Beach Changes in the Oceanside Littoral Cell

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Abstract: The Oceanside Littoral Cell, extending about 80 km southward from Dana Point in Southern California to Point La Jolla, is one of the most extensively studied coastal regions in the world and among the first to be investigated regionally. It is clearly defined by prominent rocky headlands at either boundary with evidence that there is little sediment exchange with neighboring cells. It is maintained by episodic river borne sediment inputs and erosion from the bluffs that back the majority of the beaches. It also suffers episodic losses of sand from the flushing of a submarine canyon near its southern boundary. The cell contains several coastal lagoons, some with jettied entrances and some connected to the sea episodically. In addition to these jetties, a system of jetties and breakwater extensions was constructed to protect an artificial harbor at the city of Oceanside, roughly in the middle of the cell. With the exception of these entrances, the cell consists of continuous beaches throughout its length.

The beaches of the Oceanside Cell are typical of those in Southern California. That is, they tend to be narrow, thin veneers of sand over bedrock with shallow, monotonic slopes. The bedrock foundation may be overlain with cobbles. Seasonal changes in the dry beach width are pronounced and during very severe winters the dry beach may entirely disappear. Sand eroded from the dry beach in winter forms an offshore bar at the breakpoint of the largest storm waves. Nearly complete recovery during the spring and summer is typical, although after a very severe winter, several years may be required for complete recovery. Long-term erosion rates are very small and difficult to discern in the highly variable seasonal profiles.

Transport alongshore is energetic, in that there are very few calm days during the whole year. Temporary strong gradients in longshore transport are present throughout the cell largely because of the shadowing effect of offshore islands. Small changes in offshore wave directionality shift the pattern of these gradients such that their effects tend to be smoothed out over time. Waves arriving from the sector ranging from west to northwest, typical of winter conditions, move sand southward in the cell. There is a steady component of swell from the southwest throughout the year. It is somewhat more energetic in the summer (southern hemisphere winter) and typically dominates during that season, moving sand northward. The result is that the annual gross transport is high and the annual net is relatively low throughout most of the cell.

The paper describes the Oceanside cell geography, the near-coast geology that impacts the beach and the physical forces that result in beach changes. It then discusses the background variability of beach volumes and the positive and negative impacts of human activities on the variations. To accomplish this analysis, the cell is divided into a small number of subregions with similar characteristics and histories. There is limited use of conventional profiles in the discussion. Emphasis is placed on changes to the recreational beach asset, that which is exposed at low tide. Seasonal, long-term and human-induced changes are separated to the extent possible for each of the subregions. Maps and aerial photography are utilized to illustrate the significant attributes.