EXHIBIT 5-A

Applied Environmental Science
100 Campus Center
Seaside, CA 93955-8001
831-582-4120
831-582-4122 Fax

2023 Carmel River Cross Section and Bed Grain Size Survey

April 19, 2023, **budget revised 7/25/23, see Table 1**

From: Dr. James Guilinger (CSUMB Department of Applied Environmental Science)

To: Thomas Christensen (Monterey Peninsula Water Management District)

Overview

San Clemente Dam was removed in 2015. We propose to continue quantifying geomorphic changes and shifts in sediment size distributions in the ***eighth*** winter runoff following dam removal (Figure 1). We will use benchmarked cross sections and bed material particle counts to collect the data. This proposed work would build upon a decade of work documenting changes in geomorphic change and bed material grain size before (2013-2015) and after the 2015 San Clemente Dam Removal. These previous field campaigns have resulted in multiple reports written by members of the CSUMB Watershed Geology Lab supervised by previous lab director Dr. Douglas Smith (e.g., Chow et al., 2017; Leiker et al., 2014; Steinmetz & Smith, 2018). Additionally, in collaboration with other agencies (NOAA and USGS), this work has resulted in two peer-reviewed articles that have synthesized post-dam geomorphic changes along the Carmel River and placed these changes in context with other large dam removals with different management strategies such as those that occurred on the Elwha River in Washington State (East et al., 2023; Harrison et al., 2018).

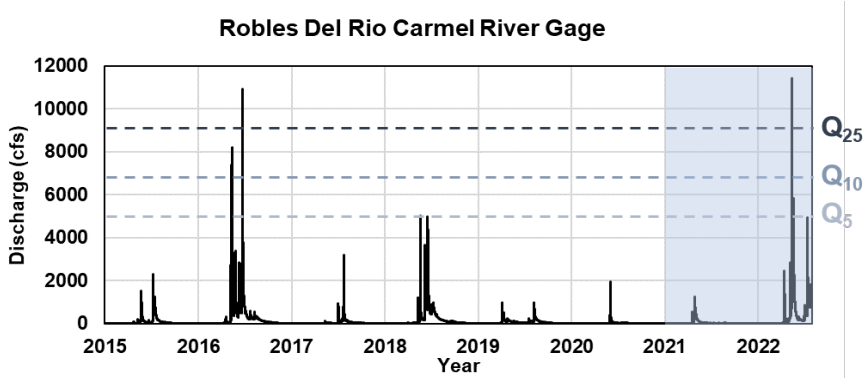

Figure 1. Time series of discharge at Robles Del Rio USGS Gage on the Carmel River from September 2015 to present (end of March 2023). Q_{25}, Q_{10}, and Q_5 refer to streamflow events corresponding to mean recurrence intervals of 25, 10, and 5 years respectively. The proposed study would add to this time series by documenting changes that occurred during the most recent time period of 2021 to 2023 (blue shading), which coincides with the largest flood event following the dam removal and two other streamflow events exceeding Q_5.

Background and Justification

Dam removals are gaining popularity as a river restoration tool in the US as dam age out and interest in restoring fish passage and aquatic habitat has increased (Habel et al., 2020). The San Clemente Dam Removal and Carmel River Reroute, still the largest dam removal in CA history, was a highly unique dam removal project that was designed to reduce downstream geomorphic changes to the Carmel River by stabilizing the primary body of reservoir sediments and opportunistically realigning the channel along a parallel tributary. This approach allayed concerns about post-dam sediment pulses reducing flood conveyance in Carmel Valley. Previous work documenting geomorphic changes and bed sediment size evolution on the Carmel River from 2015 to 2021 showed that the management aims of reduced downstream bed aggradation and generally high channel stability were largely successful (e.g., Harrison et al., 2018; East et al., 2023). However, the removal initially released an unanticipated fine gravel and sand bedload pulse that transiently filled pools and reduced quality steelhead spawning habitat in the lower reaches of the channel (Klein et al., 2019). Though much of this finer sediment wave appeared to be flushed through the system by 2021 (East et al., 2023). This most recent also work documented smaller-scale coarser gravel and cobble sediment waves which could move through the system via dispersion during high flow events (East et al., 2023).

As measured at a long-term rain gauge near Los Padres Dam, water year 2023 thus far represents the wettest time period in the Carmel River watershed following the dam removal (MPWMD, 2023). Three flow events exceeded 5-year recurrence interval flows and one event exceeded the 25-year flow during a series of atmospheric river storms in January of this year (Figure 1). We propose to repeat the methods of previous studies (Leiker et al., 2014) and re-survey 37 of the original 40 cross-sections and perform grain size measurements to assess geomorphic and sedimentological change of the river following this exceptional water year. We would also assess if bed aggradation was significant in the lower Carmel River, which could potentially increase flood risk along the lower reaches. In addition to flood-driven morphologic changes, we would assess how floods have altered bed material grain size such as further entrainment former dam site related sediment sources, winnowing of fines, and continued dispersion of coarse material downstream. This study represents a very unique opportunity to continue a world-class study of the long-term physical evolution of a river corridor to a lower-impact large dam removal in a variable Mediterranean climate. In coordination with data collection at other sites along the river by agency partners at the USGS and NOAA, these results will be written up in a peer-reviewed journal article.

Deliverables

The deliverables to MPWMD will include one final report and associated data in spreadsheet format. The cross-section report will include data for 37 cross sections spanning from below Los Padres Dam to the Crossroads shopping center. The report will include the following sections:

1) Project background
2) Data collection methods
3) Presentation of cross section and grainsize analyses in graphs and summary data tables
4) Comparison with previous data sets to analyze change occurring before dam removal and as a result of dam removal.

Budget

We propose to complete the work for $22,450, a summary budget is included in Table 1. All survey equipment will be provided by the CSUMB Watershed Geology Lab. We propose to complete the fieldwork late summer or fall of 2023 before significant runoff of 2024 water year impedes access to the channel. Reports will be completed before March 2024. Work on this project is contingent upon contracting between the MPWMD and the University Corporation at Monterey Bay.

James ("Jimmy") J. Guilinger, PhD (jguilinger@csumb.edu, cell: 303-549-2183)
Assistant Professor, Director of Watershed Geology Lab
Dept. of Applied Environmental Science, CSU Monterey Bay

Table 1. Budget Items Requested for CSUMB Carmel Monitoring (Year 1: 8/1/2023 to 2/28/2024) ***Version 2: updates made to reflect new indirect rate of 35% (compared to historical 20%)

A. Direct Costs	
A1. Salaries and Wages (salary for PI management, student employee support, etc.)	$13,188
A2. Fringe Benefits (PI and Grad Student) (11%)	$1,451
A3. Materials and Supplies	$502
A4. Field vehicle use	$1,490
B. Indirect Costs (***35%**)	$5,820
TOTAL	**$22,450**

References

Chow, K., Luna, L., & Smith, D. (2017). 2016 Post-San Clemente Dam Removal Morphological Monitoring of the Carmel River Channel in Monterey County, California. *CSUMB Watershed Institute.* https://ccows.csumb.edu/pubs/

East, A. E., Harrison, L. R., Smith, D. P., Logan, J. B., & Bond, R. M. (2023). Six years of fluvial response to a large dam removal on the Carmel River, California, USA. *Earth Surface Processes and Landforms*. https://doi.org/10.1002/esp.5561

Habel, M., Mechkin, K., Podgorska, K., Saunes, M., Babiński, Z., Chalov, S., Absalon, D., Podgórski, Z., & Obolewski, K. (2020). Dam and reservoir removal projects: a mix of social-ecological trends and cost-cutting attitudes. *Scientific Reports*, *10*(1). https://doi.org/10.1038/s41598-020-76158-3

Harrison, L. R., East, A. E., Smith, D. P., Logan, J. B., Bond, R. M., Nicol, C. L., Williams, T. H., Boughton, D. A., Chow, K., & Luna, L. (2018). River response to large-dam removal in a Mediterranean hydroclimatic setting: Carmel River, California, USA. *Earth Surface Processes and Landforms*, *43*(15), 3009–3021. https://doi.org/10.1002/esp.4464

Leiker, S., Delforge, A., Geisler, E., & Smith, D. (2014). Pre-San Clemente Dam Removal Morphological Monitoring of the Carmel River Channel in Monterey County, California. *CSUMB Watershed Institute.* https://ccows.csumb.edu/pubs/

Monterey Peninsula Water Management District (2023). San Clemente Rain Gauge Record. https://www.mpwmd.net/rain-gauges/

Steinmetz, C., & Smith, D. (2018). 2017 Post-San Clemente Dam Removal Morphological Monitoring of the Carmel River Channel in Monterey County, California. *CSUMB Watershed Institute.* https://ccows.csumb.edu/pubs/