INTEGRATING STAKEHOLDER PERSPECTIVES IN A SYSTEMS APPROACH TO EXPLORING SUSTAINABLE SOLUTIONS: TRIPLE VALUE SIMULATION (3VS) MODELS IN COASTAL WATERSHEDS

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Decision makers often need assistance in understanding the dynamic interactions and linkages among economic, environmental and social systems in coastal watersheds. They also need scientific input to better evaluate the potential costs and benefits of intervention options. The US Environmental Protection Agency is applying sustainability science to integrate environmental, economic, and social issues at a watershed systems scale. This "systems approach" is based on dynamic, interactive modeling tools that enable investigation of alternative strategies aimed at creating a resilient system of water resources that serves the needs and welfare of a growing population while seeking to minimize the ecological footprint. Triple Value (3V) Scoping and Modeling projects bring a systems approach to complex environmental problems to help regulators, policy makers, local decision makers, scientists, and stakeholders achieve sustainability goals.

A key aspect of this systems approach is the sharing of knowledge between decision makers and stakeholders in a collaborative modeling effort that illustrates linkages among social, environmental, and economic components of human and natural systems. This participatory effort brings into focus the direct and indirect benefits and costs of potential actions. For example, potential strategies to reduce excess nutrients in coastal waters include utilization of green infrastructure, alternative water supply systems, aquaculture, constructed wetlands, improved stormwater management, alternative toilets, and use of permeable reactive barriers. Water quality degradation has impacts on local quality of life, tourist economies, and employment, while potential nutrient management options can vary widely in cost, burden, timing, and location of implementation. The shared learning and incorporation of human dimensions in the models allows deeper discussion of tradeoffs between economic, social, and environmental goals. Training in systems thinking and the process of participatory modeling has expanded decision capacity in five Regional 3V Cases: Narragansett Watershed Nutrient Management (MA/RI), Cape Cod Nutrient management (MA), Snohomish River Nutrients and Cultural Resources (WA), Delmarva Land Use and Climate Resiliency (MD/DE/VA), and Suffolk County Nutrient Management and Resilience (NY). For these cases, the goal is to create scenarios that encourage strategic dialogue about alternative water resource management policies. Stakeholder perspectives have been included in stages of 1) drafting the problem statement and policy questions, 2) developing the conceptual model, 3) collecting and examining data and models, 4) feedback and revisions, and 5) exploring scenarios. The Triple Value Framework and participatory modeling method have been developed and tested to ensure they are transferable to other

locations and to other issues.