
Life's a Beach!

What Is a Beach?

What Are Its Dynamics?

How do Humans Affect Beaches?

Beach or No Beach?

1) Beach form controlled by a number of factors:

- ✓ Water motion (waves, tides, and currents)
- ✓ Sediment motion (longshore drift, surf zone ingress and egress)
- ✓ Sediment Input (rivers, bluffs, reefs, and artificial enrichment)
- ✓ Sediment Output (submarine canyons, coastal dunes, and artificial extraction)
- ✓ Offshore bottom contour (narrow vs. broad shelf; gradual vs. steep)
- ✓ Shoreline shape (irregular vs. straight; low relief vs. high relief)

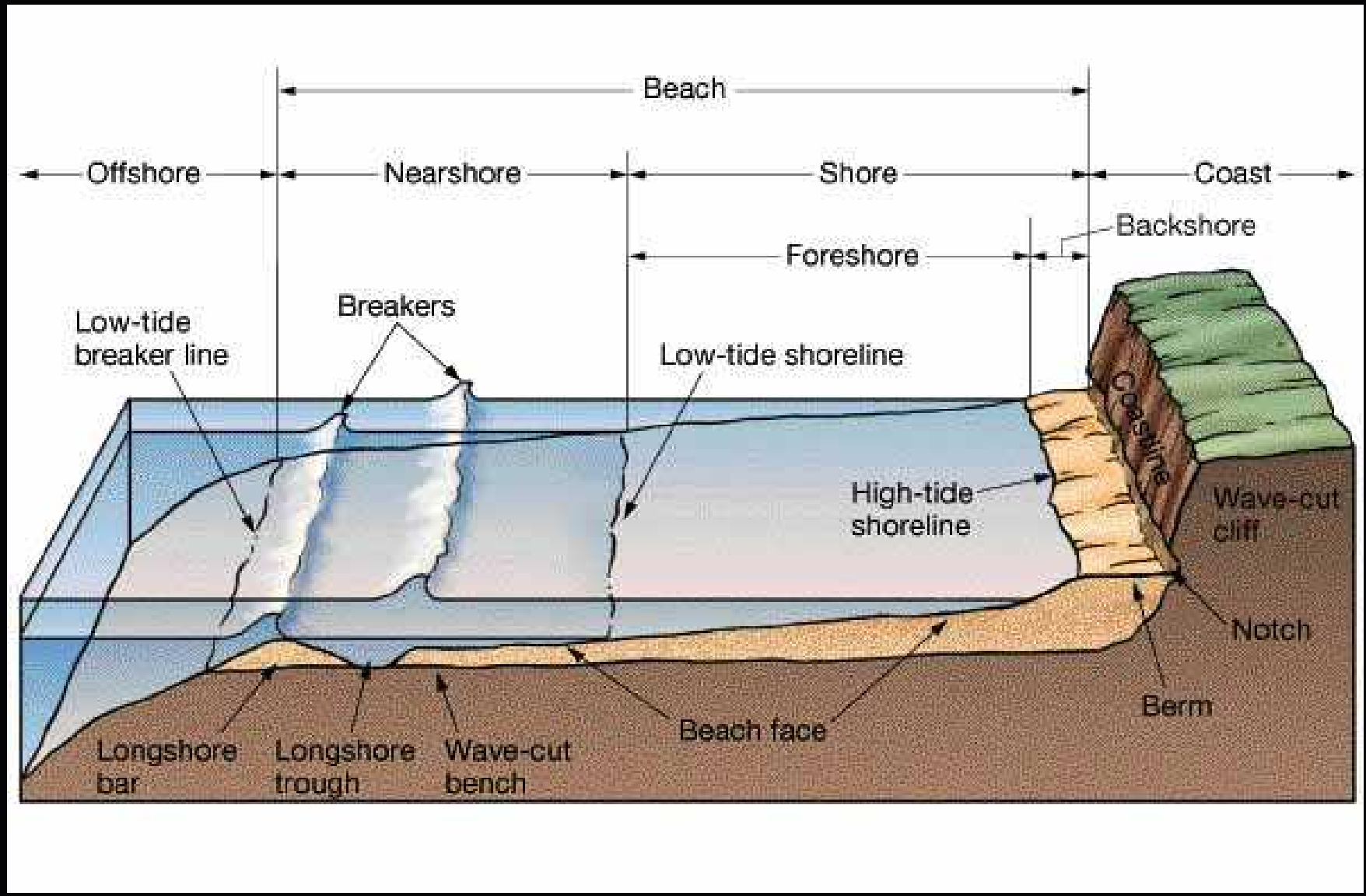
2) The two primary processes affect the beach:

- ✓ Erosion = removal of sediment from beach
- ✓ Deposition = addition of sediment to beach

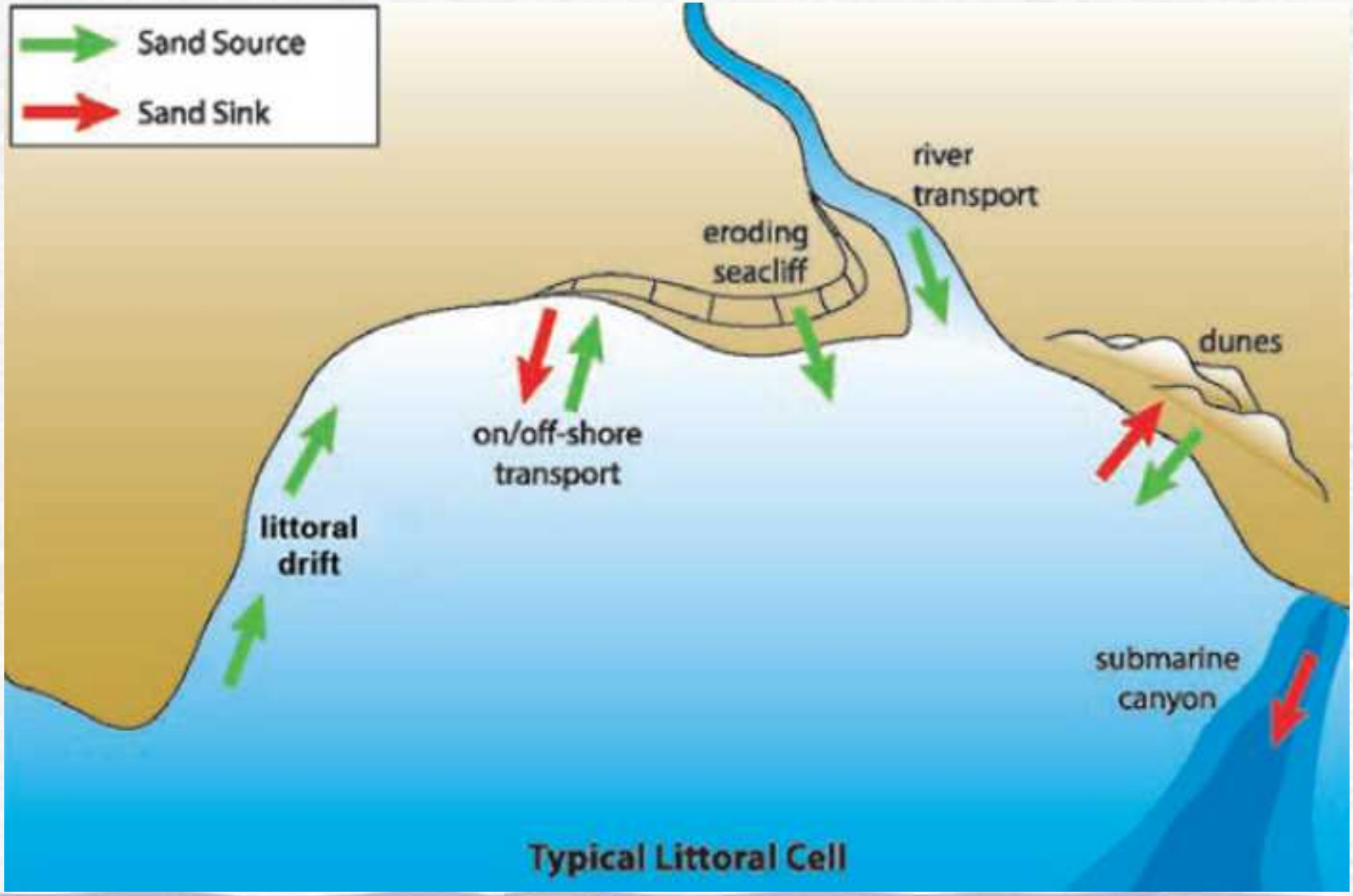
3) Humans attempt to control beach erosion and deposition by building artificial shoreline structures

- ✓ Groins, jetties, breakwaters, seawalls, and reefs
- ✓ Most structures ultimately produce negative effects
- ✓ Major debate over what and what not to do to a shoreline

Beach Anatomy 101



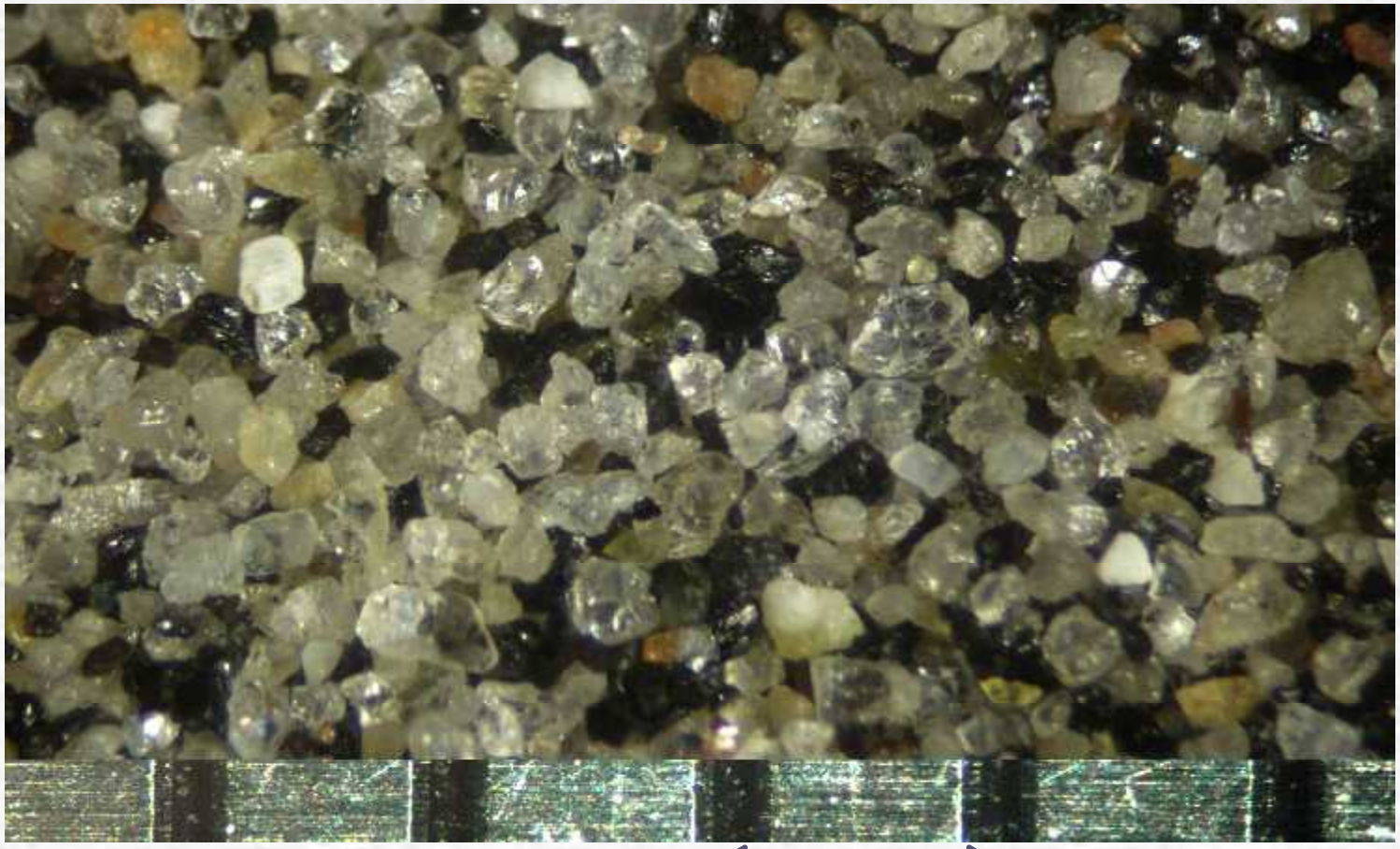
Beach System Sand Account



Natural Sand Replenishment


0 %
Loading

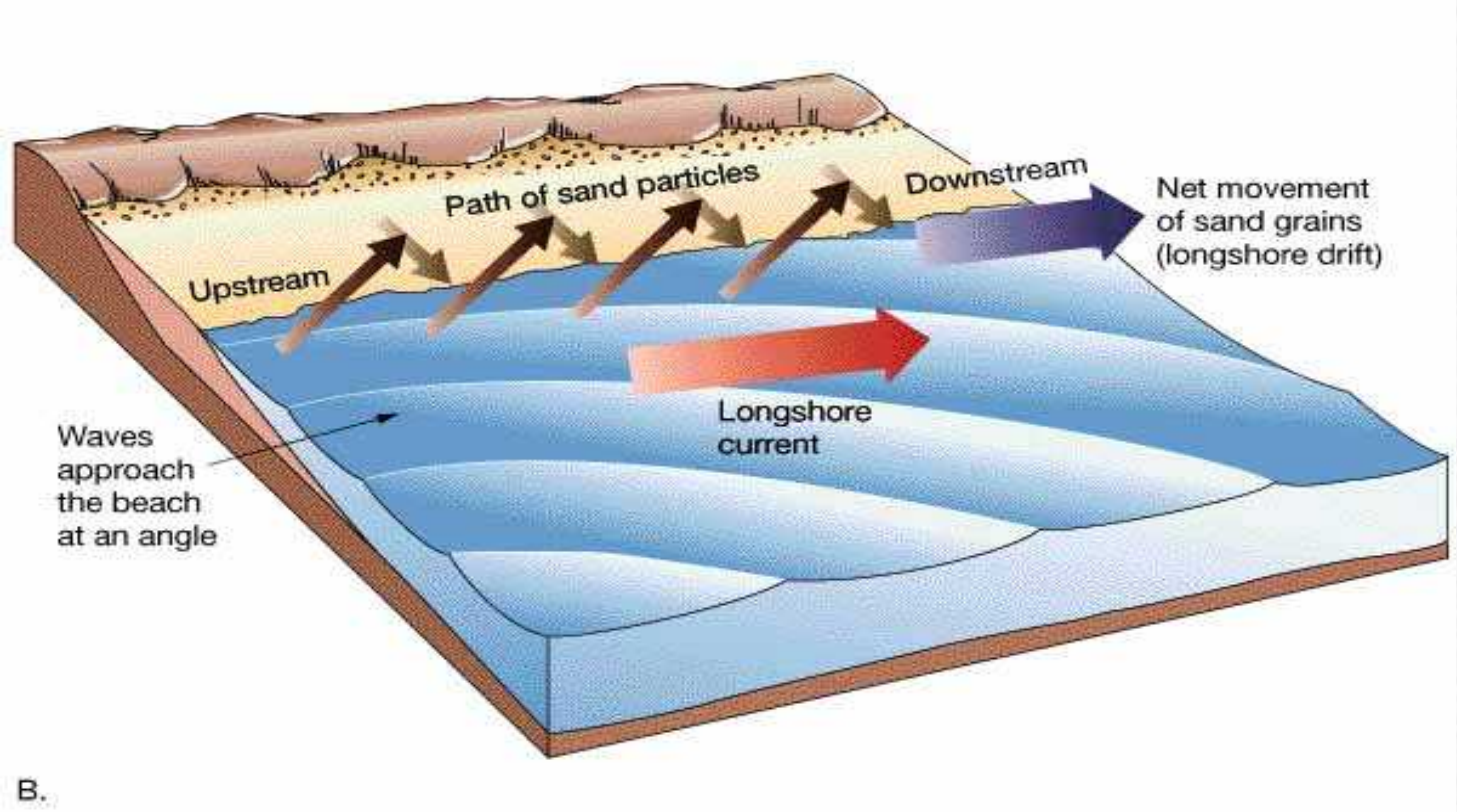
San Diego Beach Sand



1) Quartz 2) Feldspar 3) Hornblende 4) Biotite

5) Pyroxene 6) Muscovite 7) Garnet 8) Magnetite

Beaches and the Longshore Current

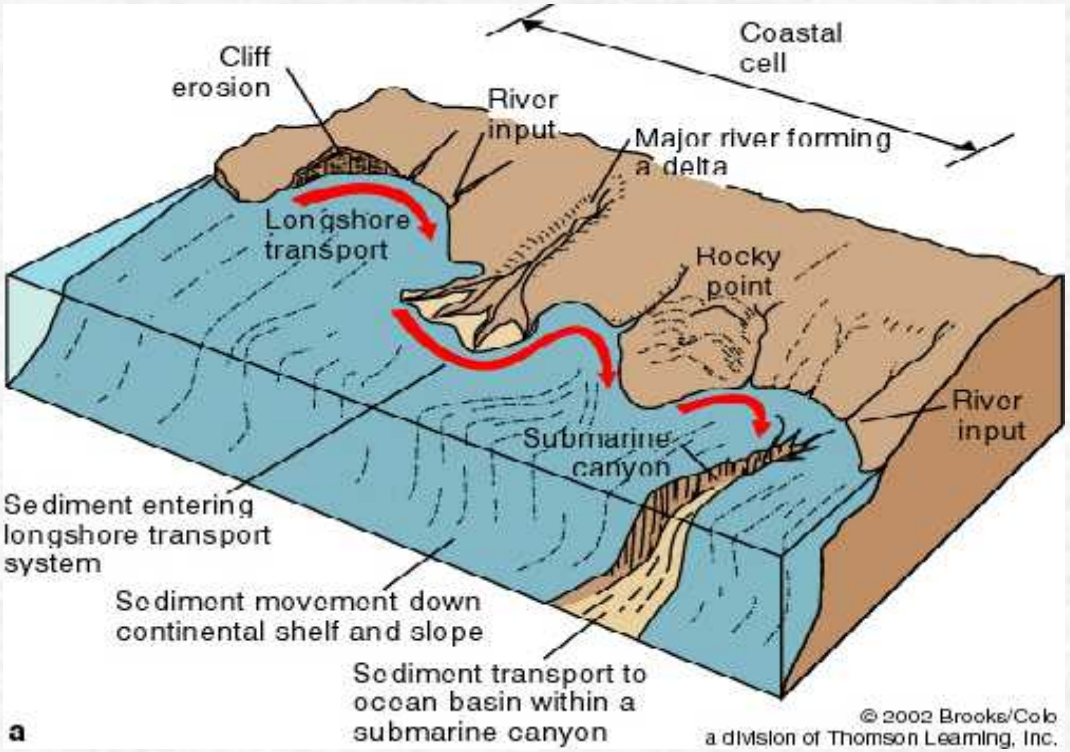


1) In San Diego, the net movement of beach sand is from north to south
2) Most of this movement occurs in the winter and spring months

Coastal Sand Cell Dynamics

1) Sand can move in coastal cells

- Sand enters the coastal cell from rivers and bluffs
- Sand moves down cell as longshore drift
- Sand leaves the coastal cell down submarine canyons



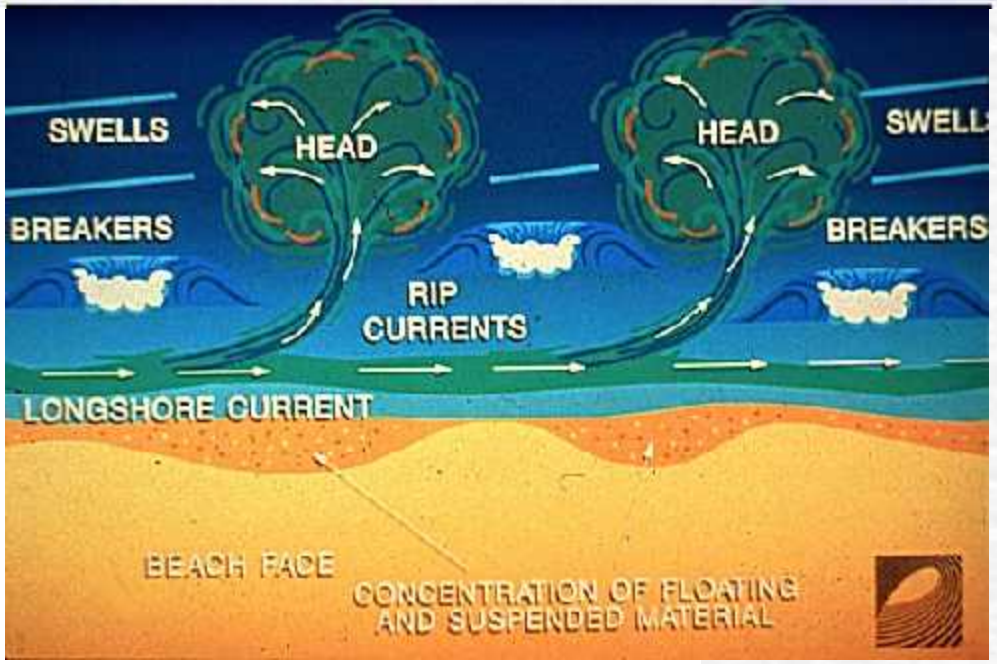
2) If sand input = sand outflow, then a beach will stay about the same size.

- Along most coasts, sand input is much less today, then in the past, mainly because of rivers being dammed

Southern California Sand Cells

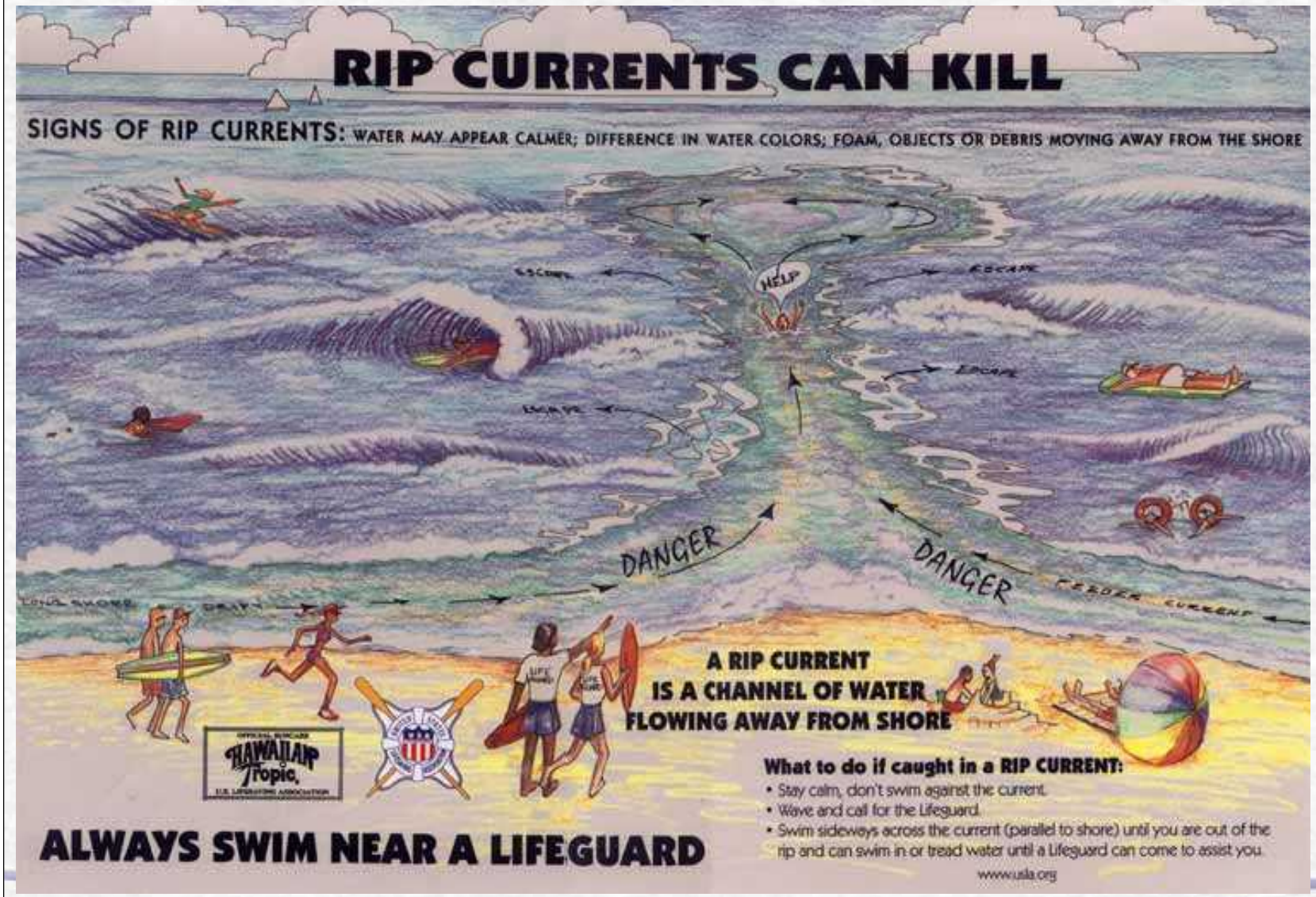
1) There are four sand cells in Southern California
2) Each sand cell starts and ends at a submarine canyon. Why?

Rip Currents



- Rip currents are narrow currents perpendicular to the shore that flow seaward through the surf zone
- Rip currents form when a group of incoming waves piles water up onto the beach
- The water exits rapidly seaward through the path of least resistance – usually along channeled out low spots in the bottom beneath the surf zone

Break the Grip of the Rip!



Shorelines – The Human Factor

People Pressure on Shorelines

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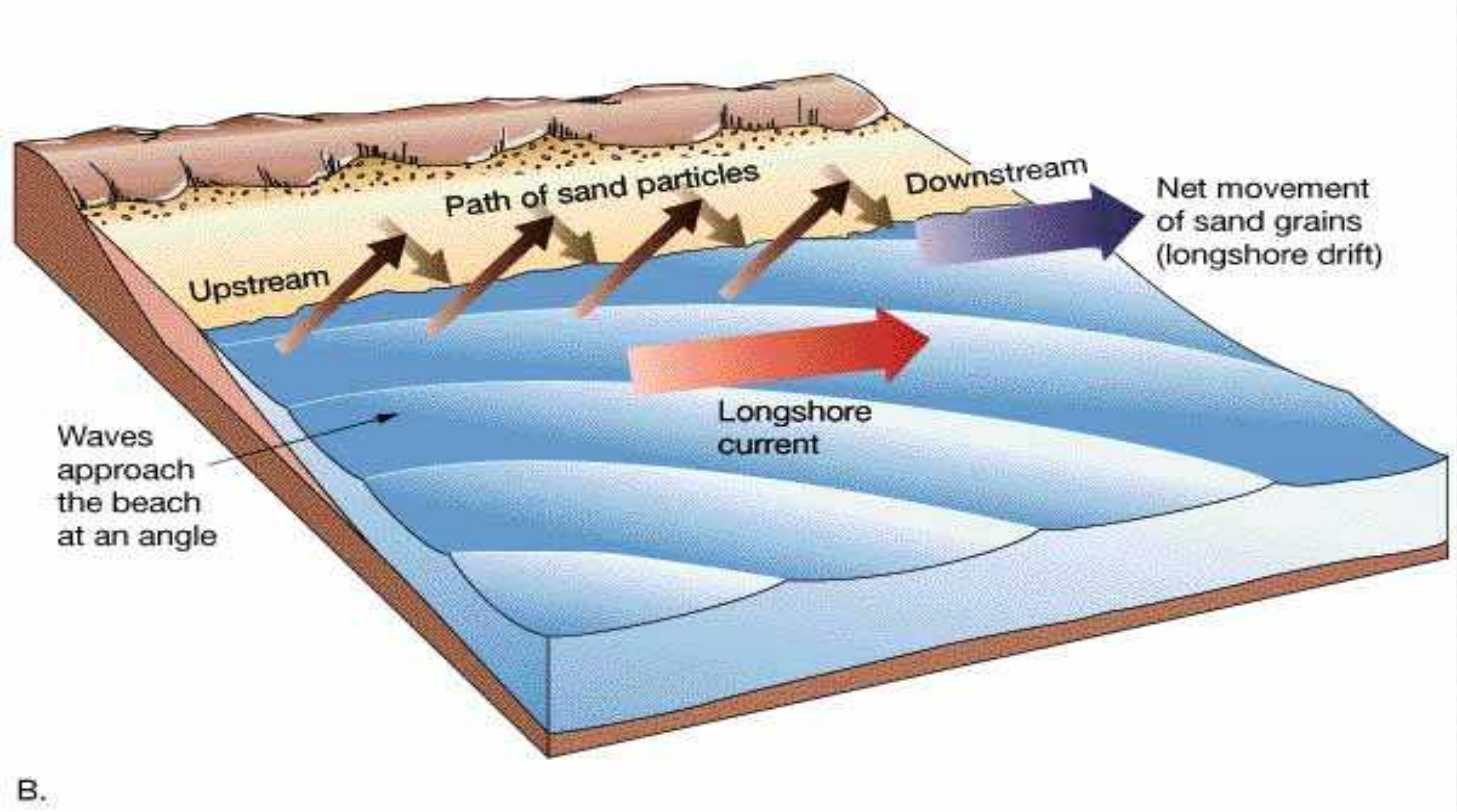

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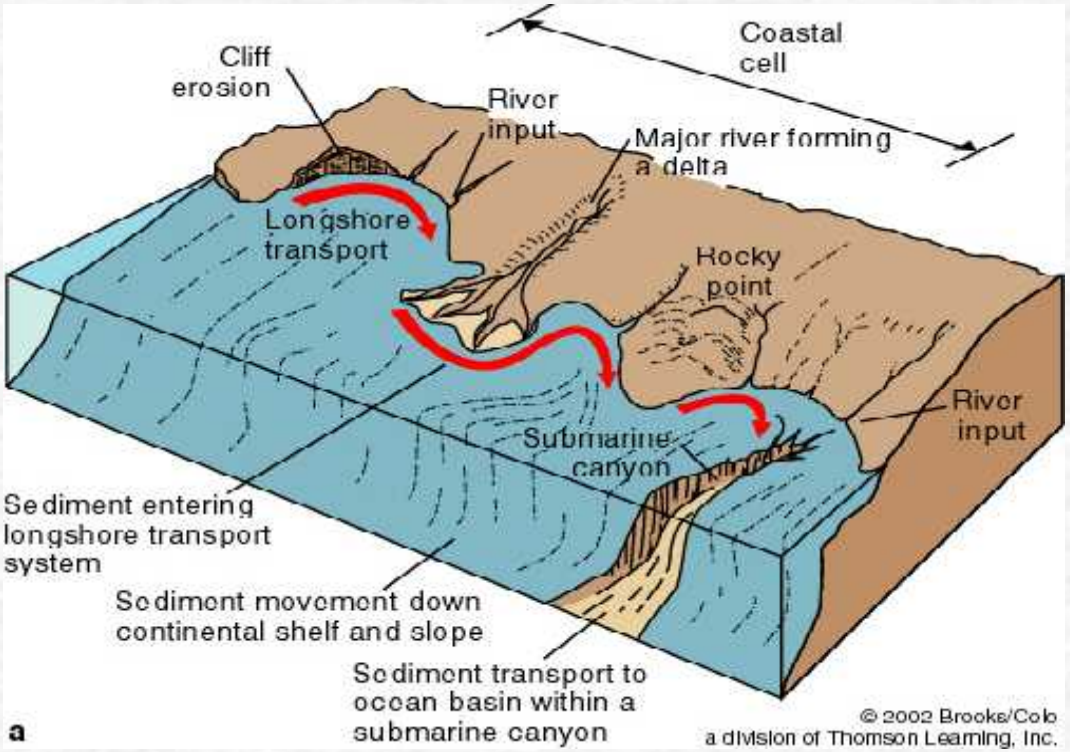

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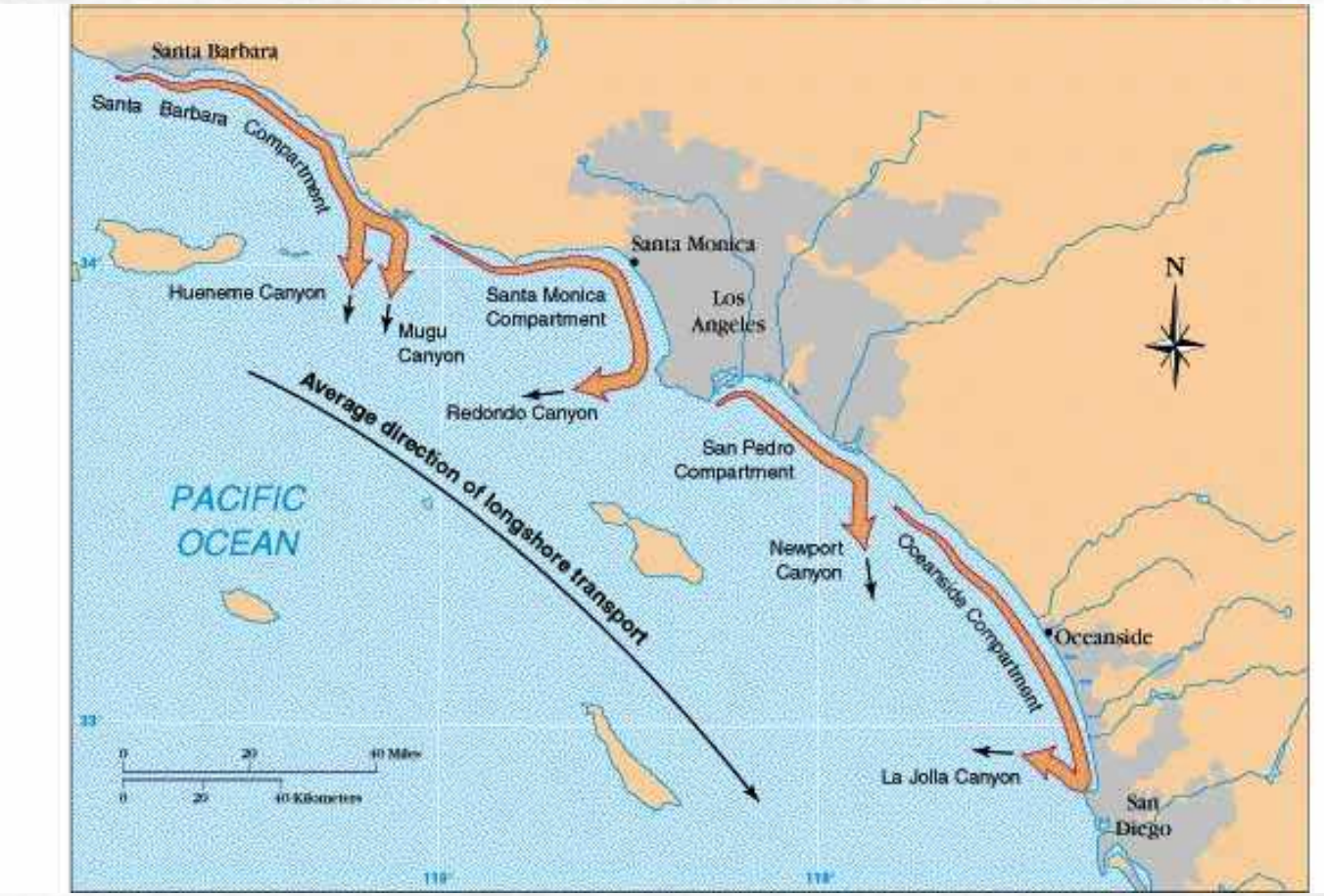

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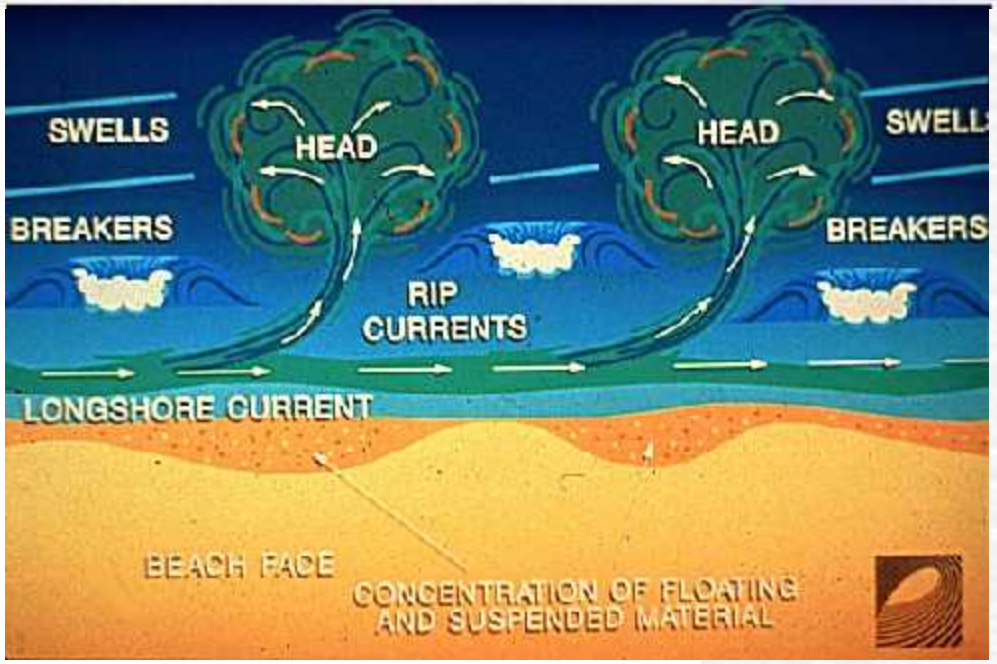

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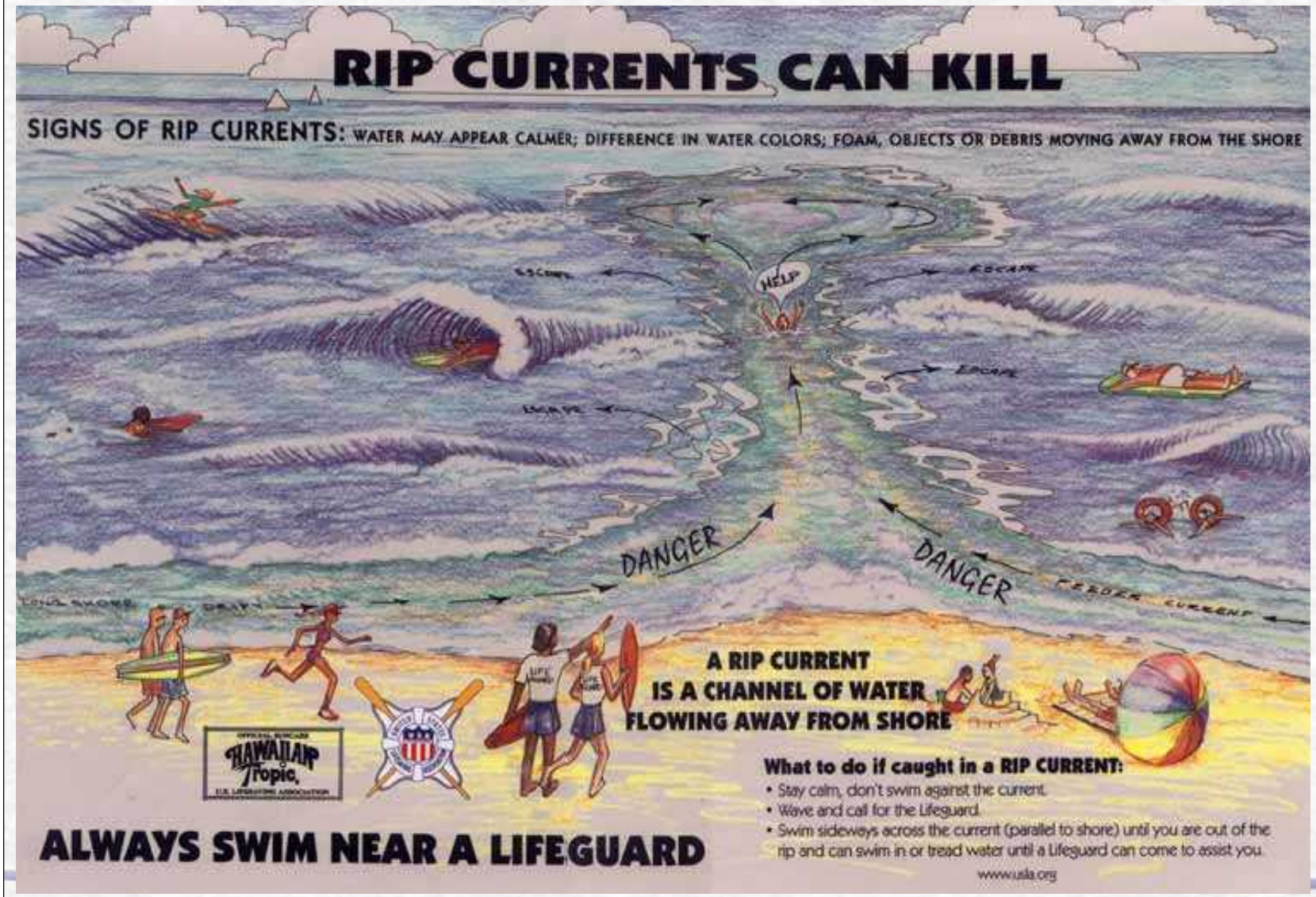
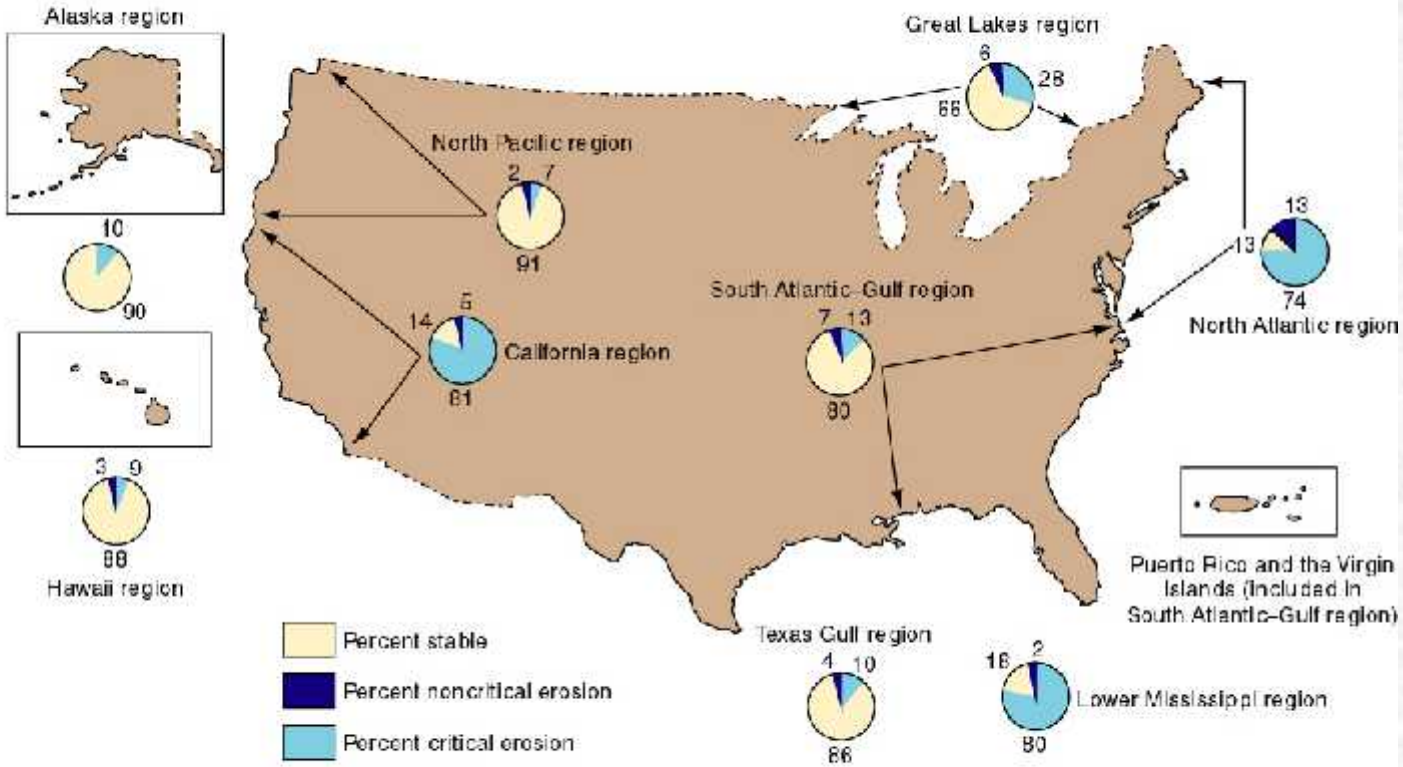


Stability of US Coastlines



Human Impact on Coastlines

Many barrier islands on the US East Coast are highly populated

Atlantic City, New Jersey is on a barrier island.

Questions:

1) What are barrier islands made of?

2) What would happen to a barrier island if a strong hurricane would strike it?

Human Impact on Coastlines

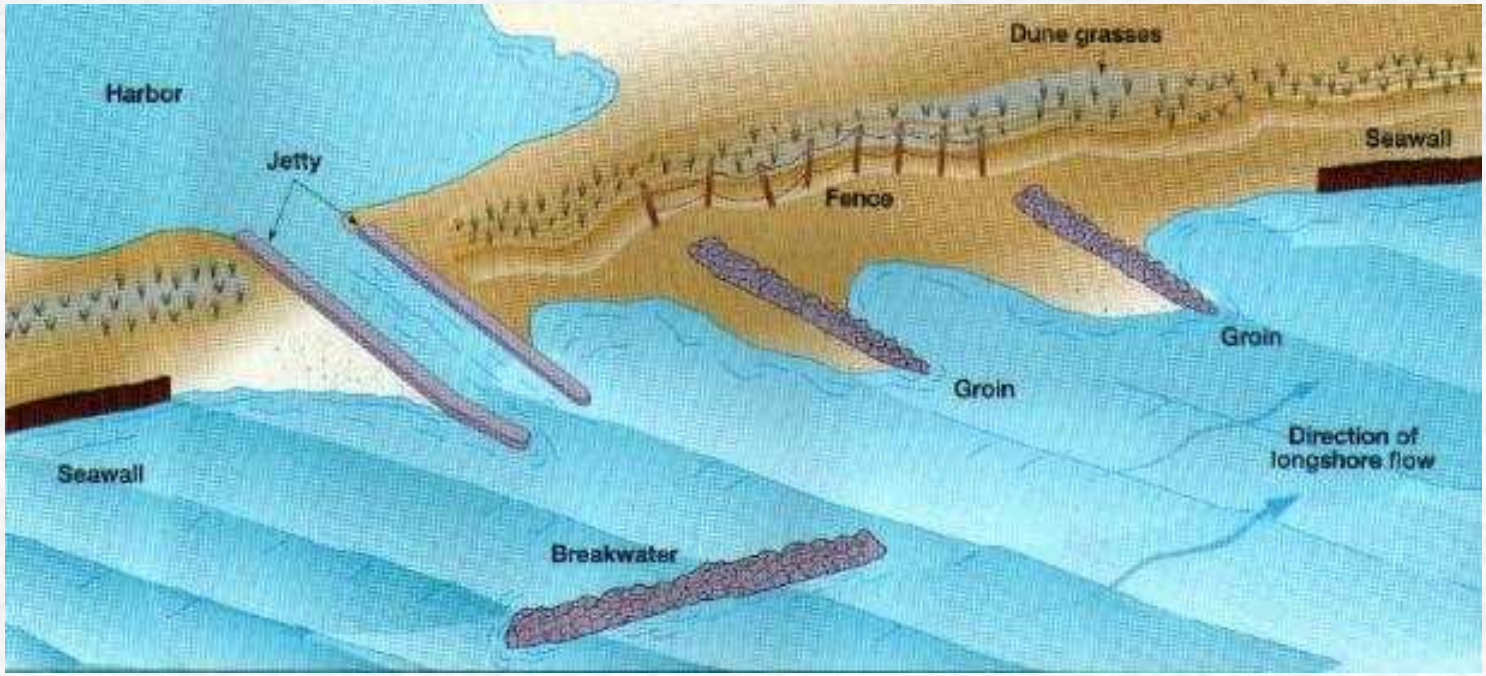
Note the various artificial structures built along the shore.

Also note the white, cloudy material in the bay – Is it of natural or human origin? How could you find out?

Human Impact on Coastlines

Question: Is it possible to identify any original shoreline predating the development of this coastal housing tract?

Artificial Shoreline Structures



- ✓ **Breakwater**
- ✓ **Groin**
- ✓ **Jetty**
- ✓ **Seawall**

1) What is the intended function of each of these structures?

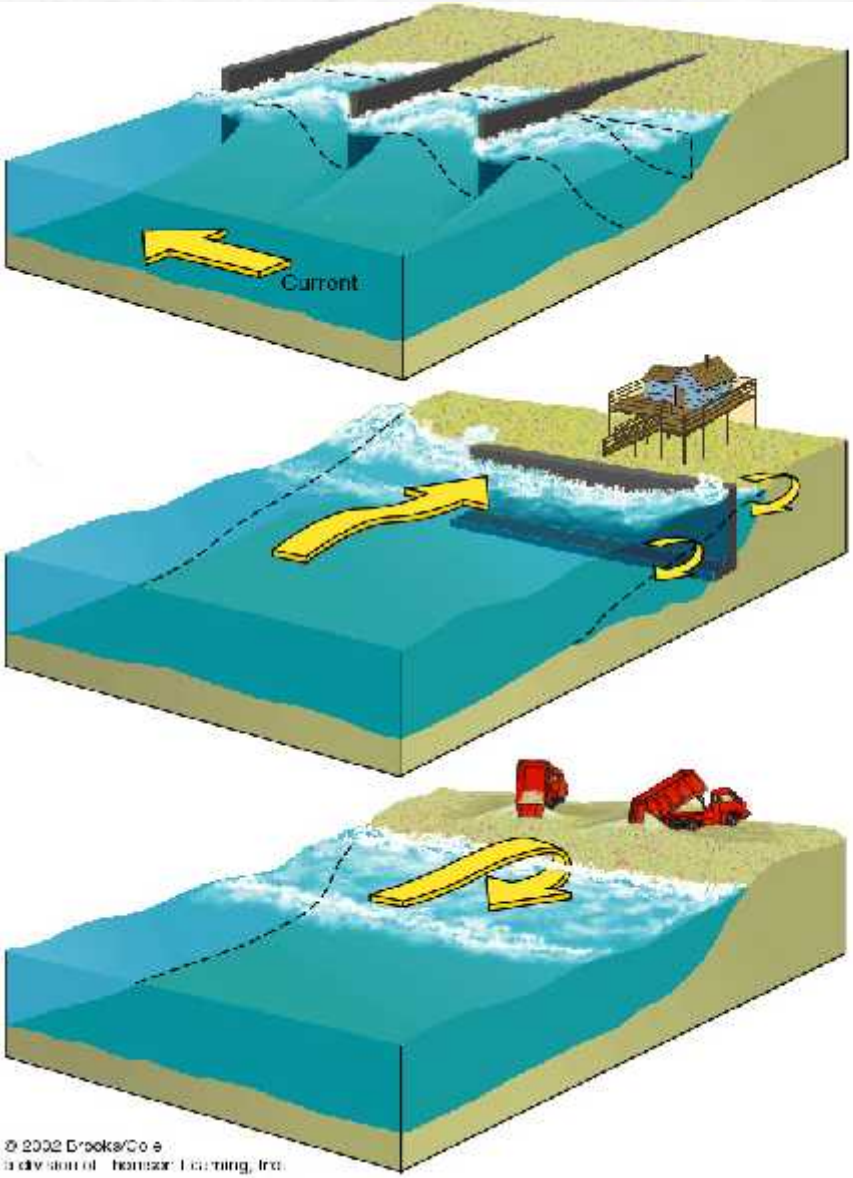
2) What are the unintended negative effects of each of these structures?

Solutions For "Saving" the Beach

Groins

Seawalls

Importing Sand

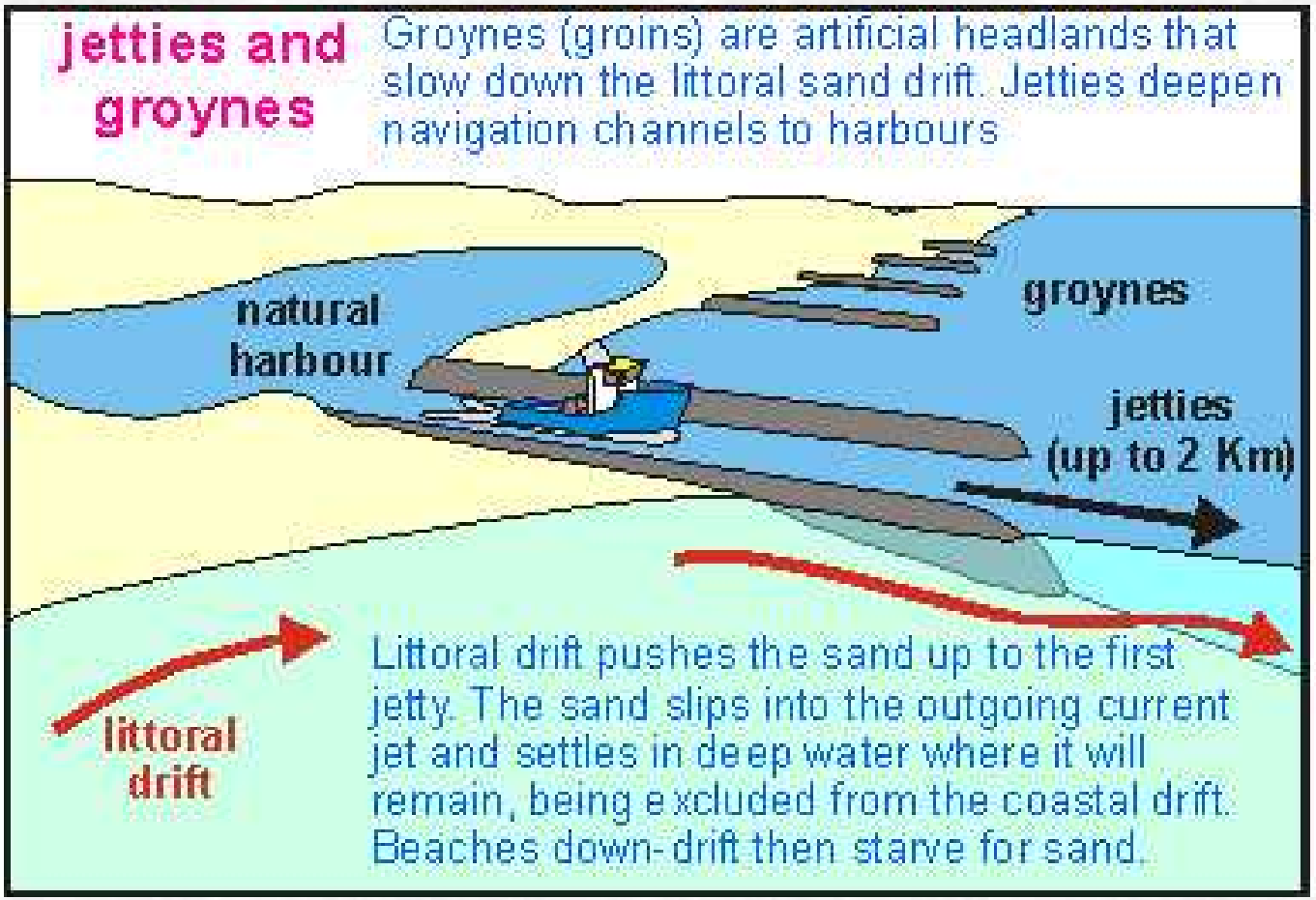


a Groin
Groins are structures that extend from the beach into the water. They help counter erosion by dissipating wave energy and by trapping sand from the current. Groins accumulate sand on their updrift side, but erosion is worse on the downdrift side, which is deprived of sand.

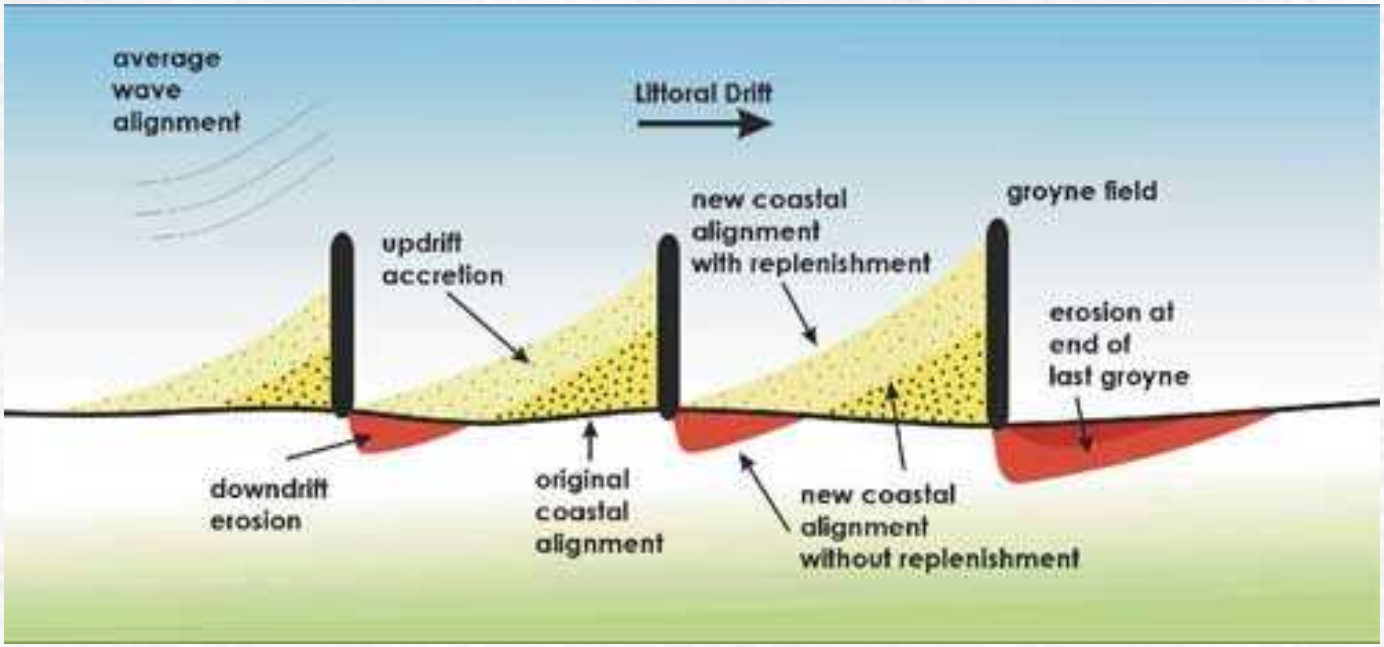
b Seawall
Seawalls protect property temporarily, but they also increase beach erosion by deflecting wave energy onto the sand in front of and beside them. High waves can wash over seawalls and destroy both the seawalls and the protected property.

c Importing sand
Importing sand to a beach is considered the best response to erosion. The new sand is often dredged from offshore and can cost tens of millions of dollars. Because it is often finer than beach sand, dredged sand erodes more quickly.

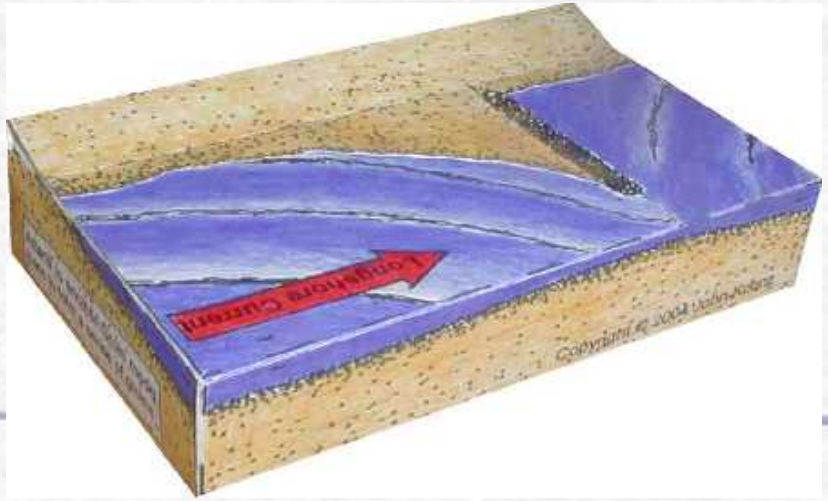
Groins and Jetties



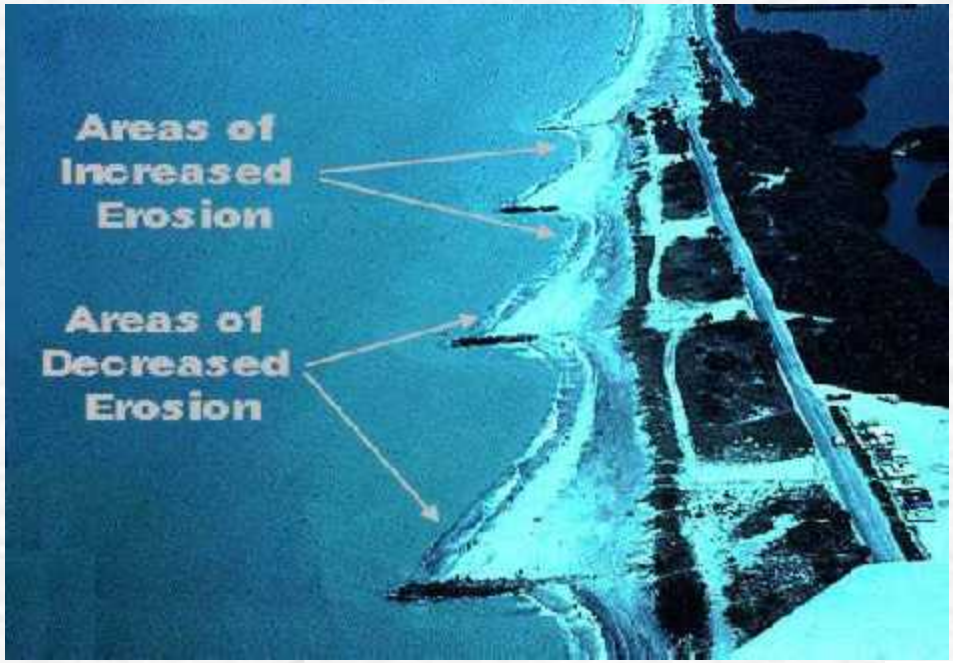
Groins: "Solution" to Beach Erosion



- ✓ Designed to Trap Beach Sediment
- ✓ Only effective on one side of structure
- ✓ Disrupts longshore transport



Groins: "Solution" to Beach Erosion?



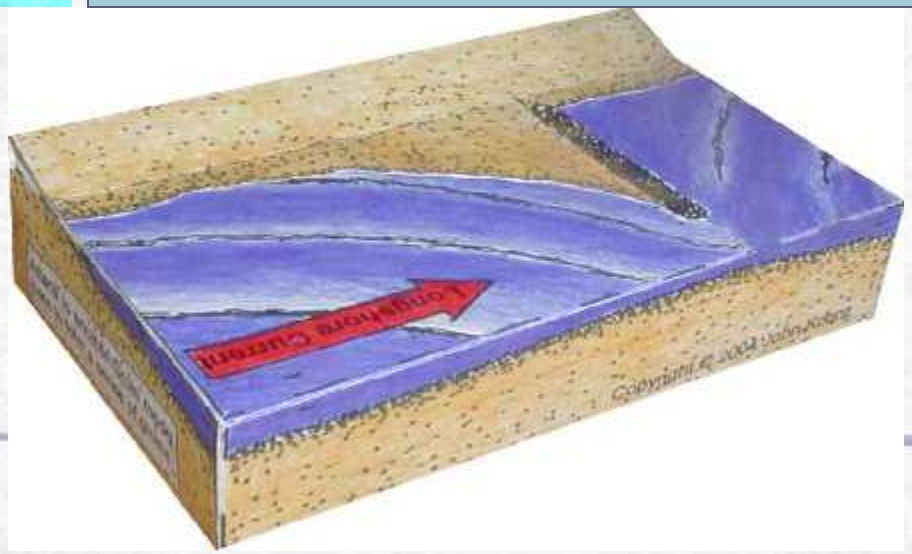
Closely examine these groins.

Note asymmetrical distribution of sand around the groins.

Which way does the longshore current move?

Are groins doing their job?

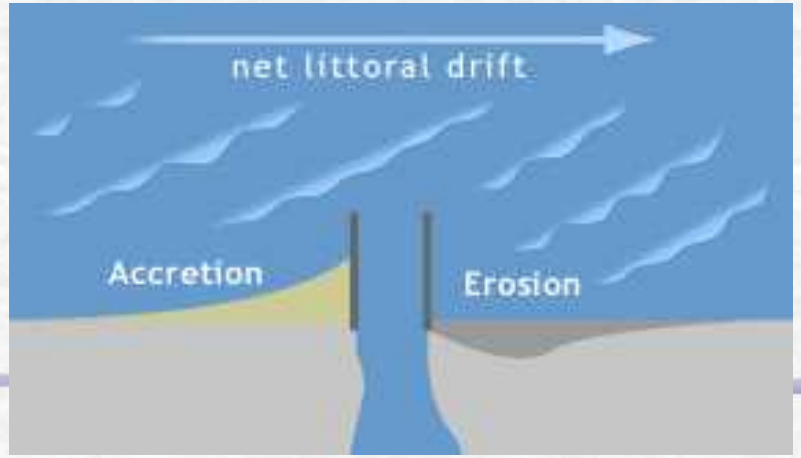
- ✓ **Designed to Trap Beach Sediment**
- ✓ **Only effective on one side of structure**
- ✓ **Disrupts longshore transport**



Jetties - "Solution" to Channel Entrances

Jetties - "Solution" to Shoreline Channels?

- ✓ Keeps channel entrances open
- ✓ LS drift eventually clogs channel
- ✓ Require periodic dredging
- ✓ Disrupts longshore transport



Back-Beach Seawalls

"Solutions" to Bluff Erosion

Save a Bluff – Starve a Beach

"Solutions" to Bluff Erosion

Seawalls built to Protect Bluff-top Buildings and Roads

Seawall Types

The “Fortress”

The “Natural”

The “Stoney”

The “Woody”

Seawall Construction

Before Construction

During Construction

After Construction

Seawalls: What are the Positive and Negative Effects?

1) Protect Bluffs

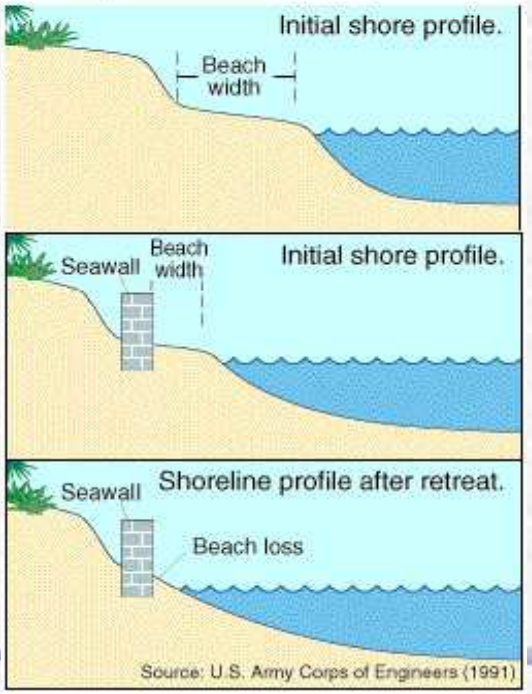
2) Protect Bluff-top Homes

3) Does Not Protect Beaches

4) Generally Not Good for Beaches

- ✓ Loss of sand supply
- ✓ Increases beach erosion

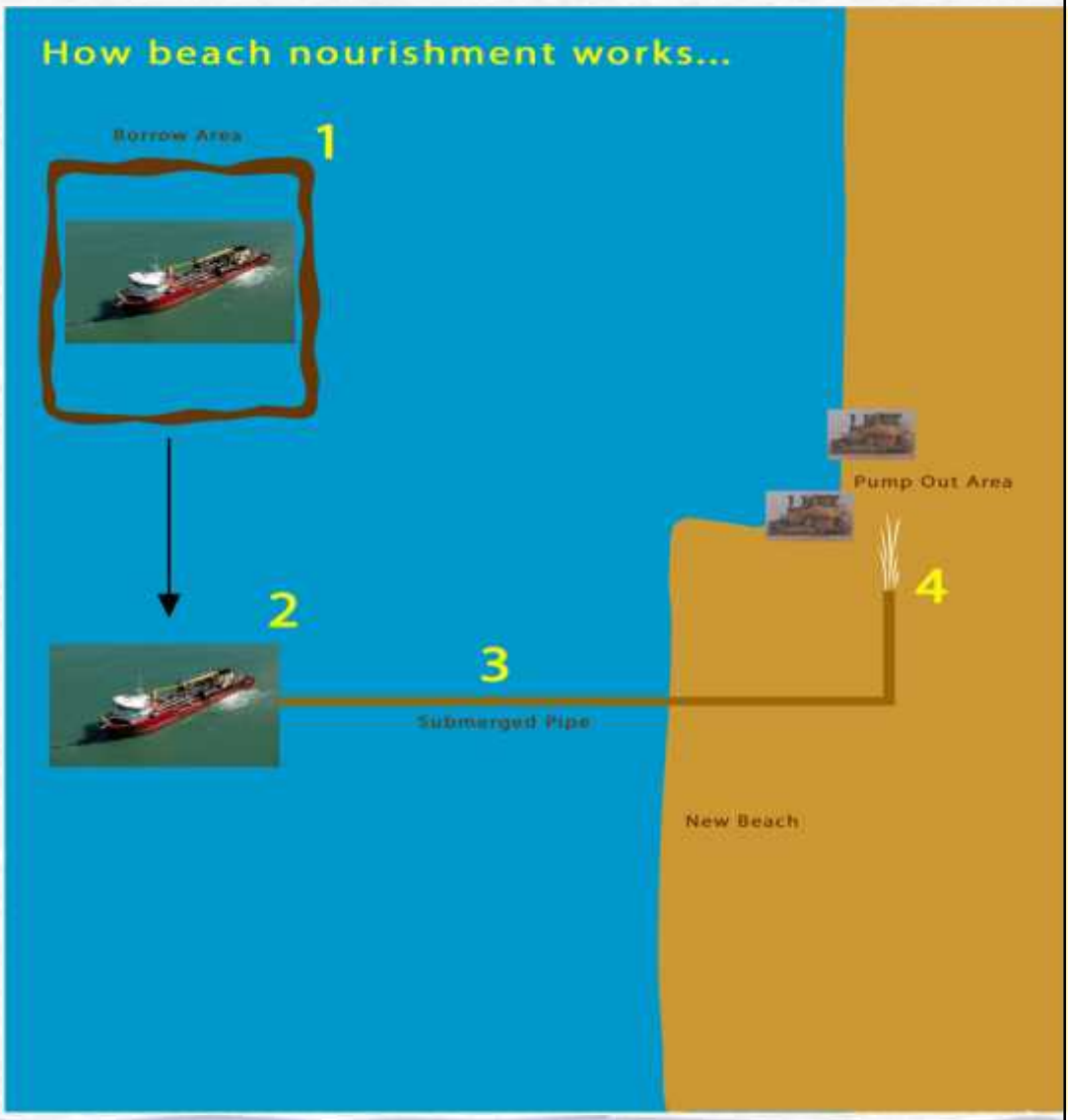
Beach loss eventually occurs in front of a seawall for a beach experiencing net longterm retreat.



"SOLUTION" TO BEACH EROSION

Artificial Sand Replenishment

Beach Sand Replenishment

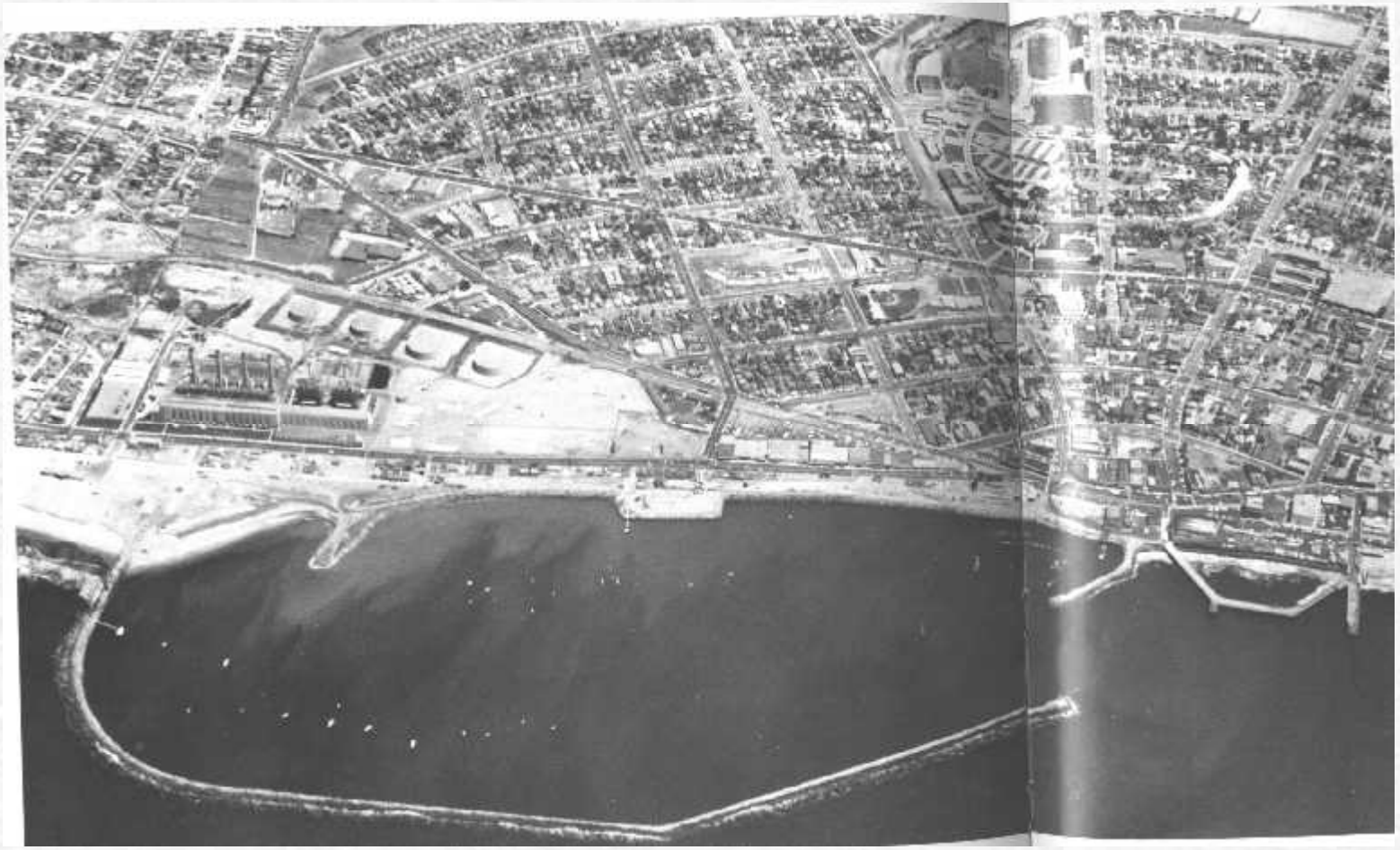


Offshore Sand Harvesting

Beach Sand Replenishment

Inland Sand Harvesting

Breakwaters – Artificial Bays and Harbors



1) Create quiet shoreline waters along an open coast.

2) Significant disruption of local longshore transport.

The Marina "Solution"

- ✓ **Breakwater**
- ✓ **Groins**
- ✓ **Jetties**
- ✓ **Seawalls**

1) Use a combination of shoreline structures to create a quiet artificial harbor space

2) Creates problems with the longshore drift

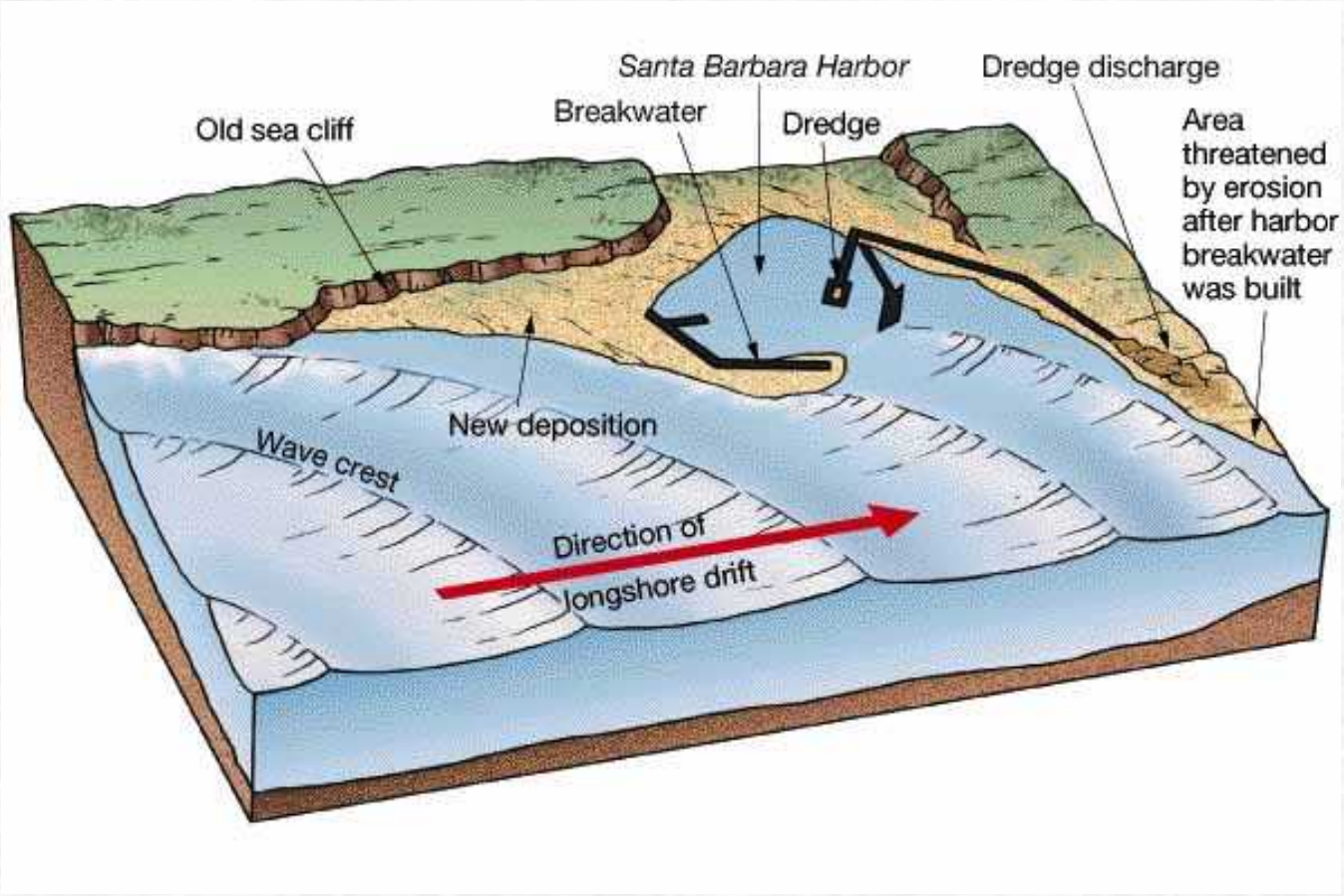
Question: Can you tell the longshore current direction?

SANTA BARBARA'S HARBOR "SOLUTION"

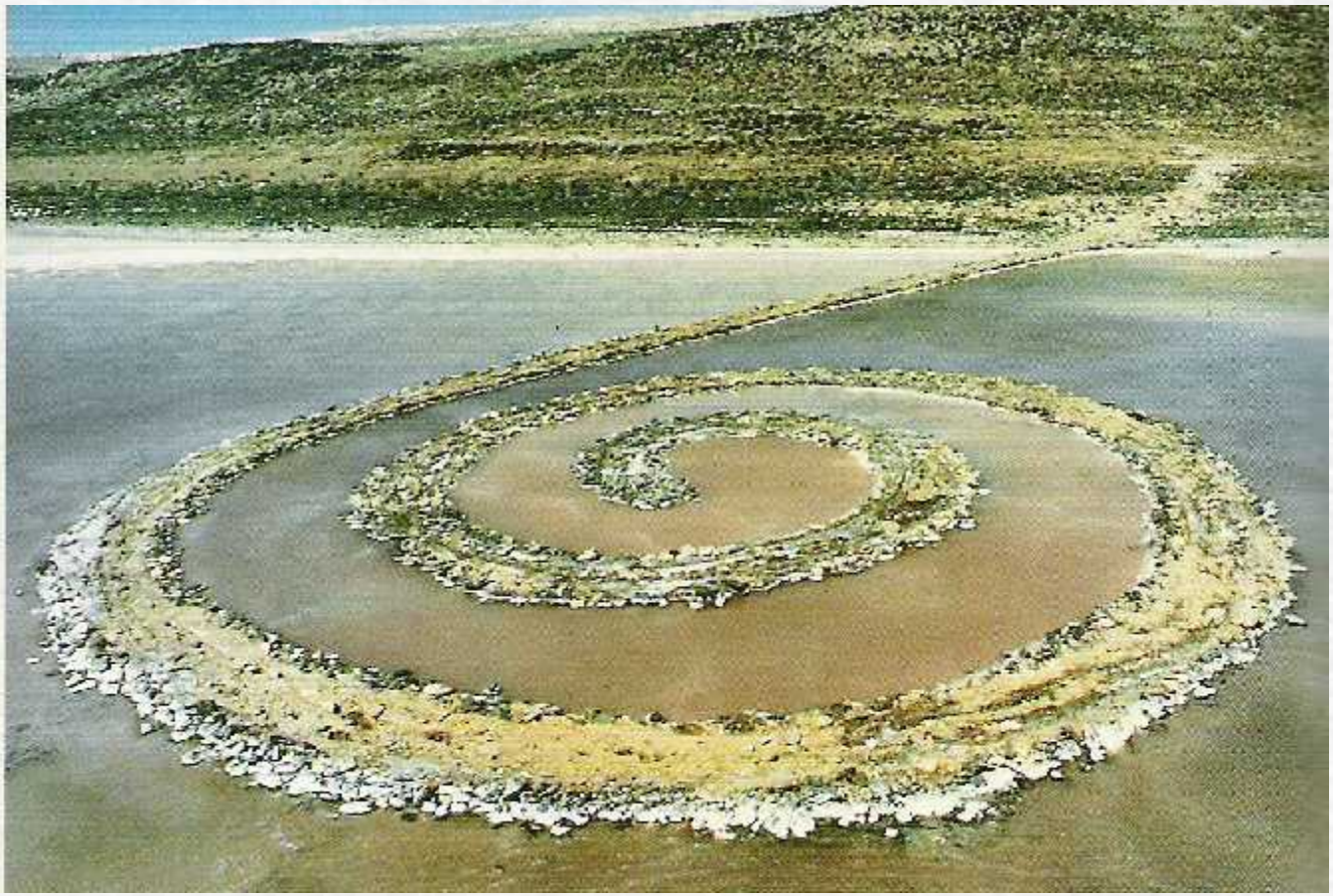
1) Southward longshore drift forms a sand spit off the harbor breakwater

2) Longshore drift clogs harbor entrance

3) A permanent dredging system must be used to keep harbor entrance open.



What's its Shoreline Function?



Groin, Jetty, Breakwater, ???

Human Impact on San Diego's Shoreline

1) Shoreline Encroachment
2) Beach and Bluff Changes
3) Ocean and Beach Pollution
4) Sand Supply Issues
5) Loss of Natural Shoreline Habitat
6) Impact on Local Sea Life

Urbanization of Coastal North County

Beachy Concepts

- Beaches are shifting ribbons of sediment occurring along shorelines
- Coasts are geologically very temporary structures, subject to rapid change
- The *location* of the coastline depends primarily on two factors: tectonic activity and the volume of water in the ocean
- The *shape* of the coastline is a product of many factors: regional uplift, subsidence, and faulting, land- and sea-based erosion, transport, and deposition of earth materials, and biological activity
- Changes in sea level has the greatest influence on coastal processes
- Eustatic sea level is controlled by global climate and ocean basin volume
- Coasts are classified by whether erosion or deposition is the dominant process
- Erosional coasts are typically new coasts in which the land is being actively eroded
- Depositional coasts are typically mature coasts in which coastal sediment materials are either in stable equilibrium (steady), or are being deposited (growing)
- Erosional coasts have characteristic features: sharp bluffs, sea caves and stacks, natural bridges, pocket beaches, and wave-cut terraces
- Depositional coasts have characteristic features: long/broad sandy beaches, dunes, barrier islands, sand spits, and tombolos


Shoreline Reflection
Beachtrek.com


DAY'S END AT
THE BEACH