

Bolinas Lagoon North End Restoration Project

Draft Conceptual Design Alternatives

Bolinas Lagoon Advisory Council Meeting

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Consulting, Peter Baye Consulting



Overview of the Project

- Project is at North End of Bolinas Lagoon
 - Uplands, streams, roads, fringing marsh, & lagoon
- Existing issues with roadway flooding
 - Expected to worsen with sea-level rise (SLR)
- Degraded stream corridors and riparian areas
- Roadway safety concerns

Overview of Goals

- Connecting streams and riparian corridors to lagoon
 - Involves changes to roadways and/or water & sediment conveyance
- Habitat enhancement for fish and wildlife
- Restore natural processes and systems
- Reduce current flooding problems
- Adapt to Sea Level Rise
- Improve road safety

Unique Project Characteristics

- Not a typical 'restoration' project
 - Existing conditions highly modified
 - Rehabilitation of stream-lagoon interface
 - Climate adaptation
 - Emphasis on natural systems and functions
- Reduce current & future flooding
- Enhance streams, riparian areas, and marsh
- Reduce maintenance dredging and disturbance

Our Task 1 Scope

- Existing Conditions Studies
 - Set of field, desktop, and literature surveys
 - Each with a technical memorandum
 - Topic-specific information
 - Assessment of possible future studies and data needs
 - Rolled together into integrative Site Conditions Report
- Final Site Conditions Report was submitted to MCP in June

Our Task 2 Scope

- Alternatives Development and Analysis
 - Driven by results of the Task 1 Site Conditions Report
 - Bundle preliminary concepts into alternatives
 - Based on Partner Agency and BLAC input
- Conceptual designs
 - **Draft Designs: Where we are now**
 - Opportunities & constraints analysis
 - Cost estimates
 - Final Designs and Report

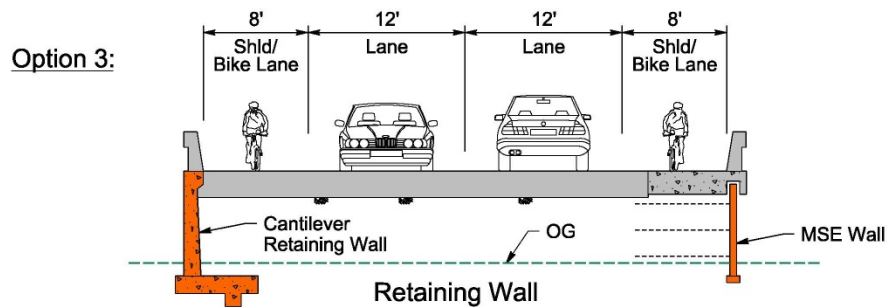
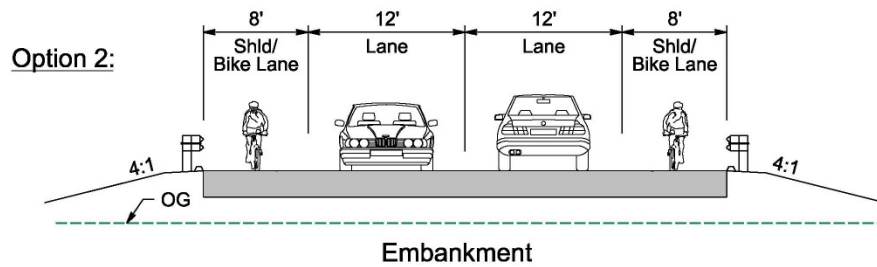
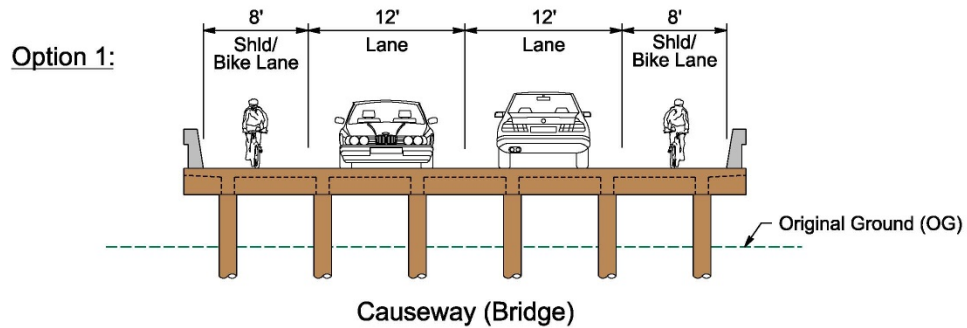
Potential Roadway Modifications

Types of changes:

- Causeways and Bridges
- Raised roadway on fill/ embankments with culverts
- Retaining walls
- Roadway relocation

Baseline understanding:

- Diff't roadway changes **enable** diff't restoration options
- Removing crossover road is okay from a traffic perspective
- ***All objectives have constraints***



Typical Sections for Hwy 1 or Olema-Bolinas Rd



**Bolinas Lagoon
North End Restoration Project**

Meeting with Partners

- Marin County Parks (MCP), AECOM, GFNMS, and Caltrans met on July 7, 2016 to discuss preliminary draft alternatives
- MCP, AECOM, GGNRA, and Watershed Sciences met on August 23, 2016 to discuss preliminary draft alternatives
- Caltrans are a new member of the project team
- Important to not put any fill in the lagoon unless it can be proven a net benefit to the Sanctuary

Alternative 1: “Wish List of Options”

- Under this alternative Wilkins and Lewis Gulch Creeks would be returned to their alluvial fans, reconnecting at the heads of their fans.
- The former relic channels would be excavated and the existing primary channel would be filled.
- Highway One would be elevated onto a causeway in three sections, and the driveway to Wilkins Ranch would be relocated.
- Fairfax-Bolinas Road optionally relocated
- Both channels would have natural alluvial fan reactivation (Option C: main channel for fish passage constructed).

Alternative 1

Draft Conceptual
Not to Scale

Key

Phase 1

- Crossover Road Removed
- Reconfigure Intersection

Phase 2

- Reactivate LGC Alluvial Fan
- Install Vegetated Berm (LGC)
- Remove Culvert
- Add Bridge/Causeway
- Raise Roadway
- Decommission Rd
- New Driveway (A or B)
- LGC Floodplain Grading
- Subsurface Water Flow
- Primary Stream Channel
- Vegetated Shoreline/
Soft Erosion Protection
- Upgrade/Add F-B Culvert

Phase 3

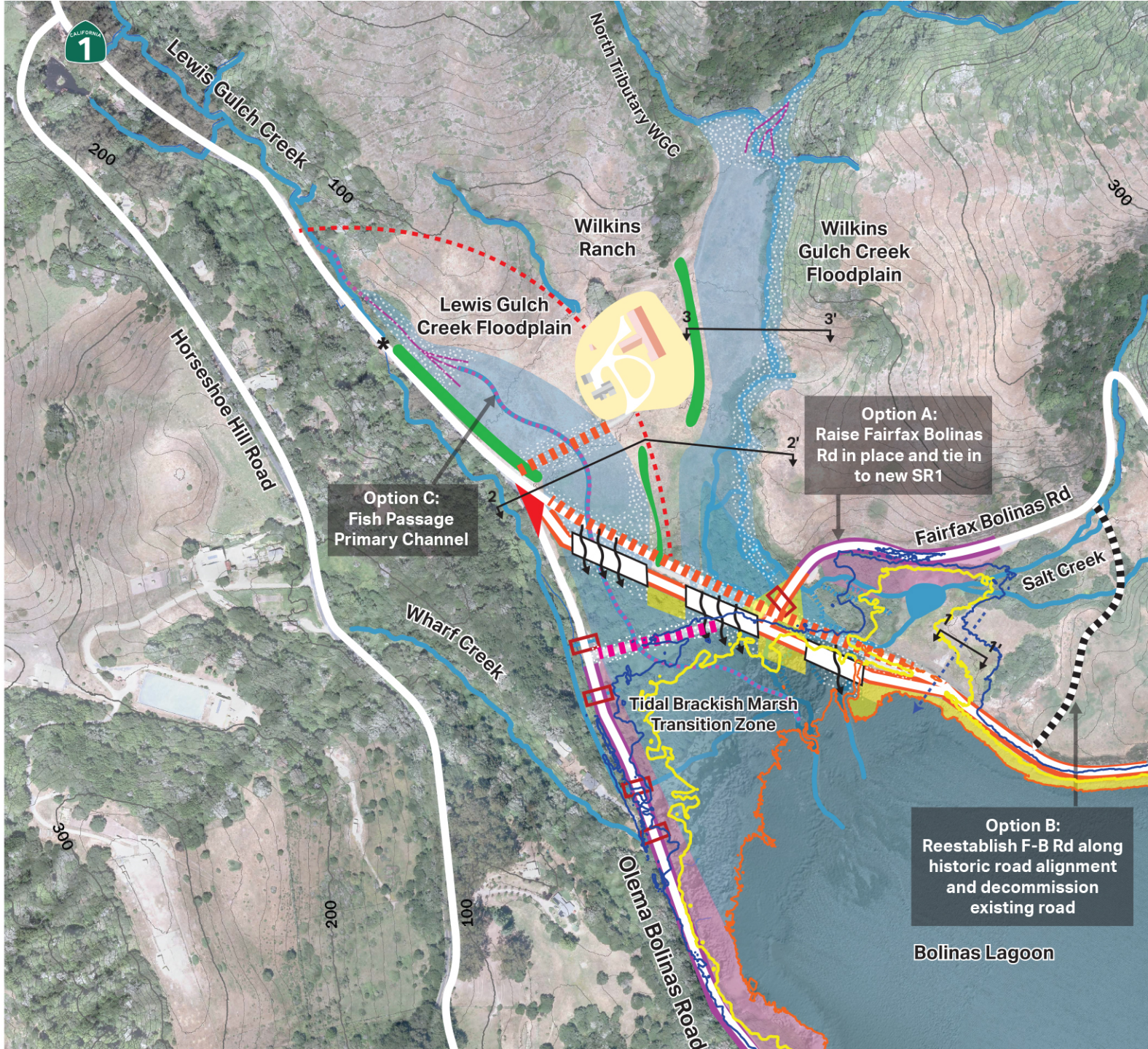
- Upgrade/Add O-B Culverts
- Vegetated Shoreline/
Soft Erosion Protection
- WGC Floodplain Grading
- Reactivate WGC Alluvial Fan
- Connector Roadway

Phase 4

- Raise Roadway

Project Features

- MHHW (5.6')
- Late Century SLR (11.1')
- Mid Century SLR (8.6')
- Surface Water Flow
- Road
- Existing Stream
- Cross Section



Option C:
Fish Passage
Primary Channel

Option A:
Raise Fairfax Bolinas
Rd in place and tie in
to new SR1

Option B:
Reestablish F-B Rd along
historic road alignment
and decommission
existing road

Bolinas Lagoon

Alternative 2: Downstream Reactivation

- Under this alternative the Wilkins Gulch Creek and Lewis Gulch Creeks would be reactivated largely within their existing footprints.
- Roads raised to accommodate stream flow
- Focus on downstream sections near the Y
- Minimal grading, with a focus on activating former channels.
- Highway One would be elevated onto a causeway in two sections.
- No driveway relocation required.

Alternative 2

Draft Conceptual
Not to Scale



Key

Phase 1

- Crossover Road Removed
- Reconfigure Intersection

Phase 2

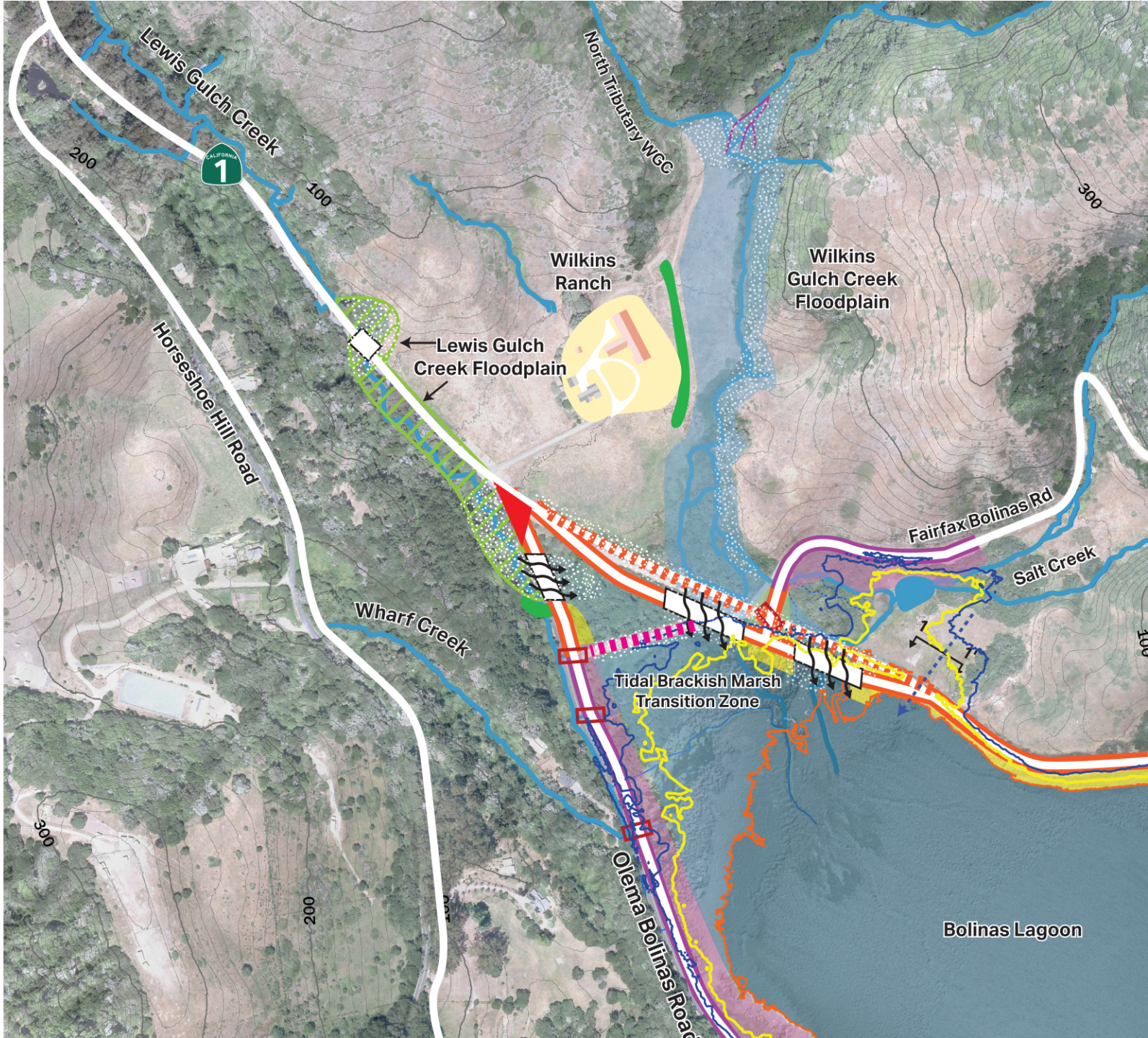
- Reactivate LGC Alluvial Fan
- Add Bridge/Causeway
- Raise Roadway
- Decommission Rd
- Vegetated Berm (Lewis Gulch Creek)
- Sub Surface Water Flow
- Vegetated Shoreline/Soft Erosion Protection

Phase 3

- Upgrade/Add Culvert
- Vegetated Shoreline/Soft Erosion Protection
- Vegetated Berm (Wilkins Gulch Creek)
- Stream Rehabilitation
- Raise Roadway
- Floodplain Grading
- Reactivate WGC Alluvial Fan

Project Features

- MHHW (5.6')
- Late Century SLR (11.1')
- Mid Century SLR (8.6')
- Road
- Existing Stream
- Cross Section



Alternative 3: Minimize Road Footprint in Floodplain (SLR/hydro connectivity)

- Highway one is fully elevated on a long-span causeway.
- Olema Bolinas Road is decommissioned at the Y and would only be elevated to the most northern resident on the road.
- The alluvial fan of Wilkins Gulch Creek is reactivated.
- Lewis Creek remains in its channel and then is redirected into the Y.
- Lower Fairfax-Bolinas Road is decommissioned in it's existing footprint and relocated south along a former roadbed.
- Horseshoe Hill Road replaces Olema-Bolinas Road as the main access to Bolinas and is reconfigured for safety, occurring over a long timespan in response to rising tides.

Alternative 3

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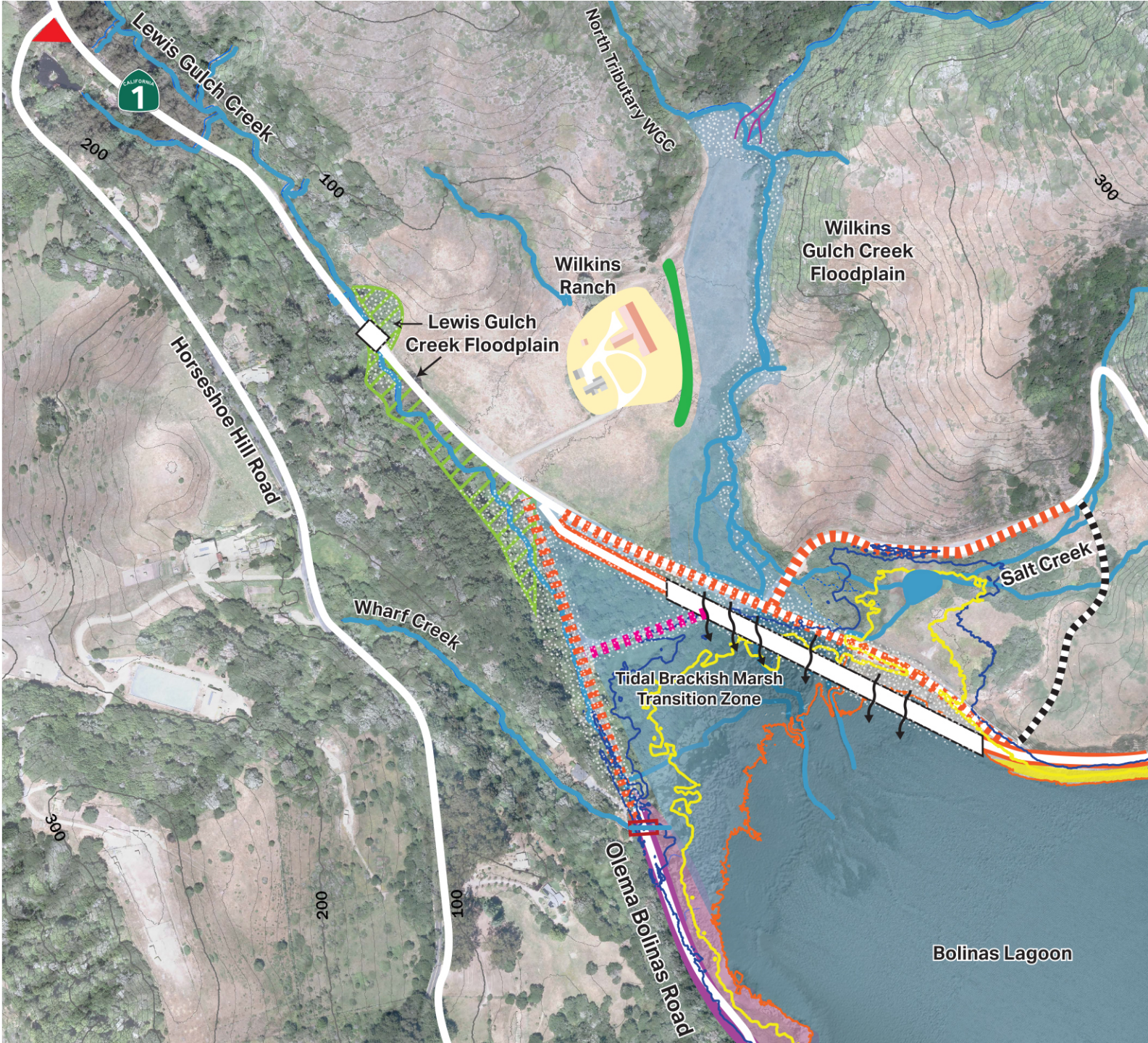


- Phase 1
- Crossover Road Removed
 - Reconfigure Intersection

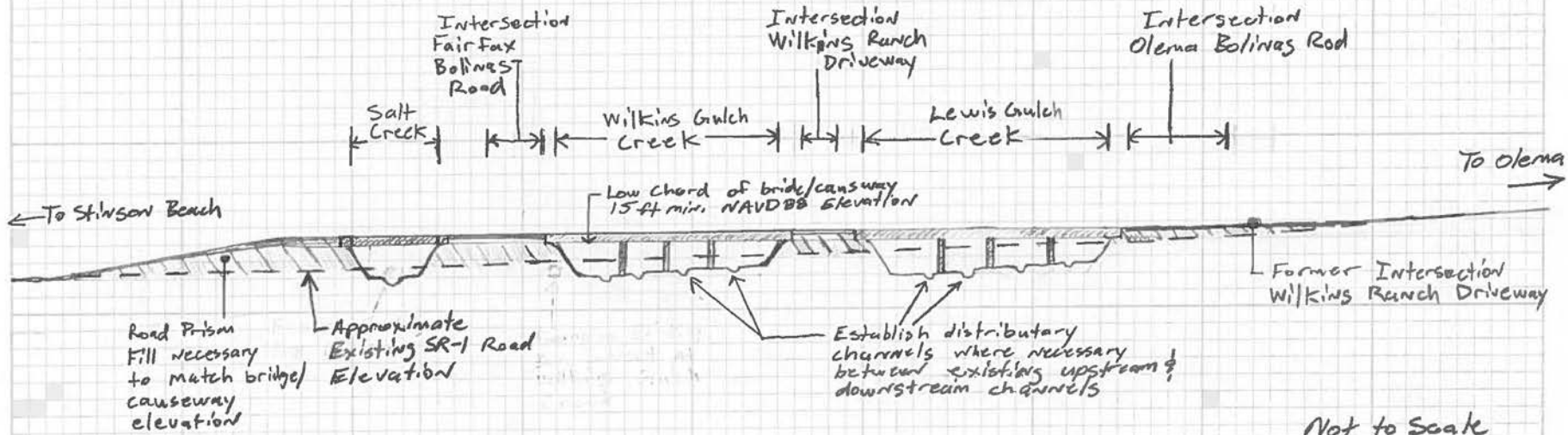
- Phase 2
- Add Bridge/Causeway
 - Raise Roadway
 - Decommission Rd
 - Connector Roadway
 - Vegetated Shoreline/
Soft Erosion Protection

- Phase 3
- Install Vegetated Berm
 - Raise Roadway
 - Long Term
Stream Rehabilitation
 - Vegetated Shoreline/
Soft Erosion Protection
 - Floodplain Grading
 - Reactivate Alluvial Fan
 - Add Culvert

- Project Features
- MHHW (5.6')
 - Late Century SLR (11.1')
 - Mid Century SLR (8.6')
 - Surface Water Flow
 - Road
 - Existing Stream



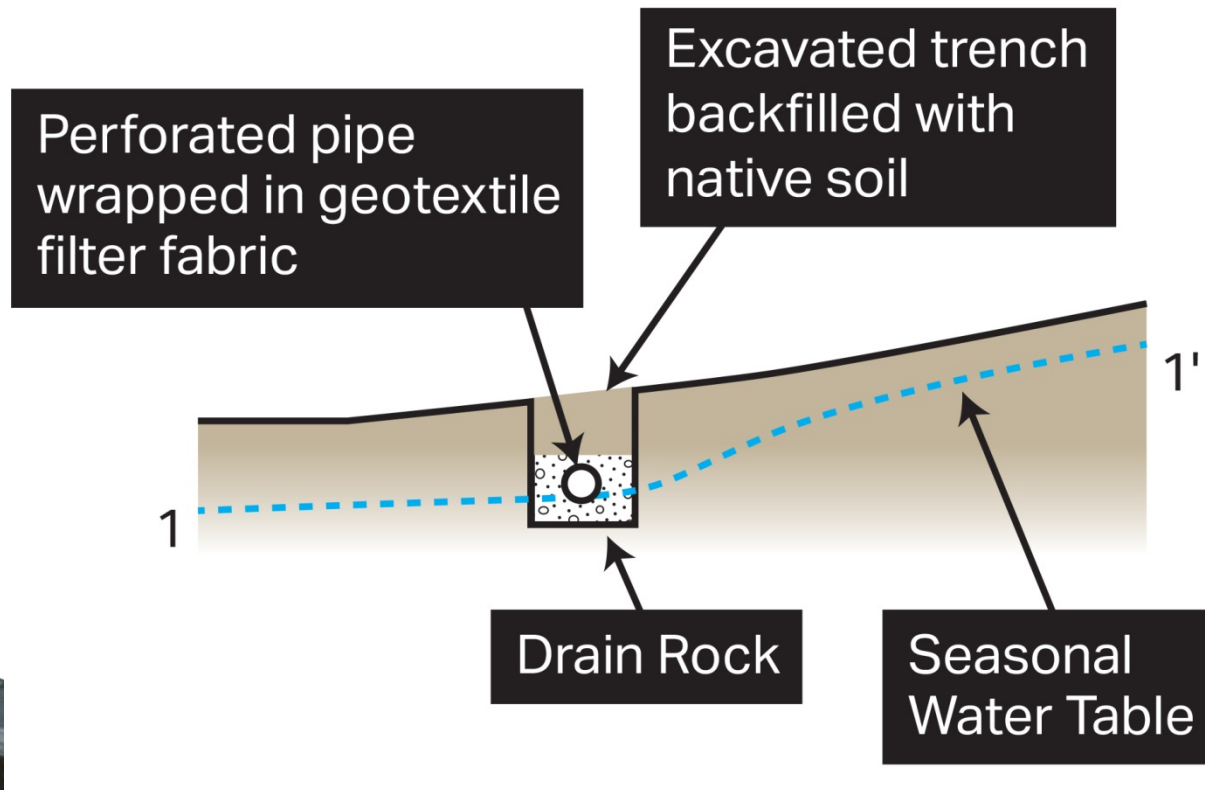
Alternative 1 SR-1 Roadway Profile Looking Downstream (South to North)



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Cross Section 1: An Experimental Approach

- Freshwater Conveyance to Support Brackish Vegetated Shoreline/Soft Erosion Protection at the Lagoon Interface

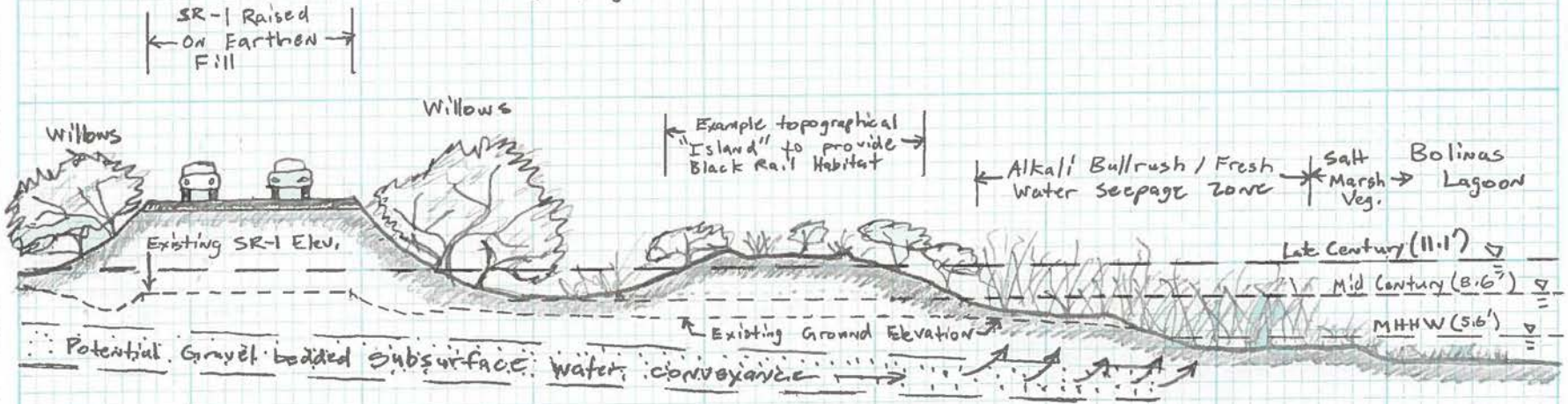


PROJECT Bolinas North End
SUBJECT Profile of Vegetated Shoreline Protection

Northeast

Profile View of Potential Vegetated Shoreline Protection (Looking SE towards Sausal Beach)

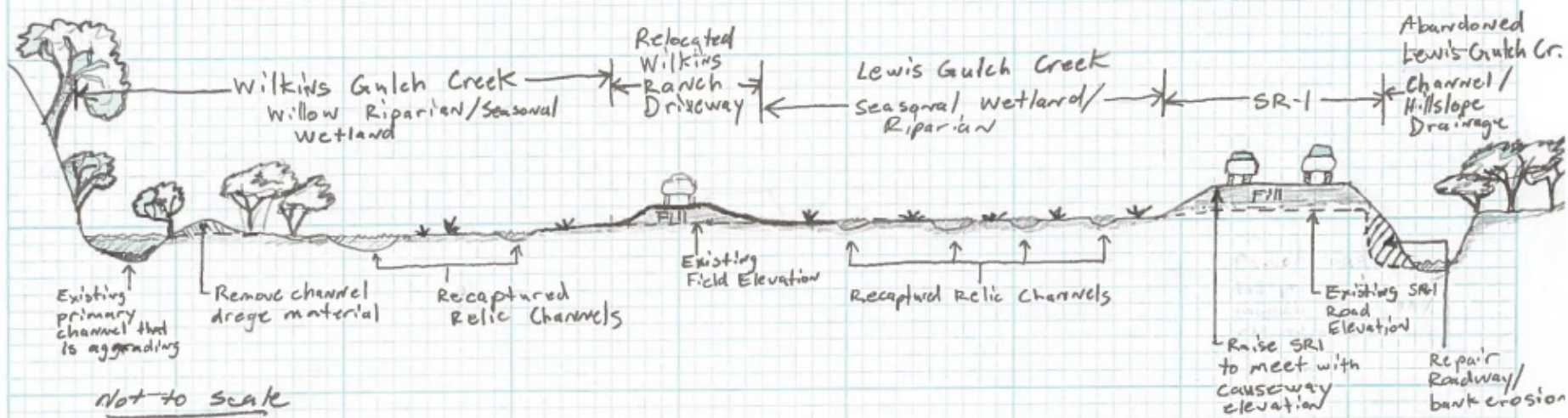
Southwest



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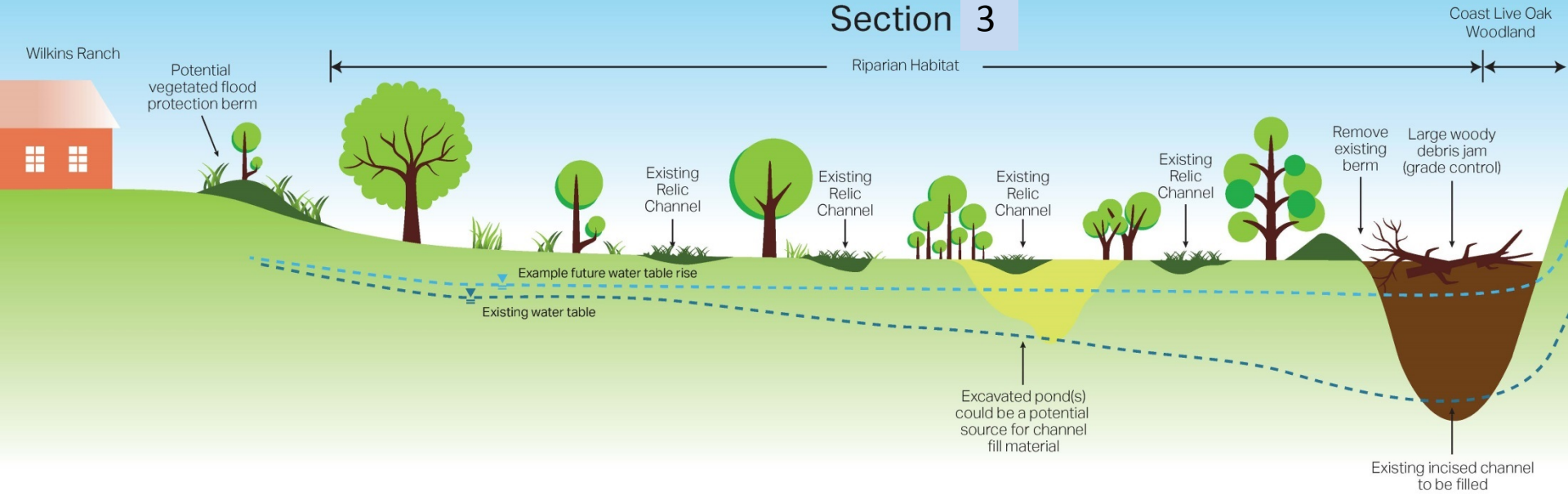
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Cross Section 2 Looking Downstream



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Section 3



Option: Alluvial Fan Reactivation with Ponds



Nature-Based Wave Attenuation: Vegetation

- Wave attenuation and wave runup height reduction during extreme high winter tides and onshore winds is critical design function for road flood control.
- Effective wave attenuation by marsh vegetation during extreme high tides requires:
 - Shoots (dead or live) persistent and upright during winter high tides
 - High shoot density
 - Shoot height (marsh canopy maximum elevation)



Left: Hwy 1 N Bolinas Lagoon with fringing salt marsh, low height (saltgrass-pickleweed high marsh, short California cordgrass low marsh); weak buffer for storm wave runoff to road bank.

Right: Hwy 1 N Bolinas Lagoon with seep forming local high brackish marsh (alkali-bulrush); strong buffer for storm wave runoff to road bank even in winter (persistent tall standing litter).



Left: contrast between height and density of salt marsh vegetation (< 20-30 cm) and local strong freshwater artesian spring in salt marsh supporting dense tall alkali-bulrush patch, green during summer (> 1 m).

Right: contrast between height and density of salt marsh vegetation (<20-30 cm) and diffuse weak freshwater seep below road fill next to steep hillsides; sparse alkali-bulrush in high marsh transition zone, senescent in summer (<0.5 m).



Next Steps

- Alternatives Development Refinement
- Opportunities & constraints analysis
- Cost estimates
- This will all be bundled in the final project report

Discussion / Q & A

