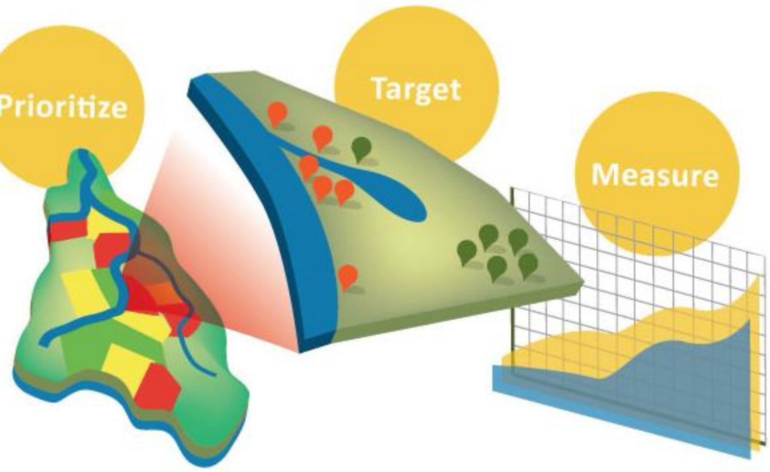
One Watershed One Plan

Tools for Prioritizing, Targeting, and Measuring

Background

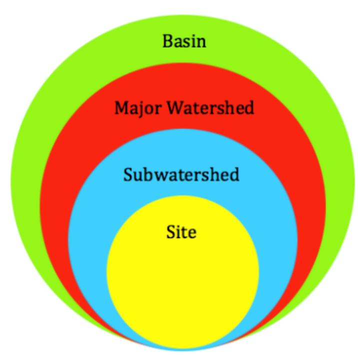
The vision of *One Watershed, One Plan* is to align local water planning on major watershed boundaries with state strategies towards prioritized, targeted and measurable implementation plans. Models and tools are capable of assisting planning partners in prioritizing water bodies or natural resources, and the potential risks impacting that water body or natural resource. They are also capable of targeting, which takes a closer look at agreed-upon priority resources and issues, and identifies specific actions, locations, and management practices for addressing the issues.



Models and tools are also capable of projecting outcomes of specific actions, locations, and management practices to forecast measurable results. This document intends to highlight different models and tools that are being supported by state agencies, and are capable of prioritizing, targeting, and measuring in watershed-level plans.

A Note on Scale

Models and tools can prioritize, target, and measure at several different scales. For the purposes of this document, scales will be defined as (from smallest to largest): site, subwatershed, major watershed, and basin. While some models or tools may broadly prioritize at a major watershed scale to rank activities in one watershed over another, other models or tools may target down to a site-specific location for identifying sites requiring on-the-ground implementation practices.



GIS Analysis Tools

What is GIS?

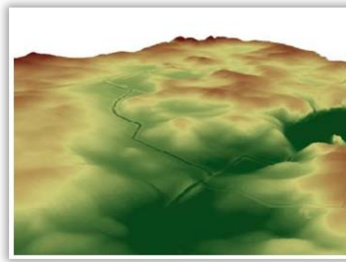
GIS, or Geographic Information System, is a computer system capable of assembling, storing, manipulating, and displaying information that is assigned to a specific location[1]. GIS systems are also capable of viewing and disseminating LiDAR-derived DEMs, which can be used to complete a digital terrain analysis to create a better understanding of how water interacts with the landscape to result in more effective clean water projects. Minnesota's Clean Water Fund has supported the acquisition of a statewide LiDAR data set[2].

What is LiDAR?

Light **D**etection **A**nd **R**anging is a remote sensing technology used to collect land elevation data, often done by an airborne survey. A LiDAR aircraft flies over a survey surface, using laser pulses to measure the distance from the aircraft to the ground surface, while using GPS to track accurate locations of each returned laser pulse. The result is the creation of a Digital Elevation Model (DEM), which creates a detailed three-dimensional representation of ground elevation.

What spatial information is needed for GIS Analysis Tools?

A variety of spatial data can be used for GIS analysis, including pollutant-loading maps generated from models like HSPF, terrain analysis output data, and general base maps including watershed boundaries or land cover imagery s. Data layers can be incorporated from other sources, and weighted to reflect stakeholder values.

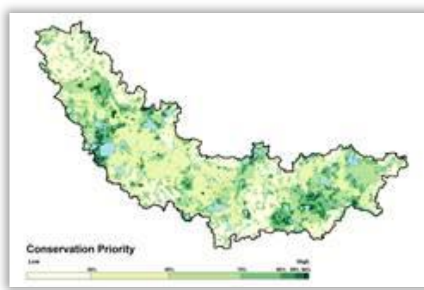


When during planning would GIS Analysis be the most useful?

Different layers, such as pollutant-loading or habit conservation maps, can be used to guide prioritization of issues and water resources in a major watershed as well as in targeting.

What are some examples of tools that leverage GIS?

Zonation is a spatial prioritization software used widely in conservation planning[3]. It utilizes GIS data to identify priority areas for targeting actions to protect and improve water quality and provide guidance on where to implement good management practices. In addition, priorities for clean water can be integrated with other priorities to achieve multiple benefits. Zonation is a values-based model, and can be easily adapted to incorporate local community objectives and priorities. Outputs include maps and GIS data that can be scaled for various purposes.



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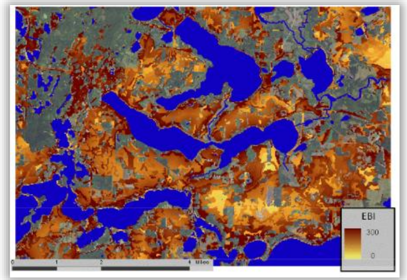
1 http://webgis.wr.usgs.gov/globalgis/tutorials/what_is_gis.htm
2 http://www.legacy.leg.mn/projects/minnesota-elevation-mapping-project-lidar-0
3 http://www.helsinki.fi/bioscience/consplan/software/Zonation/Introduction.html

Ecological Ranking Tool/Environmental Benefits combines soil erosion potential, terrain analysis / proximity to surface water, and habitat quality indices to establish a composite priority-ranking map for areas of the state. This tool can be used to help prioritize tracts of land to be targeted for conservation easements or other conservation practices, and has the potential to incorporate additional data sets where they are available[4].



Terrain Analysis Tools

What is Terrain Analysis?

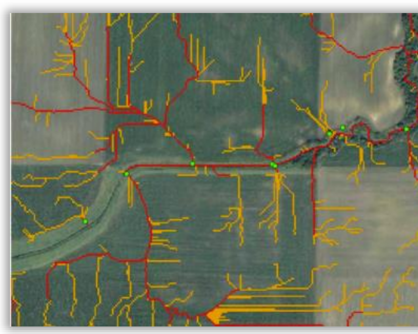
Terrain analysis is a methodology that models the landscape for conservation planning purposes. It relies heavily on Geographic Information Systems (GIS) and remote sensing technology, such as the LiDAR-derived Digital Elevation Model (DEM). Selected terrain attributes such as slope, aspect, or flow direction can be analyzed to identify problem sites related to upland erosion and surface runoff, such as gullies. Terrain analysis can then provide a quantitative, detailed, repeatable procedure to accurately model real landscape processes and scenarios for conservation planning purposes[5].

What is hydro - conditioned data?

Hydro conditioning is a term used to describe any alteration to the DEM that improves flow-through/drainage to more accurately model the "real life" flow of water. Hydro conditioning fills in artificial sinks and pits to ensure that water is projected to flow the way it does on the field[10]. It also solves problems associated with digital damming, where elevation data disrupts connectivity through features such as culverts and bridges[11]. These features are cut to ensure that surface water is modeled to flow the same way it does in real life.

What baseline information is needed for Terrain Analysis?

Depending on the desired accuracy of the project, DEMs derived from remote sensing technology may need to be hydro-conditioned. Hydro-conditioned data of varying accuracy and resolution is available statewide.



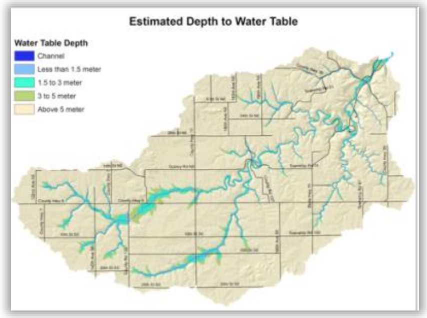
When during planning would Terrain Analysis be the most useful?

Terrain analysis can be used to prioritize problem areas in a watershed that are susceptible to water degradation, and target site-specific locations for restoration or protection activities.

[4] http://www.bwsr.state.mn.us/ecological_ranking/
[5] http://www.mda.state.mn.us/protecting/cleanwater/pilotprojects/~/media/Files/protecting/waterprotection/lidarworkshopshow.ashx

What are some examples of tools that leverage Terrain Analysis?

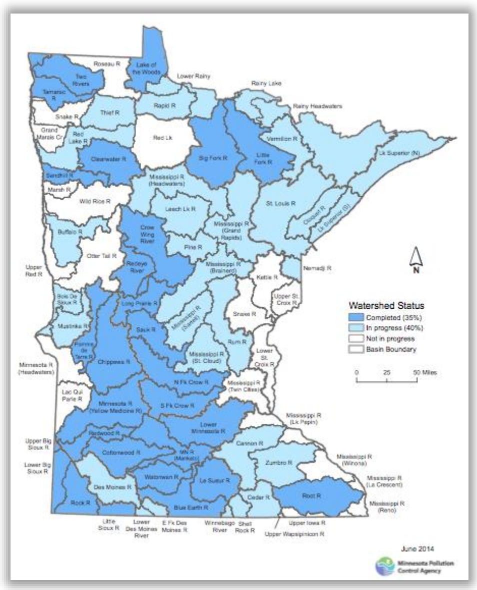
The **Prioritization, Targeting, and Measuring Water Quality Improvement Application (PTMA)** builds off of the existing Water Quality Decision Support Application that has been piloted in the Red River Basin (shown below). The PTMA is a GIS web and desktop application that can be used by local decision-makers to prioritize subwatersheds for implementation, target specific fields for best management practices, and project water quality improvement by cost and expected load reductions within the watershed. This tool is also capable of "ingesting" HSPF model results.



The **Agricultural Conservation Planning Toolbox**[6] develops conservation planning scenarios that are matched to both landowner preferences and landscape-based risks. In example, areas in the landscape where the water table is close to the ground surface may be targeted for wetland restoration. After landscape-level targeting occurs, results from this tool can be used to narrow down from a landscape scale to a site-specific location. It also tailors management practices to the selected site.

Hydrological Simulation Program – Fortran (HSPF)

What is HSPF?



Developed and supported by the USEPA and USGS, the Hydrologic Simulation Program – Fortran (HSPF) is a watershed scale model that can simulate water flow rates as well as sediment (including sand, silt, and clay), nutrients, and other substances found in a water body. The model uses real world observed data to ensure it properly mimics these interconnected processes. After confirming the model's accuracy, with a process called calibration, agency scientists and local partners can use it to model different scenarios of land-use change and how those changes might affect water quality[7].

[6] http://www.jswconline.org/content/68/5/113A.extract
[7] http://www.pca.state.mn.us/index.php/view-document.html?gid=21398

What baseline information is needed for HSPF?

In an effort to support the development and implementation of TMDLs across the state and support watershed programmatic activities, the MPCA has invested in statewide expansion of the HSPF model at the major watershed scale. Because of this, long-term hydrologic data has been incorporated into MPCA work, which is necessary baseline information for HSPF. There is no need to consider varying this dataset used by MPCA unless there is a justifiable reason.

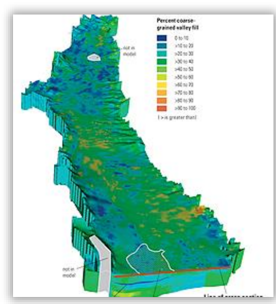
When during planning would HSPF be the most useful?

It is generally required to have specific training and quite a bit of computer power to work directly with HSPF. Load reductions established in the WRAPS use HSPF, and should be used in planning process to set goals. Model results from HSPF, such as pollutant-loading maps, can be used in prioritizing, likely using GIS analysis. HSPF is not capable of site-specific targeting. Note: In a few areas of the state, SWAT is used in place of HSPF.

Are there any additional HSPF tools or extensions?

HSPF-SAM (Scenario Application Manager) was designed to provide a user-friendly desktop interface to HSPF model applications to facilitate prioritization and placement of best management practices (BMP) based on current conditions and under alternative future conditions as predicted by the calibrated model application. HSPF-SAM consists of a GIS component for site selection and spatial visualization of model results, a Design component to build user-specified or optimized management scenarios, and an Analysis component to graph and tabulate model results.

The tool utilizes a BMP database and an HSPF model application to simulate the impact of the custom management scenarios including the fate and transport of pollutants to effectively represent downstream impacts. The BMP database includes costs and efficiencies by flow path (surface and subsurface) that allow seasonal and flow based comparisons of the cost benefit scenarios. Alternative scenarios can also be designed to simulate land use, point source, and climate changes to evaluate further conditions and develop comprehensive cost effective protection and restoration strategies.[8] The HSPF-SAM tool was funded by the MPCA through a Clean Water Fund grant.



Modular Three-Dimensional Finite Difference Groundwater Flow Model (MODFLOW) is a three-dimensional groundwater model developed by the USGS that can simulate steady and non-steady flow in confined or unconfined aquifer layers. External stresses generate groundwater flow. These stresses can also be simulated, generated from flow to wells, areal recharge, evapotranspiration, flow to drains, and flow through riverbeds[9]. MODFLOW can also be coupled with HSPF to simulate accurate groundwater/surface water interactions[10]. MODFLOW has been considered as an international standard for simulating and predicting groundwater conditions and groundwater/surface-water interactions.

[8] http://www.sdstate.edu/abe/wri/activities/ESDWC/upload/McCutcheon_ESDWC2014_Pic.pdf
[9] http://water.usgs.gov/ogw/modflow/MODFLOW.html
[10] http://pubs.usgs.gov/sir/2009/5127/pdf/sir2009-5127_part5_508.pdf