



## EXHIBIT 4-A

### ***Applied Environmental Science***

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### ***2019 Carmel River Cross Section and Substrate Survey***

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From: Dr. Douglas Smith (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 document geomorphic changes and shifts in sediment size distributions in the fourth winter runoff following dam removal. We will use benchmarked cross sections and bed material particle counts to collect the data.

The proposed work is timely in that it would capture the geomorphic changes in the active channel resulting from a 10-year event that occurred in winter 2019. It is also timely in that it would build upon and expand similar surveys by USGS/NOAA that will occur in mid-July 2019. The last time the surveys were completed in this way, a peer-review article resulted (Harrison et al. 2018). An updated article would result from this mission as well.

#### **Justification**

The dam removal project is unique in the world because it was designed to produce *de minimis* negative impacts to the downstream reach of river, while providing the ecological benefits of fish passage, restoration of steelhead spawning gravel, and the safety benefits of dam removal (Blanco et al., 2013; Boughton et al., 2016). In contrast, the project has brought abundant sand to the lower river, resulting in pool-filling and degraded spawning conditions (Chow et al. 2016a; Steinmetz and Smith 2018a; Klein et al. 2019). It is clear that the post-dam river behavior is driven by both high sediment supply in the old reservoir sediment and the inherent variability of the Mediterranean climate (Harrison et al. 2018). In addition to biological impacts, the reintroduced bedload (whether sand or gravel) can locally influence flood hazard through channel-filling bar formation and floodplain aggradation. Further, bar formation can force flows against stream banks, leading to accelerated erosion of public and private property. Continued monitoring of the channel behavior is warranted given these unanticipated impacts of San Clemente dam removal. The high flows of winter 2019 had the potential to significantly alter the channel geometry and substrate characteristics.

## **Background**

CSUMB established 40 benchmarked river cross sections to monitor the changes in the river related to dam removal. We periodically collect topographic data and perform grainsize analysis on the Carmel River (e.g., Leiker et al. 2014; Chow et al. 2016a; 2017; Steinmetz and Smith 2018a, Klein et al. 2019). The work to date has shown that a small, pool-filling wave of sand and fine gravel prograded just 3.5 km downstream from the dam site in the first post-dam winter (Chow et al. 2016a), and virtually no cross sectional changes or variations in grain size were noted downstream of that point. In the second year (water year 2017), high flows eroded a large volume of sediment from above the dam site and deposited it throughout the lower Carmel River all the way to the coast. The resulting significant cross sectional changes and changes to sediment size were reported in Steinmetz and Smith (2018a) and Harrison et al. (2018). Much of the lower river was blanketed in sand and small gravel, leaving fewer opportunities for steelhead spawning in the lower river than existed before the dam removal. Further substrate fining and aggradation was noted following the average runoff year of winter 2018 (Klein et al. 2019). While spawning-sized gravel has been transported to the lower river, it is clear that subsequent flows will be needed to winnow the fine sediment and concentrate the high quality gravel for spawners. The proposed work will continue monitoring the river to document the changes driven by the 10-year flow event water year 2019.

## **Deliverables**

The deliverables will include one final report and associated data in spreadsheet format. The cross section report will include data for approximately 40 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 \$24,839, a summary budget is included. All survey equipment will be provided by the CSUMB Watershed Geology Lab. We propose to complete the fieldwork fall of 2019 before significant runoff of 2020 water year impedes access to the channel. Reports will be completed before March 2020. Work on this project is contingent upon contracting between the MPWMD and the University Corporation at Monterey Bay.



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| <b>Budget Items Requested</b>  | <b>Budget period<br/>9/1/19 to 2/28/20</b> |
|--|--|
| <b>A. Direct Costs:</b>  |  |
| 1. Salaries & Wages (professional & clerical employees, temporary and student support, etc.) | \$ 16,994                                  |
| 2. Fringe Benefits   | \$ 1,869                                   |
| 3. Materials and Supplies  | \$ 300                                     |
| 4. Vehicle   | \$ 1,568                                   |
| <b>Total Direct Costs:</b>   | <b>\$ 20,699</b>                           |
| <b>B. Indirect/Administrative Costs: 20%</b>   |  |
|  | \$ 3,996                                   |
| <b>TOTAL PROJECT FUNDS:</b>  | <b>\$ 24,839</b>                           |

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