

USING NATURAL INFRASTRUCTURE TO PROTECT COASTAL ROADS AND BRIDGES



U.S. Department of Transportation
Federal Highway Administration

The Federal Highway Administration (FHWA) is producing research and technical assistance to enable transportation agencies to use natural and nature-based features to improve the resilience of transportation systems. FHWA sponsored five pilot projects to assess the potential for nature-based techniques to protect specific locations along coastal roads and bridges. The project also includes a white paper, regional peer exchanges, and an implementation guide.



photo credit: Rob Hyman



photo credit: Oregon DOT

Oregon DOT, FHWA, and partner organizations visit a segment of US-101 that is severely threatened by coastal erosion. Under a pilot project with FHWA, Oregon DOT developed conceptual designs for protecting three segments of US-101 using nature-based techniques similar to the engineered cobble beach and artificial sand dune at Cape Lookout State Park.

► What is natural infrastructure or green infrastructure?

[Nature-based features mimic characteristics of natural features and processes but are created by human design and engineering.](#) Examples

include restoration of dunes, wetlands, maritime forests, beaches, and reefs. These features can protect coastal highways from the brunt of storm surges and waves. Some can adapt to sea level rise by accreting sediment or migrating inland. They can also provide benefits such as recreation opportunities, habitat needed for commercial fisheries, and a healthier environment.

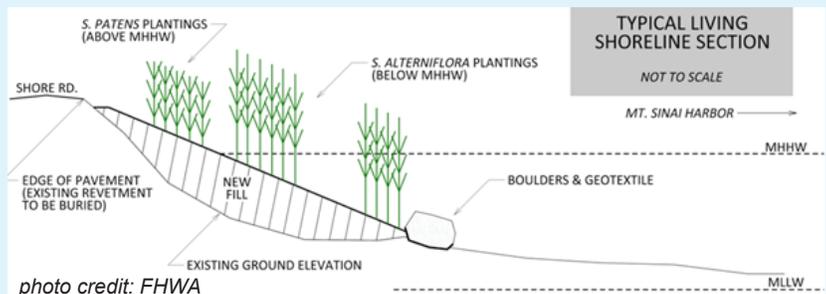


photo credit: FHWA

Diagram of a constructed marsh profile on a shoreside road on Long Island, New York. The diagram pictures the road (left), clean sand fill, toe protection boulders, and vegetation plantings below and above high tide (MHHW).

► Why use natural features instead of conventionally engineered protection?

Conventional coastal highway protection includes walls, seawalls, bulkheads, and revetments.

Unfortunately, the function of many of our shorelines has been significantly altered because of the interaction of these protection strategies with natural processes. The results include

reductions in sediment transport and the loss of intertidal habitats of wetlands and beaches among others.



photo credit: Tina Hodges

Rock revetment (also called rip rap) protecting highway from erosion from waves.

► What about cost considerations?

Nature based solutions can be less expensive than others especially where wave action is less severe.

The installation of pocket beaches in Yorktown, VA, provides an example. The original breakwaters, 7,500 cubic yards of beach fill and marsh plantings, cost \$260,000 for protection of 1,350 feet of shoreline for an average cost of \$193 per linear foot. The project was designed for a 50-year storm but its level of performance currently exceeds the 100-year storm. It was subjected to the 100-year storm event in Hurricane Isabel (2003) and the system experienced sand losses and local scour but maintained its overall integrity with no damage to the breakwater units themselves. The beach required only the placement of 3,500 cubic yards of sand to be brought back to its pre-storm condition.



Aerial view of pocket beaches installed in Yorktown, VA.

The project was designed for a 50-year storm but its level of performance currently exceeds the 100-year storm. It was subjected to the 100-year storm event in Hurricane Isabel (2003) and the system experienced sand losses and local scour but maintained its overall integrity with no damage to the breakwater units themselves. The beach required only the placement of 3,500 cubic yards of sand to be brought back to its pre-storm condition.

Where can I find examples of successful projects?

FHWA's Nature-based Resilience for Coastal Highways [website](#) includes a white paper with several examples of natural infrastructure projects, the final reports from each of the sponsored pilots, additional examples, webinar recordings, and links to partner agency websites.

The Delaware DOT pilot project analyzed green infrastructure solutions to protect sections of State Route 1 from coastal flooding, and developed design guidelines to implement across their projects. DeIDOT will implement solutions developed under the pilot on SR-1, including oyster reefs to break waves, marsh and dune plantings to prevent erosion, and a tide flap on the stormwater outfall to prevent backflow.



In Pensacola, FL, "Project GreenShores," a constructed marsh with breakwaters designed to create habitat, protects a one mile segment of Bayfront Parkway from coastal erosion.



LEARN MORE

FHWA's [Website](#) [Nature Based Resilience for Coastal Highways](#)

Contacts: [Tina Hodges](#), Sustainable Transport and Resilience Team, 202-366-4287