

**Coastal Rail Resiliency Study Draft Alternative Concepts**

<b>Bluffside Concepts</b>	<b>Beachside Concepts</b>	<b>Rail Concepts</b>
<ol style="list-style-type: none"> <li>1. Catchment walls (block slide debris)</li> <li>2. Stabilization grading (buttress slide toe)</li> <li>3. Tieback / soil nail / pin-pile walls (mitigate larger slides)</li> <li>4. Ground improvement (bluff stabilization)</li> <li>5. Surface matting and deep-rooted vegetation planting (reduce sediment erosion)</li> <li>6. Drainage improvement via grading / detention basins / undertrack outlets</li> <li>7. Deflection walls in tributaries (reduce flood and sedimentation flow rates)</li> <li>8. Up-gradient cut-off drains (reduce source of water)</li> <li>9. Hydraugers (lower hydraulic pressure and slide potential)</li> </ol>	<ol style="list-style-type: none"> <li>1. Riprap placement</li> <li>2. Engineered rock revetment</li> <li>3. Vertical seawall</li> <li>4. Hybrid structural solution</li> <li>5. Beach nourishment with shoreline protection structure (1-4 above)</li> <li>6. Beach nourishment with sand retention measures and shoreline protection structure (1-4 above)</li> <li>7. Watershed modifications to increase beach sand supply (implemented by others)</li> <li>8. No railroad action - monitor regional beach nourishment activities* and participate as appropriate</li> </ol>	<ol style="list-style-type: none"> <li>1. Elevate tracks</li> <li>2. Alternative materials for critical railroad infrastructure to reduce lifecycle costs</li> <li>3. Ground improvement (track-bed stabilization)</li> </ol>

\* Regional beach sand projects include the United States Army Corps of Engineers with the City of San Clemente, County of Orange, and San Diego Association of Governments Regional Beach Sand Program III.