USGS Chesapeake Science, 2020-2025 Work Plans:

Studies to assess land-use change and BMP effects on stream health and aquatic response

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U.S. Geological Survey

Science to understand and predict the response of streams to management actions

What are the effects of watershed BMPs and land use change on downstream:

Aquatic conditions
Stream health
Fish habitat

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Theme 1: Provide an integrated understanding of the factors affecting fish habitat, fish health, and landscape conditions

state of the science

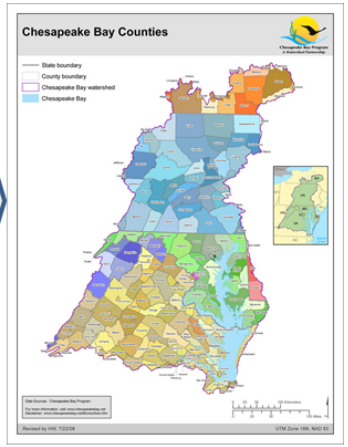
1C
Status
and
Trends

new metrics
data, new questions
data, new questions
new metrics
new questions
new processes

1B
Assessment

1A
Focal
Studies

stakeholders



scientific continuum

Larger extent	Smaller extent
Correlative	Mechanistic/Process
Space	Time
Organismal endpoints	Multiple endpoints
Assess condition	R&D
Existing data	Some new data

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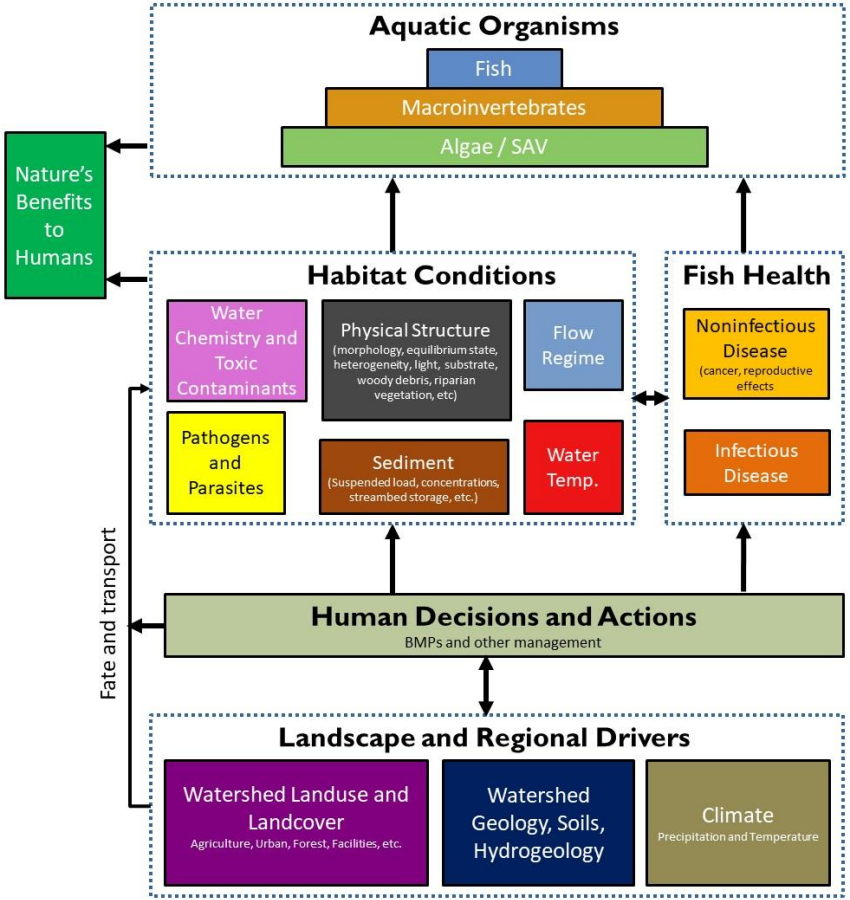
Conceptual model for explaining change of fish habitat, fish health, and aquatic conditions in relation to stressors and management activities



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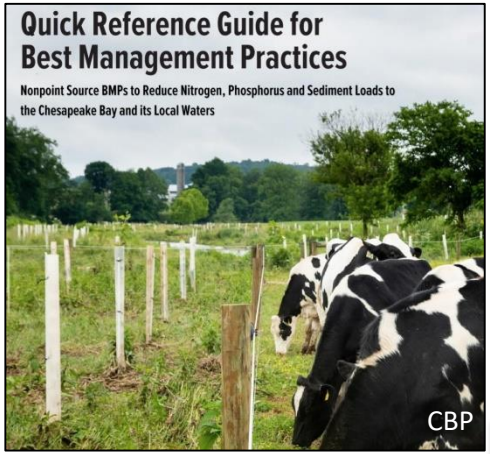
In other words…



Assessments

Integration Topic 1B: Quantitative Stream Condition, Fish Habitat and Fish Health Assessments

1. Assess relationships and identify stressors affecting stream health and freshwater fish habitats. [Improve predictive modeling of stream conditions using the Chessie BIBI]
2. Plan and conduct pilot assessment of watershed-estuary fish habitats and fish health.
3. Coordinate science support for Brook Trout.
4. Collaborate with partners and stakeholders to better understand science needs related to invasive and pre-listing species and species of listing concern.
5. Collaborate with partners and stakeholders to better understand science needs related to fish passage.

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Status and Trends

Integration Topic 1C: Data compilation, integrated monitoring networks and monitoring and computation of status and trends for relevant topics

1. What data are available for status and trends and for inclusion in assessment and focus studies on stream health, fish habitat and fish health?
   - Aquatic communities, flow and temperature, water quality, toxics, conductivity

2. What variables have data sufficient for a status and trends analysis and what is the status and trend for each?

3. What is the optimal framework for an integrated network to effectively monitor stream health, fish habitat and fish health?

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Factors affecting streams and implications for management decisions

Tasks for 2020	Collaborating Scientists (leaders underlined)
A. Summarize what is known about the stressors and drivers that are affecting stream health in the Chesapeake Bay Watershed	Fanelli, Cashman, Rapp, Maloney, Jastram, Hopkins (ending FY21)
B. Determine the effect of BMPs and other aquatic condition drivers on temporal and spatial water-quality responses in four showcase watersheds	Webber, Sekellick, Clune, Chanat, Devereux (ending FY22)
C. Land-use change and BMPs effects on stream health and aquatic habitat response in select small watersheds with intensive BMP implementation	Noe
i. Analyze relationships between management actions, drivers, stressors, aquatic habitat, and macroinvertebrates and fish	Cashman, Fanelli, Webber, Maloney (ending FY20 with additional synthesis in FY22)
ii. Initiate studies on the effects of land-use change and BMPs on stream health, aquatic conditions (WQ), physical habitat, and aquatic organisms	Noe, Cashman, Fanelli, Rapp, Smalling, Wagner, Webber (ending in FY25)
iii. Planning of whole-system models of stream health, fish habitat and aquatic conditions response to management actions	Chanat, Noe, Cashman (ending in FY25)
D. Detailing the lessons learned from urban BMP implementation on toxics	Majcher (ending in FY20)
E. Integrate with Integration Topics 1B (assessments) and 1C (status and changes) and Theme 3	Noe, all Stream scientists
F. Engage stakeholders	Noe and others

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Factors affecting streams and implications for management decisions

A. Summarize what is known about the stressors and drivers that are affecting stream health in the Chesapeake Bay Watershed

1. The team will summarize available information regarding the stressors and drivers across a range of landscape types, including both urban, agricultural and mix land uses. To develop this summary, at least 2 approaches will be considered:
    a. The project team will develop a white paper to summarize our current understanding of the stressors and drivers affecting stream health in urban and agricultural settings in the Chesapeake and Mid-Atlantic region.
    b. Working with the lists of state-identified impaired waters, the team will consider summarizing the stressors that have been identified as responsible for causing impairment of streams throughout the Chesapeake Watershed. Variability in jurisdictional approaches to characterizing likely stressors may represent a challenge to applying this approach in a regional manner.
2. The project team will begin to consider other potential stream-health metrics that can characterize both current conditions and indicators of recovery.

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Factors affecting streams and implications for management decisions

B. Determine the effect of BMPs and other aquatic condition drivers on temporal and spatial water-quality responses in four showcase watersheds

Identify spatiotemporal water-quality response patterns in the four showcase watersheds in response to BMP implementation and changes in other watershed drivers:

Smith Creek VA; Upper Chester MD; Conewago Creek PA; and Difficult Run VA

from discrete and real-time data collected between 2011 – 2019.

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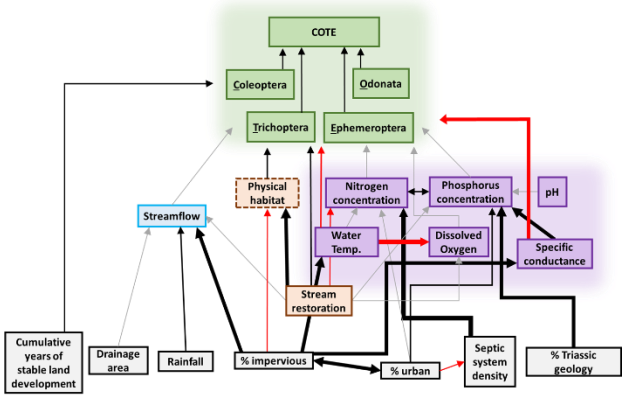
Factors affecting streams and implications for management decisions

C. Land-use change and BMPs effects on stream health and aquatic habitat response in select small watersheds with intensive BMP implementation

i. Analyze relationships between management actions, drivers, stressors, aquatic habitat, and macroinvertebrates and fish

Hierarchical causal analysis will be completed using existing data from the following locations: 1. Clarksburg and Montgomery County to determine if low-impact development can protect high-quality stream ecosystems, 2. Fairfax County to understand if restorations “restore” previously developed urban stream ecosystems, and 3. Monocacy, North/South Fork Shenandoah, or Upper Chester Watershed to determine if agricultural BMPs mitigate impacts to agricultural stream ecosystems.

Approaches such as structural equation modeling or path analyses will be used to combine process-based understanding of environmental systems with statistical testing of these hypotheses, allowing the explicit testing of causal mechanisms and drawing causal inferences about how stressors and drivers interact and their ultimate influence on outcomes through both direct and indirect pathways. Changes across both space and time in response to management actions will be an explicit consideration in this study. The new understanding of mechanistic drivers of change identified by these studies will be used to directly inform management efforts.



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Factors affecting streams and implications for management decisions

C. Land-use change and BMPs effects on stream health and aquatic habitat response in select small watersheds with intensive BMP implementation

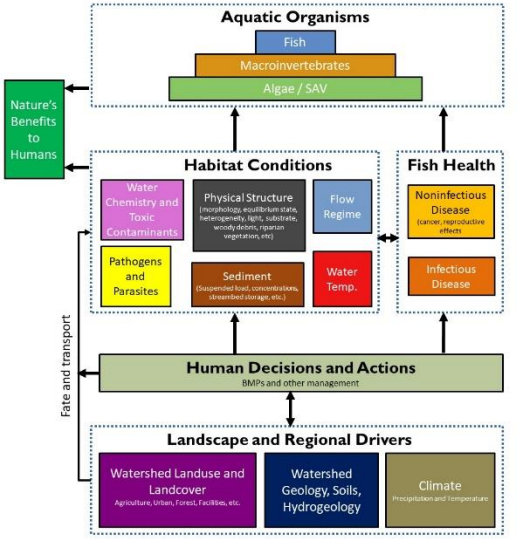
ii. Initiate studies on the effects of land-use change and BMPs on stream health, aquatic conditions (WQ), physical habitat, and aquatic organisms

iii. Planning of whole-system models of stream health, fish habitat and aquatic conditions response to management actions

ID the causative mechanisms for how management actions and land use effect stream ecosystems using new measurements and approaches. Do responses to management actions vary as a function of a watershed's broader ecological context (e.g., land use, geographic and physiographic settings)?

Synoptic sampling sites (~20-30 sites) will be chosen in each of four selected focal small watersheds will be chosen along gradients of intensity of management actions (i.e. density of BMP implementation), land use, and hydrogeology, allowing space-for-time analyses to determine the specific effects of management actions and time lags of system responses. Where possible, synoptic study sites will be chosen to overlap with historic data collections to allow analysis of direct system response over time in response to stressors and drivers. Attributes to be measured or characterized will include land use and BMP characterization, stream flow and temperature, stream geomorphology and riparian/floodplain condition, water quality and contaminants, and organismal responses (macroinvertebrate and fish communities and functional groups, and fish health).

Conceptual model for explaining change of fish habitat, fish health, and aquatic conditions in relation to stressors and management activities



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Factors affecting streams and implications for management decisions

D. Detailing the lessons learned from urban BMP implementation on toxics

We will review concurrent regulatory programs for priority toxic contaminants (PCBs, PAHs, organochlorine pesticides) in the watershed and their goals and limitations relative to the Bay Program outcomes. We will also perform a review of select project investigations under the various programs including the Anacostia Sediment Project publications and reports, Back River source delineation project, identification of relevant Delaware WATAR program projects, and the DRBC PCB reduction program. Efforts will be made to identify projects within the Chesapeake Bay Watershed, but a short summary of approaches and advances from other watersheds will be included, such as DRBC and others.

A synthesis of outcomes will result in the identification and compilation of the most critical lessons learned for stakeholders. Some translation of how to appropriately modify or adapt approaches from non-TMDL regulatory programs will be conducted.

The product will be a publication detailing advances and lessons learned across various regulatory programs and how the findings from these studies can be adapted and applied to toxic contaminant reduction goals in Chesapeake Bay Watershed.

Washington State Health Dept.

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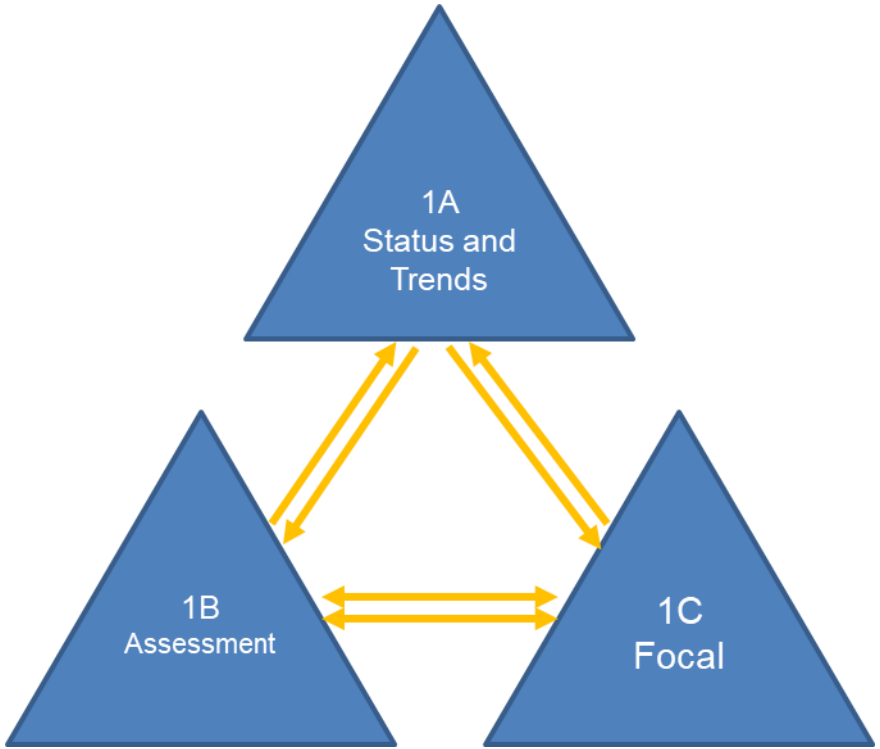
Factors affecting streams and implications for management decisions

E. Integrate with Integration Topics 1B (assessments) and 1C (status and changes) and Theme 3 (landscape + BMP data and analyses)



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Factors affecting streams and implications for management decisions

F. Engage stakeholders

We will communicate, coordinate, and collaborate with CBP to ensure we do relevant science and to ensure communicate new knowledge

Kelly Maloney and Greg Noe will be USGS Points-of-Contact with Stream Health WG

Rosemary Fanelli, Matt Cashman, John Jastram, and other USGS scientists will be active participants in WG

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Chesapeake Bay Program

Science. Restoration. Partnership.

Factors affecting streams and implications for management decisions

USGS will be addressing Stream Health WG needs ("Gap" in Logic and Action Plan):

Non-biological factors are not considered for measures of stream health. We need more information on how they can be utilized and addressed.

There is a lack of understanding regarding how a management practices will affect the stressors identified by the Maryland Biological Stressor Identification Index.

Few resources offer a holistic view of stream restoration and BMP guidance. They have an emphasis on sediment and nutrient reductions without consideration co-benefits

Let us know how we could better meet your science needs!

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Holistic system science to address management needs