West Virginia Watershed Assessment Pilot Project
Outline & Assessment Methodology
March 2012

Introduction

The West Virginia Watershed Assessment Pilot Project was developed to define the methodology and identify the information and tools necessary to meet the project objectives stated below. The intent is to provide a tested, peer reviewed assessment process that can be duplicated in other watersheds throughout West Virginia. The information and tools presented in the assessments will hopefully provide guidance to regulatory agencies, decision makers, non-governmental organizations (NGOs), and other partners on key strategies and places to work within the watersheds that will contribute to the protection and restoration of critical aquatic and terrestrial resources. A few examples of intended uses include: identifying areas of high conservation value for protection by state and federal government agencies or NGOs; identifying high priority sites for conducting restoration activities; and assessing cumulative watershed effects contributing to the degradation of aquatic resources.

Project Objectives

1. Design and test a watershed assessment process that includes analysis of cumulative watershed effects.
2. Establish priorities for protection and restoration of aquatic resources and evaluate/rank areas within watersheds accordingly.
3. Provide relevant information, strategies/actions, and a decision support tool to assist partners, stakeholders and regulatory staff with decisions affecting watershed resources.

Project Process

1. Define watershed **assessment methodology** and preliminary prioritization metrics.
2. Conduct **technical advisory team meeting** to review proposed assessment methodology and identify data gaps and sources.
3. Complete a **watershed characterization** that describes watershed resources and function, impacts, and current condition.
4. Conduct **expert workshop one** to review assessment methodology, evaluate data collected, obtain local information on watershed-specific resources, issues and relevant information, and refine metrics used for prioritization.
5. Complete a **consolidated analysis** that evaluates the cumulative watershed effects of individual stressors on the watershed, as well as historical and possible future conditions analyses.
6. Conduct **expert workshop two** to allow for peer review and refinement of the watershed assessments, consolidated analysis and prioritization results. Complete **draft watershed assessments**.
7. Conduct **decision maker/end user workshop**.
8. Complete **final watershed assessments**.

Watersheds

The assessments will occur in five (5) 8-digit HUC watersheds (referred to as HUC8 watersheds) within West Virginia including: Lower and Upper Monongahela (05020005 and 05020003, respectively); Elk (05050007); Upper Guyandotte (05070101); Little Kanawha (05030203) and Gauley (05050005). Watershed assessments will be completed in two of the five identified watersheds first (the Lower/Upper Monongahela and the Elk). After these watersheds are completed, the project team will utilize the assessment methodology to complete assessments in the final three watersheds. The intent is to ensure, through replication, that the process is transferable to other watersheds and that we have evaluated the potential variability from one watershed to the next. These watersheds will be assessed using the same general process, with adjustments made based on lessons learned completing the earlier watershed assessments.

Planning Units

This watershed assessment project will be conducted at two spatial scales. Planning units at a coarser scale will initially be 12-digit HUC watersheds (referred to as HUC12 watersheds) within each HUC8, which are often of interest to state agencies for regulatory purposes and that capture conditions not evident at smaller spatial scales. The analysis will be then be refined to a smaller scale of planning units, NHDPlus catchments, a scale at which conservation or restoration activities are more likely to take place. To ensure a more even size distribution, this dataset will be modified by merging very small NHDPlus catchments into larger catchments according to hydrology or by dividing very large NHDPlus catchments into sub-catchments more appropriately scaled for analysis.

Riparian/Wetlands/Uplands classification

Riparian areas will be classified using The Nature Conservancy's Active River Areas (ARA) dataset, which delineates riparian wetlands and a buffer zone around stream segments. Additionally, a 125-meter buffer of NHD 24k data will be used to delineate the riparian area of headwaters streams that are not included in the ARA. Wetlands and a 50-meter wetland buffer will be delineated using National Wetlands Inventory (NWI) data. To assure data accuracy, NWI data will be compared to NLCD 2006 wetlands classification data for additional verification, and advanced quality control will be conducted comparing hydric soils data against digital orthophotography interpretation. To capture more of the functional attributes of wetlands in the landscape, "wetland catchments" will be delineated from stream network and DEM datasets as the portion of the corresponding NHDPlus catchment that drains to a given wetland; these areas contribute to specific wetland hydrology and are distinct from the NHDPlus

catchments that are used as planning units. Uplands will be characterized as all lands outside of the riparian buffers and wetlands.

Watershed Characterization

The watershed characterization is intended as a baseline analysis to compile and integrate datasets into a format appropriate for use in the Priority Models (described below). Datasets will be processed and analyzed for each planning unit to calculate metrics for a variety of individual indices (such as water quality and quantity, hydrology, habitat, biodiversity, etc.), which will be scored by planning unit.

The objective is to identify and utilize datasets that characterize the following criteria, though it is recognized that suitable datasets may not be available for all criteria listed.

I. Current Watershed Condition/Function
   a. Riparian, wetland and upland natural resources in the watershed
   b. Functional values and ecological services provided by the natural resources in the watershed (surface water use, flood storage/abatement, groundwater use, sediment retention, pollutant assimilation, recreational benefits, etc.)
   c. Freshwater connectivity within the watershed, and hydrologic connections upstream and downstream of the watershed (where appropriate), to determine how these affect watershed condition
   d. Water quality impairments (including 303d stream listings, AMD-impaired and TMDL streams) within the watershed and issues affecting hydrology and environmental flows
   e. The contribution of consumptive water use on aquatic resource quantity and function
   f. Rare, unique and/or sensitive species (and their habitat requirements) and vegetative communities within the watershed
   g. Existing conservation investments on the ground (local, state, federal, and private conservation lands; conservation easements; mitigation sites)
   h. Identified government and private conservation priorities within the watershed (protection and/or restoration priorities identified by conservation organizations and government agencies)
   i. Natural physical vulnerability of the watershed as indicated by factors such as slope, highly erodible soils, etc.
   j. Land use practices in the watershed with the potential to negatively impact natural resource value and function (resource extraction activities such as mining, oil and gas well drilling, mineral operations; development; road construction, etc.)

k. Land use practices in the watershed with the potential to cause pollution of aquatic resources (point sources such as facilities that discharge to water, non-point sources such as impervious cover runoff, agriculture, landfills, etc.)
l. Sources of natural resource and/or function loss due to fragmentation (dams, transportation infrastructure, energy transmission, etc.)

II. Future threats (Cumulative effects)
   a. Projected land use change with the potential to negatively impact natural resource value and function (population growth and urban expansion, planned energy projects)
   b. Potential for increased resource extraction activities due to the presence of unexploited natural resources (unmined coal, high wind or geothermal energy potential, Marcellus shale gas play)
   c. Potential effects of climate change

Defining the actual metrics datasets used in each index will be an ongoing and iterative process at the beginning of the assessment, taking guidance from previous literature and expert opinion. Each metric will be normalized on a scale from 0 to 1, with 0 being defined as the worst quality value and 1 being defined as the best quality value for a particular metric over all planning units. For example, to score for the amount of forested riparian area, a metric where a high value indicates a higher quality (designated as a "Positive" metric in the analysis), the highest scoring planning unit's metric would be set to a value of "1" and the lowest scoring planning unit would be set to a value of "0", with all remaining scores distributed between 0 and 1. Conversely, to score for the amount of mining in a planning unit, a type of metric where a higher value indicates lower quality (designated as a "Negative" metric), the highest scoring planning unit's metric would be set to a value of "0" and the lowest scoring planning unit would be set to a value of "1". These scores will be determined for both HUC12 and NHDPlus catchment scales of planning unit analysis.

This methodology will result in a relative comparison of planning units for each metric, indicating which planning unit ranks higher than another one, but not necessarily providing enough information to define the quality of each planning unit on a non-relative basis. To accomplish this, each metric will also be evaluated in an objective fashion, by using thresholds to assign metric values to one of four quality categories: Very Good, Good, Fair, and Poor. Thresholds will be defined based on literature review (where available), expert opinion, and a data analysis process using reference streams as defined by the West Virginia Department of Environmental Protection. These "categorized" rankings will also be determined for both the HUC12 and NHDPlus catchment scales of planning units. This will result in a separate scoring process, so that each planning unit will have two scores for each metric and index: a relative score and an objective score.

Metrics will be weighted to ensure that each metric contributes a value in its corresponding index relative to its significance in terms of affecting watershed condition (i.e., it may be determined that certain metrics have less influence on overall condition/function than others). Metric scores will be weighted and aggregated to determine index scores, and index scores will be weighted and aggregated to determine model scores. Metric and index weights will be determined through literature review, expert opinion, and statistical analysis. The index scores will be used in the Priority Models to prioritize protection and restoration sites and activities. A higher score will indicate a higher priority for a certain site and activity, while a lower score will indicate a lower priority for a certain site and activity.

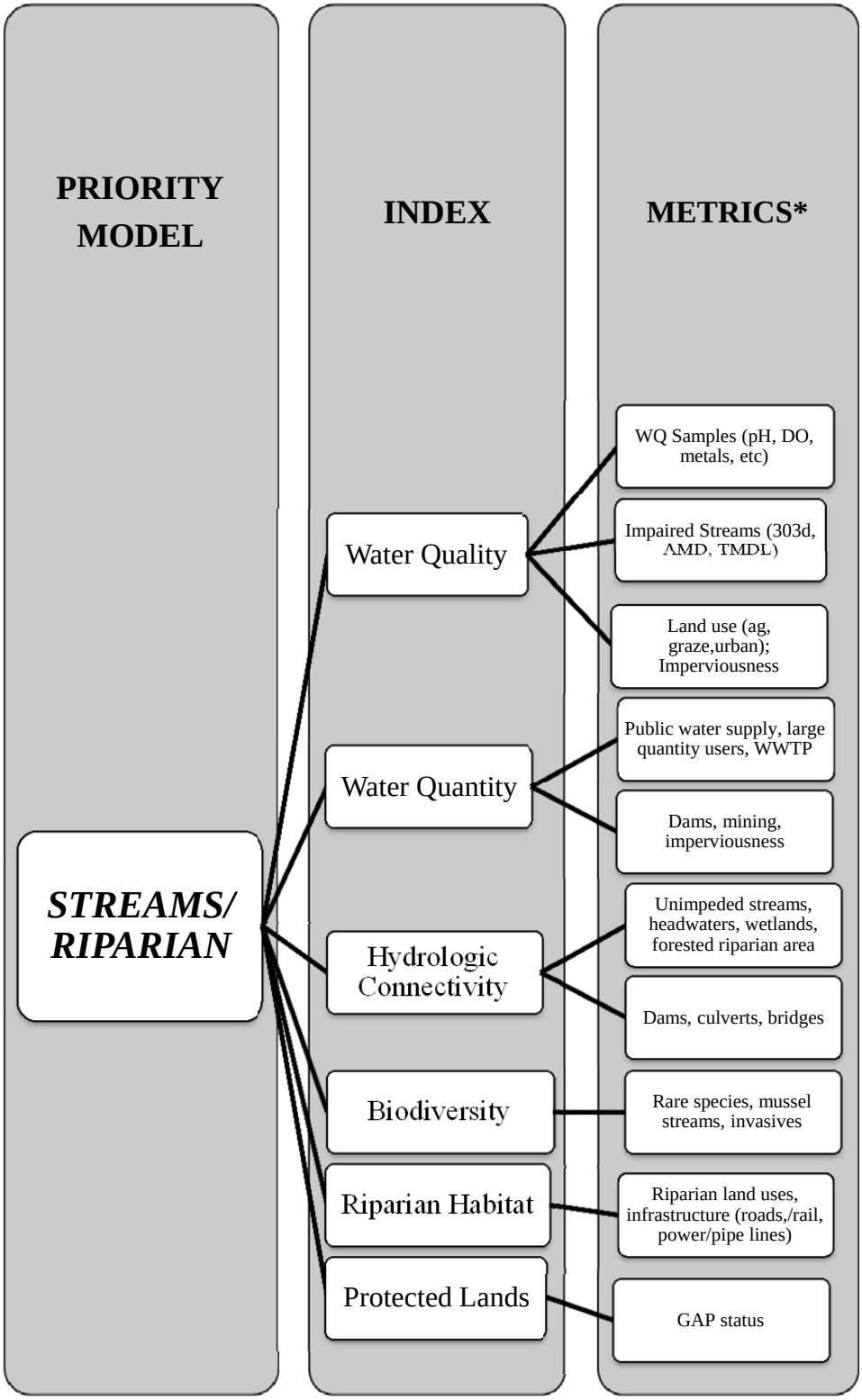
As watershed assessments are completed in additional HUC8 watersheds (initially, for the 5 HUC8 watersheds of this pilot project, and potentially for the remaining HUC8 watersheds in West Virginia, as funding becomes available to complete additional assessments), planning units will also be evaluated relative to each other over all completed HUC8 watersheds. This will provide a means of prioritizing catchments not only within a HUC8 watershed but also over all assessed watersheds.

Priority Models

The Priority Models will use the aggregated index scores produced during the Watershed Characterization analysis to generate priority rankings for protection and restoration areas and activities. Prioritization will occur in three distinct phases:

1. an initial ranking of HUC12 watersheds in terms of their overall and index scores,
2. a second ranking of NHDPlus catchments based on overall and index scores calculated at that scale, and
3. a final, more detailed, identification of key areas within each NHDPlus catchment.

Figure 1. Flowchart of proposed watershed assessment process (*listed metrics are a sample and not an exhaustive list)



Three Priority Models will be generated:

Streams/Riparian Priority Model (SRPM)
Wetlands Priority Model (WPM)
Uplands Priority Model (UPM)

These models will remain separate, as they identify key landscapes (riparian/wetlands/ uplands) that will be relatively and objectively ranked, thus presenting an inventory of areas most in need of restoration or protection activities.

For example, results from the relative ranking for the Priority Models will identify the highest quality areas in a HUC8 watershed as the highest priority. Results from the objective ranking for the Priority Models will identify areas of mid-quality (Fair-Good) where restoration activities are needed and have the most potential to improve overall conditions as the highest priority. Key guidelines for the selection of restoration priorities include: areas with the highest potential for feasible or successful restoration projects, areas with the highest potential for an increase in overall watershed function should they be successfully restored, and areas most in need of restoration projects.

The first phase analysis will present the final ranks for each planning unit (HUC12 and NHDPlus catchment), with a high score indicating a higher priority within that Priority Model. The second phase analysis will involve highlighting and mapping key target areas within each planning unit to identify which geographic areas should be prioritized and what specific restoration or protection activities may be most appropriate within each planning unit.

Priority models will be developed before the first expert workshop to present the methodology for review by the experts. They will, however, be considered preliminary until the consolidated analysis has been completed, incorporated into the models, and reviewed at the second expert workshop.

Consolidated Analysis

An additional goal of the project is to conduct a cumulative watershed effects analysis that evaluates the cumulative impacts of individual stressors on the watershed. This type of analysis is necessary to ensure that potential protection and restoration priorities and strategies take into consideration not only individual stressors, but also the potential interaction of various factors, in the evaluation of priorities and potential strategies, with the goal of a net reduction in adverse impacts within the watershed. The project will analyze historical and possible future conditions, with the intent of assessing the impacts of past changes on the watershed and projecting future trends that may significantly impact the planning units over time (such as climate change or population growth).

The objective is to incorporate the following into the consolidated analysis:

a. Impacts and stresses to natural resources, functions and sensitive species (and their habitats) and vegetative communities in the watershed
b. Current and past land use changes in the watershed, evaluating their cumulative watershed effects on natural resource condition and function
c. The extent and location of riparian, wetland, and upland loss compared to historic conditions, including the loss of any species or vegetative communities
d. Natural resources, functions, and/or services that have been lost or degraded, where they are, and how significantly they have been impacted
e. Trends analysis (land development/conversion; permitting; water quality, flow and water usage; population growth; climate change)
f. Evaluation of how projected trends could impact current watershed condition/function or the success of potential restoration/protection projects

Due to the coarse scale of available data for this analysis, metrics will only be calculated at the HUC12 watershed level of planning units, not for NHDPlus catchments, and scores will only be analyzed on a relative basis comparing planning units with each other, not on the objective, threshold-based assessment also completed for the Current Condition/Function analysis.

Various spatial tools will be explored and evaluated for assessment of cumulative watershed effects and incorporation of historical and future conditions and trends. The results of these analyses will be incorporated into the final version of the Priority Models to identify restoration priorities as well as where applied protection and restoration strategies will likely have the greatest impact.

Expert Workshops

Two workshops with local experts will be held for each watershed during the course of the project to evaluate datasets, metrics calculated, the assessment methodology, and analyses performed. Local experts may include state and federal agency personnel, university researchers, non-profit staff, and local individuals with relevant expertise to help inform the process. The first workshop will be held after the Watershed Characterization and preliminary Priority Models have been completed to review the metrics used and weightings applied. The second workshop will be held after the Consolidated Analysis and final Priority Models are completed. Any recommendations from the experts will be evaluated and incorporated into the final products.

Final Products

The watershed assessment reports will include a compilation of all of the items defined in the proposed methodology above, along with specific strategies and priorities developed to accomplish the goals and objectives for the project. The reports will describe the methodology and references used to complete the assessments as well as lessons learned during the process. They will include detailed descriptions of the prioritization process used to evaluate protection and restoration opportunities and will identify opportunities to integrate and use monitoring and assessment as an adaptive feedback loop in the regulatory and restoration decision-making process.

In addition to the watershed assessment reports, an anticipated final product of the project will be an interactive web mapping application that presents a watershed map for each of the Pilot Project HUC8 watersheds, illustrating the priority ranking for protection and restoration activities for each planning unit. The initial HUC8 watershed-scale map will display the first phase results (relative and objective priority rankings by HUC12 and NHDPlus catchment), with the ability to zoom into a particular planning unit and focus on the phase two results (identifying key target areas). This tool will provide a level of interaction for partners, stakeholders, and regulatory staff, with the ability to zoom in to specific sites within catchments, identify potential target areas for protection and restoration activities, and evaluate the potential overall watershed effects of selected strategies.

Decision Maker/End User Workshop

A final workshop (for each watershed) will be held with stakeholders and potential end users to present the final products and solicit their input into the format and usability of the interactive web mapping application and other documents produced. Workshop participants may include federal, state, and local government personnel, potential partners in protection and restoration efforts, and other groups or individuals who may use the products. Any recommended changes will be evaluated and incorporated into the final version of the end product.