

**Introduction:** The concept that navigation infrastructure can serve as valuable habitat is not novel. However, the concept of designing navigation infrastructure with the specific intent of accomplishing both the engineering goal and specific environmental goals is, in most instances, a new idea for many planners and designers.

**Project Goal:** The overall goal of this effort is to increase application of environmental sustainability to the design and maintenance activities associated with Great Lakes breakwaters, jetties, and other navigation infrastructure. The study approach involved (1) assembling an inventory of potential actions that could be conducted to add environmental enhancements to Great Lakes navigation infrastructure through interaction with regional experts, (2) classifying the existing navigation infrastructure, (3) developing a compatibility matrix of the potential actions and infrastructure.

**Project Description:** This effort is developing technical documents for use by the Corps and Great Lakes stakeholders that evaluates alternatives for enhancing aquatic ecosystem benefits at existing breakwaters and navigation structures during routine repairs and maintenance, as part of modifications, or during comprehensive structural repairs and replacements.

**Ecosystem Benefits:** The Corps has over 107 miles of navigation structures (breakwaters, piers and jetties), including structures at most of the U.S. Great Lakes Areas of Concern. These structures already provide some valuable habitat for fisheries and waterfowl. This effort will help the Corps and Great Lakes stakeholders to evaluate opportunities for enhancing aquatic habitat in and around these structures through low-cost measures that might be implemented as part of routine maintenance or scheduled repairs or modifications.



The project currently being conducted with a focus on the Great Lakes was preceded by a national effort in FY10 sponsored by the DOER Program that investigated opportunities, impediments, and research needs for environmental enhancements of navigation infrastructure (EENI) throughout the US. Through that earlier study, a large number of ideas and projects were identified. that were identified that illustrate the concept included making changes in design to build a jetties in ways that will provide enhanced use by creating a sinuous toe to provide semi-protected refuge areas or adding caverns for fish or invertebrate use.

## EENI Examples from Coastal Systems:

- Pea gravel around toe of breakwater for fish spawning
- Modify breakwater toe, rock sizes, cross section, etc. to create habitat variety
- Add marine mammal haul-out shelves to jetties
- Add osprey nesting platforms to structures
- Create terraces in channel side slopes for sea grass



The above photo of navigation enhanced infrastructure is a former dredged material disposal island which was graded and planted with marsh and dune grasses. The 6 acre site near Morehead City, NC included placement of oyster cultch was completed in 1995.

## Existing EENI Inland River Systems:

- Dike notching/chutes
- Nature-inspired fish ladders
- Groove articulated concrete mats
- Chevron notching

Upper Mississippi River Restoration Environmental Management Program (UMRR-EMP)  
<http://www.mvr.usace.army.mil/EMP/designhandbook.htm>



Conceptual illustration of bendway weirs.

## River Training Structures

Center section of chevron can be notched at lower elevation creating habitat variety with deeper pool and island

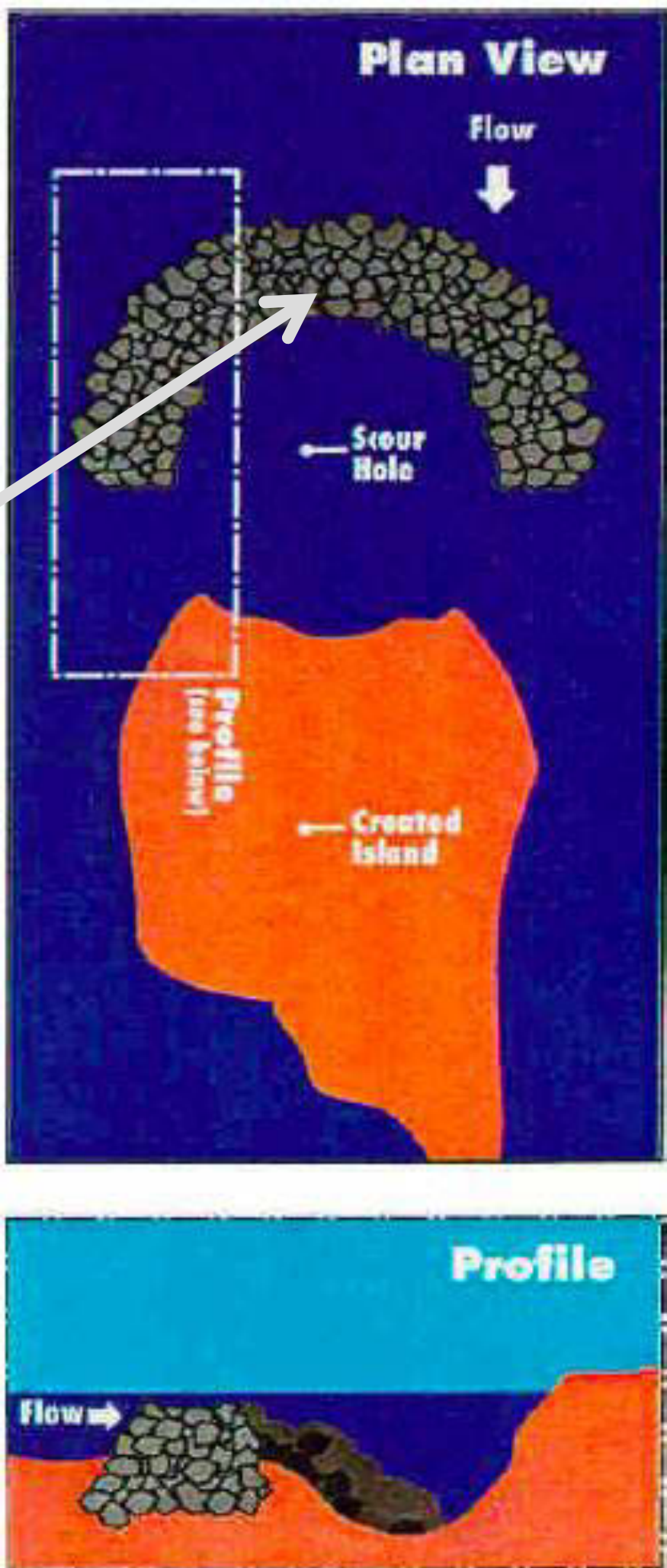
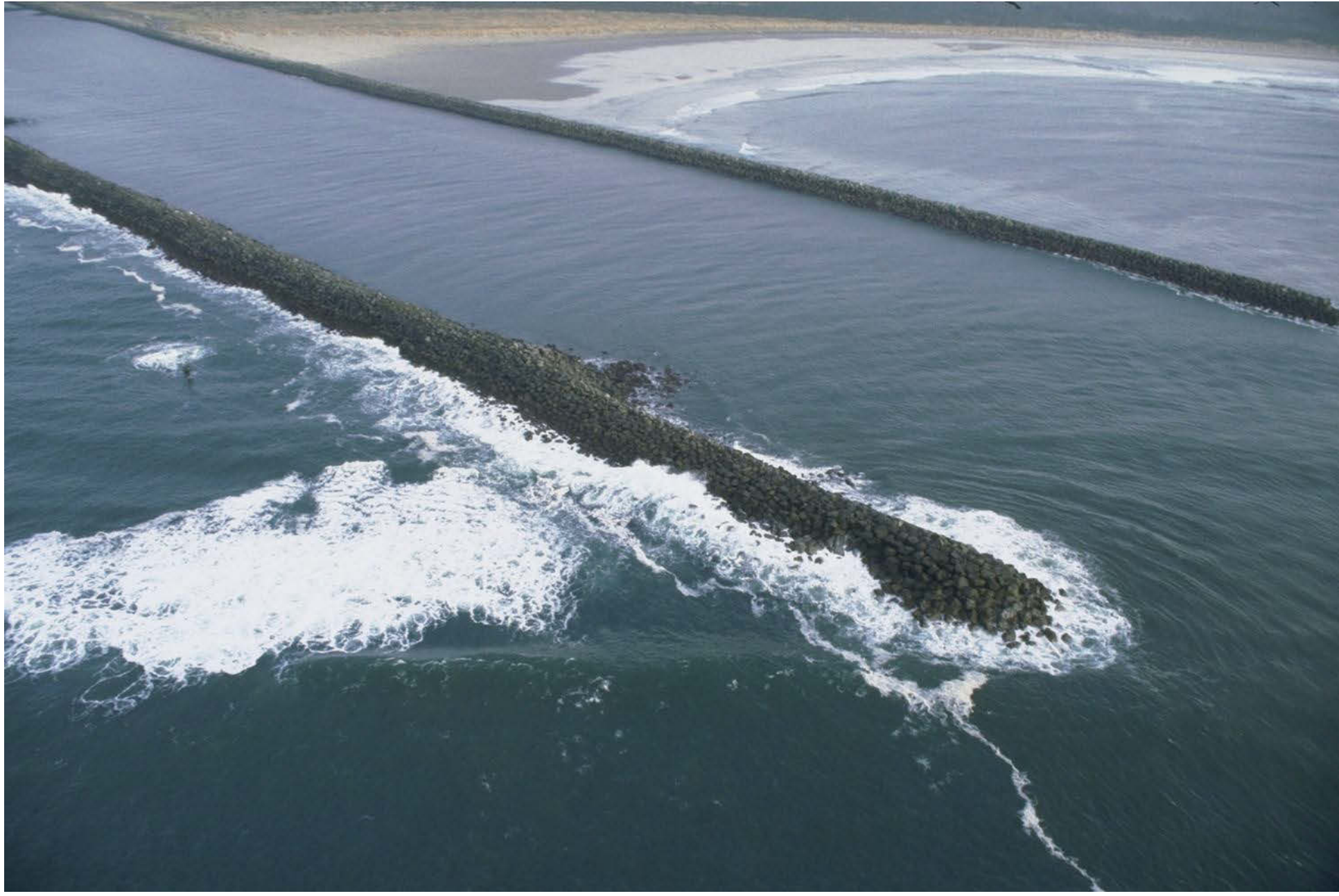


Figure 5.10. Blunt Nosed Chevron



## Research and Other Needs:

- Document case studies and benefits
- Conduct demonstration projects
- Develop success assessment tools
- Prioritization of sites where EENI might work
- Reduce impediments to implementation

## Suggestions to Reduce Impediments:

- Greater stakeholder interaction
- Interagency agreements
- Special program funding
- Promote the EENI concept
- Document case studies
- Develop agency goals/metrics



## Next Steps:

- Promote the EENI concept
- Establish EENI goals
- Conduct national workshop exchanging ideas
- Develop pilot projects of innovative ideas

## Reports in Progress:

Technical Note: Existing Practices, Innovative Ideas, Impediments, and Research Needs for Environmental Enhancements and Navigation Infrastructure

Technical Report: Environmental Enhancements and Navigation Infrastructure: A Study of Existing Practices, Innovative Ideas, Impediments, and Research Needs

Journal Article: Environmental Engineering of Navigation Infrastructure: A Survey of Existing Practices, Challenges, and Potential Opportunities (*IEAM*)

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