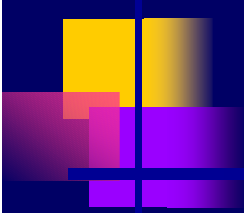


# SAND DISPOSAL OPTIONS FOR AGUA HEDIONDA LAGOON, CARLSBAD, CALIFORNIA

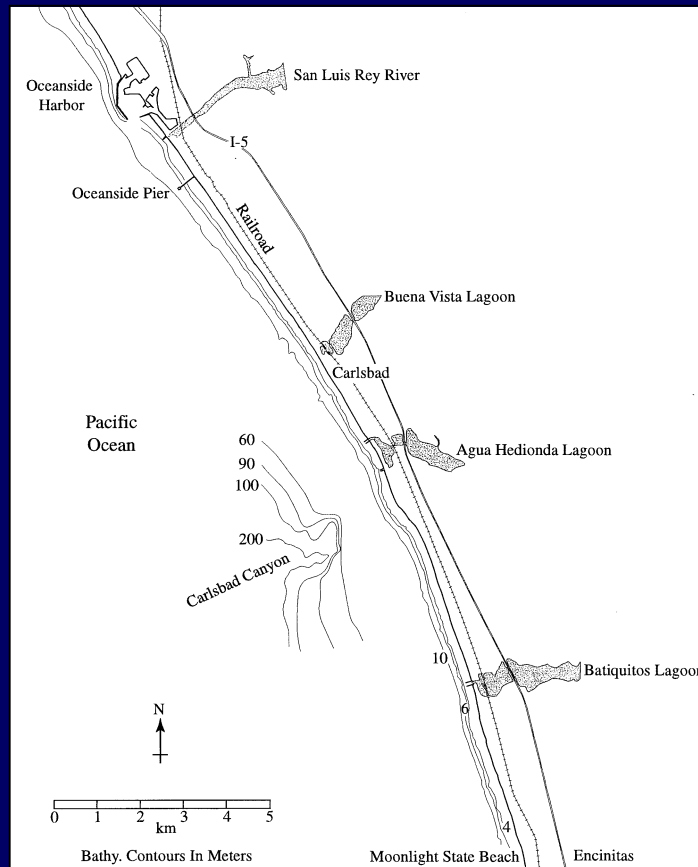


Hany Elwany, Ph.D  
Coastal Environments  
and  
Steve Jantz, Engineer  
City of Carlsbad

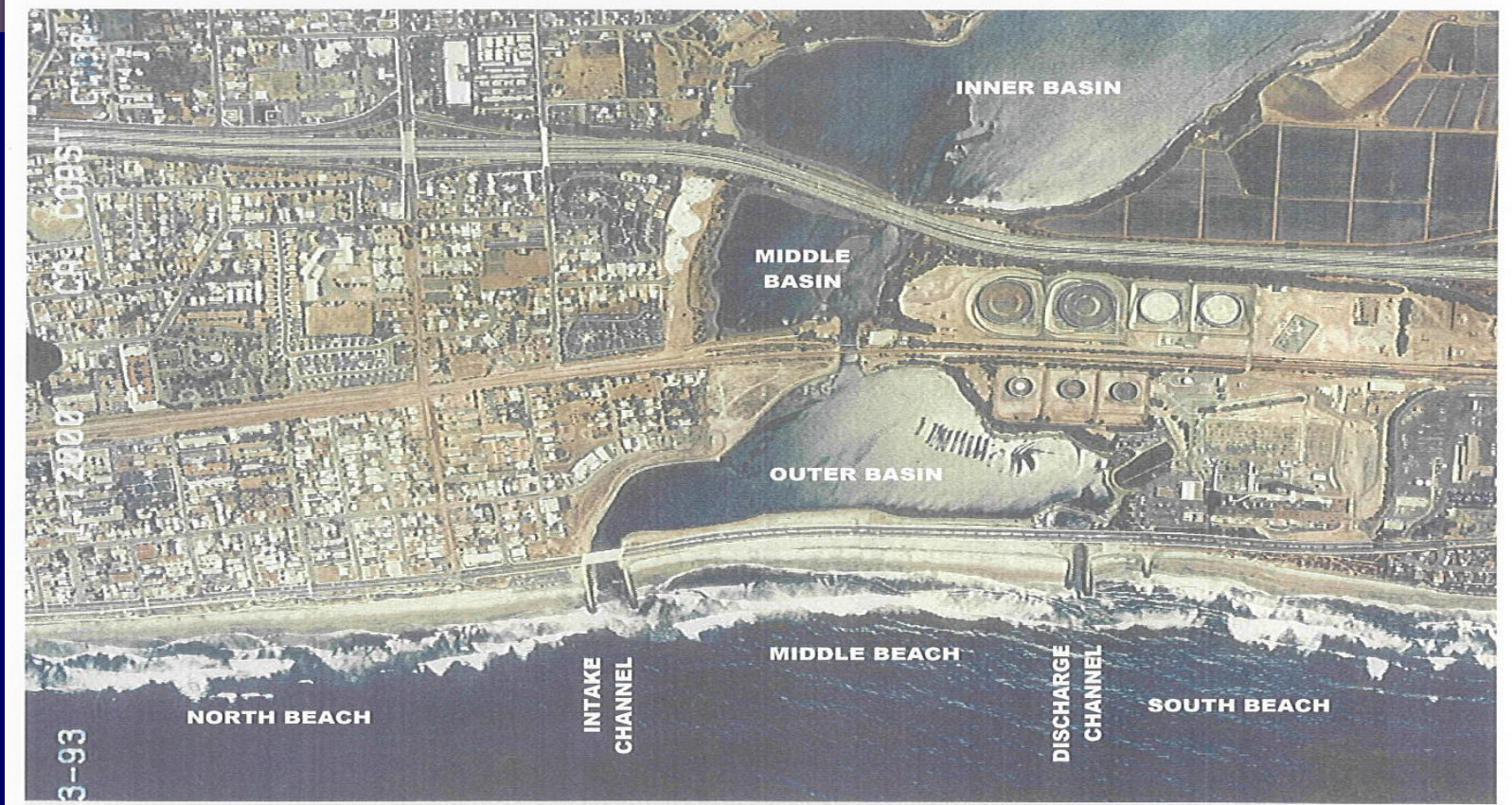
29 October 2004  
CE Ref. No. 04-16



# Location of Agua Hedionda Lagoon



# Aerial Photo of Agua Hedionda Lagoon





# Project Background and Purpose

- Agua Hedionda Lagoon is situated next to the Encina Power Plant.
- Plant operations result in reduced flushing in the lagoon inlet, which in turn results in sand accumulation.
- This sediment must be dredged from the Agua Hedionda Lagoon and disposed of elsewhere.
- The purpose of this study was to evaluate the various disposal options and to select the optimal solution.
- In order to evaluate the options, it was necessary to perform an analysis of sediment transport in the vicinity.



# Criteria for Selection of Optimal Disposal Option

- The option chosen was expected to meet the following 4 objectives:
  - To replenish sand removed from littoral transport by the power plant.
  - To minimize the need to re-dredge the lagoon.
  - To maximize public recreational benefits.
  - To mitigate beach erosion.





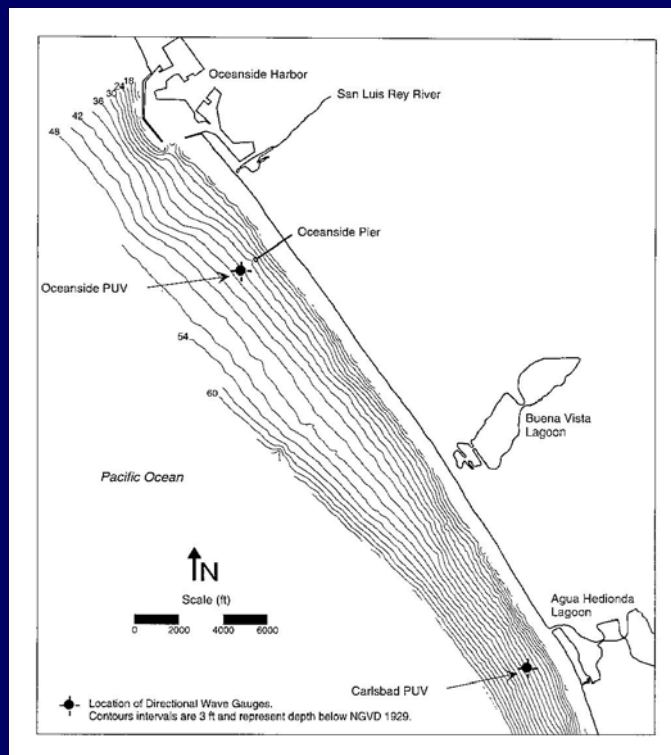
# Tasks Performed

- Review coastal processes and sediment transport in the area
- Evaluate the effects of the Encina Power Plant and Agua Hedionda Lagoon on sediment transport and deposition
- Identify areas that could serve as stable sand deposition sites
  - If stability is equal, identify sites that will increase recreational benefits
- Develop and evaluate placement options for the dredged sediment

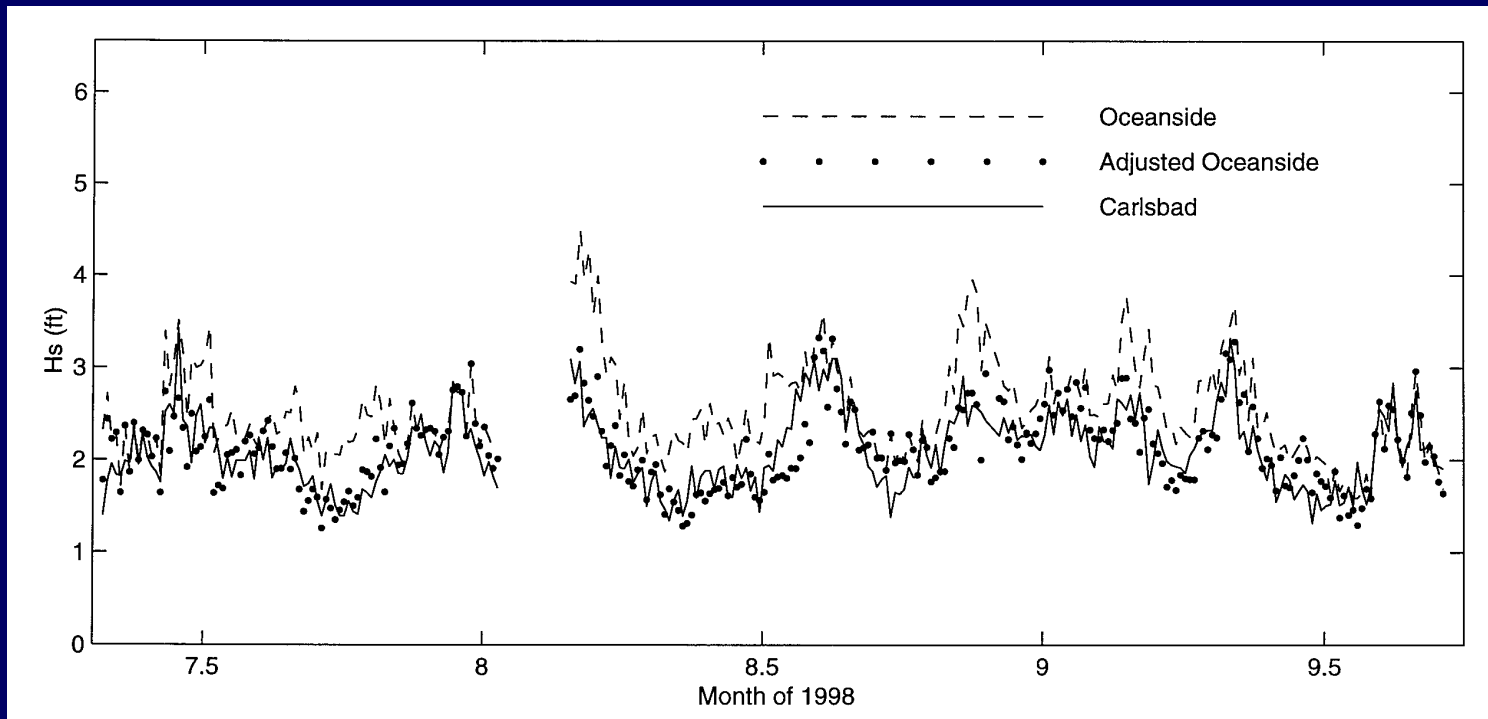


# Sediment Transport Around Agua Hedionda Lagoon

## Wave Experiment (For 2 Months)

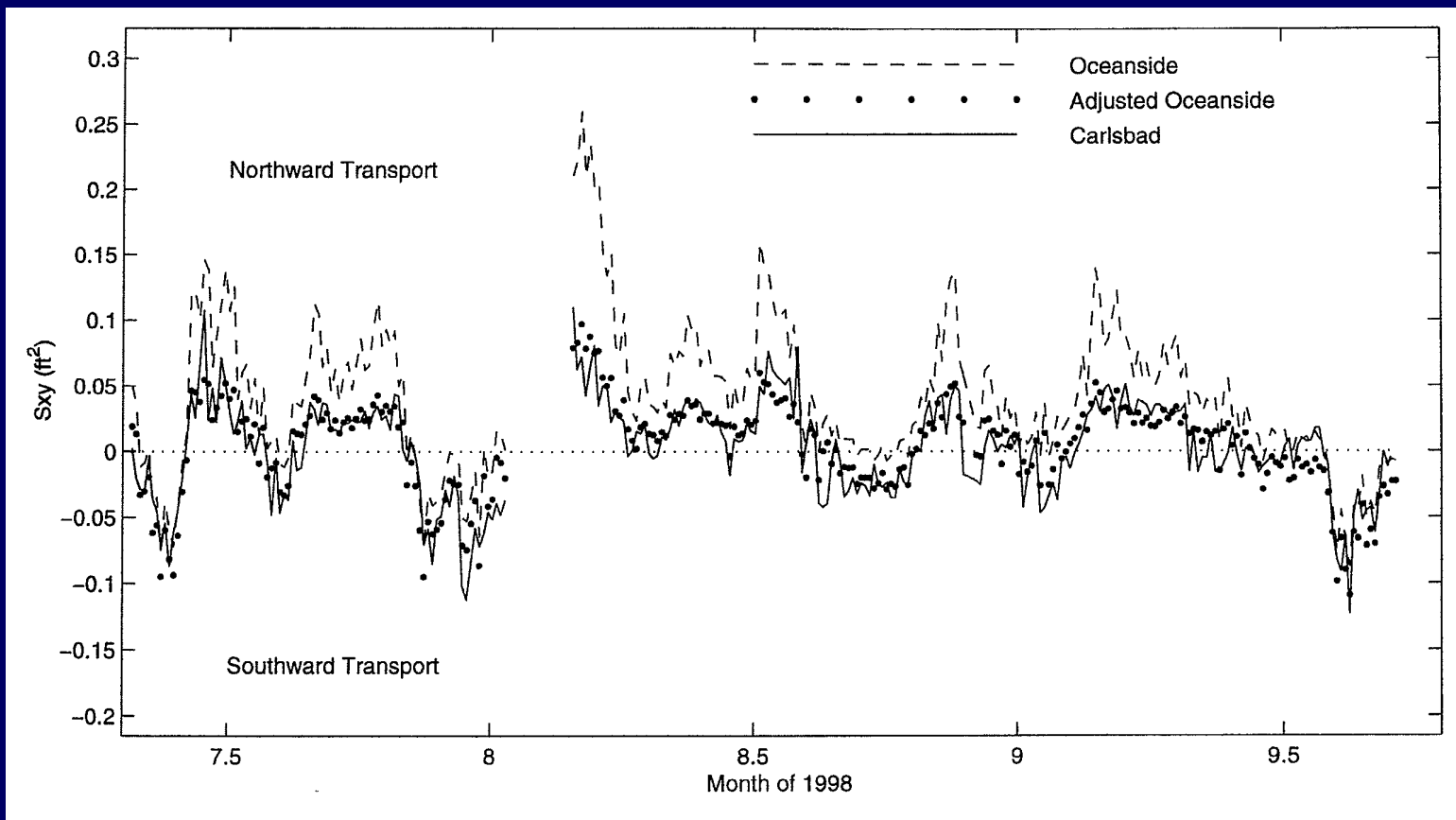


# Sediment Transport Around Agua Hedionda Lagoon

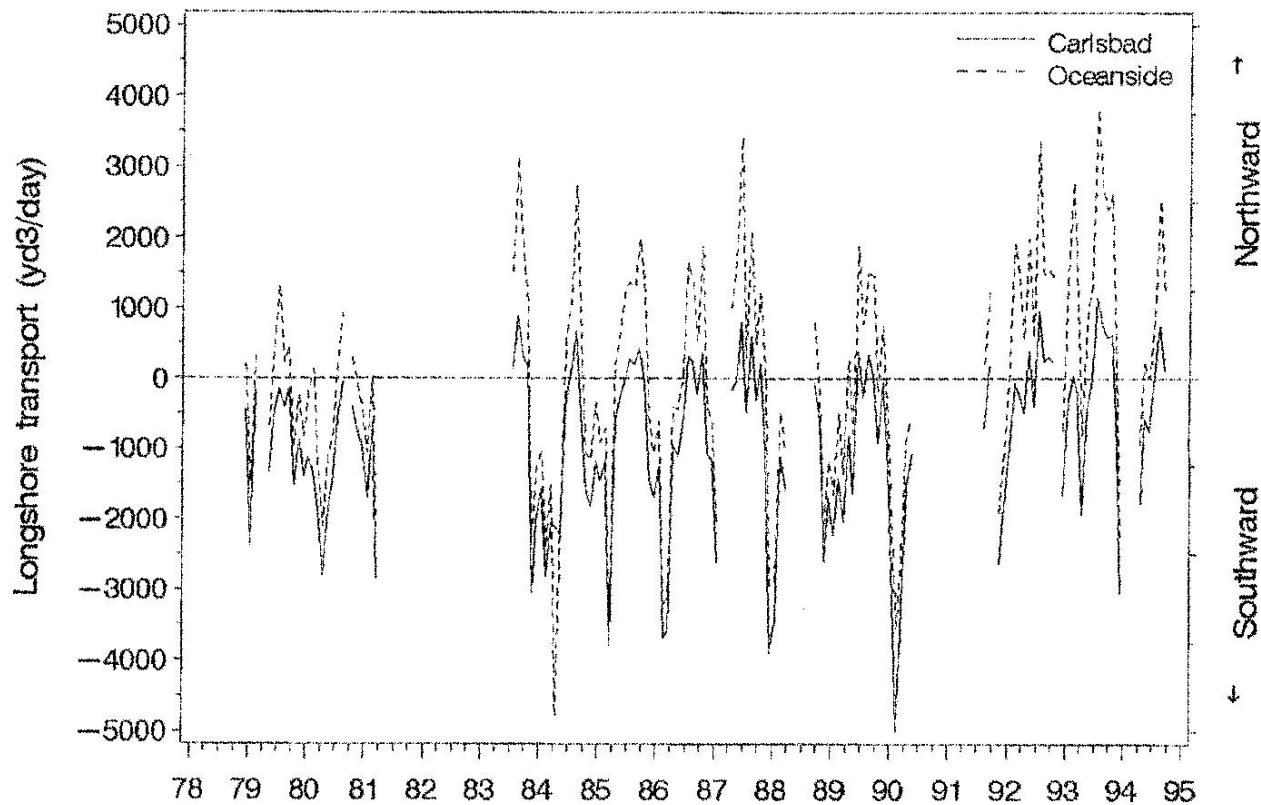




# Sediment Transport Around Agua Hedionda Lagoon

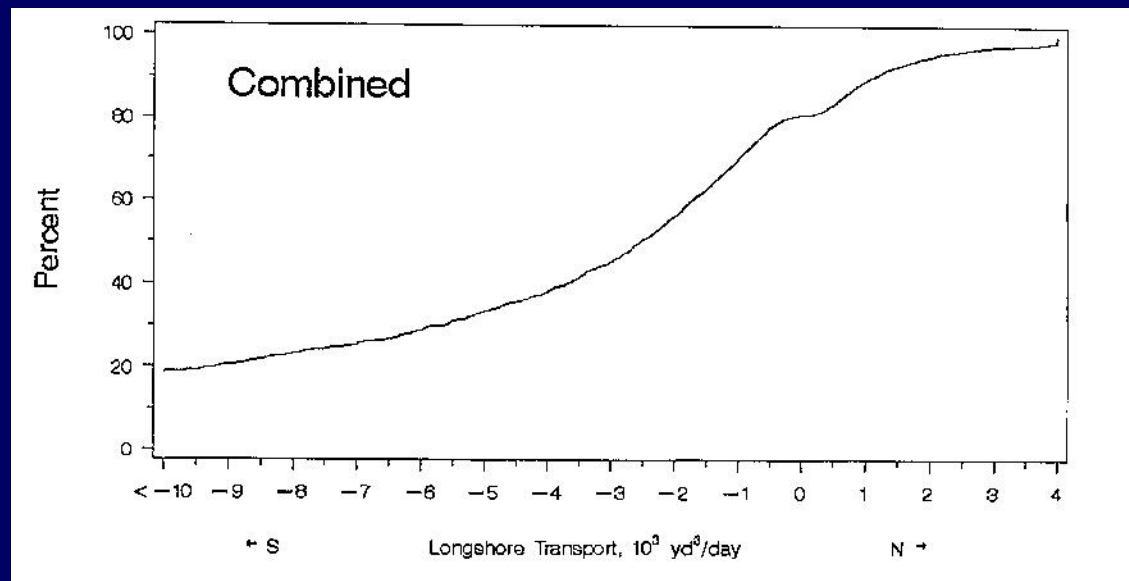


# Sediment Transport Around Agua Hedionda Lagoon



# Sediment Transport Around Agua Hedionda Lagoon

- Cumulative Sand Transport at Carlsbad  
(Negative to the south, positive to the north)  
80% to the south and 20% to the north, due to Carlsbad Canyon



# Sediment Transport Around Agua Hedionda Lagoon

Variable	Oceanside		Carlsbad	
	yd <sup>3</sup>	m <sup>3</sup>	yd <sup>3</sup>	m <sup>3</sup>
Mean north transport per day	1,757	1,343	784	599
Mean south transport per day	-2,036	-1,557	-1,865	-1,426
Transport to the north per year	320,625	245,150	113,059	86,445
Transport to the south per year	-371,570	-284,102	-425,316	-325,197
Gross transport per year	692,195	529,252	538,375	411,642
Net transport per year	-50,945	-38,953	-312,257	-238,752



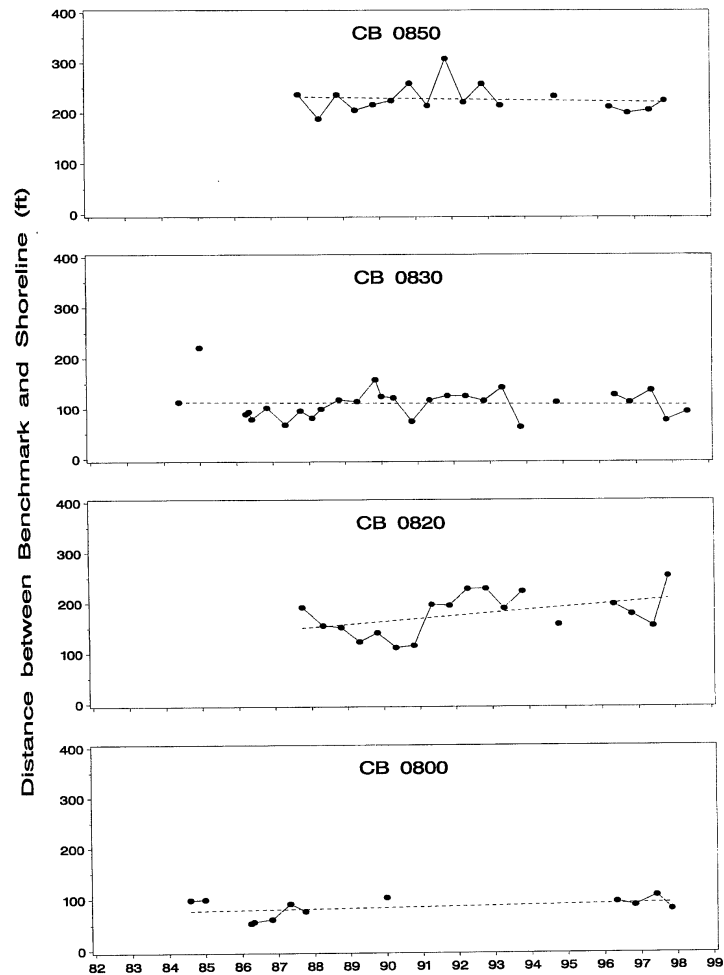
# Shoreline Change Rates

North Beach

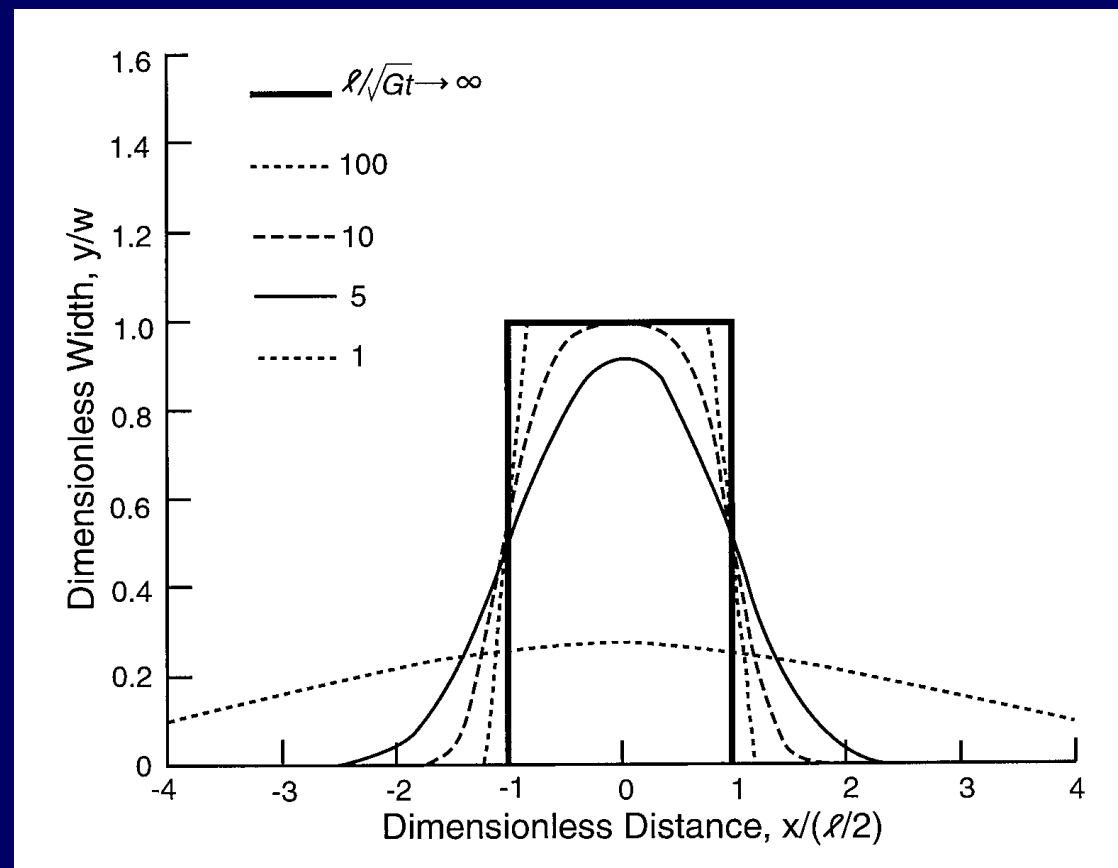
North Beach

Middle Beach

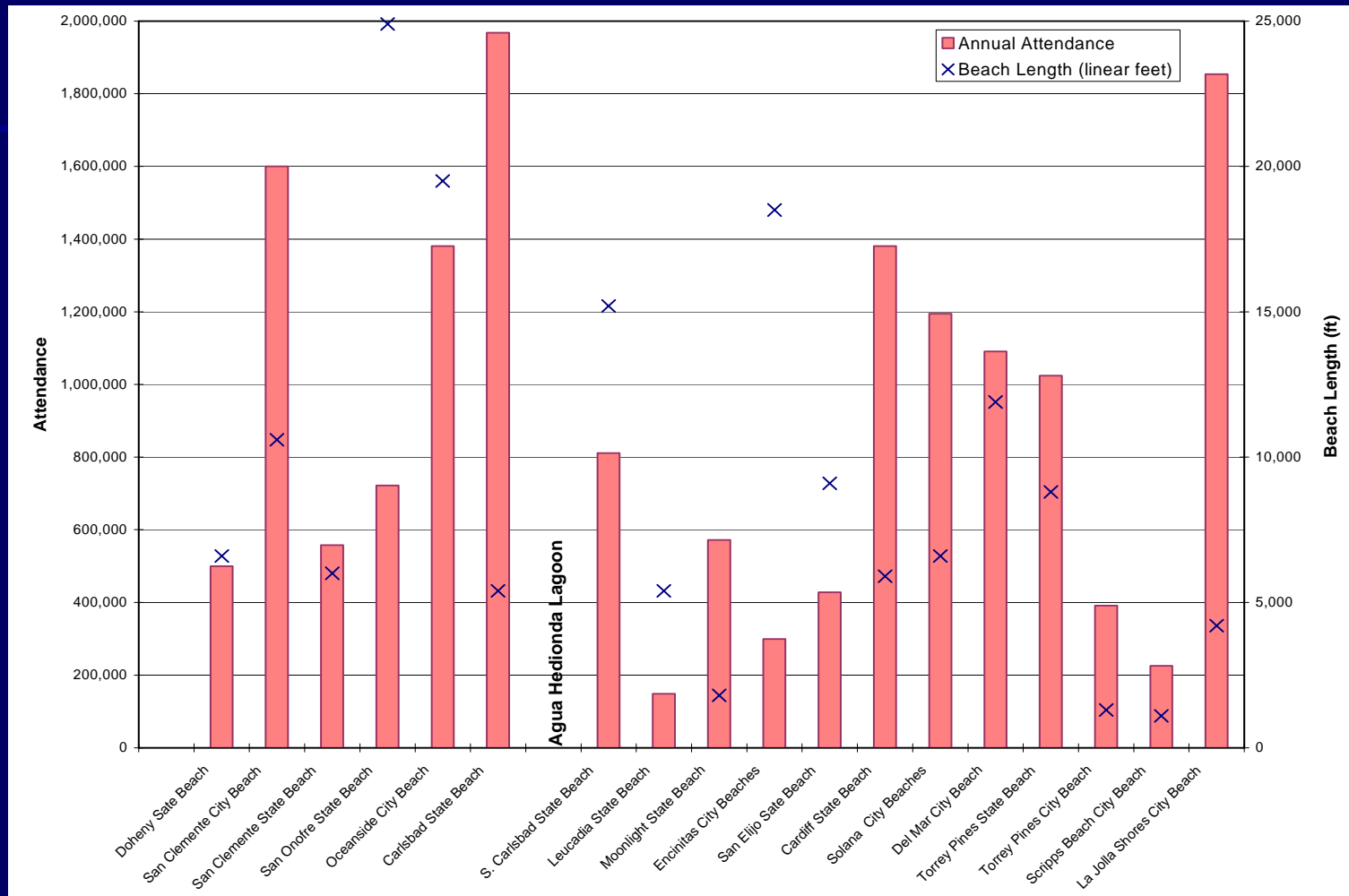
South Beach



# Sand Disposal Behavior



# Annual Beach Attendance





# Sand Placement Options

1. Place 80% of sand on Middle and South Beach and 20% on North Beach.
2. Place sand as far as possible from intake channel (within certain constraints).
3. Distribute sand on all three beaches (North, Middle, and South) in quantities proportionate to beach length available to beach users.
4. Dispose of sand on the three beaches near Agua Hedionda Lagoon that are in need of replenishment due to erosion.







# Option 1

- To replenish sand removed by the operation of the power plant:
  - Place about 80% of the dredged sand on Middle and South Beach and the remaining 20% on North Beach.





# Option 2

- To minimize the need to re-dredge the lagoon:
  - Place dredged sand as far as possible from the intake channel, within the following constraints:
    - For North Beach, a buffer of at least 4,000 ft from the intake channel would be needed to minimize impacts on hard substrate north of the intake channel that extends about 2000 ft.
    - For Middle Beach, a buffer of 500 ft from the intake channel is recommended.





# Option 3

- To maximize public recreational benefits:
  - The sand should be distributed on the three beaches in proportion to the beach length available for beach users.
  - This conclusion is based on the fact that parking is limited near Agua Hedionda Lagoon.
  - Consequently, neither North, Middle, nor South Beach could accommodate the expected increase in visitors that would result from placing all of the sand on one beach.





# Option 4

- To optimally mitigate regional beach erosion:
  - The dredged sand should be disposed of on the 3 beaches near Agua Hedionda Lagoon because:
    - The amount of sand dredged from Agua Hedionda Lagoon is not enough to restore the beaches between Oceanside and La Jolla.
  - This relatively small amount of sand could most effectively be used to address the problems of a more limited area, such as the area near Agua Hedionda Lagoon.





# Stable Disposal Sites

- The study concluded that Middle Beach, South Beach, and North Beach near Pine Avenue could serve as stable disposal sites.
- These beaches can retain sand for longer periods than other beaches in the area.





# Recommendation

- It was recommended that 30% of the dredged sand be placed on North Beach, and 70% be placed on Middle and South Beaches.
- The recommended distribution represented a reasonable compromise between several competing factors, including:
  - Competing needs for the sand,
  - Benefits,
  - Costs, and
  - Environmental constraints on placement.





# Conclusions

- Understanding coastal processes, sediment transport, beach characteristics, biological resources, the fate of added sand, beach usage, parking, and economics can help with management of sand placed on our beaches.

