Agreement between the Richardson's Bay Regional Agency (RBRA) and the San Francisco Bay Conservation and Development Commission (BCDC)

This Agreement is made and entered into by and between the San Francisco Bay Conservation and Development Commission (BCDC or Commission) and the Richardson's Bay Regional Agency (RBRA). The parties to this Agreement are referred to herein individually as "Party" and collectively as "Parties."

Recitals

WHEREAS, the McAteer-Petris Act (Act), Government Code Sections 66600 through 66666, established the San Francisco Bay Conservation and Development Commission as the state agency charged with planning for the long-term use of the Bay; and

WHEREAS, pursuant to the Act, BCDC adopted the San Francisco Bay Plan, which has been amended from time to time consistent with the Act, and which establishes a policy that live-aboard boats should be allowed only in marinas and only if certain other requirements are met; and

WHEREAS, in April of 1984, BCDC, working with a steering committee composed of representatives of the local jurisdictions, finalized the Richardson Bay Special Area Plan to guide actions more precisely in Richardson Bay; and

WHEREAS, the Richardson Bay Special Area Plan includes the following policies regarding residential vessels and floating structures:

(1) Vessels and floating structures used for residential purposes (i.e., houseboats and live-aboards) should be allowed only in recreational or houseboat marina berths when consistent with and in compliance with local codes, Commission policies, and public trust needs;
(2) All anchor-outs should be removed from Richardson Bay; and
(3) A limited number of live-aboards and houseboats should be permitted in existing or new recreational boat marinas provided (a) they are necessarily incidental to the recreational boating use; and (b) they are in compliance with the applicable local government codes, including parking requirements; Bay Commission policies; and policies of the Special Area Plan; and

WHEREAS, despite these policies, anchor-outs, houseboats, and floating homes have remained on Richardson Bay outside of marinas; and

WHEREAS, following adoption of the Richardson Bay Special Area Plan, RBRA was formed in 1985 to locally and jointly manage the waters of Richardson Bay; and

WHEREAS, RBRA was formed as a Joint Powers Agency and is comprised of: County of Marin, City of Mill Valley, Town of Tiburon, and City of Belvedere; and

WHEREAS, from time to time beginning with its formation, RBRA has removed vessels from the anchorage, but the number of vessels increased from 98 in 2008 to a high of 215 in 2014 and decreasing after that; and

WHEREAS, on February 21, 2019, the BCDC Enforcement Committee held a policy briefing and discussion on the local efforts to improve the management of vessels moored in Richardson Bay at which there were presentations on the pertinent State law and policies, from RBRA and from California Audubon on the adverse impacts to eelgrass caused by anchor outs; and

WHEREAS, in July 2019, RBRA's Board of Directors adopted Ordinance 19-1 updating anchoring and enforcement requirements for vessels on Richardson Bay; and

WHEREAS, in September and November 2019, the BCDC Enforcement Committee received a second and third briefing on the Richardson Bay matter directing staff to direct RBRA to develop and implement a management plan to address ongoing anchorage management issues; and

WHEREAS, on December 3, 2019, BCDC transmitted a letter to RBRA setting forth actions BCDC staff expected to be undertaken to address the vessels anchored in RBRA waters including: Initiation of all appropriate actions to remove from RBRA waters all marine debris, unoccupied vessels, unregistered vessels, and vessels occupied by persons who are not able to control the vessels during storm events or vessels that are endangering or threatening to endanger others; Preparation of a plan with timelines to transition all other vessels off the water within a reasonable period; Preparation of a plan for how RBRA will address and resolve the damage to natural habitat in Richardson Bay; and Monthly reporting to BCDC on the status of implementing these actions; and

WHEREAS, on June 11, 2020, RBRA's Board of Directors adopted Resolution Number 05-20, A Transition Plan for the Richardson's Bay Regional Agency Anchorage with a vision, goal, principles, and policy direction for the anchorage. The plan affirms a vision for the bay as a temporary anchorage, while providing a pathway for certain pre-existing eligible vessels that are determined by RBRA to be safe & seaworthy to remain for limited durations of time; and

WHEREAS, in 2020, the BCDC Enforcement Committee received briefings on Richardson Bay. The Committee directed BCDC staff to direct RBRA to implement its anchorage management plan including terms regarding vessel influx management, removal of noncompliant vessels within 5 years, a commitment to cooperate in a regional solution, implementation of eelgrass subtidal habitat restoration and monitoring, ongoing community enrichment and engagement measures, and progress reporting; and

WHEREAS, RBRA retained the environmental consulting firm Coastal Policy Solutions, who with the involvement of stakeholders and other interested parties, drafted an Eelgrass Protection and Management Plan (EPMP); and

WHEREAS, since 2014, RBRA efforts have reduced the number of vessels on Richardson's Bay to 88 as of the date of this Agreement; and

WHEREAS, the parties enter into this Agreement for the sole purpose of setting forth RBRA's and BCDC's agreed-upon next steps for the transition of vessels and environmental efforts on Richardson Bay and does not constitute an admission by RBRA that any of its past acts or omissions were inconsistent with the Bay Plan or the Richardson Bay Special Area Plan, violated the Act or any other law, or otherwise constituted wrongdoing;

NOW, THEREFORE, the RBRA and BCDC do agree as follows:

1. **COVID-19 Pandemic Considerations.** The parties understand that COVID-19 pandemic emergency shelter-in-place restrictions may be in place during this Agreement. RBRA shall not be required to take any action that conflicts with the guidance or orders from federal, state, or local officials. If such guidance or orders prohibit the removal of vessels as required by this Agreement, RBRA may seek extensions of time for vessel removal required in this Agreement.

2. **Richardson Bay Special Area Plan Compliance.** RBRA agrees to comply with and implement the Richardson Bay Special Area Plan (SAP) and the ordinances RBRA has issued pursuant to the SAP, as they may be amended from time to time.

3. **Eelgrass Habitat Protection**. RBRA will finalize its Draft Eelgrass Protection and Management Plan (EPMP) by December 15, 2021, and submit a copy to BCDC. If RBRA selects a boundary for the Eelgrass Protection Zone that is less protective of eelgrass than the alternatives presented in the RBRA's Draft EPMP then BCDC will consider the new boundary and inform RBRA if this Agreement must be amended to prevent the need for further BCDC oversight. Within 60 days of finalizing the EPMP, RBRA shall petition for any federal administrative action necessary to implement the EPMP's anchoring zone and Eelgrass Protection Zone/no-anchoring zone. BCDC agrees to provide letters of support for federal administrative actions consistent with the draft EPMP. RBRA will complete the administrative actions, including updating RBRA's Ordinances for consistency, by December 15, 2023, subject to extensions of time for circumstances beyond its control. Vessels will be removed from the Eelgrass Protection Zone as soon as possible, but moving boats can be done in phases based on consultation with experts selected by RBRA who are well versed in the California Eelgrass Mitigation Policy and its Implementing Guidelines (hereinafter, "CEMP") and its periodic updates. In any event, no vessels will anchor in the Eelgrass Protection Zone after October 15, 2024.

4. **Eelgrass Habitat Restoration.** During 2022, RBRA will initiate active eelgrass restoration studies within the Eelgrass Protection Zone comparing restoration scenarios such as: (1) Passive (no intervention) restoration of scour pits; (2) Restoring the bay bottom grade of scour pits by adding clean dredged sediment without planting eelgrass; (3) Planting

eelgrass in scour pits without first restoring the bay bottom grade of scour pits; and (4) Planting eelgrass in scour pits after restoring the bay bottom grade of scour pits by adding clean dredged sediment. RBRA will report its findings to BCDC.

RBRA will develop a ten-year adaptive management plan for eelgrass restoration in Richardson Bay, and submit a copy to BCDC. RBRA will begin implementing this plan by December 15, 2023. The ten-year adaptive management plan will be consistent with the Bay Plan and the Richardson Bay Special Area Plan; incorporate the best available science on eelgrass habitat restoration & the CEMP and its periodic updates; and the results of RBRA's restoration study scenarios as they are obtained. Restoration work will be done in a phased approach pursuant to the ten-year adaptive management plan. RBRA agrees to pursue grants and other funding to implement the adaptive management plan. RBRA shall implement the ten-year adaptive management plan in a timely manner, notwithstanding any funding shortfalls.

5. **Restoration Collaboration.** BCDC and RBRA agree to collaborate on the reuse of dredged materials from Schoonmaker Point Marina or other local dredging projects for use in eelgrass restoration in Richardson Bay, subject to the Dredged Material Management Office (DMMO) determination that the dredged materials are clean and suitable for this purpose.

6. **Temporary Use of Moorings.** By December 15, 2022, RBRA will install in its anchoring zone (outside of its Eelgrass Protection Zone) approximately 15 to 20 moorings such as those described in RBRA's Ecologically-based Mooring Feasibility Assessment and Planning Study. RBRA will use these moorings temporarily for vessels that relocate from the Eelgrass Protection Zone, vessels that are enrolled in the Safe and Seaworthy program, and other temporary uses as the moorings are installed. RBRA will monitor the moorings to evaluate their effectiveness at protecting subtidal resources and securing vessels. RBRA will report its findings on mooring effectiveness and mooring removal to BCDC. If RBRA wishes to retain these mooring after October 15, 2026, it must apply for and obtain a permit from BCDC. Prior to that date, this Agreement is sufficient authorization for RBRA's installation of these moorings; BCDC agrees that it will not pursue any enforcement action claiming or imposing any further permit or other authorization requirement related to such installation.

7. **Prevention of Future Subtidal Habitat Damage.** RBRA shall prevent future subtidal habitat damage by identifying and undertaking all necessary and proper measures to ensure (1) that no new vessels anchor in the Eelgrass Protection Zone after December 15, 2021; and (2) that only seaworthy vessels, as defined in RBRA's Transition Plan and with standard removable marine anchoring equipment, are allowed to anchor in the anchoring zone after October 15, 2026. If subtidal habitat damage is caused by vessels relocated from the Eelgrass Protection Zone to the anchoring zone before the ten-year adaptive management plan for eelgrass restoration is implemented, RBRA will take necessary measures to halt the damage and restore habitat conditions within a

reasonable timeframe as determined by qualified scientists selected by RBRA. Subtidal habitat damage that occurs after the ten-year adaptive management plan is implemented will be restored pursuant to the provisions of the ten-year adaptive management plan, and/or the Bay Plan and SAP, as applicable.

8. **Housing.** BCDC supports RBRA's efforts to continue to connect vessels' occupants with outreach agencies and organizations for assistance with finding shelter and encourages expansion of shelter and housing opportunities. BCDC commits to considering (1) proposals to increase the percentage of affordable marina slips available for vessels described in this agreement or their occupants for temporary discrete time periods; and (2) minor permit applications to build affordable live-aboard slips at existing Richardson Bay marinas. RBRA will provide quarterly reports to BCDC to include non-confidential information received from outreach agencies, organizations and local entities that RBRA is collaborating with related to shelter and housing opportunities and the status of housing efforts as it relates to removing all vessels described in this agreement and their occupants from Richardson Bay by October 15, 2026.

9. **Management of Vessels Arriving on the Richardson Bay Anchorage After August 2019.** All illegally anchored vessels on Richardson Bay that arrive after August 2019 will be removed along with their ground tackle no later than October 15, 2023. RBRA shall undertake reasonable efforts to prevent continued importation of derelict vessels into Richardson Bay for permanent anchorage. These efforts shall include, if warranted, legal actions against individuals involved in this activity. RBRA shall report these efforts to BCDC on a monthly basis. *As of the date of the signing of this agreement there were approximately 20 vessels in this category.*

10. **Management of Vessels on the Anchorage Before August 2019.** All illegally anchored vessels present on the anchorage before August 2019 will be removed from the anchorage no later than October 15, 2026 as outlined below. *As of the date of the signing of this agreement, there were approximately 68 vessels in this category.*

    a. **Unoccupied Marine Debris and Other Vessels.** All unoccupied marine debris vessels and their ground tackle/moorings will be removed by October 15, 2021.

    b. **Floating Homes.** No later than October 15, 2023, the floating homes located offshore from the Waldo Point Harbor houseboat marina and all associated ground tackle/moorings will be removed from Richardson Bay and either legally disposed of or relocated to a legal berth at an authorized houseboat marina in accordance with all applicable local, state and federal laws.

    c. **Occupied Vessels without Safe and Seaworthy Status.** Occupied vessels that failed to enroll in the Safe and Seaworthy Program shall be subject to immediate removal with their ground tackle/moorings and all vessels shall be removed no later than October 15, 2024.

d. **Occupied Vessels with Safe and Seaworthy Status.** The occupied vessels that enrolled in the Safe and Seaworthy Program and are maintained in a seaworthy condition shall be removed no later than October 15, 2026. Vessels and their ground tackle/moorings enrolled in the Safe and Seaworthy Program that are not maintained in a seaworthy condition shall be subject to immediate removal.

11. **Ground Tackle/Moorings.** Removal of ground tackle/moorings will be consistent with the CEMP and its periodic updates, as well as area-specific research as to what ground tackle will be removed, when it will be removed, and how it will be removed.

12. **Extensions of Time for Vessel Removal.** The RBRA and BCDC agree that so long as the overall rate of vessel removal remains consistent with the rate specified in this agreement, RBRA may elect, after consultation and approval from BCDC, to delay, to a date not to exceed October 15, 2026, removing specific vessels or individuals from the anchorage when additional services or resources are necessary to protect the health and safety of vessel occupants. Otherwise, the time periods set forth above for removal of occupied vessels shall be extended only for good cause. For purposes of this agreement, good cause may include (1) local, state, or federal orders related to pandemics or emergencies that preclude RBRA from implementing this agreement; (2) the issuance of any court order precluding the RBRA from complying with the terms of this agreement; and (3) any other factor outside RBRA's control that RBRA and BCDC agree could not have been reasonably foreseen at the time this agreement was signed.

13. **Commitment to Cooperation in Actions that Promote a Regional Solution to Issues Surrounding Unauthorized Vessels in Richardson Bay.** The RBRA shall:

    a. Participate in regional efforts to address unauthorized vessels and identify housing alternatives for occupants of anchor-out vessels.

    b. Continue to connect persons living on vessels with outreach agencies and organizations that provide assistance with finding upland housing.

    c. Encourage expansion of housing opportunities consistent with the policies laid out in the RBRA's Transition Plan.

14. **Waiver.** The failure of a Party to insist upon strict adherence to any term of this Agreement on any occasion shall not be considered a waiver nor shall it deprive such party of the right to insist upon strict adherence to that term or any other term of this Agreement. Any waiver must be in writing signed by the waiving Party.

15. **Reporting Requirements.** In addition to any reporting requirement specified above, RBRA will provide the following reports to BCDC:

a. **Monthly reports,** provided to BCDC staff by the 12th of each month, discussing:
   i. **Vessel metrics.** The number, type, category, and condition of registered and unregistered vessels entering, leaving, and currently anchoring in Richardson Bay; the number of anchoring permits RBRA has issued and any permits not adhered to; the number of moorings installed and their use; the amount of ground tackle/moorings removed or left behind and how this complies with CEMP; and the number of vessels removed or moved pursuant to this agreement by category .
   ii. **Eelgrass metrics.** Progress and results from restoration studies in the Eelgrass Protection Zone; progress on completing and implementing the 10-year adaptive management plan and how it meets the minimum requirements of the CEMP (including goals, performance standards, monitoring performance milestones, and contingency plans); findings on effectiveness of temporary moorings and their removal; new subtidal habitat damage and the RBRA's response.
   iii. **Housing metrics.** No monthly reporting requirements.
   iv. **Governance metrics.** BCDC's long term expectation is that the anchorage will be available to seaworthy, self-propelled vessels subject to periodic inspection. As the RBRA works towards meeting this long-term expectation the following information will be included in its governance metrics. Progress implementing the no-anchoring zone; the number of illegal anchor outs in the no-anchoring zone and in Richardson Bay; Efforts to reduce the number of illegal anchor-outs and their effectiveness; The number of vessels attempting to anchor in the no-anchoring zone; RBRA's cooperative efforts to address illegal anchor-outs and eelgrass restoration; Any changes in RBRA membership, staffing, or funding; any water quality monitoring results; Any debris and flotsam clean-up data; and any anticipated requests for extension of time.

b. **Quarterly reports,** provided to BCDC's Enforcement Committee. RBRA staff commits to attend the Committee meeting and address any questions regarding the reporting. Quarterly reports will discuss all the above reporting requirements, and:
   i. **Vessel metrics.** RBRA's efforts to prevent importation of derelict vessels into Richardson Bay; whether RBRA is on pace to meet the obligations of this agreement.
   ii. **Eelgrass metrics.** RBRA's acquisition of restoration funds and how RBRA will address projected budget surplus and/or deficits; progress on the beneficial reuse of dredged materials; effectiveness of eelgrass restoration planning and implementation.
   iii. **Housing metrics.** As described in Section 8.
   iv. **Governance metrics.** As above.

c. **Annual Reports**, provided to the BCDC Commission. RBRA staff commits to attend the Commission meeting and address any questions regarding the reporting. The annual report will summarize the results of the monthly and quarterly reports, and RBRA's progress towards implementing this agreement by the October 15, 2026 deadline for the removal of all illegally anchored vessels.

16. **Reservation of Rights**. The Executive Director and the Commission reserve the right to take appropriate enforcement action in the event of any failure by the RBRA to comply with the terms of this Agreement. No less than 30 days prior to issuing a Violation Report regarding compliance with this Agreement, BCDC will give written notice to the RBRA or, as appropriate, Marin County or the other member agencies, of such failure under the Agreement and the Parties will meet informally in an effort to resolve the issue without the necessity of commencing a formal enforcement action.

17. **Authority**. Each Party has the full and complete authority to execute this Agreement as set forth below. The Parties further warrant and represent that the individuals executing and delivering this Agreement have the full and complete authority and capacity to execute this Agreement.

18. **Mutual Release**. Execution and delivery of this Agreement and implementation of the terms herein constitutes a full and complete satisfaction of all claims and demands by BCDC against RBRA related to the failure to prevent Bay fill through permanent houseboats and anchor-out vessels through October 15, 2026. BCDC hereby agrees not to pursue additional enforcement related to this failure through October 15, 2026.

19. **No Admission of Liability.** This Agreement does not constitute an admission by RBRA of any violation of federal, state, or local law, ordinance or regulation or of any violation of RBRA's policies, procedures or ordinances, or of any liability or wrongdoing whatsoever. Neither this Agreement nor anything in this Agreement shall be construed to be or shall be admissible in any proceeding as evidence of liability or wrongdoing by RBRA. Nothing in this agreement constitutes mitigation required because of RBRA acts or omissions. BCDC agrees to provide letters of support for any grant applications RBRA submits to fund activities specified in this Agreement stating that this Agreement does not constitute legally required mitigation for RBRA's acts or omissions. This Agreement may be introduced, however, in any proceeding to enforce the Agreement.

20. **Governing Law.** This Agreement shall be governed by, interpreted, and construed in accordance with the laws of the State of California.

21. **Effective Date.** This Agreement is effective on the date it is signed by the representatives authorized to sign for the Parties.

Richardson's Bay Regional Agency

DocuSigned by:
S Moulton Peters
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Stephanie Moulton-Peters, Board Chair

San Francisco Bay Conservation
And Development Commission

DocuSigned by:
Larry Goldzband
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Lawrence J. Goldzband, Executive Director

Attachments:

- Transition Plan for the Richardson's Bay Regional Agency Anchorage
- Ecologically-based Mooring Feasibility Assessment and Planning Study by Merkel & Associates
- Draft Eelgrass Protection and Management Plan
- Photo image of each floating home and aerial image of their locations
- Current California Eelgrass Mitigation Policy and its Implementing Guidelines

Richardson's Bay Regional Agency

Transition Plan

Adopted June 11, 2020

Richardson's Bay Regional Agency Board of Directors

Richardson’s Bay Regional Agency Transition Plan
June 2020

Transition Vision:
Richardson’s Bay has essential value as a recreational and environmental resource where eelgrass and the ecological systems it supports are increasingly protected, preserved and restored; vessels on the anchorage become safe, seaworthy, operable and compliant with other requirements; and the number of occupied vessels diminishes over time.

Transition Principles:
- Affirm Richardson’s Bay as a temporary anchorage and prevent additional vessels from extended stays
- Conditionally and discretionarily allow occupied legacy vessels that comply with RBRA requirements to remain for a limited period of time
- Support initiatives for relocating occupants of vessels to alternative housing
- Realize a decreasing number of occupied vessels over time
- Protect and promote eelgrass habitat and growth

Transition Goal:
A safe, healthy, and well-managed Richardson’s Bay.

Transition Policy Direction:
1) Maintain existing enforcement priorities for unoccupied vessels and time limits on incoming vessels, including required notifications and removal
2) Implement a “Safe & Seaworthy” program available to vessels identified in the August 2019 anchorage census performed by the Marin County Sheriff’s Office, to enable a discretionary legacy designation for vessels meeting existing RBRA regulations, and State and Federal regulations, allowing deferred enforcement of time limits
3) Connect persons living on vessels with outreach agencies and organizations for assistance with finding alternative housing, and encourage expansion of housing opportunities
4) Set a sunset date by which occupied vessels with extended stays will not be allowed in Richardson’s Bay
5) Working with agencies, organizations, and other stakeholders, develop eelgrass protection measures and consider specific eelgrass restoration funding and projects

Transition Policy Direction Descriptions:

1) **<u>Maintain existing enforcement priorities for unoccupied vessels and time limits on incoming vessels, including required notifications and removal.</u>**

The RBRA Board initiated this policy direction when:

- In November 2018 it added all unoccupied vessels to its enforcement priorities.
- In July 2019 it expanded its enforcement priorities to include the time limits stated in the RBRA Code for vessels arriving into the Richardson's Bay anchorage.

Unoccupied vessels are posted with appropriate notification and ultimately removed by the agency if they are not voluntarily removed. Incoming vessels are notified of the 72-hour time limit for anchoring in the bay, and provided information about 30-day Anchoring Permits. Failure to comply with the codified time limit requirements subjects the vessel to removal.

Richardson’s Bay is a 72-hour anchorage, not a storage yard or marina. Individuals with multiple vessels should contact local marinas or storage yards to properly store their vessels. Vessels that are located in Richardson’s Bay for storage purposes will be considered unoccupied and subject to removal pursuant to Chapter 3.04 of the RBRA code. Occupants of vessels may not claim more than one vessel as their occupied vessel. Any additional vessels (other than dinghies, skiffs, or tenders) are considered unoccupied vessels and are subject to removal.

<u>Resources:</u>
RBRA has long employed a full-time Harbormaster. In the 2020-21 fiscal year, RBRA expanded its staffing to add a full-time Assistant Harbormaster. The RBRA member cities of Belvedere, Mill Valley, and Tiburon each provide a law enforcement officer to accompany RBRA staff for a shift on a bi-weekly basis. The Marin County Sheriff has a two-member Marine Patrol Unit responsible for patrolling all of Marin County waters, including law enforcement in County jurisdiction on Richardson’s Bay.

RBRA received $250,000 in the California Division of Boating & Waterways’ 2019-20 funding cycle for its Surrendered and Abandoned Vessel Exchange (SAVE) grant program. RBRA has applied for $400,000 in the SAVE 2020 funding cycle. However, due to State budget constraints related to COVID-19, and other harbor agencies’ needs for funds, RBRA did not project an increase in SAVE funds in its 2020-21 budget. Going forward, RBRA will continue to apply for and rely on SAVE funding to remove vessels that are marine debris, abandoned, or voluntarily turned-in by their owner.

RBRA has utilized virtually all of the $150,000 granted by the National Oceanic & Atmospheric Administration (NOAA) for removal of marine debris and vessels in marine debris condition. RBRA will apply for funding in the next grant cycle, which if successful, would give the agency funding beginning in September 2021 for removal of marine debris.

2) Implement a "Safe & Seaworthy" program available to vessels identified in the August 2019 anchorage census performed by the Marin County Sheriff's Office, to enable a discretionary legacy designation for vessels meeting existing RBRA regulations, and State and Federal regulations, allowing deferred enforcement of time limits.

Safe & Seaworthy Program Objectives:

1. Avoid injury or death of persons occupying vessels
2. Protect bay habitat and preventing waste and debris from polluting bay waters
3. Minimize the risk of vessels running adrift or running aground into the shoreline, or sinking
4. Encourage vessel occupants with aspirations for extended travel to realize these dreams with a safe, working vessel
5. Promote vessel eligibility for liveaboard slips in marinas because of their improved conditions
6. Limit new persons and vessels from settling in to the anchorage
7. Improve the management of the bay

Safe & Seaworthy Program Summary: Under this program, vessels that were identified in the Marin County Sheriff's August 2019 vessel census are eligible for enrollment in RBRA's Safe & Seaworthy program. The program is the route to a discretionary RBRA legacy vessel designation. Legacy is a vessel designation, not occupant designation. Eligible vessels may obtain legacy designation by meeting existing RBRA codes, and State and Federal requirements for safety, operability, registration, waste management, and other requirements for vessels, and are subject to any other rules, regulations and criteria as established by the agency.

Occupants of vessels that are enrolled in RBRA's Safe & Seaworthy program will be required to provide personal identification information and vessel information and consent to inspections. Only vessels that upon such inspections meet RBRA regulations as adopted in its ordinances and any other requirements set by RBRA will be eligible for the discretionary RBRA designation of legacy vessel.

Vessels whose occupants decline to enroll in the Safe & Seaworthy program or otherwise refuse to provide required information will not be eligible for legacy status.

The Safe & Seaworthy program will allow RBRA to better manage the safety and health of the bay by ensuring that vessels from the August 2019 census that are allowed to conditionally remain are seaworthy. Vessels that fail to comply with program requirements and other criteria will become an enforcement priority and subject to removal.

Safe & Seaworthy Enrollment Eligibility: In July 2019, the RBRA Board added time limits on incoming vessels to its enforcement priorities. To establish a clear determination of new incoming vessels, the Marin County Sheriff's Marine Patrol Unit conducted a comprehensive vessel census in August 2019. The RBRA has been utilizing the data from this survey to identify and enforce time limits on new vessels entering the bay. The RBRA will now utilize this survey data to determine eligibility for enrollment in the Safe & Seaworthy program.

Safe & Seaworthy Enrollment: In its initial period, RBRA will notify eligible vessels about the enrollment process, and RBRA requirements to apply for legacy vessel designation under the Safe & Seaworthy program. Interested parties may seek to enroll their vessels in the program. The enrollment process will include verification that the occupied vessel was in the August 2019 census, identification of the persons occupying the vessel, and an inspection of the vessel by RBRA staff. Through the inspection, the vessel owner/occupants will be advised of any deficiencies in the vessel, its registration, or other matters as the deficiencies exist at that time, requiring correction to successfully meet the qualifications of the Safe and Seaworthy program. Vessels not enrolled by a date set by the RBRA will become subject to removal as an enforcement priority.

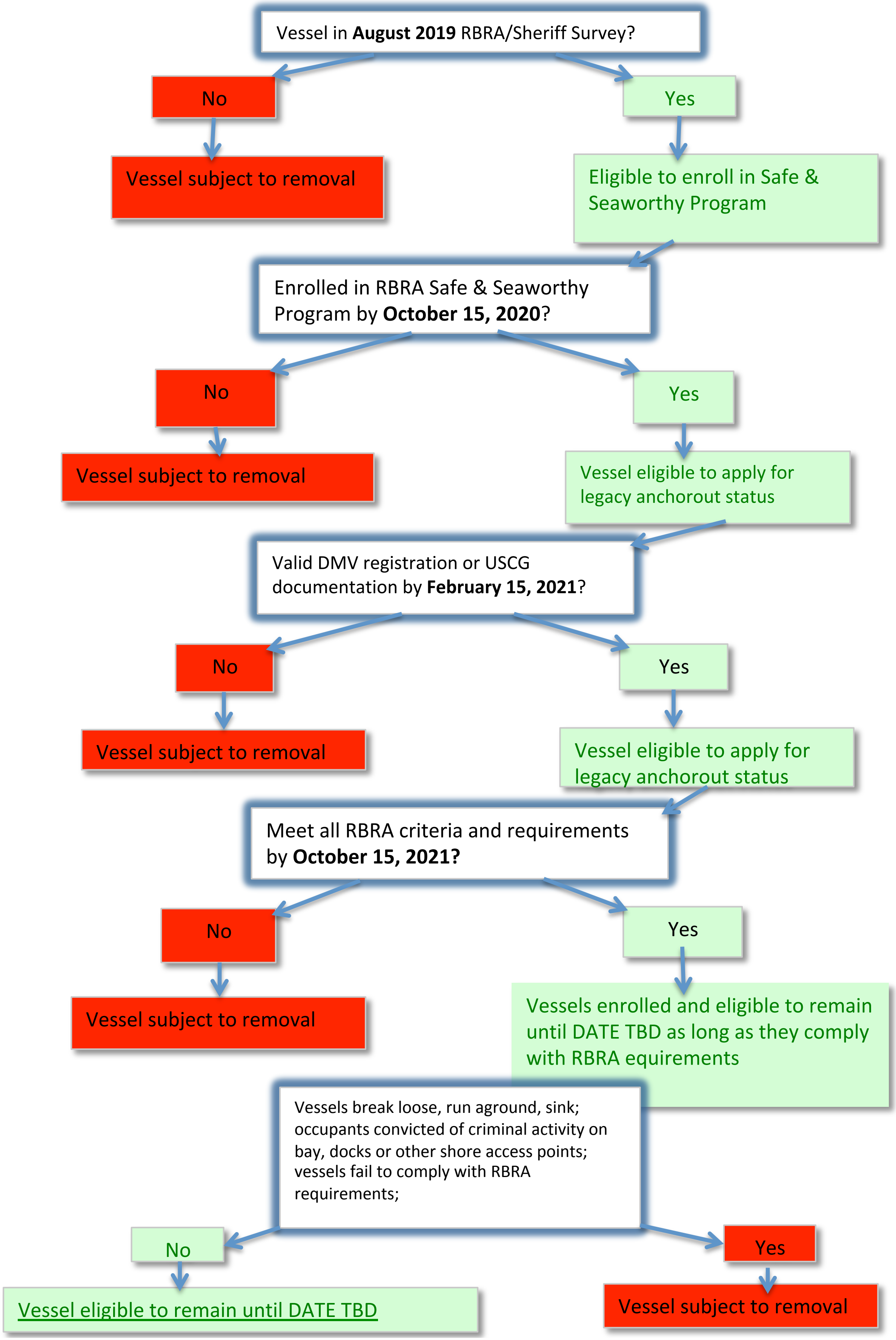
Safe & Seaworthy Requirements: The Safe & Seaworthy program will require vessels to meet RBRA, State, and Federal regulations, and any other program requirements as set by the Board of Directors, which may be amended from time to time.

Safe & Seaworthy Timeline: The RBRA Board will adopt a timeline for implementation and compliance with the Safe & Seaworthy Program.

Agency Resources:
Two full-time staff (Harbormaster and Assistant Harbormaster), member agency law enforcement assistance, CA Boating & Waterways SAVE grant funds, and potentially NOAA funds.

Vessel owner resources to improve conditions:
Dependent upon private funding or grants that may be obtained by individual vessel owners or through the Richardson’s Bay Special Anchorage Association (RBSAA). The non-profit supporter MarinLink has been serving as a fiscal sponsor for the RBSAA, and could potentially assist with directing community donations made for vessel improvements or relocation.

RBRA Safe Seaworthy Timing and requirements flowchart



3) Connect persons living on vessels with outreach agencies and organizations for assistance with finding alternative housing, and encourage expansion of housing opportunities

In fiscal year 2020-21, RBRA contracted with Andrew Hening to coordinate outreach efforts among public and non-profit agencies to persons on the anchorage. Close to 100 persons on vessels were identified, of which two-thirds were assessed for their level of vulnerability and therefore eligibility for subsidized housing with case management through the County's Coordinated Entry System.

Policy considerations:

Vulnerable people, vulnerable vessels:
While living on a vessel can be hazardous to health and safety, it is not considered a factor in the coordinated entry ranking system. For those who have other vulnerabilities that place them in a higher priority category, continued outreach and encouragement is needed but is not necessarily successful in moving persons to safer conditions. It can be very difficult for people to let go of the only housing they have known for a long period of time, similar to when persons on land face moving from long-time homes to more supportive housing.

There are some persons who have scored high on the Coordinated Entry System's vulnerability scale but who have shown reluctance to leave their boat and the bay when a potential opportunity arises. Of particular concern is the combination of a vulnerable person on a vessel that itself is in significant marine debris condition that contributes to the vulnerability of the person aboard the vessel and endangers others in the vicinity. For the protection of persons who are a high priority for subsidized housing because of their health and safety vulnerability and who are on vessels that are in marine debris and otherwise hazardous conditions, RBRA will prioritize work with agencies and organizations to relocate those persons into supportive housing.

Expanding housing alternatives
Before and after the Safe & Seaworthy compliance deadline, RBRA will work with occupants of vessels to encourage them to move into other housing on land, to move themselves and their vessels into liveaboard marina slips, or to berth their vessels in marina slips. Such efforts will continue after the compliance date, in advance of the legacy vessel sunset date.

Alternatives for housing that is affordable is in very short supply. Affordability is a problem not unique to this community. There is a push on local, regional, and state levels to expand supply for persons who have very-low-to-medium income who are homeless or at risk of becoming homeless, which includes many of those currently eligible for the Safe & Seaworthy program and legacy vessel status. State Senator Mike McGuire and representatives from RBRA, County of Marin, and City of Sausalito have expressed support for collaborating on a solution for housing availability for vessel occupants – including expanding the supply.

Expanding supply through construction will take years, and the budget constraints from the COVID-19 pandemic add additional uncertainty. Nevertheless, it is possible that the attention on homelessness and housing from the pandemic could create other opportunities. Rapid Rehousing, for example, is a category of housing subsidy that is well-suited to a number of anchorouts as it only requires short to medium-term case management support.

Another housing alternative that RBRA will pursue is liveaboard slips at existing marinas. The City of Sausalito has managed and allocated funds for up to about eight anchorouts in Sausalito waters to move into marina slips in Sausalito. The City has proposed to the Bay Conservation & Development Commission (BCDC) to expand the percentage of marina slips allowed to be used for liveaboards from 10 percent to 15 percent. BCDC has expressed a willingness to entertain this proposal, for a specified period of time to be determined, as an alternative to occupied anchored-out vessels. At the last BCDC Enforcement Committee, members encouraged Sausalito and RBRA to incorporate marina slips into their transition plans.

Qualifying for a liveaboard marina slip not only requires a space to be available, but also the vessel to be in condition akin to those required by RBRA in its ordinances as well as being insured. The marinas also have required a case manager from a social services agency to be assigned to occupants on the vessel to serve as a go-between, which adds approximately another 40% to the cost of renting the slip and paying liveaboard fees. Under these circumstances, the total cost of the marina slip alternative is similar to the rental cost of a Rapid Rehousing unit on land.

As vessels meet RBRA requirements, they also will meet marina standards for liveaboard slips. RBRA will encourage the transition to slips, and will seek funding for subsidizing the slip fees and case management where needed for particular individual(s). However, especially with slips being a non-traditional subsidized housing option, RBRA should exercise caution around its participation and commitment involving slip arrangements without sufficient guarantee of a continuous funding source from outside agencies or the liveaboards themselves, or fixed arrangements for transition into other housing.

<u>Resources</u>:
RBRA will continue its contract with Andrew Hening in fiscal year 2020-21 to coordinate housing outreach and placement and to work towards expanding housing opportunities. Partner agencies include St. Vincent DePaul, Marin City Health & Wellness Clinic, Downtown Streets, County of Marin, Marin Housing Authority, Ritter House, Marin County Sheriff, City of Sausalito, and others. In addition, Audubon California has generously contributed the use of its vessel and its staff/volunteers to take outreach workers out on the bay to connect with anchorouts.

4) <u>Set a sunset date by which occupied vessels with extended stays will not be allowed in Richardson's Bay</u>

There are approximately 100 vessels on the bay that were present for the August 2019 count and are therefore eligible at this time to enroll in the Safe & Seaworthy program and potentially receive legacy vessel status and thus deferred enforcement of RBRA's current time limits on the anchorage. It is estimated that only about 20-25 vessels may currently meet RBRA requirements. If one-half of the remaining vessels are able to meet the requirements with additional work, that would mean about 55 vessels eligible for legacy status. It is roughly estimated that in any given year, about five to ten percent will depart the anchorage for a variety of reasons, including falling out of compliance with requirements. Therefore it is estimated that through natural attrition and upholding vessel requirements and enforcement priorities, in 20 years about a dozen or fewer would likely remain on the anchorage, a substantial decrease from current conditions.

The Enforcement Committee of the Bay Conservation and Development Commission (BCDC) has given RBRA its expectation that occupied vessels be removed from the bay in five to ten years. The challenges of this timeline include shortages of resources in these areas:

- Available, affordable and subsidized housing for low-to-very low-income vessel occupants. Without a realistic housing opportunity as an alternative to their vessel, vessel occupants face homelessness if removed from the Bay.
- Affordable liveaboard marina slips. In situations where marinas will require case management/wrap-around services, affordability is more challenging.
- Affordable marina slips in the San Francisco Bay to lease for vessel occupants to berth their vessels upon moving onto land. For people attracted and accustomed to a mariner lifestyle, giving up their boat can be a significant impediment to relocating off the bay. Having affordable marina slips to store their vessels for recreational use – even if not liveaboard slips – could assist the transition to land.
- The cost of enforcement and abatement work. Removal and abatement is an inevitable aspect of enforcing time limits against vessels that may be derelict or abandoned when their operators leave the anchorage. The RBRA has increased its enforcement staffing budget and outside assistance, but can only meet the cost of vessel removal and abatement through grants from state and federal agencies. Removal and abatement costs increase when the economy turns sour and vessels from around the Bay Area are dumped in public waterways like Richardson's Bay.

Legacy anchorout status provides deferred enforcement of existing time limits solely at RBRA's discretion. The RBRA's implementation of a Safe & Seaworthy program will materially reduce the number of vessels, significantly increase safety, improve bay health, and enhance the management of the bay. With success will come decreasing impacts on the bay and shoreline without contributing to homelessness populations in the area.

RBRA has considered the Richardson's Bay Special Area Plan Residential Vessels and Floating Structures policy to limit stays on the bay, and the Board has adopted ordinances setting limits on the length of time vessels may remain anchored.

Accordingly, the RBRA will commit to setting a sunset date for deferred enforcement for legacy occupied vessels on the bay, considering the extent of available, affordable housing - on land or in marina slips, removal and abatement resources, benefits of boater expertise, and other factors affecting the health, safety, and management of the bay in setting such a date.

Resources:

Timing for Implementation of this policy will depend on factors such as RBRA operational resources, resources for affordable housing alternatives, vessel removal and abatement resources, and review of any other resource advantages and disadvantages for deferring enforcement for vessels remaining on the bay at a certain point in time.

5) <u>Working with agencies, organizations, and other stakeholders, develop eelgrass protection measures and consider specific eelgrass restoration funding and projects</u>

Eelgrass is a critical habitat resource for the San Francisco Bay Ecosystem, where Richardson's Bay is one of two high-priority eelgrass locations. Eelgrass supports a wide variety of life including fish spawning grounds, bird migrations and food resources for multiple species. Furthermore, eelgrass is a substantial tool for sequestering carbon and mitigating ocean acidification.

In 2019, RBRA conducted a Mooring Feasibility and Planning Study that was prepared by Merkel & Associates, Inc. As part of the study, Merkel performed sidescan bathymetry and eelgrass bed surveys in Richardson's Bay. Combining this survey data with previous eelgrass surveys, Merkel prepared maps showing where eelgrass has tended to grow and at what density, where it is unlikely to grow due to depth of the bay, and where damage to eelgrass beds has occurred. The information in the Merkel study provides a foundation upon which to build protection, restoration, and environmental review efforts.

A report issued by Audubon California in October 2018 concluded that about 57 acres of eelgrass in Richardson's Bay had been damaged by ground tackle. Eelgrass restoration to date has had mixed results and warrants some additional research and analysis to conclude best practices for particular conditions in the bay. A project to conduct this research was poised to begin in Spring 2020 but was put on hold due to the COVID-19 pandemic and shelter-in-place restrictions.

Somewhat reflective of the varying conditions and uncertainties for restoring eelgrass is the wide cost estimate for such efforts, which can range from $100,000 to even $150,000 per acre. Using 57 acres as the area of damage, the cost to restore that size could range upwards in the range of $8.5 million or more - if undertaken as a replanting project above and beyond allowing eelgrass to expand naturally and progressively away from ground tackle and other sources of impacts.

The approach for RBRA's development of a restoration plan relies on a combination of research, replanting, and natural restoration and expansion in the most eelgrass-friendly habitats of the bay. Accordingly, the protection and restoration measures RBRA will consider as part of its transition are:

1. <u>The potential designation of up to four zones in Richardson's Bay for varying levels of vessel usage and eelgrass restoration and protection:</u>

a) <u>Eelgrass Restoration Zone</u>: This is the area where vessels would not be authorized to anchor or moor, and which will be a priority area for eelgrass restoration. This area potentially extends from the boundary with the Audubon Sanctuary south to approximately in the general vicinity of the Bay Model, not including the deeper water in Belvedere. About a half dozen vessels are currently anchored in this location; the benefits and risks to eelgrass from requiring their relocation out of the zone would be evaluated. The four floating homes in the anchorage would be subject to removal.

b) Eelgrass Protection Zone: This is an area where existing occupied vessels could anchor or moor, which could be subject to ground tackle rules that may be developed. The potential boundary of this zone is from the edge of the Restoration Zone in the north to approximately in line with Turney Street in the south.

As shown in the Merkel study, this area contains eelgrass beds - some of which have already been damaged by vessels and anchor chain. Issues that will be considered include whether to:

- o Require a two-point anchoring system to secure vessels, or pursue a pilot project to test conservation moorings, to help protect against eelgrass damage
- o Require permission to move or remove existing ground tackle, due to potential risk to eelgrass beds in removing or setting ground tackle
- o As vessels depart and/or eelgrass restoration work is completed, expand the Restoration Zone into this zone – notably the north/northeast areas

c) Anchoring Zone: Where cruisers/visiting vessels would anchor or moor for the time permitted under the RBRA code. This area is potentially south of where anchorout vessels would be located. For future RBRA consideration is whether to pursue a mooring project – either pilot or permanent - in this zone for cruisers/temporary visiting vessels.

The remainder of the anchorage would be remain available for brief anchoring, such as daytime/weekends, and related recreational use, as under existing conditions. Vessels in the Belvedere portion of the RBRA anchorage are and would remain subject to that city's ten-hour anchoring limit.

The first phase of this step is to draft boundary maps using the eelgrass survey data from the Merkel study with an overlay of RBRA vessel survey data, review with stakeholders, and undergo any applicable environmental review. Establishing boundaries of a proposed restoration zone would enhance efforts to pursue eelgrass restoration funding, so as to provide assurance that restored areas would be protected against anchoring-related damage in the future.

A second phase would be to identify, analyze and discuss advantages and disadvantages of pursuing two-point anchoring and/or conservation moorings, controlling the placement of ground tackle, specific ground tackle requirements if any, and pursuing relocation of any existing vessels from one zone to another. RBRA could consider whether and if so, under what circumstances to expand the Restoration Zone into the Protection Zone as part of this phase or at a later time, again following any necessary environmental review.

2. Work with organizations and agencies that support eelgrass preservation and protection to seek grant funding and other support to conduct proposed eelgrass research, protection, and restoration work in Richardson's Bay.

With the cost to restore eelgrass throughout Richardson's Bay ranging up to in the range of $10 million, potential restoration work can only be accomplished with grants and other outside funding. There are organizations and agencies for which eelgrass is considered critical that are potential partners in grant applications or sources of grant funding. There is sometimes mitigation funding available from projects in San Francisco Bay that could be potential funding sources.

In a collaborative communication from State Senator Mike McGuire and representatives from the County of Marin, RBRA, and the City of Sausalito to the Bay Conservation & Development Commission, it was stated that: "*We are in agreement that over time, a multi-agency effort must be initiated to restore Eelgrass habitat and improve water quality in Richardson Bay.*"

The information on eelgrass habitat in the 2019 Merkel study provides a basis upon which to craft restoration approaches and funding requests. RBRA will collaborate with other interested entities to seek funding resources from state and federal agencies and other organizations. RBRA also will work with State Senator McGuire and related partners on opportunities for collaboration and support.

As the number of long-term vessels declines and visiting vessels anchoring in the bay are steered clear of eelgrass habitat, eelgrass beds will have the opportunity to expand naturally and progressively into damaged areas that otherwise are well-suited habitat. Where the size and nature of the scarring and related damage in eelgrass beds is severe, findings from eelgrass research can help inform best practices for encouraging growth or focusing elsewhere.

Resources:
Due in part to COVID-19 related budget constraints, RBRA was unable to program funding specific to eelgrass restoration in the 2020-21 budget. A modest amount of funds could be allocated from Contingency for outside services that may be needed to augment staff resources for working with stakeholders and collaborating with partner agencies on eelgrass restoration grants and initiatives.

RBRA, with assistance from other agencies and organizations, will continue to be on the lookout for grant funding opportunities and partnerships, When the State and other governmental and non-profit budgets recover from negative COVID-19 impacts, RBRA will work with Senator McGuire as well as the City of Sausalito to collaborate on potential funding solutions.

Richardson's Bay Regional Agency

Ecologically-based Mooring Feasibility Assessment and Planning Study

Prepared for:

Richardson's Bay Regional Agency

c/o Marin County Community Development Agency,

Planning Division,

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November 2019

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PREFACE

Merkel & Associates, Inc. (M&A) was retained by the Richardson's Bay Regional Agency (RBRA) to prepare an ecologically-based mooring feasibility and planning study to evaluate the nature and scale of ecological impacts associated with moorings and anchor-outs and to determine if there are feasible means to ameliorate the conflicts while retaining moorings. In submitting this mooring feasibility and planning study, our objective has been to provide defensible data on which to base actions and recommendations, or ranges of recommendations, for actions.

Over time there has been considerable contention related to moorings in Richardson Bay and we do not expect unanimous agreement as to the best course of action when all factors presented in this study are considered. Further, there are many factors that must be weighed beyond those within the scope of the requested planning study such as social considerations, culture and heritage, environmental justice, regulations and policy, as well as land-use, planning, and available services.

For these reasons, it is important to advise that authors have taken a narrow role in exploration of means of reducing or eliminating existing ecological conflicts associated with moorings. This effort has been informed through interviews and interactions with affected representatives of varying interests, field investigations, and document research. Through these efforts, we have developed strategies that we believe provide workable solutions to ecological conflicts. The recommendations also integrate insights into the factors constraining various options. However, the solutions are not all encompassing in that they are very explicitly focused on one aspect of vessel mooring and anchor-out issues.

There has been considerable effort put into development of a self-governance system for the waters of Richardson Bay. This effort has been mainly, but not exclusively, invested as an effort of self-preservation by a community that is diverse and generally poorly represented and which fears future actions that may result in the demise of the anchor-out community in Richardson Bay. However, we believe that such a self-governing system cannot be successful without greater shared interests within the community and adequate enforcement tools and on the ground resources. Notwithstanding trepidation about the ability to effectively police management activities with current allocated resources, the self-governance concepts provide many elements of the structure and commitment of the engaged parties that can, and should, play an important role in ensuring effective management of moorings, should moorings be retained in the bay. Further, success of any management measures would require effective long-term implementation efforts and enforceable regulations.

Having completed the study, it is the authors' opinions that the solutions proposed are technically workable, would resolve ecological conflicts, and would allow continued presence of moorings while substantially or fully eliminating ecological impacts associated with the anchor-out moorings. We are equally convinced that there are things about the solutions posed that will be disliked by all, but that the dislikes will vary across different slices of the community.

The present study is an informational document rather than a decision document. This means that it provides information to end users on which to base further actions. Truth be told, resolving ecological conflicts while maintaining moorings and anchor-out opportunity is a far easier task than obtaining consensus on an ultimate action to be undertaken. With the conclusion of this study, there remains considerable need for planning, regulatory and policy consideration and potential conflict resolution, environmental review, and ultimately decision making on the part of many entities. It is also important to keep in mind that the recommendations made in this document rely on vigilant management and enforcement to be successful which is why the recommendations seek to embrace a community involvement in implementation of the management process.

Richardson's Bay Regional Agency

Ecologically-based Mooring Feasibility Assessment and Planning Study

TECHNICAL APPROACH

Purpose

The overall purpose of this mooring feasibility and planning study is to provide informed recommendations regarding the feasibility of retaining moorings, resolving conflicts between moorings and natural resources, and determining the sustainable capacity, suitable locations, and design for moorings in Richardson Bay that will avoid or minimize damage to natural resource values. In addition to the broad questions of where moorings should and should not be located, there are logistical considerations of what shore access, shoreline infrastructure, services, and mooring management activities would be recommended to facilitate the purpose of protecting natural resources in the context of mooring establishment and uses in the bay.

Overall Approach

The overall approach to the planning study is one of spatial analyses wherein data are accumulated and digested down to spatial data layers that may be used to investigate, identify, and quantify existing conflicts and opportunities for conflict resolution between natural resources and moorings. From this evaluation process, the locations and magnitude of existing conflicts was identifiable and opportunities for both spatial and design resolution of conflicts have been identified. It was anticipated that gaps in existing data or knowledge about conflicts would be identified and as much as practical, filled through additional information gathering. Where data gaps remain, these have been acknowledged and the relative importance of the gaps to the study conclusions and management recommendations has been discussed.

The area evaluated in this study included the waters within the RBRA Special Area Plan Boundary excluding the Richardson Bay Audubon Sanctuary, the federal navigation channel, and developed marinas (Figure 1). The waters within the study area fall under the RBRA member agency local jurisdictions of the County of Marin and cities of Belvedere, Tiburon, and Mill Valley. The study area also includes waters within the City of Sausalito.

The study area extends from waters that are too shallow to support moorings within the waters of Mill Valley and east and west of the Strawberry Peninsula out to deeper waters of San Francisco Bay at the west end of Raccoon Strait.

This study has been structured around a data collection phase, analyses and conflict identification between ecological resources and moorings, and conflict resolution seeking to identify means and opportunities to resolve conflicts through changes in mooring locations, changes in mooring methods, and identification of operational and management needs. This planning study identifies recommended management actions based on known information and identifies recommended actions based on general ecological, physical, engineering, planning, and regulatory principles.

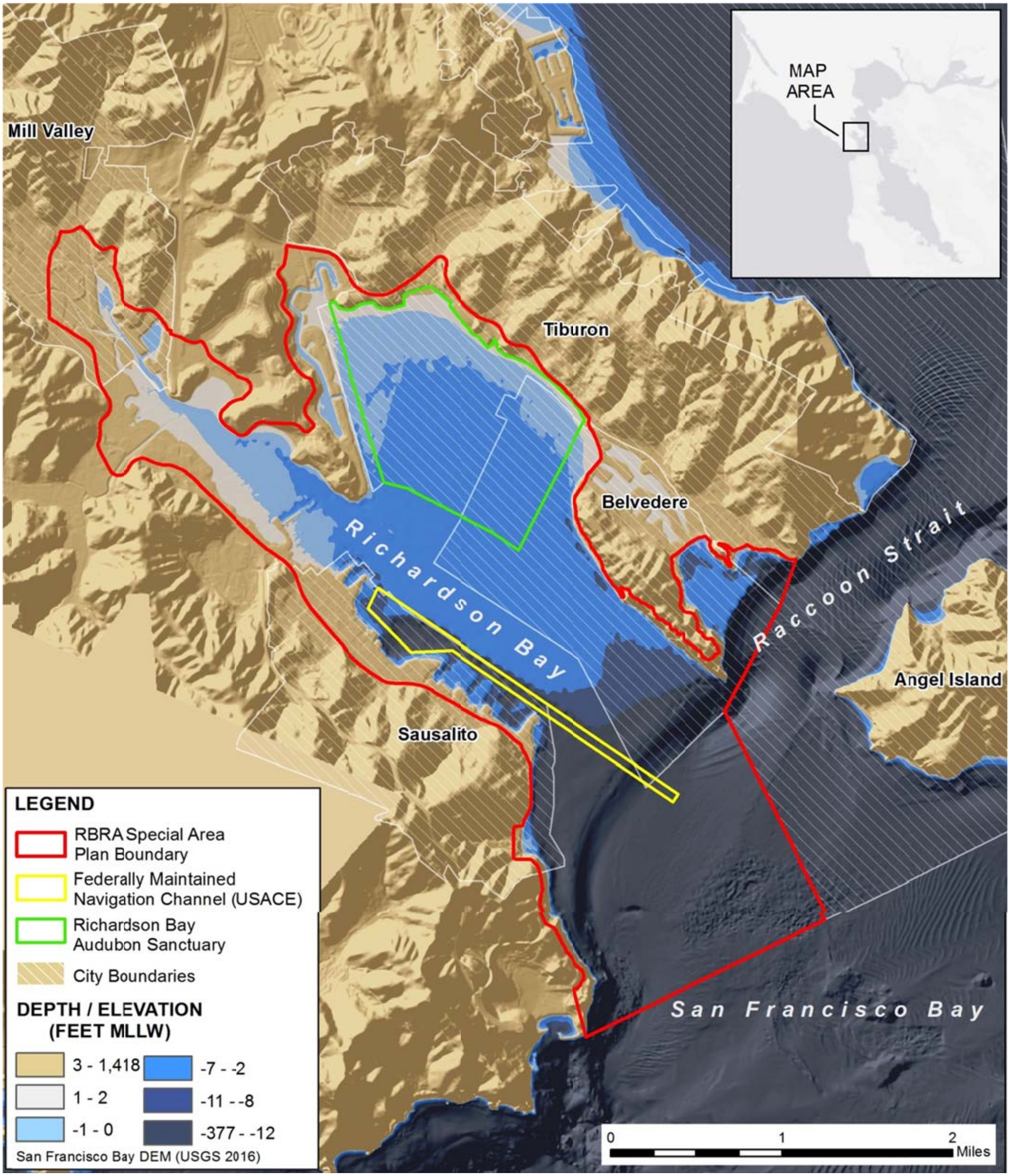


***Figure 1. Richardson's Bay Regional Agency Special Area Plan**. The study area is bounded by deepwater of Raccoon Strait, shallow water of the Mill Valley western finger of the bay, and closed waters of the Audubon Sanctuary. In addition, the federal navigation channel and developed waterside lands further constrain the operative study area*

Some of the most salient operating assumptions that have been defined in the study are:

- Existing shoreside landings would remain unchanged in Sausalito; however, other potential landings elsewhere should be evaluated if they can be identified;
- The study excludes evaluation of suitability or adequacy of shoreside support facilities, but rather evaluates potential issues of impact from transit to and from shoreside landings as well as distances of travel between moorings and landings;
- The study is intended to answer questions related to whether ecological resource protection can be achieved concurrently with mooring retention. However, there is no specific number or scale of moorings that should be targeted for accommodation;
- If moorings may be accommodated in a manner protective of ecological resources, the study should make recommendation as to where moorings could be situated and what mooring tackle would be appropriate for the moorings;
- The study should seek to identify the mooring carrying capacity of the RBRA Special Area;
- The study explicitly does not intend to address whether moorings should or should not be retained, and finally;
- The study does not address land-use, regulatory, social, or political issues associated with mooring elimination, retention, relocation, or scaling.

STUDY METHODS

Information Gathering

Outreach for Ecological and Mooring Information

From February through April 2019 interviews were held with many individuals representing diverse backgrounds and providing varied insights into the moorings. The subject matter of interviews ranged from ecological observations including eelgrass, marine mammal, bird, and herring spawning activities in and around the moorings to mooring life. Interviewees included residents of vessels on moorings, agencies administering waters (RBRA and City of Sausalito), social welfare representatives, and concerned environmental groups (Audubon California and Marin Audubon Society). Over 20 individuals were interviewed, some on multiple occasions. Tours of the moorings were also taken separately with environmental advocates, enforcement agencies, and research scientists. However, the interview process should not be considered exhaustive but the interactions do provide a good perspective on life on moorings, systemic challenges faced by those on and off moorings as well as issues resulting from the moorings. In addition, the interviews provide insights into governance and enforcement efforts and the complexity of issues associated with both.

Interviews were either coordinated directly by M&A with stakeholder parties, or were advertised to the anchor-out community by RBRA as a means to seek information through informal sit-down discussions at the local Sausalito waterfront restaurant, Taste of Rome.

Ecological and Physical Data Collection

Ecological and physical data collection included multiple avenues of information gathering. These were:

- Collection of previously released study information;
  - Many years of bird survey data from the Richardson Bay Audubon Sanctuary, Audubon Christmas Bird Counts, eBird, and Point Blue data base records
  - Baywide eelgrass survey data from 2003, 2009, and 2014
  - Areas specific eelgrass surveys from 2013 and 2018
  - Herring spawning information from California Department of Fish & Wildlife
  - Marine mammal data from Golden Gate Cetacean Research
  - Water quality data from the Regional Water Quality Control Board
  - Physical wave field model data from Our Coast Our Future (OCOF)
  - Other data garnered from reports of various types focused on conditions of Richardson Bay as discussed in this study document

- Collection of information through interviews of stakeholders;
  - Data collection included accumulation of anecdotal observation data on marine mammals and birds, herring spawning
  - Data on mooring designs in use within the anchorage and specific as well as general issues with moorings related to cost, mooring effectiveness, failure points, and frequency of vessel breakaway
  - Data on the nature of vessels on the moorings including ownership, seaworthiness, waste management strategies
  - Information on dinghy travel routes and use, vessel distribution on moorings, and logic behind mooring location selection
  - Effectiveness of community support and policing on the water

    - Perspectives on the limitations and constraints to effective management and servicing of anchor-outs

- Original data collection and data mining from previously collected data
    - Completion of a 2019 comprehensive survey to collect eelgrass and bathymetric data
    - Reprocessing of prior eelgrass survey data to extract higher resolution eelgrass distribution information than incorporated in baywide and regional survey reporting
    - Aerial imagery review and extraction of data on the number and locations of moored vessels on the bay through time
    - Digitizing of historic bathymetric chart data, boundaries, and survey features and resources for spatial analyses purposes

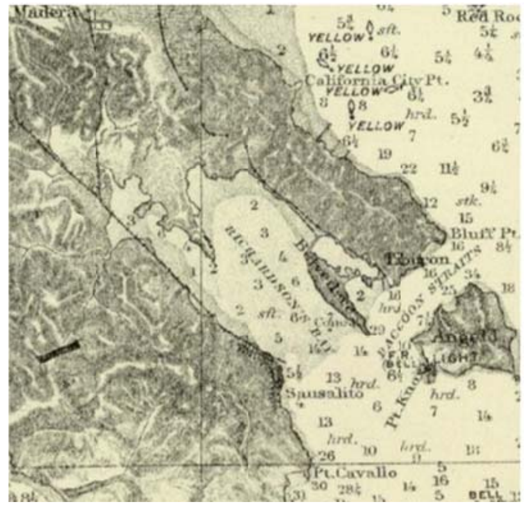
Wherever practical, accumulated data were geographically plotted to allow for the spatial analysis. This included plotting of biological and physical features, vessel moorings and landings, land and water use constraint areas, etc. In addition, temporal elements of the data were also captured by segregating information by time steps so that conditions could be viewed as a function of time.

Planning Process

Existing Setting Characterization

Bay Nomenclature

Richardson Bay is named after Captain William Anthony Richardson, an English whaling captain that married the daughter of the Commandant of the Presidio of San Francisco, Ygnacio Martinez, in 1826. Richardson was an important figure in the San Francisco bay maritime ventures and even served as the Captain of the Port of San Francisco. In 1838, Richardson received a 19,500-acre Mexican land grant over Rancho Saucelito. A significant portion of what is now called Richardson Bay fell within this land grant and the bay was given the name of Richardson's Bay with a possessive tense. This name was the common period vernacular and was present on some but not all historic maps of the bay. For instance the Alden chart of San Francisco Bay drafted in 1856 uses Richardson Bay while the 1908 Earthquake Investigation Commission chart uses Richardson's Bay to describe the area. As a convention, United States Board on Geographic Names created in 1890 adopted a convention of omitting the possessive tense from place names and thus more current period maps and place name reference recognize the bay as Richardson Bay. The RBRA has retained the traditional nomenclature of the Bay. This study follows the applicable conventions used for proper names, published references, and published maps. The possessive and non-possessive nomenclature is intended to be synonymous.



Richardson's Bay remained in some use on maps in the early part of the twentieth century as indicated in this 1908 Earthquake Investigation Commission map.

Physical Setting

Geomorphology and Bathymetry

Richardson Bay is a shallow soft bottom embayment of San Francisco Bay. The bay supports principally marine deposited sediments of silts and clays with a sandy sediment transition to deep waters of Raccoon Strait along the southern margin of Richardson Bay. The mud deposits are young Bay Muds of the Holocene Age (less than 10,000 years). Cone Rock is the single rocky protrusion rising through the bay muds to the surface of the water. However, the margins of the bay are defined by similar rocky features including the Strawberry Peninsula, Peninsula Pt. at Belvedere and Saucelito Pt. in Sausalito.

- Historic Conditions

Richardson Bay has historically been a shallow soft bottom embayment of the Bay bounded on the south by deep waters of Raccoon Strait and surrounded by the hills of Marin County. The embayment was surrounded by coastal salt marsh that extended from Richardson Bay into Belvedere Cove resulting in an isolated Belvedere Island of what is now western Belvedere connected to the remainder of the Tiburon Peninsula by a narrow sand tombolo crossing the marsh lands (Figure 2). A circuitous channel crossed through the bottom of the bay flats extending bayward from the small western creeks of Arroyo Corte Madera del Presidio and Coyote

San Francisco Harbor surveyed by Lt. James Alden, U.S. Navy 1856 (published by British Admiralty, London). Soundings are in fathoms.

Creek. The channel, while not easy to detect from the point sounding map of 1859 curved around Strawberry point and extended slightly northward and then south to the bay within the eastern lobe of the bay where it crossed the bay to the east and hugged Belvedere Island traveling to the deeper waters of the bay in Raccoon Strait. This channel formed during a period when sea level was lower and the creek crossed a shallow flat valley.

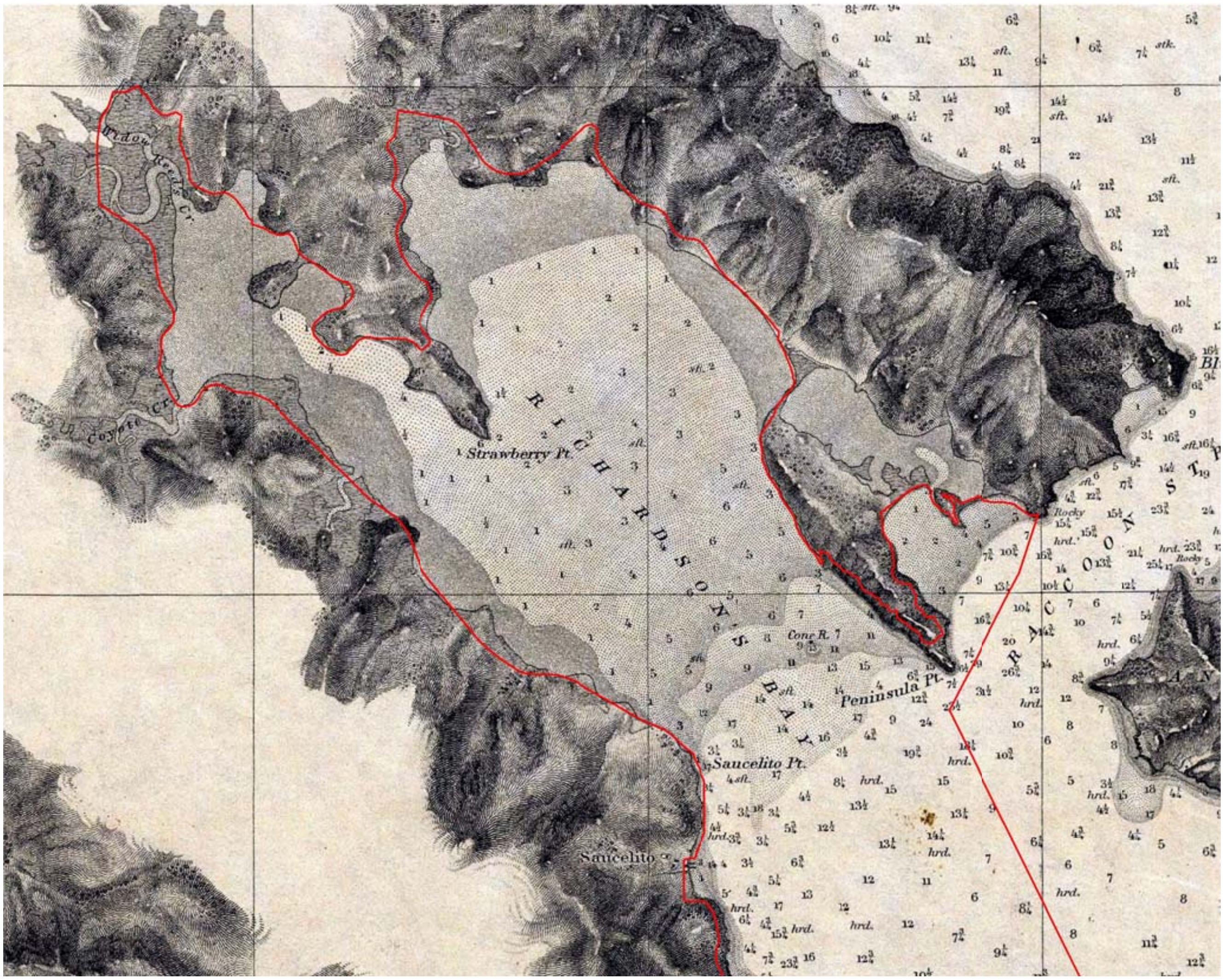


Figure 2. 1859 Richardson's Bay bathymetry.

- Current Conditions

A bathymetric survey was completed within Richardson Bay concurrent with completion of a 2019 eelgrass inventory. The survey was limited to waters of Richardson Bay and Belvedere Cove and did not extend outward to deeper waters of Raccoon Straits or San Francisco Bay within the RBRA study area located to the south of the two embayments. At the upper end of Richardson Bay within the Richardson Bay Audubon Sanctuary, eelgrass was mapped using an Unmanned Aerial Vehicle (UAV)-based aerial imagery and thus bathymetric data collection was not practical. However, bathymetry for this upper intertidal portion of the bay was completed using a combination of aerial imagery-based interpretation of edge-of-water calibrated to image acquisition time stamps and local tidal water level observations derived from the San Francisco (Golden Gate Station) station - Station ID: 9414290 and corrected to the Sausalito Corps of Engineers Dock, - Station ID: 9414819; as well as interpolation of the 2016 USGS San Francisco Bay Digital Elevation Model (DEM) that provided supplemental shoreline elevation information.

Bathymetric surveys reveal an extremely shallow and flat bottom embayment over most of the bay with a gentle slope to the southern end of the bay where the bay falls abruptly to the deeper waters of San Francisco Bay. Dredged channels are the most notable topographic features followed by scour pits at the western side of Strawberry Point and those derived from moorings on the otherwise featureless flats (Figure 3). Within the inner portions of the bay, some areas have a slope ratio of less than 1 foot of fall in more than a half mile of distance.

Figure 3. 2019 Richardson Bay bathymetry.

- Evolving Conditions

To evaluate how the bay bathymetry has changed, the sounding points and elevation relatable boundary information (e.g., marsh edge, upland boundaries) depicted in the 1859 Entrance to San Francisco Bay Chart were used to develop a bathymetric raster of the bay. The lower edge of salt marsh was interpreted to be approximately coincident with MSL and assigned elevation of +3 ft MLLW. The lowest upland contour was interpreted at the shore transition where stippling transitions to hash fill. This area was assigned a value of +7ft. MLLW. The topo to raster tool in ArcGIS was used to surface the point and contour data at 5-m resolution coincident with the 2019 topobathy DEM.

The 1859 bathymetry was subtracted from the 2019 bathymetry using math algebra to determine how the elevation of the bay floor has changed between the two survey periods. Confounding the observed changes, there has been a 0.8-foot sea level rise across eight tidal epochs during the 160-year period between surveys. The general rate of sea level rise over this period has been approximately 0.005 feet/year (Smith 2002). Accompanying this rise has been an upward shift in the mean lower low water (MLLW) tidal datum on which the two charts are based. To correct for changes in the tidal epoch between 1859 and 2019, a tidal datum correction was applied by lowering the 1859 bathymetric surface by 0.8 foot. This adjustment allows for an assessment of the true change in bay floor elevation after removing the tidal datum shift (Figure 4).

Over the 160 year period between 1859 and 2019, the water depth within Richardson Bay has changed with the bay becoming gradually shallower. However, the rate of change has been remarkably slow. In general, sediment has accreted over much of the bottom of the bay raising the bay floor by approximately 1.5 feet over much of the central portion of the bay; however, the 0.8-foot sea level rise during this period has resulted in an effective change in water depth of only approximately 0.7 feet since 1859. Bathymetric change has been extremely gradual with the principal areas of accretion being along the historic channel system that historically snaked through the bay floor. In deeper waters, a greater difference in infill has been noted. However, it is uncertain as to the extent of error that may have existed in the deeper swift moving waters that would have been very difficult to accurately sound in 1859.

In addition to areas of natural bay deposition, there are areas of bay fill that are associated within shoreline development, areas of no detectible elevation change, and areas where the bay is presently deeper than was depicted in the 1859 charts. Most of the areas of deeper water are the results of prior excavations for channels and borrow sites for shoreline fill sediments. It is highly likely that the dredging along the Sausalito side of the bay resulted in an enhanced conveyance of water along the western bay margin and accelerated the infill of the circuitous channel that previously extended through the center portion of the bay.

Along the western and northwestern shorelines of Sausalito and Mill Valley there was historically a gradual upland transition with lower gradient valleys transitioning to intertidal marsh. The heavy development of the Sausalito waterfront during the early part of last century resulted in a combination of dredging and filling in support of maritime commerce. This was significantly expanded during World War II with the Marinship shipyard development along with supporting ship and boatyards and channel infrastructure improvements being undertaken. In these areas, substantial infilling/reclamation of former tideland (salt marsh) to support development occurred along the waterfront. Dredging of the channel to facilitate navigation and shoreline reconfiguration occurred substantially along the Sausalito side of the bay. After the end of the war, waterfront development transitioned from a working waterfront to a more gentrified recreational, tourism, and residential focused waterfront. This spawned the replacement of industrial and commercial fishing focused development to recreational boating marinas. Often the conversion to recreational uses from prior industrial uses has been through partial retrofit rather than full infrastructure replacement. This has given rise to the oddly formed convoluted shoreline configuration of narrow peninsulas and oversized piers supporting small slip marinas.

The most extensive change in the eastern portion of Richardson Bay associated with the development of the Belvedere Peninsula and Lagoon from what was Belvedere Island and the saltmarsh and mudflats that historically connected the island to the Tiburon Peninsula. In addition, Belvedere Cove was deepened to navigable depths from very shallow intertidal and subtidal flats. Marsh lands along the eastern shore were filled to support roadway. However, surprisingly most of the core of Richardson Bay has remained relatively unmodified from its natural conditions with only slow sediment accretion altering the bay conditions.

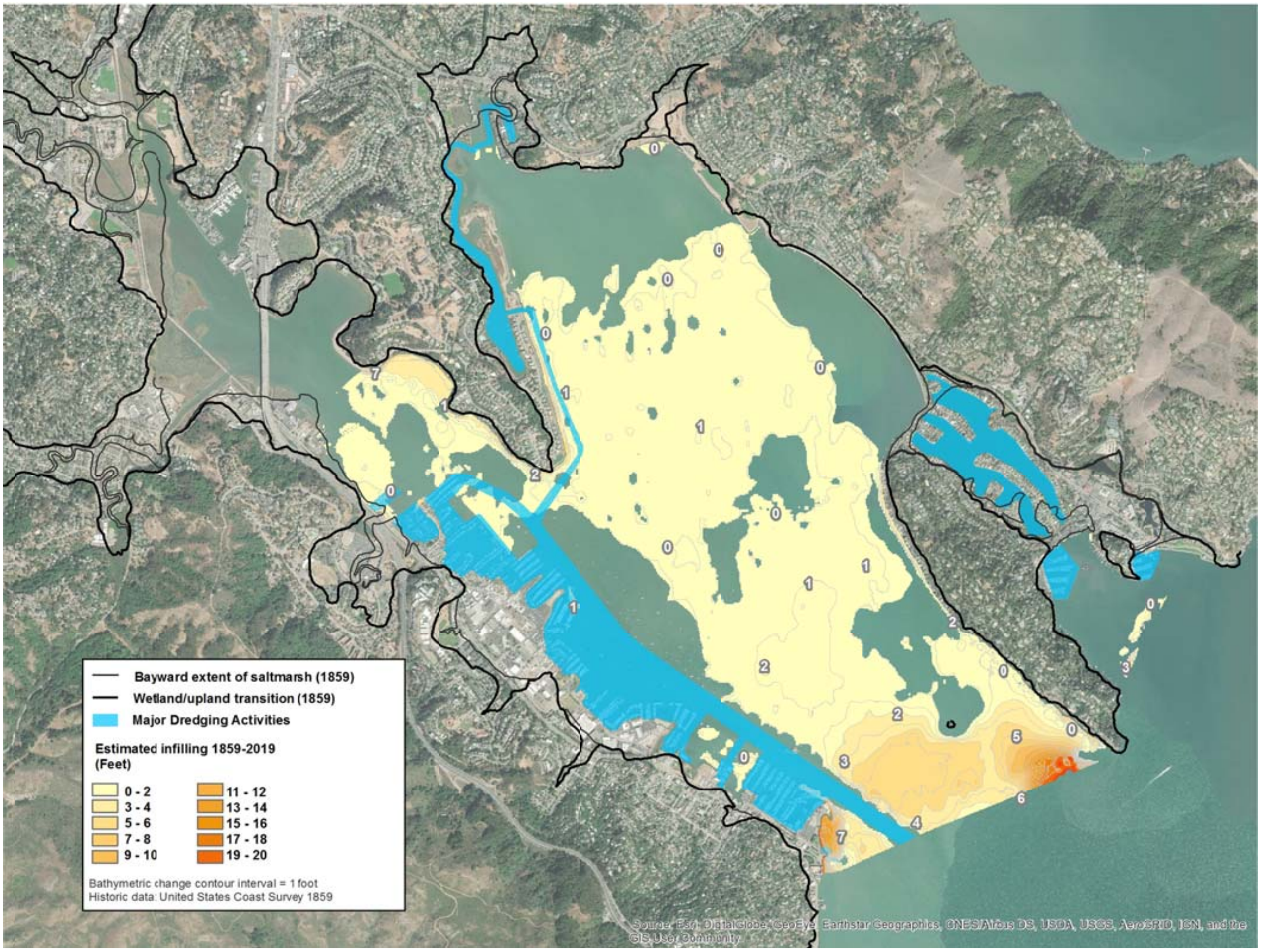


Figure 4. Richardson Bay sediment accretion from 1859 to 2019. *Bathymetric change has been extremely gradual with the principal areas of accretion being along the historic channel system that historically snaked through the bay floor. In addition to areas of natural bay deposition, there are areas of bay fill for development, areas of no detectible elevation change and areas where the bay is presently deeper than was depicted in the 1859 charts. Most of the areas of deeper water are the results of prior excavations for channels and shoreline fill sediments.*

Hydrology (Waves, Currents, and Freshwater Flows)

- Wind and Wave Environment

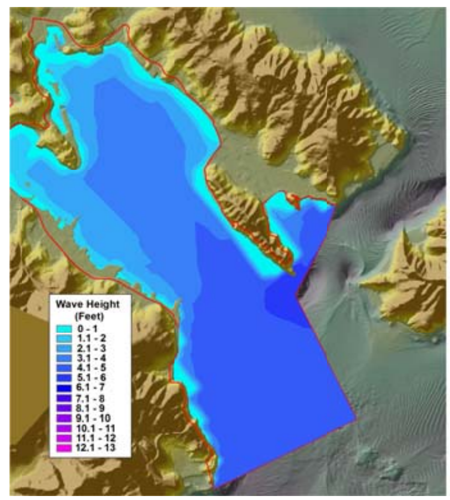
Richardson Bay is a relatively protected embayment, sheltered from winds from the west by hilly terrain of the Marin Peninsula. The bay is further sheltered from propagation of waves into the bay from the deeper waters of the entrance of San Francisco Bay by the pronounced concavity of the bay shoreline and the shallow waters of the bay that preclude large swell from penetrating into the bay.

No new modeling of the wind and wave environment was completed for this study; instead, data was drawn from prior modeling efforts completed by the Our Coast Our Future (OCOF). OCOF is a collaborative project focused on providing California coastal resource managers and planners locally relevant, online maps and tools to help understand, visualize, and anticipate vulnerabilities to sea level rise and storms. The modeling is based on the USGS Coastal Storm Modeling System (CoSMoS), version 1.5. For analysis purposes the available modeled maximum wave heights generated under 1-year, 20-year, and 100-year return event frequencies were evaluated throughout Richardson Bay (Figure 5).

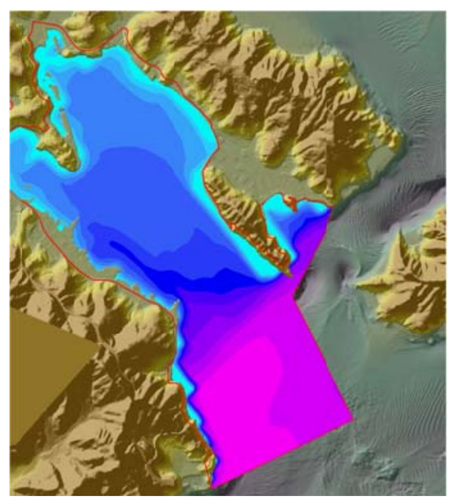
As anticipated the results of the OCOF modeling suggest that the annual peak wave environment within Richardson Bay is of a relatively low amplitude with the maximum annual (1-year) wave heights of 3 feet being reached near the eastern shoreline of the southern end of the bay where wind fetch, water depth, and wave penetration from the deeper waters to the south are at their maximum. Similar to the conditions of the 1-year wave environment, the 20-year and 100-year maximum wave conditions follow the same pattern with the greatest wave conditions being expressed at the south end of the bay. Within Richardson Bay a 20-year event produces a maximum modeled wave height of 5 feet. A 100-year event produces a maximum modeled wave height of 8 feet. However with the 100-year wave environment, the deeper Army Corps dredged channel is modeled to promote a greater penetration of large waves along the Sausalito side of the bay. This is a condition not seen in the 1-year and 20-year model results. In all modeled scenarios an erroneous anomaly exists in the model at the upper end of the bay near the Highway 101 Bridge.

What is not depicted in the OCOF modeling and which is of high importance in understanding wave environments is that all of the modeled waves are of a short-period wind-generated variety. This means that the waves travel fast and the space between waves is short. As a result, waves slap vessels and can inflict considerable force on mooring tackle, anchors, and vessel cleats unless moorings are designed to effectively absorb such energy.

1-year maximum wave model results



20-year maximum wave model results



100-year maximum waves model results

Figure 5 Richardson Bay wave field model from Our Coast Our Future (OCOF) modeling developed by USGS using Coastal Storm Modeling System (CoCMoS) version 1.5.

- Currents

Richardson Bay is a flat shallow and principally subtidal basin that is subject to full tidal circulation with the deepwater entrance channel of San Francisco Bay. The configuration of the basin would tend to support efficient tidal flushing of the southern portion of the bay and substantially lesser flushing of the northern portions of the bay where waters would move in an oscillatory manner with the tides, moving southward with the ebbing tide and northward with a flooding tide. This would result in greater residence of waters at the north end of the bay, particularly within the Mill Valley northwesterly arm of the bay and within the northeastern arm of the bay dominated by the Sanctuary. Adding to the controls on tidal circulation are inefficiency of water movement over the shallow flats, particularly where the roughness of the flats is dramatically increased by the presence of eelgrass, and efficiencies added by the deepened channel system extending along the Sausalito shoreline and on up to the eastern side of the Strawberry Point. There is a slight gyre to the circulation as a result of winds and passing tidal waters through Raccoon Strait. Currents along the dredged federal channel can be strong at times during spring tide exchanges, but current velocities over the central bay flats are generally slow to the north end of the bay and increase towards the south end as greater exchanged volume is added.

- Freshwater Influences

Richardson Bay is a highly marine influenced embayment within the San Francisco Bay estuary. Its position near the Golden Gate places it in a position where oceanic waters predominate in the bay significantly more so than do the Sacramento-San Joaquin River Delta discharges that can strongly influence other areas of the bay.

Local freshwater discharges to Richardson Bay are limited to small local drainages of Arroyo Corte Madera del Presidio, Coyote Creek, and unnamed drainages from Warner Canyon, Homestead Valley, and a number of smaller urban drains. Nearly all of the fluvial discharge is derived from the collective discharge to the bay from the northwestern Mill Valley arm of Richardson Bay (USGS Topographic Map San Francisco North and San Rafael Quadrangles). The local urbanized environments of Sausalito, Tiburon, Belvedere and unincorporated Marin County lands contribute mostly minor storm drain and sheetflow discharge to the bay and thus discharge events are of short duration and of limited volume.

The geographic position in the San Francisco Bay estuary and the small scale of the watersheds draining to Richardson Bay tend to result in a stabilizing influence on salinities that is unique to the area. Even during major freshwater floods during spring of 2017 that had devastating effects on eelgrass and marine invertebrate communities of the North Bay and East Bay, Richardson Bay was principally spared and did not suffer detectible effects of depressed salinities (K. Merkel, pers. obs.).

Water Quality

- Bacterial Contamination

Over the years, waters within Richardson Bay have suffered from multiple sanitary sewage spills in the watershed (2013-2014 Marin County Civil Grand Jury, 2014) that have continued through the present period with a May 17, 2019 spill of 670 gallons of sewage into the bay near Blackie's Pasture (The Mercury News, Tiburon beaches closed amid bay contamination probe, July 27, 2019). Quoted to The Mercury News, Bill Johnson San Francisco Bay Regional Water Quality Control Board (SFRWQCB) noted that sewage spills into the bay are a common occurrence and when inspected on the State Water Resources Board Sewage Spill Map (https://www.waterboards.ca.gov/water_issues/programs/sso/sso_map/sso_pub.shtml) it is clear that Category 1 spills reaching surface waters or not fully collected, regularly occur around Richardson Bay from sanitary sewer system failures. While most of these are small, they do occasionally lead to elevated bacteria levels in the bay near the waste entry points.

The SFRWQCB prepared staff report supporting a Total Maximum Daily Load (TMDL) for pathogens in Richardson Bay (SFRWQCB 2008) summarized bacterial monitoring data for many years within Richardson Bay. Data reported on extends back to 1973; however, the most useful data are from widespread sampling completed from 1994 through 2004, subsequent sampling by RBRA from 2004 to 2006 for *Escherichia coli* (*E.coli*) and Enterococcus bacteria, and fecal coliform sampling in 2006 and 2007. Sampling revealed regular exceedance of bacterial indicator levels within marina basins along the Sausalito shoreline with increasing exceedances of shellfish harvesting water quality standards and the higher threshold water contact recreation thresholds being exceeded at the upper Clipper Basin and further up the bay gradient past Waldo Point and into the Kappas Houseboat Marina. However, notably two control stations (Stations B and C) selected as reference conditions were generally low with Control B, an inner channel station off Clipper Yacht Harbor regularly exceeding the shellfish harvesting standards but being well below the contact recreation standard, and Control C, located on the shallow subtidal flats of Richardson Bay, typically being well below both standards (SFRWQCB 2008). Most notable in the control stations is that both of these stations are much closer to the moored vessels than are the shoreside sampling stations and showed a much lower level of fecal coliform, Enterococcus, and *E. coli* throughout the sampling than observed along the waterfront shore stations.

The TMDL staff report references various potential sources of pollutant discharge including sanitary sewer system overflows and leaks, stormwater runoff, houseboats, vessels at marinas, and anchor-out boats. The TMDL further outlines plans, policies and prohibitions intended to curb bacteriological discharges from the various sources (SFRWQCB 2008). While the various potential sources of bacterial pollutant discharges are all very likely contributors to one degree or another, it is likely that the concentration of discharge associated with sanitary sewer spills and storm water discharges are a primary culprit to the greatest exceedances of standards, while the concentrated vessels, including houseboats, in shoreline marinas are the most likely source of chronic exceedances. The observed increasing levels of indicator bacteria counts with increasing distance up bay along the Sausalito shoreline is also suggestive of a potential strong roll in tidal flushing to maintain lowered pollutant loads. The test results from control stations compared to monitoring stations as well as the diffuse generation of vessels within the anchor-out areas suggests that these areas may also benefit from tidal flushing.

Notwithstanding intermittent discharges and a history of water quality concerns in the bay, the water quality overall in Richardson Bay has improved through time. The County of Marin Environmental Health Services monitors water quality throughout the County and has a permanent weekly station at Schoonmaker Beach. This beach has received an A+ grade for Summer Dry Weather conditions from the non-profit environmental group Heal the Bay that scores beach conditions relative to bacterial pollutants. In spite of the fact that the beach was impacted by a 750 gallon sewage spill during the 2018-2019 monitoring period (Heal the Bay 2019).

- Temperature

Temperatures in Richardson Bay exhibit significant geographic, seasonal and daily variation due to a dominance of ocean water sources over bay water sources feeding the bay, and the extremely shallow and low circulation conditions of the inner bay flats that allow for atmospheric temperatures and solar heating of the bay floor to play major roles in dictating water column temperatures. Notably, the waters of the upper Richardson Bay Audubon Sanctuary can become very warm during hot summer days when wind does little to lower water temperature and long-periods of solar heating affect the water temperature. The water temperatures under such conditions have been measured to be within the high 70 and mid-80˚F range at times within the Audubon Sanctuary (K. Merkel, pers. obs., K. Boyer, pers. comm.). Further south in the bay where waters are deeper, the temperature range is more dampened.

While the shallow flats promote high atmospheric influence on water temperature, so too do wind waves that aid in heat dissipation to the atmosphere. As a result, the prevailing winds, solar angle, atmospheric temperature, tidal circulation, and ocean temperatures all play roles in dictating the prevailing water temperatures and temperature fluctuations in Richardson Bay.

Ecological Setting

Eelgrass

- Ecological Importance

Eelgrass is a marine flowering plant and the most widely distributed and abundant of the seagrasses in the world with a global north temperate range. Common eelgrass (*Zostera marina* L.) is a marine flowering plant and the most widely distributed marine angiosperm in the Northern Hemisphere (den Hartog 1970). It is a native plant indigenous to the soft-bottom bays and estuaries and occurs along the Pacific coast of North America from the Bering Strait down to lower Baja California. Eelgrass is considered to be a habitat forming species that creates unique biological environments when it occurs in the forms of submerged or intertidal aquatic beds or larger meadows. Eelgrass is considered to be a "foundation" or habitat forming species as it provides three dimensional structure to an otherwise two dimensional soft bottom seafloor and contributes disproportionately to defining the physical, chemical, and biological character of the local ecology within and around the eelgrass beds and can also have far reaching influences beyond the eelgrass beds and even outside of the systems within which eelgrass occurs. Eelgrass provides significant physical, chemical, and biological services (Orth et al. 2012, Waycott et al. 2009, Cole and Moksnes 2015).

Eelgrass is recognized as an ecosystem engineer, providing protection against coastal erosion, increasing water clarity through the reduction of wave energy, trapping of particulates, and stabilizing of sediments (Orth et al. 2012). Dense rhizome mats of eelgrass meadows stabilize sediments near channel banks against surficial slides, while the leaf canopy dampens wave energy, traps sediment, and stabilizes sediment against wave resuspension. These functions result in clarifying the water column and reducing shoreline and mudflat erosion.

From a chemical standpoint, eelgrass provides a high degree of function in nutrient uptake and cycling and influences multiple water column properties including dissolved oxygen, temperature, turbidity, total dissolve solids, and pH. It also serves a role in nutrient trapping and cycling (McGlathery et al. 2012), sequestration of atmospheric carbon (Duarte et al. 2005, Fourqurean et al. 2012), and buffering against the effects of ocean acidification (Shaughnessy and Tyburczy; in progress).

Eelgrass is a major source of primary production in many bay and estuary marine systems, underpinning detrital-based food webs both locally and in areas where dead leaf matter accumulates. In addition, several organisms directly graze upon eelgrass or consume epiphytes and epifauna supported by eelgrass plant structures, thus contributing to the system at multiple trophic levels (Phillips 1984, Thayer et al. 1984). Eelgrass beds function as habitat and nursery areas for commercially and recreationally important open ocean marine fish and invertebrates, and provide critical structural environments for resident bay and estuarine species, including abundant fish and invertebrates (Hoffman 1986, Kitting 1994, Simenstad 1994). Besides providing important habitat for fish, eelgrass is considered to be an important resource supporting migratory birds during critical migration periods. Eelgrass is particularly important to waterfowl such as black brant that feed nearly exclusively on the plants and to a number of other species that make a diet of both eelgrass and the epiphytic growth that occurs on the leaves. Beyond direct habitat functions, eelgrass benefits nearshore benthos through detritus export, producing significantly greater secondary production than mudflats, marshes and sandflats (Heck et al. 1995) and supporting much greater species richness than other habitats of shallow marine embayments (Orth et al. 1984, Zieman and Zieman 1989).

Notwithstanding the high importance of eelgrass to structuring and enriching nearshore marine environments, eelgrass abundance, and that of seagrasses in general, has declined worldwide over the past four decades due to increased anthropogenic as well as climatic shifts (Short and Wyllie-Echeverria 1996). As a result of the vulnerability of seagrasses, the noted declines, and the multifaceted benefits provided, eelgrass habitats and other vegetated shallows, are considered special aquatic sites under the 404(b)(1) guidelines of the Clean Water

Act (40 C.F.R. § 230.43). Eelgrass is given special status as submerged aquatic beds under the Clean Water Act of 1972 (as amended), Section 404(b) (1) "Guidelines for Specification of Disposal Sites for Dredged or Fill Material," Subpart E, "Potential Impacts on Special Aquatic Sites." In addition, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), eelgrass is designated as a habitat area of particular concern (HAPC) within essential fish habitat (EFH) designated for various federally-managed fish species within the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2014). An HAPC is a subset of EFH that is rare, particularly susceptible to human-induced degradation, especially ecologically important, and/or located in an environmentally stressed area. HAPC designations are used to provide additional focus for conservation efforts. As a result of concerns over the protection of eelgrass, additional policies for eelgrass conservation and mitigation of impacts have been adopted in California in the form of the California Eelgrass Mitigation Policy (CEMP) (NMFS 2014).

- Historic Conditions

In the late 1920s eelgrass was reported as an abundant species along the shores of San Francisco Bay (Setchell 1929). In 1987, about 60 years later, a survey of the Bay, relying principally on aerial surveys and single-beam sonar surveys was completed by the National Marine Fisheries Service (NMFS). This survey revealed only 316 acres of eelgrass throughout the Bay, with much of the existing habitat exhibiting conditions of environmental stress (Wyllie-Echeverria and Rutten 1989, Wyllie-Echeverria 1990). A decade later, surveys of the San Pablo Peninsula, documented over 400 acres of eelgrass, suggesting extremely dynamic conditions within the existing beds, an underestimation in the 1987 studies resulting from limited survey techniques, or a combination of factors may have influenced earlier surveys (SAIC and Merkel & Associates 1997a, 1997b).

In 2003, a comprehensive inventory of San Francisco Bay eelgrass habitats was completed using a combination of survey methodologies, predominantly relying on sidescan sonar that allows detection and mapping of eelgrass within waters that are too turbid to allow effective aerial mapping and in eelgrass beds too sparse to allow effective mapping by single-beam sonar methods (Merkel & Associates 2004). This survey yielded the first comprehensive inventory of eelgrass in San Francisco Bay. The survey was followed up by other baywide eelgrass inventories in 2009 and 2014 (Merkel & Associates 2010, 2015). In addition to these baywide inventories, several smaller segments of the bay have been mapped over multiple years in an effort to investigate eelgrass dynamics. In Richardson Bay additional comprehensive surveys have been completed in 2013 and most recently in 2019 in association with this current study. When evaluating the results of these inventories, eelgrass has been noted to expand and contract over time and varies by bottom coverage (Figure 6). Low bottom coverage within an eelgrass bed is typically associated with seedling recruitment events and young plants that have not yet coalesced. However, where intact beds are on the decline, they are generally characterized by a greater proportion of higher cover classes even though the margins of the beds may be deteriorating.

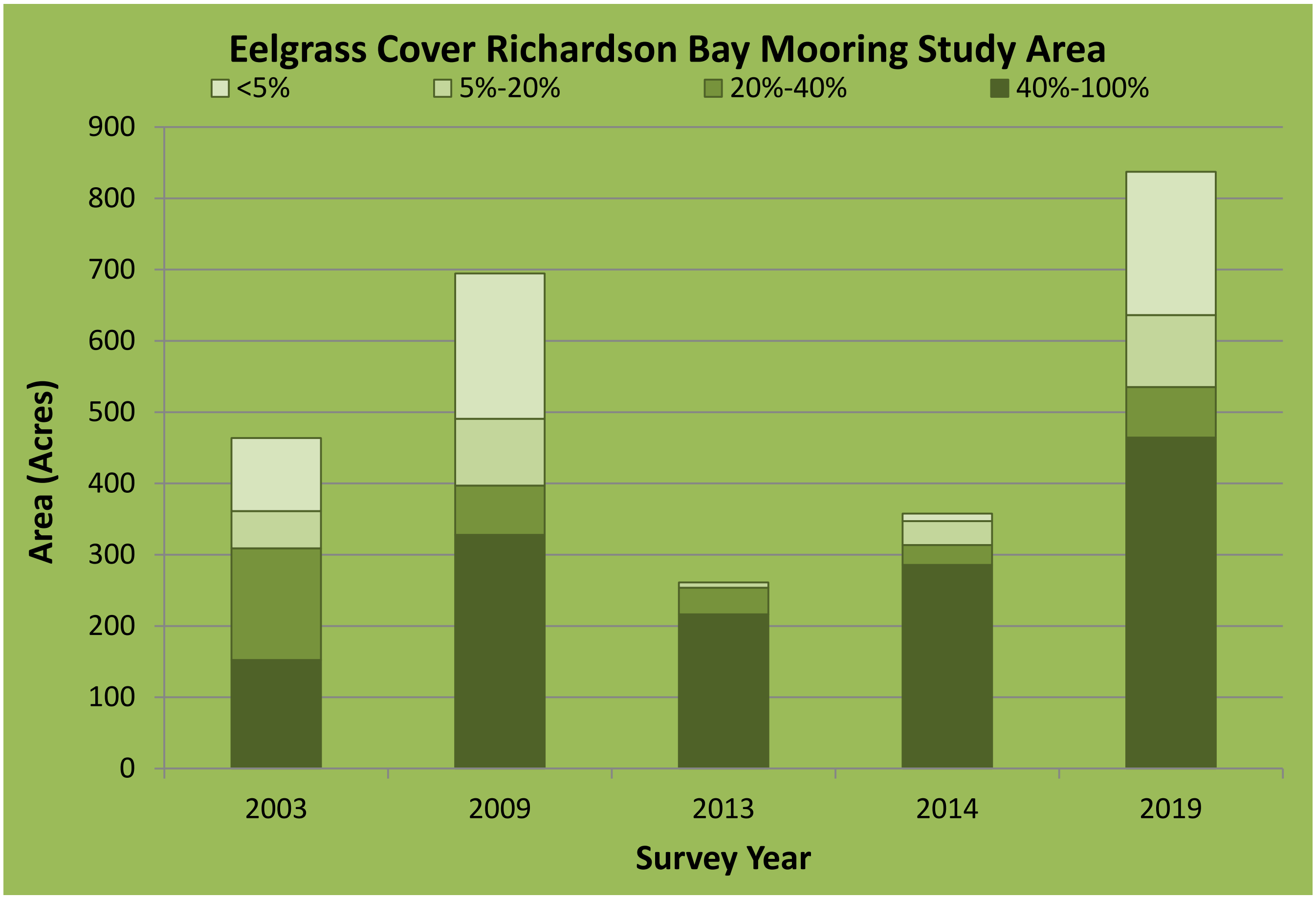


Figure 6. Eelgrass distribution within Richardson Bay Mooring Study Area inclusive of Richardson Bay and Belvedere Cove for comprehensive survey years. *Eelgrass bottom coverage is defined as the openness of the eelgrass plants distributed across the bayfloor. A 20%-40% eelgrass bed means that within this portion of the beds a random sampling by dropping a 1 meter quadrat would be expected to hit eelgrass 20-40% of the time.*

It is likely that eelgrass was once more widespread within Richardson Bay as well as Belvedere Cove. When the maximum extent of eelgrass (2003-2019) is overlain on the 1859 it appears that additional depths and exposure conditions suitable to support eelgrass once occurred along much of the Sausalito shoreline and inner Belvedere Cove in areas now occupied by shoreside fills and marinas (Figure 7). However, it should also be noted that the presence of deeper channels plays an important role in circulating water and maintaining cooler conditions in shallow water embayments. In 1859 channel definition was poor compared to the present navigation channels that extend along the western bay margin. As a result, it is uncertain whether eelgrass today extends over a greater or lesser extent of Richardson Bay than was the historic condition. Also notable is that while the Sausalito shoreline undoubtedly was suitable to support more eelgrass historically than during post-urbanization, the bathymetry of 1859 also suggests that eelgrass was unlikely to be more extensive elsewhere due to unsuitably shallow or deep waters.

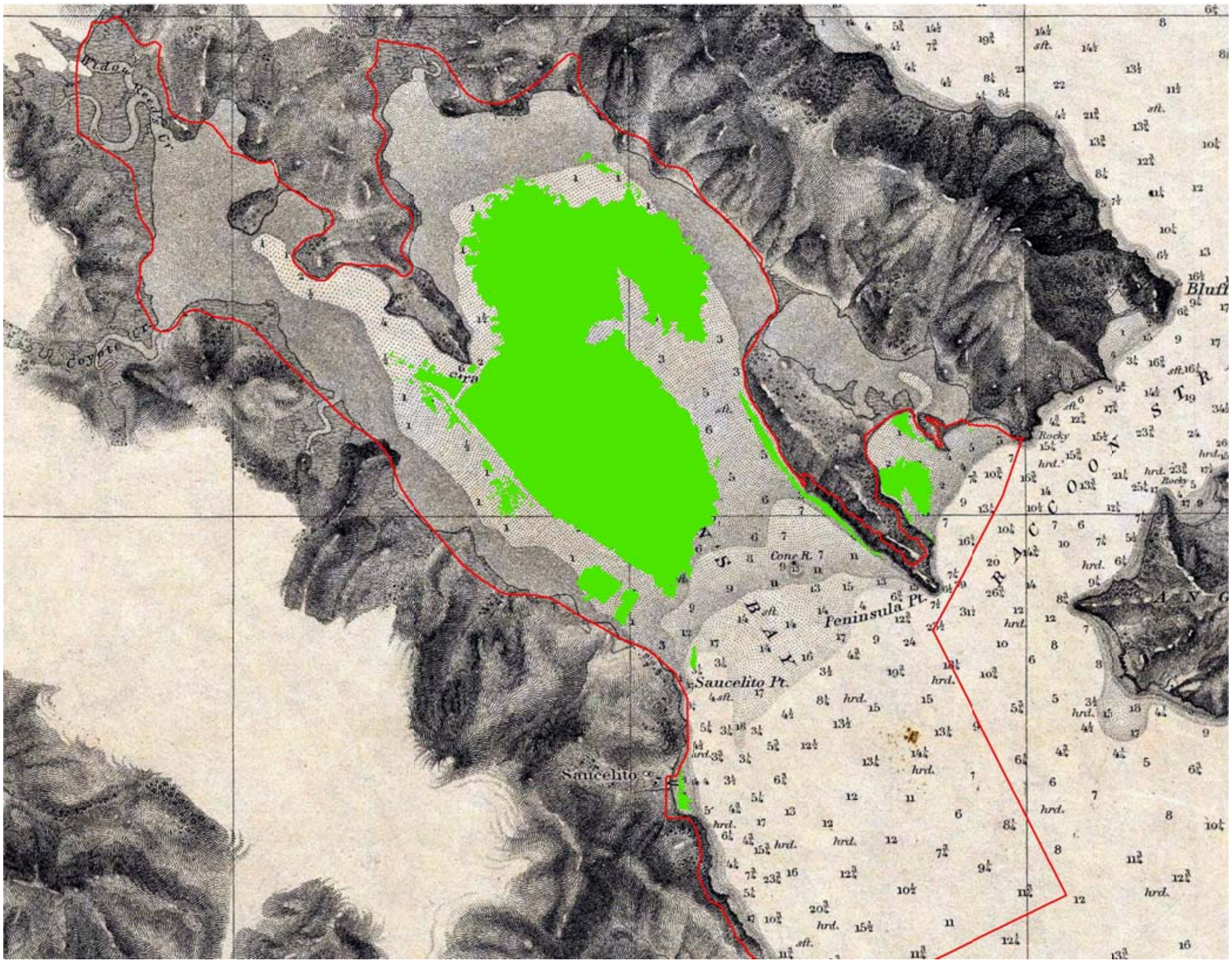


Figure 7. Maximum extent of eelgrass (2003, 2009, 2013, 2014, and 2019) overlain on 1859 bathymetric chart *(depth in fathoms) suggests that greater eelgrass habitat suitability likely once existed along the Sausalito waterfront and within Belvedere Cove. Similar suitability of deeper and shallower margins of the bay is not suggested by current distribution patterns and bathymetric ranges occupied by eelgrass.*

Considering the individual survey year conditions of the beds it is possible to examine the frequency of occurrence of eelgrass across the bay through time. This is helpful in understanding the dynamics of the beds and the distribution of the most and least stable eelgrass beds within the study area (Figure 8). Alternatively, it is also possible to refine the frequency distribution mapping further by integrating the bottom cover class data from the regional mappings into the overall frequency analyses. This approach uses the mean eelgrass bottom coverage within each of the cover classes (i.e., 70% represents 40-100%, 30% represents 20-40%, 12.5% represents 5-20%, and 2.5% represents less than 5%) as a weighting factor for each inventory year. The results of this scoring produce a cover weighted frequency distribution wherein higher bottom cover results in greater weighting in the analyses (Figure 9). The outcome provides a graphically meaningful presentation of eelgrass on the basis of persistence and maturity of beds through time. Note that beds that have historically always been within the highest cover class and persistent in every survey year can only reach a value of 70%, while rare occurrences of low bottom cover beds are severely penalized in the analysis with the lowest cover weighted eelgrass frequency being 0.5%.

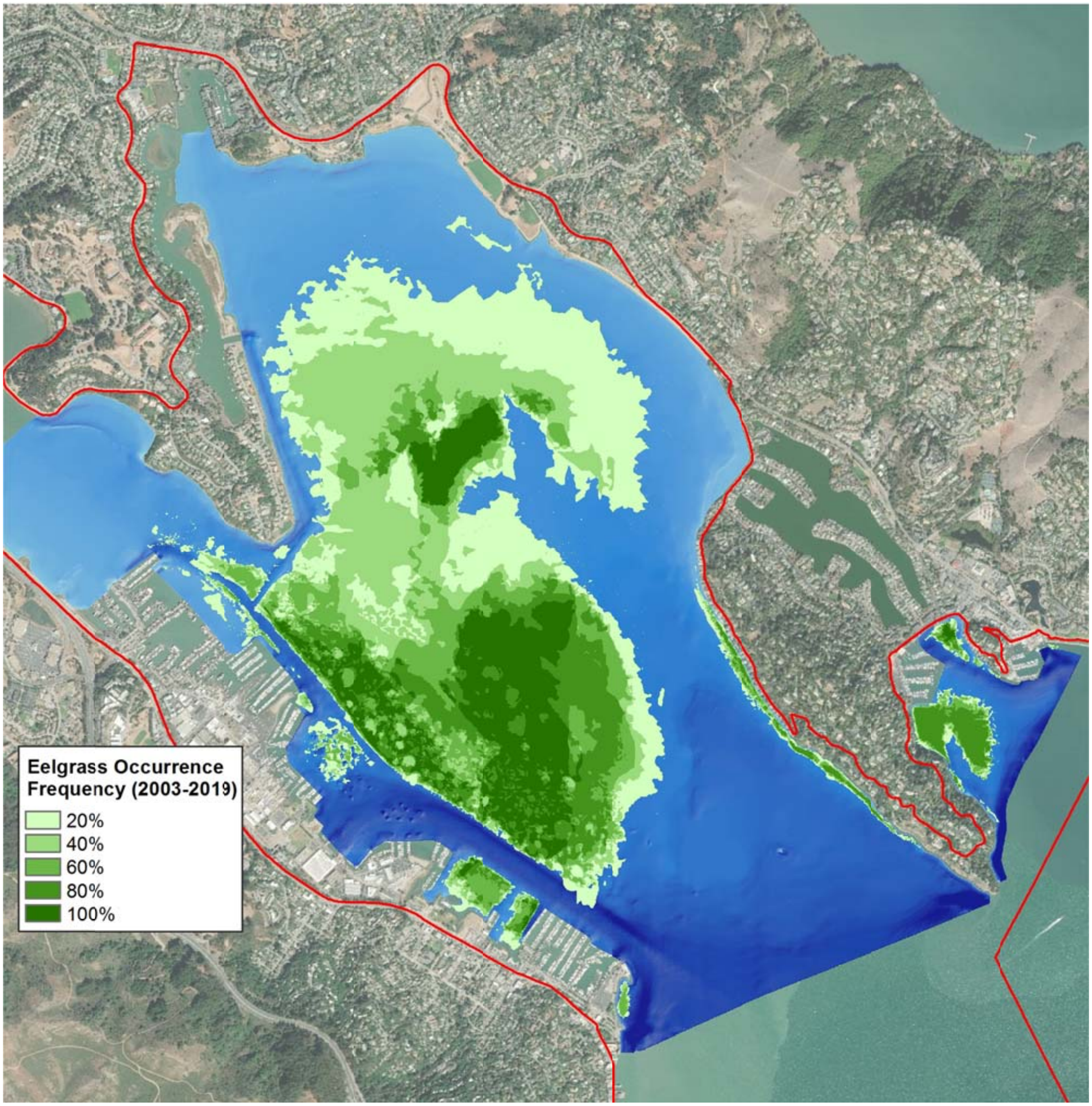


Figure 8. Eelgrass frequency distribution based on surveys conducted 2003, 2009, 2013, 2014, and 2019. *The data layer exhibits the average extent of mapped eelgrass, regardless of bottom cover class present during the contributing years.*

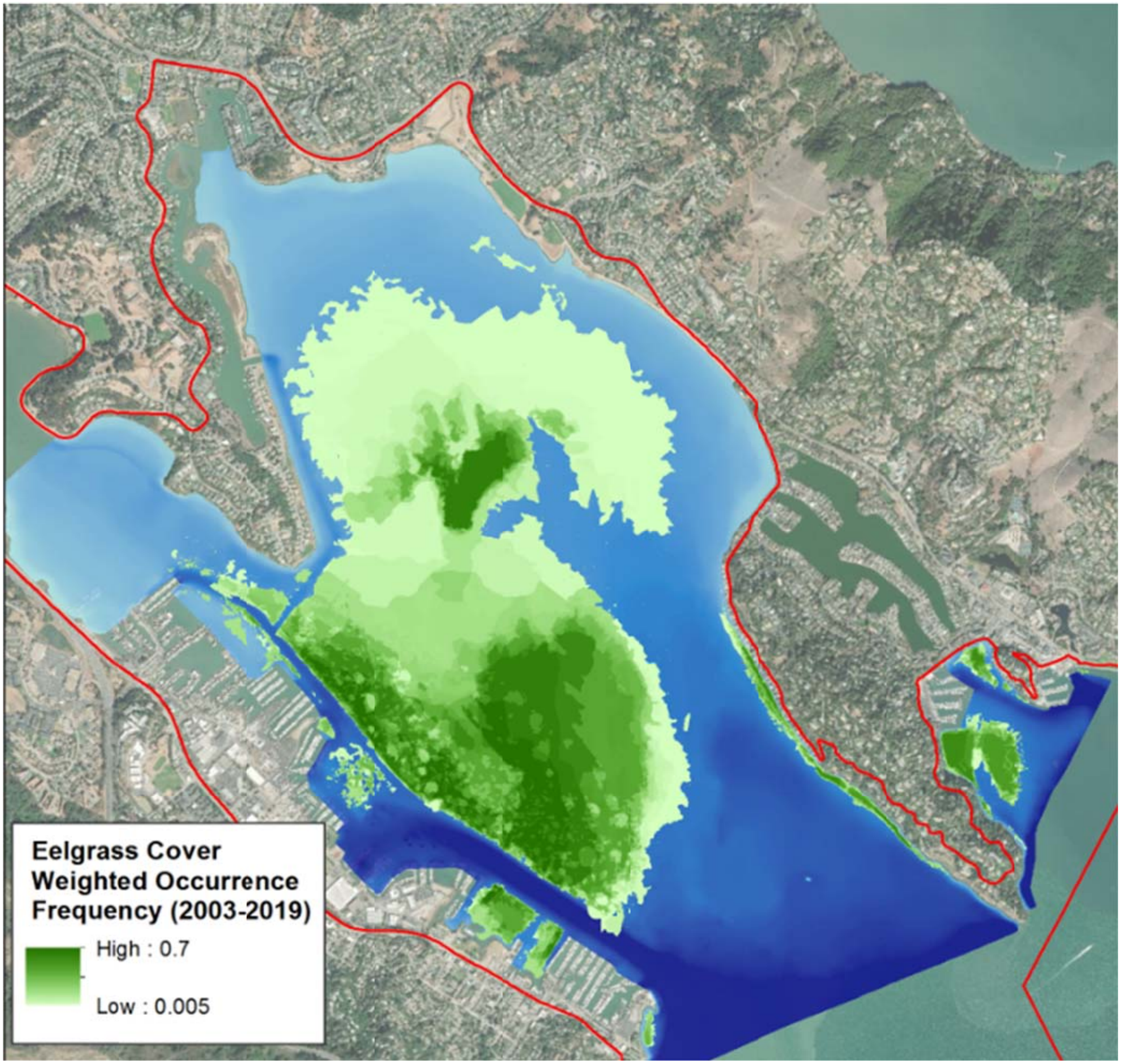


Figure 9. Bottom coverage weighted eelgrass frequency distribution based on surveys conducted 2003, 2009, 2013, 2014, and 2019. *The data layer exhibits the average extent of mapped eelgrass, weighted by the mean eelgrass bottom cover class from the contributing survey years.*

- Current Conditions

From a planning perspective, the long-term frequency distribution of eelgrass is more valuable than a single survey result; however, it is notable that the 2019 eelgrass survey found more eelgrass present within the study area than any of the prior surveyed years (Figure 6). In fact, 2019 held more than three and two times the extent of eelgrass than mapped in either 2013 or 2014, respectively. Both 2013 and 2014 were considered to be extremely poor years for eelgrass in Richardson Bay. Eelgrass in 2019 extended significantly further northward into the Richardson Bay Audubon Sanctuary than has historically been the case, although most of this extension has been due to seedling recruitment at sparse densities (Figure 10). As has been the case in prior surveys, eelgrass areas along the federal navigation channel continues to show substantial evidence of damage from vessel and mooring scarring. Expansion of eelgrass within the Audubon Sanctuary near the tip of the Strawberry

Peninsula and west of the northern core bed has been fostered by active restoration which accounts for the higher bottom coverage than seen elsewhere in the upper lobe of the bay.

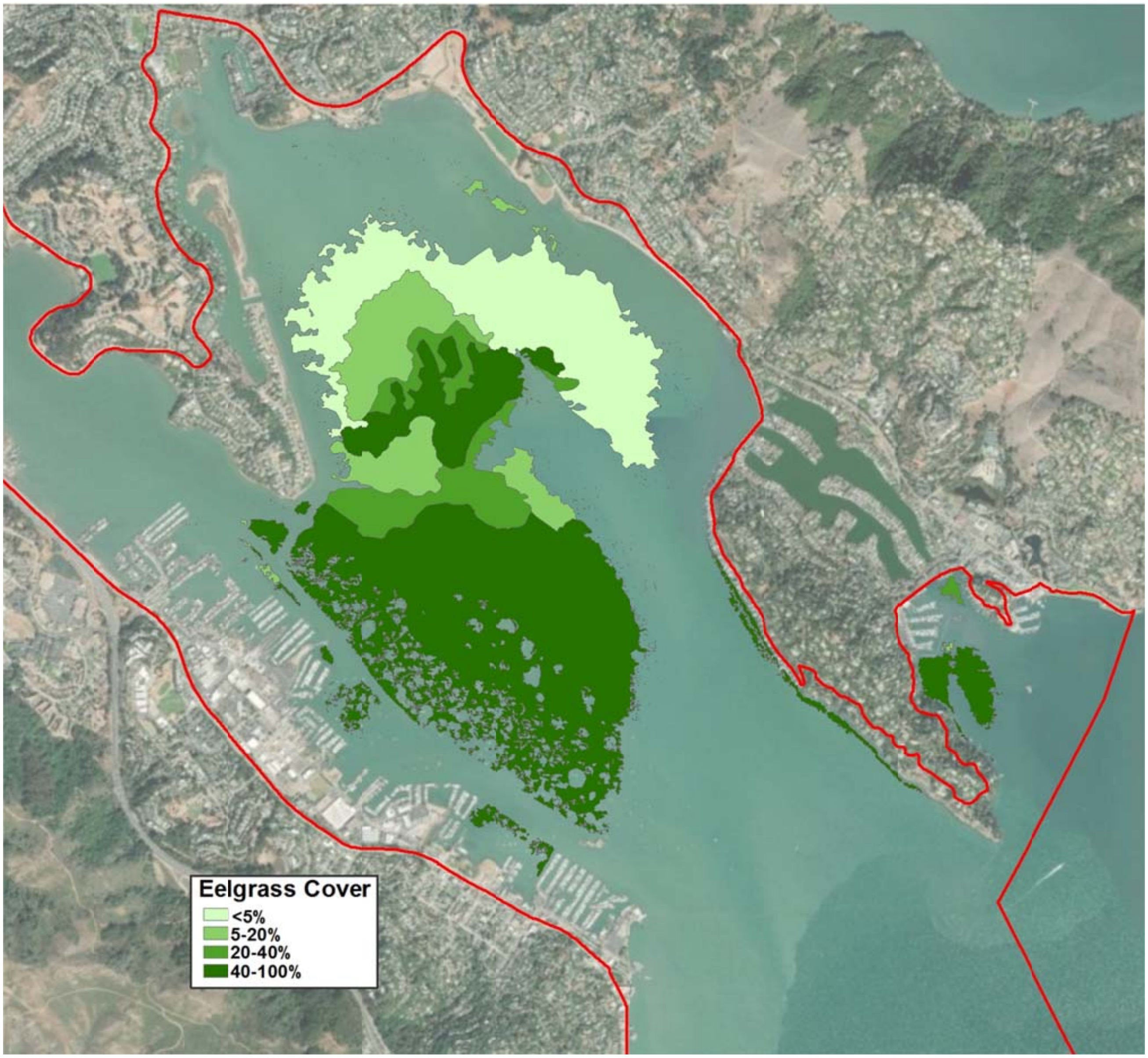


Figure 10. 2019 eelgrass distribution by bottom percent cover class. *The data layer exhibits the distribution of eelgrass based on a hybrid of interferometric sidescan sonar and UAV based aerial photographic survey with surveys being completed in June and July 2019.*

- Stressors on Richardson Bay Eelgrass

As discussed previously, Richardson Bay is uniquely situated within San Francisco Bay to support relatively stable eelgrass beds. The controlled input of freshwater, the limited sedimentation and predominance of marine waters, and the position of the bay adjacent to deepwater channels all favor physical environmental conditions conducive to eelgrass. However, Richardson Bay is prone to other factors that are stressful to eelgrass. Most notably, these include broad intertidal mudflats and shallow waters that are subject to considerable solar radiation and atmospheric heating that can result in thermal stress to eelgrass. This stress is exacerbated by dense eelgrass beds within shallow waters that trap waters in the shallows and calm wind waves, resulting in reduced heat dissipation during some periods. The extreme heating that can occur in inner Richardson Bay is illustrated by water temperatures measured near the tip of the Strawberry Peninsula of 25.3°C (77.5˚F) on June 13, 2019, and sustained temperatures in excess of 24°C (75°F) during eelgrass restoration in Richardson Bay in 2015. While it is not certain, it is believed that significant die-offs of eelgrass noted between the 2009 and 2013 period may be substantively attributed to thermal stress and resultant cumulative factors.

Secondary to thermal stress, for which the magnitude of effect is uncertain and the influence is manifested most substantially in the shallows of the Audubon Sanctuary, the second greatest and very documentable stressor on eelgrass in Richardson Bay is damage due to mooring of vessels within eelgrass beds and associated ground tackle dragging, vessel dragging, and damage from vessels transiting through the eelgrass beds during low tide conditions. While the large scale of mooring scars in Richardson Bay has been known for some time, dating back to at least the late 1980s when eelgrass monitoring in San Francisco Bay was initiated, explicit quantification of impacts was not undertaken. During the 2003 eelgrass inventory and subsequent inventories the damage to eelgrass from moorings in Richardson Bay was noted, but again not explicitly quantified (Merkel & Associates 2004, 2009, 2015a). A localized pilot assessment of eelgrass damage from moorings was undertaken to evaluate how moorings were affecting both eelgrass and the underlying topology of the bottom (Merkel & Associates 2015b); however, again no attempt was made to systematically quantify the magnitude of the impacts, although quick analyses based on estimating the average mooring scar area and counting the visible moorings suggested that impacts likely fell between 20-40 acres (K. Merkel, unpublished data).

In 2017, California Audubon undertook a rigorous process of quantifying eelgrass impacts by mooring tackle and moored vessels (Kelly et al. 2019). This included low altitude, low tide aerial surveys flown on July 23, 2017 that were subsequently mosaicked to an orthorectified image of the moorings and subject to high resolution mapping using GIS software. Because the photography is not capable of distinguishing eelgrass at depth with the greatest level of accuracy, and thus impacts may be over-estimated using purely photographic tools, Audubon developed both high (84.01 acres) and low (49.42 acres) estimates of eelgrass impacts for 2017. This approach provided a very robust estimate of eelgrass impact albeit establishing a wide range of uncertainty. To apply these results in the present study, the mean of the high and low impact assessment (66.72 acres) was used for the 2017 impact level.

Following up on the Audubon assessment, six additional survey years were analyzed to assess mooring and vessel damage in Richardson Bay. This work included revisiting sidescan sonar mosaics prepared to support the 2003, 2009, 2014, and 2019 San Francisco baywide eelgrass inventories in order to more explicitly map eelgrass in and around moorings and to identify physical evidence of bottom scarring by moorings and vessel transit through the eelgrass. In addition, two additional surveys were evaluated; these included a 2018 partial interferometric sidescan sonar survey of the moorings within Richardson Bay and a 2013 NOAA high resolution aerial photographic survey of Richardson Bay. The results of the eelgrass impact assessments from these various years are illustrated in Figure 11. In all cases, eelgrass impact was determined where surrounding bottom supported eelgrass at the time of the survey and impacts were not quantified if bottom scarring occurred outside of eelgrass beds present at the time of the survey.

In addition to mapping of the spatial extent of eelgrass impacts (Figure 11), a quantification of eelgrass impacted by vessels was undertaken (Figure 12). This chart illustrates an increasing trend of greater eelgrass impacts from vessel activities over time. In 2003 impacts to eelgrass were quantified at approximately 22 acres and by the present 2019 survey eelgrass impacts were quantified to be nearly 74 acres.

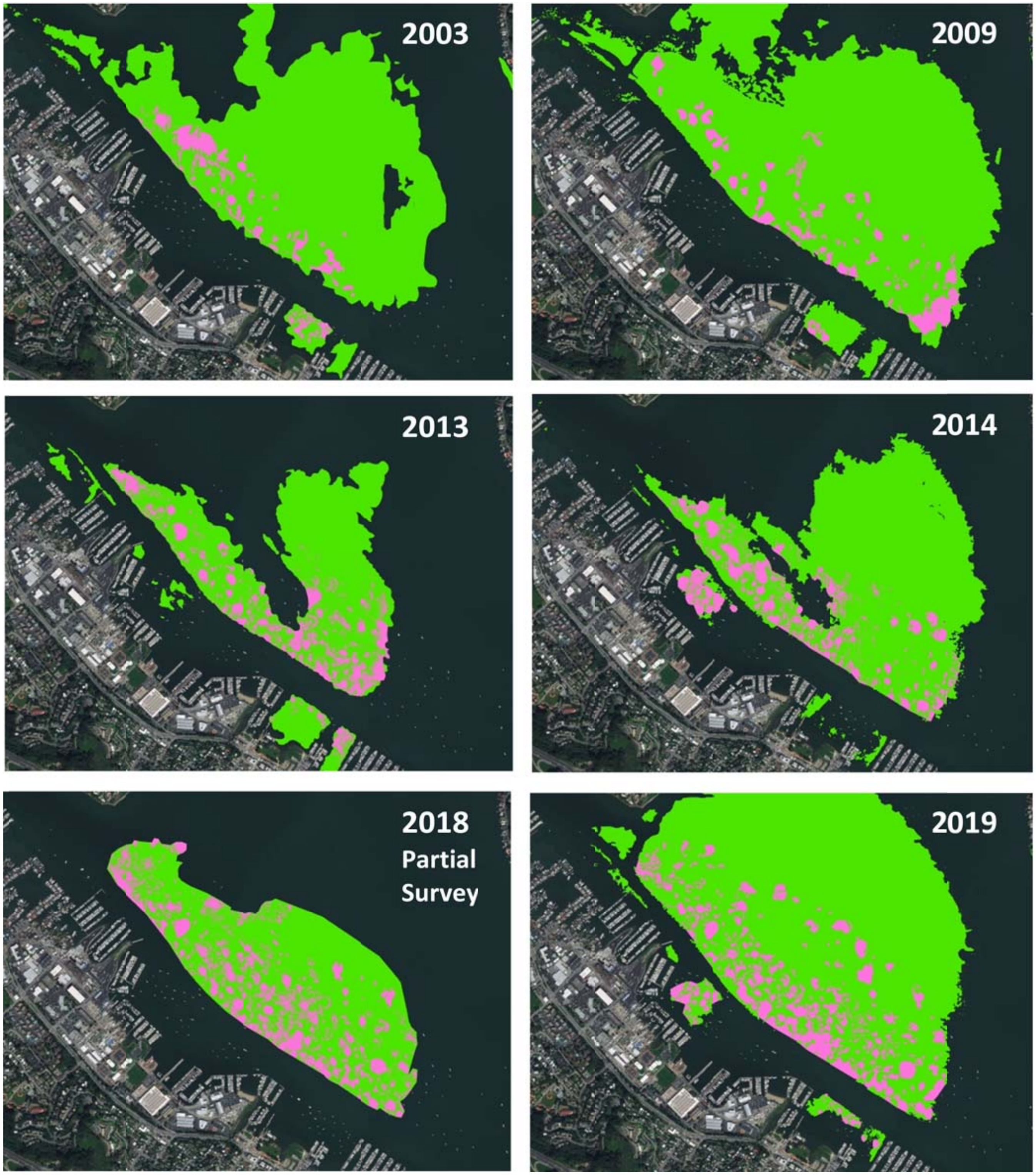


Figure 11. Eelgrass impact by moorings, vessel grounding and propeller wash over multiple years. Images depict eelgrass absence as a result of mooring and vessel damage (pink) along with adjacent eelgrass (green) existing during the analyzed year. Note bottom scarring that occurs outside of eelgrass beds existing during the analyzed year was not considered to be an eelgrass impact.

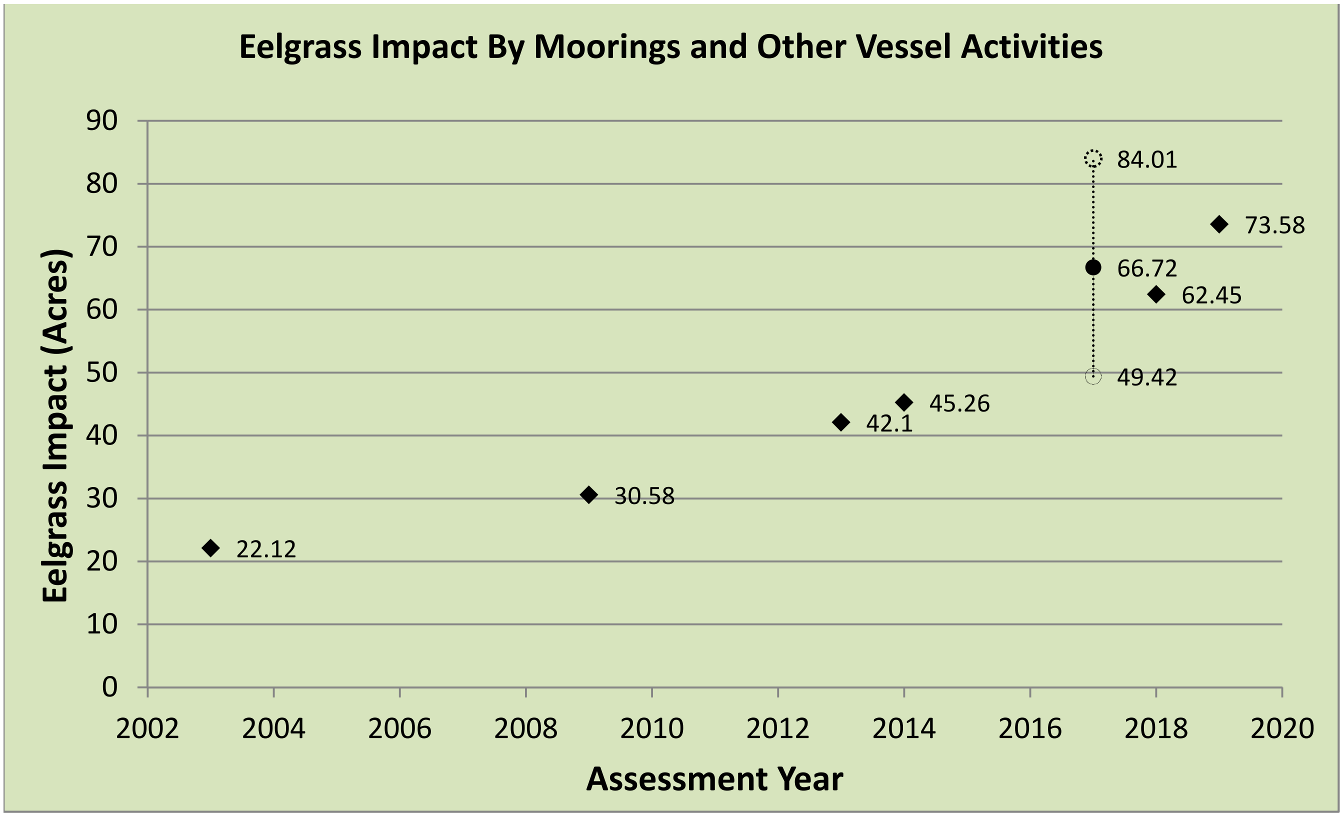


Figure 12. Change through time of eelgrass impact area as a result of moorings, vessel grounding and propeller wash. *Data are derived from eelgrass surveys and mapping using acoustic sonar and aerial photographic interpretation completed under this study with an additional estimate for 2017 derived from work by Audubon California (Kelly et al. 2019).*

The trend toward increasing eelgrass damage in recent years is the result of many factors including expanding numbers of vessels on moorings, changing make up of vessels on moorings, and changing distribution of vessels and eelgrass. It is also possible that sediment accretion and reduction of water depths within the inner portions of the Bay is playing a role in increasing damage; however, this is not clear since the history of accretion over time has not been ascertained.

The nature of eelgrass damage from moorings is often viewed as simple scouring of the bottom by mooring tackle dragging. However, in truth the damage is more complex within Richardson Bay. Most moorings in Richardson Bay are single point moorings with a gravity mooring weight and chain mooring tackle that rises to a mooring ball from which a pendant attaches the vessel to the ball. Conventional wisdom is that the longer the chain the less risk of dragging the mooring anchor or pulling cleats and the smoother the ride on the boat due to energy absorbed by lifting the chain. However, the more chain on the bottom, the greater the damage due to vessel rotation around the anchor in response to wind and currents. As the chain sweeps the bottom, it stirs up the fine sediments creating turbidity plumes that drift away from the points of disturbance. Over time the suspension of sediment and export by currents generates a pit around the mooring anchor. The depth and shape of the pit depends upon many factors; however, within Richardson Bay there are many such mooring scar pits that are as much as 2-3 feet below the surrounding bottom elevations. The pits are regularly scoured by the chain and as they deepen they become traps for algal detritus and other drift debris. The high frequency of disturbance and accumulation of debris makes the pits unsuitable to support eelgrass. Macolino et al. (2019) has also demonstrated that ecological effects seen on macro-habitat scales can also be detected in the infaunal communities as a diminishing signal with increasing distance from moorings.

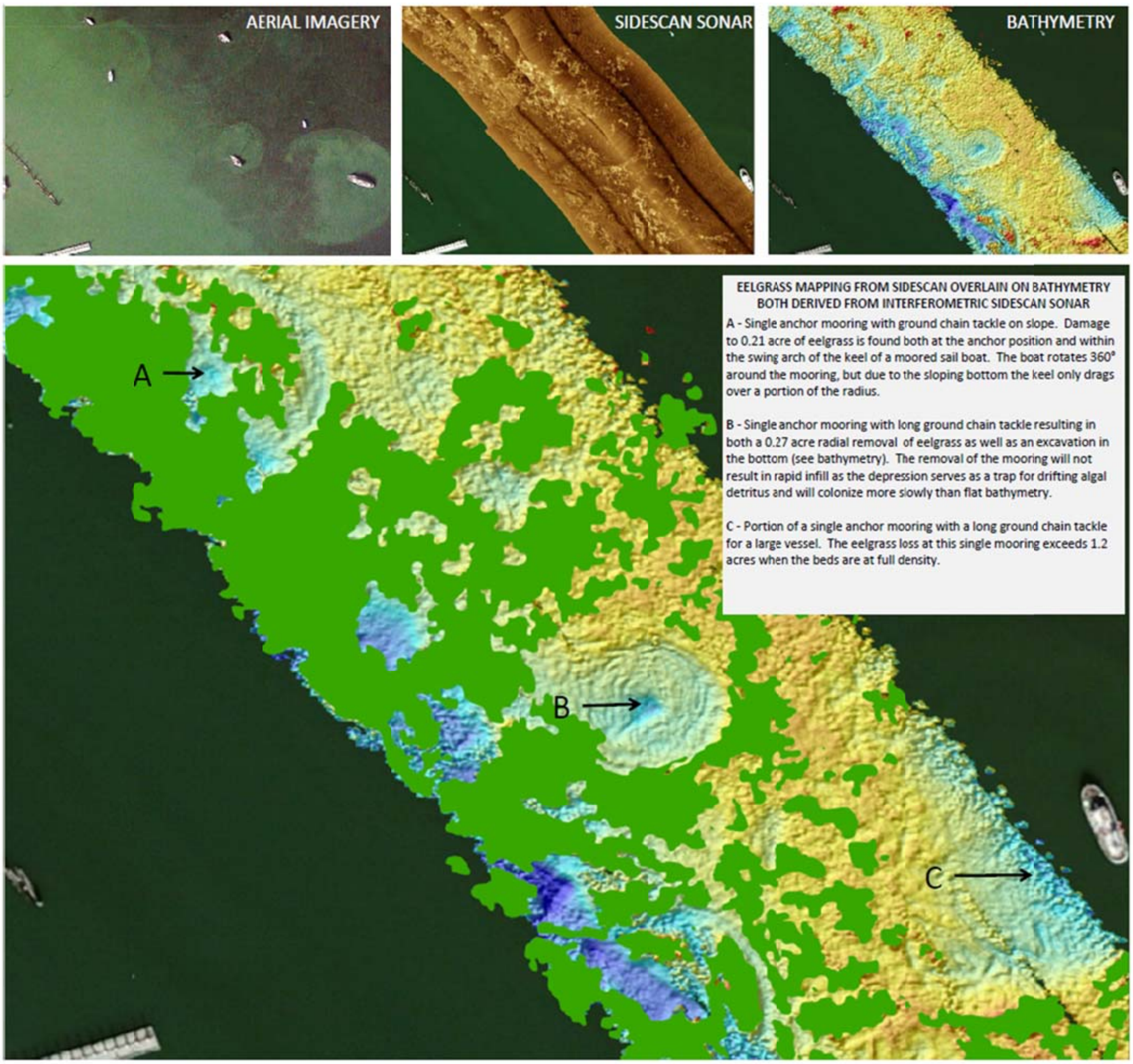
In addition to ground tackle damage, most of the vessels within the bay are in waters too shallow for the vessels moored in them. As a result, vessels drag keels and or motors on the bottom. This also cuts into the bottom and liberates fine silt clouds. Where vessels don't actually drag bottom, the vessels and stern tied dinghies drag deeply through the eelgrass and can, over time reduce the extent of eelgrass within the swing radii of the vessels.

Eelgrass damage from mooring ground tackle dragging and vessel grounding drags at low tides. The dark mottling is eelgrass, the brownish tinge is a diatom film on the bottom and the bluegreen color is unvegetated silt and clay from recent disturbance. (Photograph taken June 2019)

Moored vessels supporting live-aboard residents make frequent trips to and from vessels and the shore. As a result the trips account for substantial low tide traffic through eelgrass beds. Eelgrass can be damaged by vessels running through the beds. However, vessel transiting to and from moorings are principally small dinghies and likely accounts for some but not the majority of the bottom damage in the eelgrass beds attributed to propeller wash and trenching. When the actual physical scars are examined in sidescan imagery, the scale of the scars and the frequency of twin propeller scars makes it more likely that the principal eelgrass damage from vessels underway is derived from larger vessels such as commercial salvage vessels, law enforcement, and vessel rescue boats that are either deep draft, or operate at inopportune tidal levels by necessity.

Finally, there is a secondary effect of moorings on eelgrass that is not completely understood but may be the result of a variety of factors. That is the fact that many of the moorings have generated "crop circles" in eelgrass beds that are of a greater radius than can be accounted for by the mooring taken and vessels alone. This can be seen in aerial photographs as well as interferometric sidescan data. These larger areas of impact can raise a single mooring scar to be greater than 1.2 acres in size. Often the larger radius beyond direct mechanical impact supports a diatom film across the bottom. The absence of eelgrass in these areas has been hypothesized to be the result of prior larger mooring system arcs on the same anchor, the localized halo area affected by regular suspension of sediment by ground tackle and vessel d ragging, or some other, as yet identified factor.

Mooring and vessel damage within Richardson Bay unquestionably accounts for the greatest extent of direct and ongoing anthropogenic impact to eelgrass in San Francisco Bay. In 2014, mooring damage suppressed eelgrass extent by an estimated 13.5 percent in Richardson Bay or 1.6 percent baywide. This is a highly significant effect in the context of the resource. Notably, it is the reversible and incomplete nature of the impacts to eelgrass associated with the moorings that make the circumstances here unique. It is likely that many times more acres of eelgrass were lost along the margins of San Francisco Bay in association with filling and dredging projects to support upland development, marinas and navigation; however, those losses are generally viewed as permanent.



A multi-media presentation of conditions along the east margin of the channel at the entrance of Clipper Yacht Harbor (July 2015). The imagery identifies the central scour pits around single point moorings as well as vessel keel drag scars on the bottom and expanded halos of eelgrass loss beyond the reach of the mooring tackle and vessels. With close inspection of the various image products, scarring of the bottom by twin and single propeller vessels can be seen.

Pacific Herring

Pacific herring (*Clupea pallasii*) is an important and historically significant commercial fishery in California (CDFW 2019). Over 90 percent of California's herring landings come from San Francisco Bay. Herring, a pelagic species moves into bays and estuaries as early as October and departs from the bays as late as April.

Pacific herring eggs on eelgrass San Francisco Bay (photo by CDFW Marine Region)

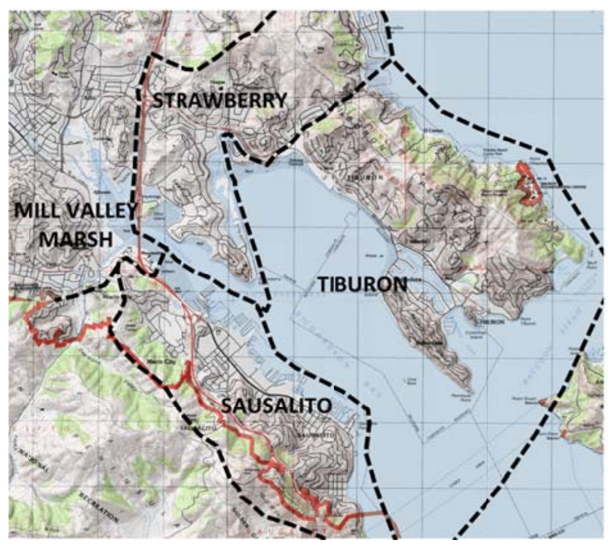
In San Francisco Bay, eelgrass is used as spawning substrate by Pacific herring with the most abundant herring spawning through time being in Richardson Bay. Since the California Department of Fish & Wildlife (CDFW) commenced tracking herring spawning locations within San Francsicso Bay in 1973, Richardson Bay has been the area of most predominant spawning by herring with 80 percent of the 45 years from the 1973-1974 to 2013-2014 having recorded spawning activities on eelgrass and other substrates (CDFW unpublished data). When parsed further by spawning events, 65.3 percent of observed spawns have been in areas around the Marin shoreline, principally within Richardson Bay. This is more than 3.5 times more spawning events than occurring within the San Francisco waterfront, the next most prolific spawning region (CDFW 2019). Based on the level of historic use, CDFW has suggested that the spawning grounds in and around Richardson Bay provide critical spawning habitat for the San Francisco Bay herring population (CDFW 2019). Further, many of the persons interviewed for this study noted a high societal value and cultural atmosphere associated with the seasonal herring runs in Richardson Bay.

Richardson Bay is considered a herring conservation area and has never been open to commercial gill net herring fishing activity. The CDFW notes that this closure protects herring during spawning in one of the most important spawning areas in San Francisco Bay. Herring eggs on kelp (HEOK) fishing is allowed in specified areas of Richardson Bay. CDFW's management of the herring fishery focuses on controls to protect the viability of the fishery and damage to important habitats that are both intrinsically important to the marine environment and which benefit the herring fishery sustainability. Prohibition on gill netting in the shallows of Richardson Bay protects against net drag and anchoring damage to eelgrass. It further limits propeller wash and scour damage to eelgrass and unvegetated soft bottom from fishing vessel operations. However, the CDFW regulations are specifically restricted to the fishing activities and do not extend over similar types of disturbances that may influence the bay's habitats and the herring fishery.

Marine Birds

Marine birds on herring in Richardson Bay moorings (top February 2019 photo by CDFW Marine Region, bottom date unknown photo by Chad Carvey, Anchor-out resident)

Perhaps the best summary of avian resources and constraints associated with data application is derived from the PRBO Waterbird Census at Richardson Bay Audubon Sanctuary 1982-2006 (Shuford 2008). This document does a very good job of placing the Richardson Bay avian community into the broader regional and global context and identifies clearly the constraints to existing data sets. As such, the present study relies heavily on this document for the present analysis. Richardson Bay is recognized as an Important Bird Area in California, yet little prior information has been compiled on the abundance of birds in this bay. A summary of waterbird censuses conducted at the Richardson Bay Audubon Sanctuary irregularly from 1982–83 to 2006–07 and in the Tiburon subarea of the Marin County (southern) Christmas Bird Count (CBC) from 1978 to 2005 documents thousands to tens of thousands of wintering waterbirds in Richardson Bay. Numbers of waterbirds in this bay are typically dominated by a few species or species groups of diving birds, mainly scaup, Ruddy Ducks, large *Aechmophorus* grebes, Double-crested Cormorants, Buffleheads, and gulls. Numbers of the most numerous waterbirds in the Tiburon subarea were high during the late 1970s and early 1980s, and declined in the mid-1980s. The numbers have been low since this time. Reportedly abundant in the late 1970s, American Wigeons, Canvasbacks, and American Coots are currently uncommon to rare in Richardson Bay. Authors have noted that limitations in census methods affect the ability to make substantial links between bird numbers and influencing factors; however, it has been suggested that fluctuations in spawning herring and the density and extent of subtidal plants (principally eelgrass) may be the most important local factors influencing waterbird numbers in Richardson Bay in winter (Shuford 2008). Additionally, wintering numbers of waterbirds on Richardson Bay may be strongly affected by factors elsewhere in their range at other seasons.



Audubon Christmas Bird Count area map. Note that the bird count survey and reporting zones cover wide expanses of the bay and are not aligned in a manner that support analytical application to mooring influence on avian distribution, diversity, or abundance questions.

Annual regional Christmas Bird Counts are compiled by survey areas that are too broad to provide adequate insight into avian distribution patterns within or near the mooring areas or adjacent portions of the bay. The entirety of Richardson Bay falls within four different count areas with one of the count areas capturing approximately 80 percent of the bay. Further, the scale of the Tiburon survey area is untenable with respect of fully capturing and recording avian distribution patterns with respect to moorings.

Trends in waterbird numbers at Richardson Bay vary across avian species. Because movements of waterbirds in and out of surveyed waters of the Richardson Bay Audubon Sanctuary are strongly influenced by the distribution of herring spawning, census data is again hard to interpret when spawning is occurring either within our outside of Richardson Bay (Shuford 2008).

Present avian survey data includes various point observation methodologies, survey zone census methods, and efforts at saturation surveys. However, all of the existing data is constrained in its application to evaluation of avian resources beyond primary ecological metrics in diminishing accuracy of species richness, abundance, diversity, and coarse spatial distribution. As a result, application of existing avian survey data to questions of ecological impact of moorings on avian resources of Richardson Bay is limited and absolute conclusion regarding mooring and bird interactions would be well informed by more focused behavioral studies targeting this specific question.

Vessel disturbance of birds has been previously evaluated in Richardson Bay specifically with respect to the Richardson Bay Wildlife Sanctuary (Zitney 2000). This study "Richardson Bay Dock and Boat Study: The Cumulative Effects of Dock Development and Boat Traffic on Wildlife and the Richardson Bay Wildlife Sanctuary" was not precisely applicable to the present question since the study tended to focus more on shoreline development and constrained environments in the northeastern portion of the bay. However, it does point to a few important factors. First, the effect of boat traffic and docks, in the present case moorings, is complicated and not readily addressed by a singular issue such as intensity of features, but rather the extent to which bird use will be influenced by boat impacts is tied to habitat resource distribution, species specific behavior, disturbance acclimation, and variable factors of forage availability, tidally influenced resource availability, wind and wave conditions, and landside disturbance patterns.

Within the widely spaced moorings, water-birds are commonly observed making use of the waters between vessels, as well as boat decks, railings, and rigging of vessels that are principally not occupied, or do not support high levels of activity. The vessels on the mooring are a relatively static feature in the context of avian use patterns; however, transit by dinghies as well as dogs and people on deck can produce discrete nodes of disturbance. During high wind and wave conditions, more birds are often noted within the moorings where the fetch length is shorter, some wind and wave protection is derived from vessels, and waves don't build as high as occurs on the east side of the bay. However, on calm days, avian distribution patterns are more diffuse and tend to be focused wherever foraging, loafing, or other resources are best represented. During herring spawning runs, habitat selection for many of the water-bird species is overwhelmingly driven by available food resources and normal behavioral response to lessor stressors break down. During these periods, it would be illogical to evaluate effects of moorings on avian resources.

While studies that explicitly evaluate the influence of moorings and mooring associated activities are lacking, it is not believed that the present moorings contribute substantially to bird abundance, diversity, or distribution patterns within Richardson Bay. This is based on anecdotal evidence of avian uses within the moorings, abundant similar habitat within the central Richardson Bay environment, and patterns of use that are driven by variable factors influencing birds. This is a different conclusion than would be made relative to the more developed and limited shoreline margin habitat where a similar low effect conclusion, especially on the western shoreline margin could not be supported. More investigation into moored vessel and avian interactions is certainly warranted, but beyond the scope of this effort.

Marine Mammals

- Cetaceans

To investigate marine mammals in Richardson Bay data were collected on mammal occurrence from multiple sources. Golden Gate Cetacean Research (GGCR) was contacted, as were California Audubon, RBRA staff, and members of the anchor-out community regarding marine mammal activities in Richardson Bay. In addition, mammal observations were made by M&A staff while conducting eelgrass surveys in June and July 2019.

Bill Keener from GGCR provided information on sightings of cetaceans within the RBRA Special Area Plan boundary (Figure 13). The data reveals four species: harbor porpoise (*Phocoena phocoena*), bottlenose dolphin (*Turisops truncates*), humpback whale (*Megaptera novaegliae*), and gray whale (*Eschrichtius robustus*) that make regular use of the deep bay environment but which do not venture into the shallows of Richardson Bay. Bill Keener also noted that several years ago a minke whale was also spotted in the area. The harbor porpoises have only been back in the San Francisco Bay in any numbers (after a multi-decadal absence) since around 2008 (Stern et al. 2017). The bottlenose dolphins have been entering San Francisco Bay for about the same period of time. GGCR noted that humpback whales have come in to feed since the summer of 2016, so the use pattern for these whales is based on only three years of data. The gray whales typically enter the bay in small numbers during their northward migration. However in 2019, gray whales were more active in the bay with three or more animals being present in the bay in March and February, including an animal working the mouth of Richardson Bay and areas off the tip of the Tiburon Peninsula.

According to all respondents to inquiries, cetaceans including whales, porpoise, and dolphins make almost no visits into the shallow waters of Richardson Bay.

- Pinnipeds

However, the bay does host a large number of harbor seals (*Phoca vitulina*) and a smaller number of California sea lions (*Zalophus californianus*). Historically harbor seals commonly hauled out on Aramburu Island in the late 1960s and 1970s. In 1975, an estimated 30 percent of San Francisco Bay's harbor seal population took refuge on the island (George 2011). However, the number of seals on the island began to seriously decline in 1976. In 1984-1989 surveys, only two seals were observed hauled out on the island in 1985 and were not observed hauled out subsequently (Zitney 2000). The last occurrence of seals meaningfully hauling out on the island has been reported as 1985 (George 2011). It is reported that seals stopped using the island, likely due to human and dog disturbance, including from land and vessel encroachment. This is probably true; however, there is certainly more to the story than vessel disturbance. A particularly notable demonstration of this point is the more recent establishment of a seal haul-out along the primary navigation channel in Richardson Bay on the pile wave break of the Clipper Yacht Harbor. At this location, seals are exposed to intermittent disturbance by vessels transiting in and out of the marina and along the navigation channel. Seals in this area continue to exhibit inherent skittishness and often enter the water as vessels pass, but also will ignore vessel traffic regularly when the vessels exhibit no particular threat.

Cetacean Occurrences
Richardson Bay
Special Area Plan Boundary
(GGCR unpublished data)

GGCR Contact:
Bill Keener
keener.bill@comcast.net

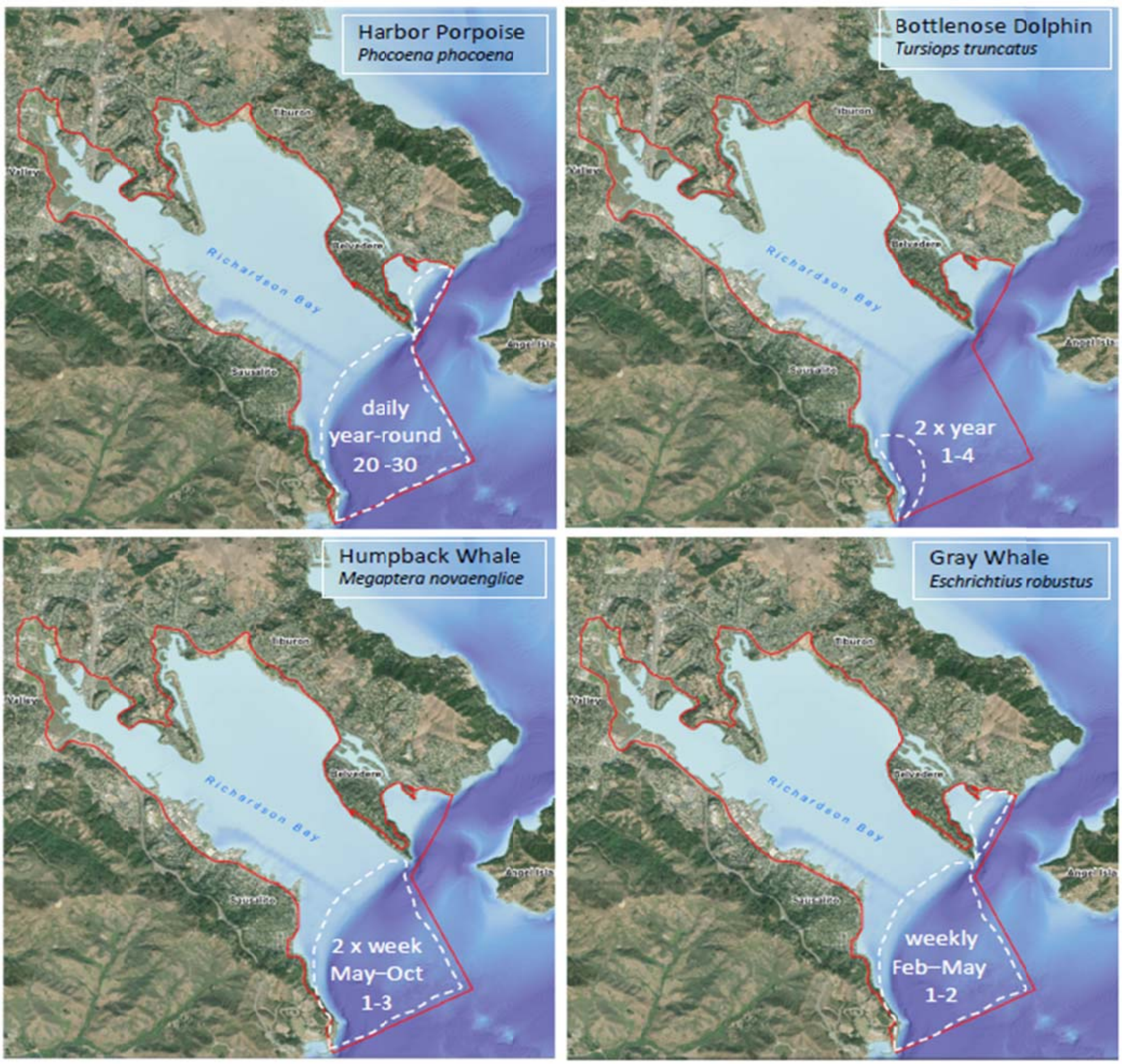


Figure 13. Cetacean records within the RBRA Special Area Plan (provided by GGCR)

The observed habituation of seals and sea lions to low-speed and non-threatening maritime activities has been seen in many areas and is not at all unexpected. Harbor seals forage commonly along the main channel of the harbor and within the deeper portions of Sausalito waterfront. To a lesser extent they also forage over the shallow flats of the broader bay. Approximately 30 seals are often times hauled out on the wooden pile wave break located along the eastern boundary of the Clipper Yacht Harbor.

Harbor seals hauled out on wooden pile breakwater adjacent to Clipper Yacht Harbor with the main navigation channel adjacent to the east and the marina channel adjacent to the west. Docked vessels are within 50 feet of the haul-out.

Sea lions are less common in the bay and generally found towards the mouth of the Bay near the deeper waters along the outer Sausalito waterfront. Why sea lions are not more common along the Sausalito waterfront is somewhat of a mystery. California sea lions have become prevalent within developed marina areas up and down the coast as populations have increased and off-shore fisheries have declined. The result has been an aggregation of animals around fishing harbors or public marinas where they can more readily garner food. Notably, some of the long-term anchor-out residents report that sea lion populations appear to have declined from earlier years when a fishing fleet was present in the waters of the western bay.

During herring runs in the bay, both harbor seals and sea lions follow spawning herring wherever they go. In addition, the spawn events attract animals from outside of the local area such that the numbers of sea lions and harbor seals observed often exceeds the regular bay population. Video provided by anchor-out resident Chad Carvey shows the influence of a herring spawning event within the moorings with both pinnipeds and birds foraging prolifically amongst the moored vessels. In addition, similar observations have been reported by others in the anchor-out community, RBRA and City of Sausalito staff, and Audubon representatives.

- Fissipeds

A more recent occurrence within Sausalito is the North American river otter (*Lontra canadensis*). At least one family of otters now occurs along the Sausalito waterfront being observed most frequently north of the Army Corps of Engineers Bay Model, but being encountered regularly in the area. While the use of the bay by otters has been generally reported to be along the Sausalito waterfront by anchor-out residents, including Greg Baker and Chad Carvey, it is assumed that otters would use other areas if the population increases, although otters generally forage on hard structure environments rather than in soft bottom areas.

None of the marine mammals present in the bay are expected to be particularly sensitive to mooring activities and their presence is not considered to be a factor in evaluating moorings in the Bay.

Moorings and Life on Moorings

Within the anchor-out residents that were interviewed many have a long history on the waters of Richardson Bay. The longest tenure on the waters includes residents with 50 and 34 years on the shore and waters of the bay with much of that time being within the anchor-out community. Several additional interviewees ranged from 10 to 4 years' experience as anchor-outs. As a result, the residents on the water provided a very unique and in-depth perspective on many aspects of Richardson Bay that can barely be appreciated by those with less interconnection to the waters. The interviewed residents on the water provide insights relative to transient ecological resources, storm conditions influencing moorings and on-water safety, mooring tackle design and demands, waste management, and shore landing logistics. They also provide keen insights into the make-up of the mooring community.

Richardson Bay May 1958 shows different distribution of moorings than occurs today. The northwestern end of the bay has a number of moorings, assumed to be houseboats, Belvedere Cove had considerable moorings, the Sausalito waterfront had moorings where many marinas are present today, and a few moorings occurred in the central portion and near the far southern end of the bay.

What is notable in the interviews is that there was widespread recognition that there were a number of members of the anchor-out community that were not represented in the section of the community interviewed. Several of those not represented were described as being very distrustful of the study process and its motivations. Some anchor-out residents, agencies, and social welfare interviewees noted that mental illness and drug abuse affects a substantial portion of this group not represented in the interviews.

- Mooring Resident and Vessel Population

Moorings have been an established use within Richardson Bay with vessels holding in the shallow waters of the bay for as long as navigation in the bay has occurred. In early years ships would await suitable tide or weather conditions to leave the bay and smaller vessels would moor offshore of south Sausalito. As the waterfront developed to include fishing operations and boatyard uses, vessels at dock and moored along the waterfront were common.

Richardson Bay May 1916 showing a history of vessel mooring at the extreme southern portions of Richardson Bay between Anchor Street and South Street, Sausalito. (Derived from Kelly et al. (2019) originally referenced to the Anne T. Kent Room of the Marin County Library)

With the meteoric growth in shoreline development in association with war time industrial manufacturing of ships and support vessels, large numbers of laborers moved to Sausalito and people living on the water rose. After the war, cheap barges and other vessels were readily available and the beginnings of a maritime anchor-out community had its origins.

During interviews, multiple anchor-out residents estimate the total number of individuals living aboard anchored vessels to be approximately 100 individuals. The anchor-out residents have noted that the number of live-aboards has increased substantially over the past several years as anchorages are being closed elsewhere in San Francisco Bay and Delta areas and cost of housing in the Bay Area rises. While it is difficult to get a precise count of residents within the anchorage, more extensive estimates have been made as to the number of vessels.

In recent years systematic inventories of vessels have been made by RBRA and the City of Sausalito. These surveys have carefully sorted vessels from tending dinghies and have recorded additional information regarding vessel condition, registration, etc. To support the present study, historic photographs were reviewed and vessels on moorings were mapped and counted by year to determine how vessel moorings have changed over time. In total 15 separate counts were made between the years of 1987 and 2019. For this investigation the vessel count did not distinguish vessels within waters of Sausalito from those within the RBRA or federal channel turning basin. The counts show high variability in the number of vessels present in earlier years hovering around 150 boats during a given year. However, between 2011 and 2013 the number of vessels increased substantially approaching 250 by 2016 (Figure 14). Note that the recent counts are generally higher than various counts made by local agencies and are based on rectified aerial image counts of vessels excluding dinghies. This is likely due to several factors including potential inclusion of very larger tender dinghies or stationary but unmoored vessels in the counts from aerial photographs. In addition, it is clear that a small number of vessels in the aerial counts were cruisers present in the bay for only brief periods. The City of Sausalito reports that the peak in vessels on the anchorage was about 250-260 in 2015. This is roughly comparable and a slightly higher estimate than obtained in the present study by aerial photo reviews.

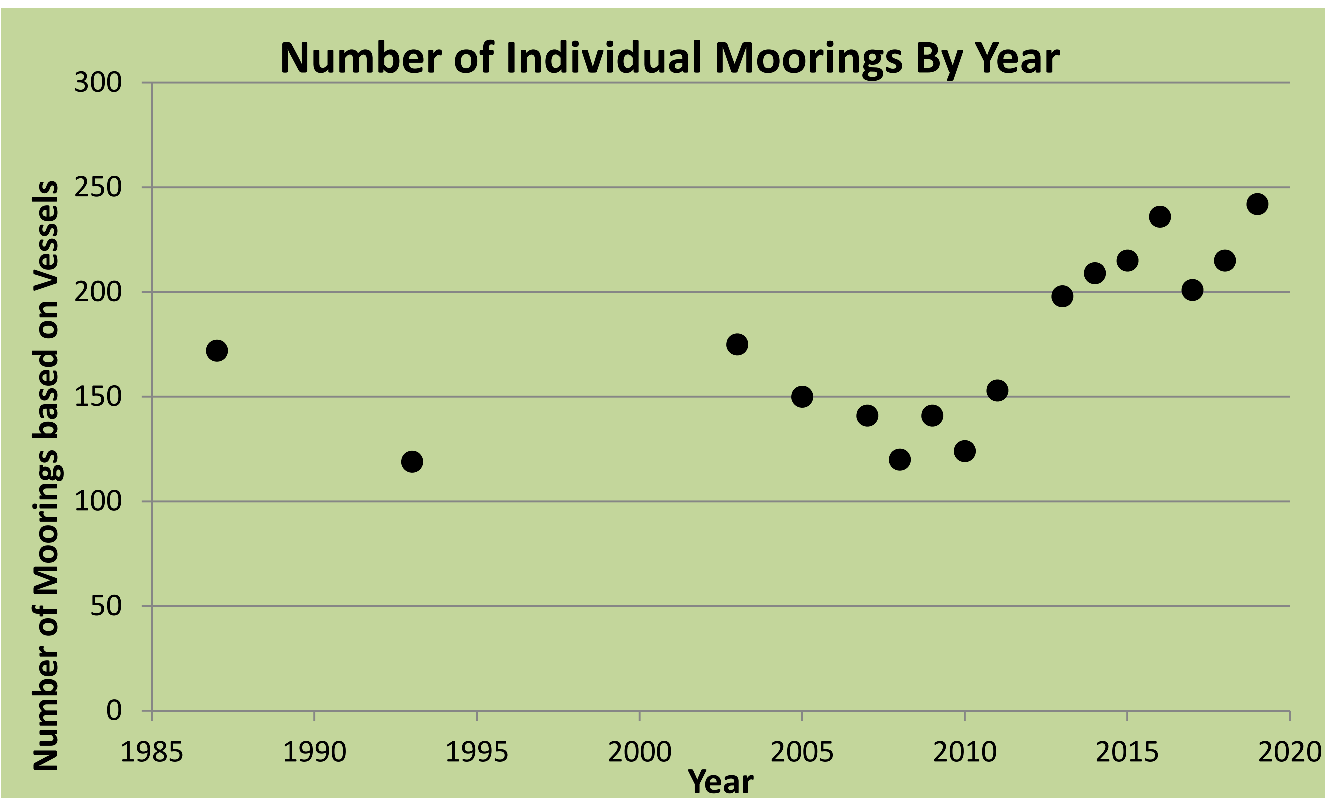


Figure 14. Vessel count within the Richardson Bay moorings over time.

An RBRA vessel survey summary covering surveys conducted in October 2018, March 2019, and June 2019 showed substantial fluctuations in vessel numbers located within County waters and a continued high rate of vessel infusion into the Bay. The study also found new vessels observed during each of the studies to account for a large percentage of the total vessel population, with 62, 33, and 54 new vessels being noted in October 2018, March, and June 2019, respectively (RBRA 2019). As a result of these observations, it is clear that any given count should be considered a snapshot in time and thus there is some imprecision in the vessel population. Further, vessels within the moorings move around from time to time making tracking the status of individual vessels more complex. This is especially true with limited resources and technology available to the local jurisdictions.

- Nature of Vessels on Moorings

The tremendous increase in moored vessels in recent years has been reported to be both the result of displacement of live-aboards from other areas as well as the recent rampant availability of free to nearly free vessels as other anchorages are closed down and agencies and marinas charged with disposal of derelict vessels have allowed vessels to be hauled away in lieu of being removed from the waters. The result of these two factors has been that the number of vessels on Richardson Bay greatly exceeds the number of residents on the water.

Many of the vessels are not registered, nor are they even titled to the parties claiming ownership. This creates some inherent stewardship and accountability issues. In a 2019 vessel survey, RBRA found that 46 percent of the vessels in County waters had expired or no vessel registration (RBRA 2019). Bill Price, previously of RBRA noted that most of the vessels that break free of their moorings or sink at the moorings do not have current registrations.

When queried about the nature of vessels on the water, some of the long-time residents noted that there are six different classes of vessels on the water:

- cruisers
- commercial boats
- pleasure boats
- live aboard boats
- storage boats
- trash

Cruisers are generally well kept larger vessels that make transitory mooring within the bay for days to months in association with long-range excursions. Commercial vessels operate along the Sausalito waterfront both within Richardson Bay and elsewhere in San Francisco Bay. Most commercial vessels staged in Richardson Bay are small vessels berthed at marinas, or moored near the waterfront. Pleasure boats are generally found in marinas, on private docks, or come into Richardson Bay for day trips. These boats occasionally anchor out in the bay.

Live aboard vessels comprise the majority of the boats on moorings in the bay. These boats are occupied by residents. Residents on the moorings describe a common progression of boats from live aboards to storage boats, which are used somewhat as floating garages on which possessions are stored to provide adequate living space on live aboard boats. As vessels fall into disrepair, are abandoned, or begin to sink, they are considered trash. Several of the residents on the moorings have noted that proliferation of vessels and the ease to which they are acquired, exchanged, and discarded has resulted in the accumulation of storage and trash vessels. One anchor-out resident noted that 30 percent, or perhaps fewer vessels, may have no known owner. This creates difficulty in administering moorings as there is limited capacity for enforcement on several vessels. However, when it becomes clear that a vessel does not have a known owner, multiple parties on the anchorage will sometimes claim ownership. This uncertainty of ownership and variable claims of ownership add complexity to the administration of the waters within Richardson Bay.

Commercial boats and pleasure boats are classes of vessels that are either temporarily anchored in the bay, unoccupied as live-aboard vessels, or are considered to have live aboard aspects that are incidental to their commercial activities. This is not to say that there are not vessels that once operated commercially that have become live aboard boats.

- Seaworthiness

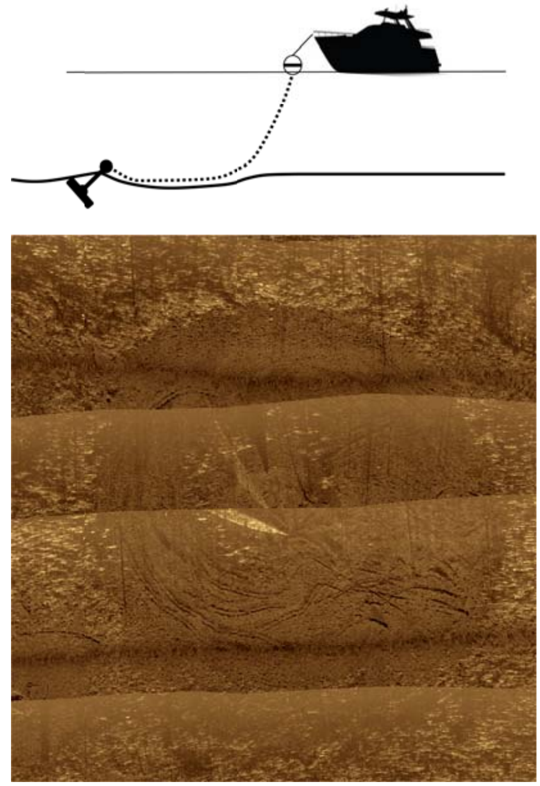
In 2019, the RBRA adopted Ordinance No. 19-1 An ordinance of the Richardson's Bay Regional Agency Updating Definitions, Providing for Vessel Conditions Required for Mooring and Anchoring in Richardson' Bay, and Amending the Location of Appeal Hearings (RBRA 2019). This ordinance defined more explicitly requirements for seaworthiness of vessels, provision of vessel sanitary facilities, and minimum conditions that a boat must be maintained at within Richardson Bay. Under the ordinance, seaworthy is defined as "Operational thru hulls, hoses and sea cocks; bilge pumps are operational and bilges are free of oil; no loose debris or materials on deck; hull, keel, decking, cabin and mast are structurally sound and vessel is free of excessive marine growth, excessive delamination or excessive dry rot that compromises the vessel's integrity to stay intact and afloat without extraordinary measures; capable of operation to avoid striking vessels, persons, and or property should it break free from its anchor." Vessels anchored or moored in Richardson Bay must also possess current and valid registration with the California Department of Motor Vehicles or current and valid documentation with the United States Coast Guard.

Ordinance No. 19-1 also provides clarity with respect to Harbor Master discretion and lack thereof with respect to various aspects of the ordinance and reiterated state and federal regulations.

Non-seaworthy vessel removed for disposal as marine debris (February 2019).

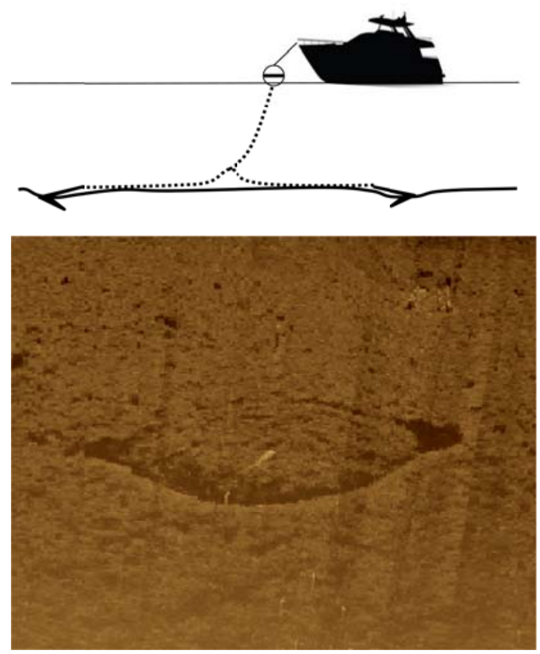
- Mooring Methods

Vessel mooring within Richardson Bay varies as the majority of the vessel moorings are privately installed and maintained. However there are two primary designs of mooring anchors in use. The details of the anchors vary considerably, but the basics are shared. The first is a single point mooring design with a central mooring anchor of either a mushroom anchor or clump weight design. There may also be standard claw anchors deployed with single point moorings in the bay. The anchor is attached to a heavy ground chain that extends to a shackle and lighter chain, cable, or line that then attaches the ground chain to the mooring ball or buoy. From the ball, a single or double pendant is used to connect the mooring to cleats on the bow of the moored vessel. Dinghies are generally stern-tied to the vessel. The lift of the ground chain accommodates tidal range and provides elasticity to the mooring dampening wave energy on the vessel and strain on the cleats. In some cases elastic pendant lines are also used. These further dampen the pull on the vessel hardware and soften the ride on the vessel.



Typical configuration for single point mooring and bottom scarring generated from such a mooring.as depicted in interferometric sidescan sonar mosaic.

The moored vessel on a single point anchor swings around the center point anchor dragging the ground chain across the bottom. This carves away at the bottom suspending the fine sediments allowing them to drift away from the mooring. In addition the mooring chain often creates ruts on the bottom. At most of the moorings within Richardson Bay the vessel keel also hits bottom during low tides and creates additional scarring. To illustrate this point, an interferometric sidescan sonar mosaic shows a single point mooring in an eelgrass bed. The image is akin to monochromatic photograph produced by sound. Eelgrass produces a bright return due to air in the leaves having a high acoustic reflectivity. The deeper scars on the bottom of the “crop circle” pattern are the result of keel dragging during low tide. Single point ground tackle moorings have the greatest capacity for seabed damage and are the most common moorings used in Richardson Bay.



Configuration of two point swing mooring and bottom scar from mooring configuration.

Two point mooring configurations are the second most common moorings in the bay. In these moorings, claw anchors are situated facing each other and a tight chain is stretched between the anchors. A swivel is then connected to the chain and a riser chain, cable, or line extends upward to a mooring ball with the rest of the mooring tackle and configuration being the same as for a single point mooring. The elasticity of the mooring is derived from lifting the two chain legs off the bottom and bowing between the anchors. The results of this design are a lesser footprint of impact due to the elimination of the full radial swing. However, bottom scarring, while dependent on many factors is generally reduced by about two thirds or more over the single point mooring system.

The two point moorings are principally in use on larger vessels that are anchored in slightly deeper waters of the bay than most vessels. While the two anchor design has some merits over the single point anchor in terms of safety against break-away at ground tackle, and reduction in bottom disturbance, the design also has some weaknesses as well in that certain orientations of the vessel to the tackle can reduce the elasticity of the tackle and put more stress on cleats. As such, correct construction of these systems takes some consideration beyond that of a single point design. Further, recognizing potential for increased stress warrants use of elastic shock pendants and good cleats.

Vessels pivoting around the mooring, whether a single point or two point swinging mooring design rotate around the mooring center point within a swing radius of the mooring, vessel, and associated dinghies. The swing radius is useful in designing moorings to ensure that one moored vessel does not impact an adjacent vessel. However, for the present analysis of ecological injury, the sweep radius is of primary concern. The sweep radius is the radius within which a vessel and the mooring tackle affect the seafloor around the mooring. In many cases for moorings this radius is distinguished by a circle cut into the bottom around a mooring anchor. However, in the case of moorings in Richardson Bay, more often than not, the sweep radius is dramatically expanded by damage from chain dragging through eelgrass in the water column and damage caused by dragging of keels and or motors in the mud. In some instances the vessel keel drag and the ground tackle drag are discontinuous resulting in survival of some eelgrass within concentric sweep radii on the same mooring.

The sweep radius in a properly designed mooring is related to the tides, water depth, anchor type, vessel type, and loading anticipated from wind, waves, and currents. In general, a typical single point mooring has a rode scope of 2.5:1 to as much as 4:1 (rode length to high water depth) resulting in a sweep radius that increases with water depth. Further, the sweep radii generally increase with vessel size meaning a greater scope is played out for larger vessels. In the case of Richardson Bay, 10 moorings sampled at random were investigated to analyze sweep radii relative to water depth and also vessel size. The results of these analyses indicate that the sweep radii tended to be inversely related to water depth while the sweep radii were related to vessel length (Figure 15). However, what is missing from this analysis is that in every case investigated, the sweep radius in shallow water was defined not only by ground tackle drag, but also vessel drag. Only vessels in slightly deeper water had bottom scour driven only by ground tackle.

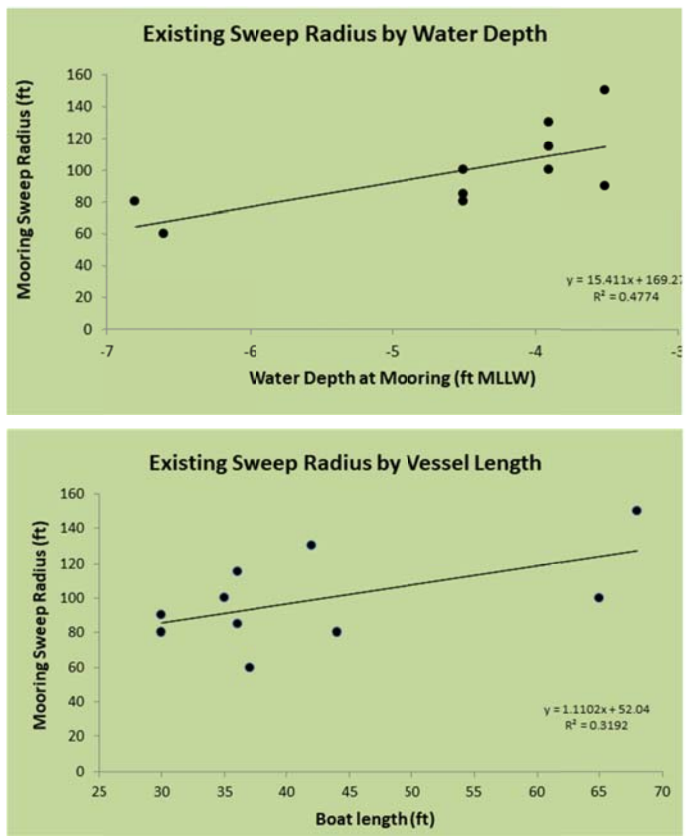


Figure 15. Relationship between sweep radius water depth and vessel lengths within Richardson Bay mooring sampling

In addition, many moorings have an expanded circular influence beyond physical indication of vessel or mooring tackle dragging that is not readily explainable by mechanical damage to the bottom. This is a halo around the mooring that is also principally devoid of eelgrass but which shows no indication of bottom dragging and which is generally beyond the radius of the mooring rode, pendant, vessel, and dinghies. It is possible that this halo affect around the moorings is the result of earlier changes in vessels or tackle on the mooring and represent prior disturbance, or it may be related to turbidity influence from chronic bottom disturbance within the mooring sweeps. Typically near sources of high turbidity, sediment settles on leaves and smothers eelgrass or otherwise impairs photosynthesis. This can be an issue around dredging projects in

Sweep radius illustrating concentric impact areas of ground tackle on the inner portion of the sweep and keel drags on the outer portion of the sweep (left). Low tide turbidity plume generated from vessel grounding at the outer margin of the sweep radius. Note the vessel keel drag scar on the bottom above dinghies in photograph (right).

shallow waters adjacent to eelgrass beds.

- Evolving Conditions

Within the last year, Sausalito has move forward with aggressive enforcement within moorings in Sausalito waters. This includes enforcement of 72 hour anchoring, removal of vessels designated as marine debris, and a stepwise progression of enforcement starting with least compliant to most compliant vessels. Legacy, long-term anchor-out residents with seaworthy vessels have been placed at the lowest priority of enforcement actions. Concurrently Sausalito has been working with various local and regional social services organizations to provide land-side assistance to those requiring it. The result of Sausalito's waterside enforcement actions have led to a shift of vessels into RBRA waters from Sausalito waters. However, the extent to which this has occurred is a matter of some disagreement among different agencies and the anchor-out community.

In recent months, the RBRA has similarly stepped up action to curb the number of vessels identified as marine debris and to implement enforcement actions under its recently adopted Ordinance No. 19-1. The work also includes a focus on curbing the influx of new boats into Richardson Bay. This activity is underway, but principally shouldered by a very small staff with limited resources, supported intermittently by available law enforcement to the extent resources can be provided.

On a broader basis, multiple agencies, marinas, and other parties are coordinating efforts in an attempt to curb the availability of cheap or free vessels that feed the supply chain of new vessels entering various areas throughout San Francisco Bay and the Delta.
In addition to the governmental shift towards greater enforcement of existing rules and regulations, as well as provision of expanded social services to support both on-water residents and displaced residents moving off of the water. This includes actions of local ministries.

Also from the non-governmental perspective, there are on-going and active efforts on the part of the anchor-out community to reduce the issues and impacts associated with the anchor-out population and vessels through the Richardson Bay Special Anchorage Association (RBSAA, 2016). This includes working on self-governance elements to reduce the burden of enforcement by understaffed government agencies. The anchor-out community has partially implemented a "self-help" system where vessel rescues and retrievals are implemented to a great degree by able-bodied mariners in the anchorage, vessel inspections and repairs are sometimes undertaken as a collaborative effort, vessel and mooring tackle inspection and shipshape stewardship is promoted along with mariner training,, and on-water security is achieved through an ad hoc neighborhood watch. Finally, as environmental impacts have been identified, the RBSAA has sought to identify and support means of addressing these concerns to the extent practicable. The RBSAA representatives have noted that the organization is seeking to both engage in conflict resolution while defending and lobbying for persistence of anchor-out use within Richardson Bay. Readers are encouraged to visit anchoredout.org for greater depth of review of community coordination towards sustaining moorings and conflict resolution.

The evolving synergy amongst public and private parties is seen as a good, but a fledgling and somewhat flawed model because parties are aligned in many respects, but pursuing often opposing goals. Further, the anchor-out community is not a unified community that can be expected to operate cohesively. This makes it difficult to fully trust in self-governance on the water and absent enforcement tools being both in place, and applied as needed, any actions to address ecological impacts and retain moorings will eventually unravel. This concern has been recognized widely within those interviewed in the anchor-out community, and recommendations as to governance structures have been put forward that would make use of community-based enforcement, assistance, and self-regulation backed up by governmental regulatory and law enforcement support.

In practice, the inaccessibility and greater resource demands to effectively police the waters where access is all by vessel to respond to social, emergency, law enforcement and regulatory functions creates a necessity to have greater reliance on the on-water residents, or an increase in resource allocation to governmental agencies expected to conduct the required work.

Notable in the interviews across a broad strata of stakeholders was the degree of commonality in concerns and recognitions of problems. Concurrent with this was a collective desire to resolve conflicts with the major departure being perspectives on where the resolution ends with respect to moorings and anchor-outs remaining or being fully removed from the water. The anchor-outs, agencies, and other stakeholders interviewed all share a common understanding that a portion of the anchor-out community is nearly unregulatable due to mental health issues, drug abuse, or efforts to maintain a lifestyle outside of the regulated society. This portion of the community is also the principal complication to development of an effective management strategy to deconflict anchor-outs and ecological resources.

Ecologically Suitable Mooring Areas and Mooring Design

Restrictive Spatial Modeling

The approach to evaluating the potential for curtailing impacts to ecological resources while retaining moorings was application of an unweighted spatial model. A spatial model is a means to combine many metrics that vary across the landscape into an objective output reflecting the degree of suitability or unsuitability to a particular purpose.

The modeling approach was designed as a restrictive model rather than an opportunity model. This means that the model was approached through documenting constraints to moorings rather than being constructed based on factors favoring moorings. However, the effect of the modeling approach makes little difference to the ultimate outcome. An additional element of the model is that it is a multiplicative rather than an additive model. This means that any factor that drives a single screening metric to zero suitability eliminates suitability within the model, irrespective of how suitable other metrics may be. To avoid a weighting bias across model parameters, all parameters were scored within a range from 0 to 1.

For the model five metrics were included as they facilitate distinctions between areas of suitability to support moorings (Figure 16). These metrics were:

- **Water Use** – Areas of the Sanctuary, navigation channels, existing marinas, and land-locked waters were considered unsuitable as were the waters of Dunphy Park in Sausalito where mooring is excluded by an adopted park plan. The area of The Marinship Launching Basin (part of the Marinship Turning Basin) was considered to be intermediately impaired due to the fact that it historically was maintained as part of the federally maintained channel, likely a wartime condition, and is privately owned with an unclear maintenance dredging future.

- **Wave Environment** – The wave environment screening was based on the modeled 20-year storm maximum wave height scenario. In the model, maximum wave heights of less than 4 feet received a score of 1.00 while waves in excess of 4 feet and less than 4.5 feet received a suitability score of 0.75, waves in excess of 4.5 feet and less than 5 feet received a suitability score of 0.5, and waves in excess of 5 feet but less than 5.5 feet received a score of 0.25. Larger 20-year storm wave conditions were considered unsuitable for mooring of vessels. Note that suitability scores within the wave climate are based on assumptions of seaworthy vessels of an approximately 24-foot and larger size on a proper mooring configuration. The comfort within individual vessels through such an extreme weather event would be expected to vary. The 20-year storm condition was adopted over a 1-year maximum wave environment or a 100-year event with the thought that smaller vessels may need to relocate to more sheltered areas in the face of very extreme events and 1-year events were more suited to defining comfort levels than distinguishing mooring acceptability levels. Finally, it should be noted for this parameter, that many of the vessels within the interior portions of Richardson Bay are not believed to be in a condition suitable to sustain the identified lower suitability scored 20-year event maximum wave conditions as they are not likely to be seaworthy.

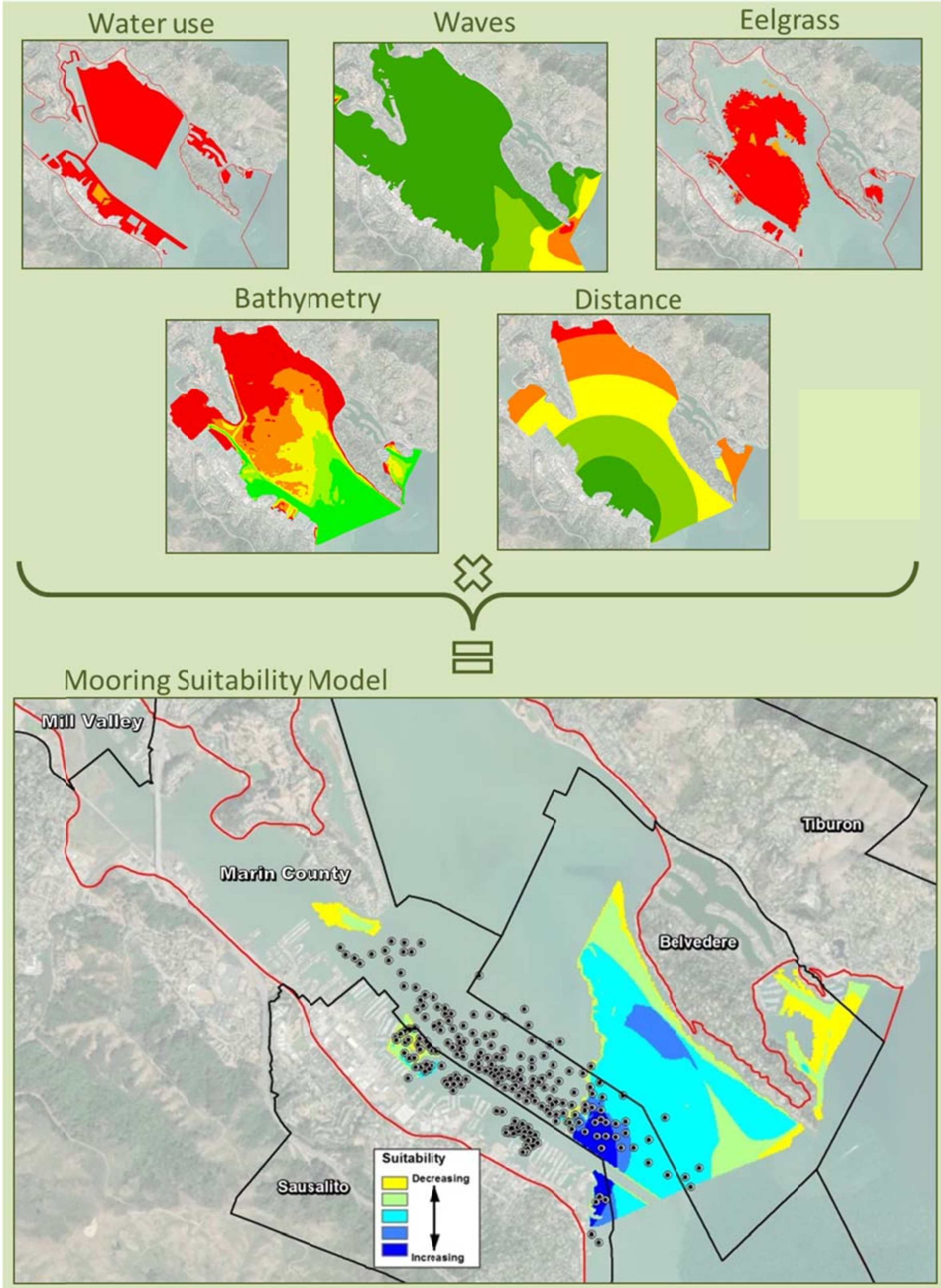


Figure 16. Mooring Suitability Model. *Yellow to Blue indicates increasing suitability. Black dots are 2018 mooring distributions.*

- **Eelgrass Habitat** – The most explicit ecological resource for which spatial definition exists and impacts can be identified is eelgrass. While less substantial or localized impacts may occur for avian resources, there is not adequate information to suggest water bird impacts within any anchorage areas and shallow flats where shorebird impacts may occur are screened out by bathymetric analyses. For the eelgrass consideration was given to both the frequency of eelgrass presence over time and the bottom cover class of eelgrass (Figure 9). Eelgrass was assigned to ether a zero suitability for moorings or 0.25, very low suitability where eelgrass occurrence through time and bottom coverage were both low. The results of this classification were limited distributions of marginally suitable conditions at the deeper and shallower margins of the beds.

- **Distance to Shoreline Landings** – The distance to shoreline landings factors into consideration of safe and effective mooring locations. Shorter distances are favored over longer distances. In discussions within the anchor-outs there was a wide mix of perspectives regarding suitable distance from shore. With most of the dinghies present on the water having small gasoline motors travel distance issues are relatively mitigated. However, in general, greater distance from shoreline landings is less desirable. The scoring of this parameter used a value of 1.0 for transit distances less than 0.5 miles, 0.75 for distances of less than 1 mile, 0.5 for distances of less than 1.5 miles and 0.25 for distances of less than 2 miles. Consideration was given to potential for alternative shoreline landings, although no logical alternatives to the existing landing locations were identified without consideration of additional infrastructure such as adding a dinghy dock. Shoreline areas within Belvedere Cove, specifically off of Beach Road, might be suited to accommodate an additional landing geometrically and could substantially alter the scoring of this metric if such a landing were incorporated.

- **Bathymetry and Vessel Draft** – The impact analysis of vessel damage to existing benthic resources includes bottom scarring, eelgrass loss, and sediment suspension in association with both mooring ground tackle dragging and vessel keel and motor dragging on the shallow bottom of the bay. While changing mooring tackle may be able to curb damage from the moorings themselves, it would not address vessel dragging damage. Further vessels that drag within eelgrass canopy can damage the eelgrass beds, irrespective of whether the vessels actually ground on the bay floor. Vessel dragging not only results in a degree of environmental effect that may range from minor to major, it also has the potential to damage the vessel hull, plug water intakes on engines, and alter movement patterns of vessels subject to wind and current shifts, and thus can result in increased risk of fouling moorings of adjacent vessels. The extent to which vessels drag is a function of draft and tidal stage. Moored and anchored vessels should not ground, even at the lowest tides and moored vessels should not bounce on the bottom as a result of wave passage. For this parameter, most of the northern end of the bay is extremely shallow and not well suited to moorings. However, some of the moored vessels are small and consist of flat bottom or semi-vee hull power boats with very shallow draft of less than a foot. At the lowest annual tides reached in the bay (approximately -1.5 to -2.0 feet MLLW during any given year), a vessel drafting more than 1.0 foot would likely ground if waters were shallower than -3 feet MLLW. It is unlikely that any of the moored vessels presently on the waters of Richardson Bay draft less than 1.0 foot.

  Conventional wisdom suggests that moorings should be placed in waters of at least 6 foot of depth below the lowest tides to allow safe mooring depths for most recreational vessels (McAllister 2018). This also ensures that vessels do not damage the bottom with low tide drag or damage the vessels by bottoming out on anchors or other hard debris on the bottom. For larger sailboats additional water depth is required to accommodate deep keels. In areas of higher wave climates, clearance should also account for water depths when vessels are in wave troughs. Waters deeper than 25-30 feet become expensive and require larger radii. In Richardson Bay this is not a particular issue since the bay does not reach these depths until the steep slope at the bay entrance that is unsuited for any moorings.

Given the makeup of the vessels on the water and conventional wisdom guidance, the ideal mooring depths in the bay are waters deeper than -8 feet MLLW. Unsuitable bathymetry was defined as shallower than -3 feet MLLW, a low suitability of 0.25 was assigned to waters shallower than -4 feet MLLW, waters of -6 feet MLLW were scored as a 0.5, and waters shallower than -8 feet MLLW were scored as 0.75. Deeper waters were given a full score of 1.0. Note that even though very shallow water still has some degree of suitability, the vessels for which mooring depths are suited are still limited by the true vessel draft. Further, the suitability scoring for bathymetry does not address shallower conditions due to eelgrass canopy as this concern is considered addressed by the eelgrass parameter.

The screening mooring suitability model identifies areas of mooring suitability from decreasing suitability to increasing suitability (Figure 16). Areas that are not colored are not considered to be suitable to support moorings. The basic premise of the suitability model is one intended to identify areas suitable to support moorings that do not conflict with ecological resource conservation within Richardson Bay. The model does not address any metrics beyond those including in the model parameters as discussed above and thus does not explore factors of appropriateness of land or water uses outside of the specifically excluded water use constraints included as a parameter in the model, nor does the model address the individual suitability of any particular vessel presently on Richardson Bay to be located within areas identified as suitable for moorings. This is a very important point in that several of the vessels on the water are not likely to be seaworthy and suitable mooring locations identified in the model principally favor areas further to the south than the central mass of vessels presently occupied. A shift in center mass would move vessels from locations that experience lower overall wave and wind energies and thus some of the vessels in the bay could likely not be suited to elevated wave exposure conditions.

Mooring Types

Moorings presently used in Richardson Bay are of a classical design of one or two point configurations with heavy chain ground tackle. There may also be other mooring configurations present as well. These have been discussed previously. Irrespective of the mooring types presently in use, due to the shallow nature of the bay and the use of bottom dragging ground tackle, impacts to eelgrass do occur when vessels are moored in eelgrass. Further, these impacts may be expanded by vessel grounding during low tides. Conventional ground tackle moorings result in scarring of the bottom associated with anchor rode dragging during changing tide and wind conditions with more or less of the rode dragging based on the tidal height and extent of tension on the anchor tackle at any given time. Except where vessel drag exacerbates benthic scarring, the pattern of damage is reduced with reducing tackle dragging. With a one-point mooring reliant on lifting of a ground-chain for surge reduction, the damage is defined by a radial scar with the central region receiving more damage and the outer radii receiving less impact. Often times the scar also reflects a bias based on predominant wind and current directions (Figure 17). With a two point system, the scarring is reduced and extends along the axis of the opposing anchors with the broadest extent of damage being towards the center of the array. Finally, with a three point anchoring system most of the lateral movement of tackle is controlled by opposing anchors and thus the bottom damage is further reduced to narrow trenches where the anchor lifts and falls in response to tides and wave motion. Greater numbers of points further reduce the lateral movement, but not significantly.

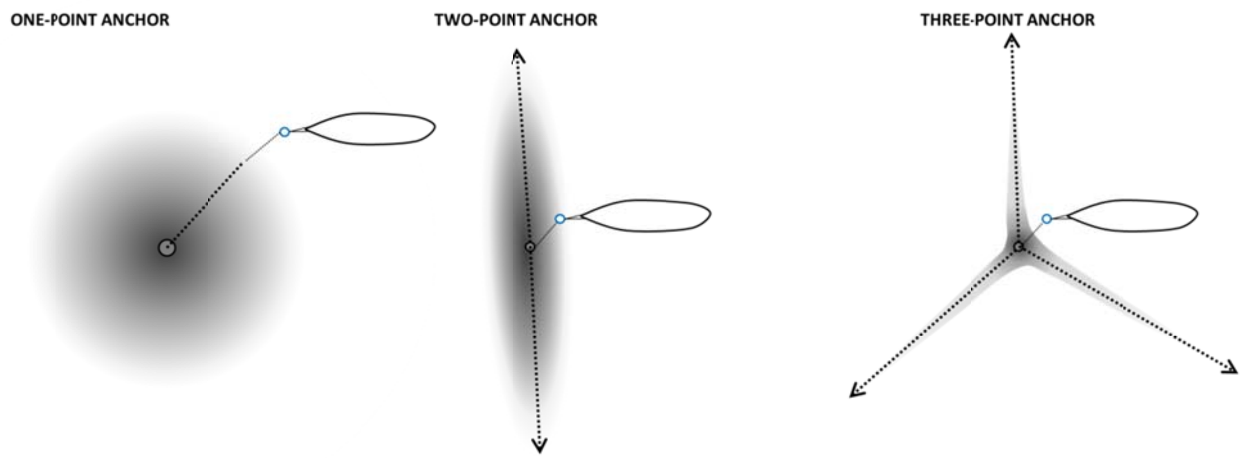


Figure 17. Conventional ground tackle anchor scarring. *Typical configuration of conventional ground tackle anchors result in diminishing benthic ecosystem damage with increasing points of anchoring.*

Vessels moored in deeper waters outside of eelgrass and employing classical mooring tackle generally are not likely to generate impacts to eelgrass; however, they may contribute to local elevation of turbidity as ground tackle drags around the anchors. This impact is lessened with two point moorings and is further lessened with three point conventional ground tackle moorings. Alternatives to conventional moorings include a suite of moorings that are marketed as “conservation moorings”, “eco-moorings”, “ecologically-friendly moorings”, etc. As a group, these moorings typically employ either a helical anchor or very heavy gravity anchor, a means to suspend the mooring tackle above the bay floor, an elastic anchor line, a mooring buoy, and a pendant line (Figure 18). The conservation moorings were initially developed as a means of reducing ecological impacts from ground-tackle dragging on the seafloor; however, they have also been used as a means of increasing mooring packing density since the required radii for moorings using an elasticized anchor line over a standard chain mooring can be substantially reduced.

The elimination of ground tackle in conservation moorings has been identified as providing benefit to previously damaged eelgrass habitats. In Maine a replacement of conventional moorings with conservation moorings resulted in a slow recovery of damage with 13 percent recovery over a 3 year period (Swan 2012). Swan noted that some continuing effects of vessel shading may have contributed to limited recovery over the 3 years post mooring transition. This observation may suggest that active restoration of mooring scars may be suitable to accelerate eelgrass recovery.

There are several manufacturers of conservation moorings and such moorings have been used in many areas around the world for many years. In general, the moorings have been time tested and demonstrated to be suitable for most mooring uses and environments when properly sized, installed, and maintained. For this reason, no particular conservation mooring is recommended in this investigation, but rather the suite of moorings is discussed and some of the various manufacturers’ information and photographs are provided. This is not to be construed as a particular product endorsement, nor is the information presented considered to be exhaustive. Several of the manufacturers have posted information on line and many of the products have been reviewed and evaluated in different studies (Massachusetts Division of Marine Fisheries 2019, Swan 2012, Outerbridge 2013).

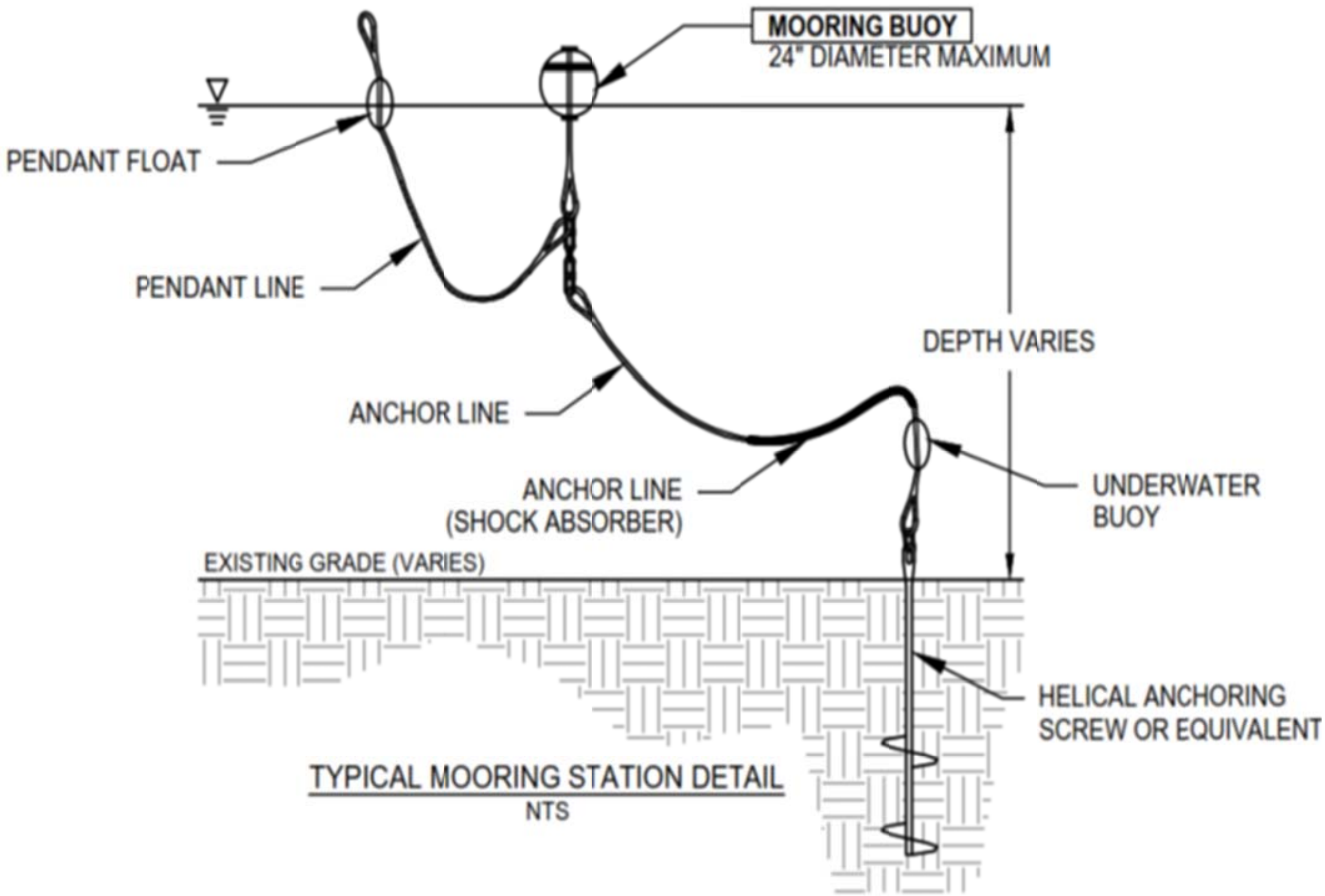
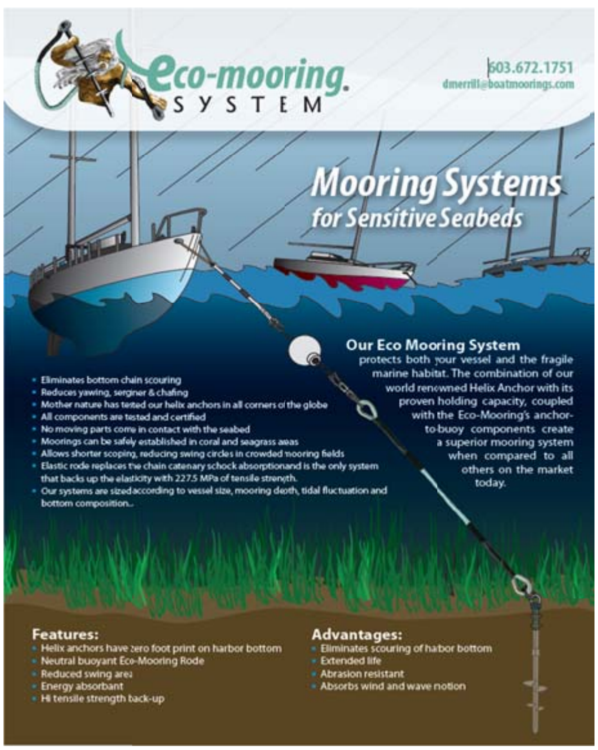


Figure 18. Conservation mooring components. *Typical configuration of various conservation moorings are similar to conventional moorings within the near surface element.*

Examples of differing systems and components are displayed in this section. Manufacturers, distributers, and installers often interchange different system components to meet particular application needs. This interchangeability of parts, as with conventional moorings provides flexibility in design; however, it also creates potential for untested pairings and potential points of failure. For this reason, any mooring system considered, of a conventional or conservation mooring type, should be engineered for the particular application and installed and maintained by a qualified party. Common manufacturers or vendors of conservation moorings, mooring systems, and mooring components include, but are not limited to the following:

- Big-e Storm Pendant (boatmooring.com)
- Eco-mooring System (boatmooring.com)
- Elastic Mooring Systems (ecomooringsystems.com)
- Hazelett Marine (hazelettmarine.com)
- Helix Mooring Systems (helixmooring.com)
- Marine Flex (marineflex.com)
- Sea-flex (seaflex.net)
- StormSoft (jwilburmarine.com)



Differing mooring systems and system components from manufacturer advertising information and evaluation reports available. Examples are provided for information only and are not a particular product endorsement.

Conservation moorings have several potential benefits beyond conventional catenary system moorings. In addition to eliminating ground tackle scour impacts in benthic environments, elastic rode moorings can be situated with tighter packing ratios (i.e., smaller mooring radii). Conventional moorings with adequate anchors and properly selected chain can be constructed with a mooring scope ratio ranging between 2.5:1 and 4:1 (length of rode to water depth at extreme high tide). Conversely, conservation moorings with elastic rodes can have a mooring scope ratio as short as 1:1 or 2:1 (McAllister 2018). The ultimate mooring radius must account for the projected length of rode from center at the lowest tide, the pendant, the vessel length, and any allowance for stern tied dinghies. This will generate the mooring swing radius. To avoid vessel contact, the mooring swing radii should not overlap and vessels placed on moorings should be appropriate in scale to the designed mooring load and swing radii.

Conservation moorings have greater rode and pendant elasticity and therefore provide more consistent energy absorption curve than conventional chain tackle. This means that the elastic mooring rode and elastic pendant lines are more efficient at absorbing wave energy by continuously increasing the tension between anchor and the moored vessel. This is especially true when vessels are already pulled tight against moorings such as in strong current or wind and subject to wave impact. This means that vessels on elastic moorings tend to ride more smoothly than those on ground chain tackle and there is less potential for bow cleat pull-out due to static shock energy such as when chains are pulled tight.

Elastic mooring rode and storm pendants can provide a reduction in jarring impacts under severe storm conditions (photo from ecomooringsystems.com)

Relative to conventional tackle, conservation moorings have reduced annual mooring cost due to many factors including less abrasion of mooring components, more robust anchoring devices, and readily swappable components. Finally, from a designed and managed mooring area configuration, use of helical anchoring systems provides a degree of positional permanence that restricts the capacity to readily reposition moorings. This makes it easier to ensure a static layout of moorings.

While there are several positive attributes of conservation moorings, there are also some drawbacks. First, these moorings have a greater capital cost due to specialized equipment needed for setting helical anchors, greater component costs, and limited numbers of suppliers. Second, less mobile moorings, while a positive factor in limiting undesirable repositioning also limit capacity to complete desired reconfiguration of moorings. Finally, conservation moorings are not familiar to many mariners and harbor masters. This means that they suffer from a high degree of skepticism and a lack of installation, maintenance, and user expertise.

There have been a number of well referenced failures of conservation mooring components that are worth noting. However, these have generally not been failures of the basic mooring elements, but rather failures in application design, installation, and component selection. Most notable, helical anchor pullout has occurred with applications in very soft sediments, where limited or poor engineering has been undertaken, and where tension testing has not been undertaken. In general, helical anchors are an extremely effective anchoring system but they require good geotechnical data, installation expertise, and load testing to be effective. In many instances, helical anchors that are not professionally installed are undersized with inadequate length and/or helix diameter, incorrect helix vane numbers, or inadequate load testing. As a result, helical type anchors and other earth anchors such as Manta Ray anchors and are not authorized in the Tomales Bay mooring program (GFNMS 2018). Notwithstanding such application issues, helical anchors are a well-tested and understood anchoring methodology, but are not for amateur installations.

Other failures of conservation moorings have been related to component failures pairing in various installations as well as poor inspection and maintenance schedules. Perhaps the most notable example of issues with conservation moorings relate to Seaflex Mooring Systems installed off Santa Barbara's East Beach. In this application, 12 Seaflex Moorings were installed along with 45 single point conventional catenary moorings. In short-order 9 of the conservation moorings had failed (Hill 2012). Blame for the failure was spread widely but appears to be most likely related to chaffing of components as a result of inappropriate component pairing and inadequate maintenance. As a result of a 75 percent failure rate, Santa Barbara ceased installation of Seaflex moorings, but allowed the existing installed helical anchors to be retrofitted with conventional ground chain moorings.

Mooring Costs

Mooring costs vary significantly based on design, sizing, material costs, labor and equipment required for installation and number of moorings to be installed. In general, conventional moorings are less expensive to install than conservation moorings and garner less synergy of scale associated with installation of multiple moorings concurrently. A single point conventional catenary mooring with a gravity anchor costs approximately $1,000-$2,000 to install, depending much on the nature of the anchor used. Two and three point conventional moorings generally rely on plow anchors rather than gravity anchors and thus are often easier to install, but may include higher material and labor costs. As a result such moorings may run from $1,500-$2,500, depending mostly on the sizing of component parts.

Conservation moorings have a longer design life than conventional moorings, but cost more to install. As an example, the Hazelett mooring has a design life of 30 years and reduced maintenance needs compared to traditional moorings. Elastic rode components can be installed as 1 unit or 4 in parallel for heavier loads. As a result of the relevant range of configurations that may be required, the price for a single unit ranges from $1,700-$4,500 without anchors and $1,850-$5,000 with helical anchors for a single system. Installation may cost an additional $500 to $2,000 per unit when installed in multiples. For individual installations, costs may be even higher unless the helical anchor is omitted and a large gravity anchor is substituted instead. This is principally due to the need for specialized equipment to install the helical anchors.

Mooring Carrying Capacity

A goal of the present study was to determine the mooring carrying capacity of Richardson Bay. To do this the mooring suitability model (Figure 16) was used. Areas of potential moorings were distributed within the modeled suitable locations with a consideration of what uses were best suited within the areas. The outermost exposed areas were identified as suited to transient cruiser mooring uses and large vessel moorings. The more protected inner portions of the bay were identified as suitable for primary moorings, including smaller vessels. Finally, an area located within the Marinship Basin was identified as most suited to transitional and storm shelter moorings (Figure 19). This area was considered to be most suited to vessels that have been damaged and under repair, or vessels that are not yet seaworthy in a transition towards some of the outer mooring locations. Notably, the Marinship Basin presently supports eelgrass and it is expected eelgrass will continue to expand in this area as the site shoals to shallower depths. However, it was recognized that any mooring shift in Richardson Bay would require a transition area and storm refuge since many of the vessels are not considered to be presently seaworthy. As previously noted, the mooring areas identified only consider resolution of ecological conflicts and do not consider other factors of land and water uses, political, or social considerations.

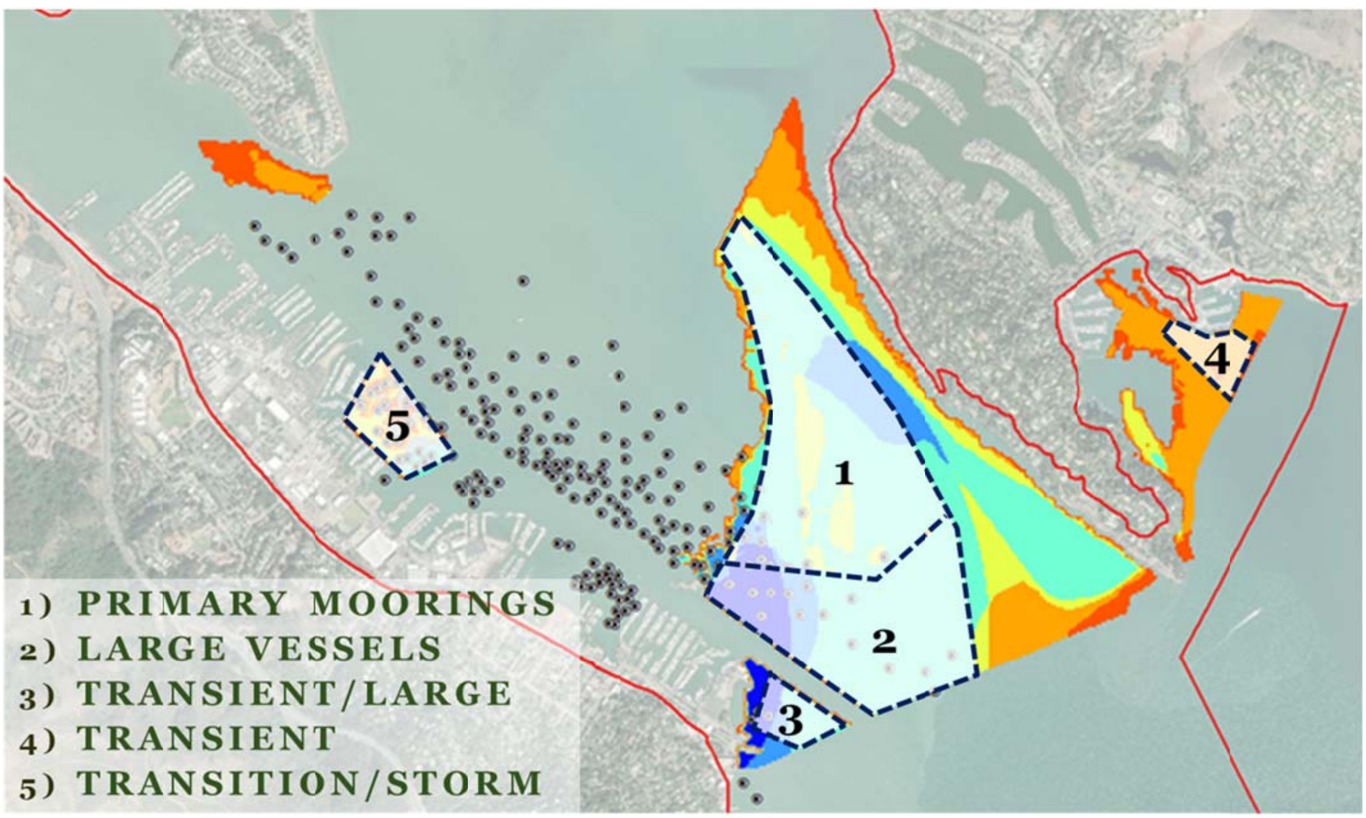
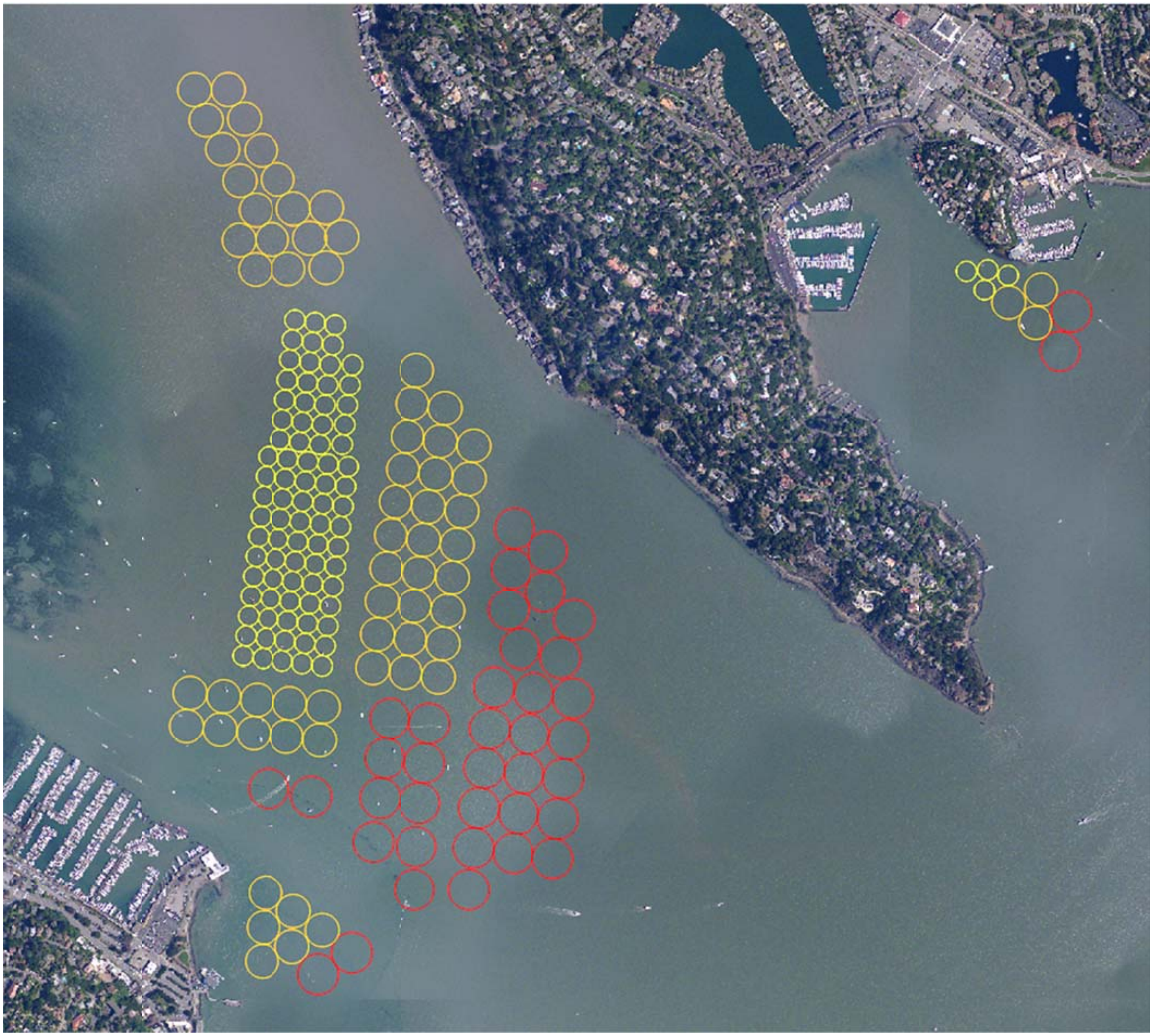


Figure 19. Potential mooring locations and uses to remove moorings from areas of ecological conflict.

The largest radii of moorings with conventional single point ground chains presently in use in the Richardson Bay moorings are approximately 150 feet. This mooring radii scale is much larger than required for either the present conventional ground tackle moorings or conservation moorings. When the suitable mooring locations are examined it is clear that dense packing of moorings with 75, 125, and the oversized 150 foot radii, would result in accommodation of a minimum mooring capacity in excess of 100 vessels. At a tight packing of moorings at the smaller 75 foot radii (still larger than necessary with conservation moorings), the number of moorings that could be accommodated are in excess of double the number of moorings presently existing within Richardson Bay.



Example configuration of moorings using extremely large radii of 75 feet (yellow), 125 feet (orange), and 150 feet (red). The tight packing of moorings with these larger than required radii demonstrates that capacity for mooring positioning exceeds need or desirability of any of the stakeholder parties. As such considerable flexibility would exist for scaling and adapting mooring locations to address concerns beyond the scope of the present study.

The adoption of policies to curb influx of new vessels and requirements for vessels in the bay to be sea-worthy means that the overall capacity of the suitable mooring locations is not an important consideration since the capacity is much greater than the vessel count available to make use of the area. However, this observation does point to the fact that opportunities are therefore available to optimize distribution of moorings based on consideration of non-ecologically based factors beyond the scope of this study.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study documents considerable ecological damage, predominantly to eelgrass habitat and presumably to resources associated with eelgrass as a result of existing mooring practices and locations. This impact has expanded in recent years. The study further documents ecological and water quality resources that are not likely to be significantly adversely affected. In the case of bird resources, robust analysis was not possible given the data available and a significant data gap exists.

The study also documented constraining factors influencing potential means of addressing ecological impacts. These included constraints of inadequate management resources both within government and community organization, constraints of existing mooring designs and vessel number and condition, and physical and biological constraints of the bay. Most notably, the majority of areas presently utilized by moored vessels are too shallow for appropriate mooring and vessels ground at low to extreme low tides.

Modeling suggests the opportunity for deconflicting moorings and eelgrass resources through spatial separation is possible. However, it is questionable that most of the existing anchor-out vessels are seaworthy and suited to relocation to more energetic environments identified through modeling.

Opportunities for reducing benthic impacts include changes in mooring technologies. This includes implementation of multi-point conventional moorings with three-point moorings being more desirable than two-point moorings. Conservation moorings are also suited for use within Richardson Bay.

Recommendations

While the study suggests means to resolve ecological conflicts several recommended actions would facilitate success of such an effort. These recommendations are:

- Enforce existing policies on vessel seaworthiness and registration
- Prohibit new vessels from becoming resident vessels by enforcing mooring time limit restrictions
- Remove unoccupied vessels and enforce a one resident, one vessel goal
- Relocate vessels out of eelgrass and into deeper waters to the south
- Install publically owned three-point conventional moorings or conservation moorings in deeper waters
- Eliminate privately owned and maintained moorings or dictate specific designs and locations
- Number all moorings and assign occupants to specific moorings to reduce management complexity
- Commit staffing and vessel resources necessary for effective enforcement
- Schedule, complete, and document regular tackle inspections
- Enlist and support community collaboration in self-reliant management to reduce enforcement needs
- Explore mooring fee-based or other means of funding regular maintenance costs
- Pursue capital funding through grants, and maybe mitigation funds to implement initial actions necessary to remove non-seaworthy vessels and relocate sea-worthy vessels

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RICHARDSON'S BAY
REGIONAL AGENCY

Richardson's Bay
Eelgrass Protection and Management Plan

July 28, 2021

Prepared for:

Richardson’s Bay Regional Agency
c/o Marin County Community Development Agency
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Executive Summary

Richardson's Bay, located north of the Golden Gate in Marin County, supports the second largest eelgrass bed in the San Francisco Bay Area. This eelgrass in turn supports tens of thousands of migratory waterbirds every year and is the preferred spawning location for over 90% of the Bay Area's Pacific herring population. Despite its ecological importance, the eelgrass bed of Richardson's Bay has been damaged by the anchors, chains, and other ground tackle of boats in the Richardson's Bay anchorage. In July of 2020, Coastal Policy Solutions was retained by the Richardson's Bay Regional Agency (RBRA) to develop the agency's Eelgrass Protection and Management Plan (EPMP). The goal of the EPMP is to establish boundaries for where anchoring can or cannot occur in Richardson's Bay in order to protect eelgrass resources and prevent further damage to the eelgrass bed from anchor scour. The development of the EPMP proceeded as follows:

- Fall 2020: Policy review and stakeholder engagement
- Winter 2021: Spatial analysis and draft plan development
- April 2021: Draft EPMP released, 30-day comment period opened
- June 2021: Response to Comments Report released, feedback received from RBRA Board of Directors for EPMP finalization
- July 2021: Final EPMP adopted by RBRA Board of Directors

The EPMP consists of three main sections: Introduction, EPMP Framework, and Plan Elements. The first two sections deal mainly with background information and EPMP development. The provisions of the plan, including the adopted boundary for the Eelgrass Protection Zone/No Anchoring Area, are included in the "Plan Elements" section of the document. The adopted boundary is depicted in Figure 11 on page 15 and demarcates an "Eelgrass Protection Zone/No Anchoring Area" northwest of a line extending from Channel/Day Marker Four along the navigation channel offshore of Sausalito to the southernmost tip of the Richardson's Bay Audubon Sanctuary. This boundary will be codified into relevant regulations during the coming months. Also included in the Plan Elements section are recommendations for EPMP implementation, wildlife and water quality monitoring, and reference to possible future mooring and/or restoration programs not proposed in, but which are consistent with, the EPMP.

The development and implementation of the EPMP represents the fulfillment of policies contained in the RBRA's June 2020 Transition Plan for the anchorage, which aims to protect the environment and public health, and support recreational use of the Bay, while reducing the number of occupied and/or abandoned vessels in the Bay. This EPMP was developed with the input of dozens of individual and organizational stakeholders and represents a feasible, cost effective program for protecting eelgrass in Richardson's Bay now and for future generations.

Introduction

Background

Richardson's Bay is managed by the Richardson's Bay Regional Agency (RBRA), a local government agency serving Belvedere, Mill Valley, Tiburon, and unincorporated Southern Marin County, in coordination with the City of Sausalito (Figure 1). In June of 2020, the RBRA adopted a "Transition Plan[1]" for the Richardson's Bay anchorage, which aims to protect the environment and public health, and support recreational use of the Bay, while reducing the number of occupied and/or abandoned vessels in the Bay.

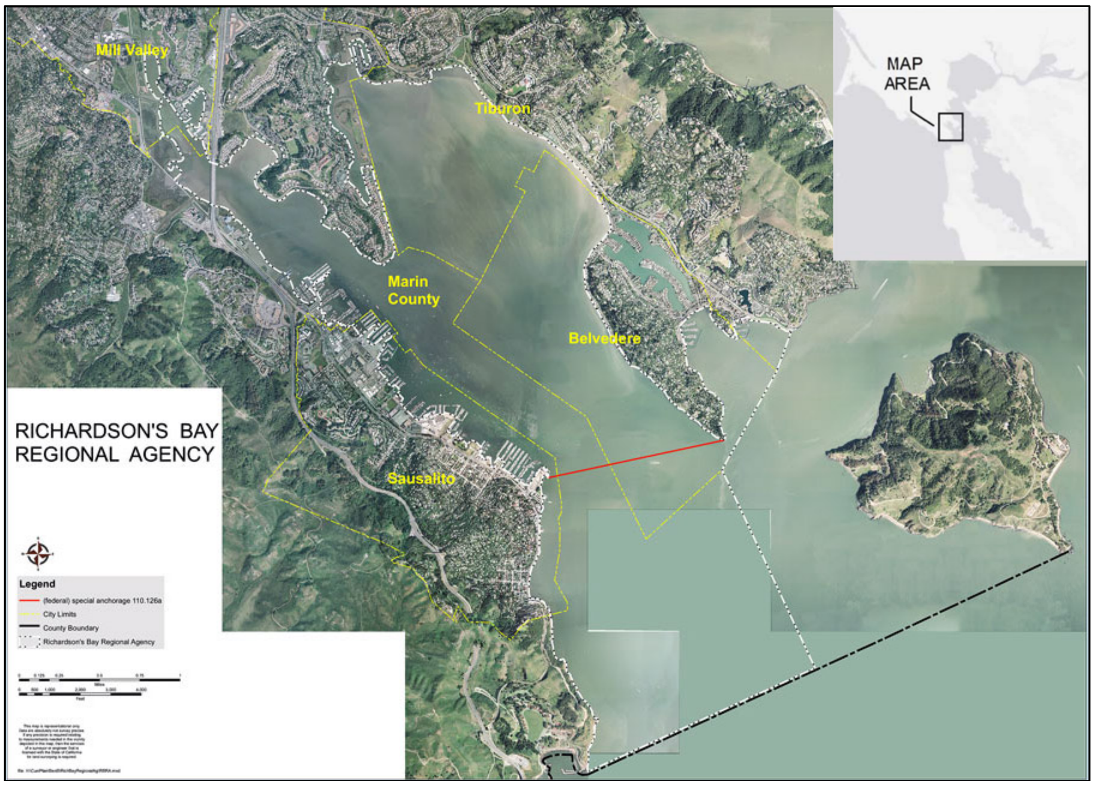

Figure 1 - Jurisdictional Map of Richardson's Bay

The Transition Plan explicitly affirms Richardson's Bay as a temporary anchorage (*i.e.*, an anchorage with enforceable time limits for a visiting vessel's length of stay), and includes initiatives aimed at increasing the seaworthiness of vessels on the anchorage and connecting vulnerable individuals living on the water with safe housing alternatives. Of the five Policy Directions included in the Transition Plan, four speak directly to issues relating to vessel enforcement, seaworthiness, and occupied vessels. The fifth Policy Direction relates to the protection and restoration of the Bay's vital eelgrass beds, and reads as follows:

> *5) Working with agencies, organizations, and other stakeholders, develop eelgrass protection measures and consider specific eelgrass restoration funding and projects.*

[1] Available online: http://rbra.ca.gov/about-rbra/transition-plan/

The full text of Policy Direction Five establishes "the potential designation of up to four zones in Richardson's Bay for varying levels of vessel usage and eelgrass restoration ad protection," including the establishment of areas in Richardson's Bay "where vessels would not be authorized to anchor or moor."

The Transition Plan was adopted by the RBRA board on June 11, 2020 and RBRA retained Coastal Policy Solutions that July to implement Policy Direction Five. It was identified that the best way to implement this Policy Direction would be to develop and implement an Eelgrass Protection and Management Plan (EPMP) using a spatial planning approach to manage natural resource conflict in Richardson's Bay. The draft EPMP was delivered to the RBRA Board of Directors in April 2021 and a final EPMP was delivered to the Board in July 2021.

About Richardson's Bay

Richardson's Bay is a relatively shallow embayment covering approximately 1,270 hectares (3,138 acres) of mostly open water habitat in Marin County, California. The Bay is located approximately 1.3 km (0.8 miles) upstream (northeast) of San Francisco's Golden Gate Bridge and includes areas under the jurisdictions of the Cities of Sausalito, Mill Valley, and Belvedere, as well as the Town of Tiburon and the County of Marin. Richardson's Bay has a long history of human use, dating back to pre-European settlement of the Bay Area when the land was part of Coast Miwok tribal territory for at least 13,000 years[2].

Like much of the rest of California, the area ultimately came under Spanish, then Mexican, and finally United States rule through the 18th-19th centuries, with large ships anchoring in the Bay since at least the 1890s[3]. Through the late 19th and 20th centuries, the shoreline of Richardson's Bay was extensively developed for commercial, residential, and maritime purposes. In addition to the floating homes in the marinas of Sausalito, many boaters continued to live on vessels in the anchorage of Richardson's Bay. In response to the growing number of so-called "anchor out" vessels, as well as ongoing shoreline development pressure, local governments and the San Francisco Bay Conservation and Development Commission developed the "Richardson Bay Special Area Plan".

Finalized in 1984, the plan's goals were "protection of [the Bay's] natural resources; use of the water for water-oriented purposes; restoration and enhancement of degraded tidal wetlands; and provision of public access to and along its shoreline." To implement this plan and provide coordination amongst the several municipalities with jurisdiction over the Bay, the Richardson's Bay Regional Agency was established in 1985 as a joint powers authority governing Richardson's Bay. Despite direction in the Special Area Plan to enforce time limits on boats anchoring in Richardson's Bay, the population of permanent liveaboards expanded from about 90 boats in the 1970s to over 240 boats in 2016[4] with many boats experiencing disrepair and

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[2] See: https://native-land.ca/maps/territories/coast-miwok/ and https://www.marinmiwok.com/

[3] Clinton, L. (2001) *Barging in: a short history of liveaboards on the Bay*. Bay Crossings, San Francisco, CA. http://www.baycrossings.com/ Archives/2001/07_August/barging_in.htm. Accessed 15 Apr 2018

[4] Fimrite, P. (2017) As more "anchor-outs" live on SF Bay, tension mounts on land. San Francisco Chronicle.

abandonment. Though not the only thing impacting eelgrass in Richardson's Bay (see the section on eelgrass below), these boats have directly removed up to 80 acres of eelgrass from the bay floor as of 2019 due the scraping of anchors, chains, and other ground tackle[5].

For a fuller description of the relationship between eelgrass and vessels anchored/moored in Richardson's Bay, see the 2019 "Ecologically-based Mooring Feasibility Assessment and Planning Study" prepared by Merkel and Associates for RBRA. Available online: http://rbra.ca.gov/wp-content/uploads/2019/11/RBRA-Ecologically-based-Mooring-Study_11-11-19.pdf

Eelgrass in Richardson's Bay

Historically, the shoreline of Richardson's Bay would likely have supported expansive native bayland habitats, including riparian areas, tidal marsh wetlands, mudflats, and, in subtidal areas, eelgrass beds. Though most of the Bay's shoreline has been developed, and much of these habitats lost, the area remains a critical natural resource owing in large part to its remaining eelgrass bed. The Richardson's Bay eelgrass bed varies in size but has averaged around 197 hectares (487 acres) between 2003 to 2014, with over 800 acres identified in 2019[6].

Figure 2- Eelgrass covered in herring eggs. Photo: California Department of Fish and Wildlife

The attributes that make Richardson's Bay attractive to boaters are also those that contribute to ideal habitat for California's native eelgrass, *Zostera marina*. Shallow depths, regular tidal flushing, and relatively low turbidity have made Richardson's Bay an eelgrass stronghold, even during periods of region-wide eelgrass decline. Eelgrass is critically important for the health of coastal estuaries as well as climate resilience for coastal communities. Eelgrass beds reduce coastal erosion, sequester carbon, reduce ocean acidification, and provide nursery habitat for commercially, recreationally, and ecologically important marine life (e.g., Pacific herring and Dungeness crab)[7].

The bays and estuaries of California are a stronghold for eelgrass, even as the species experiences significant declines along the Pacific Coast and abroad (at global decline rates of up

[5] Kelly, J. J., Orr, D., & Takekawa, J. Y. (2019). Quantification of damage to eelgrass (*Zostera marina*) beds and evidence-based management strategies for boats anchoring in San Francisco Bay. *Environmental management*, *64*(1), 20-26.

[6] Merkel & Associates (2019). Ecologically-based Mooring Feasibility Study for Richardson's Bay. *Richardson's Bay Regional Agency*. Sausalito, California.

[7] Orth, Robert J., et al. (2006) "A global crisis for seagrass ecosystems." *Bioscience* 56.12: 987-996.

to 30,000 acres per year[8]). Just five bays support over 80% of our state's remaining eelgrass[9], with 50% found in San Francisco Bay alone[10], and the Richardson's Bay eelgrass bed is the second largest in the San Francisco Bay estuary. Beyond its size, the Richardson's Bay eelgrass bed is also disproportionately important in supporting commercial and recreational fisheries – in the 2019/2020 Pacific herring season, for example, 90% of San Francisco Bay's herring spawning biomass occurred in Richardson's Bay[11]. Tens of thousands of migratory waterfowl and shorebirds rely on Richardson's Bay eelgrass beds for feeding and resting during migration along the Pacific Flyway[12]. Without the eelgrass-herring ecosystem, species survival would be in jeopardy.

Figure 3- Birds using Richardson's Bay.
Photo: B. Hinz. Courtesy of Audubon California

Despite its importance, eelgrass faces myriad threats, both locally and regionally. Human activity (e.g., dredging, boating, and anchoring) and climate change (sea level rise and warming ocean temperatures) are leading threats to eelgrass. This is coupled with limited restoration success, and a lack of both formal valuation and community understanding of its benefits[13]. In Richardson's Bay, eelgrass is only able to survive in up to about 1.7 m (5.5 feet) of water[14]. Because of eelgrass's narrow depth limits, coupled with Richardson's Bay homogeneous bathymetry (i.e., the bay floor is relatively flat), just a few inches of sea level rise will likely drown out the deepest areas of the eelgrass bed. Therefore, improved management of the eelgrass bed is required as part of the area's climate resilience and adaptation efforts.

Since January 2018, RBRA staff have removed more than 180 abandoned and derelict vessels from the Richardson's Bay anchorage. This, coupled with active enforcement of the Bay's 72-hour time limit for visiting vessels, has greatly reduced the impact of boats on eelgrass in Richardson's Bay. However, more specific action is needed to actively protect of eelgrass in Richardson's Bay. This is because existing regulations allow for boats to anchor almost

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[8] Waycott, M., Duarte, C.M., Carruthers, T.J., Orth, R.J., Dennison, W.C., Olyarnik, S., Calladine, A., Fourqurean, J.W., Heck, K.L., and Hughes, A.R. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. Proc. Natl. Acad. Sci. 106, 12377–12381.

[9] National Fisheries, West Coast Region, National Oceanic and Atmospheric Administration, 2014. California Eelgrass Mitigation Policy and Implementing Guidelines.

[10] Merkel & Associates (2009). San Francisco Bay Eelgrass Inventory: October - November 2009 (San Diego, CA).

[11] California Department of Fish and Wildlife report to the Director's Herring Advisory Committee Meeting (October 13, 2020)

[12] Audubon California. 2018. Eelgrass, herring, and waterbirds in San Francisco Bay: a threats and opportunities assessment. Report to the Gordon and Betty Moore Foundation. Richardson Bay Audubon Center & Sanctuary. Tiburon, California.

[13] *Id.*

[14] Merkel, K. (2004) Baywide Eelgrass Inventory of San Francisco Bay. Merkel & Associates, Inc., San Diego, CA

anywhere in Richardson's Bay (including in areas of eelgrass), with the exception of the Audubon Sanctuary in northern Richardson's Bay, Sausalito's Dunphy Park, and certain channels. As long as boats are in compliance with time limits and seaworthiness, there are currently no anchoring location restrictions to protect the Bay's eelgrass beds.

Regulatory/Policy Context

Richardson's Bay and its natural resources, including eelgrass, exists within an overlapping framework of laws, regulations, policies, and directives. While we do not intend to fully describe or unpack that framework here, several of these policies have significantly informed EPMP development and are described below.

- McAteer-Petris Act[15] (enacted 1965, amended many times since) – This is the key legal provision under California state law to preserve San Francisco Bay from indiscriminate filling. Established the Bay Conservation and Development Commission (BCDC).
- San Francisco Bay Plan[16] (adopted 1969, amended since) – Includes major policies and findings for the long term use of San Francisco Bay. Objectives: 1) Protect the Bay as a great natural resource for the benefit of present and future generations; and 2) Develop the Bay and its shoreline to their highest potential with a minimum of Bay filling. Several findings and policies are relevant here, including Subtidal Areas Policy #2: "Subtidal areas that are scarce in the Bay or have an abundance and diversity of fish, other aquatic organisms and wildlife (e.g., eelgrass beds, sandy deep water or underwater pinnacles) should be conserved."
- Richardson's Bay Special Area Plan[17] (adopted 1985) – Adopted a common set of policies, findings, and regulatory controls for managing Richardson's Bay. Several of these are relevant for the EPMP, including Aquatic and Wildlife Resources Policy #1: "Eelgrass beds, important to herring spawning and for production of detritus, should also receive maximum protection."
- California Eelgrass Mitigation Policy[18] (CEMP) and Implementing Policies (adopted 2014) – Established a National Marine Fisheries Service policy of "no net loss of eelgrass habitat function in California" and provided compensatory mitigation ratios for unavoidable loss of eelgrass habitat function. Note that this EPMP does *not* intend to serve as a Comprehensive Management Plan (CMP) as defined on page 17 of the CEMP, but may serve as a basis for future CMP efforts.
- Recent direction from the BCDC Enforcement Committee to "address eelgrass damage and restoration."[19]
- RBRA Transition Plan (adopted June 2020) – Policy Direction #5 states, "Working with agencies, organizations, and other stakeholders, develop eelgrass protection measures and consider specific eelgrass restoration funding and projects."

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[15] Available here: https://www.bcdc.ca.gov/plans/mcateer_petris.html
[16] Available here: https://www.bcdc.ca.gov/plans/sfbay_plan.html
[17] Available here: http://rbra.ca.gov/wp-content/uploads/2018/04/Special_Area_Plan-1.pdf
[18] Available here: https://media.fisheries.noaa.gov/dam-migration/cemp_oct_2014_final.pdf
[19] Described here: https://bcdc.ca.gov/enforcement/2021/20210324-ITEM-7-Richardson's-Bay-Staff-Presentation-FINAL.pdf

EPMP Framework

Development of the EPMP

This EPMP was developed in three parts: policy review, stakeholder engagement, and spatial analysis/planning. During the policy review, relevant laws, regulations, policies, and directives were analyzed to identify appropriate actions for protecting and managing eelgrass in Richardson's Bay (see Regulatory/Policy Context section above).

Following the policy review, stakeholder engagement was conducted during fall 2020 and winter 2021. Stakeholder engagement included the following:

- Five 1.5 hour facilitated listening sessions were held via Zoom, targeting environmental groups, scientists, elected officials, marina operators, resource/regulatory agencies, and Richardson's Bay mariners. These sessions engaged 40+ participants representing 20+ organizations (Figure 4).

Organizations Represented		
Audubon CA	Marin Audubon Society	Regional Water Quality Control Board
Bay Conservation and Development Commission	Marin Conservation League	San Francisco Bay Joint Venture
Belvedere City Council	County of Marin	San Francisco State University - Estuary and Ocean Science Center
California Department of Fish and Wildlife	Marina Plaza Harbor	Sausalito Yacht Harbor
California State Coastal Conservancy	Merkel and Associates	US Army Corps of Engineers
City of Sausalito	NOAA Fisheries	Waldo Point Harbor
Galilee Harbor	Pew Charitable Trust	

Figure 4- Organizations represented during stakeholder engagement listening sessions.

- During these sessions, participants were provided with an overview of the EPMP process and information about eelgrass, and were then taken through a series of facilitated questions addressing threats to eelgrass in Richardson's Bay, key uses to consider during EPMP development, and time for additional thoughts/questions.

Despite repeated, targeted attempts to reach the community of individuals living on the water in Richardson's Bay (Figure 5), none participated in the formal EPMP stakeholder engagement. Unfortunately, this community is notoriously hard to reach using virtual engagement strategies, and in-person outreach was severely limited due to the COVID-19 global pandemic. In efforts to engage mariners, links for participation were shared at three RBRA meetings, posted to social media, and shared directly with key members of the mariner community. Mariner-focused Zoom listening sessions were held on three separate occasions (two during the day, including during and after the free lunch provided by Sausalito Presbyterian Church, and one in the evening). Additionally, an email address was set up where people could email their thoughts directly to project consultants.

Fortunately, significant stakeholder feedback from the mariner community was generated during the 2018/2019 RBRA meetings held during the development of the Ecologically-based Mooring Feasibility Assessment and Planning Study as well as the Transition Plan. This feedback was reviewed during the EPMP development process.

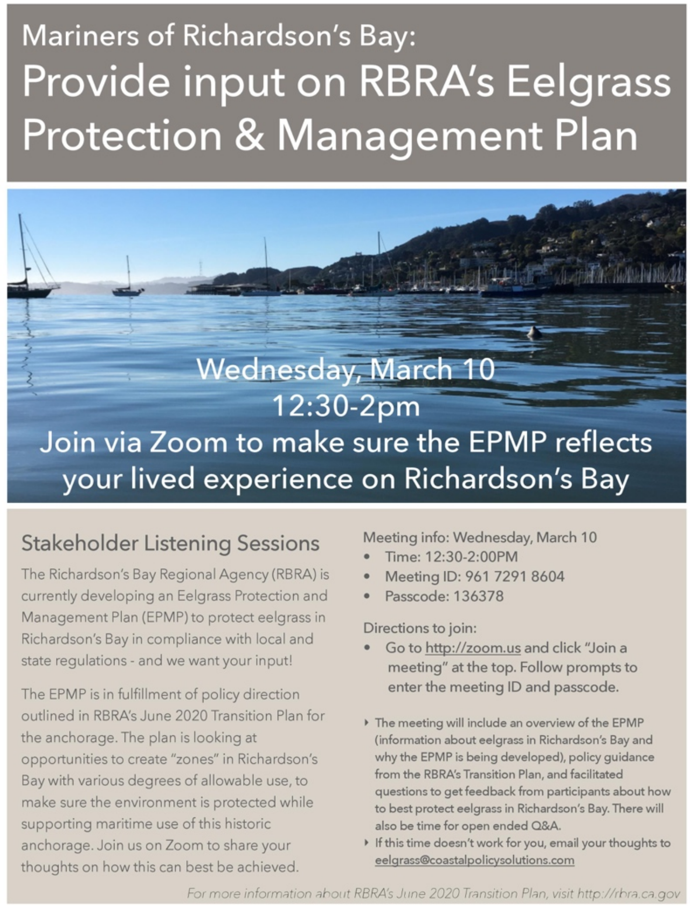

Figure 5- Example flier for targeted outreach to mariners

Following the stakeholder engagement, spatial analysis was conducted and two preliminary proposed boundary areas were developed for an "Eelgrass Protection Zone/No Anchoring Area." These two plans were included in a draft EPMP, which was presented to the public and the RBRA Board of Directors at their April 2021 RBRA Board meeting. Board and public feedback were received at that time and the Board commenced a 30 day comment period. Following the comment period, a Response to Comments Report was prepared and delivered to the public and the RBRA Board of Directors at their June 2021 RBRA Board meeting. At that meeting, the RBRA Board provided direction for EPMP finalization, including a preferred boundary for the Eelgrass Protection Zone/No Anchoring Area.

Summary of Stakeholder Feedback

A full presentation describing stakeholder feedback was presented to the RBRA Board of Directors during their monthly meeting on December 10, 2020. A recording of that meeting is available online at: http://rbra.ca.gov/meeting-archives/. A summary of stakeholder feedback by theme is described below.

Theme 1: Threats to Richardson's Bay to consider during EPMP development

- Sea level rise and other impacts of climate change
- Public safety
- Damage from anchors, chains, and other ground tackle
- Marine debris
- Stormwater runoff/water quality
- Shading and other impacts from docks
- Loss of maritime culture (not just liveaboards), including herring/fishing culture

- Regulatory burdens on marina operators
- Natural fluctuation in eelgrass determining static boundaries
- Lack of awareness about importance of eelgrass to communities

Theme 2: Uses to consider during EPMP development

- Richardson's Bay is an anchorage
- Recreation, especially non-motorized
- RB as a sailing destination for cruisers/visiting vessels
- Education
- Marinas
- Science/research
- Eelgrass restoration and bed migration with sea level rise
- Birds and wildlife
- Beneficial reuse of sediment/dredge material
- Opportunities for deeper water off Belvedere/Tiburon

Theme 3: Additional feedback

- Vessel enforcement will be key to success
- Partnerships important
- Should include monitoring on ecological scale (10 years+)
- Don't make marina operation harder
- Keep zones as simple as possible (anchoring/no anchoring)
- Include an alternatives analysis
- Mooring program: safer, better for eelgrass; should be considered now rather than a separate planning process down the line; visitor-serving, revenue generating
- Need for spatial analysis, not just planning
- Need to consider social issues/impacts of EPMP implementation, especially with regards to people living on the anchorage

Spatial Analysis and Preliminary Proposed No Anchoring Areas

The spatial analysis used in development of this final EPMP consisted of two main parts: 1- GIS mapping and analysis of eelgrass distribution/ frequency of occurrence as well as the distribution of herring spawning events; 2- Development and consideration of two initial proposed boundaries for an "Eelgrass Protection Zone/No Anchoring Area", including an estimate of each zone's size (acreage) and carrying capacity for anchored vessels. The two aspects of spatial analysis are described more fully below.

1. <u>Distribution of eelgrass and herring in Richardson's Bay:</u> To plan for and mediate natural resource conflict in Richardson's Bay, the following data layers were analyzed and mapped using geographic information systems (GIS) mapping software:
    - NOAA Nautical Chart #18649 – This navigational chart was used as the base layer for the spatial analysis so that any recommendations for zoning were based on how the space is being used by mariners on the water.

- Eelgrass Frequency Distribution (Figure 6) – Based on data collected in 2003, 2009, 2013, 2014, and 2019, this data layer exhibits the extent of eelgrass in Richardson's Bay during the contributing years, regardless of cover class (*i.e.*, percent cover or density). This provides insight about where eelgrass is most frequently occurring in Richardson's Bay and provides a way to manage for the spatial variability of eelgrass across years. These data were provided by Merkel and Associates.
- Herring Spawning Occurrences (Figure 7) - Herring spawn deposition spatial data for the years 2013-2020 were mapped. This provides insight regarding how the eelgrass resources are being used by other species in the ecosystem to ensure that areas proposed for protection adequately encompass how the system functions. These data were provided by the California Department of Fish and Wildlife. (Note: mapping of waterbird use of Richardson's Bay was not included due to the limited availability of robust, spatial explicit data but would be valuable for future adaptive management efforts if the data become available.)
- Combined eelgrass frequency distribution and herring spawning occurrences (Figure 8) – The same eelgrass and herring data layers as used in the individual analysis were combined to be viewed simultaneously to better understand combined spatial use of the Bay.

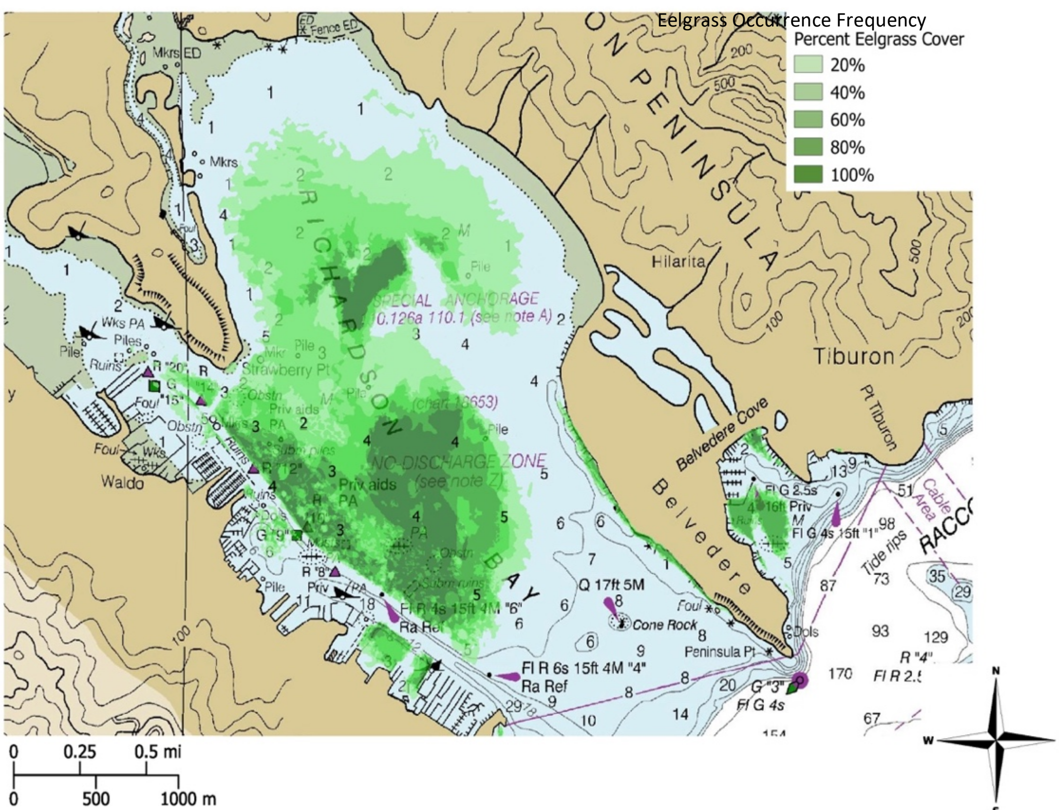

Figure 6- Eelgrass frequency distribution in Richardson's Bay (2003-2019)
Data are derived from side-scan sonar surveys conducted by Merkel and Associates in years 2003, 2009, 2013, 2014, and 2019. The data layer exhibits the frequency with which eelgrass was identified during survey years, regardless of cover class (percent cover/density).

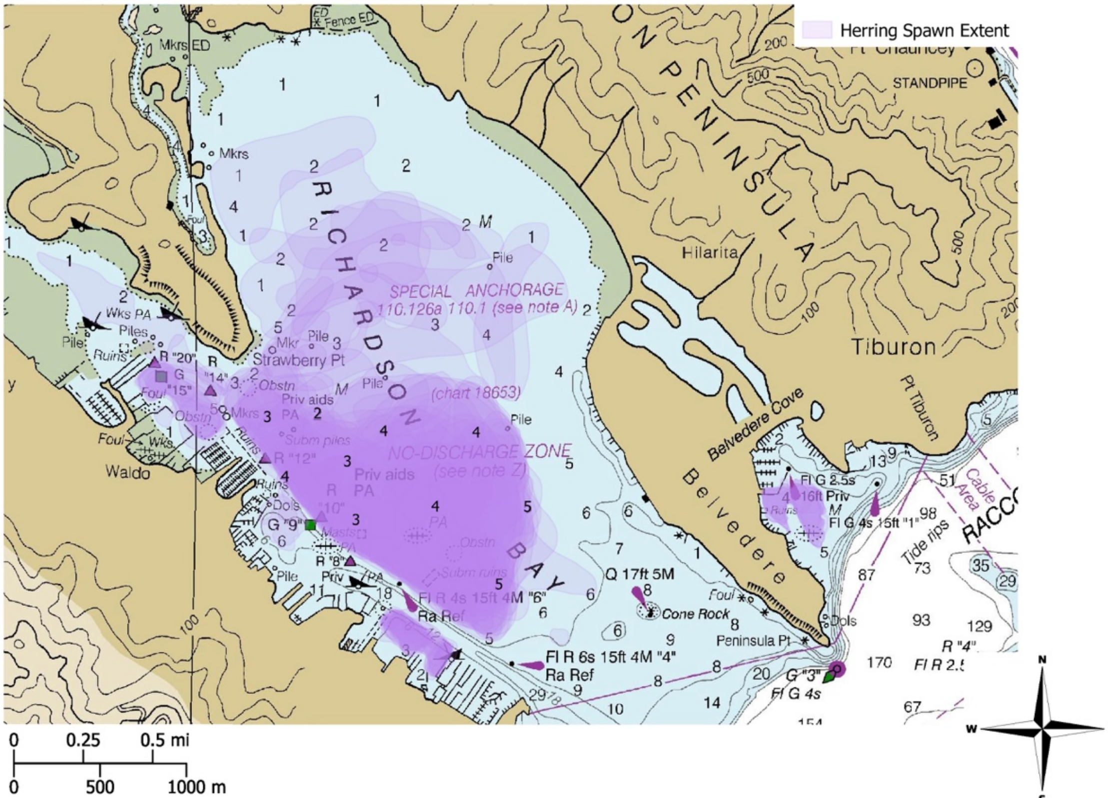

Figure 7- Herring spawning events, depositional data (2013-2020)
Each purple polygon represents one spawning event. Note: multiple spawning events occur during each year. Areas of darker purple indicate repeated spawning events.

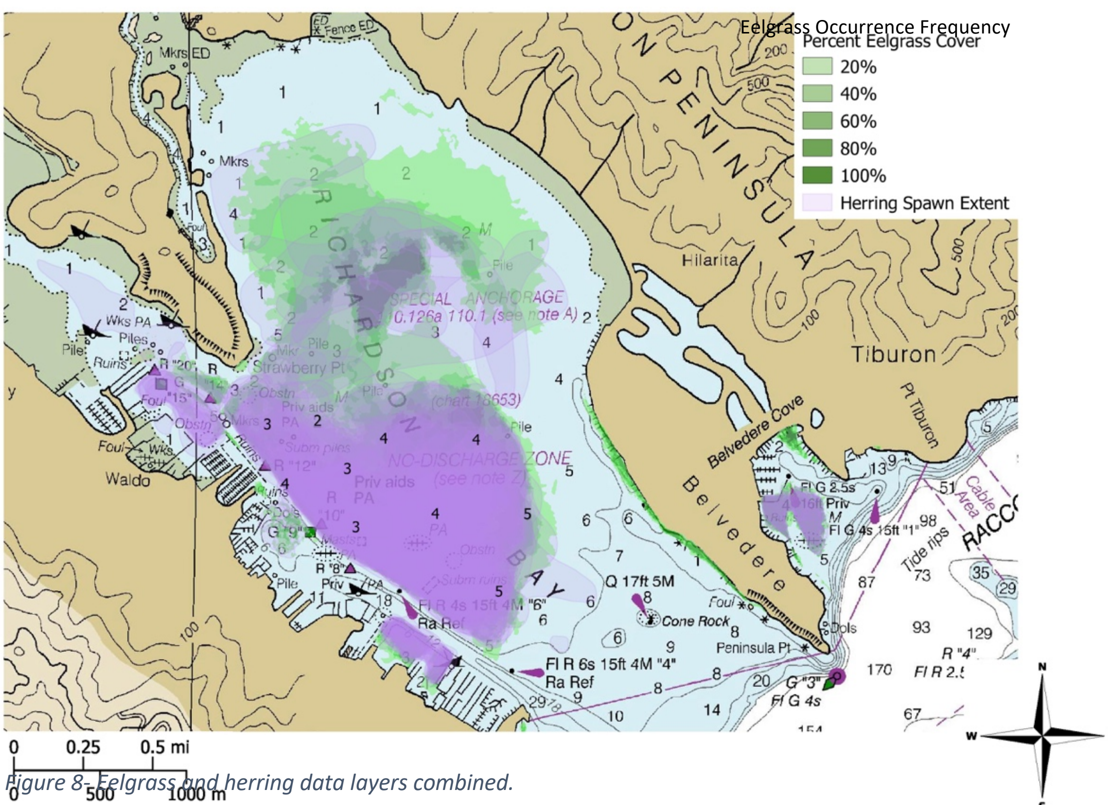

Figure 8- Eelgrass and herring data layers combined.

2. Preliminary Proposed No Anchoring Areas: Based on the policy review, stakeholder engagement, and the eelgrass/herring spatial analysis, two initial “Eelgrass Protection Zone/No Anchoring Areas” were proposed in the draft EPMP.

    - **Proposed Boundary A**: This boundary demarcates an “Eelgrass Protection Zone/No Anchoring Area” northwest of a line extending from Channel/Day Marker Four to the southernmost tip of the Richardson’s Bay Audubon Sanctuary, shown in the image below as “Proposed Boundary A” (Figure 9).

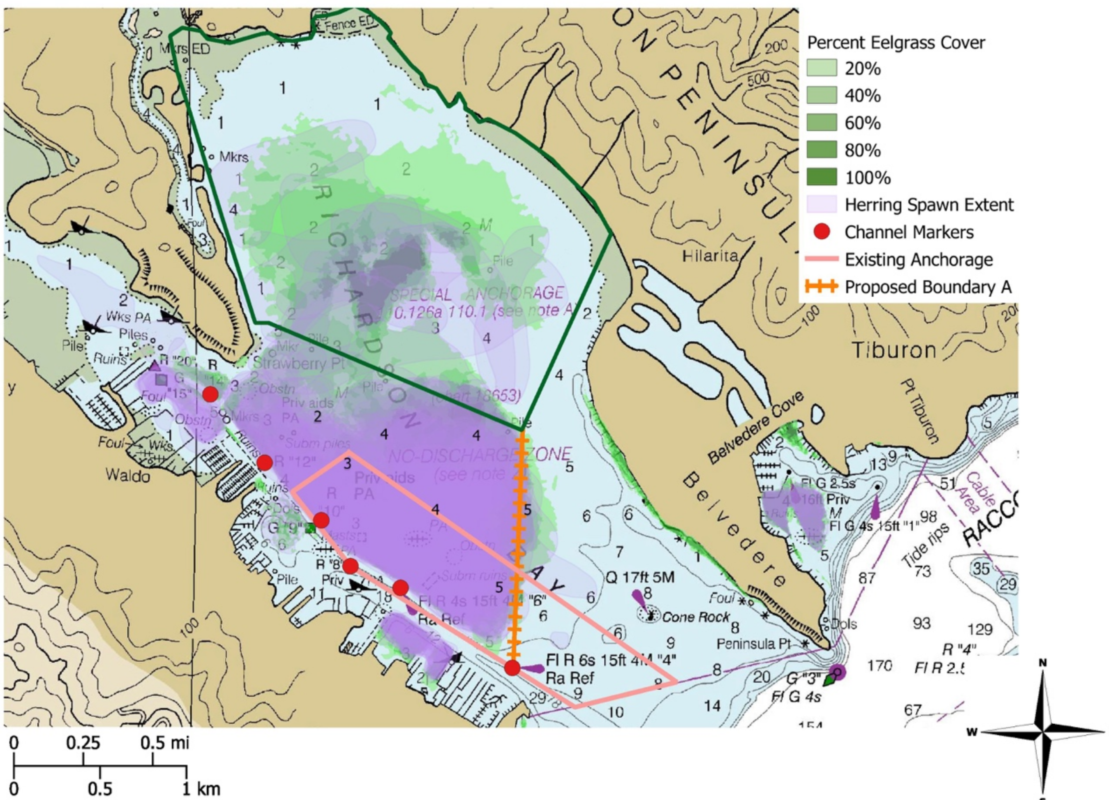

Figure 9- Eelgrass Protection Zone/No Anchoring Area (Proposed Boundary A)

To protect eelgrass in Richardson’s Bay from damage associated with anchor scour, an “Eelgrass Protection Zone/No Anchoring Area” is proposed. The proposed area extends northwest of a line running from Channel Marker Four in the south to the southern tip of the Audubon Sanctuary in the north (the orange hashed line in the figure above). This area would be off-limits for anchoring, but available for all other activities allowed in Richardson’s Bay (e.g., sailing, motoring, kayaking, etc.).

    - **Proposed Boundary B:** An alternative boundary for the “Eelgrass Protection Zone/No Anchoring Area” was considered (Figure 10), which followed the six-foot contour shown on the nautical navigation chart for the area, shown below as “Proposed Boundary B”.

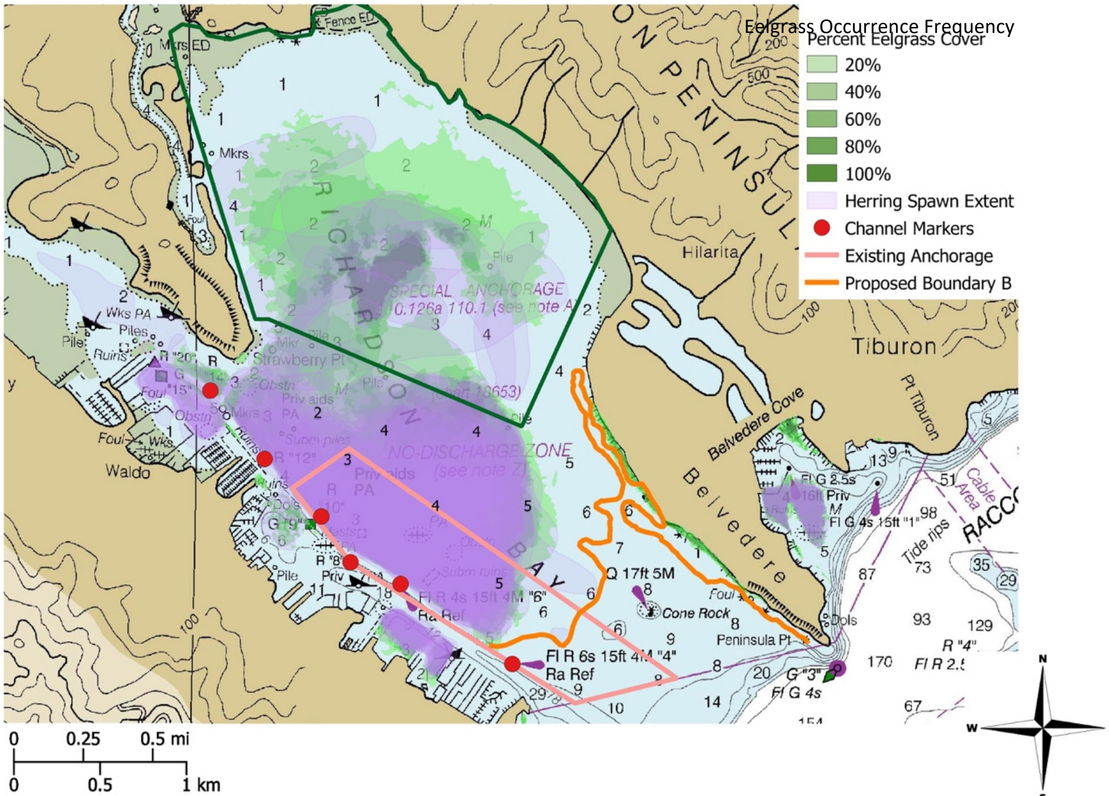

Figure 10- Eelgrass Protection Zone/No Anchoring Area (Proposed Boundary B)

An alternate boundary for the Eelgrass Protection Zone/No Anchoring Area that followed the existing six-foot navigational contour was considered, depicted as the orange line in the image above. While this boundary more fully protected the full extent of eelgrass in Richardson's Bay, with room for bed expansion, the enforcement of such a boundary was deemed infeasible and it provided too little area for anchoring.

- **Analysis of Proposed Boundaries:**
    - Because both boundaries prohibit anchoring in areas where anchoring and eelgrass have historically overlapped, both are consistent with the CEMP's no-net-loss policy as described in the Regulatory/Policy Context section above, as well as eelgrass policies in other guiding documents.
    - By including the eelgrass along the shoreline of Belvedere, Proposed Boundary B explicitly places 100% of eelgrass within the No Anchoring Zone. However, this boundary would also disallow anchoring in significant portions of unvegetated bay-bottom without additional benefits to the eelgrass.
    - By using existing boundaries (Audubon Sanctuary) and existing channel markers (Day Marker Four), and creating one clear Eelgrass Protection Zone/No Anchoring Area, Proposed Boundary A is consistent with stakeholder feedback requesting fewer, simpler zones as compared to the draft zones described in the Transition Plan. Meanwhile, Proposed Boundary B is likely to be confusing for visiting mariners and difficult to communicate with on-the-water signage.

- Both proposals would only prohibit anchoring from occurring in the Eelgrass Protection Zone/No Anchoring Area. All other activities currently supported in Richardson's Bay (kayaking, sailing, motoring, fishing, etc.) would be unaffected by the proposed changes. However, all allowed activities would be required to avoid damaging the eelgrass below (i.e., avoiding propeller and/or keel dragging along the bay bottom).
- Neither proposal has foreseen consequences on local marinas and do not change regulations affecting their operations.

- **Acreages available for anchoring**: RBRA regulations currently identify an official "RBRA Anchoring Area" in Marin County waters where boats are permitted to anchor for up to 72 hours (shown as the salmon-colored rectangle in Figures 9 and 10). Anchoring in the City of Belvedere waters north and east of the RBRA Anchoring Area is allowed for a maximum of 10 hours. The table below shows acreages for both existing anchoring areas (RBRA and Belvedere), and the acreages of those areas under both proposed No Anchoring Zone boundaries.

Existing area for anchoring (acres)			Proposed Boundary A (acres)			Proposed Boundary B (acres)		
RBRA Anchoring Area	Belvedere Water	Total	RBRA Anchoring Area	Belvedere Water	Total	RBRA Anchoring Area	Belvedere Water	Total
262.7	464.6	727.2	89.5	316.0	405.5	66.0	171.5	237.5
Percent of existing:			34%	68%	56%	25%	37%	33%

- **Carrying Capacity**: The carrying capacity of an anchorage is difficult to estimate because there are many variables to consider, such as boater preference, distance to shore access, water depth, availability of pump-out services, and varying wind and current conditions, etc. However, a rough estimate of carrying capacity of the Richardson's Bay anchorage under various scenarios was calculated as follows: The maximum number of vessels anchored in Richardson's Bay was documented at approximately 240 boats in 2016. Assuming that figure approximates the maximum functional carrying capacity of the existing anchorage, the carrying capacities of the reduced-size anchorages can be approximated based on the percent reduction in space for anchoring.
  - Therefore, a very rough approximation of the anchorage's carrying capacity is:
    - Existing anchorage: 240 boats
    - Proposed Boundary A: 56% of 240 = 134 boats
    - Proposed Boundary B: 33% of 240 = 79 boats
  - As of the date of this writing, 15 vessels are enrolled in the RBRA's Safe and Seaworthy Program. Either proposed scenario would provide ample accommodation for so-called "legacy" liveaboard vessels and visiting cruisers.

Plan Elements

Eelgrass Protection Zone/No Anchoring Area

In adopting this EPMP, the RBRA Board of Directors adopts and plans to implement an "Eelgrass Protection Zone/No Anchoring Area" consistent with "Proposed Boundary A" depicted in Figure 9 (page 12) and copied below for reference:

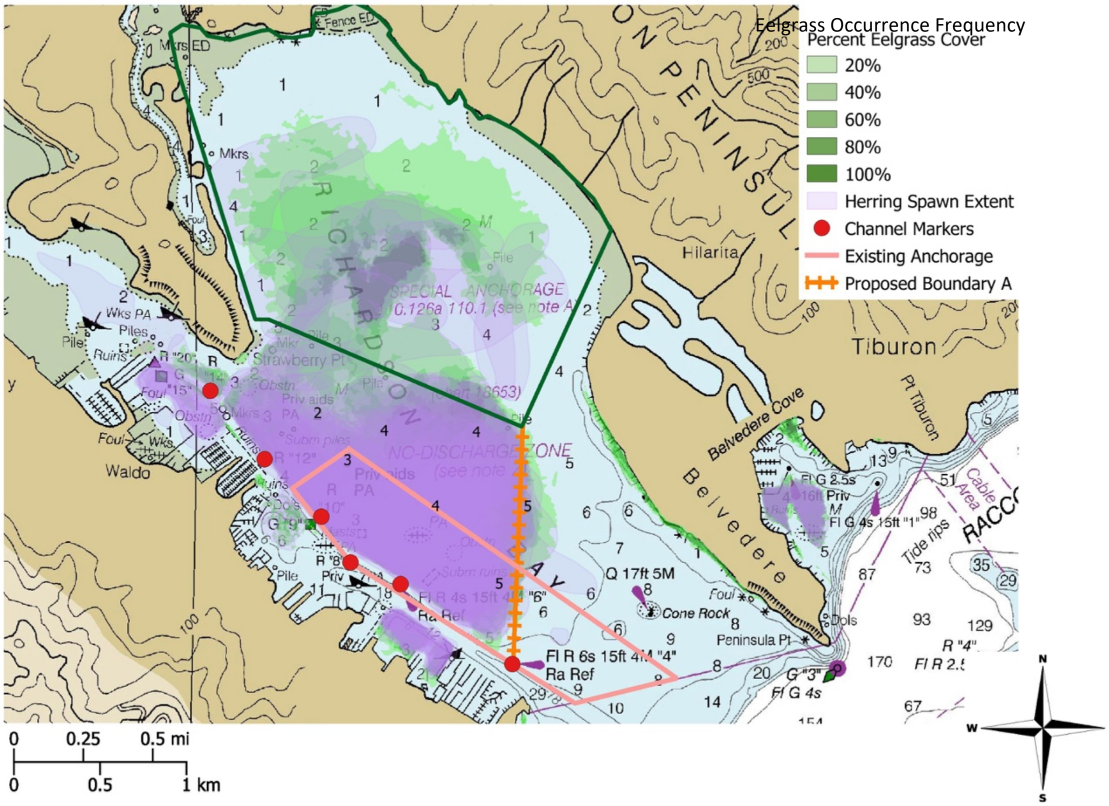

Figure 11- Eelgrass Protection Zone/No Anchoring Area (Proposed Boundary A)
To protect eelgrass in Richardson's Bay from damage associated with anchor scour, an "Eelgrass Protection Zone/No Anchoring Area" is proposed. The proposed area extends northwest of a line running from Channel Marker Four in the south to the southern tip of the Audubon Sanctuary in the north (the orange hashed line in the figure above). This area would be off-limits for anchoring, but available for all other activities allowed in Richardson's Bay (e.g., sailing, motoring, kayaking, etc.).

The proposed "Eelgrass Protection Zone/No Anchoring Area" would reduce the size of the official RBRA Anchorage Area by approximately two-thirds. The Protection Zone would also include (and, therefore, prohibit anchoring in) approximately one third of the Richardson's Bay waters within the City of Belvedere's jurisdiction. City of Belvedere waters outside of the Protection Zone would retain time limits according to Belvedere regulations (currently 10 hours).

In making these changes to areas available for anchoring in Richardson's Bay, it would limit the number of boats the anchorage could support at any one time. However, the following factors were taken into consideration when developing this proposal:

- The proposed "Eelgrass Protection Zone/No Anchoring Area" aligns closely with the five foot mean lower-low water (MLLW) contour in Richardson's Bay, meaning most of the area is five feet deep or less during low tide. Many cruising/visiting vessels, especially sailboats with keels, are unlikely to choose to anchor in such shallow water.
- The majority of vessels currently enrolled in RBRA's Safe and Seaworth Program are located outside of this proposed "Eelgrass Protection Zone/No Anchoring Area."
- Boats currently anchored in Richardson's Bay could be anchored more closely together than is seen under current conditions, so the functional carrying capacity of the official Anchorage Area is likely to still meet demand for a 72-hour anchorage.

Monitoring and adaptive management

The following monitoring and adaptive management actions are proposed, pending the availability of funding:

- <u>Annual monitoring:</u> Aerial (UAV or similar) photography and GIS analysis of the anchorage area to quantify anchor scour damage and/or recovery of eelgrass for ten years or until at least 80% of the damage has been recovered (whichever occurs later). After 80% recovery, discontinue annual aerial photography monitoring.
- <u>Tri-annual (every three years) monitoring:</u> Bathymetric mapping of Richardson's Bay using sidescan sonar or equivalent technology to document eelgrass density and spatial extent of the bed, to be continued until the damage from anchor scour is been at least 80% recovered. After 80% recovery, decrease to mapping once every five years as part of an ongoing monitoring program.
- <u>Water quality monitoring:</u> Expand water quality monitoring efforts in Richardson's Bay with a focus on evaluating impacts from storm runoff and sewage outflow events. Engage with municipalities surrounding Richardson's Bay to identify collaborative solutions to municipal water issues potentially impacting the bay. Continue working with the Regional Water Quality Control Board to conduct at least twice-yearly water quality testing and reporting.
- <u>Five-year adaptive management review:</u> Every five years, compare changes in the eelgrass bed with the area of the "Eelgrass Protection Zone/No Anchoring Area." Consider amending the Protection Zone if it no longer serves the intended needs. For example, if eelgrass has migrated northward in the Bay (which may occur with sea level rise) and the deeper portions of the Protection Zone no longer contain eelgrass, consider shifting the Protection Zone accordingly and increasing areas open for anchoring. Alternatively, if the bed has expanded and the Protection Zone no longer encompasses at least 90% of the eelgrass bed, consider expanding the Protection Zone and reducing anchoring area accordingly.

Implementation

- <u>Cost:</u>
    - The costs associated with implementation of the EPMP include personnel time to update relevant regulations to codify the adopted Eelgrass Protection Zone/No Anchoring Area boundary, education and outreach to communicate the changes,

    - wildlife and water quality monitoring, and hard costs associated with installation of new and updated signage (on and off the water).
    - In 2021, RBRA was awarded a Proposition 68 Coastal Resilience Grant from the Ocean Protection Council funding all these activities exclusive of water quality monitoring and installation of updated signage. RBRA staff will continue to seek grant funding for expanded water quality monitoring, and the installation of updated signage is likely to be funded with existing RBRA operational budget but may also be the focus of future grant-making endeavors.
    - It is not expected that implementation of the EPMP will require an increase in RBRA member agency contributions.
- <u>Social Considerations:</u> Implementation of the EPMP should be mindful of the social impacts of changes to water uses in Richardson's Bay, particularly as it relates to vulnerable individuals living on the anchorage. RBRA should continue, and where possible expand, efforts to connect these individuals with supportive services.
- <u>Other Considerations:</u>
    - Signage – New and updated signage will be required in order to communicate the boundaries of the Eelgrass Protection Zone/No Anchoring Area. In addition to signage at relevant locations along the Sausalito shoreline (installed in collaboration with the City of Sausalito and other landowners), RBRA should consider the importance of updated signage on the water. Specifically, the installation of a hard piling or marker at the southern tip of the Richardson Bay Audubon Sanctuary, marked appropriately for visibility from Day Marker Four, should be considered.
    - Shore access – As part of EPMP implementation efforts, as well as efforts to implement the full suite of policy directives included in the June 2020 Transition Plan, RBRA should consider efforts to engage with shoreline municipalities and stakeholders to expand shore access. This should include working with marina operators to allow guest dock dinghy access for visiting cruisers and other appropriate user groups in Richardson's Bay, in accordance with marina rules and regulations.

Acknowledgements

The author would like to thank the numerous stakeholders who engaged with the efforts to develop this EPMP. This document, and the plan it outlines, would not have been possible without the dedicated individuals that spent time reviewing and providing input at all stages of the process.

Special thanks are due to the following individuals and organizations:

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CF 7281 KW


CF 6426 UF


Image Landsat / Copernicus
Google Earth
1985
37°52'23.48" N 122°29'56.76" W elev -1 ft eye alt 1933 ft

NOAA FISHERIES
West Coast Region

California Eelgrass Mitigation Policy and Implementing Guidelines

October 2014

Photo credit: www.Lorenz-Avelar.com

Table of Contents

I. National Marine Fisheries Service's (NMFS) California Eelgrass Mitigation Policy

A. Policy Statement

It is NMFS' policy to recommend **no net loss of eelgrass habitat function** in California.

For all of California, compensatory mitigation should be recommended for the loss of existing eelgrass habitat function, but only after avoidance and minimization of effects to eelgrass have been pursued to the maximum extent practicable. Our approach is congruous with the approach taken in the federal Clean Water Act guidelines under section 404(b)(1) (40 CFR 230). In absence of a complete functional assessment, eelgrass distribution and density should serve as a proxy for eelgrass habitat function. Compensatory mitigation options include comprehensive management plans, in-kind mitigation, mitigation banks and in-lieu-fee programs, and out-of-kind mitigation. While in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis.

Further, it is the intent of this policy to ensure that there is no loss associated with delays in establishing compensatory mitigation. This should be accomplished by creating a greater amount of eelgrass than is lost, if the mitigation is performed contemporaneously or after the impacts occur. To achieve this, NMFS, in most instances, should recommend compensatory mitigation for vegetated and unvegetated eelgrass habitat be successfully completed at a ratio of at least 1.2:1 mitigation area to impact area. This ratio is based on present value calculation[1] using a discount rate of 0.03 (NOAA-DARP 1999). This ratio assumes that restored eelgrass habitat achieves habitat function comparable to existing eelgrass habitat within a period of three years or less (Hoffman 1986, Evans & Short 2005, Fonseca *et al.* 1990).

For ongoing projects, once mitigation has been successfully implemented to compensate for the loss of eelgrass habitat function within a specified footprint, NMFS should not recommend additional mitigation for subsequent loss of eelgrass habitat if 1) ongoing project activities result in subsequent loss of eelgrass habitat function within the same footprint for which mitigation was completed and 2) the project applicant can document that no new area of eelgrass habitat is impacted by project activities.

This policy does not address mitigation for potential eelgrass habitat. NMFS recognizes impacts to potential eelgrass habitat may preclude eelgrass movement or expansion to suitable unvegetated areas in the future, potentially resulting in declines in eelgrass abundance over time. In addition, it does not address other shallow water habitats. Regulatory protections in the estuarine/marine realm typically focus on wetlands and submerged aquatic vegetation. Mudflats, sandflats, and other superficially bare habitats do not garner the same degree of recognition and

[1] Present Value (PV) is a calculation used in finance to determine the present day value of an amount that is received at a future date. The premise of the equation is that receiving something today is worth more than receiving the same item at a future date; $PV = C_1/(1+r)^n$ where C_1= resource at period 1, r= interest or discount rate, n=number of periods.

concern, even though these are some of the most productive and fragile ecosystems (Reilly *et al*. 1999). NMFS will continue to collaborate with federal and state partners on these issues.

B. Eelgrass Background and Information

Eelgrass species (*Zostera marina* L. and *Z. pacifica*) are seagrasses that occur in the temperate unconsolidated substrate of shallow coastal environments, enclosed bays, and estuaries. Eelgrass is a highly productive species and is considered to be a "foundation" or habitat forming species. Eelgrass contributes to ecosystem functions at multiple levels as a primary and secondary producer, as a habitat structuring element, as a substrate for epiphytes and epifauna, and as sediment stabilizer and nutrient cycling facilitator. Eelgrass provides important foraging areas and shelter to young fish and invertebrates, food for migratory waterfowl and sea turtles, and spawning surfaces for invertebrates and fish such as the Pacific herring. Eelgrass also provides a significant source of carbon to the detrital pool which provides important organic matter in sometimes food-limited environments (*e.g.*, submarine canyons). In addition, eelgrass has the capacity to sequester carbon in the underlying sediments and may help offset carbon emissions. Given the significance and diversity of the functions and services provided by seagrass, Costanza *et al.* (2007) determined seagrass ecosystems to be one of Earth's most valuable.

California supports dynamic eelgrass habitats that range in extent from less than 11,000 acres to possibly as much as 15,000 acres statewide. This is inclusive of estimates for poorly documented beds in smaller coastal systems as well as open coastal and insular areas. While among the most productive of habitats, the overall low statewide abundance makes eelgrass one of the rarest habitats in California. Collectively just five systems, Humboldt Bay, San Francisco Bay, San Diego Bay, Mission Bay and Tomales Bay support over 80 percent of the known eelgrass in the state. The uneven distribution of eelgrass resources increases the risk to this habitat and also contributes to its dynamic nature. Further, the narrow depth range within which eelgrass can occur further places this habitat at risk in the face of global climate change and sea level rise predictions.

Seagrass habitat has been lost from temperate estuaries worldwide (Duarte 2002, Lotze *et al.* 2006, Orth *et al.* 2006). While both natural and human-induced mechanisms have contributed to these losses, impacts from human population expansion and associated pollution and upland development is the primary cause (Short and Wyllie-Echeverria 1996). Human activities that affect eelgrass habitat distribution and abundance, including, but not limited to, urban development, harbor development, aquaculture, agricultural runoff, effluent discharges, and upland land use associated sediment discharge (Duarte 2008) occur throughout California. For example, dredging and filling; shading and alteration of circulation patterns; and watershed inputs of sediment, nutrients, and unnaturally concentrated or directed freshwater flows can directly and indirectly destroy eelgrass habitats. Conversely, in many areas great strides have been made at restoring water quality and expanding eelgrass resources through directed efforts at environmental improvements and resource enhancement. While improvements in eelgrass management have occurred overall, the importance of eelgrass both ecologically and economically, coupled with ongoing human pressure and potentially increasing degradation and losses associated with climate change, highlight the need to protect, maintain, and where feasible, enhance eelgrass habitat.

C. Purpose and Need for Eelgrass Mitigation Policy

Eelgrass warrants a strong protection strategy because of the important biological, physical, and economic values it provides, as well as its importance to managed species under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Vegetated shallows that support eelgrass are also considered special aquatic sites under the 404(b)(1) guidelines of the Clean Water Act (40 C.F.R. § 230.43). The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) developed this policy to establish and support a goal of protecting this resource and its habitat functions, including spatial coverage and density of eelgrass habitats. This NMFS policy and implementing guidelines are being shared with agencies and the public to ensure there is a clear and transparent process for developing eelgrass mitigation recommendations.

Pursuant to the MSA, eelgrass is designated as an essential fish habitat (EFH) habitat area of particular concern (HAPC) for various federally-managed fish species within the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2008). An HAPC is a subset of EFH that is rare, particularly susceptible to human-induced degradation, especially ecologically important, and/or located in an environmentally stressed area. HAPC designations are used to provide additional focus for conservation efforts.

This policy and guidelines support but do not expand upon existing NMFS authorities under the MSA, the Fish and Wildlife Coordination Act (FWCA), and the National Environmental Policy Act (NEPA). Pursuant to the EFH provisions of the MSA, FWCA, and obligations under the NEPA as a responsible agency, NMFS annually reviews and provides recommendations on numerous actions that may affect eelgrass resources throughout California. Section 305(b)(1)(D) of the MSA requires NMFS to coordinate with, and provide information to, other federal agencies regarding the conservation and enhancement of EFH. Section 305(b)(2) requires all federal agencies to consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Under section 305(b)(4) of the MSA, NMFS is required to provide EFH Conservation Recommendations to federal and state agencies for actions that would adversely affect EFH (50 C.F.R. § 600.925). NMFS makes its recommendations with the goal of avoiding, minimizing, or otherwise compensating for adverse effects to EFH. When impacts to NMFS trust resources are unavoidable, NMFS may recommend compensatory mitigation to offset those impacts. In order to fulfill its consultative role, NMFS may also recommend, among other things, the development of mitigation plans, habitat distribution maps, surveys and survey reports, progress milestones, monitoring programs, and reports verifying the completion of mitigation activities.

Eelgrass impact management and mitigation throughout California has historically been undertaken without a statewide strategy. Federal actions with impacts to eelgrass require considerable NMFS staff time for project review, coordination and development of conservation recommendations. As federal staff resources vary with budgets, and threats to aquatic resources remain steady or increase, regulatory streamlining and increased efficiency are crucial for continued protection of important coastal habitats, including eelgrass. The California Eelgrass Mitigation Policy (CEMP) is meant to increase efficiency of existing regulatory authorities in a programmatic manner, provide transparency to federal agencies and action proponents, and ensure that unavoidable impacts to eelgrass habitat are fully and appropriately mitigated. It is the intent of NMFS to collaborate with other federal, state, and local agencies charged with the protection of marine resources to seek a unified approach to actions affecting eelgrass such that consistency across agencies with respect to this resource may be enhanced.

D. Relevance to Other Federal and State Policies

Based on our understanding of existing federal and state policies regarding aquatic resource conservation, the CEMP does not conflict with existing policies and complements the federal and state wetland policies as described below. NMFS does not intend to make any recommendations, which, if adopted by the action agency and carried out, would violate other federal, state, or local laws. The CEMP also complements the NOAA Aquaculture Policy and National Shellfish Initiative and builds upon the NOAA Seagrass Conservation Guidelines and the Southern California Eelgrass Mitigation Policy.

1. Corps/EPA Mitigation Rule and supporting guidance

In 2008, the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) issued revised regulations governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under Section 404 of the Clean Water Act. The regulations emphasize avoiding impacts to wetlands and other water resources. For unavoidable impacts, the rule incorporates Natural Resource Council recommendations to improve planning, implementing and managing wetland replacement projects, including: science-based assessment of impacts and compensation measures, watershed assessments to drive mitigation sites and plans, measurable and enforceable ecological performance standards for evaluating mitigation projects, mitigation monitoring to document whether the mitigation employed meets ecological performance standards, and complete compensation plans. The regulations also encourage the expansion of mitigation banking and in lieu fee agreements to improve the quality and success of compensatory mitigation projects.

The NMFS policy to recommend no net loss of eelgrass function and the eelgrass mitigation guidelines offered herein align with the provisions of the EPA and Corps mitigation rule, but provide more specific recommendations on how to avoid and minimize impacts to eelgrass and how to implement eelgrass surveys, assessments, mitigation, and monitoring.

2. State of California Wetland Conservation Policies

The 1993 State of California Wetlands Conservation Policy established a framework and strategy to ensure no overall net loss and long-term gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship, and respect for private property, reduce procedural complexity in administration of state and federal wetlands conservation programs, and encourage partnerships to make landowner incentive programs and cooperative planning efforts the primary focus of wetlands conservation and restoration.

The State of California is also developing a Wetland and Riparian Area Protection Policy. The first phase of this effort was published as the "Preliminary Draft Wetland Area Protection Policy" with the purpose of protecting all waters of the State, including wetlands, from dredge and fill discharges. It includes a wetland definition and associated delineation methods, an assessment framework for collecting and reporting aquatic resource information, and requirements applicable to discharges of dredged or fill material. The draft specifies that dredge or fill projects will provide for replacement of existing beneficial uses through compensatory mitigation. The preliminary policy includes a determination that compensatory mitigation will sustain and improve the overall abundance, diversity and condition of aquatic resources in a project watershed area.

Based on the definition of wetlands included in these state wetland policies, the policies do not directly apply to subtidal eelgrass habitat, but may apply to intertidal eelgrass habitat. The NMFS policy of recommending no net loss to eelgrass habitat function and recommendations for compensatory mitigation for eelgrass impacts complement the state protection policies for wetlands.

3. NOAA Aquaculture Policy and National Shellfish Initiative

In 2011, NOAA released the National Marine Aquaculture Policy and the National Shellfish Initiative. The Policy encourages and fosters sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent with the National Policy for the Stewardship of the Ocean, our Coasts, and the Great Lakes (National Ocean Policy). The goal of the Initiative is to increase populations of bivalve shellfish in our nation's coastal waters—including oysters, clams, abalone, and mussels—through both sustainable commercial production and restoration activities. The Initiative supports shellfish industry jobs and business opportunities to meet the growing demand for seafood, while protecting and enhancing habitat for important commercial, recreational, and endangered and threatened species and species recovery. The Initiative also highlights improved water quality, nutrient removal, and shoreline protection as benefits from shellfish production and restoration. Both the Policy and the Initiative seek to improve interagency coordination for permitting commercial and restoration shellfish projects, as well as support research and other data collection to assess and refine conservation strategies and priorities.

The regulatory efficiencies, transparency, and compensation for impacts to eelgrass promoted by the CEMP directly support the National Aquaculture Policy statements and National Shellfish Initiative through: (1) protection of eelgrass, an important component of productive and resilient coastal ecosystems in California and habitat for wild species, and (2) improved coordination with federal partners regarding planning and permitting for commercial shellfish projects. Furthermore, research conducted under the direction of the National Shellfish Initiative could be informed by and also inform NMFS consultations regarding eelgrass impacts and mitigation in California.

4. NOAA Seagrass Conservation Guidelines

The NOAA publication, "Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters" (1998) was developed by Mark Fonseca of NOAA's Beaufort Laboratory along with Jud Kenworthy and Gordon Thayer and was funded by NOAA's Coastal Ocean Program. The document presents an overview of seagrass conservation and restoration in the United States, discusses important issues that should be addressed in planning seagrass restoration projects, describes different planting methodologies, proposes monitoring criteria and means for evaluation success, and discusses issues faced by resource managers. The CEMP considers information presented in the Fonseca *et al*. document, but deviates in some cases in order to provide reasonable and practicable guidelines for eelgrass conservation in California.

5. Southern California Eelgrass Mitigation Policy

In southern and central California, eelgrass mitigation has been addressed in accordance with the Southern California Eelgrass Mitigation Policy applied by NMFS, US Fish & Wildlife Service, California Department of Fish and Wildlife, California Coastal Commission, US Army Corps of Engineers, and other resource and regulatory agencies since 1991, and which has generally been effective at ensuring eelgrass impacts are mitigated in most circumstances. Given the success of the Southern California Eelgrass Mitigation Policy over its 20-year history, this policy reflects an expansion of the application of the Southern California policy with minor modifications to ensure a high standard of statewide eelgrass management and protection. This policy will supersede the Southern California Eelgrass Mitigation Policy for all areas of California upon its adoption.

II. Implementing Guidelines for California

This policy and guidelines will serve as the guidance for staff and managers within NMFS for developing recommendations concerning eelgrass issues through EFH and FWCA consultations and NEPA reviews throughout California. This policy will inform NMFS's position on eelgrass issues for California in other roles as a responsible, advisory, or funding agency or trustee. In addition, this document provides guidance to assist NMFS in performing its consultative role under the statutes described above. Finally, pursuant to NMFS obligation to provide information to federal agencies under Section 305(b)(1)(D) of the MSA, this policy serves that role by providing information intended to further the conservation and enhancement of EFH. Should this policy or guidelines be inconsistent with any formally-promulgated NMFS regulations, those formally-promulgated regulations will take precedence over any inconsistent provisions of this policy.

While many of the activities impacting eelgrass are similar across California, eelgrass stressors and growth characteristics differ between southern California (U.S./Mexico border to Pt. Conception), central California (Point Conception to San Francisco Bay entrance), San Francisco Bay, and northern California (San Francisco Bay to the California/Oregon border). The amount of scientific information available to base management decisions on also differs among areas within California, with considerably more information and history with eelgrass habitat management in southern California than the other regions. Gaps in region-specific scientific information do not override the need to be protective of eelgrass habitat while relying on the best information currently available from areas within and outside of California. Although the primary orientation of this policy is toward statewide use, where indicated below, specific elements of this policy may differ between southern California, central California, northern California and San Francisco Bay.

NMFS will continue to explore the science of eelgrass habitat and improve our understanding of eelgrass habitat function, impacts, assessment techniques, and mitigation efficacy. Approximately every 5 years, NMFS intends to evaluate monitoring and survey data collected by federal agencies and action proponents per the recommendations of these guidelines. NMFS managers will determine if updates to these guidelines are appropriate based on information evaluated during the 5-year review. Updates to these guidelines and supporting technical information will be available on the NMFS website.

The information below serves as a common starting place for NMFS recommendations to achieve no net loss of eelgrass habitat function. NMFS employees should not depart from the guidelines provided herein without appropriate justification and supervisory concurrence. However, the recommendations that NMFS ultimately makes should be provided on a case-by-case basis to provide flexibility when site specific conditions dictate. In the EFH context, NMFS recommendations are provided to the action agency, which has final approval of the action; in accordance with the MSA, the action agency may take up NMFS recommendations or articulate its reasons for not following the recommendations. In the FWCA context, NMFS makes recommendations which must be considered, but the action agency is ultimately responsible for the wildlife protective measures it adopts (if any). For these reasons, neither this policy nor its implementing guidelines are to be interpreted as binding on the public.

A. Eelgrass Habitat Definition

Eelgrass distribution fluctuates and can expand, contract, disappear, and recolonize areas within suitable environments. Vegetated eelgrass areas can expand by as much as 5 meters (m) and contract by as much as 4 m annually (Donoghue 2011). Within eelgrass habitat, eelgrass is expected to fluctuate in density and patch extent based on prevailing environmental factors (*e.g.*, turbidity, freshwater flows, wave and current energy, bioturbation, temperature, etc.). To account for seagrass fluctuation, Fonseca *et al.* (1998) recommends that seagrass habitat include the vegetated areas as well as presently unvegetated spaces between seagrass patches.

In addition, there is an area of functional influence, where the habitat function provided by the vegetated cover extends out into adjacent unvegetated areas. Those functions include detrital enrichment, energy dampening and sediment trapping, primary productivity, alteration of current or wave patterns, and fish and invertebrate use, among other functions. The influence of eelgrass on the local environment can extend up to 10 m from individual eelgrass patches, with the distance being a function of the extent and density of eelgrass comprising the bed as well as local biologic, hydrographic, and bathymetric conditions (Bostrom and Bonsdorff 2000, Bostrom *et al*. 2001, Ferrell and Bell 1991, Peterson *et al*. 2004, Smith *et al.* 2008, van Houte-Howes *et al.* 2004, Webster *et al*. 1998). Detrital enrichment will generally extend laterally as well as down slope from the beds, while fish and invertebrates that utilize eelgrass beds may move away from the eelgrass core to areas around the bed margins for foraging and in response to tides or diurnal cycles (Smith *et al*. 2008).

To encompass fluctuating eelgrass distribution and functional influence around eelgrass cover, for the purposes of this policy and guidelines, eelgrass habitat is defined as areas of vegetated eelgrass cover (any eelgrass within 1 m^2 quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area (See Attachment 1 for a graphical depiction of this definition). Unvegetated areas may have eelgrass shoots a distance greater than 1 m from another shoot, and may be internal as well as external to areas of vegetated cover. For isolated patches and on a case-by-case basis, it may be acceptable to include an unvegetated area boundary less than or greater than 5 m wide. The definition excludes areas of unsuitable environmental conditions such as hard bottom substrates, shaded locations, or areas that extend to depths below those supporting eelgrass. Suitable depths can vary substantially depending upon site-specific conditions. In general, eelgrass does not extend deeper than 12 feet mean lower low water (MLLW) in most protected bays and harbors in Southern California, and is more limited in Central and Northern California embayments. However, eelgrass can grow much deeper in entrance channels and offshore areas

B. Surveying Eelgrass

NMFS may recommend action agencies conduct surveys of eelgrass habitat to evaluate effects of a proposed action. Eelgrass habitat should be surveyed using visual or acoustic methods and mapping technologies and scales appropriate to the action, scale, and area of work. Surveys should document both vegetated eelgrass cover as well as unvegetated areas within eelgrass habitat (See section II.A. for definition). Assessing impacts to eelgrass habitat relies on the completion of quality surveys and mapping. As such, inferior quality of surveys and mapping (*e.g.*, completed at an inappropriate scale or using inappropriate methods) may make proper evaluation of impacts impossible, and may result in a recommendation from NMFS to re-survey and re-map project areas. Also, to account for fluctuations in eelgrass habitat due to environmental variations, a reference site(s) should be incorporated into the survey (See section V.B.4 below for more details).

1. Survey Parameters

Because eelgrass growth conditions in California vary, eelgrass mapping techniques will also vary. Diver transects or boundary mapping may be suited to very small scale mapping efforts, while aerial and/or acoustic survey with ground-truthing may be more suited to larger survey areas. Aerial and above-water visual survey methods should be employed only where the lower limit of eelgrass is clearly visible or in combination with methods that adequately inventory eelgrass in deeper waters.

The survey area should be scaled as appropriate to the size of the potential action and the potential extent and distribution of eelgrass impacts, including both direct and indirect effects. The resolution of mapping should be adequate to address the scale of effects reasonably expected to occur. For small projects, such as individual boat docks, higher mapping resolution is appropriate in order to detect actual effects to eelgrass at a scale meaningful to the project size. At larger scales, the mapping resolution may be less refined over a larger area, assuming that minor errors in mapping will balance out over the larger scale. Survey reports should provide a detailed description of the survey coverage (*e.g.*, number, location, and type of samples) and any interpolation methods used in the mapping.

While many parameters may be useful to describe eelgrass habitat condition (*e.g.*, plant biomass, leaf length, shoot:root ratios, epiphytic loading), many are labor intensive and may be impractical for resource management applications on a day-to-day basis. For this reason, four parameters have been identified for use in eelgrass habitat surveys and assessment of effects of an action on eelgrass. These parameters that should be articulated in eelgrass surveys are: 1) spatial distribution, 2) areal extent, 3) percentage of vegetated cover, and 4) the turion (shoot) density.

a) Spatial Distribution

The spatial distribution of eelgrass habitat should be delineated by a contiguous boundary around all areas of vegetated eelgrass cover extending outward a distance of 5 m, excluding gaps within the vegetated cover that have individual plants greater than 10 m from neighboring plants. Where such separations occur, either a separate area should be defined, or a gap in the area should be defined by extending a line around the void along a boundary defined by adjacent plants and including the 5 meter perimeter. The boundary of the eelgrass habitat should not extend into areas where depth, substrate, or existing structures are unsuited to supporting eelgrass habitat.

b) Aerial Extent

The eelgrass habitat aerial extent is the quantitative area (*e.g.*, square meters) of the spatial distribution boundary polygon of the eelgrass habitat. The total aerial extent should be broken down into extent of vegetated cover and extent of unvegetated habitat. Areal extent should be determined using commercially available geo-spatial analysis software. For small projects, coordinate data for polygon vertices could be entered into a spreadsheet format, and area could be calculated using simple geometry.

c) Percent Vegetated Cover

Eelgrass vegetated cover exists when one or more leaf shoots (turions) per square meter is present. The percent bottom cover within eelgrass habitat should be determined by totaling the area of vegetated eelgrass cover and dividing this by the total eelgrass habitat area. Where substantial differences in bottom cover occur across portions of the eelgrass habitat, the habitat could be subdivided into cover classes (*e.g.*, 20% cover, 50% cover, 75% cover).

d) Turion (Shoot) Density

Turion density is the mean number of eelgrass leaf shoots per square meter within mapped eelgrass vegetated cover. Turion density should be reported as a mean ± the standard deviation of replicate measurements. The number of replicate measurements (n) should be reported along with the mean and deviation. Turion densities are determined only within vegetated areas of eelgrass habitat and therefore, it is not possible to measure a turion density equal to zero. If different cover classes are used, a turion density should be determined for each cover class.

2. Eelgrass Mapping

For all actions that may directly or indirectly affect eelgrass habitat, an eelgrass habitat distribution map should be prepared on an accurate bathymetric chart with contour intervals of not greater than 1 foot (local vertical datum of MLLW). Exceptions to the detailed bathymetry could be made for small projects or for projects where detailed bathymetry may be infeasible. Unless region-specific mapping format and protocols are developed by NMFS (in which case such region-specific mapping guidance should be used), the mapping should utilize the following format and protocols:

a) Bounding Coordinates

Horizontal datum - Universal Transverse Mercator (UTM), NAD 83 meters, Zone 11 (for southern California) or Zone 10 (for central, San Francisco Bay, and northern California) is the preferred projection and datum. Another projection or datum may be used; however, the map and spatial data should include metadata that accurately defines the projection and datum.

Vertical datum - Mean Lower Low Water (MLLW), depth in feet.

b) Units

Transects, grids, or scale bars should be expressed in meters. Area measurements should be in square meters.

c) File Format

A spatial data layer compatible with readily available commercial geographic information system software producing file formats compatible with ESRI® ArcGIS software should be sent to NMFS when the area mapped supports at least 10 square meters of eelgrass. For those areas supporting less than 10 square meters of eelgrass, a table may alternatively be provided giving the vertices bounding x, y coordinates of the eelgrass areas in a spreadsheet or an ASCII file format. In addition to a spatial layer and/or table, a hard-copy map should be included with the survey report. The projection and datum should be clearly defined in the metadata and/or an associated text file.

Eelgrass maps should, at a minimum, include the following:

- A graphic scale bar, north arrow, legend, horizontal datum and vertical datum;
- A boundary illustrating the limits of the area surveyed;
- Bathymetric contours for the survey area, including both the action area(s) and reference site(s) in increments of not more than 1 foot;
- An overlay of proposed action improvements and construction limits;
- The boundary of the defined eelgrass habitat including an identification of area exclusions based on physical unsuitability to support eelgrass habitat; and

- The existing eelgrass cover within the defined eelgrass habitat at the time of the survey.

3. Survey Period

All mapping efforts should be completed during the active growth period for eelgrass (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California) and should be considered valid for a period of 60 days to ensure significant changes in eelgrass distribution and density do not occur between survey date and the project start date. The 60 day period is particularly important for eelgrass habitat survey conducted at the very beginning of the growing season, if eelgrass habitat expansion occurs as the growing season progresses. A period other than 60 days could be warranted and should be evaluated on a case-by-case basis, particularly for surveys completed in the middle of the growing season. However, when the end of the 60-day validity period falls outside of the region-specific active growth period, the survey could be considered valid until the beginning of the next active growth period. For example, a survey completed in southern California in the August-October time frame would be valid until the resumption of the active growth phase (i.e., in most instances, March 1). In some cases, NMFS and the action agency may agree to surveys being completed outside of the active growth period. For surveys completed during or after unusual climatic events (*e.g.*, high fluvial discharge periods, El Niño conditions), NMFS staff should be contacted to determine if any modifications to the common survey period are warranted.

4. Reference Site Selection

Eelgrass habitat spatial extent, aerial extent, percent cover and turion density are expected to naturally fluctuate through time in response to natural environmental variables. As a result, it is necessary to correct for natural variability when conducting surveys for the purpose of evaluating action effects on eelgrass or performance of mitigation areas. This is generally accomplished through the use of a reference site(s), which is expected to respond similarly to the action area in response to natural environmental variability. It is beneficial to select and monitor multiple reference sites rather than a single site and to utilize the average reference site condition as a metric for environmental fluctuations. This is especially true when a mitigation site is located within an area of known environmental gradients, and reference sites may be selected on both sides of the mitigation site along the gradient. Environmental conditions (*e.g.*, sediment, currents, proximity to action area, shoot density, light availability, depth, onshore and watershed influences) at the reference site(s) should be representative of the environmental conditions at the impact area (Fonseca *et al*. 1998). Where practical, the reference site(s) should be at least the size of the anticipated impact and/or mitigation area to limit the potential for minor changes in a reference site (*e.g.*, propeller scarring or ray foraging damage) overly affecting mitigation needs. The logic for site(s) selection should be documented in the eelgrass mitigation planning documents.

C. Avoiding and Minimizing Impacts to Eelgrass

This section describes measures to avoid and minimize impacts to eelgrass caused by turbidity, shading, nutrient loading, sedimentation and alteration of circulation patterns. Not all measures are equally suited to a particular project or condition. Measures to avoid or minimize impacts should be focused on stressors where the source and control are within the purview of the permittee and action agency. Action agencies in coordination with NMFS should evaluate and establish impact avoidance and minimization measures on a case-by-case basis depending on the action and site-specific information, including prevailing current patterns, sediment source, characteristics, and quantity, as well as the nature and duration of work.

1. Turbidity

To avoid and minimize potential turbidity-related impacts to eelgrass:
- Where practical, actions should be located as far as possible from existing eelgrass; and
- In-water work should occur as quickly as possible such that the duration of impacts is minimized.

Where proposed turbidity generating activities must occur in proximity to eelgrass and increased turbidity will occur at a magnitude and duration that may affect eelgrass habitat, measures to control turbidity levels should be employed when practical considering physical and biological constraints and impacts. Measures may include:
- Use of turbidity curtains where appropriate and feasible;
- Use of low impact equipment and methods (*e.g.*, environmental buckets, or a hydraulic suction dredge instead of clamshell or hopper dredge, provided the discharge may be located away from the eelgrass habitat and appropriate turbidity controls can be provided at the discharge point);
- Limiting activities by tide or day-night windows to limit light degradation within eelgrass habitat;
- Utilizing 24-hour dredging to reduce the overall duration of work and to take advantage of dredging during dark periods when photosynthesis is not occurring; or
- Other measures that an action party may propose and be able to employ to minimize potential for adverse turbidity effects to eelgrass.

NMFS developed a flowchart for a stepwise decision making process as guidance for action agencies to determine when to implement best management practices (BMPs) for minimizing turbidity from dredging actions as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the NMFS West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that generates increased turbidity.

2. Shading

A number of potential design modifications may be used to minimize effects of shading on eelgrass. Boat docks, ramps, gangways, and similar structures should avoid eelgrass habitat to the maximum extent feasible. If avoidance of eelgrass or habitat is infeasible, impacts should be minimized by utilizing, to the maximum extent feasible, design modifications and construction materials that allow for greater light penetration. Action modifications should include, but are not limited to:

- Avoid siting over-water or landside structures in areas where shading of eelgrass habitat would occur;
- Maximizing the north-south orientation of the structure;
- Maximizing the height of the structure above the water;
- Minimizing the width and supporting structure mass to decrease shade effects;
- Relocating the structure in deeper water and limiting the placement of structures in shallow areas where eelgrass occurs to the extent feasible; and
- Utilizing light transmitting materials in structure design.

Construction materials used to increase light passage beneath the structures may include, but are not limited to, open grating or adequate spacing between deck boards to allow for effective illumination to support eelgrass habitat. The use of these shade reducing options may be appropriate where they do not conflict with safety, ADA compliance, or structure utility objectives.

NMFS developed a stepwise key as guidance for action agencies to determine which combination of modifications are best suited for minimizing shading effects from overwater structures on eelgrass as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that results in shading.

3. Circulation patterns

Where appropriate to the scale and nature of potential eelgrass impacts, action parties should evaluate if and how the action may alter the hydrodynamics of the action area such that eelgrass habitat within or in proximity to the action area may be adversely affected. To maintain good water flow and low residence time of water within eelgrass habitat, action agencies should ensure actions:

- Minimize scouring velocities near or within eelgrass beds;
- Maintain wind and tidal circulation to the extent practical by considering orientation of piers and docks to maintain predominant wind effects;
- Incorporate setbacks on the order of 15 to 50 meters from eelgrass habitat where practical to allow for greater circulation and reduced impact from boat maneuvering, grounding, and propeller damage, and to address shading impacts; and
- Minimize the number of piles and maximize pile spacing to the extent practical, where piles are needed to support structures.

For large-scale actions in the proximity of eelgrass habitats, NMFS may request specific modeling and/or field hydrodynamic assessments of the potential effects of work on characteristics of circulation within eelgrass habitat.

4. Nutrient loading

Where appropriate to the scale and nature of potential eelgrass impacts, the following measures should be considered for implementation to reduce the potential for excessive nutrient loading to eelgrass habitat:

- diverting site runoff from landscaped areas away from discharges around eelgrass habitat;
- implementation of fertilizer reduction program;
- reduction of watershed nutrient loading;
- controlling local sources of nutrients such as animal wastes and leach fields; and
- maintaining good circulation and flushing conditions within the water body.

Reducing nutrient loading may also provide opportunities for establishing eelgrass as mitigation for project impacts.

5. Sediment loading

Watershed development and changes in land use may increase soil erosion and increase sedimentation to downstream embayments and lagoons.

- To the extent practicable, maintain riparian vegetation buffers along all streams in the watershed.
- Incorporate watershed analysis into agricultural, ranching, and residential/commercial development projects.
- Increase resistance to soil erosion and runoff. Sediment basins, contour farming, and grazing management are examples of key practices.
- Implement best management practices for sediment control during construction and maintenance operations (*e.g.,* Caltrans 2003).

Reducing sediment loading may also provide opportunities for establishing eelgrass as mitigation for project impacts in systems for which sedimentation is a demonstrable limiting factor to eelgrass.

D. Assessing Impacts to Eelgrass Habitat

If appropriate to the statute under which the consultation occurs, NMFS should consider both direct and indirect effects of the project in order to assess whether a project may impact eelgrass. NMFS is aware that many of the statutes and regulations it administers may have more specific meanings for certain terms, including "direct effect" and "indirect effect", and will use the statutory or regulatory meaning of those terms when conducting consultations under those statutes.[2] Nevertheless, it is useful for NMFS to consider effects experienced

[2] In the EFH context, adverse effects include any impact that reduces quality and/or quantity of EFH, including direct or indirect physical, chemical, or biological alterations of the waters or substrate (50 CFR 600.910). The Council of Environmental Quality (CEQ) regulations regarding NEPA implementation (40 CFR 1508.8(a)) define direct and indirect impacts of an action for the purposes of NEPA. Other NMFS statutes provide their own definitions regarding effects.

contemporaneously with project actions (both at the project site and away from the project site) and which might occur later in time.

Generally, effects to eelgrass habitat should be assessed using pre- and post-project surveys of the impact area and appropriate reference site(s) conducted during the time period of maximum eelgrass growth (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California). NMFS should consider the likelihood that the effects would occur before recommending pre- and post-project eelgrass surveys. The pre-construction survey of the eelgrass habitat in the action area and an appropriate reference site(s) should be completed within 60 days before start of construction. After construction, a post-action survey of the eelgrass habitat in the action area and at an appropriate reference site(s) should be completed within 30 days of completion of construction, or within the first 30 days of the next active growth period following completion of construction that occurs outside of the active growth period. Copies of all surveys should be provided to the lead federal agency, NMFS, and other interested regulatory and/or resource agencies within 30 days of completing the survey. The recommended timing of surveys is intended to minimize changes in eelgrass habitat distribution and abundance during the period between survey completion and construction initiation and completion. For example, a post-action survey completed beyond 30 days following construction or outside of the active growing season may show declines in eelgrass habitat as a result of natural senescence rather than the action.

The lead federal agency and NMFS should consider reference area eelgrass performance, physical evidence of impact, turbidity and construction activities monitoring data, as well as other documentation in the determination of the impacts of the action undertaken. Impact analyses should document whether the impacts are anticipated to be complete at the time of the assessment, or whether there is an anticipation of continuing eelgrass impacts due to chronic or intermittent effects. Where eelgrass at the impact site declines coincident with and similarly to decline at the reference site(s), the percentage of decline at the reference site should be deducted from the decline at the impact site. However, if eelgrass expands within the reference site(s), the impact site should only be evaluated against the pre-construction condition of the reference site and not the expanded condition. If an action results in increased eelgrass habitat relative to the reference sites, this increase could potentially be considered (subject to the caveats identified herein) by NMFS and the action agency as potential compensation for impacts to eelgrass habitat that occur in the future (see Section II. E. 3). An assessment should also be made as to whether impacts or portions of the impact are anticipated to be temporary. Information supporting this determination may be derived from the permittee, NMFS, and other resource and regulatory agencies, as well as other eelgrass experts.

For some projects, environmental planning and permitting may take longer than 60 days. To accommodate longer planning schedules, it may also be necessary to do a preliminary eelgrass survey prior to the pre-construction survey. This preliminary survey can be used to anticipate potential impacts to eelgrass for the purposes of mitigation planning during the permitting process. In some cases, preliminary surveys may focus on spatial distribution of eelgrass habitat only or may be a qualitative reconnaissance to allow permittees to incorporate avoidance and minimization measures into their proposed action or to plan for future mitigation needs. The pre-and post- project surveys should then verify whether impacts occur as anticipated, and if planned mitigation is adequate. In some cases, a preliminary survey could be completed a year or more in advance of the project action.

1. Direct Effects

Biologists should consider the potential for localized losses of eelgrass from dredging or filling, construction-associated damage, and similar spatially and temporally proximate impacts (these effects could be termed “direct”). The actual area of the impact should be determined from an analysis that compares the pre-action condition of eelgrass habitat with the post-action conditions from this survey, relative to eelgrass habitat change at the reference site(s).

2. Indirect Effects

Biologists should also consider effects caused by the action which occur away from the project site; furthermore, effects occurring later in time (whether at or away from the project site) should also be considered. Biologists should consider the potential for project actions to alter conditions of the physical environment in a manner that, in turn, reduce eelgrass habitat distribution or density (*e.g.*, elevated turbidity from the initial implementation or later operations of an action, increased shading, changes to circulation patterns, changes to vessel traffic that lead to greater groundings or wake damage, increased rates of erosion or deposition).

For actions where the impact cannot be fully determined until a substantial period after an action is taken, an estimate of likely impacts should be made prior to implementation of the proposed action based on the best available information (*e.g.*, shading analyses, wave and current modeling). A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be performed. The action party should complete the first post-construction eelgrass survey within 30 days following completion of construction to evaluate any immediate effects to eelgrass habitat. The second post-construction survey should be performed approximately one year after the first post-construction survey during the appropriate growing season. The third post-construction survey should be performed approximately two years after the first post-construction survey during the appropriate growing season. The second and third post-construction surveys will be used to evaluate if indirect effects resulted later in time due to altered physical conditions; the time frames identified above are aligned with growing season (attempting a survey outside of the growing season would show inaccurate results).

A final determination regarding the actual impact and amount of mitigation needed, if any, to offset impacts should be made based upon the results of two annual post-construction surveys, which document the changes in the eelgrass habitat (areal extent, bottom coverage, and shoot density within eelgrass) in the vicinity of the action, compared to eelgrass habitat change at the reference site(s). Any impacts determined by these monitoring surveys should be mitigated. In the event that monitoring demonstrates the action to have resulted in greater eelgrass habitat impacts than initially estimated, additional mitigation should be implemented in a manner consistent with these guidelines. In some cases, adaptive management may allow for increased success in eelgrass mitigation without the need for additional mitigation.

E. Mitigation Options

The term mitigation is defined differently by various federal and State laws, regulations and policies. In a broad sense, mitigation may include a range of measures from complete avoidance of adverse effects to compensation for adverse effects by preserving, restoring or creating similar resources at onsite or offsite locations. The Corps and EPA issued regulations governing compensatory mitigation to offset unavoidable adverse effects to waters of the United States authorized by Clean Water Act section 404 permits and other permits issued by the Corps (73 FR 19594; April 10, 2008). For those regulations (33 CFR 332.2 and 40 CFR 230.92, respectively), the Corps and EPA, define "compensatory mitigation" as "the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse effects which remain after all appropriate and practicable avoidance and minimization has been achieved."

When impacts to eelgrass would occur, the action agency should develop a mitigation plan to achieve no net loss in eelgrass function following the recommended steps in this policy. If NMFS determines a mitigation plan is needed, and it was not included with the EFH Assessment for the proposed action, NMFS may recommend, either as comments on the EFH Assessment or as an EFH Conservation Recommendation, that one be provided. Potential mitigation options are described below. The action agency should consider site specific conditions when determining the most appropriate mitigation option for an action.

1. Comprehensive management plans

NMFS supports the development of comprehensive management plans (CMPs) that protect eelgrass resources within the context of broader ecosystem needs and management objectives. Recommendations different from specific elements described below for in-kind mitigation may be appropriate where a CMP (*e.g.,* an enforceable programmatic permit, Special Area Management Plan, harbor plan, or ecosystem-based management plan) exists that is considered to provide adequate population-level and local resource distribution protections to eelgrass. One such CMP under development at the time these guidelines were developed is *City of Newport Beach Eelgrass Protection Mitigation Plan for Shallow Water in Lower Newport Bay: An Ecosystem Based Management Plan.* If satisfactorily completed and adopted, it is anticipated the protection measures for eelgrass within this area would be adequate to meet the objectives of this policy.

In general, it is anticipated that CMPs may be most appropriate in situations where a project or collection of similar projects will result in incremental but recurrent impacts to a small portion of local eelgrass populations through time (*e.g.*, lagoon mouth maintenance dredging, maintenance dredging of channels and slips within established marinas, navigational hazard removal of recurrent shoals, shellfish farming, and restoration or enhancement actions). In order to ensure that these alternatives provide adequate population-level and local resource distribution protections to eelgrass and that the plan is consistent with the overall conservation objectives of this policy, NMFS should be involved early in the plan's development.

2. In-kind mitigation

In-kind compensatory mitigation is the creation, restoration, or enhancement of habitat to mitigate for adverse impacts to the same type of habitat. In most cases in-kind mitigation is the preferred option to compensate for impacts to eelgrass. Generally, in-kind mitigation should achieve a final mitigation ratio of 1.2:1 across all areas of the state, independent of starting mitigation ratios. A starting mitigation ratio is the ratio of mitigation area to impact area when mitigation is initiated. The final mitigation ratio is the ratio of mitigation area to impact area once mitigation is complete. The 1.2:1 ratio assumes: (1) there is no eelgrass function at the mitigation site prior to mitigation efforts, (2) eelgrass function at the mitigation site is achieved within three years, (3) mitigation efforts are successful, and (4) there are no landscape differences (*e.g.*, degree of urban influence, proximity to freshwater source), between the impact site and the mitigation site. Variations from these assumptions may warrant higher or lower mitigation ratios. For example, a higher ratio would be appropriate for an enhancement project where the mitigation site has some level of eelgrass function prior to the mitigation action.

Typically, in-kind eelgrass mitigation involves transplanting or seeding of eelgrass into unvegetated habitat. Successful in-kind mitigation may also warrant modification of physical conditions at the mitigation site to prepare for transplants (*e.g.*, alter sediment composition, depth, etc.). In some areas, other in-kind mitigation options such as removing artificial structures that preclude eelgrass growth may be feasible. If in-kind mitigation that does not include transplants or seeding is proposed, post-mitigation monitoring as described below should be implemented to verify that mitigation is successful.

Information provided below in Section II.F includes specific recommendations for in-kind mitigation, including site selection, reference sites, starting mitigation ratios, mitigation methods, mitigation monitoring and performance criteria. Many of the recommendations provided in these guidelines for eelgrass assessments, surveys, and mitigation may apply throughout the state even if a non-transplant mitigation option is proposed.

3. Mitigation banks and in-lieu-fee programs

In 2006 and 2011, the NMFS Southwest Region (merged with the Northwest Region in 2013 to form the West Coast Region) signed interagency Memorandum of Understandings that established and refined a framework for developing and using combined or coordinated approaches to mitigation and conservation banking and in-lieu-fee programs in California. Other signatory agencies include: the California Resources Agency, California Department of Fish and Wildlife, the Corps, the US Fish &Wildlife Service, the EPA, the Natural Resource Conservation Service, and the State Water Resources Control Board.

Under this eelgrass policy, NMFS supports the use of mitigation bank and in-lieu fee programs to compensate for impacts to eelgrass habitat, where such instruments are available and where such programs are appropriate to the statutory structure under which mitigation is recommended. Mitigation banks and in-lieu fee conservation programs are highly encouraged by NMFS in heavily urbanized waters. Credits should be used at a ratio of 1:1 if those credits have been established for a full three-year period prior to use. If the bank credits have been in place for a period less than three years, credits should be used at a ratio determined through application of the wetland mitigation calculator (King and Price 2004).

At the request of the action party, and only with approval of NMFS and other appropriate resource agencies and subject to the caveats below, surplus eelgrass area that, after 60-months, exceeds the mitigation needs, as defined in section II.F.6 Mitigation Monitoring and Performance Milestones, has the potential to be considered for future mitigation needs. Additionally, only with the approval of NMFS and other appropriate resource agencies and subject to the caveats below, eelgrass habitat expansion resulting from project activities, and that otherwise would not have occurred, has the potential to be considered for future mitigation needs. Exceeding mitigation needs does not guarantee or entitle the action party or action agency to credit such mitigation to future projects, since every future project must be considered on a case-by-case basis (including the location and type of impact) and viewed in light of the relevant statutory authorities.

4. Out-of-kind mitigation

Out-of-kind compensatory mitigation means the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type. In most cases, out-of-kind mitigation is discouraged, because eelgrass is a rare, special-status habitat in California. There may be some scenarios, however, where out-of-kind mitigation for eelgrass impacts is ecologically desirable or when in-kind mitigation is not feasible. This determination should be made based on an established ecosystem plan that considers ecosystem function and services relevant to the geographic area and specific habitat being impacted. Any proposal for out-of-kind mitigation should demonstrate that the proposed mitigation will compensate for the loss of eelgrass habitat function within the ecosystem. Out-of-kind mitigation that generates services similar to eelgrass habitat or improves conditions for establishment of eelgrass should be considered first. NMFS and the federal action agency should be consulted early when out-of-kind mitigation is being proposed in order to determine if out-of-kind mitigation is appropriate, in coordination with other relevant resource agencies (e.g., California Department of Fish and Wildlife, California Coastal Commission, U.S. Fish and Wildlife Service)

F. In-kind Mitigation for Impacts to Eelgrass

As all mitigation project specifics will be determined on a case-by-case basis, circumstances may exist where NMFS staff will need to modify or deviate from the recommended measures described below before providing their recommendation to action agencies.

1. Mitigation Site Selection

Eelgrass habitat mitigation sites should be similar to the impact site. Site selection should consider distance from action, depth, sediment type, distance from ocean connection, water quality, and currents. Where eelgrass that is impacted occurs in marginally suitable environments, it may be necessary to conduct mitigation in a preferable location and/or modify the site to be better suited to support eelgrass habitat creation. Mitigation site modification should be fully coordinated with NMFS staff and other appropriate resource and regulatory agencies. To the extent feasible, mitigation should occur within the same hydrologic system (*e.g.*, bay, estuary, lagoon) as the impacts and should be appropriately distributed within the same ecological subdivision of larger systems (*e.g.*, San Pablo Bay or Richardson Bay in San Francisco Bay), unless NMFS and the action agency concur that good justification exists for altering the distribution based on valued ecosystem functions and services.

In identifying potentially suitable mitigation sites, it is advisable to consider the current habitat functions of the mitigation site prior to mitigation use. In general, conversion of unvegetated subtidal areas or disturbed uplands to eelgrass habitats may be considered appropriate means to mitigate eelgrass losses, while conversion of other special aquatic sites (*e.g.*, salt marsh, intertidal mudflats, and reefs) is unlikely to be considered suitable. It may be necessary to develop suitable environmental conditions at a site prior to being able to effectively transplant eelgrass into a mitigation area. Mitigation sites may need physical modification, including increasing or lowering elevation, changing substrate, removing shading or debris, adding wave protection or removing impediments to circulation.

2. Mitigation Area Needs

In-kind mitigation plans should address the components described below to ensure mitigation actions achieve no net loss of eelgrass habitat function. Alternative contingent mitigation should be specified and included in the mitigation plan to address situations where performance milestones are not met.

a) Impacts to Areal Extent of Eelgrass Habitat

Generally, mitigation of eelgrass habitat should be based on replacing eelgrass habitat extent at a 1.2 (mitigation) to 1 (impact) mitigation ratio for eelgrass throughout all regions of California. However, given variable degrees of success across regions and potential for delays and mitigation failure, NMFS calculated *starting* mitigation ratios using “The Five-Step Wetland Mitigation Ratio Calculator” (King and Price 2004) developed for NMFS Office of Habitat Conservation. The calculator utilizes methodology similar to Habitat Equivalency Analysis (HEA), which is an accepted method to determine the amount of compensatory restoration needed to provide natural resource services that are equivalent to loss of natural resource services following an injury (http://www.darrp.noaa.gov/economics/pdf/heaoverv.pdf). HEA is commonly used by NOAA during damage assessment cases, including those involving seagrass. Similar to HEA, the mitigation calculator is based on the “net present value” approach to asset valuation, an economics concept used to compare values of all types of investments, and then modified to incorporate natural resource services. Using the calculator allows for consistency in methodology for all areas within California, avoids arbitrary identification of size of the mitigation area, and avoids cumulative loss to eelgrass habitat that would likely occur with a standard 1:1 ratio (because of the complexity of eelgrass mitigation and the time for created eelgrass to achieve full habitat function).

The calculator includes a number of metrics to determine appropriate ratios that focus on comparisons of quality and quantity of function of the mitigation relative to the site of impact to ensure full compensation of lost function. (see Attachment 4). Among other metrics, the calculator employs a metric of likelihood of failure within the mitigation site based on regional mitigation failure history. As such, the mitigation calculator identifies a recommended starting mitigation ratio (the mitigation area to eelgrass impact area) based on regional history of success in eelgrass mitigation. Increased initial mitigation site size should be considered to provide greater assurance that the performance milestones, as specified in Section II.F.6, will be met. This is a common practice in the eelgrass mitigation field to reduce risk of falling short of mitigation needs (Thom 1990). Independent of starting mitigation ratio utilized for a given mitigation action, mitigation success should generally be evaluated against a ratio of 1.2:1.

The elevated starting mitigation ratio should be applied to the area of impact to vegetated eelgrass cover only. For unvegetated eelgrass habitat, a starting mitigation ratio of 1.2:1 is appropriate.

To determine the recommended starting mitigation ratio for each region, the percentage of transplant successes and failures was examined over the history of transplanting in the region. NMFS staff examined transplants projects over the past 25 years in all mitigation regions (see Attachment 6). Eelgrass mitigation in Southern California has a 35-year history with 66 transplants performed over that period. In the past 25 years, a total of 47 eelgrass transplants for mitigation purposes have been conducted in Southern California. Forty-three of these were established long enough to evaluate success for these transplants. The overall failure rate, with failure defined as not meeting success criteria established for the project, was 13 percent. Eelgrass mitigation within central California has a better history of successful completion than within southern California, San Francisco Bay, and northern California. However, the number of eelgrass mitigation actions conducted in this region is low and limited to areas within Morro Bay. While the success of eelgrass mitigation in central California has been high, the low number of attempts makes mitigation in this region uncertain. Eelgrass habitat creation/restoration in San Francisco Bay and in northern California has had varied success.

In all cases, best information available at the time of this policy's development was used to determine the parameter values entered into the calculator formula. As regional eelgrass mitigation success changes and the results of ongoing projects become available, the starting mitigation ratio may be updated. Updates in mitigation calculator inputs should not be made on an individual action basis, because the success or lack of success of an individual mitigation project may not reflect overall mitigation success for the region. Rather NMFS should re-evaluate the regional transplant history approximately every 5 years, increasing the record of transplant success in 5 year increments for new projects implemented after NMFS' adoption of these guidelines. If the 5-year review shows that new efforts are more successful than those from the beginning of the 25-year period, NMFS staff should consider removing early projects (*e.g.,* those completed 20 years prior) from the analysis.

On a case-by-case basis and in consultation with action agencies, NMFS may consider proposals with different starting mitigation ratios where sufficient justification is provided that indicates the mitigation site would achieve the no net loss goal. In addition, CMPs could consider different starting mitigation ratios, or other mitigation elements and techniques, as appropriate to the geographic area addressed by the CMP.

Regardless of starting mitigation ratio, eelgrass mitigation should be considered successful, if it meets eelgrass habitat coverage over an area that is 1.2 times the impact area with comparable eelgrass density as impacted habitat. Please note, delayed implementation, supplemental transplant needs, or NMFS and action agency agreement may result in an altered mitigation area. In the EFH consultation context, NMFS may recommend an altered mitigation area during implementation of the federal agency's mitigation plan following EFH consultation or NEPA review, or as an EFH Conservation Recommendation if the federal agency re-initiates EFH consultation.

(1) Southern California (Mexico border to Pt. Conception)

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.38 to 1 (transplant area to vegetated cover impact area) should be recommended to counter the regional failure risk. That is, for each square meter of vegetated eelgrass cover adversely impacted, 1.38 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(2) Central California (Point Conception to mouth of San Francisco Bay).

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.20 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 0 percent failure rate over the past 25 years (4 transplant actions). It should however be noted that all of these successful transplants included a greater area of planting than was necessary to achieve success such that the full mitigation area would be achieved, even with areas of minor transplant failure.

(3) San Francisco Bay (including south, central, San Pablo and Suisun Bays).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass bed resource, a ratio of 3.01 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 60 percent failure rate over the past 25 years (10 transplant actions). That is, for each square meter adversely impacted, 3.01 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(4) Northern California (mouth of San Francisco Bay to Oregon border).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass habitat, a starting ratio of 4.82 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 75 percent failure rate over the past 25 years (4 transplant actions). That is, for each square meter of eelgrass habitat adversely impacted, 4.82 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

b) Impacts to Density of Eelgrass Beds

Degradation of existing eelgrass habitat that results in a permanent reduction of eelgrass turion density greater than 25 percent, and that is a statistically significant difference from pre-impact density, should be mitigated based on an equivalent area basis. The 25 percent and statistically significant threshold is believed reasonable based on supporting information (Fonseca *et al.* 1998, WDFW 2008), and professional practice under SCEMP. In these cases, eelgrass remains present at the action site, but density may be potentially affected by long-term chronic or intermittent effects of the action. Reduction of density should be determined to have occurred when the mean turion density of the impact site is found to be statistically different (α=0.10 and β=0.10) from the density of a reference and at least 25 percent below the reference mean during two annual sampling events following implementation of an action. The number of samples taken to describe density at each site (*e.g.,* impact and reference) should be sufficient to provide for appropriate statistical power. For small impact areas that do not allow for a sample size that provides statistical power, alternative methods for pre- and post- density comparisons could be considered. Mitigation for reduction of turion density without change in eelgrass habitat area should be on a one-for-one basis either by augmenting eelgrass density at the impact site or by establishing new eelgrass habitat comparable to the change in density at the impact site. For example, a 25 percent reduction in density of 100-square meters (100 turions/square meter) of eelgrass habitat to 75 turions/square meter should be mitigated by the establishing 25 square meters of new eelgrass habitat with a density at or above the 100 turions/square meter pre-impact density.

3. Mitigation Technique

In-kind mitigation technique should be determined on a case-by-case basis. Techniques for eelgrass mitigation should be consistent with the best available technology at the time of mitigation implementation and should be tailored to the specific needs of the mitigation site. Eelgrass transplants have been highly successful in southern and central California, but have had mixed results in San Francisco Bay and northern California. Bare-root bundles and seed buoys have been utilized with some mixed success in northern portions of the state. Transplants using frames have also been used with some limited success. For transplants in southern California, plantings consisting of bare-root bundles consisting of 8-12 individual turions each have proven to be most successful (Merkel 1988).

Donor material should be taken from the area of direct impact whenever practical, unless the action resulted in reduced density of eelgrass at the area of impact. Site selections should consider the similarity of physical environments between the donor site and the transplant receiver site and should also consider the size, stability, and history of the donor site (*e.g.*, how long has it persisted and is it a transplant site). Plants harvested should be taken in a manner to thin an existing bed without leaving any noticeable bare areas. For all geographic areas, no more than 10 percent of an existing donor bed should be harvested for transplanting purposes. Ten percent is reasonable based on recommendations in Thom *et al.* (2008) and professional practice under SCEMP. Harvesting of flowering shoots for seed buoy techniques should occur only from widely separated plants.

It is important for action agencies to note that state laws and regulations affect the harvesting and transplantation of donor plants and permission from the state, where required, should be obtained; for example, California Department of Fish and Wildlife may need to provide written authorization for harvesting and transplanting donor plants and/or flowering shoots.

4. Mitigation Plan

NMFS should recommend that a mitigation plan be developed for in-kind mitigation efforts. During consultation, NMFS biologists should request that mitigation plans be provided at least 60 days prior to initiation of project activities to allow for NMFS review. When feasible, mitigation plans should be developed based on preliminary or pre-project eelgrass surveys. When there is uncertainty regarding whether impacts to eelgrass will occur, and the need for mitigation is based on comparison of pre- and post-project eelgrass surveys, NMFS biologists should request that the mitigation plan be provided no more than 60 days following the post-project survey to allow for NMFS review and minimize any delay in mitigation implementation.

At a minimum, the mitigation plan should include:

- Description of the project area
- Results of preliminary eelgrass survey and pre/post-project eelgrass surveys if available (see Section II.B.1 and II.B.2)
- Description of projected and/or documented eelgrass impacts
- Description of proposed mitigation site and reference site(s) (see Section II.B.4)
- Description of proposed mitigation methods (see Section II.F.3)
- Construction schedule, including specific starting and ending dates for all work including mitigation activities. (see Section II.F.5)
- Schedule and description of proposed post-project monitoring and when results will be provided to NMFS
- Schedule and description of process for continued coordination with NMFS through mitigation implementation
- Description of alternative contingent mitigation or adaptive management should proposed mitigation fail to achieve performance measures (see Section II.F.6)

5. Mitigation Timing

Mitigation should commence within 135 days following the initiation of the in-water construction resulting in impact to the eelgrass habitat, such that mitigation commences within the same eelgrass growing season as impacts occur. If possible, mitigation should be initiated prior to or concurrent with impacts. For impacts initiated within 90 days prior to, or during, the low-growth period for the region, mitigation may be delayed to within 30 days after the start of the following growing season, or 90 days following impacts, whichever is longer, without the need for additional mitigation as described below. This timing avoids survey completion during the low growth season, when results may misrepresent progress towards performance milestones.

Delays in eelgrass mitigation result in delays in ultimate reestablishment of eelgrass habitat functions, increasing the duration and magnitude of project impacts to eelgrass. To offset loss of eelgrass habitat function that accumulates through delay, an increase in successful eelgrass mitigation is needed to achieve the same compensatory habitat function. Because habitat function is accumulated over time once the mitigation habitat is in place, the longer the delay in initiation of mitigation, the greater the additional habitat area needed (i.e., mitigation ratio increasingly greater than 1.2:1) to offset losses. Unless a specific delay is authorized or dictated by the initial schedule of work, federal action agencies should determine whether delays in mitigation initiation in excess of 135 days warrant an increased final mitigation ratio. If increased mitigation ratios are warranted, NMFS should recommend higher mitigation ratios (see Attachment 7). Where delayed implementation is authorized by the action agency, the increased mitigation ratio may be determined by utilizing the Wetlands Mitigation Calculator (King and Price 2004) with an appropriate value for parameter D (See Attachment 4). Examples of delay multipliers generated using the Wetlands Mitigation Calculator are provided in Attachment 5.

Conversely, implementing mitigation ahead of impacts can be used to reduce the mitigation needs by achieving replacement of eelgrass function and services ahead of eelgrass losses. If eelgrass is successfully transplanted three years ahead of impacts, the mitigation ratio would drop from 1.2:1 to 1:1. If mitigation is completed less than three years ahead of impacts, the mitigation calculator can be used to determine the appropriate intermediate mitigation ratio.

6. Mitigation Monitoring and Performance Milestones

In order to document progress and persistence of eelgrass habitat at the mitigation site through and beyond the initial establishment period, which generally is three years, monitoring should be completed for a period of five years at both the mitigation site and at an appropriate reference site(s) (Section II.B.4. Reference Site Selection). Monitoring at a reference site(s) may account for any natural changes or fluctuations in habitat area or density. Monitoring should determine the area of eelgrass and density of plants at 0, 12, 24, 36, 48, and 60 months after completing the mitigation. These intervals will provide yearly updates on the establishment and persistence of eelgrass during the growing season. These monitoring recommendations are consistent with findings of the National Research Council (NRC 2001), the Corps requirements for compensatory mitigation (33 CFR 332.6(b)), and other regional resource policies (Corps 2010, Evans and Leschen 2010, SFWMD 2007).

All monitoring work should be conducted during the active eelgrass growth period and should avoid the recognized low growth season for the region to the maximum extent practicable (typically November through February for southern California, November through March for central California, November through March for San Francisco Bay, and October through April for northern California). Sufficient flexibility in the scheduling of the 6 month surveys should be allowed in order to ensure the work is completed during this active growth period. Additional monitoring beyond the 60-month period may be warranted in those instances where the stability of the proposed mitigation site is questionable, where the performance of the habitat relative to reference sites is erratic, or where other factors may influence the long-term success of mitigation. Mitigation plans should include a monitoring schedule that indicates when each of the monitoring events will be completed.

The monitoring and performance milestones described below are included as eelgrass transplant success criteria in the SCEMP. These numbers represent milestones and associated timelines typical of successful eelgrass habitat development based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing mitigation monitoring results for projects implemented under SCEMP. Restored eelgrass habitat is expected to develop through an initial 3 year monitoring period such that, within 36 months following planting, it meets or exceeds the full coverage and not less than 85 percent of the density relative to the initial condition of affected eelgrass habitat. Restored eelgrass habitat is expected to sustain this condition for at least 2 additional years.

Monitoring events should evaluate the following performance milestones:

Month 0 – Monitoring should confirm the full coverage distribution of planting units over the initial mitigation site as appropriate to the geographic region.

Month 6 – Persistence and growth of eelgrass within the initial mitigation area should be confirmed, and there should be a survival of at least 50 percent of the initial planting units with well-distributed coverage over the initial mitigation site. For seed buoys, there should be demonstrated recruitment of seedlings at a density of not less than one seedling per four (4) square meters with a distribution over the extent of the initial planting area. The timing of this monitoring event should be flexible to ensure work is completed during the active growth period.

Month 12– The mitigation site should achieve a minimum of 40 percent coverage of eelgrass and 20 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 24– The mitigation site should achieve a minimum of 85 percent coverage of eelgrass and 70 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 36– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 48– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 60– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Performance milestones may be re-evaluated or modified if declines at a mitigation site are also demonstrated at the reference site, and therefore, may be a result of natural environmental stressors that are unrelated to the intrinsic suitability of the mitigation site. In the EFH consultation context, NMFS should provide recommendations regarding modification of performance milestones as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation.

7. Mitigation Reporting

NMFS biologists should request monitoring reports and spatial data for each monitoring event in both hard copy and electronic version, to be provided within 30 days after the completion of each monitoring period to allow timely review and feedback from NMFS. These reports should clearly identify the action, the action party, mitigation consultants, relevant points of contact, and any relevant permits. The size of permitted eelgrass impact estimates, actual eelgrass impacts, and eelgrass mitigation needs should be identified, as should appropriate information describing the location of activities. The report should include a detailed description of eelgrass habitat survey methods, donor harvest methods and transplant methods used. The reports should also document mitigation performance milestone progress (see II.F.6. Mitigation Monitoring and Performance Milestones). The first report (for the 0-month post-planting monitoring) should document any variances from the mitigation plan, document the sources of donor materials, and document the full area of planting. The final mitigation monitoring report should provide the action agency and NMFS with an overall assessment of the performance of the eelgrass mitigation site relative to natural variability of the reference site to evaluate if mitigation responsibilities were met. An example summary is provided in Attachment 3.

8. Supplemental Mitigation

Where development of the eelgrass habitat at the mitigation site falls short of achieving performance milestones during any interim survey, the monitoring period should be extended and supplemental mitigation may be recommended to ensure that adequate mitigation is achieved. In the EFH consultation context, NMFS should provide recommendations regarding extended monitoring as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation. In some instances, an adaptive management corrective action to the existing mitigation area may be appropriate. In the event of a mitigation failure, the action agency should convene a meeting with the action party, NMFS, and applicable regulatory and/or resource agencies to review the specific circumstances and develop a solution to achieve no net loss in eelgrass habitat function.

As indicated previously, while in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis. In cases where it is demonstrated that in-kind replacement is infeasible, out-of-kind mitigation may be appropriate over completion of additional in-kind mitigation. The determination that an out-of-kind mitigation is appropriate will be made by NMFS, the action agency, and the applicable regulatory agencies, where a regulatory action is involved.

G. Special Circumstances

Depending on the circumstances of each individual project, NMFS may make recommendations different from those described above on a case by case basis. For the scenarios described below, for example, NMFS could recommend a mitigation ratio or 1:1 or for use of out-of-kind mitigation. Because NMFS needs a proper understanding of eelgrass habitat in the project area and potential impacts of the proposed project to evaluate the full effects of authorized activities, NMFS should not make recommendations that diverge from these guidelines if they would result in surveys, assessments or reports inferior to those which might be obtained through the guidance in Section II. The area thresholds described below are taken from the SCEMP and/or reflect recommendations NMFS staff have repeatedly made during individual EFH consultations. These thresholds minimize impacts to eelgrass habitat quality and quantity, based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing project monitoring results for projects implemented under SCEMP. The special circumstance included for shellfish aquaculture longlines is supported by Rumrill and Poulton (2004) and the NMFS Office of Aquaculture.

1. Localized Temporary Impacts

NMFS may consider modified target mitigation ratios for localized temporary impacts wherein the damage results in impacts of less than 100 square meters and eelgrass habitat is fully restored within the damage footprint within one year of the initial impact (e.g., placement of temporary recreational facilities, shading by construction equipment, or damage sustained through vessel groundings or environmental clean-up operations). In such cases, the 1.2:1 mitigation ratio should not apply, and a 1:1 ratio of impact to recovery would apply. A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be completed in order to demonstrate the temporary nature of the impacts. NMFS should recommend that surveys be completed as follows: 1) the first post-construction eelgrass survey should be completed within 30 days following completion of construction to evaluate direct effects of construction, 2) the second and third post-construction surveys should be performed approximately one year after the first post-construction survey, and approximately two years after the first post-construction survey, respectively, during the appropriate growing season to confirm no indirect, or longer term effects resulted from construction. A compelling reason should be demonstrated before any reduced monitoring and reporting recommendations are made.

2. Localized Permanent Impacts

a) If both NMFS and the authorizing action agencies concur, the compensatory mitigation elements of this policy may not be necessary for the placement of a single pipeline, cable, or other similar utility line across existing eelgrass habitat with an impact corridor of no more than 1 meter wide. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. The actual area of impact should be determined from the post-action survey. NMFS should recommend the completion of an additional survey (after 1 year) to ensure that the action or impacts attributable to the action have not exceeded the 1-meter corridor width. NMFS should recommend that, if the post-action or 1 year survey demonstrates a loss of eelgrass habitat greater than the 1-meter wide corridor, mitigation should be undertaken.

b)) If both NMFS and the authorizing action agencies concur that the spacing of shellfish aquaculture longlines does not result in a measurable net loss of eelgrass habitat in the project area, then mitigation associated with local losses under longlines may not be necessary. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. NMFS should recommend the completion of additional post-action monitoring surveys (to be completed approximately 1 year and 2 years following implementation of the action) to ensure that the action or impacts attributable to the action have not resulted in net adverse impacts to eelgrass habitat. NMFS should recommend that, if the 1-year or 2-year survey demonstrates measurable impact to eelgrass habitat, mitigation should be undertaken. c) NMFS should consider mitigation on a 1:1 basis for impacts less than 10 square meters to eelgrass patches where impacts are limited to small portions of well-established eelgrass habitat or eelgrass habitat that, despite highly variable conditions, generally retain extensive eelgrass, even during poor years. A reduced mitigation ratio should not be considered where impacts would occur to isolated or small eelgrass habitat areas within which the impacted area constitutes more than 1% of the eelgrass habitat in the local area during poor years.

c) If NMFS concurs and suitable out-of-kind mitigation is proposed, compensatory mitigation may not be necessary for actions impacting less than 10 square meters of eelgrass.

III. Glossary of Terms

Except where otherwise specified, the explanations of the following terms are provided for informational purposes only and are described solely for the purposes of this policy; where a NMFS statute, regulation, or agreement requires a different understanding of the relevant term, that understanding of the term will supplant these explanations provided below.

Compensatory mitigation – restoration, establishment, or enhancement of aquatic resources for the purposes of offsetting unavoidable authorized adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Ecosystem – a geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem.

Ecosystem function – ecological role or process provided by a given ecosystem.

Ecosystem services – contributions that a biological community and its habitat provide to the physical and mental well-being of the human population (*e.g.*, recreational and commercial opportunities, aesthetic benefits, flood regulation).

Eelgrass habitat – areas of vegetated eelgrass cover (any eelgrass within 1 square meter quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area

Essential fish habitat (EFH) – EFH is defined in the MSA as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

EFH Assessment – An assessment as further explained in 50 C.F.R. § 600.920(e).

EFH Consultation – The process explained in 50 C.F.R. § 600.920

EFH Conservation Recommendation – provided by the National Marine Fisheries Service (NMFS) to a federal or state agency pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act regarding measures that can be taken by that agency to conserve EFH. As further explained in 50 C.F.R. § 600.925, EFH Conservation Recommendations may be provided as part of an EFH consultation with a federal agency, or may be provided by NMFS to any federal or state agency whose actions would adversely affect EFH .

Habitat – environment in which an organism(s) lives, including everything that surrounds and affects its life, including biological, chemical and physical processes.

Habitat function – ecological role or process provided by a given habitat (*e.g.*, primary production, cover, food, shoreline protection, oxygenates water and sediments, etc.).

In lieu fee program – a program involving the restoration, establishment, and/or enhancement of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation needs; an in lieu fee program works like a mitigation bank, however, fees to compensate for impacts to habitat function are collected prior to establishing an on-the-ground conservation/restoration project.

In-kind mitigation – mitigation where the adverse impacts to a habitat are mitigated through the creation, restoration, or enhancement of the same type of habitat.

Mitigation – action or project undertaken to offset impacts to an existing natural resource.

Mitigation bank – a parcel of land containing natural resource functions/values that are conserved, restored, created and managed in perpetuity and used to offset unavoidable impacts to comparable resource functions/values occurring elsewhere. The resource functions/values contained within the bank are translated into quantified credits that may be sold by the banker to parties that need to compensate for the adverse effects of their activities.

Out-of-kind mitigation – mitigation where the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type

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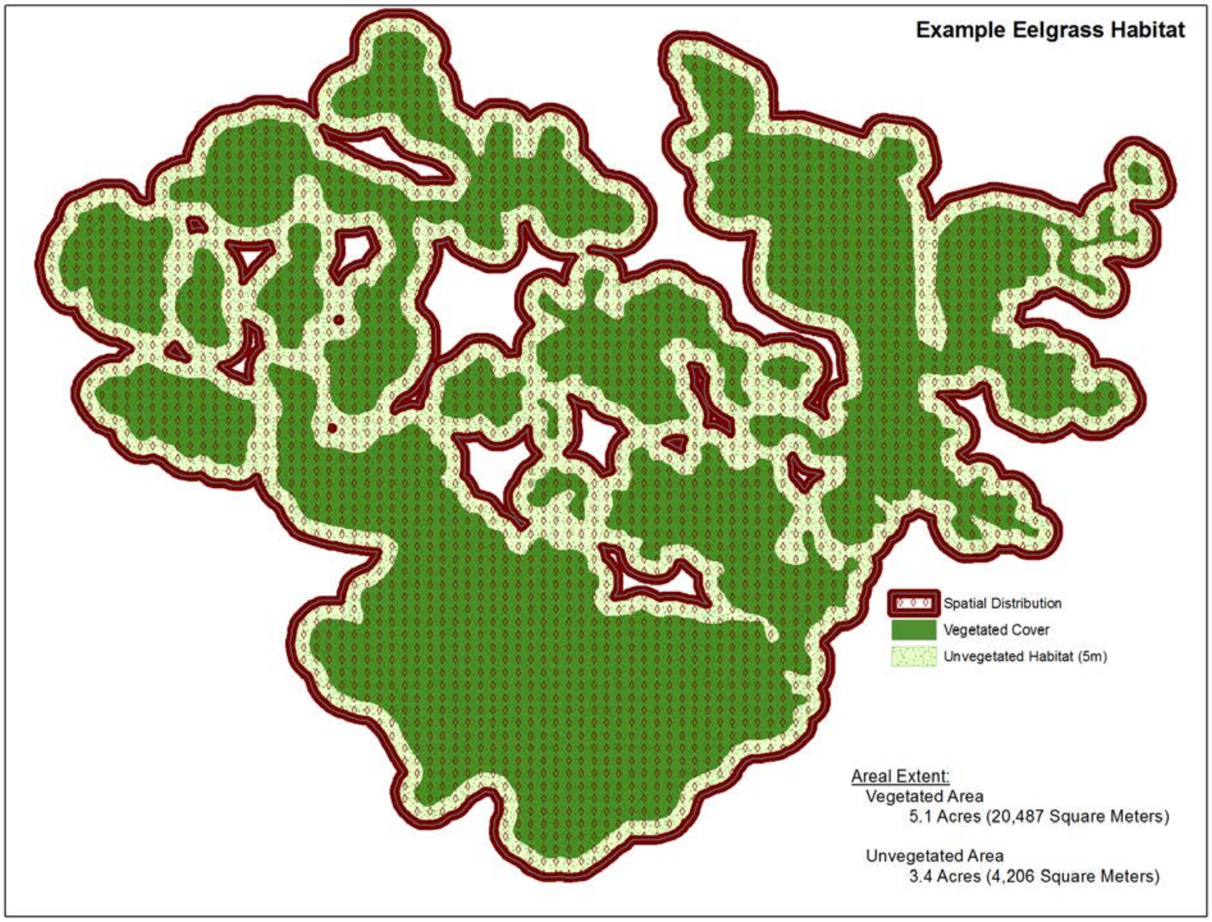
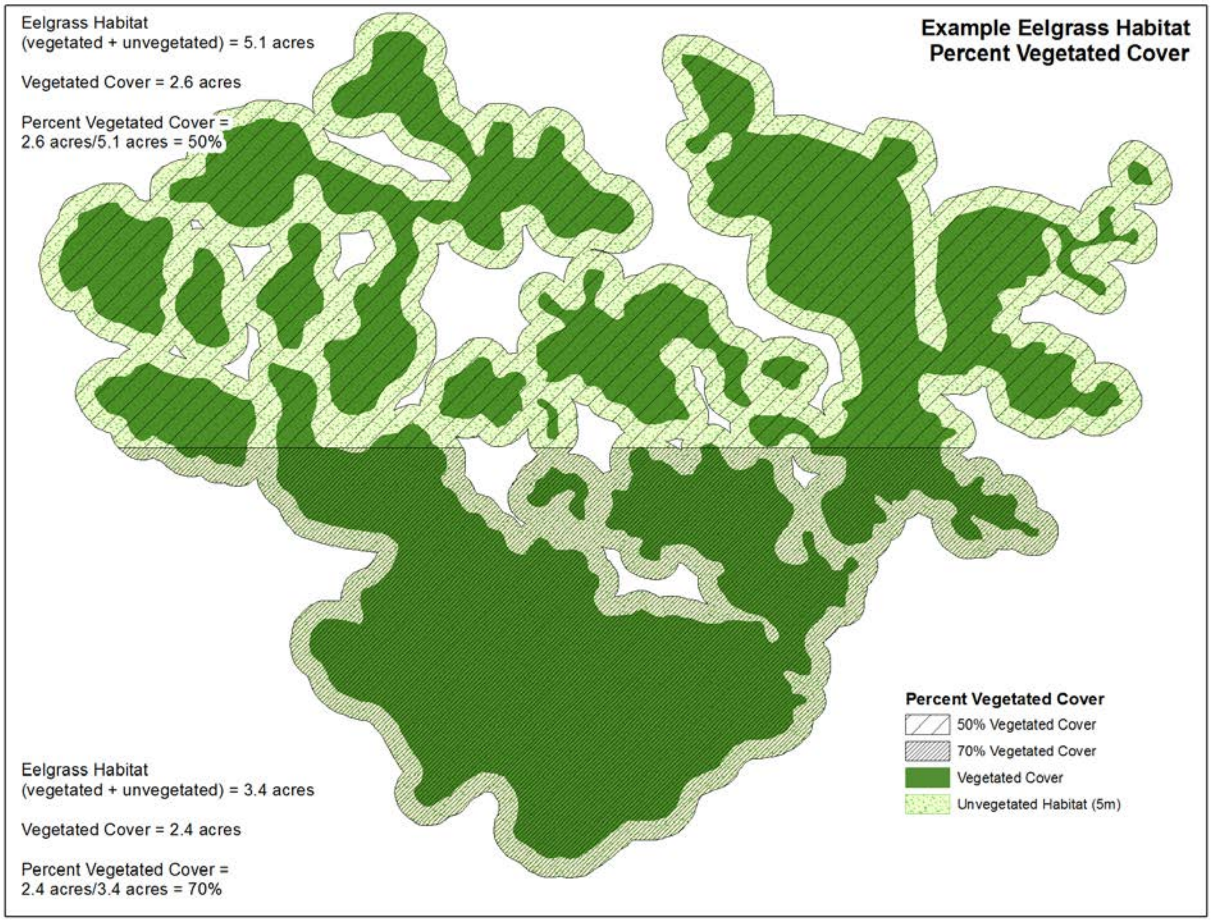
ATTACHMENT 1. Graphic depiction of eelgrass habitat definition including spatial distribution and aerial coverage of vegetated cover and unvegetated eelgrass habitat.

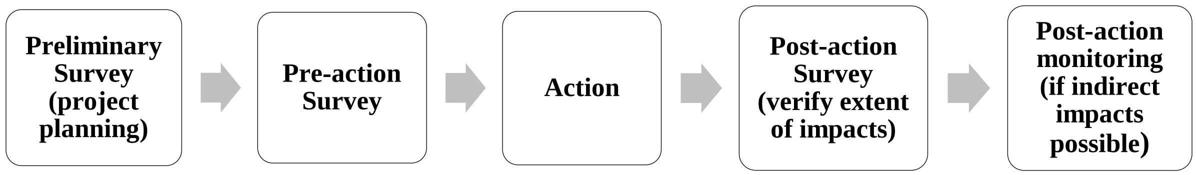


ATTACHMENT 2. Example Eelgrass Habitat Percent Vegetated Cover.



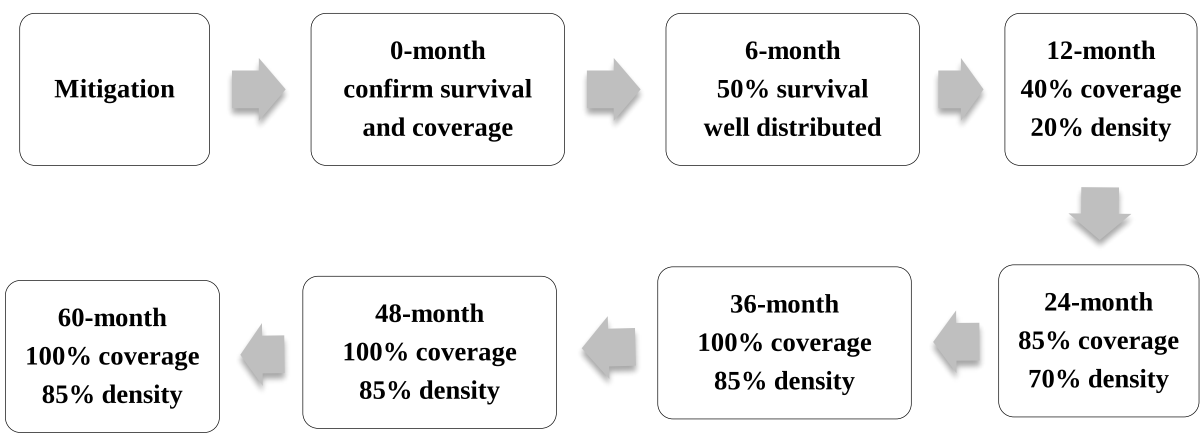
ATTACHMENT 3. Flow chart depicting timing of surveys and monitoring.

a) Eelgrass impact surveys



- All surveys should be completed during the growing season
- Surveys should be completed at the impact site and an appropriate reference site(s)
- A preliminary survey completed for planning purposes may be completed a year or more in advance of the action.
- Pre-action and post-action surveys should be completed within 60 days of the action.
- A survey is good for 60 days, or if that 60 day period extends beyond the end of growing season, until start of next growing season
- Two years of monitoring following the initial post-action monitoring event may be needed to verify lack or extent of indirect effects.
- Survey reports should be provided to NMFS and the federal action agency within 30 days of completion of each survey event

b) Eelgrass mitigation monitoring



- Mitigation should occur coincident or prior to the action
- All monitoring should be completed during the growing season
- Performance metrics for each monitoring event are compared to the 1.2:1 mitigation ratio
- Monitoring reports should be provided to NMFS and the federal action agency 30 days of completion of each monitoring event
- NMFS and action agency will evaluate if performance metrics met, and decide if supplemental mitigation or other adaptive management measures are needed

ATTACHMENT 4. Eelgrass transplant monitoring report.

In order to ensure that NMFS is aware of the status of eelgrass transplants, action agencies should provide or ensure that NMFS is provided a monitoring report summary with each monitoring report. For illustrative purposes only, an example of a monitoring report summary is provided below.

ACTION PARTY CONTACT INFORMATION:

Action Name (same as permit reference):

(a) Action party Information

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

MITIGATION CONSULTANT

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

PERMIT DATA:

Permit	Issuance Date	Expiration Date	Agency Contact

EELGRASS IMPACT AND MITIGATION NEEDS SUMMARY:

Permitted Eelgrass Impact Estimate (m^2):			
Actual Eelgrass Impact (m^2):		On (post-construction date):	
Eelgrass Mitigation Needs (m^2):		Mitigation Plan Reference:	
Impact Site Location:			
Impact Site Center Coordinates (actionion &			

datum):	
Mitigation Site Location:	
Mitigation Site Center Coordinates (actionion & datum):	

ACTION ACTIVITY DATA:

Activity	**Start Date**	**End Date**	**Reference Information**
Eelgrass Impact			
Installation of Eelgrass Mitigation			
Initiation of Mitigation Monitoring			

MITIGATION STATUS DATA:

	Mitigation Milestone	**Scheduled Survey**	**Survey Date**	**Eelgrass Habitat Area (m^2)**	**Bottom Coverage (Percent)**	**Eelgrass Density (turions/m^2)**	**Reference Information**
Month	**0**						
	6						
	12						
	24						
	36						
	48						
	60						

FINAL ASSESSMENT:

Was mitigation met?	
Were mitigation and monitoring performed timely?	
Were mitigation delay increases needed or were supplemental mitigation programs necessary?	

ATTACHMENT 5. Wetlands mitigation calculator formula and parameters.

Starting mitigation ratios for each region within California were calculated using "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004) developed for NMFS Office of Habitat Conservation. The discrete time equation this method uses to solve for the appropriate mitigation ratio is as follows:

$$R = \frac{\sum_{t=0}^{T_{max}} (1+r)^{-t}}{(B(1-E)(1+L)-A)\left[\sum_{t=-D}^{C-D-1} \frac{(t+D)}{C(1+r)^{t}} + \sum_{C-D}^{T_{max}} (1+r)^{-t}\right] + \left[\sum_{t=-D}^{T_{max}} \frac{\left(1-(1-k)^{(t+D)}\right)}{(1+r)^{(t+D)}}\right](A(1+L))}$$

The calculator parameters in the above equation and values used to calculate starting mitigation ratios for CEMP are as follows:

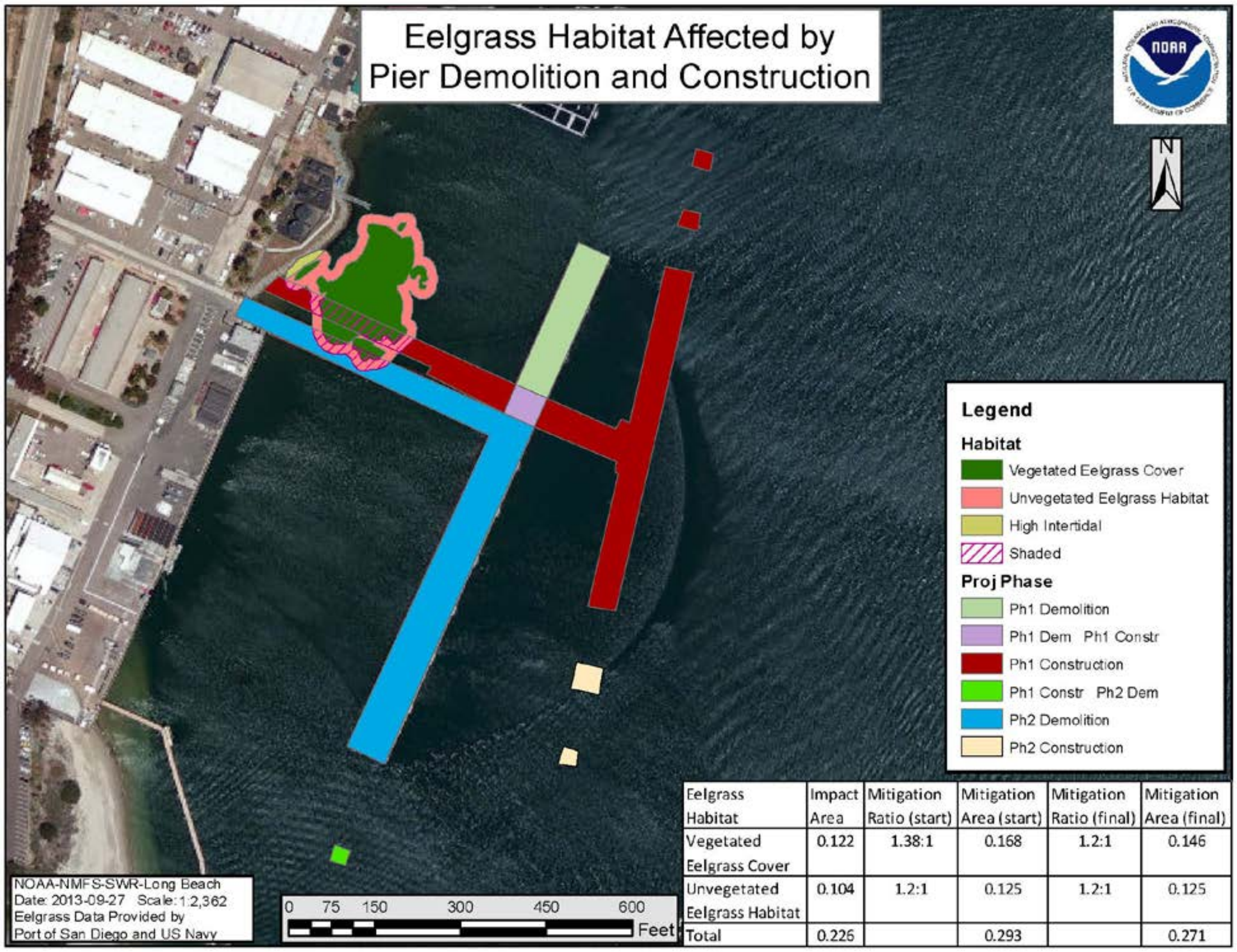
Symbol	Calculator Parameter	Value
A	The level of habitat function provided at the mitigation site prior to the mitigation project	0%
B	The maximum level of habitat function that mitigation is expected to attain, if it is successful	100%
C	The number of years after construction that the mitigation project is expected to achieve maximum function	3 yrs
D	The number of years before destruction of the impacted wetland that the mitigation project begins to generate habitat function	0 yrs
E	The percent likelihood that the mitigation project will fail and provide none of the anticipated benefits	various*
L	The percent difference in expected habitat function based on differences in landscape context of the mitigation site when compared with the impacted wetland	0%
k	The percent likelihood that the mitigation site, in the absence purchase or easement would be developed in any future year	0%
r	The discount rate used for comparing gains and losses that accrue at different times in terms of their present value	3%**
Tmax	The time horizon used in the analysis (chosen to maintain 1.2:1 ratio at E=100% and other parameter values listed above).	13 yrs

* The value for E was based on regional history of success in eelgrass mitigation and varied between regions (see Attachment X).

** NOAA suggests the use of a 3 percent real discount rate for discounting interim service losses and restoration gains, unless a different proxy for the social rate of time preference is more appropriate. (NOAA-DARP 1999) We use this value here, because it is based on best available information and is consistent with the NOAA Damage Assessment and Restoration Program.

ATTACHMENT 6. Example calculations for application of starting and final mitigation ratios for impacts to eelgrass habitat in southern California.

In this example, a pier demolition and construction would impact 0.122 acres of vegetated eelgrass habitat (dark green) and 0.104 acres of unvegetated habitat (pink). Area of impact is indicated by purple hatch mark. Application of recommended starting mitigation ratio for southern California (1.38:1) and final mitigation ratio (1.2:1) to compute starting and final mitigation area for this example are shown in the table.



Eelgrass Habitat	Impact Area	Mitigation Ratio (start)	Mitigation Area (start)	Mitigation Ratio (final)	Mitigation Area (final)
Vegetated Eelgrass Cover	0.122	1.38:1	0.168	1.2:1	0.146
Unvegetated Eelgrass Habitat	0.104	1.2:1	0.125	1.2:1	0.125
Total	0.226		0.293		0.271

ATTACHMENT 7. Example mitigation area multipliers for delay in initiation of mitigation activities.

Delays in eelgrass transplantation result in delays in ultimate reestablishment of eelgrass habitat values, increasing the duration and magnitude of project effects to eelgrass. The delay multipliers in the table below have been generated by altering the implementation start time within "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004).

MONTHS POST-IMPACT	DELAY MULTIPLIER (Percent of Initial Mitigation Area Needed)
0-3 mo	100%
4-6 mo	107%
7-12 mo	117%
13-18 mo	127%
19-24 mo.	138%
25-30 mo.	150%
31-36 mo	163%
37-42 mo.	176%
43-48 mo.	190%
49-54 mo.	206%
55-60 mo.	222%

ATTACHMENT 8. Summary of Eelgrass Transplant Actions in California

See table starting next page.

SUMMARY OF EELGRASS (*ZOSTERA MARINA*) TRANSPLANT PROJECTS IN CALIFORNIA

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Southern California Eelgrass Restoration History									
	Southern	San Diego Bay	North Island	1976	<0.1	SP	yes	no	-
	Southern	San Diego Bay	"Delta" Beach	1977	1.6	SP	yes	partial	-
	Southern	San Diego Bay	North Island	1978	<0.1	SP	yes	yes	+
	Southern	Newport Bay	Carnation Cove	1978	<0.1	SP	no	no	-
	Southern	Newport Bay	West Jetty	1980	<0.1	SP	yes	partial	0
	Southern	Mission Bay	multiple beaches	1982	<0.1	SP	no	partial	0
	Southern	LA/LB Harbor	Cabrillo Beach	1985	<0.1	BR	yes	yes	+
	Southern	Alamitos Bay	Peninsula	1985	<0.1	BR	yes	yes	+
	Southern	Huntington Hbr.	Main Channel	1985	<0.1	BR	yes	no	0
	Southern	Newport Bay	Upper	1985	<0.1	BR	yes	no	0
	Southern	Mission Bay	Sail Bay	1986	2.7	BR	yes	yes	+
	Southern	San Diego Bay	NEMS I	1987	3.8	BR	no	yes	+
	Southern	San Diego Bay	Chula Vista Wildlife Reserve	1987	<0.1	BR	yes	no	+[1]
	Southern	San Diego Bay	Harbor Island	1988	0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Entrance Channel	1989	0.1	BR	no	yes	+
	Southern	San Diego Bay	Le Meridien Hotel	1990	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Embarcadero	1991	<0.1	BR	yes	yes	+[2]
	Southern	Mission Bay	Sea World Lagoon	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Loew's Marina	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 2	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Sea Grant Study	1993	<0.1	BR	yes	yes	+
	Southern	Agua Hedionda Lagoon	Outer Lagoon	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 5	1994	0.4	BR	yes	yes	+
	Southern	Mission Bay	South Shores Basin	1994	2.9	BR	yes	yes	+
	Southern	Talbert Marsh	Talbert Channel	1995	<0.1	BR	na	yes	+[4]
	Southern	Mission Bay	various sites	1995	4.8	BR	yes	yes	+
	Southern	Mission Bay	Ventura Cove[5]	1996	0.5	BR	yes	yes	+[6]
	Southern	Mission Bay	Santa Clara Cove	1996	<0.1	BR	yes	no	0[10]
	Southern	Mission Bay	West Mission Bay Drive Bridge	1996	<0.1	BR	no	yes	0[10]
	Southern	Mission Bay	De Anza Cove	1996	<0.1	BR	yes	yes	+
	Southern	Batiquitos Lagoon	all basins	1997	21.6[7]	BR	yes	yes	+[4]
	Southern	San Diego Bay	NEMS 5	1997	7.1	BR	yes	yes	+
	Southern	San Diego Bay	Convair Lagoon	1998	2.5	BR	yes	no	-[12]
	Southern	San Diego Bay	NEMS 6	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Bristol Cove	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Middle Lagoon and Inner Lagoon	1999	4	BR	yes	yes	+
	Southern	Newport Bay	Balboa Is.Grand Cana	1999	<0.1	BR	yes	yes	+
	Southern	Mission Bay	West Ski Island	2001	0.2	BR	yes	yes	+

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
	Southern	San Diego Bay	Expanded NEMS 6	2001	0.6	BR	yes	yes	+
	Southern	Newport Bay	USCG Corona del Mar	2002	<0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Sunset Bay	2002	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Navy Enhancement Is.	2002	1	BR	yes	yes	+
	Southern	San Diego Bay	Coronado Bay Bridge	2003	0.3	BR	no	no	0
	Southern	LA Harbor	P300 Expansion Area	2003	5.9	BR	yes	partial	-[9]
	Southern	Newport Bay	Newport Bay Channel Dredging	2004	0.4	BR	yes	no	-
	Southern	San Diego Bay	South Bay Borrow Pit	2004	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	USCG ATC Pier	2004	0.1	BR	yes	yes	+
	Southern	San Diego Bay	South Bay Borrow Pit Sup.	2006	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	D Street Marsh	2006	0.3	BR	yes	pending	pending
	Southern	LA Harbor	P300 Supplement	2007	0.8	BR	yes	yes	pending
	Southern	San Diego Bay	Glorietta Bay Shoreline Park	2007	0.2	BR	yes	yes	pending
	Southern	Bolsa Chica	Pilot Eelgrass Restoration	2007	0.5	BR	yes	yes	+[4]
	Southern	San Diego Bay	Borrow Pit Supplement	2007	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	Sweetwater Silvergate Frac-out	2008	<0.1	BR	yes	yes	0[11]
	Southern	San Diego Bay	Harbor Drive Bridge/NTC Channel	2009	<0.1	BR	yes	pending	pending
Southern California Eelgrass Success Rate (1989-2009, Last 20 Years)								**87%**	**n=43**
Central California Eelgrass Restoration History									
	Central	Morro Bay	Anchorage Area	1985	<0.1	BR	no	yes	+
	Central	Morro Bay	Target Rock	1997	<0.1	BR	no	yes	+
	Central	Morro Bay	Morro Bay Launch Ramp	2000	<0.1	BR	yes	yes	+
	Central	Morro Bay	Mooring Area A1	2002	0.3	BR	yes	yes	+
	Central	Morro Bay	Western Shoal	2010	0.8	BR	yes	pending	pending
Central California Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**100%**	**n=4**
San Francisco Bay Eelgrass Restoration History									
	San Francisco Bay	San Francisco Bay	Richmond Training Wall	1985	<0.1	BR	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Keil Cove and Paradise Cove	1989	0.1	Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island/Middle Harbor Shoal	1998	0.1	BR and Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island	1999	0.1	BR	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Brickyard Cove, Berkeley	2002	0.2	BR	yes	yes	+[13]
	San Francisco Bay	San Francisco Bay	Emeryville Shoals	2002	0.1	Mixed Test	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	0.6	Seed Bouy	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	mod. TERFS	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	Seeding	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Clipper Yacht Harbor, Sausalito	2007	<0.1	Frames	yes	pending	pending
	San Francisco Bay	San Francisco Bay	Albany, Emeryville, San Rafael	2007	<0.1	BR	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Belvedere	2008	<0.1	Frames	yes	pending	pending
San Francisco Bay Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**40%**	**n=10**

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Northern California Eelgrass Restoration History									
	Northern	Humboldt Bay	Indian Island	1982	unknown	BR	unknown	no	-
	Northern	Bodega Harbor	Spud Point Marina	1984	1.3	BR	yes	no	-
	Northern	Humboldt Bay	Indian Island	1986	<0.1	BR	yes	no	-
	Northern	Humboldt Bay		1986	0.2	unknown	unknown	no	-
	Northern	Humboldt Bay	SR255 Bridge	2004	<0.1	BR	yes	no	-
	Northern	Humboldt Bay	Maintenance Dredging Project	2005	<0.1	BR	yes	yes	+
Northern California Eelgrass Success Rate (1982-2009, Inadequate History to Exclude Older Projects)								**25%**	**n=4**

* size in hectares

SP = sediment laden plug

** BR = bare root

*** success status is measured as yes, no, partial, pending, or unknown. Success rate is reported as percentage of sucessful over total completed within the past 25 years.

yes = 1, partial = 0.5, no = 0, and pending or unknown are not counted in either the numerator or denominator in determining success percentage.

**** + = net increase in eelgrass coverage, 0 = no change in eelgrass coverage, - = net decrease in eelgrass coverage

1 Transplant was initially adversely impacted by an unknown source of sediment and was deemed unsuitable.

2 The transplant declined initially and later recovered from what was determined to be a one time sedimentation event.

3 Transplant was experimental due to dense beds of the exotic muscle *Musculista senhousia*
which inhibited the growth of the transplant. Replacement transplant done elsewhere.
Transplant was completed in an area deemed unsuitable. Insufficient coverage required the construction of a remedial site.
Monitoring continues at both the initial and remedial sites.

4 Transplant was experimental.

5 Multiple sites.

6 Mitigation for marina at Princess Resort, project not built

7 Amount of eelgrass present within all basins as of 2000 mapping.

8 Regional eelgrass decline has resulted in die-offs both within restoration and reference areas equally full recovery had not occurred at the time of evaluation, yet project exceeds control-corrected requ

9 Original site was constructed as a plateau that was underfilled and anticipated to fall short of objectives. A supplemental
transplant was therefore completed when development began to exhibit shortfalls in area.

10 Shortfall mitigated by withdraw from established eelgrass mitigation bank.

11 Exception conditions from SCEMP requiring only replacement in place for unanticipated damage

12 Mitigated out-of-kind with non-eelgrass to satisfy permit requirements after shortfall in eelgrass mitigation.