

# Framework for NNBF Projects

## Jeffrey K. King

Assistant Lead, Engineering With Nature Initiative  
U.S. Army Engineer Research and Development Center,  
U.S. Army Corps of Engineers  
[jeffrey.k.king@usace.army.mil](mailto:jeffrey.k.king@usace.army.mil)

ICCE 2018



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of Engineers®

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Engineer Research and  
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# International Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems

**Purpose: Develop guidelines for using NNBF to provide engineering functions relevant to flood risk management while producing additional economic, environmental and social benefits.**

- Publish NNBF technical guidelines by 2020:
  - ▶ Multi-author: government, academia, NGOs, engineering firms, construction companies, etc.
  - ▶ Addressing the full project life cycle
  - ▶ Guidelines in 4 Parts
    - Overarching
    - Coastal Applications
    - Fluvial Applications
    - Conclusions



THE WORLD BANK





# Guidelines Development Approach

- Voluntary project team
- Editorial Board
- Individual Chapter Teams, with Co-Leads
- Peer review of final product
- Periodic, in-person working meetings combined with virtual engagement and drafting

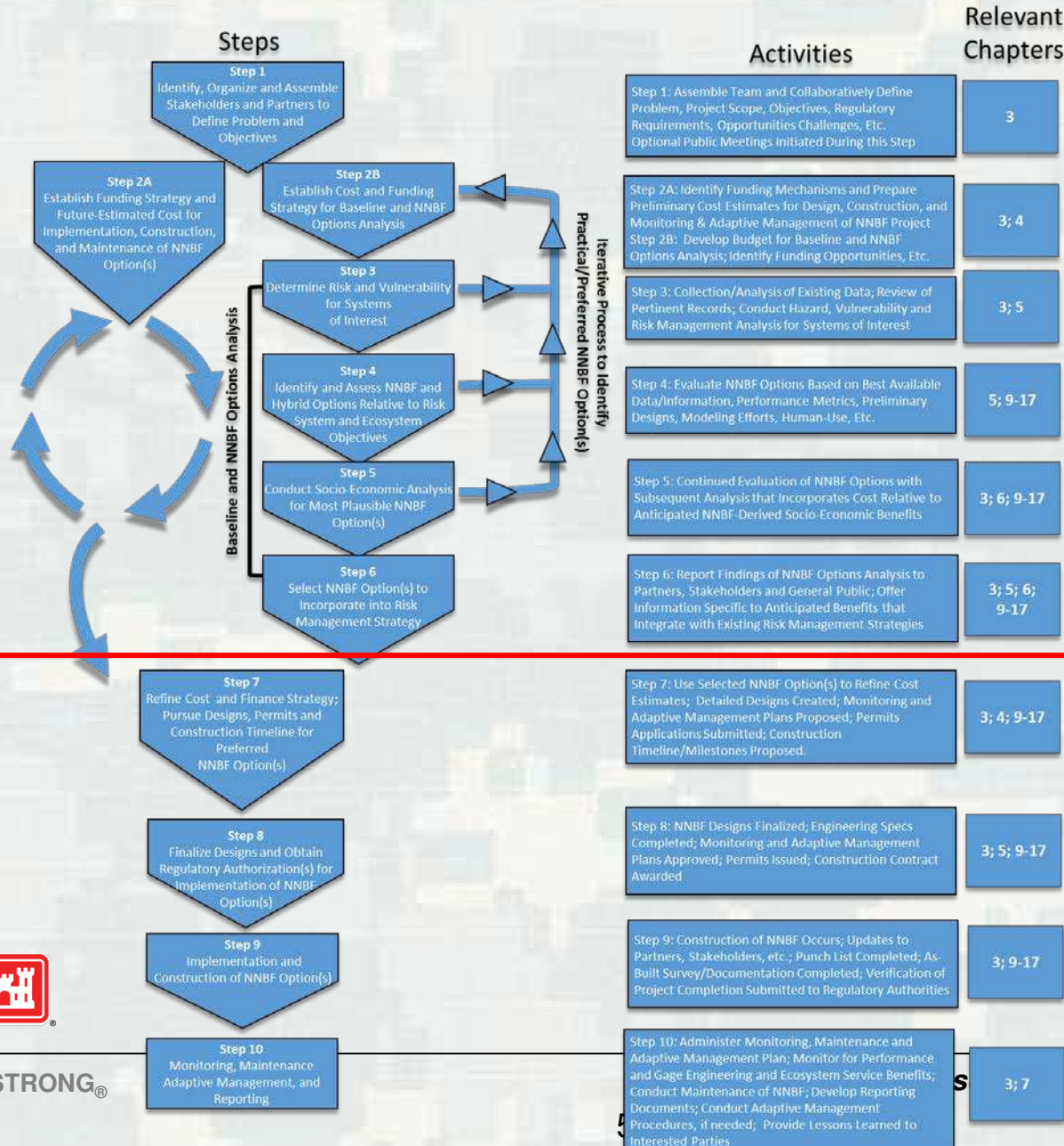


# NNBF Guidelines

Chapter	Co-Leads		Editorial Board Member
1. Introduction	Todd Bridges		Jonathan Simm
2. Principles, Outcomes & Framework	Jeff King	Jonathan Simm	Todd Bridges
3. Community Engagement	Marla Dillard		Georganna Collins
4. Systems	Denise Reed	Jure De Vries	Todd Bridges
5. Performance Measures & Metrics	Candice Piercy	Claire Jeuken	
6. Benefits	Todd Swannack	Katie Arkema	Mike Beck
7. Adaptive Management	Tim Welp	Harry de Looff	Ram Mohan
8. Introduction to NNBF in Coastal Systems	Todd Bridges	Jonathan Simm	
9. Beaches & Dunes	Claire Jeuken	Quirijn Lodder	Jonathan Simm
10. Wetlands	Candice Piercy	Nigel Pontee	Mike Beck
11. Islands	Joe Gailani		Quirijn Lodder
12. Reefs	Ryan Lowe		Mike Beck
13. SAV	Safra Altman	Colette Cairns	Ram Mohan
14. Environmental Enhancement	Burton Suedel	Larissa Naylor	Todd Bridges
15. Introduction to NNBF in Fluvial Systems	Chris Haring	Ralph Schielen	Quirijn Lodder
16. Watershed Scale	Chris Haring		Georganna Collins
17. Sub-Watershed Scale	Ralph Schielen		Ram Mohan
18. Naturalizing Techniques	Marta Roca		
19. Summation & Future Directions			



# NNBF FRAMEWORK



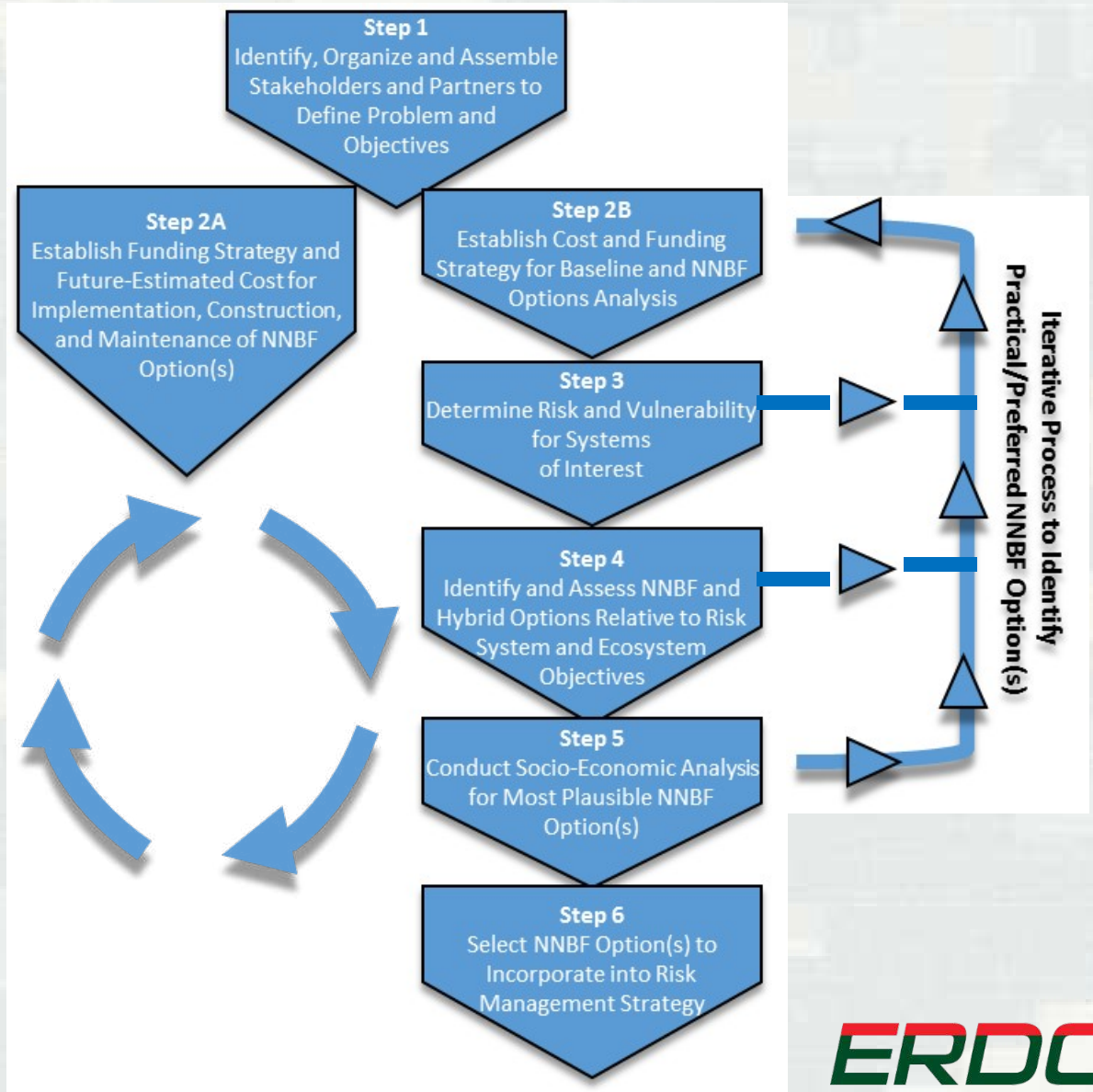
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# Framework Initial Phase



# Framework Second Phase



**Step 7**  
Refine Cost and Finance Strategy;  
Pursue Designs, Permits and  
Construction Timeline for  
Preferred  
NNBF Option(s)

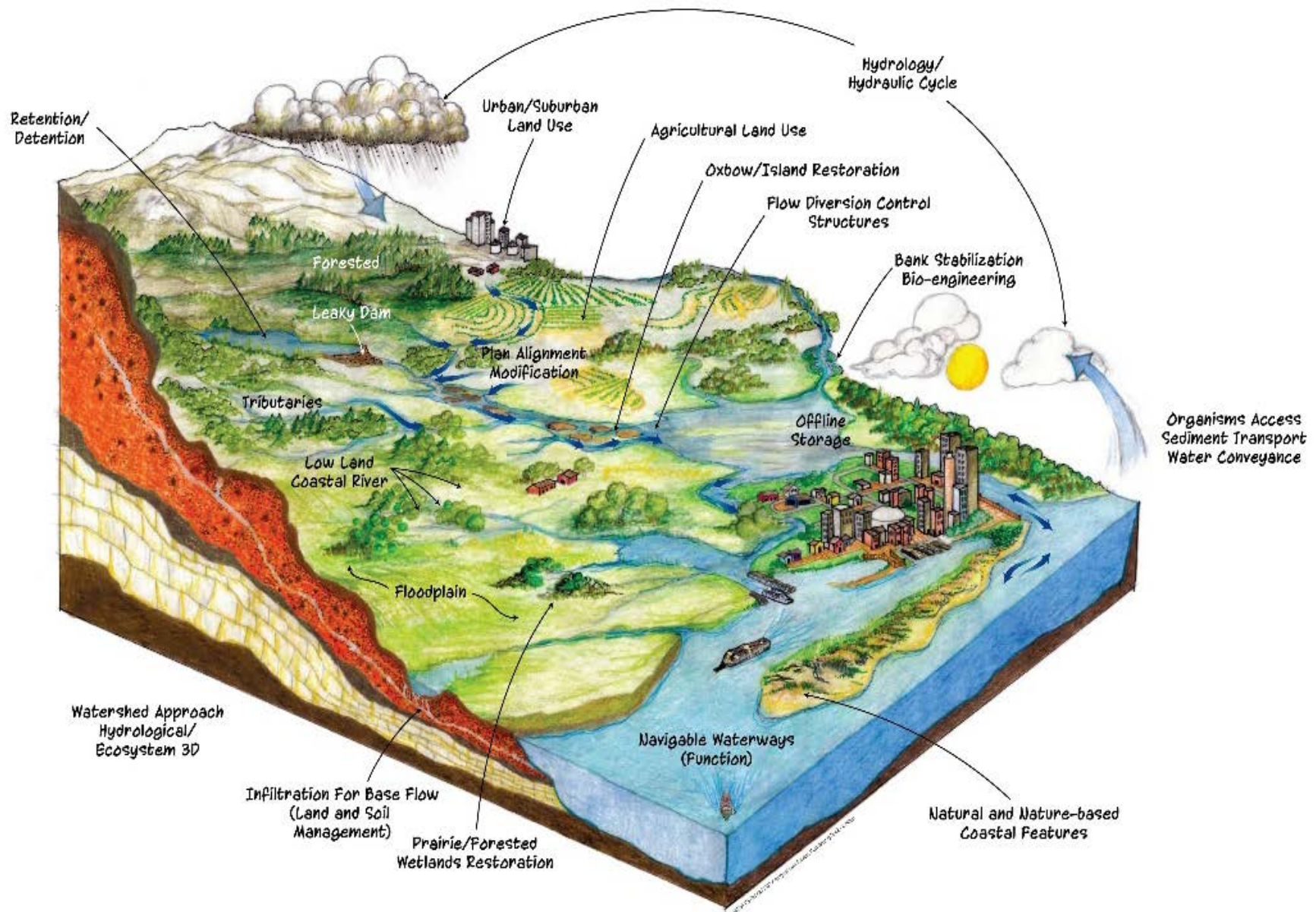
**Step 8**  
Finalize Designs and Obtain  
Regulatory Authorization(s) for  
Implementation of NNBF  
Option(s)

**Step 9**  
Implementation and  
Construction of NNBF Option(s)

**Step 10**  
Monitoring, Maintenance  
Adaptive Management, and  
Reporting



# A Systems View of Solutions





# What is an integrated, resilient solution?

## *Example barrier island cross-section*



*Ocean*

*Bay*

*Raised infrastructure*

*Consider climate change*

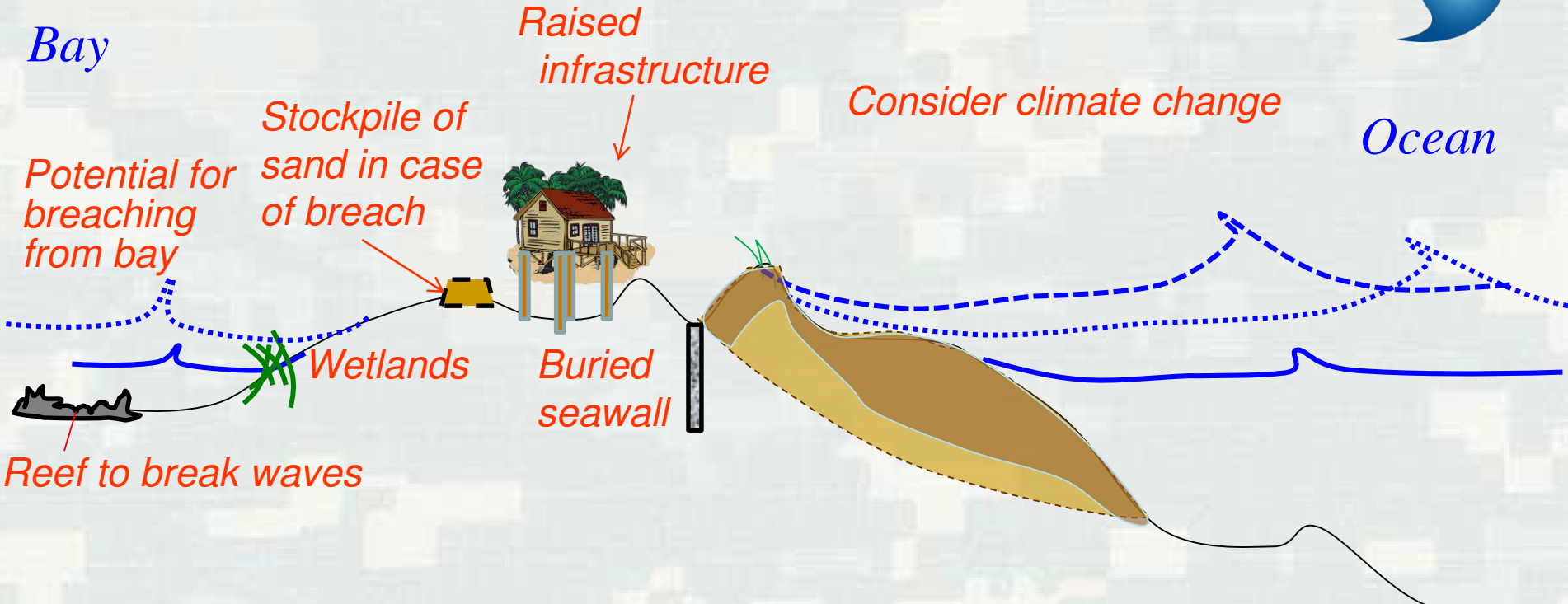
*Stockpile of sand in case of breach*

*Potential for breaching from bay*

*Wetlands*

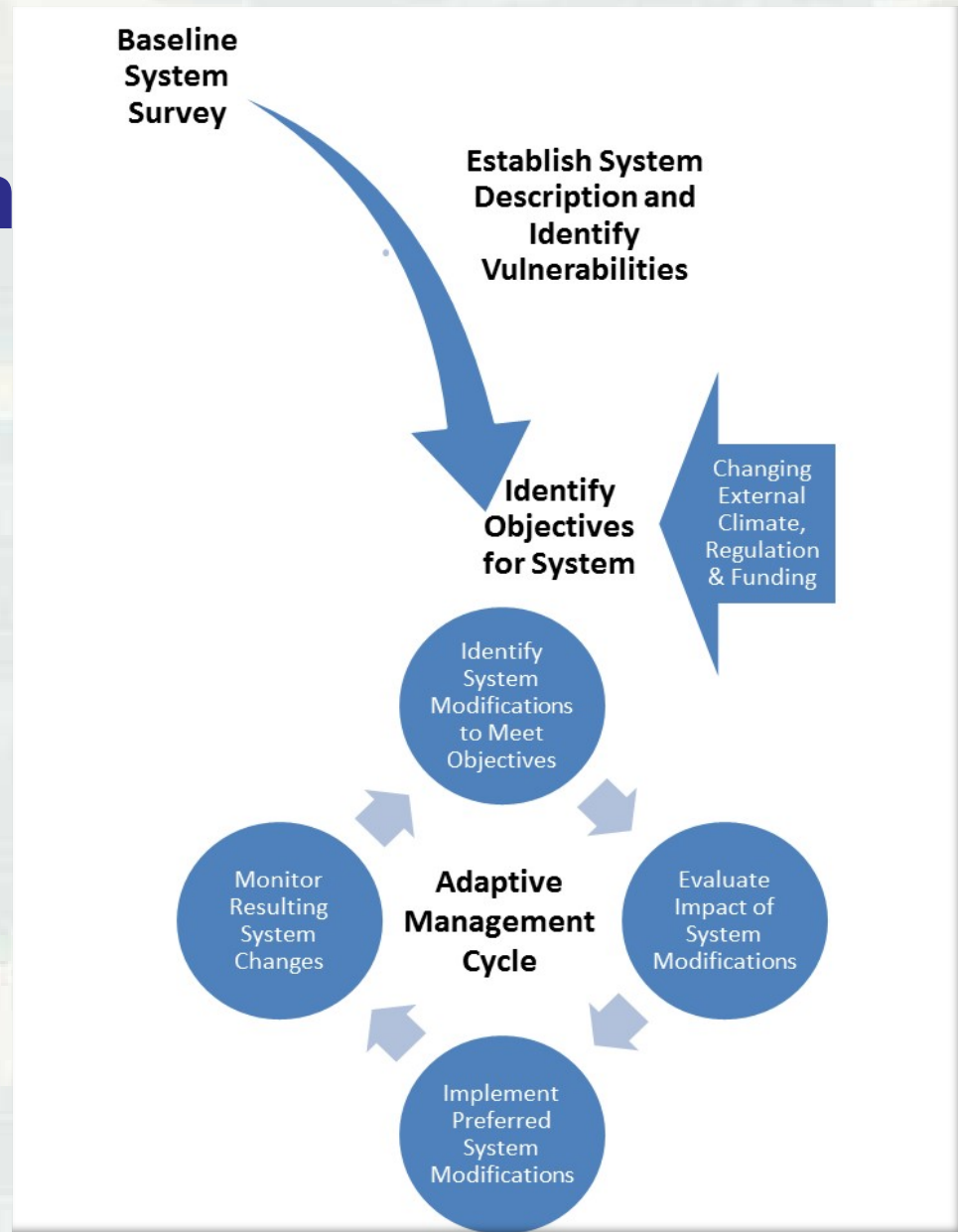
*Buried seawall*

*Reef to break waves*



- Understand the system, vulnerabilities and engineering.
- Provide diverse and reinforcing measures.
- Consider benefits across all the domains: economic, environmental, social.
- Actively monitor and adapt.

# Systems Approach when Considering an NNBF Project



# Desired Outcomes

O1

- Communication processes established with all stakeholders and publics

O2

- Problem identified and stakeholders committed to action

O3

- Funding streams identified and delivered.

O4

- Impact on system identified and accepted

O5

- Approvals and authorities in place

O6

- Overall solution portfolio delivered with NNBF elements optimised

O7

- Monitoring and adaptive management processes established

