Water Conservation Priority: Amherst, MA

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Introduction

Protecting local drinking water resources requires identifying land that plays a critical role in maintaining groundwater quality and watershed health. Amherst relies heavily on a network of forested lands, wetlands, and hydrologically connected soils that can become vulnerable without targeted conservation. The Conservation Priority Index (CPI), developed by Gartner et al. in *Natural Infrastructure* (Figure 2), provides a framework for ranking land based on factors such as slope, soil permeability, proximity to surface water, and forest cover.

The purpose of this project is to apply the CPI methodology to Amherst, MA to determine which areas are most important to preserve for long-term water supply protection. This analysis tests the hypothesis that significant areas within Amherst score highly on the CPI and therefore represent valuable conservation targets.

Methods

The map was constructed using public data from Mass.gov, outlined in Figure 3. After importing the data into ArcGIS, the following steps were taken:

1. Set all environmental parameters to match the topography tiff.
2. For the municipalities border, search select attributes for “Amherst”, create a new shapefile for just Amherst’s border, and clip all shapefiles and rasters to Amherst’s area.
3. Merge all the wetland, pond, and stream shapefiles. Using the buffer tool, make buffers of 0-100ft, 100-200ft, and 200-300ft.
4. Use select attributes to create shapefiles for “poor, intermediate, and well drained” permeability, as well as “shallow, intermediate, and deep” water table depth.
5. For the topography tiff file, use the slope tool to get a raster of slope values in percentages. Then use the reclassify tool to sort slope into the steep, intermediate, and gentle categories.
6. Use the intersect tool on the roads, forest, and streams shapefiles to make a shapefile for where they intersect.
7. For all the newly created shapefiles, add new fields in their attribute tables with values corresponding to table 1. Then convert them to rasters, with NODATA set equal to 0.
8. Use the raster calculator tool to merge all the rasters together.

Results

The final map (Figure 1) shows conservation priority values ranging from 0 (low) to 18 (high). High-priority areas (pink) are concentrated in the southern forested region of Amherst and within the large wetland complex in the southeast. These locations contain combinations of steep slopes, hydrologically connected soils, and proximity to surface water features—all factors associated with elevated conservation value.

Medium-priority areas (purple) are distributed along streams and wetland zones across the town. Low-priority areas (light blue) are generally associated with developed land or soils with low hydrologic sensitivity.

Overall, the analysis indicates that Amherst contains multiple high-value conservation zones that warrant protection to maintain water quality and recharge capacity.

Discussion

The results highlight several regions in Amherst that should be prioritized for land conservation, particularly large forest blocks and wetland complexes that contribute significantly to water resource protection. These findings can inform town planning efforts, land acquisition strategies, and watershed protection initiatives.

This analysis has several limitations. First, it is constrained by the resolution and accuracy of publicly available MassGIS datasets. Second, the CPI model assumes equal weighting of inputs, whereas local hydrologic processes may give greater importance to certain variables. Third, this study focuses only on Amherst; applying the model at a regional or statewide scale would provide a broader conservation context.

Future work could incorporate groundwater model outputs, updated land-use change data, or climate-driven hydrologic projections to refine CPI scoring and improve conservation planning.

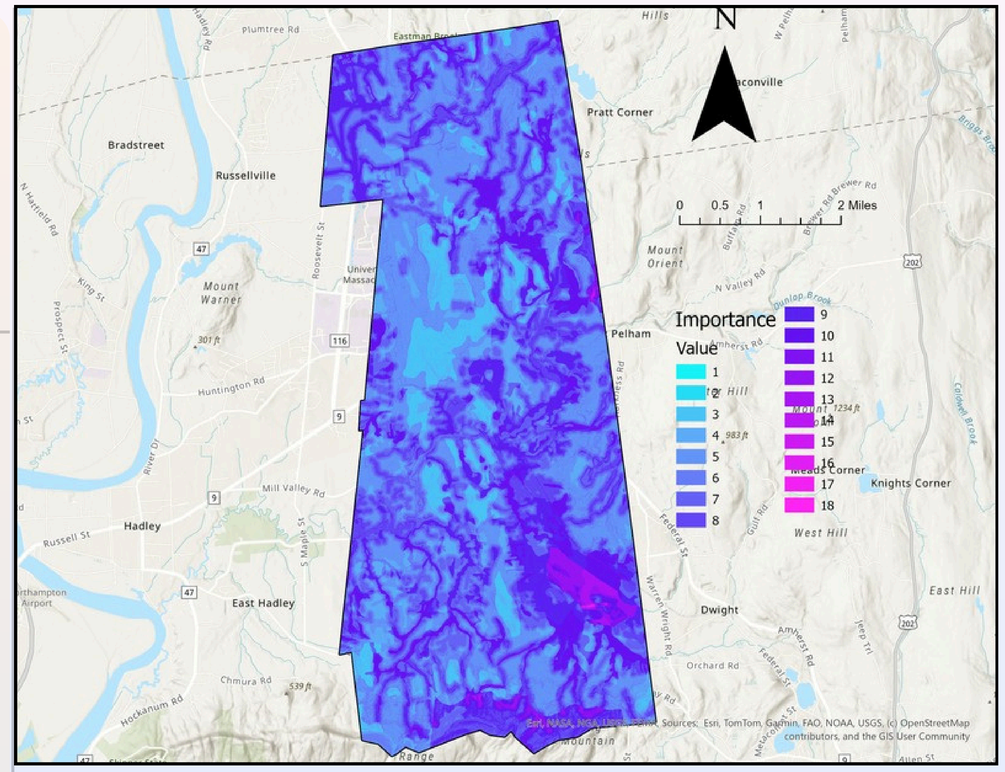

Figure 1 map of importance levels for water conservation in Amherst

Table 4 | **CPI Inputs Used for Crooked River Watershed**

LANDSCAPE CHARACTERISTIC	WHY IS IT IMPORTANT?	INCREASING IMPORTANCE			DECREASING IMPORTANCE
		3	2	1	0
Land use	Forests provides the best protection of water resources of any land cover.	Forest/ wetland	—	—	All others
Distance to streams (feet)	Forests provide shade, organic matter, and woody material while they absorb nutrients and trap sediment. The “riparian forest buffer” has a major influence on streamflow and water quality.	0 to 100	100 to 200	200 to 300	> 300
Distance to ponds/ wetlands (feet)		0 to 100	100 to 200	200 to 300	> 300
SOILS (1/2 WEIGHT): Depth to water table	If forests are removed more water enters the soil. If the shallow water table reaches the surface it can lead to overland flow and erosion.	shallow	intermediate	deep	—
SOILS (1/2 WEIGHT): Permeability	This is the rate at which water flows into and through soils. Poorly drained soils can lead to overland flow and erosion.	poorly drained	intermediate	well drained	—
Slope	The rate of water flow is directly related to land slope. Steep slopes also may be less stable and more prone to erosion.	steep (> 15%)	intermediate (5 – 15%)	gentle (< 5%)	—
Water – Forest – Roads	The narrow strips of forest between roads and streams are especially important for water quality protection.	yes	no	no	no

Figure 2 shows framework for determining importance levels

Source	Use
MassGIS Data:	forest .shp
MassGIS Data: Major Ponds	streams and ponds .shp
MassGIS Data:	wetlands .shp
MassGIS Data:	roads .shp
MassGIS Data: Soils	soil permeability & depth to water table.
MassGIS Data:	town boundaries .shp
MassGIS Data:	slope .tiff

Figure 3 links to where data was retrieved