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Gualala River Prioritization Framework Report

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Prepared for:

CALIFORNIA WATER BOARDS
State Water Resources Control Board

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Introduction

This report was contracted to Sonoma Resource Conservation District (SRCD) to provide technical support to the North Coast Water Board in its development of components of the Gualala Total Maximum Daily Load (TMDL) Action Plan Implementation Program. It is the second of four technical reports developed to support this effort. A component of the program is to provide landowners in the Gualala River Watershed with road assessments to address erosion and sediment delivery to watercourses. The SRCD, with input from a Technical Advisory Committee, developed a framework to prioritize sub-watersheds within the Gualala River Watershed for road assessments. This prioritization is intended to serve as a resource and land management tool for landowners and others in the watershed. It also may guide decision-making on how state contract funds are allocated to landowners who choose to participate in these no-cost road assessments if interest exceeds available capacity.

This prioritization framework is a technical, non-regulatory resource to support land management decisions within the Gualala River Watershed. It does not impose or alter any regulatory requirements. Rather, it is intended as a tool available to landowners, watershed partners, agencies, and other entities to support informed decision-making for land management and water quality protection within the watershed.

There are various landscape and watershed attributes that contribute to erosion and sediment loading of downstream rivers, and this report highlights the data layers taken into account when prioritizing subwatersheds as well as those that were considered but ultimately not included in the framework. The attributes were normalized to a score between 0-1 to understand the relative importance compared across different metrics. A metric weight was applied to the individual scores to represent the significance in watershed health and beneficial uses. The sum of the weighted metrics provides the subwatershed's total score.

Watershed/Landscape Attributes Descriptions and Rationale:

Subwatershed Boundaries:

The Gualala River Watershed was divided into subwatersheds by using the California Interagency Watershed Map version 2.2.1 (Calwater). The map is the State of California's working definition of watershed boundaries by standardizing boundary delineation, coding, and naming of California's watersheds by government agencies including California Department of Water Resources, California State Water Resources Control Board and Regional Water Quality Control Boards, as well as Hydrologic Unit Codes published by the U.S. Geological Survey. Calwater has evolved to describe California watersheds at various levels of granularity, beginning with the division of the state into 10 Hydrologic Regions (HR). Each HR is progressively subdivided into six smaller levels: Hydrologic Units (major rivers), Hydrologic Areas (major tributaries), Hydrologic Sub-Area, Super Planning Watershed, and Planning Watershed. At the Planning Watershed level, the most detailed, polygons range in size from approximately 3,000 to 10,000 acres. By using the Calwater 2.2.1 subwatershed mapping designations, the Gualala watershed was divided into 29 subwatersheds.

Revised Universal Soil Loss Equation (RUSLE):

The Revised Universal Soil Loss Equation (RUSLE) is an empirical equation to model soil erosion and is a multi-criteria analysis based on five distinct factors: rainfall erosivity, soil erodibility, slope length and steepness, vegetation cover, and land use and farmland state. Soil loss is the product of these five factors, and results reflect annual soil loss per year. For this report the final units are given in tons per hectare per year.

- Rainfall Erosivity (R)[1]: evaluates the erosion potential from kinetic energy of rainfall impact and runoff. The equation used a dataset from the National Centers for Environmental Information (NCEI) and resampled to a 10 meter footprint clipped to the Gualala watershed.
- Soil Erodibility (K)[2]: Represents the soil's vulnerability to erosion by rainfall and runoff. It takes into account physical and geological properties of such as structure, texture, materials, porosity, granulometry, and organic content. The equation used a dataset from the National Resources Conservation Service (NRCS) that derived the layer from 30 meter rasters and is updated annually by Esri.
- Slope Length and Steepness (LS)[3]: Reflects the effect of topography on soil erosion as the combination of total length and angle of slopes. Also known as the Sediment Transport Index (STI). The equation utilized the 10 meter Digital Elevation Model from The National Map dataset by the United States Geological Survey (USGS) to identify flow accumulation and slope of the Gualala watershed. The slope length was limited to a maximum of 200 meters to prevent mapping of stream channels, as the RUSLE method is intended to capture hillslope erosion and not streambeds.
- Vegetation Cover (C)[4]: Canopy cover helps dissipate the kinetic energy of rainfall and roots play a major role in increasing soil cohesion. In essence, more dense vegetation cover will result in lower rates of soil erosion and is applied on the landscape using a Normalized Difference Vegetation Index (NDVI). The equation utilized the Global Sentinel-2 Level-1C multispectral imagery sourced from the Sentinel-2 on Amazon Web Services collections which is updated daily with new imagery. The imagery used was from 2025 which had little cloud cover over the Gualala watershed. Raw NDVI values were scaled to match EPA guidance that C values for dense forest should be 0.003.
- Land Use and Farmland State (P)[5]: Attempts to estimate the effects of different types of land use and farming practices would have on the amount of runoff and therefore the rate of soil erosion. The equation utilized the Farmland Mapping and Monitoring Program data and assigned the P factor values to land use based on this table:

Table 1: Table illustrating land use types and associated P Value

Land Use	P factor
Forest and Rangeland	1
Unique Farmland	0.75
Farmland of local importance	0.5
Urban and Water	0

[1] https://data.noaa.gov/metaview/page?xml=NOAA/nos/ocm//iso/xml/48224.xml&view=getDataView&header=none
[2] https://www.arcgis.com/home/item.html?id=ac1bc7c30bd4455e85f01fc51055e586
[3] https://apps.nationalmap.gov/downloader/
[4] https://www.arcgis.com/home/item.html?id=fd61b9e0c69c4e14bebd50a9a968348c
[5] https://gis.conservation.ca.gov/portal/home/search.html?q=FMMP

Method of Scoring:
The values of each individual RUSLE characteristic were multiplied together in the formula A = RKLSCP, where A equals cumulative ton of soil lost per hectare per year. The RUSLE metric was given a weight of 2 towards the final input in the total subwatershed score.

Salmonid Population Distribution:

The Gualala River and its tributaries are vital to the conservation of Coho salmon, steelhead trout, and other aquatic species. The Central California Coast (CCC) Coho salmon Evolutionary Significant Unit are listed as endangered under both the federal and state Endangered Species Acts. The Northern California (NC) Distinct Population Segment (DPS) of Steelhead trout are listed as federally threatened. Both species were present in large numbers historically and have declined due to human activities that have degraded stream habitat.

Subwatersheds that have historical high occurrence of salmon and/or steelhead, or contain potential high quality habitat are vital towards the protection of these sensitive aquatic species and would benefit the most from an improvement in ecological conditions such as water quality. The framework considered data from a number of different data sources, including: *Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit* (NOAA, 2012), Priority Action Coho Team: Strategic Partnering to Accelerate Central California Coast Coho Salmon Recovery (NOAA, 2019), Recovery Strategy for California Coho Salmon (CDFW, 2004), Gualala River Watershed Assessment (NCWAP, 2003), and Historical Occurrence of Coho Salmon in Streams of the Central California Coast Coho Salmon Evolutionarily Significant Unit (NOAA, 2005)

Method of scoring:
Subwatersheds were evaluated by length of stream representing potential habitat within each basin. The dataset used provides an estimate for the spatial distribution of intrinsic potential habitat for the Central California Coast coho salmon and steelhead trout utilized in recovery planning. Datasets for current distribution are not currently conducted watershed wide, and restoration and improvements to water quality would increase the distribution to streams with intrinsic potential and therefore make improvements more vital to recovery efforts.

Central California Coast Coho Salmon - the subwatershed scores were normalized based on stream length compared to subwatershed total size and then to a final score between 0-1. Scores were multiplied by the metric weight of 4 to give a final input into the overall subwatershed score.

Steelhead trout - the subwatershed scores were normalized based on stream length compared to subwatershed total size and then to a final score between 0-1. Scores were multiplied by the metric weight of 3 to give a final input into the overall subwatershed score.

Landslide Potential:
Landslides act as one of the primary drivers of sediment loading within a watershed. By introducing vast volumes of rock, soil, and organic debris rapidly into stream channels, they can also trigger severe secondary impacts that can persist for decades. Dramatic debris loads will increase water turbidity and degrade aquatic ecosystems and impact drinking water supplies. Large landslides can dam rivers, alter natural flow paths, and impact public infrastructure such as culverts and diversions for agriculture or drinking water. Exposed slide scars and runout deposits serve as persistent, long-term sediments sources as rainfall and bank erosion continuously erode the exposed sediment.

Method of Scoring:
Data was collected from the California Department of Conservation – Gualala River Watershed Maps and Data which estimated relative landslide potential within the watershed. Values were averaged within the watershed subbasins and then normalized to a value between 0-1. Landslide potential was given a metric weight of 2 to give a final input into the overall subwatershed score.

Surface Water Diversions:

The water quality goals for the Gualala River Watershed set forth by the watershed planning document are centered on protection of beneficial uses associated with drinking water supply and aquatic life sustainment. Additionally, the amount of water that flows through the Gualala River Watershed is in flux, due to a combination of drought, climate change, and agricultural uses which has resulted in degraded water quality as well. These impacts have the potential to negatively impact drinking water supply and other surface water uses by the local community. As most public water infrastructure systems rely on wells and contain systems of treatment, surface water diversions was the most applicable dataset to understand where surface water use was most commonly found and thereby most affected by water quality degradation.

Method of Scoring:
Data was collected from the California State Water Resources Control Board's Division of Water Rights which tracks all registered points of diversion in the State. The spatial and attribute information are maintained in the electronic Water Rights Information Management System (eWRIMS). Each subwatershed contained a number of diversions that was normalized based on subwatershed total size and then to a score between 0-1. Surface water diversions were given a metric weight of 1 so the normalized score is the value added to the subwatershed's total score.

Subwatershed Total Score Format:

Each metric varies spatially across the watershed. To vary the relative importance between metrics, weights were applied. The scores for each individual metric were normalized to values between 0-1, with 1 being the highest score within the dataset. The normalized scores were then multiplied by metric weight and summed to give a total score for each subwatershed. Finally, the score was normalized to values between 0-100.

Table 2. Metric weights and formulas for normalization and subwatershed combined scores

Metric (M)	Weight (W)	Description
Coho Habitat Length	4	Length of potential coho habitat from IP model normalized by subwateshed area
Steelhead Habitat Length	3	Length of potential steelhead habitat from IP model normalized by subwateshed area
RUSLE	2	Revised Universal Soil Losss Equation Soil loss (A) = Rainfall Erosivitiy (R) x Soil Erodibility (K) x Slope Length and Steepness (LS) x Vegetation Cover (C) x Landuse (P)
Landslide Potential	2	Relative landslide potential
Diversions	1	Count of registered diversions
Normalized Metric (M')	$M' = \frac{M - M_{min}}{M_{max} - M_{min}}$	Each metric normalized, 0-1
Final Subwatershed Score (S)	$S = \sum_{i=1}^{n} M'_i \, W_i$	For each subwatershed, the normalized metric is multipled by the weight, and the final score is sum of values. The Score is normalized 0-100.

Cumulative Geographic Consideration:

The final score for each of the 29 subwatersheds provides a cumulative metric that may help inform and guide the prioritization of road assessments for landowners in the watershed. A further step in analysis could be to geographically consider neighboring watersheds, especially if a high-scoring watershed is adjacent or upstream of a medium or similarly high-scoring watershed. To create the most impact for reducing sediment, it could be beneficial to group subwatersheds that have aquatic connectivity and thereby cumulative impacts on downstream water quality when considering prioritization, even if a subwatershed on its own is not a top ranked watershed for sediment loading. A weighted average based on the adjacent watershed's total score and acreage could be one form for adjusting based on aquatic connectivity.

Datasets Excluded From Analysis:

A number of landscape and watershed attributes were considered for the analysis but ultimately rejected from the prioritization framework. Specific road metrics such as distance from road to stream, stream crossing density, road density, road treatment history, and road assessment history were excluded for a number of reasons. Some of these metrics/variables were not consistently available across a watershed scale or were limited in their utility from a planning watershed scale.

Recent fire history was another landscape attribute that was considered in the analysis but ultimately rejected from the final framework. The area has only experienced one significant fire in the last decade and it was located on a very small portion of a subwatershed on the boundary of the entire watershed. It was deemed to not have a significant impact on the sedimentation and could falsely raise the prioritization of the subwatershed being the only one to score points in this category.

Conclusion

The proposed framework identifies attributes that directly impact potential sedimentation of streams or are themselves negatively impacted by sedimentation and the corresponding decrease in water quality. Datasets used to measure these metrics were peer-reviewed and widely accepted for use in watershed and landscape planning exercises. The framework was reviewed by the Technical Advisory Committee (TAC) that was developed to provide expert review of the development of this work. The Sonoma RCD will leverage this framework to conduct the analysis and submit the results in the forthcoming *Prioritization Assessment Report*. The results will serve as a land management resource for landowners and other decision makers in the watershed and may help guide how state-supported contract funds are directed to support on-the-ground road assessments as part of the Gualala Total Maximum Daily Load (TMDL) Action Plan Implementation Program.