



Technical Memorandum

July 30, 2021

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Subject	Terrain Data and Imagery Technical Memorandum		

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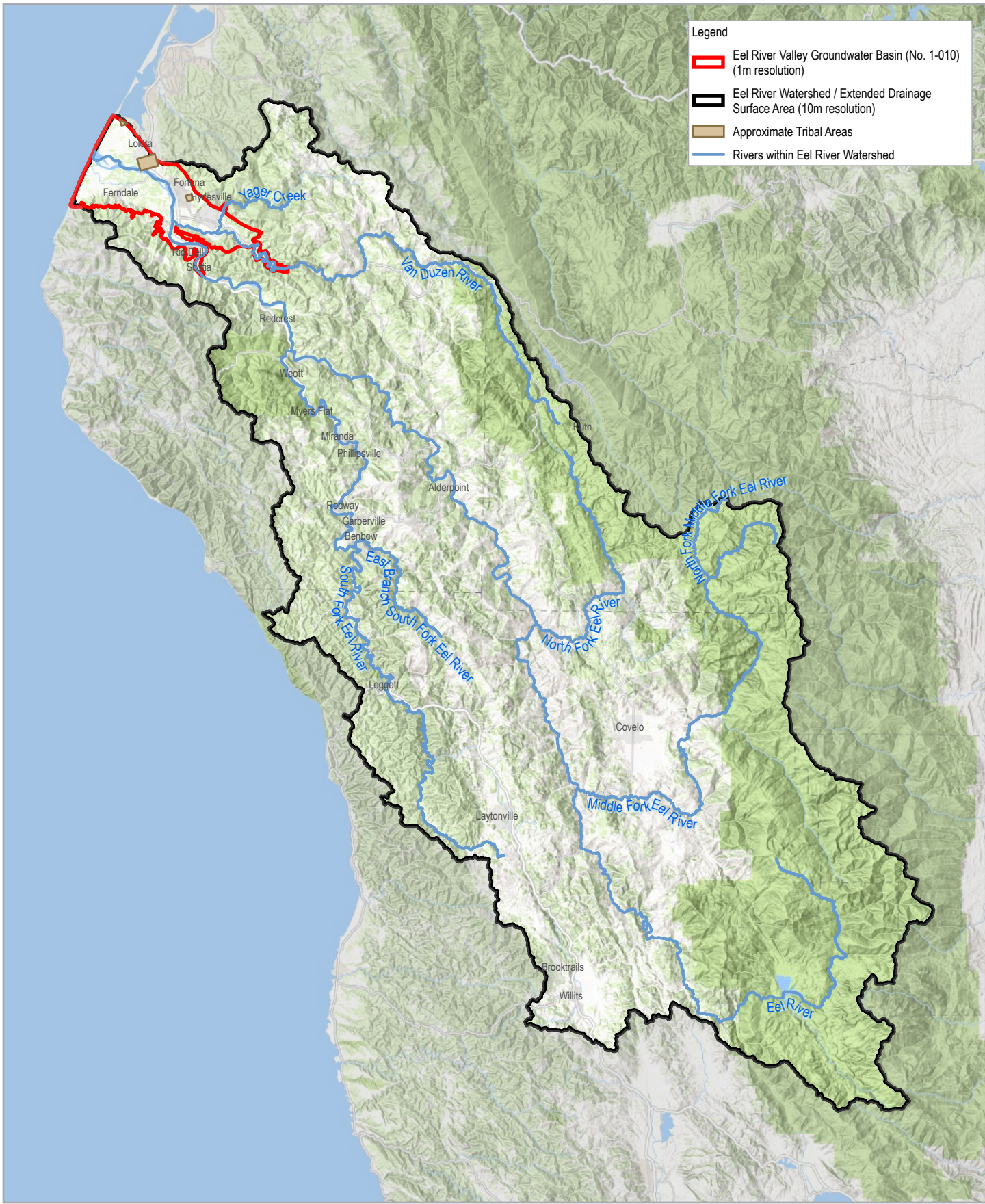
Technical Memorandum

1. Introduction

The Terrain Data and Imagery Technical Memorandum outlines the data and methodologies used to develop a topographical model of the Eel River Valley Basin (ERVB) for inclusion in the Eel River Valley Groundwater Sustainability Plan (GSP).

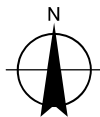
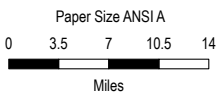
The ERVB topographic model encompasses areas of the ERVB, as defined by the Department of Water Resources (Basin 1-010, DWR Bulletin-118), and adjacent watersheds that contribute surface and groundwater to the basin. Areas within the ERVB include tribal lands of the Wiyot Tribe and Bear River Band of the Rohnerville Rancheria.

Using several surface models and topography data acquired via Light Detection and Ranging (LiDAR), a Digital Elevation Model (DEM) was developed to accurately model the ERVB topography. Three distinct regions comprise the total surface model: Basin Surface, Extended Drainage Surface, and River Cross-sections. Each region has a unique data resolution requirement for use in the various study applications. The Extended Drainage Surface and Basin Surface regions were compiled into a comprehensive DEM for groundwater modeling. The River Cross-sections region was then employed to compare groundwater levels, with recorded river stage, in GSFLOW, a coupled groundwater and surface water FLOW model based on the integration of the U.S. Geological Survey (USGS) Precipitation-Runoff Modeling System (PRMS-V) and the USGS Modular Groundwater Flow Model (MODFLOW-2005 and MODFLOW-NWT). Figure 1 shows the extent of ERVB and the Extended Drainage Surface region.



Legend

- Eel River Valley Groundwater Basin (No. 1-010) (1m resolution)
- Eel River Watershed / Extended Drainage Surface Area (10m resolution)
- Approximate Tribal Areas
- Rivers within Eel River Watershed



Humboldt County Department of Public Works
 Eel River Valley Groundwater
 Sustainability Plan

Project No. 11217388
 Revision No. -
 Date July 2021

Map Projection: Lambert Conformal Conic
 Horizontal Datum: North American 1983
 Grid: NAD 1983 StatePlane California 1 FIPS 0401 Feet

**Eel River Valley Basin and
 Extended Drainage Surface Areas**

FIGURE 1

2. Surface Data Used

The following surface models and topography data were used to develop the composite DEM and river bathymetry model:

Table 1: Data Sources and Application

Application:	Data Source:
ERVB Basin Surface	USGS National Map DEM
ERVB Basin Surface	Wiyot Tribe and Bear River Band of the Rohnerville Rancheria addendum to National Map DEM
Extended Drainage Surface	Hollister J, Shah T, Robitaille A, Beck M, Johnson M (2020). <i>elevatr: Access Elevation Data from Various APIs</i> . R package version 0.3.1. (accessed with: R Core Team. 2020. <i>R: A Language and Environment for Statistical Computing</i> . Vienna, Austria: R Foundation for Statistical Computing.)
River Cross-sections	Stillwater Sciences Bathymetry Survey of Eel and Van Duzen Rivers; River cross-section data also provided by: <ul style="list-style-type: none"> • Tom Bess Asphalt Company • Jack Noble • Humboldt County

3. Basin Surface

The ERVB Basin Surface was created using a USGS-developed DEM, acquired from the USGS National Map downloader (TNM Download v2.0) with a standard one-meter resolution. Two sets of tiles were downloaded from The Nation Map data downloader. The main tile index consists of 22 tiles with bare earth elevation values referenced to the North American Vertical Datum of 1988 (NAVD88) and covers the majority of the area within the groundwater basin; it was found by selecting the "1 meter DEM" subcategory in the "Elevation Products (3DEP) category" and zooming to the extent of the groundwater basin. This data was collected during 2018 and 2019 as part of the "NoCAL Wildfires B4 2018" collection. The data was originally projected in in NAD 1983 UTM Zone 10N before being reprojected into NAD_1983_StatePlane_California_I_FIPS_0401_Feet during the final mosaic process that incorporated the supplemental tiles.

The supplemental tile index was based on the same LiDAR acquisition of the main tile index, consisting of the Wiyot Tribe (Table Bluff Reservation) and (Bear River Band) Rohnerville Rancheria tribal areas that were clipped out of the one-meter DEMs due to delays in the tribal notification process. These tiles were downloaded separately from The National Map by selecting the "DEM Source OPR" subcategory in the "Elevation Source Data (3DEP)- Kidar, IfSAR" category, and zooming to the extent of each clipped-out area missing from the main tile index. The supplemental tiles were Original Project Resolution (OPR) DEMs but were the same resolution as one-meter (3DEP) DEMs in the main tile index. Requiring definition in a standard projection and then reprojection to align with the data in the main tile index, the supplemental tiles were in a custom projection of NAD83(2011) / Conus Albers.

The final project was a DEM representing bare earth elevation values in Feet (NAVD88), with a pixel type of 32 bit float, at one-meter resolution, and projected in NAD_1983_StatePlane_California_I_FIPS_0401_Feet.

4. Extended Drainage Surface

The Extended Drainage Surface region extends approximately 100 miles southeast of the ERVB, encompassing all surface water features that flow into the ERVB. The DEM for the Extended Drainage Surface was based on the same 2019 LiDAR data as the Basin Surface region, obtained using the elevation library (Hollister, et al., 2020) within the R programming language (R Core Team, 2020) with a 10-meter resolution. The Extended Drainage Surface DEM was referenced to NAVD88, NAD83 and projected in the State Plane California Zone I (FIPS 0401) coordinate system.

5. River Cross-sections

A groundwater/surface water model was developed for the GSP that simulates the movement of surface and groundwater through the Eel River Basin. The spatial representation of creeks and rivers in the model was derived from the National Hydrologic Model (NHM) and the National Hydrography Dataset (NHD). The NHD (NHDPlus HR) is a high-resolution set of geospatial hydrography data that includes flow-lines and waterbody polygons, watershed boundary datasets, and a 1/3-arc-second 3D Elevation Program DEM. The NHM incorporates information from NHD, as well as the Soil Survey Geographic Database (SSURGO), National Land Cover Database, PRISM rasters, and National Renewable Energy Lab (NREL) solar radiation to develop consistent geospatial data structures to be applied in modelling applications. These are transmitted through an NHM parameter database (NhmParamDb) so that preliminary parameters values can be incorporated directly into PRMS modelling applications. The development of the groundwater/surface water model is presented in the Groundwater Model Construction and Calibration Technical Memorandum (GHD 2021).

The model's representation of the creek and river system was also compared with river cross-section data provided by Stillwater Sciences and the County, who have collected cross-sections for the Van Duzen and Lower Eel Rivers, both located in the ERVB. Cross-section data was collected at multiple locations throughout the Van Duzen and lower Eel River reaches as part of gravel mining activities at various times between 2004 and 2020. The Tom Bess Asphalt Company and Jack Noble supplied full channel cross-sections for the Van Duzen River, while Humboldt County provided Lower Eel River cross-sections located immediately upstream of Fernbridge. All cross-section data was collected in accordance with the protocol contained within the Letters of Permission Procedure for Gravel Extraction in Humboldt County (LOP 2015-1), developed by the U. S. Army Corps of Engineers (USACE) for in-stream gravel extraction operations in the County. The protocol states:

All survey data must be referenced to State Plane California Zone I (FIPS 0401) coordinate system, NAD83 and NAVD88. Cross-sections must be resurveyed from the same endpoints each year. The endpoints should be located at or above the 100-year flood water surface elevation unless another flood level is agreed upon by agencies and CHERT and far enough from the river's edge to remain consistent from year to year. The maximum distance between any two elevation points along a cross-section shall be 50 feet, including the wetted channel portion. Exception: if ground outside wetted channel is essentially smooth and rises less than 0.5 feet for a distance of 100-feet, distance between points can be increased to 100 feet. All obvious breaks in slope must still be included in order to collect accurate topography that is representative of site conditions. Cross-sections shall be surveyed and drafted consistently so that the right bank (RB) of the river as you face downstream is at the right side of the drafted cross-section. Zero (0) distance in cross-sections shall be at the left bank (LB) endpoint as you face downstream.

6. Composite Surface

A Composite Surface model was created by merging the Basin Surface and the Extended Drainage Surface, referenced to NAVD88 vertical datum and NAD83 horizontal datum, then projected in the State Plane Coordinate System (FIPS 0401). The DEM for the Composite Surface retained one-meter resolution for the Basin Surface and ten-meter resolution for the Extended Drainage Surface.

7. Imagery

Imagery in this GSP serves two primary purposes: as background layers in figures, and as inputs for remote sensing analysis.

The imagery used for background layers in figures was sourced through ESRI World Imagery (Clarity). The images are licensed under the ESRI Master License Agreement.

Remote sensing analysis played a key role in the land use characterization process. Aerial images were used to delineate such land use types as impervious, open water, riparian, native vegetation, forest land, and urban vegetation. A detailed discussion of the delineation process can be found in Land Use Technical Memorandum (GHD, 2021). The imagery used for the analysis was 4-band multispectral imagery provided by the 2020 U.S. Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP). Imagery tiles were downloaded from the USGS Geospatial Data server (<https://www.usgs.gov/centers/eros>). Approximately 325 individual imagery tiles were downloaded for the ERVB, as defined by the CA_Bulletin_118 Groundwater Basins_Eel.shp shapefile. The individual tiles were combined to create a single multiband orthomosaic of the entire extent of the basin (NAIP20_4B_Pro_SPC.tif).

8. References

Description of the National Hydrologic Model for Use with the Precipitation-Runoff Modeling System (PRMS). Regan, R. Steven, Steven L. Markstrom, Lauren E. Hay, Roland J. Viger, Parker A. Norton, Jessica M. Driscoll, and Jacob H. LaFontaine. 2018. Reston, VA. Report. <http://pubs.er.usgs.gov/publication/tm6B9>.

Groundwater Model Construction and Calibration Technical Memorandum. GHD Inc., 2021.

Land Use Technical Memorandum. GHD Inc., 2021.

9. Electronic Deliverable Inventory

The following electronic deliverables are attached:

- Appendix A: ERVB Basin Surface DEM
- Appendix B: Extended Drainage Surface DEM
- Appendix C: River Cross-section Bathymetry Data
- Appendix D: Composite Surface DEM