The Watershed Institute is an Educational, Research, Public Outreach, and Service component of the Applied Environmental Science Department (AES) at CSUMB.

MISSION
The primary mission of the Watershed Institute is to support the vision and academic programs of AES and CSUMB through education, research, restoration, and policy that will protect and enhance the watersheds of the Monterey Bay Area and beyond.
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1 Preamble
The Watershed Institute is proud to submit our annual report of activities. This year marks our 25th year of collaboration between faculty, researchers, outreach specialists, undergraduate and graduate students and community members.

2 Introduction
The Watershed Institute is an educational, research, public outreach, and service component of the Applied Environmental Science Department (AES) at CSUMB.

2.1 Primary Mission
The primary mission of the CSUMB Watershed Institute is to support the vision and academic programs of AES and CSUMB through education, research, restoration, and policy that will protect and enhance the watersheds of the Monterey Bay Area and beyond.

2.2 Purpose
The purpose of the Watershed Institute is to:

1) Assist CSUMB to fulfill its mission, goals, and objectives by providing community outreach and education, research, and Service Learning opportunities, environmental restoration, and resource policy development.

2) Provide an institutional base for visiting scholars, adjunct faculty, and post-doctoral and other academic fellows, thus augmenting the teaching and scholarship efforts of CSUMB faculty and students.

3) Provide research opportunities and association for CSUMB faculty, staff, and students.

The CSUMB Watershed Institute has been continuously operational and self-funded since 1994, one year before CSUMB admitted its first students. The mission of the Watershed Institute remains vital and unchanged in 25 years of operation. While the mission statement is specific to conservation and restoration of Monterey Bay watershed systems, our work influences a much broader region, and now continues to spread outward through an army of trained watershed scientists who take the values and skills of the CSUMB Watershed Systems curriculum to their various careers and graduate school experiences.

The Watershed Institute was envisioned as a center for research, education, and outreach with the simple goal of improving the flora, land, and water resources of the Monterey Bay region. Today that vision continues to be realized, and the regional scope has increased as new faculty and staff continue to bring diverse interests and expertise to the table.

This Annual Report complies with CSUMB Policy and Procedures for Centers and Institutes (Academic Affairs, 2009a, 2009b).
3 Activities
The 2019-2020 Watershed Institute activities are organized as annotated lists with headings that place the activity within the context of the Watershed Institute mission statement and purpose. While the individual activities usually fulfill more than one part of the mission statement, they are presented only once, under the most representative heading. These lists are renewed annually as evidence of recent mission fulfillment.

3.1 Article One of the Watershed Institute Purpose
Article one of the Watershed Institute purpose states that we will, “Assist CSUMB fulfill its mission, goals, and objectives by providing community outreach and education, research and Service Learning opportunities, environmental restoration, and resource policy development.”

3.1.1 Resource Policy Development and Community Outreach
We are very deeply involved in resource policy development in our region and beyond. We serve the community in this regard by giving lectures, developing curriculum, organizing symposia, and holding community-based watershed restoration events. We have a history of strong civic engagement in local resource management, and currently represent CSUMB at several important venues. Collectively, the Watershed Institute Faculty and Staff serve on numerous technical advisory committees (TAC) and advisory boards to foster science-based environmental decision making, and to advocate for community involvement in environmental decision making. A sample of 2019-2020 activities is presented below.

1) **CSU Water Resources Policy Initiative**
   Actively participates in the CSU-wide initiative.

2) **Zambian Carnivore Programme**
   Conducts research for protected area management through local capacity building including training and employment of Zambian nationals in ecological research techniques (e.g., habitat mapping).

3) **Fort Ord Regional Trail and Greenway (FORTAG)**
   Faculty conceived and act as community leaders of 31-mile trail project for which $31M in funding has been obtained to date. CEQA review is now essentially complete. Approvals in progress. Construction design is imminent. Governmental lead agency: Transportation Agency for Monterey County. See Section 12 of this document.
4) **Fort Ord Land Use**  
Collaboration with over 70 community groups and agencies on regional planning, mapping, spatial analysis, and conservation analysis.

5) **Toro Trails Task Force**  
Convened by Monterey County Resource Management Agency to solve trail-related resource management problems at Toro Regional Park.

6) **Camp SEA Lab Board**  
Provides guidance for residential marine science education program.

7) **Carr Lake Core Planning Group for Community Engagement**

8) **Carr Lake Hydrology**  
Class project completed web-published study for Big Sur Land Trust looking at hydrology and water quality of parcel newly acquired by BSLT.

9) **Satellite Irrigation Management Support (SIMS)**  
Collaborative effort to develop new information products from satellite data to support optimization of agricultural water management; project partners include NASA Ames Research Center (ARC), CA Department of Water Resources (DWR), CSU Fresno, USDA Agricultural Research Service, UC Davis, UC Cooperative Extension, USGS, Scheid Vineyards, Driscoll’s, Huntington Farms, and Western Growers Association.  
http://ecocast.arc.nasa.gov/sims/

10) **Fallowed Area Mapping Project**  
Research to develop within-season maps of drought impacts on agricultural production, and map land fallowing across California, Washington and Nevada during drought events.  
Project partners include NASA ARC, CA DWR, the CA Department of Food and Agriculture, USGS, Washington State Department of Agriculture, Nevada State Engineer’s Office, USDA, and the Nature Conservancy.  
CSUMB is currently working with NASA and CA DWR to transfer the workflows developed to CA DWR for sustained operational use.

11) **Expanded Bioreactor Project**  
Four new four-channel research bioreactors have been built on campus. These research bioreactors are used for investigating different types of support matrices, elevated temperature operation, and supplemental carbon injection with the intent of improving bioreactor efficiency by a factor 10X. A larger, field scale, comparative reactor is being constructed in collaboration with the Central Coast Wetlands Group and Waterways Consulting Inc. Additionally, an on-farm trial was conducted in summer 2019. The goal is to use a model-based approach to compare treatment systems in triplicate, simulating a 5-10-acre farm runoff volume through each reactor. The current funding is from the CSU ARI and the CA Leafy Greens.

12) **Return of the Natives Advisory Board**  
Meets annually to advise the RON program.

13) **Carmel River Watershed Conservancy Board of Directors and Advisory Board.**  
Provide guidance for actions aiming to preserve and restore the Carmel River, its watershed, and its populations of threatened species, such as steelhead and California red-legged frogs.
14) Moro Cojo Technical Advisory Committee

15) FogNET research collaborative
   Dedicated to measuring and analyzing the impact of fog water as a resource in California coastal ecosystems. Research has been supported by grants from the National Science Foundation, a contract with a startup called NBD Nano, and a donation from Proximo Spirits.

16) Greater Monterey County Regional Water Management Group
   The Regional Water Management Group is the entity tasked with developing and implementing the Integrated Regional Water Management (IRWM) Plan, reviewing projects submitted to the plan, and choosing which projects to put forward for funding.

17) Monterey Peninsula, Carmel Bay, and South Monterey Bay Regional Water Management Group

18) Sustainable City Year Program
   A new campus program that began in 2015 that integrates class projects with city sustainability needs. The City of Seaside was the second city partner (2017/2018 and 2018/2019). Several of the projects with the City (taken from across campus) addressed issues of environmental education and environmental literacy, consistent with the stated purposes of the Watershed Institute. The City of Pacific Grove is our partner in 2019/2020.

19) Salinas Trash Advisory Committee
   A group of regional stakeholders looking at innovative methods to reduce waste runoff through storm drains.

20) President’s Sustainability Committee
   The mission of the committee is to promote sustainability throughout CSUMB in planning, development, and operation of the campus facilities, including student support services. It will also support sustainability through curriculum innovation, faculty, staff, and student research, and outreach to the local, regional, and global community.

21) California Higher Education Sustainability Conference Steering Committee
   Sets policies and procedures for running the conference annually.

22) CSU Sustainability Policy Education and Engagement Working Group
   Works to establish CSU-based policies and practices to enhance sustainability.

23) Pacific Grove Museum of Natural History Science Advisory Council
   Guides the museum on its displays.

24) Everyone’s Harvest Board of Directors

25) Alisal Vibrancy Plan Community Health and Safety Working Group

26) Sand Gilia recovery
   Review of endangered plant status, led by WI faculty, in collaboration with USFWS.

27) National Marine Sanctuary Water Quality Protection Committee
3.1.2 Service Learning

Each semester, the Watershed Institute Staff provide many undergraduate students with Service Learning opportunities through a course called “Community-Based Watershed Restoration.” In that experience, students come to understand the value of creating community events where residents can emotionally connect with the land on which they live. It is believed that through this connection individual citizens grow to become better stewards of the environment. A key component of this effort is working with K-12 students on hands-on plant ecology restoration projects that foster good stewardship at a young age. Other Service Learning courses from across campus also utilize watershed topics in their curricula with their students completing their service through the Watershed Institute’s Return of the Natives Restoration Education Project, RON. These classes include, ENSTU349S, ENSTU 369S, ENSTU384S, BIO 379S, MSCI 361S, and SL200s.

3.1.3 Environmental Restoration

Environmental restoration is the intentional, incremental improvement of natural ecological or resource function of the landscape in direct response to centuries of unintentional incremental degradation. The Watershed Institute is directly involved with environmental restoration in three ways. First, we have led community-based restoration efforts for many years in the region around CSUMB. This effort has brought thousands of hands, young and old, to work on ecological restoration of native plant communities and the eradication of non-native invasive species. Second, we design and implement river/floodplain restoration projects, and review and improve the designs of others. Faculty and students have been the primary researchers monitoring the positive and negative impacts of the San Clemente dam removal (the largest in such project in CA history). There is a Watershed Institute presence on a variety of technical advisory committees whose purpose is to restore specific sites in California. Examples of these TAC positions are listed in Resource Policy Development section. Less directly, we have educated hundreds of CSUMB students in the value and skills of environmental- and community based-habitat restoration and restoration monitoring.

3.1.4 Presentations to the local community


Smith, D. Regional Geology for Naturalists presentation to the California Science Naturalists Course at PG Museum of Natural History.


Watson, F. Fort Ord Regional Trail and Greenway. Presentation to Board of Directors, Monterey Peninsula Regional Park District. Feb 2020.


3.2 Article Two of the Watershed Institute Purpose

The second article of the Watershed Institute purpose states that we will, “Provide an institutional base for visiting scholars, adjunct faculty, and post-doctoral and other academic fellows, thus augmenting the teaching and scholarship efforts of CSUMB faculty and students.”

Dr. Lars Pierce and Forrest Melton are professors currently associated with the Watershed Institute. Their research, which is briefly described below, provides multiple opportunities for CSUMB students to engage in cutting edge research in the use of satellite data and sensor networks to enhance the sustainability and efficiency of agricultural operations in California.

Dr. Pierce has lead plant and fire ecology studies on Fort Ord FORA and ESCA property located adjacent to campus. These projects have involved local land management agencies, including the Ft. Ord Reuse Authority, the US Army BRAC, the BLM, and Fort Ord Coordinated Resource Management and Planning Group. Dr. Pierce is currently focused on his vineyard irrigation business, where he sends out weekly forecasts and satellite imagery to growers at 50 vineyards across CA. His work with table grape growers is helping them save 25% of their irrigation water without any changes in quality or yield. Dr. Pierce has been associated with CSUMB for over a decade and continues to serve CSUMB in a variety of ways through his association with the Watershed Institute. Dr. Pierce has continuously generated financial support and mentorship for student researchers; he maintains excellent relationships with community partners. Dr. Pierce can be reached at aguavu.com

Forrest Melton is leading a research mission to develop new information products from satellite data and surface sensor networks to address agricultural water management challenges in the western U.S. Ongoing work conducted in collaboration with growers in the Salinas Valley and the California Central Valley is developing near real-time estimates of crop conditions, crop water requirements, and land fallowing across millions of acres of irrigated farmland. The project is also developing web and mobile data interfaces to enhance the ability of growers to access and use satellite information in irrigation management. His work integrates CSUMB students in a variety of paid, research and technology-based internships. Forrest is also the Program Scientist for the NASA Western Water Applications Office (WWAO), which developed new applications of NASA data and technologies for address key water resource management challenges in the western U.S. Forrest is one of our key collaborative links with the NASA Ames Research Center research group. For more information, please see https://appliedsciences.nasa.gov/about/our-team/forrest-melton.

3.3 Article Three of the Watershed Institute Purpose

The third article of the Article of the Watershed Institute purpose states that we will, “Provide research opportunities and association for CSUMB faculty, staff, and students.”

The faculty, staff, and students of the Watershed Institute have published a great number of peer-review journal articles, abstracts, technical reports, and theses as evidence of the research opportunities we enjoy. Since 2000, over 200 publications have been generated by the Watershed Institute faculty, and a great number of those have student coauthors. A nearly complete list of publications is kept up to date at the Watershed Institute Publications website.
These publications focus on serving community research needs, so they represent solid evidence of CSUMB community outreach via Watershed Institute associates. One tangible way that the Watershed Institute enables publication is through the “Watershed Institute Publication Series,” an internally-reviewed and moderated technical report series that archives applied science performed by the research arm of the Watershed Institute. To date there are over 180 Watershed Institute technical reports published on the Watershed Institute Publications website; virtually all of them have at least one student co-author. The great majority of the technical reports were commissioned contract products, underscoring a strong record of grantsmanship through the CSUMB University Corporation. The Watershed Institute Publication Series has been highlighted in the Environmental Monitor, the quarterly publication of the Association of Environmental professionals.

Occasionally, the Watershed Institute publishes a digital newsletter.

Publications representing activity in 2019-2020 are listed below, including CSUMB student co-authors.

3.3.1 Peer-Reviewed Journal Articles 2019-2020


### 3.3.2 Published Abstracts/Posters 2019-2020

* denotes CSUMB undergraduate or graduate student


Olson, J.R., 2019. Assessing the relative impacts of different human activities on stream and river salinity. Annual Meeting of the Society for Freshwater Science, Salt Lake City, UT.


3.3.4 Theses and PSM Internships (Master of Science in Applied Marine and Watershed Science)

<table>
<thead>
<tr>
<th>Student</th>
<th>Project Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew Caudillo</td>
<td>Development of predictive bioassessment indices of non-perennial streams and rivers in the arid Southwestern United States</td>
</tr>
<tr>
<td>John Inman</td>
<td>Native species response to goat foraging in a shrub-invaded grassland</td>
</tr>
<tr>
<td>Joey Klein</td>
<td>Geomorphic inventory of Central Coastal Ca rivers</td>
</tr>
<tr>
<td>Amanda Preece</td>
<td>Associating landscape variables with nest success of songbirds using nest boxes in semi-urban landscapes</td>
</tr>
<tr>
<td>Alexandra Thomsen</td>
<td>Examining natural vegetation colonization at a high-elevation marsh restoration site</td>
</tr>
<tr>
<td>Eric Walmsley</td>
<td>Fire prevention planning and mapping</td>
</tr>
</tbody>
</table>
### Undergraduate Student Reports/Capstones

<table>
<thead>
<tr>
<th>Students</th>
<th>Project Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marinn Browne, Erin Elm, Griffin Hummeldorf, and Larissa Neilson, Alexus Cobarrubias, Will Gorham, and Yessica Cuevas Perez</td>
<td>Patterns of outdoor cat predation in central California</td>
</tr>
<tr>
<td>Fransico Villegas</td>
<td>Removal of <em>Arundo donax</em> improves benthic macroinvertebrate diversity</td>
</tr>
<tr>
<td>Madison McCarty</td>
<td>Determining the ideal number of ramp traps for dry stream sampling using species area curves</td>
</tr>
<tr>
<td>Kathryn Nickel, Bijan Emadi, Jessica Skaggs</td>
<td>Detection of California red-legged frogs in Monterey County using Environmental DNA</td>
</tr>
<tr>
<td>Anthony Yung, Bridget Rittmann, Kayla Lane, Madyson Slaven</td>
<td>Quantifying the progress of the New Zealand Mudsnail (<em>P. antipodarum</em>) invasion in the lower Carmel River</td>
</tr>
<tr>
<td>Joseph Huerta, Josh Bowman, Neil Morrison, Rilynn Misa, Darryl Lewis</td>
<td>A bike lane study and plan for the City of Pacific Grove</td>
</tr>
<tr>
<td>Mitchell Balce, Stephano Murguia, Lauren Bailey, Ezekiel Avila, Joshua Norden, Bryan Jung</td>
<td>Development of electric vehicle infrastructure in the City of Pacific Grove</td>
</tr>
<tr>
<td>Shannon Skidmore, Jordan McCabe, Kevin Weaver, Eleanor Markarian</td>
<td>Stormwater runoff in Pacific Grove: Mitigation techniques and public outreach</td>
</tr>
<tr>
<td>Jiane Dionisio, Miki Ijima, Natalie Olivas, Richard Conell, Skylar Saechao, Marrion Gestat</td>
<td>Green Business Certification in the City of Pacific Grove</td>
</tr>
<tr>
<td>Jack Jarvis, Alyssa Albert, Brianna Arroyo, Vanessa Arroyo-Sanchez, Evalina Hansen, David Valenzuela</td>
<td>Single-use plastic ordinance in the City of San Juan Bautista</td>
</tr>
<tr>
<td>Natalie Vaughn</td>
<td>Predicting the spread of the invasive New Zealand Mud Snail in the Carmel River</td>
</tr>
<tr>
<td>Brittany Scerini, Diana Murillo, Kristi Kissomartinez, Lauren Castanon, Monica Martinez and Patrick Lopez</td>
<td>Did San Clemente dam removal increase flood risk on the lower Carmel River?</td>
</tr>
</tbody>
</table>
4 Connection to University

The Watershed Institute exists to serve the CSUMB mission. That commitment is explicitly stated in the mission and purpose statements of the Watershed Institute and is demonstrated in evidence throughout the report. The Watershed Institute is fully integrated with the University because it is run by dedicated CSUMB professors and long-term staff.

5 Impact of Activities on the Academic Program(s) of the University

The Watershed Institute positively impacts the academic programs of the university in a variety of significant ways. The Watershed Institute faculty design, continually improve, and deliver the core curriculum in the Watershed Systems concentration of the B.S. in Environmental Science, the B.A. in Environmental Studies, and the M.S. in Environmental Science. Course activities within this core curriculum are often tied to real-world projects based in the local community. We teach watershed-centric Service Learning courses and coordinate Service Learning for the Service Learning Institute. Research projects and contracts associated with The Watershed Institute provide continual student opportunities for meaningful work, internships, research, and publication. These projects provide CSUMB students with hands-on experience in real-world projects, and provide external funding to support undergraduate capstone projects and graduate theses.

The “Bob Curry Watershed Scholarship Fund” was established by the Institute in early 2012 for the annual benefit of a Watershed Science graduate student and a Watershed Concentration undergraduate student. Funds were obtained from a gift from Bob Curry and the sale of a collection of 19th Century maps. Dr. Robert Curry was the founding faculty member of the Watershed Institute. Bob also mentored numerous CSUMB faculty as they became acquainted with the unique geology and hydrology of Central California. The 2019-2020 “Bob Curry Watershed Scholarship Fund” graduate recipient is Mikaela Bogdan who is a graduate student in Dr. Doug Smith’s Hydrology lab. The 2019-2020 Undergraduate recipient of the Bob Curry Watershed Scholarship Fund award is Gretchen Wichman.

The Watershed Institute is also instrumental in choosing winners of CSUMB’s annual “Garden Club of America” scholarship. The 2019-2020 Winner is who has worked with Return of the Natives for several semesters is Olivia Equinoa.

The Watershed Institute has been a key organizer of the yearly Central Coast Invasive Plant Conference (formerly the “War on Weeds” Conference). November 2019 featured the 19th annual conference attended by 110+ agency and academic personnel. The Institute also hosts an annual welcome reception for incoming science graduate students, and an annual post-semester reception celebrating students finishing their degrees.

Watershed Institute Faculty continue to mentor the student chapter of the California Land Surveyors Association.
Watershed Institute Faculty Member Dr. Jennifer Duggan, is one of the advisers for the CSUMB Chapter of SEEDS. SEEDS is the flagship award-winning education program of the Ecological Society of America. Its mission is to diversify and advance the ecology profession through opportunities that stimulate and nurture the interest of underrepresented students to participate, and to lead in ecology. Focused mainly at the undergraduate level, with extension services for communities, high schools, graduate students, and international collaborations, the SEEDS program promotes an ecology profession with wide representation to ensure environmental understanding and a sustainable future for all. The core SEEDS program components offer hands-on, engaging experiences with ecology that exhibit the relevance and applications of the science. Each experience also provides opportunities to interact with a diverse group of ecologists and other motivated students to both broaden and deepen students’ understanding of ecology and potential careers. In 2018, the CSUMB SEEDS Club began a webpage detailing events and activities: https://csumb.edu/twe/seeds-club.

Watershed Institute Faculty Member Dr. Jennifer Duggan advises a student club newly formed in 2018, the CSUMB Wildlife Conservation Society. The mission of the club is to promote student awareness of and support for conservation of wildlife.

6 Finances

The Watershed Institute has an incentive account that was funded by the University Corporation as part of PI grant overhead. As of April 9, 2007, institutional incentive overhead generated by Watershed PI’s is now pooled with SEP.org incentive funds. Institute activities this year were supported by the following categorized expenses (Table 1). The total budget is provided in Table 2.

Table 1. The Watershed Institute Donation Fund 72038 1027 Approximate annual expenses between April 15, 2019 and May 7, 2020

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Balance April 15, 2018</td>
<td>$5,083.85</td>
</tr>
<tr>
<td>Income</td>
<td>0</td>
</tr>
<tr>
<td>Disbursements of Assets to Bob Curry Scholarship Fund-</td>
<td>($5,083.85)</td>
</tr>
<tr>
<td>Ending Balance May 7, 2020</td>
<td>$0</td>
</tr>
</tbody>
</table>

* $4,500 of this amount (2016) was a donation from PG &E to support a graduate student who would work with PG&E on a local gas-line improvement project in regard to plant surveys.

*In the fall of 2017 Watershed Institute PI’s voted to move $5,000 of the funds from this account to the Bob Curry Scholarship Fund. However, Watershed Institute Director Laura Lee Lienk halted this transfer for the next several years so that the PG &E project from the previous paragraph could proceed or not. University Development, under direction from UCORP auditors, returned to Laura Lee Lienk in January 2020 to close the account, thus precipitating the move of remaining funds to the Bob Curry Scholarship Fund.
Table 2: Watershed Institute Incentive Fund  #10002143 Annual budget between May 7, 2019 and April 12, 2020

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Balance April 15, 2018</td>
<td>$653.69</td>
</tr>
<tr>
<td>Income</td>
<td>$264.12</td>
</tr>
<tr>
<td>Expenses</td>
<td>0</td>
</tr>
<tr>
<td>Ending Balance May 7, 2019</td>
<td>$917.81</td>
</tr>
</tbody>
</table>

7 Budget Forecast

The Watershed Institute personnel continue to actively pursuing extramural funds to support ongoing, new, and future research and outreach activities. Evidence is provided in the following two lists of current and proposed contracts. None of these contracts have increased the Watershed Institute operating budget since 2007, when all grant incentive funds were pooled with SEP.org.

7.1 Research Grants Received and Current Contracts 2019-2020

Aecom, Inc. Five-year post dam removal monitoring, San Clemente Dam ($53,200) D. Smith and J. Olson, Co-PIs.

Big Sur Land Trust-Restoration by RON at the BSLT Carr Lake Site 2019-2021 ($30,000) LLLienk, PI.

CA Dept of Forestry and Fire Protection, Support for fire prevention planning, Awarded 2019 ($227,591) J. Olson, PI.


CA State Parks Habitat Conservation Fund for weekend programs in Salinas Funded through 2021 ($71,240) LLLienk, PI.

CA State Parks. Watershed Assessment of Hollister Hills State Vehicular Recreation Area ($230,298). D. Smith, PI.

California American Water. Post-Dam-Removal Studies of Carmel River ($20,000) D. Smith, PI.

Central California Alliance for Health Healthy Food Access (Awarded to Everyone’s Harvest) 2020-2021. ($155,000) H. Parker and R. Norris, Co-PIs; V. Lopez-Littleton and E. Mosqueda, Collaborators.

CSU Agricultural Research Initiative, Assessing the effects of agriculture on non-perennial rivers and streams, Awarded 2019 ($22,000) J. Olson, PI.


Monterey County Gives: a project of the Community Foundation for Monterey County 2019. ($6,566) LLLienk, PI.

Monterey Peninsula Management District. 2019 Carmel River Cross Section Surveys ($24,839) D. Smith, PI.

Monterey Peninsula Unified Applied Environmental Science Department District in support of 4th and 5th grade Eco-Ambassadors Program with Return of the Natives. ($15,000) LLLienk, PI.


REI Bannff Mountain Film Festival Co-sponsorship 2020 (~$15,000) LLLienk, PI.

San Jose Research Foundation/USDA, Evaluation of agricultural management practices and water quality, Awarded 2019 ($13,458) J. Olson, PI.

Santa Lucia Preserve. Hydrology monitoring, Awarded 2019 ($6,202) J. Olson, PI.

Sean Parker Conservation Fund. 2014-2020. Bringing Marginalized Students to Monterey Coast ($200,000) still active funding LLLienk, PI.

Southern California Coastal Water Research Project, Biological indicators for assessment of intermittent and ephemeral rivers during dry phase ($32,945) J. Olson, PI.

State Water Resources Control Board/USEPA, Dry stream assessment phase III, Awarded 2019 ($75,000) J. Olson, PI.

Tetra Tech/US EPA. U.S. Phosphorus Model Development, Awarded 2020 ($20,000) J. Olson, PI.

USDA Agricultural Research Service. Site-specific soil pest management in strawberry and vegetable cropping systems using crop rotation and a needs-based variable rate fumigation strategy. 2019-2024 ($429,547). F. Melton, PI.

USDA-Farmers Market and Local Food Promotion Program (FMLFPP), Awarded 2019 to Everyone’s Harvest. 2020-2022 ($184,390) H. Parker and R. Norris, Co-PIs.

US Dept of Interior/BLM. For Return of the Natives’ community-based restoration programs in Applied Environmental Science Departments and with general public, includes plant production and out-planting. 2019-2020 (Many student assistant positions $30,000) LLLienk, PI.

US Dept of Interior/BLM to hire CSUMB science grads as Weed Interns working under BLM supervision 2019-2020 ($50,000) LLLienk, PI.


Zambian Carnivore Programme & WWF Netherlands. Conservation Science in Zambia 1 ($6,738) F. Watson, PI.

Zambian Carnivore Programme & IUCN-SOS. Conservation Science in Zambia 2 ($6,000) F. Watson, PI.

Zambian Carnivore Programme & WWF Netherlands. Conservation Science in Zambia 3 ($3,840) F. Watson, PI.
7.2 Research Grants and Contract Proposals Submitted 2019-2020

CA Arts Council proposal in partnership with Arts Council for Monterey County “Eco-Ambassadors in Monterey County. (~$103,000) Submitted 4/30/2020. L.Lienk, PI.

CA Coastal Conservancy. “Eco-Ambassadors Go to the Coast” for 4th grade restoration field trips. ($48,199) Submitted April 2019. Not funded. L.Lienk, PI.

Creek Lands Conservation/ CA Dept Fish & Wildlife, Salinas River Watershed Steelhead Distribution Study. ($44,191) Submitted May 2020. J. Olson, PI.

CSU COAST, Quantifying the amount, type, and ecotoxicity of micro-plastics in California runoff. ($356,494) submitted April 2020. J. Olson, PI.

NSF IUSE. Collaborative Research: Squirreling around for science: Scaffolding ecological field research into the undergraduate curriculum through a networked CURE. ($399,861) Submitted December 2019. J.M. Duggan, PI.


Western SARE Research and Education Pre-proposal. Evaluating animal movement in and near 3 types of agricultural ditches: key data for co-management of water quality and food safety. ($350,000) Submitted May 2020. J.M. Duggan, Co-PI.

8 Current Income

As reported above, the Watershed Institute has a small source of residual funds in the Watershed Institute Incentive Account.

9 Personnel

The following list includes CSUMB faculty and staff who identify themselves with the Mission of the Watershed Institute via grant-funded activities, unfunded service, or by providing mission-specific curriculum in AES courses during the 2019-2020 year in review.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laura Lee Lienk</td>
<td>Adjunct Faculty</td>
<td>Co-Director, PI, instructor</td>
</tr>
<tr>
<td>Dr. Jennifer Duggan</td>
<td>Faculty</td>
<td>Co-Director, PI, instructor</td>
</tr>
<tr>
<td>Dr. Fred Watson</td>
<td>Faculty</td>
<td>PI, instructor</td>
</tr>
<tr>
<td>Dr. Suzanne Worcester</td>
<td>Faculty</td>
<td>PI, instructor</td>
</tr>
<tr>
<td>Dr. Dan Fernandez</td>
<td>Faculty</td>
<td>PI, instructor</td>
</tr>
<tr>
<td>Dr. Arlene Haffa</td>
<td>Faculty (Dept. of BIOC)</td>
<td>PI, instructor</td>
</tr>
<tr>
<td>Dr. Doug Smith</td>
<td>Faculty</td>
<td>PI, instructor</td>
</tr>
<tr>
<td>Dr. John Olson</td>
<td>Faculty</td>
<td>PI, instructor</td>
</tr>
<tr>
<td>Forrest Melton</td>
<td>Adjunct Faculty</td>
<td>PI</td>
</tr>
<tr>
<td>John Silveus</td>
<td>Adjunct Faculty</td>
<td>instructor</td>
</tr>
<tr>
<td>Dr. Lars Pierce</td>
<td>Faculty</td>
<td>PI</td>
</tr>
</tbody>
</table>
10 Organizational Structure

The organizational structure of the Watershed Institute includes a director (or two co-directors) nominated and elected by simple majority of the AES faculty who actively lead, or participate in, Watershed Institute activities (Figure 2). The directorship involves oversight of Watershed Institute incentive and donation accounts, setting meeting agendas, scheduling meetings, research and writing of the annual report, and fostering periodic institute review. In collaboration with the Watershed Institute Advisory Board, the director fosters work leading toward achieving the Institute Mission.

While not officially part of the Institute Structure, several “programs” have emerged as distinct entities. These programs are shown schematically below. The research arm represents faculty, staff, and students involved in applied science driven by community needs. The community outreach arm includes faculty and staff involved in several long-term initiatives to improve the environment through community education and community-based restoration projects.
The Watershed Institute Organizational Chart

College of Science, (COS; Dean)

Department of Applied Environmental Science (Chair)

Local Community (e.g., Resource Management, Agriculture, Education, etc.)

Watershed Institute Advisory Board (COS Dean, AES chair, AES faculty, Community members)

The Watershed Institute (Laura Lee Lienk, Jennifer Duggan co-directors)
Watershed-based AES faculty, staff, students, alumni

Environmental Ed & Service Learning

Conservation & Restoration

Central Coast Watershed Studies

Crop Water & Nutrient Management
11 Facilities

Between 1994 and 2003, the Watershed Institute housed many of its core faculty, researchers, and operations in Building 42. Building 42 provides 2400 ft\(^2\) of space for offices, restroom, utility room and hallway. It also provides a 760 ft\(^2\) teaching space. The Watershed Institute nursery, occupies approximately 3000 ft\(^2\) of open land. The nursery is essential to cornerstones of the Watershed Institute mission--community outreach, education, and restoration. The native plant nursery is used to grow thousands of plants every year in support of WI restoration projects and provide meaningful activities for a variety of community members, including a developmentally disabled adult group “Green Thumbs.”

The 7+ acre field where the Watershed Institute nursery, the CSUMB Garden Club garden, and the Bio-Reactors are located was renamed the “Sustainability Commons” in late 2015 after a name vetting process involving all members of the WI team. The name “Sustainability Commons” can now be found on campus planning documents and maps.

In 2003, simultaneous overcrowding in Building 42, and opportunities for office and teaching lab space in the new Chapman Science Center (Bldg. 53) led to decentralization of Watershed Institute operations and faculty. In essence, the research arm of the Watershed Institute moved offices to building 53 and expanded the research and teaching laboratory operations to available space in Building 13 and the new capstone laboratory spaces in Building 53.

It is now very difficult to judge how much space the Watershed Institute operations occupy, since faculty activities are inextricably integrated with everyday operations of SEP and State teaching space and State offices. While we distinguish State-funded and Corporation-funded activities and equipment, they occur seamlessly in shared spaces across campus, including Building 42, where the Institute was founded and still thrives today.

The space needs of the Watershed Institute are forecast to increase as new science analytical equipment is purchased. Nursery operations will need to expand in response to funded community needs. In 2015 the addition of space for the Bio-reactor complex and its assorted structures has been absorbed into the WI Greenhouse Area. Building 13 space is efficiently utilized to employ 2 staff and a number of graduate and undergraduate students who work on externally funded projects. Currently, all the available office space is being used, and there remains a critical need for more office space, especially if more students are to benefit from grant-funded research.

12 Community Service

The CSUMB Watershed Institute has a very strong presence in the community. Community service is central to the Watershed Institute mission, and is embodied in its support of the CSUMB mission statement. The community we serve includes students, local, state, federal, and international resource agencies, NGOs, municipalities, other academic institutions, and individual stakeholders.

As detailed in section 2.1 of this report, the faculty volunteer on several regional technical advisory committees and advisory boards. In that role, we provide scientific input aimed at sound environmental policy decisions. As detailed in section 2 of this report we serve the community’s environmental needs through funded research, technical reports, and very substantially through community-based restoration projects (Tables 3 and 4).
Table 3: Return of the Natives Participants  June 1, 2019-May 1, 2020.

<table>
<thead>
<tr>
<th>Activity</th>
<th># Community Served</th>
</tr>
</thead>
<tbody>
<tr>
<td>General public Involved in watershed restoration with Return of the Natives</td>
<td>465</td>
</tr>
<tr>
<td>K-12 school children contact experience in watershed restoration with Return of the Natives single activities</td>
<td>11921</td>
</tr>
<tr>
<td>K-12 individual children involved in multiple activities, including Eco-Ambassadors with MPUSD.</td>
<td>3974</td>
</tr>
<tr>
<td>Number of Classroom Teachers Involved in RON Programs. This includes 54 MPUSD teacher with Eco-Ambassadors</td>
<td>172</td>
</tr>
<tr>
<td>Weekend Stewardship Activities--youth</td>
<td>239</td>
</tr>
<tr>
<td>Weekend Stewardship Activities--families</td>
<td>226</td>
</tr>
<tr>
<td>On-going Greenhouse Volunteers</td>
<td>17</td>
</tr>
<tr>
<td>On-going Adults with disabilities</td>
<td>60</td>
</tr>
</tbody>
</table>

93% of the K-12 students reached by RON in 2019-20 experienced multiple lessons in the classroom, school yard, local parks, and restoration sites in Monterey County Wild Areas.

Table 4: Return of the Natives Brings CSUMB students to Community Service 2019-2020

<table>
<thead>
<tr>
<th>Annual Activity</th>
<th>Hours of Community Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return of the Natives staff supervises CSUMB Learning Students from courses across campus</td>
<td>59 students x 30 hours = 1770 hours</td>
</tr>
<tr>
<td>Return of the Natives hires CSUMB student assistants as mentors and leaders in the community</td>
<td>15 students x 10 hours/week x 40 weeks/year = 6000 hours</td>
</tr>
<tr>
<td>Return of the Natives hires CSUMB grads for Internships at BLM</td>
<td>3 grads x 1000 hours = 3000 hours</td>
</tr>
<tr>
<td>Return of the Natives staff supervises an AmeriCorps VIP member</td>
<td>1700 hours/year</td>
</tr>
</tbody>
</table>

Dr. Smith engages students in data collection and analysis for a variety of regional resource managers including helping Fort Ord BLM and State parks managers quantify erosion magnitudes and management. Students are also working to monitor the extreme environmental changes occurring near the former San Clemente dam site. They are also assessing the use of beach nourishment to protect Monterey’s coastal development.
Further, Watershed Institute faculty regularly train regional environmental docents. Recent activity includes several hours of training on regional geology and natural history interpretation for 30 Docents in training at Pacific Grove Natural History Museum’s “California Naturalists” class.

Dr. Watson works with numerous stakeholders in the reuse of the Former Fort Ord, most actively with respect to the Fort Ord Regional Trail and Greenway (FORTAG) project. Dr Watson co-created and co-leads the FORTAG initiative with Dr Scott Waltz (also at CSUMB). To date, the team has worked with 88 local organizations, convened 321 FORTAG meetings, given 44 public presentations & tours, been highlighted in 18 media articles, and – with the Transportation Agency for Monterey County as lead agency - secured $31M in funding for FORTAG via a voter-approved county sales tax increment (Nov 2016) and three allocations of State transportation funds. See: http://www.fortag.org

Dr Watson has also created a series of trans-jurisdictional trail maps of the region encompassing the former Fort Ord. See: http://www.fortord.info

Dr Watson is a founding member of the nascent Park It! Initiative, a collaboration of about 15 agencies with a goal to revolutionize vehicular transportation to recreational destinations in the Big Sur and Monterey Peninsula region.

Dr Watson is conducting a status review of the endangered Sand Gilia in collaboration with USFWS and with the cooperation of about 10 landowner organizations. This began as a voluntary effort in 2017 and 2018, with funding sought for the first time in 2019. The team has surveyed over 400 miles of field transects. One graduate student has joined the project via an internship with BSLT; and another joined in 2019 and is completing a PSM Internship with the project, funded by USFWS. A 400/500-level class completed a class research project on related work (weed mapping).

Dr. Pierce works with growers on the North Coast and Central Coast, as well as in the San Joaquin Valley, applying remote sensing and water balance modeling towards the design and development of efficient irrigation schedules in wine grape vineyards. He also works with local resource agency personnel (US Army, BLM, FORA) in assessing the effects of prescribed fire on the Fort Ord Maritime Chaparral plant community.

Dr. Worcester works with the BLM on effectively managing grasslands to reduce fire hazard, increase species of interest, and increase biodiversity over all. This includes evaluating the effectiveness of using sheep or goats to manage grasslands for specific goals. This collaborative partnership has led to joint academic-agency presentations at local, state-wide and national conferences on the use of goats to maintain grassland habitats.

Dr. Fernandez coordinates the Environmental Studies program and engages students in 3 classes in the Environmental Studies Program, namely, capstone, systems thinking and sustainability, and infrastructure systems. He also coordinates the campus-wide Sustainable City Year Program, which engages campus classes and regional city and county sustainability-related projects. He integrates his work on collection of water from fog within his research, teaching, and some of his professional activities within in the community. See csumb.edu/fernandezlab
Dr. Duggan engages students in monitoring and research used to inform management of the CSUMB campus, local parks, and nature reserves. Examples include establishment of small mammal monitoring at both the Point Lobos State Natural Reserve and the University of California Fort Ord Natural Reserve, research on wildlife responses to urbanization (including study sites on Fort Ord National Monument and the Santa Lucia Preserve) and research on responses of wildlife to domestic animals. See csumb.edu/twe

Dr. Duggan and Dr. Olson include students in research monitoring the responses of invertebrate and vertebrate wildlife to removal of invasive *Arundo donax* along the Salinas River. Both undergraduate and graduate students receive funding for their research through the Resource Conservation District of Monterey County.

Dr. Parker engages students in community-based environmental projects with local non-profit organizations throughout the region through her teaching of Social and Ecological Justice Service Learning. She has also mentored the Independent Capstone students in the Environmental Studies major and teaches Critical Thinking and Communication in Environmental Studies. In her capacity as President of the Board of Everyone’s Harvest, Dr. Parker has acquired grant funding for “Everyone’s Harvest” to expand their collaboration with area medical professionals to prescribe produce for patients with diet related illnesses and food insecurity. Dr. Parker is collaborating with Dr. Lopez-Littleton and Dr. Mosqueda to conduct a CBPR evaluation of the program’s efficacy.

Dr. Parker co-founded the Monterey County Coalition for Agriculture (MC-COA) in March 2020 with Dr. Brenda Eskenazi of UC Berkeley and PI of the CHAMACOS study, Dr. Pedro Moreno of the Alisal Health Clinic, and Aaron Voit, Esq. of California Rural Legal Assistance, Inc. to address farmworker health and work safety issues associated with COVID-19. Since March 2020, the coalition has been meeting weekly, acting as a clearinghouse for information, and has grown to 75 members, including members of the Monterey County Board of Supervisors and staff, the County Public Health Officer and staff, the Mexican Consulate in San Jose, the Monterey and Santa Cruz Agricultural Commissioners, the Farm Bureau, Grower Shipper Association, Strawberry Commission, Monterey County Vintners, and other agricultural industry leaders, medical, public health, and legal professionals, academics and students from UC Berkeley, CSUMB, and Stanford, and farmworker advocacy organizations. Group members have successfully requested, acquired, and disseminated PPE for farmworkers from state and private resources, increased testing capacity for farmworker communities in the county, increased information for farmworkers through print, visual media and in-person informational sessions in Spanish and indigenous languages, and members of the group are initiating seroprevalence studies of COVID-19 in farmworking communities. Since May 2020, the MC-COA has been coordinating with Santa Cruz County Agricultural and Public Health staff and medical professionals to share resources and best practices.

13 New for 2019-2020

**Sustainability Commons**

The 7+ acre field where the Watershed Institute nursery, the CSUMB Garden Club garden, and the Bio-Reactors are located was renamed the “Sustainability Commons” in late 2015 after a name vetting process involving all members of the WI team. The name “Sustainability Commons” can now be found on campus planning documents and maps. In keeping with the underlying theme of
sustainability in the renaming of the space, for the past year, members of the WI have been gathering data through focus groups of students from a cross-section of majors on campus, as well as meetings with Associated Students and faculty in Environmental Studies and the College of Science to discuss the design of a comprehensive outdoor space for sustainability-related activities. The emphasis of these initial discussions has been the identification and inclusion of potential stakeholders’ ideas for the future use of the space and the development of a core mission for the Sustainability Commons in order to eventually seek funding for the planning and infrastructure needs of the area. The mission is to provide experiential course-based learning, research, and co-curricular opportunities for CSUMB undergraduates and community members in sustainable and healthful living practices, habitat restoration, hands-on environmental and informal science education, and small-scale urban and peri-urban agriculture. This project is led by Adjunct Faculty, Dr. Hester Parker who has developed a research opportunity for a UROC Researcher to collaborate with her on further planning of the Sustainability Commons. Dr. Parker co-mentored the UROC Scholar with Dr. Tori Derr during the summer of 2019 and the student completed a data analysis of the focus groups conducted by Hester during the previous semesters, but the student was unable to present her work at the UROC Symposium. Her presentation was postponed until a later symposium.

**Expanded Research into Bioreactors**

In the past year, we have expanded our original research on woodchip bioreactors for remediation of agricultural runoff. Four 4 channel bioreactors are now operational at research site on campus, near our existing greenhouse facility. The new complex also consists of outdoor classroom space. The site also has supported ~half a dozen funded undergraduates working on bioreactor projects since its inception. Funding for the group has come from the CSUMB Undergraduate Research Opportunity Center (UROC), the CA Department of Pesticide Regulation, the CSU Agricultural Research Institute (ARI), Water Resources Policy Institute (WRPI), and the CA Leafy Greens.

**Sustainable City Year Program partnership with City of Pacific Grove**

Beginning Fall 2019, CSUMB classes worked with the City of Pacific Grove to address some of their desired sustainability-related projects through campus course-based projects.

**Unique Partnership with CA State Parks**

California State Parks and CSUMB have developed an internship program focusing on research and data analysis that is focused on answering specific natural resource management issues at Pt. Lobos State Natural Reserve, including helping Fort Ord BLM and State parks managers quantify erosion magnitudes and management. We are also working to monitor the extreme environmental changes occurring near the former San Clemente dam site. Students are also assessing the longevity of a beach nourishment project in Monterey. Data collected will help state park staff manage these critical natural resources while providing a balance between human recreation and natural resource protection.
14 Plans for Future Activities

We anticipate that the next year will closely follow the success of the past 24 years of operation. The following un-prioritized bullet points provide insight into topical areas where we anticipate expansion of current initiatives and development of new work.

We anticipate that the next year will closely follow the success of the past 24 years of operation. The following un-prioritized bullet points provide insight into topical areas where we anticipate expansion of current initiatives and development of new work.

- Continue pro-bono trail and greenway master planning, GIS, and land-use mapping activities on Fort Ord (and surrounding areas) for the general benefit of open-space planning
- Continue to work with the Army, BLM, FORA, and the Ft. Ord CRMP Group to assist with the transition of former Ft. Ord Army lands to the public and private sectors. This will also include subcontract work with numerous Army restoration sub-contractors.
- Include increasing numbers of Environmental Studies undergraduate major students in RON outreach programs.
- Increase restoration work on CSUMB Campus in conjunction with Campus Planning.
- Initiate opportunities for Environmental Science graduate students to become more fully involved in strengthening the Watershed Institute infrastructure, i.e., through the recreation of the Watershed Institute website, or, in representing the Watershed Institute in local and regional meetings/events.
- Increase the number of volunteers working with Return of the Natives through the RON’s DONs and RON Restorers Volunteer Programs.
- Expand the use of GIS and modeling tools in the local agricultural community to enhance grower-understanding of crop water needs and to improve irrigation efficiency.
- Continue to expand the Watershed Institute role in the new CSU-Water Resources Policy Initiative.
- Continue to influence emerging water supply policy along the Central Coast.
- Increase the collaboration with the agricultural industry to promote practices that protect the region’s water quality and water supply using external sponsored funds (e.g., USDA, CSU ARI)
- Continue collaboration with organizations working on wildlife-landscape interactions in primarily international developing regions.
- Develop environmental service and outreach programs for youth in Salinas both for CSUMB outreach but also to address issues of marginalization and violence.
- Expand existing network of regional fog water collection instruments to document the relationships between the fog and the local flora, fauna, geography, and climate change.
• Continue to build linkages to the local agricultural community by providing access to summaries of satellite imagery and weather data, as well as modeling, for use in irrigation planning and assessment.
• Continue collaborations with the US Army, BLM, FORA, and local community to better understand the need for and the effects of fire on plant species composition in maritime chaparral, a special-status plant community with a limited distribution.
• Continue collaboration with the Resource Conservation District of Monterey County to monitor restoration along the Salinas River.
• Continue collaborations with the BLM on ways to effectively monitor grasslands to determine if resource management goals are being met.
• Developing closer ties to the Salinas Valley agricultural community by providing funded internships for students through the USDA NIFA grant.
• Continuing the MC-COA’s unique collaboration between Monterey County and Santa Cruz public officials and staff, Salinas Valley agricultural community leaders, public health, medical, legal, and academic professionals and farmworker advocates to continue sharing resources and best practices for maintaining the health of farmworkers.

15 Problems to be Addressed and being addressed

The following bullets identify areas that we would like to improve or explore.

• Advocating for new building as CSUMB renovates the campus
• Keeping WI vehicle use consistent so that per mile charge is reasonable
• Purchasing new WI vehicle to replace very aged vehicles
• Maintaining ability to use Procards
• CSU-support (buoyout or overload) for faculty leading the newly mandated annual reports and periodic program reviews
• Improve website review and revise Mission Statement and Purpose – working with AES staff
• Attracting post docs (from UCSC and elsewhere)
• Solicit community advisory board member(s)
• Updating all computers utilized for grants
• Continuing funding for WI greenhouse equipment and supplies not allowed to be charged to grant budgets
• Clarifying and strengthening identity of WI affiliation with existing faculty and students, including those who are not necessarily directly funded by WI, but still participate in WI-relevant activities

16 Advisory Board

The Founding Agreement between WI and CSUMB (CSUMB, 1999) dictates that we maintain an advisory board that guides the Watershed Institute toward fulfilling its mission to the university and community (Table 1). The Steve Bachman (Monterey District Planner, CA State Parks) indicate interest has become the community member of the advisory board.
Table 1: Advisory Board.

<table>
<thead>
<tr>
<th>Required Membership</th>
<th>Spring 2020 Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>COS Dean</td>
<td>Andrew Lawson</td>
</tr>
<tr>
<td>AES Chair</td>
<td>Worcester</td>
</tr>
<tr>
<td>University Corporation</td>
<td>Lopez</td>
</tr>
<tr>
<td>Watershed Institute Director(s)</td>
<td>Duggan &amp; Lienk</td>
</tr>
<tr>
<td>Two AES faculty</td>
<td>Watson &amp; Haffa</td>
</tr>
<tr>
<td>One community member</td>
<td>Steve Bachman, CA State Parks</td>
</tr>
</tbody>
</table>

The Watershed Institute Executive Committee is a subset of the Advisory Board (Table 2). The Executive Committee selects the community member and AES faculty members of the Advisory Board by simple majority vote.

Table 2: Advisory Board Executive Committee.

<table>
<thead>
<tr>
<th>Required Membership</th>
<th>Spring 2020 Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>COS Dean</td>
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</tr>
</tbody>
</table>

17 References

