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Changing Landscapes

Land use planning curriculum for natural resource professionals

P rinciples, people, and policies
L and planning and pressures
A pproaches
N atural resource planning tools

A4: Using Science to Substantiate Natural Resource Planning

Science-based information helps validate the protection of natural resources during planning.

Overview

Communities are looking for scientific research to provide direction and support for the decisions they are making about protecting natural resources when planning. This factsheet explains how science plays a role in validating the protection of natural resources during the planning process. Discussion centers on tools that natural resource professionals should be aware of and the importance of knowing when, where, and how to provide science-based information.

How to Integrate Science into the Planning Process

A key to sustainable management of natural resources is the ability to use science to better understand natural systems and develop applications and strategies that can be used to better protect natural resources. Successfully integrating the knowledge gained by science into the planning process requires a thorough understanding of the scientific evidence and a way to share it with those who are making planning decisions.

Integrating science into planning is critical, according to Haller and Gerrie (2007): "If we do not base our public policy decisions, at least in part, on objective science, then it is feared that our decisions will be open to the whims of political fashion."

Science can be categorized as pure or mandated. Pure science represents an open-ended process that arrives at empirical truths and scientific consensus. Pure science generally appeals to reason and truth and is free from political bias. Mandated science, on the other hand, is constrained by shorter time frames, and it must provide definitive statements on issues relevant to decisionmakers. The planning process uses mandated science, which requires scientists to provide expert scientific testimony in a way that is acceptable to the scientific community and to policymakers.

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Scientific research, like planning, can be conducted at a variety of scales from landscapes to ecosystems. The level of information collected and imparted to the planning process should correspond to the level and scale of planning. If science is to be successful in making policy, it must have relevance to solving human problems and consider social values.

> Science should be viewed as a knowledgeable participant whose role in the planning process is to inform, not make decisions.

Role of Science in Planning

Science is an ongoing process of discovery. It should be viewed as knowledge gained through observation and experiment that can be integrated into the planning process to successfully craft policies. Science is an empirical process whereas planning is an ethical and political process. Therefore, the role of science should be one of collaboration in which science is a well-informed stakeholder or participant that provides information about options, costs, and benefits that can be evaluated to guide social action. The key to successfully integrating science into the planning process is to keep science in the loop and use it to inform, not make decisions.

> "It will always be a human problem to judge the adequacy of scientific knowledge and to factor that knowledge into decisionmaking."
>
> —Ehrlich and Daily (1993)

How much someone understands stewardship and natural resource protection differs based on his or her knowledge of and exposure to the decisionmaking environment and often the role that individual has in this process:

Decision/Policymaker: Planners and elected officials must make decisions that benefit the greater good of the community. They must be able to take in and evaluate a variety of information and social values to understand the potential impacts of their decisions and policies.

Developer: To the developer, resource protection and stewardship are generally not priorities unless they provide minimal cost and maximum economic benefit.

Urban/Rural: The perceptions and understanding of stewardship and resource protection can be vastly different between urban and rural residents. This usually relates to familiarity with and access to the environment. People living in rural areas tend to be more likely to exhibit a stewardship or land ethic than a person who has grown up in a city.

Homeowner/Citizen/Descendants: When large tracts of land are passed down, those inheriting the land can be faced with the decision of either protecting the land or subdividing and selling it. When zoning places a highest and best use value on properties, which puts agriculture and open space at the bottom and development at the top, protecting resources may not be an economically feasible option.

Family members who inherit large tracts of land may have to decide between protecting the land or subdividing and selling it. (Photo: Robert Fitzhenry, U.S. Forest Service)

Scientific Tools to Assist in Planning

There are a number of tools that promote scientific inquiry and research. This section highlights some of the more commonly used tools and their applicability to planning.

Computer Models and Geographic Information System (GIS)-based Tools

In this age of increasing technological innovations, computers, software, and mapping technologies are greatly enhancing the ability of resource professionals to efficiently collect and manage data that can then be used to create plans and monitor projects.

ArcGIS/ArcInfo

When purposefully applied GIS modeling is integrated into the design and planning process, it can help users understand the structure and function of natural systems and guide decisionmaking.

- Spatial Analyst – This ArcGIS extension provides powerful tools for comprehensive, raster-based spatial modeling and analysis.
- 3D Analyst – This ArcGIS extension creates a 3D GIS environment for viewing, managing, and sharing geospatial data.
- ArcHydro – This geodatabase tool supports water resource applications in ArcGIS.

> "Form must follow more than just function; it must also respect the natural environment in which it is placed."
>
> —Ian McHarg, Design with Nature (1967)

i-Tree

i-Tree is a suite of software tools developed by the U.S. Forest Service that is driven by validated, peer-reviewed science and modeling. These easy-to-use freeware programs allow users to assess the structure, function, and value of urban tree populations for advocacy, management, and planning. i-Tree uses local data to statistically assess urban forest composition, benefits, and value that the urban forest provides.

- i-Tree ECO (adaptation of the Urban Forest Effects model) – Provides a broad picture of the whole urban forest; quantifies urban forest structure, environmental effects, and value to communities.
- i-Tree Streets – Focuses on benefits provided by street trees; places a monetary value on the environmental and aesthetic benefits that street trees provide each year.
- i-Tree Hydro – Simulates the effects of changes in tree and impervious cover on streamflow and water quality within a watershed.

WinSLAMM

This Windows-based simulation program models the stormwater impacts of new or existing development and the benefits of various control measures. The model has been used for over 15 years to calculate urban stormwater runoff volume and pollution loads, and to asses a wide range of management measures. The model enables accurate analysis at the planning and design levels.

Habitat Suitability Index

This tool evaluates the impacts of changes in water or land use on fish and wildlife habitat. It estimates the ability of an area to meet an animal specie's requirement for food and cover.

Air Quality Index (AQI)
This EPA tool reports daily air quality. The AQI focuses on the health effects related to air pollution.

Condition Index
This EPA tool evaluates a region's environmental condition by watershed. Resource managers can use the resulting condition map to identify areas vulnerable to resource loss.

Riparian Buffer Mapper
This tool for large-scale projects or community plans uses high-resolution imagery to monitor the extent of riparian forest buffers.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*..air quality conditions are:*	*...as symbolized by this color:*
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

EPA's Air Quality Index is divided into six categories. (Graphic: http://www.epa.gov)

Resource Assessments
Resource assessments provide foundational information for developing plans at all scales, both public and private. Assessments can be made at a broad resource/watershed level or may be more focused and resource specific.

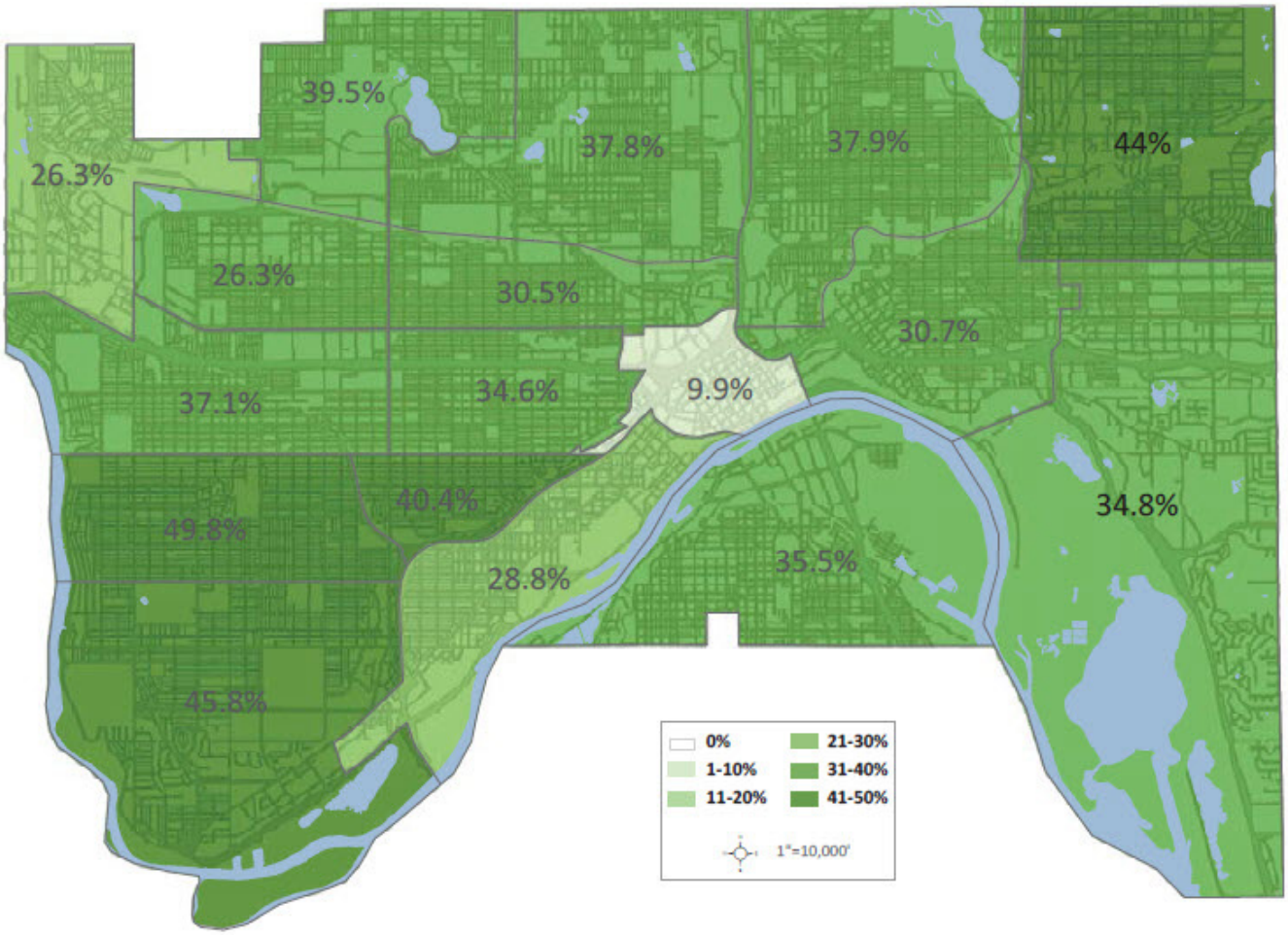
Natural Resources
- **Existing Resource and Site Analysis** – Provides mapping and written descriptions that identify all existing natural resources on a site. Site analysis is an important first step in the submission of applications for subdivision and land development projects.
- **Natural Resources Conservation Service Rapid Watershed Assessment** – Provides initial estimates of where conservation investments would best address concerns of stakeholders within a watershed.

Assessing existing natural resources on a site provides essential information for planning.

Water Resources
- **Stream Visual Assessment Protocols** – U.S. Department of Agriculture assessment protocol evaluates the condition of aquatic ecosystems associated with streams.
- **Wetland Identification, Delineation, and Assessment** – U.S. Army Corps of Engineers 1987 Wetland Delineation Manual and Regionals Supplements that identify, delineate, and assess the condition of wetland and water resources.

Urban Tree Canopy Assessments

These assessments increase decisionmakers' understanding of their urban forest resources, particularly tree canopy and the beneficial ecosystem services trees provide to a community (pollution mitigation, carbon sequestration, and stormwater mitigation, among others). Assessments provide key information related to the extent of the urban forest to resource managers so they can begin to set goals and plan.



Urban tree canopy assessments provide information for setting goals and planning. (Map: http://www.stpaul.gov)

Wildlife Resources

Many States use assessment protocols to evaluate the condition and value of natural communities for wildlife. Assessments may be at the community or species-specific level.

America's Byways®

This program was previously called the Scenic Byways Program. The factors that determine scenic byway designation are referred to as intrinsic qualities—attributes or features that are considered to be representative, unique, irreplaceable, or distinctly characteristic of an area. These qualities are categorized as archeological, cultural, historical, natural, recreational, and scenic.

(Logo: http://commons.wikimedia.org)

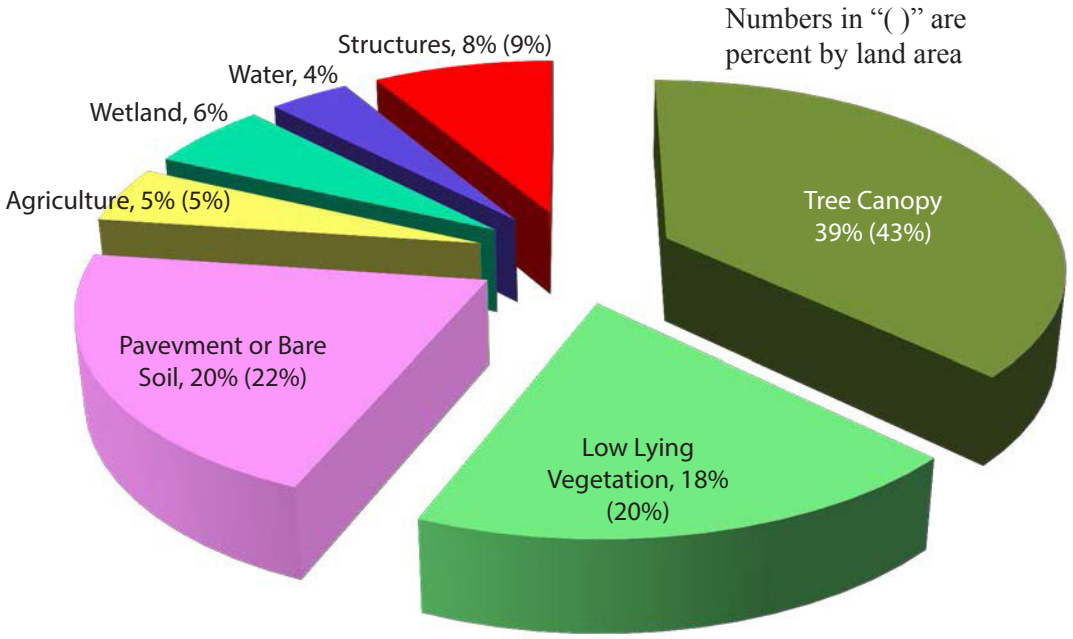
Historical and Cultural Resource Assessments

These can be used to preserve natural resources that are directly linked to the historic and/or cultural resources within a site. The U.S. Department of the Interior provides numerous guidance documents to help conduct these types of assessments.

Case Study — Mapping Tree Canopy for Long-term Urban Forestry Planning

Connecticut, Massachusetts, Rhode Island, Vermont, and the District of Columbia conducted urban tree canopy (UTC) assessments and site-selection analysis in two communities in each State and in Washington, DC. The information gained from these assessments has led to numerous positive outcomes that include the establishment of UTC goals and increased funding for urban forestry programs. The UTC assessments are actively used by communities, cities, academic institutions, private industry, nongovernmental organizations, and State government. Advances in UTC assessment protocols will give communities access to more relevant information about their urban forests.

For more information about assessing urban tree canopy, visit the Web site: http://nrs.fs.fed.us/urban/utc.

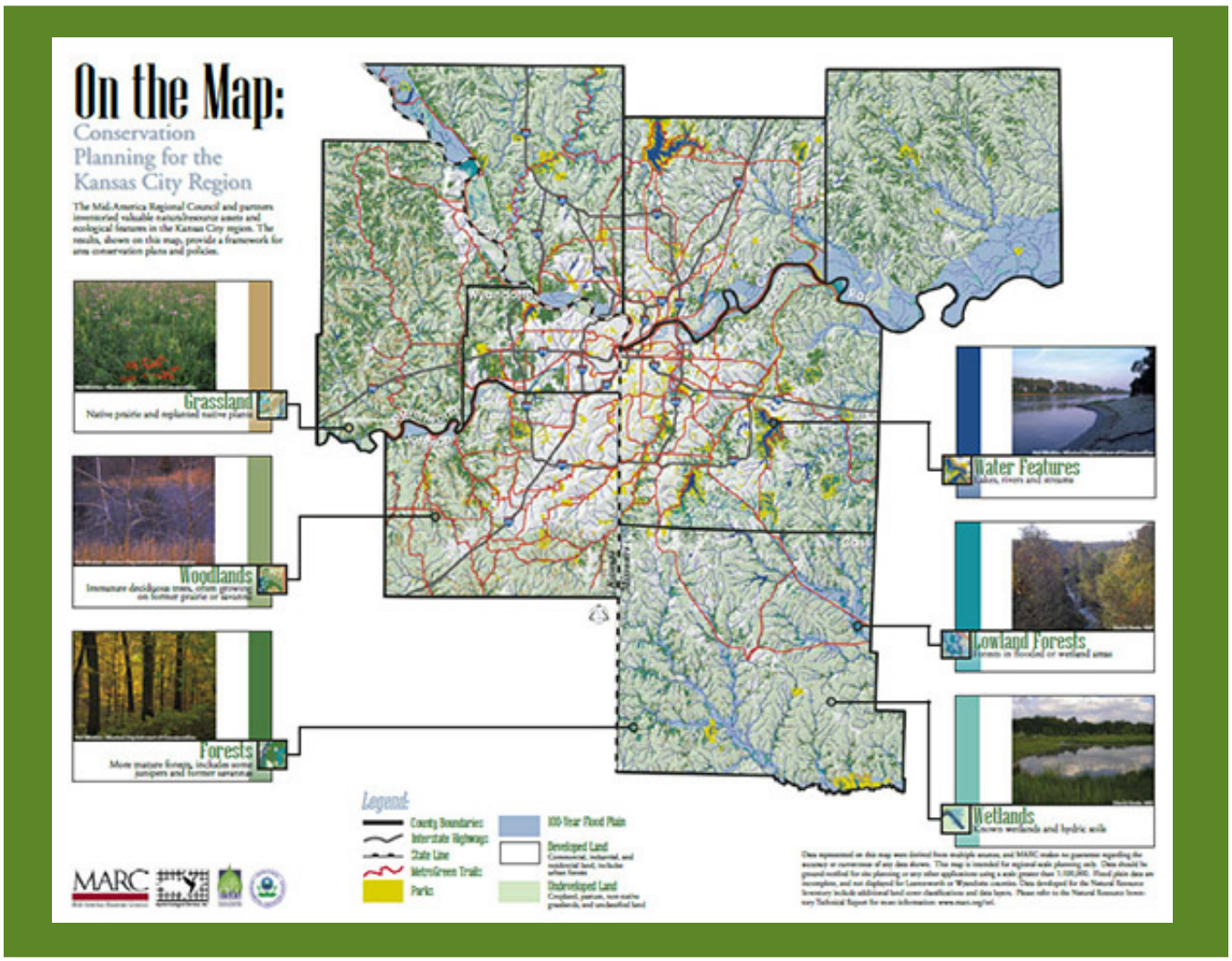


A pie chart summarizes land cover, including tree canopy, in the city of Burlington, VT. Numbers in "( )" represent the percentage based on the city's land area (water and wetland excluded). (Pie chart: http://www.fs.fed.us/nrs/utc/reports/UTC_Report_Burlington.pdf)

Case Study — Mid-America Regional Council Natural Resource Inventory

In 2003, the Mid-America Regional Council began developing an inventory of digital map data that show valuable natural resource assets and ecological features in the Kansas City region. Kansas City's natural resources, from forests and glades to prairies, wetlands, and stream corridors, and threatened by intense development pressure. The natural resource inventory map provides a framework for environmental planning at local and regional levels to help local communities proactively conserve or restore natural resources during development. This effort is also expected to help create high-quality livable environments through coordinated conservation and economic development.

For more information about urban tree canopy assessment, visit the Web site: http://nrs.fs.fed.us/urban/utc.



The Mid-America Regional Council and partners developed this natural resource inventory map for the Kansas City region. (Map: http://www.marc.org/Environment/Natural-Resources/pdf/NRI-one/nrimap.aspx)

Relevant Factsheets

P3 – *The Role of the Natural Resource Professional in Planning* – Emphasizes how natural resource professionals can use science during the planning process to validate protecting natural resources.

P5 – *Principles of Ecosystem Services* – Provides an understanding of ecosystems and the services they provide.

L2 – *Scales of Planning: From Landscapes to Ecosystems* – Helps resource professionals understand options for integrating science-based information into different levels of planning.

L4 – *The Power of Collaboration in Community Planning* – Ties into the role of the resource professional in integrating scientific information into planning at various levels and helps them understand how to communicate this information to a broader audience.

N1 – *Developing a Natural Resource Assessment* – Directs resource professionals to natural resource assessment tools that can provide communities with essential resource information before the planning process.

Resources

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Acknowledgements

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