, Mohseni et al. 2002). These facts are represented in the sensitivity analysis results shown in Figure 2.1. The model used to generate Figure 2.1, SSTEMP, calculates daily average water temperatures based in part on

equilibrium temperatures. It is not surprising then, that the simulated reach, which is low in the Navarro system in a reach with little groundwater inputs, is calculated to be most sensitive to air temperature, shade, and wind speed. Despite the sensitivity of equilibrium temperature to air temperature and wind speed, solar radiation (which is represented in Figure 2.1 by total shade and possible sun) has been demonstrated to result in heat fluxes an order of magnitude higher than those associated with air temperature and wind speed (i.e., convection and evaporation), which explains why shade is so important for stream temperature control (Johnson 2004).

The equilibrium temperature is not constant, just as air temperature is not constant. While all stream reaches approach the equilibrium, many stream reaches do not reach the highest daily equilibrium temperature of the day before the equilibrium temperature drops as the air temperatures drop in the late afternoon and evening. Factors other than air temperature, such as shade, depth, flow, and groundwater inputs, determine how quickly a stream reaches the equilibrium temperature, and what that equilibrium temperature is in that reach (Mohseni et al. 2002, Bogan et al. 2004, Herb and Stefan 2010).

To summarize the discussion above:

1. Streams reflect the temperature of their sources (e.g., groundwater, snow melt, or lake temperatures) near their headwaters.
2. An equilibrium temperature exists that represents the temperature a stream will eventually reach, given the external temperature drivers don't change and enough time has passed.
3. Streams that are above or below the equilibrium temperature trend toward that equilibrium temperature.
4. Increasing shade, depth, flow, or groundwater inputs will slow the rate at which streams approach equilibrium.
5. Increasing solar radiation, or reducing flow and/or depth will increase the rate at which streams approach equilibrium.

Given the temperature dynamics described above, the ways in which the drivers of temperature interact becomes clearer. Air temperature determines equilibrium temperatures, and thus how hot a stream can be, while shade and flow determine how quickly a stream approaches the equilibrium, and thus how hot a stream actually becomes. A reduction in flow requires an increase in shade in order to maintain the same temperatures and vice versa. Also, increases in air temperature will result in increased water temperatures, with the magnitude of the increase dampened by higher shade and flow levels.

The water temperature dynamics described above have implications for the future, given the fact that global temperatures are increasing (Wu et al. 2012, Bartholow 2005). Climate is outside the control of the Regional Water Board. However, the factors that can lessen the impacts of climate change - shade, flow, and depth (to the degree that sediment loads and channel alterations affect stream depth) - can be

managed. Given the forecasted changes in global climate, the protection of shade and flows and control of sediment loads becomes even more important for the protection of beneficial uses into the future.

Another practical implication of the discussion above relates to the preservation and restoration of shade. Preservation of shade is most important in stream reaches with temperatures far below the equilibrium temperature because they are the reaches the most susceptible to rapid heating. Newton's Law of Cooling states that the rate of temperature change is proportional to the difference in temperature, which is the difference between the stream temperature and equilibrium in these situations. Conversely, restoration of shade in reaches of stream that regularly reach or come near equilibrium temperatures is not likely to result in significant temperature changes until upstream reaches are addressed, and in some cases, such as wide high-order streams, the increased shade may only have a negligible effect, regardless, as described in more detail in section 2.3, below.

2.3 Additional Considerations

It is important to note that solar radiation loads are not always the primary controllable driver of elevated water temperatures in most waterways in the North Coast Region. For instance, some situations exist where vegetation is ineffective at increasing effective shade. High-order streams are often too wide relative to the height of vegetation to provide levels of shade that have a substantial temperature effect. The Klamath and Eel River Temperature TMDLs recognize this phenomenon and do not assign riparian shade load allocations for the mainstems. However, in these cases the shade provided by riparian vegetation may still be important for the maintenance of thermal refugia. In summary, increased solar radiation loads are likely to be the primary controllable driver of elevated water temperatures in most waterways in the North Coast Region, but aren't always.

In addition to the benefits of shade, riparian vegetation provides many other water quality benefits besides those associated with temperature, such as bank stability, nutrient and sediment filtering, and large woody debris recruitment (see section 5.2.2 for further discussion). These benefits are additional considerations that should be evaluated when the Regional Water Board evaluates projects that involve alterations to riparian vegetation, in addition to shade.

Another important consideration regarding temperature dynamics and compliance with temperature objectives involves scale, from both spatial and temporal perspectives. The intrastate water quality objective for temperature states "at no time or place" shall the temperature be increased by more than 5°F above natural receiving water temperature (see section 3.0). Some have questioned if there is a minimum scale of consideration that should be applied to the assessment of this objective. The objective doesn't explicitly state there are minimum dimensions that should be considered, however, the objective references adverse impacts to beneficial uses as the ultimate criteria. From a practical perspective then, the spatial scale of consideration is that which is relevant to the beneficial uses in question.

Staff have witnessed distressed juvenile steelhead gathered in high densities within a small volume of water colder than its surroundings as a result of hyporheic exchange through a gravel bar. In that case, the relevant spatial scale was small, yet the biological importance appeared to be very high.

Other issues of spatial and temporal scales involve the rate of physical and biological processes. One of the time scales most relevant to the recovery of temperature in previously impacted stream systems of the north coast is the rate of tree growth. In places where recovery of temperatures is dependent on the restoration of riparian shade, recovery occurs as fast as trees grow. Similarly, the impacts of large sediment pulses on stream morphology can persist for many decades. An example of this is the Eel River system where large volumes of sediment delivered in the 1955 and 1964 floods still remain in the active channel (USEPA 2007).

2.4 Temperature TMDL Analyses

A necessary step in the development of Total Maximum Daily Loads is the interpretation of water quality objectives. The intrastate water quality objective for temperature is the only temperature objective applicable to all of the TMDLs developed, and thus has been the focus of temperature TMDL development in the North Coast Region. The temperature TMDL analyses have consistently found that the shade provided by riparian vegetation has a dramatic beneficial effect on stream temperatures, and that achieving the intrastate water quality objective for temperature requires riparian shade consistent with natural conditions. This concept is the basis of TMDL load allocations prescribed in every north coast temperature TMDL. Similarly, north coast temperature TMDLs have also identified the alteration of channel geometry caused by elevated sediment loads as a factor that must be controlled in order to meet the intrastate water quality objective for temperature. Load allocations for sediment are absent from many north coast temperature TMDLs due to the fact that sediment TMDLs were developed concurrently for the same waterbodies. In those cases, the control of elevated sediment loads was identified in the temperature TMDL margins of safety. Additionally, some north coast temperature TMDLs have identified the role of hydrologic alteration as a causative factor that must be addressed in order to meet the intrastate water quality objective for temperature.

The technical approach to developing load allocations meeting the water quality objectives for temperature in north coast temperature TMDLs has varied among the 13 temperature source analyses, based on the situations present. However, the 13 temperature TMDL analyses share common elements. All of the temperature TMDLs have made use of temperature models to investigate temperature dynamics using locally derived data. Most temperature TMDLs also have made use of shade models that predict the incidence of shade on stream segments. Table 2.1 summarizes information pertaining to the development of the 13 temperature TMDLs completed in the North Coast Region to date.

2.4.1 Shade Analyses

Shade models have been used in the development of north coast temperature TMDLs to quantify the difference between current and potential stream shade conditions on both a watershed and reach scale. The products of the watershed-scale shade models - spatial databases of current and potential shade condition approximations - were used as the basis of TMDL load allocations (loads that meet the intrastate water quality objective for temperature). The watershed-scale shade models used in the development of north coast temperature TMDLs are simplified applications of the approach presented by Chen and others (1998a & 1998b), who developed the approach for the Upper Grand Ronde River (Oregon) Temperature TMDL.

The shade models used to determine north coast temperature TMDLs determine whether sunlight reaches a given segment of stream based on the location of the stream channel, the surrounding topography, attributes of the surrounding vegetation, and the path of the sun in the sky. The models calculate shade using readily available data describing ground elevations, stream hydrography, and vegetation present on the landscape (Boyd and Kasper 2003, Kennedy et al. 2005, Tetra Tech 2002). Information describing bankfull channel dimensions and the relationship of tree diameter to tree height was also collected and incorporated into the spatially explicit shade models.

The shade models used in the development of north coast temperature TMDLs provide a relative index of shade values in a spatially explicit manner. The models calculate the incidence of sunlight on a stream channel for each hour of the day, by determining whether sunlight is blocked by topography or vegetation at a given site and time of day. The daily score is the sum of the hourly scores, weighted by the relative magnitude of the solar load for each hour of the day.

The determination of whether sunlight is blocked by riparian vegetation is partly based on the assumed height of the vegetation, which in turn is based on relationships of diameter-at-breast-height (dbh) to tree height for the species of vegetation present. Information describing the species of vegetation at a given site is based on remotely sensed data describing vegetation distributions. Current vegetation heights were approximated based on the dbh of the species present in each grid cell, whereas the potential vegetation heights were based on the assumed mature height for the same species. The remotely sensed data used for these analyses include the Timber Task Force Klamath Province habitat database developed as part of the Klamath Region Vegetation Mapping Project and the CALVEG database developed by the USFS.

TMDL Assessment	South Fork Eel River	Navarro River	Mattole River	North Fork Eel River	Middle Fork Eel River	Upper Main Eel River	Middle Main Eel River	Lower Main Eel River	Upper Lost River	Salmon River	Scott River	Shasta River	Klamath River
Year	1999	1999	2001	2002	2003	2004	2005	2007	2004	2005	2005	2006	2009
Temperature Model	BasinTemp	SSTEMP	SSTEMP	Q2ESHADE	Q2ESHADE	Q2ESHADE	Q2ESHADE	Q2ESHADE	SSTEMP	SSTEMP	Heat Source	TVA	RMA-2, RMA-11, CE-QUAL-W2
Shade Model	Topquad	RipTopo	RipTopo	Q2ESHADE	Q2ESHADE	Q2ESHADE	Q2ESHADE	Q2ESHADE	n/a	SSTEMP	Heat Source	n/a	n/a
Vegetation Data Source	Klamath Bioregional Mapping Project	Klamath Bioregional Mapping Project	Calveg	Calveg	Calveg	Calveg	Calveg	Calveg	measured values	measured values	Calveg	measured values	n/a
Factors Identified	Shade, Sediment	Shade, Sediment, Flow	Shade, Sediment	Shade, Sediment	Shade, Sediment	Shade, Sediment	Shade, Sediment	Shade, Sediment	Delisted	Shade, Sediment	Shade, Sediment, Flow	Shade, Flow, Ag Return Flows	Shade, Sediment, Impoundments
Concurrent Sediment TMDL?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Lead agency (development)	USEPA	NCRWQCB	NCRWQCB	USEPA	USEPA	USEPA	USEPA	USEPA	NCRWQCB	NCRWQCB	NCRWQCB	NCRWQCB	NCRWQCB, ODEQ, USEPA

Table 2.1: Summary of North Coast Temperature TMDL development information

The first temperature TMDL developed in the North Coast Region was the South Fork Eel River Temperature TMDL (USEPA 1999). The temperature source analysis was conducted by Stillwater Sciences under contract to the USEPA and utilized a temperature model called the Stillwater Sciences Temperature Model, which in turn relied on a geographic information system (GIS) based method to calculate solar radiation reductions resulting from riparian vegetation and topography (Stillwater Sciences 1999). The solar radiation loads were then incorporated into a one-dimensional heat balance model (ibid). Figure 2.2 presents a graphical representation of the stream shade modeling approach.

The results of the South Fork Eel River temperature TMDL analysis demonstrated the importance of the shade provided by riparian vegetation for achievement of the intrastate water quality objective for temperature.

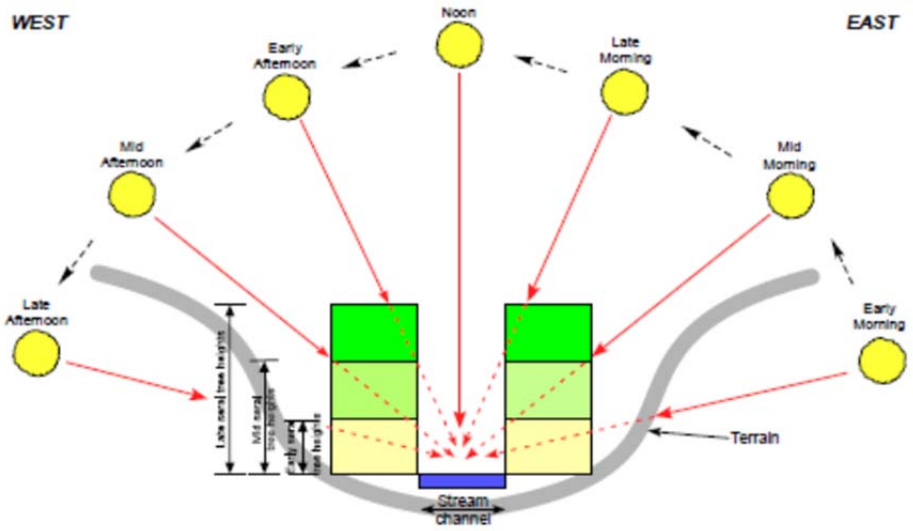


Figure 2.2: conceptual representation of riparian shade model. (Allen 2008)

The second temperature TMDL developed in the North Coast Region was the Navarro River Temperature TMDL (Navarro TMDL; USEPA 2000). The Navarro River temperature source analysis also identified the importance of shade provided by riparian vegetation for protection of stream temperatures. The Navarro River temperature source analysis was conducted by the NCRWQCB with assistance from the UC Davis Information Center for the Environment. The temperature source analysis utilized a riparian shade model called RipTopo, a GIS-based model much like the model developed by Stillwater Sciences for the South Fork Eel River Temperature TMDL (Kennedy et al. 2005). The Navarro TMDL also relied on the use of the USGS stream reach temperature model SSTEMP as a screening tool, as discussed above. The TMDL load allocations were set at the effective shade levels that represent potential vegetation conditions, based on the screening analysis

conclusions. The RipTopo shade modeling results were the basis of the TMDL load allocations (NCRWQCB 2000, USEPA 2000).

The RipTopo model was later used for the Mattole River Temperature TMDL (NCRWQCB 2002, USEPA 2002a) and the Scott River Temperature TMDL (NCRWQCB 2005) in the same manner (defining TMDL load allocations) as in the Navarro TMDL. However, the Mattole River Temperature TMDL source analysis also estimated current and potential temperatures in nine tributary and three mainstem reaches using the SSTEMP model (NCRWQCB 2002), while the Scott River Temperature TMDL made use of the Heat Source temperature model to calculate stream shade and temperature approximations for the Scott River mainstem and three tributaries (Boyd and Kasper 2003, NCRWQCB 2005). The more sophisticated modeling approach was employed for the Scott River Temperature TMDL due to the more complex hydrology (i.e., effects of surface diversions, groundwater-surface water dynamics) present in that watershed. The Mattole River and Scott River temperature TMDLs also assigned temperature load allocations at levels corresponding to shade conditions representing potential vegetation conditions (USEPA 2003a, NCRWQCB 2005).

Five of the six of the Eel River basin temperature TMDL source analyses were developed by Tetra Tech, Inc., under contract to the USEPA (USEPA 2002b, USEPA 2003a, USEPA 2004, USEPA 2005, USEPA 2007). Tetra Tech developed a modeling system called Q2ESHADE for use in the temperature TMDL process (Tetra Tech 2002). The Q2ESHADE model combines the USEPA-supported QUAL2E hydrodynamic and water quality model with a shade modeling routine called SHADE, a GIS-based model formulated based on the model developed by Chen et al. (1998a) and applied to the Upper Grande Ronde River watershed (Chen et al. 1998b). The Q2ESHADE modeling system calculates hourly shade-attenuated solar radiation at various locations based on riparian vegetation characteristics and topographic relief, and utilizes these solar radiation loads to predict in-stream temperatures throughout a stream network (Tetra Tech 2002). The six temperature TMDLs developed in the Eel River basin assigned temperature load allocations at levels corresponding to shade conditions representing potential vegetation conditions based on the results of the modeling analysis (USEPA 2002b, USEPA 2003a, USEPA 2004, USEPA 2005, USEPA 2007).

The Klamath River temperature TMDL analysis also evaluated the impacts of shade on tributary temperatures. The Klamath tributary analysis relied on principles of stream thermal dynamics supported by scientific literature and the analyses and conclusions of previous temperature TMDLs, particularly those developed for the Salmon, Scott, and Shasta River, and assigned load allocation for effective shade at levels corresponding to shade conditions representing potential vegetation conditions accordingly (NCRWQCB 2010).

2.4.2 Hydrologic Analyses

The evaluation of temperature impacts associated with changes in hydrology was a major focus of both the Shasta River Temperature TMDL (Shasta TMDL) and Klamath River Temperature TMDL (Klamath TMDL). The Shasta TMDL analysis evaluated the effects of stream diversions, irrigation tailwater return flows, impoundments, and riparian vegetation on temperatures of the Shasta River. The analysis of impacts relied on an application of the Tennessee Valley Authority's River Modeling System (TVA-RMS) temperature model originally developed for the Shasta Valley Resource Conservation District's Shasta River Flow and Temperature Modeling Project (Deas et al. 2003, Deas 2005). The shade values depicting current vegetation conditions and represented in the model were based on riparian vegetation inventories and measurements conducted by UC Davis, Watercourse Engineering, and Regional Water Board staff. Potential solar transmittance values representing potential vegetation conditions were developed by Regional Water Board staff, with consideration of existing vegetation, channel geometry, and soil conditions (NCRWQCB 2006). The effects of tailwater return flows and stream diversions were also evaluated using the TVA-RMS model. Temperature load allocations corresponding to potential shade conditions, increased cold water flows of 45 ft^3/s, and zero thermal loading from tailwater returns were assigned based on the modeling exercise.

The Klamath TMDL analysis evaluated the effects of flow alteration and impoundments using a package of riverine hydrodynamic and water quality models (RMA-2 and RMA-11, respectively), coupled with a reservoir model (CE Qual-W2). The Klamath TMDL analysis evaluated the temperature impacts of altered tributary flows, altered mainstem flows, point sources, and reservoir operations on mainstem Klamath River temperatures. The analysis evaluated the effects of current and historic tributary flows on the temperature of the Klamath mainstem and determined that the tributary flows are too small to substantially alter the temperature of the much larger Klamath River in either the current or historic situation. The impacts of reduced flows from Upper Klamath Lake, the origin of the Klamath River, were also evaluated and found to have no appreciable effect on temperatures at the California-Oregon border.

The Upper Main Eel River Temperature TMDL and Middle Main Eel River Temperature TMDL also included an explicit evaluation of temperature effects associated with the Potter Valley Project, a Pacific Gas and Electric project that alters hydrologic conditions in the Eel River (USEPA 2004, USEPA 2005). That analysis determined that the impacts of the flow alteration were not impacting beneficial uses because the flows during the summer months under the 2004 FERC/NMFS flow schedule are of the same magnitude as unimpaired flows. EPA found that the current FERC/NMFS summer flow schedule likely results in stream temperatures cooler or nearly equal to the possible natural stream temperatures, and thus the FERC/NMFS flow schedule is projected to attain water quality standards.

The Scott River temperature TMDL source analysis explicitly evaluated the stream temperature impacts of reduced groundwater accretion. Regional Water Board staff used the Heat Source model to evaluate changes in stream temperature associated with both increases and decreases in the magnitude of groundwater accretion values based on measured flows and mass balances. The results of the analysis showed that the temperatures of the Scott River, which is primarily a groundwater dominated stream from July-September, are driven in part by the amount of groundwater entering the river as diffuse accretion.

2.4.3 Microclimate

Air temperature, wind speed, and relative humidity interact with one another to create microclimates associated with riparian corridors, and thus can affect stream temperatures. However, while these conditions are demonstrated to be factors indirectly affected by human activities, the information describing the magnitude of effects of human activities on microclimates indicate changes are relatively small and difficult to quantify (Bartholow 2000, Brosofske 1997, Chen et al. 1993, Chen et al. 1999, Dong et al. 1998, Ledwith 1996). Additionally, the types of changes in air temperature, wind speed, and relative humidity anticipated to arise from disturbance of riparian areas do not all act to increase stream temperatures. For instance, decreased relative humidity and increased wind speed, a likely result of riparian zone disturbances, act in concert to remove heat from a stream surface by increasing evaporation (Moore et al. 2005). Conversely, increased air temperatures that may result from riparian disturbances act to increase stream temperatures.

The magnitude of stream temperature impacts associated with changes in microclimate was explicitly evaluated in the Scott River TMDL analysis. In that TMDL analysis, a modeling exercise was conducted that evaluated the change in stream temperature resulting from a combination of changes in air temperature, relative humidity, and wind speed of magnitudes reported in the literature. The micro climate changes were represented in three scenarios that span the range of changes reported in the literature. The analysis results, presented in Figure 2.3, indicate that the magnitude of temperature alteration would be small, on the order of 0.5 ^{o}C or less, whereas the temperature alteration associated with changes in vegetative shade could result in changes of up to 1.5 ^{o}C over the same reach.

The impacts of elevated sediment loads are another factor identified as having the potential to elevate water temperatures. Elevated sediment loads, while not directly addressed in the sensitivity analysis presented in Figure 2.1, indirectly impact many of the factors evaluated by the sensitivity analysis. For instance, elevated sediment loads can result in increased channel widths. Increases in channel widths result in a shallower stream for a given flow condition, which results in more of the water being accessible to solar radiation incidence. Conversely, narrower channels have less of their surface exposed to solar radiation. Elevated sediment loads can also lead to the removal of vegetation that shades a watercourse, as well as fill in deep pools that may thermally stratify in low flow conditions.

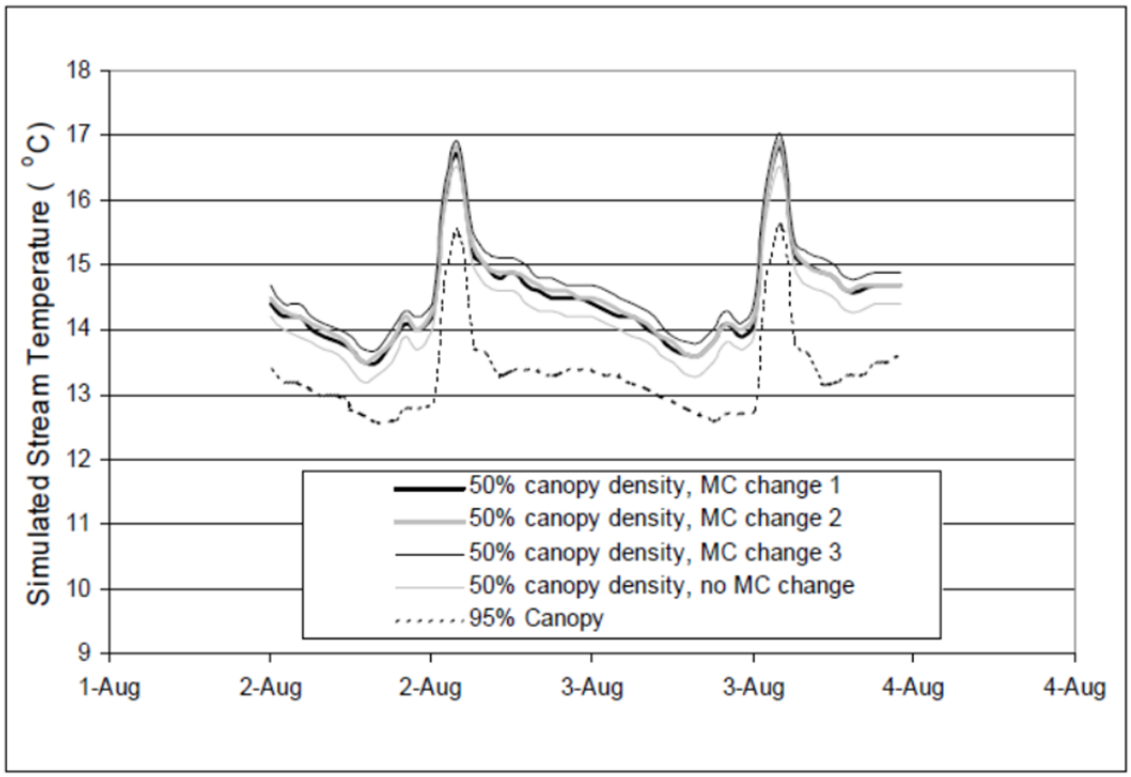


Figure 2.3: Temperature modeling analysis results showing theoretical impacts of microclimate relative to impacts of canopy removal (Source: NCRWQCB 2005). Note that "MC" stands for microclimate.

Based on the analyses described above and the available literature, the implementation strategies developed to achieve TMDLs and the intrastate water quality objective for temperature have focused on a common set of pollutant discharges and controllable factors that have the potential to elevate water temperatures. These controllable factors and discharges are shade, flow, and sediment load.

3.0 TEMPERATURE WATER QUALITY OBJECTIVES

The Basin Plan includes both narrative and numeric water quality objectives which describe the ambient water quality conditions necessary to protect beneficial uses. The Basin Plan contains two separate water quality objectives for temperature. The first objective is the intrastate temperature objective. This objective applies to all waters of the state.

The intrastate temperature objective is a narrative objective with associated numeric criteria and reads:

> The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.
>
> At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.
>
> At no time or place shall the temperature of WARM intrastate waters be increased more than 5°F above natural receiving water temperatures.

The second water quality objective for temperature is the interstate temperature objective contained in the statewide *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California* (Thermal Plan). The Thermal Plan, as adopted by the State Water Board, is incorporated by reference in the Basin Plan (see Appendix 3 of the Basin Plan). The "Cold Interstate Waters" objective is as follows:

> Elevated temperature waste discharges into cold interstate waters are prohibited.

"Elevated Temperature Waste" is defined as:

> Liquid, solid, or gaseous material including thermal waste discharged at a temperature higher than the natural temperature of receiving water. Irrigation return water is not considered elevated temperature waste for the purpose of this plan.

The interstate objective applies to waters that cross or define the state border. The interstate temperature objective augments, but does not supersede, the intrastate temperature objective.

For those waterbodies which do not attain the ambient water quality conditions described by the water quality objectives, the federal Clean Water Act (CWA)

requires an evaluation of the sources of pollution contributing to the impairment and the calculation of the reduced pollutant loads necessary to attain objectives. For waters impaired by elevated temperatures, CWA section 303(d)(1)(D) specifically requires that states estimate "the total maximum daily thermal load required to assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife."

Finally, the State Water Board adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California", commonly known as the Antidegradation Policy. The Antidegradation Policy states:

> "Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies." (State Water Board Resolution 68-16)

Accordingly, all waters in the North Coast Region with ambient water temperatures representing natural conditions are identified as high quality waters. There is a current scarcity of waterbodies with temperatures that fully support the Region's COLD beneficial use, as indicated in part by the listing of red-legged frogs and several Pacific salmonids as threatened or endangered, and others designated as species of special concern (e.g., southern torrent salamanders and summer-run steelhead). The implication of the Antidegradation Policy is that waterbodies with temperatures that are cold enough to support these sensitive organisms during their temperature sensitive life stages, or colder, represent high quality waters regardless of their temperature status, and that any proposal likely to result in the elevation of water temperatures must be able to make the demonstrations spelled out in the Antidegradation Policy. This application of the Antidegradation Policy to temperature is supported by the Basin Plan on page 3-2.00, which states:

> "Where water quality is better than the minimum necessary to support instream uses, the federal [antidegradation] policy requires that quality to be maintained and protected unless the state finds, after ensuring public participation, that:
>
> 1) Such activity is necessary to accommodate important economic or social development in the area in which the waters are located,
> 2) Water quality is adequate to protect existing beneficial uses fully, and
> 3) The highest statutory and regulatory requirements for all new and existing point source discharges and all cost-effective and reasonable best management practices for non point source control are achieved."

4.0 INTERPRETATION AND IMPLEMENTATION OF THE WATER QUALITY OBJECTIVES FOR TEMPERATURE

The interstate temperature objective is written in the form of a prohibition preventing the discharge of elevated temperature waste. Interpretation of the interstate objective is relatively simple, requiring the determination of whether a discharge meets the robust definition of "elevated thermal waste" presented in Section 3.0.

The intrastate temperature objective calls for the maintenance of natural ambient temperature conditions, with certain flexibility afforded at the discretion of the Regional Water Board. The intrastate temperature objective is a narrative objective with associated numeric criteria that allows for its interpretation in the context of specific beneficial uses. Figure 4.1 presents a decision tree representing the logical process of interpreting the intrastate objective. The intrastate objective is interpreted at both the watershed scale and at discrete locations such as a stream reach or pond.

The process shown in Figure 4.1 is most useful in assessments of point sources, impoundments, and discrete sources of elevated water temperature. In other contexts, such as nonpoint source land use permitting, staff typically relies on the implementation of management practices such as riparian buffers and similar conservation practices (see section 4.4, Reliance on Management Practices Associated with Land Uses). Nonpoint source pollution is challenging to control because it is the result of many diffuse and diverse sources occurring across the landscape. Each individual source may contribute only a small portion, but all the sources combined can cumulatively result in water quality problems. A precise quantification of either the condition or the potential impacts associated with any individual parcel is not practicable in implementing temperature protections. Rather, the Nonpoint Source Program focuses on implementing management measures that are known to be effective in controlling nonpoint source pollution, often in the context of other agency's rule making processes or established best management practices. Staff often incorporate such practices as permit terms, as appropriate; Figure 4.1 depicts the process that staff follow in evaluating the efficacy of those practices, and whether additional permits terms are required. However, this process is not typically incorporated into the permit application or enrollment process in these situations.

As seen in Figure 4.1, the first test in interpreting the intrastate objective is whether water temperature is altered from natural conditions. If temperatures have already been altered or could be altered by a proposed project, then a demonstration must be made (to the satisfaction of the Regional Water Board) that (1) the alteration in ambient water temperature has been or would be less than 5 ^{o}F above natural receiving water temperatures and (2) any elevated ambient water temperatures do not adversely affect beneficial uses. The assessment of natural temperature conditions is discussed in Section 4.1, below.

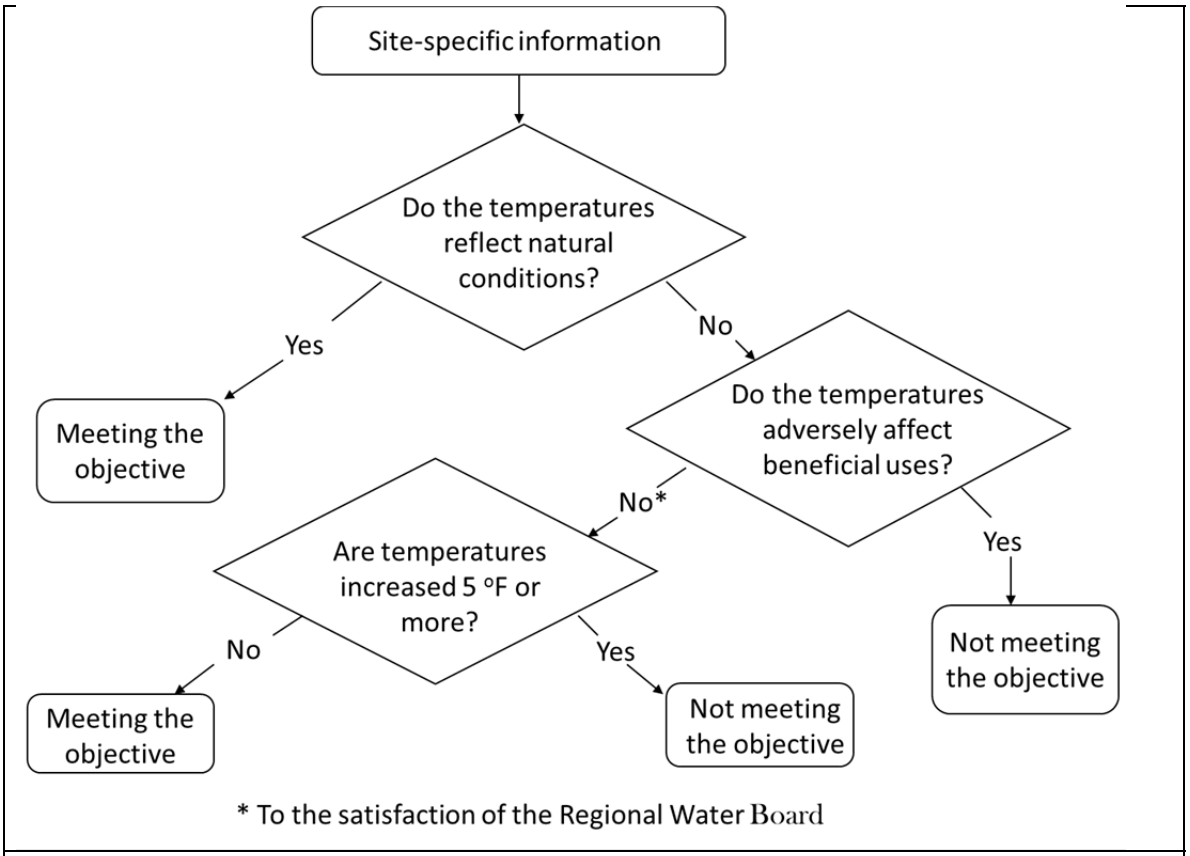


Figure 4.1: Decision tree representing the logical process for determining attainment of the Intrastate Water Quality Objective for Temperature

In the absence of a demonstration that a given temperature alteration won't adversely affect beneficial uses or increase temperatures by 5 °F or more, the objective defaults to no change in temperature. The language of the objective places the burden of proof on the proponent of the action that has potential to alter the temperature. Accordingly, Regional Water Board staff typically establishes permit conditions that are expected to result in no alteration of temperature.

The Regional Water Board may authorize an increase in temperature of up to 5 °F, if appropriate. Given the ongoing and accelerating impacts of global climate change (Cayan et al. 2006), consideration should be given to the expected rise in air temperature over the life of a project when considering increases of temperature of up to 5 °F. For instance, if air temperatures are expected to rise 2 °F over the life of a project, the Regional Water Board should consider limiting any water temperature increases to 3 °F as a precautionary measure. In a study of air temperature records in the Klamath Basin, Bartholow (2005) found that air temperatures have increased 0.5 °C/decade since the 1960s. Other researchers have estimated that water temperatures will rise 0.6-0.8 °C for every 1.0 °C of air temperature rise (Null et al. 2012, Morrill et al. 2005). Given that human-caused climate change is expected to increase air temperatures for decades to come, and that those impacts are outside of

the control of the Regional Water Board, the effects of those impacts should be taken into account when considering controllable water temperature increases.

The determination of adverse effects on beneficial uses is based on the thermal requirements of the most sensitive beneficial use present. In most cases in the North Coast Region, the cold freshwater habitat beneficial use (COLD) is the most sensitive beneficial use. Cold water ecosystems in the North Coast Region support fish, amphibians, macroinvertebrates, and other organisms with specific thermal tolerances. Therefore, interpreting the intrastate temperature objective nearly always involves comparing the temperature conditions being considered relative to the temperature conditions that fully support one or more of these organisms.

In situations in which temperatures exceed the biological temperature requirements for full support of the beneficial uses present, no increase in temperature can occur without adverse effects.

Regional Water Board staff typically addresses both cumulative impacts associated with the implementation of multiple projects across landscapes and discrete impacts associated with individual projects through prohibitions and terms of permits. Permit terms are crafted to ensure individual impacts do not cause or contribute to the cumulative impacts of multiple activities by requiring management practices that simulate natural conditions (see sections 4.1 and 4.4). This approach is preferred because it ensures compliance with objectives, prevents impairment associated with the cumulative impacts of multiple projects, and avoids the need for project proponents and staff to quantify thermal impacts associated with small individual projects and assess the cumulative impacts of one project in the context of other projects.

The development of temperature TMDLs in the North Coast Region requires interpretation of the intrastate objective, and thus the application of the logical process shown in Figure 4.1. The temperature TMDLs have also identified and defined conditions necessary to achieve the objective at a watershed scale, drawing on the results of temperature modeling and peer-reviewed scientific literature.

4.1 Estimation of Natural Stream Temperatures

Natural receiving water temperatures are either estimated using standard techniques as described below, or assumed where the factors controlling stream temperature (e.g., shade, sediment deposition, and flow) represent natural conditions.

Natural receiving water temperatures are the temperatures that occur when the factors controlling water temperature, including shade, flow, and channel morphology, are equivalent to their natural condition. Accordingly, the Regional Water Board issues permits to achieve the environmental conditions controlling stream temperature that are equivalent to the thermal regime associated with

natural conditions (e.g., restoration of site-specific potential shade, restoration of natural hydrologic form and function, and control of erosion to natural rates).

The control of shade on the surface of waters of the state is a major focus of the Regional Water Board's efforts to meet the intrastate water quality objective for temperature. All temperature TMDLs developed in the Region assign load allocations for shade, with the allocated amount equivalent to natural conditions, and referred to as site-specific potential effective shade. Site–potential effective shade refers to the amount of shade that can be provided by vegetation at a site, given the species of vegetation present, and taking into consideration the growing conditions at the site (see section 4.2, below). The temperature TMDLs and load allocations are discussed in detail in section 2.4, above.

The intrastate water quality objective for temperature references natural receiving water temperatures. An accurate interpretation of the intrastate water quality objective for temperature then relies in part on the assessment of natural temperatures. In such an assessment, all anthropogenic factors that may cumulatively act on a stream to alter its temperatures must be considered, including:

- Upstream flow alterations;
- Past canopy removal, either mechanically or as a result of increased sediment loads or other types of disturbance; and,
- Alteration of channel characteristics such as width, depth, and streambed permeability, either from engineered alterations or those associated with geomorphic changes caused by hydromodification or altered sediment loads.

Often the temperature of a waterbody in question has been altered in the past. In this case, the degree of temperature alteration must be evaluated to determine:

- Whether the existing temperatures meet the intrastate water quality objective for temperature;
- What beneficial uses may have been supported prior to alteration of the temperature; and,
- How much temperature increase can occur without exceeding the intrastate water quality objective for temperature.

A variety of common techniques are available for estimation of natural stream temperatures for a given situation. Reasonable estimates of natural temperatures can be developed by comparison with reference streams, simple calculations, or use of computer models, depending on the situation. Though a number of techniques may be applied, the most appropriate technique will depend on the site-specific conditions of the location of interest. Factors that may necessitate a more in-depth analysis are:

- Significant alteration of shade conditions;
- Significant alteration of natural hydrologic conditions;,
- Unique hydrologic features such as springs or cold tributaries;

- Estuarine environments; and,
- Thermal stratification.

Defining the alteration of thermal influences

The first step in estimating natural stream temperatures is to identify the thermal factors (such as those listed above) that have been altered from natural conditions. Once the altered thermal factors have been identified, the effects of those alterations can be assessed using the tools described below.

Comparison with reference streams

Reference streams can be helpful for estimating natural temperatures if the reference stream closely resembles the location of interest in a natural state. Headwater stream reaches and mainstem trunk stream reaches are two types of stream environments that are particularly suited for this type of analysis, if shade and meteorological conditions are comparable.

Headwater streams are suited to these types of comparisons because they are close to the stream source, most often groundwater or melting snow. Groundwater is fairly constant year round, and generally defines the lower temperature limit for streams in the summer months. The lowest reaches of mainstem trunk streams, such as the mainstem Eel River at Alderpoint, are also suited to these types of comparisons because they typically represent temperatures that are in equilibrium with heat sources and sinks. Maximum stream temperatures of the lower reaches of major rivers are typically very similar in the summer months. Stream reaches in between the headwaters and lower mainstem stream reaches are only suited for comparison with reference streams if the riparian, hydrologic, and meteorologic conditions are comparable from the headwaters to the location of interest, which becomes increasingly unlikely with increasing distance from the headwaters.

Simple Calculations

The use of simple calculations can be useful in estimating natural stream temperatures. The mixing equation, $Q_{ds}*T_{ds} = Q_{us}*T_{us} + Q_{trib}*T_{trib}$ (where the Qs represent flows, Ts represent temperatures, ds denotes downstream, us denotes upstream, and trib denotes tributary temperatures and flows) is a helpful equation for calculating the change in temperature downstream of a confluence of two streams. Similarly, Brown's equation, a simple equation representing the relationship of flow, channel geometry, and solar radiation, gives a reasonable estimate of temperature change due to alteration of solar exposure for short stream reaches, where the conditions in the reach are homogeneous (Brown 1970).

Computer models

Many computer models have been developed with the ability to calculate stream temperatures. Some of these models were developed for other purposes and only calculate temperature in order to calculate other water quality related processes, while others were specifically developed with stream temperature applications in

mind. Either type of model can be used to estimate stream temperatures if all the relevant processes and factors are accounted for in the model. For instance, some models do not take into account riparian shade, while others do.

One of the more commonly used simple stream temperature models is SSTEMP, maintained by the USGS. SSTEMP is considered a simple model because it requires no compiler or complicated input files. The calculation scheme is also simple, relying on daily average input data to estimate daily average stream temperatures for a single reach. Accordingly, SSTEMP is well-suited for simple thermal situations. It can be used to evaluate the effects of changes in channel geometry, vegetation, meteorological conditions, and changes in flow. A limitation of the SSTEMP model is that the averaging period of the data used to run the model must be approximately equal to the travel time of the reach being modeled. Also, the SSTEMP model does not perform well if the reach in question encompasses drastic differences in shade, flow, channel geometry, or meteorological conditions within it.

Deterministic computer models are useful in situations where a reach of stream, or a stream network, requires a more sophisticated analysis. These models are designed to accommodate variable conditions in time and space, which requires that those variables be defined in time and space. The definition of those conditions requires large amounts of data. To use a deterministic model to estimate natural temperatures, the natural condition of each factor that influences stream temperatures must be estimated over for the entire temporal and spatial extent of the analysis.

The Klamath TMDL temperature analysis is an example of the use of deterministic models to estimate natural temperatures. As part of that analysis, natural temperatures were estimated by defining the estimated natural conditions of the Klamath River and calculating the temperatures that would result from those conditions using the RMA model (Tetra Tech 2009). Estimates of natural flows from Upper Klamath Lake and downstream tributaries were used to represent natural hydrologic conditions. Similarly, the natural, un-dammed geometry of the Klamath River was characterized to define the natural channel geometry. Finally, existing mainstem shade and meteorological conditions were assumed to be comparable to natural conditions.

4.2 Site-Specific Potential Effective Shade

Temperature TMDLs developed in the North Coast Region have interpreted the intrastate water quality objective for temperature and assigned load allocations for solar radiation loading based on its surrogate, effective shade. This metric was chosen because effective shade is inversely and directly proportional to heat, and it is readily measured in the field or calculated using mathematical models.

North Coast Temperature TMDL load allocations associated with effective shade conditions are based on the concept of natural vegetation conditions, and have been described using various terminology. The Navarro, Mattole, Salmon, Scott, and

Shasta River Temperature TMDLs, developed by the Regional Water Board, express shade-related load allocations as "adjusted potential effective shade." In those analyses, the potential effective shade conditions at a site are estimated as potential effective shade (based on fully mature trees growing along the bankfull channel of the streams) reduced by 10 percent to account for natural effects such as fire, windthrow, and earth movements that would reduce the actual riparian area vegetation below the site potential. The Eel River Temperature TMDLs, developed by the USEPA, defines shade-related temperature allocations in terms of Langleys, a unit of heat loading. The shade-related allocations for these TMDLs are set at the heat load that corresponds to effective shade levels corresponding to natural vegetation conditions. Though the allocations are expressed using different terms, the conditions that the allocations define are the same: the level of effective shade provided by vegetation when the vegetation is growing at potential. For any given location, this term is called "site-specific potential effective shade."

4.2.1 Definition of Terms:

The term "site-specific potential effective shade" is defined as:

> The shade equivalent to that provided by topography and potential vegetation conditions at a site.

This term combines two concepts: "effective shade" and "site-specific potential." These two concepts are described herein.

The term "effective shade" is widely used in the solar power industry as a measure of solar radiation available at a site. Effective shade is also used to compare solar power potential between sites. The term has been adopted by hydrologists to quantify the solar radiation amount received by bodies of water.

The term "effective shade" is defined in the Basin Plan as:

> The percentage of direct beam solar radiation attenuated and scattered before reaching the ground or stream surface from topographic and vegetation conditions.

Webster's dictionary defines "effective" as "producing the intended or desired effect", and "shade" as "comparative darkness caused by the screening of rays of light." In this context, the terms are combined to denote the degree to which objects creating shade effectively reduce solar radiation.

Effective shade is a measurement unit that describes the amount of solar energy received in relation to the possible solar energy associated with an unobstructed sky. Effective shade is different from other units of measure related to the density of trees, branches and leaves overhead. It explicitly takes into account the path of the sun through the sky. It also accounts for the fact that the intensity of solar radiation is greatest at noon and least in the morning and evening. Other vegetation density

measurements - for example, the percentage of overhead vegetation and basal area - do not distinguish between vegetation that reduces solar radiation and vegetation that only blocks the view to the sky.

The term "site-specific potential" is a modifier that describes a particular effective shade condition. The term "site-specific potential" is defined as: the vegetation conditions possible at a location, considering the vegetation species present, and any natural factors that limit vegetation size and density.

Site-specific is defined as "relating to a particular place." The North Coast Region encompasses a variety of vegetation communities and ecological settings. The Policy recognizes this variability and requires that potential effective shade be evaluated relative to the vegetation, soil, hydrology, and other factors affecting growing conditions at any given site.

The term "site" is also used in forestry, and has been defined in that context as follows:

> The area in which a plant or stand grows, considered in terms of its environment, particularly as this determines the type and quality of the vegetation the area can carry. (Society of American Foresters 1998)

This definition is consistent with its use in the term "site-specific", however in forestry the term is often combined with other terms (e.g., site class, site index, site quality, and site productivity class) to refer to the growth rate and production capacity of a location. Site-specific potential effective shade refers to the site-specific potential for effective shade at a site, and does not pertain to growth rate and productive capacity.

Webster's dictionary defines "potential" as "capable of being or becoming." In this case, the term refers to the shade that occurs when the riparian vegetation naturally occurring at a site is at a level that the site is capable of supporting, Many riparian areas in the North Coast Region reflect the effects of past management activities that have removed or prevented the ongoing presence of vegetation. The application and assessment of site-specific potential shade is discussed in section 4.2.3. Site-specific potential effective shade describes an effective shade level that existed prior to reductions associated with management activities. Riparian areas that haven't experienced vegetation removal or suppression, or that have regained characteristics reflecting those that existed prior to management-related reductions, are considered to be at a *potential* level of vegetation, and therefore provide *potential effective shade*.

4.2.2 Measurement and Approximation of Effective Shade

Effective shade can be measured using simple devices. Solar Pathfinders and angular canopy densiometers are examples of such devices. Such devices identify

several factors: the objects obstructing direct sunlight, the time of day that the object will obstruct sunlight, and the corresponding intensity of solar radiation. These devices are based on geometric relationships between earth and sun at a given latitude, and the daily distribution of solar radiation.

Effective shade can be approximated using models that take into account the same geometric relationships and solar radiation distributions as the devices used for measuring it. These models use spatial data describing the elevation, vegetation, and stream location for a site to calculate the timing and effect of solar obstructions.

4.2.3 Application and Assessment

Evaluating the effects of a proposed action relative to *site-specific potential effective shade* requires evaluation of whether the action will result in riparian shade conditions equivalent to that provided by potential riparian vegetation conditions in the near or long term. The factors that must be assessed generally relate to the height, depth, and density of vegetation as it relates to effective shade.

The assessment of management effects on effective shade related to vegetation removal occurs in two contexts: (1) the effective shade at a site is equivalent to the site-specific potential, and (2) the effective shade at a site is less than the site-specific potential.

In the first case, the evaluation of the proposed management actions on effective shade involves judging whether the proposed practices will reduce the effective shade (i.e, increase solar radiation) on the waterbody. To do this, the vegetation proposed for removal is considered in terms of its position relative to the path of the sun and the waterbody. Maintaining site-specific potential effective shade involves retaining the vegetation that provide the effective shade.

In the second case, the evaluation of the proposed management actions on effective shade involves judging whether the proposed practices will prevent the re-growth of vegetation to site-specific potential effective shade conditions. In this situation, the assessment of practices is very similar to that of the first situation, where the vegetation proposed for removal is considered in terms of its position relative to the path of the sun and the waterbody. However, in this case management consistent with site-specific potential effective shade involves retaining the vegetation that will provide, or will continue to provide, effective shade as it reaches site-specific potential.

The assessment of management effects on effective shade doesn't always involve active removal of vegetation. Some situations, such as evaluation of a grazing management plan, involve evaluating the effects of proposed management practices on the natural processes that establish and maintain riparian vegetation. In these cases the activity is evaluated for impacts that will limit germination, growth, and persistence of riparian vegetation in a manner that reduced the amount of riparian

vegetation providing effective shade over the timeframe the management activity is proposed.

The Regional Water Board develops and administers permits and programs for various activities that include restrictions and requirements for the protection of water quality. In some cases these restrictions and requirements include effective shade considerations, as appropriate. Evaluation of the effectiveness of permit or program restrictions and requirements is similar to the evaluation of project-specific management actions described above. These permits and programs often rely on the development of riparian management plans that describe practices that will be employed to achieve or maintain site-specific potential effective shade.

4.2.4 Restoration and Maintenance of Site-Specific Potential Effective Shade

Action 1 of the Policy directs the Regional Water Board to "Restore and maintain riparian shade." The use of the term "restore" in Action 1 applies to situations in which the effective shade at a site is less than the site-specific potential. In such a case, the Policy directs the Regional Water Board to use its authorities in a manner that ensures that the management occurring at the site allows the vegetation present to achieve conditions equivalent to site-specific potential effective shade. The use of the term "maintain" in Action 1 applies to situations in which the effective shade at a site is equivalent to the site-specific potential. In this situation, the Policy directs the Regional Water Board to use its authorities to ensure management occurring at the site is consistent with the maintenance of effective shade equivalent to the site-specific potential.

This Policy is not intended to preclude management of riparian areas. Use of the terms "restore" and "maintain" does not mean that the Regional Water Board should require active restoration such as tree planting projects, nor does it mean that management actions in the riparian zone are prohibited, either in areas where site-specific potential effective shade already exists or in areas where site-specific potential effective shade conditions do not exist. This policy is not intended to predetermine precise parameters for achieving potential effective shade for a specific location or land use, and does not necessarily preclude management in riparian areas. There are circumstances in which management actions within riparian areas that reduce effective shade conditions in the near- and short-term are necessary and appropriate in order to achieve potential effective shade in the long-term.

4.3 Project-specific Implementation

Interpretation of the intrastate water quality objective for temperature at the project scale requires consideration of the particular conditions present in each unique situation. The drivers of elevated water temperature are well understood (see sections 2.0-4, 5.1, and 5.2), however the site-specific impacts of those drivers in any specific setting are best evaluated on a case by case basis for each situation.

In the case of nonpoint source land uses, these evaluations are often made on the basis of prescribed operation rules, performance standards, or best management practices (see section 4.4: Reliance on Management Measures for Nonpoint Sources Associated with Land Uses). However, even in these situations some site-specific evaluation is often necessary to evaluate the application of operating rules or management practices to the unique attributes of the setting in question. For instance, some permits involve an on–the-ground assessment of water quality protection and preparation of plans to address specific water quality issues identified in the assessment. An example of this is the Regional Water Board's USFS Waiver (order R1-2010-0029), which allows for the removal of riparian vegetation if it can be demonstrated that the exception will result in a net long-term benefit to water quality and stream temperatures, which must be evaluated against the specific characteristics of the project. The CA Forest Practice Rules have a similar provision for exceptions to canopy retention prescriptions when alternative prescriptions provide equal or more favorable protection than that afforded by the standard prescriptions. In processes such as these, the application of management practices or performance standards is translated to the unique conditions present at the site in question.

In order to evaluate whether water temperatures in a given waterbody represent natural conditions, the natural state of temperature drivers must be assessed. For instance, a riparian area with a history of canopy removal may provide the same level of solar attenuation as another undisturbed riparian area with low levels of canopy due to sub-optimal growing conditions, with resulting temperatures that are nearly identical. In the first case, the site may not be meeting the intrastate water quality objective for temperature because the levels of solar radiation are unnaturally high due to reduced riparian vegetation from past activities resulting in unnaturally elevated water temperatures, whereas the same temperatures in the second stream would meet the objective if the other drivers were also consistent with natural conditions. Similarly, a project that removes riparian vegetation may or may not increase solar radiation loading in the stream depending on the geometry of the vegetation relative to the stream and surrounding topography. Finally, the relative stream temperature condition is another factor that must be considered when evaluating whether a project will cause exceedence of the intrastate water quality objective for temperature. For instance, a stream that is cold relative to air temperatures, such as a spring-fed inland stream near its source, will be much more sensitive to additional heat loads than a stream that is already warm and near the equilibrium temperature (see section 2.2, Interaction of Temperature Drivers).

The site-specific approach to implementing the temperature objectives at the project scale also allows for Regional Water Board staff to make determinations that unique circumstances exist that allow exceptions to standard practices employed for the protection of water temperature. For instance, the Regional Water Board has approved restoration projects conducted on the Mendocino Coast that involve the felling of riparian trees into watercourses to add large woody debris to the stream. Large woody debris in stream channels has been identified as a critically important

habitat component for Coho salmon that are missing in these streams. These projects occurred in streams that have cold water temperatures, relatively high canopy and shade levels, and cool coastal air temperatures. In these cases, Regional Water Board staff weighs the risk of elevating water temperatures against the benefits of eliminating an important factor limiting the recovery of a listed species.

Another unique example of an instance in which actions resulting in reduced shade were approved by the Regional Water Board is the General Water Quality Certification for the Bureau of Reclamation Trinity River Restoration Program's channel rehabilitation activities downstream of the Trinity River reservoirs (Order No. R1-2010-0028). The primary purpose of the project is to increase salmonid habitat in the mainstem Trinity River and its side channels. Channel rehabilitation activities include removal of encroaching riparian vegetation, rehabilitation of floodplain and in-channel alluvial features, construction of off-channel habitat for aquatic and riparian dependent species, coarse and fine sediment management, and rehabilitation of upland habitat. Channel habitat rehabilitation activities are designed to use the alluvial processes of the Trinity River to maintain and increase salmonid habitat and complexity for all life-stages over time, and to provide conditions suitable for reestablishing and sustaining native riparian vegetation. Collectively, channel rehabilitation activities are intended to meet the overarching goal of the Trinity River Restoration Program (TRRP) to create, restore, and enhance the full range of habitats for native anadromous fishes, including salmon and steelhead. The removal of riparian vegetation associated with the project was deemed necessary to meet the goals of the program because decades of controlled releases from the Trinity River reservoirs had eliminated high flows that prevented the encroachment of riparian vegetation. The resulting riparian encroachment altered the channel morphology in a manner detrimental to beneficial uses.

Other situations in which reductions of shade may be consistent with the goal of restoring and maintaining site-specific potential effective shade include actions that require short-term reductions of effective shade to enhance the size, density, or resiliency of riparian vegetation over time.

Short-term reduction of effective shade associated with fuels reduction projects in riparian areas may be appropriate when the long-term benefits are considered. In such cases, the impacts of vegetation thinning are weighed against the long-term benefits of a riparian ecosystem that is resilient against fire impacts. Similarly, the short-term reduction of shade associated with thinning projects designed to increase the growth rate of retained trees or replace suppressed trees with vigorous saplings may represent an acceptable tradeoff if the project results in increased shade levels in a shorter timeframe. Likewise, a short-term reduction of effective shade associated with efforts to increase deciduous hardwood species in a riparian zone may be appropriate where it can be demonstrated that natural primary productivity levels are suppressed due to a lack of nutrients, leading to a reduced capacity to support beneficial uses, or actions proposed to improve conifer site occupancy in forest stands currently dominated by evergreen hardwoods.

In each of the situations described above, the Regional Water Board considers the short term impacts of the proposed action in light of the site-specific conditions in the affected area. Factors taken into consideration include existing water temperatures relative to biological thresholds, the level of solar radiation increase associated with the project, likely temperature impacts associated with the project, the current capacity for support of beneficial uses, condition of riparian vegetation in adjacent reaches, and the expected amount of time for necessary for riparian recovery.

4.4 Reliance on Management Practices for Nonpoint Sources Associated with Land Uses

The Regional Water Board prefers to regulate discharges of waste and controllable water quality factors associated with nonpoint sources in the context of adaptive management, wherein management measures designed to address a water quality concern are implemented and monitored in a manner that provides for feedback on the performance of the measures and any need for modification of the practice, as appropriate. In the case of temperature, this approach substitutes the use of pre-defined operating rules, performance standards, best management practices, or restrictions on certain activities, for the sometimes difficult and unwieldy process of determining natural conditions and estimating the anticipated temperature changes associated with an activity. This approach is advantageous to the project proponent because it streamlines the evaluation and approval process and provides a level of regulatory certainty. The same process is advantageous for the Regional Water Board because it increases the efficiency of regulatory permitting, allowing staff to focus on on-the-ground water quality issues, by streamlining the evaluation and approval process. This approach also allows for the development of general permits for certain activities, rather than the inefficient process of developing individual permits for similar activities.

Certain nonpoint source activities may also be subject to regulatory or non-regulatory actions of other entities that provide temperature protections. If the Regional Water Board determines that those actions will result in attainment of water quality standards, the Regional Water Board may include those actions as implementation measures in a permit. The Regional Water Board can, and often does, rely on existing non-Water Board programs for permit measures, adding new requirements only as necessary to provide adequate water quality protection. When addressing compliance with the temperature objective, the geographic location, existing regulatory and non-regulatory programs, and other relevant factors should be evaluated in determining appropriate and necessary shade controls.

Compliance with the intrastate water quality objective for temperature as it relates to shade and solar radiation is generally achieved by managing vegetation that provides shade to a waterbody in a manner consistent with site-specific potential effective shade. To accomplish this, responsible parties are encouraged to delineate

a separate management area for riparian vegetation that has the potential to shade a waterbody, and manage these riparian areas differently than the surrounding land. These areas are often referred to variously as a riparian management zone, streamside buffer area, or a watercourse and lake protection zone.

When Regional Water Board staff evaluates the shade-related temperature controls provided through riparian management practices, staff evaluate whether the practices employed result in riparian shade conditions consistent with shade conditions representative of riparian vegetation undiminished by human activities. The evaluation is not whether the vegetation conditions are, in fact, unaltered, but rather if the vegetation conditions result in roughly equivalent solar radiation loading at the water surface. For instance, site-specific potential vegetation conditions in a coastal redwood environment may have historically included redwoods trees in excess of 300 feet in height. However, the same solar radiation loading may result from trees half that height or less, due to vegetation overhang, understory vegetation, and riparian hardwood species present. The factors that must be assessed generally relate to the height, depth, and density of vegetation, as well as the geometry of the water surface relative to the sun and any topographic shading provided by mountains and streambanks. Management practices that provide this type of protection are considered consistent with the intrastate water quality objective as it relates to shade and solar radiation.

An example of management practices relied on for the maintenance of shade are the Forest Practice Rules relating to watercourse and lake protection zones for fish-bearing streams in areas where anadromous salmonids are present. These rules result in shade levels consistent with natural conditions through the designation of no-cut zones adjacent to streams and canopy retention zones adjacent to the no-cut zone. Additionally, the rules require retention of the 7 largest trees per acre of the inner and core zones in the interior of the north coast (See Figure 4.2), and the 13 largest tress per acre within the core and inner zones in the coastal anadromous zone. The Forest Practice Rules allow for exceptions to these requirements for projects that "would result in effects to the beneficial functions of the riparian zone equal to or more favorable than those expected to result from the application of the operational provisions required under" the standard watercourse and lake protection rules that apply (CA Forest Practice Rules 2013).

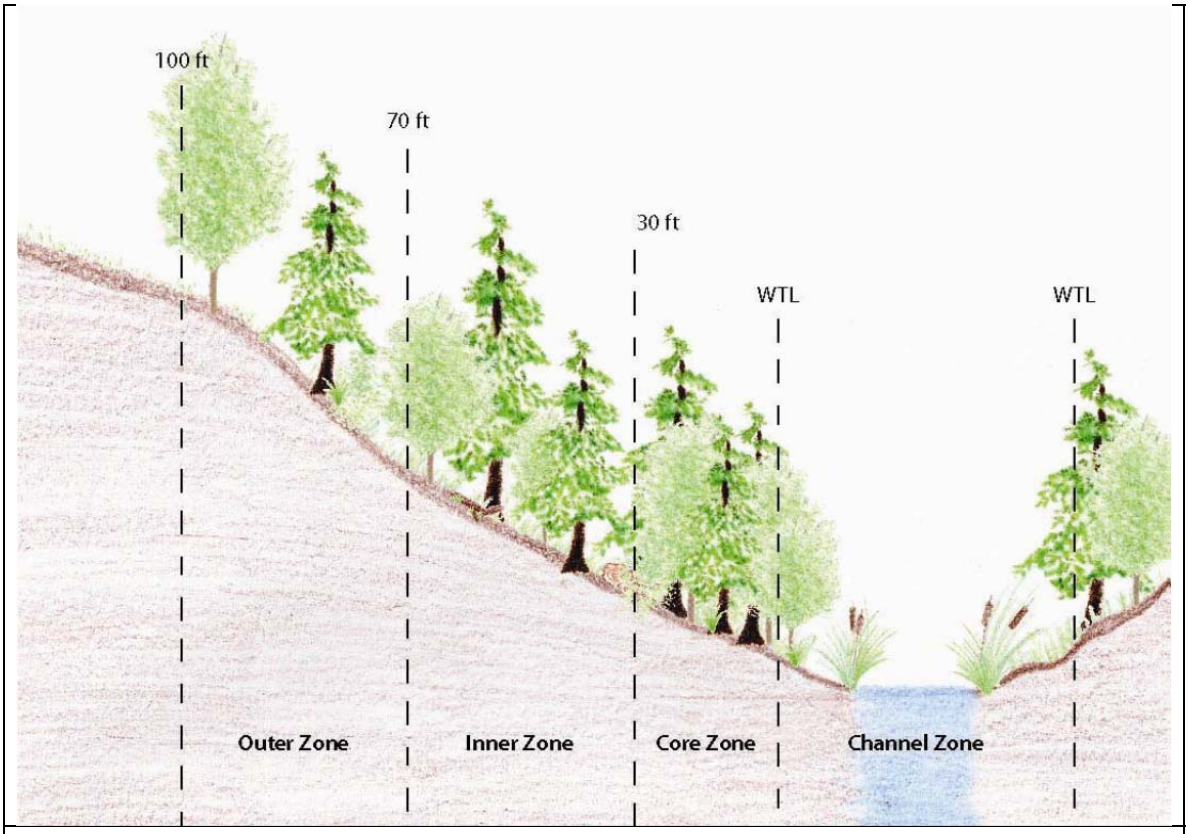


Figure 4.2: Watercourse and lake protection zone for confined fish-bearing streams outside the coastal anadromous zone. In this setting, the core zone must be left un-cut, 70% overstory canopy must be retained in the inner zone, and 50% overstory canopy in the outer zone. Additionally, the 7 largest trees per acre of the core and inner zone must be retained. (CA Forest Practice Rules 2013)

Many timber companies have adopted additional standard management practices that they implement as a matter of practice, and that are considered during the timber harvest plan review process. For example, the Green Diamond Resource Company has developed an aquatic habitat conservation plan (AHCP) that defines operation rules and management practices that address habitat concerns related to sensitive and threatened aquatic species, including rules and practices to address habitat needs of temperature-sensitive species that in some cases go beyond the levels of protection afforded by the Forest Practice Rules, and are consistent with this Policy. The Regional Water Board relies on the implementation of the AHCP's water quality protection practices as a part of the timber regulatory program.

The Forest Practice Rules also establish management practices for the control of sediment discharges. The Regional Water Board relies on the implementation of those management practices, in part, as an element of the sediment control requirements of its timber regulatory program.

Another example of the reliance on management practices is the incorporation of the USFS best management practices as conditions of the USFS Waiver. This permit,

by virtue of its conditions, also implements sediment, temperature, and nutrient TMDLs, and meets the Basin Plan intrastate temperature objective. The USFS Waiver adopts the USFS program that manages and maintains designated riparian zones to ensure retention of adequate vegetative cover that results in natural shade conditions. The USFS program requires retention of trees within 300 feet slope distance on each side of fish-bearing streams, 150 feet slope distance on each side of perennial streams, and 100 feet slope distance on each side of ephemeral/intermittent streams, or the site-specific potential tree height distance on each side of the stream, whichever is greatest. The USFS Waiver provides for exceptions to these requirements if it can be demonstrated that the exception will result in a net long-term benefit to water quality and stream temperatures. Additional best management practices are defined for the control of sediment and nutrient discharges associated with road management, grazing, and other sources of nonpoint source pollution.

Regional Water Board staff sometimes relies on management measures defined at a site-specific level to address specific water quality concerns. An example of this approach is that taken in the Scott and Shasta River TMDL conditional waivers. These waivers rely on the development of site-specific plans, including ranch plans, to define what actions the landowner will take to address identified water quality concerns, including those associated with temperature, sediment, and nutrients. An adaptive management process involving effectiveness monitoring and adaption of practices to achieve water quality goals ensures the approaches achieve water quality protection.

The uncontrolled use of riparian areas by livestock can lead to impacts that elevate water temperatures. However, the use of riparian areas by livestock can be conducted without these temperature impacts. Grazing of riparian areas is not incompatible with water quality goals if conducted in a manner with water quality protection in mind. The intensity, duration, and timing of livestock use are critical considerations that determine whether livestock use is or is not harmful to riparian areas. Livestock management in riparian areas often requires an approach similar to the management practices employed in forestry, wherein a special management zone near the stream is managed differently from the surrounding areas. Practices such as flash grazing, where livestock are allowed to graze in the special management zone until thresholds, such as a minimum stubble height of grass, are met can be conducted without interfering with the natural riparian vegetation processes that provide the shade necessary to achieve temperature objectives. In such cases, a riparian grazing and monitoring plan can be the basis of Regional Water Board staff's evaluation of water quality protection.

4.5 Implementation in Impaired vs Unimpaired Waterbodies

Waterbodies that are not meeting the water quality objectives for temperature are considered impaired, and are identified on the 303(d) list of impaired water bodies as such. Many, but not all waterbodies impaired by elevated water temperatures have had TMDLs developed for them. The development of temperature TMDLs in

the North Coast Region is discussed in Section 2.0. When waterbodies are not meeting the temperature objectives, either because their water temperatures have been elevated above a temperature threshold associated with a beneficial use, or because they have temperatures elevated above 5 ^{o}F, no additional temperature increase can be accommodated.

Because temperature impaired waterbodies cannot accommodate any increase in temperatures, the intrastate water quality objective for temperature requires that permitted conditions result in natural conditions in these waterbodies. In the case of shade, natural conditions are defined as site-specific potential conditions, as discussed in section 3.1, above. Thus, the approach to regulating impaired waterbodies must be consistent, regardless of whether a TMDL has been developed.

The actions necessary to recover a waterbody that is temperature impaired due to alteration of the drivers of water temperature are the same types of actions that prevent a waterbody from becoming temperature impaired by such alterations. For instance, in the case of a stream with elevated temperatures caused by increased solar radiation resulting from vegetation removal, the action necessary to recover the natural temperature regime is to allow the riparian vegetation to grow back (or actively restore the vegetation conditions) such that the natural shade condition is once again achieved. In the case of an unimpaired stream with unaltered temperatures, the riparian management action necessary to prevent the elevation of water temperatures is to prevent increases in solar radiation by maintaining sufficient riparian vegetation. In both cases, the riparian vegetation must be maintained and allowed to persist. The difference is that some amount of increased solar radiation exposure may be allowed in the unimpaired stream if it can be demonstrated to the Regional Water Board's satisfaction that:

- any temperature change won't adversely affect beneficial uses;
- water temperatures are not increased by 5 ^{o}F or more at any time or place; and,
- the Antidegradation Policy is not violated.

The Regional Water Board establishes permit conditions that are expected to result in no alteration of temperature, as explained in section 4.0, above. Accordingly, it is appropriate for the Regional Water Board to establish permit conditions consistent with natural conditions, including site-specific potential effective shade. Dischargers and project proponents seeking a relaxation of this requirement should submit an analysis that satisfies the requirements described in the paragraph above.

In order to prevent future impairments and address existing temperature impairments, the regulatory approach to managing riparian vegetation for the protection of unimpaired temperatures and the regulatory approach to managing riparian vegetation to correct elevated water temperatures should be consistent throughout the region. Furthermore, the regulatory approach should be based on

implementation of both the intrastate water quality objective for temperature and the Antidegradation Policy, as described above.

4.6 Regulation of Shade as a Controllable Factor

The Regional Water Boards regulate the thermal impacts associated with increased solar radiation loads and the shade provided by riparian vegetation in the context of discharges. The Porter-Cologne Water Quality Control Act (Act) authorizes the State and Regional Water Boards to control the discharges of waste to waters of the state through issuance of permits and by prohibiting certain activities. Solar radiation loads are not a discharge of waste, as defined by the Act. However, the Act states in Section 13263, Requirements for Discharge:

> "The regional water board, after any necessary hearing, shall prescribe requirements as to the nature of any proposed discharge, existing discharge, or material change in existing discharge…with relation to the conditions existing in the disposal area or receiving waters upon, or into which, the discharge is made or proposed. The requirements shall implement any relevant water quality control plans that have been adopted, and shall take into consideration the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, the need to prevent nuisance, and the provisions of Section 13241[2]." (emphasis added.)

The act defines "water quality control" as follows:

> "Water quality control" means the regulation of any activity or factor which may affect the quality of the waters of the state and includes the prevention and correction of water pollution and nuisance. [Section 13050(i)]

The Basin Plan is a water quality control plan. Thus, the Act authorizes the Regional Water Board to "prescribe requirements", including requirements related to "any activity or factor which may affect the quality of the waters of the state", that implement the Basin Plan and its programs of implementation. Controllable water quality factors are explicitly addressed in the Basin Plan. The Basin Plan states on page 3-1.00:

> "Controllable water quality factors shall conform to the water quality objectives contained herein. When other factors result in the degradation of water quality beyond the levels or limits established herein as water quality objectives, then controllable factors shall not cause further degradation of water quality. Controllable water quality factors are those actions, conditions, or circumstances resulting from

[2] Section 13241 pertains to the establishment of water quality objectives.

man's activities that may influence the quality of the waters of the State and that may be reasonably controlled."

The Porter-Cologne Act establishes the authority of Regional Water Boards to adopt waste discharge requirements and prohibitions to control the discharge of waste to waters of the State in order to achieve water quality objectives that support beneficial uses, as defined in the Basin Plan. This proposed amendment to the Basin Plan clarifies that the alteration of shade caused by human activities is a controllable water quality factor that must be addressed, as appropriate, in waste discharge requirements issued by the Regional Water Board, and regulatory actions by other state agencies. This is not a new interpretation, nor is it a change in Regional Water Board practice. However, identifying shade as a controllable water quality factor in the Basin Plan makes clear the importance of addressing shade to other agencies, dischargers, and other interested parties.

5.0 REGIONAL POLICY TO IMPLEMENT THE WATER QUALITY OBJECTIVES FOR TEMPERATURE

The staff of the Regional Water Board is proposing a Basin Plan amendment that will establish a Policy for the Implementation of the Water Quality Objectives for Temperature (Policy) in the North Coast Region. The Policy identifies land use and discharge factors that have potential to elevate water temperatures, and directs staff to use all available tools and approaches, both regulatory and non-regulatory, to ensure water temperature concerns are addressed. The land use and discharge factors have been identified during the development of north coast temperature TMDLs. The amendment identifies actions staff will undertake to address those factors that may prevent the attainment of the water quality objectives for temperature. The actions were developed so that implementation of the actions implement load allocations established in temperature TMDLs and maintains compliance with the water quality objectives for temperature in waterbodies not already impaired by elevated water temperatures.

5.1 Factors Identified in the Policy to Implement the Water Quality Objectives For Temperature

The proposed Policy identifies a number of activities and other actions (factors) that have potential to elevate water temperatures. The Policy identifies these general factors as those the Regional Water Board will address through implementation of regulatory programs and collaboration with partners to attain and maintain the intrastate and interstate water quality objectives for temperature. The factors were identified based on the conclusions and insights developed during the development of temperature TMDL analyses, as explained in Section 2.0. The factors are:

1. Activities with the potential to reduce riparian shading of waterbodies;
2. Activities with the potential to increase sediment delivery;
3. The quality, quantity, location and timing of effluent, storm water, and agricultural return flow discharges;
4. The location, size, and operation of in-channel impoundments with the ability to alter the natural temperature regime;
5. Actions with the potential to change stream channel geometry;
6. Activities with the potential to reduce instream flows or reduce specific sources of cold water, including cold water refugia.

The factors identified above represent a range of activities and actions. Many of the factors come under the direct permitting authority of the Regional Water Board, while others are regulated through the authorities of other agencies.

5.2 Justification of the Policy Factors

The justification and scientific rationale for each of the identified factors is presented below. Each of the Policy Factors is also represented in Figure 5.1, a conceptual model originally developed for the Klamath River temperature TMDL which graphically represents the drivers of temperature alteration, the resulting physical changes to environmental conditions, and consequent impacts to beneficial uses.

5.2.1 Activities with the potential to reduce riparian shading of waterbodies

Direct solar radiation is the primary factor influencing stream temperatures in most stream environments during summer months. The energy added to a stream from solar radiation far outweighs the energy lost or gained from evaporation or convection (Beschta et al. 1987, Johnson 2004, Sinokrot and Stefan 1993). At a given location, incoming solar radiation is a function of position of the sun, which in turn is determined by latitude, day of the year, and time of day. During the summer months, when solar radiation levels are highest and streamflows are low, shade from streamside forests and vegetation can be a significant control on direct solar radiation reaching streams (Beschta et al. 1987). Because shade limits the amount of direct solar radiation reaching the water, it provides a direct control on the amount of heat energy the water receives. At a workshop convened by the state of Oregon's Independent Multidisciplinary Science Team, 21 scientists reached consensus that solar radiation is the principal energy source that causes stream heating (Independent Multidisciplinary Science Team 2000).

Although the dominance of solar radiation as the primary driver of stream temperature is well accepted (Johnson 2004, Johnson 2003, Sinokrot and Stefan 1993, Theurer et al. 1984), some studies have indicated that air temperatures are the prime determinant of stream temperatures. This is because of the relationship between air temperature and equilibrium temperature discussed in section 2.2. In short, air temperature determines equilibrium temperatures, and thus how hot a stream can be, while shade and flow determine how quickly a stream approaches the equilibrium, and thus how hot a stream actually becomes. Heat budgets developed to track heat exchange consistently demonstrate that solar radiation is the dominant source of heat energy in stream systems (Johnson 2004, ODEQ 2002, Sinokrot and Stefan 1993). Stream temperature modeling conducted in support of north coast temperature TMDLs (see section 2.4, above) confirmed that solar radiation is the dominant heat exchange process in the North Coast Region.

The conclusion that solar radiation is the dominant source of stream temperature increases is supported by studies that have demonstrated both temperature increases following removal of shade-producing vegetation, and temperature decreases in response to riparian planting. Johnson and Jones (2000) documented temperature increases following shade reductions by timber harvesting and debris flows, followed by temperature reductions as riparian vegetation became re-established. A study of changes in primary productivity and fish biomass associated with increased exposure to solar radiation documented an instance where

temperatures increased by 1.5 ^{o}C over a 100 meter reach due to canopy removal (Wilzbach et al. 2005). Shade loss caused by debris flows and high waters of the flood of 1997 led to temperature increases in some Klamath National Forest streams (de la Fuente and Elder 1998). Riparian restoration efforts by the Coos Watershed Association reduced the maximum value of the weekly average temperature of Willanch Creek by 2.8 ^{o}C (6.9 ^{o}F) over a six-year period (Coos Watershed Association undated). Miner and Godwin (2003) reported similar successes following riparian planting efforts.

Shade is created by vegetation and topography; however, vegetation typically provides more shade to rivers and streams than topography in streams that are not wide relative to the height of vegetation. In these streams the shade provided by vegetation has a dramatic, beneficial effect on stream temperatures. The removal of vegetation can decrease shade, which increases solar radiation levels, which, in turn, increases both average and maximum stream temperatures, and leads to large daily temperature variations (see Figure 5.1). Additionally, the removal of vegetation can alter microclimates, increasing ambient air temperatures, and vegetation removal can result in bank erosion, and result in a wider and shallower stream channel geometry, all of which can increase water temperatures.

A review of the scientific literature prepared for the California Board of Forestry and Fire Protection (Board of Forestry) supports the principles regarding riparian shade and water temperature that this Policy incorporates (Sound Watershed Consulting 2008). For instance, the opening sentences of the report's section titled "Inferences for Forest Management" states:

> "The literature on riparian heat exchange tells us that shade from riparian timber stands is a key factor controlling heat input to streams. Therefore, maintaining riparian vegetation to block direct solar radiation (i.e., shade) is the intent of forest practice prescriptions for protecting stream temperature during the summer. However, water temperature is a function of a host of physical factors that control heat transfer between air, water, and the streambed. Consequently, the relative importance of riparian vegetation to influence stream temperature varies by location (geographic province) and by site specific conditions (stream width, depth, flow, groundwater inflow, streambed substrate composition, valley orientation, topographic shading and watershed position). This spatial variability indicates that a simple fixed-width buffer or canopy closure prescription (e.g., minimum 50% canopy cover as required in CA) will probably not achieve management goals in all cases." (Sound Watershed Consulting 2008, page 29).

The report goes on to discuss the potential of watershed scale analyses to identify stream reaches most sensitive to temperature changes, and combining rankings of temperature sensitivity with assessments of site-specific conditions to identify specific shade requirements to protect individual reaches from temperature increases, buffering class II streams to prevent temperature increases in class I

receiving waters, and the need to consider the temperature needs of salmonids. The section of the report ends with the following:

> "Finally, riparian stand effectiveness for shading is a function of the forest canopy density, height, and species composition, which is related to stand type and age. Because stand type and age may vary by geographic province and disturbance history the buffer width that is adequate for shading will vary as well. This fact undermines the one-size-fits-all (i.e., fixed width) prescription that is commonly applied in forest management. Research shows that effective shading can be provided by buffer widths ranging from 10 m to 30 m (30 to 100 ft) depending on stand type, age, and location. However, quantitative relationships between buffer width and shade for typical forest types and stand age classes in California are not reported in the literature. Potential quantitative relationships between stand density and shade or basal area and shade are lacking. Consequently a riparian stand metric that may function as a reliable surrogate for shade has not been developed." (Sound Watershed Consulting 2008, page 31)

The Sound Watershed Consulting literature review supports the principles that management of shade is paramount for control of elevated water temperatures, that a fixed-width buffer or canopy closure prescription is not likely to achieve management goals in all cases, and that site-specific considerations need to be made on a case-by-case basis.

A similar summary of current understandings of thermal processes in forested environments was prepared by a technical advisory committee for consideration by the Board of Forestry (CBOF-TAC 2007). This summary relied on a published review of forest management effects on water temperature and microclimate by R.D. Moore, D.L. Spittlehouse, and A. Story (Moore et al. 2005). The conclusions of the review and summary are also consistent with the principles of this Policy.

Activities with the potential to reduce riparian shade include timber harvest, road building and maintenance, property development, vegetation conversions, agriculture, grazing, and other activities that have the potential to result in modification of riparian vegetation conditions.

5.2.2 Activities with the potential to increase sediment delivery

Increased sediment loads and associated changes in channel morphology can affect stream temperature conditions in multiple ways. These effects can manifest at both large (watershed-wide) and small (individual reach) scales. Sediment is defined as any inorganic or organic earthen material, including but not limited to: soil, silt, sand, clay, and rock (NCRWQCB 2007). The sizes of sediment that present a temperature concern are those that may result in pool filling, increased channel width, decreased channel depth, and/or a reduction of hyporheic (i.e., intergravel) flow.

Increased sediment loads may also reduce heat exchange associated with hyporheic processes through simplification of the bed topography and reduced permeability due to increases in fine sediment deposition. Hyporheic exchange occurs when surface waters infiltrate into the interstitial spaces of streambeds. As surface water passes through the porous sediment, heat is lost (or gained) through conduction with the sediments. In some settings, streambed conduction can be a significant heat sink that buffers daily maximum temperatures in the summer season (Loheide and Gorelick 2006).

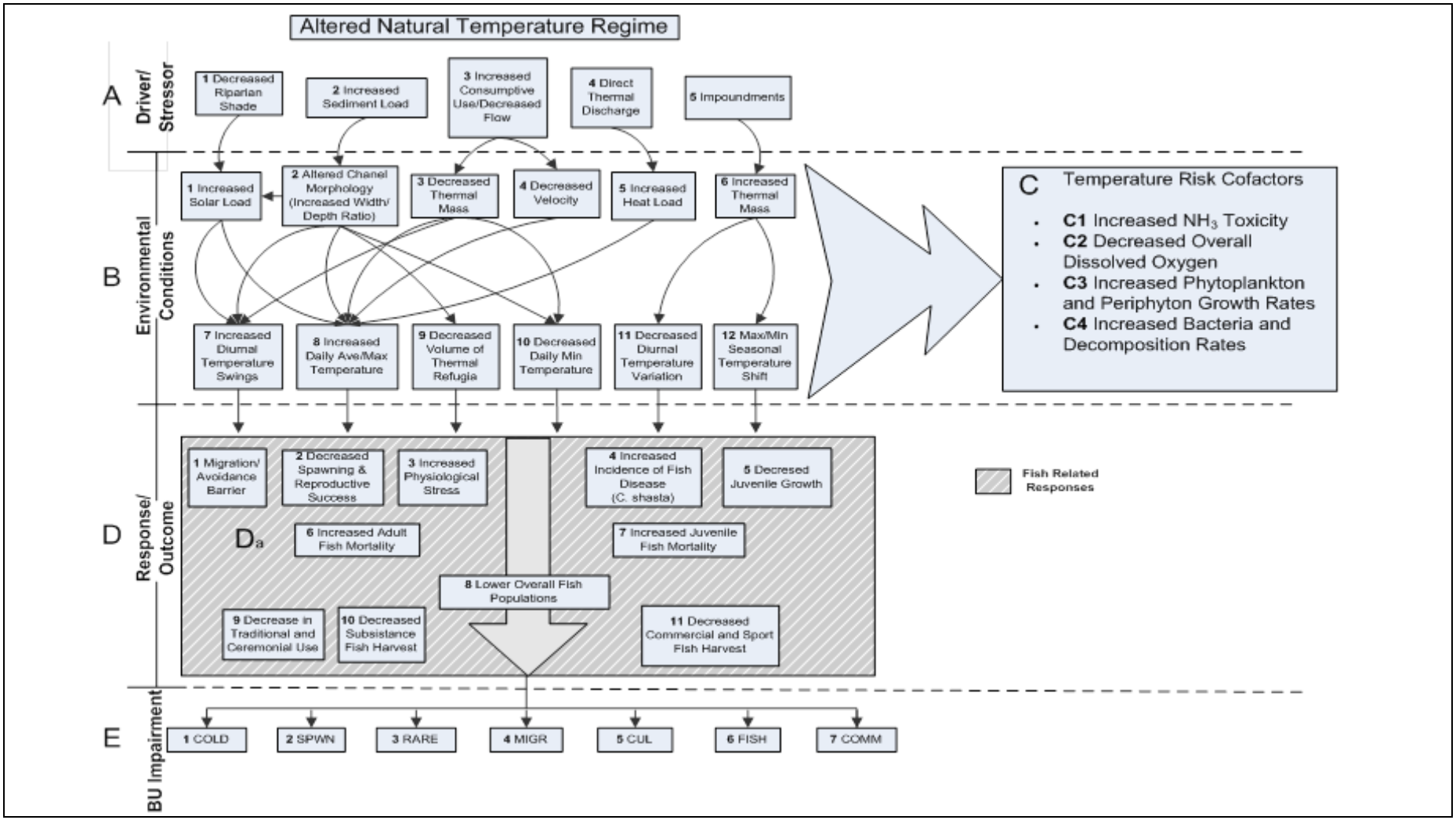


Figure 5.1: Conceptual representation of the causes and effects of temperature alteration and associated impacts to beneficial uses. (Source: NCRWQCB 2010)

Several published studies describe mechanisms of heat transfer dependent on permeability of bed sediments, effects of sediment on stream channel morphology, and stream channel characteristics related to thermal refugia. Vaux (1968) demonstrated that hyporheic exchange is dependent on the topographic complexity of the bed surface and permeability of the sediments. Lisle (1982) reported a simplification of streambed complexity associated with aggradation at stream gauge sites in the North Coast Region following the 1964 flood. He observed that gauging sites went from a pool-like form prior to aggradation, to a riffle-like form with flat cross-sectional profiles following aggradation. Wondzell and Swanson (1999) similarly evaluated the effects of large events on channel form. They specifically evaluated changes in the hyporheic zone resulting from large flood events and demonstrated that simplification of stream channel geometry, including loss of step-pool sequences, decreases intra-gravel exchange rates.

More recently, researchers have quantified the reduction in surface stream temperatures attributable to hyporheic exchange. In a study of Deer Creek in northern California, Tompkins (2006) found that reduced daily maximum water temperatures in hyporheic seeps on the order of 3.5 ^{o}C (6.3 ^{o}F) created thermal refugia for salmonids. In a study similar to Tompkins', Loheide and Gorelick (2006) documented daily maximum temperature reductions on the order of 2 ^{o}C (3.8 ^{o}F) in study of a 1.7 km (1.1. mi) stream reach of Cottonwood Creek in Plumas County, California.

Temperature and sediment concerns are often addressed together through careful management of riparian areas. The establishment of riparian buffers for temperature protection is an effective and important management measure for the control of some types of sediment discharges (Rashin et al. 2006). Maintenance of a vegetated buffer provides a control on the discharge of sediment mobilized by surface erosion (Brandow et al. 2006). Also, the retention of mature trees (and their roots) along a streambank provides bank stability, reducing the discharge of sediment associated with streambank landslides, streambank erosion, and debris flows (Cafferata et al. 2005). Maintenance of a vegetated buffer along streams also can ensure a supply of large woody debris to the stream channel, which is critical for metering of sediment, channel forming processes, and fish habitat.

Activities with the potential to increase sediment delivery include road building and maintenance, timber harvest, property development, vegetation conversions, agriculture, and other activities that have the potential to disturb soils, concentrate runoff, and decrease hill slope and streambank stability.

5.2.3 The quality, quantity, location and timing of effluent, storm water, and agricultural return flow discharges

Discharges of waste such as wastewater effluent, cooling water, stormwater runoff, and irrigation return flows can elevate the temperature of receiving waterbodies through the direct discharge of warmer water.

Flood irrigation is a common irrigation practice in parts of the Klamath basin, including the Klamath Project area and the Shasta River watershed. When irrigation water is applied to a field in this manner, it generally flows across the field as a thin sheet or in shallow rivulets. As the irrigation water runs across the ground it absorbs heat. When irrigation flows return to a stream, they carry with them the increased heat load added as they passed through the irrigated lands. Temperature monitoring of tailwater returns in the Shasta Valley found the highest values of the 7-day average of maximum temperature ranged from 26.9 – 34.5 ^{o}C (80 -94 ^{o}F) at 7 sites (AquaTerra 2012). The net effect of direct thermal discharges is an increase in both daily average and maximum temperatures. The thermal impact of a direct discharge to a stream can be calculated using the mixing equation discussed in section 3.1, above.

5.2.4 The location, size, and operation of in-channel impoundments with the ability to alter the natural temperature regime

The water stored behind an in-channel impoundment (e.g., dam) functions as thermal mass, storing heat. Because larger volumes of water heat and cool slower than smaller volumes, the large volume of water behind an impoundment acts as a temperature buffer, reducing daily temperature variations downstream. Similarly, large volumes of water resist seasonal changes in temperature, and thus delay seasonal temperature changes, resulting in colder temperatures in the spring and warmer temperatures in the fall. In the Klamath River, these effects extend 190 miles downstream to the Pacific Ocean under certain conditions (Bartholow et al. 2004). On the Klamath River the effects are most pronounced immediately downstream of Iron Gate Dam, diminishing in the downstream direction.

The expected biological implications of the changes in diurnal temperature patterns caused by dams are mixed. The decreased diurnal temperature variations associated with dams lead to reduced peak temperatures, thereby reducing the most acutely harmful temperatures. Conversely, the increased daily low temperatures associated with dams could reduce the time available for fish to leave thermal refugia to feed. Also, higher daily low temperatures may lead to higher temperatures at the bottom of thermally stratified pools (Nielsen et al. 1994).

The analysis of the impacts of the four impoundments associated with the Klamath Hydropower Project on river temperatures conducted as part of the Klamath River temperature TMDL found that those effects were significant (NCRWQCB 2010). The seasonal temperature changes caused by the dams have biological implications. The results of the Klamath TMDL analysis are consistent with the findings of Bartholow et al. (2005), who evaluated the thermal effects of the Klamath River dams on downstream reaches and determined that the dams delay the seasonal temperature patterns by approximately 18 days on an annual basis.

The physical implication of an 18-day shift in the seasonal temperature pattern is that the river is cooler in the springtime when juvenile salmonids are migrating to

the ocean, and warmer in the fall when adults are migrating upstream and spawning, and when eggs are incubating in the gravels. Cooler temperatures are known to reduce juvenile salmonid growth rates; however this effect may be mitigated by the benefit gained by reduced incidence of stressfully high temperatures during outmigration. Warmer temperatures in the summer period may reduce the nocturnal feeding opportunities of juvenile salmonids that persist at thermal refugia, thereby reducing their ability to withstand stressfully high daytime temperatures (National Research Council of the National Academies 2004). Warmer temperatures in the fall may delay adult migration or lead to stressfully high temperatures when adults are present or eggs are incubating in gravels.

5.2.5 Actions with the potential to change stream channel geometry

A wider and shallower channel gains and loses heat more readily than a narrow and deep channel. This principal is true for any stream. A stream's width-to-depth ratio influences stream heating processes by determining the relative proportion of the wetted perimeter in contact with the atmosphere versus the streambed. Water in contact with the streambed exchanges heat via conduction. Conductive heat exchange with the streambed has a moderating influence, reducing daily temperature fluctuations. Water in contact with the atmosphere exchanges heat via evaporation, convection, solar radiation, and long-wave radiation. However, wide and shallow channels have a greater surface area per unit of volume in contact with the atmosphere than a narrower, deeper channel. Heat exchange from solar radiation far outweighs heat exchange from evaporation, convection, and long-wave radiation, unless the stream is significantly shaded. The net effect of changes in width-to-depth ratios is that streams that are wide and shallow heat and cool faster than streams that are narrow and deep (Poole and Berman 2001).

The effects of a wider and shallower channel are similar to the effects of increased solar loading, in part because channel widening results in increased solar loading. Both changes lead to increases in daily average and maximum temperatures, increased diurnal fluctuations, and may lead to decreased daily minimum temperatures.

The width-to-depth ratio of a stream can be altered through many avenues. Direct manipulation of the stream channel during construction or flood control maintenance activities can result in the removal of roughness elements such as boulders and large woody debris. Activities with potential to cause coarse sediment discharges can cause changes in streambed morphology downstream of the sediment inputs. Similarly, hydromodification associated with increases in impervious surfaces and stormwater routing can also change the geometry of a stream channel.

5.2.6 Activities with the potential to reduce instream flows or reduce specific sources of cold water, including cold water refugia.

Surface water diversions decrease the volume of water in the stream, and thereby alter a stream's response to heat inputs. When water is removed from a stream the

thermal mass and velocity of the water is decreased. Thermal mass refers to the ability of a body to resist changes in temperature. Basically, less water heats or cools faster than more water. Decreases in velocity increase the time required to travel a given distance, and thus increases the time heating and cooling processes can act on the water. These principles are true for any stream, and work in concert with other heat exchange processes to determine the overall temperature of a stream.

Groundwater withdrawals can also decrease the volume of water in a stream, depending on the situation. Where groundwater aquifers interact with streams groundwater withdrawals can either draw water from the stream or intercept groundwater that would have otherwise discharged to the stream (Winter et al. 1998). The Scott River temperature TMDL analysis identified the interaction of groundwater and surface water as a key factor determining stream temperatures of the mainstem Scott River. The Scott River is primarily a groundwater dominated stream from July-September (NCRWQCB 2005).

The increase in the rate of heating that accompanies a decrease in the volume of flow in a stream can have significant temperature effects. A decrease in thermal mass results in higher daily high stream temperatures and lower daily low stream temperatures, as well as higher daily average temperatures. Reduced velocities also result in higher daily average stream temperatures.

Direct diversion of surface water reduces stream flows and extraction of groundwater connected to surface waters may as well. Activities that reduce infiltration of precipitation and flood waters, such as construction of impervious surfaces and levees, can reduce groundwater inputs to surface waters (Winter et al. 1998).

Thermal refugia are typically identified as areas of cool water created by inflowing tributaries, springs, seeps, upwelling hyporheic flow, stratified pools, and/or groundwater in an otherwise warm stream channel offering refuge habitat to cold-water fish and other cold water aquatic species (NCRWQCB 2007). Thermal refugia are often the only environments in north coast streams that are habitable to salmonids during the hot summer months (Nielsen and others 1994, Watercourse Engineering 2006, Belchik 1997).

Thermal refugia are often formed in deep pools or pockets of water sheltered from mixing during low flow periods. Nielsen et al. (1994) demonstrated the relationship between pool volume and flow and pool stratification. Simply put, in order for a pool to stratify in the absence of physical features that separate cold water inputs from the main stream flow, the volume of the pool must be large relative to the flow, resulting in extremely low velocities. In these situations, the bottom temperature is determined by the daily low temperature. Activities that either raise the daily minimum temperature or decrease the volume of the pool can impact these stratified pools.

Thermal refugia also can form in areas of a stream separated from currents where cold water sources such as springs, tributaries, or intergravel flows enter the stream (Nielsen and others 1994, Belchik 1997). These refugial areas can be impacted in various ways by activities that discharge fine sediments. Fine sediments can fill the voids between substrate, thereby decreasing intergravel flow decreasing intergravel flow, reduce the volume or cause warming of cold tributary or spring flows, or reduce the topographic complexity of stream channels.

Morphological changes associated with increased sediment loads can also eliminate or result in a decreased volume of thermal refugia in a stream or river and impede access to thermal refugia provided by tributaries. Refugial volume can be reduced or eliminated when deep pools fill with sediment, when side channels are buried, or when cold tributary flows percolate into aggraded tributary deltas or gravel bars before entering the river. Similarly, access to refugial tributaries can be reduced or eliminated when sediment loads result in aggradation and cause a tributary to percolate before entering the mainstem and thus become disconnected from the mainstem or become too shallow for fish to swim. Aggradation has impacted the mouths of Hunter, Turwar, Independence, Walker, Oneil, Portuguese and Grider Creeks (Klamath River tributaries), as well as 14 of 17 small lower Klamath River tributaries surveyed by the Yurok Tribe (De La Fuente and Elder 1998, Kier Associates 1999). Finally, refugia can be eliminated when tributary temperatures increase beyond salmonid thresholds due to the other effects of increased sediment loads discussed above.

Activities that can lead to reduced numbers or volumes of thermal refugia include those that can alter the stream channel configuration, reduce pool volumes, reduce flows, or discharge sediment, such as construction, timber harvest, road building, irrigation, mining, and other activities with the potential to disturb soils, decrease slope stability, increase surface erosion, alter channel morphology, and reduce stream flows.

5.3 Actions to Achieve and Maintain Water Quality Objectives for Temperature

The following are actions identified in the proposed *Policy to Implement the Water Quality Objectives for Temperatures* (Policy). The actions are intended to achieve water quality objectives for temperature and implement temperature TMDLs, including EPA-established TMDLs. The Policy language is presented in bold for emphasis, with a discussion following.

5.3.1 Address Riparian Shade, Control Sediment Loading and Address Hydrologic Conditions Resulting in Exceedence of Temperature Objectives Using Regulatory and Non-Regulatory Tools

Restore and maintain riparian shade, as appropriate, through nonpoint source control programs; permits and waivers, grants and loans, and enforcement actions; support of restoration projects; and coordination with other agencies with jurisdiction over controllable factors that influence water temperature,.

This action directs Regional Water Board staff to consider all opportunities to restore and maintain riparian shade, including both regulatory and non-regulatory means. This direction incorporates the concept of shade as a controllable factor into the water pollution control plan, and in so doing strengthens the Regional Water Board's authority to address riparian shade when establishing waste discharge requirements, waivers, and/or prohibitions.

Nonpoint Source Permitting, Permits, and Waivers

The Regional Water Board has developed nonpoint source permitting programs to address water quality concerns associated with a range of activities. To date, permitting programs involving waste discharge requirements, waivers of waste discharge requirements, or a combination of both have been developed for private timber activities, USFS activities, dairy operations, implementation of the Scott and Shasta River TMDLs, and management of county roads. Regional Water Board staff are currently in the process of developing a permitting program to address water quality concerns associated with agricultural operations, a separate permitting program to address road improvement and related restoration activities in Mendocino County, and participating in a multi-regional effort to develop a framework for a permitting program addressing grazing-related water quality concerns.

An example of the incorporation of shade concerns in nonpoint source permitting is the *Waiver of Waste Discharge Requirements for Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System Lands in the North Coast Region* (USFS Waiver). The USFS Waiver establishes conditions designed to prevent water quality impacts associated with USFS management activities, such as those related to the management of riparian areas for the purposes of controlling sediment discharges and preserving riparian shade. The USFS Waiver conditions address temperature concerns by requiring the protection, maintenance, and enhancement of riparian conditions and shade.

Another example of the implementation of shade concerns is in the implementation of the *General Waste Discharge Requirements for Discharges Related to Timber Activities on Non-Federal Lands in the North Coast Region* (Timber GWDRs) and

other permits of the North Coast Region's timber regulatory program[3]. Timber harvest activities have the potential to impact water temperature, depending on how the activities are conducted. For timber harvest activities on private lands, the Regional Water Board incorporates the California Board of Forestry's Forest Practice Rules into water quality permits for ease of reference, for consistent terminology, and to avoid duplicative processes to the degree possible.

The California Department of Forestry and Fire Protection (CAL FIRE), as the lead agency in approving timber harvest activities on private lands, convenes a multi-agency team that includes CAL FIRE, the California Department of Fish and Wildlife, the California Regional Water Quality Control Boards, the California Geological Survey, and other agencies as needed, to conduct a review of a timber harvest plan (THP). Each agency may recommend incorporating mitigating measures into the THP to reduce adverse impacts of the operation on timberland resources, including the beneficial uses of water. Through this process, Regional Water Board staff have an opportunity to make specific THP recommendations and clarify Basin Plan requirements, if needed, so that the final THP is eligible for enrollment in the timber GWDRs or waivers.

Under the Forest Practice Rules, timber operations within designated watercourse and lake protection zones must adhere to canopy retention standards to address stream temperature issues, sediment and nutrient loading, and recruitment of large woody debris. Recent modifications to the Forest Practice Rules to address anadromous fish habitat (Anadromous Salmonid Protection rules) have resulted in canopy retention standards that are generally protective of shade and water temperatures in the areas where they apply. Compliance with the intrastate water quality objective for temperature may in some instances require additional canopy protections, particularly in areas outside the range of anadromy (e.g., upstream of dams, headwaters of streams and other planning watersheds above migration barriers, and coastal streams with no anadromous salmonid habitat that flow directly to the ocean) and in streams that support aquatic habitat other than fish (i.e., streams identified in the Forest Practice Rules as Class II watercourses). In these areas the enhanced riparian protections of the Forest Practice Rules' Anadromous Salmonid Protection rules do not apply. The protective measures for watercourse and lake protection zones on such streams require that at least 50% total vegetative canopy, including at least 25% of the existing overstory conifers be retained (the Rules also have additional requirements for retention of a minimum basal area, which can result in higher canopy levels). The Regional Water Board has found that the 50% total canopy retention standard is consistent with site-specific

[3] Other permits that comprise the North Coast Region's timber regulatory program include the *Categorical Waiver of Waste Discharge Requirements for Discharges Related to Timber Harvest Activities On Non-Federal Lands in the North Coast Region* (Non-Federal Timber Waiver), *General Waste Discharge Requirements for Discharges for Timber Operations on Non-Industrial Timber Management Plans (NTMPs) in the North Coast Region* (NTMP General WDR), and WDRs for discharges related timber harvesting and related land management in the Bear Creek, Elk River, and Freshwater Creek watersheds.

potential effective shade conditions in some, but not all situations, and thus does not ensure the site-specific potential effective shade condition is met. To address this potential gap between temperature protection and Forest Practice Rule requirements, Regional Water Board staff evaluate the proposed harvest in the field during pre-harvest field inspections with the forester and other members of the interdisciplinary review team, and following discussion with the interdisciplinary team, make recommendations to ensure adequate temperature protection, as needed.

The Timber GWDRs contain a provision that all water quality requirements must be met to qualify for enrollment in the Timber GWDRs. As defined, water quality requirements include water quality objectives (narrative or numeric), prohibitions, TMDL implementation plans, policies, or other requirements contained in a water quality control plan adopted by the Regional Water Board and approved by the State Water Board, and all other applicable plans or policies adopted by the Regional Water Board or State Water Board, including, but not limited to, the State Water Board Resolution No. 68-16: Statement of Policy with Respect to Maintaining High Quality Waters in California. This proposed Policy would require that timber harvest plans be consistent with this Policy in order to qualify for enrollment in the Timber GWDRs. In application, this policy directs staff to continue implementing temperature load allocations through Timber GWDRs enrollments in areas subject to existing temperature TMDLs, including EPA-established temperature TMDLs. It also directs staff to implement similar shade controls through Timber GWDRs enrollments in areas listed as impaired for temperature, as appropriate, and region-wide, as appropriate and necessary, to prevent future impairments and ensure compliance with the intrastate water quality objective for temperature.

Grants and Loans and Support of Restoration Projects

The Regional Water Board administers programs that include loan and grant funding for construction of municipal sewage and water recycling facilities, remediation of underground storage tank releases, watershed protection and restoration projects, irrigation efficiency, and nonpoint source pollution control projects. These funds can be used for projects that preserve and/or enhance riparian shade, such as riparian fencing, alternative stock watering systems, riparian planting, beaver management, and bioengineered bank stabilization projects. California's Clean Water State Revolving Funds are typically used to fund municipal wastewater infrastructure. However, it's possible that these types of projects could involve aspects that relate to riparian shade also, such as projects involving the upgrading of treatment systems that are adjacent to riparian areas.

Enforcement Actions

The Regional Water Board often takes enforcement actions to address the impacts associated with unpermitted activities causing discharges of waste and associated impacts to riparian areas, including unpermitted removal or destruction of riparian vegetation associated with other discharges. In such cases, the Regional Water Board issues orders, such as a cleanup and abatement order, that require the

remediation of impacts to waters of the state, including impacts to riparian vegetation. Remediation of such impacts typically involves the restoration of vegetation that has been removed or destroyed.

Coordination with Other Agencies with Jurisdiction Over Controllable Factors that Influence Water Temperature

The Regional Water Board has the authority to issue permits for the discharge of waste to waters of the state. Temperature impacts are sometimes caused by factors that are not associated with discharges of waste, but are instead caused by activities coming under the direct authority of other agencies. An example of this is the near stream activities that come under the land use planning authority of cities and counties. Cities and counties develop ordinances and define appropriate land uses through the adoption of land use plans and zoning. Sonoma County, for example, has established riparian setbacks in their general and area specific plans that call for restricted activities within certain defined distances from streams.

5.3.2 Implement Sediment Controls

Continue to implement the Sediment TMDL Implementation Policy as a means of addressing elevated water temperature associated with excess sediment discharges. Implement sediment controls consistent with the approach articulated in the Sediment TMDL Implementation Policy to address temperature concerns associated with sediment in areas not impaired by sediment.

This action directs staff to pursue the existing *Sediment TMDL Implementation Policy* (Sediment Policy) as a means of addressing sediment loads for the benefit of temperature conditions. The Sediment Policy directs staff to use existing authorities to strengthen regulatory controls of nonpoint source discharges of sediment. Implementation of that Sediment Policy also partially implements the intrastate water quality objective for temperature insofar as the control of sediment discharges partially addresses elevated water temperatures.

The Sediment Policy is very similar to this proposed policy and reads, in part:

> "The Sediment TMDL Implementation Policy states that the Regional Water Board shall address sediment waste discharges on a watershed-specific basis and directs staff to take the following actions to control sediment waste discharges:
>
> 1. Rely on the use of existing permitting and enforcement actions. These actions are consistent with the NPS Policy.
> 2. Rely on the use of existing prohibitions, including any future amendments.
> 3. Pursue non-regulatory actions, such as Memoranda of Understanding, with other agencies and organizations.
> 4. Work with local governments and non-profit organizations to develop sediment control strategies, such as grading ordinances.
> 5. Encourage organizations and individuals to control sediment waste discharges and conduct watershed restoration activities.
> 6. Focus on public outreach and education.
> 7. Develop a guidance document on sediment waste discharge control.

8. Develop a sediment TMDL implementation monitoring strategy." (Basin Plan, page 4-36)

The implementation of the Sediment Policy has been largely achieved to date through the same nonpoint source permitting programs identified above. For instance, the Timber GWDRs require the development of erosion control plans and mitigation of all controllable sediment discharge sites within the timber harvest plan area during the life of the plan (usually 5 years).

5.3.3 Address Temperature Concerns in Future Nonpoint Source Programs

Examine and address temperature impacts when developing permits or programs for nonpoint source activities. Consider and implement, where applicable, all available measures to prevent and control the elevation of water temperatures in permit or program development. Such measures shall include, but are not limited to, sediment Best Management Practices and cleanups, memoranda of understanding or agreement with other agencies, prohibitions against waste discharges, management of riparian areas to retain shade, and control and mitigation of tailwater and impoundments. Where appropriate, include monitoring requirements for incorporation into permits, programs, and other orders to confirm that management actions required to prevent or reduce elevated temperatures are implemented and effective.

This action directs staff to incorporate elements that address temperature concerns when developing nonpoint source control programs. Regional Water Board staff is currently in the process of developing a permitting program to address water quality concerns associated with cultivated agricultural operations, and participating in a multi-regional effort to develop a framework for a permitting program addressing grazing-related water quality concerns.

There is a wide range of practices that can be employed to address temperature impacts associated with nonpoint sources. These include the designation of riparian management zones that are managed differently than surrounding lands, as well as the avoidance of other factors like tailwater discharges and the removal of vegetation that provides shade to a waterbody. In many cases the development of a water quality management plan is a preferred framework for identifying areas that require special management considerations to prevent water quality impacts, as well as the management practices employed, and documentation of the effectiveness of the practices.

This action also directs Regional Water Board staff to incorporate monitoring requirements into permits to ensure that actions taken to address temperature concerns are effective. The types of monitoring that might accomplish this span a range of monitoring types. For instance, photo point monitoring could be used to verify that best management practices are effective at maintaining riparian vegetation. Similarly, instream temperature monitoring could be required to verify that required conditions of an NPDES permits are achieved.

5.3.4 Address Temperature Concerns in Individual Permits

Address factors that contribute to elevated water temperatures when issuing 401 certifications, NPDES permits, Waste Discharge Requirements, or Waivers of Waste Discharge Requirements, or Prohibitions.

This action envisions conditioning individual waste discharge requirements, waivers of waste discharge requirements, 401 water quality certifications, or prohibitions to address any factors that contribute to elevated water temperatures.

The Clean Water Act delegates the authority to issue permits for dredge and fill activities within waters of the US to the US Army Corps of Engineers (USACE) and USEPA. The authority to issue such permits is declared in section 404 of the Clean Water Act, and these permits are often called 404 permits. Section 401 of the Clean Water Act requires applicants for 404 permits to obtain certification from the state verifying that the activity will comply with state water quality standards. These certifications are often called 401 water quality certifications, or just 401 certifications.

The scope of the State's jurisdiction is more broad than the USACE and USEPA's dredge and fill permitting jurisdiction. The federal authority is limited to waterbodies (i.e.,streams, wetlands, and tidal areas) that are navigable, or have a clear nexus to a navigable waterway (e.g. a wetland that has a surface connection to a navigable stream). The State's authority applies to all waterbodies within the borders of the State. For this reason, the Regional Water Board often issues waste discharge requirements for some dredge and fill activities through a general waste discharge requirement permit for dredge and fill activities. However, the same concerns and considerations are addressed, regardless of the permit.

Regional Water Board staff routinely issue 401 certifications and dredge and fill permits for projects such as bridge maintenance and retrofitting, streambank restoration, road construction and maintenance, as well as one-time projects such as pipeline and communication line crossings, flood channel maintenance, and land developments in areas with wetlands. The Regional Water Board has also issued 401 certifications for unique projects such as the Trinity River Restoration Program and the Highway 101 Willits bypass.

The Regional Water Board also develops and administers Waste Discharge Requirements and Waivers of Waste Discharge Requirements for individual projects. These projects are often unique projects for which no general permit has been developed. These types of projects are often combined with a 401 certification when they involve dredge and fill activities.

The Regional Water Board issues National Pollutant Discharge Elimination System (NPDES) permits for point source discharges, such as wastewater treatment plants, industrial processing facilities, state highways, dairies and confined animal feeding operations, and other facilities that discharge effluent to surface waters. The

Regional Water Board also issues NPDES permits for stormwater discharges associated with construction sites, industrial sites, and municipal runoff.

The 401 certifications, NPDES permits, waste discharge requirements, or waivers of waste discharge requirements issued by the Regional Water Board set conditions to address concerns associated with temperature factors such as reductions in shade, changes in cross sectional configuration, temporary dewatering impacts, and/or sediment deliveries.

Prohibitions against discharges of waste, such as the prohibition against the discharge of soil, silt, bark, slash, sawdust, or other organic and earthen material in relation to logging, construction, and associated activities, act to control discharges that may impact temperature conditions through the discharge of sediment and other settleable materials.

5.3.5 Address Temperature Concerns Using Other Tools

Use other regulatory, executive, and enforcement tools, as appropriate, to address elevated water temperatures and preserve existing cold water resources.

This action calls for approaches that can be employed to address temperature concerns that don't involve the development and administration of permitting processes. Other regulatory, executive, and enforcement tools include basin planning exercises, memoranda of understanding and/or agreement with tribes or other agencies, and enforcement orders, such as cleanup and abatement orders and cease and desist orders.

Other regulatory actions include those that arise from the Regional Water Board's basin planning authority, such as the establishment of beneficial uses and water quality objectives. For instance, the establishment of a riparian ecology beneficial use could be contemplated as an appropriate beneficial use that warrants incorporation into the Basin Plan. Similarly, the Board has the authority to "establish prohibitions that specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted" (Porter-Cologne, Section 13243).

Executive tools such as memoranda of understanding with states, tribes, or other agencies can be utilized to acknowledge common interests, establish procedures for coordination and collaboration in the exercise of authorities, and establish agreements relative to the administration of their authorities and programs for the benefit of water temperature and other water quality conditions.

5.3.6 Address Temperature Concerns Through Support of Restoration

Support and encourage restoration projects that are designed to eliminate, reduce, or mitigate existing sources of temperature impairments. Administer, encourage, and support the use of grant funds to facilitate projects that

address elevated water temperature concerns. Pursue non-regulatory actions with organizations, landowners and individuals to encourage the control of elevated water temperatures, watershed restoration, and protection activities.

Restoration is an important tool for achieving water quality conditions sufficient to protect and restore beneficial uses, and may be particularly necessary to address some temperature impairments. This action directs staff to encourage and promote restoration through the administration of grant funds and collaboration with organizations and individuals as a tool to achieve the water quality objectives for temperature. The Regional Water Board administers a number of grant programs that fund restoration, including the 319(h) and 205(j) grant programs, and sometimes proposition bond funds. However, most of the grant funded projects that address temperature concerns in the North Coast Region are funded through grant programs administered by other agencies, such as the California Department of Fish and Wildlife, US Fish and Wildlife Service, or Natural Resource Conservation Service. This action identifies the role the Regional Water Board can play in the promotion of individual projects funded through grant programs administered by the Regional Water Board, as well as those funded through other funding programs.

Some examples of restoration projects addressing temperature concerns that have been or could be funded through grants are the following:

- the planting of riparian vegetation in areas slow to recover from the legacy effects of past management activities;
- infrastructure, such as fences, stock watering systems, and shade structures to reduce impacts of livestock on riparian vegetation;
- projects that conserve water, resulting in reduced diversion of cold water from springs, streams, and aquifers in connection with surface waters;
- projects that lead to improved understanding of groundwater and surface water dynamics in areas where the interaction of these waters has been identified as a factor contributing to elevated water temperatures; and,
- water storage projects that result in reduced diversion of water during the drier months.

5.3.7 Coordinate with the Division of Water Rights in the Water Rights Permitting Process

Continue to coordinate with the Division of Water Rights by participating in the water right application and petition process, providing monitoring recommendations, conducting joint inspections, submitting data in support of 401 certifications related to water diversions and/or facilities regulated by the Federal Energy Regulatory Commission, and any other appropriate means to help ensure that the terms of water right permits and licenses are consistent with the water quality objectives for temperature.

This action directs staff to make use of the processes available for interacting with the State Water Resources Control Board's Division of Water Rights in all official capacities the Regional Water Board's authority provides. The State Water Board's Division of Water Rights (Division of Water Rights) issues water right permits for the diversion of surface waters, and Regional Water Board staff often work with Division of Water Rights staff to ensure Basin Plan requirements are reflected in water right permits and other water right orders. The *Policy for Maintaining Instream Flows in Northern California Coastal Streams* (May 4, 2010) specifically calls for involvement by Regional Water Boards to help ensure adequate consideration of water quality concerns. The Division of Water Rights also issues 401 water quality certifications for projects requiring a Federal Energy Regulatory Commission (FERC) license. Regional Water Board staff provides recommendations and identify water quality conditions that are necessary to ensure that the activity will comply with water quality standards. This action directs Regional Water Board staff to continue to work with the Division of Water Rights to ensure that temperature and other water quality concerns are identified and addressed in the water right permitting process in all waterbodies. The process in which the Regional Water Board staff and Division of Water Rights staff have agreed to coordinate on these issues has been established in an interagency memorandum.

5.3.8 Coordinate with the Division of Water Rights in the Development of Instream Flow Studies and Flow Objectives

Coordinate with the Division of Water Rights on the development of instream flow studies and flow objectives, as appropriate.

This action directs staff to coordinate with the Division of Water Rights on the development of instream flow studies. Instream flow studies are sometimes necessary to determine the dynamics of hydrologic systems, including the sources and losses of water, and to understand the amount and distribution of water necessary to support beneficial uses.

This action also directs staff to coordinate with the Division of Water Rights on the development of flow objectives. The development of flow objectives may be appropriate in cases where the instream flow requirements for support of beneficial uses are defined. For instance, a watershed hydrology objective that describes narrative goals for the timing, quantity, and distribution of water could be incorporated into the Basin Plan, as could a numeric flow objective for a particular watershed where specific flow related thresholds are understood.

5.3.9 Provide Other Agencies Guidance and Recommendations

Provide cities, counties, state, and federal agencies guidance and recommendations on compliance with the water quality objectives for temperature. Work with local governments to develop strategies to address the prevention, reduction, and mitigation of elevated water temperatures, including, but not limited to, riparian ordinances, general plans, and other management policies.

This action directs staff to communicate guidance and recommendations, such as comment letters or face-to-face meetings, with state, federal, and local government officials and planning staff, to advise and assist them in developing policies and plans that comply with and support the water quality objectives for temperature. Regional Water Board staff often submits water quality comments to cities and counties during the development of their ordinances and general plans. Section 13247 of the Porter-Cologne Water Quality Control Act states:

> "State offices, departments, and boards, in carrying out activities which may affect water quality, shall comply with water quality control plans approved or adopted by the state board unless otherwise directed or authorized by statute, in which case they shall indicate to the regional boards in writing their authority for not complying with such plans."

An example of the Regional Water Board providing guidance and recommendations to another state agency is the input Regional Water Board staff has provided the California Board of Forestry regarding revisions and implementation of the Forest Practice Rules. Regional Water Board staff regularly attend Board of Forestry meetings in which changes in the rules are contemplated, and have submitted comment letters on rule changes to ensure the Board of Forestry is aware of Basin Plan considerations. Similarly, Regional Water Board staff participated in Cal Fire's Section V Technical Advisory Committee that developed a guidance document for foresters wishing to make use of that relatively recent section of the Forest Practice Rules added as part of the Anadromous Salmonid Protection rule package, which involves timber operations within the riparian zone.

State guidelines require that local general plans should incorporate water quality policies from Basin Plans to the extent they are relevant. The planning and land use authorities entrusted to cities and counties include the authority to limit impacts from land uses to waters of the state and other natural resources. This action directs staff to continue to provide guidance and recommendations to cities and counties on compliance with the water quality objectives for temperature and work with local governments to develop strategies to address the prevention, reduction, and mitigation of elevated water temperatures, including, but not limited to, riparian ordinances, general plans, and other management policies. Regional Water Board staff have actively participated in meetings with the Sonoma County Permit and Resource Management Department regarding the development of the County's Riparian Zoning ordinance, and hope to have similar opportunities with other county planning departments.

5.3.10 Coordinate with Other State Agencies

Identify statewide policies under development with implications for water temperature, collaborate with State Water Board counterparts, and provide recommendations and guidance with respect to this policy.

This action directs staff to collaborate with State Water Board and other state agencies in the development of statewide policies that may have implications for water temperature. An example of such a policy is the Wetland and Riparian Area Protection Policy currently being developed by the State Board. Similarly, the State and Regional Water Boards are collaborating in a multi-regional effort to develop a framework for a permitting program addressing grazing-related water quality concerns.

5.3.11 Monitor Temperature Trends

Develop and implement a region-wide water temperature trend monitoring program to assist the Regional Water Board in determining whether this Policy is effectively reducing and preventing elevated temperatures over the long-term.

This action directs staff to develop a monitoring plan to track regional temperature trends to understand whether the actions identified in this Policy are effective at controlling stream temperatures. Section 7.0 is a description of the temperature monitoring strategy Regional Water Board staff are pursuing.

5.3.12 Develop and Maintain a Temperature Workplan

Develop and maintain a temperature implementation workplan consistent with the Policy to prioritize efforts, track progress, and identify specific action to address elevated water temperatures. The temperature implementation workplan shall describe actions that will be taken throughout the North Coast Region and set watershed priorities for addressing elevated water temperatures at a watershed-specific level. The temperature implementation workplan shall be presented to the Regional Water Board on a triennial basis.

This action directs staff to develop and maintain a temperature implementation workplan similar to the *Work Plan to Control Excess Sediment in Sediment Impaired Watershed* (NCRWQCB 2008), which identifies the actions and tasks Regional Water Board staff should take to control human-caused excess sediment in the sediment-impaired water bodies of the North Coast Region over a ten-year time frame. The temperature implementation workplan should identify both regional and watershed-specific tasks Regional Water Board staff intend to execute to control elevated temperatures in the North Coast Region. This action also mandates review of the work plan by the Regional Water Board every three years.

6.0 ACTION PLANS TO ADDRESS TEMPERATURE IMPAIRMENTS IN THE MATTOLE, NAVARRO, AND EEL RIVER WATERSHED

6.1 Stipulated Agreement

The Regional Water Board and State Water Resources Control Board were sued several years ago by six environmental groups. The suit was filed to compel the development of implementation plans for the temperature TMDLs defined in the following documents[4]:

- *Navarro River Total Maximum Daily Loads for Sediment and Temperature* (2000),
- *Mattole River Total Maximum Daily Loads for Sediment and Temperature* (2002),
- *Upper Main Eel River and Tributaries (including Tomki Creek, Outlet Creek and Lake Pillsbury) Total Maximum Daily Loads for Temperature and Sediment* (2004),
- *Middle Main Eel River and Tributaries (from Dos Rios to South Fork) Total Maximum Daily Loads for Temperature and Sediment* (2005),
- *Lower Eel River Total Maximum Daily Loads for Temperature and Sediment* (2007),
- *South Fork Eel River Total Maximum Daily Loads for Sediment and Temperature* (1999),
- *North Fork Eel River Total Maximum Daily Loads for Sediment and Temperature* (2002), and
- *Middle Fork Eel River Total Maximum Daily Loads for Sediment and Temperature* (2003)

The TMDLs listed above contain all of the components of a TMDL (problem statement, source analysis, load allocation, numeric targets, load allocations, linkage analysis, and margin of safety) but do not include implementation plans. These TMDLs were developed on an aggressive schedule, pursuant to a consent decree, which did not allow for the development and adoption of implementation plans. The three stand-alone *Action Plans to Control Elevated Water Temperatures in the Mattole, Navarro, and Eel River Watersheds* were developed to address elevated water temperatures, implement the TMDLs listed above, and satisfy the stipulated agreement.

6.2 Geographic Scope

The stand-alone Action Plans to Control Elevated Water Temperatures in the Mattole, Navarro, and Eel River Watersheds apply to the following watersheds:

[4] The watersheds referenced above had TMDLs developed for both temperature and sediment, which were developed at the same time and presented in the same document. The sediment TMDLs contained in these documents are addressed through implementation of the Sediment Policy. This Policy addresses the temperature TMDLs only.

- Mattole River
- Navarro River
- Upper Main Eel River
- Middle Main Eel River
- Lower Main Eel River
- South Fork Eel River
- North Fork Eel River
- Middle Fork Eel River

6.3 Relationship to the Regional Temperature Policy

The stand-alone Action Plans to Control Elevated Water Temperatures in the Mattole, Navarro, and Eel River Watersheds are consistent with the concurrently proposed Policy and for the Implementation of the Water Quality Objectives for Temperature. The actions described in the stand-alone *Action Plans to Control Elevated Water Temperatures in the Mattole, Navarro, and Eel River Watersheds* apply the principles of the Policy to temperature issues identified in those watersheds with a goal of implementing the TMDL load allocations and achieving the TMDL targets.

The Policy directs the Regional Water Board to focus temperature implementation actions on three factors: shade, flow, and sediment. The actions described in the Mattole, Navarro, and Eel River watershed Action Plans address shade and flow issues. Elevated sediment issues in these watersheds are addressed through implementation of the Sediment TMDL Implementation Policy contained in the Basin Plan.

6.4 Temperature Total Maximum Daily Load Assessments

6.4.1 Problem Statements

Each of the eight TMDLs addressed by these Action Plans contains a problem statement. The problem statements consistently identify the decline of the salmonid fishery and degradation of habitat as symptoms of the water quality impairment caused by elevated water temperatures. Many of the problem statements also discuss the science of salmonid life cycle and habitat requirements, with a discussion of the temperature conditions as they existed at the time the TMDLs were prepared. For further information describing the problems associated with elevated water temperatures in the eight watersheds, see the TMDL documents listed in Section 2.4.

6.4.2 Source Analyses

The source analysis methods and conclusions are summarized in section 2.4, Temperature TMDL Analyses, above. See the TMDL documents listed in Section 6.1, Stipulated Agreement, above, for a full discussion of each of the source analyses.

6.4.3 Total Maximum Daily Loads

The temperature TMDLs developed for the Mattole, Navarro, and Eel River watersheds were developed using consistent methodologies and interpretations. Accordingly, the TMDLs, load allocations, and targets were established to achieve conditions that are consistent among all of the TMDLs. Despite this consistency, the

calculated thermal loads established vary from watershed to watershed due to differences such as vegetation type, channel width, and channel orientation. However, the loads were developed consistently on a single conceptual basis: the potential amount of effective shade provided to the water surface from near stream vegetation taking into account topography, stream orientation, differences in vegetation type, and natural factors that can reduce that amount such as fire, disease, geology, soils, landslides, windthrow, and other natural processes. The established TMDLs and a description of the basis for the TMDL are presented in Table 6.1, below.

6.4.4 Numeric Targets

Total maximum daily load numeric targets are a quantitative value or values used to measure whether or not the applicable water quality standard is attained. Numeric targets for temperature TMDLs developed in the North Coast Region are used to measure progress towards achievement of the applicable water quality objectives for temperature, as the objectives apply to the individual TMDL watersheds. The Mattole, Navarro, and Eel River watersheds are intrastate waters, and thus only the intrastate water quality objective applies. The targets are summarized in Table 6.2, below.

Table 6.1: Summary of the Total Maximum Daily Thermal Loads established for each watershed.

Watershed	Total Maximum Daily Thermal Load	Basis
Upper Main Eel River	Average solar loading of 289 langleys/day	Shade associated with "full natural growth"
Middle Main Eel River	Average solar loading of 233 langleys/day	Shade associated with "full natural growth"
Lower Main Eel River	Salt River subbasin: 362 langleys/day All other tributary reaches: 118 langleys/day Lower main Eel: no TMDL needed.	Heat load that corresponds to "natural shade conditions"
South Fork Eel River	Effective shade levels, varied by stream width and vegetation type, ranging from 26-96%	Shade associated with "natural conditions"
Middle Fork Eel River	NF of MF Eel: 118 langleys/day Upper Black Butte: 100 langleys/day Other MF Eel tributaries: 109 langleys/day MF Eel Mainstem: 9% reduction in heat	Shade associated with "natural full growth vegetation"
North Fork Eel River	North Fork Eel watershed upstream of Yellowjacket Creek and Hulls Creek subbasin: Modeled shade results depicted in figures. Remainder of North Fork Eel: 41% average shade.	"Natural Potential Shade"

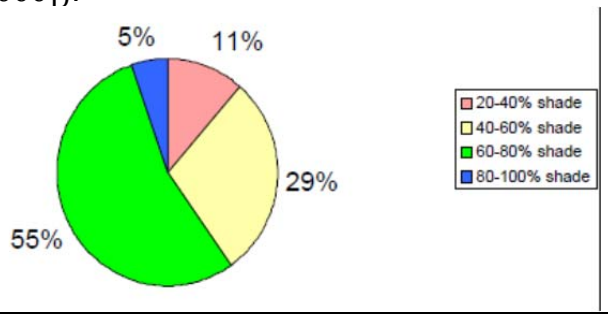
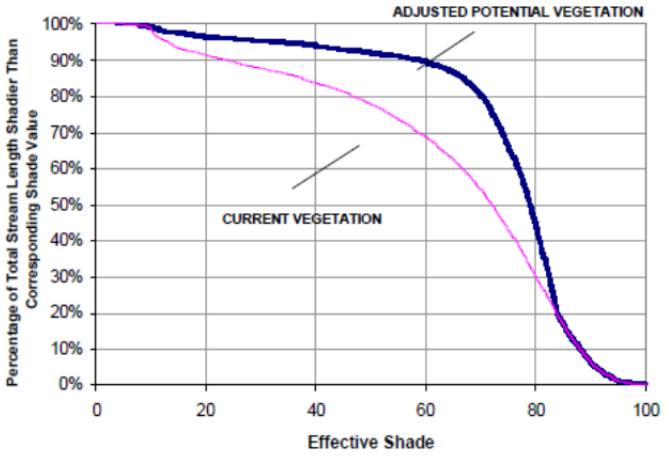
Navarro River	Cumulative distribution of potential effective shade (presented in Table 3-1 and Figure 3-4 of the Navarro TMDL document [USEPA 2000]): 	Potential effective shade conditions, with allowances for effects of natural factors that reduce shade
Mattole River	The distribution of effective shade conditions identified as "adjusted potential vegetation", below (figure 4-8 of the Mattole TMDL [USEPA, 2002]): 	Potential effective shade conditions, with allowances for effects of natural factors that reduce shade

Table 6.2: Summary of Numeric Targets in the Mattole, Navarro, and Eel River Watershed Temperature TMDLs

<table>
<tr><th>Watershed</th><th>Numeric Targets</th></tr>
<tr><td>Upper Main Eel River</td><td>Achievement of temperature at designated location.</td></tr>
<tr><td>Middle Main Eel River</td><td>None explicitly defined.</td></tr>
<tr><td>Lower Main Eel River</td><td>None explicitly defined.</td></tr>
<tr><td>South Fork Eel River</td><td>
<table>
<tr><th>Cold water habitat</th><th>Bull Creek</th><th>Elder Creek</th><th>Rattlesnake Creek</th></tr>
<tr><td>Good < 15</td><td>37%</td><td>38%</td><td>0%</td></tr>
<tr><td>Marginal 15-17 C</td><td>31%</td><td>52%</td><td>1%</td></tr>
<tr><td>Poor 17-19 C</td><td>18%</td><td>10%</td><td>21%</td></tr>
<tr><td>Inadequate 19-21 C</td><td>14%</td><td>0%</td><td>55%</td></tr>
<tr><td>>21 C</td><td>0%</td><td>0%</td><td>23%</td></tr>
</table>
These goals are based on the natural condition scenario, using Elder Creek as a reference
</td></tr>
<tr><td>Middle Fork Eel River</td><td>The minimum target value is the distribution of stream lengths that fall into the adequate and marginal temperature categories under the full growth scenario:
<table>
<tr><th>Temperature range</th><th>Upper Black Butte subbasin</th><th>North Fork of Middle Fork subbasin</th><th>Remainder of the Middle Fork Eel River watershed</th></tr>
<tr><td>Good (MWAT < 15° C)</td><td>0%</td><td>0%</td><td>0%</td></tr>
<tr><td>Adequate (15° C < MWAT < 17° C)</td><td>28%</td><td>6%</td><td>23%</td></tr>
<tr><td>Marginal (17° C < MWAT < 19° C)</td><td>71%</td><td>78%</td><td>72%</td></tr>
</table>
</td></tr>
<tr><td>North Fork Eel River</td><td>The distribution of stream temperatures represented in the following table:</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><th>Steelhead habitat quality (in MWAT)</th><th>Percent of Stream Length in Five Northern Subwatersheds</th></tr>
<tr><td>Good < 15°</td><td>1%</td></tr>
<tr><td>Adequate 15-17°C</td><td>7%</td></tr>
<tr><td>Marginal 17-19°C</td><td>52%</td></tr>
<tr><td>Inadequate 19-24°C</td><td>40%</td></tr>
<tr><td>Lethal >24°C</td><td>0%</td></tr>
</table>
</td></tr>
<tr><td>Navarro River</td><td>

“Temperature conditions in the Navarro should show the general pattern illustrated in Figure 3-2. Good or suitable habitat conditions for cold water fish (<17°C [62.6°F] as measured by MWAT) should exist in most tributaries. Streams that cannot support ambient suitable conditions (e.g., mainstem Navarro, Anderson and lower Rancheria) will provide improving conditions for pool refugia and connectivity between refugia through sufficient natural surface and groundwater flow.”
“The quantity of flow diverted from the Navarro in the summer is not increased, unless it can be shown that such an increase does not adversely affect beneficial use. The NMFS guidelines provide details of the documentation required for summer diversions.”

</td></tr>
<tr><td>Mattole River</td><td>

Adjusted potential shade conditions from riparian vegetation
Increased volume of thermally stratified pools

</td></tr>
</table>

6.4.5 Margins of Safety

The Clean Water Act requires that TMDLs include a margin of safety that takes into account any lack of knowledge concerning the relationship between the pollutant loads and the desired receiving water quality. The margin of safety is often implicitly incorporated into conservative assumptions used in calculating loading capacities, waste load allocations, and load allocations (EPA 1991). The margin of safety may also be incorporated explicitly as a separate component in the TMDL equation. The Mattole, Navarro, and Eel River watershed temperature TMDL analyses all contain implicit margins of safety, based on conservative assumptions that were made to account for uncertainties in the analysis. See the individual TMDL documents listed in Section 6.1, Stipulated Agreement, above, for a full discussion of the conservative assumptions that comprise the margins of safety for these TMDLs.

6.5 Description of Implementation Actions to Address Temperature Impairments in the Mattole, Navarro, and Eel River Watershed

The implementation actions described below comprise the suite of implementation actions identified in the three Action Plans to address temperature impairment in the Mattole, Navarro, and Eel River watersheds. However, because some activities are not present in each of the watersheds, not all apply in every watershed.

6.5.1 Timber Harvest Activities on Non-Federal Lands

Responsible Party: Regional Water Board

Action Plans: Mattole, Navarro, and Eel

Action: Regional Water Board staff shall make recommendations for additional measures to ensure the TMDL load allocations and water quality objectives for temperature are achieved during the timber harvest review process, if necessary.

This action calls on Regional Water Board staff to rely on the riparian shade protections required by the California Forest Practice Rules as a starting point to protect and maintain riparian shade. However, compliance with the intrastate water quality objective for temperature may in some instances require additional canopy protections, particularly in areas outside the range of anadromy (see additional discussion in sections 4.4 and 5.3.1). Accordingly, this action calls for Regional Water Board staff to make recommendations for additional measures necessary to achieve the water quality objectives during the timber harvest review process when the Forest Practice Rule protections are insufficient. Through this process Regional Water Board staff have an opportunity to make specific THP recommendations and clarify Basin Plan requirements, if needed, during the timber harvest review process so that the final THP is eligible for enrollment in the timber GWDRs or waivers.

The Regional Water Board regulates discharges of waste associated with private timber activities in the Mattole, Navarro, and Eel River watersheds through the following general permits and watershed-wide permit:

- *General Waste Discharge Requirements for Discharges Related to Timber Harvest Activities on Non-Federal Lands in the North Coast Region* (Timber GWDRs)
- *Categorical Waiver of Waste Discharge Requirements for Discharges Related to Timber Harvest Activities On Non-Federal Lands in the North Coast Region* (Non-Federal Timber Waiver)
- *General Waste Discharge Requirements for Discharges for Timber Operations on Non-Industrial Timber Management Plans (NTMPs) in the North Coast Region* (NTMP General WDR)
- *Waste Discharge Requirements For Discharges Related to Timber Harvesting and Related Land Management Activities Conducted by Humboldt Redwood Company, LLC, in the Bear Creek Watershed Humboldt County*

In 2011, the Mattole Restoration Council received approval for their Mattole Forest Futures Project. This program establishes a suite of "light touch" forestry practices described and analyzed in the Mattole Programmatic Timberland Environmental Impact Report. This program provides landowners a streamlined approval process for their logging plans, provided their harvest meets the program's standards. Regional Water Board participated in the development of the program, which addresses temperature concerns.

Responsible Party: Parties conducting timber activities on private lands.
Action Plans: Mattole, Navarro, and Eel
Action: Implement riparian management measures that meet the riparian shade allocations and water quality standards. Where the Forest Practice Rules are not sufficient to meet the TMDL allocations or water quality standards, implement additional measures as directed by Regional Water Board staff during the timber harvest review process.

This action directs private parties conducting timber harvest activities that discharge waste, or have the potential to discharge waste, to manage riparian areas consistent with the TMDL load allocations for riparian shade. Because TMDL load allocations are established as necessary conditions for achievement of water quality standards (i.e., water quality objectives in the context of beneficial uses), applicable load allocations should be incorporated into a timber harvest plan to qualify for enrollment in any of the timber permits described above. The action also directs those parties to implement additional measures identified by Regional Water Board staff during the timber harvest planning process.

These actions implement actions 1 and 2 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.2 Activities on Lands Managed by the U.S. Forest Service (USFS)
Responsible Party: Regional Water Board
Action Plan: Eel
Actions: 1) Implement Order No. R1-2010-0029, *Waiver of Waste Discharge Requirements for Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System Lands in the North Coast Region,* and any future revisions, *(* USFS Waiver of WDRs) as a mechanism for compliance with temperature objectives.
2) Regional Water Board staff shall make recommendations for additional measures to ensure the water quality objective for temperature is achieved during the project review process, as necessary.

These actions direct staff to continue implementing the USFS Waiver of WDRs as a mechanism for compliance with temperature TMDLs and the intrastate water quality objective for temperature, and to make further recommendations during the project review process, as necessary, to ensure achievement of the water quality objective for temperature.

In 2010, the Regional Water Board issued Order R1-2010-0029: *Waiver of Waste Discharge Requirements for Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System Lands in the North Coast Region* (USFS Waiver), a conditional waiver addressing certain nonpoint source activities on United States Forest Service lands in the region, including timber, roads, and grazing. This permit, by virtue of its conditions, also implements sediment, temperature, and nutrient TMDLs, and meets the Basin Plan intrastate temperature objective.

The USFS Waiver of WDRs adopts the USFS program that manages and maintains designated riparian zones to ensure retention of adequate vegetative cover that results in natural shade conditions. The USFS program requires retention of trees within 300 feet slope distance on each side of fish-bearing streams, 150 feet slope distance on each side of perennial streams, and 100 feet slope distance on each side of ephemeral / intermittent streams, or the site-specific potential tree height distance on each side of the stream, whichever is greatest. The USFS Waiver of WDRs provides for exceptions to these requirements if it can be demonstrated that the exception will result in a net long-term benefit to water quality and stream temperatures. The USFS Waiver of WDRs is the sole implementation mechanism in the Black Butte River, Upper Middle Fork Eel River, and Upper North Fork Eel River watersheds.

Responsible Party: U.S. Forest Service
Action Plan: Eel
Actions: Conduct land management activities in compliance with the USFS Waiver of WDRs, and in accordance with project-level recommendations.

This action simply calls on the USFS to comply with terms of the USFS Waiver of WDRs.

These actions implements actions 1 and 2 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.3 Agricultural Activities on Non-Federal Lands
Responsible Party: Regional Water Board
Action Plans: Mattole, Navarro, and Eel
Action: Develop and implement the Agricultural Lands Discharge Program as a mechanism for compliance with temperature objectives.

This action directs the Regional Water Board to develop an Agricultural Lands Discharge Program (ALDP) that achieves riparian load allocations, and to implement the ALDP or elements thereof, upon adoption, as a means of achieving the water quality objective for temperature.

The ALDP is currently under development, and is intended to address water quality concerns associated with cultivated agricultural crops such as grapes, orchard crops, flowers, medical marijuana, vegetables, and other commodities. The regulatory program will likely be composed of a number of waivers and WDRs for specific agricultural categories.

Responsible Party: Any party conducting activities associated with agriculture that discharge waste or have the potential to discharge waste on nonfederal land, except dairies.

Action: 1) "Implement riparian management measures that meet the riparian shade load allocations and water quality standards."

2) "Conduct land management activities in compliance with the Agricultural Lands Discharge Program when adopted. "

The first of these two actions directs parties engaged in agricultural activities that discharge waste, or have the potential to discharge waste, to manage riparian areas consistent with the TMDL load allocations for riparian shade. The second of these actions simply directs agricultural operators to comply with the ALDP upon adoption.

These actions are consistent with actions 1, 2, and 3 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.4 Road Construction and Maintenance of State Highway Facilities
Responsible Party: State Water Resources Control Board, Regional Water Board
Action Plans: Navarro, and Eel

Action: Implement the NPDES Statewide Storm Water Permit and Waste Discharge Requirements for the State of California, Department of Transportation (Caltrans permit).

This action directs the State and Regional Water Boards to implement the Caltrans permit as a means of addressing temperature concerns associated with maintenance and operation of the state highway system. The Caltrans permit was adopted by the State Water Board after close coordination with the Regional Water Boards and was developed to address TMDLs and general Basin Plan requirements.

Responsible Party: Caltrans
Action Plans: Navarro, and Eel
Action: Conduct road construction, maintenance and associated activities in compliance with the Caltrans permit.

This action simply requires Caltrans to comply with the terms of the Caltrans permit.

These actions are consistent with actions 1 and 2 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.5 Road Construction and Maintenance on County Lands
Responsible Party: Regional Water Board
Action Plans: Mattole, Navarro, and Eel
Action: 1) Implement Order No. R1-2013-0004, *Waiver of Waste Discharge Requirements and General Water Quality Certification for County Road Management and Activities Conducted under the Five Counties Salmonid Conservation Program In the Counties of Del Norte, Humboldt, Mendocino, Siskiyou, and Trinity in The North Coast Region*, and any future revisions (5C Waiver of WDRs).

2) In the event that a county does not show intent to implement the 5C Waiver of WDRs, develop WDRs or a conditional waiver of WDRs for that county.

This action directs the Regional Water Board to address temperature concerns through the implementation of the 5C Waiver of WDRs. The 5C Waiver Program addresses sediment and temperature impairments by requiring:

- The application of BMPs on county roads and at corporation yards to avoid excess sediment discharges;
- The protection and maintenance of riparian conditions and shade, within the County road right of way and property; and
- Inventories, prioritization and remediation of sediment delivery sites. These measures are consistent with existing sediment and temperature TMDL implementation requirements to meet relevant load allocations.

The 5C Program is also recognized as a proper implementation tool under the Sediment TMDL Implementation Policy.

In the event that a county decides to not participate in the program, the Regional Water Board is directed to develop a permit to address that county's road maintenance and associated operations.

Responsible Party: Humboldt, Mendocino, and Trinity Counties
Action Plans: Mattole, Navarro, and Eel
Action: Conduct road construction and maintenance in compliance with the 5C Waiver of WDRs.

This action directs Humboldt, Mendocino, and Trinity Counties to comply with the 5C Waiver as a means of addressing temperature concerns associated with county road maintenance and associated activities.

These actions are consistent with actions 1 and 2 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.6 Dairy Operations
Responsible Party: Regional Water Board
Action Plan: Eel
Action: Implement temperature allocations through the Water Quality Compliance Program for Dairies & Concentrated Animal Feeding Operations and any future revisions (Dairy Program).

This action directs the Regional Water Board to continue addressing temperature impacts associated with dairy operations through the implementation of the Dairy Program. The Dairy Program involves inspections of individual dairy facilities to identify water quality concerns, including concerns associated with riparian management. Regional Water Board staff communicate water quality concerns at the time of the inspection and through inspection reports that identify improvements to be addressed by the operator. Regional Water Board staff follow-up with the operators regarding the implementation of the recommendations, and often work with third parties such as the Western United Dairymen, NRCS, or resource conservation districts, or the UC Cooperative Extension to help the operators find assistance with implementing the recommendations. Examples of the types of recommendations that address temperature concerns include riparian fencing, alternative water source development, construction of shade structures, and placement of salt blocks away from watercourses.

Responsible Party: Dairy Operators
Action Plan: Eel
Action: Conduct land management activities in compliance with the Dairy Program.

This action directs dairy operators to comply with the Dairy Program as a means of implementing the water quality objectives for temperature, and is consistent with action 1 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.7 Dredge and Fill Activities in Waters of the State
Responsible Party: Regional Water Board
Action Plans: Mattole, Navarro, and Eel
Action: Incorporate measures to meet the temperature allocations in 401 water quality certifications.

This action directs Regional Water Board staff to condition 401 water quality certifications to address any factors that contribute to elevated water temperatures.

This action is consistent with action 4 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.8 Waste Discharge Requirements
Responsible Party: Regional Water Board
Action Plans: Mattole, Navarro, and Eel
Action: Incorporate measures to meet the temperature allocations in Waste Discharge Requirements and Waivers thereof.

This action directs Regional Water Board staff to condition individual waste discharge requirements and waivers of waste discharge requirements, to address any factors that contribute to elevated water temperatures.

This action is consistent with action 4 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

6.5.9 Water Use
Responsible Party: Regional Water Board; State Water Resources Control Board, Division of Water Rights
Action Plans: Mattole, Navarro, and Eel
Action: Work with other agencies and non-governmental organizations to support off-stream storage projects for water diverters currently diverting directly from streams during summer. Work with other agencies and non-governmental organizations to streamline permitting process for conversion of on-stream to off-stream storage.

This action directs the Regional Water Board to support efforts to develop off-stream water storage for diverters that currently divert surface water during the dry season (e.g., June through September). This effort is intended to lead to increased cold water flows instream during the time of highest water temperatures.

The Regional Water Board can support this action in the following ways:

- Prioritization of grant funds for the construction of off-stream reservoirs, the removal of on-stream impoundments, and other infrastructure needed to facilitate the transition from direct diversion to off-stream storage.
- Support of projects in grant programs not administered by the Regional Water Board. This may include letters of support for individual projects to agencies such as the Natural Resource Conservation Service (NRCS), who administers the Environment Quality Incentives Program.
- Permit streamlining. The Regional Water Board can affect permit streamlining through the development of general WDRs for pond construction and/or impoundment removal. Development of general WDRs and 401 water quality certifications could be completed in a way that includes a CEQA analysis that could be relied on for multiple projects, thereby decreasing the costs associated with projects. This same approach has already been taken to streamline the permitting of sediment source reduction, streambank restoration, and riparian planting projects implemented by the Mendocino Resource Conservation District and NRCS.

These actions are consistent with actions 4, 5, 6, and 7 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

Responsible Party: Water Users
Action Plans: Mattole, Navarro, and Eel
Action: The Regional Water Board encourages all water users to implement water conservation practices and develop off-stream storage facilities to minimize water diversions during low flow periods.

This statement makes clear to all water users the actions that can be taken on their own initiative to address water quality concerns associated with their water use.

Responsible Party: Regional Water Board, State Water Resources Control Board, Division of Water Rights
Action Plans: Mattole, Navarro, and Eel
Action: Pursue instream flow studies:

- Work with others to attain funding for instream flow studies to (1) quantify flows necessary for beneficial use support, (2) quantify flow impacts to assist outreach and education efforts, or (3) identify opportunities to increase summer low flows.
- Coordinate with the Division of Water Rights and California Department of Fish and Wildlife.
- Consider all sources of water, including headwaters, groundwater, and waters flowing in subterranean streams.

This action directs the Regional Water Board to pursue the development of instream flow studies to provide information for the development of regulatory actions, assist outreach and education efforts, and identify opportunities to increase low flows.

The action directs the Regional Water Board to work in close coordination with the State Water Resource Control Board Division of Water Rights and California Department of Fish and Wildlife. Studies developed pursuant to this action should consider upland hydrologic process, the interaction of groundwater and surface water, and surface water flowing in subterranean streams.

Regional Water Board staff have identified the Navarro watershed as the highest priority watershed for flow studies, given the level of flow reductions apparent from historic flow records. The Regional Water Board should also consider instream flow studies in the Mattole and Eel River watersheds, as appropriate. Flow studies in individual subbasins may be particularly appropriate in the Mattole and Eel River watersheds, where water use is often concentrated in localized areas.

These actions are consistent with actions 6, 7, and 8 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

Responsible Party: Regional Water Board, State Water Resources Control Board, Division of Water Rights
Action Plans: Mattole, Navarro, and Eel
Action: Support third-party efforts to address temperature related concerns, including:

- Education of water users on the importance of water conservation efforts;
- Education of water users on water conservation practices and opportunities;
- Assistance for water users in the implementation of water conservation practices;,
- Restoration of riparian vegetation; and,
- Other efforts that address water temperature-related concerns.

This action directs the support of third party efforts to address the impacts of water diversion and loss of riparian vegetation on stream temperatures. A multitude of non-profit organizations are currently active in the North Coast Region, working on efforts to restore fish populations, address pollution, and improve overall watershed health.

In the Mattole watershed, Sanctuary Forest has developed a tank and forebearance program that has successfully reduced summer water diversions from the upper Mattole River in the Whitethorn area. Similarly, the Salmonid Restoration Federation and Friends of the Eel River have been active in the South Fork Eel River watershed developing informational flyers and raising awareness of flow and water quality issues through feature shows on local radio programs. These same groups were also instrumental in convening a community informational meeting on July 11, 2013, which provided a forum for community members to ask agency representatives, including the Regional Water Board staff, questions regarding

compliance with the water code and protection of streams and the organisms that inhabit them.

The Mattole Restoration Council and Mattole Salmon Group also have long histories of assisting the Mattole River watershed communities in conservation efforts to restore streams and recover salmon runs. The Mattole Restoration Council has been a recipient of 319(h) and Proposition 50 grant funds administered by the Regional Water Board.

The Eel River Recovery Project is another group working on issues related to flow and temperature. Their approach involves monitoring temperatures and flow throughout the Eel River watershed at sites previously monitored by the Humboldt Resource Conservation District in the 1990s, and presenting the information to water users to illustrate the magnitude of flow reductions that have occurred in the past 15 years and persuade users to conserve water. The Regional Water Board has supported this effort by loaning temperature data loggers for the collection of temperature data.

A recent effort led by Cal Trout, called the Eel River Forum, provides a forum for discussions among agencies and watershed restoration practitioners with the goal of sharing information, discussing strategies, and coordinating and integrating conservation and recovery efforts in the Eel River watershed. The Eel River Forum has been well attended by agencies and watershed stewardship and restoration practitioners.

The Nature Conservancy has recently taken an active role In the Navarro River watershed. Their efforts involve stream gauging and funding support for a study of agricultural water use in Anderson Valley.

These actions are consistent with actions 5 and 6 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

Responsible Party: Regional Water Board, State Water Resources Control Board, Division of Water Rights
Action Plans: Mattole, Navarro, and Eel
Action: Take actions to address the impacts of marijuana cultivation, through the following:

- Outreach and education;,
- Grant support for outreach and water conservation and pollution control efforts;
- Coordination with other agencies; and,
- Enforcement actions.

This action directs the Regional Water Board to address the impacts of marijuana cultivation using all available means, both regulatory and non-regulatory. The

regulation of water quality impacts associated with marijuana cultivation is addressed in the action directing the development and implementation of the Agricultural Lands Discharge Program (see section 6.5.3). One of the most effective means of addressing water quality impacts associated with this activity is the disbursal of information on water conservation and pollution prevention through outreach and education on a broad level. The recent rapid expansion of the marijuana cultivation industry has resulted in an influx of new landowners from outside the area. Many of these landowners are not aware of the regulatory requirements in place to protect fish and water resources.

The Regional Water Board has been active in interagency enforcement efforts to address the environmental impacts associated with marijuana cultivation activities. Many of these enforcement situations involve the cleanup and abatement of discharges associated with road building, site preparation, reservoir construction, fuel and pesticide storage, and debris disposal.

These actions are consistent with actions 1 and 2 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

Responsible Party: Regional Water Board
Action Plans: Mattole, Navarro, and Eel
Action: Continue to coordinate with the State Water Board's Division of Water Rights by participating in the water right application and petition process, providing monitoring recommendations, joint inspections as appropriate, submittal of data in support of 401 certifications related to water diversions and/or facilities regulated by the FERC, participation in instream flow studies, participation in proceedings related to instream flow, and any other appropriate means to help ensure that the terms of water right permits and licenses are consistent with the intrastate water quality objective for temperature.

This action directs the Regional Water Board to continue coordination efforts with the State Water Board's Division of Water Rights to address water temperature concerns. The Division of Water Rights provides the Regional Water Board notification of opportunities to comment on water right permitting actions that occur in the North Coast Region, as well as other opportunities for input. This coordination has resulted in enhanced stream protection from sedimentation and temperature impacts and protection of wetlands.

This action is consistent with action 7 of the concurrently proposed *Policy for the Implementation of the Water Quality Objectives for Temperature*.

Responsible Party: State Water Resources Control Board Division of Water Rights
Action Plans: Navarro

Action: Achieve the Navarro River Temperature TMDL Flow and Temperature Target through implementation of the *Policy for Maintaining Instream Flows in Northern California Streams.*

The Navarro River Temperature TMDL Flow and Temperature Target states: "The quantity of flow diverted from the Navarro in the summer is not increased, unless it can be shown that such an increase does not adversely affect beneficial uses."[5]

The target is based on the Guidelines for Maintaining Instream Flows to Protect Fisheries Resources Downstream of Water Diversions in Mid-California Coastal Streams, developed by the National Marine Fisheries Service and California Department of Fish and Game (2000). The guidelines suggest new diversions be limited to the December 15 to March 31 time period. These guidelines were eventually incorporated into the *Policy for Maintaining Instream Flows in Northern California Coastal Streams* (flow policy), which is currently vacated due to legal challenges, but due to be considered for readoption by the State Water Resource Control Board before this Policy's adoption hearing. Implementation of the flow policy will achieve the target. In the interim, or if the flow policy is not reinstated, Regional Water Board staff will continue to participate in the Division of Water Rights' permitting process to ensure the water quality objective for temperature and target are met.

[5] Section 101(g) of the Clean Water Act expresses a congressional policy not to interfere with state authority over allocation of water quantities. Consistent with this policy, it would be inappropriate for USEPA to require a state to adopt or implement a TMDL through water right permit conditioning to limit the season or amount of diversion. But it would also be inconsistent with the policy of section 101(g) to limit the authority of a state to include measures involving allocation of water quantities or water right administration in a TMDL if the state chooses to adopt those measures, and the California Water Code expresses a policy that state water right administration and state water quality control should be integrated. Thus, the inclusion of this measure in the TMDL is based on state law and state policy, and should not be interpreted as recognition of USEPA authority in this area.

7.0 DESCRIPTION OF SURVEILLANCE ACTIVITIES

Regional Water Board staff will develop and implement a region-wide temperature monitoring plan to assist the Regional Water Board in determining whether this policy is effectively reducing and preventing elevated temperatures over the long-term. The monitoring plan will have the following elements:

- Long-term trend monitoring at established sites monitored by the Surface Water Ambient Monitoring Program (SWAMP).
- A regional cooperative monitoring, coordination, and data sharing program drawing on the voluntary efforts of landowners and organizations collecting water temperature data.
- A cooperative monitoring equipment loan and data sharing program.
- Special studies to support investigations of discrete temperature issues.
- Participation in the Board of Forestry's Effectiveness Monitoring Committee.
- Guidance and criteria for staff to consider regarding temperature monitoring requirements.

A description of each of the proposed monitoring plan elements is presented below.

<u>Long-term trend monitoring at SWAMP monitoring sites</u>
This element involves the addition of continuous temperature monitoring in the warmer months (May to September) at a subset of sites routinely monitored as part of the SWAMP Status and Trend Monitoring Program. The Regional SWAMP Program rotates through watersheds on a planned basis as resources allow. The Regional Board believes this approach allows for the best use of resources given available resources. The approach focuses on a few watersheds at a time, cycling back through them every four years as funding allows. The Regional SWAMP Program began the Status and Trend Monitoring Program in Fiscal Year (FY) 2000-01. The original monitoring design utilized a two-component approach to address regional monitoring: 1) long-term "permanent" monitoring sites for trend analysis, and 2) rotating "temporary" sites for basin surveys. The original rotation schedule was closely coordinated with the TMDL development schedule to provide additional current information on water quality parameters to the TMDL development process. The current SWAMP workplan for Calendar ((CY) 2012 through CY 2015 identifies 28 of the original long-term sites and 38 of the rotating basin sites for monitoring, while also adding 12 new sites. The Regional Temperature Monitoring Program will monitor temperature at a subset of these sites to monitor temperature status and trends at key locations.

<u>Regional cooperative monitoring, coordination, and data sharing program</u>
Many organizations collect water temperature data in the North Coast Region. These include timber companies, government agencies, resource conservation districts, watershed groups, and research organizations. This effort will rely on the voluntary participation of these organizations. This element of the Regional Temperature Monitoring Plan will focus on data sharing, data collection protocols,

and coordination of efforts to prevent unnecessary duplication. Staff will draw on the experiences gained through participation in the Klamath Basin Monitoring Program's efforts to develop a similar cooperative temperature data sharing and analysis process for the region. This effort will both aid and benefit from the Watershed Stewardship Approach initiative identified in the region's Nonpoint Source Five-Year Plan. The Watershed Stewardship Approach aims in part to promote collaboration, and provide feedback on progress in improving water quality in an adaptive management framework.

Cooperative monitoring equipment loan and data sharing program

One of the most cost effective ways the Regional Water Board attains temperature data is through cooperative agreements with conservation organizations. The Regional Water Board loans approximately 150 temperature data loggers each year to organizations seeking to understand the temperature dynamics in their watersheds. In return, the Regional Water Board receives the temperature data collected using the instruments. This element of the Regional Temperature Monitoring Plan will continue this cooperative program and bolster its effectiveness through the development of a more standardized approach to quality assurance and data submittal, as well as a standardized application process for organizations requesting equipment.

Special studies to support investigations of discrete temperature issues

The Regional Water Board often engages in efforts to determine the temperature dynamics at play in specific instances. These include monitoring in support of TMDL development, focused water quality investigations, such as the study of algae dynamics in the South Fork Eel River or groundwater dynamics in Scott Valley, and other investigations of discrete temperature issues. These studies typically involve the deployment of simple continuous data loggers, but could also involve more sophisticated monitoring techniques involving thermal infrared data collection, deployment of fiber optic cables, or use of other special data collection technologies.

Participation in the Board of Forestry's Effectiveness Monitoring Committee

The Board of Forestry is currently in the process of establishing an Effectiveness Monitoring Committee (EMC) to provide an active feedback loop to policymakers, agencies, managers, and the public in support of adaptive management principles. One of the specific purposes of the EMC identified in its charter is the evaluation of the effectiveness of the Forest Practice Rules watercourse and lake protection zone requirements in achieving the water quality objectives for temperature. Through this effort, staff hope to further the collective understanding of such topics as post-harvest canopy retention levels relative to targeted canopy levels, the relationship of overhead canopy to effective shade, and changes in temperature relative to changes in effective shade.

Guidance and criteria for staff to consider regarding temperature monitoring requirements

This element of the Regional Temperature Monitoring Program will be primarily intended as guidance to staff developing permits and contemplating temperature monitoring requirements. Most Regional Water Board permits do not contain temperature monitoring requirements. However, some permits, particularly those associated with point sources, contain monitoring and reporting programs which require the monitoring of temperature. This element will discuss the circumstances in which temperature monitoring is appropriate, the required frequency of measurement to achieve the monitoring goals, the proximity of monitoring to discharges, and other considerations important for a successful temperature monitoring and reporting program.

8.0 ENVIRONMENTAL SETTING

The environmental setting of a proposed project establishes the baseline condition against which potential environmental impacts of the proposed project are compared. The proposed project is a water quality protection program, designed to address existing or potential impacts to water quality within the Region with the goal of improving water quality for the protection of human health, recreation, aquatic life, and ecosystem function. As a programmatic analysis, this section provides a general description of the Region, highlighting the key factors identified in the CEQA analysis including: aesthetics, agricultural resources, air quality, biological resources, cultural resources, geology and soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, noise, population and housing, public services, recreation, transportation/traffic, and utilities and service systems.

The North Coast Region comprises all basins including Lower Klamath Lake and Lost River Basins draining generally westward into the Pacific Ocean from the California-Oregon state line southerly to the southerly boundary of the watershed of the Estero de San Antonio and Stemple Creek in Marin and Sonoma Counties[6]. The Region is divided into two natural drainage basins: 1) the Klamath River sub-basin which drains the Cascade Range Geomorphic Province, the Modoc Plateau Geomorphic Province and the Klamath Mountain Geomorphic Province and 2) the North Coastal sub-basin which drains the Coast Range Geomorphic Province. The North Coast Region covers all of Del Norte, Humboldt, Trinity, and Mendocino Counties, major portions of Siskiyou and Sonoma Counties, and small portions of Shasta, Glenn, Lake, and Marin Counties.

The North Coast Region comprises a total area of approximately 19,390 square miles (mi^2), including 340 miles of scenic coastline, 362 miles of designated Wild and Scenic Rivers, 416 mi^2 of National Recreation Areas, and 1,627 mi^2 of National Wilderness Areas, as well as urbanized and agricultural areas. The Region is characterized by steep, mountainous forested terrain with distinct temperature and precipitation zones. The mountain crests, which form the eastern boundary of the region, are about 6,000 feet elevation with a few peaks higher than 8,000 feet. Much of the region is mountainous and rugged; only 13 percent of the land is classified as valley or mesa, and more than half of that is in the higher- elevation northeastern part of the region in the upper Klamath River Basin. The coast is mild, foggy and produces moderate variations in seasonal temperatures. Coastal redwoods and Douglas fir-tanoak forests dominate this landscape. Inland areas outside of the coastal influence undergo more extreme seasonal temperature variation with seasonal maximums exceeding 100 ºF. Oaks and pines interspersed with grasslands and chaparral are more common inland.

[6] CWC § 13200(a)

In 1998, the U.S. Geological Survey (USGS) published a report entitled "The Status and Trends of the Nation's Biological Resources." What follows are excerpts from this report for northwestern California[7].

> "Northwestern California has the wettest, most consistent climate in the state. It is composed mainly of the coastline and several metamorphic mountain ranges, including the Klamath Mountains and the north Coast Ranges. The coastal region, from the Oregon border south to Bodega Bay, is dominated by areas of coastal prairie, some coastal marsh, closed-cone pine and cypress forests on poor soils, and grand fir–Sitka spruce forests on better soils (Hickman 1993). Many of the cypress groves are associated with chaparral, rock outcrops, or serpentine soils. The closed-cone pines are generally small in stature and, like the cypresses, are associated with chaparral, fire, and shallow, acidic, nutrient-poor soils, often serpentine or sandstone. These pines are short-lived (50–100 years), and their seeds can only germinate on bare mineral soils. Like the cypresses, the closed-cone pines require fire for successful reproduction. Knobcone pine is the most widespread of the closed-cone pines, ranging nearly the length of the state."
>
> "The Klamath Mountains are geologically old and support mixed evergreen forests of Douglas-fir, ponderosa pine, and sugar pine, with mountain hemlock, white fir, and chinquapin found at higher elevations. Serpentine soils are common in the Klamath Mountains. On the west side, Douglas-fir–hardwood forests grow at low elevations, giving way at higher elevation to white fir–Douglas-fir forests, white fir–California red fir forests, and finally to mountain hemlock–California red fir at the highest elevations. East and south of the highest ridges, the climate is drier and more continental. At low elevations, forests are dominated by ponderosa pine, which is replaced by white fir–pine forests at higher elevations, then red fir–white fir forests, and finally mountain hemlock–red fir, with whitebark pine occurring at the highest elevations. The Klamath Mountains have a high floristic diversity, in part because they have acted as refugia supporting many endemics and relict species, including Pacific silver fir, subalpine fir, Alaska-cedar, Brewer spruce, Engelmann spruce, and foxtail pine. The complex vegetation patterns in the Klamath Mountains seem based primarily on differences in soils and secondarily on elevation and soil moisture (Sawyer and Thornburgh 1977)."
>
> "The northern Coast Ranges occur immediately south of the Klamath Mountains. Coast Range forests do not include hemlock and have

[7] http://www.nwrc.usgs.gov/sandt/SNT.pdf accessed August 16, 2013.

noble or red fir replacing grand fir, with rhododendron replacing chinquapin in the understory. Hardwoods increase in frequency on the drier slopes inland. The outer northern Coast Ranges, those farthest to the west, receive a great deal of rain (Hickman 1993). Riparian areas and north-facing slopes of the Coast Range fog belt support redwood forests…, which thrive where coastal fog is frequent. Redwood is a California endemic and is the tallest (112 meters) and fastest-growing tree in the world (Zinke 1977); one of these trees may live more than 2,000 years (Bakker 1972). Although redwoods were common in the Tertiary over much of North America, they are now restricted to the fog belt of maritime central and northern California. Proximity to the sea moderates temperatures, and fog helps prevent evapotranspiration (moisture loss from leaves). Fog drip contributes considerable moisture to the soil during the otherwise dry summer season (18–30 centimeters per year; Zinke 1977). The continuous moisture enables redwood forests to be home to a number of amphibians, including ensatinas, ocelot-spotted giant salamanders, tailed frogs, and seep salamanders, as well as the more common banana slugs (Bakker 1972)."

"Douglas-fir is often a codominant in redwood forests, becoming established after fires, and tanoak, California bay, madrone, and western hemlock are common understory trees where enough light penetrates the canopy (Zinke 1977). Redwood is a valuable timber tree because of its size and because of the wood's unique resistance to rot. More than 85% of the oldgrowth coast redwood forests has been logged, but much of the original distribution of about 810,000 hectares remains in second-growth redwood forests of varying ages. Second-growth redwood forests support most of the same native vascular plants as old-growth forests, but habitat for species that depend on old-growth forests—such as spotted owls, marbled murrelets, some arthropods, mollusks, and canopy lichens—has been greatly reduced (U.S. Fish and Wildlife Service 1995a). Logging of redwood continues, although most old-growth stands are now protected in state parks and in Redwood National Park."

"Drier slopes of the Coast Ranges support mixed-evergreen and mixed-hardwood forests, whereas montane forests of subalpine fir and pines are found at higher elevations. Vegetation on the highest peaks is similar to that found at high elevations in the Sierra Nevada; peaks above 1,500 meters are treeless and experience heavy winter snows. Summers are hot and rainfall is low in the inner northern Coast Ranges, especially on eastern slopes in the rain shadow of the peaks. Serpentine soils are common, and dry eastern slopes support chaparral and pine–oak woodland. (Hickman 1993)."

8.1 Aesthetics

The North Coast Region is a predominantly rural region with numerous outstanding natural features and scenic vistas, including dramatic coastline, rolling hills, mountains, forests, rivers, wetlands, and estuaries. Hundreds of miles of highway cross through the North Coast Region. But, only a total of 52 miles have been designated officially as State Scenic Highway. This includes 12 miles of Highway 101 as it passes through Redwood State Park in Del Norte County; 12 miles of Highway 12 east of Santa Rosa in Sonoma County, and 28 miles of Highway 116 west of Santa Rosa in Sonoma County. Much of the rest of the highway system in the region is eligible as State Scenic Highway but has not been designated. These are listed in Table 8.1.

Table 8.1. Highways eligible but not designated as State Scenic Highways[8]

County	**Highways**
Del Norte	101 north of Crescent City, 169, 197, and 199
Glenn	None
Lake	20, 29, and 281
Mendocino	1, 20 and 101
Modoc	139 and 299
Siskiyou	96
Sonoma	1 and portions of 12
Trinity	2 and 299

As a general matter, light pollution resulting from outdoor lighting is restricted to the urban areas around Humboldt Bay from McKinleyville to Fortuna, Fort Bragg, Willits, Ukiah, and the greater Santa Rosa area from Windsor to Cotati. Light pollution may be locally present wherever there are multiple outdoor lights.

8.2 Agriculture

The predominant land uses in the North Coast Region are in the agricultural sector, including farming, ranching and timber production.

The California State Department of Conservation (Conservation) produces maps of counties with Prime Farmland, Unique Farmland, and Farmland of Statewide Importance (agricultural lands of special significance). These are farmlands which based on their soil characteristics are especially well suited for agricultural production. Conservation has produced maps for Modoc, Siskiyou, Mendocino, and Sonoma counties. These maps indicate agricultural lands of special significance predominantly concentrated in: 1) the Tule Lake region in Modoc County; 2) the Scott Valley, Shasta Valley, and upper Klamath River Valley in Siskiyou County; 3) Round Valley, Potter Valley, Eden Valley, Anderson Valley and the upper Russian

[8] http://www.dot.ca.gov/hq/LandArch/scenic_highways/, accessed 8/16/13.

River Valley in Mendocino County; and 4) Alexander Valley, Dry Creek Valley, and the Laguna de Santa Rosa in Sonoma County.

Conservation also defines areas of grazing land, based on certain environmental characteristics. Mendocino County is identified as predominantly grazing land. Sonoma County is a patchwork of farm land and grazing land. Modoc and Siskiyou counties are predominantly National Forest, interspersed with farmland and grazing land.

The U.S. Forest Service (USFS) manages lands encompassing approximately 56% of the North Coast Region (6,889,419 acres) spread between two USFS Regions and six national forests:

1. USFS Region 5 (Pacific Southwest Region), manages all of or a portion of the following National Forests: Modoc National Forest, Klamath National Forest, Shasta/Trinity National Forest, Six Rivers National Forest, and Mendocino National Forest. These Forests comprise about 6,793,819 acres of the North Coast Region.

2. USFS Region 6 (Pacific Northwest Region) manages a portion of the Rogue River-Siskiyou National Forest, accounting for approximately 95,600 acres of the North Coast Region.

Private timber land accounts for a substantial amount of the region's land area, including lands managed for industrial and non-industrial timber production. The California Board of Equalization reports a total harvest from counties of the North Coast Region of 575,900 MBF or 575,900,000 board feet in 2012. This is more than 40% of the timber harvested in the state. The North Coast Region contains about 57% of California's private lands zoned as Timber Production Zone (Shih 2002).

8.3 Air Quality

According to the California Air Resources Board (Air Board), the North Coast Region contains 3 separate, designated air basins. These include:

1. North Coast Air Basin encompassing Del Norte, Humboldt, Mendocino, Trinity, and substantial portions of Sonoma counties;
2. Northeast Plateau Basin encompassing Modoc, Lassen, and Siskiyou counties; and
3. Lake County Air Basin

The southern portion of Sonoma County is contained in the Bay Area Air Basin.

The pollutants of concern to air quality include: particulate matter (PM), ozone, nitrogen dioxide, sulfates, carbon monoxide, sulfur dioxide, visibility reducing particles, lead, hydrogen sulfide, and vinyl chloride. Statistics for ozone, particulate matter, carbon monoxide, nitrogen dioxide, and hydrogen sulfide are readily

available for the 3 air basins within the North Coast Region, and Sonoma County, as shown in Table 8.2.

Ozone, an important ingredient of smog, is a highly reactive and unstable gas capable of damaging the linings of the respiratory tract. This pollutant forms in the atmosphere through complex reactions between chemicals directly emitted from vehicles, industrial plants, and many other sources. Key pollutants involved in ozone formation are hydrocarbon and nitrogen oxide gases. Particulate matter (PM) is a complex mixture of tiny particles that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. These particles vary greatly in shape, size and chemical composition, and can be made up of many different materials such as metals, soot, soil, and dust. Particles 10 microns or less in diameter are defined as "respirable particulate matter" or "PM 10." Fine particles are 2.5 microns or less in diameter (PM 2.5) and can contribute significantly to regional haze, reduction of visibility, and respiratory illness. Carbon monoxide (CO) is a colorless, odorless gas. It results from the incomplete combustion of carbon-containing fuels such as gasoline or wood, and is emitted by a wide variety of combustion sources. Sulfur dioxide (SO_2) is a gaseous compound of sulfur and oxygen. SO_2 is formed when sulfur-containing fuel is burned by mobile sources, such as locomotives, ships, and off-road diesel equipment. SO_2 is also emitted from several industrial processes, such as petroleum refining and metal processing. Hydrogen sulfide (H_2S) is a colorless gas with the odor of rotten eggs. It is formed during bacterial decomposition of sulfur-containing organic substances. Also, it can be present in sewer gas and some natural gas, and can be emitted as the result of geothermal energy exploitation.

Table 8.2. 2012 Air Quality Statistics for the 3 Air Basins, and Sonoma County, contained within the North Coast Region[9]

	North Coast Air Basin	Sonoma County	Northeast Plateau Air Basin	Lake County Air Basin
Ozone, # of days > 1-hour CA standard	1	0	0	2
Ozone, # of days > 8-hour CA standard	0	0	1	3
PM2.5, # of days > 24-hour Nat'l standard	0	0	0	0
PM10, # days > 24-hour CA standard	0	*	0	0
Carbon Monoxide, # of days > CA standard	0	*	*	*
Nitrogen Dioxide, # of days > CA standard	0	0	*	*

[9] http://www.arb.ca.gov/adam/topfour/topfour1.php, accessed on August 16, 2013.

Hydrogen Sulfide, # of days > CA standard	*	*	*	0

*Insufficient data to calculate

As indicated in Table 8.2, the air quality in the North Coast Region is exceptionally good. The California Air Pollution Control Officers Association reports that none of the counties within the North Coast Region had any days in 2012 in which overall air quality was "unhealthy" and all had" good" overall air quality for an average of 349 days of the year (CAPCOA 2013). With respect to ozone, the numbers of exceedences indicated in Table 8.2 are among the lowest of any of the air basins in the State.

8.4 Biological Resources

The mission of the Regional Water Board is to develop and implement water quality standards and programs of implementation designed to restore and maintain the beneficial uses of water within the region. In the North Coast Region, some of the beneficial uses of water that often drive the water quality protection efforts of the agency are Cold Freshwater Habitat (COLD); Spawning, Reproduction, and Early Development (SPWN); Migration of Aquatic Organisms (MIGR); and Rare, Threatened or Endangered Species (RARE). The water quality programs designed to protect these beneficial uses, in turn, are most often driven by the habitat requirements of salmonids.

Salmonidae are a family of aquatic vertebrates which during the freshwater portion of their life cycle require cold, clear, well-oxygenated freshwater, free of excessive fine sediment or obstructions to migration. As such, they are often recognized as indicators of watershed health, where populations are stable. Historically, they were abundant in watersheds of the North Coast Region. Today, populations of several Salmonidae species are listed by federal and state wildlife agencies as threatened or endangered by extinction. Species listed in some or all watersheds of the North Coast Region include: Chinook salmon, coho salmon, and steelhead trout. The proposed program is designed, in part, to protect the COLD, SPWN, MIGR, and RARE beneficial uses.

The Regional Water Board designs its water quality programs to protect other beneficial uses associated with the Region's biological resources as well, including:

- Warm Freshwater Habitat (WARM)
- Estuarine Habitat (EST)
- Wildlife Habitat (WILD)
- Preservation of Areas of Special Biological Significance (ASBS)
- Wetland Habitat (WET)

The North Coast Region includes numerous threatened and endangered faunal and floral species (T&E species). The presence and disposition of T&E species must be evaluated at the project level to ensure their adequate site specific protection. The

proposed program which is the subject of this CEQA analysis is intended to be implemented in a manner which restores and maintains the beneficial uses of the North Coast Region, including those beneficial uses identified above. As elsewhere in the State, the quantity and quality of wetland habitat has been substantially reduced from historic levels. As such, the restoration and maintenance of the Region's wetland and riparian resources is an important element of the Regional Water Board's effort. Riparian habitat is associated with virtually every waterbody in the North Coast Region. Substantial wetland habitat exists in the upper Klamath River basin, the Laguna de Santa Rosa, Humboldt Bay, Bodega Bay, and associated with the estuaries of most of the rivers in the Region.

Similarly, the water quality protection efforts of the Regional Water Board are intended to support and complement the environmental protection efforts represented in local policies and ordinances, Habitat Conservation Plans, Natural Community Conservation Plans, and other approved local, regional, or state habitat conservation plans. Any project implemented under this proposed program should be designed to avoid, minimize or mitigate any potential impact to biological resources.

8.5 Cultural Resources

The North Coast Region has a rich human history going back perhaps 10,000 years. Lands throughout the Region, therefore have the potential to harbor buried ancient cultural resources. Similarly, there are numerous sites of historic interest scattered throughout the Region, representing the Region's mining, shipping, logging, and agricultural history, among others. The presence and disposition of cultural resources must be evaluated at the project level to ensure their site-specific protection. Any project implemented under this proposed program should be designed to avoid, minimize or mitigate any potential impact to cultural resources.

The Regional Water Board has adopted a Native American Culture (CUL) beneficial use designed to support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses. The CUL beneficial use has been designated in the Smith River, Klamath River, Trinity River, Redwood Creek, Mad River, Jacoby Creek, Freshwater Creek, Salmon Creek, Van Duzen River, and Oil Creek watersheds, as well as Trinidad Hydrologic Unit, Humboldt Bay, and Ferndale Hydrologic Subarea. . However, CUL is an existing beneficial use in other locations throughout the Region, which will be designated once the data is collected. The proposed program which is the subject of this CEQA analysis is intended to be implemented in a manner which restores and maintains the beneficial uses of the North Coast Region, including the CUL beneficial use.

8.6 Geology and Soils

The California Geological Survey divides the state into 11 distinct geomorphic provinces. A geomorphic province is a naturally defined geologic region that

displays a distinct landscape or landform. The Klamath River sub-basin includes the Modoc Plateau, Cascade Range, and Klamath Mountain provinces. The North Coastal sub-basin includes the Coastal Range province.

Modoc Plateau Geomorphic Province

The Modoc Plateau is a volcanic table land (elevation 4,000-6,000 feet above sea level) consisting of a thick accumulation of lava flows and tuff beds along with many small volcanic cones. Occasional lakes, marshes, and sluggishly flowing streams meander across the plateau. The plateau is cut by many north-south faults. The province is bound indefinitely by the Cascade Range on the west and the Basin and Range Province on the east and south.

Cascade Range Geomorphic Province

The Cascade Range, a chain of volcanic cones, extends through Washington and Oregon into California. It is dominated by Mt. Shasta, a glacier-mantled volcanic cone, rising 14,162 feet above sea level.

Klamath Mountain Geomorphic Province

The Klamath Mountain Geomorphic Province has rugged topography with prominent peaks and ridges reaching 6,000-8,000 feet above sea level. In the western Klamath, an irregular drainage pattern is incised into an uplifted plateau called the Klamath peneplain. The uplift has left successive benches with gold-bearing gravels on the sides of the canyons. The Klamath River follows a circuitous course from the Cascade Range through the Klamath Mountains. The province is considered to be a northern extension of the Sierra Nevada (CDC 2002). The Klamath Mountain Geomorphic Province consists of four mountain belts: the eastern Klamath Mountain belt, central metamorphic belt, western Paleozoic and Triassic belt, and western Jurassic belt. Low-angle thrust faults occur between the belts and allow the eastern blocks to be pushed westward and upward. The central metamorphic belt consists of Paleozoic hornblende, mica schists, and ultramafic rocks. The western Paleozoic and Triassic belt, and the western Jurassic belt consist of slightly metamorphosed sedimentary and volcanic rocks. This is an uplifted and dissected peneplain on strong rocks; there are extensive monadnock ranges. Elevation ranges from 1,500 to 8,000 ft (456 to 2,432 m). Soils include Alfisols, Entisols, Inceptisols, and Ultisols, in combination with mesic and frigid soil temperature regimes and xeric and udic soil moisture regimes.

Coast Ranges

The Coast Ranges are northwest-trending mountain ranges (2,000 to 4,000, occasionally 6,000 feet elevation above sea level), and valleys. The ranges and valleys trend northwest, subparallel to the San Andreas Fault. Strata dip beneath alluvium of the Great Valley. To the west is the Pacific Ocean. The coastline is uplifted, terraced and wave-cut. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing San Francisco Bay. The northern Coast Ranges are dominated by irregular, knobby, landslide-topography of the Franciscan Complex.

The eastern border is characterized by strike-ridges and valley in Upper Mesozoic strata. In several areas, Franciscan rocks are overlain by volcanic cones and flows of the Quien Sabe, Sonoma and Clear Lake volcanic fields. The Coast Ranges are subparallel to the active San Andreas Fault. The San Andreas is more than 6000 miles long, extending from Point Arena to the Gulf of California (CDC 2002). This area has parallel ranges, and folded, faulted, and metamorphosed strata; there are rounded crests of subequal height. Elevation ranges from 1,000 to 7,500 ft (304 to 2,280 m). Soils include Alfisols, Entisols, Inceptisols, Mollisols and Ultisols in combination with mesic and thermic soil temperature regimes and xeric soil moisture regime.

Tectonics

Of prime significance to the geology and soils of the North Coast Region, are the collision and subduction of the Juan de Fuca tectonic plate under the North American plate and the transform (strike-slip) movement between the Pacific and North American plates along the San Andreas fault, including activity at the Triple Junction where the North American, Gorda, and Pacific plates meet. The tectonic activity of the North Coast Region generally results in steep, unstable slopes and a mixture of consolidated and unconsolidated, marine and continental-derived geology. As a result erosional potential in the North Coast Region can generally be described as high.

8.7 Greenhouse Gas Emissions (GHGs)

Gases that trap heat in the atmosphere are called greenhouse gases (GHGs).[10] The major greenhouse gases of concern include the following:

- *Carbon dioxide (CO_2)*-- Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement). Carbon dioxide is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.
- *Methane (CH_4)* -- Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.
- *Nitrous oxide (N_2O)* -- Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
- *Fluorinated gases* -- Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for stratospheric ozone-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse

[10] http://www.epa.gov/climatechange/ghgemissions/gases.html accessed August 26, 2013.

gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP gases").

A statewide GHG inventory conducted by the California Air Board indicates that of the total GHG emissions in California in 2004, the categories of GHG sources rank as follows by percent contribution: transportation (38%); electricity generation (25%); industrial processes, including landfills and wastewater treatment (20%); commercial and residential fuel uses (9%); agriculture and forestry (5%); and unspecified emissions (3%). The estimate of agriculture and forestry contributions to GHG emissions includes consideration of the carbon sequestration services provided by trees and rangeland.[11]

The net GHG emissions in the state increased from 1990 to 2004 by about 12%. The source categories contributing most significantly to the increase in emissions came from electricity generation (19% increase above 1990 contributions from this source category), transportation (21% increase), agriculture and forestry (39% increase) and an increase in unspecified emission sources (1161% increase). These increases were balanced by decreases in other source categories, including decreased emissions from commercial and residential fuel uses (13% decrease) and industrial fuel uses (7% decrease). The Global Warming Solutions Act of 2006 (AB 32) calls for the reduction by 2020 of GHG emissions to California's 1990 levels.

With respect to the analysis of potential environmental impacts associated with this proposed program, the source categories of most interest include: road transportation, electricity generation, landfills, waste water treatment, residential and commercial fuel uses, and agriculture and forestry. A project implemented under this proposed program could result in an increase in GHGs over baseline conditions if it results in an increase in: fuel use associated with transportation, electricity use, land disposal or composting of waste (including wood and agricultural waste), wastewater influent volumes or concentrations, residential or commercial density, or fire potential. A project could result in a decrease in GHGs over baseline conditions if it results in an increase in woody biomass or a decrease in any of the categories listed above.

8.8 Hazards and Hazardous Materials

A CEQA analysis includes evaluation of the project impacts with respect to the use of hazardous substances, proximity to hazardous waste facilities, proximity to airports, likelihood of interfering with emergency response, and potential to expose people to significant wildfire risk.

[11] http://www.arb.ca.gov/cc/inventory/archive/tables/ghg_inventory_sector_90-04_sum_2007-11-19.pdf accessed August 26, 2013.

Hazardous Materials

According to the California Department of Toxic Substances Control's (DTSC) website[12] there are no commercial offsite hazardous waste removal facilities in the North Coast Region, except for a used oil and antifreeze facility in the City of Fortuna. Also reported on their website, there are 12 sites in the North Coast Region which are included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5. They include: 1 in Del Norte, 2 in Humboldt, 1 in Lake, 3 in Mendocino, 1 in Modoc, 2 in Sonoma, 2 in Siskiyou and 0 in Trinity counties. Further, staff of the Regional Water Board oversees hundreds of groundwater contamination site cleanups in the North Coast Region, including leaking underground storage tank and spill sites. These sites are spread throughout the Region and information about them can be found on the State Water Board's website.[13]

Airports

There are numerous airports throughout the North Coast Region, including 3 passenger airports: the Jack McNamara Field Airport in Del Norte County, the Arcata-Eureka Airport in Humboldt County, and the Charles Schultz Airport in Sonoma County. In addition, there are 22 public use airports found in Cloverdale, Covelo, Eureka (3), Fortuna, Garberville, Gasquet, Gualala, Hayfork, Healdsburg, Hoopa, Hyampom, Klamath Glen, Little River, Sonoma, Trinity Center, Tulelake, Ukiah, Weaverville, and Willits.

Risk of Wildfire

The North Coast Region is predominantly rural and largely vegetated with grassland, woodland, and forest. The California Department of Forestry and Fire Protection (CalFire) has identified hundreds of North Coast communities at risk from wildfires on either federal or non-federal lands. Further, CalFire has identified at least 5 communities as existing in a Very High Fire Hazard Severity Zone, including: Cloverdale, Santa Rosa, Ukiah, Willits, and Yreka. As such, the existing risk to North Coast residents from wildfire can be considered high.

Hazardous Substances and Emergency Response Plans

The baseline condition as it relates to the use of hazardous substance and the availability of a local emergency response plan can only be determined at the project level. Any project implemented under this proposed program should be designed to avoid, minimize or mitigate any potential impact due to hazardous substances.

[12] http://www.envirostor.dtsc.ca.gov/public/ accessed August 16, 2013.
[13] http://geotracker.waterboards.ca.gov/ accessed August 16, 2013.

8.9 Hydrology and Water Quality

Water Quality

The surface water quality issues of most concern in the North Coast Region are excess sediment, elevated water temperatures, and excess nutrients. These water quality conditions are the result of point and non-point sources of pollution and other controllable factors (e.g., landscape alteration, road building, etc.) and are exacerbated by hydrologic modification, water withdrawal, and the loss of competent riparian zones and floodplains to development, agriculture, and logging. Many north coast aquatic ecosystems are impacted by these constituents and controllable factors, resulting in a loss of streamside property to erosion, destruction of water intakes, loss of aquatic habitat and risk to threatened and endangered aquatic species, increased winter flood potential, and increased risk of summer nuisance algal blooms (including microcystis and other cyanobacteria).

There are more localized water quality issues, as well. For example, surface water monitoring indicates a problem with pathogens in Bodega Bay Hydrologic Area, Hare Creek Beach and Pudding Creek Beach on the Mendocino Coast, several coastal beaches in the Trinidad Hydrologic Unit, and riverfront beaches on the Russian River and its tributaries, as well as the Laguna de Santa Rosa and its tributaries. In addition, several of the region's waterbodies are impaired by mercury, including: Lake Pillsbury, the Laguna de Santa Rosa, Lake Sonoma, Trinity Lake, and the East Fork Trinity River. Exotic species are listed as a water quality problem in Bodega Bay and dioxin and PCBs are listed as impairing Humboldt Bay.

In 2009, the USGS, in conjunction with the State Water Resources Control Board, collected untreated groundwater data from 58 wells selected from the California Department of Public Health database within 34 groundwater basins located in the North Coast Region. Wells were randomly selected from Napa, Lake, Mendocino, Glenn, Humboldt, and Del Norte Counties. The results of the study are published in Methany et al. (2011). All detected concentrations of organic constituents, nutrients, major and minor ions, and radioactive constituents were less than health-based benchmarks for the 30 wells sampled in the Northern Coast Ranges. There were a few detections of arsenic, boron, and barium in the 28 wells of the interior basins which exceeded MCLs or notification levels; but, these are likely related to the area's geology. The results of this study indicate that community drinking water systems drawing from primary aquifer systems in the North Coast Region generally provide safe drinking water, with the exceptions noted.

Shallow groundwater, however, has been pervasively contaminated by a long history of activities and operations, primarily: wood treatment facilities, unlined landfills, leaking underground storage tanks, and dry cleaning facilities. In many regions, shallow groundwater is neither used nor useable. But, because the North Coast Region is predominantly rural, many people rely on shallow (sometimes hand-dug) wells for their drinking water. There may be contributions of nutrients and pesticides to shallow groundwater resulting from the continued conversion of

land to vineyards in Sonoma and Mendocino counties and other widespread farming activities in the Upper Klamath River basin and the Smith River plain, among other disperse locations of the region. Aging wastewater treatment ponds and leaking septic tanks play a part in shallow groundwater contamination in the Region, as well. Groundwater is likely to become an increasingly important source of domestic, municipal, and agricultural water supply, as a result of climate change and predicted impacts to surface water discharge volumes and timing.

Hydrology

Because of the low infiltration capacity and permeability of the Franciscan and volcanic rocks common in the North Coast Region, groundwater origin baseflows in streams are sometimes poorly maintained. Along the mountain drainages, baseflow that does occur is maintained by groundwater discharge emerging from fractures through springs and seeps. Some streams may be composed of discontinuous wet reaches with pools sustained over summer by groundwater discharge. Some higher elevation streams may run dry from summer to late fall. As a consequence, flows between these ephemeral streams and the underlying aquifer may periodically cease.

In the valleys, groundwater occurs in the alluvial deposits. There, baseflow is maintained by groundwater discharge along reaches where the water table is higher than the adjacent stream. In the larger valley drainages, such as the Russian River, groundwater discharge is large enough to sustain perennial flow (R2 Resource Consultants & Stetson Engineers, 2007). This is similarly the case in the Klamath River basin. Groundwater pumping for irrigation can impact stream flows; a study in the Scott River watershed indicates that groundwater pumping has impacted Scott River flows.

Groundwater depletion is a potential risk, including for example in the Santa Rosa Plain Groundwater Basin, where a groundwater management plan is being developed under the leadership of the Sonoma County Water Agency. Many rural residents throughout the Region intercept groundwater in fractures or localized alluvium. In these settings, groundwater may be impacted by periodic or seasonal depletion.

Surface flows in the North Coast Region are impacted by numerous water diversions, both permitted and unpermitted, legal and illegal. The State Water Board has adopted the North Coast Instream Flow Policy to better ensure that future water rights permits contain the provisions necessary to protect the stream flows necessary to support salmonids and salmonid habitat. Further, recent collaboration between the staff of the North Coast Region and the Division of Water Rights has resulted in contemporary water rights permits containing provisions specific to the protection of water quality conditions in the North Coast Region, as well. For example, erosion control plans and riparian protection plans are sometimes required in new water rights permits.

On the other end of the spectrum, the North Coast Region contains hundreds of miles of rural private and public roads which sometimes serve to extend the drainage network of the Region's watersheds with inadequate, poorly designed, or failing road drainage features. The result, in some watersheds, has been an increase in peak flows or peak flow timing, accompanied by an increased risk of erosion, sedimentation, and flooding.

Also, with respect to flooding, many of the watersheds of the North Coast Region are still moving quantities of stored sediment first deposited during catastrophic flooding events of 1955 and 1964. Flooding events of 1974, 1982, 1995, and 1997 also have had dramatic impact on North Coast rivers.

The California Emergency Management Agency has mapped a tsunami inundation risk for all of Del Norte County, Humboldt County from its border with Del Norte to Ferndale, Mendocino County from Brunel Point to Gualala, and Sonoma County from Russian Gulch to Bodega Head.[14]

8.10 Land Use and Planning

As above, it is not the intention of this proposed program to interfere with or supercede any land use plan, policy or regulation of another agency. Any project implemented under this proposed program should be designed in a manner consistent with other applicable land use plans, policies, or regulations.

8.11 Mineral Resources

As elsewhere in the State, the North Coast Region was substantially impacted by the the presence of precious metals, particularly in the Klamath Geomorphic Province where hundreds of gold claims were exercised and where suction dredging is still of interest. Abandoned mines in the Klamath Basin are the focus of cleanup. Further, sand, gravel and other aggregate is a substantial commodity in the North Coast Region, whose extraction has the potential to impact numerous watersheds in the Region.

8.12 Noise

The North Coast Region is substantially rural, with a limited number of larger communities, the largest being Santa Rosa and its surrounding communities in Sonoma County. As a general matter, noise pollution is limited to localized areas. Any project implemented under this proposed program should be designed to avoid, minimize or mitigate any potential noise impacts.

[14] http://www.consrv.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Pages/Statewide_Maps.aspx accessed August 16, 2013.

8.13 Population, Housing, and Public Services

The North Coast Region includes all residents of Del Norte, Humboldt, Trinity, and Mendocino counties, the majority of Modoc, Siskiyou, and Sonoma counties, and a small percentage of the populations of Glenn, Lake and Marin counties. The population of the entire North Coast Region was about 670,700 in year 2010[15], which is less than 2 percent of California's total population. More than half of this region's population lives in the southern part, primarily in Santa Rosa and the surrounding communities of Cotati, Healdsburg, Rohnert Park, Sebastopol and Windsor along the Russian River watershed. Urban growth in these cities, whose population totaled an estimated 261,485 people in year 2010[16], is heavily influenced by the overall urban expansion of the adjacent San Francisco Bay region. Other smaller communities in the northern portions of this region include Eureka, 27,191; Ukiah, 16,075; Arcata, 17,231; Crescent City, 7,643; and Yreka, 7,765.[17]

When compared with the 2000 regional population of 636,000, the 670,300 in 2010 represents a growth rate of 5.4 percent over the 10 years, which is a little over half the statewide growth rate of about 9.7 percent over the same period. Projections today indicate that the regional population is expected to grow to about 809,400 by year 2050, which represents about a 21 percent increase from year 2010 totals. More than half of this projected growth is anticipated to occur in the Santa Rosa region, as urban populations from the San Francisco Bay area continue to expand north. Population increases in the rural communities in the northern portion of this region are projected to grow more slowly.

The North Coast Region has experienced steady population growth over the past two decades and is projected to continue positive growth through the year 2050[18]. Due to the rural nature of much of the region and the fact that there is a lower associated cost of living, many communities within the region are seeing an influx of retirees from larger, more urbanized settings. This has placed pressure on existing community services. Additionally, as population densities encroach in the more urban settings, some of the more rural communities are becoming bedroom communities. There is also a rise in migrant workers within the region. Modoc County has a county operated migrant camp. The trend for both Modoc and Siskiyou counties is that many of the migrant workers are becoming permanent residents, while younger non-migrant residents continue to leave the area. Despite the overall growth rates of the Region, population growth rates are not as great as those of the rest of the State, reflecting the rural character of the Region. In fact, some of the more remote counties of the region - Modoc and Siskiyou - are projected to lose overall population in the coming decades. The most populated area of the Region,

[15] http://www.dof.ca.gov/research/demographic/state_census_data_center/census_2010/ accessed August 16, 2013.
[16] Ibid.
[17] Ibid.
[18] Ibid.

Sonoma County, experienced a higher growth rate than the State's average in 1980 and 1990, and is estimated to continue this pattern with population increases of 14% by 2020.

8.14 Recreation

The Regional Water Board implements water quality protection programs designed to result in water quality suitable for full contact water recreation such as swimming and surfing (REC-1), as well as non-contact water recreation (REC-2). Other beneficial uses potentially relevant to recreational uses include Navigation (NAV), Commercial and Sport Fishing (COMM), and Shell Fish Harvesting (SHELL). As a predominantly rural region, the North Coast Region offers a multitude of recreational opportunities in addition to water-related activities, including camping, hiking, backpacking, horseback riding, bike riding, bird watching, and much more.

8.15 Transportation/Traffic, Utilities and Service Systems

Transportation and Traffic

The North Coast Region is serviced by Districts 1, 2, and 4 of the California Department of Transportation (CalTrans). Highway 101 is the major highway corridor from north to south and Highways 128, 20, 162, 36, 299, and 199 are the major highway corridors from west to east. These highway corridors are 2 and 4 lane highways, vulnerable to traffic delays when road work is undertaken. CalTrans projects currently affecting transportation and traffic include: the Willits Bypass in District 1; on-going maintenance on Hwy 299 and the Anderson Grade Project near Yreka in District 2; and road widening on Hwy 101 through Sonoma County in District 4. Activities associated with the development of the SMART train from Cloverdale in Sonoma County to the Larkspur Landing ferry terminal in Marin County also have the potential to cause traffic congestion as a baseline condition.

Wastewater Treatment Facilities, Water Treatment Facilities, Stormwater Facilities, Landfills

The point source discharge of waste to waters of the Region is prohibited except in the Mad, the Eel, and Russian rivers during the wet weather season. All other wastewater treatment is provided by percolation ponds, evaporation ponds, or other land disposal, including septic systems. Discharge to the Mad, Eel and Russian rivers is further limited to 1% of river flow. Many of the wastewater treatment systems, including septic systems, in the North Coast Region are very old and require upgrade.

Water is abundant in many parts of the North Coast Region. According to Methany et. al. (2011), community water delivery systems in the North Coast Region provide good drinking water to their customers. Many residents of the North Coast Region, however, rely on private domestic wells, surface water intakes, or small community systems; except in localized areas, water availability is generally good and is sometimes consumed untreated. The Regional Water Board implements water quality protection programs designed to result in water resources which are

suitable as drinking water, as defined by the Municipal and Domestic Supply (MUN) beneficial use.

The Regional Water Board oversees implementation of NPDES permits for the control of stormwater from industrial facilities, construction sites, and municipalities. These primarily rely on best management practices (BMPs) to avoid, reduce and mitigate the impacts of stormwater discharge. The City of Santa Rosa, Sonoma County, and Sonoma County Water Agency implement an extensive stormwater control program under their MS4 permit issued by the Regional Water Board.

All the landfills in the North Coast Region have been closed, except the Meacham Road Landfill in Sonoma County. Transfer stations are operated throughout the rest of the region with much of the waste material transferred outside the Region for disposal.

9.0 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) ENVIRONMENTAL ANALYSIS

9.1 Introduction

Staff from the Regional Water Board developed a proposed amendment to the Water Quality Control Plan for the North Coast Region (Basin Plan) that would incorporate the *Policy for the Implementation of the Water Quality Objectives for Temperature* (hereinafter proposed Temperature Implementation Policy) into the Basin Plan. The proposed amendment would modify Section 4 of the Basin Plan by adding the Temperature Implementation Policy. Additionally, staff propose the adoption of action plans to implement the Total Daily Maximum Loads (TMDLs) for elevated water temperature in the Upper Main Eel, Middle Main Eel, Lower Main Eel, South Fork Eel, North Fork Eel, Middle Fork Eel, Mattole, and Navarro River watersheds (hereinafter proposed Action Plans for the Eel River, Mattole River and Navarro River Temperature TMDLs).

This staff report which includes the discussions on the background and purpose of the proposed Basin Plan amendment, the interpretation and implementation of the water quality objectives for temperature, North Coast Temperature TMDL analyses, proposed Temperature Implementation Policy and Action Plans, environmental impact and economic analysis, is part of the overall Substitute Environmental Document (hereinafter SED). This chapter of the staff report identifies mitigation for compliance measures identified for the factors influencing temperature. Consistent with the California Environmental Quality Act (CEQA), this document does not engage in speculation or conjecture, but rather considers the project alternatives, the reasonably foreseeable environmental impacts of the reasonably foreseeable methods of compliance, and the mitigation measures which would be required to avoid, minimize, or mitigate the identified impacts. The adoption of the proposed Basin Plan amendment does not result in any direct adverse effects on the environment. All potentially significant adverse effects are related to individual site-specific projects or permits and site-specific compliance measures. The analysis provided uses site-specific circumstances as example or illustration of how the Temperature Implementation Policy and Action Plans could be implemented, and thus indirectly effect the environment. However, this analysis does not constitute an absolute outcome or certainty in the determinations made in this staff report. Therefore, this environmental analysis is set at a programmatic level and is more general in nature to cover the range of potential effects.

Many of the projects that might be undertaken by affected persons as a result of the Temperature Implementation Policy and Action Plans would be subject to a project-level CEQA review conducted by the Regional or State Water Board or by another lead agency, which would entail identification and mitigation of any significant environmental effects. In addition, other regulatory mechanisms can be expected to provide opportunities for minimizing and avoiding significant environmental effects. These regulatory requirements and mitigation measures are likely to reduce many, but not all, of the potential indirect impacts to less than significant levels. In

some cases it may not be possible to mitigate the indirect impacts of the Temperature Implementation Policy to a less-than-significant level. In addition some actions may not require discretionary approvals or an agency with regulatory authority may not take action. Finally, some impacts may not be identified or mitigated because it is impossible to predict who will take action in response to the Temperature Implementation Policy and Action Plans, or what action they will take. For these reasons, this programmatic analysis must acknowledge the potential for significant impacts that cannot be mitigated to a less than significant level.

9.2 California Environmental Quality Act Requirements for Exempt-Regulatory Programs

The Regional Water Board is the lead agency for evaluating the environmental impacts of Basin Plan amendments pursuant to CEQA. Although subject to CEQA, the Regional Water Board basin planning process is certified by the Secretary for Resources as "functionally equivalent" to CEQA, and therefore exempt from the requirement for preparation of an environmental impact report or negative declaration and initial study[19]. The State Water Resources Control Board (State Water Board) has promulgated guidelines for exempt regulatory programs that describe the documents required for the adoption or approval of standards, rules, regulations or plans[20]. These documents must do the following:

1. Provide a brief description of the proposed activity.
   In this case, the proposed activity is the adoption of a Basin Plan amendment including: a) A regional Temperature Implementation Policy; and b) Temperature Action Plans for the Eel River, Mattole River and Navarro River Temperature TMDLs. The rationale to support the policy and action plans are fully described in the Chapters 5 and 6. A brief description is provided in Section 9.2.1.

2. Provide a reasonable discussion of alternatives to the proposed activity.
   Discussion is provided in Section 9.3.

3. Provide an analysis of mitigation measures needed to minimize any significant adverse environmental impacts of the proposed activity. Discussion is provided in Section 9.4.

Additionally, for actions by the Regional Water Board that adopt a rule or regulation requiring the installation of pollution control equipment, establish a performance standard or establish a treatment requirement, CEQA[21] and CEQA Guidelines[22] require an environmental analysis of the reasonably foreseeable methods by which

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19 Cal. Code Regs., tit. 14, § 15251(g).
20 Cal. Code Regs., tit. 23, § 3777.
21 Pub. Resources Code, § 21159 (a).
22 Cal. Code Regs., tit.14, § 15187 (c).

compliance with that rule or regulation will be achieved. A SED satisfies this requirement if it contains the following components, some of which are repetitive with the list above:

1. An analysis of the environmental impacts from the reasonably foreseeable methods of compliance. The reasonably foreseeable methods of compliance (hereinafter compliance measures) are the potential actions that responsible parties may employ to comply with the TMDL load allocations, numeric targets and the implementation measures in the proposed Action Plans. This analysis is presented in Section 9.4.
2. An analysis of the reasonably foreseeable feasible mitigation measures relating to the identified environmental impacts. This analysis is presented in Section 9.4.
3. An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate any identified impacts. This analysis is presented in Section 9.4.

The environmental analysis must take into account a reasonable range of:[23]

- Environmental factors (see Environmental Setting and Land Use, Chapter 8.0);
- Technical factors (see Analysis of Compliance Measures, Associated Environmental Impacts, and Potential Mitigation Measures, Sections 9.4 and 9.5);
- Population (see Environmental Setting and Land Use, Chapter 8.0);
- Geographic areas (see Environmental Setting and Land Use, Chapter 8.0);
- Specific sites (see Analysis of Compliance Measures, Associated Impacts, and Potential Mitigation Measures, Section 9.4); and
- Economic factors (see Economic Considerations, Chapter 10).

While the regulations require consideration of a "reasonable range" of the factors listed above, an examination of every site is not required, only consideration of a reasonably representative sample of them. The statute specifically states that the agency shall not conduct a "project level analysis[24]." Rather, in most circumstances, the project level analysis will be performed by the responsible party or the agency with jurisdiction over the activity conducted.

9.2.1 Description of the Proposed Activity

The proposed project is the adoption of a Temperature Implementation Policy and Action Plans, which comprehensively address controllable factors that adversely affect stream temperatures. Controllable factors include increased exposure to solar radiation due to loss of stream shade, physical stream channel alteration in response to elevated sediment loads, engineered stream channel alteration, and

[23] Cal. Code Regs., tit. 14, § 15187(d); Pub. Resources Code, § 21159 (c).
[24] Public Resources Code, § 21159(d).

alteration of hydrology resulting from impoundments, water diversions, and landscape alteration. The intent of the Temperature Implementation Policy and Action Plans is to document in one place the tools and actions available and necessary to achieve temperature water quality standards so as to protect and restore the beneficial uses of water in the North Coast Region.[25] Many of actions described in the Temperature Implementation Policy and Action Plans are already in effect and being implemented, while others will be developed in the future. The Temperature Implementation Policy and Action Plans provide a common approach to ensuring attainment of the water quality objective for temperature, and ensure that high quality waters are also protected.

Implementation actions to meet temperature objectives are described in this chapter as a range of compliance measures in the following categories: Measures to Preserve and Maintain Shade; Measures to Control Sedimentation; Measures to Address Tailwater and Surface Impoundments; Measures to Preserve Existing Cold Water Resources; Restoration; and Measures to Restore and Maintain Stream Flows. Specific compliance measures are detailed in section 9.4, along with associated impacts and mitigation measures. Further discussion of potential environmental impacts and levels of significance from implementing compliance measures is presented in section 9.5.

While the compliance measures themselves are forms of mitigation to be applied in the context of the activity or factor influencing water temperatures, CEQA requires review of environmental impacts that result from measures intended to improve the environment. Several compliance measures evaluated do have potentially significant adverse effects on the environment such as air quality, noise and traffic from temporary construction activities. However, the long term benefits from implementation of compliance measures (such as aquatic ecosystem restoration) could and will likely outweigh any short term adverse effects.

9.2.2 Scoping

The Regional Water Board has solicited comments from interested persons and governmental agencies regarding the scope and content of the environmental information to be included in the SED. On February 5th, 2013, the Regional Water Board circulated a Notice to Hold CEQA Scoping Meetings for a Proposed Amendment to the Water Quality Control Plan for the North Coast Region Incorporating a Policy for the Implementation of the Water Quality Objective for Temperature and Temperature TMDL Action Plans for the Navarro, Eel, and Mattole River Water. On February 15th, 27th and 28th, 2013, Regional Water Board staff held scoping meetings in Santa Rosa, Bayside, and Yreka CA, respectively.

The purpose of the meetings was to explain the proposed project and provide related information to resource agency personnel and the interested public and to

[25] 40 CFR § 131: water quality standards include beneficial uses, the water quality objectives to protect those uses, and the anti-degradation policy (Resolution No. 68-18).

invite them to submit written comments concerning the range of actions, Policy alternatives, mitigation measures, and significant effects that should be analyzed in the SED. Staff provided relevant information including a presentation on the Basin Plan amendment process, the Temperature Implementation Policy and Action Plans, and CEQA process. Informational handouts included the scoping notice and fact sheet, Regional Water Board Resolution No. R1-2012-0013 (Policy Statement for the Implementation of the Water Quality Objective for Temperature in the North Coast Region), and checklist based on appendix G of the CEQA guidelines.

The scoping period ended on April 1, 2013. 41 comments provided were received in written form, while 59 were received verbally form at the scoping meetings. With some comments being identical there was a total of 88 public comments received. Comments were received from five federal, state and local agencies, eight nongovernmental organizations and special-interest groups, and four individuals.

9.3 Analysis of Reasonable Alternatives to the Proposed Activity

Regional Water Board staff has identified four approaches (or alternatives) to succeed in the fulfillment of the project objectives to attain water quality standards for ambient water temperatures in the North Coast Region. The purpose of this analysis is to determine if there is an alternative that would feasibly attain the basic project objective of the rule or regulation, but would lessen, avoid, or eliminate any identified adverse environmental impacts.

The first alternative, analyzes a "No Action" alternative with no change to the Basin Plan or program implementation. The second alternative contemplates a broad approach to riparian protection that requires designation of riparian buffer zone (e.g. stream setback requirement) and implements a regional waste discharge prohibition. The third alternative includes the adoption of individual temperature TMDLs for each impaired watershed listed on the Clean Water Act 303(d) list as discrete and individual actions. The fourth and final alternative, and staff's recommended approach, is to develop and adopt a comprehensive policy for restoring and maintaining ambient water temperature throughout the region in impaired and non-impaired waters, as well as, three stand-alone temperature TMDL Action Plans for the Eel, Mattole and Navarro River watersheds.

The alternatives are compared on the basis of their ability to protect water quality and beneficial uses (i.e., their likelihood of success) and whether the approach is feasible, flexible and equitable.

9.3.1 No Action - No Change in Basin Plan Language or in Program Implementation

Under the "No Action" alternative, no amendment to the Basin Plan would occur and staff would continue to implement existing Regional and State Water Board programs, as in the past. Under this alternative, the Regional Water Board would continue to implement temperature controls in a piecemeal fashion as individual permits were developed and adopted. This alternative would not increase the likelihood of water quality protection because it may not address all the controllable

factors that affect stream temperature (i.e., shade, sediment and flow) nor prioritize the restoration of the impaired beneficial uses of water. Further, under this alternative the Regional Water Board would not have documented and organized its strategy for addressing temperature in one place that helps guide staff, other agencies, and the public. Additionally, with the Basin Plan remaining nearly silent on the controllable factors that affect stream temperatures other agencies are more likely to develop programs that do not consider or overlook these important influences.

Pros:

- Allows re-direction of Basin Planning staff to begin/continue work on the next issue on Triennial Review Priority List.
- Allows TMDL Development staff to begin/continue work on the development of the next TMDL on Impaired Waters List.

Cons:

- Temperature continues to be addressed in a piecemeal fashion as individual permits are developed and adopted.
- Lack of documented and organized strategy for addressing temperature to help guide staff, other agencies and public to ensure regional action to attain and maintain the water quality objective for temperature throughout the region.
- The basin plan remains silent on the importance of shade, sediment and flow as controllable factors affecting stream temperatures.

9.3.2 Adopt a Basin Plan Amendment that defines prescriptive rules for specific land uses and establishes prohibitions (broad riparian protection) at the regional level

This approach would be based on the development of riparian buffers for streams and waste discharge prohibitions to those areas on the regional level for all land use activities. Adoption of general riparian setbacks on all streams throughout the region is an option to protect water quality and achieve water quality standards. Natural and/or well vegetated riparian zones provide numerous functions and values including but not limited to aesthetics, wildlife habitat, sediment retention, pollutant reduction/removal, nutrient cycling, flood peak attenuation, habitat complexity and stream temperature.

This approach would include the regionwide application of riparian setbacks along stream courses to ensure the preservation of riparian vegetation to protect beneficial uses, notwithstanding site specific conditions or activities. Control factors and compliance measures would not be assessed at the project level, but applied universally throughout the region. Waste discharge prohibitions within a riparian buffer would be the primary regulatory tool used to protect beneficial uses. Stream and/or riparian setbacks would also be implemented and enforced through existing permits/orders administered within existing regulatory programs such as timber harvest, non-point source, 401 certification, and storm water.

The application of riparian buffers does not directly address areas that have been degraded or do not currently meet site-specific potential shade. Restoration actions alone will be insufficient to restore ambient water temperatures in some areas. For example management measures within regulated lands, such as stream and riparian enhancement/mitigation, sediment remediation, and stream flow allocations will still be needed in some areas so as to restore degraded areas to fully attain water quality standards. Furthermore, this blanket approach may be overly prescriptive and burdensome in some geographic areas while inadequate in others. Even though this approach protects water quality and provides several benefits to wildlife, it only partially promotes site-specific potential shade and does not address the other controllable factors (i.e., flow and sediment) that affect stream temperatures.

Pros:

- Broadly supports water quality protection and preservation of existing conditions.
- Would save time and resources for staff by avoiding site by site review and assessment to areas with well vegetated riparian area.

Cons:

- Would not proactively address proactively degraded or barren riparian areas.
- Would be overly burdensome in some geographic areas while inadequate in others.
- Does not address all controllable factors such as flow, and lacks documented and organized strategy to help guide other agencies to ensure regional action to attain and maintain the water quality objective for temperature throughout the region.
- Could make the conversion of in-stream impoundments to off-channel storage within the riparian zones difficult.

9.3.3 Develop technical TMDLs, Action Plans, and Adopt Basin Plan Amendments for each individual impaired watershed

This alternative would entail the status quo approach to temperature TMDL development for each impaired watershed. In general this approach requires data collection and assessment and 303 (d) listing for waters not yet identified. It requires technical TMDL development (extensive data collection, assessment, and modeling of load allocations) and the development of an action plan and Basin Plan amendment. Technical TMDLs for elevated water temperatures have been developed for the Eel, Mattole and Navarro watersheds; but the action plans/Basin Plan amendments are still required. The following are a list of temperature impaired waters requiring both a technical TMDL and action plan.

Albion River Hydrologic Area (HA)
Big River HA
Garcia River HA
Gualala River HA (with the exception of the Little North Fork Gualala River)

Noyo River Hydrologic Sub-Area (HSA)
Pudding Creek HSA
Ten Mile River HSA
Redwood Creek HA
Russian River Watershed: Lower Russian River HA, Middle Russian River Mark West Creek HSA, Middle Russian River HA: Santa Rosa Creek HSA
Trinity River: South Fork HA

Individual TMDL development for the watersheds listed above would be overly consumptive of staff resources as the timeline for completion of each technical TMDL and Actions Plan would be a range of three to five years to complete.

Pros:

- More public outreach.

Cons:

- Defers the implementation of TMDL action plans for many years-to-decades.
- Creates an unfair regulatory environment where some watersheds come under regulation much sooner than others.
- Focuses considerable staff resources over a long period of time to a single water quality issue.

9.3.4 Adopt Basin Plan Amendment to include a Regional Temperature Implementation Policy and Temperature Action Plans for the Eel River, Mattole River and Navarro River Temperature TMDLs (Recommended Alternative)

Staff recommends adoption of the Basin Plan amendment to include a Regional Temperature Implementation Policy and Temperature Action Plans for the Eel River, Mattole River and Navarro River Temperature TMDLs. The scientific justification for the policy and action plans is detailed in Section 2 of this staff report. In summary, Regional Water Board staff finds the proposed policy to comprehensively address all controllable factors that adversely affect stream temperatures and highlight the importance of shade, sediment and stream flow. Addressing actions to achieve and maintain the water quality objective for temperature in the proposed fashion is the most efficacious strategy for Regional Water Board staff resources and regional water quality protection and restoration. Existing programs at the Regional Water Board and State Water Board Division of Water Rights will be directed to consider all opportunities to restore and maintain riparian shade, including both regulatory and non-regulatory means. While this amendment does not establish blanket riparian setbacks throughout the region, it does establish riparian protection in the Basin Plan and in so doing strengthens the Regional Water Board's authority to address riparian shade when issuing permits and making recommendations to other local, state, and federal agencies.
The case-by-case nature of the policy avoids overly burdensome prescriptions and promotes riparian protection at the program and permit levels. In addition, the Temperature Implementation Policy and Actions Plans enable staff to effectively

address discrete temperature related concerns throughout the entire region in a consistent manner. The science supporting the proposed Basin Plan amendment is well established and results in consistent findings throughout the region. Therefore, the proposed adoption of the Temperature Implementation Policy and Actions Plans is the preferred alternative. It applies broadly to address all impaired waters and non-impaired waters and focuses staff resources on regional implementation actions as opposed to the development of individual TMDLs. Since factors affecting stream temperature are so similar throughout the region this amendment is the superior alternative in both the attainment and maintenance of temperature objectives and effective use of staff resources.

The technical support for the proposed Temperature Implementation Policy and Action Plans can be found, in part, in Sections 2 and 6 of this staff report. The technical TMDLs are also available on the Regional Water Board webpage: http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/

Pros:

- Identifies shade as an important controllable factor in the Basin Plan.
- Ensures regional action to attain and maintain the water quality objective for temperature throughout the region.
- Takes full advantage of the commonality of factors that affect stream temperature in all watersheds.
- Promotes efficient working relationships with other agencies to build synergies in actions addressing the protection of beneficial uses.
- Clarifies priorities for temperature protection for consideration by other agencies.

Cons:

- Reliance on site-specific approaches doesn't provide clear information on compliance measures in a prospective manner.

9.4 Analysis of Compliance Measures, Potential Environmental Impacts, and Possible Mitigation Measures

This analysis of potential environmental impacts was conducted by considering a wide range of compliance measures available to comply with the Temperature Implementation Policy and Action Plans. Specific compliance measures and other pollution controls that likely will be used to comply with requirements of the Temperature Implementation Policy and Action Plans will depend on a number of conditions such as the factors contributing to impairment (e.g., shade, sediment, and/or flow), source category (e.g., land use activity such as road and crossing construction, reservoir management, or agriculture) and environmental setting (e.g., rainfall, geology, and topography). A combination of structural (e.g., engineered) and non-structural (e.g., operation and maintenance) compliance measures will likely be used by responsible parties. Compliance measures likely to be included as part of those future programs are analyzed broadly in this document. The compliance measures that could be used to comply with the proposed Temperature

Implementation Policy and Action Plans, and the potential environmental impacts associated with their implementation are discussed below. The categories of resources that the Regional Water Board has identified as potentially being impacted by the implementation of compliance measures include:[26]

- Aesthetics;
- Agriculture
- Air quality;
- Biological resources;
- Cultural resources;
- Geology and soils;
- Greenhouse Gases;
- Hazards and Hazardous Materials;
- Hydrology and water quality;
- Land use / planning;
- Mineral resources;
- Noise;
- Population and housing;
- Public Services;
- Recreation;
- Transportation/traffic; and
- Utilities and service systems;

The environmental analysis of the compliance measures, potential impacts and possible mitigation measures to avoid those impacts is presented below. It is generally organized to correspond with the organization of the proposed implementation actions presented in the draft Temperature Implementation Policy which correspond to the actions detailed in the Action Plans for the Eel River, Mattole River and Navarro River Temperature TMDLs. The following examples are not meant to be exhaustive of the suitable suite of compliance measures, but rather provide a representative sample with the widest range to accommodate as many compliance scenarios as possible.

9.4.1 Analysis of Compliance Measures, Potential Environmental Impacts, and Potential Mitigation Measures to Preserve and Maintain Shade

Compliance Measures to Restore and Maintain Site-Specific Potential Effective Shade:

- Increase riparian and in-channel tree canopy retention for surface waters to support beneficial uses.
- Limit development and harvest actions in riparian areas to attain site-specific potential effective shade.
- Develop a grazing management plan for upland and riparian management.

[26] See CEQA Checklist (Section 9.5.2)

- Calculate the timing and number of livestock that can be accommodated while maintaining adequate vegetative cover, stream corridor integrity, and water resources.
- Establish native or introduced forage species (grasses, forbs, legumes, shrubs, and trees) through pasture, field, orchard and rangeland planting.
- Implement the controlled harvest of vegetation with grazing or browsing animals to achieve a specific objective.
- Exclude animals, people, or vehicles from an area to protect, maintain, or improve the quantity and quality of riparian vegetation.
- Construct animal trails to provide movement of livestock through difficult or ecologically sensitive terrain.
- Stabilize stream crossings to provide controlled access across a stream for livestock and farm machinery.
- Plant vegetation to increase shade in accordance with site-specific potential.

Potential Environmental Impacts

- Aesthetics - Decrease scenic views of waterbodies through the retention of vegetation. Ponds could create a new source of glare. Increased riparian vegetation and the preservation of large woody vegetation could lead to increased fuel load for wildfires which degraded scenic views.
- Agriculture - Potential conflict with or conversion of prime agricultural land or land subject to the Williamson Act from implementing grazing restrictions.
- Biological Resources - Risk of introducing invasive species thorough pasture, hay and rangeland planting and management. Risk of conflict between site-specific potential effective shade and requirements of sensitive flora or fauna.
- Hydrology/water quality – Reduction in stream flows due to the increase in evapotranspiration from increased riparian tree retention. Temporary sediment discharges from construction and/or restoration activities.
- Mineral resources - Decreased access for gravel, gold or other mineral extraction activities.
- Transportation/traffic – Increased tree retention may conflict with transportation agencies (public roads) site distance requirements and areas designated as clear recovery zones.

Possible Measures to Avoid, Minimize or Mitigate Potential Impacts from Compliance Measures to Maintain Site-Specific Potential Effective Shade

- Aesthetics – Proper siting, constructing berms or excess freeboard around the perimeter of a pond. Planting vegetation such as native trees, grasses, and forbs. Fuel management measures such as understory thinning, select harvest prescriptions and firebreaks.
- Agriculture - Coordination between project proponents, Regional Water Board staff and other local, state and federal agencies to achieve site-specific potential effective shade and attempt to ensure the preservation of agricultural lands.
- Biological Resources - Use certified weed-free grass and seed mix to prevent

the introduction of invasive species. Consult with federal, state and local agencies regarding location of sensitive (e.g., threatened or endangered) wildlife resources.

- Hydrology/water quality – Plant native vegetation that has evolved with the natural environment. Allow for the removal or thinning of upland vegetation that has high evapotranspiration rates and increases fire risks. Implement standard BMPs to control erosion and sediment from construction sites.
- Public Services – Strategically placing firebreak lines in riparian and upland areas that don't affect temperature, to prevent fires, reduce erosion and sedimentation, and protect public safety.
- Transportation/traffic – Strategic planning and design to avoid and minimize the placement of facilities that have site distance conflicts. Case-by-case evaluations may reveal that appropriate site distance may be attained through minor vegetation trimming that does not affect water temperatures. Otherwise, off-site compensatory mitigation such as riparian planting or restoration within a watershed boundary may be necessary to off-set the affects.

9.4.2 Analysis of Compliance Measures, Potential Environmental Impacts, and Potential Mitigation Measures to Address Sedimentation

Compliance Measures for Erosion and Sediment Control:

Structural erosion and sediment control compliance measures:

- Soil conservation cover straw cover, bonded fiber matrix, grass seeding, temporary plastic cover, residue tillage, heavy use area protection, strip cropping.
- Silt fence, straw waddle, straw bale, gravel check dam, gravel bag berm, stock pile cover.
- Sediment control basin, pond, embankment pond.
- Riparian buffer/filter strip, grassed waterway/bioswale.
- Active sediment treatment system.
- Culverts, stream crossings, water diversions, bridges.
- Bench contouring, contour farming, terrace, vegetated windbreak/hedgerow planting.
- Exclusionary fences.
- Micro-irrigation systems.
- Lined irrigation channels.
- Rock slope protection, lined waterway/outlet, road/trail access control, underground outlet, vertical drain.
- Road/trail landing closures/treatment, forest trails and landings.
- Slide stabilization, soil stabilization or fill and cut slopes, removal of unstable fill.
- Low impact development (LID) to maintain the predevelopment hydrograph to sustain site runoff volume and velocity to attain sediment and water discharge equilibrium within streams.

- In-stream bioengineering.
- In-stream and riparian planting.
- Stream bank/shoreline protection.
- Road surface materials, paving, chip sealing, rocking, dust abatement. Establish native or introduced forage species (grasses, forbs, legumes, shrubs, and trees) through pasture, field, orchard and rangeland planting.
- Exclude animals, people, or vehicles from an area to protect, maintain, or improve the quantity and quality of riparian vegetation.
- Construct animal trails to provide movement of livestock through difficult or ecologically sensitive terrain.
- Stabilize stream crossings to provide controlled access across a stream for livestock and farm machinery.

Non-structural erosion and sediment control compliance measures:

- Dry weather construction or harvest scheduling.
- Inventory excessive sediment delivery sites, prioritize sites by threat to water quality, design and plan remediation, track and report remediation implementation success.
- Road drainage design, disconnect road drainage from watercourses (drain to hill slopes), install drainage structures at intervals to prevent erosion of the inboard ditch or gull formation at the hill slope outfall, outslope roads.
- Timing and intensity of road use.
- Proximity of roads to watercourses.
- Proximity of roads to unstable or landslide prone areas.
- Develop a grazing management plan for upland and riparian management.
- Calculate the number of livestock that can be maintained while maintaining adequate vegetative cover, stream corridor integrity, and water resources.

Potential Environmental Impacts

- Aesthetics - Decrease scenic views of waterbodies through the retention or planting of vegetation.
- Agriculture - Potential conflict with or conversion of prime agricultural land or land subject to the Williamson Act from implementing riparian buffers.
- Air quality – Short term construction-related emissions could include exhaust from construction equipment and fugitive dust from land clearing, earthmoving, movement of vehicles, and wind erosion of exposed soil during reservoir construction or removal, stream and/or riparian restoration. Potential odors from stagnant water in sediment basins or ponds.
- Biological – Short term construction, stream dewatering or diversions, turbidity discharges from construction actives or in-stream dam removal, stream and/or riparian restoration. Several species of fauna (e.g., snakes, fish, salamanders, and birds) have been entrapped or tangled in erosion control products such as the plastic casing covering straw waddles, or from the monofilament fibers from silt fences that are either in place on active construction sites or from materials that were left in place and degraded.

Stream restoration actions to reduce erosion, remove sediment, and improve habitat or riparian restoration actions to increase shade may conflicts with the requirements of certain flora or fauna.

- Cultural - Short term construction disturbance from earth moving.
- Geology/Soils – Construction activities or poorly designed facilities could results in short term and long term erosion, and could results in soils compaction reducing soil moisture and biological functions.
- Water Quality – Excessive use of rip-rap or stream stabilization structures intended to beneficially affect flow could alter conditions downstream. Work within and adjacent to waters increases the risk of leaking equipment or hazardous material spills, short term turbidity increases and/or discharges of settable solids. Decrease stream flows and/or aquifer storage from dust abatement. Alterations of natural hydrology and increases in stream temperatures by concentrating or redirecting road runoff. Increased risk of soil or groundwater contamination with concentrated minerals, salts, or persistent pesticides. Increased risk of erosion and sedimentation from the construction of trails, stream crossings, and riparian grazing. Increase risk of groundwater contamination of petroleum hydrocarbons and metals from the infiltration of storm water runoff.
- Mineral resources – Decreased access for gravel, gold and other mineral activities.
- Noise – Exposure to short term construction equipment, alternative water supply operations and maintenance.
- Public Services – Restoration or construction activities within parks that have streams or landslides adjacent to streams. Increased enforcement on sediment discharges from illegal cultivations could lead to an increased demand in local, state and federal law enforcement resources. Increase burden on vector control from wetland creation and sediment control basins.
- Transportation – Short term traffic increases associated with sediment reduction project, construction projects, dam removal, stream and/or riparian restoration.
- Utilities and service systems – Construction and installation of sediment catch basins or irrigation delivery/recovery systems could cause an adverse impact to the environment.

<u>Potential Measures to Avoid, Minimize or Mitigate Impacts from Erosion and Sediment Control Compliance Measures</u>

- Air quality – Dust control, avoid days or poor air quality, monitor levels and cease work prior to exceeding standards, retrofit equipment, use low emissions vehicles when possible, schedule work to reduce the use of high emission vehicles. Proper design to eliminate standing water, covers, aeration, filters, barriers, and/or odor suppressing chemical additives.
- Biological – Consult with federal, state and local agencies regarding location of sensitive (e.g., threatened or endangered) wildlife resources. Select appropriate or alternate structural BMPs such as bio-degradable, synthetic

free or earthen material BMPs. Implement non-structural BMPs such as scheduling, proper design and the removal of temporary BMPs for erosion and sediment controls after stabilization and or project completion. Developing species relocation plans or interpreting natural site vegetative conditions to include sensitive flora. Develop compensatory mitigation projects for aquatic ecosystem creation, restoration or enhancement.

- Cultural – Consult with Tribes, historical societies, federal, state and local agencies regarding location of cultural resources prior to use of heavy equipment in areas with known or suspected cultural resources. Projects subject to the jurisdiction of the Water Boards will be required to comply with Public Resource Code section 21159. This is expected to ensure the implementation of necessary site specific actions to avoid, minimize and mitigate any impacts to historical, archaeological, and paleontological resources or site, or unique geologic features. All future actions must comply with the CEQA process and requirements for tribal consultation provided by Senate Bill 18 (SB 18) (State 2004, Ch 905) and Government Code section 65252.
- Geology/Soils – One of the core actions in the proposed policy, as well as existing regulation, is erosion and sediment control. All future actions subject to this proposed Basin Plan amendment must focus on the avoidance, minimization and mitigation of impacts related to unstable or sensitive geologic areas, soil erosion or the loss of topsoil. Typically, an array of structural and non-structural BMPs will be used in any future project as the means to comply with this proposed Basin Plan amendment and existing regulations such as the Sediment Implementation Policy, WDRs and Waivers, NPDES permits, and 401 Certifications.
- Water Quality – Plant native vegetation that has evolved with the natural environment. Allow for the thinning of upland vegetation that has high evapotranspiration rates and increases fire risks. Use sediment, erosion, spill prevention, and waste management BMPs during construction and vegetation thinning activities. For example scheduling, straw, seed, silt fence, straw waddle, straw bales, drip protection, vehicle cleaning and maintenance, and site inspections. Install and maintain erosion control measures (e.g. waterbars, rolling dips, mulch, rock rip-rap) to prevent discharge of excess sediment from soil disturbing activities. Relocate roads away from unstable and landslide prone terrain. Drain roads away from unstable areas during construction, reconstruction of maintenance activities. Locate new roads on stable ground to the maximum extent practicable. Minimize cutbank height and avoid placement of fill on steep slopes. Use off-channel water collection features for dust abatement purposes. Install adequate number/type of road drainage features to prevent concentration of road runoff. Seek professional (e.g. Natural Resources Conservation Service, local resource conservation district) in developing land management plans and observational techniques to ensure optimal stocking rates for rangelands. Protect drainage channels from sediment contributions with vegetated buffers, wattles or similar erosion

control devices. Plant a cover crop on exposed soil to reduce the length of time in which soil is exposed to wind and water. Cover exposed soil that will not receive immediate planting with straw or other suitable erosion control material. Ensure proper design, siting, and operational timing to reduce alterations of natural hydrology and adverse effects on stream and groundwater quality and quality from structural BMPs.

- Transportation – Through the existing project planning, CEQA process, interagency coordination and existing regulation (NPDES storm water permits and 401 Certifications) potential conflicts are resolved by avoidance, minimization, or off-site compensatory mitigation.

9.4.3 Analysis of Compliance Measures, Potential Environmental Impacts, and Potential Mitigation Measures to Address Tailwater and Surface Impoundments

Flood irrigation is a common irrigation practice in parts of the North Coast Region. When irrigation water is applied to a field in this manner, it generally flows across the field as a thin sheet or in shallow rivulets, and is prone to heating during daylight hours and cooling at night in response to air temperature. Proper tailwater management is a factor in achieving compliance with the water quality objectives for temperature and temperature TMDLs.

A number of tailwater management practices are presented in the Non-Point Source (NPS) Program and the CDFW Coho Recovery Strategy. Practices include the reuse of tailwater, constructing off-stream retention ponds for evaporating and percolating tailwater through the ground, and a community based approach to managing tailwater among groups of water users.

Several large dams exist throughout the North Coast Region; additionally, there are several smaller impoundments – often termed "flashboard" dams – that are used to raise the water levels in streams to provide for diversion (either direct or pumping) primarily for agricultural use. Large and small scale impoundments can alter the thermal regime of a river system. Differences in heat loading due to impoundments can occur because of an increase in water surface area, providing a larger surface area over which energy transfer can occur. Larger air-water interface provides additional area for solar radiation to enter the system; however, the larger surface area also allows increased fetch (allowing more wind mixing) and potentially improved cooling due to evaporation. Probably a more important characteristic of the impoundment is the increased thermal mass, which leads to moderation of the diurnal temperature signal. Finally, impoundments generally increase river width and limit the ability of riparian shading to reduce incoming solar radiation. Similarly, the effect of topographic shading due to stream banks or bluffs is reduced when the river width is increased due to an impoundment. Therefore, addressing surface water impoundments is a major factor in achieving compliance with the water quality objectives for temperature and temperature TMDLs.

Compliance Measures for Tailwater and Surface Water Impoundments:

Structural compliance measures:

- Pond, embankment pond.
- Riparian buffer/filter strip, grassed waterway/bioswale.
- Lining of an irrigation channel.
- Installation of a pipeline in lieu of an uncovered channel.
- Install surface drainage field ditch to collect excess water.
- Minimize discharge from edge of fields.
- Construct tailwater management system.
    - Construction of a reservoir and pumping facilities.
- Land leveling to prevent discharge from field edges to surface waters.
- Construct off-stream retention ponds for evaporating and percolating tailwater.
- Control structures for irrigation.
- Micro-irrigation systems.
- Dam removal.
- Bypass flow structures.

Non-structural BMPs/compliance measures:

- Irrigation management plans to operate the irrigation system so that the timing and amount of irrigation water applied matches crop needs.

<u>Potential Environmental Impacts Associated with Compliance Measures for Tailwater and Surface Water Impoundments</u>

- Aesthetics – Potential glare from ponds or unsightly water facilities.
- Air quality – Short term construction-related emissions could include exhaust from construction equipment and fugitive dust from land clearing, earthmoving, movement of vehicles, and wind erosion of exposed soil during pond or embankment construction.
- Biological – Short term construction, stream dewatering or diversions, turbidity discharges from construction actives or in-stream dam removal. Loss of wetlands habitat from repair of leaky conveyance systems or alteration of irrigation practices. Switching from on-stream storage facilities to springs, seeps or groundwater as potential water sources could reduce the input of cold water and could results in impacts to areas of thermal refugia. Loss of critical habitat from sediment discharges. Loss of warm water habit for non-native species.
- Cultural - Short term construction disturbance from earth moving or reservoir drawdowns. Construction or removal of recreational, water supply or hydroelectric facilities could result in long term adverse cultural or historical impacts.
- Geology/Soils –Poorly designed or operated irrigation facilities could results in short term and long term erosion. Water facility construction could results in soils compaction reducing soil moisture and biological functions.
- Water Quality –Increased risk of soil or groundwater contamination with concentrated minerals, salts, nutrients or persistent pesticides from the infiltration of irrigation water. Increased risk of soil erosion from soil

disturbance. Work within and adjacent to waters increases the risk of leaking equipment or hazardous material spills, short term turbidity increases and/or discharges of settable solids. The removal of dams could result in a short term violation of water quality standards as sediments and organic rich waters flow downstream. The removal of on-stream and off-stream storage facilities, dams, and construction of minimum bypass flow and fish passage structures could result in changes to hydrology in streams as well as short term violation of water quality standards. Switching from on-stream storage facilities to springs, seeps or groundwater as potential water sources could reduce the input of cold water and could results in impacts to areas of thermal refugia.

- Noise – Exposure to short term construction equipment, alternative water supply operations and maintenance.
- Transportation – Short term traffic increases associated construction projects and dam removals.
- Utilities and service systems –Dam removal could lead to short term interruptions in utilities such as gas, water, electricity, phone, etc. Dam removal could lead to a temporary decrease in available water supply.

The monitoring conducted will focus on the protocols that will aid in the compilation and assessment of data collected to verify effectiveness.

<u>Potential Measures to Avoid, Minimize or Mitigate Impacts from Tailwater and Surface Water Impoundment Compliance Measures</u>

- Aesthetics - Proper siting for facilities, constructing berms or excess freeboard around the perimeter of a pond, or planting vegetation along the perimeter of a pond.
- Air quality – Dust control, avoid days or poor air quality, monitor levels and cease work prior to exceeding standards, retrofit equipment, use low emissions vehicles when possible, schedule work to reduce the use of high emission vehicles.
- Biological – Consult with federal, state and local agencies regarding sensitive (e.g., threatened or endangered) wildlife resources. Implement non-structural BMPs such as scheduling, proper design and the removal of temporary BMPs for erosion and sediment controls after stabilization and or project completion. Developing species relocation plans or interpreting natural site vegetative conditions to include sensitive flora. Develop compensatory mitigation projects for aquatic ecosystem creation, restoration or enhancement.
- Cultural – Consult with Tribes, historical societies, federal, state and local agencies regarding location of cultural resources prior to use of heavy equipment in areas with known or suspected cultural resources. Projects subject to the jurisdiction of the Water Boards will be required to comply with Public Resource Code section 21159. This is expected to ensure that the implementation of any necessary site specific actions to avoid, minimize and mitigate any impacts to historical, archaeological, and paleontological resources or site, or unique geologic features. All future actions must comply

with the CEQA process and requirements for tribal consultation provided by Senate Bill 18 (SB 18) (State 2004, Ch 905) and Government Code section 65252.

- Geology/Soils – One of the core actions in the proposed policy as well as existing regulation is erosion and sediment control. All future actions subject to this proposed Basin Plan amendment must focus on the avoidance, minimization and mitigation of impacts related to unstable or sensitive geologic areas, soil erosion or the loss of topsoil. Typically an array of structural and non-structural compliance measures will be used in any future project as means to comply with this proposed Basin Plan amendment and existing regulations such as the Sediment Implementation Policy, WDRs and Waivers, NPDES permits, and 401 Certifications.
- Noise – Exposure to short term construction equipment, alternative water supply operations and maintenance.
- Water Quality – Plant native vegetation. Allow for the removal or thinning of upland vegetation that has high evapotranspiration rates and increases fire risks. Use precision (site specific) farming techniques; monitor chemical condition of soil, water, and plant residuals carefully prior to applying fertilizers, pesticides, or water, including tailwater. Leach soils within the root zone as necessary to prevent salt build up in that portion of the soil profile. Monitor ground water to ensure no salt (or other constituents) accumulate in ground water. Avoid introduction of storm water into tailwater system to prevent impacts to storm water. Maintain filter strips between fields and surface water to prevent discharge of tailwater directly into surface waters. Install surface drainage field ditch to collect excess water. Seek professional (e.g. Natural Resources Conservation Service, local resource conservation district, consultants, etc.) in developing land management plans and observational techniques to ensure efficient and effective water use. Ensure proper design, siting, and operational timing to reduce alterations of natural hydrology and adverse effects on stream and groundwater quality and quality from structural compliance measures. Don't concentrate drainage such that toxic levels of constituents are discharge to waters.
- Transportation – Short term traffic increases associated dam removal.
- Utilities and service systems – Develop waste management plans for dam removal projects. Coordinate with prospective landfills regarding the estimated amount of waste generated by a proposed project and landfill capacity. Plan for and develop conservation and efficiency projects for water supply. Plan for and develop recycled water projects and aquifer storage and recovery (ASR) projects.

9.4.4 Analysis of Compliance Measures, Potential Environmental Impacts, and Potential Mitigation Measures Associated with Preserving Existing Cold Water Resources

The preservation of cold water resources is a critical component in the proposed Basin Plan amendment. Areas of thermal refugia in the North Coast Region are essential to the support of the cold water fishery because they moderate the impact of naturally elevated temperatures. Thermal refugia are typically identified as areas of cool water created by inflowing tributaries, springs, seeps upwelling hyporheic flow, and/or groundwater in an otherwise warm stream channel offering refuge habitat to cold-water fish and other cold water aquatic species (Watercourse, 2005). The refugia created by some tributaries are typically in the plumes and pools of cold water that form in the mainstems at the tributary confluence. Refugia also exist in some tributary streams themselves. The shape and extent of refugia are highly variable and are dependent on stream geomorphology, riparian canopy, sediment dynamics, and flow. Regional Water Board staffs recognize there are a number of factors that can cause seasonal and inter-annual changes in the existence, location, and size of the thermal refugia. Taken as a whole, these thermal refugia comprise a network of support for populations of cold water fishes and healthy aquatic ecosystem conditions. Their protection has become even more important with the abundance of impairments for temperature throughout the North Coast Region.

Compliance Measures Associated with Preserving Cold Water Resources:

- Avoid of areas of known thermal refugia during critical time for fish.
- Control of erosion and sediment discharges to areas of known thermal refugia.
- Remove fish passage barriers to areas of known thermal refugia.
- Conduct streambank restoration and riparian revegetation to areas of known thermal refugia.
- Construct riparian fencing to preserve areas of known thermal refugia
- Modify and/or remove on-stream storage facilities and dams which influence identified cold water resources.
- Construct new or modify off-stream storage facilities to replace on-stream facilities affecting cold water resources.
- Install and operate groundwater wells at a location with little or no influence over the flows associated with a cold water resource.
- Modify the operation and timing of groundwater, surface water, or riparian right water extraction.
- Rely on alternative water sources and conservation efforts.
- Construct and/or modify water transfer, irrigation and/or irrigation water management facilities to improve water use efficiency.
- Enhanced aquifer recharge (i.e., ASR).

Potential Environmental Impacts Associated with Preserving Cold Water Resources

- Aesthetics – Construction activities could have short term aesthetic impacts while sitting for water facility locations could degrade or impede scenic views in the long term.
- Agricultural Resources – Potential conflict with or conversion of prime agricultural land or land subject to the Williamson Act from implementing riparian buffers.
- Air Quality – Construction could increase short term exhaust and particulate matter. Alternative water supplies or increased pumping could result in long term increase in greenhouse gases.
- Biological Resources – Construction or removal of in-stream facilities could result in short term disturbances of wetlands, special status species and sensitive natural areas. Reduction in surface flows through groundwater extraction or increased reliance on riparian rights could degrade riparian habitat. Switching from on-stream storage facilities to springs, seeps or groundwater as potential water sources could reduce the input of cold water and could results in impacts to areas of thermal refugia.
- Cultural Resources – Short term construction disturbance from earth moving or reservoir drawdowns, stream and/or riparian restoration could cause adverse impacts to cultural or historical resources. Construction or removal of recreational, water supply or hydroelectric facilities could result in long term adverse cultural or historical impacts.
- Geology/Soils – Construction activities or poorly designed facilities could results in short term and long term erosion, and could results in soil compaction, reduced soil moisture, and reduced biological productivity within soils.
- Hazards and Hazardous Materials – Construction activities could result in the increase in hazardous materials used in construction, and in the operation and maintenance of new or expanded facilities.
- Hydrology / Water Quality – Excessive use of rip-rap or stream stabilization structures intended to beneficially affect flow could alter conditions downstream. Work within and adjacent to waters increases the risk of leaking equipment or hazardous material spills, short term turbidity increases and/or discharges of settable solids. Decrease stream flows and/or aquifer storage from dust abatement. Alterations of natural hydrology and increases in stream temperatures by concentrating or redirecting road runoff or diverting stream during construction. Increased risk of erosion and sedimentation from the construction of stream crossings, and riparian fencing.
- Land Use/Planning – Reliance on alternative water sources, water conservation efforts, and preservation of areas of known thermal refugia could have a conflict with local plans or ordinances that call for an increase through various water supply and/or development projects. Municipal, domestic, agricultural and industrial water supply could be impacted by certain restrictions on the extraction of water from riparian areas or areas of

known thermal refugia. Construction or expansion of off-stream water storage facilities could conflict with local plans or ordinances.

- Mineral Resources – The construction or expansion of a water storage facility could reduce the ability to access mineral resources in the project footprint.
- Noise – Construction, modification or removal of facilities for the purpose of groundwater or surface water extraction, energy supply and/or recreation could result in short term and long term impacts from noise.
- Population and Housing – Water conservation and/or reliance on alternative water sources could have an impact on housing development or existing housing populations. Moving to reliance on larger water suppliers could increase their demand and thus lead to an increased level of water extraction in specific locations.
- Recreation - Dams (for whatever purpose – hydropower, summer recreation, and drinking water extraction) could be removed to achieve flows needed to comply with temperature objectives reducing the area of water available for recreating. If dam removal is selected as a compliance measure swimming and boating (lake skiing and whitewater boating) could be adversely affected. In addition, recreational facilities such as campgrounds and boat launches would be removed if full or partial removal of the dams is selected as a compliance measure. Additionally, recreational fishing for introduced species would be lost after dam removal eliminated their habitat and conditions favored native species.
- Transportation and Traffic – Compliance measures that require construction activities could result in traffic delays. A reduction in water resource availability could lead to agricultural land conversion, which in turn could lead to increased development and traffic.
- Utilities/Service Systems – Compliance measures that require construction or demolition of facilities could result in short term interruption of utilities. Hydroelectric dam removal could create a local or regional shift in power supply services. Water conservation and/or reliance on alternative water sources could have an impact on municipal water supply.

<u>Possible Mitigation Measures Associated with Preserving of Cold Water Resources Compliance Measures</u>

- Aesthetics –Proper siting, constructing berms or excess freeboard around the perimeter of a pond, or planting vegetation along the perimeter of a pond.
- Agricultural Resources – Implement structural and non-structural water irrigation water management, irrigation pipelines, conservation cover, cover crop, pond sealing or lining, field borders, stream buffers, roof runoff capture structures, and culverts for water conveyance. Coordination between project proponents, Regional Water Board staff, Division of Water Rights, other local state and federal agencies to achieve mutually beneficial solutions that ensure the preservation of agricultural lands and cold water resources.
- Air Quality – Air monitoring, dust control BMPs, design water retention BMP structures to drain in 72 hours to prevent vectors and odors, equipment

timing, wind barriers, aggregate cover, multi-year crop, and residue management.

- Biological Resources – Consult with USFWS, CDFW, and NMFS, erosion and sediment control BMPs, waste management BMPS, biological monitors, work-windows, vegetated stream buffers, critical habitat/species identification surveys, water diversion fish screens, velocity dissipaters, and water drafting protocols.
- Geology/Soils – One of the core actions in the proposed policy, as well as existing regulation, is erosion and sediment control. All future actions subject to this proposed Basin Plan amendment must focus on the avoidance, minimization and mitigation of impacts related to unstable or sensitive geologic areas, soil erosion or the loss of topsoil. Typically, an array of structural and non-structural BMPs will be used in any future project as the means to comply with this proposed Basin Plan amendment and existing regulations such as the Sediment Implementation Policy, WDRs and Waivers, NPDES permits, and 401 Certifications.
- Hazards and Hazardous Materials – Develop pollution prevention plans incorporating structural and non-structural waste handling, storage and management BMPs including, but not limited to water tight containers, spill kits, and appropriate material labels.
- Hydrology / Water Quality – In general, the combination of several structural and non-structural compliance measures/BMPs can be used to mitigate impacts to water quality. Use sediment, erosion, spill prevention, and waste management BMPs during construction and vegetation thinning activities. For example scheduling, straw, seed, silt fence, straw waddle, straw bales, drip protection, vehicle cleaning and maintenance, and site inspections. Install and maintain erosion control measures (e.g. waterbars, rolling dips, mulch, rock rip-rap) to prevent discharge of excess sediment from soil disturbing activities. Use off-channel water collection features for dust abatement purposes. Ensure proper design, siting, and operational timing to reduce alterations of natural hydrology and adverse effects on stream from structural compliance measures.
- Land Use/Planning – Consult with local, state and federal agencies for guidance and recommendations.
- Transportation – Through the existing project planning, CEQA process, interagency coordination and existing regulation (NPDES storm water permits and 401 Certifications) potential conflicts are resolved by avoidance, minimization, or off-site compensatory mitigation.
- Utilities and service systems – Develop management plans for water conservation and water efficiency projects (i.e., ASR).

9.4.5 Analysis of Compliance Measures, Potential Environmental Impacts, and Potential Mitigation Measures Associated with Aquatic Ecosystem Restoration to Address Stream Temperatures

Generally aquatic ecosystem restoration actions are planned, designed and implemented in ways to best reduce environmental impacts. While there are potential short term impacts associated with these types of compliance measures they are generally beneficial for the environment in the long term and can be implemented without any adverse environmental impacts. For example there is a categorical exemption within the CEQA guidelines that allow for small habitat restoration projects[27].

Compliance Measures Associated with Aquatic Ecosystem Restoration to Address Stream Temperatures

- Stabilize stream crossings to provide controlled access across a stream for livestock and farm machinery.
- Stream or river bank revegetation to increase shade in accordance with site potential.
- In-stream gravel augmentation.
- Large woody debris/habitat enhancement projects.
- Stream or river bank stabilization with native vegetation or other bioengineering techniques, the primary purpose of which is to reduce or eliminate erosion and sedimentation and support site-specific potential effective shade.
- Culvert replacement conducted in accordance with published guidelines of the Department of Fish and Wildlife or National Marine Fisheries, the primary purpose of which is to improve habitat, provide shade, reduce sedimentation, or provide access to areas of thermal refugia.

Potential Environmental Impacts Associated with Aquatic Ecosystem Restoration to Address Stream Temperatures

- Aesthetics - Decrease scenic views of waterbodies through the retention of vegetation.
- Air quality – Short term construction-related emissions could include exhaust from construction equipment and fugitive dust from land clearing, earthmoving, movement of vehicles, and wind erosion of exposed soil during reservoir construction or removal, stream and/or riparian restoration.
- Agriculture - Potential conflict with or conversion of prime agricultural land or land subject to the Williamson Act from implementing grazing restrictions.
- Biological Resources - Risk of introducing invasive species thorough pasture, hay and rangeland planting and management. Short term construction, stream dewatering or diversions, turbidity discharges from construction actives or in-stream dam removal, stream and/or riparian restoration.

[27] Cal. Pub. Resources Code, § 21083 &21084

- Cultural - Short term construction disturbance from earth moving.
- Hydrology/water quality – Reduction in stream flows due to the increase in evapotranspiration from increased riparian tree retention. Temporary sediment discharges from construction and/or restoration activities. Excessive use of rip-rap or stream stabilization structures intended to beneficially affect flow could alter conditions downstream. Work within and adjacent to waters increases the risk of leaking equipment or hazardous material spills, short term turbidity increases and/or discharges of settable solids. Decrease stream flows and/or aquifer storage from dust abatement.
- Mineral resources - Decreased access for gravel, gold or other mineral extraction activities.
- Noise – Exposure to short term construction equipment, alternative water supply operations and maintenance.
- Public Services – Restoration or construction activities within parks that have streams or landslides adjacent to streams.
- Transportation/traffic – Increased tree retention may conflict with transportation agencies (public roads) site distance requirements and areas designated as clear recovery zones. Short term traffic increases associated with sediment reduction project, construction projects, dam removal, stream and/or riparian restoration.

<u>Possible Mitigation Measures for Impacts Associated with Compliance Measures to Restore Aquatic Ecosystems</u>

- Air quality – Dust control, avoid days or poor air quality, monitor levels and cease work prior to exceeding standards, retrofit equipment, use low emissions vehicles when possible, schedule work to reduce the use of high emission vehicles.
- Agriculture - Coordination between project proponents, Regional Water Board staff and other local, state and federal agencies to achieve restoration goals and attempt to ensure the preservation of agricultural lands.
- Biological Resources - Consult with federal, state and local agencies regarding location of sensitive (e.g., threatened or endangered) wildlife resources. Select appropriate or alternate structural BMPs such as bio-degradable, synthetic free or earthen material BMPs. Implement non-structural BMPs such as scheduling, proper design and the removal of temporary BMPs for erosion and sediment controls after stabilization and or project completion. Developing species relocation plans or interpreting natural site vegetative conditions to include sensitive flora.
- Cultural – Consult with Tribes, historical societies, federal, state and local agencies regarding location of cultural resources prior to use of heavy equipment in areas with known or suspected cultural resources. Projects subject to the jurisdiction of the Water Boards will be required to comply with Public Resource Code section 21159. This is expected to ensure the implementation of necessary site specific actions to avoid, minimize and mitigate any impacts to historical, archaeological, and paleontological

resources or site, or unique geologic features. All future actions must comply with the CEQA process and requirements for tribal consultation provided by Senate Bill 18 (SB 18) (State 2004, Ch 905) and Government Code section 65252.

- Geology/Soils – One of the core actions in the proposed policy, as well as existing regulation, is erosion and sediment control. All future actions subject to this proposed Basin Plan amendment must focus on the avoidance, minimization and mitigation of impacts related to unstable or sensitive geologic areas, soil erosion or the loss of topsoil. Typically, an array of structural and non-structural BMPs will be used in any future project as the means to comply with this proposed Basin Plan amendment and existing regulations such as the Sediment Implementation Policy, WDRs and Waivers, NPDES permits, and 401 Certifications.
- Water Quality – Plant native vegetation that has evolved with the natural environment. Use sediment, erosion, spill prevention, and waste management BMPs during construction and vegetation thinning activities. For example scheduling, straw, seed, silt fence, straw waddle, straw bales, drip protection, vehicle cleaning and maintenance, and site inspections. Install and maintain erosion control measures (e.g. waterbars, rolling dips, mulch, rock rip-rap) to prevent discharge of excess sediment from soil disturbing activities. Relocate roads away from unstable and landslide prone terrain. Use off-channel water collection features for dust abatement purposes. Install adequate number/type of road drainage features to prevent concentration of road runoff. Ensure proper design, siting, and operational timing to reduce alterations of natural hydrology and adverse effects on stream from structural compliance measures.
- Transportation – Through the existing project planning, CEQA process, interagency coordination and existing regulation (NPDES storm water permits and 401 Certifications) potential conflicts are resolved by avoidance, minimization, or off-site compensatory mitigation.

9.4.6 Analysis of Compliance Measures, Potential Environmental Impacts, and Potential Mitigation Measures to Restore and Maintain Stream Flows that Support Beneficial Uses

Coordination with the State Water Board is ongoing. The Regional Water Board participates in the appropriative water right permitting and water quality certification (pursuant to section 401 of the Clean Water Act) processes associated with water rights. Potential projects that require 401 certifications (e.g. Federal Energy Regulatory Commission-Licensing Projects) and/or water rights permits will be subject to the CEQA process and must provide additional project-level analysis. The majority of the foreseeable compliance measures associated with the actions referenced above address dams (hydropower, seasonal, and recreation and drinking water supply) and surface water allocations.

Compliance Measures to Restore and Maintain Stream Flows that Support Beneficial Uses

- Construct, modify and/or remove on-stream storage facilities and dams.
- Construct new or modify off-stream storage facilities.
- Install and operate groundwater wells.
- Modify the operation and timing of groundwater, surface water, or riparian right water extraction.
- Rely on alternative water sources and conservation efforts.
- Construct and/or modify water transfer, irrigation and/or irrigation water management facilities.
- Enhanced infiltration of groundwater (i.e., ASR)

Potential Environmental Impacts of Compliance Measures to Restore and Maintain Stream Flows that Support Beneficial Uses

- Aesthetics – Construction activities could have short term aesthetic impacts while sitting for water facility locations could degrade or impede scenic views in the long term.
- Agricultural Resources – Switching from surface water diversions to groundwater pumping could lower water table, reduce soil moisture, contribute to land subsidence and reduce aquifer storage capability. Regulation on water use could lead to the conversion of agricultural lands.
- Air Quality – Construction could increase short term exhaust and particulate matter. Alternative water supplies or increased pumping could result in long term increase in greenhouse gases.
- Biological Resources – Construction or removal of in-stream facilities could result in short term disturbances of wetlands, special status species and sensitive natural areas. Reduction in surface flows through groundwater extraction or increased reliance on riparian rights could degrade riparian habitat. Switching from on-stream storage facilities to springs, seeps or groundwater as potential water sources could reduce the input of cold water and could results in impacts to areas of thermal refugia.
- Cultural Resources – Short term construction disturbance from earth moving or reservoir drawdowns, stream and/or riparian restoration could cause adverse impacts to cultural or historical resources. Construction or removal of recreational, water supply or hydroelectric facilities could result in long term adverse cultural or historical impacts.
- Geology/Soils – Construction activities or poorly designed facilities could resulting in short term and long term erosion, and could results in soil compaction, reduced soil moisture, and reduced biological productivity within soils.
- Hazards and Hazardous Materials – The increased use of groundwater and construction of water supply facilities could result in the increase in hazardous materials used in construction, and in the operation and maintenance of new or expanded facilities.

- Hydrology / Water Quality – Short term construction and poorly designed facilities could lead to erosion, sedimentation or hazardous materials discharges. The increase in groundwater extraction could reduce surface water flows and result in increased pollutant concentration due to less dilution. The removal of dams could result in a short term violation of water quality standards as sediments and organic rich waters flow downstream. The removal of on-stream and off-stream storage facilities, dams, and construction of minimum bypass flow and fish passage structures could result in changes to hydrology in streams as well as short term violation of water quality standards. Switching from on-stream storage facilities to springs, seeps or groundwater as potential water sources could reduce the input of cold water and could results in impacts to areas of thermal refugia.
- Land Use/Planning – Increased riparian water rights use as a result of the policy may result in impacts on local plans to increase surface and groundwater extraction. Reliance on alternative water sources could have a conflict with local plans or ordinances. Construction or expansion of off-stream water storage facilities could conflict with local plans or ordinances.
- Mineral Resources – The construction or expansion of a water storage facility could reduce the ability to access mineral resources in the project footprint.
- Noise – Construction, modification or removal of facilities for the purpose of groundwater or surface water extraction, energy supply and/or recreation could result in short term and long term impacts from noise.
- Population and Housing – Water conservation and/or reliance on alternative water sources could have an impact on housing development or existing housing populations. Moving to reliance on larger water suppliers could increase their demand and thus lead to an increased level of extraction in specific locations.
- Recreation - Dams (for whatever purpose – hydropower, summer recreation, and drinking water extraction) could be removed to achieve flows needed to comply with temperature objectives reducing the area of water available for recreating. If dam removal is selected as a compliance measure, swimming and boating (lake skiing and whitewater boating) could be adversely affected. In addition, recreational facilities such as campgrounds and boat launches would be removed if full or partial removal of the dams is selected as a compliance measure. Additionally, recreational fishing for introduced species would be lost after dam removal eliminated their habitat and conditions favored native species.
- Transportation and Traffic – Compliance measures that require construction activities could result in traffic delays.
- Utilities/Service Systems – Compliance measures that require construction or demolition of facilities could result in short term interruption of utilities. Hydroelectric dam removal could create a local or regional shift in power supply services.

Potential Measures to Avoid, Minimize or Mitigate Impacts from Compliance Measures to Preserve Adequate Stream Flows

- Aesthetics –Proper siting, constructing berms or excess freeboard around the perimeter of a pond, or planting vegetation along the perimeter of a pond.
- Agricultural Resources – Implement structural and non-structural water irrigation water management, irrigation pipelines, conservation cover, cover crop, pond sealing or lining, field borders, stream buffers, roof runoff capture structures, and culverts for water conveyance.
- Air Quality – Air monitoring, dust control BMPs, design water retention BMP structures to drain in 72 hours to prevent vectors and odors, equipment timing, wind barriers, aggregate cover, multi-year crop, and residue management.
- Biological Resources – Consult with USFWS, CDFW, and NMFS, erosion and sediment control BMPs, waste management BMPS, biological monitors, work-windows, vegetated stream buffers, critical habitat/species identification surveys, water diversion fish screens, velocity dissipaters, and water drafting protocols.
- Geology/Soils – One of the core actions in the proposed policy, as well as existing regulation, is erosion and sediment control. All future actions subject to this proposed Basin Plan amendment must focus on the avoidance, minimization and mitigation of impacts related to unstable or sensitive geologic areas, soil erosion or the loss of topsoil. Typically, an array of structural and non-structural BMPs will be used in any future project as the means to comply with this proposed Basin Plan amendment and existing regulations such as the Sediment Implementation Policy, WDRs and Waivers, NPDES permits, and 401 Certifications.
- Hazards and Hazardous Materials – Develop pollution prevention plans incorporating structural and non-structural waste handling, storage and management BMPs including, but not limited to water tight containers, spill kits, and appropriate material labels.
- Hydrology / Water Quality – See compliance measures throughout this SED. In general, the combination of several structural and non-structural compliance measures/BMPs can be used to mitigate impacts to water quality.
- Land Use/Planning – Consult with agencies for guidance and recommendations.
- Transportation – Through the existing project planning, CEQA process, interagency coordination and existing regulation (NPDES storm water permits and 401 Certifications) potential conflicts are resolved by avoidance, minimization, or off-site compensatory mitigation.
- Utilities and service systems – Develop management plans for waste handling. Water conservation and water efficiency projects. Aquifer storage and recovery (ASR).

9.5 Discussion of Potential Environmental Impacts

Potential impacts of the reasonably foreseeable compliance measures were evaluated with respect to earth, air, water, plant life, animal life, noise, light, land use, natural resources, risk of upset, population, housing, transportation, public services, energy, utilities and services systems, human health, aesthetics, recreation, and archeological/historical concerns. Additionally, mandatory findings of significance regarding short-term, long-term, cumulative and substantial impacts were evaluated.

9.5.1 Thresholds of Significance

A significant effect on the environment is defined in statute as "*a substantial, or potentially substantial, adverse change in the environment*" where "*Environment*" is defined by Public Resources Code section 21060.5 as "*the physical conditions which exist within the area which will be affected by a proposed project, including air, water, minerals, flora, fauna, noise, objects of historic or aesthetic significance*."[28]

Social or economic changes related to a physical change of the environment were also considered in determining whether there would be a significant effect on the environment. However, adverse social and economic impacts alone are not significant effects on the environment. A more detailed analysis of the range of costs of compliance measures, and potential funding sources in discussed in Chapter 10.

In this analysis, the level of significance was based on baseline or current conditions. Short-term impacts associated with the construction of compliance measures with the exception of dam decommissioning activities) were considered less than significant with mitigation because the impacts due to construction activities are temporary and similar to typical capital improvement projects and maintenance activities currently performed throughout the region. Because of this, where it is uncertain whether the potential impacts could be mitigated to levels of insignificance, the Regional Water Board acted conservatively and concluded in this analysis that potential compliance measures would result in a potentially significant impacts.

When assessing the significance of impact- related implementation of the proposed Basin Plan amendment it is imperative to distinguish the level of mitigation possible under a proposed project versus a proposed policy. A complex policy could lead to several potential outcomes that are much more difficult to predict as compared to a complicated project at one place in time that has many moving parts, but none the less has a quantifiable impact on the environment. Additionally, the inclusion of mitigation measures within the adoption of a policy or action plan has the same level of potential as does the impact itself. For example, a potential mitigation measure to address air quality impacts as a result of a compliance measure designed to comply with Temperature Implementation Policy or Action Plans is not directly

[28] Pub. Resources Code §21068

enforceable by the Regional Water Board and therefore is deferred mitigation that can only be addressed and implemented at the project level.

The evaluation considered whether the construction or implementation of compliance measures would cause a substantial, adverse change in any of the physical conditions within the area affected by the measure. In addition, the evaluation considered environmental effects in proportion to their severity and probability of occurrence.

9.5.2 Environmental Checklist

1. Project title:
Proposed Amendment to the Water Quality Control Plan for the North Coast Region to add the *Policy for the Implementation of the Water Quality Objectives for Temperature* and *Action Plans to Address Water Temperature Impairments in the Mattole, Navarro, and Eel River Watersheds.*

2. Lead agency name and address:
North Coast Regional Water Quality Control Board
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403

3. Contact person and phone number:
Matt St John (707) 576-3762

4. Project location:
The project would be applicable to the area under the jurisdiction of the North Coast Regional Water Quality Control Board.

5. Description of the project: See section 9.2.1.

I. AESTHETICS -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect on a scenic vista?			X	
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?		X		
c) Substantially degrade the				

existing visual character or quality of the site and its surroundings?			X	
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?		X		

AESTHETICS a) and c): Less Than Significant

Discussion: Compliance measures such as planting trees and/or retaining trees are generally regarded as positive aesthetics. Scenic vistas usually include well vegetated areas. In some cases the planting or retention of large woody vegetation could reduce visibility to and adjacent water body; however, vegetation also provides habitat for wildlife and in known to enhance water quality which would improve the overall landscape. Compliance measures such as riparian restoration, modifications to water supply and water storage practices in agricultural lands, and erosion and sediment control measures may modify the appearance of an area; however, these measures are not likely to result in the elimination of agricultural occupations thereby eliminating areas of open space. Therefore, impacts to scenic vistas are considered less than significant.

AESTHETICS b) and d): Less Than Significant with Mitigation Incorporated

Compliance measures such as the preservation of large woody vegetation could lead to an increase fuel load for wildfires which could then impact scenic areas. Fire impacts on riparian zones vary proportionally with the severity and extent of burning in the catchment and are affected by stream size. Riparian zones can act as a buffer against fire and therefore as a refuge for fire-sensitive species. However, under some circumstances, such as dry pre-fire climatic conditions and the accumulation of dry fuel, riparian can areas become corridors for fire movement. Fire incursion into riparian zones creates canopy gaps and drier conditions, which allow subsequent buildup of dead wood and establishment of fire adapted species. In concert, this increases fuel loads and the probability of another fire. Secondary effects of riparian fire include altering nutrient fluxes and cycling, increasing sediment loads, and stimulating erosion. Riparian fires are potentially important in shaping ecological characteristics in many regions, but this is poorly quantified. A better understanding of riparian fire regimes is essential to assess the effects of fire in helping shape the complex ecological characteristics of riparian zones over the longer-term. (Pettit, N. E., and R. J. Naiman. 2007) Based on the evidence and nature of forest fires this appears to be a less than significant impact on the environment, if mitigated with proper fuel management. For example, the thinning of understory vegetation and select harvest prescriptions can decrease the fuel load while concurrently preserving and restoring shade along water courses. Additionally,

firebreaks can be used in upland and riparian areas that do not affect water temperatures to ensure strategic defense against wildfires.

A compliance measure that required land disturbance, such as the construction of a settling basin or a riparian fence, may include minor surface soil excavation or grading during construction, which could result in increased disturbance of the soil. If, however, scenic resources were identified at the site, they would be avoided, and standard construction techniques and erosion and sediment control practices would require revegetation and would not result in permanent damage to scenic resources.

Neither the structural nor the non-structural compliance measures would be expected to degrade the existing visual character or quality of a site and its surroundings with the application of appropriate mitigation measures. Although implementation of structural BMPs could result in some change in visual character or ground surface relief features, most of the compliance measures identified as part of the environmental analysis are of relatively small scale, such as installation of road drainage features, riparian planting, riparian fencing, or small scale water diversion systems. Likely, changes to the visual character or quality of the site and its surroundings will not be noticeable.

The larger scale projects, such as dam decommissioning, road decommissioning on USFS land, or construction of an off stream water storage facility could potentially impact aesthetic resources. Visual impacts associated with dam decommissioning can be addressed through the decommissioning plan by including mitigation measures such as early establishment of native vegetation (grass, forbes and trees) on exposed surfaces.

The construction of an off stream storage facility (i.e., pond) could be expected to occasionally create a new source of substantial glare. Mitigation measures to reduce the significance include proper siting, constructing berms or excess freeboard around the perimeter of a pond, or planting vegetation along the perimeter of a pond.

II. AGRICULTURE AND FOREST RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment Project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources

Boards. Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	X			
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	X			
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?				X
d) Result in the loss of forest land or conversion of forest land to non-forest use?				X
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to nonagricultural use or conversion of forest land to nonforest use?	X			

AGRICULTURE AND FOREST RESOURCES: a), b) and e) Potentially Significant and Unavoidable

Discussion: Compliance measures such as riparian buffers could cause incidental loss of agricultural use in lands mapped as Prime Farmland, Unique Farmland or

Farmland of Statewide Importance. These losses on a regionwide basis would only affect a very narrow band of land on either side of the watercourse, and as derived from the readily accessible information from the Farmland Mapping and Monitoring Program the U.S. Department of Agriculture National Agriculture Statistics Service it is estimated that no more than 5% of the North Coast Region is mapped as Prime Farmland, Unique Farmland, and Farmland of Statewide Importance. Additionally, some areas that are mapped as prime, unique or important may comply with the proposed Basin Plan amendment while others may not. Although there are many factors that affect this determination, it can be assumed that agricultural lands that implement new riparian protection actions or compliance measures to mitigate elevated stream temperatures could be taking land out of production. While avoidance and minimization measures can be used to lessen impacts, there is no mitigation for loss of land; therefore, this is potentially significant and unavoidable impact.

AGRICULTURE AND FOREST RESOURCES: c) and d) No Impact

Discussion: No elements of the proposed Basin Plan amendment will rezone or force the rezoning of Timberlands Production or result in the conversion of forested land to non-forested land. In short, the anticipated compliance measures for timberlands is to retain more forested areas along streams and therefore has no impact on the classification of conversion of timberlands.

III. AIR QUALITY -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Conflict with or obstruct implementation of the applicable air quality plan?				X
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	X			
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing	X			

emissions which exceed quantitative thresholds for ozone precursors)?				
d) Expose sensitive receptors to substantial pollutant concentrations?				X
e) Create objectionable odors affecting a substantial number of people?		X		

AIR QUALITY: a) and d) No Impact.

Discussion: Compliance measures would not result in any conflicts with or obstruction to the implementation of the applicable air quality plan or expose sensitive receptors to substantial pollutant concentrations.

AIR QUALITY: b) and c) Potentially Significant and Unavoidable.

Discussion: Excluding the issue of Klamath dam removal, the policy is anticipated to have a beneficial effect on the environment, greenhouse gas (GHG) emissions and climate change. Further, actions such as riparian preservation and restoration will sequester carbon from the atmosphere through plant photosynthesis. In addition, trapping soils through erosion and sediment control will reduce GHGs when carbon is locked up in trapped sediments, as well as living vegetation. Therefore, it is staff's judgment that the overall long term benefits of the proposed Basin Plan amendment will aid in the reduction of GHGs and help provide resilience in the condition of North Coast watersheds and water resources as we face the uncertainty of climate change.

Compliance measures could result in the generation of fugitive dust and particulate matter during construction or maintenance activities, which could temporarily impact ambient air quality. Any such impacts would be temporary, and would be controlled with standard construction operations, such as the use of moisture to reduce the transfer of particulates and dust to air and conducting operations when the air quality in the basin is good (i.e. no catastrophic wildfires). The emissions of air pollutants during the construction of facilities for compliance are unlikely to have an effect on ambient air quality.

Implementation of compliance measures that require the use of heavy equipment, such as dam decommissioning, construction of settling basins, road drainage installation or re-contouring of existing road prisms, could result in vehicle emissions during construction. However, these impacts would be short-term, and would not result in conflicts with, or obstruction of the implementation of the applicable air quality plan. Air quality impacts associated with heavy equipment used to modify or remove on-stream or off-stream storage facilities or implement

other structural compliance measures such as those could be potentially significant, but they would be limited to those resulting from short-term construction activities.

Large scale dam removal (demolition) and other large-scale restoration activities are reasonably foreseeable compliance measure that could result in the short term violation of local air quality standards, and therefore pose a potentially significant impact. Compliance measures such as erosion control, reservoir reseeding and riparian planting are not likely to result in a violation of air quality standards; however, the fine particulate matter and vehicle emissions from dam removal activities could exceed established thresholds and as a result would be considered a potentially significant impact and unavoidable.

AIR QUALITY: e) Less Than Significant with Mitigation

Discussion: The majority of compliance measures would not be expected to result in objectionable odors affecting a substantial number of people.

Compliance measures may result in objectionable odors in the short-term due to exhaust from construction equipment and vehicles. Certain structural compliance measures, such as detention basins, could become a source of objectionable odors if designs allow for water stagnation or collection of water with sulfur-containing compounds. This could also be the case if anaerobic sediment is exposed to the air as a result of dam removal operations. The application of mitigation measures designed to offset the number of people impacted will likely decrease this to a less than significant effect. Any odors would be very short-lived.

Dischargers and other responsible parties will likely be required to monitor the implementation of compliance measures to ensure they are working correctly. If odors were occurring from implementation of a settling or filtration basin, mitigation measures, such as proper design to eliminate standing water, covers, aeration, filters, barriers, and/or odor suppressing chemical additives, would be required. Compliance measures that could result in stagnant water should be inspected regularly to ensure that treatment devices are not clogged, pooling water, odorous, or mosquito vectors.

IV. BIOLOGICAL RESOURCES -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate,		X		

sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?				
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?		X		
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?		X		
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?		X		
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?			X	
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?			X	

BIOLOGICAL RESOURCES: a) Less Than Significant with Mitigation Incorporation

Discussion: Compliance measures may have a potential impact upon species identified as a candidate, sensitive, or special status species in local or regional plan, policies or regulations or by the CDFW or USFWS if they occur in an area where such species are located.

Riparian and wetland communities have been greatly reduced in size within California with wetland losses of up to 91 percent by estimation of the US Fish and Wildlife Service (USFWS). Thus, such habitats within the region are very important to the many species they support. Special-status species are vulnerable to any habitat loss or degradation. The ability to move to other habitat through wildlife corridors is vital to many terrestrial species. Modification of existing terrestrial habitat in the project area, especially limited riparian and wetland habitat, would have the potential to cause adverse effects.

Compliance measures could potentially have an impact if they are implemented in sensitive areas or areas of critical habitat. When installing structural compliance measures that involve substantial earth moving or riparian restoration activities that have the potential to affect candidate, sensitive, or special status species, project proponents are required to consult with federal, state and local agencies, including but not limited to the county, CDFW and the USFWS. Project proponents must ensure project actions avoid, minimize and/or mitigate for impacts to rare, threatened or endangered species.

Disturbances associated with dam demolition or haul roads where clearing, grading, and staging of equipment occurs could have impacts on sensitive habitats, including wetlands and riparian habitats along reservoirs and river reaches. Heavy machinery traversing wetland and riparian areas could change local topography and destroy wetland and riparian vegetation, and could introduce hazardous materials that would adversely affect water quality in wetland and riparian areas.

Once a project plan is prepared and construction areas are delineated, measures would be implemented prior to and during construction to avoid and mitigate impacts to sensitive vegetation communities such as wetlands. During project level construction activities to implement compliance measures, both structural and non-structural compliance measures can be implemented to avoid, minimize or mitigate potentially significant impacts to sensitive species.

For example, wetlands within 100 feet of any ground disturbance and construction-related activities (including staging and access roads) would be clearly marked and/or fenced to avoid impacts from construction equipment and vehicles. If new, temporary access roads are required, grading would be conducted such that existing hydrology would be maintained. In addition, water pollution control measures such as erosion control, sediment control, and waste management would be implemented

to avoid and minimize potential water quality impacts from polluted storm water runoff to streams, wetlands and riparian areas. Another example of avoidance or minimization includes work window restriction on stream restoration activities for the protection of several aquatic species. Additionally, aquatic ecosystem creation, restoration or enhancement projects are often designed to provide compensatory mitigation for impacts that cannot be avoided or minimized. See section 9.4 for more detail on potential compliance measures that can also be implemented as mitigation measures to reduce impacts to biological resources.

Stream restoration actions to reduce erosion, remove sediment, and improve habitat or riparian restoration actions to increase shade may conflict with the requirements of certain flora or fauna. Specific examples include low lying flora that would be out competed in the riparian zone by taller shade producing trees. In most cases impacts could be avoided by adjusting the timing and/or location of the actions to take into account candidate, sensitive, or special status species or their habitats. Additionally, the Temperature Policy and Actions Plans rely on site potential conditions and case-by-case determinations for implementation. Therefore, conflicts between the proposed Temperature Implementation Policy/Action Plans and particular species would be resolved at the project level. Mitigation measures would include collaboration between water board staff and CDFW and USFWS staff to reach agreement on the most sensitive beneficial use.

Substantial adverse effects either directly or through habitat modification, on any species identified as a candidate, sensitive or special status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS are less than significant with mitigation.

BIOLOGICAL RESOURCES: b) Less Than Significant with Mitigation Incorporation

Discussion: Substantial long term adverse effects on any riparian habitat or other sensitive natural community are not expected because the proposed Policy and Action Plan requires protection of riparian areas, reduction of anthropogenic sources of sediment, and recommendations to allocate water rights in a manner that support all beneficial uses. However, the implementation of various compliance measures has the potential to result in short term adverse effects.

For example, according to one of the dam decommissioning studies for the Klamath River hydroelectric facilities, approximately 480 acres of riparian area surrounding the three reservoirs could be lost through dam removal. If wetland construction, watershed-wide riparian protection and replanting, and re-vegetation of the exposed reservoir surfaces are applied as mitigation measures, the impact from the loss of riparian habitat from these sites will likely be less than significant (Klamath EIS/EIR, 2012).

Compliance measures that may not have an impact when implemented in one area could potentially have an impact if they are implemented in a sensitive area. Therefore, when installing structural BMPs that may include substantial earth moving or other alteration to riparian habitat, riparian habitat or other sensitive natural communities should be avoided. Because of these mitigation requirements, substantial adverse effects are not expected to occur either directly or through habitat modifications, on any species identified as a candidate, sensitive or special status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS.

As a result of the Temperature Policy, there could be an increase in riparian diversion of surface water and groundwater if water users choose to utilize riparian basis of right in addition to or in lieu of utilizing an appropriative water right. Increased riparian diversion could reduce surface water flows in the spring and summer, which are critical periods for fish habitat.

Although riparian water rights do not require the State Water Board's approval, the State Water Board has the authority to regulate riparian rights under the reasonable use doctrine. A particular water use or method of diversion may be determined to be unreasonable based on its impact on fish, wildlife, or other instream beneficial uses. (*Environmental Defense Fund, Inc. v. East Bay Municipal Utility District* (1980) 26 Cal.3d 183 [161 Cal.Rptr. 466].)

The State Water Board also has an affirmative duty to take the public trust into account in the planning and allocation of water resources. The purpose of the public trust doctrine is to protect navigation, fishing, recreation, environmental values, and fish and wildlife habitat. (*National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419, 434-435 [189 Cal.Rptr. 346].) Under the public trust doctrine, the State retains supervisory control over the navigable waters of the state and the lands underlying those waters. (*Id*. at p. 445.) In applying the public trust doctrine, the State Water Board has the power to reconsider past water allocations even if the State Water Board considered public trust impacts in its original water allocation decision. Thus, the State Water Board may exercise its authority under the doctrines of reasonable use and the public trust to address reduced instream flows in the policy area and adverse effects to fish, wildlife, or other instream beneficial uses due to riparian diversions.

The potential impacts are less than significant with mitigation incorporated.

BIOLOGICAL RESOURCES: c) Less Than Significant with Mitigation Incorporated

Discussion: All activities in federally protected wetlands, except those statutory exemption like agricultural, require the responsible party to obtain a Clean Water Act (CWA) Section 404 permit from the Army Corps of Engineers and a CWA Section

401 Water Quality Certification. These permits must include conditions that ensure that all water quality objectives for the wetland are protected.

Disturbances associated with dam demolition or haul roads where clearing, grading, and staging of equipment occurs could have impacts on sensitive habitats, including wetlands and riparian habitats along reservoirs and river reaches. Heavy machinery traversing wetland and riparian areas could change local topography and destroy wetland and riparian vegetation, and could introduce hazardous materials that would adversely affect water quality in wetland and riparian areas. However, once a project level plan is prepared and construction areas are delineated, measures would be implemented prior to and during construction to avoid, minimize and mitigate impacts to sensitive vegetation communities such as wetlands. During project level implementation of compliance measures, both structural and non-structural BMPs can be used to avoid, minimize or mitigate potentially significant impacts to sensitive species.

BMPs avoid and minimize impacts to wetlands by identifying construction buffers to limit access to wetlands near the construction area. For wetlands that are temporarily or permanently impacted, compensatory mitigation requirements will be required, implemented and monitored for success under state and federal law. In addition, if new temporary access roads are required for construction or demolition, grading would be conducted such that existing hydrology would be maintained. Also, BMPs would be implemented to address potential water quality impacts from polluted storm water runoff to streams, wetlands and riparian areas. Therefore, this is a less than significant impact with mitigation incorporated.

BIOLOGICAL RESOURCES: d) Less Than Significant with Mitigation Incorporated

Discussion: The majority of the North Coast rivers and their tributaries provide habitat, including the migration, for both native resident and migratory fish. A migratory corridor is generally described as a landscape feature (such as a ridgeline, canyon, stream or riparian strip) within a larger natural habitat area that is used frequently by animals to facilitate movement and provide access to necessary resources such as water, food, or den sites. Wildlife corridors are generally an area of habitat, usually linear in nature, which connect two or more habitat patches that would otherwise be fragmented or isolated from one another.

Most of the compliance measures will likely not interfere with the movement of these species. Although dam removal would ultimately result in greater movement for spawning fish, significant adverse effects on fish movement could occur at least temporarily unless appropriate mitigation is implemented to limit the duration of increased turbidly associated with dam removal and the decommissioning activities are timed to protect the most sensitive species/life stages.

Compliance measures and BMPs such as riparian fencing (for cattle exclusion), silt fence and straw wattles (for sediment control) have been known to entrap or entangle terrestrial wildlife (such as elk and deer) as well as some aquatic species (salamanders) and reptiles (snakes). Some specific areas are more prone to creating barriers to wildlife and can best be dealt with on a case-by-case basis. If there is a potential for an adverse impact to wildlife migration and/or use of a native wildlife nursery, the timing of the discharge, the location or the type of the compliance measure can be changed to avoid or minimize the impact to less than significant levels. For example rotational grazing practices and hot wire fences are alternatives to exclusionary fencing that have the potential to impede wildlife migration. Another example is concentrating efforts on erosion control methods to avoid using silt fences in sensitive areas. Additionally, natural fiber straw waddles without plastic netting are available to use as alternatives to sediment control technologies that may be a migration barrier. Based on the site specific situation, the case-by-case flexibility associated with the Temperature Implementation Policy and Action Plans and the avoidance, minimization, and mitigation measures associated with a particular project, the potential impacts are less than significant with mitigation incorporated.

BIOLOGICAL RESOURCES: e) Less Than Significant

Discussion: Compliance measures encourage riparian protection through the development of localized policies and ordinances are not expected to conflict with ordinances protecting biological resources, such as a tree preservation policy.

BIOLOGICAL RESOURCES: f) Less Than Significant

Discussion: It is unlikely that the implementation of compliance measures would conflict with the provisions of an adopted Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP) or other approved local, regional, or state habitat conservation plan. More likely the compliance measures would be similar to measures already committed to under these types of plans. Such similarities are likely to ensure that compliance measures are in alignment with any adopted HCP, NCCP or other approved local, regional, or state habitat conservation plan.

In some rare instances it could be possible that a low lying special status species with an associated conservation plan could be present in the riparian zone that could accommodate larger trees to produce shade. However, the larger shade producing vegetation may out compete or adversely affect that special status species. These instances are likely sparse and since the Temperature Implementation Policy and Action Plans are to be implemented case-by-case these types of discrepancies can be handled at the project or permit level through agency collaboration and so as to prevent significant impact on the environment.

V. CULTURAL RESOURCES -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5?	X			
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5?	X			
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?			X	
d) Disturb any human remains, including those interred outside of formal cemeteries?	X			

CULTURAL RESOURCES: a), b) and d) Potentially Significant and Unavoidable

Discussion: It is unlikely that the majority of compliance measures would cause a substantial adverse change in the significance of a historical or archaeological resource pursuant to section 15064.5. The implementation of compliance measures as recommended under the proposed Basin Plan amendment would not result in the alteration of a significant historical or archaeological resource unless that resource was otherwise impairing flows, causing excessive erosion or limiting site-specific potential effective shade. However, in cases where the installation of structural compliance measures may involve large scale excavation activities or the construction of a large scale infrastructure, a cultural resources investigation should be conducted before any substantial disturbance. The cultural resources investigation will include, at a minimum, a records search for previously identified cultural resources and previously conducted cultural resources investigations of the project parcel and vicinity. All future actions must comply with the CEQA process and requirements for tribal consultation provided by Senate Bill 18 (SB 18) (State 2004, Ch 905) and Government Code section 65252.

In the event that avoidance is infeasible, the future projects will be required to follow Native American Heritage Commission's mandate for Native American Human Burials and Skeletal Remains, in partnership with affected tribe(s), in order to adequately provide for recovering scientifically consequential information for the site. In the event that the ground disturbances or reservoir drawdowns uncover

previously undiscovered or documented resources, California law protects Native American burials, skeletal remains, and associated grave goods regardless of the antiquity and provides for the sensitive treatment and disposition of those remains. (Health & Safety Code, Section 7050.5; Public Resource Code, Section 5097.9 et seq) This record search should also include, at a minimum, contacting the appropriate information center of the California Historical Resources Information System, operated under the auspices of the California Office of Historic Preservation. In coordination with the information center or a qualified archaeologist, a determination regarding whether previously identified cultural resources will be affected by the proposed project must be made and if previously conducted investigations were performed to satisfy the requirements of CEQA. If not, a cultural resources survey would need to be conducted. The purpose of this investigation would be to identify resources before they are affected by a proposed project and avoid the impact. If resources are identified site-specific implementation will minimize impacts. Even with such measures incorporated, impacts may still be potentially significant and unavoidable.

CULTURAL RESOURCES: c) Less Than Significant Impact

Discussion: The implementation of compliance measures would not directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. Non-structural BMPs will not result in the direct or indirect destruction of a unique paleontological resource or site or unique geologic feature.

Similarly, it is unlikely that implementation of any structural BMP would result in the destruction of a unique paleontological resource or site or unique geologic feature. However, in cases where the installation of structural BMPs may involve excavation activities, an investigation of paleontological resources would need to be conducted by a trained professional before any substantial disturbance of land that has not been disturbed previously.

VI. GEOLOGY AND SOILS -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning				X

Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.				
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?		X		
b) Result in substantial soil erosion or the loss of topsoil?		X		
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or offsite landslide, lateral spreading, subsidence, liquefaction or collapse?		X		
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?				X

GEOLOGY AND SOILS: a)(iv), b) and c) Less Than Significant with Mitigation

Compliance measures do not change the exposure of people or structures to potential substantial adverse effects involving landslides over current conditions. The geographic scope of the activities covered under the proposed Basin Plan amendment will include areas that are highly susceptible to soil erosion and shallow landslides due to the presence of steep slopes, high rainfall rates, and/or underlying geology. A major focus of the sediment control actions and in existing regulation ensure proper road drainage, surface soil stability, and full vegetation potential which reduces soil erosion, and can reduce or prevent large-scale slope and fill failures.

Implementation of compliance measures may result in minor temporary soil excavation or disturbance during implementation of compliance measures that involve construction of structural BMPs such as road drainage installation, field leveling for irrigation management or installation of off channel stock watering ponds. Construction related erosion impacts should cease with the cessation of construction activity. As a result of the correct implementation and maintenance of compliance measures outlined in section 9.4.2 the potential for increased soil erosion, loss of topsoil or landslides is less than significant with mitigation incorporated.

GEOLOGY AND SOILS: a)(i, ii and iii), d) and e) No Impact

None of the compliance measures would result in any adverse impact related to fault zones, liquefaction or other seismic related activity. Nor would it result in any lateral spreading, subsidence, liquefaction, or collapse. Even if structural BMPs that were recommended were located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), they would not create substantial risks to life or property. The structural BMPs that have been identified as the foreseeable means of compliance do not involve moving permanent structures or people into a new area, and so there would be no risk to life or property created. In addition, the proposed Basin Plan amendment (and the identified compliance measures) will not result in any impacts from septic tanks or alternative waste water disposal systems.

VII. GREENHOUSE GAS EMISSIONS – Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Generate Greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	X			
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?			X	

GREENHOUSE GAS EMISSIONS: a) Potentially Significant and Unavoidable

Discussion: Adoption of the policy itself will not cause a direct impact to greenhouse gases (GHGs). Implementation of the compliance measures at the project level could results in an increase risk or contribution to greenhouse gases

related to exhaust and equipment from vehicles during construction activities such as restoration and alternate water supply construction. In the case of dam removal, emissions from replacement power sources will likely cause a significant and unavoidable impact from GHG emissions until PacifiCorp can add new sources or renewable power to compensate for the loss of the hydroelectric facilities.

GREENHOUSE GAS EMISSIONS: b) Less Than Significant

Discussion: Compliance measures could conflict with an applicable plan, project or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases. However, this project will be consistent with the State Water Board Resolution No. 2008-0030 which directs Water Board staffs to "require…climate change considerations, in all future policies, guidelines, and regulatory actions." Also, the proposed Basin Plan amendment is intended to conform with the goals of Assembly Bill (AB) 32 (States, 2005, ch 488). AB 32 requires that GHG emissions be reduced to 1990 levels by 2020. This requirement relates to anthropogenic sources of GHGs. Impact associated with individual projects will be analyzed and appropriate mitigation implemented to reduce GHGs.

VIII. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?		X		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?		X		
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?			X	
d) Be located on a site which is included on a list of hazardous			X	

materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				X
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				X
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				X
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				X

HAZARDS AND HAZARDOUS MATERIALS: a) and b) Less Than Significant with Mitigation Incorporated

Discussion: Road repair and maintenance can involve the transport and use of materials that would qualify as hazardous pursuant to the California Health and Safety Code section 25501(o). There is the possibility that hazardous materials may be transported to a site and be present during compliance measure construction, installation and maintenance activities. These materials include gasoline and diesel to fuel equipment, hydraulic fluid associated with equipment operations and machinery, asphalt and oils for road surfacing, and surface stabilizers (e.g. lignin) for running surfaces on unimproved roads. Maintenance yards house fuel, oil

(machine, hydraulic, crankcase), chemicals (acids, solvents & degreasers, corrosives, antifreeze), hazardous waste, heavy metals, nutrients, fertilizer, pesticides, herbicides, paint products, and sediments. Maintenance yard activities have the potential to discharge these materials to storm water drain systems or watercourses. Some BMPs specifically target proper storage of these types of materials. Dust palliatives and de-icing agents may be used in some instances but these materials properly applied according to BMPs are not considered hazardous materials. Compliance measures would have the potential for a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials.

In order to mitigate the potential adverse effects, pollution prevention and waste management BMPs should be used in the implementation of compliance measures. Existing regulations require the proper storage, handling and use of these types of materials. The U.S. Forest Service, California Department of Transportation, Five Counties Salmonid Conservation Program in the Counties of Del Norte, Humboldt, Mendocino, Siskiyou, and Trinity in the North Coast Region, California Association of Storm Water Quality, are just a few of the examples of exiting manuals that provide numerous pollution prevention and waste management BMPs. Many of these manuals include measures to be taken in the event of a spill.

In the event of an accident, responsible parties must comply with the requirements of the California Emergency Management Agency Hazardous Materials Spill reporting process. Any significant release or threatened release of a hazardous material requires immediate reporting by the responsible person to the Cal EMA State Warning Center (800) 852-7550 and the Certified Unified Program Agency (CUPA) or 911. The CUPA may designate a call to 911 as meeting the requirement to call them. Contact information for a jurisdiction's CUPA can be found at: http://cersapps.calepa.ca.gov/Public/Directory/ or http://cersapps.calepa.ca.gov/Public/UPAListing.
Notifying the State Warning Center (800) 852-7550 and the CUPA or 911 constitutes compliance with the requirements of section 11004 of title 42 of the United States Code regarding verbal notification of the SERC and LEPC (California Code of Regulations, Title 19 Section 2703 (e)). Additional information regarding spill reporting may be found at:
http://www.calema.ca.gov/HazardousMaterials/Pages/Spill-Release-Reporting.aspx

Any hazardous waste generated from the demolition of dams and any associated hydroelectric facilities would need to be disposed of in designated hazardous waste landfills. This would include treated wood waste, PCBs present in transformers and other electrical equipment, asbestos in building materials, fuels and oils, concrete dust (if it generates high pH waste) and soils or other material contaminated with lead from the use of lead-based paint. Incorporating a suite of mitigation measures will reduce the potential impacts to less than significant.

Any blasting activities would need to be conducted by a licensed professional and mitigation measures clearly described in the dam decommissioning plan, including a transportation plan for the explosive materials. At a minimum, these measures should include, all non-essential workers being prohibited from entering the site and stationed downwind at a safe distance away from blasting operations.
Based on the existing regulations and BMPs available to use in conjunction with selected compliance measures, the potential impact from the proposed Basin Plan amendment is less than significant with mitigation incorporated.

HAZARDS AND HAZARDOUS MATERIALS: c) and d) Less Than Significant

Discussion: Compliance measures would not emit hazardous emissions or result in the handling of hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. Again, there is the possibility that hazardous materials (e.g., oil, gasoline) may be present during construction and installation activities, but potential risks of exposure would be small, especially with proper handling and storage procedures. All risks of exposure would be short term and would be eliminated with the completion of construction and installation activities.

HAZARDS AND HAZARDOUS MATERIALS: e), f), g) and h) No Impact

Discussion: Compliance measures would not result in the emission or handling of hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school, nor is it located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code section 65962.5. The proposed project would not expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands. Therefore, there is no impact.

IX. HYDROLOGY AND WATER QUALITY -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Violate any water quality standards or waste discharge requirements?	X			
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of	X			

the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	X			
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite?			X	
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?			X	
f) Otherwise substantially degrade water quality?			X	
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				X
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?		X		
i) Expose people or structures to a significant risk of loss, injury or death involving flooding,			X	

including flooding as a result of the failure of a levee or dam?				
j) Inundation by seiche, tsunami, or mudflow?				X

HYDROLOGY AND WATER QUALITY: a) Potentially Significant

Discussion: By requiring the implementation of compliance measures to preserve and maintain shade, control sediment, and maintain stream flows supportive of beneficial uses, the proposed Basin Plan amendment will have an overall beneficial impact on water quality in the North Coast Region.

There are special circumstances, however, under which potential significant impacts could occur. For example, the primary environmental impact associated with dam removal is the short term impact to water quality from the release of the stored in-reservoir sediment. Dam decommissioning will result in temporary increases in turbidity, suspended sediment load and reduction of dissolved oxygen, which will likely exceed Basin Plan water quality objectives. Short term water quality exceedances may be acceptable in cases where long term benefits to be beneficial uses outweigh short term impacts, based on detailed, site-specific information and findings.

HYDROLOGY AND WATER QUALITY: b) Potentially Significant

Discussion: The proposed Basin Plan amendment identifies the alteration of the natural pattern and range of surface water flows as a controllable factor with respect to ambient water temperatures. Alteration of a water right as a result of this policy could result in some project proponents seeking alternative water sources.

In addition, surface water supplies may be insufficient to meet all future demands even in the absence of the proposed Basin Plan amendment. Surface water resources are already limited in some regions of the North Coast Region and future water supplies in those areas will be limited by the natural supply availability rather than restrictions on water diversion and storage. Some streams in the region are already fully appropriated for some or all of the year.

Pumping groundwater instead of diverting surface water could potentially deplete groundwater resources, which could potentially result in a reduction in surface water flows, particularly summer flows, which could affect surface water flows. Reduced surface water flow could potentially harm riparian vegetation or degrade habitat for sensitive species; could potentially adversely affect water temperature and increase constituent concentrations due to reduced dilution; and could potentially adversely affect recreational opportunities.

Depending on the circumstances, switching from surface water diversions to groundwater pumping or diverting water under riparian rights could have a

significant adverse impact on biological resources, water quality, or recreation. As discussed below, however, the possible effects of a user switching from a surface water diversion to a ground water diversion are dependent on a wide range of variables, and therefore it is highly uncertain whether any particular user who may switch to groundwater will cause a delay in surface water flow depletion, whether any such delay will cause a significant reduction in surface water flows, or whether any delayed reduction in flows will have a significant adverse impact on the environment.

Surface water flow depletion may continue after groundwater pumping stops because it takes time for groundwater levels to recover from the previous pumping stress and for the depleted aquifer defined by the cone of depression to be recharged with water. Therefore the time of maximum stream depletion may occur after pumping has stopped. Eventually, the aquifer and stream may return to their pre-pumping conditions, but the time required for full recovery may be quite long and exceed the total time that the well was pumped. Any time delay may range from a few days in the zone adjacent to the stream to thousands of years for water that moves from the central part of some recharge areas through deeper parts of the groundwater system (Heath, 1983).

The level of significance for a potential impact to hydrology/watery quality attributable to a delay in surface water flow depletion as a result of diverters switching to groundwater pumping or riparian rights is dependent on site specific circumstances. In light of the fact that the switch to groundwater or riparian diversions as alternative sources of supply is possible the potential impacts to hydrology and water quality are significant and unavoidable.

HYDROLOGY AND WATER QUALITY: c) Potentially Significant

Discussion: This staff report has identified a number of compliance measures that could result in the construction of structural compliance measures, such as infiltration basins, field leveling or road construction, bioengineering and in-stream restoration which could potentially cause an alteration of the existing drainage pattern of a site. In most cases however, these measures would be small and installed with appropriately designed mitigation measures, which would limit any alteration of the existing drainage pattern unless beneficial to the environment, and therefore would not result in substantial erosion of siltation on- or off-site.

The exception would be in the event of dam decommissioning such as has been proposed for the Klamath River hydroelectric facilities. The greatest impacts from erosion or siltation associated with the decommissioning of the dams Klamath would be during drawing down of the reservoir water level. However, once a new channel was established, the erosion of the in-reservoir sediment would dissipate. Impacts that cause erosion or siltation are potentially significant and unavoidable.

HYDROLOGY AND WATER QUALITY: h) Less Than Significant with Mitigation Incorporated

Discussion: It is possible that compliance with the proposed Basin Plan amendment would place structures within a 100-year flood hazard area which could impede or redirect flood flows. For example, switching from an in-stream diversion to off-stream storage could result in a structure being placed within the flood plain. However, it is in these instances that coordination with project proponents and other agencies is best suited to reduce potentially significant impacts. Ideally, these types of conversions would be subject to an individual CEQA analysis and would be implemented in a manner that avoid, minimize or mitigates potential significant impacts. As presented in section 9.4.3, mitigation measures include proper design, siting, and operational timing to reduce alterations of natural hydrology and adverse effects. Although there is a possibility that these types of compliance measures could cause an adverse impact, any potentially significant impacts will be avoided or mitigated to less than significant with mitigation incorporated.

HYDROLOGY AND WATER QUALITY: d) e), f), and i) Less Than Significant

Discussion: A number of compliance measures could result in the construction of infiltration basins, field leveling or road construction, bioengineering and in-stream restoration each of these have the potential to cause an alteration of the existing drainage pattern of a site. In most cases however, these measures would be small and be installed with appropriately designed mitigation measures such as those presented throughout section 9.4, so as to reduce the alterations of the existing drainage pattern in a manner which would result in a potential for flooding on- or off-site.

The Regional Water Board implements the NPDES program for storm water in the North Coast Region. Staff implementing this proposed Basin Plan amendment will consult with storm water staff to ensure that no permitted projects result in the concentration of runoff that would exceed that capacity of planned storm water facilities or result in additional sources of polluted runoff.

None of the compliance measures identified in this staff report contemplate the use of non-structural or structural BMPs that would expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam.

HYDROLOGY AND WATER QUALITY: g) and j) No Impact

Discussion: None of the compliance measures identified in this staff report would place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map. Staff has determined that this finding is still appropriate even under a dam

decommissioning scenario as the dams were not designed nor operated as flood control structures. As such their ultimately removal would not significant impact housing with a flood area as described above

None of the compliance measures identified in this staff report contemplate the use of non-structural or structural BMPs that would cause inundation by seiche, tsunami, or mudflow.

X. LAND USE AND PLANNING - Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Physically divide an established community?				X
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?		X		
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?		X		

LAND USE AND PLANNING: a) No Impact

Discussion: None of the compliance measures identified in this SED contemplate the use of non-structural or structural BMPs that would physically divide an established community.

LAND USE AND PLANNING: b) Less Than Significant with Mitigation Incorporated

Discussion: The primary goal of this project is the protection and restoration of water quality and beneficial uses of water in the North Coast Region. One of the staff actions in the proposed Basin Plan amendment is to provide cities, counties, and state and federal agencies guidance and recommendations on compliance.

Additionally, the proposed amendment directs staff to work with local governments to develop strategies to address the prevention, reduction, and mitigation of elevated water temperatures, including, but not limited to, riparian ordinances, general plans, and other management policies. Therefore, it is unlikely that compliance with the proposed Basin Plan amendment would conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect and the appropriate finding is less than significant with mitigation incorporated.

LAND USE AND PLANNING: c) Less Than Significant with Mitigation Incorporated

Discussion: Depending on the structural compliance measures selected, direct or indirect impacts to existing fish or wildlife habitat may occur; however, any such impact would be temporary. Compliance measures that may not have an impact when implemented in one area could potentially have an impact if they are implemented in a sensitive area. For instance the construction of a compliance measure such as an off-channel water storage facility could be located in an identified habit conservation area. Therefore, when installing structural compliance that may include substantial earth movement, responsible parties will be required under their applicable permit (or as necessary to comply with applicable prohibitions), to consult with various Federal, State and local agencies, including but not limited to the county the project is located in, CDFG and the USFWS. Typically Regional Water Board staff work with other agencies and project proponents on the development of Habitat Conservation Plan (HCP) or Natural Community Conservation Plan (NCCP) to ensure compliance with all regulations.

If appropriate to avoid conflicts with any HCP or NCCP, the timing and/or location of the BMPs may be adjusted to reduce any potential conflict with any such plans. If, however, such adjustments could not be made, the compliance measures would have to be changed to avoid any adverse impacts to rare, threatened or endangered species, or the discharge would not be permitted to occur. Because of these mitigation requirements, conflict with the provisions of an adopted HCP or NCCP is not likely to occur. Therefore the appropriate finding is less than significant with mitigation incorporated.

XI. MINERAL RESOURCES -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Result in the loss of			X	

availability of a known mineral resource that would be of value to the region and the residents of the state?				
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?			X	

MINERAL RESOURCES: a) and b) Less Than Significant

Discussion: None of the compliance measures identified in this SED contemplate the use of non-structural or structural BMPs that would result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state or the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan. It is possible that access to certain areas for gravel, gold or other mineral extraction activities could be affected by compliance measures such as riparian buffers, or areas of exclusion or stream bank stabilization projects. While possible, these management measures are unlikely to bar access completely. Therefore, the appropriate finding is less than significant.

XII. NOISE -- Would the project result in:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	X			
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	X			
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?			X	

d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	X			
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?			X	
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?			X	

NOISE: a), b) and d) Potentially Significant and Unavoidable

Discussion: Increased noise levels would likely be associated with heavy equipment operation associated with construction of structural compliance measures. For the most part the implementation of structural compliance measures may result in localized increased noise levels that can be minimized or mitigated through timing are not predicted to be a significant impact. For example noise levels from activities such as road construction and/or maintenance would not exceed the existing levels and the loudest activities from other construction actions can be planned during peak daily noise. However, dam decommissioning would likely involve drilling and blasting of the concrete structures, and this will cause an adverse impact to the noise level in the surrounding communities even with minimization and mitigation measures incorporated. Demolition of several of the dams and their associated facilities would result in significant and unavoidable impacts by exceeding local noise ordinances, exposing people to groundborne vibrations and increasing the ambient noise levels for outdoor receptors.

NOISE: c), e) and f) Less Than Significant

Discussion: None of the compliance measures identified in this SED contemplate the use of structural BMPs that would result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project as noise generation is associated with the short term, temporary use of heavy equipment.

None of the compliance measures identified in this SED contemplate the use of structural BMPs that would likely be located within an airport land use plan or within two miles of a public airport or public use airport. However, even if this were to occur, the implementation of the compliance measures would not result in excessive noise levels. The use of heavy equipment for the construction and installation of some structural BMPs could result in temporary increases in existing noise levels, but the noise associated with heavy equipment use is not any louder than noises that would typically occur within two miles of an airport.

None of the compliance measures identified in this SED contemplate the use of structural BMPs that would likely be located in the vicinity of a private airstrip. However, even if this were to occur, the compliance measures identified in this SED would not result in excessive noise levels. The use of heavy equipment for the construction and installation of some structural BMPs could result in temporary increases in existing noise levels, but the noise associated with heavy equipment use is not any louder than noises that would typically occur within the vicinity of a private airstrip.

XIII. POPULATION AND HOUSING -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				X
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				X
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				X

POPULATION AND HOUSING: a), b) and c) No Impact

Discussion: None of the compliance measures identified in this SED contemplate the use of structural BMPs that would induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or

indirectly (for example, through extension of roads or other infrastructure). None of the compliance measures identified in this SED contemplate the use of structural BMPs that would displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere. None of the compliance measures identified in this SED would displace substantial numbers of people, necessitating the construction of replacement housing elsewhere. Therefore, there is no impact.

XIV. PUBLIC SERVICES				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?		X		
Police protection?			X	
Schools?				X
Parks?				X
Other public facilities?				X

PUBLIC SERVICES: Fire Protection) Less Than Significant with Mitigation Incorporated

Logically, the increase in riparian vegetation increases the fuel loads for wildfires. While fuel loads do not cause fires the increasing mass available can increase severity of a fire and could impact the demand on fire protection services. Allowing for the removal or thinning of upland vegetation that has high evapotranspiration rates and increases fire risks could be a mitigation measure that result in multiple benefits to the environment. For more discussion see the section on aesthetics. The appropriate finding is less than significant with mitigation incorporated.

PUBLIC SERVICES: Police Protection) Less Than Significant

With the widespread increase in marijuana cultivation throughout the region both local and state law enforcement and resource agencies have seen an increase in the number of cases that lead to enforcement actions. Marijuana cultivation in the region has caused discharges of sediment and pesticides as well as an increased water demand. While many of these operations are legal under California law they are still illegal under federal law. According to Regional Water Board staff, many of these small and state legal operations are seeking input and making attempts to reduce their impacts to environment through routine BMPs that address erosion and sediment control as well as water efficiency strategies. Still many more large scale operations go fully beyond the scope law with little caution towards criminal and environmental legality. With observations spanning over the past few decades and special emphasis on the last few years, the demand on law enforcement including the Regional Water Board has already taken place. Moreover, while the Temperature Policy will apply to marijuana growers with respect shade, sediment, and flow, these components do not necessarily implicate police resources. Therefore, a significant increase in the demand for public services has already occurred and the impact from this Policy on police services is less than significant.

PUBLIC SERVICES: Schools, Parks or other public facilities) No Impact

Discussion: The proposed Basin Plan amendment does not involve new or physically altered government facilities. Because the proposed project does not involve these elements, the appropriate finding is no impact.

XV. RECREATION-- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	X			
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	X			

RECREATION: a) and b) Potentially Significant and Unavoidable

Discussion: None of the compliance measures identified in this SED, with the exception of dam decommissioning, contemplate the use of structural BMPs that would increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated.

In the event that the Klamath River reservoirs are decommissioned, flatwater recreation users will have to use the other flatwater facilities in the region. In addition, impact to white-water recreation will be adversely affected in specific reaches of the Klamath River due to changes in flow stages at certain times of year and have been determined to be significant and unavoidable.

Once a decommissioning plan is developed, mitigation measures identified, in the plan must ensure that the other regional facilities have the infrastructure in place to support the increased user base. Mitigation measures identified include such things as installation/relocation of campgrounds, restrooms, boat ramps, garbage service, etc.

Although, significant impacts to recreation have been identified the long term benefit associated with the removal of the Klamath hydroelectric facilities is positive towards recreational values. For example several of the reservoirs and reaches of the Klamath River are impaired for recreation due to poor water quality associated with toxic algal blooms. It has been determined that dam removal would alleviate these impairments. Additionally, it has been determined that dam removal would have long-term beneficial effects on free-flowing condition, water quality, scenic, wildlife, fishery, and recreation river values associated with the upstream and downstream reaches designated as Wild and Scenic.

XVI. TRANSPORTATION/TRAFFIC -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant			X	

components of the circulation system, including, but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?				
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?			X	
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?		X		
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?		X		
e) Result in inadequate emergency access?			X	
f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?			X	

TRANSPORTATION/TRAFFIC: a) and b) Less Than Significant

Discussion: None of the compliance measures identified in this SED, contemplate the use of structural BMPs that would cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections). Construction activities have the potential to increase traffic volumes or reduce speeds on public roads.

However, it is staffs judgment that the potential compliance measures are unlikely to be correlated with the public road systems to any significant degree.

TRANSPORTATION/TRAFFIC: c) and d) Less Than Significant with Mitigation Incorporated

Discussion: Increased tree retention may conflict with the site distance requirements of transportation agencies (public roads) areas designated as clear recovery zones. Different levels of road systems (e.g. freeways, highways, interstates, city streets and county roads) have various levels of design requirements in consideration of site distance to help ensure public safety. In addition, clear recovery zones (areas adjacent to road shoulders) are created and maintained in certain locations outside the highway shoulder to provide an opportunity for vehicles that leave the roadway to come to a safe stop or to return to the roadway. A recoverable slope is a slope on which a motorist may, to a greater or lesser extent, retain or regain control of a vehicle by slowing or stopping. Slopes flatter than 1V:4H are generally considered recoverable (U.S. Federal Highway Administration).

Thousands of miles of roads either parallel or intersect streams, riparian areas and/or floodplains. Therefore, it is possible that retaining riparian vegetation to provide site-specific potential effective shade or the installation of sediment control compliance measures could infringe upon site distance or clear recovery zone requirements. However, with proper planning and coordination with local, county and state transportation agencies most conflicts could be resolved. For instance during the road planning, design and environmental impact assessment stages these types of constraints or conflicts are analyzed by transportation engineers and biologists. Through the existing project planning, CEQA process, interagency coordination and existing regulation (NPDES storm water permits and 401 Certifications) potential conflicts are resolved by avoidance, minimization, or off-site compensatory mitigation. For example many structural BMPs designed to reduce sediment and polluted storm water runnoff have often been determined to be possible to construct, but infeasible due to safety constraints. Alternately, adequately vegetated slopes flatter than 1V:4H are also potential locations for structural BMPs for biofiltration of polluted storm water and are known to reduce erosion and sediment transport. Through proper coordination, planning and design clear recovery zones can meet public safety, storm water treatment, and erosion and sediment control goals. Therefore, it is staffs determination that the potential impacts are less than significant with mitigation incorporated.

TRANSPORTATION/TRAFFIC: e) and f) Less Than Significant

The proposed project does not involve installation of hazardous design features, and will not affect emergency access or parking capacity. The proposed project will not conflict with policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such

facilities. Because the proposed project does not involve these elements, the appropriate finding is less than significant.

XVII. UTILITIES AND SERVICE SYSTEMS -- Would the project:				
	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	X			
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	X			
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	X			
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				X
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?			X	
g) Comply with federal, state,				

and local statutes and regulations related to solid waste?			X	

UTILITIES AND SERVICE SYSTEMS: a) and e) No Impact

The proposed Basin Plan amendment will not have any effect on wastewater treatment requirements. Therefore, the appropriate finding is no impact.

UTILITIES AND SERVICE SYSTEMS: b), c), and d) and Potentially Significant and Unavoidable

Compliance measures that require construction or demolition of facilities could result in short term interruption of utilities. Several compliance measures, including but not limited to, sediment control basins, LID features, irrigation systems and tailwater management systems to reduce sediment transport to streams have the potential to cause an impact on utilities. However, mitigation measures can reduce any impacts to a less than significant level. Dam removal could lead to short term interruptions in utilities, including but not limited to water, gas and electricity.

Reliance on groundwater or alternate water sources could result in expansion of existing water and energy delivery systems. This amount would depend on which compliance measures are selected and on the hydrology and extent of existing permitted water use at future points of diversion. In addition, surface water supplies may be insufficient to meet all future demands even in the absence of the Basin Plan amendment. Surface water resources are already limited in some areas and future water supplies will be limited by the natural supply availability rather than by restrictions on water diversion and storage. Some streams in the region area are already fully appropriated for some or all of the year. The selection of the appropriate compliance measures by responsible parties will need to take into consideration their existing water resources. Basing selection of compliance measures on existing water resources will prevent the need to seek new entitlements.

Another alternative water supply practice for water purveyors currently being considered in the North Coast Region is groundwater banking, also known as aquifer storage and recovery (ASR). With potential restrictions on municipal water supplies there is the potential for ASR projects to become more common place throughout the region. There are potential adverse environmental impacts with these types of projects. However, in light of climate change and existing regulations on flow restrictions in many areas in the North Coast Region, these types of measures could mitigate potential increases in demand.

One of the potential alternative practices that could be used by growers would be the use of cover crops to increase infiltration and reduce surface runoff of water, which may contain contaminants. The use of cover crops may require additional irrigation water, but may also result in reduced evaporation from soil surfaces, resulting in no or little net change in irrigation water needs. Improved irrigation efficiency, one of the principle means of reducing agricultural discharges, will likely result in water savings.

If additional riparian diversion facilities are constructed, the construction activity should be undertaken in a manner that does not adversely affect fish and wildlife resources, per Fish and Wildlife Code section 1602. If CDFW determines that the construction activity may substantially adversely affect fish and wildlife resources, a Lake or Streambed Alteration Agreement (Agreement) would be prepared. Conditions that CDFW may require include, but are not limited to, avoidance or minimization of vegetation removal, use of standard erosion control measures, limitations on the use of heavy equipment, limitations on work periods to avoid impacts on fisheries and wildlife resources, minimum bypass flow requirements, and requirements to restore degraded sites or compensate for permanent habitat losses. In addition, rendering a dam incapable of storing water by leaving the structure in place while allowing water to pass through, may be a less costly alternative, and may reduce impacts to fish and wildlife habitat to less than significant levels. The Agreement would include reasonable conditions necessary to protect those resources and must comply with CEQA.

In addition to the regulatory requirements described above, the seasonal storage of surface water in most new off stream storage facilities will require a water right permit from the State Water Board. Unless an exemption applies, the State Water Board's review of water right applications is subject to CEQA. In addition, in acting on water right applications, the State Water Board must take into consideration the public interest and the applicable Basin Plan. (Wat. Code, §§ 1253, 1255, 1257, 1258.) Accordingly, the State Water Board will have the opportunity to identify and mitigate the impacts of constructing off-channel storage reservoirs as part of the State Water Board's review of individual water right applications. Similarly, the State Water Board will have the opportunity to ensure that applicants comply with any other applicable regulatory requirements. Inclusion of the following permit terms, will ensure that applicants comply with any other applicable regulatory requirements.

- *No water shall be diverted under this permit, and no construction related to such diversion shall commence, until permittee obtains all necessary permits or other approvals required by other agencies. If an amended permit is issued, no new facilities shall be utilized, nor shall the amount of water diverted increase beyond the maximum amount diverted during the previously authorized time period, until permittee complies with the requirements of this term.*

Within 90 days of the issuance of this permit or any subsequent amendment, permittee shall prepare and submit to the Division of Water Rights a list of, or provide information that shows proof of attempts to solicit information regarding the need for, permits or approvals that may be required for the project. At a minimum, permittee shall provide a list or other information pertaining to whether any of the following permits or approvals are required: (1) lake or streambed alteration agreement with the Department of Fish and Wildlife (Fish & G. Code, § 1600 et seq.); (2) Department of Water Resources, Division of Safety of Dams approval (Wat. Code, § 6002.); (3) Regional Water Quality Control Board Waste Discharge Requirements (Wat. Code, § 13260 et seq.); (4) U.S. Army Corps of Engineers Clean Water Act section 404 permit (33 U.S.C. § 1344.); or, (5) local grading permits.

Permittee shall, within 30 days of issuance of all permits, approvals or waivers, transmit copies to the Division of Water Rights.

Based on the wide range of potential impacts associated with water treatment and supply, and enforcement of mitigation a measure is uncertain, adverse impacts to the environment are potentially significant and unavoidable.

UTILITIES AND SERVICE SYSTEMS: f) and g) Less Than Significant

Discussion: Other than the discussion of compliance measures for dam removal, none of the compliance measures identified in this SED generate a significant source of solid waste. Construction and implementation of structural BMPs may generate solid wastes requiring disposal such as earthen material or erosion control materials (e.g. silt fences, temporary fencing, rusted out culverts). The amount of waste needing disposal, however, will be very minimal, and could therefore be served by an existing landfill.

For dam removal, the implementation of a Hazardous Materials Management Plan (HMMP) would mitigate the effects on the environment to a less than significant amount. HMMPs typically include potential options for disposal sites and BMPs for waste handling, transporting and disposal, as well as health and safety measures to protect workers and the public. This mitigation measure should reduce the impacts and eliminate problems with compliance with federal, state, and local statutes and regulations related to solid waste disposal.

The potential practices that could be applied by growers should not result in any changes in the generation of solid waste and therefore should not affect compliance with federal, state, or local statutes and regulations related to solid waste.

MANDATORY FINDINGS OF SIGNIFICANCE a) Potentially Significant and Unavoidable

Discussion: All of these compliance measures identified in this environmental analysis will likely improve water quality from the current baseline in the watershed which will likely continue without the application of these additional protections.

Compliance measures that require substantial earth movement would likely undergo consultation with federal, state and local agencies, including but not limited to the county the project is located in, CDFG and the USFWS. Specific mitigation measures would be applied by the agencies to avoid impacts to rare, threatened or endangered species. If no such mitigation is available, the use of that compliance measure in the specific area should not be implemented. In most cases the impacts of installing structural compliance measures would be temporary, and any impacts could be avoided by adjusting the timing and/or location to take into account any candidate, sensitive, or special status species or their habitats.

The exception to this would be short term impacts associated with dam decommissioning which has the potential to significantly impact water quality from the release of increased loads of fine grained sediment. It is estimated that impacts to water quality would range from weeks to months with the application of appropriate mitigation measures.

The potential impacts of the project will not cause a significant cumulative impact in the environment with the exception of a dam decommissioning scenario. In fact, the adoption of the proposed Basin Plan amendment should result in improved water quality in the North Coast Region will have significant beneficial effects on the environment over the long term.

MANDATORY FINDINGS OF SIGNIFICANCE b) Potentially Significant and Unavoidable

Discussion: Cumulative impacts, defined in section 15355 of the CEQA Guidelines, refer to two or more individual effects, that when considered together, are considerable or that increase other environmental impacts. Cumulative impact assessment must consider not only the impacts of the proposed Basin Plan amendment, but also the impacts from other Basin Plan Amendments, municipal, and private projects, which have occurred in the past, are presently occurring, and may occur in the future, in the watershed during the period of implementation.

Non-structural compliance measures that may be implemented are not likely to have cumulative impacts on the environment. Impacts associated with implementation of most of the structural measures will be short-term, temporary and spatially distributed across the watershed, and will not have significant adverse effects on the environment. Compliance measures that involve substantial earth

movement could have potentially significant cumulative impacts. However, many of these activities will be regulated under existing State and Regional permits, including but not limited to state-wide Caltrans storm water permit, storm water permit for construction sites over one (1) acre, or timber harvest operations on public and private lands. The likelihood of installation of structural compliance measures on federal land is quite high as approximately 55% of the region is in federal ownership. Regional Water Board staff's engagement in these regulatory programs will provide an opportunity to limit the potential for cumulative impacts by ensuring that multiple projects proposing implementation of BMPs with the potential to cause short-term impacts are phased appropriately to limit potential cumulative impacts.

Based on a review of the available information, and as a result of implementing the range of compliance measures from the preservation of shade to sediment controls and the modification of water supply to dam decommissioning, it has been determined that significant and unavoidable impacts to the environment are likely to occur. These impacts include elevated exhaust levels, fugitive dust, vehicle and GHG emissions, turbidity, suspended sediment loads and reductions of dissolved oxygen, potential negative alteration of critical habitat for multiple fish species, groundwater resources, cultural resources, scenic quality, recreation, and noise. Most of these impacts are expected to be short term. Individual project-specific CEQA review will be necessary in those cases as appropriate. Many can and will be mitigated to less than significant levels with the implementation of specific mitigation measures. However, because of the programmatic nature of this CEQA analyses, it is not possible to say with certainty that all impacts will be mitigated to less than significant levels. Identified mitigation will become enforceable in permits and other orders by the Regional Water Board, but we cannot be certain that other agencies will adopt the recommended mitigation for activities under the jurisdiction of other agencies. As a result, even impacts identified as less than significant with mitigation incorporated must also be considered unavoidable at this time.

Notwithstanding the potential negative affects discussed above and throughout this SED, it is likely that long term beneficial effects will be realized on aesthetic resources, biological resources, geology and soils, GHG emissions, hydrology and water quality, and recreation.

MANDATORY FINDINGS OF SIGNIFICANCE c) Less Than Significant

Discussion: As explained previously, the proposed Basin Plan amendment is designed to improve long term water quality by providing a regulatory program designed to protect and restore water quality and the beneficial uses of water in the North Coast Region. An important objective of the proposed Basin Plan amendment is the restoration of a healthy and viable salmonid fishery and the preservation of high quality waters.

9.6 Alternative Means of Compliance

The CEQA requires an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts[29]. The responsible parties can use the structural and non-structural compliance measures described in section 9.4, or other structural and non-structural compliance measures, to control and prevent pollution, and meet the requirements of the proposed Basin Plan amendment. The alternative means of compliance consist of the different combinations of structural and non-structural compliance measures that the responsible parties might use to meet their load allocations and achieve compliance with the temperature objectives or TMDL Action Plans. Because there are innumerable ways to combine compliance measures, all of the possible alternative means of compliance cannot be discussed here. However, because most of the adverse environmental effects are associated with the construction of structural compliance measures related to earth movement or construction of infrastructure (e.g., fencing, off-channel water facilities, aquatic ecosystem restoration restoration) to avoid or eliminate impacts, project proponents should always maximize the use of non-structural measures to the extent feasible, and design structural compliance measures to take into consideration site-specific conditions to minimize environmental effects.

[29] Cal. Code Regs., tit. 14, § 15187(c)(3).

10.0 ECONOMIC ANALYSIS

10.1 Introduction

The Regional Water Boards are legally required to consider economics in Total Maximum Daily Load (TMDL)[30] development and water quality control planning (basin planning)[31]. There are three triggers for Regional Water Board consideration of economics or costs in basin planning. They are:

- The Board must consider economics in establishing water quality objectives that ensure the reasonable protection of beneficial uses.
- The Boards must comply with the California Environmental Quality Act (CEQA)[32] when they amend their basin plans. CEQA requires that the Boards analyze the reasonably foreseeable methods of compliance with proposed performance standards and treatment requirements. This analysis must include economic factors.

Chapter 9 is the analysis of potential environmental impacts, as required under CEQA, associated with adopting an amendment to the Water Quality Control Plan for the North Coast Region (Basin Plan) to include the draft regional Temperature Implementation Policy and Action Plans for the Eel River, Mattole River and Navarro River Temperature TMDLs. In Chapter 9, staff identifies the reasonably foreseeable compliance measures necessary to achieve compliance with the Temperature Implementation Policy and associated actions. These compliance measures are management practices most likely to be implemented to achieve compliance with water quality standards for temperature.

10.2 Scope of the Economic Analysis

What follows is an estimate of the costs associated with compliance measures. The costs are given as a range, dependent on the specific characteristics of the land or operation to which a given management practice is applied. A list of potential funding sources is also given.

The Regional Water Board is not obligated to consider the balance of costs and benefits associated with implementation of a TMDL or Basin Plan amendment. It is only obligated to consider economic factors and may adopt a TMDL or Basin Plan amendment even if the costs are significant.

10.2.1 Methodology

The costs identified in this chapter primarily come from four sources of information: the Natural Resources Conservation Service (NRCS) Field Office Technical Guide (FOTG), California Department of Fish and Wildlife (CDFW) Salmonid Stream Habitat Restoration Manual (2006) (Manual), CDFW Coho Salmon Recovery

[30] See 33 U.S.C. § 1313(d); 40 C.F.R. § 130.7.
[31] See Wat. Code, § 13240-13247
[32] Pub. Resources Code § 21000 *et seq.*

Strategy, California Department of Transportation (Caltrans) 2013 contract proposal award information. The cost information provided in the NRCS FOTG is a national dataset to assist local NRCS Districts in setting cost shares for implementing conservation practices. Cost estimates are provided at the county level and the data used for this analysis are specific to Northern California (including Del Norte, Humboldt, Trinity, Siskiyou, Mendocino and Sonoma Counties), as described in their Fiscal Year 2013 Payment Schedule.

The costs included in the CDFG Manual are described as upslope erosion inventory and sediment control guidance. The numbers are based on estimates from Pacific Watershed Associates, a consulting firm specializing in erosion control work. Actual costs can vary considerably depending on operator skill and experience, equipment types, local site conditions, and regional location.

10.2.2 Existing Requirements

Landowners and project proponents are bound by various existing regulatory requirements that involve water quality and natural resource protection. The economic impact of existing obligations should not be attributed to the costs of compliance with the proposed Basin Plan amendment. Limiting the scope of the economic analysis is difficult given the similarity of measures necessary to achieve a wide range of water quality and wildlife protection goals. To remain as focused as possible, this economic analysis only contemplates the costs of measures identified as reasonably foreseeable (see Chapter 9) in the implementation of the Temperature Implementation Policy and Action Plans. However, if taken as a whole, they are likely an overestimate of the actual costs of compliance. This is because of the multiple and overlapping regulatory programs under which the same measures are reasonably foreseeable.

For example, some temperature control costs are related to actions necessary to avoid a violation of the sediment prohibitions in the Basin Plan and to avoid a taking under the Endangered Species Act or to fully mitigate impacts of authorized takes. Other costs may be incurred as a result of compliance with the Clean Water Act (CWA), other related statutes and regulations, or local land use ordinances. Conversely, compliance with the proposed Temperature Implementation Policy and Action Plan(s) will help dischargers comply with the other regulatory requirements.

10.2.3 Geographic Scope

The implementation actions within the proposed Basin Plan amendment are not uniformly required across the North Coast Region or even across properties with similar land uses. Instead, many of the implementation actions will be required of landowners/project proponents on an as-needed, site-specific basis or are simply activities that are encouraged by the Regional Water Board.

Economic considerations differ with site-specific issues and applicable actions necessary for compliance within the three main categories (shade, sedimentation, and flow) that affect stream temperature. For example the cost for retaining shade

on timber lands will be different across the region depending on the amount of yield and product (a.ka. species) to harvest. Likewise restoration action cost will not be uniform since diverse bioregions and microclimates within those regions will play a role in the species composition in riparian areas. In addition, more intensive land use activities will face greater costs than less intensive land use activities. Activities on steep, erosive slopes in proximity to waterbodies will require greater care and higher costs than activities on lands that do not deliver to a water body or on lands that are not highly erosive. Additionally, developing alternative water supplies, conservation practices, and switching from surface water diversions to groundwater pumping are highly site-specific economic considerations that can be generally assessed but should not be implied as the absolute upper and lower limit of costs in all instances.

Dam Removal

The cost of removing dams varies fairly regularly with the height and width of the dam, but project-specific factors, such as structure type, sediments, water rights, easements, and the need for monitoring can greatly impact the total cost of treatment. Friends of the Earth performed case studies of more than 30 dam removal projects in the United States and found that some small dams can be removed for under $10,000. The removal of a larger dam (e.g., 15-20 feet in height) can cost as much as $1 million. In neither case do these cost estimates include the important considerations of the cost of permits, easements, design, or monitoring. The median cost of dam removal in this study was about $100,000. However, this finding cannot be interpreted to suggest that this will always be true in California or elsewhere in the future. Previous dam removals were not the result of a random selection; it is likely that relatively inexpensive removal projects have been undertaken first and that average removal costs will rise over time. (Sunding, D./A. P. Zwane, 2004)

Irrigated Agriculture

Irrigated agriculture occurs throughout the North Coast Region and is predominantly concentrated in: 1) the Tule Lake region in Siskiyou and Modoc Counties; 2) the Scott Valley, Shasta Valley, and upper Klamath River Valley in Siskiyou County; 3) Round Valley, Potter Valley, Eden Valley, Anderson Valley and the upper Russian River Valley in Mendocino County; and 4) Alexander Valley, Dry Creek Valley, Russian River Valley Below Dry Creek and the Laguna de Santa Rosa in Sonoma County. Principal irrigated crops are barley, irrigated pasture, alfalfa hay and other hay, oats, potatoes, wheat and grapes. For most of the management practices, a range of costs is given, depending on numerous site-specific factors to be determined by landowners/dischargers. Typical categories of compliance for irrigated agriculture include maintaining and preserving site-specific potential effective shade, controlling erosion and sediment, addressing tailwater and surface water impoundments, preserving existing cold water resources, aquatic ecosystem restoration and actions to restore or maintain stream flows to support all beneficial uses.

Grazing

Grazing activities occur throughout the North Coast Region both on private and public lands. As with the estimated costs to the irrigated agricultural community to comply with the proposed Basin Plan Amendment, the estimates to the grazing community are derived from NRCS Fiscal Year 2013 Payment Schedule. Typical categories of compliance for grazing include maintaining and preserving site-specific potential effective shade, controlling erosion and sediment, preserving existing cold water resources, aquatic ecosystem restoration and actions to restore or maintain stream flows to support all beneficial uses.

Roads

The road networks in the North Coast Region contribute to elevated temperatures in tributary watersheds through the discharge of excess sediment. In some cases, an inventory of roads will determine that decommissioning or upgrading of roads is required.

Regardless of the method of regulation or the responsible party, the requirements for controlling sources of sediment from roads are similar and implementation will potentially focus on the following process:

1. Inventory: Identify sources of excess sediment discharge or threatened discharge and quantify the discharge or threatened discharge from the source(s).
2. Prioritize: Prioritize efforts to control discharge of excess sediment based on, but not limited to, severity of threat to water quality and beneficial uses, the feasibility of source control, and source site accessibility.
3. Implement: Develop and implement feasible sediment control practices to prevent, minimize, and control the discharge. Road decommissioning may be required as part of a responsible parties' load allocation if maintaining the road is cost prohibitive, road is not needed or is a source of uncontrollable excess sediment discharge.
4. Monitor and Adapt: Use monitoring results to direct adaptive management in order to refine excess sediment control practices and implementation schedules until discharges are reduced to a level that meets any applicable TMDL load allocations and water quality standards.

Typical categories of compliance for roads include maintaining and preserving site-specific potential effective shade, controlling erosion and sediment, preserving existing cold water resources, and aquatic ecosystem restoration.

Timber

Timber harvest activities can substantially impact water temperature. The Temperature Implementation Policy and Action Plans focuses on controlling sediment and protecting riparian functions from timber harvest activities to meet

the watershed-wide TMDL allocations and temperature objectives as described throughout this staff report. Timber harvest on nonfederal lands is currently regulated by the Regional Board through a combination of general WDRs and conditional waivers of WDRs. The costs associated with WDRs are not outlined here as they are a current requirement. Roads that are part of a timber harvest plan or Non-Industrial Timber Management Plan (NTMP) area required by the WDRs and waivers for timber harvest on nonfederal lands to implement an erosion control plan. Additional costs to timber operators associated with the proposed Basin Plan amendment could come from the additional retention of trees above the existing requirements in certain areas. Therefore, the additional retention of trees could potentially be a foregone revenue. However, due to the broad range of potential factors including site potential, topography, existing requirements, and amount of timber available the specific costs are too complex to estimate. Typical categories of compliance for timber operations include maintaining and preserving site-specific potential effective shade, controlling erosion and sediment, preserving existing cold water resources, and aquatic ecosystem restoration.

10.3 Estimated Costs of Compliance

The following examples are not meant to be exhaustive of the suitable suite of compliance measures, but rather provide a representative sample with the widest range to accommodate as many compliance scenarios as possible. Site potential is defined as the shade provided by topography and full potential vegetation conditions at a site, with an allowance for natural disturbance such as floods, wind throw, disease, landslides, and fire. Table 10-1 presents the estimated costs of compliance measures to preserve, maintain and restore shade. Addressing elevated water temperature associated with excess sediment discharges includes controlling the cumulative impacts of sediment waste discharges on such watersheds that affect stream temperature. Table 10-2 presents the estimated costs of compliance measures to control sedimentation. Addressing elevated water temperature associated with alteration of natural thermal regimes includes a balance of water demand for all beneficial uses. Table 10-3 presents the estimated costs of compliance measures that address tailwater, surface water impoundments, input from cold water resources, and surface water flows.

Table 10-1 Estimated Costs of Reasonably Foreseeable Compliance Measures to Preserve, Maintain and Restore Shade			
Reasonably Foreseeable Compliance Measure	**Practice Name**	**Range of Practice Costs**	**NRCS Practice Code or Source**
Use exclusion	Forage exclusion	$0.64-1.32/ft	#472
Riparian Restoration	Riparian forest buffer/herbaceous cover	$165.04-22,916.06/acre	#390, #391
Protect and manage existing wetland and/or riparian areas for their natural filtering functions	Riparian herbaceous cover/forest buffer, wetland restoration	$165.04-22,916.06/acre	#390, #391, #657
Animal trails and walkways	Animal trails and walkways	Not available	#575
Stream crossing	Ford, culvert, bridge	$363-1,488 per/Lft	#578
Riparian Restoration	--	$44.03/ft^2 -$2,706/Lft	A.Riley, 2008
Riparian Restoration	--		A.Riley, 2008
Retain in-channel trees following timber operations Increased riparian canopy retention in Class II and III watercourses	Not applicable	Dependent on site specific determinations	Staff judgment

Table 10-2
Estimated Costs of Reasonably Foreseeable Compliance Measures Associated with Erosion and Sediment Control

Reasonably Foreseeable Compliance Measure	Practice Name	Range of Practice Costs	NRCS Practice Code or Source
Reduce erosion -Maintain crop residue or vegetative cover	Cover Crop	$113.75-206.64/acre	#340
Erosion control	Dry Seed	$0.40/ft^2	Caltrans 2013
Erosion control	Compost Cover	$0.20-0.80/ft^2	Caltrans 2013
Erosion control	Compost Blanket	$250/cubic yard	Caltrans 2013
Erosion control	Rolled Erosion Control Blanket	$2.00/ft^2	Caltrans 2013
Erosion control	Straw	$0.05/ft^2	Caltrans 2013
Erosion control	Hydroseed	$0.05/ft^2	Caltrans 2013
Reduce erosion and sequester sediment - Stream buffer areas/Field borders	Field Borders: Riparian tree & shrub establishment; Non-native or native seedbed preparation	$211-1,617/acre	#386
Reduce erosion and sequester sediment - Riparian restoration	Tree & Shrub Establishment	$1.20-3.20/unit	#612
Reduce soil erosion - Improve soil properties	Deep tillage/1 Scenario	$20.10/acre	#324
	Res. & Tillage Mgt, Mulch Till	$28.10/acre	#345
Reduce slope length, steepness, or unsheltered distance	Precision land forming	$175/acre	#462
	Contour Farming	$10.10/acre	#330
	Contour Buffer Strips	$282.30-917.40/acres	#332
Reduce soil erosion - Practices to reduce detachment	Conservation Cover	$237.40-2,279.90/acre	#327
	Conservation Crop Rotation	$6.10-30.90 /acre	#328
	Residue and Till Management	$36-71.12/acre	#329
	Cover crop	$113.75-206.64/acre	#340
	Critical area planting	$398.21-14,046.80/acre	#342
	Seasonal residue management	$3.76/acre	#344
	Diversion	$3.17-5.69/ft	#362
	Windbreak/shelterbelt establishment	$0.45-0.90/ft	#380
Practices to reduce detachment (cont.)	Windbreak/shelterbelt renovation	$0.56-4.77/ft	#650
	Mulching	$297.73-756.15/acre	#484
	Hydromulch	$0.05/yard^2	Caltrans 2013
	Irrigation water management	$28.09-	#449

Table 10-2 Estimated Costs of Reasonably Foreseeable Compliance Measures Associated with Erosion and Sediment Control			
		202.12/acre	
	Cross wind ridges/stripcropping/trap strips	Not available	#589
	Surface roughening		
	Waste utilization	$175.21-949.51/acre	#612
	Wildlife upland habitat management	Not available	#633
		$17.50-392.05/acre	#645
Practices to reduce transport within the field	Contour farming	$304.10/acre	#330
	Field windbreak	Not available	#392
	Grassed waterway	$1502.42/acre	#412
	Contour stripcropping	$1.60-3.83/acre	#585
	Herbaceous wind barriers	Not available	#442A
	Field stripcropping	Not available	#586
	Terrace	$2.09-3.40/Lft	#600
	Contour buffer strips	$282.29-917.41/acre	#332
Practices to trap sediment below the field or critical area	Sediment basins	Not available	#350
	Field border	$210.57-1617.25/acre	#386
	Filter strip	$210.57-448.10/acre	#393
	Water and sediment control basin	$4.86/cubic yard	#638
Mulch exposed areas	Mulching	$297.73-756.15/acre	#484
Grazing Management Plan		To be determined	
Pasture and hay planting	Seedbed preparation, seeding, non-native	$191.43-501.24/acre	#512
Rangeland planting	Drill or broadcast, native or non-native	Not available	#550
Animal trails and walkways	Animal trails and walkways	Not available	#575
Stream crossing	Ford, culvert, bridge	$90-1,488 per/Lft	#578/ Caltrans 2013
Forage harvest management	Forage harvest management	$12.74-61.61/acre	#511
Vegetation control with grazing	Prescribed grazing	$3.89-5.80/acre	#528
Wetland wildlife habitat management	Low, medium or high intensity	$17.50-248.94/acre	#644

Table 10-2 Estimated Costs of Reasonably Foreseeable Compliance Measures Associated with Erosion and Sediment Control			
Installation of grade stabilization structures	Grade stabilization structure	Not available	#410
Streambank and shoreline protection	Low-high complexity	$17.58-80.26/ft	#580
Stream channel stabilization	Stream channel stabilization	Not available	#584
Road Surface stabilization	Asphalt paving	$238,000/mile	Siskiyou County Public Works
	Asphalt paving	$115.00-300.00/ton	Caltrans 2013
	Chip sealing	$57,000/mile	Siskiyou County Public Works
	Rocking	$4,250-10,000/1000 ft	Weaver, et. al. (2006)
	Class II Aggregate Base	$75.00/cubic yard	Caltrans 2013
	Import Rock Material	$100.00/cubic yard	Caltrans 2013
	Dust abatement	$90hr	Harris Blade Rental,
Road Fill slope/cutbank compliance measures	Removal/stabilization of unstable fill.	$2-5/cubic yard	Weaver, et. al. (2006)
	Soil stabilization (mulch/vegetate) of fill and cut slopes.	$19-22/1,000 ft.	Weaver, et. al. (2006)
Control sediment	Disconnect road drainage from watercourses (drain to hillslopes).	$170/1,000 ft	Weaver, et. al. (2006)
	Install rolling dip	$85-170/ each	Weaver, et. al. (2006)
	Install ditch relief culvert	$645-825/ each	Weaver, et. al. (2006)
	Install stream crossing	$3,270/each	Weaver, et. al. (2006)
	Fiber roll	$5.00-20.00/Lft	Caltrans 2013
	Silt fence	$8.00-20.00/Lft	Caltrans 2013
	Gavel check dam	$8.00-20.00/Lft	Caltrans 2013
Stabilize/treat crossing approach	Rock road surface	$4,250-10,000/1,000 ft	Weaver, et. al. (2006)
	Install additional road drainage: waterbars, rolling dips, cross drains	$85-3,270/each	Weaver, et. al. (2006)
Stabilize/treat crossings and associated fills	Remove undersized/failing culverts	$3-10/cubic yard	Weaver, et. al. (2006)
	Remove unstable fill	$2-5/cubic yard	Weaver, et. al. (2006)
	Rock armor, rip rap fill slopes	$150-725.00/Cubic yard	Caltrans 2013
	Rock slope protection fabric	$5.00-100.00/ yard[2]	Caltrans

Table 10-2 Estimated Costs of Reasonably Foreseeable Compliance Measures Associated with Erosion and Sediment Control			
	Drain road away from unprotected fills	$10,000-75,000/mile	Weaver, et. al. (2006)
Develop a Road System Plan	Erosion Control Plan, non-timber land use	$3528-7,740/100 acres	R. Fitzgerald Memo dated August 6, 2005
	Erosion Control Plan, timber land use	$2,370-7,740/100 acre	
	Water Pollution Control Plan	$650-10,000/per	Caltrans 2013
Road decommissioning	Recontour road to provide for a stable, hydrologically "invisible" site (e.g. remove perched fill, outslope old road prism, remove crossings)	$2,000-$50,000/mile depending on steepness and location of road	Weaver, et. al. (2004)
	Minimize road system (density) to correspond with maintenance resources	$2,000-50,000/mile to recontour unnecessary roads	Weaver, et. al. (2004)
	Decommission roads adjacent to watercourse and relocate to midslope or ridgetop if possible	$3,000-23,000 per mile	CDFW Coho Recovery Plan

Table 10-3
Estimated Compliance Measures Costs to Address Tailwater/Surface Water Impoundments/ Cold Water Resources/In-Stream Flows

Reasonably Foreseeable Compliance Measure	NRCS Practice Name	NRCS Practice Cost	NRCS Practice Code
Irrigation scheduling	Irrigation water management	$28.09-202.12/acre	#449
Efficient application of irrigation water	Microirrigation	$503.85-1835.93/acre	#441
Efficient transport of irrigation water	Installation of piping to replace open ditches	$2.47-5.13/ft	#516
Use of runoff or tailwater	Irrigation system/tailwater recovery	Not available	#447
Management of drainage water	Runoff management system	Not available	#570
Vegetated filter strips	Filter strip	$210.57-448.10/acre	#393
Surface field ditch	Field ditch	Not available	#607
Water table control, controlled drainage	Subsurface drain	$3.86-6.44/ft	#606
Installation of pipeline for off-channel water	Pipeline, rough terrain, steel or plastic	$2.47-5.13/ft	#516
Constructing off-stream pond	Pond up to 50 AcFt	$12,969.38-32,068.24/no.	#378
Installing trough or tank for off-channel water	Watering facility	$1,958.69-5,020.64/no.	#614
Constructing well	Water well	$15,413.45-41,537.97/no.	#642
Improving springs	Spring development	$2,629.19-4,335.61/no.	#574
Barrier removal (dam)	NA	$10,00 -500,000/per	CDFW Coho Recovery Plan
Barrier removal (non-structural sites)	NA	$2,400-34,000/per	CDFW Coho Recovery Plan
Barrier removal (stream crossings)	NA	$15,000-500,000/per	CDFW Coho Recovery Plan
Riparian revegetation	NA	$5,000-135,000/acre	CDFW Coho Recovery Plan
Streambank restoration	NA	$125.00/ft^2	CDFW Coho Recovery Plan
Fencing	NA	$3.00-12.00/Lft	CDFW Coho Recovery Plan

10.4 Sources of Funding

Potential sources of funding include monies from private and public sources. Public financing includes, but is not limited to: grant funds, as described below; single-purpose appropriations from federal, state, and/or local legislative bodies; and, bond indebtedness and loans from government institutions.

10.4.1 Summary of Pertinent State Funding Programs

There are several potential sources of public financing through grant and funding programs administered, at least in part, by the Regional Water Board and the State Water Board. These programs vary over time depending upon federal and state budgets and ballot propositions approved by voters. State funding programs pertinent to the proposed Basin Plan amendment are summarized and described below. Additional information can be found on the State Water Resources Control Board webpage (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/).

Agricultural Drainage Loan Program

The Agricultural Drainage Loan Program was created by the Water Conservation and Water Quality Bond Act of 1986 to address treatment, storage, conveyance, or disposal of agricultural drainage water that threatens waters of the State. There is a funding cap of $20 million for implementation projects and $100,000 for feasibility studies. Loan repayments are for a period of up to 20 years.

Agricultural Drainage Management Loan Program

The Agricultural Drainage Management Loan Program, created by Proposition 204 and distributed through the Agricultural Drainage Management Subaccount, provides loan and grant funding for Drainage Water Management Units. Drainage Water Management Units are land and facilities for the treatment, storage, conveyance, reduction or disposal of agricultural drainage water that, if discharged untreated, would pollute or threaten to pollute the waters of the State. This program is available to any city, county, district, joint power authority, or other political subdivision of the State involved with water management.

Agricultural Water Quality Grants Program

The Agricultural Water Quality Grant Program provides funding for projects that reduce or eliminate non-point source pollution discharge to surface waters from agricultural lands. Funding from Propositions 50 has approximately $15 million in grant funding is available under this funding cycle. Eligible projects include:

- Agricultural Water Use Efficiency Implementation Projects that result in water savings, increased in-stream flow, increased water quality, and increased energy efficiency
- Agricultural Water Use Efficiency Technical Assistance, Planning, Feasibility Studies, Research and Development, Training, Education, Public Outreach, and Pilot projects

Federal Clean Water Act Section 319 Nonpoint Source Implementation Program
This program is an annual federally funded nonpoint source pollution control program that is focused on controlling activities that impair beneficial uses and on limiting pollutant effects caused by those activities. States must establish priority rankings for waters on lists of impaired waters and develop action plans, known as Total Maximum Daily Loads (TMDLs), to improve water quality. Project proposals that address TMDL implementation and those that address problems in impaired waters are favored in the selection process. There is also a focus on implementing management activities that lead to reduction and/or prevention of pollutants that threaten or impair surface and ground waters.

Clean Water State Revolving Fund
The Federal Water Pollution Control Act (Clean Water Act or CWA), as amended in 1987, provides for establishment of a Clean Water State Revolving Fund (CWSRF) program. The program is funded by federal grants, State funds, and Revenue Bonds. The purpose of the CWSRF program is to implement the CWA and various State laws by providing financial assistance for the construction of facilities or implementation of measures necessary to address water quality problems and to prevent pollution of the waters of the State.

The CWSRF Loan Program provides low-interest loan funding for construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, water recycling facilities, as well as, expanded use projects such as implementation of nonpoint source (NPS) projects or programs, development and implementation of estuary Comprehensive Conservation and Management Plans, and storm water treatment.

Integrated Regional Water Management Grants
Integrated Regional Water Management (IRWM) is a collaborative effort to manage all aspects of water resources in a region. IRWM crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions.

The Department of Water Resources has a number of IRWM grant program funding opportunities. Current IRWM grant programs include: planning, implementation, and stormwater flood management. DWR's IRWM Grant Programs are managed within DWR's Division of IRWM by the Financial Assistance Branch with assistance from the Regional Planning Branch and regional offices.

10.4.2 Summary of Pertinent Federal Funding Programs
Several federal agencies, including but not limited to the U.S. Environmental Protection Agency, NOAA Fisheries, U.S. Fish and Wildlife Service, and USDA Natural Resources Conservation Service, also provide grants and other funding opportunities. Table 10-4 presented below provides a summary of the pertinent federal funding programs.

The U.S. Environmental Protection Agency provides access through its webpage to a catalog of federal funding opportunities:
http://water.epa.gov/grants_funding/shedfund/databases.cfm

The U.S. Department of Agriculture – Natural Resource Conservation Service has a wide variety of agricultural/timber financial support programs. The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, a purpose of EQIP is to help producers meet Federal, State, Tribal and local environmental regulations. The financial assistance programs include:

Agricultural Management Assistance
Agricultural Water Enhancement Program
Air Quality Initiative
Cooperative Conservation Partnership Initiative
Conservation Innovation Grants
Conservation Stewardship Program
Environmental Quality Incentives Program
Emergency Watershed Protection Program
Wildlife Habitat Incentive Program

Website http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/

For additional agriculture specific grants:
http://www.grants.gov/search-grants.html?fundingCategories%3DAG%7CAgriculture

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
Aquatic Ecosystem Restoration (CAP Section 206)	Work under this authority may carry out aquatic ecosystem restoration projects that will improve the quality of the environment, are in the public interest, and are cost-effective. There is no requirement that an existing Corps project be involved
Bring Back the Natives Grant Program	The Bring Back the Natives initiative (BBN) funds on-the-ground efforts to restore native aquatic species to their historic range. Projects should involve partnerships between communities, agencies, private landowners, and organizations that seek to rehabilitate streamside and watershed habitats. Projects should focus on habitat needs of species such as fish, invertebrates, and amphibians that originally inhabited the waterways across the country. Funding for the BBN program is administered through NFWF from federal agencies cooperating to support this program. Cooperating agencies and organizations include the US Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), USDA Forest Service (USFS), and Trout Unlimited (TU).
Coastal Program	The U.S. Fish and Wildlife Service (USFWS) Coastal Program works to conserve healthy coastal habitats on public or private land for the benefit of fish, wildlife, and people in 22 specific coastal areas. The program forms cooperative partnerships designed to (1) protect costal habitats by providing technical assistance for conservation easements and acquisitions; (2) restore coastal wetlands, uplands, and riparian areas; and (3) remove barriers to fish passage in coastal watersheds and estuaries. Program biologists provide restoration expertise and financial assistance to federal and state agencies, local and tribal governments, businesses, private landowners, and conservation organizations such as local land trusts and watershed councils.
Community-based Habitat Restoration Partnership Grants	The NOAA Community-based Restoration Program (NOAA CRP) provides funds for small-scale, locally driven habitat restoration projects that foster natural resource stewardship within communities. The program seeks to bring together diverse partners to implement habitat restoration projects to benefit living marine resources. Projects might include restoring salt marshes, mangroves, and other coastal habitats; improving fish passage and habitat quality for anadromous species; removing dams; restoring and creating oyster reefs, removing exotic vegetation and replanting with native species; and similar projects to restore habitat or improve habitat quality for populations of marine and anadromous fish.
Conservation Reserve Program	The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners. Through CRP, you can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland.
Conservation Security Program	The Conservation Security Program (CSP) is a voluntary conservation program that supports ongoing stewardship of private lands by providing payment for maintaining and enhancing natural resources. CSP identifies and rewards those farmers and ranchers who are meeting the highest standards of conservation and environmental management on their operations.
Cooperative Watershed Management Program	Department of the Interior Bureau of Reclamation. The purpose of the Cooperative Watershed Management Program is to enhance water conservation, including alternative uses; improve water quality; improve ecological resiliency of a river or stream;, and to reduce conflicts over water at the watershed level by supporting the formation of watershed groups to develop local solutions to address water management issues.
Emergency Watershed	The USDA Natural Resources Conservation Service's Emergency Watershed Protection (EWP) program helps protect lives and property threatened by

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
Protection	natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. EWP provides funding for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing river banks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. EWP also provides funds to purchase floodplain easements as an emergency measure. Floodplain easements restore, protect, maintain, and enhance the functions of the floodplain; conserve natural values including fish and wildlife habitat, water quality, flood water retention, ground water recharge, and open space; reduce long-term federal disaster assistance; and safeguard lives and property from floods, drought, and the products of erosion. EWP can provide up to 90 percent cost share in limited resource areas as determined by the US Census.
Environmental Quality Incentives Program	The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide financial assistance to program participants to implement conservation practices. Persons or legal entities, who are owners of land under agricultural production or who are engaged in livestock or agricultural production on eligible land may participate in EQIP. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. NRCS approves the plan of operations and obligates contract funds for the conservation practices listed in the plan of operations.
Farm and Ranch Lands Protection Program (FRPP)	The USDA Natural Resources Conservation Service's Farmland Protection Program (FPP) is a voluntary program that helps farmers and ranchers keep their land in agriculture and prevents conversion of agricultural land to non-agricultural uses. The program provides matching funds to organizations with existing farmland protection programs that enable them to purchase conservation easements. These entities purchase easements from landowners in exchange for a lump sum payment, not to exceed the appraised fair market value of the land's development rights. The easements are for perpetuity unless prohibited by state law. Eligible land is land on a farm or ranch that has prime, unique, statewide, or locally important soil or contains historical or archaeological resources; supports the policy of a State or local farm and ranch land protection policy; is subject to a pending offer by an eligible entity; and includes cropland, rangeland, grassland, pasture land, forest land and other incidental land that is part of an agricultural operation.
Five-Star Restoration Program	The EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference will

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
	be given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution.
Fish and Wildlife Management Assistance	Department of the Interior Fish and Wildlife Service Funds may be used to conduct fish and wildlife management activities that align with the conservation, restoration, and management goals and priorities of the Fish and Wildlife Conservation Offices. This includes goals and priorities identified by the National Fish Passage Program (NFPP) and individual partnerships under the National Fish Habitat Partnership (NFHP). Restoration work can consist of habitat construction activities such as culvert replacements, damn removals, fishway construction, installation of fish habitat structures and vegetation plantings. Examples of funded activities include habitat restoration (stream improvements or deconstruction of barriers to increase quality of aquatic habitats), monitoring and assessment, removal of barriers to passage, fish propagation, and aquatic plant establishment. This also includes efforts to minimize the establishment, spread, and impact of aquatic invasive species, including those efforts conducted under the auspices of the State/Interstate Aquatic Nuisance Species (ANS) Management Plan Grant Program. Technical assistance –in the form of advice on biological, chemical, and/or physical aspects of a project –is also available to awardees. Awardees are expected to include a public outreach component in their project. Applicants applying for State/Interstate ANS Management Plan funds must be a State or Interstate organization with an ANS Task Force approved plan.
Healthy Forests Reserve Program	The Healthy Forests Reserve Program (HFRP) is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to: 1) promote the recovery of threatened and endangered species, 2) improve biodiversity; and, 3) enhance carbon sequestration. Program implementation has been delegated by the Secretary of Agriculture to the Natural Resources Conservation Service.
Forest Legacy Program	Through its Forest Legacy Program (FLP), the USDA Forest Service supports state efforts to protect environmentally sensitive forest lands from the conversion to non-forest uses through the use of conservation easements and fee-simple purchase. Designed to encourage the protection of privately owned forest lands, FLP is an entirely voluntary program. The program enables landowners to retain ownership of their land and continue to earn income from it while keeping drinking water safe and clean, conserving valuable open space as well as protecting critical wildlife habitats and outdoor recreation opportunities. The program promotes professional forest management and requires forest management plans. The program emphasizes strategic conservation - working in partnership with States, local communities and non-governmental organizations to make a difference on the land and for communities by conserving areas of

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
	unbroken forest, watershed or river corridor forests or by complimenting existing land conservation efforts. FLP conservation easements restrict development, protect a range of public values and many require public access for recreation.
NOAA Open Rivers Initiative	The NOAA Open Rivers Initiative (ORI) provides funding and technical expertise for community-driven, small dam and river barrier removals, primarily in coastal states. Projects are expected to provide an economic boost for communities, enhance public safety, and improve populations of NOAA trust resources such as striped bass, Atlantic and shortnose sturgeon, Atlantic and Pacific salmon, American eel, American shad, blueback herring, and alewife. Proposals selected will be implemented through a cooperative agreement
National Integrated Water Quality Program (NIWQP)	The National Integrated Water Quality Program (NIWQP) provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds. The NIWQP has identified eight "themes" that are being promoted in research, education and extension. The eight themes are (1) Animal manure and waste management (2) Drinking water and human health (3) Environmental restoration (4) Nutrient and pesticide management (5) Pollution assessment and prevention (6) Watershed management (7) Water conservation and agricultural water management (8) Water policy and economics. Awards are made in four program areas - National Facilitation Projects, Regional Coordination Projects, Extension Education Projects, and Integrated Research, Education and Extension Projects. Please note that funding is only available to universities.
National Wildlife Refuge Friends Group Grant Program	The National Fish and Wildlife Foundation provides grants for projects that help organizations to be effective co-stewards of our Nation's important natural resources within the National Wildlife Refuge System. This program provides competitive seed grants to help increase the number and effectiveness of organizations interested in assisting the refuge system nationwide. The program will fund: (1) Start-up Grants to assist starting refuge support groups with formative and/or initial operational support (membership drives, training, postage, etc.); (2) Capacity Building Grants to strengthen existing refuge support groups' capacity to be more effective (outreach efforts, strategic planning, membership development); and (3) Project Specific Grants to support a specific project (conservation education programs for local schools, outreach programs for private landowners, habitat restoration projects, etc.)
Native Plant Conservation Initiative	The National Fish and Wildlife Foundation's Native Plant Conservation Initiative (NPCI) supports on-the-ground conservation projects that protect, enhance, and/or restore native plant communities on public and private land. Projects typically fall into one of three categories and may contain elements of each: protection and restoration, information and education, and inventory and assessment. Applicants are encouraged, when appropriate, to include a pollinator component in their project. This program is funded by the Bureau of Land Management, Forest Service, Fish and Wildlife Service, and National Park Service.
North American Wetlands Conservation Act Grants Program	The U.S. Fish and Wildlife Service's Division of Bird Habitat Conservation administers this matching grants program to carry out wetlands and associated uplands conservation projects in the United States, Canada, and Mexico. Grant requests must be matched by a partnership with nonfederal

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
	funds at a minimum 1:1 ratio. Conservation activities supported by the Act in the United States and Canada include habitat protection, restoration, and enhancement. Mexican partnerships may also develop training, educational, and management programs and conduct sustainable-use studies. Project proposals must meet certain biological criteria established under the Act. Visit the program web site for more information. (Click on the hyperlinked program name to see the listing for "Primary Internet".)
Partners for Fish and Wildlife Program	The Partners for Fish and Wildlife Program provides technical and financial assistance to private landowners to restore fish and wildlife habitats on their lands. Since 1987, the program has partnered with more than 37,700 landowners to restore 765,400 acres of wetlands; over 1.9 million acres of grasslands and other upland habitats; and 6,560 miles of in-stream and streamside habitat. In addition, the program has reopened stream habitat for fish and other aquatic species by removing barriers to passage.
Pesticide Environmental Stewardship Grants	EPA's Pesticide Environmental Stewardship Program (PESP) offers grants to support the reduction of risks from pesticides in agricultural and non-agricultural settings, and to implement pollution prevention measures. All organizations with a commitment to pesticide risk reduction are eligible to join PESP as members, either as Partners or as Supporters. For more information about membership requirements and available grants, click on the program name and refer to the link listed under "Primary Internet."
Project Modifications for Improvement of the Environment (CAP Section 1135)	Work under this authority provides for modifications in the structures and operations of water resources projects constructed by the Corps of Engineers to improve the quality of the environment. Additionally, the Corps may undertake restoration projects at locations where an existing Corps project has contributed to the degradation. The primary goal of these projects is ecosystem restoration with an emphasis on projects benefiting fish and wildlife. The project must be consistent with the authorized purposes of the project being modified, environmentally acceptable, and complete within itself
Pulling Together Initiative	The National Fish and Wildlife Foundation's Pulling Together Initiative (PTI) provides a means for federal agencies to partner with state and local agencies, private landowners, and other interested parties to develop long-term weed management projects within the scope of an integrated pest management strategy. The goals of PTI are: (1) to prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships; and (2) to increase public awareness of the adverse impacts of invasive and noxious plants. PTI provides support on a competitive basis for the formation of local weed management area (WMA) partnerships, allowing them to demonstrate successful collaborative efforts and develop permanent funding sources for the maintenance of WMAs from the involved parties. Successful projects will serve to increase public awareness and interest in future partnership projects.
Watershed Protection and Flood Prevention Program	Also known as the 'Watershed Program' or the 'PL 566 Program,' this program provides technical and financial assistance to address water resource and related economic problems on a watershed basis. Projects related to watershed protection, flood mitigation, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, agricultural water conservation, and public recreation are eligible for assistance. Technical and financial assistance is also available for planning new watershed surveys.

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
Sustainable Agriculture Research and Education	The Sustainable Agriculture Research and Education (SARE) program of the U.S. Department of Agriculture works to advance farming systems that are more profitable, environmentally sound and good for communities through an innovative grants program. More specifically, SARE funds scientific investigation and education to reduce the use of chemical pesticides, fertilizers, and toxic materials in agricultural production; to improve management of on-farm resources to enhance productivity, profitability, and competitiveness; to promote crop, livestock, and enterprise diversification and to facilitate the research of agricultural production systems in areas that possess various soil, climatic, and physical characteristics; to study farms that have are managed using farm practices that optimize on-farm resources and conservation practices; and to promote partnerships among farmers, nonprofit organizations, agribusiness, and public and private research and extension institutions. Click on program name and check the link in the Primary Internet box for more information about grant opportunities and program results.
Watershed Rehabilitation Program	This program provides Federal cost-share funding for the rehabilitation of aging dams that were installed primarily through the Watershed Protection and Flood Prevention Program over the past 55 years. The purpose for rehabilitation is to extend the service life of dams and bring them into compliance with applicable safety and performance standards or to decommission the dams so they no longer pose a threat to life and property.
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Watershed Restoration and Enhancement Agreement Authority	Department of Agriculture Forest Service. Projects that protect, enhance, or restore resources within a watershed and provide tangible benefits to achieving Forest Service goals and objectives are allowable under Wyden. Project types are not limited to actual projects on the ground; for example, stream gabion installation, check dam construction, fish habitat restoration, or culvert cleaning. Watershed analysis studies, habitat surveys and wildlife species monitoring, depending on the benefit to resources within the watershed, are also permissible under Wyden. Any project carried out under Wyden authority must comply with all applicable Federal, State and local laws and regulations, policies and permit requirements; for example, National Environmental Policy Act, Clean Water Act, and Endangered Species Act. Projects must be within a watershed for the stated program objectives. Use of grants is restricted to State and Private Forestry funding.
Wetlands Reserve Program	Through this voluntary program, the USDA Natural Resources Conservation Service (NRCS) provides landowners with financial incentives to restore and protect wetlands in exchange for retiring marginal agricultural land. To participate in the program landowners may sell a conservation easement or enter into a cost-share restoration agreement (landowners voluntarily limit future use of the land, but retain private ownership). Landowners and the NRCS jointly develop a plan for

Table 10-4 Summary of Pertinent Federal Funding Programs	
Funding Program	**Program Description**
	the restoration and maintenance of the wetland.
Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat on private lands. It provides both technical assistance and cost sharing to help establish and improve fish and wildlife habitat. Participants work with USDA's Natural Resources Conservation Service to prepare a wildlife habitat development plan in consultation with a local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement.

11.0 PUBLIC PARTICIPATION

This chapter describes some of the opportunities that have been made available to the public for comment on and participation in the development of the *Policy to Implement the Water Quality Objectives for Temperature* and *Action Plans to Address Temperature Impairments in the Mattole, Navarro, and Eel River Watersheds*.

11.1 Temperature Policy Statement Resolution Process

The *Policy Statement for Implementation of the Water Quality Objective for Temperature in the North Coast Region* (policy statement; Resolution No. R1-2012-0013) established the scope and approach of this Policy and directed its incorporation into the Basin Plan. The content of the policy statement is incorporated into this Policy. The Regional Water Board held three public hearings as part of the policy statement adoption process: on September 29, 2011, November 3, 2011, and January 19, 2012. That process included two public comment periods. Additionally, Regional Water Board staff held numerous meetings with stakeholders during that process.

11.2 CEQA Scoping

Regional Water Board staff held CEQA scoping meetings on February 15th, 27th and 28th, 2013, in Santa Rosa, Bayside, and Yreka CA, respectively. Forty-one comments were received in written form, while 59 were received in verbal form at the scoping meetings. Comments were received from five federal, state and local agencies, eight nongovernmental organizations and special-interest groups, and four individuals. See section 9.2.2 for further discussion.

11.3 Presentations to the Regional Water Board

Regional Water Board staff has provided two updates to the Regional Water Board as information items at Regional Water Board meetings. The first of these was on March 15, 2012, and focused on the schedule for the development of this Policy. The second was on June 13, 2013. At that meeting staff presented a broad overview of the history, approach, status, and remaining steps in the process of developing this Policy.

11.4 Other Activities

Regional Water Board staff has taken the opportunity to discuss the development and approach of this Policy at various meetings in 2012 and 2013. Staff has given brief updates and overviews of the Policy at the Eel River Watershed Forum, Cal Fire's Section V Technical Advisory Committee meetings, a Sonoma County Planning Commission meeting, and other similar venues. Additionally, staff organized a meeting with the plaintiffs in the lawsuit that resulted in the Stipulated Agreement (see section 6.1) on May 28, 2013. Staff also organized meetings with environmental advocates on June 26, 2013, Farm Bureau representatives on August 9, 2013, and with forestry advocates on August 13, 2013.

11.5 TMDL Development Process

The development of technical TMDL analyses for the Mattole, Navarro, and Eel River TMDLs included a full public participation process at the time of their development. Each of the processes included at least one public meeting in or near the watershed, as well as a public hearing, public comment solicitation, and responses to comments. The public process for each of these TMDLs is discussed below for completeness. The following discussion paraphrases the public participation discussions contained in the individual TMDLs.

Mattole River Temperature TMDL

The USEPA and Regional Water Board staff held two public meetings in the Mattole River watershed during the public comment period on the draft TMDL. The first was held on November 12, 2002, at the Mattole Grange in Petrolia, and the second was held on November 13, 2002, at the Whitethorn Grange in Whitethorn. Staff from the USEPA and the Regional Water Board staff gave presentations on the content of the draft TMDL and associated Technical Support Document (TSD) and answered questions from the public at those meetings. A legal notice was placed in the Eureka Times-Standard and Humboldt Beacon, which are newspapers of general circulation in the Mattole River watershed. In addition, the public comment period was announced in the Mattole Restoration Council newsletter distributed during the comment period. The USEPA prepared a response for all written comments on the draft TMDLs received during the comment period, as well as the major comments from the informational public meetings. (USEPA 2002a)

Navarro River Temperature TMDL

The USEPA placed a public notice of the draft Navarro River temperature TMDL in the Santa Rosa Press Democrat, Anderson Valley Advertiser, and Mendocino Beacon, which are newspapers of general circulation in the Navarro River watershed. The USEPA held a public meeting on Tuesday, October 3, 2000, at the Apple Hall Dining Room at the Mendocino County Fairgrounds in Boonville. At the meeting, staff of the USEPA and Regional Water Board described the TMDL and answered questions regarding them. The USEPA prepared a written response to all written comments on the draft TMDL received by EPA during the comment period. In response to comments, the Regional Water Board staff conducted additional technical analysis on the impacts of flow conditions on temperature. A technical addendum was prepared and the draft TMDL was revised. The TMDL established by the USEPA were largely based on the TSD prepared by Regional Water Board staff. Regional Water Board staff provided for public participation in the development of the TSD through meetings, presentations, and a newsletter. (USEPA 2000)

South Fork Eel River Temperature TMDL

The USEPA held two public meetings in Garberville, several meetings with interested parties, a public hearing, and responded to public comments through changes to the TMDL and a comment response summary. In addition, USEPA staff participated in a radio show discussing the TMDL. Notices of the availability of the draft TMDL were sent to local newspapers and radio stations, which generated

several newspaper articles in the Eureka Times Standard and Santa Rosa Press Democrat. (USEPA 1999)

North Fork Eel River Temperature TMDL

The USEPA placed a public notice of the draft North Fork Eel River temperature TMDL in the Willits News and Santa Rosa Press Democrat, which are of general circulation in Mendocino and Trinity County, as well as to individuals on the Upper Eel Watershed Forum mailing list. The USEPA prepared a written response to all written comments on the draft TMDL received during the comment period. In addition, an informal meeting to discuss the draft TMDL was held on September 18, 2002 in Covelo. (USEPA 2002b)

Middle Fork Eel River Temperature TMDL

The USEPA placed a public notice of the draft Middle Fork Eel River Temperature TMDL in the Willits News and Santa Rosa Press Democrat, which are papers of general circulation in Mendocino and Trinity Counties. In addition, the USEPA sent a notice to those on the mailing list of the Upper Eel Watershed Forum. The USEPA held a public meeting on October 16, 2003, in Covelo, California. The USEPA prepared a responsiveness summary that addressed all the comments that were received during the public comment period. (USEPA 2003)

Upper Main Eel River Temperature TMDL

The USEPA placed a public notice of the draft Upper Main Eel River Temperature TMDL in the Willits News and Santa Rosa Press Democrat, which are papers of general circulation in Mendocino County. The USEPA also met with PG&E, Friends of the Eel River, and National Marine Fisheries Service during the Fall of 2003. The USEPA held a meeting in Willits during the summer of 2004 for landowners whose land was to be surveyed for the sediment source analysis. The public notice regarding availability of the draft Upper Main Eel TMDL was posted on the USEPA's web site, and mailed or emailed to additional parties. The USEPA prepared a responsiveness summary that addressed all the comments that were received during the public comment period. (USEPA 2004)

Middle Main Eel River Temperature TMDL

The USEPA placed a public notice of the draft Middle Main Eel River Temperature TMDL in the Willits News and Eureka Times-Standard, papers of general circulation in Mendocino, Humboldt, and Trinity counties. The USEPA and the Regional Water Board staff also held public meetings in Alderpoint in April and November 2005 to discuss the TMDL. The public notice regarding availability of the draft Middle Main Eel TMDLs was posted on the USEPA's web site and mailed or emailed to additional parties. The USEPA received 3 comments on the draft TMDL and made revisions based upon those comments. (USEPA 2005)

Lower Main Eel River Temperature TMDL

The USEPA placed a public notice of the draft Lower Eel River Temperature TMDLin the Willits News and Eureka Times-Standard, papers of general circulation in

Mendocino and Humboldt counties. The USEPA also discussed the TMDL with various land owners in the watershed, beginning in early 2006. The public notice regarding availability of the draft Lower Eel River TMDL was posted on the USEPA's web site and mailed or emailed to additional parties.

A public meeting on the draft Lower Eel River Temperature TMDL was held on October 22, 2007, at the Six Rivers National Forest conference room in Eureka, California. The USEPA also responded to inquiries for information during the public comment period. The USEPA reviewed all written comments that were received during the public comment period, revised the final TMDL as appropriate, and prepared a responsiveness summary that addresses the comments received. (USEPA 2007)

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Appendix 1: Regional Water Board Staff Response to Peer Review Comments on the Peer Review Draft Staff Report Supporting the Policy for the Implementation of the Water Quality Objectives for Temperature

August 28, 2013

In accordance with Section 57004 of the California Health and Safety Code, the North Coast Regional Water Quality Control Board (Regional Water Board) is required to receive external scientific peer review of the scientific basis of any proposed amendment to the Water Quality Control Plan for the North Coast Region (Basin Plan).

This document is a compilation of comments provided by the scientific peer reviewers of the Peer Review Draft Staff Report Supporting the Policy for the Implementation of the Water Quality Objectives for Temperature, July 1 2013.

The following individuals provided scientific peer review of the Peer Review Draft Staff Report Supporting the Policy for the Implementation of the Water Quality Objectives for Temperature:

Mark T. Stacey, Ph.D.
Professor, Department of Civil and Environmental Engineering
University of California

John C. Stella, Ph.D.
Assistant Professor
Department of Forest and Natural Resources Management
State University of New York

Sally E. Thompson, Ph.D.
Assistant Professor
Department of Civil and Environmental Engineering
University of California

The reviewers were asked to evaluate 6 statements representing the assumptions, assertions, and conclusions that constitute the scientific basis of the proposed actions to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. Reviewers were also invited to address any other scientific issues that should be part of the scientific portion of the proposed rule that are not otherwise described. Finally, the reviewers were invited to comment on whether taken as a whole, the scientific portion of the proposed actions are based upon sound scientific knowledge, methods, and practices.

The reviewer's comments and Regional Water Board staff responses are presented below.

1. Increased solar radiation loads are the primary controllable driver of elevated water temperatures. Increasing solar radiation loads (decreased shade) result in increasing stream temperatures. Preserving shade is a legitimate means of preventing stream temperature increases.

Stacey 1:
The approach of preserving shade is well argued and presented, but the conceptual model for how shade interacts with other factors should be further developed, in particular the role of air temperature, equilibrium temperature and the interaction of shade and flow in defining the spatial structure of water temperature must be considered both in the discussion of the factors that govern water temperature and in defining the "natural state" for the system (discussed above in "Big Picture" comments).

Regional Water Board response:
Additional discussion describing equilibrium temperature and the interaction of temperature drivers has been added to the report in response to the comment.

Thompson 1:
Firstly, it is clear from the review presented by the scientists here, as well as other research, that solar radiation is not *always* the primary driver of elevated water temperatures. Examples can be readily found where lowered groundwater tables (Loinaz, Davidsen et al. 2013), surface water diversions, point-scale discharges (Loinaz, Davidsen et al. 2013), agricultural return flows (Oremland, Steinberg et al. 1991; Fujimoto, Ouchi et al. 2008), and potentially anthropogenic climate change (Roth, Westhoff et al. 2010) contribute to stream temperature increases. While Conclusion 5 "Evaluation of these impacts is most appropriate on a site-specific, case-by-case basis" broadly covers these distinctions, it may be appropriate to consider rephrasing Conclusion 1:

"Increased solar radiation loads are **likely to be** the primary controllable driver of elevated water temperatures **in most waterways in the North Coast Region**."

Regional Water Board response:
Regional Water Board staff acknowledge that the suggested qualifiers are appropriate. The conclusion referred to was written to direct the reviewers to the scientific issues in the Policy; however, the specific language is not contained in the Policy. The temperature impacts associated with surface water diversions, point source discharges, and agricultural return flows are addressed through this Policy. Staff have modified the staff report to reflect the qualified statement.

Thompson 2:
Secondly it is not clear that preserving shade will *always* be effective in preventing stream temperature increases. The value of riparian shading for temperature modification is contingent on channel width (Moore, Spittlehouse et al. 2005). In

large streams where riparian canopies cannot effectively shade the entire water surface, riparian shading is unlikely to modify stream temperature on average (Lee, Huang et al. 2012). Similarly, the importance of riparian shading for temperature control appears to vary throughout the river network. A recent study suggests that **riparian buffers may have minimal influence on the temperature of headwater streams**. In a clear-cut experiments over 11 small headwater channels (1.9 – 8.5 ha watersheds) in Washington State, Janisch et al. (2012) found no significant differences in temperature between clear cut channels, continuously buffered channels, and patch-buffered channels. Tree cover provided little predictive insight into temperature changes, which were more strongly correlated to the total water surface area in the streams.
Again, the case-by-case approach suggested in Conclusion 5 is suitable for addressing many of these special cases. These observations do suggest, however, that a more cautious statement about the legitimacy of preserving shade to maintain low stream temperatures might be warranted.

"Where existing stream channel shading is extensive or can otherwise be shown to represent a significant control on stream temperatures, preserving shade is a legitimate means of preventing stream temperature increases."

Regional Water Board response:
Staff agrees that shade is not an effective means of preventing temperature increases in streams with great widths in relation to tree heights, on average. Staff also agrees with Dr. Thompson's comment (Thompson 12) that shade provided by vegetation may be ecologically significant in situations where it reduces solar loading to thermal refuges. Language acknowledging these concepts has been incorporated into the staff report.

Staff have reviewed the article by Janisch, et al (2012), and note the authors' reservations that confounding factors were not controlled in the experiment, such as the shade provided by slash debris, the composition of the streambed substrate, and the degree of interaction with wetlands. Both the interaction with wetlands and the substrate composition were shown to correlate with temperatures after the fact. Furthermore, the authors point out that while the results of the study generally show higher temperature increases in clear cut streams versus buffered streams, the results did not agree with other studies of headwater streams (Gomi et al 2006), that showed much higher temperature increases associated with loss of shade. The authors point out the extremely low flows that existed during the experiment, as well as the possibility that the temperatures were buffered by hyporheic exchange. The sum of this information indicates that in some cases thermal processes other than solar insolation may be the dominant process determining stream temperatures. Language acknowledging this concept has been incorporated into the staff report.

Thompson 3:
Site potential effective shade: The site potential effective shade concept is appealing, but will present challenges in terms of evaluation over large scales, realism and consistency between different locations with different land use history, climate, geology etc. In highly disturbed systems where streams are already extensively managed, linking channels to local natural benchmarks may be unrealistic. By setting TMDL levels on shade as a function of potential shading, problematic situations could arise where the shade could be considered highly impacted, even where full shading would do little to affect bulk stream temperatures (the lower reaches of large rivers again provide an example of this situation). These distinctions are addressed at the policy level based on the proposed site-specific approach. The TMDL development, however, does not seem to have adopted a fully site-specific approach by linking TMDLs to potential effective shading, rather than the temperature changes that could be achieved by potential effective shading.

Regional Water Board response:
The topic of when shade controls are not effective at controlling temperatures, such as wide stream channels relative to the height of vegetation, has been incorporated into the staff report.

Stella 1:
From the large number of studies conducted, it appears that riparian shade is the major driver of water temperature that can be controlled directly by human land management actions…

Regional Water Board response:
Comment noted.

2. The establishment of riparian buffers for temperature protection is an effective and important management measure for the control of some types of sediment and discharges.

Stacey 2:
I found the report convincing that many management actions would act to control sediment discharge and water temperature simultaneously. However, the causal link between sediment loads and water temperature is less well established, but in my opinion it doesn't need to be.

Regional Water Board response:
Comment noted. The causal link between sediment loads and water temperature is discussed below.

Thompson 4:
It is uncontroversial that the presence of riparian vegetation will reduce rates of bank erosion and sediment mobilization in many circumstances (Liu, Zhang et al.

2008). Provided the spatial extent of riparian vegetation is large enough (both in terms of buffer width, buffer slope and buffer length along the channel), and the vegetation is sufficiently dense, it is feasible that riparian vegetation will provide an important management measure to prevent addition of sediment into streams.

Regional Water Board response:
Comment noted.

Thompson 5:
Two things are unclear in this conclusion specifically, and in the policy overall. The first is the basis for defining a riparian buffer. The second is whether the "establishment of riparian buffers" is intended purely as a preventative measure (to preserve existing vegetation and prevent future impacts) or if it also is considered a technique for mitigation, offset or restoration. Assessing the likely value of restoration for both sediment and temperature management perspectives is considerably more problematic than assessing the value of prevention. I have expanded on these comments under the "Big Picture" section.

Regional Water Board response:
These issues are addressed in the response to the "big picture" comments, below.

Thompson 6:
All the provided supporting information relates to in-channel geomorphology, which may be negatively impacted by increased sediment loading on streams. The additional role of sediment in increasing turbidity, which alters the absorption of light by the water column was not discussed (Henderson-Sellers 1986). It is unclear whether this factor has been overlooked or considered unimportant in this study. It may be more direct to develop conclusions about channel geomorphology, and the value of riparian vegetation for channel geomorphology (by stabilization of banks and regulation of sediment discharges).

Regional Water Board response:
Staff has been unable to find support in the literature for the hypothesis that turbidity has a significant effect on stream temperatures. Staff are familiar with the literature on stream heating processes and note that the seminal works on the topic are silent on the topic of turbidity (e.g., Poole and Berman 2001, Sinokrot and Stefan 1993, Webb et al 2008). It may be that turbidity impacts the distribution of temperatures in the water column. The notion that turbidity leads to increased temperatures through altering the absorption of light doesn't comport with the known properties of water, where water bodies act as "black bodies" with high absorption properties. To some degree the issue is moot, because turbidity is most often present at times when temperatures are not a concern, and more significantly turbidity is a pollutant that is already regulated. The water quality objective for turbidity requires turbidity be increased no more than 20% above background, which is a relatively stringent standard.

Stella 2:
…Maintaining some form of riparian buffer protection throughout a network, particularly in low-order stream reaches, should result in the preservation of more riparian shade and consequently lower levels of solar heating to the water surface.

Regional Water Board response:
Comment noted.

3. The diversion and storage of water has the potential to elevate water temperatures.

Stacey 4:
As described in the "Big Picture" comments above, the interplay between shade, flow and air temperature (even though it is external to management control) should be more clearly developed in the report. Flow has a similar effect on water temperature to shade: both reduce the rate at which the water temperature approaches its equilibrium. As such, changes in flow can mitigate or accentuate the effectiveness of shade in pursuing the policy objectives.

Regional Water Board response:
See response to Stacey 1.

Thompson 7:
Again, this conclusion is substantively sound, with minor caveats. Reductions in flow will reduce the thermal mass and the velocity within a stream. This can be readily observed from the energy balance equation for a reach:

$$\Delta T = \frac{\sum Q}{\rho C_p V D} L$$

Here ρ is the density of water, Cp the heat capacity of water, V the mean streamflow, D the mean depth, and Q is the net heat exchange. Clearly for lower depths and velocities, greater temperature increases will occur (Moore, Spittlehouse et al. 2005).

It is not always true, however, that storage will increase temperatures. The Klamath River study cited in the Staff Report suggests that thermal delays and reduced temperature extremes result from dam releases. While these delays and reduced temperature extremes may be problematic in unimpaired waterbodies, they may also offer opportunities to mitigate thermal effects in streams that are experiencing high temperature conditions.

Regional Water Board response:
Staff agree that storage of water doesn't always increase temperatures, and that management of cold water from the bottom of reservoirs may provide opportunities to positively affect water temperatures. However, the stated assumption is that the storage of water has the potential to increase water temperatures; the implication is that the Regional Water Board should evaluate such conditions when considering the water quality impacts associated with onstream impoundments.

Thompson 8:
Similarly, diversion of flow suggests that only surface water abstraction has the potential to alter stream temperatures. In groundwater-fed streams, it is clear that significant impacts may also result from groundwater pumping. For instance, in a modeling study, water table fluctuations leading to reduced groundwater input were shown to potentially increase stream temperatures by 0.3 to 1.5^{o}C (Loinaz, Davidsen et al. 2013). This is comparable to the changes associated with solar radiation. Groundwater abstraction has the same potential to influence stream flow and temperatures as surface diversions and should be explicitly identified as such.

Thus, a more appropriate conclusion might be:

Reductions in streamflow due to surface water diversion, groundwater abstraction or storage of water have the potential to elevate water temperatures **and alter the magnitude and temporal pattern of in--stream temperature variations.**

Regional Water Board response:
Staff agrees that groundwater withdrawals have potential to impact stream temperatures, depending on the situation. The topic is explicitly identified in section 4.3 (hydrodynamics) in relation to the Scott River TMDL. The Policy directs staff to address "…activities with the potential to reduce instream summer flows or reduce sources of cold water…", which includes reductions of cold water derived from groundwater.

4. The Policy comprehensively identifies the temperature factors that must be addressed.

Stacey 4:
I think the report does a good job of identifying the important controllable factors, but their interaction is not well-developed, and I think it is a mistake to leave out factors that are not under (immediate) human control (specifically air temperature). Further, although Manning's n is identified as a factor, it is discounted quickly and its effect on both depth and flow, and hence water temperature, are not developed.

Regional Water Board response:

Additional discussion describing equilibrium temperature and the interaction of temperature drivers, as well as air temperatures and channel roughness (Manning's n) has been added to the report in response to this and other comments offered by Dr. Stacey.

Thompson 9:
The policy has identified the major factors that must be addressed, however there is scope to be more explicit and to add some further factors that are likely to be minor in most cases, but might be important in some specific instances:

1. As discussed above, turbidity alters stream energy budgets, and has not been explicitly addressed in this policy.
2. Groundwater abstraction should be more explicitly identified as a factor impacting temperature. Listing it as a "land use" factor is indirect.
3. Similarly, surface water abstraction should be explicitly identified as a factor, rather than considering it a function of land use.
4. Recent studies highlight a national trend of increasing stream temperatures. One potential reason for this may be global warming (Kaushal, Likens et al. 2010). While it is unlikely that this can be addressed at the local level, it may be important to consider stronger local mitigation targets to offset this background of regional temperature rise. For example, if 1^{o}C temperature rises were expected due to background warming, it may be more appropriate to limit in---stream warming to 4^{o}C rather than 5^{o}C, as an uncontrollable factor would be likely to impose the additional 1^{o}C rise.
5. Urbanization is strongly associated with increased stream temperatures, and urban stormwater may thus merit consideration as a point source of heat (Kaushal, Likens et al. 2010). While Northern California is not extensively impacted by urbanization, population growth in the region is likely to mean that urban land area will increase in the future. Since urban development is often planned and regulated, there are real opportunities to design urban water management to minimize thermal impacts on receiving water bodies.
6. Irrigation return flows have a real potential to provide a point heat source and may require more overt consideration (Oremland, Steinberg et al. 1991; Fujimoto, Ouchi et al. 2008).

Regional Water Board response:
The following responses correspond to the numbered points above:
1: See response to comment "Thompson 6", above.
2 & 3: The intent is to address temperature concerns with water withdrawals, both surface and subsurface. The wording "land uses associated with" is meant to be broad to cover the range of activities that may reduce cold water flows. Often the reductions in flows are associated with active diversions, but other land use activities, such as those that limit or eliminate groundwater recharge resulting in

decreased groundwater inputs to a stream, for instance, are not associated with diversions. Text has been added to the report discussing this topic.
4. Additional text has been added discussing the issue of global warming and the associated regulatory implications.
5 & 6. The Policy explicitly directs the Regional Water Board to prevent, minimize, and mitigate temperature alterations associated with "(t)he quality, quantity, location and timing of effluent, storm water, and agricultural return flow discharges."

5. Evaluation of the risk of temperature impacts associated with a project is most appropriate on a site-specific, case-by-case basis.

Stacey 5:
I believe this balance is handled, and justified, well.

Regional Water Board response:
Comment noted.

Thompson 10:
It is *highly appropriate* that temperature impacts should be evaluated on a site specific, case-by-case basis.

Regional Water Board response:
Comment noted.

6. The types of actions necessary to recover a waterbody that is temperature impaired due to reductions in stream shade are the same types of actions that prevent a waterbody from becoming temperature impaired.

Stacey 6:
I commend the authors on the clarity with which they addressed this issue.

Regional Water Board response:
Comment noted.

Thompson 11:
This is scientifically justifiable. The only point of differentiation that requires clarification is how the policy relates to mitigation/offsets/restoration, in the context of impaired versus unimpaired water bodies. There is more confidence and a greater chance of success associated with preventing temperature impairment through the recommended strategies than there is in reversing temperature impairment through restoration, mitigation or offset creation. See big picture comments below.

Regional Water Board response:
Comment noted. The issue of prevention vs restoration is addressed below.

7. "Big Picture" Comments:

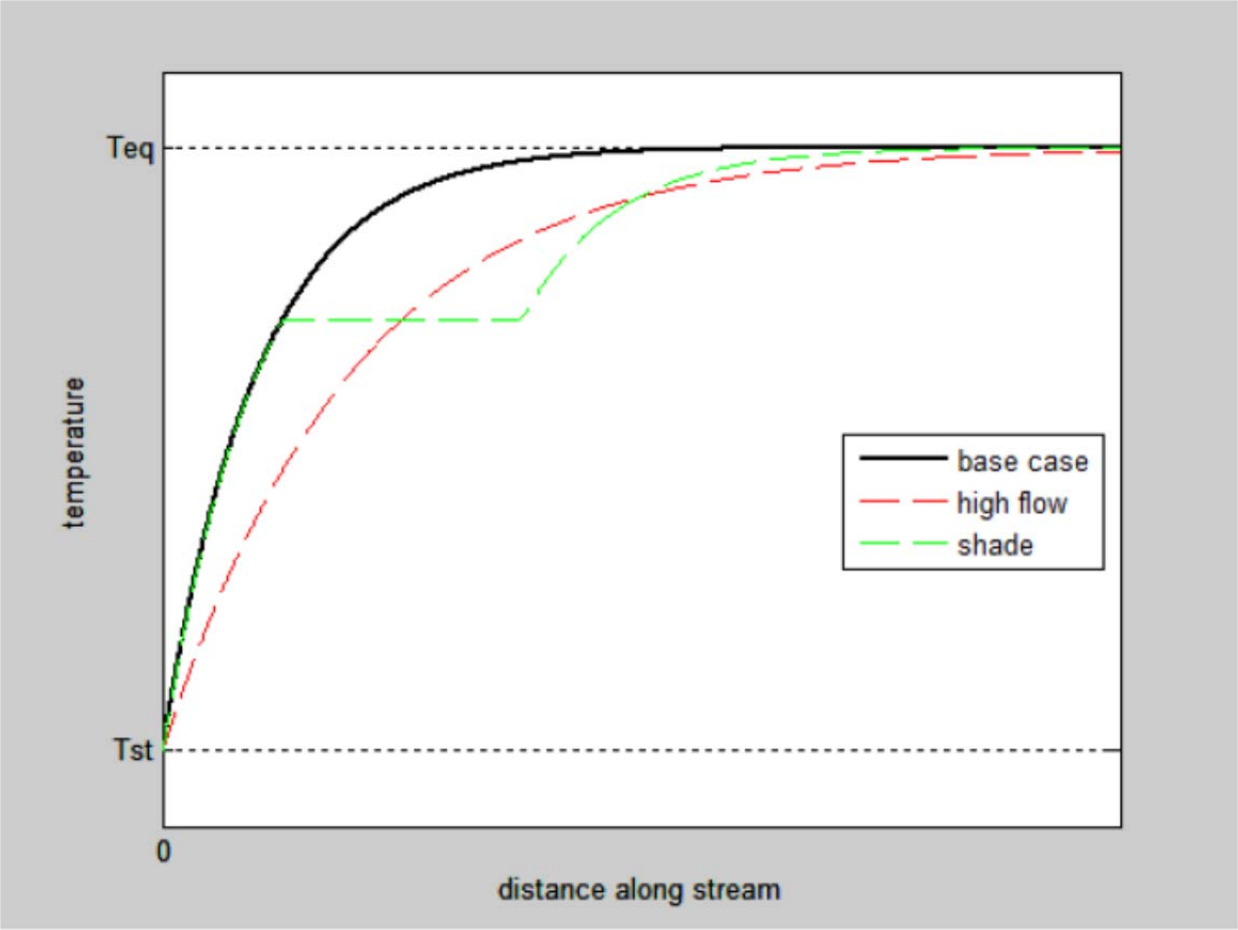
Stacey 7:
Discussion of Conceptual model. The authors make it clear that multiple factors are simultaneously acting to alter stream temperatures, but the description they provide seems to convey a conceptual model that does not address the interactions between the various factors.

Regional Water Board response:
See response to Stacey 1.

Stacey 8:
Further, the role of long-term atmospheric warming must be better integrated into the discussion, as shade, flow and other factors must all be considered in that context. Briefly, air temperature, which will increase by several degrees under most climate projections, establishes the equilibrium temperature for a waterbody. The other factors described in this report, including shade, flow, and ratio of depth to width, affect the *rate* (in space or time) at which the water temperature approaches that equilibrium. As a result, if air temperatures increase, the demands on shade, flow and other factors will increase if water temperatures are to be preserved.

Regional Water Board response:
See responses to Stacey 1, Stacey 4, and Thompson 9.

Stacey 9:
I try to illustrate these interactions with the following, conceptual figure showing the evolution of water temperature along an arbitrary channel reach:



In this case, we start at a cool temperature ('Tst') at the upstream end of the reach, and then the waters approach the equilibrium temperature ('Teq') with distance along the reach. Here I show the temperatures actually reaching the equilibrium temperature, but of course that may or may not happen within a given reach. The key point here is that the base case trajectory will be determined by the equilibrium temperature, which is itself strongly dependent on air temperature and will increase over time with climate forcing. The second case shown in the figure illustrates the effects of increased flow (dashed red line), which decreases the effective spatial rate of approach to the equilibrium temperature (note that the temporal rate of increase remains the same, but the whole temperature distribution is pushed downstream). The final case illustrates how a region of complete shading modifies the temperature trajectory (dashed green line). Here I show the extreme case where in a portion of the reach (the part with the flat part of the green curve) the water temperature does not increase at all in order to illustrate the spatial interactions between these three driving forces. Note that downstream of the shaded section, the water temperature again begins to increase towards the equilibrium temperature; this rate of increase is determined by the flow rate. As such, both shade and flow have similar buffering effects on water temperature – they extent the cool water signature from upstream further down into the reach –

but neither addresses the equilibrium temperature that would be reached at the end of a long reach. I think the report would benefit from a clearer, and more complete, presentation of these factors and how they interact to determine the distribution of water temperature along a stream reach.

Regional Water Board response:
Staff agree with the Dr. Stacey's description of these processes. The concepts discussed above have been incorporated into the staff report.

Stacey 10:
This also leads to a related question as to ***how the "natural state" should be defined***. If "natural state" is based on historical temperatures, then under warming air temperatures, *more* shade or flow would be required than during historical conditions. Alternatively, if "natural state" is based on historical distributions of shade and flow, then preserving the natural state will lead to increases in water temperature due to changes in air temperature (and equilibrium water temperature). In essence, my conceptual picture of the goals of the policy is to do our best to fight a losing battle against increasing air and water temperatures, by making use of shade and flows to mitigate the effects of elevated equilibrium temperatures. Even though air temperatures and, by extension, equilibrium water temperatures are beyond management control, they need to be discussed in order to clearly establish the goals and approaches of the policy.

Regional Water Board response:
This Policy attempts to achieve natural temperatures by restoring and maintaining the conditions that drive temperature consistent with their unaltered states. Dr. Stacey is correct in pointing out that this is to some degree a losing battle in the face of global climate change. Additional language discussing these topics and their regulatory implications has been incorporated into the staff report.

Stacey 11:
Spatial Scales of Interest and Level of Detail in the Report. It was very difficult to determine the approach used to reach the qualitative results, for example in Figure 2 in the report. Even going to the supplementary materials (NCRWQB 2000), I was left with uncertainty as to exactly how these sensitivity calculations were done. Of particular concern in this case is the spatial structure of the calculations and where the analyzed temperatures were relative to the shade. It appears that the analysis was for a single reach with a single-valued fractional shading and the output temperature was at the downstream end of that reach. The sensitivity of water temperature to shading will decrease with distance downstream of the shaded region (as illustrated in the figure above), and it isn't clear what spatial scale should be resolved or considered to meet the policy goals.

Regional Water Board response:
Dr. Stacey is correct that "the analysis was for a single reach with a single-valued fractional shading and the output temperature was at the downstream end of that reach." This has been clarified in the text of the staff report.

Stacey 12:
This leads to a related concern about how ***thermal refugia*** are to be considered, both in the analysis of water temperature and in the application of the policy. Does the removal of a small pool that locally leads to an increase in water temperature of more than 5 degrees violate the standard? How small of a pool would be negligible? I think the report would benefit from a clear statement as to how the authors are thinking about spatial scales of interest, even if it is just to give a context to the report and the results presented (particularly in Figure 2).

Regional Water Board response:
The water quality objective for temperature states "at no time or place" shall temperatures be increased 5^{o}F. This language is unequivocal, thus the consideration of thermal refugia is appropriate. The question of how small of a pool would be negligible relates back to beneficial uses. Water quality objectives are established to maintain beneficial uses, therefore the scale that is relevant is the scale that is significant in the context of the beneficial uses in question. Language describing this concept has been incorporated into the staff report.

Stacey 13:
Finally, I would note that the link between sediment load and water temperature is not well developed. The report does make the effective argument that many of the management options available for controlling water temperature will also help control sediment loading. But, the authors also go on to state that sediment load is one of the factors that causes changes in water temperatures. The reasoning goes that sediment load can (a) change the width-to-depth ratio of the stream; and (b) alter (reduce) hyporheic exchanges, which are sources of cool water at various locations along the streams. While I agree that the effects of fine sediments on hyporheic exchange would likely increase stream temperatures, the scale of the effect, both in terms of the spatial scale and the magnitude of the temperature change, is not analyzed or presented. The report would be more persuasive if these effects were quantified.

Regional Water Board response:
Staff also identified the loss of riparian vegetation associated with channel widening and the loss of thermal refugia associated with stratified pools as possible temperature impacts associated with increased sediment loads. However this discussion was not included in the section titled "Land use activities with the potential to increase sediment delivery." The report includes discussion of a study of Deer Creek in northern California, where Tompkins (2006) found that reduced daily maximum water temperatures in hyporheic seeps on the order of 3.5 ^{o}C (6.3

°F) created thermal refugia for salmonids. The report also discusses a study similar to Tompkins', in which Loheide and Gorelick (2006) documented daily maximum temperature reductions on the order of 2 °C (3.8 °F) in a study of a 1.7 km (1.1. mi) stream reach of Cottonwood Creek in Plumas County, California.

Stacey 14:
With regards to the influence of sediment load on width-to-depth ratio, I would note that this is an indirect effect on water temperature. Further, there are other factors besides sediment load that have strong influence on width-to-depth ratio, ***most notably Manning's n***. I would suggest that the report acknowledge these related influences: that width-to-depth ratio may be the factor that directly influences water temperature (or rather, the rate of change of water temperature as discussed above), but that other factors (such as Manning's n) that are under management control will work to determine the width-to-depth ratio.

Regional Water Board response:
Staff have included language to the staff report acknowledging other factors under management control that determine width-to-depth ratios.

Thompson 12:
One limitation of the existing policy is that the nuances of stream temperature as an indicator of habitat quality are not explored. For example, while bulk stream temperatures may not be affected by bank shading, local cool sites might be generated. These sites are significant aquatic refuges. Because only "stream temperature" was discussed, I have highlighted that riparian vegetation in wide channels may not be significant as a driver of in---channel temperatures. This of course ignores its potential significance in generating local thermal refuges, which can be ecologically significant (Nichols, Willis et al. 2013).

Regional Water Board response:
Staff have added language to the staff report that discusses these concepts. Also, see response to Stacey 12.

Thompson 13:
Significant temporal variability in stream temperatures also often occurs, even within a day. Lags due to travel time between upstream and downstream areas may mean that "pulses" of hot water arrive in different locations at different times. This generates challenges for monitoring, but also variation that can be important for habitat diversity (Nichols, Willis et al. 2013). It is unclear whether or how this policy could account for spatial and temporal variability. There are several anecdotal accounts of misinterpretation of local stream temperatures based on a fixed monitoring time missing the arrival of thermal pulses from upstream. High frequency monitoring methods can circumvent this problem. Explicitly considering the role of localized cool refuges might also provide greater flexibility in identifying site-specific strategies.

Regional Water Board response:
This Policy attempts to achieve natural temperatures by restoring and maintaining the conditions that drive temperature consistent with their unaltered states. This approach addresses spatial and temporal variability through the recognition of the spatial and temporal variability of the drivers of temperature. Regional Water Board staff have found temperature data collected from grab samples to have little utility. Staff monitors temperature using temperature recorders that measure at least every hour, deployed for multiple days and often many weeks.

Thompson 14:
Although there is significant literature describing the effect of removing shade and riparian vegetation on stream temperatures, peer reviewed studies describing the effects of restoration of riparian vegetation are less widely published, and unclear in their results. For instance, in a paired study along four streams in New Zealand, some of which had experienced restoration of riparian habitat 20 years previously, no significant differences in stream temperature between treatment and control sites could be found (Collins, Doscher et al. 2013). A review of multiple riparian buffer plantings in New Zealand found that in only one site (where complete canopy closure had occurred) were stream temperatures reduced in the reach where restoration occurred (Parkyn, Davies---Colley et al. 2003). There is therefore an asymmetry, in that **it is very clear that removal of vegetation and increases in solar exposure are likely to increase temperatures; but it is not clear that restoration of riparian vegetation will lower stream temperatures**. It is likely that this discrepancy results from the need to consider the specific characteristics of riparian buffers. Since these considerations are relevant to the design of buffers, whether for restoration or protection, I have elaborated on some issues below.

Regional Water Board response:
Staff have reviewed the papers cited, and note that the buffers evaluated in them were intended to address sediment and nutrient concerns. Staff agree that adding shade to a stream that is at equilibrium with high air temperatures will not have a great effect. This appears to be the case in the reaches studied. Still, others have demonstrated that reductions in temperature associated with restored riparian areas, and even restored emergent vegetation, can be achieved in relatively short time scales. The report provides examples of this from the Pacific Northwest. This issue is also relevant to the topic of equilibrium temperature. Staff have added language to the staff report discussing the concepts of equilibrium, preservation, and restoration.

Thompson 15:
Ignoring groundwater, hyporheic and tributary inputs, the change in temperature ΔT within a stream over any reach length L:

$$\Delta T = \frac{\sum Q}{\rho C_p V D} L$$

Here ρ is the density of water, *Cp* the heat capacity of water, *V* the mean streamflow, *D* the mean depth, and *Q* is the net heat exchange. The length of the reach *L* over which solar inputs are reduced needs to be large enough to meet a target value of ΔT for that reach; the greater the flow rate (*VD*) the longer *L* will have to be (Moore, Spittlehouse et al. 2005). Thus, short buffer lengths may be ineffective in modifying temperatures.

Regional Water Board response:
The Regional Water Board most often relies on the implementation of pre-defined operating rules, performance standards, best management practices, or restrictions on certain activities to address potential water quality impacts associated with nonpoint source land uses, in lieu of prescribed buffer requirements for individual projects, often in the context of adaptive management. This approach addresses multiple water quality concerns associated with near-stream activities, as well as the cumulative impacts associated with multiple projects across the landscape. Language describing this approach has been incorporated into the Staff Report.

Thompson 16:
While a narrow buffer can reduce stream-shading, wider buffers are needed to allow a distinct microclimate (e.g. with cooler air temperatures and greater humidity) to be generated relative to open surroundings (Moore, Spittlehouse et al. 2005). Wider buffers also have a greater potential to become self- sustaining from an ecological point of view, rather than becoming colonized by weedy vegetation (Collins, Doscher et al. 2013).

Regional Water Board response:
See response to Thompson 15. Also, the information describing the magnitude of effects of human activities on microclimates indicates changes are relatively small and difficult to quantify (Bartholow 2000, Brosofske 1997, Chen et al. 1993, Chen et al. 1999, Dong et al. 1998, Ledwith 1996). The Regional Water Board's approach of addressing site potential effective shade through riparian buffers addresses solar radiation, which has been demonstrated to result in heat fluxes an order of magnitude higher than those associated with air temperature and wind speed (i.e., convection and evaporation) (Johnson 2004). Nonetheless, riparian management practices that address site potential effective also provide a level of protection of microclimates.

Thompson 17:
Detailed analyses of sediment sources in stream networks usually identify particular locations (subwatersheds, point sources, etc) that dominate the input of

sediment into watersheds. Buffers should include these areas to have a significant impact on sediment loading.

Regional Water Board response:
While it is true that buffers must functionally capture and contain significant volumes of sediment in order for them to affect geomorphology, this is not the only purpose buffers serve. Buffers prevent disturbances that often generate sediment delivered to stream channels, they filter sediments eroded from activities outside of buffers, they provide root strength in streambanks and unstable areas, and they provide vegetative cover to prevent surface erosion. Sediment load reductions associated with these benefits may not be large enough to affect geomorphology, but they do contribute to other water quality issues associated with biology, such as spawning gravel composition, that the Regional Water Board has an interest in controlling. The point of assumption number 2 is that riparian buffers for temperature protection are an effective and important measure for other water quality concerns besides temperature, not that they provide the sediment controls necessary to prevent changes in geomorphology by themselves. The Regional Water Board addresses sediment discharges directly through the implementation of the Sediment TMDL Implementation Policy, which requires the Regional Water Board address sediment sources through both regulatory and nonregulatory activities, similar to this Policy.

Thompson 18:
As intimated in the examples from New Zealand, it may require decades for restoration of riparian vegetation to meaningfully alter physical characteristics of the local thermal regime. Similarly, even if buffers are successful in reducing sediment inputs into channels, the long residence time of sediment within channels may mean that few if any changes to the in-stream geomorphology and thus vulnerability to thermal loading occur on observable timescales.

Regional Water Board response:
Regional Water Board staff concur with Dr. Thompson's statement regarding long recovery timescales following vegetation removal and sediment inputs. These timescales of recovery support the need to prevent, minimize, and mitigate impact associated with nonpoint sources of pollution.

Thompson 19:
As alluded to in several points above, the policy is silent on space and timescales. While perhaps "site-specific" and "case-by-case" analysis encapsulates this, it is worth reiterating that there are specific lengthscales (related to flow and channel morphology) and timescales (related to processes of plant growth, riparian recovery and sediment residence times) that will impact the efficacy of any given intervention. A broader discussion of these issues would be beneficial.

Regional Water Board response:
Staff have added new text that addresses the issues Dr. Thompson raises above.

Thompson 20:
Protection of riparian buffers leads to broader questions of riparian management, weed control, ecological value etc. While this policy is clearly targeted at in-channel conditions, a holistic approach that acknowledges the interface with riparian ecology more broadly would be valuable. I also note that although the policy has focused on riparian vegetation, emergent, in-channel vegetation has also been shown to help control stream temperatures, and often leads to improvements on faster timescales than are needed to develop a closed-canopy riparian buffer (Roth, Westhoff et al. 2010).

Regional Water Board response:
The Regional Water Board recognizes that efforts to protect the functions of riparian areas should not lead to riparian areas becoming "no management zones", and that doing so can create other issues such as those identified by Dr. Thompson. The Regional Water Board embraces an approach of prevention, minimization, and mitigation of impacts associated with activities that have potential to cause or contribute to elevated water temperatures. At the same time, the Regional Water Board acknowledges that management activities in riparian zones are often necessary. Text has been added to the staff report that acknowledges these ideas. Staff are also keenly aware of the incredible temperature reductions that have accompanied the growth of emergent vegetation following cattle exclusion in areas of the Shasta River watershed and recognize the need to consider these benefits as well as benefits associated with riparian vegetation. Staff has added language clarifying the site potential effective shade concept also applies to emergent vegetation.

Stella 3:
There is a general lack of quantification of uncertainty in either the natural system or in temperature models presented as the scientific basis for the proposed policy change. Quantifying uncertainty is critical for assessing how well models can predict system behavior, and management prescriptions and recommendations that are based on modeling results need to be considered in light of uncertainty in the models. There are at least three types of uncertainty analysis which are relevant here: (a) accuracy assessment of modeled temperature compared to observed instream temperature (i.e., model validation); (b) sensitivity analysis of model parameters on predicted temperatures; and (c) propagation of parameter error through the temperature models.

In a brief review of several original reports (e.g., Navarro, Scott and Klamath River TMDL studies), I have not seen many examples of rigorous model validation or uncertainty analysis presented. The Navarro River temperature TMDL study provides one good example of a parameter sensitivity analysis (Figure 4 of the Staff

Report, and Figure 5-2 of NCRWQCB 2000), and the prominence of riparian shade as a driver is supported by strong correlations between water temperature and measured shade (Figures 5-3 and 5-4 in NCRWQCB 2000). However, the degree to which the temperature models were quantitatively validated, and how uncertainty in model parameters may qualify model predictions are not apparent. I recognize that these studies operated under time and budget constraints, and in some cases the complexity of the water quality/temperature models made uncertainty analysis difficult. Consistent with TMDL guidelines, the studies typically include sections on Margins of Safety, and assume a conservative approach to recommendations. Nevertheless, some numerical estimates as to model uncertainty should be included in the Staff Report, to the degree that these analyses were completed for individual projects with specific consideration of modeling shade and its influence on water temperature.

Regional Water Board response:
Regional Water Board staff agree that model validation and accuracy assessment are important components of water quality modeling analyses. The Regional Water Board, the USEPA, and their contractors have attempted to address this step in the process in each instance. For instance, the Scott River temperature model development process for the temperature TMDL analysis follows the standard approach of calibrating the model using data from one period and evaluating the performance of the model based on the model's predictions for another, independent time period. A suite of accuracy statistics are provided in a table and discussed in the text, and comparisons between predicted and observed temperatures traces are provided in an appendix. A separate appendix contains an assessment of the RIPTOPO shade model's performance compared to measured data. The modeling exercise conducted explicitly evaluated the sensitivity of the model parameters on predicted temperatures. Similarly, the Klamath River TMDL report includes an appendix that discusses the model testing process in great detail. Other analyses also contain discussions of model validation, and sensitivity, albeit not through a consistent approach.

It is important to understand the utility of the modeling exercises, which is the identification of temperature factors that are affected by human activities and most important for the control of temperature. The results of the modeling exercises are not integrated into permits and have only been integrated in water quality goals in a few select cases. The results of the shade and temperature models developed for the temperature TMDLs are not intended to be used in place of a site-specific approach to implementing temperature protection. The shade and temperature models have been used to identify the most important factors to consider in source reduction efforts, estimate loading at a watershed scale, and elucidate important physical processes and interactions, such as the temperature effects of the interaction of groundwater and surface water.

Stella 4:
One particularly important case of the uncertainty issues described above is in the calculation of shade potential for any given project. Knowing what the potential shade for a reach is, relative to its current condition, is critical for 'regulation of shade as a controllable factor' (Section 3.4 of the Staff Report). Though temperature models differ somewhat in approach, all the studies I reviewed appear to include a spatially-explicit (e.g., GIS-based) submodel that calculates the potential shade for each site or reach. As reported in the methods sections of these studies, potential shade is calculated based on the stream channel morphology and orientation, surrounding topography, vegetation communities present in the riparian zone, tree density, and the maximum height growth potential of tree species in those communities. The calculation of potential tree height and density can vary considerably among sites and reaches, especially within environmentally heterogeneous environments such as riparian zones (Friedman and Lee, 2002; Balian and Naiman, 2005; Fierke and Kauffman, 2005). If the approach taken in the Navarro River study is typical, potential shade is predicted using predictions of tree height based on diameter at breast height (dbh), with a single curve determined for each species[33]. However, there is considerable variation in both the dbh-height curve and maximum tree height at maturity for key species such as redwood and Douglas-fir. When implementing the proposed policy changes for reaches of interest, it would be helpful at a minimum to propagate the error associated with the dbh-height relationship, as well as riparian stand density, through the calculations of potential shade, in order to understand the likely variation potential shade values. Some range of these values should be used as goals for restoration and as inputs to the stream temperature models. The data on modeled versus observed shade presented in Figure 5-17 of the Navarro River study (NCRWQCB 2000) is a good start in this direction. This study also used a range of 5% to 70% shade in the model sensitivity analysis, and found differences in predicted temperature of >3 degrees C. For any given project that falls within the proposed Water Quality Control Plan amendment, how great is the uncertainty in potential shade estimates, and how great the resulting temperature uncertainty?

Regional Water Board response:
The results of the shade and temperature models developed for the temperature TMDLs are not intended to be used in place of a site-specific approach to implementing temperature protection. The greatest utility of the model exercises conducted in support of temperature TMDL development is in identifying which factors that drive temperature dynamics are important, as well as when temperature drivers have a negligible effect on temperatures. An example of this is the analysis conducted for the Lower Eel River temperature TMDL. The results of

[33] Though out of the scope of the current review, it should be noted that recent advances in remote sensing, especially in acquisition and processing of LiDAR data, have the potential to greatly increase the accuracy of riparian canopy height estimation and structure (e.g., Seavy et al., 2009), and consequently estimates of riparian shade potential.

that analysis were used to demonstrate that: 1) the shading of the mainstem Eel River (and corresponding temperature differences) was negligible under any vegetation scenario. The same analysis showed that temperatures of tributary streams are quite sensitive to riparian vegetation conditions. The results were not used to define what levels of shade, or height of vegetation, or water temperatures are necessary for achievement of the TMDL and water quality objectives. Rather, the results are used to illustrate that riparian vegetation needs to be managed in a manner that does not elevate temperatures in these areas. In this way the policy implications and implementation strategies are not sensitive to the model calibration. However, Regional Water Board staff acknowledges that developing a better understanding of the relationship of effective shade to buffer depth and density is a good goal and intend to pursue the goal through effectiveness monitoring.

Stella 5:
The Staff Report includes a section on "Site-specific implementation" (Section 3.2), which identifies some of the local factors that may influence the effect of riparian shade on instream temperature. In addition to the factors listed, I suggest several more to consider in reference to their effect on potential shade for a site. These are described below. Overall, it is unclear how these considerations—both those described in the existing document and others that reviewers identify—will be implemented in a consistent way within the policy amendment. Perhaps further development of quantitative or qualitative guidelines will be necessary, either as ranges of parameter inputs into models or some rubric to scale their outputs in light of site-specific factors.

Regional Water Board response:
Regional Water Board staff has expanded the section on site-specific implementation and added a section discussing the use of management measures and adaptive management in the context of nonpoint source permitting.

Stella 6:
One important consideration influencing shade potential is that species composition and canopy structure of riparian vegetation varies greatly depending on network position and geomorphic controls on the reach (e.g., unconfined vs. confined, alluvial versus bedrock). Particularly in the North Coast region, low-order streams tend to be dominated by tall conifers that grow close to the stream channel, whereas high-order streams may have a mixture of conifers and much shorter hardwoods, particularly along wider alluvial reaches. Vegetation community maps used to calculate potential shade typically do not take into account this level of detail, yet this can be very important in terms of estimating maximum potential height of the streamside vegetation. The variation in riparian vegetation composition within a network can amplify the difference in shade potential between narrow, confined, conifer-dominated headwater streams and downstream reaches with wider active channels, less topographic shading from unconfined valleys, and more varied

vegetation with significant amounts of hardwood and shrub species of shorter stature. The descriptions of shade models that I reviewed take into account the topography and active channel width, but not the near-stream vegetation communities as separate from the landscape level vegetation maps. Looking to the applicability of this temperature TMDL approach beyond the North Coast region, the variation in riparian community structure and composition within a network can be even more pronounced in other regions (e.g., Central Valley and/or desert streams). Therefore in both the North Coast region and more generally, there should be some thought as to how to quantify the effects of vegetation composition gradients within stream networks as inputs to shade-based temperature models.

Regional Water Board Response:
These issues are important considerations in the development of shade models. However, these considerations are made at the site-specific level for individual projects. In these situations the types of vegetation present are known. The assumptions of the shade models do not come into play at the project level permitting scale. This policy directs staff to address elevated water temperature concerns at the project-level, taking into account the site-specific factors, as they relate to the consistent conclusions of north coast TMDLs: that shade, sediment, and flow concerns need to be evaluated and addressed, if necessary, for the protection of water temperature.

Stella 7:
A related issue is that the natural and human disturbance history of a reach needs to be considered when setting potential shade targets. Riparian zones are highly dynamic ecosystems, with physical drivers such as flooding, fire and drought exerting strong influences on the vegetation community trajectory. The structure of riparian vegetation will be highly dependent on the time since a large disturbance, particularly in steep, semi-arid systems such as the North Coast region where extreme events (e.g., the 1964 and 1997 floods) cause channel-setting disturbances over large spatial scales (e.g., networks to regions) and subsequent riparian community recovery can last decades until maximum vegetation height and density are achieved. The Staff Report alludes to this process directly affecting instream temperatures, in its citation of Klamath River water temperature rising following the clearing of riparian vegetation in the 1997 flood event (de la Fuente and Elder 1998, as cited on p. 22 of the Staff Report). That peak flow event, which was classified at a 19.5 year recurrence interval, resulted in acute alteration—bank erosion, deposition or removal of vegetation—of 16% to 19% of all stream channels within the Klamath River basin (de la Fuente and Elder 1998). Presumably events of this magnitude will occur at least several times a century, well within the life span of the dominant shade tree species in the region. Therefore disturbance is a major control on the shade potential of the riparian ecosystem in the North Coast region, can affect large areas of the stream network synoptically, and can limit the spatial extent of older riparian stands dominated by tall trees. This process must be

considered when using reference reaches to set potential shade targets and in predicting the long-term effect of management actions.

Regional Water Board response:
Staff agrees that the issues presented in the comment above are relevant and must be considered in any analysis of a site's history, trajectory, and potential. The site-specific approach this policy directs allows for those types of considerations in the implementation of the permitting and grant programs. The general approach that this policy and the intrastate temperature objective calls for is the regulation of activities in a manner that ensures that natural recovery processes that disturb, rearrange, and recover stream channels and riparian zones continue. Additional text discussing these issues has been added to the Staff Report.

Stella 8:
The discussion of sediment processes in conjunction with stream temperature is a useful feature of the Staff Report and reflects complex interactions among multiple water quality components. As noted in the report, excess sediment loading can affect instream temperature through alteration of the channel morphology and interactions with riparian vegetation dynamics. In addition, many of the riparian buffer prescriptions to mitigate high instream temperatures through increased shade will have the positive benefit of mitigating sediment delivery to the channel, and vice versa. In a similar vein, it is important to consider potential ***negative*** interactions between riparian vegetation management and geomorphic process goals, particularly along regulated streams in the North Coast region. Along the Trinity River, for example, severe alteration of the river's hydrology led to riparian encroachment within the former active channel (Trush et al., 2000). Presumably, this created increased riparian shade as the active channel decreased and vegetation increased in density and height, and the increased shade was presumably a benefit to maintaining low instream temperature, particularly in a reach with greatly reduced discharge and thus less capacity to buffer high heat loads. However, the vegetation encroachment and subsequent formation of high, immobile riparian berms severely altered the channel morphodynamics, sediment delivery processes, and large woody debris recruitment, and greatly reduced the overall habitat for native salmonids and other aquatic organisms. In the case of the Trinity River, the interests of maintaining riparian shade and of maintaining a natural, dynamic stream channel were at odds, and contemporary river restoration efforts are focused on removing the riparian berms and rescaling the active channel (TRRP 2013). The Trinity River is a fairly extreme case of river manipulation, but it highlights the importance of considering potential tradeoffs between competing management concerns, in this case shade potential and sediment processes.

Regional Water Board response:
Staff agrees with the point Dr. Stella makes and has added new text describing how the site-specific approach is intended to allow for these kinds of situations to be acknowledged and addressed.

Stella 9:
The issue of climatic warming poses challenges to stream and riparian management worldwide, in particular in sensitive areas such as California and other Mediterranean-climate regions (Underwood et al., 2009; Stella et al., 2012). Because of the strong link between air temperature and instream temperatures, ongoing regional warming in California will make freshwater streams less habitable for salmonids and other cold water organisms at the southern edge of their ranges. It is unclear to me how this non-stationarity of the system will be considered within the proposed TMDL policy amendment. How will temperature models incorporate the 'new normal' into predictions and land management prescriptions? Is it possible that meterological and hydrologic changes may increase the relative strength of these drivers on instream water temperature, with potentially less influence from riparian shade? I recommend that the Staff Report provide some acknowledgement of this issue, and potential implications for policy.

Regional Water Board response:
Staff have added new text to the staff report discussing the topic of climate change and its ramifications.