Appendices to the Novato Creek Baylands Strategy

Appendix A: Site-Level Summaries

Appendix B: Hydraulic Modeling

Attachment to Appendix B: Tidal Channel Hydraulic Geometry

Appendix C: Construction Cost Estimates

Appendix D: Mitigation Credit Agreements

Appendix A. Site-Level Summaries

Purpose:

This document summarizes the restoration opportunities and feasibility considerations for each parcel within the study area, based on our conversations with landowners. It focuses on publicly owned lands that can be restored in the near term and includes key takeaways from outreach conversations with partners.

Landowners had the opportunity to review and provide feedback on these summaries in June 2025. We recognize that management actions, goals, opportunities, and constraints may have shifted since then.

Map

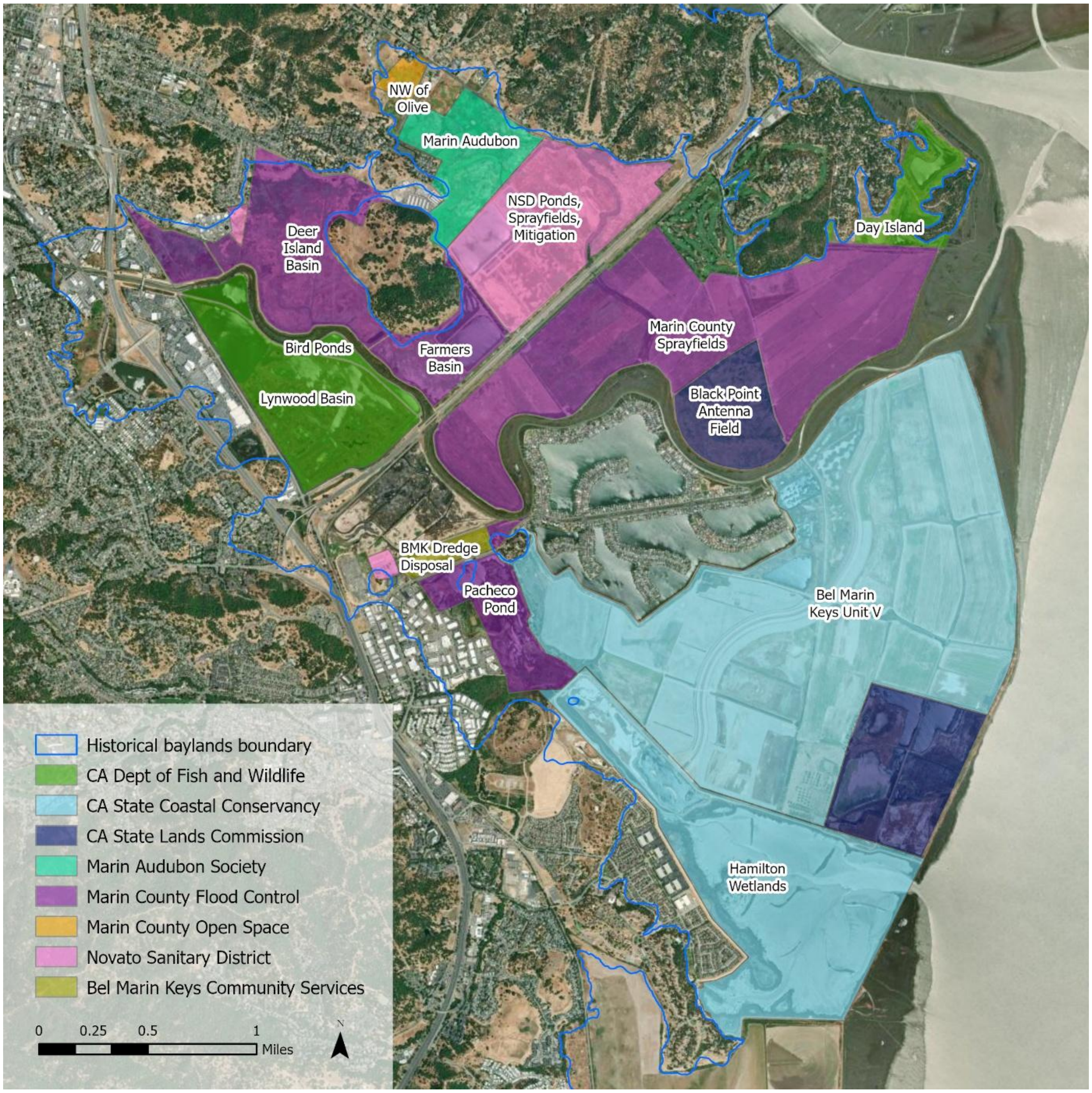
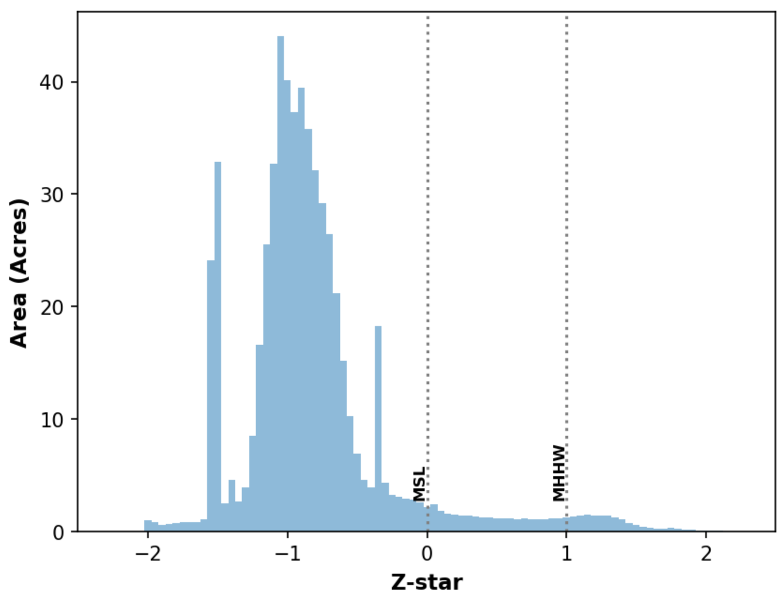


Figure 1. Publicly owned diked bayland parcels within the study area (described below).

Simmons Slough Wetlands

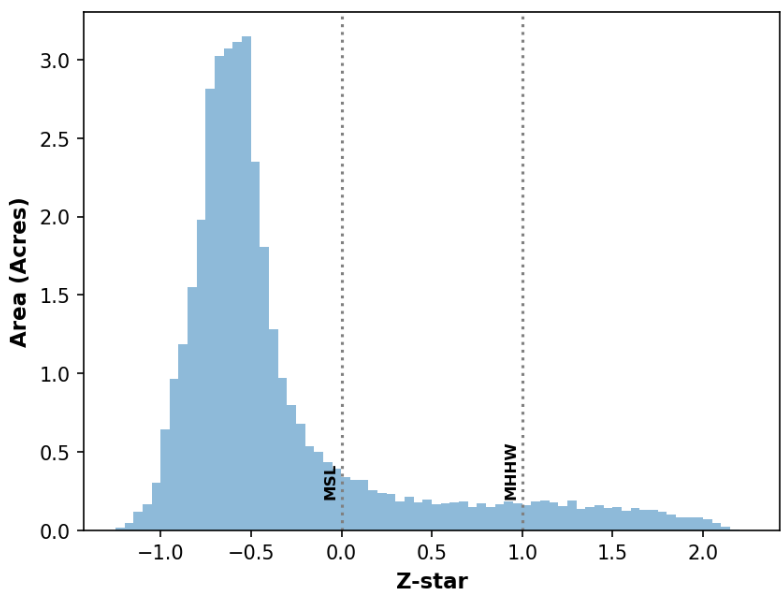
- **Ownership:**
  - Marin Audubon Society
  - NRCS conservation easement on this entire property
- **Current Management:**
  - Habitat is protected and managed as seasonal wetlands.
  - Invasive plants are periodically cleared along the edges of the seasonal wetlands (Harding grass is a problem in particular).
  - A weir structure with removable boards was installed by the Marin County Flood Control District to help keep water on the property to support seasonal wetlands. The weir boards are added or removed to control the flow of water draining to the Bay. The weir structure is located south of the property in the Novato Sanitary District parcel.
  - No plans for public access. Views from Atherton Avenue and bike path along Olive
- **Physical Setting:**
  - Diked seasonal wetlands. Water ponds in winter when rainfall is high.
  - Area: ~140 acres
  - Elevation: Majority of property lies at MLLW to MSL (0-3ft NAVD), with some areas at shallow subtidal elevation (<0ft NAVD). Small parts of the property's border are at MSL to MHHW (3-6ft NAVD), and there are two small islands above highest astronomical tide elevation.



  -
- **Landowner Management Goals:**
  - Restore parcel to tidal marsh
- **Landowner Planned Changes:**
  - None planned; desired full restoration as part of NCBS

- **Restoration Opportunities:**
  - Opportunity for full tidal marsh restoration; tide will be significantly muted by the time it reaches this far away from the Bay.
  - Key question for restoration is how to route tidal prism through Simmons Slough and under SR37 and SMART Rail.
- **Feasibility Considerations:**
  - NSD's Bahia Force Main crosses through the parcel; force main infrastructure would need to be protected or relocated
  - Need to prevent flooding of Olive Ave (MSL-MHW elevation), Atherton Ave (low-lying sections at MSL-MHW elevation), and adjacent private properties.
  - PGE lines (tower is on adjacent private property, not Marin Audubon property)
  - Residential properties on the western side of the property. Need to determine their elevation relative to projected tide levels, need for setback levee, and possible stormwater detention changes.
  - Boundary with storage facilities on the western side of the property is unclear. Need to determine their elevation relative to projected tide levels.

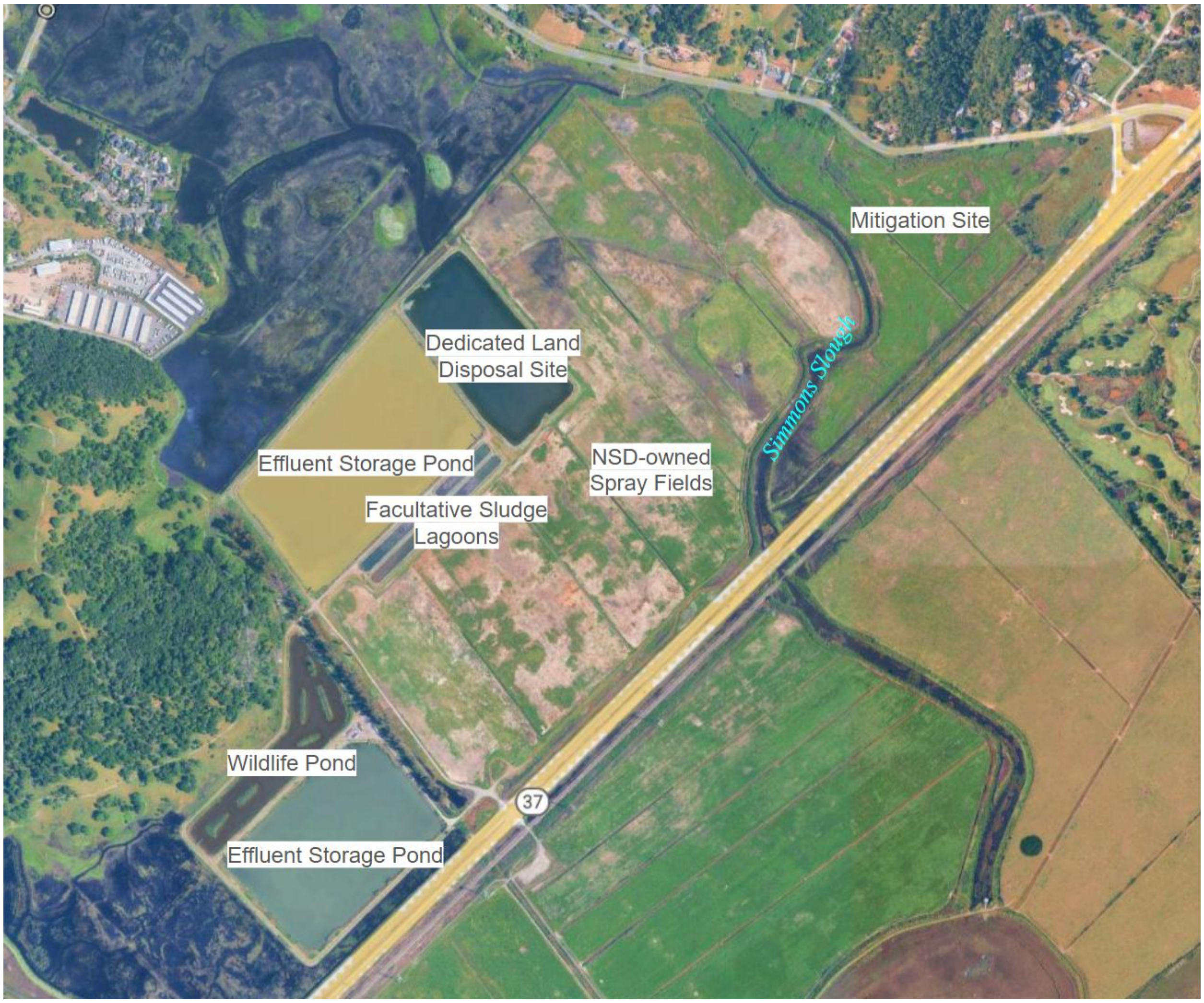
Northwest of Olive Ave – Marin County

- **Ownership:**
    - Marin County Open Space District (MCOSD) (Marin Audubon originally bought the property, then gave it to the county)
- **Current Management:**
    - This parcel is not actively managed and the representative from MCOSD (Jon Campo) did not have any information about it.
- **Physical Setting:**
    - Mostly diked seasonal wetlands, with a small area of upland near Atherton. Seasonal wetlands are contiguous with seasonal wetlands on property to the south.
    - Currently no tidal action
    - Area: ~20 acres
    - Elevation: Almost entirely MLLW to MSL (0-3 ft NAVD); northern border ranges from MSL to MHHW (3-6 ft NAVD)
    - 

    -
- **Landowner Management Goals:**
    - This Deer Island parcel is part of the MCOSD Preserve system with consistent goals of habitat preservation and recreation.
- **Landowner Planned Changes:**
    - None
- **Restoration Opportunities:**
    - Possibility to restore tidal or muted tidal action to wetlands. This would allow a connection to upland transition zone at this parcel if Olive Ave is raised. This would require inclusion of the adjacent privately owned parcel in the restoration. Muted tidal may not require raising Olive Avenue.

- **Feasibility Considerations:**
    - Requires modifications to Olive Ave, a low-lying and a county-maintained road, or at least a new culvert under Olive
    - Need to protect adjacent privately owned parcels to the northwest from tidal flooding
    - Requires participation of adjacent private landowners

NSD Ponds, Spray Fields, and Mitigation Site

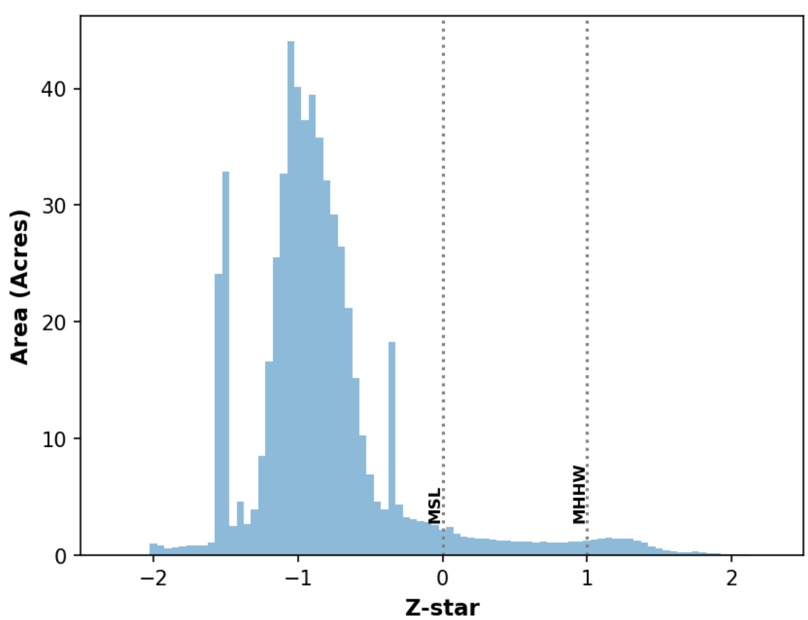


- **Ownership:**
    - Novato Sanitary District
- **Current Management:**
        - Facultative sludge lagoons: settling basins for biosolids drying. Decanted water is pumped back to plant for further treatment and biosolids are left behind.
        - Once a year (Sept-Oct), NSD transfers the biosolids from the sludge lagoons to the adjacent dedicated land disposal site.
    - Effluent storage pond next to sludge lagoons:
        - 100 MG capacity
    - Dedicated land disposal (DLD) site:
        - Permanent biosolids disposal site with 10-12 more years of capacity
        - NSD has looked at alternative dewatering options at the treatment plant but still need a disposal location for the biosolids. They are in the early stages of

investigating other options such as land application or biochar that would provide alternative disposal pathways in the long term when the DLD is full.

- Spray fields:
  - Historically there was a prohibition on summer discharge to the Bay so NSD has irrigated spray fields north and south of SR37 with treated wastewater effluent. Fields to the north of SR 37 are owned by NSD and fields to the south were historically leased from Marin County.
  - The irrigated spray fields are also used for cattle grazing
- Wildlife pond:
  - 1980s mitigation project for reclamation project (irrigation).
- Effluent storage pond (next to wildlife pond)
  - Connected to other effluent storage pond to the northeast
  - Used as storage for irrigation but NSD has more flexibility now that year-round discharge is permitted.
  - Even if irrigation goes away, NSD will still need storage for recycled water
  - Recycled water use is based on demand by the North Marin Water District
- Mitigation property between Simmons Slough and Atherton Ave
  - Designated as mitigation property for 1984 project; currently left undisturbed and not actively managed.

- **Physical Setting:**
  - Diked (nontidal)
  - Area: ~300 acres
  - Elevation: Majority of area at shallow subtidal elevation (<0 ft NAVD) or MLLW to MSL (0-3 ft NAVD); berms at or above MSL (3 ft NAVD)



- **Landowner Management Goals:**
    - Need to retain capability to use NSD-owned spray fields as a back-up for the next 10-20 years.
    - Need to retain capacity in effluent storage pond(s) for maintenance, emergency, and/or recycled water storage
- **Landowner Planned Changes:**
    - Facultative sludge lagoons and dedicated land disposal site: A change is likely needed after 10-12 years when it is full. Status quo option would be to raise the embankment, but NSD will also be looking at multiple alternative options for dewatering and disposal of biosolids. One possibility being explored is reuse of biosolids for fertilizer or biochar.
- **Restoration Opportunities:**
    - If allowed to discharge year-round into Deer Island Basin, NSD could be open to restoration of a portion of the sprayfields on their property sooner than 10-20 years.
    - NSD is open to tidal restoration at mitigation property between Simmons Slough and Atherton Ave, if allowed by overseeing agency
    - NSD is potentially open to new channels being dug through their property to facilitate restoration at the Marin Audubon property to the north.
    - Possible future reconfiguration and restoration of facultative sludge lagoons and dedicated land disposal site when no longer in use.
- **Feasibility Considerations:**
    - The dedicated land disposal site will still need to be managed and protected after closure to prevent leaching and possible contamination of adjacent wetlands.
    - PGE transmission lines and towers running through the spray fields from the Simmons Slough bridge to the northwest across Atherton Ave

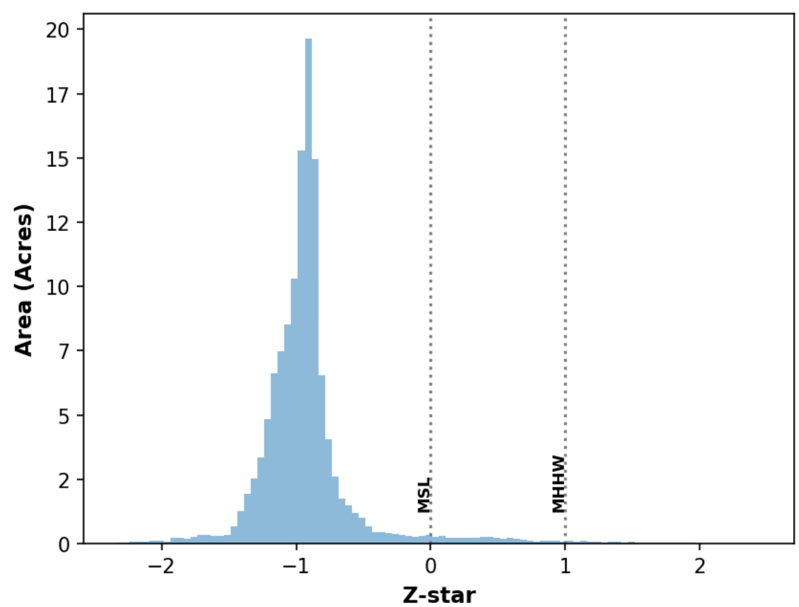
Pattern Energy

- **Ownership:**
    - Private: Pattern Energy (owner-operator of renewable energy projects)
- **Current Management:**
    - No active management other than maintaining the pre-existing pump system to manage water levels during the winter months.
- **Physical Setting:**
    - Area: ~130 acres
    - Elevation: Mix of shallow subtidal (<0 ft NAVD) and mudflat elevations MLLW to MSL (0-3 ft NAVD); majority of eastern area is at shallow subtidal elevations.
- **Landowner Management Goals:**
    - Maintain the land as is and manage water levels during the winter months.
- **Landowner Planned Changes:**
    - Planned battery storage project. It likely will not be built for at least the next 5 years; even after development, it can take a long time to be approved to connect to the grid.
    - Pattern Energy is still determining scope and timing of development activities but intends to engage with Strategy stakeholders on potential partnerships.
- **Restoration Opportunities:**
    - If they pursue a project, Pattern Energy may not need the entire parcel for their planned battery storage facility. The area next to PGE substation would likely be developed first. Restoration of the eastern side of the parcel (nearer to Novato Creek) may be possible even if a battery storage facility is constructed, especially as enhanced flood protection will be necessary for development of the storage facility. A new setback levee could help provide this protection.
- **Feasibility Considerations:**
    - The current levee system is in poor condition and there have been levee breaches during high flows in Novato Creek that have resulted in flooding near SMART Rail and SR 37.
    - A force main runs through the site from the NSD pump station to the main treatment plant. This critical infrastructure would need to be relocated to the west if the full parcel were to be restored or protected by a levee if partial restoration is implemented.

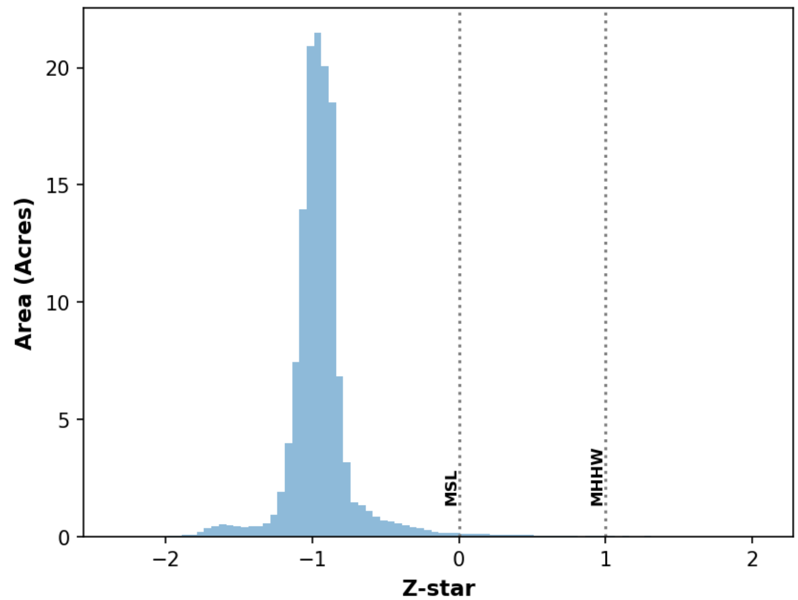
Marin County Flood Control District Spray Fields

- **Ownership:**
  - Marin County Flood Control District
- **Current Management:**
  - Leased to NSD for spraying effluent and sublet to ranchers for grazing
  - One 27-acre parcel bayward of the Vince Mulroy Preserve is leased to the Stonetree Golf Club and used as a driving range
  - Stormwater management:
    - One County-owned and managed pump station at Simmons Slough
    - Two NSD-owned and managed pump stations upstream (west) and downstream (east)
- **Physical Setting:**
  - Area: ~720 acres
  - Elevation: Mix of shallow subtidal (<0 ft NAVD) and MLLW to MSL (0-3 ft NAVD); majority of eastern area is at shallow subtidal elevations.

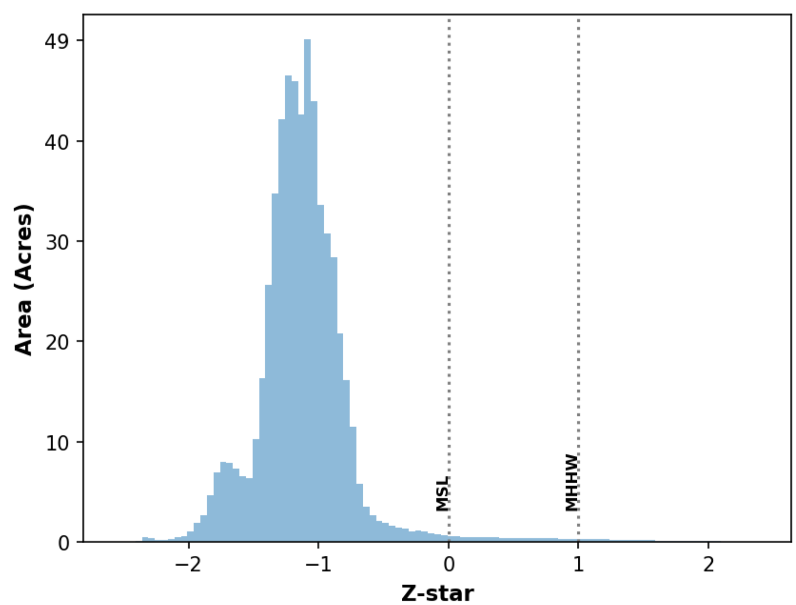
East of Novato Creek, west of access road to pump stations:



West of Simmons Slough, east of access road berm to pump station:



East of Simmons Slough:

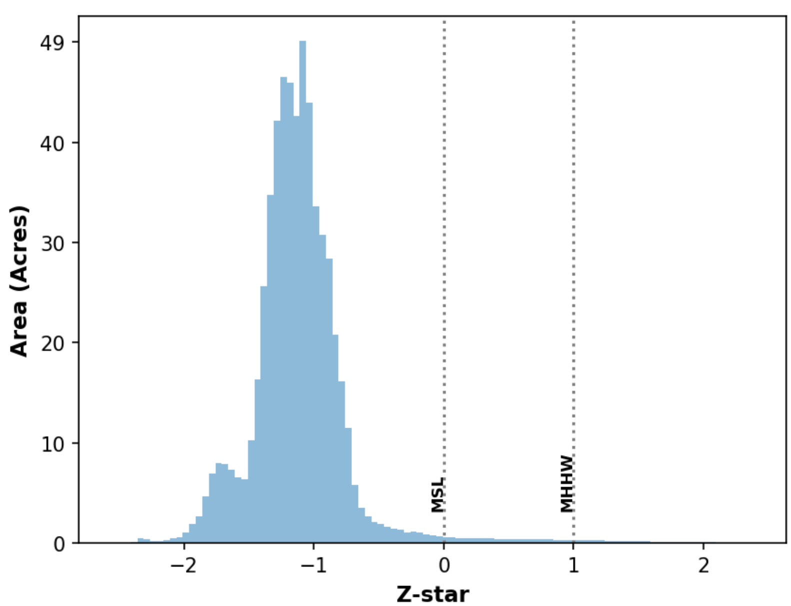


- **Landowner Management Goals:**
  - Restore spray fields to tidal wetlands to shorten the line of protection and reduce levee maintenance costs.

- **Landowner Planned Changes:**
    - NSD lease will expire in the next few years, and spray field irrigation will be discontinued.
- **Restoration Opportunities:**
    - Extensive restoration of mixed tidal wetlands (subtidal, mudflat, and tidal marsh)
    - Possible connection to upland transition zone at Vince Mulroy Preserve.
- **Feasibility Considerations:**
    - Protection of railroad and SR 37 likely required with setback levee if restoration proceeds in near term.
    - PGE transmission lines and towers south of the rail line, spanning from Novato Creek to Simmons Slough, and spanning from BMK Unit V to Day Island through the spray fields.
    - The spray fields are contiguous with the adjacent and contaminated State Lands Commission parcel (Black Point Antenna Field). Action to remediate on site or protect the Antenna Field from tidal inundation may need to be considered as spray fields are restored.
    - Irrigation infrastructure is currently in place and will need to be removed prior to restoration.
    - Border between Marin County fields and the Vince Mulroy Nature Preserve: one formally designated fire road at southern end of preserve property. Unclear whether it provides critical fire access (Jon Campo to confirm).
    - Avoid detrimental impacts to neighboring BMK community across Novato Creek

Black Point Antenna Field

- **Ownership:**
  - State Lands Commission
- **Current Management:**
  - The federal government completed some remediation work on the Black Point site prior to 1985, but the Commission has conducted none since it acquired the property and has no plans for any going forward. The California Department of Toxic Substances Control maintains information on the site (EnviroStor facility 2197 0013).
  - There are two active leases on the Black Point site: Lease 6991 is a Grazing Lease covering the entire 135-acre site. The lease will expire in June 2026. Lease 7008 is a Public Agency lease to the Marin County Flood Control District which also covers the entire 135-acre site including levees. The District's authorized use is for a storm water basin and surface level monitors for water velocity and surface water levels. That lease expires in August of 2036. So long as a lessee is in good standing (both are at this time), lease terms prohibit the Commission from unilaterally amending or terminating a lease.
  - Commission approval for such a project requires a lease. Lead agency would be responsible for submitting all permits, CEQA etc.
- **Physical Setting:**
  - Currently diked, nontidal
  - Area: ~130 acres
  - Elevation: Almost entirely subtidal elevations (<0 ft NAVD); small pockets (mostly where infrastructure is located) at MLLW to MSL (0-3 ft NAVD)

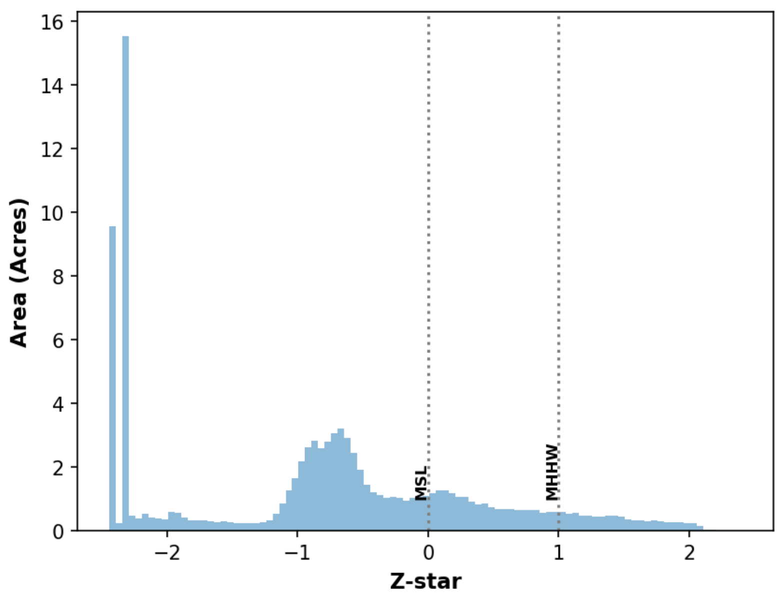


- **Landowner Management Goals:**

- None

- **Landowner Planned Changes:**
  - None
- **Restoration Opportunities:**
  - Create a more cohesive habitat patch connected to restored Marin County Spray Fields and reduce costs for levee construction and/or maintenance to protect the site
- **Feasibility Considerations:**
  - The extent and cost of cleanup required prior to restoration is unknown
  - SLC's approval process involves applying for a lease to conduct the necessary data gathering, field work, and project activities. Any work on the site, its levees, or in Novato Creek will require Commission authorization. SLC can discuss more detailed lease application requirements including costs when/if a project progresses to the point where you can provide a detailed project description.

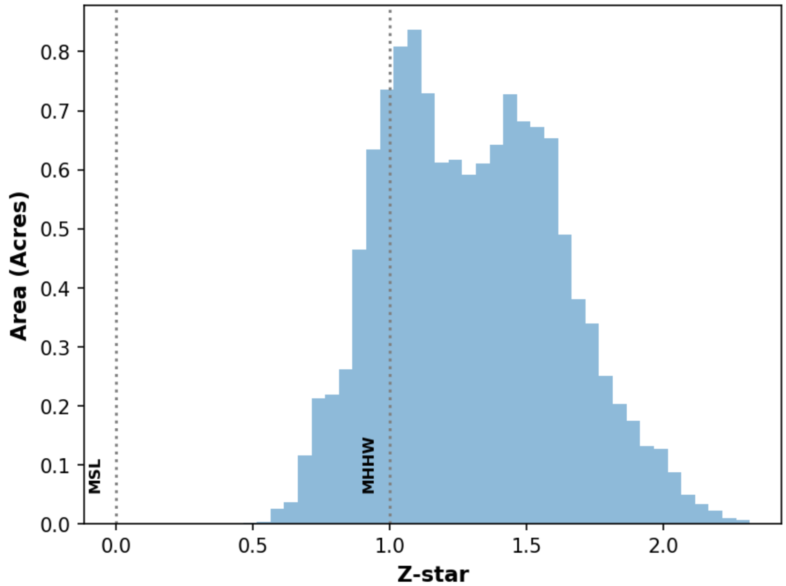
Day Island Unit

- **Ownership:**
    - California Department of Fish and Wildlife (CDFW)
- **Physical Setting:**
    - Diked baylands (seasonal wetlands), perennial ponds
    - Area: ~110 acres
    - Elevation:
        - Area between Day Island and mainland: Mostly subtidal (<0 ft NAVD) and MLLW to MSL (0-3 ft NAVD) with some higher areas up to HAT.
        - 

- **Landowner Management Goals:**
    - CDFW intends to maintain this area as it currently exists and says it will not be including it in any foreseeable restoration projects or strategies.
- **Landowner Planned Changes:**
    - None
- **Restoration Opportunities:**
    - No restoration is planned at the site. Over the long term (beyond the scope of this effort), there could be opportunity to restore tidal wetlands adjacent to upland transition zone and/or to restore and reconnect Novato baylands to Petaluma baylands. Marin Audubon Society owns parcels in this area and would participate in future restoration efforts. There are other privately and publicly owned parcels in this area and further coordination would be required to proceed with restoration.

BMK Community & Dredged Sediment Disposal Area

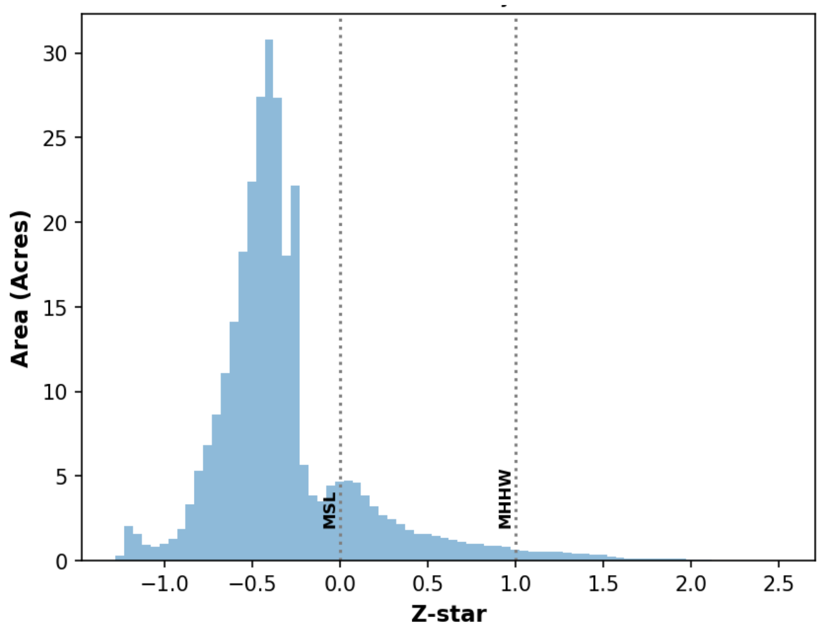
- **Ownership:**
    - Dredged Sediment Disposal Area: Bel Marin Keys Community Services District (BMK CSD)
    - Community: Privately owned parcels
- **Current Management:**
    - Lagoon management:
        - The North lagoon is dredged every 12-15 years. The south lagoon has never been dredged.
        - Water is released through locks at low tide and brought into the lagoons at high tide. Water is released from lagoons prior to storms. A recent parcel tax was passed to fund renovation of the locks, levees, and marine infrastructure.
        - Overflow from lagoons into seasonal wetlands.
    - Dredged sediment from the north lagoon is placed at the DMMO site north of Pacheco Pond. The site is currently at about 50% capacity. Additional disposal into BMK V, Port Sonoma.
    - Historically Novato Creek has been dredged 4-5 times all the way out to the shoal, but this doesn't work and there are no plans to dredge again. The channel has silted in so much that there is minimal access for homeowners to the channel and some people have built dock extensions to access it.
- **Physical Setting:**
    - Area: ~30 acres
    - Elevation:
        - BMK community (houses, roads) - Mostly HAT (~7ft NAVD) to 10 ft NAVD
        - DMMO: MHW (6 ft) to 10 ft NAVD.
        -



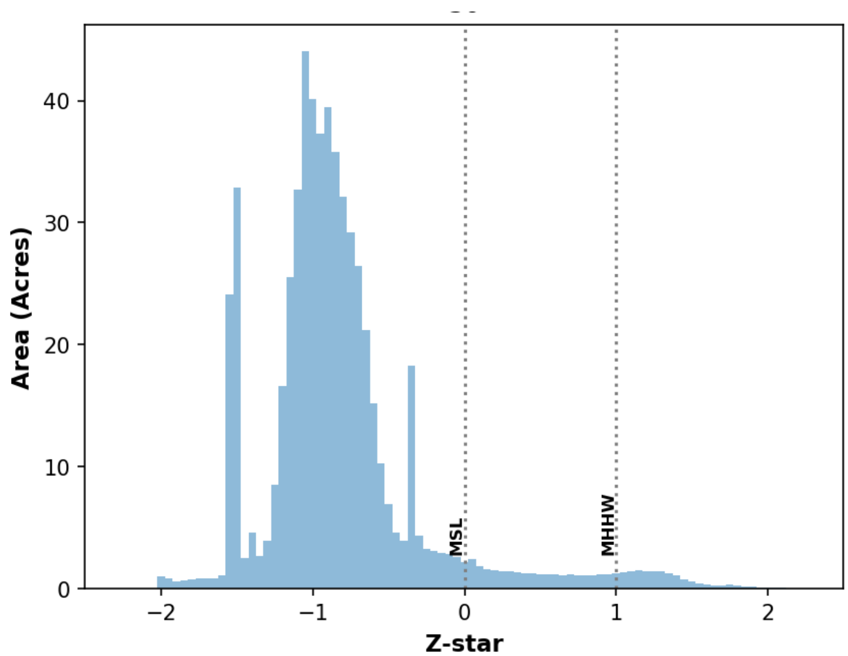
- **Landowner Management Goals:**
    - Plan on maintaining DMMO as a dredged sediment disposal site. Possibility to use material stored here to benefit nearby restoration projects.
    - Considering raising doors on locks to adapt to rising sea levels
    - BMK CSD is generally supportive of restoration and actions that benefit the creek and watershed, and works to inform the community of these benefits.
- **Landowner Planned Changes:**
    - No planned changes to dredging operations. Considering raising doors on locks for SLR
- **Restoration Opportunities:**
    - Opening up Novato Creek to more tidal prism would be a welcome change as it would improve the creek's navigability.
    - DMMO could be restored if there is an alternative viable location to store dredged material.
    - Dredged sediment currently stored in DMMO and material dredged from lagoons in the future could be used to raise elevations prior to restoration (direct placement) or after restoration (marsh spraying)
- **Feasibility Considerations:**
    - BMK V transfer – Conservancy sale to private meditation center; created legal/permitting issues

Deer Island Basin Complex – Deer Island Basin, West Deer Island Basin, Farmers Basin

- **Ownership:**
    - Marin County Flood Control District
    - Novato Sanitary District has easements to maintain pipelines within Deer Island Basin and Farmers Basin
- **Current Management:**
    - Managed as flood storage basin for runoff from the surrounding sub-watersheds and rare flooding events from Novato Creek that may overtop the Novato Creek Left Bank Levee that borders the Deer Island Basin
    - Small portion of the Deer Island Basin along the West Basin Cross Levee is used by the District as a beneficial reuse location for material removed from lower Novato Creek
- **Physical Setting:**
    - Area - Comprised of three basins separated by levee berms
        - West Deer Island Basin (separated from Deer Island Basin by the West Basin Cross Levee) – 38 acres
        - Deer Island Basin – 250 acres
        - Farmers Basin (separated from Deer Island Basin by the Deer Island Cross Levee)- 48 acres
    - Elevation
        - Historic marsh plain subsided down to EL 1.0 to 4.0-ft, remnants of historic channel network present below EL 1.0
        - Novato Creek Levees range from EL 11.0 to 16.0
        - Deer Island Basin / West Deer Island Basin:



- Farmer’s Basin (histogram includes NSD parcels as well):



- **Management Goals:**
  - Restore floodplain and tidal connectivity to diked historic wetlands
  - Enhance ecological functions
  - Contribute to long-term flood protection goals along Novato Creek
  - Retain the north-west portion of the Deer Island Basin for storage of flood waters
- **Planned Changes:**

- The District has CEQA coverage (approved IS/MND) for restoration of the southern half (south of the NSD Force Main) of Deer Island Basin to tidal channel, pond, and wetland, lowland grassland, and upland habitats and improvements to West Deer Island Basin to improve flood protection and create transitional habitat along the levees and berms. The District is looking for full restoration of the entire Deer Island Basin and prefers not to do the Phased restoration unless the interim benefits are high
- The District has completed concept level design for restoration of the full Deer Island Basin and Farmers Basin.
- Improvements to raise the elevation and improve the stability of the Novato Creek levee along Famers Basin are planned for construction under the Bird Ponds restoration project (first phase of the Deer Island Complex Tidal Restoration Project), starting in 2026.

- **Restoration Opportunities:**
  - Opportunity for full tidal habitat restoration
  - Additional tidal prism would help scour Novato Creek channel and improve hydraulic connectivity for ecological values, increase the level of flood protection, and reduce the need to dredge upstream Novato Creek.
- **Feasibility Considerations:**
  - Full restoration of the Deer Island Basin and Farmers Basin not feasible unless NSD outfall pipeline is relocated or terminated. Moving the discharge location to Deer Island Basin could involve seeping the treated wastewater through a horizontal levee for planted with native vegetation to establish freshwater wetlands along the proposed levee slopes.
  - Need to manage stormwater from surrounding neighborhoods that currently drains to Deer Island Basin.
  - The majority of all three basins are currently seasonal wetland habitat, which would likely be converted to tidal pond habitat due to subsided existing elevations.
  - Marin County Flood Control District still needs to make a final determination on the area of Deer Island Basin that needs to be preserved for flood protection for the City of Novato

Bird Ponds

- **Ownership:**
  - Marin County Flood Control District and the State of California
    - The District owns the Novato Creek Levee and a small portion of interior of both Heron's Beak and Duck Bill Ponds.
    - The State of California owns the Lynwood Levee and a large portion of the interior of both Heron's Beak and Duck Bill Ponds.
- **Current Management:**
  - Ponds are currently managed, in collaboration, by the District and CDFW for wildlife habitat.
  - Duck Bill Pond relies on rainfall and as-needed supplemental pumping from Lynwood Basin to maintain water surface elevations in the pond. There is no outlet connection to Novato Creek or Lynwood Basin.
  - Heron's Beak Pond relies on rainfall, as-needed supplemental pumping from Cheda Creek, and a culvert connection to Novato Creek. The culvert connection is open from June to February and closed from February to June to prevent fish entrainment.
- **Physical Setting:**
  - **Area**: Duck Bill Pond – 21 acres, Heron's Beak Pond – 22 acres
  - **Elevation:**
    - Subsided basins range from EL -4.0 to 1.0ft NAVD with an island in the northern corner of the Duck Bill Pond at EL 3.0 NAVD
    - Lynwood levee between Bird Ponds and Lynwood Basin ranges from EL 11.0 to 17.0 NAVD
    - In 2020, District placed dredge sediment in Heron's peak pond along the Lynwood Levee to EL 5.0 NAVD to create bench sloping between EL 4.0 and 5.0 NAVD
- **Landowner Management Goals:**
  - Restore floodplain and tidal connectivity to diked historic wetlands
  - Enhance ecological functions
  - Contribute to long term flood protection goals along Novato Creek
- **Landowner Planned Changes:**
  - The District is planning to begin construction in 2026 of the Bird Ponds Project, which will:
  - Restore 71.1 acres of habitat in the Bird Ponds and the adjacent Novato Creek corridor, including 57.6 acres of aquatic habitat, 3.1 acres of transitional habitat, and 10.4 acres of upland.
  - Provide improved flood protection along the Novato Creek Left bank levee adjacent to Farmers Basin by raising the levee.
  - Improve Lynwood Levee to address seepage and stability concerns.

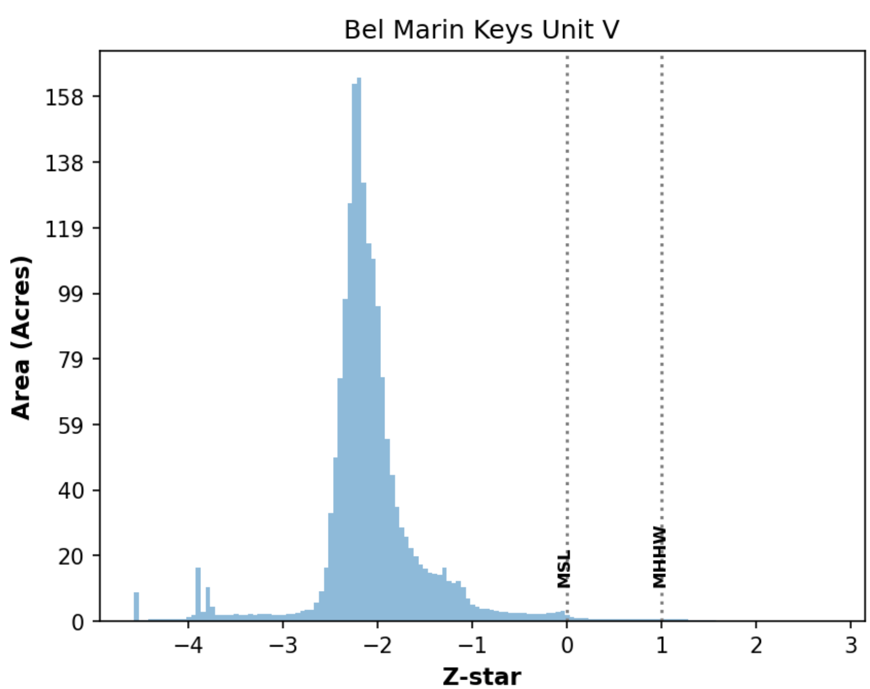
    - Breach and lower the existing levee along Novato Creek to restore tidal connectivity to the ponds, and create a range of high marsh to mid marsh habitat including areas of ecotone and upland transition.
    - Create new channels and widen existing channels within the Novato Creek corridor to increase channel conveyance.
- **Restoration Opportunities:**
    - Opportunity for full tidal habitat restoration
    - Additional tidal prism will help scour Novato Creek channel

Hamilton Wetlands

- **Ownership:**
  - California State Coastal Conservancy (SCC); USACE leads post construction monitoring activities until 2027, then SCC will lead an additional three years.
- **Current Management:**
  - The project is monitored and managed in accordance with the HWRP Monitoring and Adaptive Management Plan (MAMP)
  - North Seasonal wetlands: water levels managed using two water control structures
  - South Seasonal Wetlands: unmanaged system. There have been unplanned breaches in several locations, converting seasonal wetland area to tidal wetland.
  - Invasive plant management by Point Blue Conservation Science (funded by SCC)
- **Physical Setting:**
  - Restored tidal marsh and seasonal wetlands (restored in 2014)
  - Area: 648 acres
  - Elevation: marsh and mudflats are at -10.8 to +4ft NAVD (based on survey bathymetry); berms up to approx. EL 11 NAVD
- **Landowner Management Goals:**
  - Create a diverse array of wetland and wildlife habitats that benefit special status species and other migratory and resident species
- **Landowner Planned Changes:**
  - None except as may be recommended through ongoing adaptive management
- **Restoration Opportunities:**
  - Restoration complete
- **Feasibility Considerations:**
  - Presence of multiple sensitive species including breeding western snowy plover

Bel Marin Keys Unit V

- **Ownership:**
  - California State Coastal Conservancy (SCC). Proposed restoration is a joint project between SCC and USACE. It is federally authorized in combination with the Hamilton Wetland Restoration.
- **Current Management:**
  - Hay farming over most of the site
  - Periodic maintenance of bayfront levee to reduce risk of bay waters flooding into the site
  - Invasive plant management by Point Blue Conservation Science (funded by SCC)
- **Physical Setting:**
  - Farm fields
  - Phase 1 of the BMK V restoration was implemented by SCC in 2020-2021 and included: construction of setback flood protection levee, construction of new pump on landward side of the levee, restoration and enhancement of 36 acres of seasonal and alkali wetlands, water control structures connecting seasonal wetlands to pump station
  - Area:
    - Bel Marin Key Unit V – 1,497 acres
    - Phase 1 Levee – 84 acres
    - North Antenna Field – 240 acres (area of contamination concern)
  - Elevation: -9.8 to 15ft NAVD

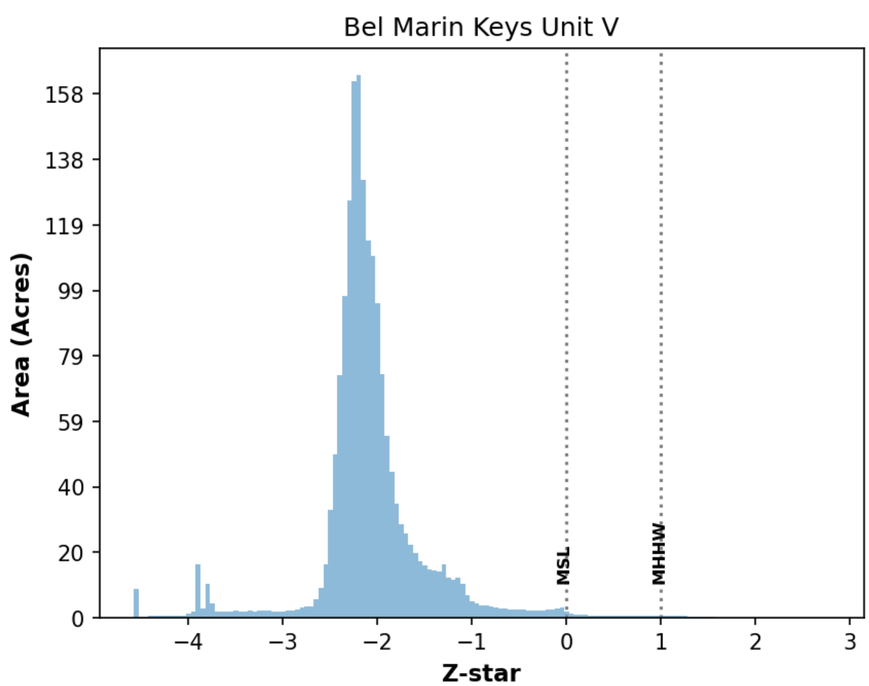


- **Landowner Management Goals:**

    - Maintain the site for future restoration
- **Landowner Planned Changes:**
    - Proposed restoration of tidal and non-tidal wetlands
    - The overall goal of the proposed restoration project is to create a diverse array of wetland and wildlife habitats that benefit endangered species as well as other migratory and resident species.
    - Project objectives are to:
        - Implement a restoration project with little need for active management
        - Demonstrate beneficial use of dredged material
        - Ensure no net loss of wetland habitat at the site
        - Create and maintain wetland habitats that sustain viable wildlife populations, including special-status species
        - Include wildlife buffer areas along the upland perimeter of the project area
        - Be compatible with adjacent land uses and wildlife habitats
        - Provide public access
- **Restoration Opportunities:**
    - Restoration of 1,168 acres of tidal wetland, mudflat and shallow subtidal habitat, and 345 acres of non-tidal/seasonal wetland
    - USACE design will leverage beneficial re-use of dredged material
    - Breach to Novato Creek and Bay (pending remediation efforts at NAF parcel) to establish tidal hydrology at project site
    - Incorporate overflows from Pacheco Pond into BMKV to enhance seasonal wetlands and provide improved flood protection to surrounding facilities
- **Feasibility Considerations:**
    - BMK project costs must fit within the authorized project cost, which may limit the amount of beneficial use of dredge material for tidal marsh creation.
    - Minimize impacts to wetlands, waters, and special status species
    - NSD outfall pipeline that runs between Pacheco Pond and BMK and between Hamilton and BMK
    - Potential contamination within the North Antenna Field (NAF) parcel must be remediated.
    - Confirm that project measures will avoid any flood impacts associated with breach to Novato Creek
    - Need to preserve access to and functionality of PGE towers in the northern part of the site.

Pacheco Pond

- **Ownership:**
    - Owned by Marin County Flood Control District (District)
- **Current Management:**
    - In a 1980 management agreement between the the District and CDFW, the District agreed to operate and maintain the pond for the dual purposes of flood control and fish and/or wildlife
    - The District maintains a set of flap-gated culverts. Maintenance of the culverts and access to them are increasingly difficult.
    - Managed for bird habitat, flood control, and mosquito control
    - 2019 and 2023 levee repairs due to overtopping of Pacheco Pond into BMK V site
- **Physical Setting:**
    - Fresh to brackish muted tidal flood basin
    - Area:
        - Pacheco Pond is 120 acres: 45 acres of open water (including 15 acres excavated in 1980) and 75 acres of mixed vegetation (cattails, tules and other emergent plants) and open water.
    - Elevation: Approx. -14 to +12ft NAVD (based on HEC-RAS model bathymetry)

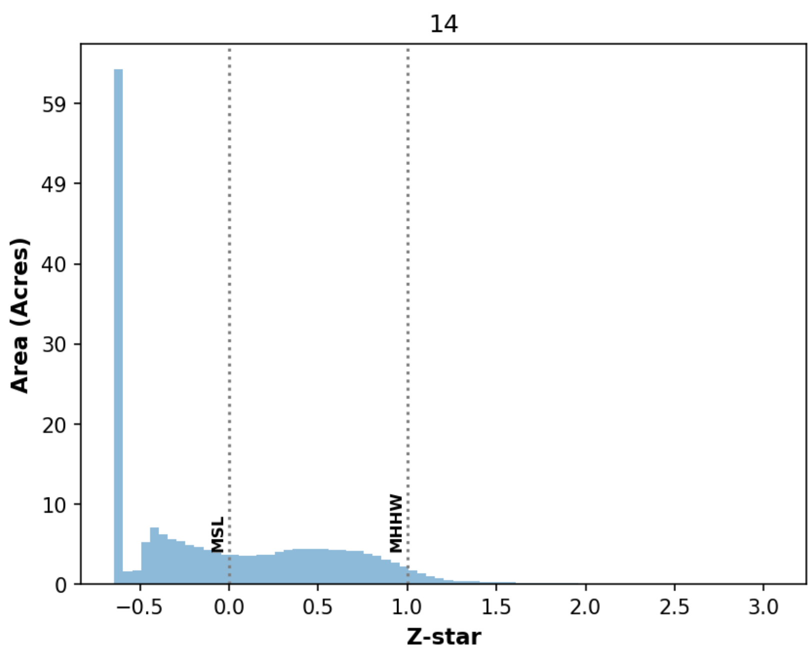


- **Landowner Management Goals:**
    - Reduce the risk of flooding for the neighboring industrial park and mobile home park, and support habitat for sensitive species per 1980 agreement with CDFW.
- **Landowner Planned Changes:**

    - The District is currently assessing potential changes to reduce required management while maintaining or improving the current beneficial uses of the pond.
    - The District is considering the following options: 1) replace the existing tide gates, but keep them in place, 2) move tide gates to Bel Marin Keys Blvd, 3) divert overflow from Pacheco Pond to Hamilton Wetlands, 4) expand Pacheco Pond into the Bel Marin Keys V restoration area, or 5) allow Pacheco Pond to become a fully tidal system.
- **Restoration Opportunities:**
    - Several of the options under consideration by the District would increase habitat connectivity and ecosystem function
- **Feasibility Considerations:**
    - The habitat restoration or enhancement must not increase flood risks to adjacent properties
    - Presence of sensitive species
    - Vector control (tidal restoration would improve vector management)
    - Maintenance of any retained tide gates

Lynwood Basin

- **Ownership:**
  - Largely owned by the State of California; under the jurisdiction of the State Lands Commission (SLC), in coordination with California Department of Fish and Wildlife
  - The District holds a lease with SLC for the Lynwood Basin Levee corridor
- **Current Management:**
  - CDFW passively manages Lynwood Basin for wildlife habitat
  - The District manages water levels in Lynwood Basin on an as-needed basis to provide protection. Lynwood Basin is part of the Arroyo Avichi Creek, Baccaglio Basin, Scottsdale Marsh and Pond, and Lynwood Basin (ABSL) Complex, which is managed to provide stormwater drainage and flood protection within the Novato Creek watershed area.
- **Physical Setting:**
  - Area: 250 acres
  - Elevation: Lynwood levee between Bird Ponds and Lynwood Basin ranges from EL 11.0 to 17.0 NAVD and the interior of the basin ranges from < EL 1.0 to EL8 NAVD
  - Habitats within Lynwood Basin are primarily permanently flooded wetland and open water pond



- **Landowner Management Goals:**
  - SLC/CDFW have not indicated long-term management goals for Lynwood Basin (to our knowledge)
  - District water level management provides flood protection for SMART rail and upstream drainage area

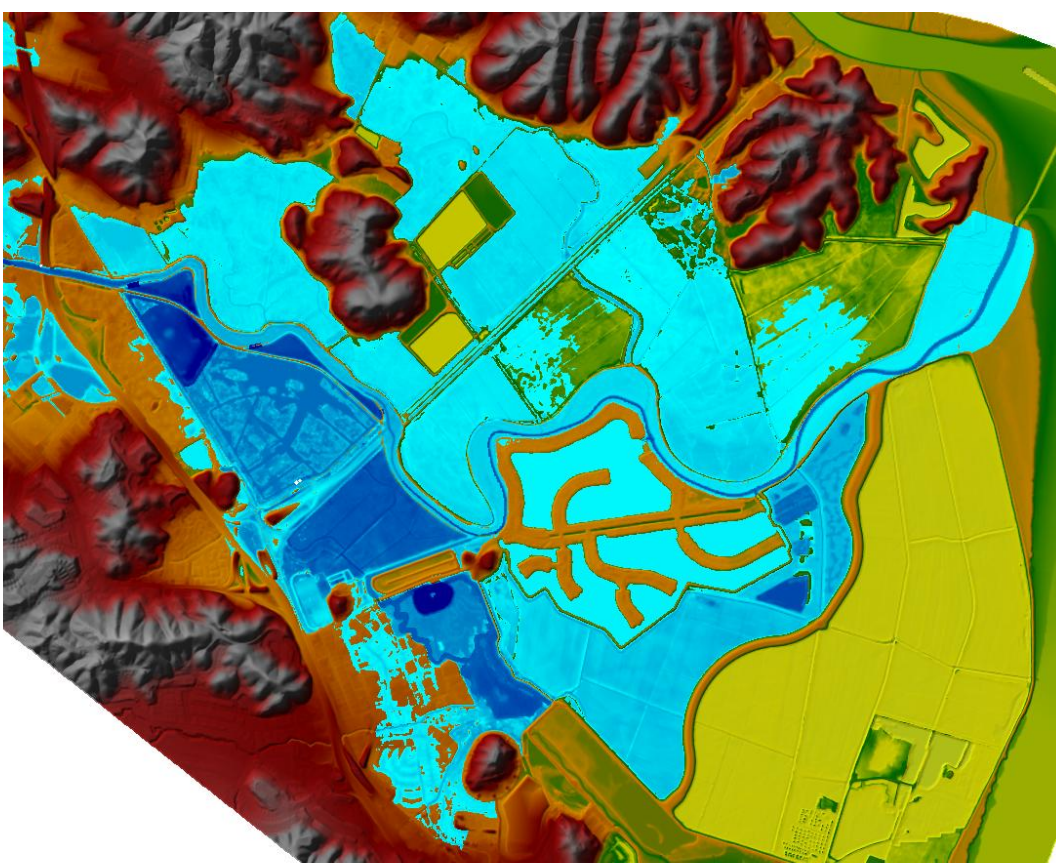
        - Maintain ability to manage basin to provide flood protection
        - Replace/rebuild Lynwood Pump Station
- **Landowner Planned Changes:**
    - Lynwood Levee seepage and stability improvements planned for implementation as part of the Bird Ponds project scheduled for construction in 2026
- **Restoration Opportunities:**
    - District completed a study in 2024 that indicated that 40% of Lynwood Basin could be restored to tidal wetland habitat (roughly the southern 40% adjacent to the downstream lobe of Heron's Beak Pond and bordering Highway 37) while still maintaining the required flood protection function in the remaining 60% of the basin.
- **Feasibility Considerations:**
    - Lynwood and Cheda Pump Stations
        - Need to be accessible from Highway 37
        - Lynwood Pump Station needs to be rebuilt
    - PGE powerline and easement bisects Lynwood Basin
    - SMART rail tracks bound Lynwood Basin to the west and would need to be protected from any changes in water surface elevation

APPENDIX B. NOVATO CREEK BAYLANDS RESTORATION STRATEGY

Hydraulic Modeling Report

Prepared for
Marin County Flood Control and Water Conservation District

June 2026



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Hydraulic Modeling Report

Prepared for
Marin County Flood Control and Water Conservation District

June 2026

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ESA

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Attachments

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1. INTRODUCTION

The Novato Creek Baylands Restoration Strategy is developing a long-term vision for restoring historic baylands along Novato Creek and identifying near-term projects that build toward that vision. Project alternatives have been conceptualized that restore different regions of the historic baylands under near and long term time horizons. This appendix documents the hydraulic modeling used to develop and evaluate the alternatives. The following sections provide key findings from the hydraulic modeling, an overview of the project alternatives, methods used to develop the hydraulic model, and the model results used for alternatives evaluation.

2. KEY FINDINGS

- Restoring the diked baylands adjacent to Novato Creek significantly increases flow conveyance during fluvial-dominated flood events, resulting in water level reductions of up to 3.5 and 1.7 ft at SR 37 and Hwy 101, respectively, for the more extensive restoration alternatives.
- Flood flows conveyed through the restored baylands return to the existing Novato Creek at the downstream end of the project area and cause a flow backup and water level rise of up to 0.6 ft near the Bel Marin Keys community. Dredging of this downstream reach of Novato Creek mitigates this issue and maintains water levels at or below their present levels.
- Under restored conditions, the baylands provide less storage capacity for stormwater runoff from adjacent upland areas, such as along Atherton and Olive Avenues. Leveed stormwater basins along the perimeter of the restored baylands would be needed to maintain this existing stormwater detention function.
- The tide range within the restored baylands could be significantly muted, depending on the alternative, given that the existing Novato Creek is undersized to convey the significantly larger tidal prism associated with the restored baylands. For example, the typical tide range is approximately 0.8 ft and 6.8 ft in the Sprayfields for Alternatives 1a and 2a, respectively, compared to 7.2 ft in San Pablo Bay.
- Dredging the downstream reach of Novato Creek improves flood conveyance and increases the tide range within the restored baylands. If Novato Creek is not dredged, a full tide range is expected to develop over time as Novato Creek scours and expands due to the increased tidal prism.

3. PROJECT ALTERNATIVES

The following alternatives were developed for the restoration strategy including more long-term and extensive restoration alternatives termed landscape level as well as more near-term and smaller restoration alternatives termed project level that build toward the landscape level (Table 1). Full descriptions and figures are provided in chapters 7 and 8. Note that not all alternatives were modeled for this study, and prior modeling by ESA (2023) was used to evaluate Alternative D.

Table 1. Restoration alternatives

	Alternative	Description
	*	Baseline (ca. 2030)
Landscape-level alternatives	1*	Multiple breaches
	1a*	Multiple breaches - near term
	2*	Single breach
	2a*	Single breach - near term
Project-level alternatives	A	Eastern sprayfields - limited
	B	Eastern sprayfields
	C*	All sprayfields
	D	Deer Island

*Modeled for this study

4. HYDRAULIC MODEL DEVELOPMENT

This section presents an overview of the HEC-RAS (version 6.4.1) hydraulic model setup, which builds on prior modeling in HEC-RAS by ESA (2023, 2024), Stetson (2020), and Schaaf & Wheeler (2018).

4.1 Model domain

The model domain consists of one-dimensional (1D) cross sections for Novato Creek, Arroyo Avichi Creek, and Warner Creek downstream of Stafford Lake, Arthur Street, and Pine Avenue, respectively, as well as two-dimensional (2D) meshes for the floodplain and baylands areas (Figure 1). Mesh cell size varies from 25 to 50 ft, and the computationally efficient diffusion wave equation set was used for all meshes as appropriate for typical floodplain 2D modeling conditions.

The downstream boundary for the 1D domain along Novato Creek was set to where the channel reaches the bayside edge of the fringing tidal marsh, which is about 3,000 ft downstream of the boundary in the prior model by ESA (2024). This boundary was set as close as possible to San Pablo Bay to simulate flood flow conveyance along all of Novato Creek as well as to impose a full tide range boundary condition on the model and evaluate how closely the restoration alternatives can achieve this within the restored baylands. We considered extending the Novato Creek channel further into San Pablo Bay. However, given model artifacts encountered when extending the 1D domain out across the mudflat or when connecting the 1D domain to a 2D mesh for this downstream area, the downstream boundary was set where the creek reaches the bayside edge of the tidal marsh.

Per a request from the District for future modeling analyses, the 2D mesh and terrain were expanded to include a portion of Rush Creek. However, no hydrologic data have been developed for this channel at this time, and channel bathymetric data will need to be collected.

4.2 Model Geometry

4.2.1 Existing Topography and Bathymetry

Topographic data sources include the 2019 Marin County LiDAR DEM for the floodplain and baylands areas and 2018 bathymetric survey data for Novato Creek downstream of SR 37 as consistent with prior modeling for this area by ESA (2023, 2024) and Stetson (2020). New topographic data added to the model include a 2025 SR 37 surface reflecting recent raising of the road, a 2025 surface for the BMKV/Pacheco Pond levee reflecting the rebuild following the 2019 storm damage, and the as-built surface for the recently constructed BMKV seasonal wetlands and phase 1 levee (Figure 2).

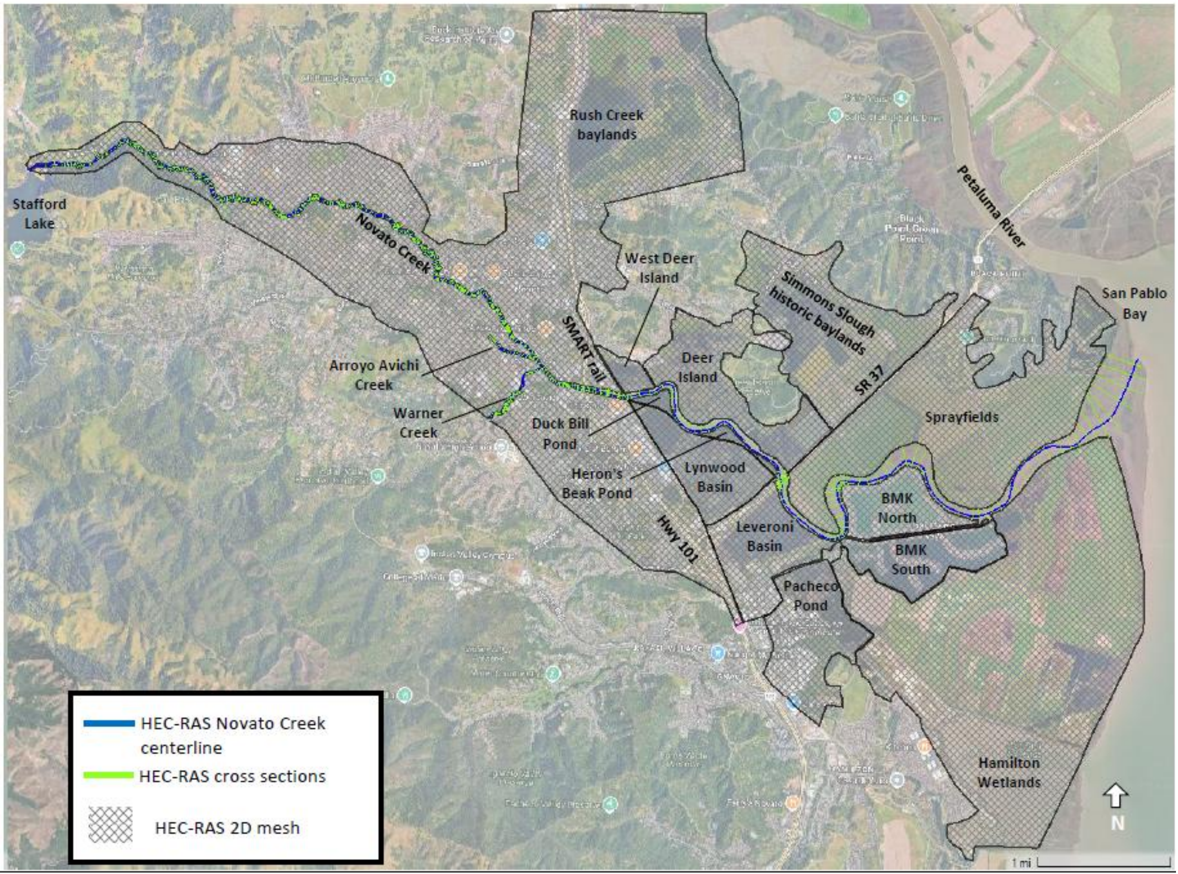

Figure 1. HEC-RAS hydraulic model domain

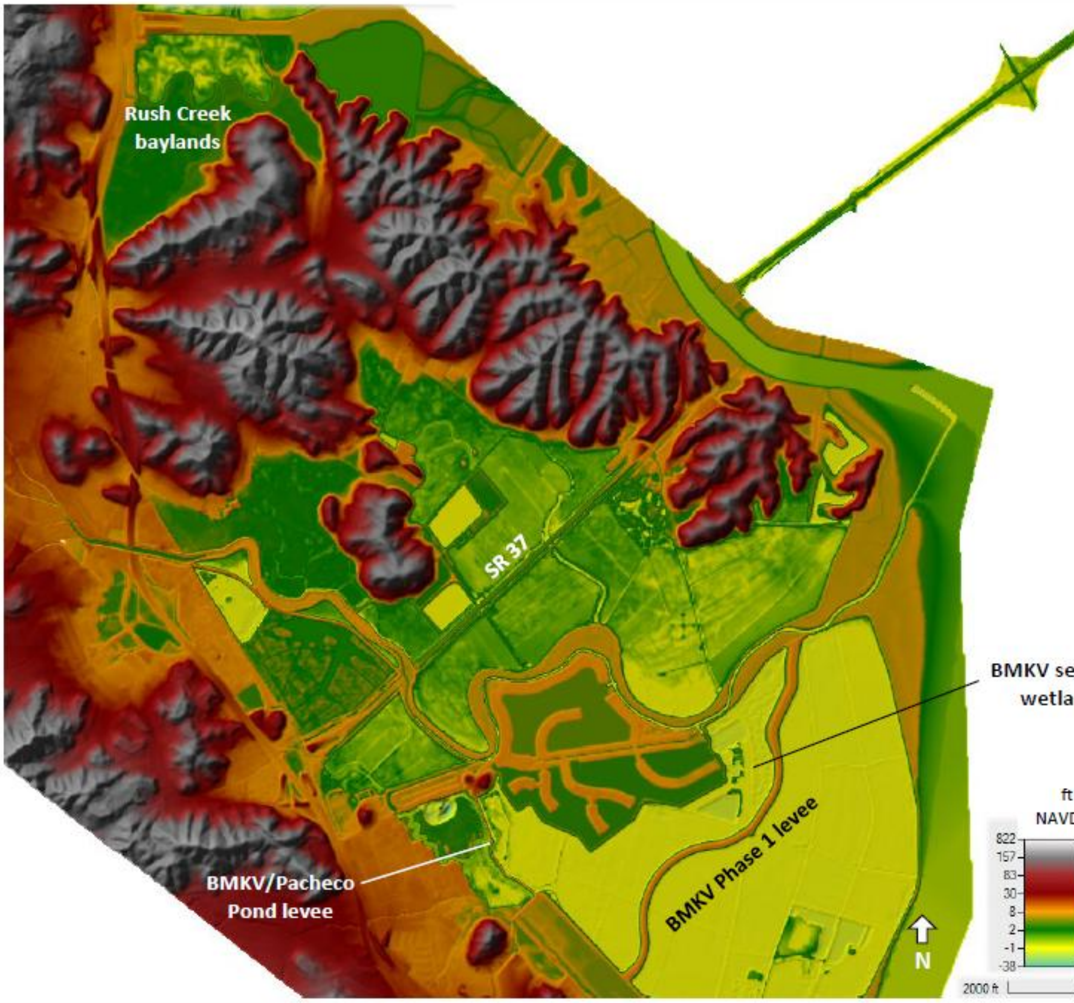

Figure 2. New topographic data added to the hydraulic model

4.2.2 Restoration Scenarios

The restoration scenarios assume excavation of select interior channels, excavation of Novato Creek, and existing grades elsewhere at the time of project implementation. More information on channel sizing is available in Attachment 1.

ESA typically considers the below two hydraulic geometry relationships for initial sizing of tidal slough channels in and around San Francisco Bay (Williams et al., 2002), based on the sizes of channels observed in natural marshes.

- Marsh area based hydraulic geometry which estimates channel dimensions with the assumption of a mature tidal marsh feeding the slough channel. In a mature tidal marsh (such as at China Camp), tidal channels are the primarily source of tidal prism within the marsh because the marshplain is at about mean higher high water (MHHW).

- Tidal prism based hydraulic geometry which estimates channel dimensions dependent on the amount of tidal prism flowing in and out of a restored site. Tidal prism-based estimates are appropriate for subsided sites that can generate much higher levels of tidal exchange per unit area than in a mature marsh. The diked parcels are generally subsided compared to a mature marshplain and have the potential to convey significant tidal prism through Novato Creek.

For channels inside the restored areas, including Simmons Slough and the major tidal channels, model scenarios assumed channels were excavated to approximately match the channel dimensions associated with the potential tidal prism of the breached areas under existing topographic conditions with no accretion and assuming a full tide range based on the relations in Williams et al. (2002). As discussed in the next section, these channel dimensions are not expected to persist, since sediment accretion would reduce the tidal prism and channel sizes over time. However, over-excavation of the channels for restoration implementation has the benefit of supplying material for berms and levees as well as increasing flood conveyance.

For Novato Creek, initial channel sizing was guided by the marsh area-based hydraulic geometry relationships with various adjustments (see Attachment 1) to maintain the channel within the existing levee footprint, improve tide range within the restored areas, avoid flood impacts, and reduce habitat impacts.

4.2.3 Geomorphic Change

The project area is expected to evolve geomorphically in response to the proposed restoration actions and to sea-level rise. Tidal inundation will deposit sediment within the breached parcels, and if Novato Creek is not widened and deepened during construction, over time, the increased tidal prism from breaching subsided basins to Novato Creek will expand Novato Creek. The expansion of Novato Creek will increase the tide range and accretion rate within the breached parcels, which in turn will affect the tidal prism associated with these features.

Given the implications for tidal marsh habitat and flood conveyance, the geometry of the Baseline and restoration scenarios were evaluated with estimated geomorphic changes for long-term conditions, with the year 2070 selected for this study.

Marsh accretion modeling by SFEI based on methodologies used in SFEI (2024) was used to estimate the future topographic surfaces of the restored areas. These accreted surfaces were then used to estimate the associated tidal prism and 2070 channel dimensions of Novato Creek, Simmons Slough, and the major tidal channels.

4.3 Structure data

Several existing culverts have been added to the model used by ESA (2024) to capture the routing of Simmons Slough flow (Figure 3) with dimensions listed in Table 2. Culvert dimensions were defined using data from Marin Map or with LiDAR and Google Earth 3D imagery where data were not available on Marin Map, which is sufficient for this planning level study. The dimensions of the Simmons Slough culvert under SR 37 have been updated based on data provided in Wood Rodgers (2019) and WRECO (2023).

Table 2. Information for culverts added to the model

Map ID	Creek	Barrels	Location	Dimensions of each barrel		Source for dimensions
				Width (ft)	Height (ft)	
1	Simmons Slough	2	SR 37	10	6	Wood Rodgers, 2019; WRECO, 2023
2	Simmons Slough tributary	1	Atherton Ave	3.5	3.5	Marin Map
3	Simmons Slough	1	adjacent to Atherton Ave	4	4	Wood Rodgers, 2019
4	Simmons Slough tributary	1	Atherton Ave	7	3	Google Earth approximation
5	Simmons Slough tributary	1	Atherton Ave	7	3	Google Earth approximation
6	Simmons Slough	1	Olive Ave	3.5	3.5	Marin Map
7	Simmons Slough	2	private driveway	1.5	1.5	Google Earth approximation
8	Simmons Slough tributary	1	Stone Tree Ln	2.5	2.5	Marin Map

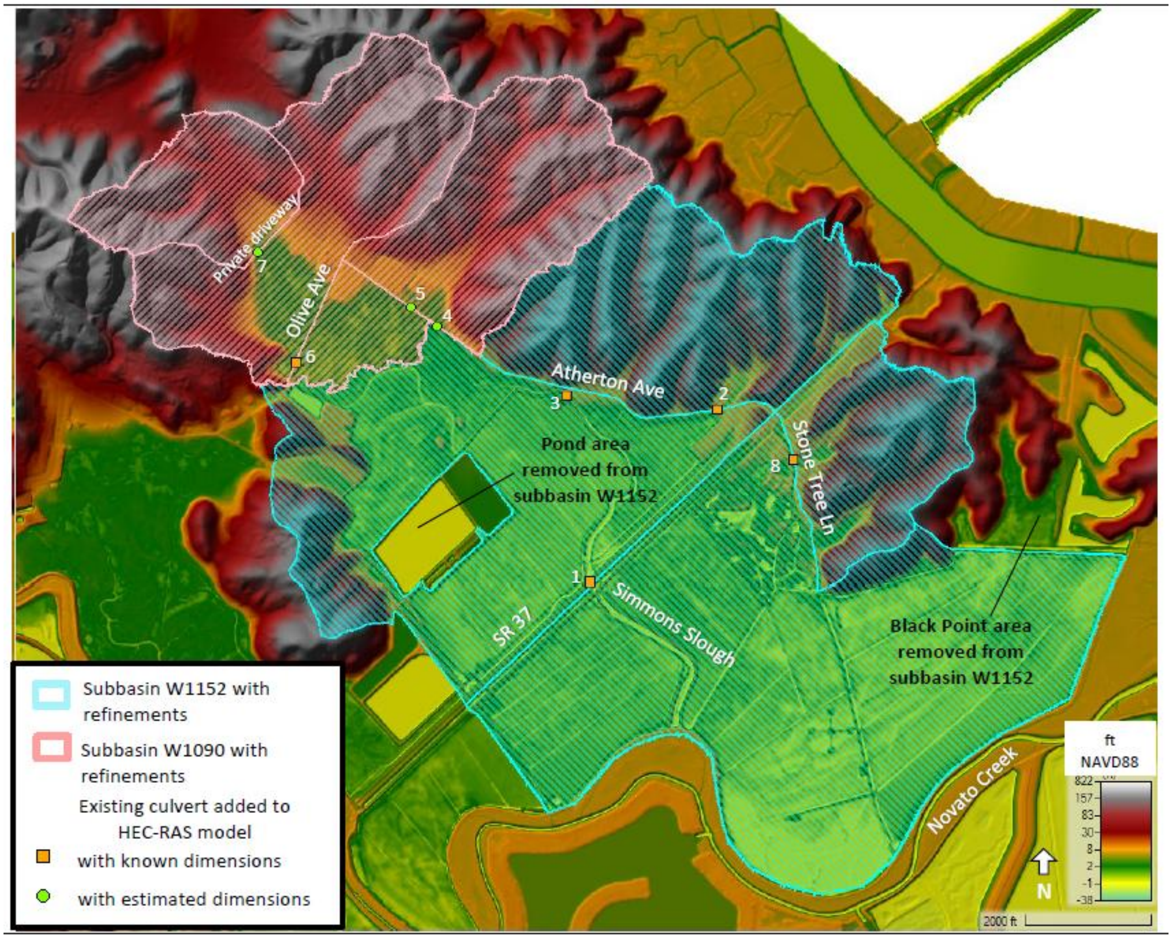

Figure 3. Culverts added to HEC-RAS model and refinements to the subbasins draining to Simmons Slough

4.4 Hydraulic roughness

Manning's n roughness values were retained from the model used by ESA (2024). A landcover map and associated roughness values were used for the new 2D domain, with the exception of the unvegetated Bird Ponds which were set to an n value of 0.03 (Table 3). Channel cross section roughness values upstream of the SMART crossing on Novato Creek ranged from 0.03-0.04 with overbank values ranging from 0.04-0.08 (Table 4). Roughness values downstream of the SMART crossing (Table 4) were adjusted during model calibration by ESA (2023) and validated for this study.

Table 3. 2D domain Manning's n roughness

Landcover	Manning's n roughness
Building	10
Commercial	0.02
Road	0.016
Bird Ponds	0.03
Other	0.06

Table 4. 1D domain Manning's n roughness

Landcover	Upstream of SMART crossing	Calibrated downstream of SMART crossing
Channel	0.03-0.04	0.027
Overbank	0.04-0.08	0.04

4.5 Hydrologic data and scenarios

Modeled hydrographs from the District's HEC-HMS hydrologic model were used as inflows to the HEC-RAS model in keeping with ESA (2024) but with the below updates that were needed given the focus of this modeling study.

4.5.1 Simmons Slough inflows

In the District HEC-RAS model used by ESA (2024), runoff from the Simmons Slough watershed directly enters Novato Creek as an inflow boundary condition instead of routing through the slough itself. Given restoration alternatives that include the area along Simmons Slough, a more refined representation of the hydrology and hydraulics is needed here. The District HEC-HMS hydrology model contains relatively coarsely delineated subbasins within the Simmons Slough watershed, so the subbasin delineation was modified to better resolve the hydrology as relevant to the alternatives.

Under breached conditions with a connection between Simmons Slough and Novato Creek, tidal inundation of the parcels adjacent to Simmons Slough will occur and create a more elevated tailwater condition for culverts draining to these parcels than exists currently with no tidal connection. This elevated tailwater could increase flooding for the areas upstream of the culverts during storm events including over the roads spanned by the culverts. Non-tidal stormwater basins within the breached parcels were therefore included in the alternatives to store water, with drainage of the basins during lower tides.

Figure 3 shows the splitting of subbasins W1152 and W1090 into multiple subbasins to estimate the runoff volumes from these drainages and the approximate sizes of non-tidal stormwater basins needed to detain this runoff. The runoff hydrographs from the original two subbasins have simply been prorated by the split subbasin areas to estimate runoff for each new subbasin, i.e. the split subbasins have not been re-parameterized and rerun in HEC-HMS, which is sufficient for this planning level study. The pond area has been removed from subbasin W1152, which will slightly scale down runoff for this subbasin, since precipitation within these features is isolated and does not drain to Simmons Slough. Similarly, the original subbasin W1152 included the Black Point area north of a berm for which there is no known hydrologic connection with the parcel to the south, so this area has been removed from the subbasin area.

4.5.2 Lynwood Basin inflows

Similar to the edits made to the hydrology for Simmons Slough, subbasin W1260 that includes Lynwood Basin was refined to estimate the runoff volume (Figure 4). Storm drain data available on Marin Map were referenced when splitting subbasin W1260 to isolate the flow draining to Lynwood Basin from that draining to the Leveroni Basin. The runoff hydrograph from the original subbasin has been prorated by the split subbasin areas to estimate runoff to Lynwood Basin. Wood Rodgers (2024) recommended that no more than 40% of Lynwood Basin be restored to tidal with 60% preserved for stormwater as shown in Figure 64 of their report; this information was used to configure the stormwater basin for this modeling analysis.

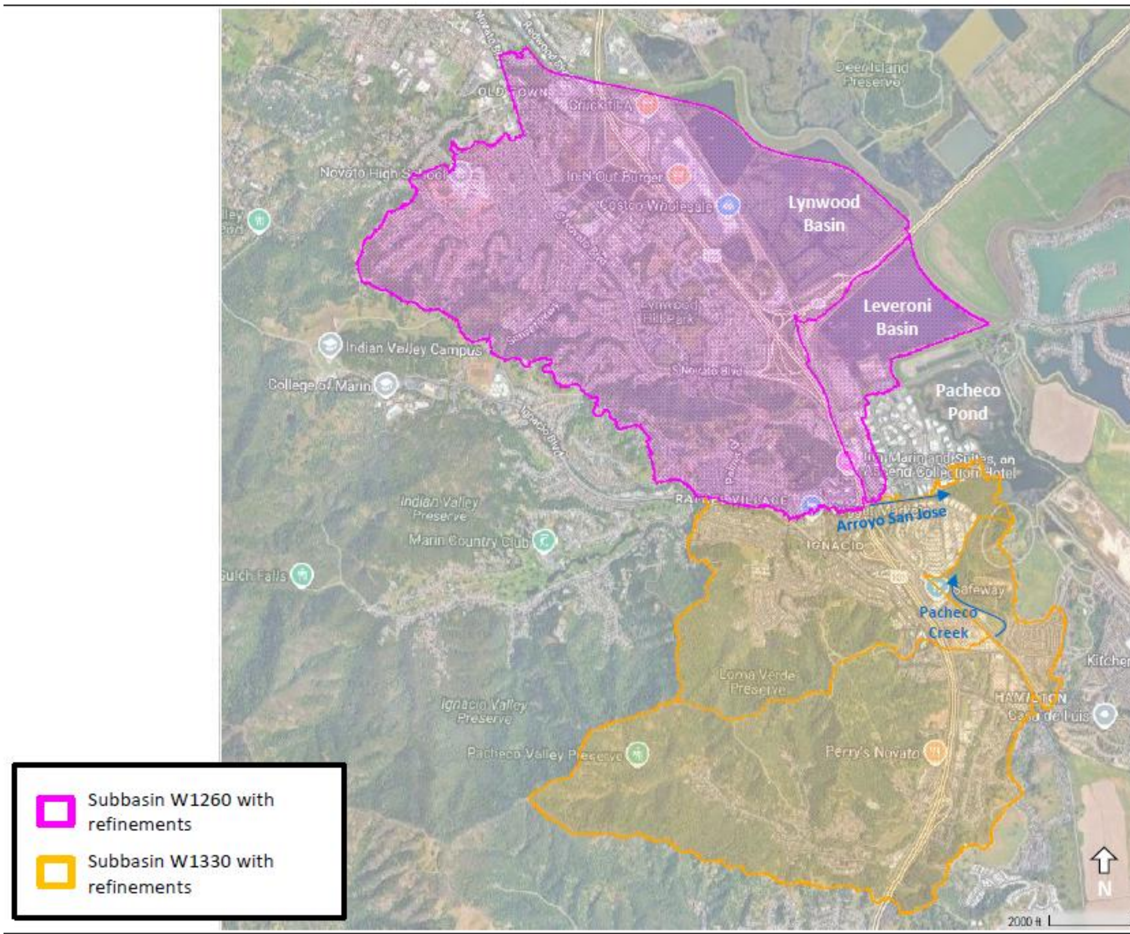

Figure 4. Refinements to the subbasins draining to Lynwood Basin, Leveroni Basin, and Pacheco Pond

4.5.3 Pacheco Pond inflows

Arroyo San Jose and Pacheco Creek are the main channels draining to Pacheco Pond, and the District HEC-HMS model lumps these watersheds such that the HEC-RAS model used by ESA (2024) includes a single inflow boundary condition combining the flows of both channels that enters directly into the pond. Since flood risk for the Los Robles Mobile Home Park and nearby business parks could be related to the water surface profiles of these two channels and not simply the water level of Pacheco Pond, splitting the flows into two boundary conditions entering the respective channels will help assess this. Stetson (2021) performed a modeling study of the flooding at the mobile home park including parsing the flows for Arroyo San Jose and Pacheco Creek by editing the subbasins in the HEC-HMS model. These subbasin delineations by Stetson (2021) (Figure 4) have been used to estimate separate hydrographs for both creeks.

4.5.4 Hydrologic scenarios

The flood conveyance and tidal marsh habitat characteristics of the restoration alternatives were evaluated using a set of hydrologic scenarios that include Novato Creek and Simmons Slough upstream boundary flows and Novato Creek downstream boundary stages. The approach below is based on that used by ESA (2023).

50-year Runoff Scenario

For flood conveyance, the 50-year event was simulated in the HEC-RAS hydraulic model given that this is the District's primary design flood event. Both current climate conditions flow and 2070 future climate conditions flow were modeled for the 50-year event (Figure 5). The former is based on a Bulletin 17C analysis by Stetson (2019), and the latter is based on hydrologic analysis for Stafford Lake by ESA (2024). The 50-year flow was paired with a 1-year tide water level time series as the downstream boundary condition for Novato Creek with the water levels shifted up 1.4 ft for the future climate scenario, which corresponds to the intermediate sea level rise scenario for 2070 (California Sea Level Rise Guidance, 2024).

Bay water levels were adjusted from those measured at the Marin OneRain gage slightly upstream of the creek mouth (38041) for January 2019. The measured water level data were shifted up to yield a peak water level matching that of the current climate 1-year tide: 7.6 ft NAVD88 (AECOM, 2016). The timing of the water level series relative to the upstream flow series was set such that MHHW (6.3 ft NAVD88) occurred on the ebb of the high tide and approximately 1 hour before the peak flow occurred at the Highway 101 crossing of Novato Creek. One hour was the approximate travel time for the tide to reach Highway 101 based on model tests, and to be conservative with potential flooding impacts, it was decided that the peak flow and MHHW should approximately coincide at this location.

The 50-year event was also used to simulate runoff volumes and estimate associated stormwater basin sizes.

Typical Tides Scenario

To estimate tidal marsh habitat characteristics of the restoration opportunities, a typical tides hydrologic scenario was modeled using a low summer baseflow for Novato Creek and the June 1-3, 2019, water level time series for the downstream boundary of Novato Creek. The water level data were recorded at a gage installed by ESA at the railroad crossing of the Petaluma River. The modeled tide range at different locations within the breached parcels was recorded.

Table 5 shows initial water levels for the 2D flows areas shown in Figure 1, which were informed by prior modeling by Stetson Engineers (2019). Restored areas with a tidal connection were allowed to warm up beyond this initial water level with tide cycles preceding the flood hydrograph, such that initially dry restored areas still exhibited a warmed-up water level before the storm. Areas without a tidal connection were not applicable to the typical tides scenario.

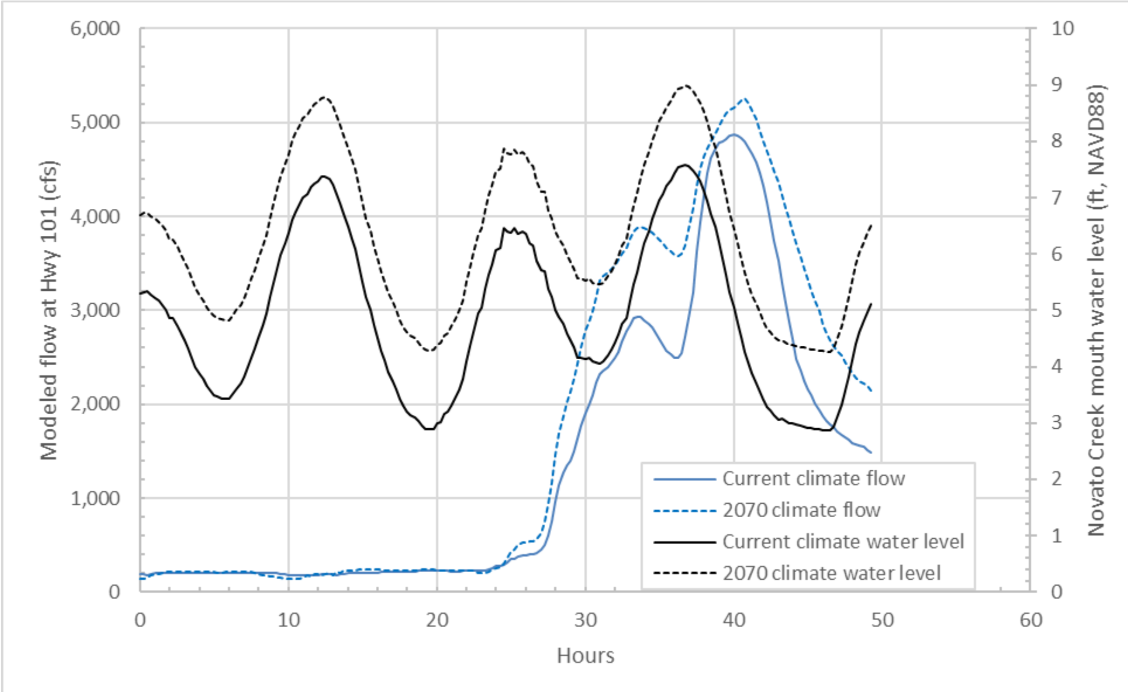

Figure 5. Modeled 50-yr flow at Hwy 101 and 1-yr tide at Novato Creek mouth for current and 2070 climate

Table 5. Initial water levels for 2D areas

2D flow area	Initial water level (ft NAVD88)	
	50-year flow, 1-year tide	Typical tides (June 2019)
BMK North	4.6	NA
BMK South	3.6	NA
Deer Island	Dry	5.5
Duck Bill Pond	6.3	5.5
Heron's Beak Pond	6.3	5.5
West Deer Island	Dry	NA
Lynwood Basin	4.5	5.5
Sprayfields	Dry	5.5
Simmons Slough historic baylands	Dry	5.5
Pacheco Pond	6.3	NA

4.6 Hydraulic model run summary

Table 6 summarizes the hydraulic model runs for this study. The 50-year flood paired with the 1-year tide and typical tides hydrologic scenarios are run for all alternatives for present day climate and geomorphic conditions. Three alternatives are also run for these hydrologic scenarios under 2070 climate and geomorphic conditions reflecting estimates for sea level rise, future precipitation, and geomorphic evolution to a long-term condition, in which sediment accretion has occurred within the restored areas along with the development of a new tidal channel network, and Novato Creek has expanded in response to the increased tidal prism.

Table 6. Hydraulic model run summary

Alternative	Timing	Hydrology scenario
Baseline (ca. 2030)	Present day	50-yr flood, 1-yr tide Typical tides
	2070	50-yr flood, 1-yr tide Typical tides
Multiple breaches (Alternative 1)	Present day	50-yr flood, 1-yr tide Typical tides
	2070	50-yr flood, 1-yr tide Typical tides
Multiple breaches - near term (Alternative 1a)	Present day	50-yr flood, 1-yr tide Typical tides
Single breach (Alternative 2)	Present day	50-yr flood, 1-yr tide Typical tides
Single breach - near term (Alternative 2a)	Present day	50-yr flood, 1-yr tide Typical tides
All sprayfields (Alternative C)	Present day	50-yr flood, 1-yr tide Typical tides
	2070	50-yr flood, 1-yr tide Typical tides

5. HYDRAULIC MODEL RESULTS AND DISCUSSION

5.1 Model validation

The hydraulic model was calibrated by ESA (2023) to both high flow conditions (January 2019 storm event) and low flow typical tide conditions (June 2019). These two hydrologic scenarios have been used for validation of the updated model in this study. Table 7, Figure 6, and Figure 7 include observed vs. modeled results along with those from the ESA (2023) calibration and confirm no significant change in model performance with results sufficient for this planning level study.

Regarding effects of the model downstream boundary location and cross section configuration on model results, tests suggested that the exact cross section configuration across the marsh on the south side of the creek was not critical to predicting water levels in this area for the 50-year flood given minimal flow conveyance over the marsh with most conveyed by the channel itself. Therefore, the fifth and fourth most downstream cross sections shown in Figure 1 were not extended further to the south over the marsh.

Initial model tests also suggested that the mudflat and channel through the mudflat do not limit flow conveyance for the 50-year flood, such that omitting this area from the final model simulations was unlikely to have affected the simulated water levels upstream along Novato Creek. However, the mudflat channel is undersized relative to that needed to convey the large tidal prisms associated with the alternatives, so the modeled tide range results for the alternatives are assumed to require excavation of the mudflat channel out to the Petaluma River to avoid tide muting that is not captured with the truncated model domain.

Table 7. Observed and modeled peak water levels for January 2019 storm event

Scenario	January 2019 peak water level at Rowland Way crossing (ft NAVD88)
Observed	13.43
Modeled from ESA (2023) calibration	13.42
Modeled from validation for current study	13.32

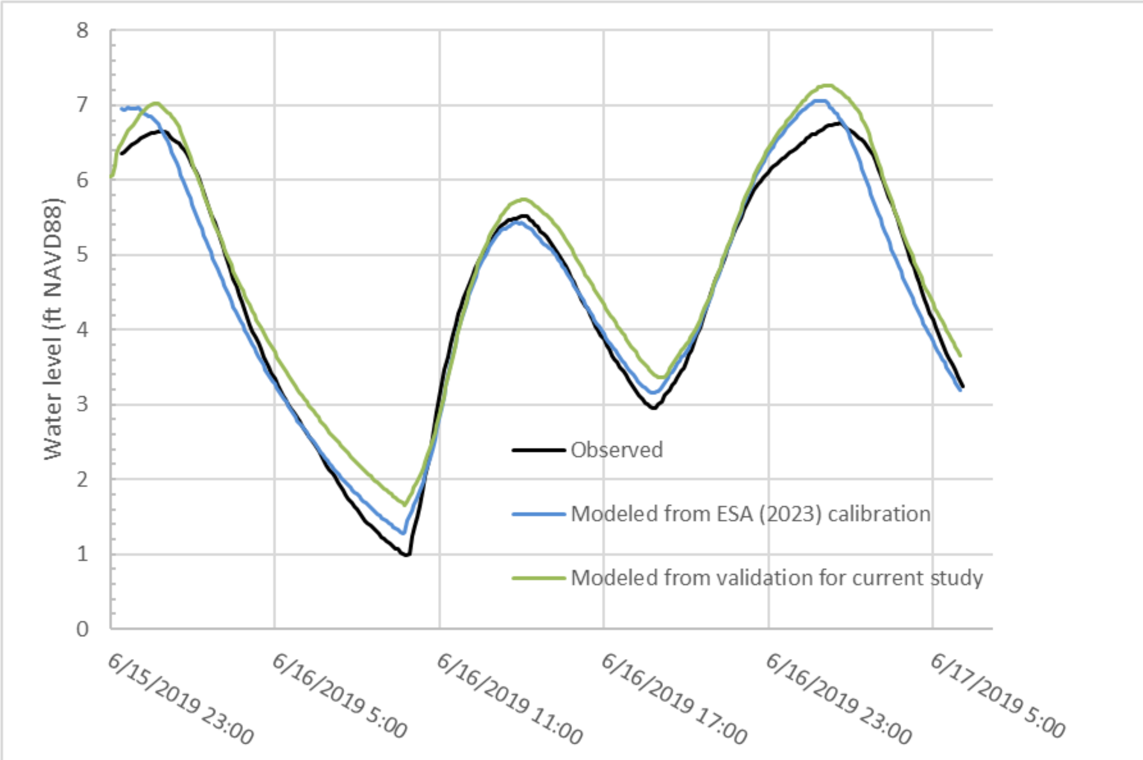

Figure 6. Observed and modeled June 2019 tides at SR 37 crossing

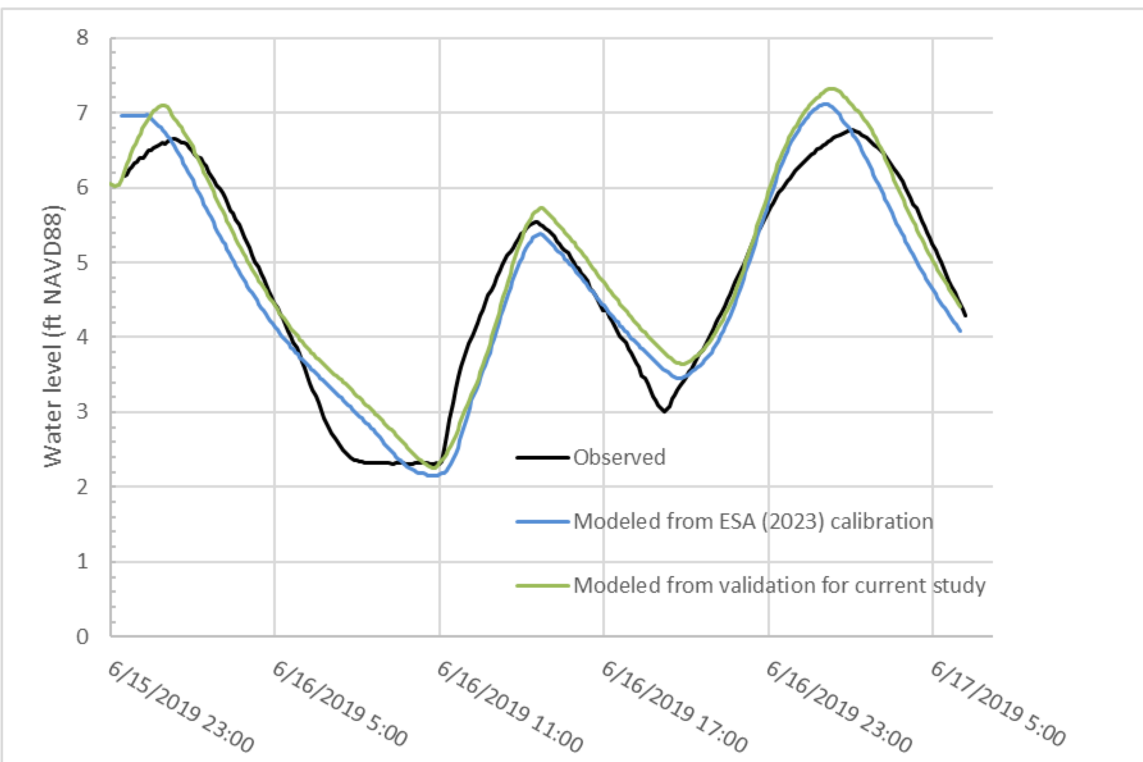

Figure 7. Observed and modeled June 2019 tides at Rowland Way crossing

5.2 50-year flood

5.2.1 Water levels

A 50-year flood modeled water level difference map between Alternative 1 and Baseline ca. 2030 is shown in Figure 8. Modeled maximum water level profiles for the restoration alternatives compared to baseline for the 50-year flood are shown in Figure 9 through Figure 11, and modeled maximum water levels at SR 37 and Hwy 101 are listed in Table 8.

Model results indicate that restoring the diked baylands and dredging Novato Creek increase the conveyance of creek flood flows and lower water levels relative to Baseline across the majority of the project area. Lower water levels extend upstream of Highway 101 for some of the alternatives though the magnitude of the lowering decreases with distance upstream. The magnitude of water level lowering increases with more extensive dredging of Novato Creek (Alternative 1) and with SR 37 and SMART raised on a causeway under which there is significant flood flow conveyance (Alternatives 1 and 2). For alternatives that include baylands restoration with no creek dredging, a slight water level rise over Baseline occurs at the downstream end of the project area. This is due to creek flow that enters the restored baylands in the upstream and middle regions of the project area and returns to the creek at the downstream end, which causes a flow backup and water level rise here, including adjacent to the BMK community. Dredging of Novato Creek in this downstream region provides the additional flow conveyance needed to avoid this flow backup and associated water level rise.

The stormwater basins that are isolated from the tides show different maximum water levels relative to the adjacent restored baylands depending on the volume of stormwater detained in each basin. Further refinement will be made in future design phases to the location and height of the basin levees to ensure adequate stormwater detention.

Below are model result observations for each of the alternatives compared to Baseline.

Alternative 1 Multiple breaches

- Water level decrease at Hwy 101, SR 37, and adjacent to the BMK community
- Water level decrease for both present day and 2070 conditions along Novato Creek is due to baylands restoration and creek dredging throughout the project area.
- Significant flow conveyance under the SR 37 and SMART causeway results in notably larger water level decreases further upstream compared to Alternatives 1a, 2a, and C that lack this feature.

Alternative 2 Single breach

- Water level decrease at Hwy 101, SR 37, and adjacent to the BMK community from baylands restoration. Novato Creek dredging downstream of the single breach avoids a water level rise in this area.

- Significant flow conveyance under the SR 37 and SMART causeway results in notably larger water level decreases further upstream compared to Alternatives 1a, 2a, and C that lack this feature.

Alternative 1a Multiple breaches - near term

- Water level decrease at Hwy 101 and SR 37 from baylands restoration but water level increase of up to 0.6 ft adjacent to the BMK community
- Water level increase is due to flow backup at the downstream breach. (dredging not included in modeling to test whether it was needed. Results indicate dredging should be included as in Alternative 1 to avoid water level increase).

Alternative 2a Single breach - near term

- Water level decrease at Hwy 101, SR 37, and adjacent to the BMK community from baylands restoration
- Novato Creek dredging downstream of the single breach avoids a water level rise in this area, and more extensive dredging than Alternative 2 likely contributes to the water level decrease upstream as well.

Alternative C All Sprayfields

- Water level decrease at Hwy 101, SR 37, and adjacent to the BMK community from baylands restoration
- Water level increase of 0.03 ft and 0.01 ft for present day and 2070 conditions, respectively, around station 500 to 2,500. This is adjacent to the Day Island Levee, which is about 9 ft NAVD88 and not close to overtopping in the 50-yr flood with 1-yr tide storm event. Flooding in this area is expected to be driven by tide dominated storm events for which the project alternatives are not anticipated to have a major influence.

Table 8. Modeled maximum water levels at SR 37 and Hwy 101 for the 50-yr flow and 1-yr tide event

Alternative	Timing	Modeled max water level (ft, NAVD88)		Water level difference with Baseline	
		SR 37	Hwy 101	SR 37	Hwy 101
Baseline	Present day	11.2	12.9	-	-
	2070	11.0[1]	13.7	-	-
1	Present day	7.7	11.2	-3.5	-1.7
	2070	9.2	11.8	-1.9	-1.9
2	Present day	8.1	11.4	-3.1	-1.5
1a	Present day	10.1	11.8	-1.1	-1.1
2a	Present day	10.2	11.9	-1.0	-1.0
C	Present day	10.6	12.7	-0.6	-0.2
	2070	10.2[1]	13.6	-0.9	-0.1

[1] Water surface elevation decreases slightly at SR37 from present day to 2070 for baseline and Alternative C, despite slightly more flow and higher sea level. This is because present day water levels at SR 37 are limited by Novato Creek conveyance and 2070 conditions include an expanded Novato Creek.

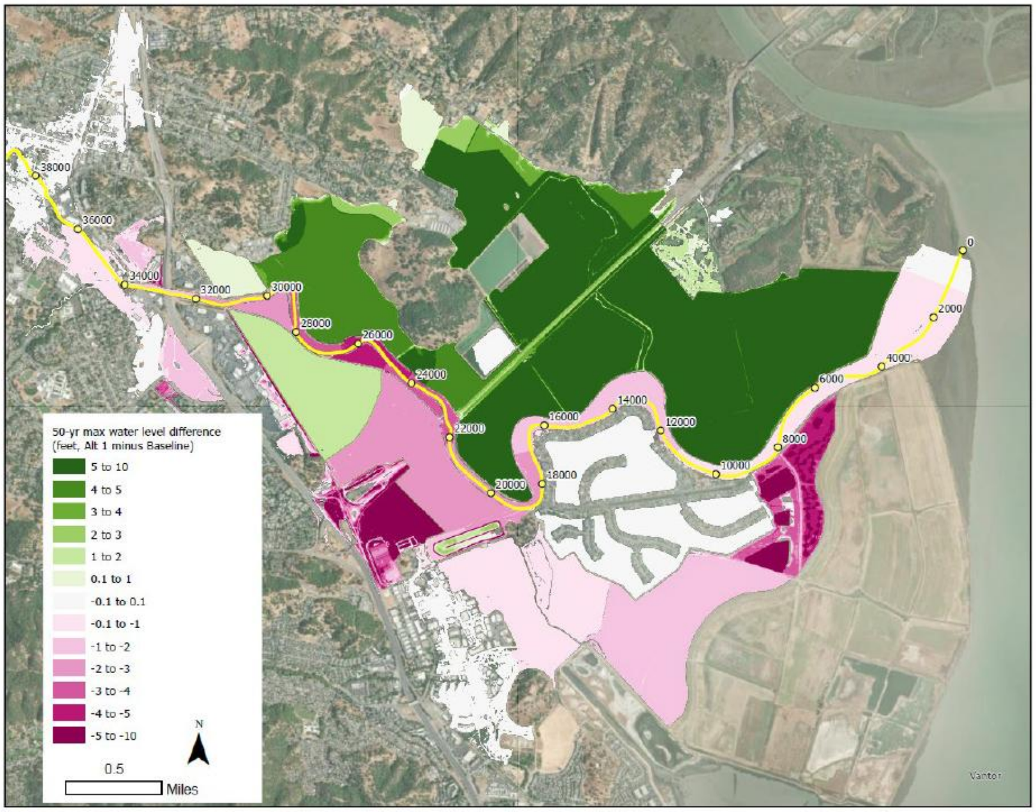

Figure 8. Modeled maximum water level difference between Alternative 1 and Baseline for the 50-yr flow and 1-yr tide event

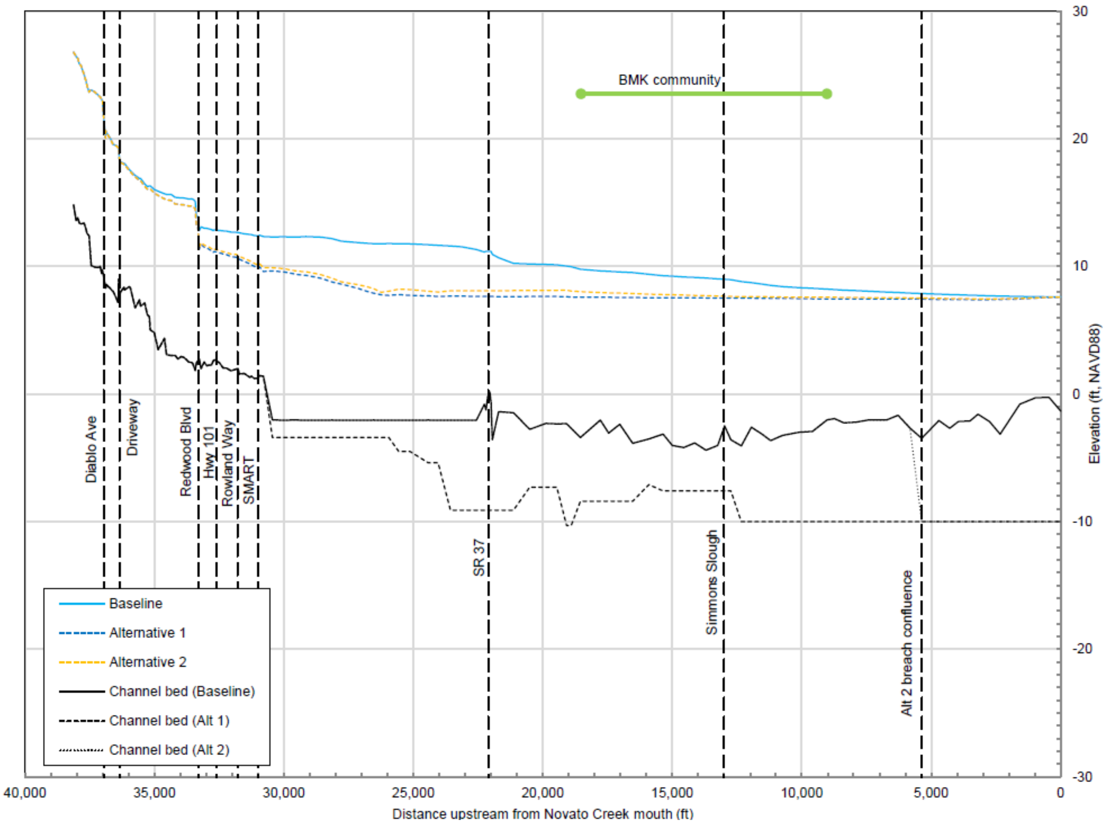

Figure 9. Modeled maximum water levels for Baseline and Alternatives 1 and 2 for the 50-yr flow and 1-yr tide event

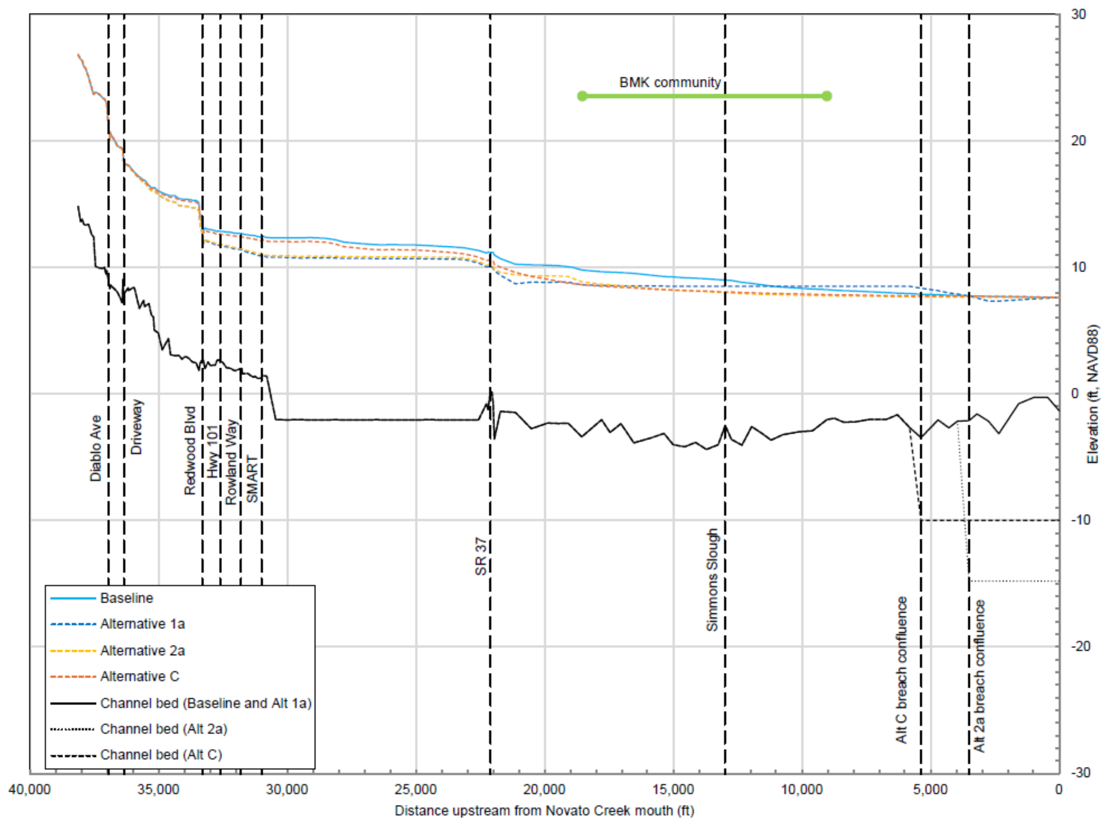

Figure 10. Modeled maximum water levels for Baseline and Alternatives 1a, 2a, and C for the 50-yr flow and 1-yr tide event

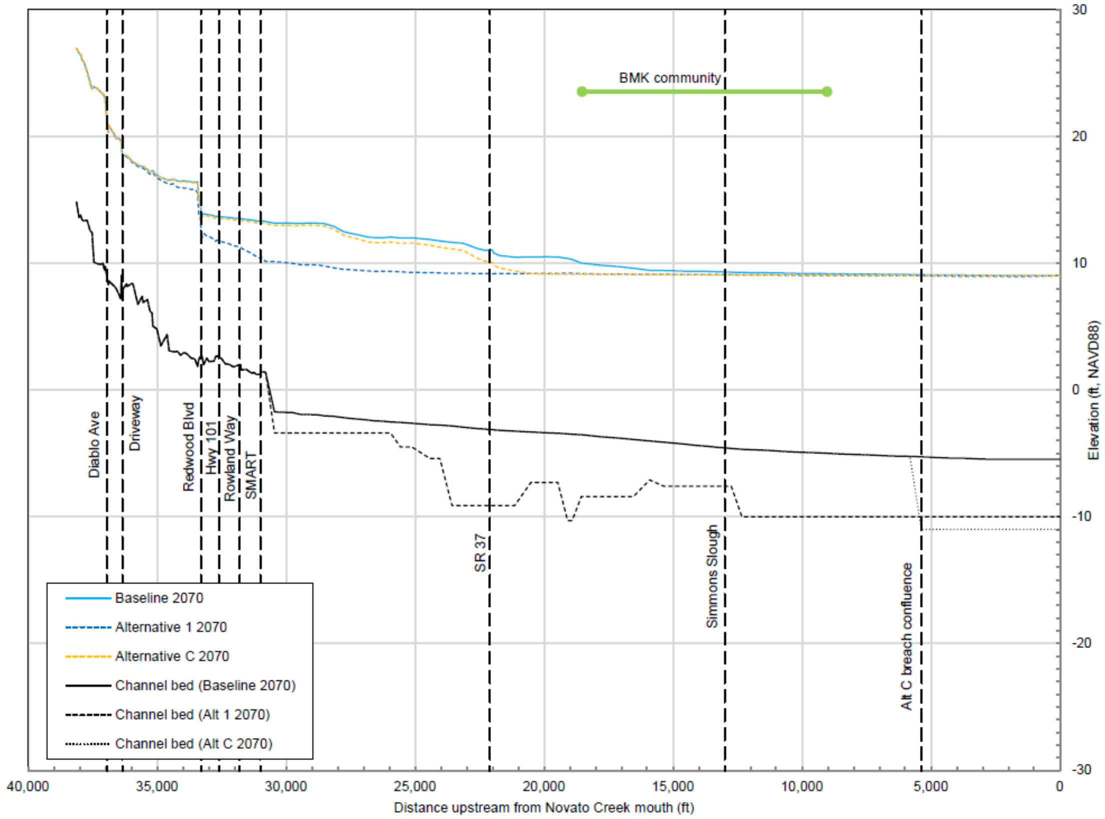

Figure 11. Modeled maximum water levels for Baseline and Alternatives 1 and C for the 2070 50-yr flow and 1-yr tide event

5.2.2 Velocities

Modeled 50-year flood velocity time series are shown in Figure 12 through Figure 14 for Novato Creek at the SMART rail crossing and three narrow locations on Novato Creek adjacent to the BMK community. These time series include creek velocities during several tide cycles preceding passage of the flood hydrograph around hour 40. Velocities directed downstream and upstream have positive and negative values, respectively.

Below are model result observations for each of the alternatives compared to Baseline.

Alternative 1 Multiple breaches

- High velocity at point 1 at beginning of run may be more related to initial conditions during the model warmup. Overall lower velocities including during flood peak likely due to expanded creek dimensions from dredging. Similar trends for the 2070 scenario.

Alternative 2 Single breach

- Lower velocities likely due to less flow within the creek given significant flow conveyed by the large channel through the sprayfields.

Alternative 1a Multiple breaches - near term

- Lower creek velocities along BMK from flow conveyed through the restored sprayfields. Higher velocity at point 4 around the flood peak likely due to steeper drawdown of the water surface profile here from the downstream restored areas and associated water level lowering.

Alternative 2a Single breach - near term

- Mostly similar velocities except higher at point 4 around the flood peak likely due to steeper drawdown of the water surface profile here from the downstream restored areas and associated water level lowering.

Alternative C All Sprayfields

- Mostly similar velocities except higher at point 4 around the flood peak likely due to steeper drawdown of the water surface profile here from the downstream restored areas and associated water level lowering.

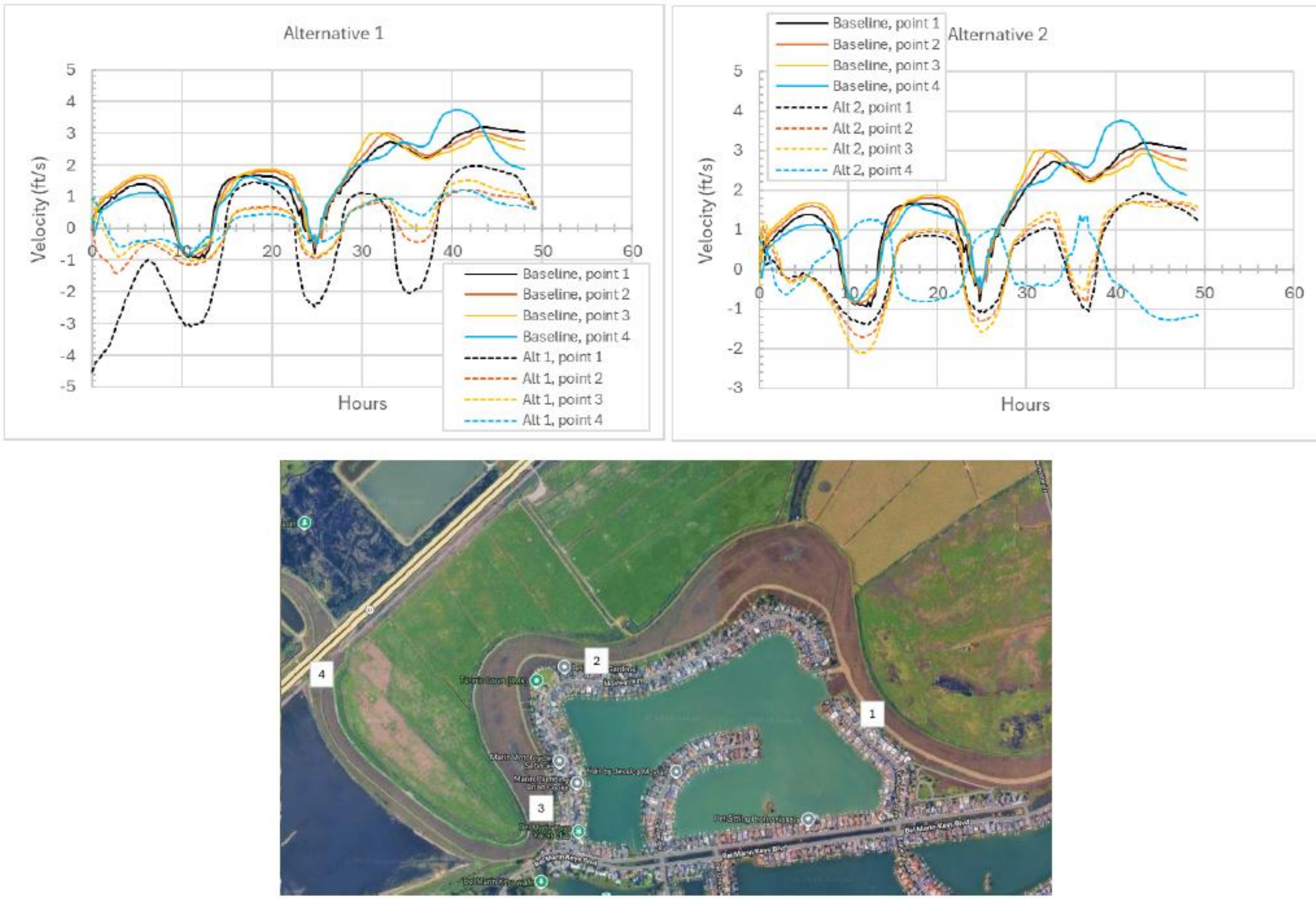

Figure 12. Modeled Novato Creek velocities for Baseline and Alternatives 1 and 2 for the 50-yr flow and 1-yr tide event

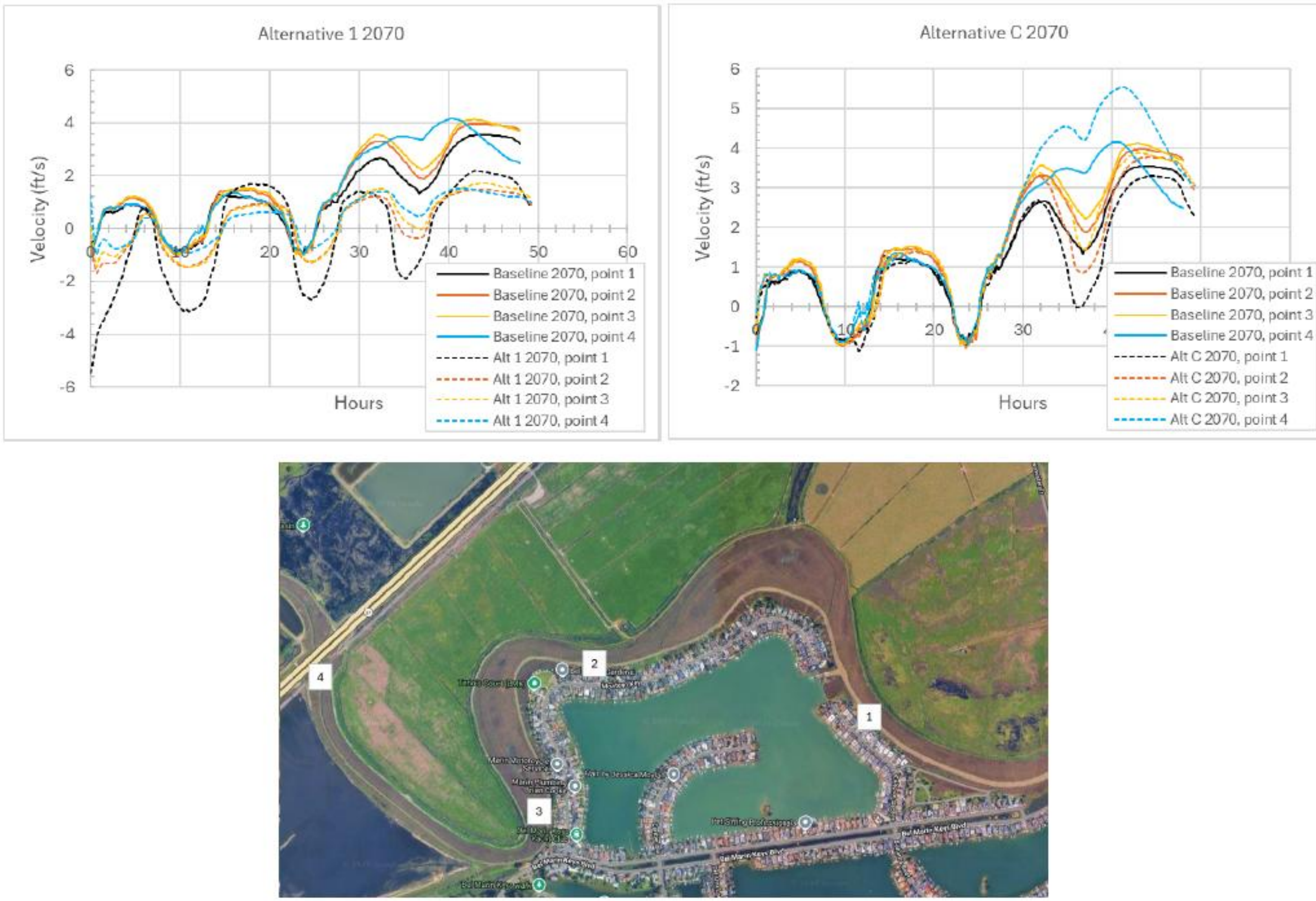

Figure 13. Modeled Novato Creek velocities for Baseline and Alternatives 1 and C for the 2070 50-yr flow and 1-yr tide event

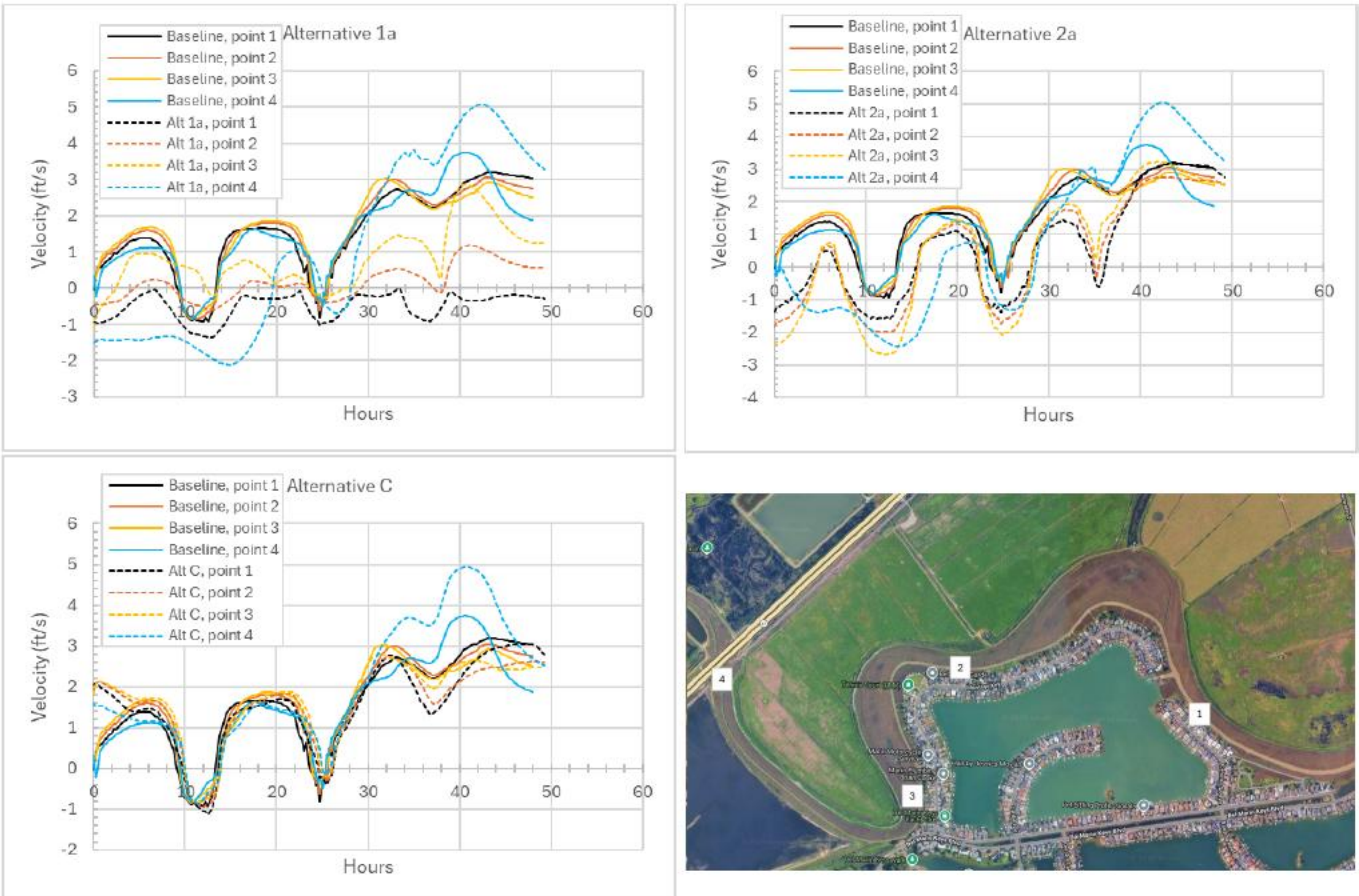

Figure 14. Modeled Novato Creek velocities for Baseline and Alternatives 1a, 2a, and C for the 50-yr flow and 1-yr tide event

5.3 Typical tides

Modeled water level time series at multiple locations for June 1-3, 2019, for the alternatives are shown in Figure 15 through Figure 17 with modeled tide ranges in Table 9. The results indicate that the existing Novato Creek does not have the capacity to convey the significantly larger tidal prism associated with the restored baylands, which results in tide muting relative to the full tide range that occurs at the creek mouth. Factors affecting the degree of tide muting include the magnitude of tidal prism increase and distance upstream. Alternatives that include more extensive restoration and larger increases in tidal prism exhibit more muting, as do restored areas located further upstream.

Dredging of Novato Creek increases conveyance of the larger tidal prism and results in less tide muting, with dredging that extends further upstream from the creek mouth and dredging that includes larger cross section dimensions both increasing the tide range. Tide range results throughout the restored Simmons Slough baylands suggest that the preliminary sizing of the new channels inside the restored area is likely close to that which is needed for achieving a full tide range throughout this area if Novato Creek downstream of the breach is sufficiently sized.

Baseline

- Tide muting upstream from the creek mouth. Some of this is due to the additional Bird Ponds tidal prism that is restored under Baseline but to which Novato Creek has not yet expanded to accommodate. However, some muting already occurs under existing conditions without Bird Ponds restoration per observed water level data recorded at SR 37 (Figure 6) and Rowland Way (Figure 7).

Alternative 1 Multiple breaches

- Tide muting despite Novato Creek dredging throughout the project area due to spatial constraints on dredging in areas with narrow widths between the levees. Despite accretion in restored basins, muting still occurs in 2070 assuming the levees continue to impose width constraints that limit further expansion of the creek.

Alternative 2 Single breach

- Slightly larger tide range in the restored sprayfields and Simmons Slough north of SR 37 than Alternative 1 due to the new large channel that conveys the tidal prism compared to the dredged Novato Creek in Alternative 1 that is more space constrained. Some additional muting at SR 37 and Deer Island due to the long upstream reach of Novato Creek with no dredging as well as the large tidal prism from the restored Deer Island.

- Smaller tide range in the restored sprayfields than Alternative 2a due to smaller Novato Creek dredge but larger range in Deer Island given that some of the Deer Island tidal prism is conveyed under the SR 37 and SMART causeway instead of through the undersized existing Novato Creek for Alternative 2a.

Alternative 1a Multiple breaches - near term

- Minimal tide range due to no Novato Creek dredging.

Alternative 2a Single breach - near term

- Extensive Novato Creek dredge downstream of the breach results in near full tide range for the sprayfields but significant muting at SR 37 and Deer Island due to the long upstream reach of Novato Creek with no dredging as well as the large tidal prism from the restored Deer Island.

Alternative C All Sprayfields

- Smaller tide range in the sprayfields relative to Alternative 2a due to smaller Novato Creek dredge downstream of the breach, but larger tide range at SR 37 given no Deer Island restoration and associated tidal prism increase. Near full tide range in 2070 following expansion of Novato Creek in response to the larger tidal prism in the restored baylands.

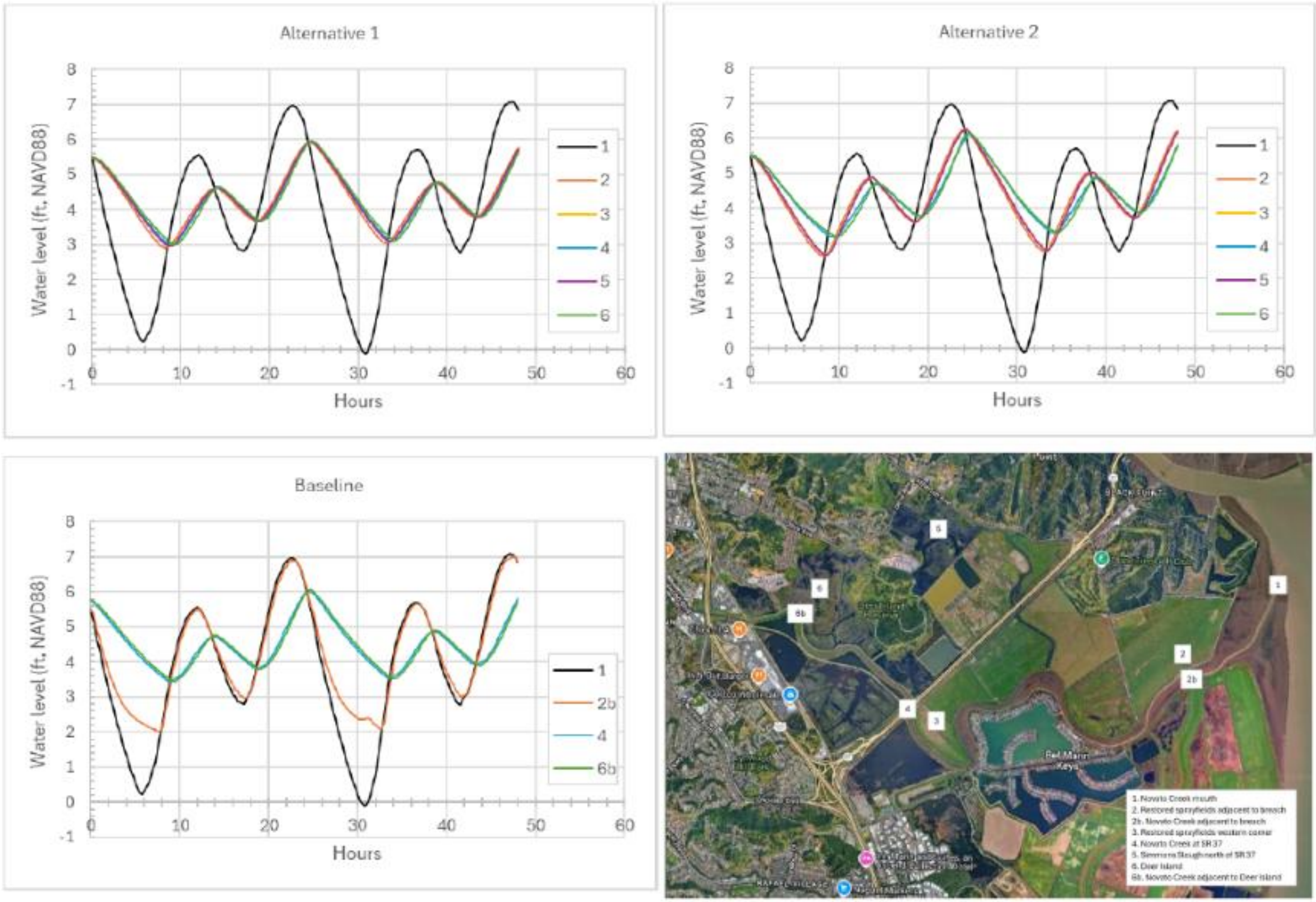

Figure 15. Modeled water levels for Baseline and Alternatives 1 and 2 for typical tides

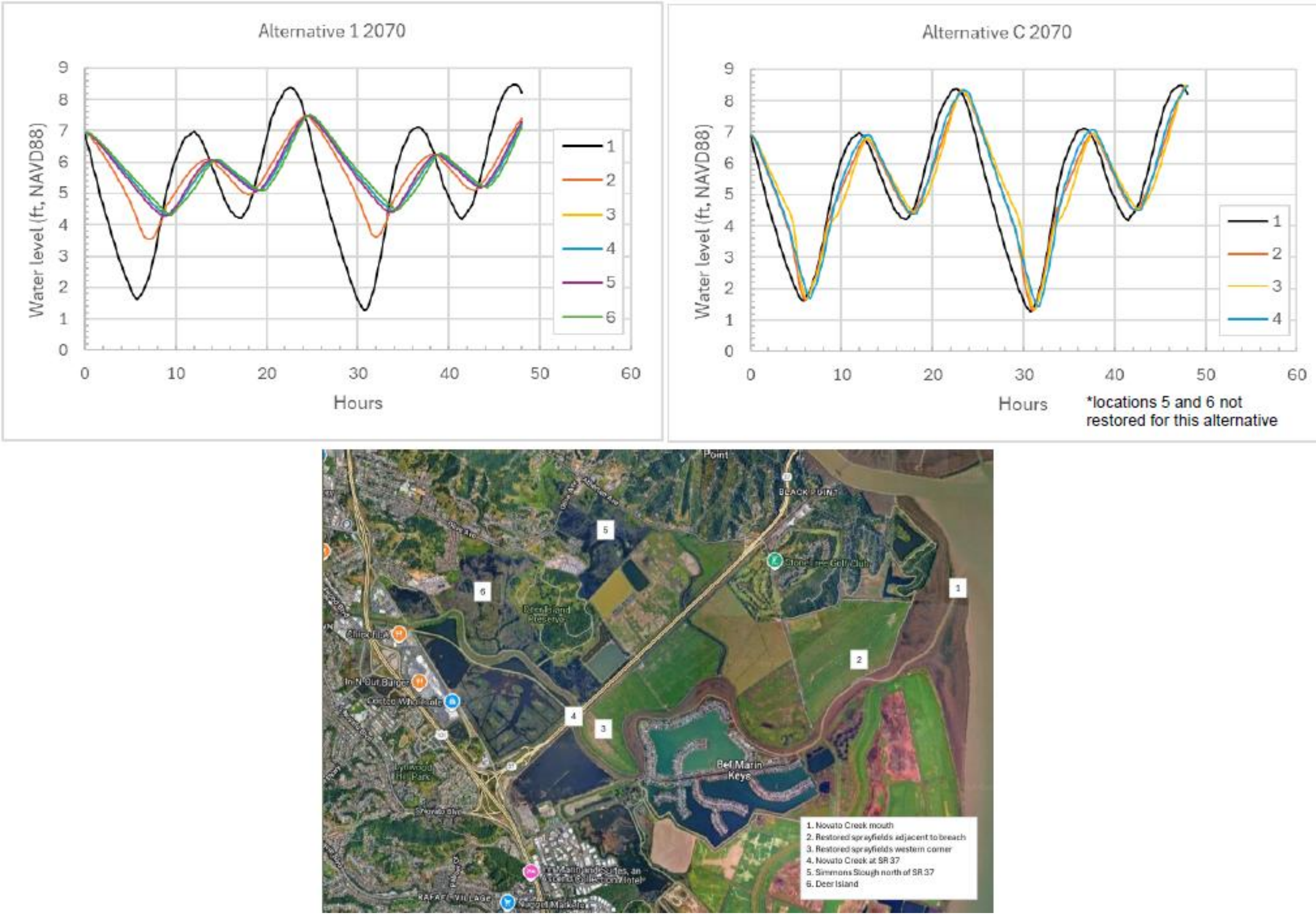

Figure 16. Modeled water levels for Alternatives 1 and C for 2070 typical tides

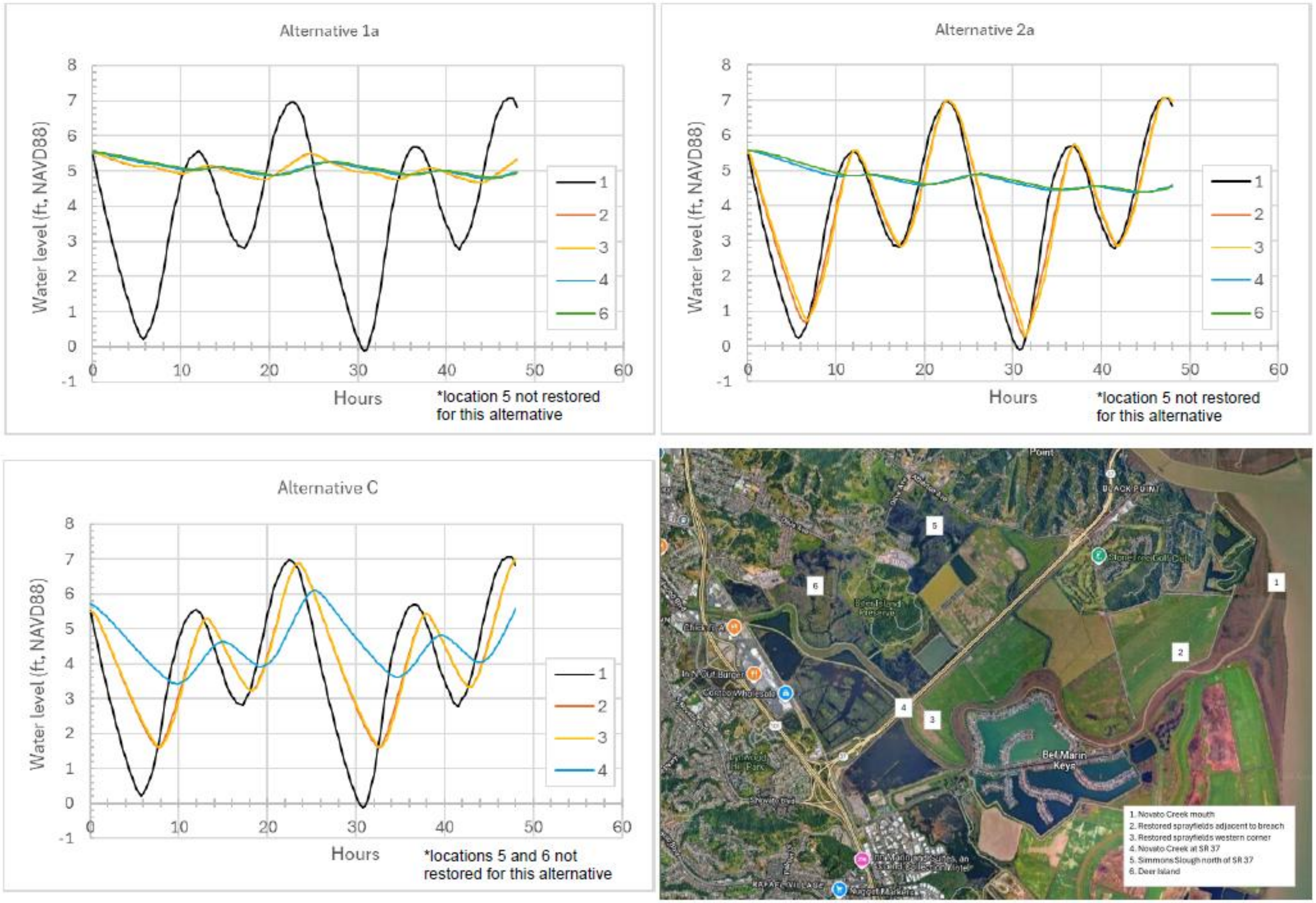

Figure 17. Modeled water levels for Alternatives 1a, 2a, and C for typical tides

Table 9. June 2019 tide ranges at point locations

Alternative	Tide range (ft) at point location							
	1	**2**	**2b**	**3**	**4**	**5**	**6**	**6b**
Baseline	7.2	-	5.0	-	2.6	-	-	2.6
1	7.2	3.0	-	3.0	3.0	3.0	2.9	-
1 (2070)	7.2	3.9	-	3.2	3.2	3.2	3.2	-
2	7.2	3.6	-	3.6	2.9	3.6	3.0	-
1a	7.2	0.9	-	0.8	0.8	-	0.8	-
2a	7.2	6.8	-	6.8	1.2	-	1.2	-
C	7.2	5.4	-	5.4	2.7	-	-	-
C (2070)	7.2	7.2	-	7.1	7.0	-	-	-

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Attachment 1.
Tidal channel hydraulic geometry calculations for Novato Creek Baylands Strategy

Alternatives developed for the Novato Creek Baylands Strategy propose excavation of new tidal channels within the restored baylands, dredging of Novato Creek, and consider geomorphic change within the channels as they evolve over time. This attachment documents the channel sizing calculations used in the Novato Creek Baylands Strategy alternatives and modeling of initial and long-term conditions. The project used hydraulic geometry calculations, i.e. the estimation of channel dimensions as a function of the potential tidal prism draining through each channel, to initially size the channels. Modifications to the channel dimensions were made as needed given other constraints. The channels were then used in the hydraulic modeling (ESA, 2026a) to evaluate flood impacts and the tide range within the restored baylands as well as for excavation cost estimates of the project alternatives (ESA, 2026b).

The following steps were used for the hydraulic geometry calculations. The steps refer to channel segments, essentially particular locations along the length of the channel. Figure 1 shows, for example, select channel segments (numbered) for Alternative 2.

Sizing channels within the restored baylands

For sizing channels within the restored baylands, we used the tidal prism-based hydraulic geometry relationships (Williams et al., 2002).

1. Calculation of potential tidal prism. Approximate tidal watersheds were delineated for the channel segments defining the area draining to each segment. The volume within each watershed between a Mean Lower Low Water (MLLW) of 0.12 ft NAVD88 and a Mean Higher High Water (MHHW) of 6.25 ft NAVD88 (AECOM, 2016) was computed and represented the potential tidal prism for a given channel segment.

2. Channel sizing. Regional San Francisco Bay tidal channel hydraulic geometry equations (Williams et al., 2002) were used to estimate the depth below MHHW, top width at MHHW, and cross-sectional area below MHHW for each channel segment as a function of potential tidal prism. A trapezoid cross section was assumed such that side slopes and a bottom width could be calculated to satisfy the depth, top width, and cross-sectional area dimensions.

3. For 2070 scenarios, marsh accretion modeling by SFEI based on methodologies used in SFEI (2024) was used to estimate the future topographic surfaces of the restored baylands. These accreted surfaces were then used to estimate the potential tidal prism and 2070 channel dimensions.

Sizing for Novato Creek dredging

For sizing the Novato Creek channel, we started with the marsh area-based hydraulic geometry relationships (Williams et al., 2002), which yield smaller channel dimensions than those based on tidal prism, to minimize dredging and associated impacts. Further modifications were made to the dimensions to avoid excavating beyond the existing leveed channel footprint, improve flood performance, improve tidal drainage, and/or reduce impacts to the existing outboard marsh.

1. Calculation of contributing marsh area. Approximate tidal watersheds were delineated for the channel segments defining the area draining to each segment.

2. Channel sizing. Regional San Francisco Bay tidal channel hydraulic geometry equations (Williams et al., 2002) were used to estimate the depth below MHHW, top width at MHHW, and cross-sectional area below MHHW for each channel segment as a function of marsh area. A trapezoid cross section was assumed such that side slopes and a bottom width could be calculated to satisfy the depth, top width, and cross-sectional area dimensions.

3. Adjustments. The initial hydraulic geometry-based channel sizes were adjusted as follows. Note that channel dimensions were iterated throughout the modeling analysis as informed by previous model runs with the alternatives not modeled in numerical order.

    - **Baseline.** No adjustments.

    - **Alternative 1 Multiple Breaches.** In multiple locations along the creek, the distance between the existing Novato Creek levees is less than the hydraulic geometry-based channel width, so the available width between levees was ultimately used. Channel depth was increased to match the hydraulic geometry-based cross-sectional area given the smaller channel width.

    - **Alternative 2 Single Breach.** For this alternative, the dimensions of the dredged Novato Creek downstream of the breach were driven by avoiding flood impacts upstream along Novato Creek. The dredged channel size was iteratively decreased to yield dimensions just large enough to avoid an increase in flood water levels as predicted with the hydraulic modeling with final dimensions smaller than those based on marsh area and tidal prism. Channel depth was capped at 16.3 ft to avoid deepening the thalweg below -10 ft NAVD.

    - **Alternative 1a Multiple Breaches – Near-term**. This alternative does not include any dredging of Novato Creek. Existing channel bathymetry was used.

    - **Alternative 2a Single Breach – Near-term.** Novato Creek dredge dimensions downstream of the breach are larger than those for Alternative 2 to increase the tide range within the restored areas with final dimensions smaller than those based on tidal prism.

    - **Alternative C All Sprayfields -** uses the same Novato Creek dredge dimensions as Alternative 2.

4. Long-term (2070) scenarios. Long-term scenarios were run for the Baseline and Alternatives 1 and C. As with the channels within the restored baylands, future topographic surfaces for the restored areas as modeled by SFEI were used to estimate the potential tidal prism and 2070 channel dimensions along Novato Creek. The channel width wasn’t expanded beyond the available width between the existing levees.

Table 1 provides the channel sizing for Alternative 2 at the numbered locations as an example.

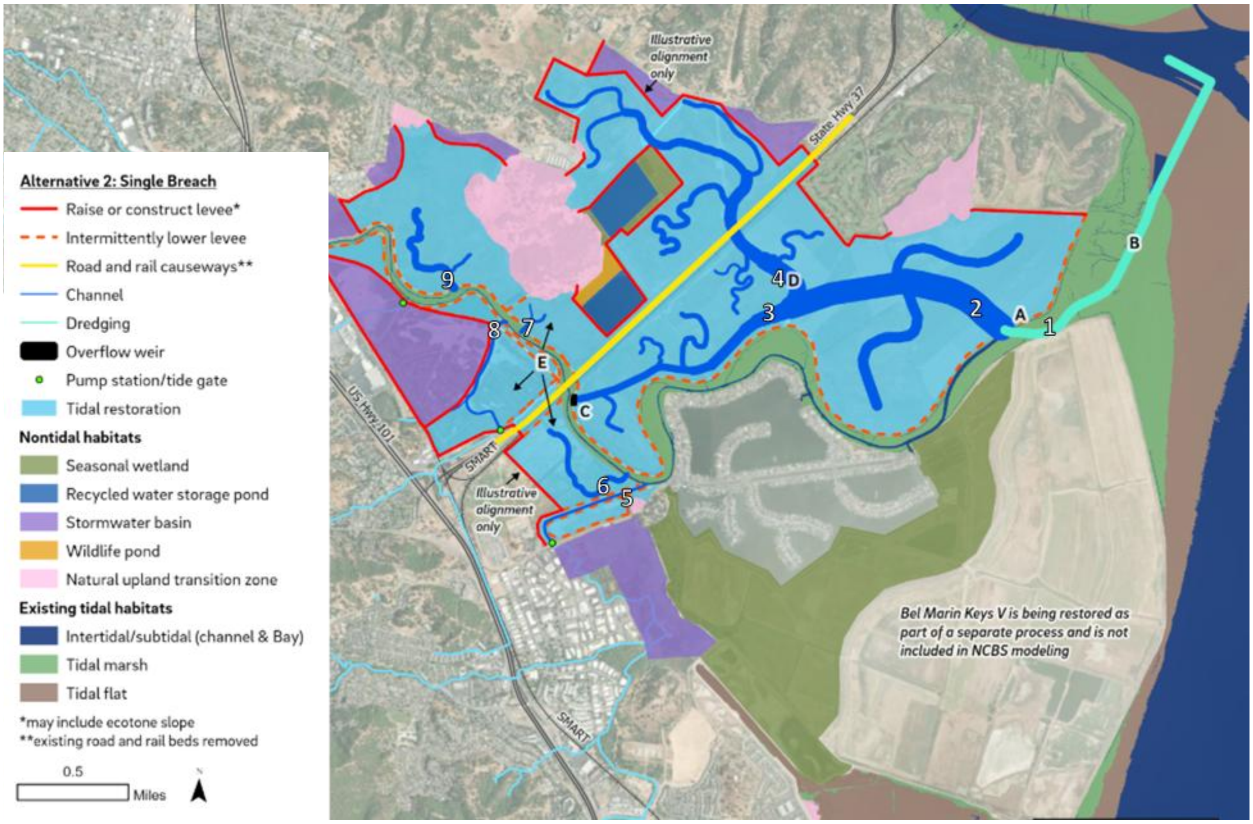

Figure 1. Alternative 2 Single Breach (SFEI, 2026) with numbered channel segments for hydraulic geometry calculations

Table 1. Channel dimensions for Alternative 2 channel segments numbered in Figure 1

Channel segment ID	Potential tidal prism (ac-ft)	Channel dimensions			Notes
		Depth below MHHW (ft)*	*Top width at MHHW (ft)*	*Cross-sectional area below MHHW (ft^2)*	
1	NA	16.3	230	2,608	Marsh area-based, adjusted to avoid flood impacts
2	6,842	21.1	752	9,560	Tidal prism-based
3	1,169	15.4	333	3,036	Tidal prism-based
4	2,753	18.0	494	5,295	Tidal prism-based
5	52	8.9	80	404	Tidal prism-based
6	460	13.1	217	1,657	Tidal prism-based
7	273	12.0	170	1,183	Tidal prism-based
8	143	10.7	127	778	Tidal prism-based
9	839	14.6	286	2,449	Tidal prism-based

*6.25 ft NAVD88

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APPENDIX C
Construction Cost Estimates

Table 1 provides a summary of rough order of magnitude (ROM) construction cost estimates by restoration alternative. The total cost is represented both in 2026 dollars and estimated 2040 dollars to provide an approximation of costs at a potential future construction date. Table 2 displays an estimated cost per acre. Tables 3 - 5 provide itemized details for project elements for the Landscape-Level and Project-Level alternatives, including quantities and unit costs. Construction cost estimates were prepared by ESA based on the conceptual alternatives developed for the project. Costs include a 30% contingency, consistent with Association for the Advancement of Cost Engineering guidance for concept screening cost estimates (AACE 2022).

Costs are shown by category - restoration, flood protection, and dredging - to indicate the relative contribution of these categories towards the overall alternative cost. These categorized costs are also scaled per unit (per CY for dredging, per acre for restoration and flood protection).

- Restoration costs include excavation of inlet channels and channels inside the restored areas, creation of habitat berms, lowering of the existing levee along Novato Creek, seeding graded marsh areas, containment berms for placement of dredged material within the restored area, and pro-rated costs for general and site preparation.
- Flood protection costs include construction of standard and ecotone levees, water control structures, levee-related access improvements (road surfacing), revegetation on levees, and pro-rated costs for general and site preparation.
- Dredging costs include excavation of Novato Creek, placement of dredged material inside the restoration area, and pro-rated costs for general and site preparation.

In addition to the cost of constructed elements shown in the tables, the project will incur 'soft costs' for pre-construction and construction period services. Pre-construction services include design, environmental compliance, and permitting, and are estimated at 4-5% of the construction cost. Construction period services include engineering support, construction management, and biological monitoring, each estimated at 5% of pre-contingency construction costs (total 15%). Construction period services also include vegetation establishment maintenance for planted areas, estimated at 1% of pre-contingency construction costs.

Each estimate also includes a 'potential cost reduction' figure, representing options to streamline restoration features. Specifically, this figure assumes that all levees are constructed as standard levees rather than ecotone levees and that the extent of habitat berms inside the restored area is reduced by 50%. These reductions would result in less vegetated marsh habitat and have implications for wind-wave sheltering and sedimentation.

Additional cost estimate notes are included below:

- The Bird Ponds project is in the baseline alternative and is not included in the with-project cost estimates.
- For the landscape-level alternatives (Table 3), costs for the Deer Island Basin part of the alternative are shown as a standalone item (line 18), since these costs were previously estimated in greater detail for the Deer Island restoration project. The exception is General and Site Preparation costs for Deer Island, which are included in lines 1 – 5.
- Costs exclude any potential remediation of contaminated soils and hazardous building materials on the Black Point Antenna Field parcel. They exclude any potential earthwork required to hydraulically isolate (levee) the Black Point Antenna Field parcel if not remediated.
- Dredging is not included in Alternative 1a Multiple Breaches – Near Term and therefore is not included in the cost estimate. However, dredging would be required for this alternative (See discussion in Chapter 7)
- Sizing of the channels inside the restored areas is based on marsh area hydraulic geometry relationships (see Appendix B, Attachment 1 for a description of hydraulic geometry). While the channel sizes used for the cost estimates are smaller than those used in the modeling, this is not expected to affect flood and drainage performance. Channel sizing and any effects on project performance would be confirmed during subsequent design if the project moves forward.

TABLE 1
ROUGH ORDER OF MAGNITUDE (ROM) CONSTRUCTION COSTS, SUMMARY BY ALTERNATIVE

	Cost by Construction Category, 2026			Total Cost, 2026	Total Cost, 2040
	Restoration Features	Flood Protection Features	Dredging		
Landscape-Scale Alternatives					
1: Multiple Breaches	$16,000,000	$67,000,000	$37,000,000	$120,000,000	$182,000,000
2: Single Breach	$15,000,000	$65,000,000	$17,000,000	$97,000,000	$146,000,000
1a: Multiple Breaches – Near-Term	$12,000,000	$45,000,000	-	$58,000,000	$87,000,000
2a: Single Breach – Near-Term	$13,000,000	$51,000,000	$39,000,000	$103,000,000	$155,000,000
Project-Level Alternatives					
A: Eastern Sprayfields - Limited	$6,000,000	$9,000,000	$13,000,000	$27,000,000	$41,000,000
B: Eastern Sprayfields	$6,000,000	$13,000,000	$13,000,000	$31,000,000	$48,000,000
C: All Sprayfields	$9,000,000	$18,000,000	$13,000,000	$40,000,000	$61,000,000
D: Deer Island	$1,000,000	$26,000,000	$1,581,000	$29,000,000	$44,000,000

Notes:
1. Cost estimates use a 30% contingency to account for project uncertainties.
2. Costs are presented in 2026 prices. The total cost shown for 2040 assumes 3% annual escalation.
3. These estimates are subject to refinement and revisions as the design is developed in future stages of the project.
4. Note that in providing cost estimates, ESA has no control over the actual costs at the time of construction.
5. This cost estimate is based on: ESA's previous experience, bid prices from similar projects, R.S Means (2026) edition. ESA makes no warranty, expressed or implied, as to the accuracy of such estimates as compared to bids or actual costs.

TABLE 2
ROUGH ORDER OF MAGNITUDE (ROM) CONSTRUCTION COSTS, CONSTRUCTION COST EFFICIENCY BY ALTERNATIVE

	Total Cost, 2026	Site Size (acres)	Construction Cost Efficiency			Total Cost per Acre	Potential Cost Reduction
			Restoration Cost per Acre	Flood Protection Cost per Acre	Dredging Cost per CY		
Landscape-Scale Alternatives							
1: Multiple Breaches	$120,000,000	1,751	$9,000	$38,000	$21	$69,000	$4,000,000
2: Single Breach	$97,000,000	1,751	$9,000	$37,000	$24	$55,000	$4,000,000
1a: Multiple Breaches – Near-Term	$58,000,000	1,257	$10,000	$36,000	-	$46,000	$3,000,000
2a: Single Breach – Near-Term	$103,000,000	1,257	$10,000	$40,000	$21	$82,000	$3,000,000
Project-Level Alternatives							
A: Eastern Sprayfields - Limited	$27,000,000	495	$12,000	$17,000	$21	$55,000	$2,000,000
B: Eastern Sprayfields	$31,000,000	575	$10,000	$22,000	$21	$55,000	$2,000,000
C: All Sprayfields	$40,000,000	829	$11,000	$22,000	$21	$49,000	$3,000,000
D: Deer Island	$29,000,000	268	$5,000	$97,000	$20	$109,000	$1,000,000

Notes:

1. Cost estimates use a 30% contingency to account for project uncertainties.
2.Costs are presented in 2026 prices.
3.These estimates are subject to refinement and revisions as the design is developed in future stages of the project.
4.Note that in providing cost estimates, ESA has no control over the actual costs at the time of construction.
5.This cost estimate is based on: ESA's previous experience, bid prices from similar projects, R.S Means (2026) edition. ESA makes no warranty, expressed or implied, as to the accuracy of such estimates as compared to bids or actual costs.

TABLE 3. ROUGH ORDER OF MAGNITUDE (ROM) CONSTRUCTION COST DETAIL, LANDSCAPE-LEVEL ALTERNATIVES

		Quantity						Total Cost			
No	Description	Alt 1. Max Multip	Alt 1a. Int Multip	Alt 2. Max Single	Alt 2a. Int Single	Unit	Unit Cost (2026)	Alt 1. Max Multiple	Alt 2. Max Single	Alt 1a. Int Multiple	Alt 2a. Int Single
GENERAL AND SITE PREP[1]								**$ 13,161,271**	**$ 11,527,033**	**$ 7,881,695**	**$ 10,907,814**
1	Mobilization (excluding Dredging)	1	1	1	1	LS	10% of Subtotal	$ 8,957,591	$ 7,323,353	$ 4,708,258	$ 7,734,377
2	Traffic Control	1	1	1	1	LS		$ 438,435	$ 438,435	$ 329,853	$ 329,853
3	Storm Water Pollution Prevention Compliance	1	1	1	1	LS		$ 1,585,816	$ 1,585,816	$ 1,203,426	$ 1,203,426
4	Demolition and Disposal	1	1	1	1	LS		$ 378,647	$ 378,647	$ 287,137	$ 287,137
5	Environmental Protection Fencing	130,672	93,358	130,672	93,358	LF	$ 12	$ 1,800,782	$ 1,800,782	$ 1,353,021	$ 1,353,021
RESTORATION								**$ 8,271,873**	**$ 8,088,114**	**$ 6,330,531**	**$ 5,970,205**
6	Excavation: Inlet channels							$ 100,000	$ 71,423	$ 100,000	$ 71,423
	General Excavation	3,333	3,333	2,381	2,381	Y	$ 30	$ 100,000	$ 71,423	$ 100,000	$ 71,423
7	Excavation: Interior Channel							$ 1,200,119	$ 2,074,197	$ 789,387	$ 1,681,773
	Topsoil Excavation	66,673	43,855	115,233	93,432	BCY	$ 4	$ 266,693	$ 460,933	$ 175,419	$ 373,727
	General Excavation	155,571	102,328	268,877	218,008	BCY	$ 6	$ 933,426	$ 1,613,265	$ 613,968	$ 1,308,045
8	Excavation and Fill: Habitat Berms							$ 6,238,054	$ 5,220,918	$ 4,849,227	$ 3,645,297
	Topsoil Excavation	245,096	193,154	185,561	125,288	*BCY*	$ 4	$ 980,383	$ 742,243	$ 772,617	$ 501,151
	General Excavation	571,890	450,693	432,975	292,338	*BCY*	$ 5	$ 2,859,449	$ 2,164,875	$ 2,253,465	$ 1,461,689
	Placement	799,408	607,715	771,266	560,819	*CY*	$ 3	$ 2,398,223	$ 2,313,799	$ 1,823,146	$ 1,682,457
9	Levee Lowering							$ 389,286	$ 389,286	$ 330,091	$ 330,091
	Topsoil Excavation	48,114	40,798	48,114	40,798	*BCY*	$ 4	$ 192,456	$ 192,456	$ 163,191	$ 163,191
	General Excavation	39,366	33,380	39,366	33,380	*BCY*	$ 5	$ 196,830	$ 196,830	$ 166,900	$ 166,900
10	Revegetation: Restoration							$ 344,413	$ 332,289	$ 261,826	$ 241,621
	Habitat Berms	39,315	29,888	37,931	27,581	LF	$ 9	$ 344,413	$ 332,289	$ 261,826	$ 241,621
FLOOD PROTECTION								**$ 25,187,609**	**$ 25,187,609**	**$ 14,532,614**	**$ 14,532,614**
11	Levees							$ 18,499,489	$ 18,499,489	$ 9,298,607	$ 9,298,607
	Excavation and Fill: Standard Levee							$ 15,382,056	$ 15,382,056	$ 6,181,174	$ 6,181,174
	Topsoil Excavation	479,920	192,853	479,920	192,853	*BCY*	$ 5	$ 2,399,601	$ 2,399,601	$ 964,263	$ 964,263
	General Excavation	1,119,814	449,989	1,119,814	449,989	*BCY*	$ 5	$ 5,599,068	$ 5,599,068	$ 2,249,947	$ 2,249,947
	Placement	1,230,564	494,494	1,230,564	494,494	*CY*	$ 6	$ 7,383,387	$ 7,383,387	$ 2,966,963	$ 2,966,963
	Excavation and Fill: Ecotone Levee							$ 3,117,433	$ 3,117,433	$ 3,117,433	$ 3,117,433
	Topsoil Excavation	97,264	97,264	97,264	97,264	*BCY*	$ 5	$ 486,320	$ 486,320	$ 486,320	$ 486,320
	General Excavation	226,949	226,949	226,949	226,949	*BCY*	$ 5	$ 1,134,746	$ 1,134,746	$ 1,134,746	$ 1,134,746
	Placement	249,395	249,395	249,395	249,395	*CY*	$ 6	$ 1,496,368	$ 1,496,368	$ 1,496,368	$ 1,496,368
12	Access							$ 134,908	$ 134,908	$ 134,908	$ 134,908
	Class II AB surfacing	10,378	10,378	10,378	10,378	SY	$ 13	$ 134,908	$ 134,908	$ 134,908	$ 134,908
13	Water Control Structures							$ 4,575,000	$ 4,575,000	$ 3,930,000	$ 3,930,000
	Remove pump station	4	3	4	3	LS	$ 500,000	$ 2,000,000	$ 2,000,000	$ 1,500,000	$ 1,500,000
	Relocate pump station	2	2	2	2	LS	$ 1,000,000	$ 2,000,000	$ 2,000,000	$ 2,000,000	$ 2,000,000
	30-inch dia. culvert w/ slide and flap gate	5	2	5	2	LS	$ 115,000	$ 575,000	$ 575,000	$ 230,000	$ 230,000
	Overflow weir	0	1	0	1	LS	$ 200,000	$ -	$ -	$ 200,000	$ 200,000
14	Revegetation: Flood Control							$ 1,978,213	$ 1,978,213	$ 1,169,099	$ 1,169,099
	Standard Levees	32,336	12,994	32,336	12,994	LF	$ 42	$ 1,352,678	$ 1,352,678	$ 543,564	$ 543,564
	Ecotone Levees	5,863	5,863	5,863	5,863	LF	$ 107	$ 625,535	$ 625,535	$ 625,535	$ 625,535
DREDGING								**$ 28,866,756**	**$ 12,708,134**	**$ -**	**$ 30,621,513**
15	Dredging Mobilization	1	-	1	1	EA	$ 521,000	$ 521,000	$ 521,000	$ -	$ 521,000
16	Dredging	1,667,474	-	621,051	1,798,820	CY	$ 15.00	$ 25,012,115	$ 9,315,762	$ -	$ 26,982,294
17	SMHM Vegetation Clearing	56		16	37	AC	$ 11,600	$ 3,333,640	$ 2,871,372	$ -	$ 3,118,220
DEER ISLAND PROJECT SUBTOTAL								**$ 16,822,648**	**$ 16,822,648**	**$ 15,606,439**	**$ 16,822,648**
18	Deer Island Full Basin[1,2]							$ 16,822,648	$ 16,822,648	$ 15,606,439	$ 16,822,648
SUBTOTAL								**$ 92,310,157**	**$ 74,333,538**	**$ 44,351,278**	**$ 78,854,794**
	Contingency - 30%							$ 27,693,047	$ 22,300,061	$ 13,305,383	$ 23,656,438
TOTAL CONSTRUCTION COSTS								**$ 120,003,204**	**$ 96,633,599**	**$ 57,656,662**	**$ 102,511,232**

[1] Deer Island Full Basin General Costs are included within the General Costs for the overall alternative.

[2] Dredging of Novato Creek at Deer Island Basin is removed from Alternative 1a to match the downstream dredging approach for this alternative.

TABLE 4. ROUGH ORDER OF MAGNITUDE (ROM) CONSTRUCTION COST DETAIL, PROJECT-LEVEL ALTERNATIVES

		Quantity						Total Cost			
No	Description	Alt A. Sprayfields East Limited	Alt B. Sprayfields East	Alt C. All Sprayfields	Alt D. Deer Island[1]	Unit	Unit Cost (2026)	Alt A. Sprayfields East Limited	Alt B. Sprayfields East	Alt C. All Sprayfields	Alt D. Deer Island[1]
GENERAL AND SITE PREP								**$ 2,947,573**	**$ 3,404,178**	**$ 4,550,086**	**$ 5,590,186**
1	Mobilization (excluding Dredging)	1	1	1		LS	10% of Subtotal	$ 1,910,731	$ 2,199,766	$ 2,813,637	
2	Traffic Control	1	1	1		LS		$ 107,496	$ 124,869	$ 180,029	
3	Storm Water Pollution Prevention Compliance	1	1	1		LS		$ 378,566	$ 439,748	$ 634,003	
4	Demolition and Disposal	1	1	1		LS		$ 107,496	$ 124,869	$ 180,029	
5	Environmental Protection Fencing	36,940	42,910	61,866		LF	$ 12	$ 443,284	$ 514,925	$ 742,388	
RESTORATION								**$ 3,234,354**	**$ 3,415,980**	**$ 5,529,361**	**$ 825,509**
6	Inlet channels							$ 54,757	$ 54,757	$ 54,757	$ 708,641
	All Material Excavation	1,825	1,825	1,825		*Y*	$ 30	$ 54,757	$ 54,757	$ 54,757	$ -
7	Interior Channel							$ 1,201,525	$ 1,204,146	$ 1,563,984	$ 23,840
	Topsoil Excavation	66,751	66,897	86,888		*BCY*	$ 4	$ 267,005	$ 267,588	$ 347,552	$ -
	General Excavation	155,753	156,093	202,739		*BCY*	$ 6	$ 934,519	$ 936,558	$ 1,216,432	$ -
8	Habitat Berms							$ 1,744,344	$ 1,913,321	$ 3,479,765	$ 59,112
	Topsoil Excavation	52,694	59,880	120,356		*BCY*	$ 4	$ 210,775	$ 239,519	$ 481,425	$ -
	General Excavation	122,952	139,719	280,831		*BCY*	$ 5	$ 614,760	$ 698,597	$ 1,404,155	$ -
	Placement	306,270	325,069	531,395		*CY*	$ 3	$ 918,809	$ 975,206	$ 1,594,186	$ -
9	Levee Lowering							$ 101,776	$ 103,705	$ 201,911	$ 33,917
	Topsoil Excavation	12,579	12,817	24,955		*BCY*	$ 4	$ 50,316	$ 51,270	$ 99,821	$ -
	General Excavation	10,292	10,487	20,418		*BCY*	$ 5	$ 51,460	$ 52,435	$ 102,090	$ -
10	Revegetation: Restoration							$ 131,952	$ 140,051	$ 228,944	$ -
	Habitat Berms	15,062	15,987	26,134		LF	$ 9	$ 131,952	$ 140,051	$ 228,944	$ -
FLOOD PROTECTION								**$ 4,817,794**	**$ 7,358,948**	**$ 10,852,246**	**$ 14,780,929**
11	Levees							$ 3,115,081	$ 5,283,790	$ 6,472,551	$ 9,672,335
	Excavation and Fill: Standard Levee							$ 1,103,611	$ 2,107,326	$ 3,296,087	$ 1,780,768
	Topsoil Excavation	34,433	65,749	102,838		*BCY*	$ 5	$ 172,163	$ 328,743	$ 514,190	$ -
	General Excavation	80,343	153,413	239,955		*BCY*	$ 5	$ 401,714	$ 767,067	$ 1,199,776	$ -
	Placement	88,289	168,586	263,687		*CY*	$ 6	$ 529,733	$ 1,011,517	$ 1,582,122	$ -
	Excavation and Fill: Ecotone Levee							$ 2,011,470	$ 3,176,464	$ 3,176,464	$ 7,891,568
	Topsoil Excavation	62,758	99,106	99,106		*BCY*	$ 5	$ 313,789	$ 495,528	$ 495,528	$ -
	General Excavation	146,435	231,247	231,247		*BCY*	$ 5	$ 732,175	$ 1,156,233	$ 1,156,233	$ -
	Placement	160,918	254,117	254,117		*CY*	$ 6	$ 965,506	$ 1,524,703	$ 1,524,703	$ -
12	Access							$ 87,047	$ 137,462	$ 137,462	$ 2,335,373
	Class II AB surfacing	6,696	10,574	10,574		SY	$ 13	$ 87,047	$ 137,462	$ 137,462	$ -
13	Water Control Structures							$ 1,115,000	$ 1,115,000	$ 3,315,000	$ 1,117,954
	Remove pump station	0	0	0		LS	$ 500,000	$ -	$ -	$ -	$ -
	Relocate pump station	1	1	3		LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 3,000,000	$ -
	30-inch dia. culvert w/ slide and flap gate	1	1	1		LS	$ 115,000	$ 115,000	$ 115,000	$ 115,000	$ -
	Overflow weir	0	0	1		LS	$ 200,000	$ -	$ -	$ 200,000	$ -
14	Revegetation: Flood Control							$ 97,050	$ 185,316	$ 289,854	$ 1,655,267
	Standard Levees	2,320	4,430	6,929		LF	$ 42	$ 97,050	$ 185,316	$ 289,854	$ -
	Ecotone Levees	3,783	5,974	5,974		LF	$ 107	$ 403,616	$ 637,380	$ 637,380	$ -
DREDGING								**$ 10,018,318**	**$ 10,018,318**	**$ 10,018,318**	**$ 1,216,209**
15	Dredging Mobilization	1	1	1		EA	$ 521,000	$ 521,000	$ 521,000	$ 521,000	
16	Dredging	621,051	621,051	621,051		BCY	$ 15	$ 9,315,762	$ 9,315,762	$ 9,315,762	
17	SMHM Vegetation Clearing	16	16	16		AC	$ 11,600	$ 181,557	$ 181,557	$ 181,557	
SUBTOTAL								**$ 21,018,038**	**$ 24,197,424**	**$ 30,950,012**	**$ 22,412,833**
	Contingency - 30%							$ 6,305,412	$ 7,259,227	$ 9,285,003	$ 6,723,850
TOTAL CONSTRUCTION COSTS								**$ 27,323,450**	**$ 31,456,651**	**$ 40,235,015**	**$ 29,136,683**

[1] For Alt D. Deer Island see Table 5 for detailed quantities and costs.

TABLE 5
ROUGH ORDER OF MAGNITUDE (ROM) CONSTRUCTION COST DETAIL, ALTERNATIVE D: DEER ISLAND

No.	Description	Quantity	Unit	Unit Cost (2026)	Total (2026 dollars)
General and Site Preparation					**$ 5,590,186**
	Mobilization (10% of Construction Costs)	*1*	*LS*	$ 2,238,867	$ 2,304,600
	Traffic Control	*1*	*LS*	$ 58,181	$ 58,181
	SWPPP Compliance	*1*	*LS*	$ 246,686	$ 246,686
	SMHM Vegetation Clearing	*100*	*Acres*	$ 26,898	$ 2,689,816
	Temporary Environmental Protection Fence	*20,000*	*LF*	$ 12	$ 232,723
Earthwork					**$ 10,497,845**
	Interior Channel Excavation				*$ 23,840*
	general - excavation & haul	*1,576*	*CY*	$ 15	*$ 23,840*
Novato Creek Excavation					**$ 1,216,209**
	side channel excavation	*24,800*	*CY*	$ 15	*$ 375,149*
	channel widening excavation	*55,600*	*CY*	$ 15	*$ 841,060*
	Novato Creek Levee Excavation				$ 33,917
	general - excavation & haul	*2,429*	*CY*	$ 14	*$ 33,917*
	Fill Area Subgrade Excavation				$ 51,199
	general - excavation	*4,400*	*CY*	$ 12	*$ 51,199*
	Deer Island Basin Habitat Berm Fill				*$ 7,913*
	Berm - place material excavated from channel	*3,400*	*CY*	$ 2	*$ 7,913*
	Deer Island Basin Perimeter Ecotone Levee Fill				$ 6,144,907
	general - excavation & haul - interior channel cut for levee fill	*305,630*	*CY*	$ 15	*$ 4,623,258*
	Levee Core - surface prep, spreading, moisture conditioning, compaction	*153,500*	*CY*	$ 7	*$ 1,071,688*
	Ecotone Slopes - surface prep, spreading, moisture conditioning, compaction	*81,600*	*CY*	$ 5	*$ 379,803*
	Drying (weekly discing over 16 weeks)	*942*	*MSF*	$ 74	*$ 70,157*
	NSD and Corp Yard Ecotone Levee Fill				$ 710,248
	general - excavation & haul - novato levee cut for levee fill	*25,480*	*CY*	$ 14	*$ 355,787*
	Levee Core - surface prep, spreading, moisture conditioning, compaction	*18,800*	*CY*	$ 7	*$ 131,256*
	Ecotone Slopes - surface prep, spreading, moisture conditioning, compaction	*800*	*CY*	$ 5	*$ 3,724*
	Drying (weekly discing over 16 weeks)	*253*	*MSF*	$ 74	*$ 18,876*
	Subsurface seepage layer - drain layer, sand filter, filter fabric	*640*	*CY*	$ 128	*$ 81,918*
	Irrigation piping & distribution - 4" main & distribution lines & turn outs	*600*	*LF*	$ 198	*$ 118,689*
	West Basin Ecotone Levee Fill				$ 1,036,412
	general - excavation & haul - subrade cut for levee fill	*45,760*	*CY*	$ 12	*$ 532,470*
	Levee Core - surface prep, spreading, moisture conditioning, compaction	*26,800*	*CY*	$ 7	*$ 187,109*
	Ecotone Slopes - surface prep, spreading, moisture conditioning, compaction	*8,400*	*CY*	$ 5	*$ 39,097*
	Drying (weekly discing over 16 weeks)	*126*	*MSF*	$ 74	*$ 9,407*
	Subsurface seepage layer - drain layer, sand filter, filter fabric	*860*	*CY*	$ 128	*$ 110,078*
	Irrigation piping & distribution - 4" main & distribution lines & turn outs	*800*	*LF*	$ 198	*$ 158,251*
	Farmers Basin Levee Fill				$ 1,698,849
	general - excavation & haul - novato levee cut for levee fill	*45,591*	*CY*	$ 14	*$ 636,604*
	general - excavation & haul - interior channel cut for levee fill	*30,394*	*CY*	$ 15	*$ 459,769*
	general - excavation & haul - farmer's berm cut for levee fill	*4,600*	*CY*	$ 9	*$ 42,821*
	general - excavation & haul - novato channel widening for levee fill	*-*	*CY*	$ 15	*$ -*
	Levee Core - surface prep, spreading, moisture conditioning, compaction	*71,200*	*CY*	$ 7	*$ 497,096*
	Ecotone Slopes - surface prep, spreading, moisture conditioning, compaction	*12,300*	*CY*	$ 5	*$ 57,250*
	Drying (weekly discing over 16 weeks)	*71*	*MSF*	$ 74	*$ 5,310*
	Slade Park Berm Fill				*$ 60,042*
	general - excavation & haul - subrade cut for levee fill	*3,640*	*CY*	$ 12	*$ 42,356*
	Berm Core - surface prep, spreading, moisture conditioning, compaction	*2,000*	*CY*	$ 7	*$ 13,963*
	Ecotone Slopes - surface prep, spreading, moisture conditioning, compaction	*800*	*CY*	$ 5	*$ 3,724*
	Louis Drive Berm Fill				*$ 21,876*
	general - excavation & haul - subrade cut for levee fill	*1,300*	*CY*	$ 12	*$ 15,127*
	Berm Core - surface prep, spreading, moisture conditioning, compaction	*900*	*CY*	$ 7	*$ 6,284*
	Ecotone Slopes - surface prep, spreading, moisture conditioning, compaction	*100*	*CY*	$ 5	*$ 465*
	Levee Breaches and Breach Channels				*$ 708,641*
	excavation & haul	*20,300*	*CY*	$ 35	*$ 708,641*

TABLE 5 (CONTINUED)
ROUGH ORDER OF MAGNITUDE (ROM) CONSTRUCTION COST DETAIL, ALTERNATIVE D: DEER ISLAND

No.	Description	Quantity	Unit	Unit Cost (2026)	Total (2026 dollars)
Water Control Structures					**$ 1,117,954**
	Lea Drive Basin (30-inch dia)				*$ 125,856*
	headwall	*2*	*EA*	$ 43,985	*$ 87,969*
	pipe	*230*	*LF*	$ 74	*$ 17,128*
	slide gate	*1*	*EA*	$ 12,614	*$ 12,614*
	flap gate	*1*	*EA*	$ 8,145	*$ 8,145*
	Olive Ave Basin (30-inch dia)				*$ 125,822*
	headwall	*2*	*EA*	$ 43,985	*$ 87,969*
	pipe	*230*	*LF*	$ 74	*$ 17,128*
	slide gate	*1*	*EA*	$ 12,614	*$ 12,614*
	flap gate	*1*	*EA*	$ 8,111	*$ 8,111*
	Lewis Drive (18-inch dia)				*$ 49,267*
	headwall	*2*	*EA*	$ 16,523	*$ 33,047*
	culvert	*70*	*LF*	$ 37	*$ 2,606*
	slide gate	*1*	*EA*	$ 8,960	*$ 8,960*
	flap gate	*1*	*EA*	$ 4,654	*$ 4,654*
	West Basin (30-inch dia)				*$ 114,651*
	headwall	*2*	*EA*	$ 43,985	*$ 87,969*
	culvert	*80*	*LF*	$ 74	*$ 5,958*
	slide gate	*1*	*EA*	$ 12,614	*$ 12,614*
	flap gate	*1*	*EA*	$ 8,111	*$ 8,111*
	Select NSD Upgrades				
	12-inch Force Main			$ -	$ 392,836
	12-inch Force Main	*1*	*EA*	$ 392,836	*$ 392,836*
	6-inch Sludge Line			$ -	$ 309,521
	6-inch Sludge Line	*1*	*EA*	$ 309,521	*$ 309,521*
Access					**$ 2,335,373**
Revegetation					**$ 1,655,267**
	Tidal Wetland (5.0 to 6.5 ft)	*12.48*	*Acres*	$ 5,236	$ 65,349
	Ecotone/Transitional (6.5 to 11.5 ft)	*21.63*	*Acres*	$ 37,701	$ 815,474
	Upland (> 11.5 ft)	*8.23*	*Acres*	$ 2,909	$ 23,941
	Temporary Irrigation	*29.86*	*Acres*	$ 25,134	$ 750,503
SUBTOTAL BID ITEMS					**$ 22,412,833**
	Contingency - 30%				$ 6,723,850
TOTAL CONSTRUCTION COST					**$ 29,136,683**

References

AACE International. (2022). Professional guidance document No. 01: Guide to cost estimate classification systems. https://library.aacei.org/pgd01/pgd01.shtml

APPENDIX D

Mitigation Credit Agreements

CDFW's RCIS Program was developed to address the growing need to have regional, ecosystem-based approaches to species protection and recovery. An RCIS is a voluntary, non-binding, nonregulatory regional plan for species and habitat conservation that identifies goals, objectives, priorities, and actions that can be implemented to guide conservation. A key function of the RCIS Program is to enable the development of Mitigation Credit Agreements (MCAs) with CDFW and, as appropriate, other regulatory agencies. MCAs allow project proponents to fulfill mitigation requirements in advance of project impacts.

RCIS Framework and Conservation Strategy

Central to an RCIS is a conservation strategy organized around focal species and other conservation elements, such as habitats and ecological processes). Each focal species and other conservation element has a specific conservation strategy with goals, measurable objectives, and habitat enhancement and conservation actions. Priority actions and, where applicable, key geographic areas for implementation are identified. Habitat enhancement or conservation actions implemented under an approved RCIS may be developed in collaboration with CDFW into an MCA.

MCAs can be used to generate mitigation credits that can be used to fulfill compensatory mitigation requirements for impacts to species' habitat and other natural resources. MCAs are intended to support larger-scale, more coordinated conservation outcomes than traditional project-by-project mitigation. This approach is designed to maximize biodiversity, ecological function, and climate resilience benefits of public and private conservation and mitigation investments.

In addition to focal species, RCISs identify non-focal species— that share ecological requirements with focal species or other conservation elements and are expected to benefit from implementation of associated actions. Non-focal species are eligible for MCA credit generation when conservation actions are implemented for their associated focal species or other conservation elements.

MCA Program Flexibility and Eligible RCIS action

The MCA Program is designed as a flexible advance crediting mitigation mechanism that can address habitat and species impacts from one or multiple infrastructure, development, or other projects. Because each MCA is tied to one or more specific RCIS actions, MCA implementation contributes directly to regional conservation, climate adaptation, and species and habitat recovery goals. Conservation, restoration, and enhancement actions identified in the RCIS may be implemented in advance of a project, enabling earlier action and larger scale conservation outcomes.

MCAs may be used to mitigate both permanent and non-permanent project impacts, including impacts with a defined duration such as temporary impacts. MCAs may also generate mitigation credit for enhancement and connectivity actions, such as wildlife crossings, and actions implemented on public lands, which are not typically available under other regulatory mitigation mechanisms.

Regional Mitigation Credit Demand

A variety of project sectors are driving the near-term need for mitigation in the San Francisco Bay region. The need for tidal wetland mitigation because of impacts from sea level rise adaptation projects is expected to increase substantially in the coming years. Sea level rise poses a growing threat to transportation and other critical infrastructure along the San Francisco Bay shoreline, prompting transportation and water districts, cities, and counties to increase the resilience of their coastal assets to climate change. Senate Bill 272 has mandated that all municipalities that have shoreline on the San Francisco Bay prepare Regional Shoreline Adaptation Plans, which is anticipated to accelerate the pace of adaptation projects, and, in turn, increase mitigation demand. Given the currently limited available mitigation and conservation banks in the region, project proponents are actively seeking new mitigation opportunities, such as those that could be provided through a Novato Creek Baylands MCA. Advance mitigation through MCAs provides a proactive and strategic mechanism to address cumulative habitat and species effects associated with adaptation projects.

In addition to shoreline adaptation planning, other large, but intermittent infrastructure projects with substantial wetland and species impacts are expected to create periodic surges in mitigation demand. Portions of State Route 37 and US 101 will become increasingly vulnerable to flooding as sea levels rise. Inevitably, projects designed to address these vulnerabilities will result in impacts to adjacent tidal habitats and associated species, further reinforcing the need for available mitigation options. Over the longer term, full implementation of Resilient 37 (30- to 50-year planning horizon), along with other Caltrans transportation projects, will require additional mitigation capacity. Collectively, these near- and long-term drivers indicate sustained regional demand for tidal wetland and tidal species credits.

Development of Mitigation Credit Agreements

MCAs can be used to fulfill mitigation requirements of the California Environmental Quality Act (CEQA), California Endangered Species Act (CESA), and the Lake and Streambed Alteration Program. Other federal, state, and local regulatory resource agencies may integrate the MCA process with their own regulatory processes to authorize advance mitigation implemented through an MCA. The requirements for developing MCAs are provided in California Fish and Game Code Section 1856(f-g) and described as part of CDFW's RCIS Program.

Unlike traditional mitigation banking, the RCIS Program allows for the development of an MCA framework. An MCA framework is an advance mitigation planning tool that is reviewed and approved by CDFW prior to submittal of a project-specific MCA package. This framework approach may be used when an MCA sponsor intends to create mitigation credits across multiple future sites, when the precise location of future actions is not yet known, and/or when the specific conservation or enhancement actions have not been fully defined.

A framework enables CDFW to review and approve core MCA components in advance and to confirm alignment with RCIS conservation objectives and MCA guidelines, while maintaining flexibility for future implementation. This approach allows for regulatory certainty without narrowly constraining the project proponent to specific sites or action(s).

Mitigation Credit Agreement Opportunities in the Novato Creek Baylands

The Strategy alternatives are summarized below, and include the NBB RCIS actions that could be developed into an MCA, as well as the species and habitats benefited. The Strategy Area was identified as a conservation priority to:

- Enhance and restore sediment supply, including connections to upland watersheds
- Accelerate conservation and restoration of habitats as identified in the Novato Creek Baylands Vision

- Acquire and conserve transition zone land and adjacent uplands that are located near present or future marshes, or are located along or near the historic Baylands margin
- Focus on protecting, enhancing, and restoring parcels in and adjacent to waterways designated by NMFS as supporting or potentially supporting spawning populations (i.e., Novato Creek)
- Increase quality and physical extent of estuarine habitat at Novato Creek Marsh
- Remove levees and reconnect lower Novato Creek to adjacent baylands

The Novato Creek Baylands Strategy alternatives each include actions identified in the NBB RCIS conservation strategy. There are several NBB RCIS actions that apply to the Project-level and Landscape-level alternatives (Tables 10.2 and 10.3). Additional actions related to monitoring, scientific studies, and on-going management could be included to increase the amount of ecological uplift from the project to species. All actions, both the on-the-ground implementation and associated management, would be included as part of future project designs so would not require a large planning effort on the part of an MCA sponsor to be developed into an MCA agreement.

The following RCIS focal and non-focal species have the potential to benefit from implementation of RCIS actions:

- Steelhead—central California coast DPS
- California black rail
- California Ridgway’s rail
- Saltmarsh common yellowthroat
- San Pablo song sparrow
- Salt marsh harvest mouse
- Soft bird’s beak

Tidal wetlands are included as a focal other conservation element in the RCIS and could be included in an MCA.

Table 10.2. NBB RCIS Actions with Potential to be Included in an MCA for Landscape-level Alternatives.

NBB RCIS Action[1]	**Base-line**	**Alt. 1**	**Alt. 2**	**Alt. 1a**	**Alt. 2a**
RL1.2.1: Removing barriers that disrupt sediment transport, hydrological processes, and/or fish, wildlife, and habitat migration and movement.	X	X	X	X	X
RL 1.2.2: Control non-native invasive species.	X	X	X	X	X
RL 1.2.3: Manage current and future anthropogenic impacts.	X	X	X	X	X
RL 1.2.6: Restore and enhance landscapes to prepare for rising sea levels.	X	X	X	X	X
WATER 1.1.2: Increase/restore fluvial connectivity and improve water exchange, temperature profiles, and dissolved oxygen concentrations.	X	X	X	X	X
WATER 1.1.3: Enhance and restore historical connections of major perennial tributaries.	X	X	X	X	X
TIDE 1.1.1: Manage flood control infrastructure to reduce impacts and increate climate resilience of tidal habitats	X	X	X	X	X
TIDE 1.1.2: Modify/remove dikes and/or levees that hinder normal circulation of tidal flows.	X	X	X	X	X
TIDE 1.2.1: Include a variety of depths and focus on connecting suitable habitat through restoration of parcels to create large blocks of suitable habitat. Focus on baylands of Novato Creek.		X	X	X	X
TIDE 1.2.3: Transition from diked wetlands to restored or enhanced tidal marsh habitat.		X	X	X	X
TIDE 1.2.4: Address habitat fragmentation through restoration designs.		X	X	X	X
TIDE 1.2.5: Reconnect major tributaries and watersheds to downstream extant tidal wetlands.		X	X	X	X
TIDE 1.2.7: Restore the natural transition zone.		X	X	X	X
TIDE 1.2.8: Create ecotone transition habitats.	X	X	X	X	X
HYDRO 1.1.1: Restore stream hydrology to supply sediment to baylands.		X	X	X	X
HYDRO 1.1.2: Implement regional sediment management strategies.		X	X	X	X
HYDRO 1.1.4 – Manage fringing marshes to sustain high marsh through sediment processes.		X	X	X	X
HC 1.1.2: Create habitat transitions between aquatic and upland systems.		X	X	X	X
HC 1.1.3: Remove levees and barriers to restore tidal and fluvial connectivity.		X	X	X	X

NBB RCIS Action[1]	Base-line	Alt. 1	Alt. 2	Alt. 1a	Alt. 2a
BLRA 1.1 and RIRA 1.1: Protect and restore high marsh and ecotonal habitat for tidal marsh birds.		X	X	X	X
STEEL 1.2.1: Improve floodplain connectivity.	X	X	X	X	X
STEEL 1.2.3: Enhance quality of habitat at mouth of tributary waterways to promote migration upstream.		X	X	X	X
SMHM 1.2.3: Manage tidal marsh habitat for preferred salt marsh harvest mouse habitat conditions.		X	X	X	X
TW 1.2.5: Include interior tidal ponds suitable for widgeon grass and pond weed in restoration designs.	X	X	X	X	X
BIRD 1.2.2: Reconstruct suitable barren to sparsely vegetated roosting sites above high tide.		X	X	X	X
BIRD 1.2.3: Include a diverse mix of tidal pans and ponds in marsh plains restoration to provide for high tide roosting and foraging areas.		X	X	X	X
BIRD 1.2.5: Enhance or create managed marsh or seasonal pond habitat.				X	X

Table 10.3. NBB RCIS Actions with Potential to be Included in an MCA for Landscape-level Alternatives.

NBB RCIS Action[1]	Eastern Sprayfields - Limited	Eastern Sprayfields	All Sprayfields	Deer Island
RL1.2.1: Removing barriers that disrupt sediment transport, hydrological processes, and/or fish, wildlife, and habitat migration and movement.	X	X	X	X
RL 1.2.2: Control non-native invasive species.	X	X	X	X
RL 1.2.3: Manage current and future anthropogenic impacts.	X	X	X	X
RL 1.2.6: Restore and enhance landscapes to prepare for rising sea levels.	X	X	X	X
WATER 1.1.2: Increase/restore fluvial connectivity and improve water exchange, temperature profiles, and dissolved oxygen concentrations.	X	X	X	X
WATER 1.1.3: Enhance and restore historical connections of major perennial tributaries.	X	X	X	X
TIDE 1.1.2: Modify/remove dikes and/or levees that hinder normal circulation of tidal flows.	X	X	X	X
TIDE 1.1.1: Manage flood control infrastructure to reduce impacts and increate climate resilience of tidal habitats	X	X	X	X
TIDE 1.2.1: Include a variety of depths and focus on connecting suitable habitat through restoration of parcels to create large blocks of suitable habitat. Focus on baylands of Novato Creek.	X	X	X	X
TIDE 1.2.3: Transition from diked wetlands to restored or enhanced tidal marsh habitat.				X
TIDE 1.2.4: Address habitat fragmentation through restoration designs.	X	X	X	X
TIDE 1.2.5: Reconnect major tributaries and watersheds to downstream extant tidal wetlands.	X	X	X	X
TIDE 1.2.7: Restore the natural transition zone.	X	X	X	X
TIDE 1.2.8: Create ecotone transition habitats.	X	X	X	X
HYDRO 1.1.1: Restore stream hydrology to supply sediment to baylands.	X	X	X	X
HYDRO 1.1.2: Implement regional sediment management strategies.	X	X	X	X

NBB RCIS Action[1]	**Eastern Sprayfields - Limited**	**Eastern Sprayfields**	**All Sprayfields**	**Deer Island**
HYDRO 1.1.4 – Manage fringing marshes to sustain high marsh through sediment processes.	X	X	X	X
HC 1.1.2: Create habitat transitions between aquatic and upland systems.	X	X	X	X
HC 1.1.3: Remove levees and barriers to restore tidal and fluvial connectivity.	X	X	X	X
BLRA 1.1 and RIRA 1.1: Protect and restore high marsh and ecotonal habitat for tidal marsh birds.	X	X	X	X
STEEL 1.2.1: Improve floodplain connectivity.	X	X	X	X
STEEL 1.2.3: Enhance quality of habitat at mouth of tributary waterways to promote migration upstream.	X	X	X	X
SMHM 1.2.3: Manage tidal marsh habitat for preferred salt marsh harvest mouse habitat conditions.	X	X	X	X
TW 1.2.5: Include interior tidal ponds suitable for widgeon grass and pond weed in restoration designs.	X	X	X	X
BIRD 1.2.2: Reconstruct suitable barren to sparsely vegetated roosting sites above high tide.	X	X	X	X
BIRD 1.2.3: Include a diverse mix of tidal pans and ponds in marsh plains restoration to provide for high tide roosting and foraging areas.	X	X	X	X
Note: 1. Action text has been summarized. The full text of actions can be found in Chapter 4 of the NBB RCIS.				