KAWARTHAS, NATURALLY CONNECTED

Working together to sustain our landscape

The
Kawarthas, Naturally Connected

A Natural Heritage System
for the Kawartha Lakes Region

Phase 1
Project Report

Part 1

Prepared by
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Victoria Stewardship Council, Ministry of Natural Resources

January 2013

Letter of Endorsement
Identifying and Sustaining a Natural Heritage System (NHS)

The collaborative, multi-partner Scenario Planning Team within the study area of *Kawarthas, Naturally Connected* has completed a project to identify a natural heritage system (NHS). The products that resulted reflect the SPT's priorities to sustain the natural environment, the foundation for our region's social, cultural and economic values.

The natural heritage system described in this report was identified through an active stakeholder engagement process that is founded on the following principles:

- The perspective is **ecological and at a landscape scale**.
- The NHS products are informed by **the best available science** using the most current information and data**.**
- The process is one of **inclusion and collaboration between a diverse group** of stakeholders and partners.
- The resulting products are available to be used as **tools to prioritize and coordinate conservation efforts** throughout the project study area.
- The products are available as technical information to **support municipalities' land use planning efforts.**
- The process promotes the **link between healthy ecosystems and healthy human communities**.

We are confident that the mapped natural heritage system will provide a sound and strategic focus for conservation groups and community organizations to help guide the selection of appropriate sites for their stewardship activities, land securement programs and conservation efforts.

It is our sincere recommendation that these NHS products be used as technical guidance to inform local municipalities as they undertake land use planning to address their responsibilities under the Provincial Policy Statement (PPS) and the Planning Act. Ideally we encourage these municipalities to consider adopting elements of the natural heritage systems into their official plans to meet the municipalities' needs and priorities as they plan sustainable, healthy communities.

We also encourage government agencies to use the products to inform strategic resource management decision-making and to support the protection of our valued natural heritage.
In addition, we continue to engage residents of the *Kawarthas, Naturally Connected* study area to work together with us to maintain and restore the elements required for a healthy and diverse natural heritage system – the foundation for healthy communities.

Together we can apply the success of this project to-date to ensure the continued maintenance of our natural wealth.

Sincerely,

The Scenario Planning Team of *Kawarthas, Naturally Connected*

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List of Abbreviations

ANSI	Area of Natural and Scientific Interest	NGO	Non Governmental Organization
ARN	Assessment Role Number	NHIC	Natural Heritage Information Centre
CA	Conservation Authority	NHRM	Natural Heritage Reference Manual
CLI	Canada Land Inventory	NHS	Natural Heritage System
DEM	Digital Elevation Model	OBM	Ontario Base Map
DRAPE	Digital Raster Acquisition Project - East	OGDE	Ontario Geospatial Data Exchange
ELC	Ecological Land Classification	OP	Official Plan
FRI	Forest Resource Inventory	PPS	Provincial Policy Statement
GIS	Geographic Information System	PSW	Provincially Significant Wetland
LIO	Land Information Ontario	PVM	Predicted Vegetation Modelling
KNC	Kawarthas, Naturally Connected		
MARXAN	Conservation planning software	SLC	Soil Landscapes of Canada
MMAH	Ministry of Municipal Affairs and Housing	SOLRIS	Southern Ontario Land Resource Inventory System
MNR	Ministry of Natural Resources	SPT	Scenario Planning Team
NAESI	National Agri-Environmental Standards Initiative	SAR	Species at Risk

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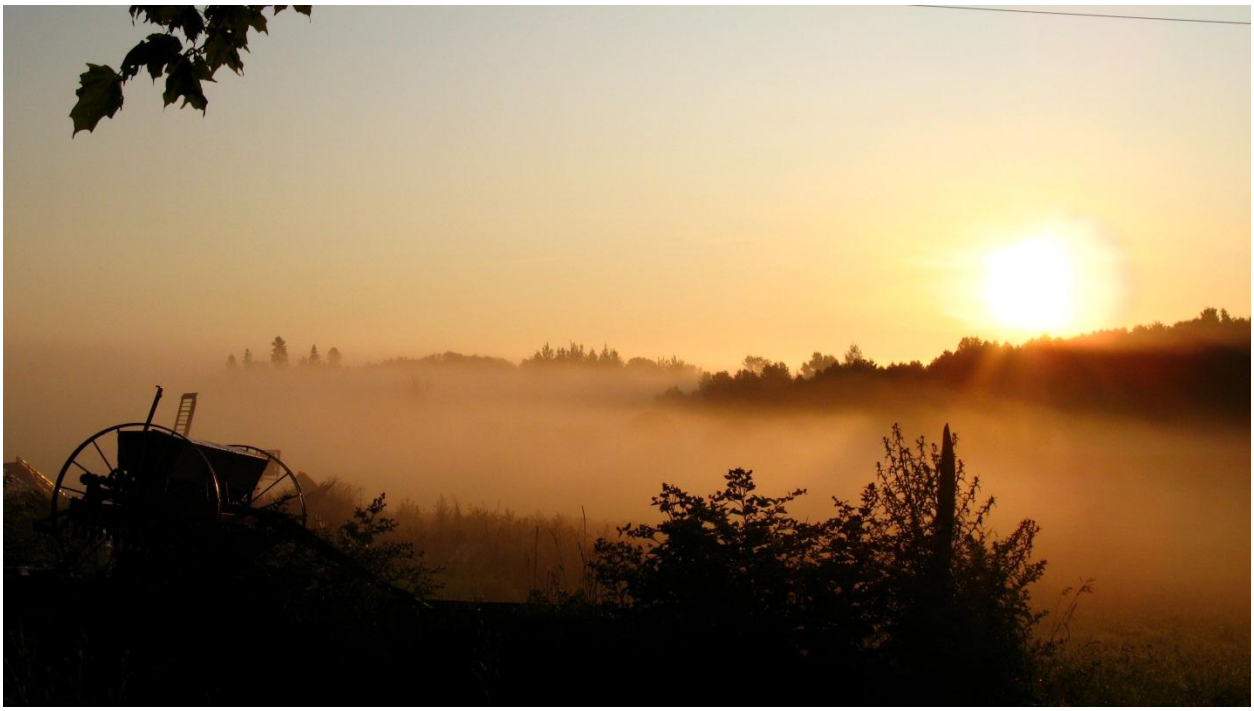

Tannis Price

Introduction

The *Kawarthas, Naturally Connected* project is a collaborative engagement process in which community members, practitioners, and other stakeholders in the Kawartha Lakes region developed a natural heritage system (NHS) using the best available data and tools.

Natural Heritage Systems design is the process of identifying critical areas on our landscape which serve as a "landscape backbone" – a set of natural areas and linkages that are important to maintain the health of the landscape. The mapping of and information about this "backbone" can be used to support land use planning, stewardship, restoration activities, the conservation of biodiversity, provision of ecosystem services, and other activities. A healthy environment is the foundation upon which a healthy community is built.

Kawarthas, Naturally Connected is a multi-partner initiative established in 2011 by community members, practitioners, and other stakeholders in the City of Kawartha Lakes, Peterborough County, and the City of Peterborough, to ensure the protection of the cultural, social, ecological and economic attributes of the area.

As a first step, this project (Phase 1) focussed on identifying the most important ecological values that form the foundation of a healthy economy and community. The project developed a Natural Heritage System (NHS) using the best available science and information and input from a stakeholder engagement process.

The purpose of this report is to describe how the natural heritage system was developed (Phase 1) and outcomes. The process was guided by a group of collaborative stakeholders from the community called the Scenario Planning Team. The activities of the Scenario Planning Team were supported by a smaller group of partner organizations that made up the Steering Committee. The Kawartha Heritage Conservancy chaired the project Steering Committee with the Victoria Stewardship Council as co-lead.

1.0 Background and Context

Southern Ontario is a complex landscape, both in social and ecological terms. More than 90 per cent of the lands are privately owned and large areas are subject to intense development pressures. Approximately 80 per cent of all woodlands and 72 per cent of all wetlands have been lost since European settlement began. The Environmental Commissioner of Ontario in his Special Report on Species at Risk (2009) stated that habitat loss, including alteration and fragmentation, is the main threat to approximately 67% of Ontario's Species at Risk. In addition to these challenges, multiple agencies, including provincial ministries, Conservation Authorities, non-governmental organizations (NGOs) and municipalities are involved in land use planning and natural heritage conservation on the same landscape, often at different scales. There is great untapped potential for all of the key players to develop a common vision and processes to support each others' natural heritage conservation efforts.

The Kawarthas is a predominantly rural area. The centrally located Kawartha Lakes and northern portions of the region attract many seasonal and retirement residents. The cities of Peterborough and Lindsay are the largest population centres, with towns such as Port Perry, Bobcaygeon, Fenelon Falls, Omemee, Millbrook, Lakefield, Norwood, Havelock, and Apsley serving residents and visitors in other areas. The Kawartha Lakes and the Trent - Severn Canal system are notable features of the landscape contributing to the flavour of everyday life.

Southern portions of the Kawarthas consist of productive farmland, forested hills and the headwaters of cold water trout streams originating from the Oak Ridges Moraine. Excellent agricultural land, intermixed with many provincially significant wetlands, and the Kawartha Lakes system predominates in the central portion of the region. The central - northern portion blends into cottage country and the southern edge of the shield, with some lakes accessible only by hiking, canoe or floatplane. With agriculture and tourism being major industries, the local economy and quality of life depends greatly on healthy, sustainable land, water and forest resources.

> *Although the Kawarthas is a huge region, the pressures on the land are relentless. One only has to look at the number of new roads, golf courses, aggregate extraction sites, housing sub-divisions and other forms of urban sprawl to get a sense of how quickly the landscape is changing. Not surprisingly, many ecosystems are increasingly threatened, along with the species that live there. When you add planet-wide threats like climate change to the mix, it's not hard to understand that the unique character of the Kawarthas can no longer be taken for granted.*
>
> Drew Monkman,
> "A Natural Kawartha Connection",
> Peterborough Examiner, June 21, 2012

Pat Durey

1.1 A Systems Approach

Over the past two decades, there has been growing recognition that a system-based approach to conservation planning is required to adequately address current ecological pressures. The need for a "landscape system" approach resulted in the establishment of the Natural Heritage System (NHS) concept through the Provincial Policy Statement (PPS) in 1997 and 2005, and the Natural Heritage Reference Manuals in 1999 and 2010. Building on previous work, the Ministry of Natural Resources (MNR) is now promoting a method for NHS design and planning at a regional landscape scale that incorporates science, technology and information, while focusing on stakeholder engagement as a vital component of the process (MNR 2006, 2008, 2010). The NHS design and planning method differs from earlier approaches in that it:

- Engages diverse stakeholders as decision-makers throughout the process (Lenihan 2009)
- Uses a science-based approach to inform stakeholders' decisions on targets for what to include in an NHS
- Is based on regional, ecological boundaries
- Uses an objective decision support tool (i.e., Marxan)
- Provides a set of digital map layers that can be used to support strategic decision making by many different organizations.

The KNC project engaged stakeholders to form a Scenario Planning Team, who designed an NHS using this methodology. The mapping and design results provide information that can be used by all stakeholder organizations to ensure synergy among their various planning, land management and stewardship activities.

1.2 What Are Natural Heritage Systems?

Natural Heritage Systems (NHS) are networks made of natural features and areas such as wetlands, forests, river corridors, lakes and meadows. They can also include areas that have the potential to be restored. These natural areas provide "ecosystem services" that support life

and the health of people, plants and wildlife. Some of the services provided by our natural systems include:

- Clean air and clean water
- Pollination and food production
- Habitat for fish and wildlife species
- Resiliency to environmental stressors - climate change, invasive species, flooding, soil erosion
- Production of medicines, biofuels and other products
- Recreational opportunities

2.0 Step 1 - Project Governance and Structure

2.1 The Working Groups

Kawarthas, Naturally Connected was structured as two core groups:

- Steering Committee
- Scenario Planning Team

The **Steering Committee** (including the Project Lead and MNR Analyst and Support Team) provided strategic direction and administration to support the activities of the Scenario Planning Team. The Steering Committee ensured access to the relevant technical and professional advice, data and information, and analytical expertise required by the Scenario Planning Team to help inform decision making. The Steering Committee also led the external communications for the project.

- **Mike Hendren**, Chair and Project Lead, Kawartha Heritage Conservancy
- **Doug van Hemessen**, Scenario Planning Team Coordinator, Victoria Stewardship Council
- **Michael Benner**, City of Kawartha Lakes
- **Joan Chamberlain**, Trent Severn Waterway
- **Rob Little**, Environment Council for Clear/Ston(e)y/White Lakes
- **Andy Millar**, City of Kawartha Lakes Agricultural Advisory Board
- **Bev Quirt**, Ministry of Culture Tourism and Sport
- **Peter Southall / Melanie Kawalec**, City of Peterborough
- **Silvia Strobl,** Ministry of Natural Resources
- **Steve Voros**, Ministry of Natural Resources
- **Peter Waring / Dave Pridham**, Kawartha Conservation
- **Bryan Weir**, County of Peterborough
- **Doug Williams**, Curve Lake First Nation

The **Scenario Planning Team** (SPT) included a balance of interests from municipalities, conservation authorities, First Nation communities, farmers, landowners, naturalists, hunters and anglers, various local industries (aggregates, forestry, agriculture, etc…), NGOs, and other conservation organizations. The team worked collaboratively toward the identification of objectives and targets to direct the development of *Kawarthas, Naturally Connected* scenarios.

- **Kerry Coleman**, Facilitator
- **Doug van Hemessen**, SPT Coordinator, Victoria Stewardship Council

- **Brad Anderson**, Durham Regional Municipality
- **Ian Attridge**, Kawartha Heritage Conservancy
- **Michael Benner / Carrie Sherk**, City of Kawartha Lakes
- **Travis Cameron / Paul Smith**, Ontario Parks
- **Donna Churipuy**, Peterborough County City Health Unit
- **Matt Demille / Shari Sokay**, Ontario Federation of Anglers and Hunters
- **James Holland**, Ducks Unlimited
- **Murray Maracle**, Scugog Island First Nation
- **Erin McGauley / Meredith Carter**, Otonabee Conservation
- **Andy Millar**, City of Kawartha Lakes Agricultural Advisory Board
- **Roz Moore**, Environment Council for Clear/Ston(e)y/White Lakes
- **Iain Mudd**, County of Peterborough
- **Ruth Pezzack**, Havelock-Belmont-Methuen Lake Association
- **Bev Quirt**, Ministry of Culture Tourism and Sport
- **Mike Scott**, Ontario Stone, Sand & Gravel Association
- **Richard Scott / Geordan Harvey**, Trent Severn Waterway
- **Rob Stavinga**, Kawartha Conservation
- **Mike Stedman**, Kawartha Lake Stewards Association
- **Richard Straka**, City of Peterborough

Other organizations' participation was less formalized but should be acknowledged, for example the Peterborough Field Naturalists and the Kawartha Field Naturalists

Ministry of Natural Resources Analyst and Support Team

The MNR Support Team provided the technical support and guidance needed to complete the NHS analysis. The MNR Support Team worked to assemble and present the relevant available science and data for the analysis. The following roles were provided by the MNR Support Team for the Steering Committee and the Scenario Planning Team:

- **Kazia Milian,** Analyst, Southern Region Planning Unit
- **Dave Tellier,** Lead Analyst, Southern Science and Information Section
- **Silvia Strobl,** Meeting preparation and documentation, Southern Science and Information Section
- **Elizabeth Spang,** Meeting logistics and communications support, Southern Region Planning Unit

Communications Subcommittee

This Committee was established with members from the KNC partners. A Communications Plan was developed and products created to describe and profile the *Kawarthas, Naturally Connected* initiative to outside organizations and individuals.

- **Chris Lemieux**, Ministry of Natural Resources
- **Joanne Barbazza**, Ducks Unlimited
- **Suresh Kandaswamy**, Kawartha Heritage Conservancy
- **Brent Kulba**, Kawartha Conservation

Iain Mudd

2.2 Vision and Goals

Vision Statement

A landscape that supports the needs of people and nature in a way that preserves and enhances the unique character of the Kawarthas.

Tag line: “The Kawarthas, Naturally Connected”

Goals

This region is vast, there are many different players, and resources are limited. The goals of this project are to:

1. Identify and map a connected system of natural areas that can inform and support:
   a) sustainable land use planning and resource management decision-making
   b) strategic priorities for stewardship and restoration projects
   c) priorities for conservation land acquisitions, and
   d) priorities for inventory programs and research projects.

To achieve number 1:

2. Bring together organizations that represent local communities to work collaboratively and provide a greater understanding of the value of a healthy natural heritage system that supports healthy communities.

3. Engage in an open, transparent and respectful process.

2.3 Project Study Area

The project study area was defined so that it would include all of Peterborough County and the City of Kawartha Lakes. Because it was an assessment of natural features and functions, it was necessary to define the area using ecological rather than administrative boundaries. The project area is composed of the 33 tertiary watersheds that overlap the City of Kawartha Lakes and the City and County of Peterborough (see Fig. 1 below) plus a 5 kilometre buffer. The core focus area includes the 8 lower tier municipalities in the County of Peterborough, the City of Peterborough, the City of Kawartha Lakes, four First Nations reserves, and all of the jurisdictions of Otonabee Region and Kawartha Region conservation authorities. This ecologically based area is an appropriate scale for designing a regional natural heritage system.

Using an ecological unit for natural heritage planning ensures a scientifically sound comparison of the landscape features and values within that ecological unit. The use of ecodistricts is also supported by other landscape-level initiatives such as Ontario's Biodiversity Strategy.

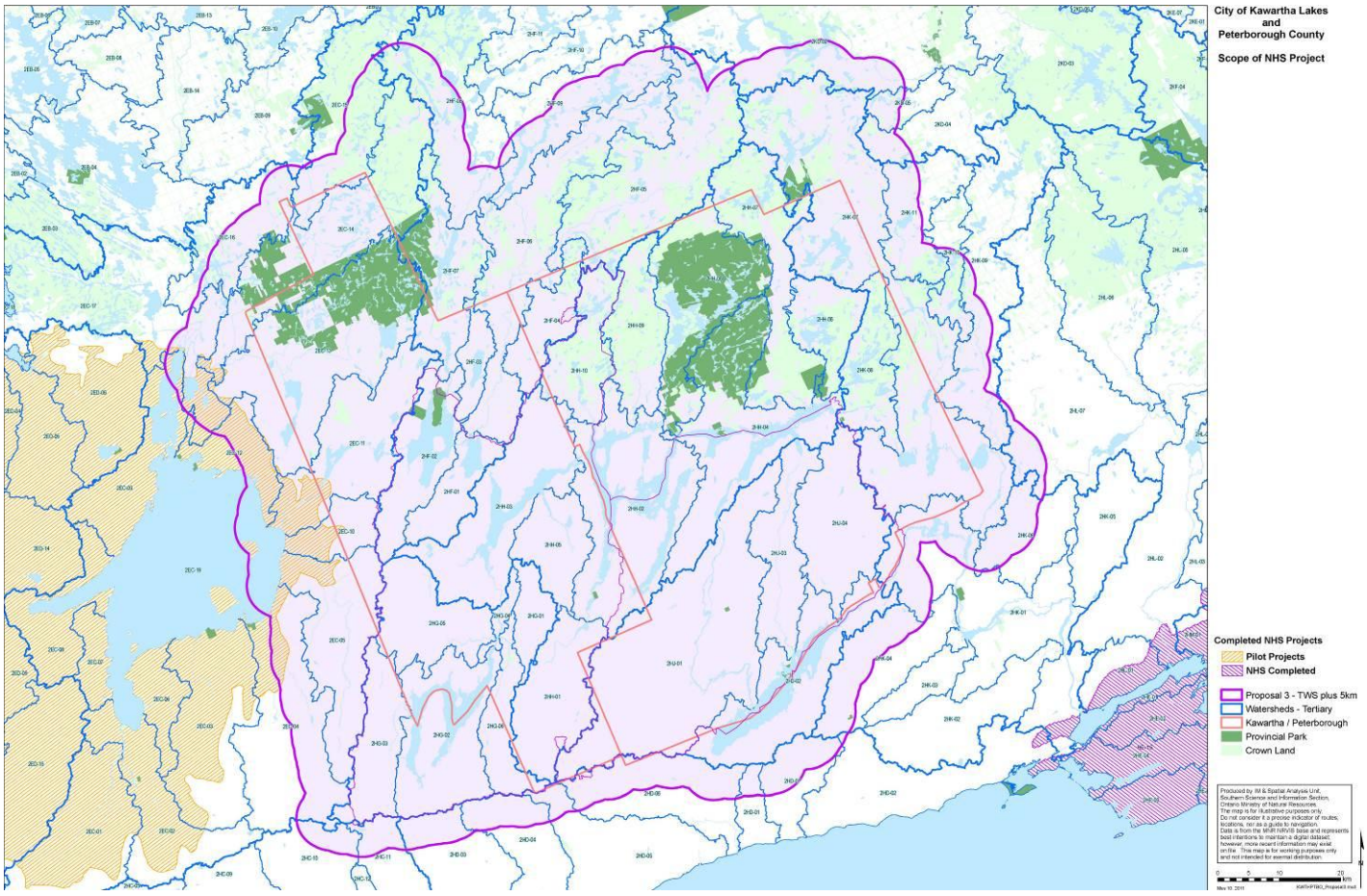

Figure 1. Project focus area

2.4 The Design Process

The Scenario Planning Team underwent a collaborative process (see Fig 2) to identify a natural heritage system. The resulting natural heritage system design reflects the Scenario Planning Team's priorities to sustain the natural environment.

The steps in the NHS design process are illustrated in Figure 2. The process alternates data preparation and analysis activities with target-setting and decision-making by the Scenario Planning Team. The timeline for this project is included for each step in the process. Working Group meetings were held approximately one day per month. Step 1 involved project planning, determining the scope of the study area, and building partnerships and support for the project (Sections 3.1-3.3 above). This process of building partnerships takes time; however the benefits (described in step 9) of knowledge sharing and trust that result from the process are worth the investment. Steps 2 – 8 are described in more detail in the next sections of this report. Eleven meetings were held from September 2011 to September 2012. Kerry Coleman, an independent consultant with experience in facilitating similar initiatives in eastern Ontario, acted as facilitator.

2.5 Use of a Decision-Support Tool

In most landscapes, there are many different options for NHS design. A decision-support tool is very useful to quickly and objectively produce a number of different options for comparison. This project used a conservation planning and decision support software called Marxan to produce several different scenarios that show important natural heritage features based on the targets set by the Working Group. Marxan was designed at the Ecology Centre at the University of Queensland, Australia and has been applied around the world to provide decision support for conservation reserve planning. The Marxan methodology for NHS design in Ontario was pilot-tested by MNR in 2006 and was found to be an effective means of identifying priority natural areas (MNR 2006, 2008).

2.6 NHS Design Process Overview and Timeline

Discussions for the project were initiated in 2010 by Kawartha Heritage Conservancy with the Ministry of Natural Resources. In late 2010 and early 2011 meetings were held and presentations given to other organizations to outline the project and generate interest and participation. The project kicked off in September 2011.

Adapted from *A Guide to Designing and Planning Natural Heritage Systems in Southern Ontario* (MNR 2011), *Kawarthas, Naturally Connected* was developed under these steps and timelines.

- Step 1: Pre-planning and Terms of Reference – **September to October 2011**
- Step 2: Compile Data – **Throughout**
- Step 3: Stakeholders set targets for initial scenarios – **October 2011 to May 2012**
- Step 4: Model scenarios for comparison – **May to June 2012**
- Step 5: Stakeholders review and discuss scenarios, and develop a preferred scenario – **June 2012**
- Step 6: Model preferred scenario – **July to September 2012**
- Step 7: Stakeholders review the map and finalize the results through consensus – **November 2012**

- Step 8: Final mapping of priority features, areas and linkages – **December 2012 and ongoing**
- Step 9 and throughout project: Integrated stakeholder team establish goals together, shares knowledge and understanding, builds trust and achieves consensus – **Ongoing**

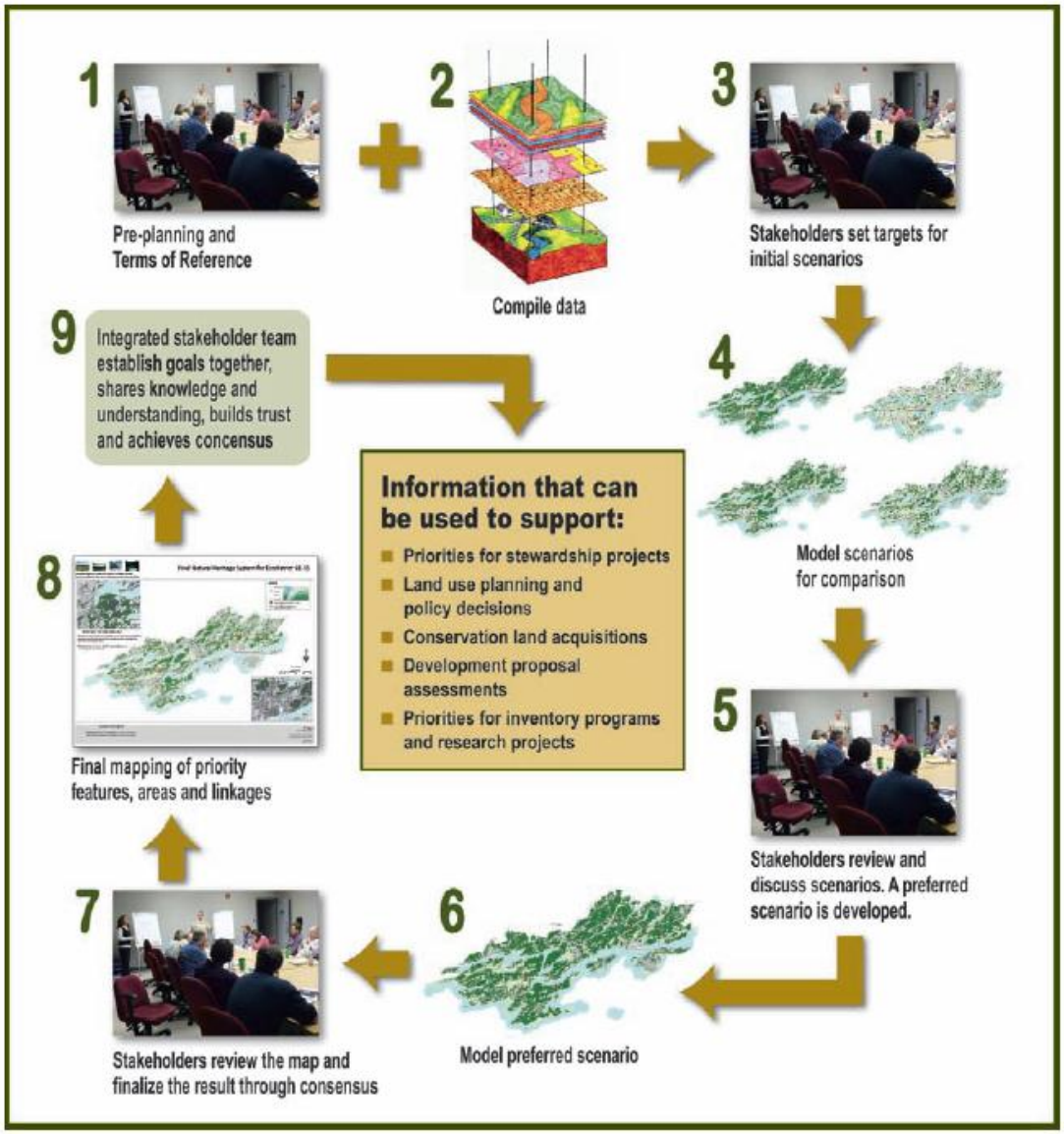

Figure 2. Overview of the NHS design process steps and timeline for the Kawarthas, Naturally Connected (Adapted from: A Guide to Designing and Planning Natural Heritage Systems in Southern Ontario, MNR 2011)

2.7 Communications

The Communications Subcommittee developed these products:

- a brochure
- logo
- Frequently Asked Questions
- PowerPoint presentation with speaking notes
- website (kawarthasnaturally.ca)
- monthly e-letter

Several SPT members used the prepared presentation to show to their organizations and to outside groups.

Larry Keeley

3.0 Step 2 – Compile Data

The primary data sources compiled for this NHS project are listed in Table 1. Datasets were obtained from MNR corporate databases such as the Land Information Ontario (LIO) Warehouse and Natural Heritage Information Centre, from other government and non-governmental organizations, or were derived from other datasets (e.g. forest interiors derived from forest cover mapping). These data layers were used to support the Working Group discussions with mapping of current conditions and to run the NHS analysis.

Table 1. Data layers used to support the NHS project (datasets are available through LIO unless otherwise noted; for more detail, see target table in Appendix A).

Data Category	Dataset
Primary/Base Data	Southern Ontario Land Resource Information System (SOLRIS) V 1.2
	Forest Resources Inventory, Management Units 140, 220, 360
	Provincial Land Cover 2000
	SOLRIS Phase 1 Wooded Areas Updated to 2008 DRAPE Imagery in Study Area
	Great Lakes Coastal Wetlands (from Great Lakes Commission)
	Ontario Ecodistricts
	Soil Landscapes of Canada (from Agriculture and Agri-Foods Canada)
	Tertiary and Quaternary Watersheds
	WRIP Delineated Catchments (Arc Hydro Quaternary Watershed Sessions)
	Ontario Road Network
	Canada Land Inventory Agricultural Capability Classes (from Agriculture and Agri-Foods Canada)
	MPAC Assessment Parcel
	Significant Groundwater Recharge Area
Costs	Licensed Aggregate Pits/Quarries (Aggregate Site Authorized)
	Prime Agricultural Lands (SOLRIS Agricultural Areas + CLI Class 1-3)
	Major Roads and Concessions (from ON Road Network)
Overlays	Areas of Natural & Scientific Interest (Earth Science)
	Areas of Natural & Scientific Interest (Life Science)
	LIO layer for Aggregate License Areas
	LIO layer for Deer Wintering Habitat
	LIO layer for Wild Rice Stands
	Oak Ridges Moraine Plan – Natural Core and Linkage
	Physiography of Southern Ontario – Beaches, Drumlins, Eskers,Shore Cliffs
	Provincially Significant Wetlands (PSW)
	Regionally or Locally Significant Wetlands (RSW)
	Trans Canada Trail

Data Dataset Category

Derived Datasets for Targets (1)	Biodiversity Representation	Forest and Wetland Types Non Forested Types Non Wetland Types
	Ecological Functions targeted by: Soil Landscape Unit Canadian Shield Land Between South of Shield	Forest Cover
		Wetland Cover
		Natural Cover
		Interior Forest Areas at 100, 200 m
		Forest Patches
		Wetland Patches (not targeted)
		Wetland Functional Zones, 120 m
		Riparian Functional Zones, 100 m riparian habitat
		Natural Cover 1 km from Roads
	Watershed Functions targeted by: Tertiary Watershed Quaternary Watershed	Headwater Areas
		Riparian Functional Zones, 30 m protection zone

Notes

Spatial data received from each respective organization
(1) Datasets derived through GIS analysis of base datasets

The Scenario Planning Team (SPT) considered the availability, quality, and extent of different datasets when discussing the NHS design inputs (targets and socio-political considerations – see next two sections of this report). Where datasets were incomplete or did not exist, the SPT identified and recorded these as data gaps (see Section 5). To be used as an input layer for NHS design, datasets must be consistent and complete across the entire study area. Incomplete datasets will bias the resulting NHS to select the areas where more data is available. Some data layers that were identified as incomplete were identified by the SPT as overlays that could be used to validate and refine the final NHS during implementation. This would ensure that the NHS adequately captures the values reflected in the datasets that could not have targets applied.

3.1 Step 3 – Scenario Planning Team Inputs

The SPT met for nine full-day sessions between November 2011 and May 2012 to identify goals and objectives and inputs for the NHS design. These meetings often included presentations from various experts whose information helped the SPT understand some of the scientific basis for recommended guidelines.

The SPT followed a series of steps to work through the various issues and decisions. Ministry of Natural Resources technical staff inputted data into the model, provided the mapping, and, ran the models and produced requested scenarios for review and further refinement.

The two main categories of NHS design inputs that the SPT discussed were:

- socio-political considerations, and
- targets for natural features

The SPT made decisions for each input to determine “how much” of each type of feature or area should be included in the NHS design.

The bedrock geology of the *Kawarthas, Naturally Connected* project area includes sedimentary limestones in the south and the granites and metamorphic rock of the Canadian Shield in the north. Between lies a transition zone the “Land Between”. In the south, glacial deposits cover much of the limestone and the topography and soils lend themselves to agriculture and other human activities. On the Shield, the relative absence of glacial deposits, deep soils, and the presence of rugged topography and many lakes and wetlands has precluded any significant agricultural development and limits other human development of the landscape. The Land Between is an ecological transition zone with a blend of both features, plus some of its own distinct characteristics and history.

The SPT recognized that these differences in landscape cover and development meant the areas should be considered differently with regard to socio-political considerations and ecological targets. See Section 4 and Appendix C for more details.

Dawn Knudsen

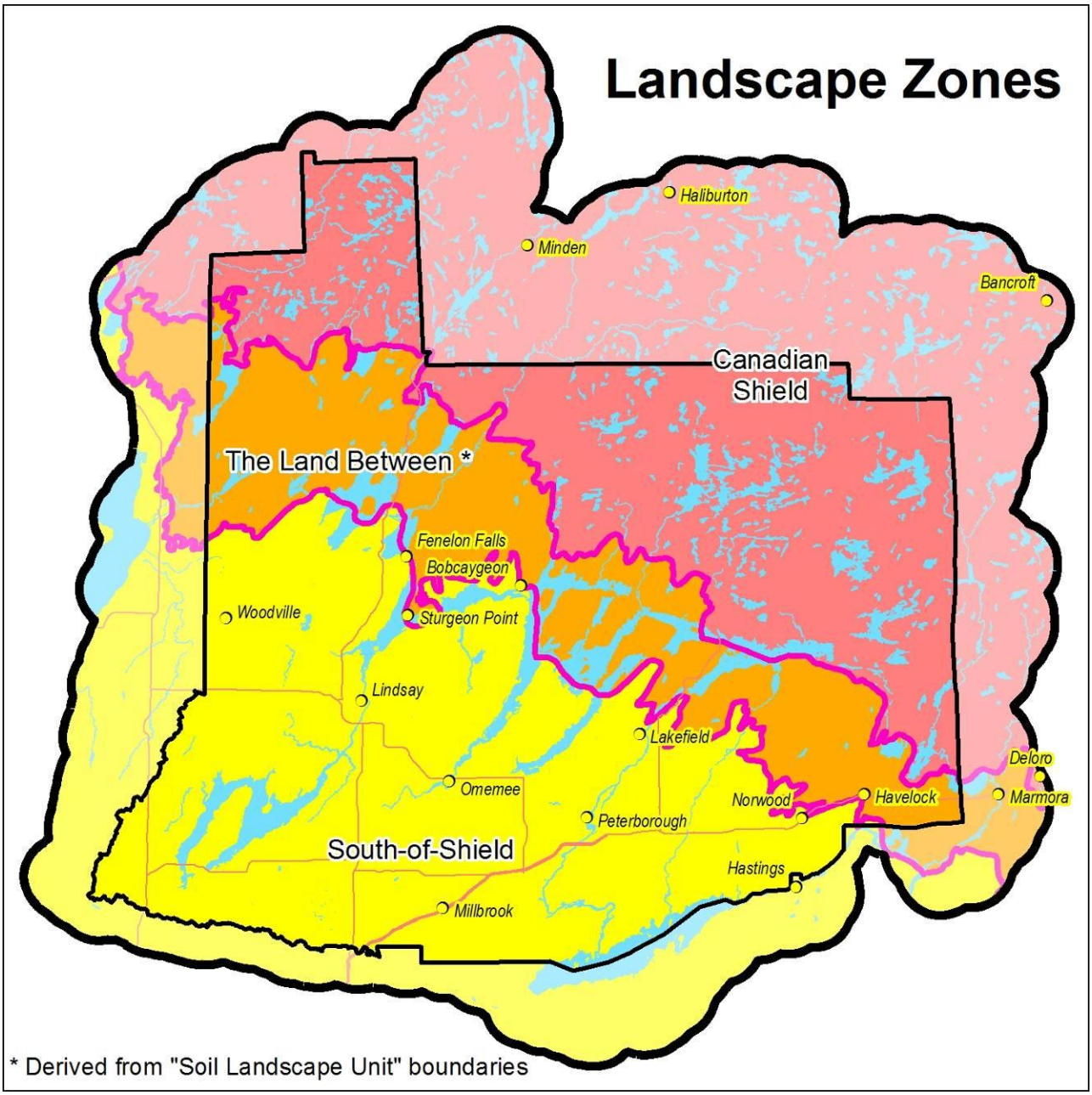

Figure 3. Landscape Zones for *Kawarthas, Naturally Connected*

3.1.1 Socio-Political Considerations

Socio-political considerations are attributes of areas that can help account for existing land use and management decisions. Incorporating socio-political considerations allowed the SPT to recognize and respect the diverse land uses found in our communities.

Socio-political considerations are accommodated in the NHS design by assigning each one a status. The status tells Marxan how a particular area of land should be treated. To be included in the design process, each targeted socio-political consideration must be mapped.

Marxan Status Types:

Conserved – these areas must always be included within the NHS

Preferred – if two or more areas contribute equally towards targets, these areas are preferred over others that are available

Excluded – these areas are never included in the NHS

Available – all other areas that do not fall into the above status categories

For *Kawarthas, Naturally Connected,* none of these status types were applied by the Scenario Planning Team. The group discussed the pros and cons of locking in substantial areas up front – there are biases in which wetlands have been evaluated, and locking in large areas can result in overachieving the targets in some areas. Also, the SPT felt it may be more advantageous to see which areas are selected by the targets only and then comparing it to the map of what's already protected. The decision was that no areas will be locked in up front – rather, the model results will be compared with what's already protected afterward – the map of areas with existing protection will be a separate product called the conserved lands overlay.

Available with Cost – these areas are available for inclusion, but the area included in the NHS will be minimized. A cost multiplier was applied to the area (in hectares) of a particular land use that the SPT felt should be minimized in the system. This parameter encourages Marxan to search all other possible options to achieve the targets at a lesser cost (see section 3.2 for more information on how Marxan works). For *Kawarthas, Naturally Connected,* this status was applied to prime agricultural lands, existing aggregate extraction areas, and roads. See Table 2 for details.

Conserved Lands Overlay: The overall intent of the Scenario Planning Team was to include areas that have strong protection status or long-term management objectives for conservation and protection of natural features. This project assembled as much of this data as possible within the timeline, while recognizing that there would be some data gaps. This layer is intended for comparative purposes only (not input into the model).

It was not always possible to set a status because of a lack of information or mapped data. The SPT identified these as data gaps for potential consideration in future NHS design and planning exercises (see Section 5).

Table 2. Summary of Socio-Political Considerations agreed to by the SPT
(For detailed target table with references, see Appendix A)

Feature	Rationale	Constraint or Cost
Prime Agricultural Lands	To minimize the amount of land with natural cover that is adjacent to Prime Agricultural Lands as defined under the PPS from being included within the learning scenarios	Apply area based COST in hectares. Minimize inclusion by applying a area-based cost. Planning Unit (hexagons) containing 100% agriculture lands are always excluded from the solution.
Existing Extraction Areas	Avoidance of NHS solution to be immediately adjacent to known extraction areas within the learning scenarios	Minimize inclusion of existing quarries through an area based COST in hectares
Roads	To ensure roads are accounted for appropriately within the learning scenarios	Apply area based COST in hectares. Applied to highways and major arterials only.

3.1.2 Landscape Features and Targets

Targets quantify the amount of or portion of a landscape feature (e.g. a forest type or species habitat) to be captured by an NHS. Explicit, numerical targets are set based on science and suggested thresholds. Where there is no documented literature available to suggest a target for an ecological feature, the target can be based on expert opinion, local knowledge and/or stakeholder consensus (a number of the SPT members had a wealth of ecological expertise and knowledge).

Prior to each SPT meeting, the MNR Support Team prepared background information on suggested thresholds and targets in consultation with resource experts. The current condition for each feature in the study area was evaluated using digital data prepared in a GIS. If a particular expertise (e.g. hydrogeology) was missing on the SPT, experts were invited to meetings to answer questions. The best available knowledge was used to create targets. The selected ecological features and their associated targets are listed in Table 3.

Table 3. Summary of landscape features for all learning scenarios
(For detailed target table with references, see Appendix C)

Biodiversity Representation	SOLRIS/CLI Upland Forest Lands Alluvium/Bottom Lands (1 class) Clayey Soils (3 classes) Gravely Soils (2 classes) Loamy soils (7 classes) Organic soils (1 class) Rocky areas (1 class) Sandy or Silty soils (5 classes) SOLRIS/CLI Forested Wetlands Alluvium/Bottom Lands Mineral soils Rock and Gravel Organic soils Forest Resource Inventory Ecosite Classes White Pine - Red Pine (4 classes) Jack Pine - Black Spruce (2 classes) Intolerant Hardwoods and Mixedwoods (6 classes) Hardwood-Oak-Maple-Basswood (4 classes) Hardwood-Maple-Birch-Hemlock (4 classes) Lowland Conifer and Hardwoods (5 classes) Non-Forested Wetlands Swamp Fen Bog Marsh Other Non-Forested Open bluff and exposed rock Open sand barren and dune Open grass
Ecological Functions and Coarse Scale Habitat	Forest Cover Wetland Cover Forest Patch Size (Classes) 100-200 ha. 200-1,000 ha. >1,000 ha. Forest Interior 100 metre interior patches 200 metre interior patches Remoteness/ Distance from Roads Natural Cover >2 km from Road Wetland Functional Zone: 120 metres Wetland Adjacent Upland Natural Cover Riparian Functional Zones: 100 metre Natural Cover Adjacent to Streams, Rivers and Lakes

	Deer Wintering Areas Rare Vegetation Habitats
Watershed Functions	Forest Cover Wetland Cover Wetlands within Headwater Catchments Upland forest within Headwater Catchments Natural cover within Significant Groundwater Recharge Areas Riparian Functional Zone – 30 metre protection zone
Other Landscape Features	Southern Ontario Physiography Features Beaches Drumlins Eskers Shore Cliffs ANSI Life Science Features Beaches Drumlins Eskers Kames Moraines Anthropogenic Features Other Life Science Features

A primary reference used to inform the targets listed in Table 3 was the science-based guidelines from the document “How Much Habitat is Enough”, which was developed by Environment Canada (2004) for the Great Lakes Areas of Concern. These guidelines are widely cited and have been used by conservation authorities as well as some municipalities to guide natural heritage planning. However, there are a few targets in Table 3 for which these guidelines do not provide specific direction. These targets drew on and integrated other sources, as well as local expert opinion. A full reference list for each target can be found in Appendix C. Each target is applied within ecologically relevant assessment units (Fig 3, 4, 5, and 6).

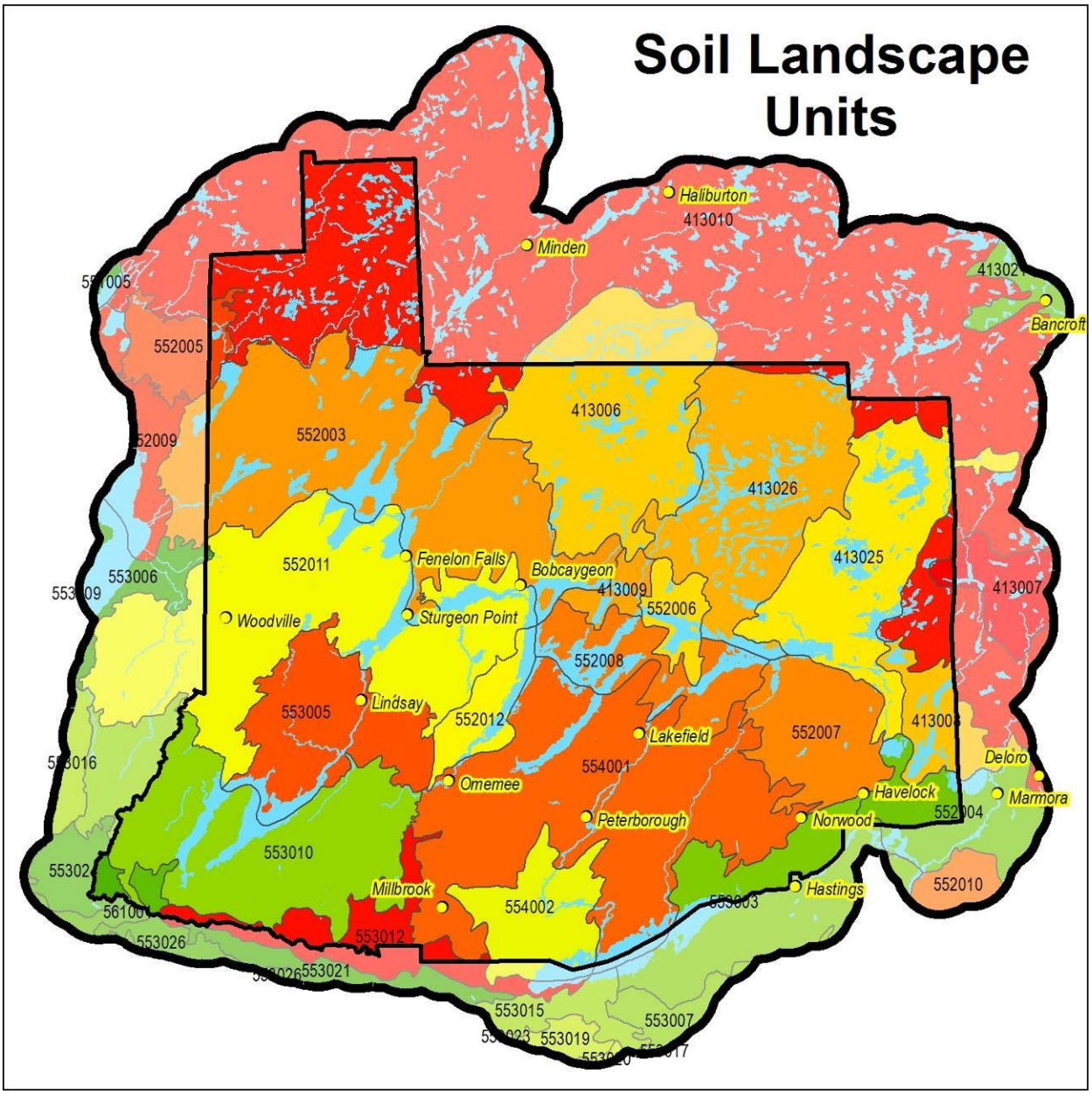

Figure 4. Soil landscape units used to assess biodiversity and ecological function targets. Targets are applied in each discreet unit to ensure distribution.

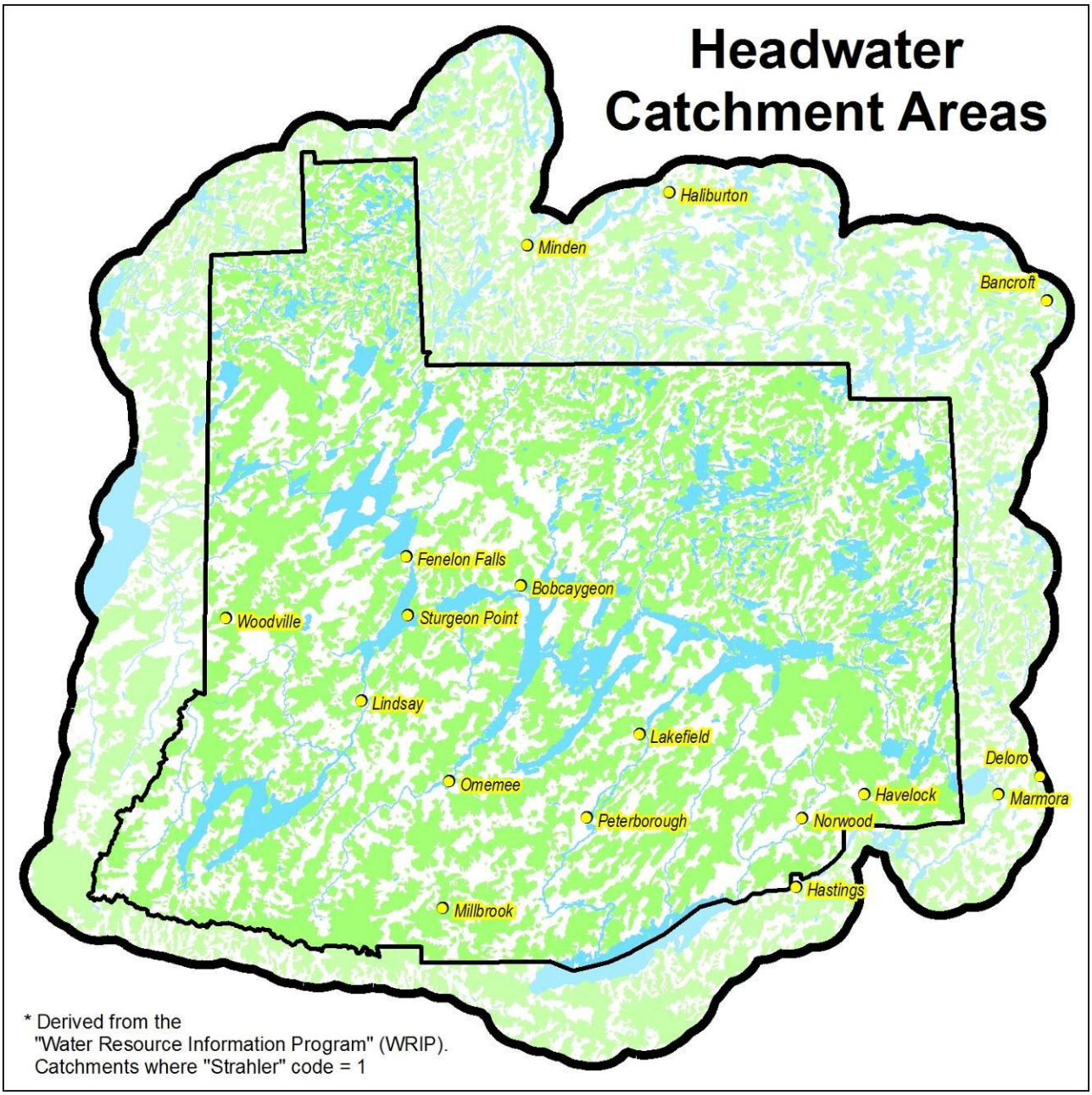

Figure 5. Headwater catchment areas used to assess the headwater area target. Targets are applied in each discreet unit to ensure distribution.

Figure 6. Tertiary watershed basins used to assess watershed function targets. Targets are applied in each discreet unit to ensure distribution.

Figure 7. Quaternary watershed basins used to assess watershed function targets. Targets are applied in each discreet unit to ensure distribution.

3.2 Step 4 - Natural Heritage Systems Analysis and Scenario Mapping

The analysts provided by the Ministry of Natural Resources used the inputs to complete the NHS analysis and scenario mapping process (step 4 in Figure 2). This step involves prepping the input data for each scenario and using **Marxan**, a decision support tool, to identify efficient configurations of sites that best meet the targets and socio-political considerations for each learning scenario. The results for each of the scenarios were mapped and brought back to the SPT for review.

3.2.1 NHS Analysis Using Marxan

For the NHS analysis, each input data layer (Table 3) corresponding to an identified ecological target or socio-political consideration was prepped and loaded into the Marxan software (for technical details, see Ardron *et al.* 2010, or see metadata in the final data package). This process was repeated for each of the NHS Scenarios identified in Table 4. As described in Section 3.3, Marxan provides decision-support by using the algorithm *simulated annealing* to identify near-optimal spatial arrangements of areas for inclusion in an NHS. The Marxan methodology divides the landscape up into regularly shaped "land units" that facilitate rapid computation. A five hectare hexagon shaped land unit has been shown to be an optimal size and shape for the southern Ontario landscape (MNR 2008). The *Kawarthas, Naturally Connected* project area has 271,334 land units meaning there are millions of design options that the software considers. Each land unit simply acts as a container for the spatial data within it; no level of detail or accuracy is lost.

Marxan seeks to achieve all the targets while minimizing the land unit cost and clumping land units together to minimize the amount of 'edge'. Since the land unit cost is set to the amount of land area, the resulting 'least-cost' solution is the NHS design that best meets the targets in the least amount of area

The Marxan algorithm uses three key parameters to determine the most efficient combination of areas to include, which are described below and illustrated in Figure 6.

- Land Unit Cost – default cost equals the area of the land unit in hectares (5 ha.).
- Land Unit Boundary Cost – equals the amount of edge X Boundary Length Modifier (BLM) which is a user defined constant (increasing the BLM value increases the cost of a more fragmented design).
- Cost of Not Meeting Targets – Not achieving a target carries a penalty cost.

The socio-political inputs from the SPT provided Marxan with additional information about each land unit, as described in Section 3.1.1. For each scenario identified in Table 4, Marxan selected and assessed 100 million different combinations of land units (iterations), and this process was repeated 100 times (runs) to identify the 'least-cost' solution. These parameters were identified through calibration of the software to ensure the number of iterations and runs were sufficient to explore the range of options in this landscape. The average computer processing time for each scenario was 9-13 hours.

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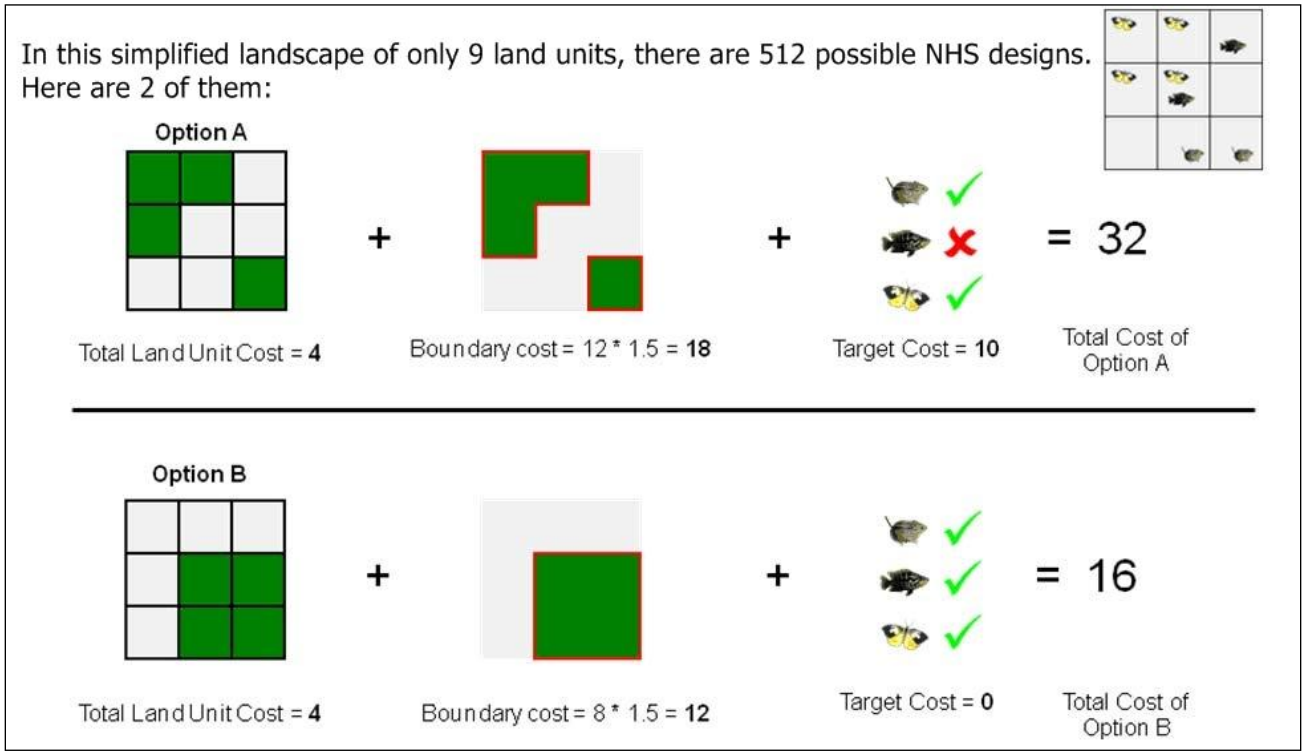


Figure 8. A simplified illustration of how the Marxan decision support software works to select the most "cost effective" option for a theoretical NHS. Land Unit Cost + Land Unit Boundary Cost + Cost of Not Meeting Targets = the Total Cost of NHS design. *(School of Anthropology and Conservation - University of Kent)*

Doug van Hemessen

3.2.2 Natural Heritage System Scenarios

Given the diverse interests of the Scenario Planning Team members and their knowledge of the local landscape, they did not always agree on a single target level or socio-political consideration status. At other times the group expressed curiosity about the impact of different target levels on the results of the analysis. These "what if" questions were grouped by theme into the 9 learning scenarios described in Table 4 below. The learning scenarios helped the SPT understand the impacts of their decisions on the NHS for this landscape.

Full details for each scenario are in Appendix B

Table 4. Learning scenarios for evaluation by the Scenario Planning Team

Scenario Number	Learning Scenario Name	Description
1	Targets at 10% of existing features in analysis area	Minimum thresholds applied to the targeted features (10%). Biodiversity representation landscape features were targeted at 1%.The other three Learning Scenarios target most features at 30%, 50% or 70%.
2	Targets at 30% of existing features in analysis area	Most features targeted at 30%. Biodiversity representation landscape features were targeted at 4%. The other three Learning Scenarios target most features at 10%, 50% and 70%.
3	Targets at 50% of existing features in analysis area	Most features being targeted at 50%. Biodiversity representation landscape features were targeted at 6%. The other three Learning Scenarios target most features at 10%, 30% or 70%
4	Targets at 70% of existing features in analysis area	Most features targeted at 70%. Biodiversity representation landscape features were targeted at 8%. The other three Learning Scenarios target the features at 10%, 30% or 50%.
5	Example Science Targets	Targets that are recommended as minimums or ideals by the scientific community and literature. As well, Learning Scenario #5 includes targets set by the Scenario Planning Team. All of the other scenarios, i.e. Scenarios #1 through #4 and Scenarios #6 through #8, are based on only targets that were expressly chosen by the Scenario Planning Team.
6	Combination of Scenario #2 and #3 Targets	A combination of the targets set for Scenarios #2 and #3
6a	Same as Scenario #6, Except Rare Habitats Targeted at 70% Instead of 100%	A test of reducing the targets for rare habitats from 100% to 70%. All other targets are the same as Scenario #6
7	The *Midpoint* Scenario	Targets applied as a midpoint between Scenario #6 (30% in the Canadian Shield and The Land Between zones and 50% in the South-of-Shield zone) and Scenario #8 (50% in the Canadian Shield and The Land Between zones and 70% in the South-of-Shield zone)
8	Combination of Targets for Scenarios #3 and #4	A combination of the targets set for Scenarios #3 and #4

3.3 Step 5 – Evaluating the Natural Heritage System Scenarios

Two full-day meetings of the Scenario Planning Team were held in 2011 (June and September) to review the learning scenarios and seek agreement on a preferred scenario. The scenarios were mapped on large posters and detailed information packages were provided containing statistics on target achievement and overall percent feature inclusion by each scenario. SPT members reviewed each map and the statistics to help them individually and as a group assessed how well each met their stated vision and goals for a preferred NHS.

3.3.1 Assessing Trade-Offs Between Scenarios

The target-achievement of each scenario was evaluated based on the following criteria:

- Does this scenario meet your/your organization's needs, given your intended use of the NHS products?
- Does the scenario adequately address the targeted ecological values?
- Does the scenario adequately consider social, economic, and cultural values, i.e. recreation, development, wild rice stands?
- Is it a product that will be useful to inform:
    1. landuse planning decisions?
    2. stewardship priorities?
    3. restoration priorities?
    4. land acquisition priorities?
    5. research priorities?
    6. inventory programs?
- Does the scenario help to maintain the unique character of the Kawarthas?
- Is the level of existing "connectivity", based on the simple assessment, sufficient in this scenario?
- What do you most like about this scenario?
- Does the scenario have a high probability of being accepted and used?
- Is this a scenario that you could support?

3.4 Step 6 & 7 – Refining the Learning Scenario Maps to Select a Preferred Solution

An additional feature was added to the solution by the Scenario Planning Team:

- *Riparian zone* on lakes greater than 200 hectares. This zone is within 100-metres of the identified lakes, where current (SOLRIS) inventory information shows it is in *natural* cover. There were 38 unique lakes >200 hectares in the *focus area* (total of 65 in the analysis area).

Michael Mason

4.0 Step 8 - The Preferred Solution

Key Messages: Inputs into the analysis

1) The targets represent a percentage of *existing* features on the landscape.
2) The solution is based on the best data and information currently available.
3) Areas not in natural cover are not considered for inclusion by the analytical algorithm (e.g., developed agricultural lands, aggregate extraction areas, urban areas). An additional project phase(s) is required and a process to prioritize and refine areas to add to this solution should be developed.
4) The size of the analysis unit (5 hectare hexagons) partly embeds the concept of *connectivity* directly into the analysis. The unit size accounts for forest and vegetation fragmentation, distance of tree seed dispersal and passive restoration based on succession.
5) For information on features targeted and rationale please see Appendix C.

General Description of Preferred Solution

Represents a combination of the targets set. The combination of targets is as follows:

- Most of the landscape features were targeted at 50% in the Canadian Shield and The Land Between zones, and at 70% in the South-of-Shield zone.
- Biodiversity representation classes were targeted at 6% in the Canadian Shield and The Land Between zones, and at 8% in the South-of-Shield zone.
- The SPT identified certain features that contribute to the unique character of Kawarthas. Features were classified from *ANSI* Earth Science, and the *Physiography of Southern Ontario.* To ensure representation of these features on the landscape, they were targeted at 6% in the Canadian Shield and The Land Between zones, and at 8% in the South-of-Shield zone.
- Known wild rice stands were targeted at 90% of existing stands for each tertiary watershed.
- Known rare habitat features were targeted at 100%.

See Appendix B for the detailed Preferred Solution report.

Summaries for the Preferred Solution

Table 5: Summary of the Amount of Area Selected (ha) and Percent for the Targeted Features

Feature Description	**Total Selected Area within *Focus Area* (ha)** **Total *Focus Area* = 808,794 ha**	**Percent of Available Area of Feature**
Land Area	266,725	36.3%
Natural Cover	265,719	62.1%
Upland Forest	140,884	60.1%
Wetland – Forested	73,745	65.7%
Wetland – Non-forested	34,676	59.3%
Natural Non-forested	16,414	71.2%

The full package of information, including mapping, inputs and background reports is available through Land Information Ontario (LIO):

Phone: 705-755-1878
Email: lio@ontario.ca
Website:
http://www.mnr.gov.on.ca/en/Business/LIO/

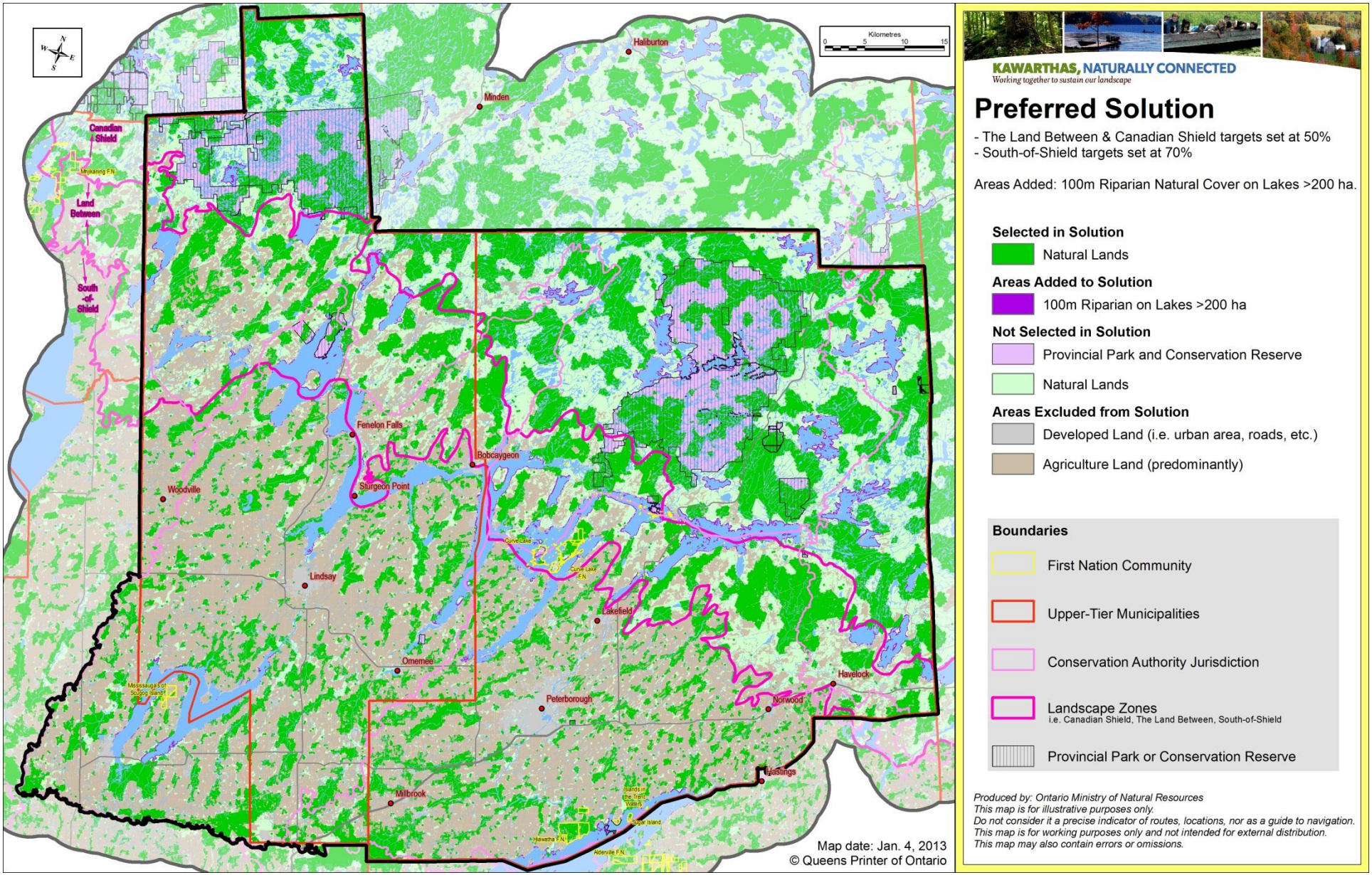


Figure 9. Preferred Solution

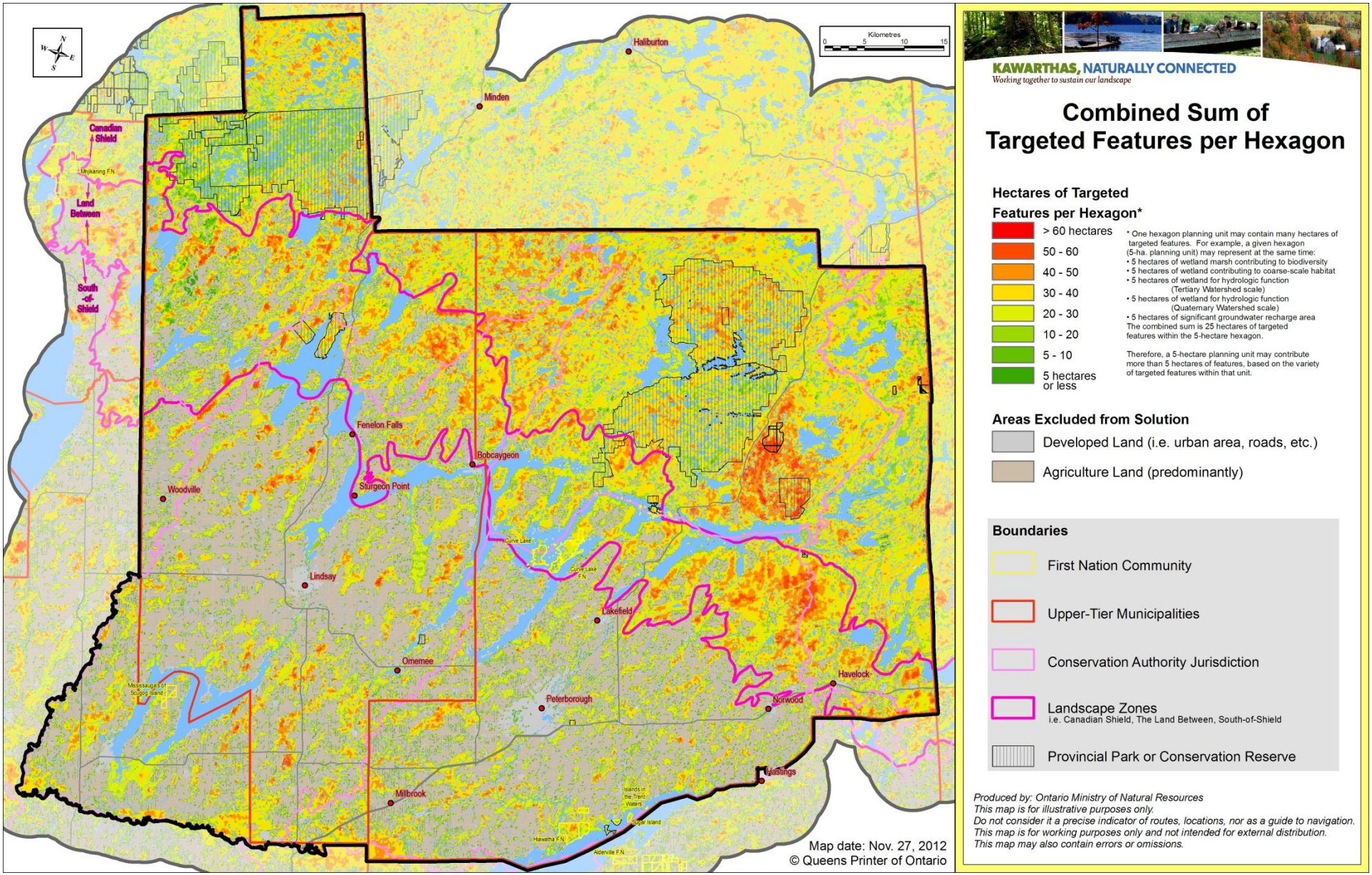


Figure 10. Combined Sum of Targeted Features per Hexagon

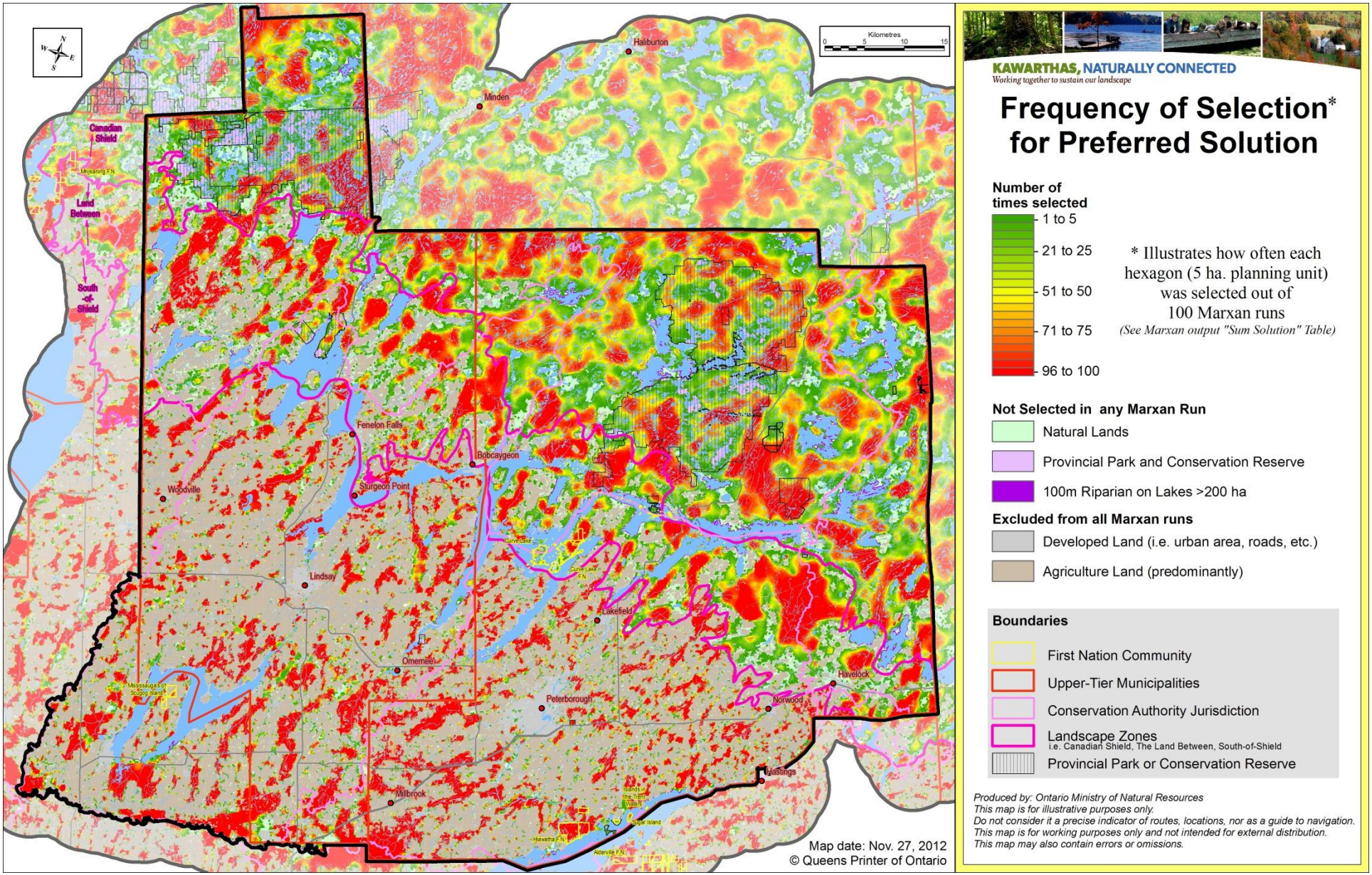


Figure 11. Frequency of Selection for Preferred Solution

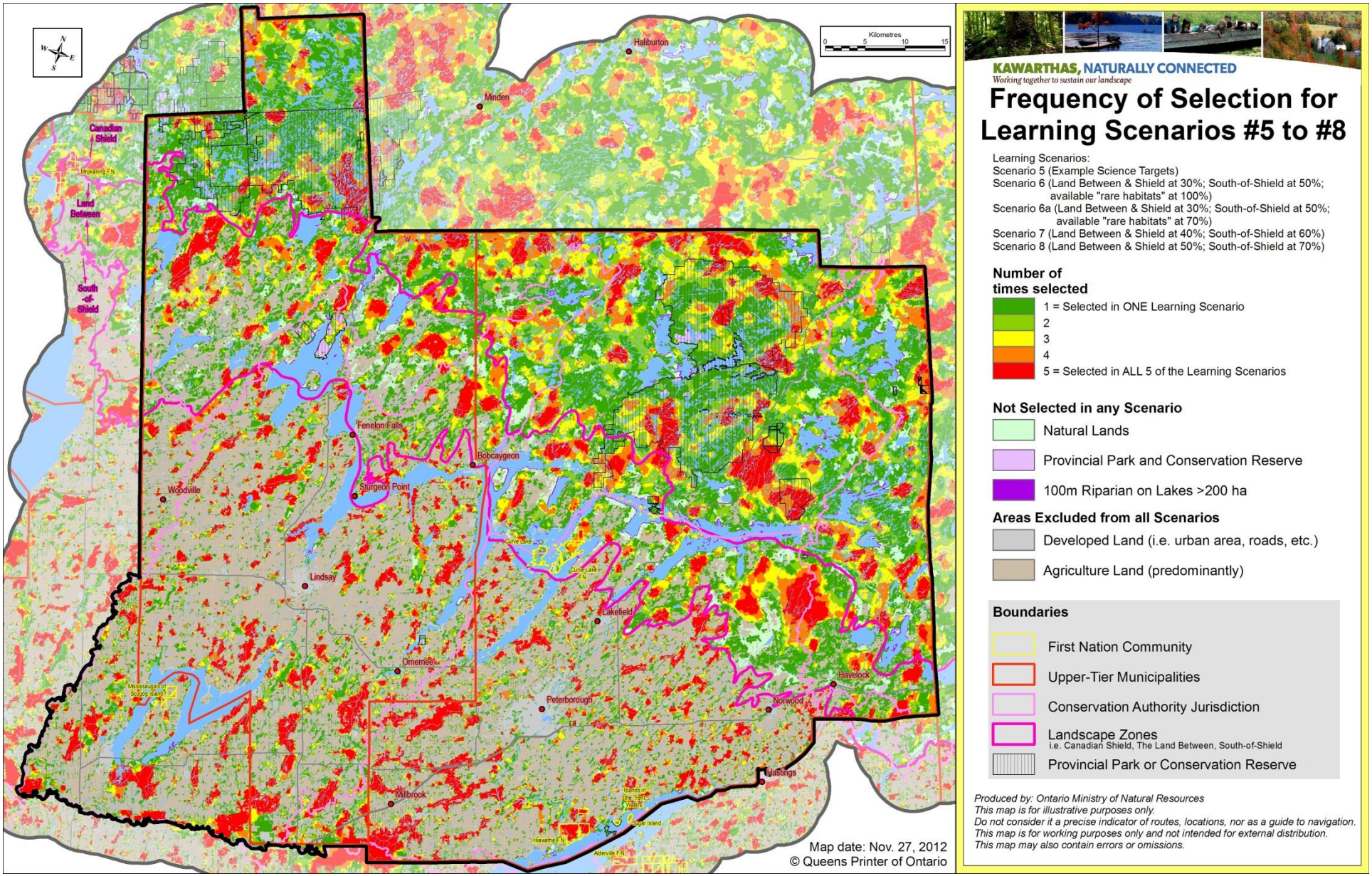


Figure 12. Frequency of Selection for Learning Scenarios #5 to #8

5.0 Identified Data Gaps and Future Updates

The NHS identified from this process used the best available data. However, there are always areas where the existing data can be improved. Throughout the NHS design process, the Scenario Planning Team identified a number of data gaps. The data gaps include information that is not yet available, or data that was inadequate to include into or inform the NHS design. The data gaps identified by the SPT are documented in Appendix C.

Beyond data gaps, there remain opportunities to include, translate and map additional data, such as those from localized data sets, field reports, related sectors, or community and traditional knowledge. Efforts to collect and incorporate such data may be useful in future refinements of the NHS.

All plans, even long range strategic plans, require periodic review to ensure that they remain a relevant tool for those using it to inform their operational decision making. At this time, it is recommended that the NHS products be assessed periodically by the agencies using it to determine whether it continues to meet their needs. The Scenario Planning Team recommends that these data gaps be used to set priorities for improving data in a future cycle of NHS design and planning.

6.0 Example Uses of the Natural Heritage System Information

Use of the NHS information produced in this project is voluntary. However, there are many benefits of using the information generated from this process. The product is grounded in documented decisions regarding which areas were included, it is based on the best available data, and it reflects the considerations and objectives of a diverse group of local stakeholders. The final product of this project is more than just a map. It is a digital information package in GIS format containing more than 30 input layers, scientific targets, and identified priority areas with their significance to the landscape as a whole. This package of compiled information and data layers can:

- inform sustainable land use planning and resource management decision-making
- determine the best areas for stewardship and restoration projects
- set priorities for conservation land securement
- identifyfurther information and inventories needed.

At its earliest meetings each member of the Scenario Planning Team identified how they and their organization could use the *Kawarthas, Naturally Connected* products.

6.1 Identifying Potential NHS Core Areas and Corridors

The Natural Heritage Reference Manual (MNR 2010) identifies core areas, corridors and linkages as fundamental components of an NHS. Core areas are considered the building blocks of an NHS. They can consist of one feature or a collection of features that can include a mix of ecosystem types (e.g., grasslands, alvars, woodlands, wetlands). Core areas should be capable of providing and sustaining ecological functions (MNR 2010). Corridors and linkages are linear

areas intended to provide connectivity (at the regional or local level, respectively) and enable plants and animals to move between core areas (MNR 2010).

The map of the Preferred NHS in Figure 9 shows the existing natural areas required to meet the ecological targets set by the Working Group in this landscape. Strictly speaking, these results may not be a complete natural heritage system. Some natural features identified may require restoration to better link them together. Identifying connections and restoration areas is a complex question that could be an entire subsequent project of its own. This project only took an initial look at what might be required to complete this type of analysis and some sample products are included in the information package.

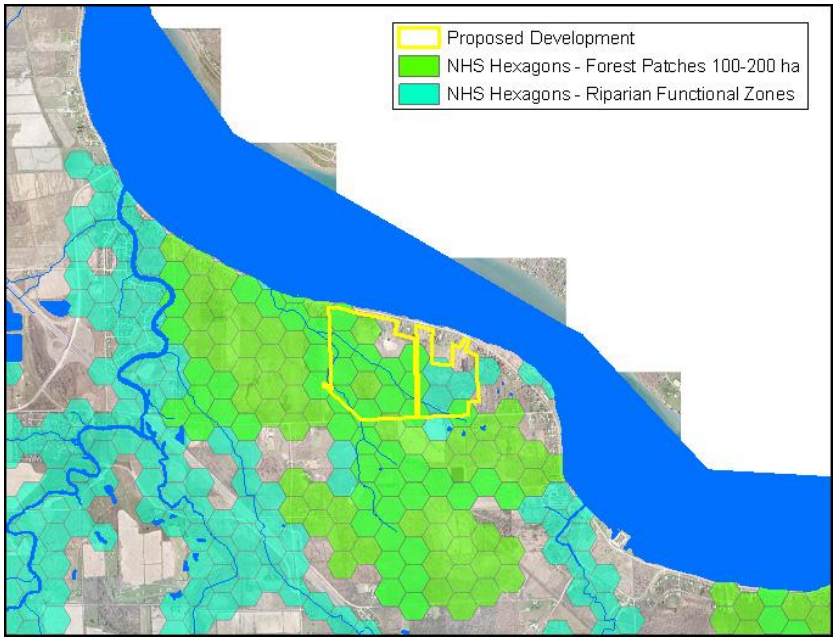
Examples of indentifying landscape connectivity include the “Big Picture” in southwestern Ontario (Jalava, *et al*, 2002) and the Kawarthas Circuitscape map developed at Trent University.

6.2 Using the NHS to identify priority areas for conservation land acquisition

Figure 10 displays the combined sum of targeted features per hexagon on the landscape (hot spots for ecological value). The red areas are the richest in terms of their contribution to the targets. This information can be used to help identify priority areas for land acquisition. In addition, the underlying data provides information on how much each hexagon contributes to the targets. This information is also useful to create an appropriate management plan for a property once acquired.

6.3 Using the NHS to assess impacts of development

The NHS analysis outputs are useful to assess the impact of a proposed development because a large amount of information is rolled up in each five hectare hexagon. The map to the right shows the top two targeted features that would be impacted by this hypothetical development.



The brighter green hexagons were selected to meet both the forest patch and riparian functional zone targets. Using the NHS information package, an impact table can be generated to add up the total hectares impacted for each target. In many cases, the total impact is substantially more than the size of the development. This is because one feature (e.g. a forest patch) can contribute to several targets. In this example, the total development area is 91 hectares, but the total impact across all targets is 195 hectares. This impact assessment calculation can inform decision-makers about the feature values that could be offset if this development went forward.

6.4 Land Use Planning and Policy Decisions

In addition to the examples shown above, the NHS package can be used to inform municipal official plans and policies if desired. The products can be used as technical guidance to inform municipal land use planning during the normal processes under the *Planning Act*. Other applications may include: zoning, setbacks, massing and density limitations, site planning, bonusing for contributions of public benefit, and development permit requirements.

It is not required that the entire product be adopted comprehensively by a municipality. A municipality may choose to adopt elements of the NHS within its official plan through a land use designation, a map schedule, an overlay type of designation, or an impact assessment tool. A major benefit of using the information products from this process is that the ecological contribution of every natural area can be explained and fully quantified. The contributions of a set of features to the overall landscape are equally valid if a municipality only implements a portion of the preferred NHS.

6.5 Other Uses

In addition to the uses described above, the data gaps identified during this project can help inform priorities for inventory programs and research projects.

As described in this chapter, the NHS information package can support a variety of strategic implementation initiatives. Each organization involved in natural heritage protection has a unique role to play. For more information on the NHS products, please download the final data package including comprehensive metadata from Land Information Ontario (under package products).

7.0 Future Directions & Activities ("Phase 2")

7.1. Implementation Coordinating Committee

Members of the Steering Committee and the Scenario Planning Team have been forthcoming with their interest in a variety of implementation measures for the project. These commitments were noted at a June 2012 implementation /visioning session at the Peterborough Chamber of Commerce 'Old Train Station' building and the Preferred Solution presentation November 27, 2012 at the Peterborough County Council Chambers.

The Steering Committee members will stay on as an 'Implementation Coordinating Committee' and hold meetings as necessary to support planned milestones to be confirmed, as well as work group activities.

7.1.1. Implementation Working Groups & Activities

A number of working group themes emerged during the June 8th session referenced above which include:

- Outreach and Engagement
- Stewardship
- Agricultural Plans
- Land Securement
- Municipal Planning
- Further refinements of Information Systems

It is proposed that each of these groups will identify a lead organization and partners and develop a description of activities on an annual basis.

7.2. Visionary Communications Documents

As one of the working groups and important directions, continued communications on the initiative and communications tools for different audiences will be developed. An updated *Kawarthas, Naturally Connected* presentation is available to all members of the SPT and the Steering Committee.

One of the things being considered is a 'popularized' visionary document that is a 'call to action' on the project region. A visual summation of the project and how we enhance efficiencies and opportunities for good planning, conservation and stewardship, as identified at the outset as one of the key communications pieces.

7.3. Ongoing review, monitoring and updates of information products

Assess how often the NHS design needs to be updated and what the process for doing so will be.

JonathanTeuche

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