Science Needs for Infrastructure Funding

1) Science Need: Explore the potential of co-location of land-based BMPs, oyster/mussel restoration, and SAV.
    a. During the SRS process it was stressed that continued improvements in WQ were paramount to SAV recovery in the Bay and that an emphasis should be placed on strategic BMP placement and implementation. In response the MB suggested the SAV Wg undergo an exercise to explore the potential benefits of co-locating land-based BMPs, oyster/mussel restoration, and SAV.
    b. CESR also raises the question of what incentives and program characteristics are most effective for getting land managers to implement effective BMPs for living resources? If a priority need for the SAV WG is for land managers to strategically place BMP to support SAV, what are the incentives for them do that? Is it for there to be already established SAV acreage or oyster restorations going forward? Do they not know what BMPs those are and need to identify land-based BMPs that best support areas with oysters, mussels, and SAV?
        i. Also with the emphasis from CESR to follow on shallow waters, understanding the impacts and effectiveness of BMPs on areas with this co-interaction will be important.
2) Science Need: Climate Refugia
    a. Tidal: Research effects of natural infrastructure on living resources, particularly their ability to provide thermal refugia to Bay species in the face of increasing water temperatures.
        i. This refers to recommendation 5 that came out of the STAC Rising Water Temperature Workshop: Chesapeake Bay Program partners should develop common criteria and metrics to help target, site, design and implement tidal natural infrastructure projects in the nearshore where ecological and climate resilience benefits are highest. A priority should be placed on the use of natural infrastructure by conserving natural shorelines including marshes, wetlands, oyster reefs, and SAV and creating living shorelines in areas that incorporate multiple habitat types. Following targeting and prioritization of projects, emphasis should be placed on accelerating preferred designs, providing information on funding opportunities and providing technical drafting assistance for implementation proposals.
    b. Nontidal: Use an integrative approach combining information on flows, groundwater, stream power, connectivity, and adaptive capacity to provide a more comprehensive approach for identifying climate refugia. This could include collecting additional data on the extent of deep and shallow groundwater to improve temperature-based estimates of climate refugia locations at finer spatial scales. Climate refugia will become increasingly important for sensitive species like brook trout as water temperatures rise. Being able to understand where these refugia are likely to be found in the watershed could help prioritize conservation and restoration efforts.
        i. This refers to recommendation 6 that came out of the STAC Rising Water Temperature Workshop: The CBP partners should enhance and facilitate partnership efforts to collect data and develop tools needed to fill critical

knowledge gaps, improve understanding of the impacts of rising temperatures on aquatic ecosystems, and inform management decisions

ii. Overall: concept of identifying and mapping climate refugia in the Chesapeake, understanding more about the design criteria for climate refugia, and to bring in a more stakeholder component, develop a guide for practitioners.

3) Other science needs that came out of the STAC Rising Water Temperatures that may help your discussion:
    a. Conduct a robust assessment of which BMPs are heaters and coolers, to what extent, and to identify any landscape characteristics influencing the temperature impacts of BMPs. This could also include research into the efficacy of other cooling mitigation strategies, including wetland creation, dam/pond removal, floodplain restoration, beaver analogue projects, and improved roadside ditch management
    b. Develop models that increase understanding of habitat change from sea level rise and use these models to develop criteria for targeting restoration for maximum ecosystem services and benefits. Development of criteria for targeting where multiple benefits and ecosystem services can be optimized and leveraging habitat restoration efforts (e.g., subtidal oysters, SAV, marshes) to maximize ecosystem services and benefits through the development of models that increase the understanding of habitat change from sea level rise. Specific research needs include:
    - conducting threshold analyses to determine when ecological impacts or benefits occur from natural infrastructure implementation.
    - developing criteria for targeting natural infrastructure projects where multiple benefits and ecosystem services can be optimized.
    - applying models to increase understanding of habitat change from sea level rise as to leverage change for different restoration efforts (such as subtidal oysters versus intertidal oysters).
        i. Tidal STAC Recommendation 5: Chesapeake Bay Program partners should develop common criteria and metrics to help target, site, design and implement tidal natural infrastructure projects in the nearshore where ecological and climate resilience benefits are highest. A priority should be placed on the use of natural infrastructure by conserving natural shorelines including marshes, wetlands, oyster reefs, and SAV and creating living shorelines in areas that incorporate multiple habitat types. Following targeting and prioritization of projects, emphasis should be placed on accelerating preferred designs, providing information on funding opportunities and providing technical drafting assistance for implementation proposals.
    c. Develop a living resource monitoring plan to monitor environmental change and resulting living resource response occurring within the Chesapeake Bay as a result of rising water temperatures from climate change. Expanded ecosystem level monitoring is needed to truly understand temperature's impact on living resources, including how it impacts habitat, predator-prey dynamics, and physiological responses. Expanded monitoring of both environmental and biological parameters is needed to understand this impact and include:
    - Establishing monitoring stations where there are significant fisheries habitat and spawning grounds (long-term monitoring currently is more set up to characterize large bay segments). There are certain sentinel sites with continuous monitoring sites that could be considered (e.g., the National Estuarine Research Reserve System).

- Improving environmental monitoring of surface and bottom temperature, dissolved oxygen and fish habitat condition. Pair fishery survey data and telemetry fish tag detections with data on changing environmental conditions to better understand impacts on fishery resources at temporal and spatial scales that can be used by managers.
- Establishing zooplankton monitoring networks to understand ecosystem changes associated with large-scale efforts to improve water quality in Chesapeake Bay and rising water temperature impacts to food web dynamics

i. Tidal STAC Recommendation 1:Establish Chesapeake Bay-wide striped bass fishing guidance based on temperature and dissolved oxygen thresholds to reduce catch and release mortality. Consider developing habitat condition thresholds and fishing guidance for other recreationally targeted species at risk during periods of poor habitat conditions.
ii. Tidal STAC Recommendation 3: Hold a workshop with multiple fishery stakeholders to explore strategic, long-term ways to advance ecosystem approaches to fishery management in the Bay that incorporate climate change. These approaches would need to address current fisheries management practices that need to be reassessed based on current climate modeling, as well as developing new fisheries management practices that will address the new, potential fisheries that will develop as southern species move into the Bay. To better inform decision-makers, there is a need to develop climate scenarios and assess the risks of environmental drivers on fishery species and their habitats to inform fishery management planning and decisions.