EEL RIVER VALLEY GROUNDWATER SUSTAINABILITY PLAN

Humboldt County Groundwater Sustainability Agency

Ferndale, Loleta, Fortuna, Carlotta, Hydesville, Alton, Metropolitan, Rio Dell, Scotia

Eel River Valley (Jack Rice, January 2022)

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Executive Summary

Part I: Introduction

- Groundwater within the Eel River Valley Groundwater Basin (Basin) is a valuable and essential resource for multiple beneficial uses including agricultural water supply, municipal and domestic water supply, industrial water supply, and freshwater replenishment to surface waters. The Basin is located along the coast of western Humboldt County at the downstream end of the Eel River watershed and extending from the Pacific Ocean upstream through the lower reaches of the Eel and Van Duzen River valleys.
- The Basin is situated primarily within a rural area of Humboldt County and includes the cities of Fortuna, Ferndale, and Rio Dell and the unincorporated communities of Loleta, Carlotta, Hydesville, Alton, Metropolitan, and Scotia. Public water suppliers utilizing groundwater within the basin include City of Fortuna, City of Rio Dell, Riverside Community Services District (CSD), Loleta CSD, Palmer Creek CSD, Hydesville Community Water District, Bear River Band of the Rohnerville Rancheria, and Del Oro Water Company. Del Oro Water Company is an investor-owned public utility company that provides water to the City of Ferndale and surrounding area. The primary water source for the City of Rio Dell and Scotia CSD is surface water from the Eel River; the City of Rio Dell utilizes groundwater as a secondary/emergency source.
- The Eel River Valley supports a vibrant agricultural community made up of both organic and conventional farms and ranches. Farming families produce milk, beef cattle, pasture, corn silage, truck crops, vegetables, apples, quinoa, and other crops in one of Humboldt County's finest growing regions. The mild climate and deep alluvial soils provide ideal conditions for raising livestock and growing forage crops. Dairy producers and ranchers pump groundwater for pasture irrigation, livestock watering, facility cleaning, and dairy nutrient management. In 2021, a total of 12,952 acres of agricultural land were irrigated by groundwater.
- The Basin is bisected by the lower reaches of the Eel River and its tributary the Van Duzen River, both of which provide habitat for anadromous salmonids and other fish and aquatic species. The Basing contains terrestrial and aquatic groundwater-dependent ecosystems (GDEs) which have high ecological value based on the presence of directly or indirectly groundwater-dependent special-status species and identified critical habitat.
- Following the adoption of the Sustainable Groundwater Management Act (SGMA) in 2014, the Basin was designated as medium-priority by the California Department of Water Resources (DWR) and subject to mandatory compliance requirements under SGMA.
- In 2015, Humboldt County received a planning grant from DWR for technical studies and planning which led to the submission in December 2016 of a Groundwater Sustainability Plan (GSP) Alternative, a streamlined version of a GSP. The GSP Alternative was disapproved by DWR in 2019 primarily because objective management criteria had not been established for 10 years; a quantitative estimate of sustainable yield was not developed; and the GSP Alternative did not quantify the impacts of groundwater use on surface water systems and determine at what point they are significant and unreasonable. As a result of the GSP Alternative being disapproved, formation of a Groundwater Sustainability Agency (GSA) was required and development of a full GSP is required by January 31, 2022.
- In May 2020, the Humboldt County Board of Supervisors formed the Humboldt County GSA. Also in 2020, Humboldt County received a planning grant from DWR to perform additional field work, develop an integrated groundwater-surface water computer model, and prepare a GSP in collaboration with water suppliers, water users, the Humboldt County Resource Conservation

District, and the U.S. Geological Survey. Humboldt County retained a consultant team to assist with data collection, technical studies, stakeholder outreach, and plan preparation. Several technical memoranda were prepared to document the data collection and analysis and these memoranda are provided in the Appendices to this GSP.

- The purpose of this GSP is to present a framework for sustainably managing groundwater resources within the Basin for economic, social, and environmental benefits through local control and based on the best available science and technical information. The GSP synthesizes empirical data, stakeholder input, computer simulation results, and geological interpretation to establish a management framework that best fits the current conditions and community interests of the Basin.
- The average annual groundwater use within the Basin from water year 2011 through 2020 was 14,837 acre-feet, which includes:

Agricultural Irrigation	12,559 acre-feet	(85%)
Municipal Drinking Water	1,733 acre-feet	(12%)
Domestic Drinking Water	414 acre-feet	(3%)
Other	132 acre-feet	(<1%)

- Irrigation water use was estimated based on direct measurements using monitoring data collected during the 2021 water year from eight flow meters installed on irrigation systems. The flow meters were spatially distributed across the Basin and represented the range of irrigation system types (traveling gun, center pivot, wheel line, handline, and K-line). Flow meter measurements were used to calculate total groundwater volume extracted at each meter location and this information was extrapolated across the Basin to provide an estimate of total groundwater volume extracted for agricultural irrigation by water year type.

Part II: Basin Setting

- The primary water-bearing units within the Basin are the alluvial aquifer and the underlying Carlotta formation. The alluvial aquifer is the most productive aquifer and most utilized aquifer in the Basin. The alluvial aquifer is most prominent within the central portions of the lower Eel River Valley, where the thickness is in excess of 260 feet, and extends up the Van Duzen River Valley, thinning from approximately 125 feet thick at the confluence with the Eel River to less than 40 feet in the vicinity of Carlotta. Most wells in the alluvial aquifer are less than 100 feet deep. The physical characteristics of the alluvial aquifer reflect the dynamic tectonic and geomorphic history in the area and are observed to have significant lateral variation. In general, the alluvium is an accumulation of a variety of relatively young unconsolidated sediment, tending to be coarser (sands, gravels) in areas where the river channels have migrated and finer (silts, clays) in areas where floodplain processes dominate. The surface waters of the Eel and Van Duzen Rivers are generally in direct contact and hydraulic connection with the alluvial aquifer.
- The Carlotta formation underlies the alluvial aquifer and consists of an interbedded range of materials, from coarse-grained sediments deposited in a near-shore or terrestrial setting to thick sequences of fine-grained sediments deposited in estuarine and bay environments. The Carlotta formation is known to be more than 1,500 feet thick and only the upper part of the Carlotta formation is tapped by water wells. Wells extracting groundwater from the Carlotta formation are predominantly found in upland areas, often on the order of 200 to 400 feet deep. In general, the Carlotta aquifer is not as productive as the alluvial aquifer.
- Historical data regarding groundwater levels is available going back to the early 1950s and more extensive groundwater investigation has been performed since 2016. Groundwater elevations within the Basin are generally stable. The range in elevations between the spring and fall seasons

is generally less than ten feet and the alluvial aquifer maintains a consistent gradient towards the ocean. The hydrograph data show that the fall elevations are particularly stable with only very slight deviations from what appears to be a baseline elevation, including during the severe drought conditions of 2013 and 2014.

- The alluvial aquifer within the lower Eel River Valley is in contact with the ocean on the west and surrounded on the east and north sides by the Eel River. The boundary conditions provided by the ocean and the Eel River play a critical role in the stability of groundwater conditions. The surface level of the ocean presents a physical limit to the level to which groundwater elevation can fall. Monitoring wells installed in close proximity to the Eel River generally encounter sediments with high hydraulic conductivity and their hydrographs show a strong connection with river level changes. The capacity for the Eel River to provide significant recharge to the adjacent alluvial aquifer sets up a condition where the base flow within the river channel provides a control on groundwater elevations within the alluvial aquifer. The elevations of the surface water and groundwater remain connected and at similar elevations through the year. Thus, the presence of the Eel River is a critical factor for maintaining stable groundwater levels.
- The seaward flow of fresh groundwater and the landward flow of seawater have a dynamic interface in coastal aquifers. The freshwater-seawater transition zone in the alluvial aquifer of the Basin changes seasonally but appears stable. The presence of the Eel River maintains a seaward groundwater gradient which serves to hold the seawater-freshwater interface steady in its position. Additional data is being collected to investigate the extend of seawater intrusion within the deeper portion of the aquifer system.
- Water quality within the Basin is generally of good quality and suitable for its intended uses. There are no known conditions of degradation of groundwater quality related to groundwater management or use. The Basin has naturally occurring moderate to high concentrations of total dissolved solids (TDS), iron, manganese, and arsenic. The water quality trends for these constituents do not show any significant increase in measured concentrations. The City of Fortuna, Del Oro Water Company, and Palmer Creek CSD all use filtration systems specifically to remove iron and manganese, which is a standard practice for water treatment. The municipal raw water data for water suppliers in the Basin do not show any exceedances of the secondary maximum contaminant levels for TDS or nitrate. Since 2002, arsenic has been detected in one water supply well at relatively steady concentrations below the maximum contaminant level (with the exception of one anomalous value). Arsenic was detected at depth (greater than 200 feet below ground surface) in six monitoring wells and is interpreted to represent an elevated background condition in deeper portions of the aquifer system.
- Annual changes in storage are primarily a function of the amount of recharge in the preceding water year. The magnitude of change is greatest when sequential winters are alternately wet and dry. The water budget indicates that groundwater storage within the Basin is stable with no significant change between 2000 and 2020.
- The ecological condition of groundwater-dependent vegetation is generally good based on satellite data which estimates vegetation greenness, an indicator of vigorous, growing vegetation.
- An integrated groundwater-surface water model (also known as a hydrologic model) was developed to simulate the movement of groundwater and surface water through the Basin. Development of this model was a major investment under the 2020 planning grant. Previous work by the U.S. Geological Survey provided the foundation for building the model. The modeling approach uses MODFLOW-2005 (groundwater flow), SEAWAT (seawater intrusion), the Streamflow Routing package of GSFLOW (groundwater/surface water interaction), and Precipitation Runoff Modeling System (PRMS, for watershed hydrology). The model provides a

computer-based representation of the Eel River watershed, the principal aquifers in the Basin, the Pacific Ocean, and the Eel and Van Duzen Rivers to gain insight into hydrologic processes and to simulate potential future scenarios. Such models provide an essential tool for examining the interactions between groundwater and surface water but have inherent limitations. Modeling results should be interpreted with an awareness of uncertainty and in conjunction with science-based reasoning and other lines of evidence.

Part III: Sustainable Management

- The fundamental goal of SGMA is to support beneficial uses of groundwater while avoiding undesirable results for six sustainability indicators: groundwater level declines, groundwater storage reductions, seawater intrusion, water quality degradation, land subsidence, and interconnected surface water depletion. SGMA requires the establishment of sustainable management criteria for each of the six sustainability indicators, unless a GSA can demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin. Undesirable results are based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin. Minimum thresholds quantify the conditions at representative monitoring sites that are used to define undesirable results. Measurable objectives are quantitative goals that reflect the basin's desired groundwater conditions.
- The sustainability goal of this GSP is to maintain high-quality and abundant groundwater resources in the Basin to support existing and long-term community needs without causing undesirable results. Groundwater is needed within the Basin for drinking water and personal use, agricultural irrigation, industrial process water, and ecosystem services. This GSP determined that the Basin's sustainability goal is being achieved, as described below for each of the six sustainability indicators.
- **Chronic lowering of groundwater levels**: The rate of groundwater pumping within the Basin has remained stable during the period of record and historical data do not reflect any significant declining trends for groundwater levels. Chronic lowering of groundwater levels could cause wells with shallow well screens (i.e., screens that are relatively close to the ground surface) to yield less water or, in the worst case, to cease production. Minimum thresholds for groundwater levels in representative monitoring sites were developed to maintain groundwater at levels that ensure at least ten feet of saturated well screen within wells installed after 1964 with appropriate sanitary seals.
- **Reduction in groundwater storage**: Maintaining groundwater elevations above the minimum thresholds for chronic lowering of groundwater levels will maintain an adequate amount of groundwater in storage, based on the well-established hydrogeologic principle that the volume of groundwater in storage is directly proportional to groundwater elevations.
- **Seawater intrusion**: Minimum thresholds for chloride concentrations were developed for representative monitoring sites to maintain the chloride concentration isocontour line near the location measured in water year 2021. In addition, minimum thresholds for groundwater levels were developed to ensure that a flow gradient toward the ocean is maintained.
- **Degraded water quality**: One constituent of concern, arsenic, was identified as a precautionary measure to ensure that concentrations within municipal supply wells remain below the maximum contaminant level for drinking water. The minimum threshold for degraded water quality is two supply wells exceeding the arsenic maximum contaminant level (currently there are none).

- **Subsidence**: The Basin is susceptible to subsidence (or uplift) caused by seismic activity associated with the Cascadia Subduction Zone, but land subsidence caused by groundwater conditions is not considered to be a concern. The granular nature of the aquifer materials, the relative stability and consistency in the range of groundwater elevation fluctuations, and the narrow range of annual groundwater fluctuation support the conclusion that the conditions that could lead to land subsidence caused by groundwater pumping do not exist in the Basin. Therefore, sustainable management criteria were not established for subsidence.

- **Depletion of interconnected surface water**: The integrated groundwater-surface water model was used to estimate the volume of surface water depletion caused by groundwater extraction in the Basin and provide the basis for minimum thresholds. The general approach focused on fish passage criteria and the minimum water depth required for passage of adult salmon. Fish passage can be limited by the river stage at critical riffles within a reach. Adult Chinook salmon begin entering the Eel River estuary in August or early September and wait, often gathering in pools, until conditions are suitable for migrating upstream to spawning areas. Steelhead begin arriving in September and coho salmon generally arrive in October. Upstream migration is typically triggered by a significant rain event and the associated increase in flows. California Department of Fish and Wildlife uses a standard of 0.7 feet as the minimum critical riffle depth to allow passage of adult salmonids. Fish have been observed at the mouth of the Van Duzen River when flows were as low as 130 cubic feet per second at the Scotia gauge.

  Because fish passage is considered one of the most sensitive indicators of surface water beneficial uses and a quantitative framework for riffle depth is available, the potential change in river stage relative to minimum fish passage depth was selected as the basis for setting minimum thresholds for surface water depletions. A reduction in stage of 0.1 feet was set as a conservative benchmark for potential impact on riffle depth and fish passage. This value represents a threshold of detection and not a threshold of significant and unreasonable impact. Exceedance of this benchmark does not mean that beneficial uses of interconnected surface waters are degraded or the viability of special-status species are threatened, but provides a starting point for analysis. Computer simulation modeling using a number of conservative assumptions indicated that groundwater pumping could increase by 150% above current conditions before the stage of the Eel River would be reduced by 0.1 feet at the downstream end of the study reach (near Fernbridge) when fish passage conditions exist.

  Minimum thresholds were developed to maintain groundwater pumping below a 100% increase from current conditions as a precautionary measure (rather than 150%) and to maintain groundwater above levels that correlate with a 100% increase in pumping using modeling simulation. If groundwater pumping within the Basin increases by 100% above current levels or if groundwater levels in two or more wells within the network of representative monitoring sites fall below their minimum thresholds for two sequential years, then further analysis would determine if beneficial uses of interconnected surface waters are degraded or the viability of special-status species are threatened, and whether reasonable reductions or limitations in groundwater pumping could avoid these effects without jeopardizing other beneficial uses of groundwater.

- The sustainable yield for the Basin is estimated to be at least 30,000 acre-feet per year.

- The Humboldt County GSA will perform the monitoring and reporting activities required by SGMA and will consider other projects and management actions as appropriate to maintain sustainable groundwater conditions and enhance beneficial uses of groundwater and interconnected surface waters. The best investment of time and resources would likely be for projects to increase streamflow entering the Basin, especially during the dry season, and for in-stream restoration projects to improve geomorphic conditions within the Eel River, Van Duzen River, and other surface waters within the Basin.

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Non-Governmental Organizations
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In Memoriam: Denver Nelson (1941-2021)