UC SANTA BARBARA
Bren School of Environmental Science & Management

Master of Environmental Data Science
Capstone Project Guidelines
MEDS Class of 2026

INTRODUCTION

These guidelines define the Bren School's expectations for the Master of Environmental Data Science Capstone Projects and explain the process, timeline, and required deliverables.

Capstone Projects are a unique and important component of the Bren School's approach to environmental data science. The Bren School developed the Capstone process in direct response to prospective employer requests that Bren graduates possess "real world" skills. These skills include excellent academic training as well as the ability to successfully work and communicate as a member of a team and manage a professional data science project. The Capstone Project provides students an opportunity to work together to design, conduct, and present a professional environmental data science product or analysis.

Without exception, all students pursuing the Master of Environmental Data Science (MEDS) degree must successfully complete a Capstone Project.

Students who pursue Capstone Projects collaborate with clients, which may be internal clients (Bren Faculty, other UCSB researchers) or external clients from industry, government, or non-government organizations. Clients must present a problem that can be addressed and solved by the Capstone Project. Students begin working on their Capstone Projects in Winter Quarter and work culminates in Spring Quarter. The project requires:

- an environment in which the students can learn to operate as an independent professional team;
- a spirit of trust and collaboration by all parties;
- healthy and professional communication and rapport among all parties; and
- the ability of students to choose courses of action, make mistakes, and learn from those experiences.

CAPSTONE PROJECT TIMELINE OVERVIEW

Below are the key deadlines in this year's Capstone Projects. Note that the instructor of EDS 411A/B, faculty advisor, or clients may request additional milestones and may set internal deadlines for drafts or other materials in addition to deadlines listed here.

Fall Quarter 2025	Due Date	
Week 9	November 24 (Monday)	Capstone group assignments announced via email
Week 10	December 2 (Tuesday)	Capstone kickoff workshop. Schedule meeting with client for Winter quarter before January 15. Schedule recurring meetings with advisor during Winter quarter.
Week 10	December 5 (Friday)	Submit group alias to the Capstone Coordinator.
Finals week	December 10 (Wednesday)	Submit sections I, II, and III from the MEDS Team Management Plan Template to the Capstone Coordinator.
Winter Quarter 2025	**Due Date**	
Week 2	January 16 (Friday)	Submit project abstract for posting on the Bren website
Week 5	February 6 (Friday)	Draft Design and Implementation Plan due to EDS 411A instructor and faculty advisor
Week 6	February 13 (Friday)	Feedback from EDS 411A instructor and faculty advisor due back to students
Week 7	February 20 (Friday)	Share link or file of Faculty Review slides (final version to be shown at the event)
Week 8	February 23 (Monday)	Capstone Projects Faculty Reviews
Week 10	March 13 (Friday)	• Submit final Design and Implementation Plan to the EDS 411A instructor, faculty advisor, client, and Capstone Project (CP) Coordinator; • Send Project Repository access to CP Coordinator; • Submit Self/Peer Evaluation to the EDS 411A instructor, faculty advisor, and CP Coordinator

Spring Quarter 2026	Due Date	
Week 3	April 17 (Friday)	Preliminary draft of Technical Documentation due to EDS 411B instructor and faculty advisor
Week 4	April 24 (Friday)	Feedback on draft from EDS 411B instructor and faculty advisor due back to group
Week 5	May 1 (Friday)	Final project title due to CP Coordinator
Week 7	May 11 (Monday)	Complete draft of Technical Documentation and Project Repository due to EDS 411B instructor and faculty advisor
Week 7	May 15 (Friday)	Submit final presentation program abstract and acknowledgements to CP Coordinator for posting on the Bren website (template will be sent by CP Coordinator) *The abstract should be approved by students' faculty advisor*
Week 8	May 18 (Monday)	Feedback on Technical Documentation from EDS 411B instructor and faculty advisor due back to students
Week 8	May 22 (Friday)	• Submit editable file of closed captioning script • Submit data to data repository and send DOI to CP Coordinator
Week 9	May 28 (Thursday)	Share link or file of Final Presentation slides (final version to be shown at the event)
Week 9	May 29 (Friday)	Capstone Project Final Presentations
Week 10	June 1 (Monday)	Revised Technical Documentation and Project Repository due to the EDS 411B instructor and faculty advisor for their review and signature *Faculty advisor should sign first before EDS 411B instructor*
Week 10	June 6 (Friday)	• Submit final deliverables to CP Coordinator: 1. Final Technical Documentation (PDF version with unsigned signature page) 2. Signature page with all signatures (students, faculty advisor and EDS 411B instructor) 3. Project Repository • Submit Self/Peer Evaluation to EDS 411B instructor, faculty advisor, and CP Coordinator • Submit faculty advisor evaluation via Qualtrics

1. GENERAL INFORMATION

A. Capstone Project Timeline

At the end of Fall Quarter, MEDS capstone groups hold meetings to establish their group responsibilities and a meeting schedule with their advisor and client. Student's work on the project is expected to resume after the Winter break. The students begin working on their Capstone Projects in the beginning of Winter Quarter and complete their projects by the end of Spring Quarter. Capstone Projects Faculty Reviews are held at the end of Winter Quarter. Capstone Project Final Presentations are held at the end of Spring Quarter, with the Technical Documentation and Project Repository also due at the end of Spring Quarter. The timeline overview provides deliverable due dates. Working with their faculty advisor, groups define their own deadlines for intermediate products.

B. Academic Units and Grading

Students must register for EDS 411A and EDS 411B in winter and spring, respectively, for a total of 8 units. The instructor for EDS 411A and EDS 411B assigns grades at the end of their respective quarters with the input from the group's advisor.

Students must achieve a grade of C or better on their Capstone Project to be eligible for the MEDS degree. Students working together on a project may not necessarily receive the same grade. Additionally, students cannot be recommended for graduation until they have submitted an approved final deliverable package.

By the last day of week 10, students are required to complete and submit a Capstone Project Peer and Self Evaluation Form to the instructor of EDS 411A/B, their faculty advisor and the Capstone Project Coordinator. These evaluations will be considered by the instructor when grades are being assigned. This form can be found on the Academic Resources for Current Students page of the Bren School website.

C. Student Time Commitment

Students should expect to devote **at least 10-12 hours per week** to their Capstone Project during Winter and Spring Quarters, although more time can be expected for some tasks. This estimate includes time spent in EDS 411A and EDS 411B. Work on Capstone Projects should be evenly allocated over the 2 quarters to avoid excess workload at the end of the project.

D. Deliverables

The academic deliverables required to complete EDS 411A/B and fulfill the requirements of the MEDS degree are:

- Design and Implementation Plan
- Capstone Projects Faculty Review presentation

- Technical Documentation
- Capstone Project Final Presentation
- Project repository, which includes as appropriate:
    - Completed analysis or model, including data description
    - Documentation and workflows
    - Interface or data visualization
- Data and metadata, as appropriate

E. Authorship and Ownership

Each member of the group is an equal owner of the intellectual property of the project. Frequently, groups divide the responsibility for some tasks that further the project; one or several individuals may invest more time in one aspect of the project than others. However, each member of the group ultimately contributes to the body of work that emerges from a Capstone Project. Therefore, every required paper, presentation, etc., that is produced by the group MUST list every member as an author.

Groups are encouraged, but not required, to present their Capstone Project findings in formal conferences outside the university. Participation in such conferences gives students valuable experience and increases the visibility of the Bren School and its students. Groups also may want to publish results in a peer-reviewed journal. Groups may collectively develop criteria for authorship of these supplemental materials but all members of the group must agree to these criteria. A group member may choose not to be included as a co-author on a publication. However, ALL group members must be offered the opportunity to make their own decision about their authorship. Even after the project has ended, if a group member adapts the deliverables for presentation at a meeting or submission to a journal, EVERY group member should be listed as a co-author. Groups also may include their faculty advisor or others who contributed substantially to the research as co-authors.

F. Data Distribution

Datasets obtained or derived during your work may be licensed, copyrighted, or confidential. Students should NOT make them available to third parties, or generally available online, without authorization from their faculty advisor AND the original source of data, such as an external client. Capstone projects should not require a Non-Disclosure Agreement (NDA). Under NO circumstances can a student independently sign an NDA with a client.

G. Publishing

If a group would like to publish its work, group members must discuss this with their advisor. Faculty advisors are experts in peer-reviewed publication, and students should take advantage of their knowledge and experience. Publishing peer-reviewed literature requires interfacing with a larger scholarly community, and this should be done in a way that reflects well on the

students, their advisor, the client, and the Bren School. Note that it often takes a prolonged period (months to years) to get a paper published.

H. Use of Human Subjects

Faculty and students who engage in research involving human subjects must obtain prior approval from the UCSB Human Subjects Committee (HSC). "Human Subject" means a living individual about whom an investigator (whether professional or student) conducting research obtains (i) data through intervention or interaction with the individual or (ii) identifiable private information. This means that if a survey will be conducted, HSC approval MUST be obtained in advance. Approval is required no matter with whom the group will interact - even friends or family!

If a group will use human subjects, it must review the Office of Research site: https://www.research.ucsb.edu/human-subjects/about. The group must understand and abide by the policies and procedures. The process for obtaining HSC approval for proposed research is not immediate and cannot be addressed at the last minute. There are serious consequences if a group is not in compliance. Human subjects cannot be interviewed, surveyed, or contacted in any way without prior approval from HSC.

2. COMPOSITION OF THE CAPSTONE PROJECTS

A. Group Members

Each group is composed of 3 to 4 students. Students vote on projects by assigning preference points in the Fall Quarter. Group assignments are determined in Fall Quarter by a computer algorithm that uses these points to optimize overall student preferences for different projects. Not all students will be assigned to their preferred project. However, almost all students are assigned to their first or second choice project. The experience of completing a Capstone Project is generally comparable across groups regardless of the topic of the project.

B. Faculty Advisors & Instructor of EDS 411 A/B

Each Capstone Project is assigned one faculty advisor; each group must have at least one advisor who is Bren School ladder faculty (or 0% affiliates) in addition to the instructor of EDS 411A/B on their master's capstone committee. The instructor of EDS 411A/B monitors progress and provides assistance on group dynamics, technical expertise, project evaluations, and grades. The faculty advisor acts as a subject matter consultant and provides environmental domain expertise, project feedback, and deliverable quality evaluations. The students are responsible for project leadership, management, and the quality of the final products.

Faculty advisors do not serve as project managers; their role is similar to that of a consultant. The EDS 411A/B instructor meets with groups regularly in class and is responsible for grading.

Faculty advisors may offer reactive advice, responding to activities in the group and providing guidance when asked. The advisor also may give proactive advice regarding deficiencies and deadlines. It is important that students understand the role of the advisor and the limited, though important, role they play in directing the project. Each faculty advisor has their own unique approach. Students should expect variability in engagement, expectations, and feedback from one advisor to the next. At the beginning of Winter Quarter, each group should clarify the expected level of interaction with their faculty advisor. Groups should include this information in their Team Management Plan.

C. Clients

Clients supply the environmental data science objectives and relevant data that are central to Capstone Projects. If the client is external to Bren, we advise them to work with the MEDS Program Coordinator, Capstone Project Coordinator and/or Bren faculty to develop and submit proposals. If incoming students have a relevant environmental data science project they are interested in proposing, they may reach out to the Capstone Project Coordinator prior to the start of Fall Quarter.

Effective clients will be engaged in the project, knowledgeable about its topics, and serve as a resource for students, while not constraining the group's approach or the project's outcome. Some clients may have a clear idea of the objective and what types of solutions are needed. Other clients may be more flexible about the types of solutions needed and they may prefer that students provide direction for how to meet the objective. Students should maintain regular, professional communication with clients throughout the project. In particular, students must engage the client within the first 2 weeks of Winter Quarter, so that all parties clearly understand the project objectives, data, deliverables and timeline. If an in-person meeting consisting of the group, faculty advisor, and client is not possible, then students should engage the client through teleconference or Zoom. The students should invite the clients to attend the project's Capstone Project Final Presentation.

D. External Advisors

Interacting and networking with the professional community may be valuable to the Capstone Project process. We encourage students to seek expertise from other professionals to assist them as informal external advisors, such as individuals from government agencies, industry, non-governmental organizations, universities, or private citizens who may be interested in the project, its data or deliverables. An external advisor is someone who has knowledge about the project topic and can provide unbiased feedback.

If an external advisor is desired, groups will be responsible for identifying external advisors and maintaining professional contact with them for the duration of the project. The external advisors may be invited to meet, together with the faculty advisor, clients, and group members.

External advisors may also be invited by the students to attend the Capstone Project Final Presentation.

E. Capstone Project Coordinator

The Capstone Project Coordinator is a Bren staff member who assists the students, faculty advisor, EDS 411 A/B instructor, and the Capstone Project Committee in facilitating the Capstone Project process. The Capstone Project Coordinator is Samantha Shanny-Csik (scsik@ucsb.edu). Any questions or concerns regarding a Capstone Project should be addressed to the Capstone Project Coordinator.

3. PROJECT MANAGEMENT

A. Group Meetings

In addition to attending EDS 411A/B, groups are encouraged to meet as often as necessary. At a minimum, student groups should be meeting twice weekly, once with their faculty advisor and once with just group members. However, it is the responsibility of the students, not the advisor, to schedule the meetings and make necessary arrangements. **Regular group meetings should not be scheduled on Monday - Thursday between 11:00 am – 12:00 pm,** as these days and times are reserved for seminars, career talks, and faculty meetings. The EDS 411 A/B instructor will lead weekly classroom sessions. Advance notification of absences to the group is expected as a matter of courtesy. Participation in the group meetings is a portion of each student's grade; missed meetings may negatively affect the overall grade

B. Scheduling Meeting Rooms

Students are responsible for scheduling their own rooms for regular Capstone Project meetings. Each group should designate a scheduler for the group and this person should be responsible for all calendar entries for their group. **It is imperative that the scheduler check availability before scheduling and never schedule over an existing reservation.** In addition, if plans change and the room is not needed as scheduled, the reservation should be removed immediately since meeting rooms are in high demand. Meeting rooms are available at Bren Hall and the UCSB library.

> Bren Hall
> You can self-book a room using RobinPowered. Bren students may book the following rooms online: Edison International Visitors Center (BH 1410), Sycamore Room (BH 1510), Oak Room (BH 1520), Pine Room (BH 3526), Manzanita Room (BH 4329), Bonsai Room (BH 4327) and Maple Room (BH 3016). Please note that you are limited to booking up to 14 days ahead, no recurring meetings, and a max meeting length of two hours.

To schedule meetings in excess of two hours, recurring meetings or meetings beyond 14 days, please complete and submit a Bren Hall Room Request Form. For weekly Capstone Project group meetings each quarter, please self-book the first one or two iterations, then send your request to extend that reservation for the rest of the quarter.

The scheduler MUST include the **group's and scheduler's names** in the title of the meeting so that the Bren scheduling team can easily contact the group in the event of a conflict.

UCSB Library

The library on campus has the following room types available for reservation by students:

- 24 Hour Group Study Rooms
- Group Study Rooms
- Presentation Practice Room

Instructions for scheduling rooms in the UCSB library are available online at: http://libcal.library.ucsb.edu/

C. Conflict Resolution

The primary responsibility for intra-group conflict resolution lies with the group members. The EDS 411A/B instructor or faculty advisor(s) can help resolve any issues that cannot be adequately addressed by the group members. If a group is still unable to resolve a conflict after faculty arbitration, the group may seek assistance from the Bren Projects Team. Students may also wish to contact the campus ombuds office (http://www.ombuds.ucsb.edu). Trained mediators are available at no cost throughout the year. Their mediation techniques are informal, confidential, and impartial. If students have difficulty with a member of their group, it is critical that they maintain written documentation of the problem and attempted solutions.

For example, if one member of a group is not doing their share of work or not providing timely products or products of adequate quality, the other group members must document dates of specific incidents and what efforts were made to address the problem. Only under these circumstances will it be possible for the EDS 411A/B instructor, faculty advisors, or administrative personnel to intervene and help craft a solution. Administrative involvement is generally limited and occurs only when there are serious issues that remain unresolved after considerable effort by the students, the EDS 411A/B instructor, or faculty advisor(s). Because of federal privacy laws, students may not be informed of specific interventions or disciplinary actions taken against other students; however, this does not mean the problem was not acted upon by the administration.

Conflict resolution process. Some of the tasks undertaken by the group may turn out to be unexpectedly difficult or even impossible. A group member who encounters such a difficulty

must communicate the problem to other members promptly, respectfully, and explicitly. The group might then share ideas or seek guidance from the EDS 411A/B instructor or faculty advisor, or re-focus the project if the task is beyond the capacities of the group. Prompt, constructive, and continuous communication will help the group overcome such difficulties and avoid late surprises or disappointment.

Other difficulties can arise because of uneven contributions among the members. This dynamic can lead to feelings of exclusion or that one or more members are not pulling their weight. To preemptively address these potential frictions, the Team Management Plan must describe steps that the group will take if a member does not sufficiently contribute. It is better to decide on ways of dealing with such problems before they arise.

To understand different working styles and minimize the likelihood of conflict, the group should discuss the following preferences, internally and with the advisor:

- How do you like to receive constructive feedback?
- How do you like to receive positive feedback, and how often do you like to receive it?
- What steps do you take to ensure your work is high quality?
- How would you like a teammate to address you if they thought your work was not up to the team's quality standard?
- How would you like a teammate to address you if they thought you were crossing the boundary of their role's responsibilities?
- How do you like a group to make decisions? How would you like a teammate to address you if you made a decision that they wanted to weigh in on?

The group's agreements on these topics should be included on their Team Management Plan. The group should then develop a common set of practices for dealing with conflict.

The starting point for managing conflict is for the group to assume initial responsibility for the problem. The group's management plan should first focus on assisting or motivating a group member having trouble, realizing that problems might arise for anyone. Methods for dealing with problems include peer review, or division or re-negotiation of responsibilities. If a resolution cannot be reached using these tools within a reasonable time (no longer than a month), the group should engage the faculty advisor, the EDS 411A/B instructor, or the Bren Projects Team. If a group member consistently fails to contribute at the expected level, the Project Manager should meet individually with the faculty advisor(s) or the Bren Projects Team to discuss the problem and possible solutions. If a serious problem emerges, Project Managers and other group members should feel free to schedule individual meetings, as needed with their EDS 411A/B instructor, faculty advisor(s), or Bren Projects Team. If it is not possible to resolve the problem with group, 411A/B instructor, and faculty advisor intervention, then it may be necessary to schedule a facilitated group meeting with the Bren Assistant Dean or campus ombuds person.

Common Capstone conflict scenarios include the following:

- A student is contributing minimally or not at all to the project, forcing others to pick up the slack
- A student is not completing assigned tasks by agreed deadlines
- A student is consistently late or missing meetings
- The quality of a student's work does not meet team expectations
- A student is not fulfilling their assigned role
- A student is completing tasks that are within another team member's responsibilities
- A student excludes team members from communications with the client or advisor
- Unprofessional communication styles, including rude comments, dismissive body language, refusal to communicate, lack of inclusivity, etc.
- Team members are unable to agree on a major aspect of the project (goals, deliverables, timeline, methodology)

Being aware of these issues is important, and talking about them early on will avoid having a major conflict.

Students may also wish to contact campus resources for assistance.

- Counseling & Psychological Services (CAPS) (https://caps.sa.ucsb.edu/; 805-893-4411; Building 599) is a resource for learning new skills in building self-confidence, relating to others, reducing stress, solving problems, and identifying options. Students can make an appointment to see a counselor individually or as a group.
- The Graduate Academic Counselor, Ryan Sims (ryan.sims@graddiv.ucsb.edu; 805-893-2068; Cheadle Hall 3rd Floor), is available to support students in their academic journey, including academic support, time management skills, communication skills, and referrals to campus resources.
- Office of the Ombuds (http://www.ombuds.ucsb.edu; 805-893-3285). Trained mediators are available for conflict management at no cost throughout the year. Their mediation techniques are informal, confidential, and impartial.

4. PROJECT DELIVERABLES

Refer to the timeline overview for a summary of Capstone Project deadlines and deliverables. In addition to submitting all project deliverables, students must pass all EDS 411 courses with a C or better in order to be eligible for the MEDS degree. Students must be actively involved with their group throughout the six-month project to receive a passing grade.

A. EDS 411A (Winter Quarter)

MEDS students begin Capstone Projects in the Winter Quarter and are required to register for EDS 411A Capstone Project (4 units). EDS 411A will have a regular class schedule and

instructor. Additionally, students are required to attend relevant workshops, and schedule weekly meetings with all group members.

EDS 411A requires completion of the following elements:

1. Scoping of the Project

As part of EDS 411A, each group transforms the project's initial proposal into a tractable Design and Implementation Plan. Students should immediately begin investigating the objective presented in the proposal. In addition to in-class participation in EDS 411A, students must schedule regular weekly meetings with their group and faculty advisor. Students should strive to meet with their faculty advisor in person, if possible, or by teleconference or Zoom if the faculty advisor is off-campus. The first in-person meeting should be scheduled during week 10 of Fall Quarter and should include all students and the faculty advisor. The group and faculty advisor should read the initial proposal critically prior to the meeting and be prepared to discuss expectations for each other.

Students should also prepare for a scoping meeting with the faculty advisor and client before the EDS 411A class in Week 2. This first meeting with the client should include a detailed walk through of the data by the client and discussion of the objectives and users of the final product. In the first 2 weeks of EDS 411A, students should determine what is feasible to complete within five months and understand the level of academic performance needed to satisfy the requirements of the MEDS program.

Subsequent weekly course sessions are intended to provide guidance and feedback as the project develops. The Winter Quarter focuses on design of the data science solution. Attention to best practices for data science should be paid early in the Winter Quarter to ensure that proposed design addresses the following:

- Data science solutions that contain
    - Robust, reproducible workflows
    - Reliable, sustainable products that are easy to use and maintain
    - Quality assurance and error-checking
- Interface development e.g., data visualization
- Testing approach
- Documentation
- Data, model, workflows, and documentation that are archivable/retrievable
- Project management strategy for design and implementation

A critical element of a successful Capstone Project is clear, frequent, and open communication with the client. Clients may be involved with their Capstone Projects to a greater or lesser degree, depending on their availability, expertise, and desired level of engagement. Central to deciding what the project will include (and what it will not include) is a scoping meeting at the latest on Week 2 with the group members, client, and faculty advisor(s). As noted above,

students should schedule a meeting with the client (in person if the client is local or by Zoom or teleconference if the client is not local), even if the faculty advisor is the client, during the second week of Winter Quarter. The purpose of the meeting with the client and faculty member is to develop a shared understanding of the data and project objectives. If any objectives in the original proposal are not feasible, the faculty advisor and students will discuss this with the client and develop an understanding of how the group plans to proceed. The meeting(s) with the faculty advisor and client should result in a clear agreement about what is possible and not possible given the available time, resources, data, client support, and faculty and student capabilities. Following the meetings, students should document the project objectives and produce a short list of deliverables.

Students may schedule additional meetings with the faculty advisor and client, as needed and appropriate.

2. Design and Implementation Plan

The Design and Implementation Plan is a concrete and realistic statement of what the group will do to solve the assigned problem for the client. The construction and articulation of this plan are significant parts of the work required to solve the problem. The Design and Implementation plan should be limited to 5-10 single-spaced pages of written text. This page limit does not include the title page, table of contents, budget and justification, references cited, or team management plan. A draft of the implementation plan is submitted to the instructor of EDS 411A and the group's faculty advisor in Week 5 of Winter Quarter (see timeline for date). The final Design and Implementation Plan is due to the instructor of EDS 411A, faculty advisor, client, and Capstone Coordinator on the last day of week 10.

The Design and Implementation Plan must include the following sections:

a. Title Page (Appendix III)
b. Table of Contents
c. Project Summary
d. Objectives
e. Deliverables
f. Solution Design
    i. Approach
    ii. Methods
    iii. Research Data
g. Data Management Plan
h. Documentation Plan
i. Timeline and Milestones
j. Budget and Budget Justification
k. References
l. Team Management Plan

Description of Design and Implementation Plan sections:

(a) Title Page

The title page must include the following information. See formatting guidelines in Appendix III.

- Title (no more than 10 words recommended)
- Names of group participants (alphabetical order by first name recommended)
- Names of faculty advisors and EDS 411A/B instructor
- Bren School of Environmental Science & Management, University of California, Santa Barbara
- Date (month and year of completion i.e., March 2026)

(b) Project Summary

Write a brief description (1 paragraph) of the environmental data science problem to be addressed. What is the larger issue that the project will address? What is the client's motivation for tackling this problem? What is the goal of the project? What is the current state of the problem? How will the project address the problem? What is the potential impact of solving the problem?

(c) Objectives

What is the specific need that this project will address? Include a short list of objectives based on the project proposal and the feedback received during meetings between the faculty advisor, client and student group. Typically, students will address only one or two objectives for a Capstone Project. If a group has more than three objectives, they are probably too specific; it may be appropriate to move this detailed information to the approach and methods of the solution design. Keep overarching objectives in mind throughout the project and use them continually to monitor whether the group is on track or whether the group needs to re-orient its activities. Do not list deliverables as objectives.

(d) Deliverables

There are two types of Capstone Project deliverables: (1) products for the client and (2) academic deliverables required to complete EDS 411A/B and to fulfill the requirements of the MEDS degree. In this section, provide a list of specific deliverables (results or products) that will be created for the client. These deliverables will be produced by the group to meet the objectives listed in the previous section. Be sure to include detailed descriptions of the expected interface, demonstration, or data visualization.

The group should use this list of deliverables to gauge progress during the project. Some of the deliverables can be produced in the early stages of the project. The group should continually keep the list of deliverables in mind when working on the project.

(e) Solution design

(e-i) Approach

Provide an overview of the tasks that need to be accomplished to achieve the project's objectives and complete the deliverables. This section should consist of a workflow diagram and an outline of steps. To help get started, consider working backwards from final products to intermediate outputs, to primary data. You should identify all necessary steps and provide a summary of "how" you will meet each objective and produce the deliverables. Each step should be presented in a workflow diagram (see example below).

For example, the approach should start with data access and then outline the overall pathway to achieve the objectives and produce the deliverables. Questions to consider are: Will you need to clean the data? Are you implementing a model, developing a new one, creating a data visualization? Is there a phase involving the testing of an interactive tool by the client or other human testers? What kind of documentation and metadata creation will be needed along the project and to ensure its future usability? Keep your answers high-level; all specific details about how the tasks will be implemented should go in the methods section.

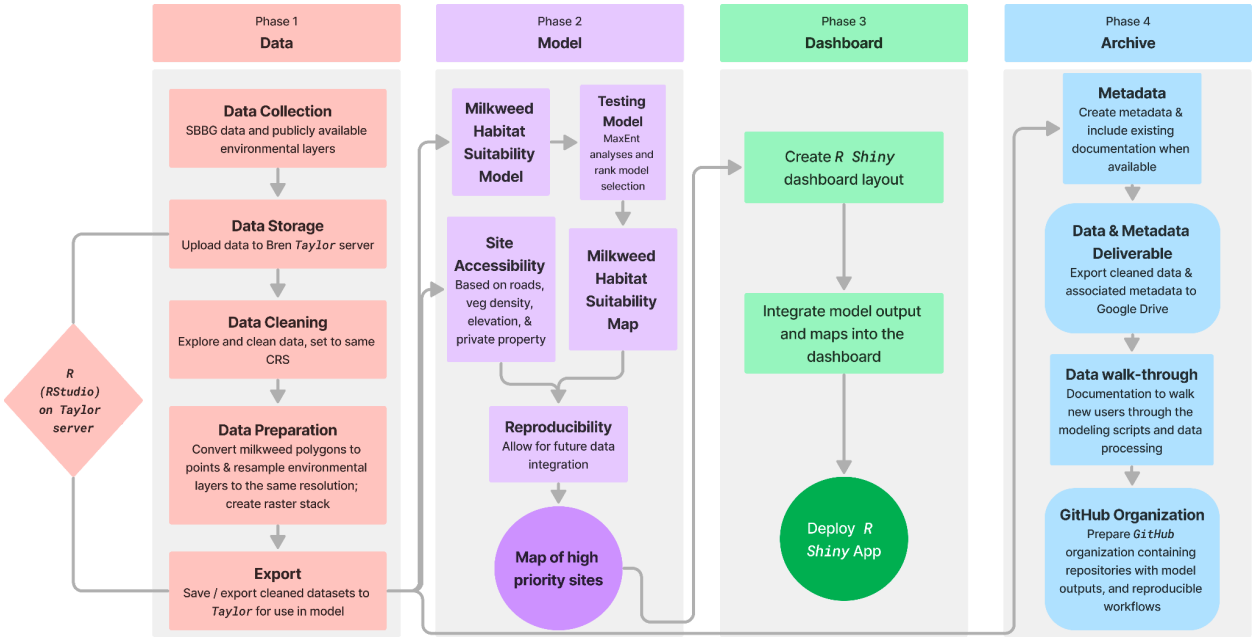

Fig 1. Capstone Project Workflow Diagram by MilkweedMod team (MEDS, 2024).

(e-ii) Methods

Elaborate on each of the specific tasks identified within the approach. This should include plans to handle the data and information about software, models, statistical analyses, visualizations, etc. Consider having each task in the "Approach" section as a bullet point with a

detailed description of its implementation beneath it. Use schematics, conceptual models or workflow diagrams where possible.

While writing this section, ask penetrating questions, such as:

- How will you access the data - is it provided by the client?, are you accessing data from an API?, and where will it be stored?
- How will the data be pre-processed for analyses and ensure its compatibility?
- What kind of statistical analyses will be used, how do they work, and why are they appropriate?
- How will missing values or outliers be identified and handled?
- Are there any underlying assumptions about the data distribution or sample size?
- What will be the nature of the results and how will results be communicated to users?
- Will unit tests be integrated to test specific functionalities of the code and ensure reliability?
- Is there specific data that will be used for testing?
- What kind of plots, graphs or maps are you planning to produce to visualize results?
- Will you test product performance, including user interface testing? If so, how?
- How is sustainability and maintenance being considered in the design, tool selection, and development of the product?
- What will documentation of workflows look like?

In conclusion, explain how software or data analysis will be used to meet the overall project objectives. Throughout, describe any open source or proprietary software expected to be used in the project. This may include modeling, spatial analysis, relational database, repository, or any other software that will be leveraged to meet the Capstone Project objectives. Describe how this software will be accessed and how it will be used to meet the objectives of the Capstone Project.

(e-iii) Research Data

Detail the data you will use as input for the project in table format. Include file types, dataset size, number of expected files or sets, content, and source of the data (creator and method of collection).

For example:

Table 1: Research Data Summary		
Variable	Type, Approximate Size	Source
Plant Polygon Survey Data	.shp, .dbf, .cpg, .prj, .shx (2.3 MB)	Botanic Garden via Ailbe Chika shared on Google Drive

Plant Polygon Metadata	.xlsx	Ailbe Chika (Botanic Garden)
Los Padres National Forest (LPNF) 2023 Trails and Roads	.shp, .dbf, .cpg, .prj, .shx	Los Padres Forest Watch via ArcGIS
Bioclim (all variables)	.tif (400 MB)	Wallace's envs_clim function, WorldClimTiles package
Canopy Cover	.tif (350 MB)	California Forest Observatory
Digital Elevation Model	7 tiles, .tif (600 MB)	USGS's TNM (the national map) download interface
Soil	.gdb (6.1 GB)	gNATSGO database

(f) Data Management Plan (DMP)

Throughout the project, the group may produce a large number of files. At the end of the project, groups must submit data used in the project and associated metadata. Not all data need to be saved, such as interim results derived from an original data set. However, the data produced by the group may have significant value for other researchers beyond this project, and sharing this data is part of the group's responsibility as members of the scientific community. Relevant data or metadata emerging from the project will be archived for public use according to a license agreed upon by the client and group. The DMP describes how research data will be managed during the project and, if appropriate, made available to others after completion.

The group should discuss with their client and advisor which data and/or metadata they anticipate to publicly archive by the completion of the project. A first step to identifying this data or metadata is to address the question: If another researcher wanted to replicate the group's work or re-use the group's data, what data and documentation would be required for them to do so? The group must briefly answer the following questions for the data and metadata they will be archiving:

1. Data description

Briefly describe the data or metadata that will be archived. Include the file types, number of expected files or sets, and content. Address whether there are any standard formats in the specific research field for managing or disseminating the data sets (e.g., XML, ASCII, CSV, .shp, .gdb, GeoTIFF).

2. Intellectual property and re-use.
If data were collected from the client organization, does the group have the right to redistribute it? If so, are there any restrictions on redistribution? If the group created its data files, will it assign a Creative Commons license to its data? If there is data that is not appropriate for sharing due to confidentiality or disclosure risk, describe that here.

3. Metadata
Metadata is documentation that helps make data sets re-usable. Think about what details (metadata) someone would need in order to be able to understand and use these files. For example, perhaps a readme.txt file is necessary to explain variables, structure of the files, etc.

4. Data sharing and access
Specify the extent to which data can be reused, including any licensing and access limitations. List any proprietary software that might be needed to read the files.

5. Data archiving and preservation
Where will the data and metadata be stored after the project is completed? Is there a subject-specific and/or open-access repository that is appropriate for the data?

If students need assistance in evaluating repositories, they should contact UCSB Library's Research Data Services (RDS) Department rds@library.ucsb.edu.

(g) Timeline and Milestones

Milestones will help students complete their Capstone Project by identifying key tasks and products that they will create as the project proceeds. In this section, students should use a Gantt chart to make a timeline of the dates by which they intend to complete each of the tasks outlined in the Approach section, including data acquisition, analyses, evaluation of results, product development, testing (if relevant) and documentation. Include the dates by which the group intends to complete drafts and final versions of each of its products and deliverables. At the end of Winter Quarter, students should review and possibly re-organize the remaining milestones.

(h) Budget and Budget Justification
Capstone Projects may not require any financial expenditures. If your project requires expenses please include a budget and budget justification by filling in the table below. If the expenses are not standard operating costs, please provide a short justification for why the expenses are critical for the project in the details column.

Table 3: Budget and Budget Justification			
Expense	Amount	Details	Fund source

If you are unsure of whether expenses are authorized, please consult Bren purchasing procedures and/or contact the Finance team.

If your project does not require any budget besides the one provided by the Bren School, please adapt this statement:

> This project requires no additional funding for software, data, or tools. We anticipate that the budget provided by the Bren School will be sufficient for [*anticipated expenditures with costs*].

(i) References

Include a bibliography of references used to support the group's research. Information derived from other authors must be cited properly. The reference citations should be presented in a standard and consistent format, and managed using citation software (e.g. Zotero).

The final Design and Implementation Plan is due to the instructor of EDS 411A, faculty advisor, and client by the last day of week 10.

(j) Team Management Plan

The Management Plan outlines the group's management structure and general plan for the form and function of the group. Within it, each team establishes agreements about code of conduct, communication and task management responsibilities, meetings structure, procedures for timely completion of tasks, expectations of group members and their faculty advisor, as well as acknowledging and expanding on the conflict resolution process outlined by these Capstone Guidelines. Each team must complete the MEDS Team Management Plan Template by the second week of Winter quarter, with the exception of sections I and II which should be submitted to the Capstone Coordinator by the end of Fall quarter.

3. Faculty Review

In Week 8 of Winter Quarter (see timeline for dates), each group presents their project progress for faculty review. These presentations will overlap with the normally scheduled class time of EDS 411A. By this point, groups should have revised the draft of their Design and Implementation Plan based on feedback from the instructor of EDS 411A and faculty advisor. The Faculty Review is an opportunity for the students to present their approach to solving their client's problem and any preliminary results they may have. The Faculty Review is a checkpoint in the Capstone Project process so that students receive verbal feedback from their faculty advisors with a primary emphasis on methodology, technical approaches, and proposed products and documentation, such as data visualization or demonstration. At the time of the

review, the project is still underway, and students should integrate feedback from faculty reviewers to the extent possible.

For the Faculty Review, groups will prepare a 15-minute presentation. The focus should be on the project's significance, data, methods, data and statistical analyses, and proposed products. Groups must include a mock up of an expected workflow, interface, data visualization, or other anticipated product. Students are also encouraged to prepare questions for which they are seeking guidance and should also come prepared to discuss them. Following the presentation, the instructor of EDS 411A and the group's faculty reviewers will engage students in 25 minutes of questions and discussion. It is recommended that no more than two group members present during the first 15-min period, since speaker transitions are disruptive and generally reduce the effectiveness of the presentation, especially when there is limited time. The entire group will participate in answering questions. All members of the group must be in attendance for the duration of the Faculty Review.

Groups should expect questions and constructive critiques from their reviewers that may result in additional revisions to their Capstone Project tobe integrated into their Design and Implementation Plan. It is the group's responsibility during the Faculty Review to explain their work to their faculty advisors and classmates. The faculty reviewers provide oral feedback to the group summarizing the strengths of the project and/or recommendations for improvement.

The instructor of EDS 411A, along with the Capstone Coordinator, will make all arrangements, including setting the presentation schedule and facilitating presentations and Q&A. Groups should invite their faculty advisor, client, and any external advisors to attend this presentation.

4. Evaluations

Each student in the group must complete a self and peer evaluation and submit it to the instructor of EDS 411A, their faculty advisor and the Capstone Project Coordinator by the last day of week 10. The evaluation requires realistic reflection on the progress and functioning of the group. The primary goal of the evaluations is to inform the instructor of EDS 411A, faculty advisor and Capstone Project Coordinator of group dynamics and any problems that may require future intervention. With appropriate justification, self and peer evaluations may impact grade assignments by the EDS 411A instructor. Evaluations are confidential from other group members. This form can be found online at:
https://bren.ucsb.edu/academic-resources-current-students

5. Timeline, milestones, and assignments from EDS 411A

The table below summarizes the milestones to be completed as part of EDS 411A. All milestones for EDS 411A are required for all students pursuing Capstone Projects. In addition to the activities below, there are tasks that students must complete which are detailed in the EDS 411A Course Syllabus.

Week	Milestone
5	Draft of Design & Implementation Plan due
8	Capstone Projects Faculty Reviews
10	Finalize Design & Implementation Plan

B. EDS 411B (Spring Quarter)

Students must enroll in EDS 411B Capstone Project for 4 units with the instructor in the Spring Quarter. EDS 411B will have a regular class schedule and instructor. Additionally, students are required to schedule weekly meetings with all group members. In Spring Quarter, students focus on implementation of the Design and Implementation Plan and execution of product development and delivery, including Technical Documentation. By the end of the year, groups will deliver final client products and final academic deliverables, such as technical documentation and the project repository.

1. Technical Documentation

The Technical Documentation is an academic deliverable where students provide a written functional discussion of the project's 1) motivation, problem, and objectives, 2) approach and methods, and 3) products or results. The documentation must demonstrate that the group has the ability to develop data science solutions that are robust, reproducible, reliable, and quality-assured.

The goal of the Technical Documentation is not to simply repeat information from the Design and Implementation Plan, but rather to build on it and communicate critical information so that a client may understand the product development, reproduce results, and use the product. Students may find it helpful to think of the Design and Implementation Plan as a document outlining "what they will do" and the Technical Documentation as one explaining "what they did."

1.1. Sections

The Technical Documentation must include the following sections:

a. Title Page
b. Signature Page
c. Acknowledgements
d. Abstract (not to exceed 200 words)
e. Table of Contents
f. Executive Summary (not to exceed 3 pages)
g. Approach
h. Methods
i. Results Report (if applicable)

j. Product Description (if applicable)
k. User Manual (if applicable)
l. Archive Access
m. References
n. Appendices (if needed)

Students may reorganize, combine, or modify the sections in their Technical Documentation to best fit their project's structure and deliverables.

Since each project has different client deliverables, the *Results Report*, *Product Description*, and *User Manual* sections may not apply to every project. For example, a project delivering a statistical analysis should include a *Results Report* section but may not require a *Product Description* or *User Manual* sections. Conversely, a team developing a data visualization platform for pre-existing data might omit the *Results Report* but should include both a *Product Description* and a *User Manual.*

Although the Technical Documentation is submitted as a single document for degree completion, it serves two distinct audiences. The abstract and executive summary are intended for a general audience and should function as stand-alone pieces that students can share with potential employers. In contrast, the *Methods*, *Results Report*, *Product Description*, *User Manual*, and *Archive Access* sections are designed to provide detailed project information for clients and faculty advisors.

Description of Technical Documentation sections:

(a) Title Page

The title page should follow the formatting guidelines outlined in Appendix III.

(b) Signature Page

The signature page should follow the formatting guidelines outlined in Appendix IV.

(c) Acknowledgments

The acknowledgements should include advisors, instructors, professionals, organizations, funding sources, or others that have supported the project in any significant way, professionally or financially. Each acknowledgment should include the person's name, title (if known), and affiliation or organization. Students must obtain permission from each person or party being acknowledged that their names can be included in the acknowledgements. These acknowledgments will also be included in the project's Bren webpage and supporters have the right not to be publicly associated with the final Technical Documentation or other project documents.

(d) Abstract

The abstract is a one-paragraph brief summary of the group project, meant for a non-technical, general audience. The length of the abstract should not exceed 200 words. This abstract will also be included in the project's Bren webpage.

(f) Executive Summary

The executive summary must be no longer than three pages and should serve as a stand-alone document for a general audience or potential employers. It should clearly summarize the following:

1. Project background and motivation
2. Problem statement or knowledge gap
3. Objectives
4. Description of products or deliverables
5. Summary of methods, results, and conclusions
6. References (only those used in the Exec. Summary)

Subsections are not strictly necessary for the executive summary. Diagrams, charts, and figures are encouraged to help illustrate key points effectively.

(g) Approach

This section should be short and include 1) a brief paragraph outlining the major steps or phases in completing the project and 2) a revised version of the workflow diagram included in the Design and Implementation Plan. The primary audience for this section is the faculty advisor and the client.

(h) Methods

This section should be a deep, detailed dive into the specific steps taken to accomplish the objectives and produce the deliverables. Its intended audience are the client and faculty advisor. Students should use schematics, conceptual models, or workflow diagrams where possible to clearly illustrate the methodology.

To enhance readability and clarity, students should break this section into smaller subsections that align with key phases of their project. In particular, they should include enough detail to answer the relevant questions about the data lifecycle, modeling process, or product development implemented in their project. Some of the questions students should address include:

Data Lifecycle

- What data was used and what is its provenance? Include an updated version of the table from the Design and Implementation Plan's Research Data section.
- Why was this data selected (and other data excluded)?

- What are the known issues in the data? (e.g., missing values, inconsistencies, biases)
- What does the data look like? If relevant, provide summary statistics (e.g., mean, median, volume) or visualizations.
- How did you alter the data? Describe steps such as imputations, transformations, filtering, or cleaning procedures.
- What steps did you take to validate the outputs of your data wrangling process? (e.g., spot checks, comparing with known values)

Modeling and Analysis

- What models, algorithms, or analytical methods were used?
- What are the inputs and outputs?
- What assumptions did you make?
- What was the control/test split?
- What did you use as a validation set?
- What evaluation metrics did you use to assess model performance? (e.g., accuracy, precision, RMSE)
- How did you test the accuracy and reliability of your analyses or models?

Tools, Libraries, and Infrastructure

- What tools and libraries did you use? Specify the programming languages, libraries, and platforms (e.g., Python, R, SQL, GitHub, cloud platforms).
- How did you manage and version your code? Mention the use of version control (e.g., Git), branching strategies, or containerization (e.g., Docker) if applicable.
- What computational resources were required? Include details about hardware, cloud services, or any special infrastructure used.
- What quality control measures did you implement? (e.g., code reviews, automated tests, peer validation)

Reproducibility and Documentation

- How can others reproduce your work? Provide details on dependencies, environments, or installation instructions.
- How did you verify the functionality and usability of interactive products or tools? (e.g., user testing, edge case testing)
- What challenges or limitations did you encounter? Discuss any difficulties in reproducing results or limitations in the methodology.

These questions do not necessarily correspond to distinct subsections. Students should critically assess which topics are relevant to their project's implementation. Using tables, diagrams, or charts to succinctly convey information is highly recommended.

Code snippets should not be included in the Methods section. Instead, the project's GitHub repository should serve as a supplementary resource, hosting all code related to the implementation of the methods.

In the event that project data is restricted by an NDA, the group should include sufficient information in the user manual section so that potential users are aware of the data and could contact the issuer of the NDA for access.

(i) Results Report (if applicable)

In this section, students who have projects where data analysis, modeling, or simulation results, or any form of quantitative evaluation is a client deliverable should present the key findings and outcomes of their project. The primary audience for this section is the faculty advisor and the client, and it should provide a clear, thorough, and objective summary and interpretation of the results. Students should address the following questions:

Key Findings and Outcomes

- What are the primary results of your analysis or product testing?
- How do the results or product meet the project objectives?
- What trends, patterns, or insights did you uncover?
- What is the accuracy or uncertainty of the results?

Interpretation and Context

- Are there any unexpected results or anomalies? How did you interpret them?
- What are the known limitations of your results? (e.g., data gaps, model constraints, performance bottlenecks)
- What do the results mean in the context of the problem or objectives?
- Are there significant findings or implications of your results that enhance their value?
- How do they compare to expected outcomes, baseline values, or industry standards?

Students should use clear and informative visualizations (e.g., charts, tables, maps) to effectively communicate the results. Key metrics should be summarized in tables for easy reference. All visualizations should include labels, legends, and captions to ensure they are interpretable without requiring excessive explanation.

(j) Product Description (if applicable)

In this section, students who have created an interactive product for their client (for example, an interactive web dashboard, a software package, or a reproducible report) should describe its functionality and how users should engage with the product. The primary audience for this section is the client.

This section should start with a succinct restatement of the product's purpose and intended user, clearly defining the problem the product addresses and the value it provides to the client. Then, students should address the following considerations:

Design and Functionality

- What are the key features of the product? List and describe the main functionalities (e.g., interactive filters, data exploration, export options).
- What types of visualizations are included? Specify whether the tool uses maps, charts, tables, or other visual components.
- What customization options are available? Explain whether users can filter, download, or modify the visualizations.

Performance and Limitations

- How does the tool handle large or complex datasets? Mention any performance optimizations (e.g., caching strategies).
- What are the known limitations? Identify any constraints, such as browser compatibility issues, load times, or scalability challenges.

Students should include diagrams, screenshots, or visualizations of the product in action to showcase key functionalities, user interfaces, or examples of how the product works. These visual elements should be clearly labeled and captioned to aid understanding and provide clarity.

(k) User Manual (if applicable)

The User Manual is a standalone guide that explains how to access, navigate, and use the product. The primary audience for this section is the client or the intended product user, and it should enable them to effectively operate and understand the product without requiring assistance from the project team.

In this section, students should provide:

Access and Setup Instructions

- How can users access the product? Include details such as URLs, installation steps, login credentials (if applicable), or system requirements.
- Are there any dependencies or configurations required? Specify any software, libraries, or browser settings needed.

Navigation and Key Features

- Provide a step-by-step walkthrough of the product's main features and interactions.
- Use screenshots or diagrams to illustrate navigation paths and highlight important functionalities.

- Clearly explain how to use any filters, search functions, or customization options available.

Troubleshooting and Support

- What are the common issues users might encounter? Consider including troubleshooting steps or FAQs.
- How can users seek support? Provide contact information or instructions for reporting issues (if applicable).

(l) Archive Access

A short section detailing where the data and code has been archived.

(m) References

Adherence to accepted rules of citation is required. Groups should choose a method of citation and use it consistently, i.e. MLA, APA, Chicago, etc. Citations must provide sufficient information for a reader to access the cited work, assuming appropriate permissions (e.g., a journal subscription).

1.2. Revisions and Timeline

Groups should expect to go through multiple revisions and iterations with the EDS 411B instructor and their faculty advisor before finalizing their Technical Documentation. It is likely that more than one round of feedback will be necessary before the Technical Documentation meets the advisors' and instructor's expectations. The project timeline must account for the required review and revision cycles.

At a minimum, students must submit the following iterations of their *Technical Documentation*:

Spring Quarter 2026	Due Date	Technical Documentation Submission
Week 3	April 17 (Friday)	Preliminary draft of Technical Documentation due to EDS 411B instructor and faculty advisor Each section of the preliminary draft must include as much information as completed to date. Clearly indicated placeholders or bulleted lists are acceptable at this point. An appendix to the preliminary draft should describe the work to be completed during the remainder of Spring Quarter,

		any remaining obstacles to its completion, and a timeline for remaining tasks and deliverables.
Week 7	May 11 (Monday)	Complete draft of Technical Documentation due to EDS 411B instructor and faculty advisor
Week 10	June 5 (Friday)	Submit to Capstone Project Coordinator: 1. Final Technical Documentation (PDF version with unsigned signature page) 2. Technical Documentation signature page with all signatures (students, faculty advisor and EDS 411B instructor) This deadline is firm.

The EDS 411B instructor and the group's faculty advisor will likely be the only ones to read and provide feedback on the complete draft of the Technical Documentation. However, some clients and external advisors may have the interest, time, and expertise to review and offer feedback on parts or all of the draft documentation or project repository. Students are encouraged to share their Technical Documentation with clients if they are available to review it.

1.3. Formatting and Filing

Technical Documentations must not exceed 30 pages (including any appendices and figures), and must be free of typographical, formatting, and other errors. All documentations must be formatted in compliance with the formatting and filing requirements (see Appendix II on formatting and filing requirements).

For the Technical Documentation to be approved and be ready for filing, it must be signed by both the faculty advisor and the EDS 411B instructor. The faculty advisor should sign first, followed by the instructor. Each group must submit a stand-alone copy of the signed signature page to the Capstone Project Coordinator. This signed page will not be posted on the website to protect the personal information of students and faculty. See Appendix IV for a sample signature page.

Once the Technical Documentation is approved and filed, each group must provide an electronic copy (PDF format), including an unsigned signature page, to the Capstone Project Coordinator, EDS 411B instructor, faculty advisor, and client. The Technical Documentation will be posted on the Bren School website unless an NDA restricts public sharing. The faculty advisor or client may also request hard copies of the documentation.

2. Capstone Project Final Presentation

Capstone Project Final Presentations celebrate the completion of product development, and offer MEDS students the opportunity to share their work with faculty, peers, potential employers, members of the community, family and friends. The Final Presentation is an opportunity for the students to present their client products and their significance. Final Presentations contribute to the reputation and prestige of the Bren School and, hence, the value of the students' degrees. Participants are advised to dress in business attire.

In Week 9 of the Spring Quarter (see timeline for dates), each group presents its final project. By this point, the project should be nearing completion. Groups will prepare a 14-minute presentation with a product-oriented focus; groups must include a demonstration of their product interface or data visualization. Following the presentation, students will engage in 5 minutes of questions and discussion with the audience. It is recommended that no more than two group members present, since speaker transitions are disruptive and generally reduce the effectiveness of the presentation, especially when there is limited time. However, three group members can present if the group works on seamless transitions between the speakers to reduce disruption. All members of the group must be in attendance and will be part of a panel seated in front of the audience. The entire group will participate in answering questions, as appropriate; groups should discuss in advance who will present at these events.

The audience at the Final Presentations is different from the audience at the Design and Implementation Plan Faculty Reviews. The Final Presentations need to be understandable to a diverse group (employers, experts, non-experts, family, and friends, etc.). Students should prepare a presentation for an audience that is more interested in substance and environmental data science products and less interested in, for example, analytical methods or data management.

Each project's Bren webpage will be linked to the electronic event program and can be viewed by the audience. An abstract and acknowledgements must be sent electronically to the Capstone Project Coordinator by the end of Week 7 of Spring Quarter (see timeline for dates). This information will be used to update the project's Bren webpage prior to the Final Presentations.

The abstract is a one-paragraph brief summary of the group project, meant for a non-technical audience. The length of the abstract should not exceed 200 words. The acknowledgements should include advisors, professionals, organizations, funding sources, etc. that assisted the Capstone Project. Each acknowledgment should include the person's name, title (if known), and affiliation/organization. Students should obtain authorization from each person or party being acknowledged that their names can be included in the abstract. A template guide for the abstract and acknowledgments will be provided to students by the Capstone Project Coordinator.

The entire Bren School community is invited to attend the Capstone Project Final Presentations. The Capstone Project Coordinator makes all arrangements, including setting the presentation schedule and facilitating presentations and Q&A. Groups should invite their client and any external advisors to attend this presentation.

3. Project Repository

Each group is required to submit a project repository of their work. This repository must be accessible by the EDS 411B instructor, faculty advisor, and the client. This may include multiple source code files, data, as well as other resources used by the project. The User Documentation section from the Technical Documentation should be included, at minimum.

A working draft of the Project Repository must be submitted during Week 7; it is not expected that students submit a complete repository at this point. The completed repository is due at the end of Week 10 of Spring Quarter (see timeline for dates). The deadline for the final Project Repository is firm.

4. Data and Metadata

By the end of Week 8, data used in the project and associated metadata and code must be archived in an approved disciplinary repository such as EDI or in a generalist repository such as Dryad or Zenodo. Groups should anticipate an iterative process of metadata augmentation and refinement in collaboration after their data submission. The group must submit the organized data and metadata, and code to the faculty advisor(s).

As described earlier, data used in a Capstone Project may have significant value for other researchers, and sharing the data is the responsibility of the group. Data protected by non-disclosure agreements (NDAs) are exempted from this requirement. Throughout the project, the group should organize the data and create metadata so, after the project is completed, another user may access and utilize the data. The Data Management Plan (DMP) included in the work plan sets forth the guidelines for data management and archiving. For assistance with preparing data for archiving, students can contact the UCSB Library Research Data Services at rds@library.ucsb.edu.

The default repository for the data and metadata generated in your MEDS Capstone Projects will be UCSB's institutional data repository Dryad. It can take up to a couple of weeks to complete the data archival. The following is a strongly suggested timeline and guidelines for your data submission:

Week	Activity
Week 6	Discuss with your advisor or client what data (if any) should be archived as part of the project deliverables.

Week 7	If necessary, make an appointment with the RDS team (rds@library.ucsb.edu) to discuss archival of data associated with your capstone project. You should have previously discussed with your advisor or client what data (if any) should be archived as part of the project deliverables. Before contacting the Library RDS team or archiving your data, please read through the Archiving and Preserving Your Data information by the Library RDS team for detailed guidelines about what to archive and the submission process to Dryad.
Week 8	Capstone deadline - Friday, May 22: submit data to repository. *Data protected by non-disclosure agreements (NDAs) are exempt from this requirement*. When you submit data to Dryad (recommended repository) the data archival process won't be complete yet, as your submission might need to be revised. However, you will get a DOI associated with your data. To fulfill the data archival requirement, you must submit your data's DOI to the Capstone Coordinator by Friday, May 22. If you are not archiving any data related to your capstone project, you must briefly explain why that is the case.
Weeks 9 & 10	Further data curation may happen. Your data's DOI will not change.

5. EVALUATIONS

A. Faculty Evaluation of Students

Each student in the group will receive a separate grade for each quarter of the project (EDS 411A/B). If a group performs well together, it is likely that all group members will receive the same grade, but this is not guaranteed.

Student performance in a Capstone Project is evaluated and graded based on demonstrated ability to develop data science solutions that are robust, reproducible, reliable, and quality-assured. The EDS 411 instructor will consult with the faculty advisor to assign project grades using the following criteria:

1. Team-oriented data science design and implementation design.
2. Project management. Students shall attend all group meetings on time and ready to engage with their team. They must manage and deliver intermediate and final products on schedule, both to meet Bren School deadlines as well as intra-group deadlines.

3. Data processing/analysis/manipulation. Students shall demonstrate their knowledge of coursework and data science techniques.

4. Data science solutions that contain:
    a. Robust, reproducible workflows
    b. Reliable and easy-to-use products
    c. Quality assurance and error checking

5. Interface development e.g., data visualization.

6. Documentation. Project documentation and demonstrations shall be well-organized, scholarly, and well-communicated.

7. Archivable/retrievable. All data, model, workflows, documentation, etc. must be easily accessible and retrievable.

8. Participation. Students shall participate and actively contribute in meetings, training sessions, and events.

9. Resourcefulness. Throughout the project, students shall demonstrate initiative in finding information and identifying tools necessary to achieve the scope of their project.

10. Professional relationships. Group members shall demonstrate the highest level of professionalism and respect in their dealings with each other, their faculty advisors, client, and other stakeholders.

11. The student peer & self-evaluation form will be taken into consideration when assigning grades.

B. Student Evaluations of Faculty Advisor

At the end of the project, all Capstone Project members should complete an evaluation for their faculty advisor and submit it to the Capstone Project Coordinator (see Appendix I). The Capstone Project Coordinator compiles all comments for anonymity and provides them to faculty only after the final grade for EDS 411B is issued.

In the event that there are any serious advising problems mid-way through the project, this should be brought to the attention of the Director of Academic Programs or the Assistant Dean for Academic Programs. These staff understand and are committed to respecting privacy and anonymity in working with students to try to find solutions to problems.

6. PROJECT BUDGET

Each MEDS Capstone Project is allotted $250 for project expenses and printing on Bren School printers. Each group should create a budget for its project, estimating expenses to the best of its ability and accounting for costs such as phone calls, travel, software, datasets, business

cards, reference books, presentation materials, photocopying, and publication expenses when preparing the budget. The budget is for reasonable expenses related to the Capstone Project. If a group does not anticipate any project expenses, a budget does not need to be created. If a group determines they have expenses above $250, they should contact the MEDS Program Coordinator to apply for an increase up to $500 (not for entertainment expenses).

Bren School Purchasing Procedures: https://bren.ucsb.edu/purchasing

Please note: There are numerous restrictions with the use of Capstone Project funds provided by the Bren School. These funds cannot be used (*see exception below*) to pay for gifts, awards, or donations. There are strict eligibility requirements related to hiring. The group must discuss all potential hires with the Bren School's Business Officer before proceeding with the hire. Restrictions related to use of funds for food and beverages are as follows:

- Funds may only be used for food and beverages associated with entertainment/business meetings if (1) prior approval is obtained from the Bren School's Business Officer; and (2) the entertainment is associated with a meeting that includes the advisor and/or client. The advisor and/or client must be present during the meeting. There are NO exceptions to this UC policy.
- Funds may only be used for food and beverages related to travel if the travel conforms to UC travel policies (https://bren.ucsb.edu/travel).

**Under special circumstances, the group can request an exception to policy for expenditure for a gift. However, requests for exception to the policy must be made to the Bren School's Business Officer in advance of the expenditure and approval is not guaranteed.*

Bren School Financial Unit

- The Bren School's Business Officer and Associate Director of Finance & Administration are the primary contacts for budget matters related to Capstone Projects. The Business Officer is Kim Fugate (finance@bren.ucsb.edu; kim@bren.ucsb.edu); The Associate Director of Finance & Administration is Bridget Mastopietro (finance@bren.ucsb.edu; bridget@bren.ucsb.edu) Shared office: Bren Hall 2516; 805-893-3540.
- The Bren School's Financial Analyst assists with budget matters related to Capstone Projects. The Financial Analyst is Sara Mata (finance@bren.ucsb.edu; sara@bren.ucsb.edu); Bren Hall 2514; 805-893-7457.
- The Bren School's Personnel/Payroll & Travel Coordinator processes paperwork related to foreign travel associated with Capstone Projects. The Personnel/Payroll & Travel Coordinator is Lucy Navarrete (travel@bren.ucsb.edu; lucy@bren.ucsb.edu); Bren Hall 3522; 805-893-7231.
- The Bren School's Purchasing Coordinator processes purchase orders, credit card purchases, miscellaneous and entertainment reimbursements for items associated with

Capstone Projects. The Purchasing Coordinator is Philip Watt (purchasing@bren.ucsb.edu; phil@bren.ucsb.edu); Bren Hall 3524; 805-893-4172.

- The Bren School's Assistant to the Deans processes domestic travel reimbursements and manages booking of pre-trip expenses. The Assistant to the Deans is Charlyna DeFeyter (travel@bren.ucsb.edu; charlyna@bren.ucsb.edu); Bren Hall 2400A; 805-893-8452.

A. Expense Tracking

The Project Manager will be responsible for tracking, managing, communicating about, and updating the group's budget. If expenses (phone, copies, travel, etc.) exceed the budgeted amount or do not conform to University policy, reimbursement requests will be returned and the group members will be responsible for funding the activity. Students are responsible for paying expenses above the project budget or not in compliance with UCSB and Bren School policies.

B. Printing

If groups require printing at Bren, then groups must request a transfer of some of their project funds to printing accounts. If there are not adequate funds remaining and groups require more printing, they will have to pay for it themselves and the charge will be billed to students' BARC accounts.

C. Copying

Bren copiers are for staff and faculty use only. Copying may be done at Davidson Library or the University Center.

D. Purchasing

All purchasing must be processed through the Bren School Purchasing Coordinator. The preferred purchasing method is to email purchasing requests, the project team name, and project code to purchasing@bren.ucsb.edu so the Purchasing Coordinator can place the order directly. Students should understand purchasing policies and procedures (https://bren.ucsb.edu/purchasing) and ensure that their group abides by these rules.
Please note: Any non-consumable items purchased by the group with project funds are the property of the Bren School and must be returned to the school at the close of the project (e.g. an external hard drive). Purchase of clothing for presentations, or other project related activity is not allowed.

E. Reimbursement

If a vendor does not accept a purchase order, group members may use personal funds and then submit a receipt to the Purchasing Coordinator to be reimbursed. When submitting receipts for reimbursement, please complete a Miscellaneous Reimbursement Form and include the following:

- Original itemized receipt(s) with your full name, name of vendor, date, and description of what was purchased
- If full name is not listed on the receipt(s), proof of payment is required in the form of a redacted credit card showing your full name and last four digits of the card matching the receipt *or* a redacted bank statement showing your full name and the charge(s) you would like reimbursed
- Name and mailing address of person to be reimbursed
- Original signature of the student requesting reimbursement and the group's finance manager

Groups have access to their Capstone Project funding until the last day of Spring Quarter. In some instances, access can be temporarily extended with advance approval from the Business Officer.

F. Travel

All travel must be processed through the Bren School Financial Office. Students should familiarize themselves with the Bren School Travel Regulations. Questions regarding travel should be sent to travel@bren.ucsb.edu. All travel reimbursement claims must be submitted to the Bren School Purchasing Coordinator via travel@bren.ucsb.edu no later than 30 days upon completion of travel to allow time for internal processing, and transfer to the UCSB Central Accounting Office in time for the 45-day UCSB processing deadline.

G. Outside Funding

Most Capstone Projects do not require outside funding and are able to fully complete the scope of work within the budget provided by the Bren School. In some cases, a project's scope of work, required travel, or materials exceed the Bren School budget and additional costs must be funded by the client. When this is the case, costs must be estimated and the client must acknowledge that they are able and willing to pay up to the amount that has been estimated. This must be established in the initial Capstone Project proposal. If a client does not pre-approve the budget, it is unlikely a project with additional costs will be selected.

Gifts

In limited circumstances a client or other external funding source may wish to make a contribution to support a Capstone Project. In this case, please contact the Bren School's Assistant Dean for Development, Dr. Lotus Vermeer, lvermeer@bren.ucsb.edu. It is imperative that individuals and organizations are NOT solicited for gifts. **Active fundraising by students without guidance from the Development team is NOT appropriate.** Any discussion about potential gifts to the Bren School should be directed to the Assistant Dean for Development. A gift cannot have deliverables of any kind. If there are deliverables, or if there is paperwork to be signed, it is highly unlikely that it is

a gift. No Bren student or faculty member has the authority to sign paperwork related to acceptance of money.

If a gift is received to support a particular Capstone Project, then a special Project Code will be created for the group to access these funds. If there are funds remaining at the end of the project, they will return to the Bren School general fund. Keep in mind that federal agencies, other governmental agencies and many nongovernmental organizations cannot give money in the form of a gift. In this case, any funds contributed toward Capstone Projects should either be managed by the agency or organization (strongly recommended) or directed to UCSB as a contract or grant.

Grants/Contracts

A contract or grant is used when money is given to the University for a specific deliverable(s). Given the complexities of submitting proposals for contract and grant funding, the length of time it tends to take to process proposals and ultimately receive funds, and the high overhead rate, it is far better if the Bren School receives funding to support Capstone Projects in the form of a gift. Please note that grants and contracts are required to provide for indirect (overhead) costs, which can be up to 55% of the award (depending on the indirect overhead set by the grantor), to be paid to the University; gifts are assessed at 6% overhead. If a Capstone Project client or external advisor would like to provide a grant or contract to the school, please direct them to the Business Officer. No Bren student or faculty member has the authority to sign agreements related to acceptance of money.

7. COMPUTER RESOURCES

The following describes computer resources available to each Capstone Project and recommended management practices. Most of these suggestions do not require any special privileges; those that require the involvement of the Bren School Compute Team are clearly noted.

A. Project Alias

Each group chooses a short alias (less than 20 characters) for their project. The alias is used to label the project's online artifacts (directories, mailing lists, etc.) and identify the project in shorthand. The alias should be professional and should reflect some aspect of the group's research topic.

B. Group Email List

Each group will be added to an email list for their project; the group email address is "cp-[alias]@bren.ucsb.edu". This will be used as a contact email for the entire group and is accessible to Bren staff and outside parties. Groups can also make an internal list for only group

members and/or their advisor as necessary. Directions on how to get oriented to your Capstone's google group: https://bren.zendesk.com/hc/en-us/articles/4415068315156

C. Shared Directory

The Bren School Compute Team will create shared folders for each Capstone Project on the MEDS computing servers. The shared directory will be named "[alias]", and will be located inside the \capstone root folder on the server. This shared directory will be accessible via Posit Workbench, SSH, and SFTP methods. The full folder path for each Capstone Project shared folder will be \capstone\[alias]. Although Capstone groups will have folders on both servers, it is recommended to choose one and use that for the duration of the project.

D. Group Access Permissions

The Bren School Compute Team will create a security group for each Capstone Project, named "[alias]". The members of these groups will be the student members of each group and their faculty advisor(s). By default all group members will have group-writable permissions to the \capstone\[alias] folder and all subfolders. If you need to restrict access to subfolders to certain members of the group, please contact the Bren School Compute Team.

E. Google Shared Drive and Box Office 365 Document Collaboration

If your group needs to collaboratively author electronic documents as a delivery or in support of your Capstone Project, there are a number of recommended solutions that support this:

- Google Shared Drive / Google Docs
- UCSB Box Account with Office 365 Integration

Both of these options allow files to be shared among multiple collaborators, and for those collaborating to edit the document at the same time. UCSB Box has the benefit of Office 365 integration, allowing a more fully featured set of authoring tools.

F. Calendar

Each group may maintain a project calendar for project events and deadlines, Google Calendar, etc. Each student has an individual Google Calendar account, which can be used to propose Capstone Project meetings, etc. Please remember that when using individual accounts, only the person proposing the meeting may make changes to the meeting. Therefore, one person should be selected to schedule meetings. For more Google Calendar information, visit: https://support.google.com/calendar/?hl=en#topic=10729441.

G. References

Each group may maintain a shared file of bibliographic references that will be incorporated into project deliverables, papers, etc. The Bren School currently supports Zotero bibliographic

software, which is free. Some groups choose to use an online citation manager; basic accounts are often free.

H. Hosting web applications

Some groups may create web applications – like Shiny apps – as part of their deliverables for clients. The Bren School Compute Team has set up a Bren server that can host web applications for capstone groups. If a group wants Bren to host their application, they need to coordinate in advance with the Bren School Compute Team. The Bren School Compute Team will maintain the web application for up to 6 months after the cohort graduates. After 6 months, it will be the client's responsibility to host the web application if still needed. The Bren School Compute Team does not have the capacity to help clients deploy/maintain their applications after the capstone project is finished.

The Bren School Compute Team requires each of the following to fulfill a web application deployment request:

- One week of advanced notice
- Link to GitHub repository containing the web application code
- Shared drive or zipped folder containing all data associated with the web application
- Confirmation that your web application can be deployed to shinyapps.io
- Primary contact information of the capstone group member that the Bren School Compute Team can communicate with regarding deployment troubleshooting.

To host a web application on a Bren server, please fill out this form: https://forms.gle/VPNV4aJcrcA3Z8gS6.

I. Additional resources

The Bren School has a suite of additional computing resources that may be helpful for Capstone Projects: virtual machines, GPU acceleration, docker support, cloud computing support, nonstandard computing environments, etc. Please discuss your computing needs with the Bren School Compute Team to see if there are available resources that might be helpful for your project.

Appendix I

Evaluations

Peer & Self Evaluation:
Peer & Self Evaluations (completed quarterly) are available on the Academic Resources for Current Students page of the Bren School website.

Faculty Evaluation:
The faculty evaluation will be submitted via Qualtrics. The Capstone Project Coordinator will send a link to the survey in the second half of Spring Quarter. Survey results will be kept anonymous, compiled in summary format, sent to advisors after Spring Quarter grades are issued, and recorded in personnel files.

Appendix II

Formatting & Filing Requirements for Capstone Project Technical Documentation

Responsibility for the content of the Technical Documentation

The group members and faculty advisor(s) are responsible for the content of the Technical Documentation. The faculty advisor must review the entire draft report before giving final approval. This review includes:

- All preliminary pages or front matter (e.g., preface, dedication, acknowledgments, etc.)
- The main body of the report (including figures, charts, or other inserted matter)
- The back matter (e.g., notes and bibliography, appendices, etc.)

In general, no changes may be made to the Technical Documentation after the faculty advisor(s) have signed the signature page. If changes are necessary after the faculty advisor(s) has approved the report, the group must have their advisor sign a new signature page.

The organization, presentation, and documentation of each Capstone Project must meet the standards set by the faculty advisor(s) and the Bren School. For general information, students may consult a standard style guide; The University of Chicago Manual of Style is recommended as an authoritative source. Students who have discipline-specific questions should consult their faculty advisor(s).

Capstone Project title and signature page requirements

Title page requirements

Each Capstone Project Technical Documentation must include a title page with the following information:

- Title of the Capstone Project
- "Master of Environmental Data Science" as the students' degree objective
- Bren School of Environmental Science & Management, University of California, Santa Barbara
- Names of group participants (alphabetical order recommended) and faculty advisor(s)
- Month and year the Technical Documentation is signed by the faculty advisor(s)

Bren staff will link each Capstone Project on the Bren School website by graduating year.

Signature page requirements

The format of the signature page is displayed in Appendix IV. The signature page should be placed immediately following the title page. The signature page should not be numbered but should be counted toward subsequent numbering.

Due to concerns over privacy and because Capstone Project Technical Documentations will be posted to the Bren website, students should include an unsigned signature page in the .pdf of their Technical Documentation. The unsigned signature page must include the typed names of students, in alphabetical order, followed by a section with names of faculty advisors, also in alphabetical order. "This MEDS Capstone Project Technical Documentation is authored by MEDS students and has been reviewed and approved by:" must appear immediately above the faculty advisor(s)' names. The approval page must contain the month and year the project is signed by the faculty advisor(s).

Capstone Project faculty advisors and project members must sign a stand-alone copy of the signature page and submit it to the Capstone Project Coordinator. All signatures must be by digital signature (e.g., DocuSign) or black or blue ink (no other color ink is acceptable). The typed name of the person signing must appear immediately to the right of or below the signature.

Standards for Capstone Project title

The Capstone Project title should use specific, unambiguous, descriptive words that will ensure electronic retrieval. Do not use formulae, symbols, superscripts, Greek letters, or other non-alphabetical symbols in the title. Capstone Project titles should represent a summary of the research and not be lengthy. Titles that contain more than 10 words are considered wordy. Subtitles should be used only when absolutely necessary.

Dates on title and signature pages

The approval/signature page and the title page must have the month and year the project is signed by the faculty advisor(s).

Table of Contents

A table of contents is required. The table of contents should include the major chapters, subchapters, figures, and tables.

Other preliminary pages, such as those for acknowledgments or lists of figures and charts, are optional.

Abstract

An abstract is required. It should provide a brief synopsis of the research and be succinct (200 words). The abstract should be placed following the table of contents and any optional preliminary pages (i.e., acknowledgments).

The table of contents, other preliminary pages, and abstract must meet all formatting requirements delineated below. All preliminary pages, with the exception of the title page and approval (signature) pages, must be numbered with lower case Roman numerals beginning with Roman numeral iii; see below for additional information on pagination and placement of page numbers.

Key Words
Select up to 10 keywords to describe the project.

Legibility and appearance
The Technical Documentation must be produced using a font that is highly legible and dark enough that it can be reprinted clearly.

Dimensions
The Technical Documentation must be formatted to letter size (8.5 x 11 inches).

Margins
The following are minimum margin dimensions. The group may set larger margins but must be sure that the final text is well within these guidelines.

LEFT = 1.25 inches (this margin is wide for binding requirements)
TOP = 1 inch from the top of the paper
RIGHT = 1 inch
BOTTOM = 1 inch from the bottom of the paper

Aside from page numbers, nothing must intrude into the margins. These minimum specifications also apply to all figures, charts, graphs, illustrations, and appendices. When oversize pages are used, the same margin measurements must be maintained.

Page Numbers
Page numbers should be centered on the page 0.75 inches from the bottom edge of the page. The placement of page numbers must be consistent throughout the Technical Documentation. Provide space between the text and the page numbers.

Pagination
Every page must be numbered consecutively. Except where noted below, each page of the entire Technical Documentation must be numbered in accordance with the following standards:

Neither the title page nor the signature page is to be numbered; however, these two pages are counted when numbering the following preliminary pages even though they are not numbered.

The preliminary pages following the title and signature pages must be numbered sequentially beginning with the lower case Roman numeral “iii.” All preliminary pages are to be numbered using lowercase Roman numerals (iii, iv, v, vi, etc.). This includes dedications; table of contents;

lists of figures, tables, symbols, illustrations, and photographs; prefaces; acknowledgments; and abstract.

The main body of the text and any back matter must be consecutively numbered with Arabic numerals (1, 2, 3, etc.), including text, illustrative materials, bibliography, notes, and appendices.

Correct pagination is required for the Technical Documentation to be acceptable: no missing pages, blank pages, or duplicate numbers or pages.

Line Spacing
The Technical Documentation should be single-spaced with double spacing between paragraphs and sections.

Single spacing also should be used in those places where conventional usage calls for it, i.e., title page; figure, table, and photo captions; footnotes; indented quotations; and bibliography. When individual footnote or bibliographic entries are single-spaced, there must be double spacing between entries.

Fonts and Font Sizes for the Text and Notes
A font size of at least 12-point must be used for the basic report text. Standard fonts such as Arial, Century Gothic, Helvetica, Verdana, Tahoma, or Times are recommended.

A font size of at least 10-point must be used for footnotes and captions. Script, calligraphy, and specialized art fonts are not acceptable for the main body of the text.

Italics may only be used for quotations, headings, labels, book titles, foreign words, scientific names, or occasional emphasis. Fonts for appendices, charts, drawings, graphs, and tables may differ from that used for the text. The print should be letter quality with dark black characters that are consistently clear and dense.

Filing the Capstone Project Technical Documentation
Once the faculty advisors approve and sign a group's project, no changes can be made to the Technical Documentation. The Technical Documentation, including the completed signature page, must be submitted in electronic (.pdf) format to the Capstone Project Coordinator by the end of Spring Quarter. A petition is required for late submissions. The Technical Documentation will be linked on the Bren School website unless it is protected by an NDA. Please contact the Capstone Project Coordinator with any issues or questions about these guidelines.

The Capstone Project Coordinator will review each Technical Documentation to verify that it meets the filing standards and will notify each group if corrections are necessary.

FORMATTING & FILING CHECKLIST

CHECKLIST AREA	BREN REQUIREMENT
Legibility	Clear and legible font used.
Dimensions	8.5 x 11 inches (exceptions made for oversize or special materials).
Number of copies	One electronic (.pdf) copy of Technical Documentation for Bren School
Margins	Left margin at least 1.25 inches; top line of type, right margin, and bottom line of type at least 1 inch from edge. Other than page numbers, nothing intrudes into margins.
Page Number Placement	Page numbers placed 0.75 inches from bottom edge of pages and consistently placed throughout the report.
Pagination Standards	Each page of the Technical Documentation numbered (except title and approval pages). No missing, blank, or duplicate numbers or pages. Lower case Roman numerals used on preliminary pages. Arabic numerals used to number text and back matter.
Numbering of Preliminary Pages	Title and approval pages counted but not numbered. Subsequent pages (e.g. the table of contents) numbered beginning with Roman numeral iii.
Spacing Between Lines	Text single spaced, except where conventional usage calls for only single spacing (title page, long quotations, etc.) or double spacing (between paragraphs and sections).
Fonts & Font Sizes	A font size of at least 12-point for preliminary pages and text. A font size of at least 10-point for footnotes and captions. Use of standard font recommended.
Dates Used On Approval and Title Pages	Month and year the faculty members will sign the approval and title page.
Abstract	Not to exceed 200 words

Standards Governing Titles and Taglines	Concise titles and taglines (strive for no more than 10 words). Easily identifiable keywords that summarize research. Word substitutes replace non-alphabetical symbols in scientific titles.
Faculty Signature on Approval Pages	Faculty advisor(s)' signatures either electronic via DocuSign or in black or blue ink.
Responsibility for Content	Students and faculty advisor responsible for all content of the Technical Documentation. Instructor of EDS 411 A/B must review the entire Technical Documentation before signing.

Appendix III

Sample Technical Documentation and Design and Implementation Plan Title Page

UNIVERSITY OF CALIFORNIA
Santa Barbara

PROJECT TITLE
Technical Documentation / Design and Implementation Plan

A Capstone Project submitted in partial satisfaction of the requirements for the degree of
Master of Environmental Data Science
for the
Bren School of Environmental Science & Management

by

MEMBER NAME
MEMBER NAME
MEMBER NAME
MEMBER NAME

Committee in charge:
FACULTY ADVISOR NAME
EDS 411A/B INSTRUCTOR NAME

MONTH AND YEAR OF FILING

Appendix IV

Sample Technical Documentation Signature Page

PROJECT TITLE

As developers of this Capstone Project documentation, we archive this documentation on the Bren School's website such that the results of our research are available for all to read. Our signatures on the document signify our joint responsibility to fulfill the archiving standards set by the Bren School of Environmental Science & Management.

_____

MEMBER NAME

_____

MEMBER NAME

_____

MEMBER NAME

_____

MEMBER NAME

[The faculty advisor may change this statement prior to submitting this report].

The Bren School of Environmental Science & Management produces professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principle of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions.

The Capstone Project is required of all students in the Master of Environmental Data Science (MEDS) Program. The project is a six-month-long activity in which small groups of students contribute to data science practices, products or analyses that address a challenge or need related to a specific environmental issue. This MEDS Capstone Project Technical Documentation is authored by MEDS students and has been reviewed and approved by:

_____

EDS 411B INSTRUCTOR

_____

FACULTY ADVISOR

_____

DATE