Work in Progress

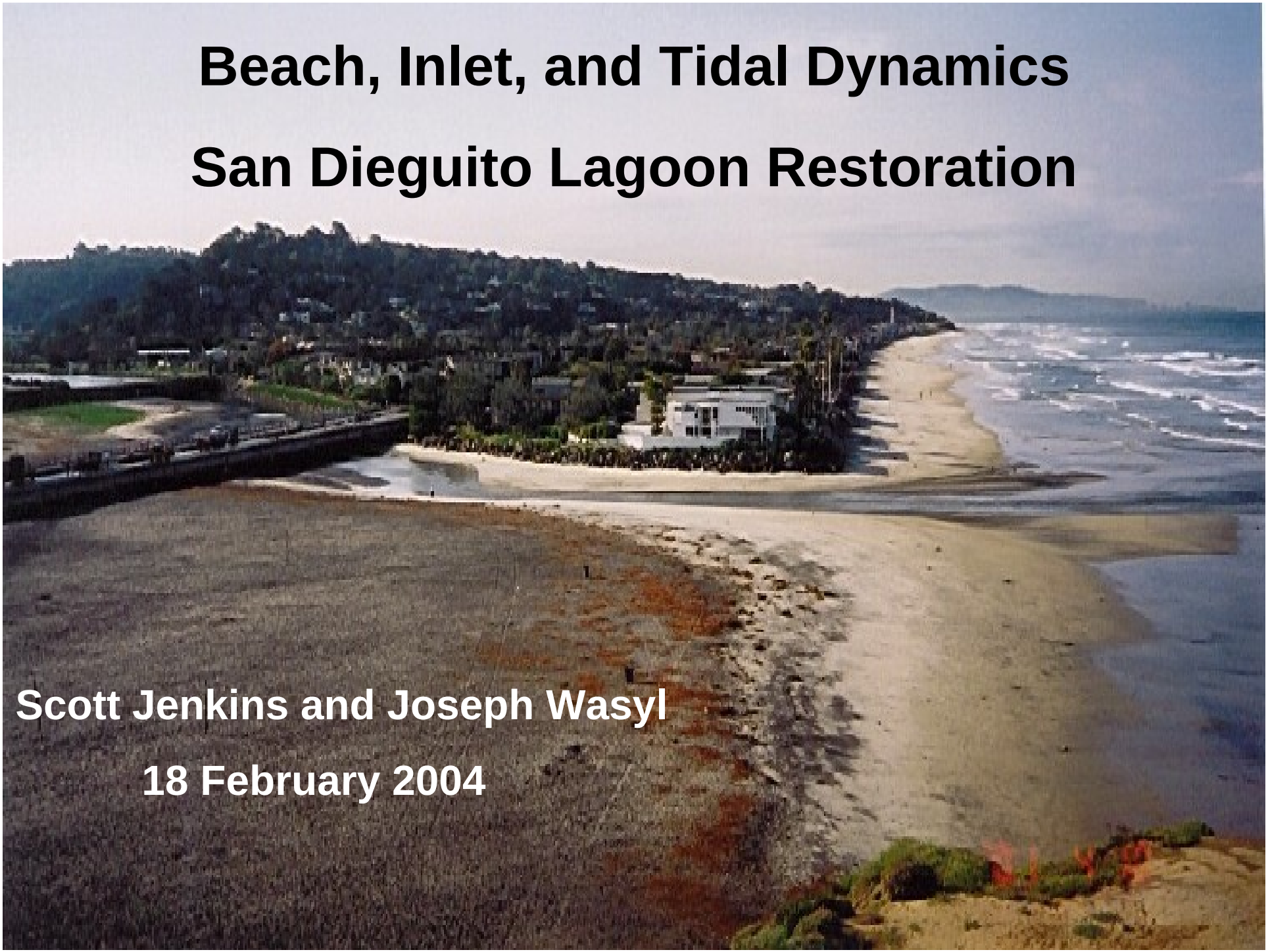
- Wetland Channel Design
- Revegetation Plan
- Inlet / Beach Sand Relationship
- Final Design, Permitting

Post-EIR Studies of Beach Erosion
Additional Assurance

- Supplement to be published by JPA
- Elwany, Flick and Hamilton (2003):
  - Analyzed 17 artificial and 5 flood-induced inlet openings over 23 years
  - No difference in beach width or sand thickness before vs. after opening
  - No difference near or far from inlet
- Jenkins, Wasyl and Elwany (2003)
  - Re-modeled effect of project on inlet and beach condition
  - Existence of bypass bar (ebb shoal) reaffirmed
  - Project (open inlet) will increase sand volume of Del Mar beaches by 23,000 cubic yards

Beach, Inlet, and Tidal Dynamics

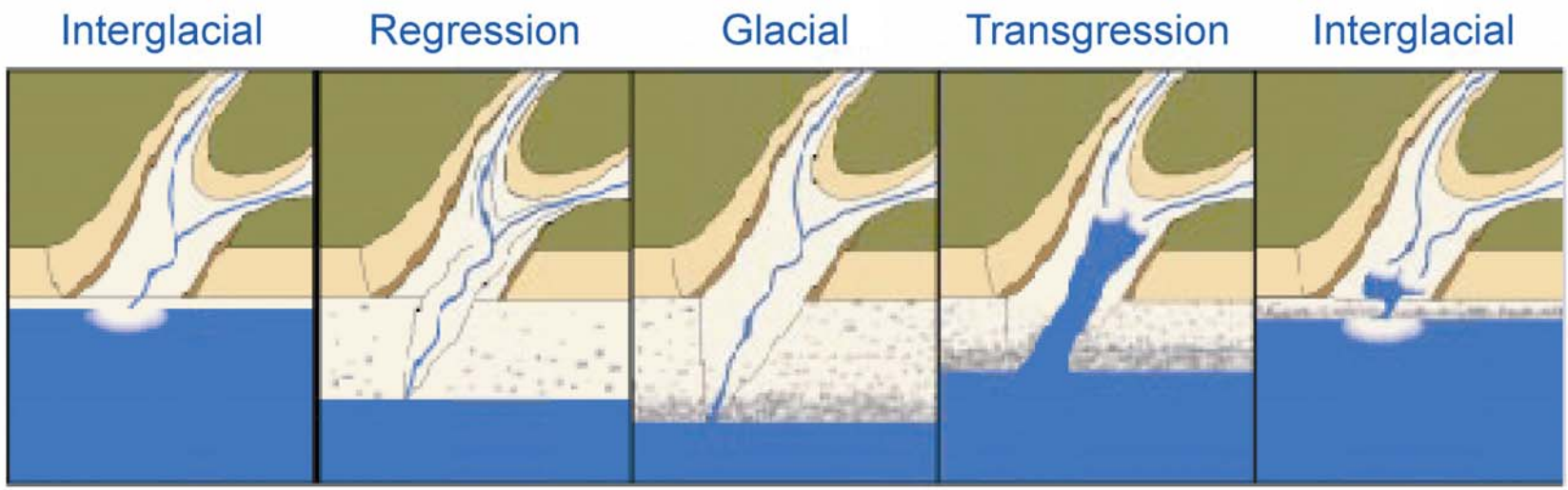
San Dieguito Lagoon Restoration

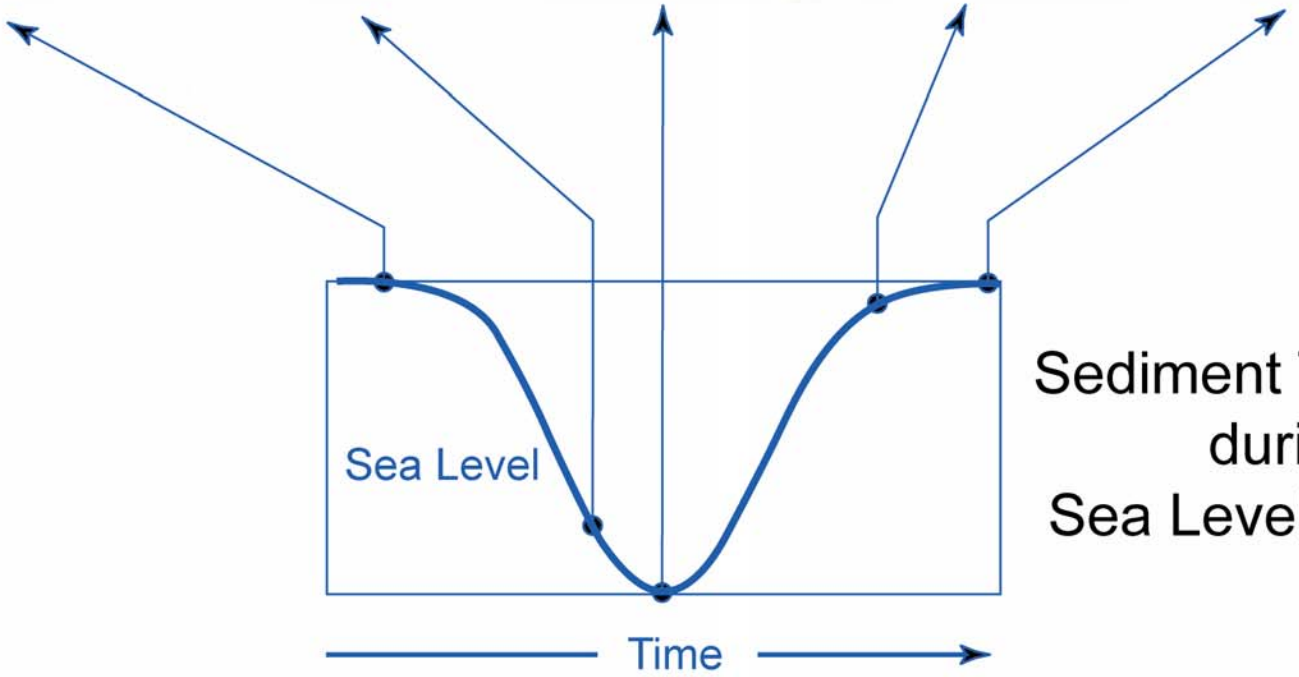


Scott Jenkins and Joseph Wasyl

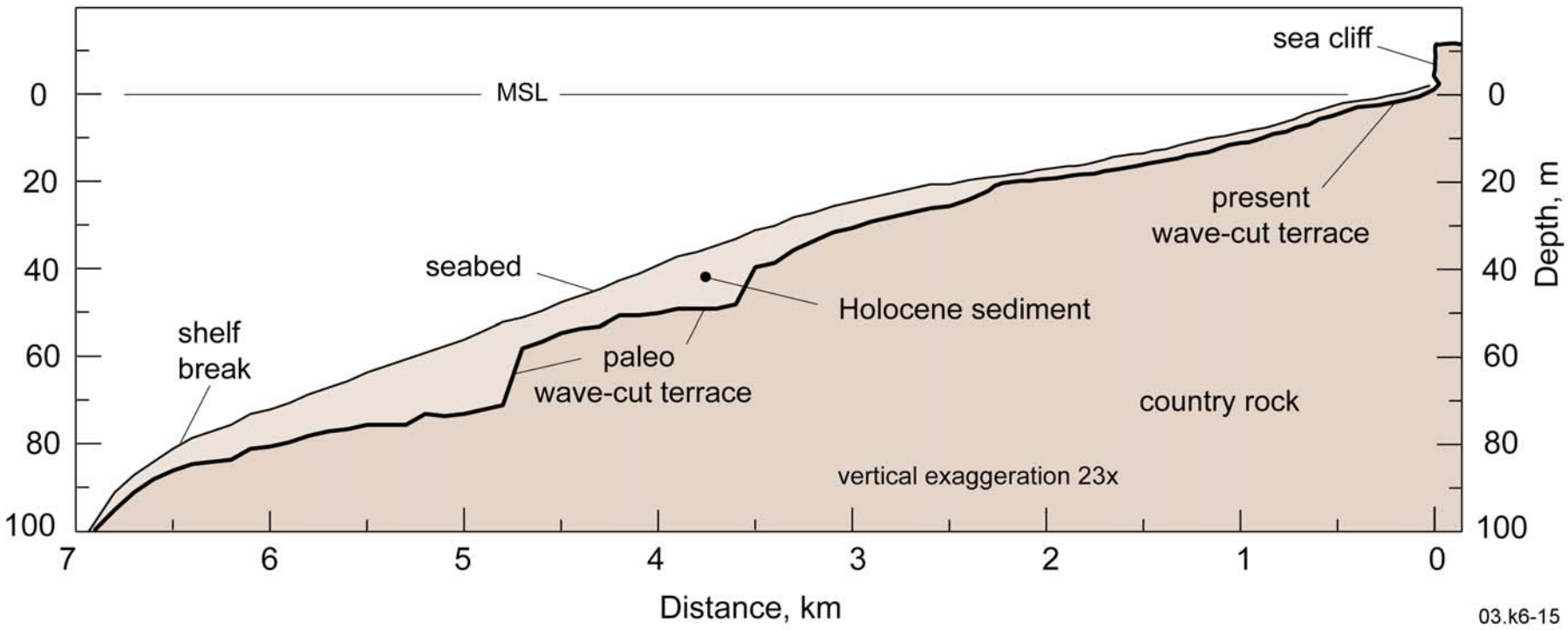
18 February 2004

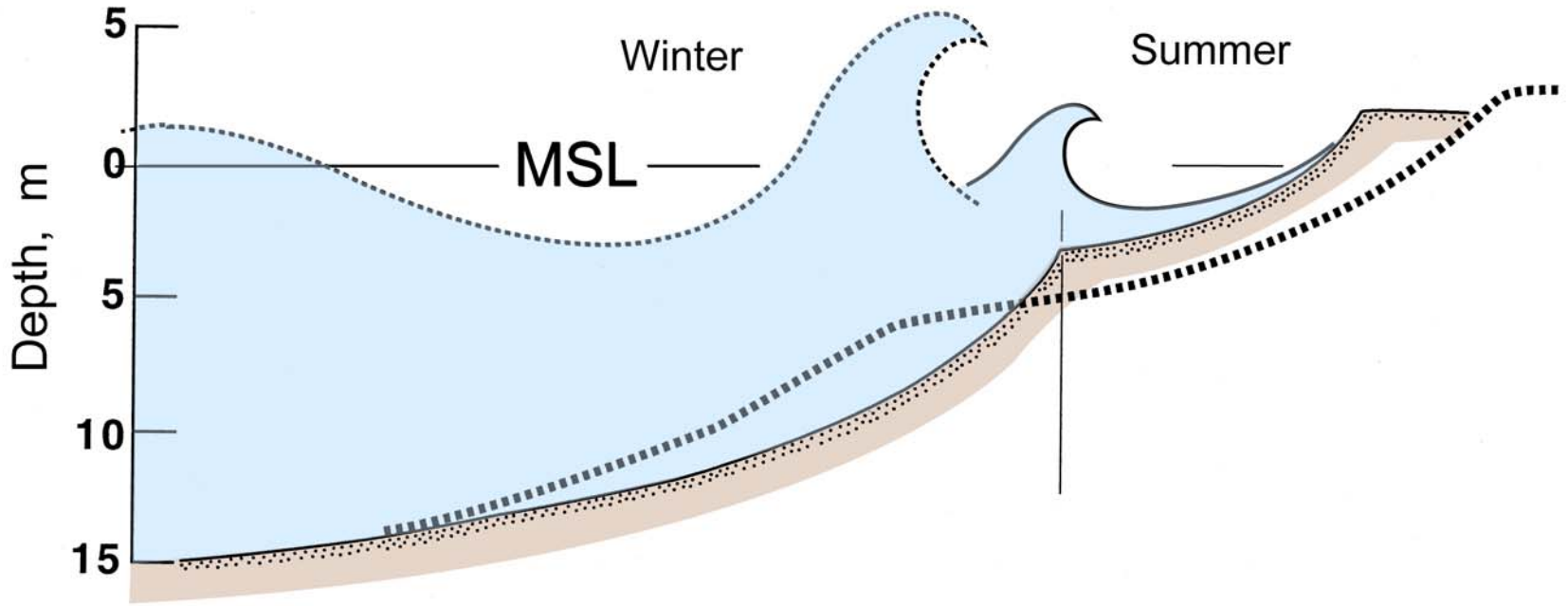
How a Lagoon is Formed



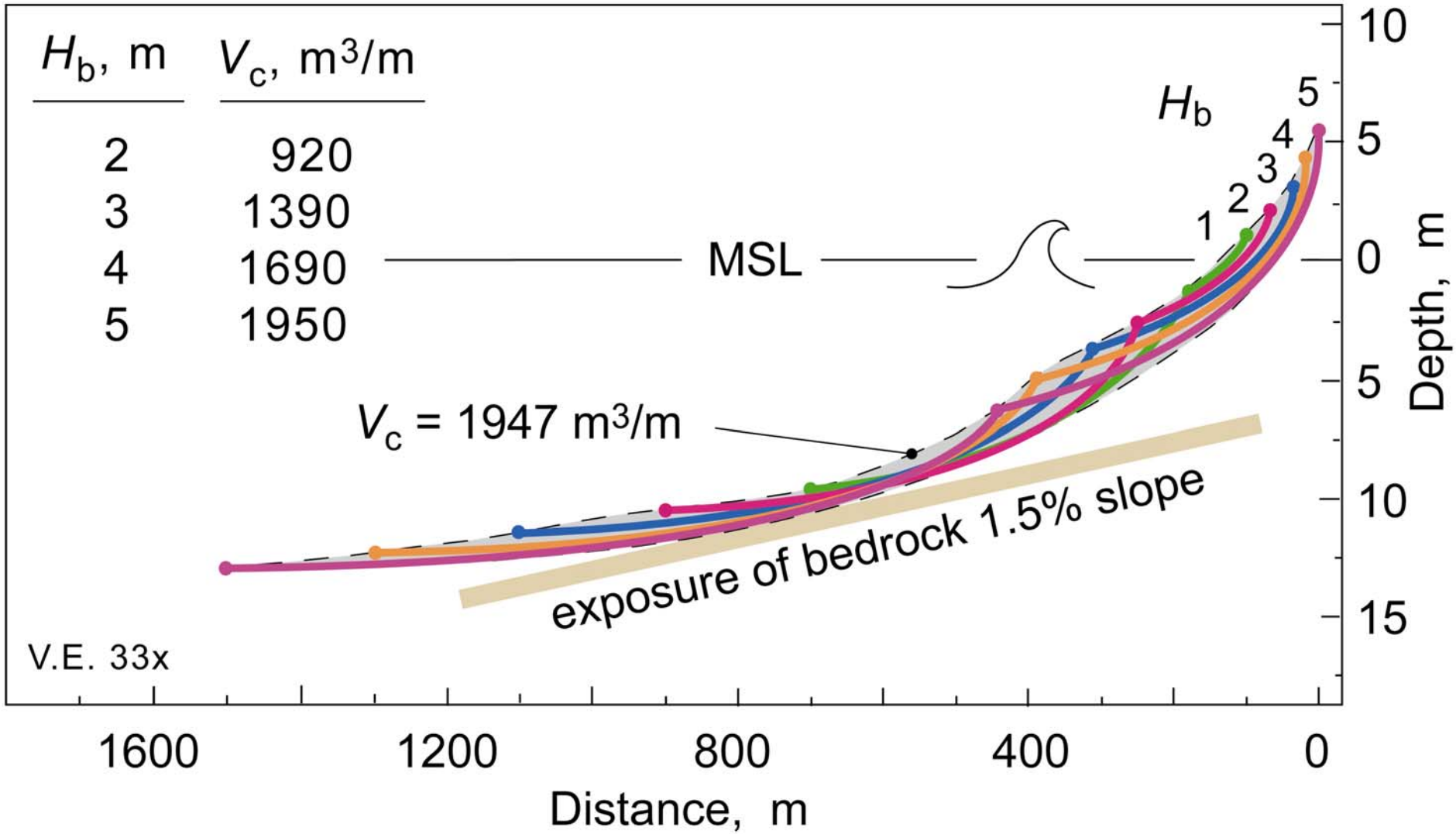


Sediment Transport during Sea Level Change


sea cliff
MSL
0
20
40
60
80
100
present
wave-cut terrace
seabed
Holocene sediment
shelf
break
paleo
wave-cut terrace
country rock
vertical exaggeration 23x
7
6
5
4
3
2
1
0
Distance, km
Depth, m
03.k6-15



03.k11-5



Equilibrium beach profiles for 12 s waves and rms breaker height H_b. V_c is the critical volume of sand required for equilibrium.

NATURE'S REQUIREMENTS FOR A SEASONAL BEACH

(What Models Tell Us about Beaches and Sea Level Rise)

- **The foundation for a beach is a wave-cut platform that forms during a prolonged stillstand in sea level.**
- **Beaches cannot form over platforms that slope more than about 1.5%.**
- **Given a sufficient mass of sand over a gently sloping platform, waves will form beaches that are in equilibrium with the wave intensity.**

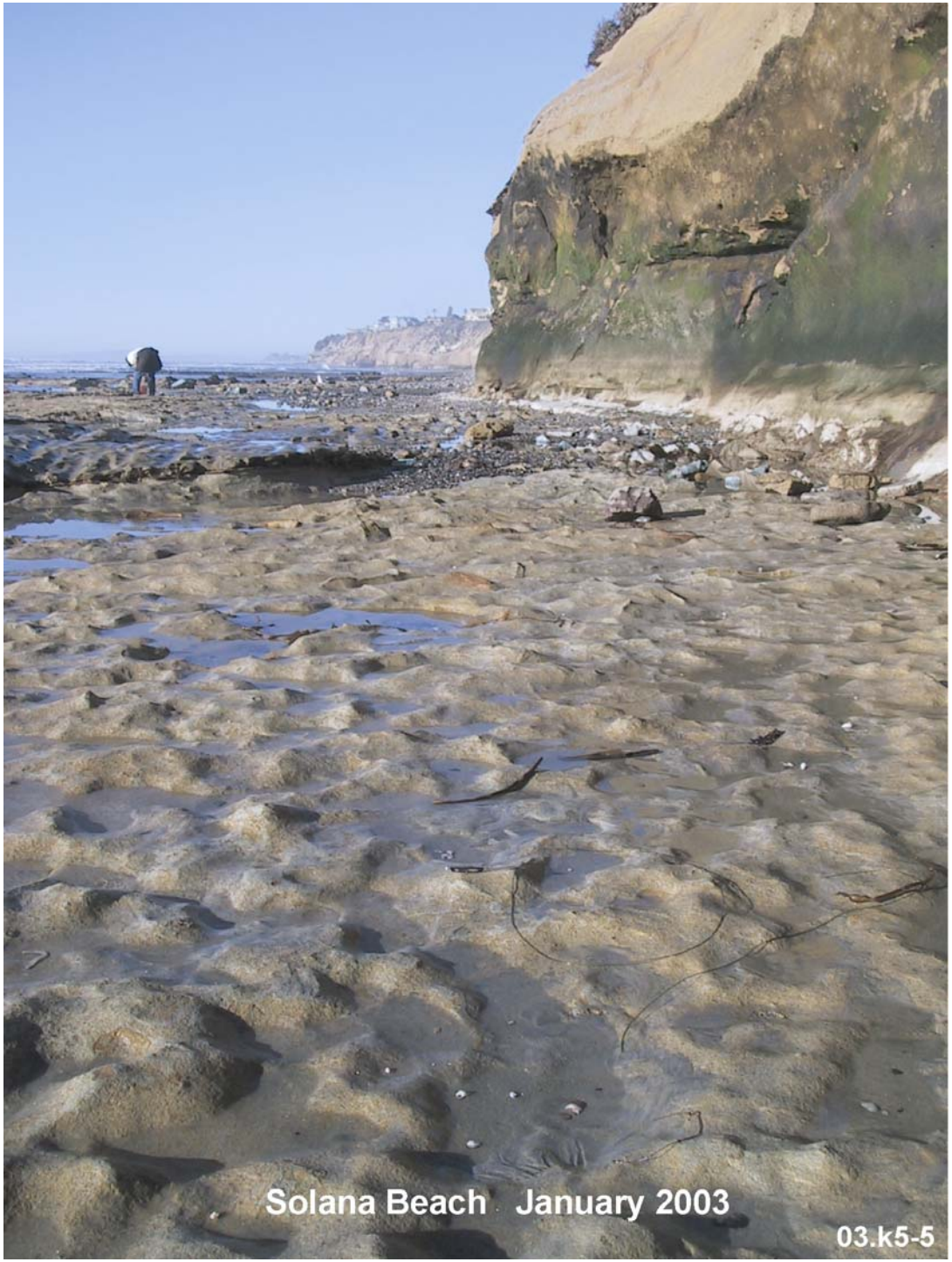

Solana Beach January 2003
03.k5-5

Figure 22. Location map for beach profille surveys in the near and farfield of the San Dieguito River mouth. [taken by Elwany, 1992-2002]

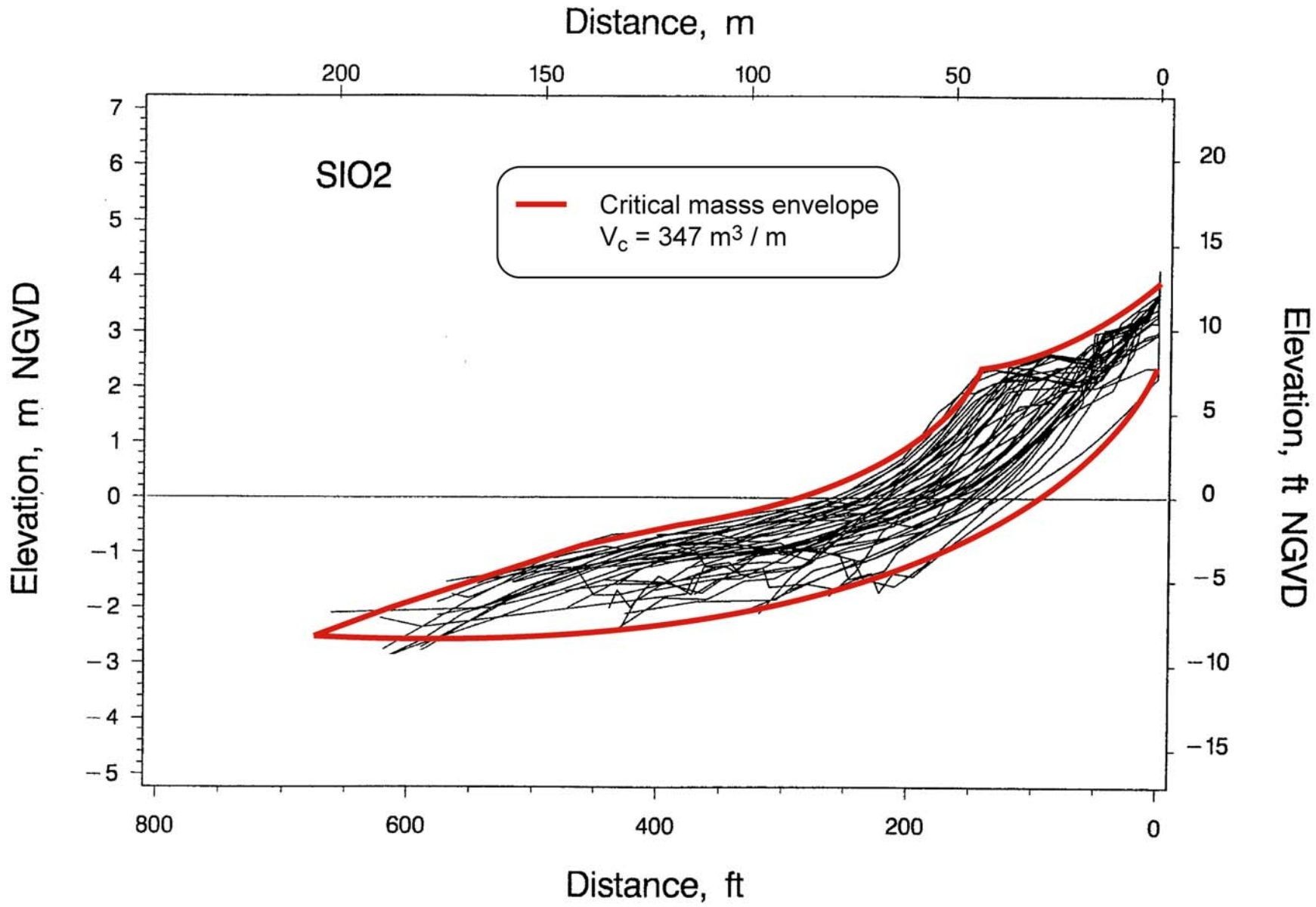


Figure 32. Critical mass envelope of beach profiles for existing conditions at Range SIO-2, Del Mar, CA, 1978-2000. Model results shown by bold red lines.

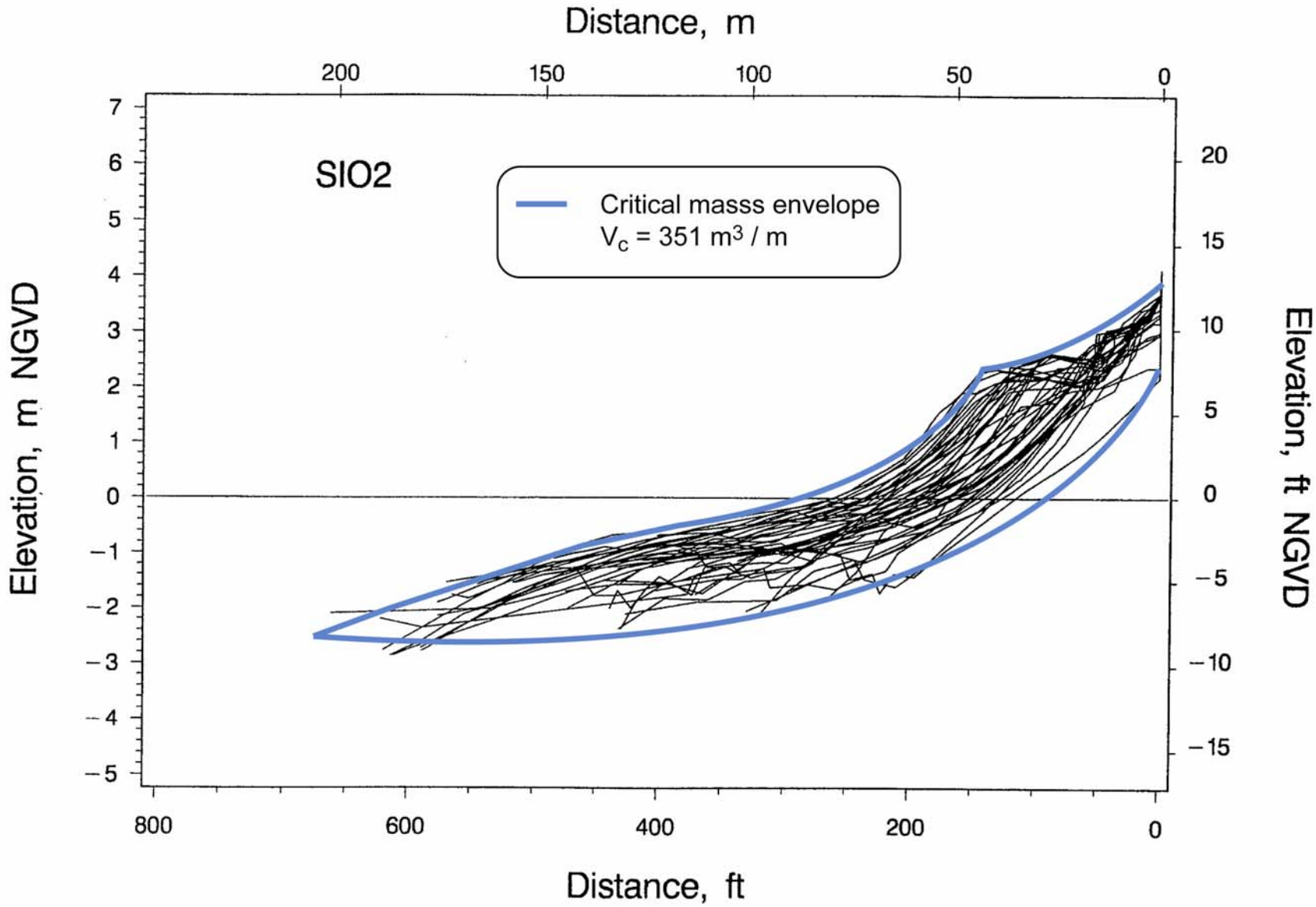
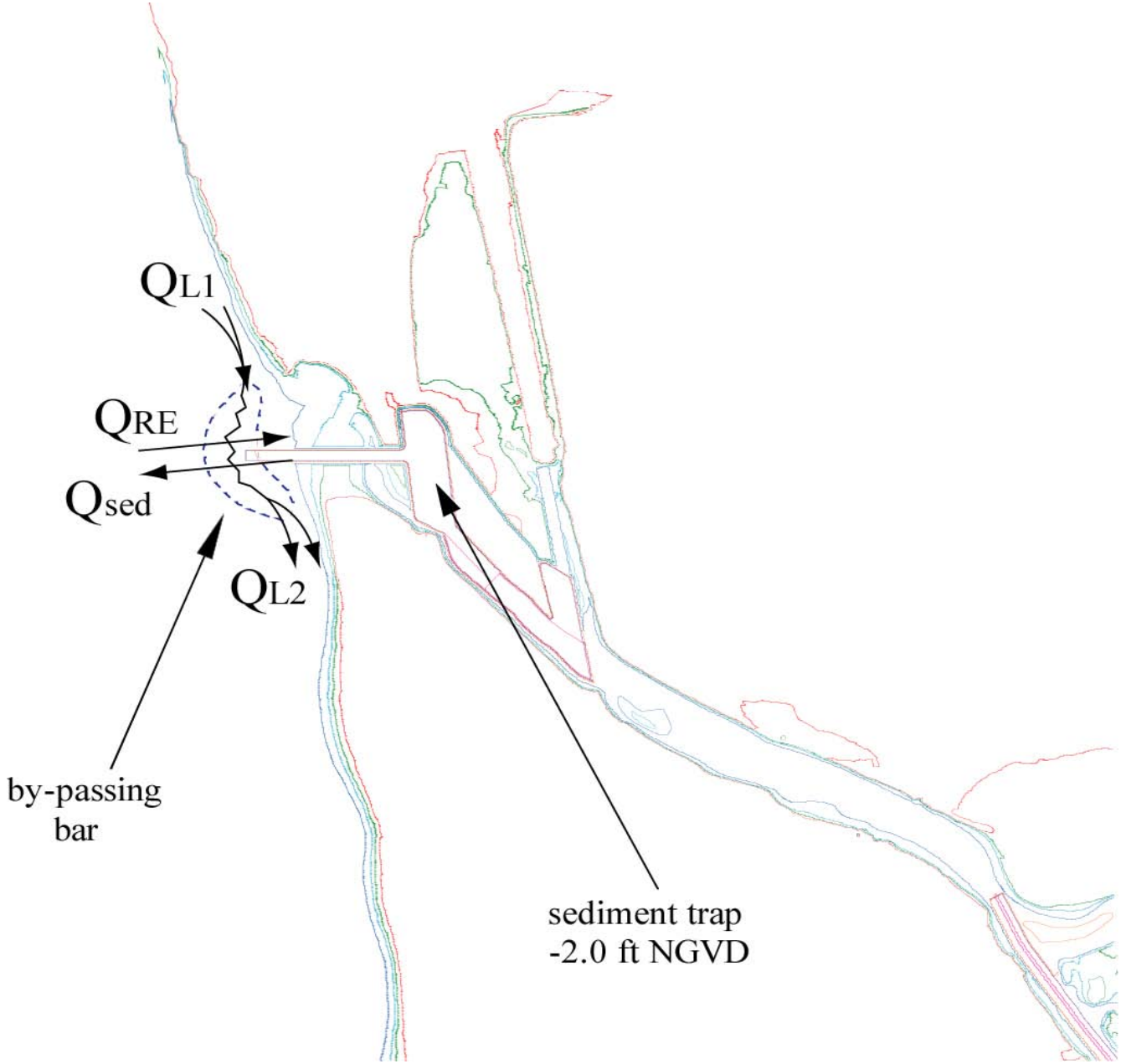


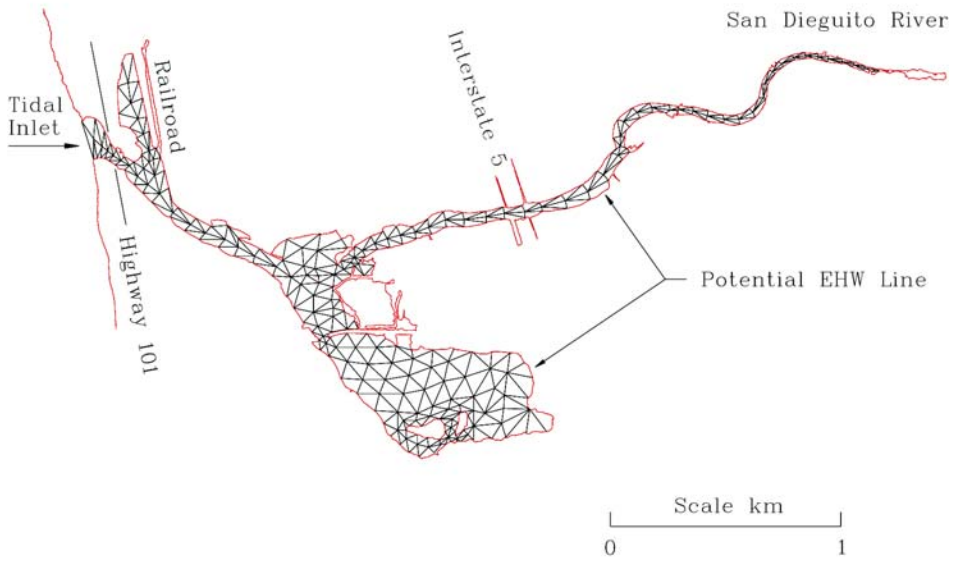
Figure 33. Critical mass envelope of beach profiles for post-project conditions at Range SIO-2, Del Mar, CA, 1978-2000. Model results shown by bold blue lines based on Edison Plan (without W6a & W6b).



By-passing bar detail with sediment flux definitions.

Finite Element Mesh of San Dieguito Lagoon

a. Existing Conditions



b. Restoration

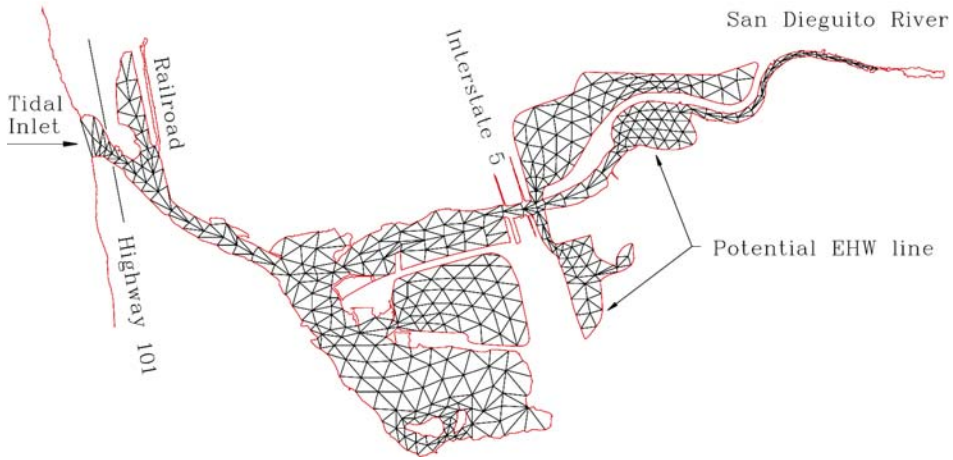
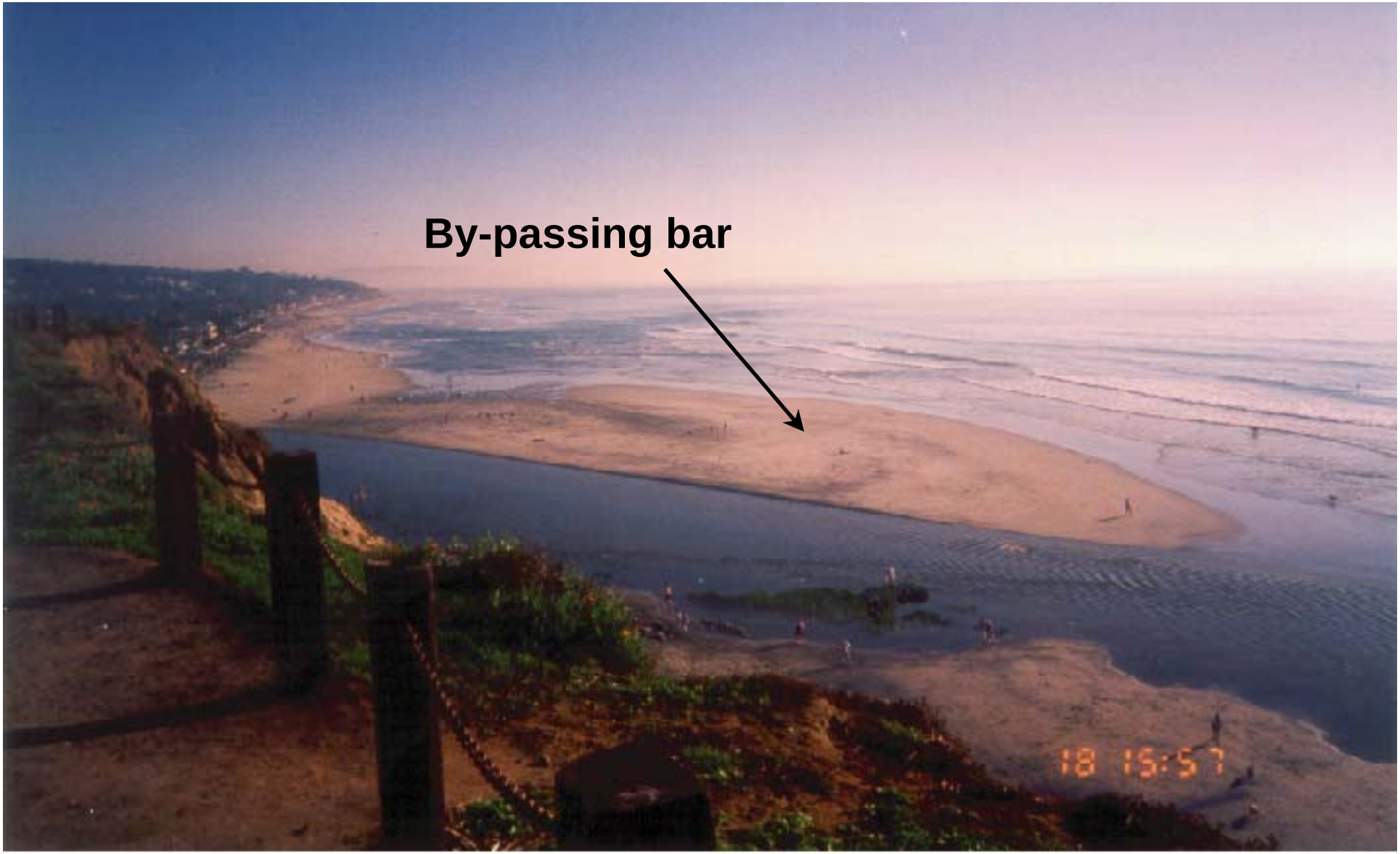


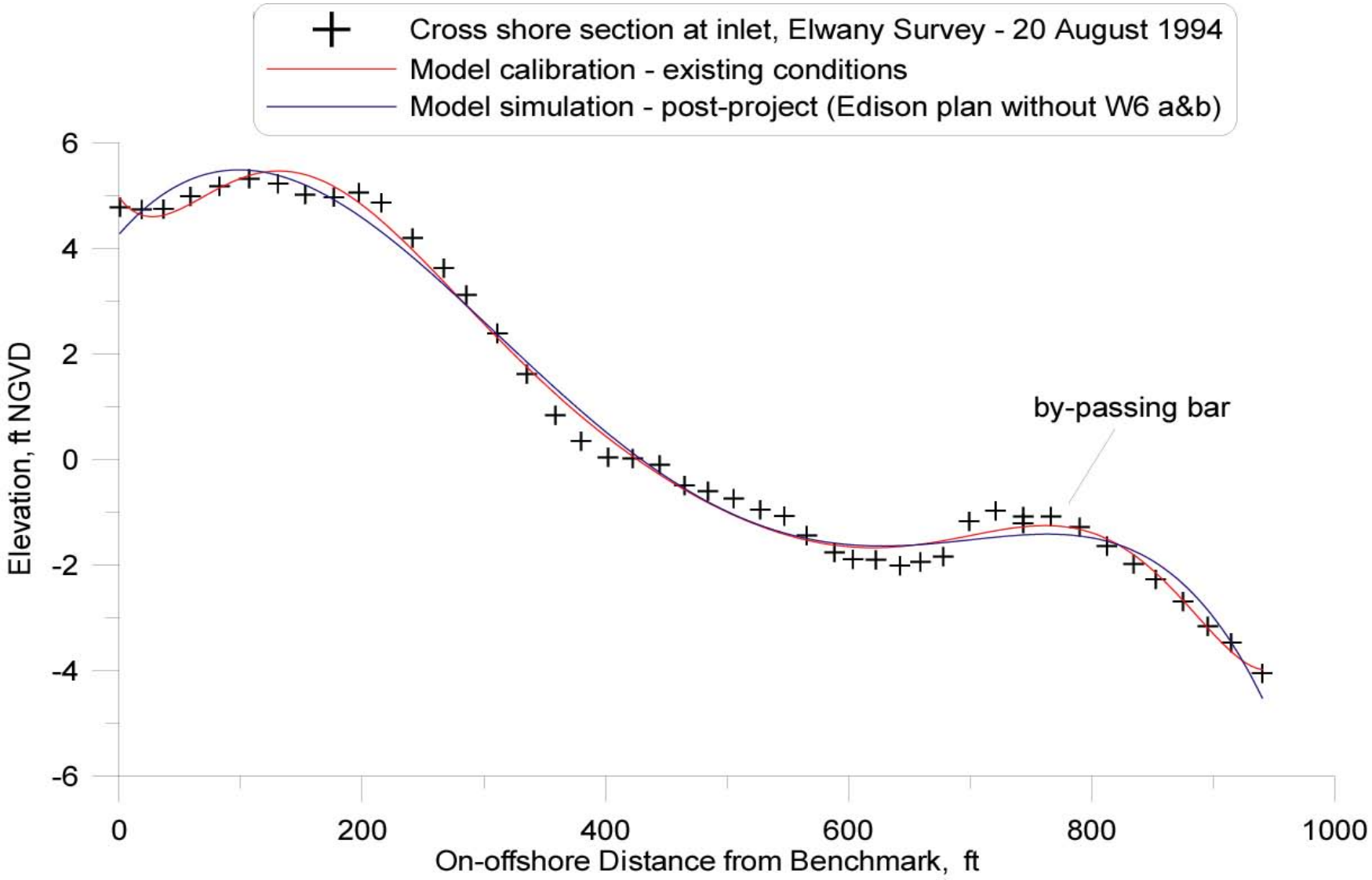
Table 3. *Inlet Channel Currents for Hydroperiod Envelope, San Dieguito Lagoon Restoration.

	November 1997			August 1988		
	Maximum Flood Current (ft./secs.)	Maximum Ebb Current (ft./sec.)	Root Mean Squared Current (ft./sec.)	Maximum Flood Current (ft./sec.)	Maximum Ebb Current (ft./sec.)	Root Mean Squared Current (ft./sec.)
Existing Conditions	+3.26	-2.50	0.86	+2.33	-1.89	0.62
Mixed Habitat Plan	+4.63	-4.25	1.46	+3.52	-3.23	1.37
Edison Plan (w/o W6a & W6b)	+4.02	-3.48	1.01	+2.87	-2.48	0.88
The Final Plan (w/ W6a & W6b)	+4.39	-3.84	1.12	+3.27	-2.86	0.97

* Based on tidal months which bound the envelope of hydroperiod variability during the period of record 1988-97, from Jenkins, Josselyn & Wasyl, 1999.


By-passing bar
18 15:57


11.24 15:26



Project Designed to Maintain Existing Beach Morphology….No Change in Existing Erosion Cycles

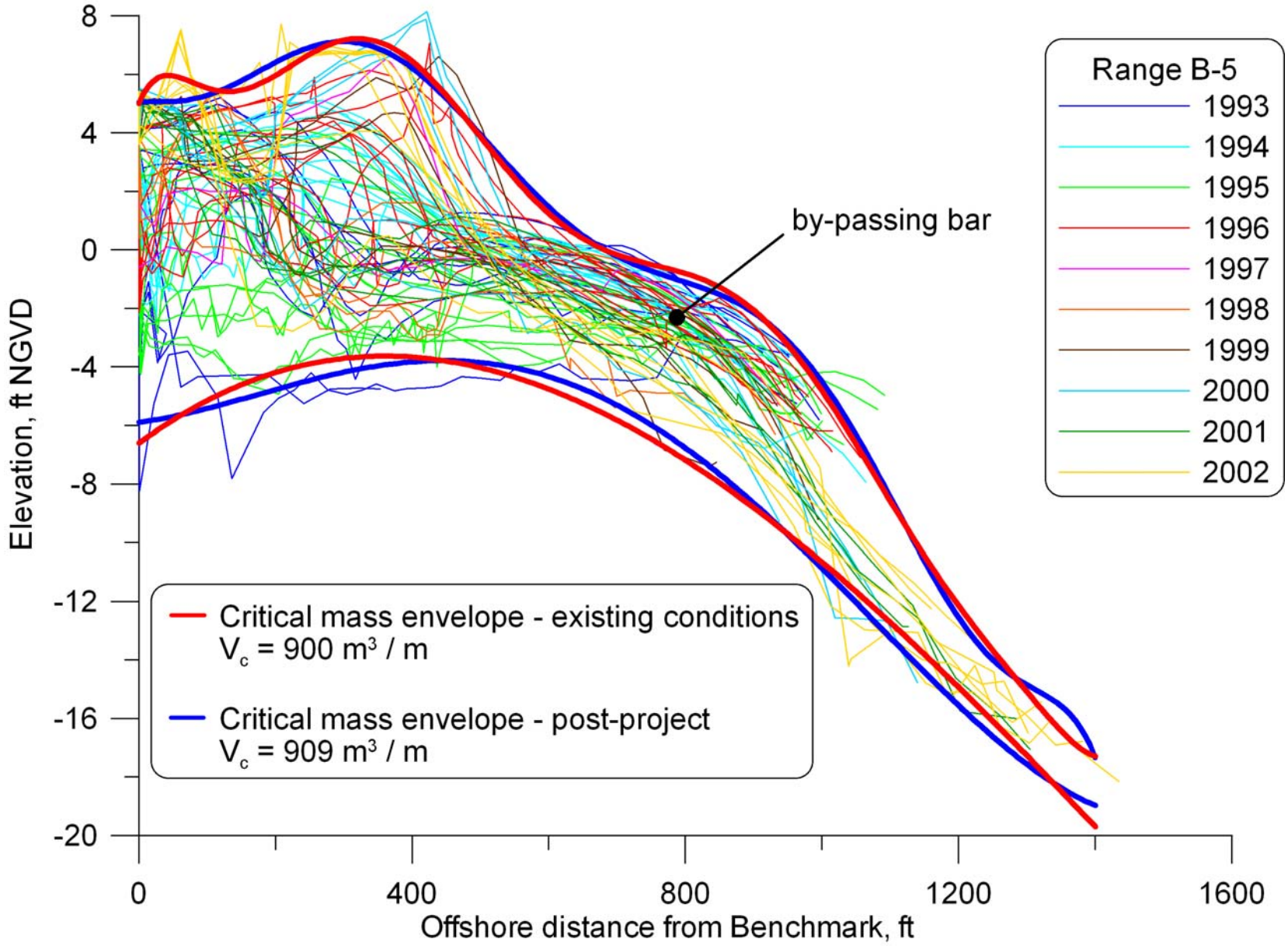


Figure 29. Critcal mass envelope of the beach profiles at Range B5, San Dieguito River mouth, for the period of 1993-2002. Model results for existing conditions shown by bold red lines; model simulation for post-project Edison Plan (without W6a & W6b) shown by bold blue lines.

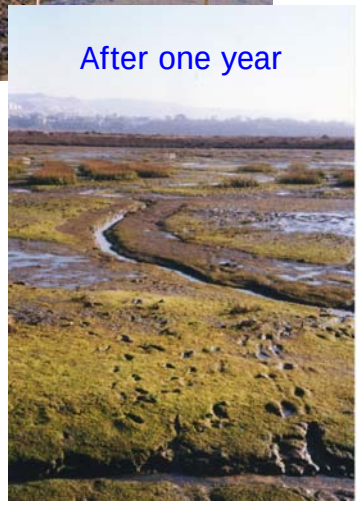
Figure 30. Reflected wave from Sandy Lane revetment (seawall) during winter erosion cycle - 4 February 1998.


8:03

Approach to Wetland Geomorphology and Small Channel Design

- Grading creates basins, major channels, and marsh plain
- Natural evolution of channels in mid marsh and high marsh using design template

Excavated Channels

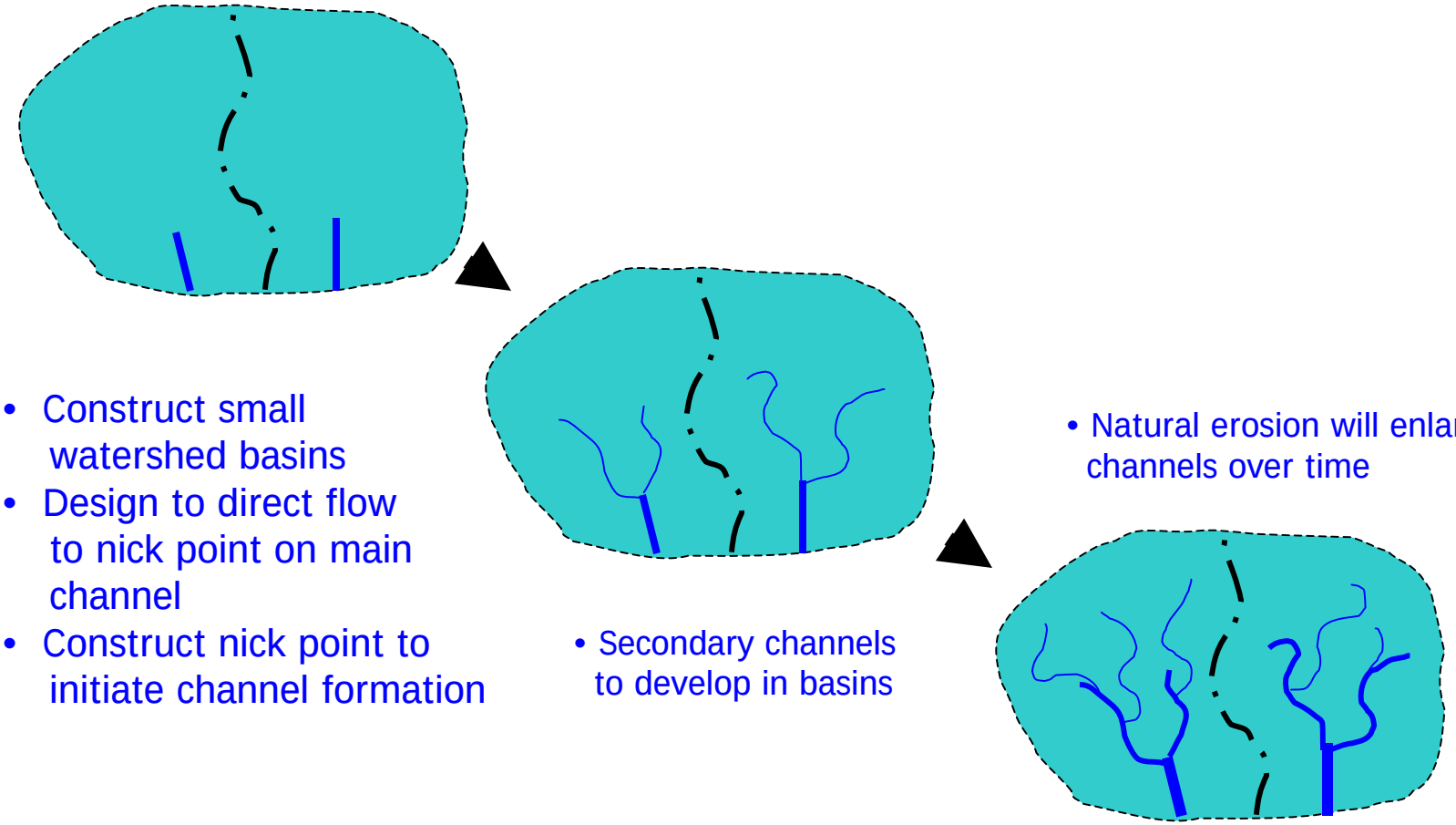


- Estimating small channel size and configuration still experimental
- Natural sinuosity difficult to replicate
- Excavated channels quickly fill in with sediments

Natural Evolution of Dendritic Channel Network

- Results in channel size in equilibrium with tidal prism
- Natural sinousity and network
- Timing can be accelerated through micro-grading of basins

Design Approach for Dendritic Channels



- Construct small watershed basins
- Design to direct flow to nick point on main channel
- Construct nick point to initiate channel formation

- Secondary channels to develop in basins

- Natural erosion will enlarge channels over time

Revegetation Plan

- Many species will recruit readily as seen in Batiquitos Lagoon restoration
- Some species to be planted:
  - Cordgrass
  - Experimental plantings of sensitive species

Revegetation strategy

- Low marsh: Planting of cordgrass and allow to spread
- Mid-marsh: Allow for natural recruitment
- High marsh: Limited planting with possible use of soil amendments

Soil amendment testing

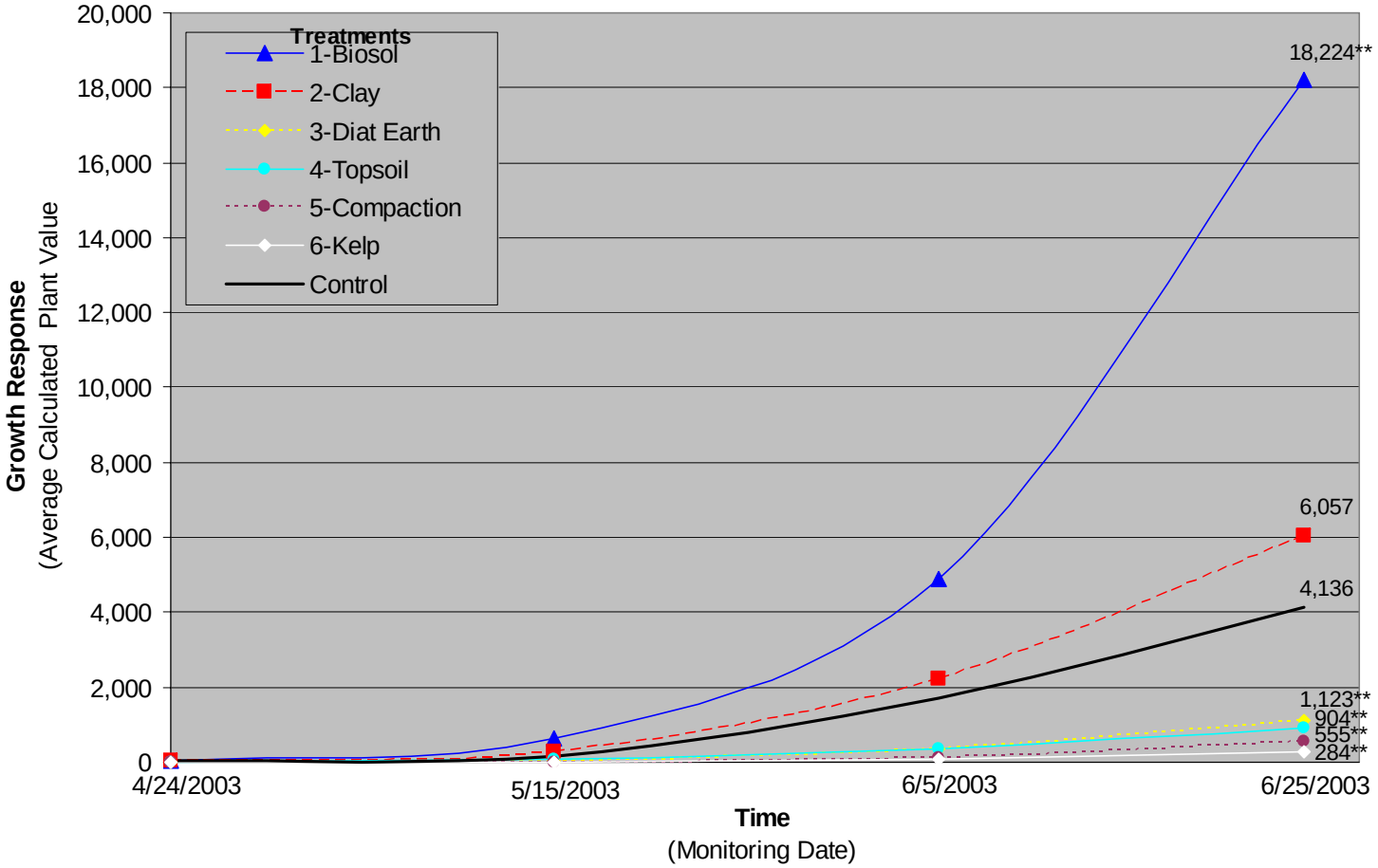
- Examined use of various soil amendments to improve moisture holding capacity
- Tested additions of clay, topsoil from site, and biosol additive
- Biosol and topsoil to be effective in promoting survival and growth

Pickleweed Growth

Figure 2

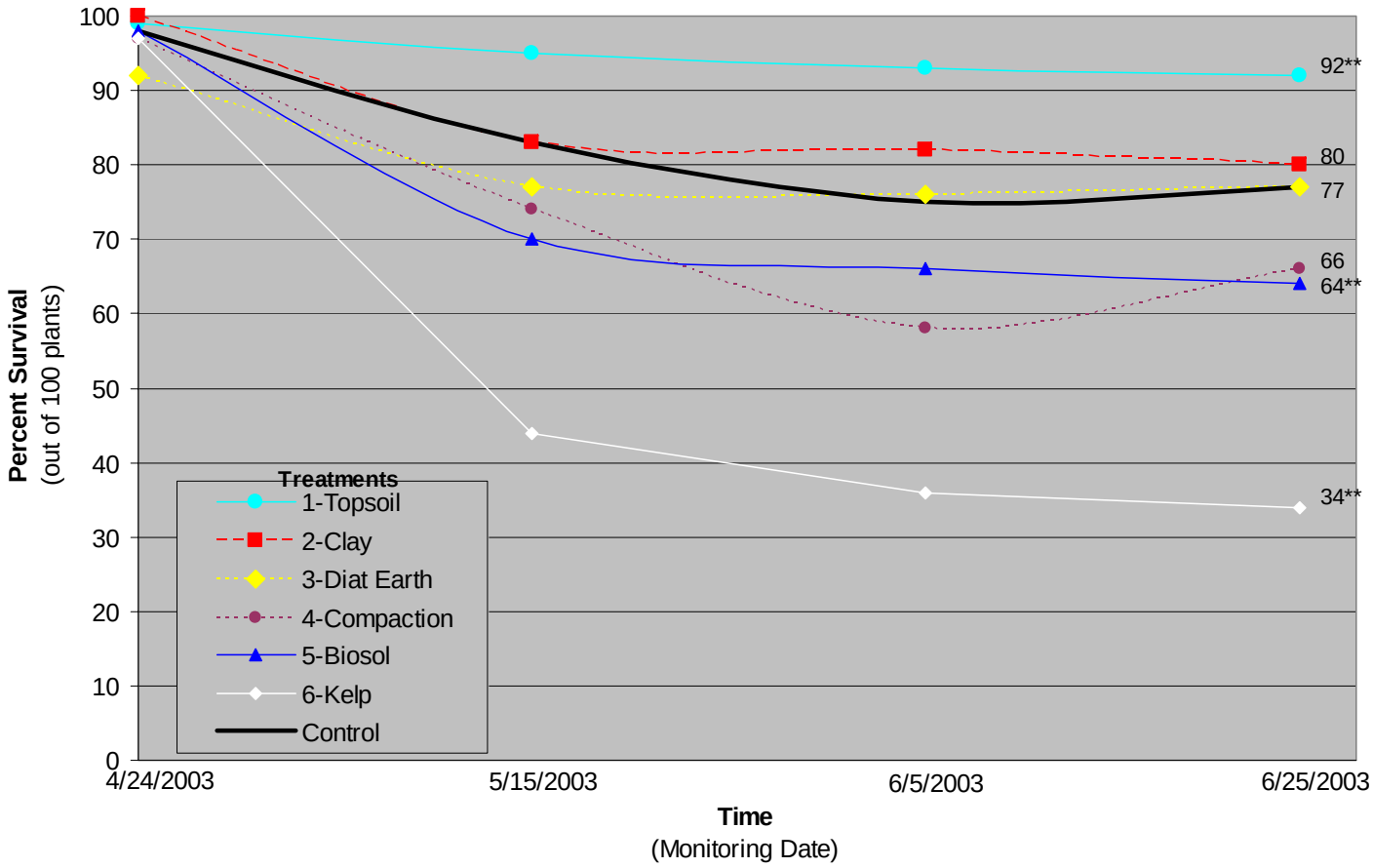
Pickleweed Soil Amendment Experiments - Growth Responses over Time

Results with ** indicate a statistically significant difference from the control group (alpha = 0.05)



Pickleweed Survival

Figure 3
Pickleweed Soil Amendment Experiments - Plant Survival over Time
Results with ** indicate a statistically significant difference from the control group (alpha = 0.05)

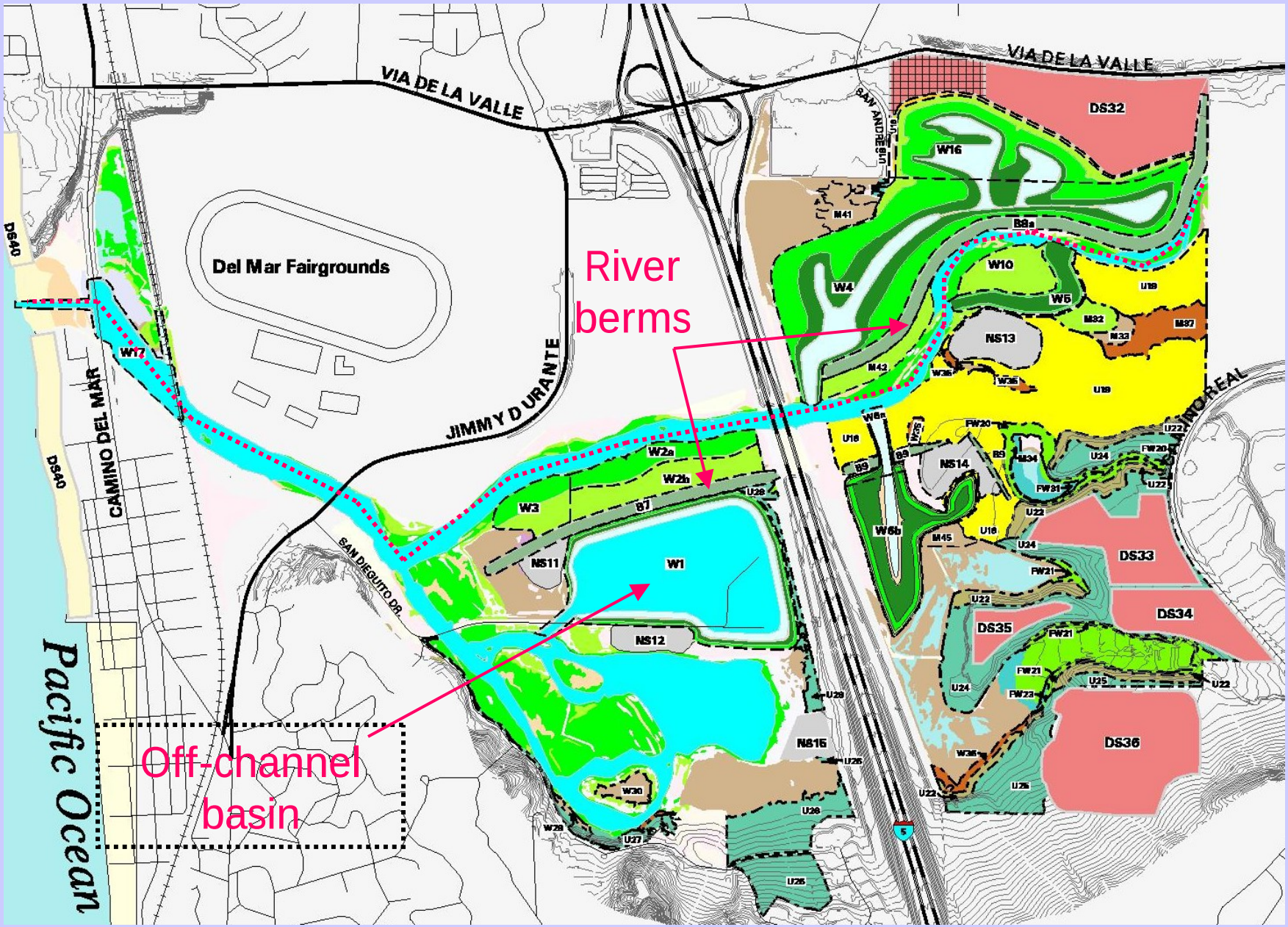


Field testing

- Set up field plots at Batiquitos Lagoon
- Soil amendments may be used in high marsh area
  - Either soil amendment or fertilizer around planted species
  - Must be cost-effective
  - May be done after initial colonization period

Final Design, Permitting, Schedule

Wetlands Project Plan View



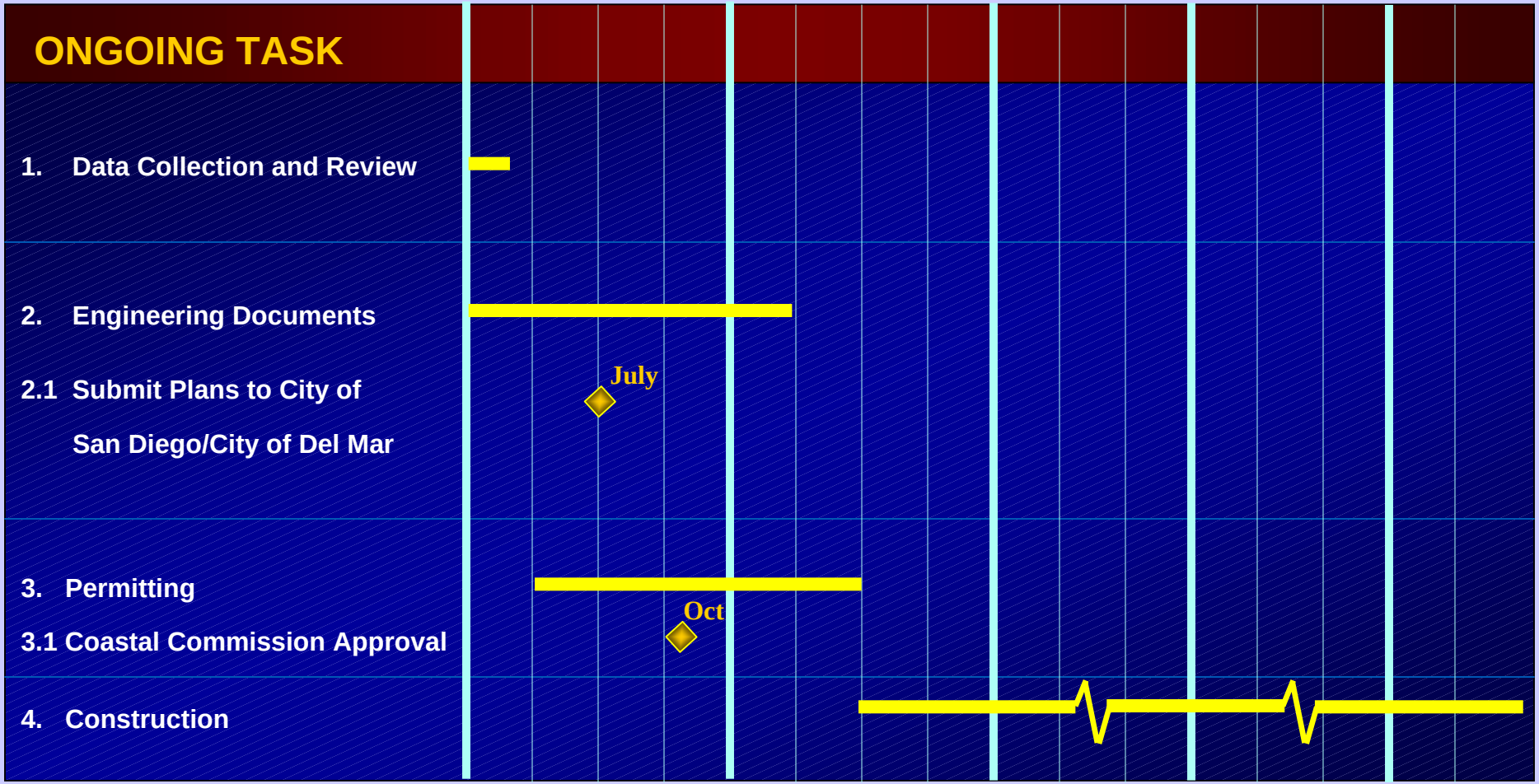
Final Design Activities

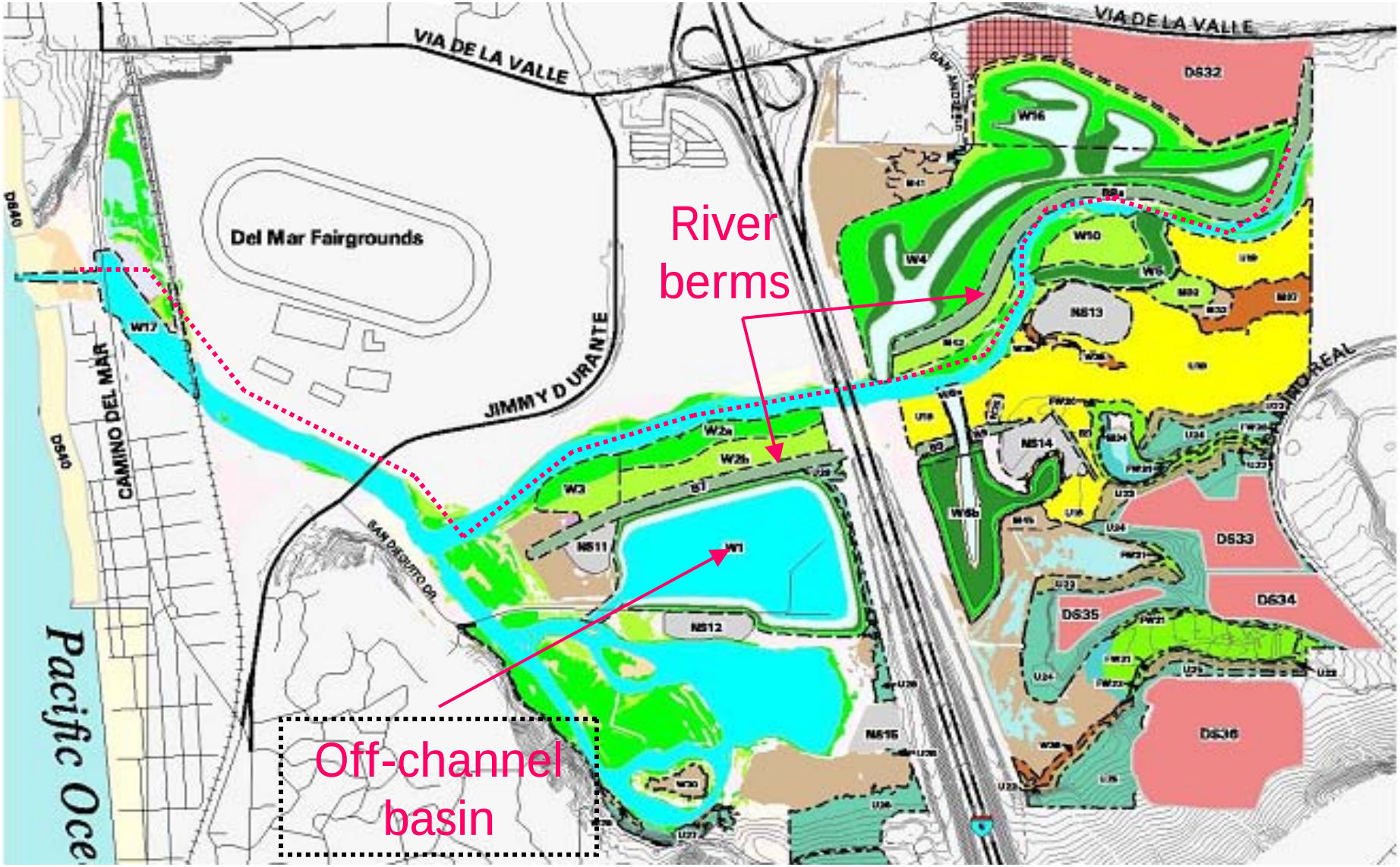
- Review preliminary designs and studies
- Prepare baseline maps
- Ensure project has no effect on infrastructure (bridges, utilities, priv. prop., etc.)
- Design various elements (tidal basins, berms, etc.)
- Preparing final grading plans
- Ensure CCC permit requirements met
- Obtain engineering/grading permits and ensure final design is permittable
- Tech specs for construction

Project Schedule and Key Tasks

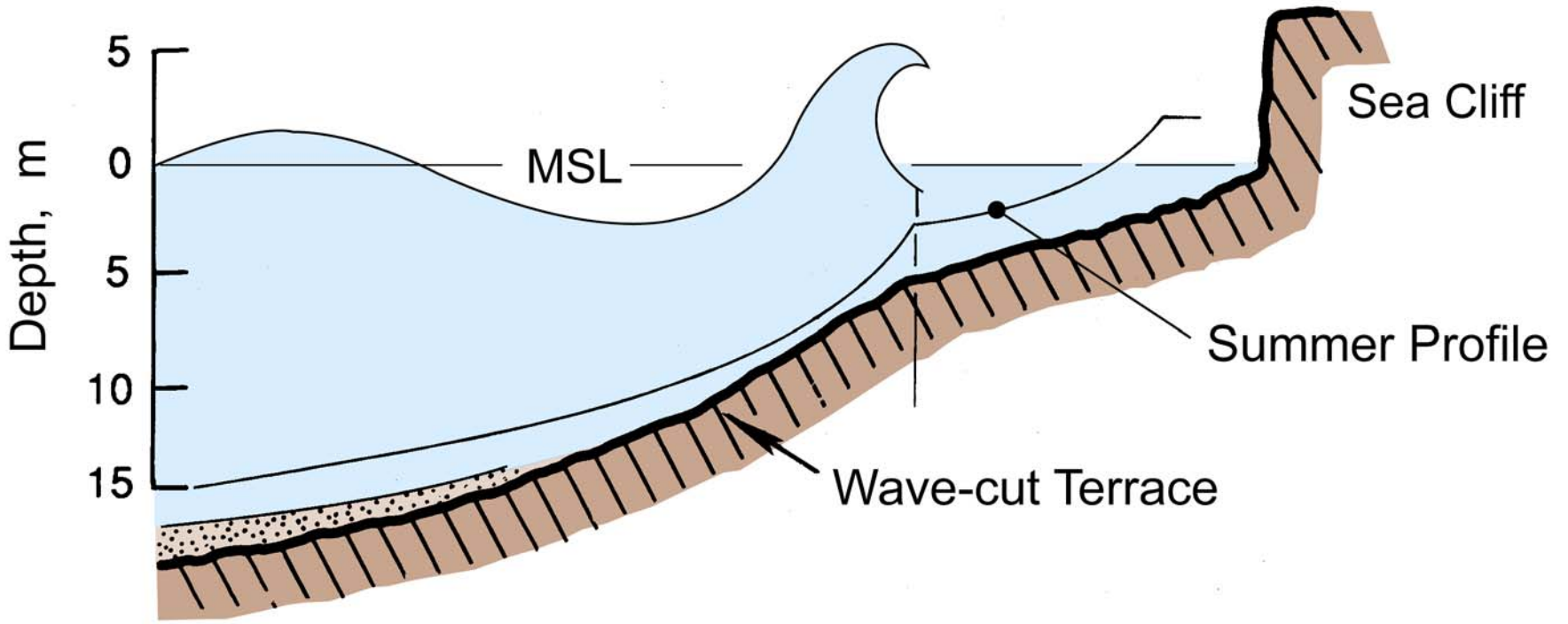
San Dieguito Wetlands Restoration Project

February 18, 2004





Restoration Designed to Convey River Sand Yield Through the Project Site and to the Beach


Depth, m
5
0
5
10
15
MSL
Sea Cliff
Summer Profile
Wave-cut Terrace

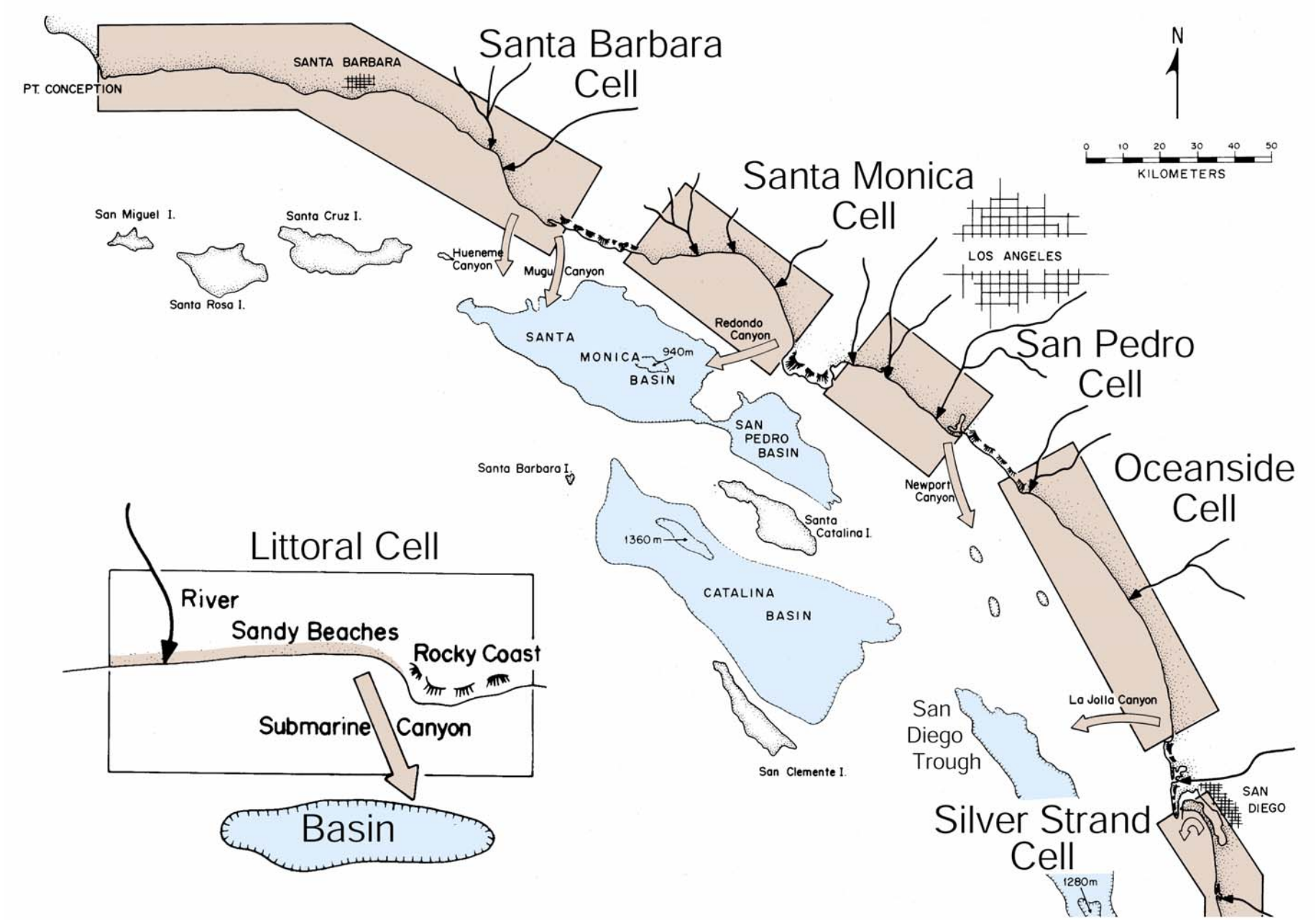
03.k11-16

CRITICAL MASS OF SAND

- **The reservoir of sand over the platform must equal or exceed the critical mass before an equilibrium beach can exist.**

- **The critical beach mass depends on:**
  - **platform size and slope**
  - **wave climate**
  - **sand size**

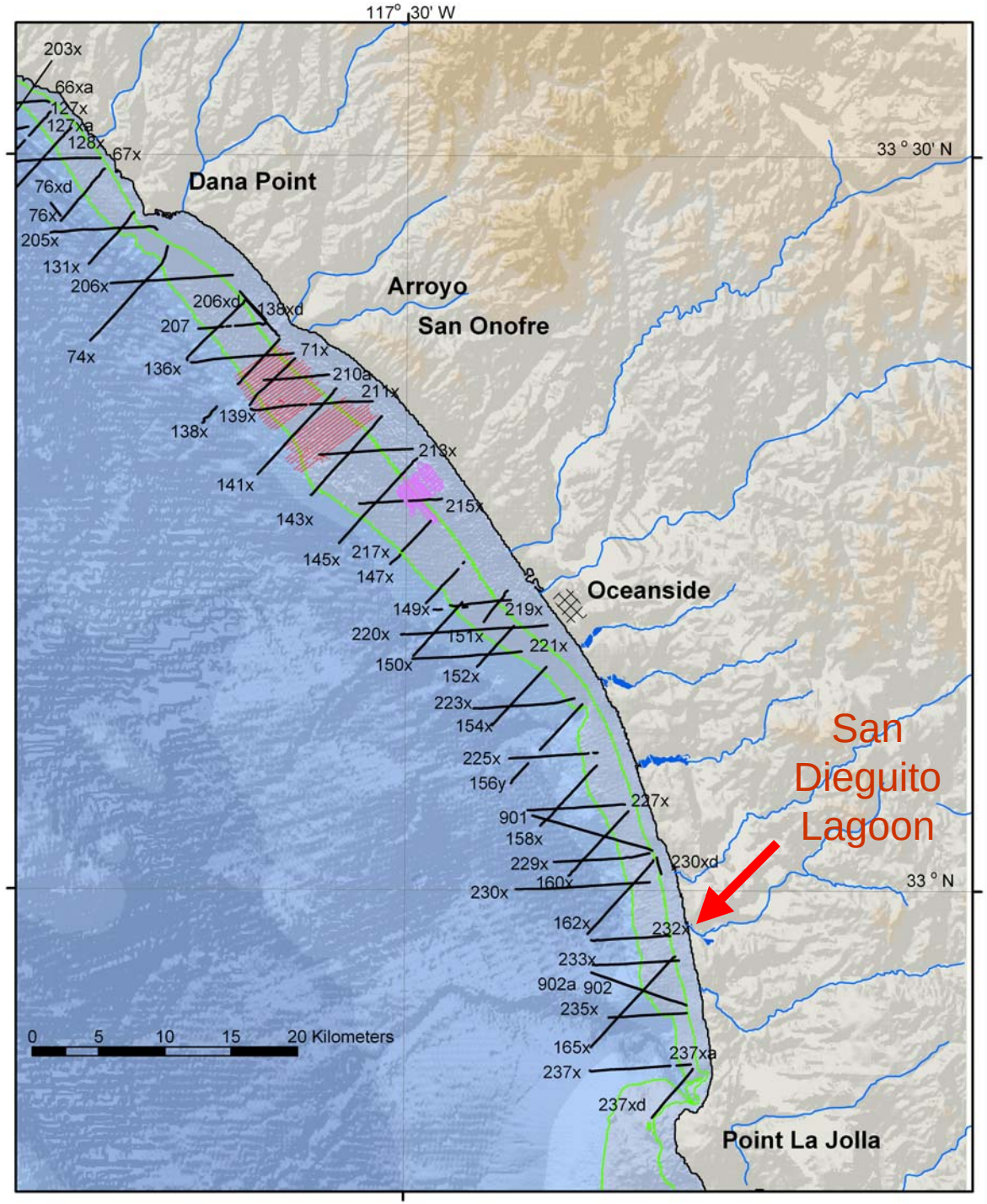
- **When the quantity of beach sand equals or exceeds the critical mass, beaches undergo equilibrium adjustments during storms. When the quantity is less than the critical mass, large waves cause disequilibrium and offshore loss of sand.**

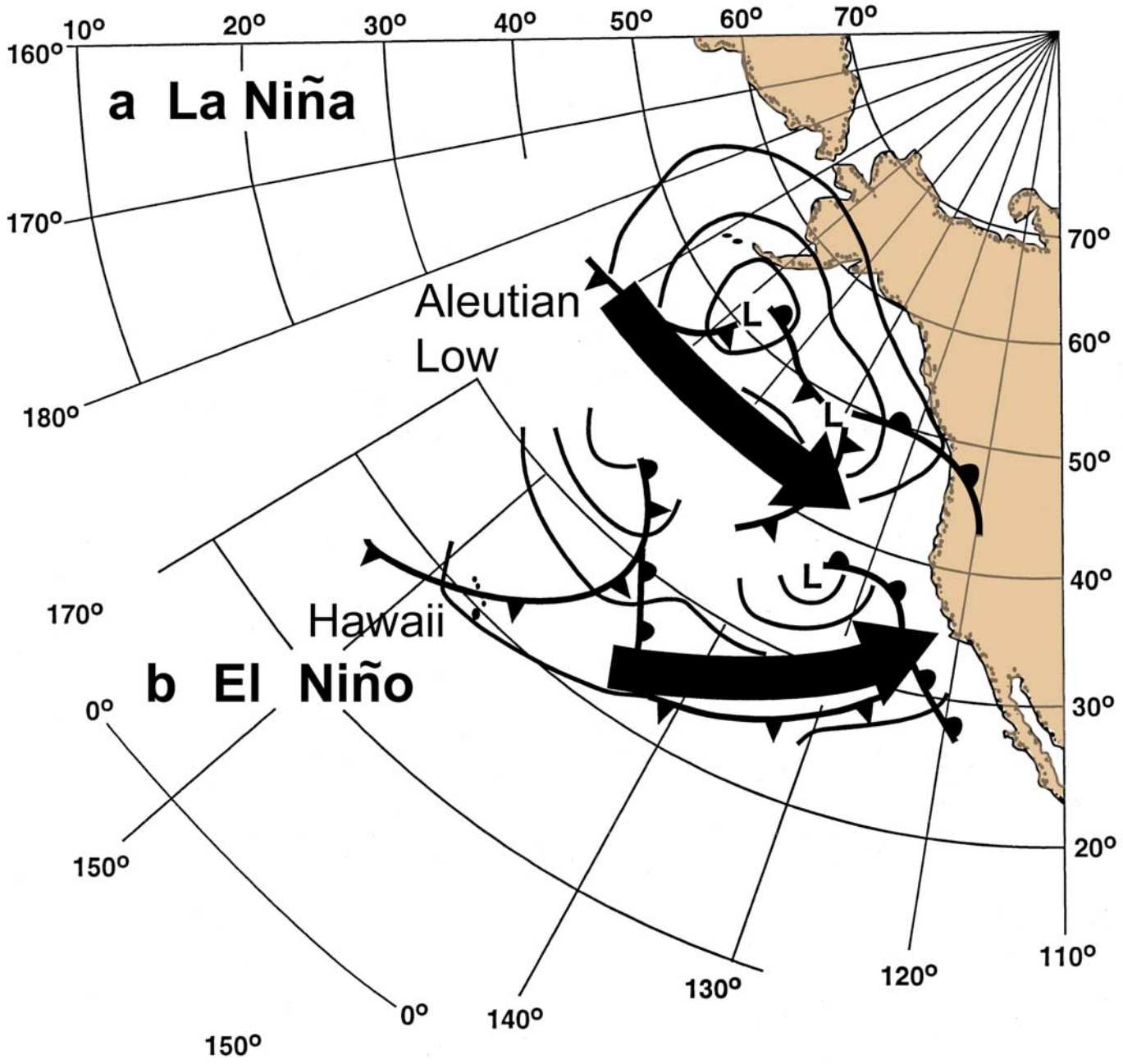


Littoral cells of the Southern California Bight [after Inman and Frautschy, 1965].

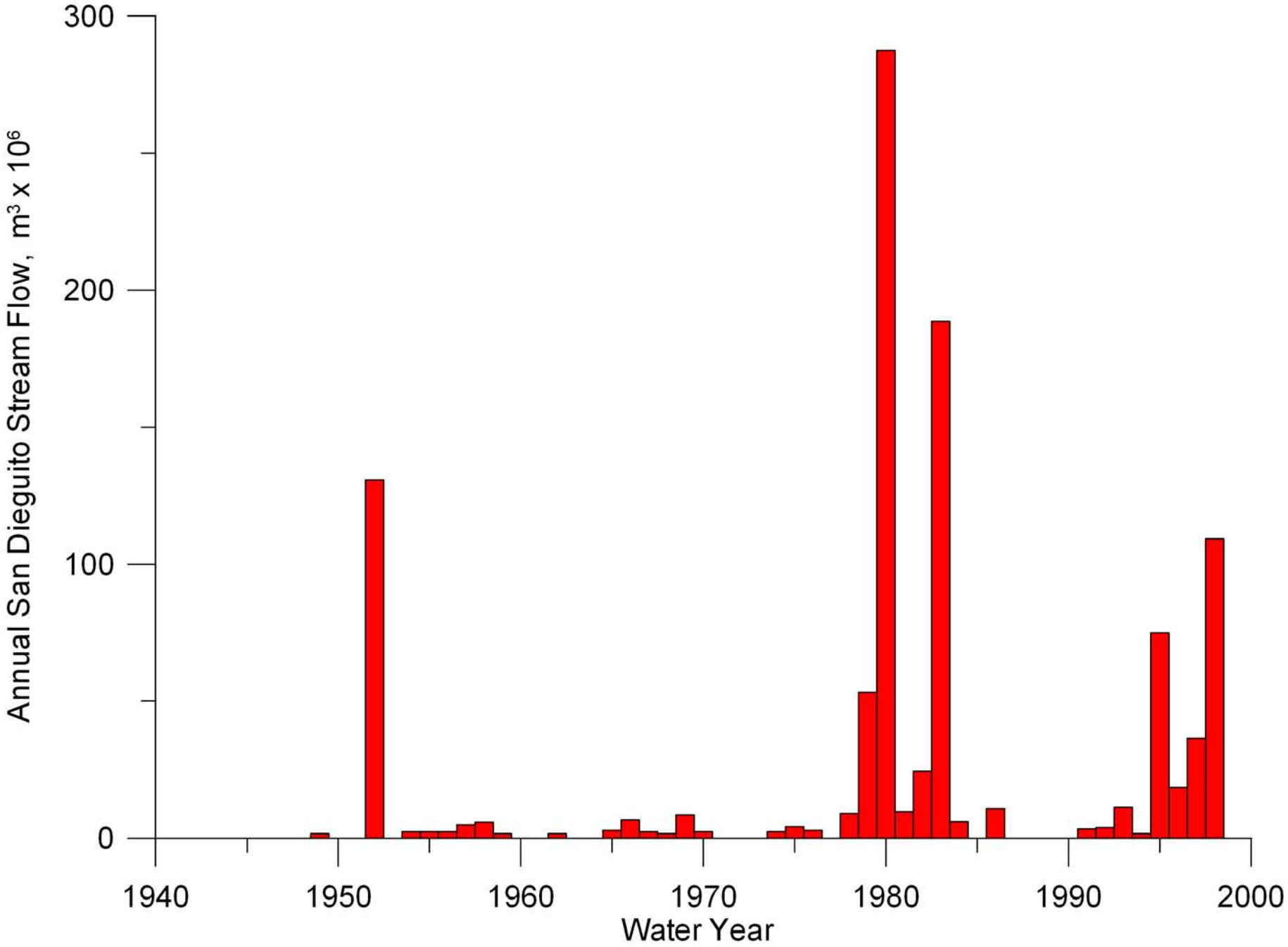
02.k1-1d

1,000,000 m^3/yr Average Transport Rate, Oceanside Littoral Cell





Seasonal and decadal storm tracks.


300
200
100
0
Annual San Dieguito Stream Flow, m³ x 10⁶
1940
1950
1960
1970
1980
1990
2000
Water Year

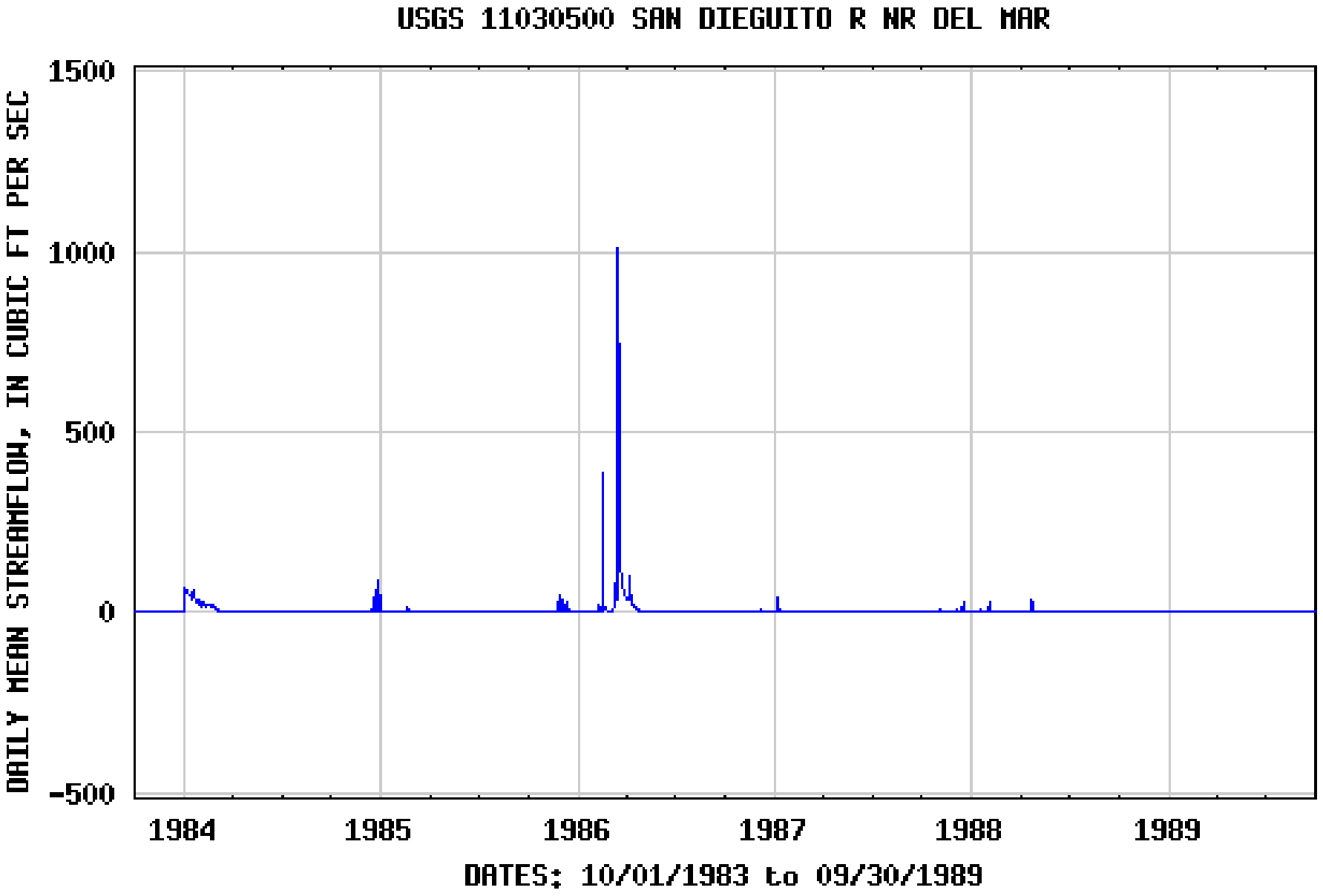
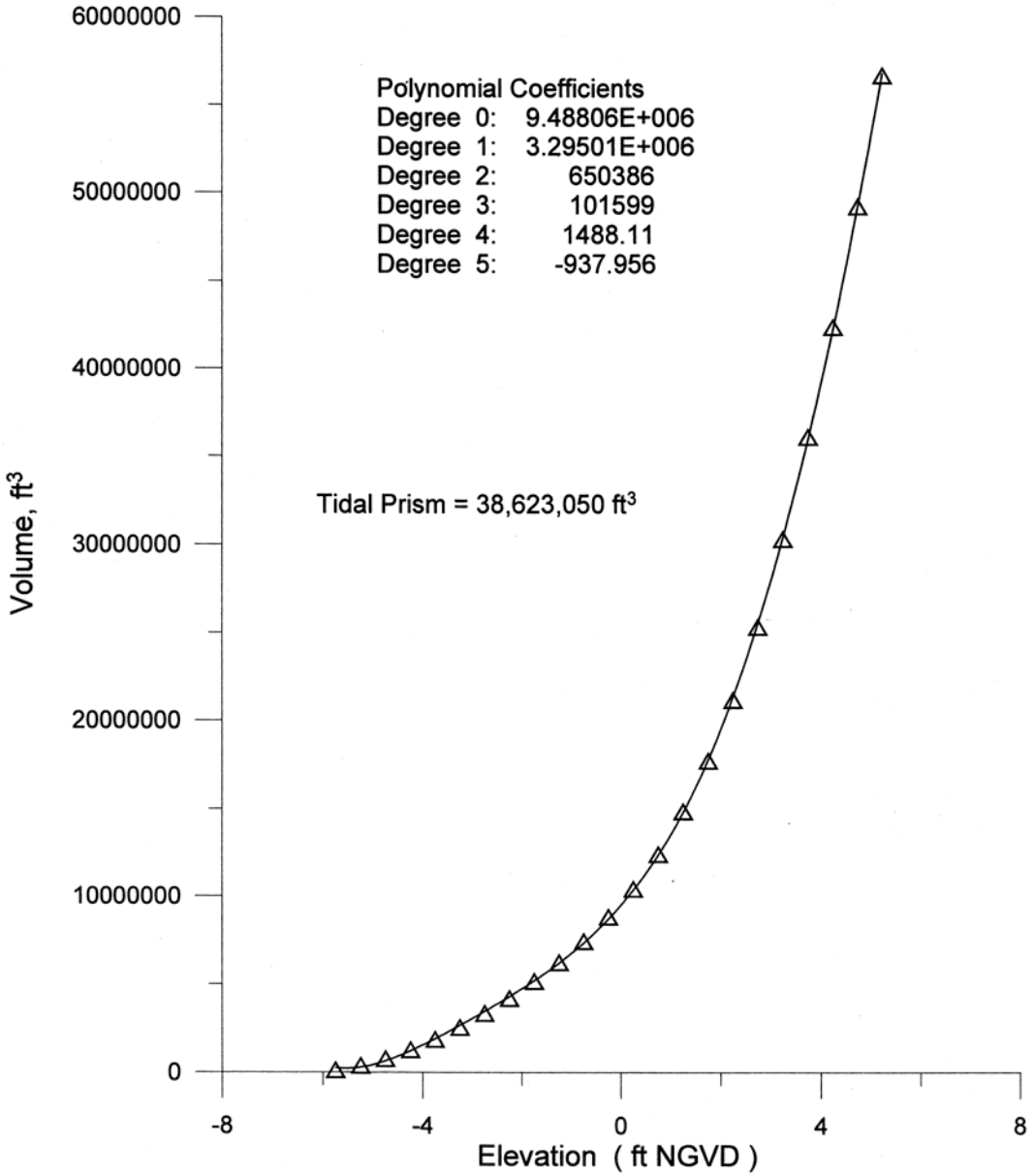

USGS 11030500 SAN DIEGUITO R NR DEL MAR
DAILY MEAN STREAMFLOW, IN CUBIC FT PER SEC
1500
1000
500
0
-500
1984
1985
1986
1987
1988
1989
DATES: 10/01/1983 to 09/30/1989

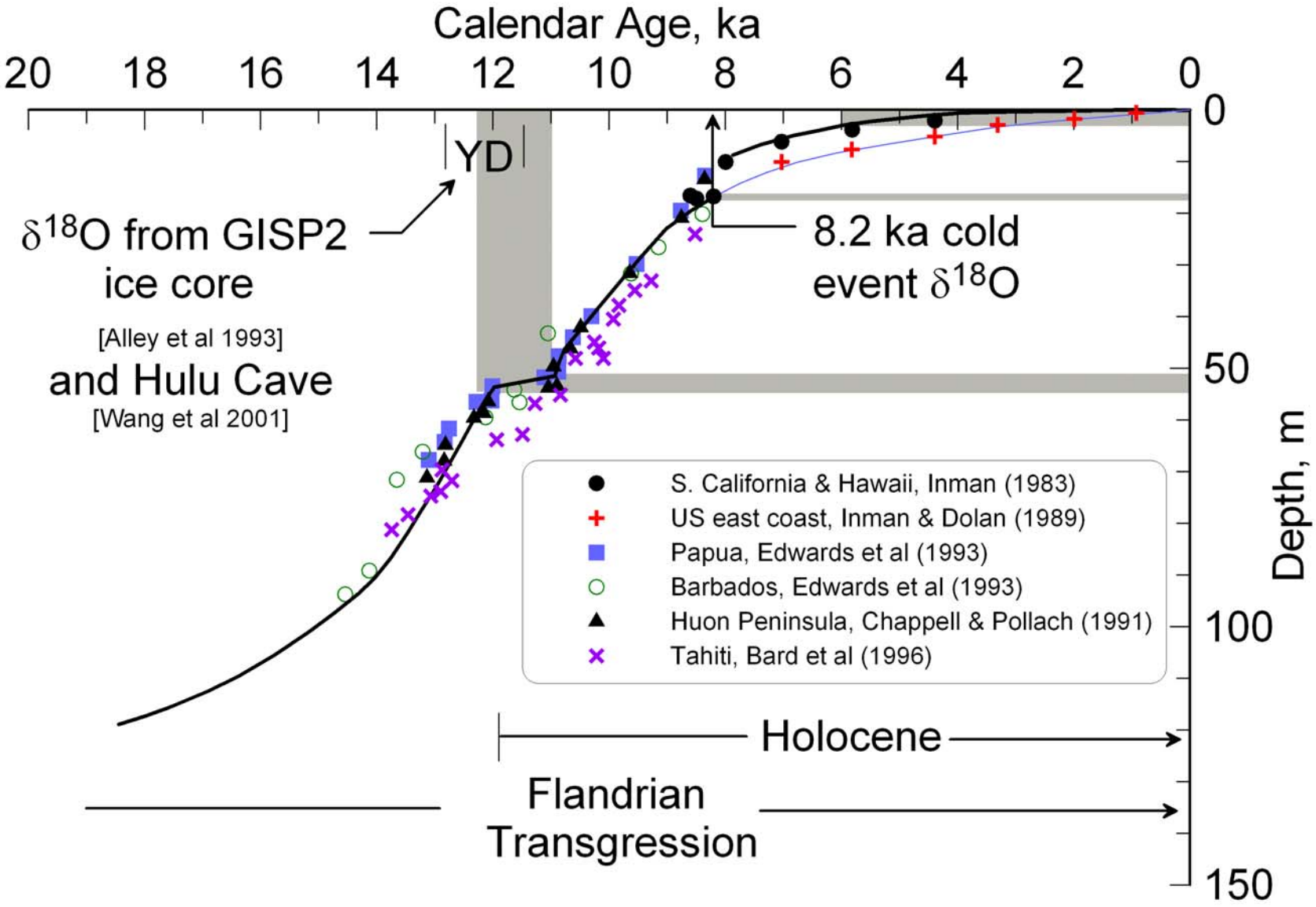
Figure 4. Storage Rating Function - Mixed Habitat Final Plan[a]
with W-16 and Without W-6a &b; Inlet Sediment Trap at -2ft NGVD;
San Dieguito Lagoon, CA



[a]based on grading plan of Moffatt & Nichol Engineers, 10 Jan 2001

Table 4. Tidal Transport Characteristics.

	Velocity Skewness	Transport Ratio (Q_{flood}/Q_{ebb})	% Reduction of Influx Rate
Existing Conditions	1.56	3.77	0%
Mixed Habitat Plan	1.12	1.39	63%
Edison Plan (without W6a & W6b)	1.17	1.60	57%
Final Plan (with W6a & W6b)	1.14	1.49	60%



Sea level during the Flandrian transgression [from Inman et al., 2002].