

CITY OF OTTAWA NATURAL LANDSCAPE LINKAGE ANALYSIS

SUMMARY

In the last Official Plan Review, which culminated in Official Plan Amendment 76 in 2009, the City introduced new policies about natural features into Section 2.4.2 of the Official Plan, to ensure consistency with the Provincial Policy Statement (2005). The significant wetlands, woodlands and other identified features need linkages to connect them into a functioning natural heritage system (NHS). While linear features such as watercourses and floodplains are considered potential linkages, and are included on the Natural Heritage System Overlay (Schedules L1, L2 and L3) for that reason, a linkage needs to be identified through planning or environmental studies in order to meet the criteria in the Official Plan. City staff has recently completed a City-wide analysis of linkage features, and is recommending some revisions to Schedules L1, L2 and L3 of the Official Plan as a result. This document describes the process by which staff identified the linkages and the proposed revisions to the NHS Overlay.

As part of a Terms of Settlement with the Greenspace Alliance, signed and dated January 26, 2012, regarding an urban boundary issue before the Ontario Municipal Board as part of Official Plan Amendment 76, the City agreed as follows:

- The City of Ottawa acknowledges that, in principle, natural heritage connectivity at multiple scales is an appropriate consideration in decisions regarding expansion of the urban boundary, in order for consistency with the Provincial Policy Statement, 2005.
- The City commits to an explicit consideration of impacts on the connectivity of the natural heritage system at multiple scales during any future analyses and Official Plan Amendments regarding possible expansion of the urban boundary.
- The City will include explicit consideration of natural heritage connectivity at multiple scales in the Terms of Reference for any new or updated subwatershed studies.
- Prior to the next comprehensive Official Plan Review in 2014, the City will identify and map existing and conceptual natural heritage linkages at a City-wide scale, including consideration of regional linkages outside the City boundaries. The city will carry out this work either in partnership with other organizations or agencies (*e.g.* The Nature Conservancy of Canada or the National Capital Commission) or on its own.

City staff has completed a natural landscape linkage analysis. Through this analysis, staff identified natural “linkage” features that qualify as part of the City’s natural heritage system under Policy 2.4.2 (1j). These features consist of remnant woodlands or floodplains lying within existing or potential natural linkage areas identified in the natural linkage analysis. Although they would not necessarily qualify as part of the natural heritage system under other sub-sections of 2.4.2 (1), they contribute to the overall connectivity of the natural heritage system. If these areas are not already designated in the Natural Heritage System Overlay, then staff proposes to add them to Schedules L1, L2 and L3 as part of the current Comprehensive Official Plan Review. Inclusion of these features in Schedules L1, L2 and L3

would not modify any policy of the Official Plan, nor would it alter the underlying land use designation or zoning of any land.

Consultation

The City opened the consultation discussion with a Stakeholder Workshop on the City of Ottawa's Natural Linkages Analysis and the Nature Conservancy of Canada's Ottawa Valley Conservation Plan, held on March 27, 2013. A further Agency Consultation meeting was held on September 11, 2013 on the Natural Linkages Analysis and proposed changes to Schedule L.

In addition, work was also carried out in partnership with The Nature Conservancy of Canada. The City has contributed to the preparation of The Nature Conservancy of Canada's Ottawa Valley Natural Area Conservation Plan, which identified areas of regional connectivity and lands of high ecological value, in both Ontario and Quebec.

Summary of Process

The natural landscape linkage analysis focused on the rural area and the National Capital Greenbelt. The urban natural heritage system linkages are addressed in the Greenspace Master Plan (2006). The Federal Ottawa Airport Authority lands will be addressed in the Airport's Land Use Master Plan.

The natural landscape linkage analysis employed methods and tools commonly used in conservation land use planning for the identification of natural landscape linkages and corridors at a regional scale. The analysis was performed using ESRI ArcGIS 10 software. It generally consisted of a "least cost corridor" analysis, in which 1 km wide linkages were identified between core natural features. Linkages were identified as those connecting landscapes between the features offering the least resistance to the dispersal and movement of plants and animals.

The analysis followed the following guiding principles, which come from research and studies in fields of Landscape Ecology and Conservation Biology:

- Short linkages are better than long linkages;
- Wide linkages are better than narrow linkages;
- Continuous linkages are better than discontinuous linkages;
- Straight linkages are better than crooked linkages.
- Linkages function best if they, themselves, provide viable habitat.

These principles are also consistent with the guidance provided by the Ontario Ministry of Natural Resources in the Natural Heritage Reference Manual (2010).

Landscape linkages are often defined in relation to a target species or group of species. In this case, the City did not identify any target species, but based the analysis on a general assessment of the extent to which certain land cover types facilitate or impede the movement of plant and animals.

The landcover mapping used for the project was produced by the environmental consulting company Morrison Hershfield, under contract to the City, using the City's 2011 color aerial photography (20 cm resolution). The land cover map followed a process and standards developed by the Rideau Valley Conservation Authority for use in Eastern Ontario. They are derived from, and consistent with, the Ecological Land Classification (ELC) system and the Southern Ontario Land Resource Inventory System (SOLRIS), which are the standard mapping systems used by the Province of Ontario and Ontario's Conservation Authorities. The landcover map appears as Figure 2 at the end of this document.

Figure 1 outlines the process and methodology that staff followed in conducting the natural landcover linkage analysis. Several concepts are important for understanding the methodology. The process, methodology and concepts are discussed following the figure.

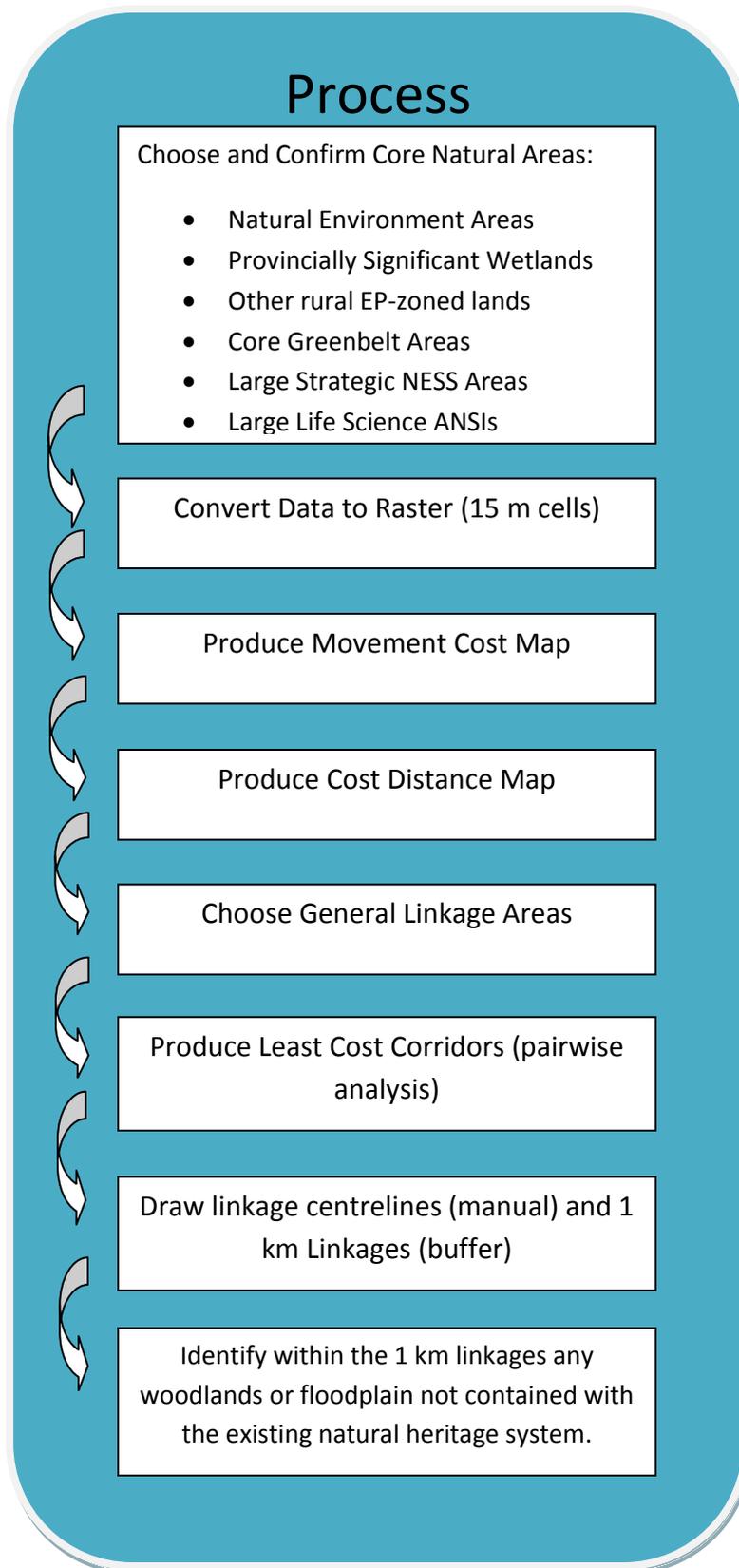


Figure 1: Natural Landscape Linkage Identification Process

Methodology

Raster Analysis

All of the landscape linkage analysis was performed using *raster* maps. A raster map is analogous to a digital photograph, in that the map consists of individual pixels or cells which only become apparent when one zooms in very close to the image (*i.e.* at high resolution). The pixels or cells are square and arranged in rows and columns, similar to a chess board. This analysis used a cell size of 15 m x 15 m, or 225 m². It required 12.7 million pixels to produce a raster map of the City of Ottawa, or the equivalent of a 12.7 megapixel digital photograph.

Once a map has been converted to a raster format, it becomes possible to perform mathematical operations on each pixel in that map using GIS software. This process is analogous to the use of photo-processing software to modify a digital photograph.

Core Natural Areas

Natural heritage systems consist of core natural areas and connecting landscapes (*i.e.* natural linkages). Core natural areas consist of large, contiguous natural vegetation communities such as woodlands, wetlands, natural grasslands, savannas, dunes, rock barrens, *etc....* These areas generally provide sufficient quality habitat to support a diverse range of native flora and fauna.

The boundaries of core natural areas often change over time, as vegetation communities change in response to natural succession, natural disturbances and human disturbances. Therefore, the landscape linkage analysis began with a review of the City's core natural areas and their boundaries. The review included Natural Environment Areas designated in Schedule A of the Official Plan, provincially significant wetlands, rural lands zoned "Environmental Protection" (EP), core natural areas within the National Capital Greenbelt, large features identified in the old Region of Ottawa-Carleton Natural Environment Systems Strategy (NESS), and large Life Science Areas of Natural and Scientific Interest (ANSIs) identified by the Province of Ontario. The identification of core natural areas included consideration of features beyond Ottawa's boundaries, such as the Larose Forest, the Limerick Forest, Gatineau Park, Goodwood Marsh and Pakenham Mountain, to ensure that regional linkages to these external features could also be captured. Each core area was closely examined using 2011 aerial photography, topographic information, and other land use information.

Where the extent of a core natural area had increased or decreased visibly since its original mapping, the boundaries of the feature were revised to reflect the changes. In the NCC Greenbelt, revisions were also guided by natural land designations in the draft Greenbelt Master Plan, which reflect recent ecological studies by the NCC. Core natural areas included areas designated as "Core Natural Areas" in the draft Greenbelt Master Plan, as well as existing, contiguous natural areas within the Greenbelt designated as "Natural Link". The final core natural areas used in the analysis appear in the figures at the end of this document.

In most cases, the boundaries of the core natural areas are already reflected in the existing natural heritage overlay in Schedules L1, L2 and L3. In some cases, however, minor additions to Schedules L1, L2 and L3 are necessary to reflect the revised boundaries. These additions are included in the proposed amendments to Schedules L1, L2 and L3.

Movement Cost

The first map to be produced in a landscape linkage analysis is a *movement cost map*. In a movement cost map, every pixel in the map is assigned a numerical value representing the cost to an animal of moving through that pixel. These costs are normally set *relative* to each other. For example, on a typical scale from 1 to 100, a forested pixel may be assigned a relative movement cost of 1, an agricultural field may be assigned a relative movement cost of 30, and a fully-developed, urban pixel may be assigned a relative movement cost of 100.

The value of a pixel in a movement cost map may also be modified by multiplication factors representing other considerations, such as foreseeable future uses or land ownership. For example, in identifying lands for long-term protection as natural linkages, preference may be given to lands in public ownership. A multiplication factor of 0.5 might be applied to the movement cost of map pixels in areas of public ownership in order to favour their selection. Table 1 provides the movement costs and multiplication factors used in this natural landscape linkage analysis, using land cover categories from the 2011 land cover mapping and other land use planning data from the City. The movement cost map appears as Figures 3a, 3b and 3c at the end of this document.

Table 1: Movement Costs and Multiplication Factors

| 2011 City of Ottawa Landcover Category | Movement Cost/Resistance |
|--|------------------------------|
| Natural Cover | |
| Wooded - Treed | 1 |
| Wooded - Hedge | 1 |
| Wooded - Plantation | 2 |
| Wooded - Island | 1 |
| Wooded - Wetland | 1 |
| Grassland | 5 |
| Rock Outcrop | 5 |
| Evaluated Wetland - Swamp | 1 |
| Evaluated Wetland - Open Water | 5 |
| Evaluated Wetland - Bog | 1 |
| Evaluated Wetland - Wetland | 1 |
| Evaluated Wetland - Marsh | 1 |
| Unevaluated Wetland - Treed Swamp | 1 |
| Unevaluated Wetland - Swamp | 1 |
| Unevaluated Wetland - Marsh | 1 |
| Water | |
| Water - Lake | 20 |
| Water - River | 20 |
| Water - Wetland | 1 |
| Water - Pond | 1 |
| Transportation | |
| Transportation - Rail | 5 |
| Transportation - Road | 80 |
| Developed Areas | |
| Aggregate Site | 75 |
| Settled - Pervious | 20 |
| Settled - Impervious | 100 |
| Settled - Homestead | 30 |
| Settled - Residential | 80 |
| Agriculture | |
| Crop and Pasture | 30 |
| Crop and Pasture - Peat Moss | 30 |
| Land Use Modifiers | Multiplication Factor |
| Floodplain | 0.5 |
| Valley land | 0.5 |
| Watercourse/buffer | 0.5 |
| Prime Agricultural Area | 2 |
| Development Reserve | 4 |
| Country Lot Estate | 4 |

Cost Distance Map

A *cost distance map* represents the cumulative movement cost for an animal travelling to a defined destination on a movement cost map. For example, let us assume that an animal must traverse four map pixels (*a*, *b*, *c*, *d*) from its origin (pixel *a*) to the defined destination (pixel *d*). If the movement costs for pixels *a*, *b* and *c* were 1, 5 and 50 respectively, then the total cost distance between pixels *a* and *d* would be $1 + 5 + 50 = 56$. Therefore, on the cost distance map, pixel *a* would have a cost distance value of 56. As one moves closer to the destination, the total cost distance decreases. Pixel *b* would have a cost distance value of 55 ($5 + 50$) and pixel *c* would have a cost distance of 50. Pixel *d*, as the assigned destination, would have a cumulative movement cost of 0.

For this natural landscape linkage analysis, the cost distance value for each pixel was calculated as the cumulative movement cost to the nearest core natural area. The cost distance map was used as a screening tool to identify existing and potential natural landscape linkages for a more detailed *least cost corridor analysis*. The cost distance map appears as Figures 4a, 4b and 4c at the end of this document.

Least Cost Corridor

A *least cost corridor* map represents the total movement cost between two defined areas on a map. Unlike a *least cost path* analysis, which traces only a single line of pixels between the defined destinations, a least cost corridor analysis can be used to identify broader linkages. It works by overlapping two cost distance maps – one cost distance map for each destination. Each pixel is then assigned a value equal to the sum of its value from each cost distance map.

For example, let us assume that pixel *a* has a cost distance of 256 relative to destination *A* and a cost distance of 125 relative to destination *B*. The value of the pixel in a least cost corridor analysis for *A* and *B* would be $256 + 125 = 381$.

The final step in a least cost corridor analysis is to establish the width of the corridor. This is normally done by restricting the least cost corridor to those pixels below a certain threshold. This is usually done using percentages (or more precisely, quantiles). For example, the least cost corridor may be restricted to the 5% or 10% of pixels with the lowest scores.

Based upon the overall cost distance map, 39 pairs of core natural areas were identified for least cost corridor analyses. Each of the 39 least cost corridor analyses required the preparation of two new least cost distance maps. All of the least cost corridor analyses, including the preparation of the new cost distance maps, were performed at the same spatial extent (824 km²) and map scale (1:130,000). The actual area subject to the analyses varied somewhat due to overlap with the City's boundaries (analyses were only performed on areas within the City boundary).

Several pairs of core conservation areas were chosen for least cost corridor analyses even though the overall cost distance map did not show high potential for connectedness. Pinhey Forest, within the National Capital Greenbelt, was chosen for least cost corridor analyses because of the declared intention of the National Capital Commission to identify and improve natural linkages to this important core,

greenbelt area. The Leitrim Wetland and Osgoode Swamp were also chosen for a least cost corridor analysis because the area presents the best opportunity for a north – south linkage on the east side of the Rideau River, particularly in the future when existing mineral aggregate areas are exhausted and rehabilitated.

Figures 5a, 5b and 5c display the 39, overlapping least cost corridor analyses. The figures display the best 10% and 5% solutions.

Identification of Linkages

The next analytical step was the identification of existing and potential linkages. This was a semi-automatic process. First, staff manually drew lines between the core natural areas, following the apparent path of least resistance shown in the least cost corridor analysis. Staff then “buffered” these lines by 500 m on each side to create a 1 km wide linkage area.

The linkages vary in quality from areas that remain entirely natural, through areas that are a mix of natural and non-natural land cover types, to areas that are predominantly non-natural vegetation. The latter linkages are best described as having long-term potential for restoration, generally as a result of restrictive landform features, such as floodplains, valleylands, or escarpments.

Because most of these landscape linkages include some portion of non-natural vegetation, human land uses and non-environmental land use/zoning designations, staff does not propose to identify them in the Natural Heritage Overlay Schedules L1, L2 and L3. Instead, staff recommends identification of only those existing or remnant features that overlap or lie within the linkage areas, and which are not already identified in the Natural Heritage Overlay for other reasons: *i.e.* any non-significant woodlot or forested area overlapping a natural linkage, and any portion of a floodplain contained within a natural linkage.

Figures 6a, 6b and 6c display the landscape linkage network recommended by staff, based upon the landscape linkage analysis.

Identification of Linkage Features

The actual features recommended for inclusion in Schedules L1, L2 and L3 appear in black in Figures 7a, 7b and 7c. These features consist primarily of those woodland and floodplain areas lying within the 1 km linkage areas, that are not already included within the existing natural heritage system overlay. They also include some additions to the core natural areas identified through the review of core natural area boundaries (as discussed above).

The completion of this City-wide analysis does not preclude the likelihood that other linkages exist and may be identified in future, through subsequent environmental or planning studies. Linkages occur at varying scales, and some may only be identified upon closer examination (e.g., through subwatershed studies or even site-specific environmental impact statements). While Schedules L1, L2 and L3 are intended to facilitate the determination of whether an Environmental Impact Statement will be required to support a development application, they remain incomplete and must continue to be treated as a partial map of the natural heritage system. The final determination on whether an Environmental

Impact Statement is needed will continue to be made by staff as part of the pre-application consultation process, in accordance with the City's Environmental Impact Statement Guidelines.

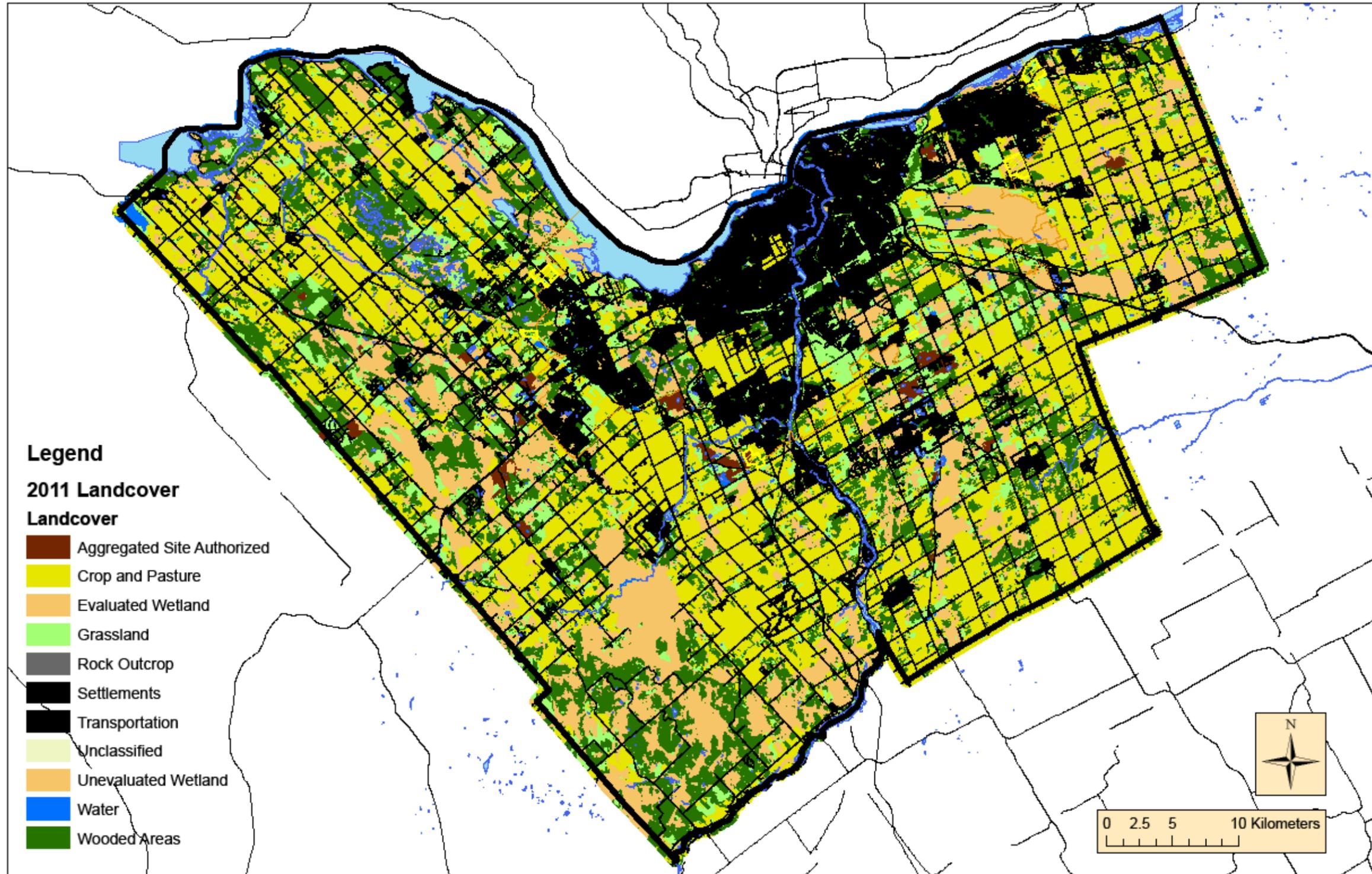


Figure 2: City of Ottawa 2011 Landcover Map.

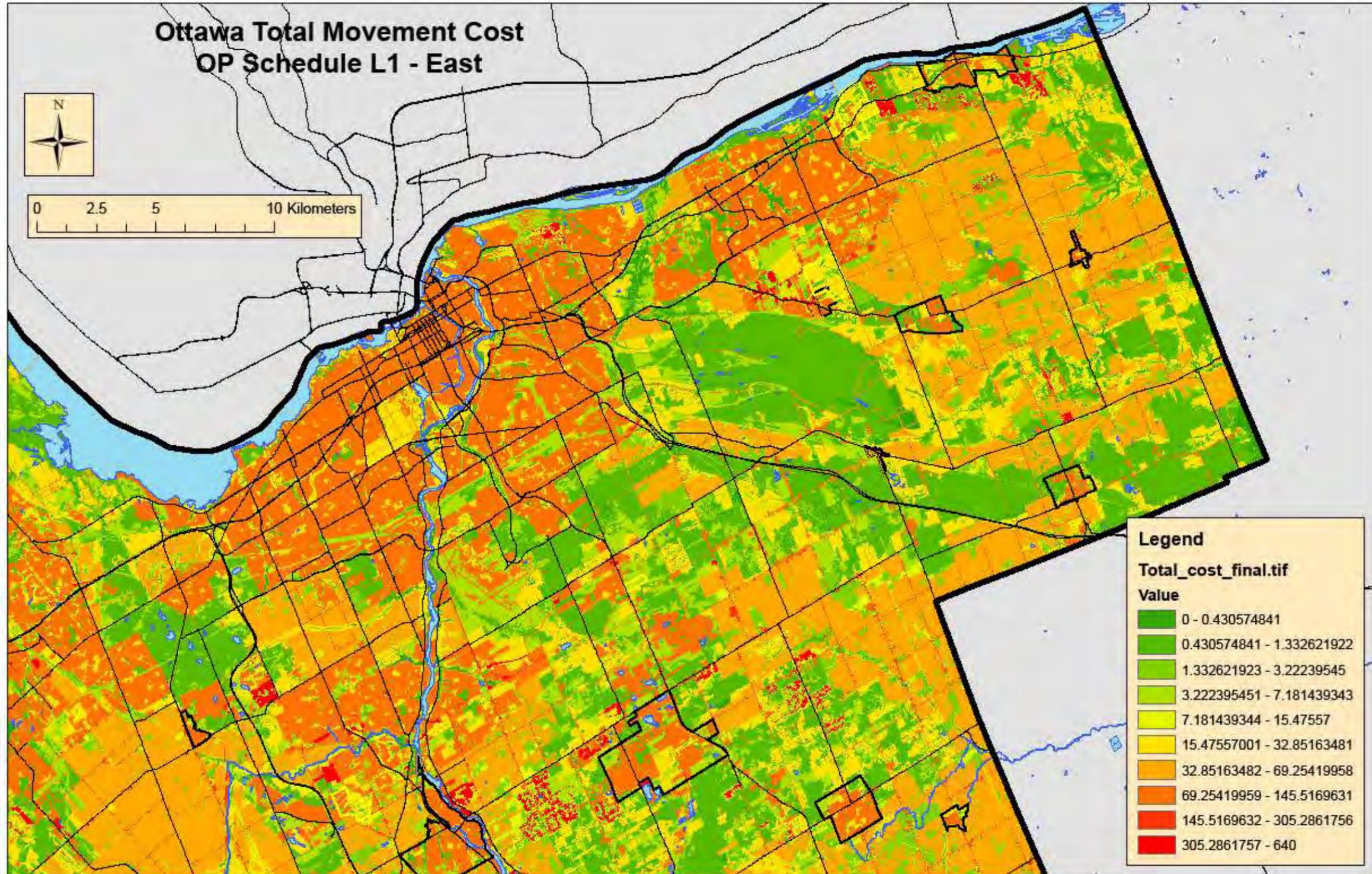


Figure 3a: Movement Cost Map for the area of Schedule L1 – East

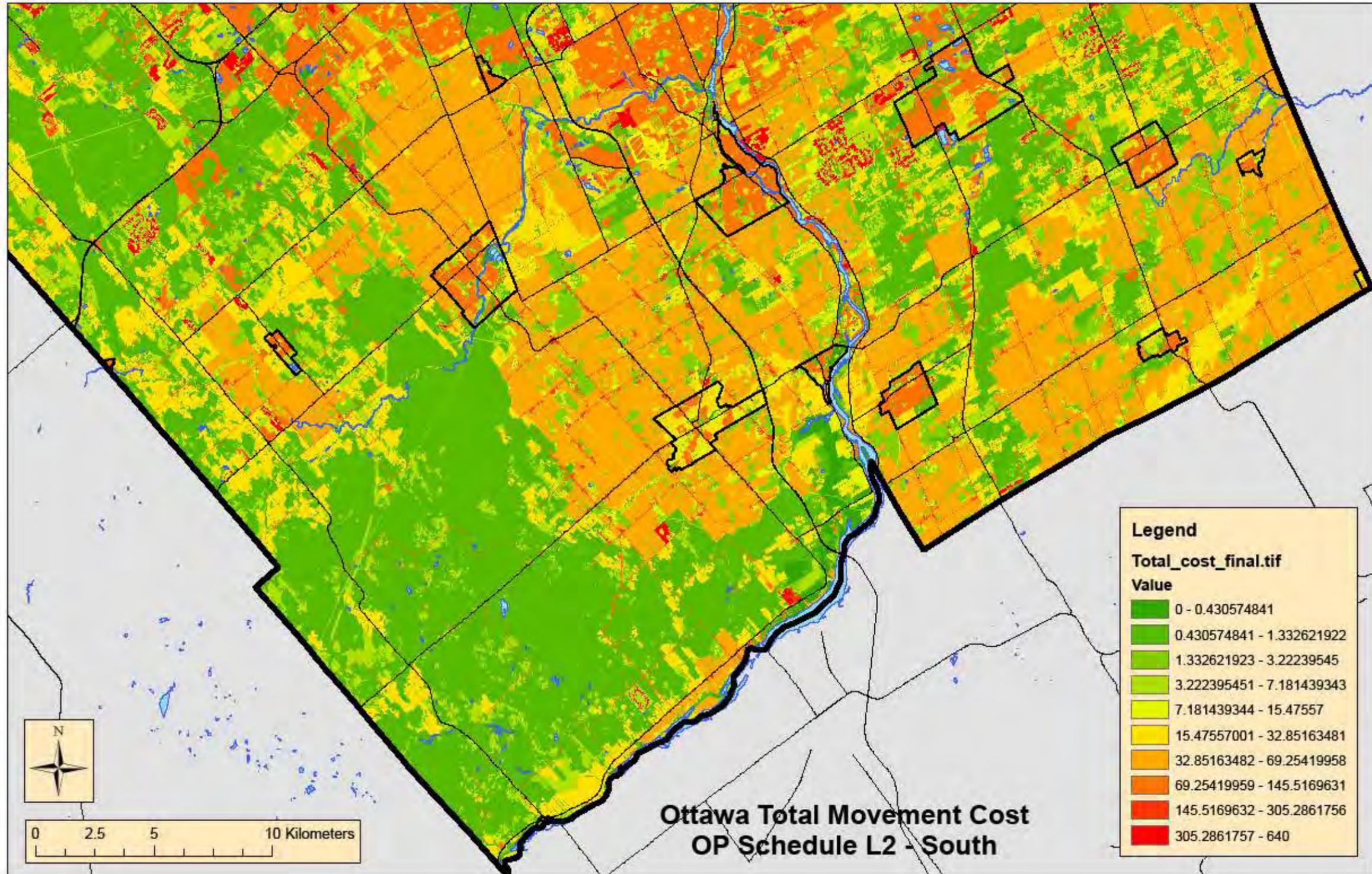


Figure 3b: Movement Cost Map for the area of Schedule L2 – South

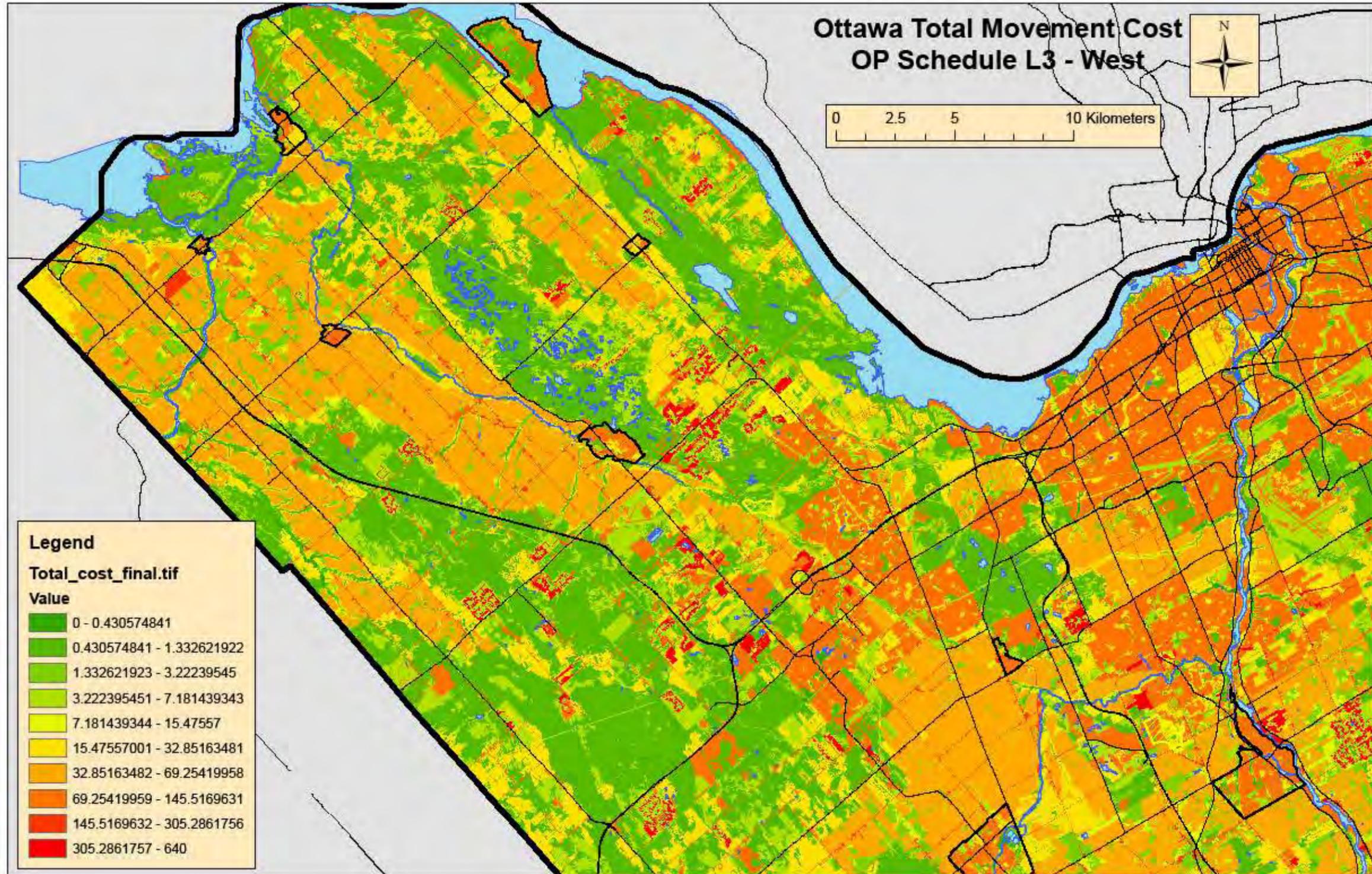


Figure 3c: Movement Cost Map for the area of Schedule L3 – West

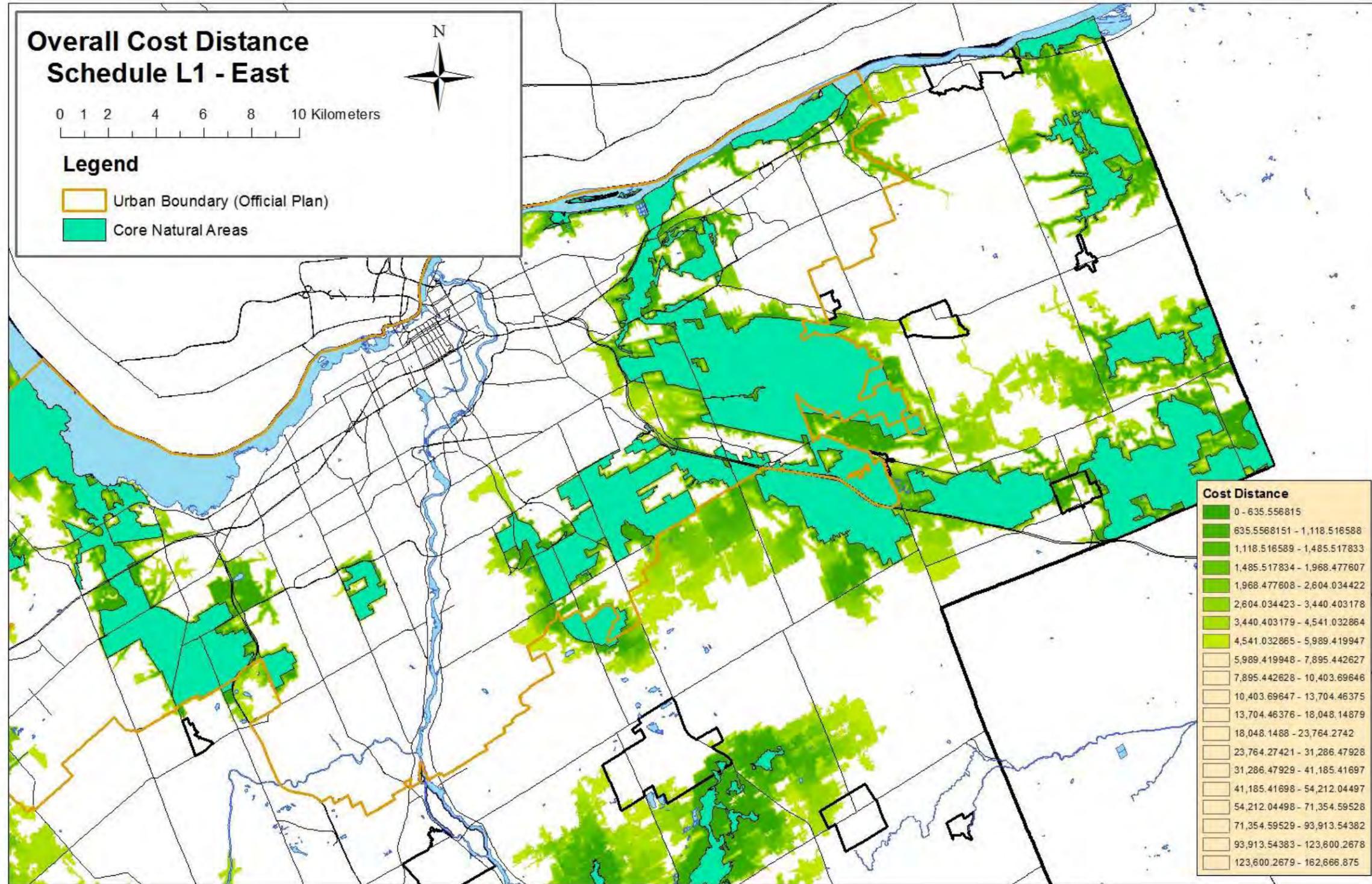


Figure 4a: Cost Distance Map for the area of Schedule L1 – East

(Display limited to lower cost pixels)

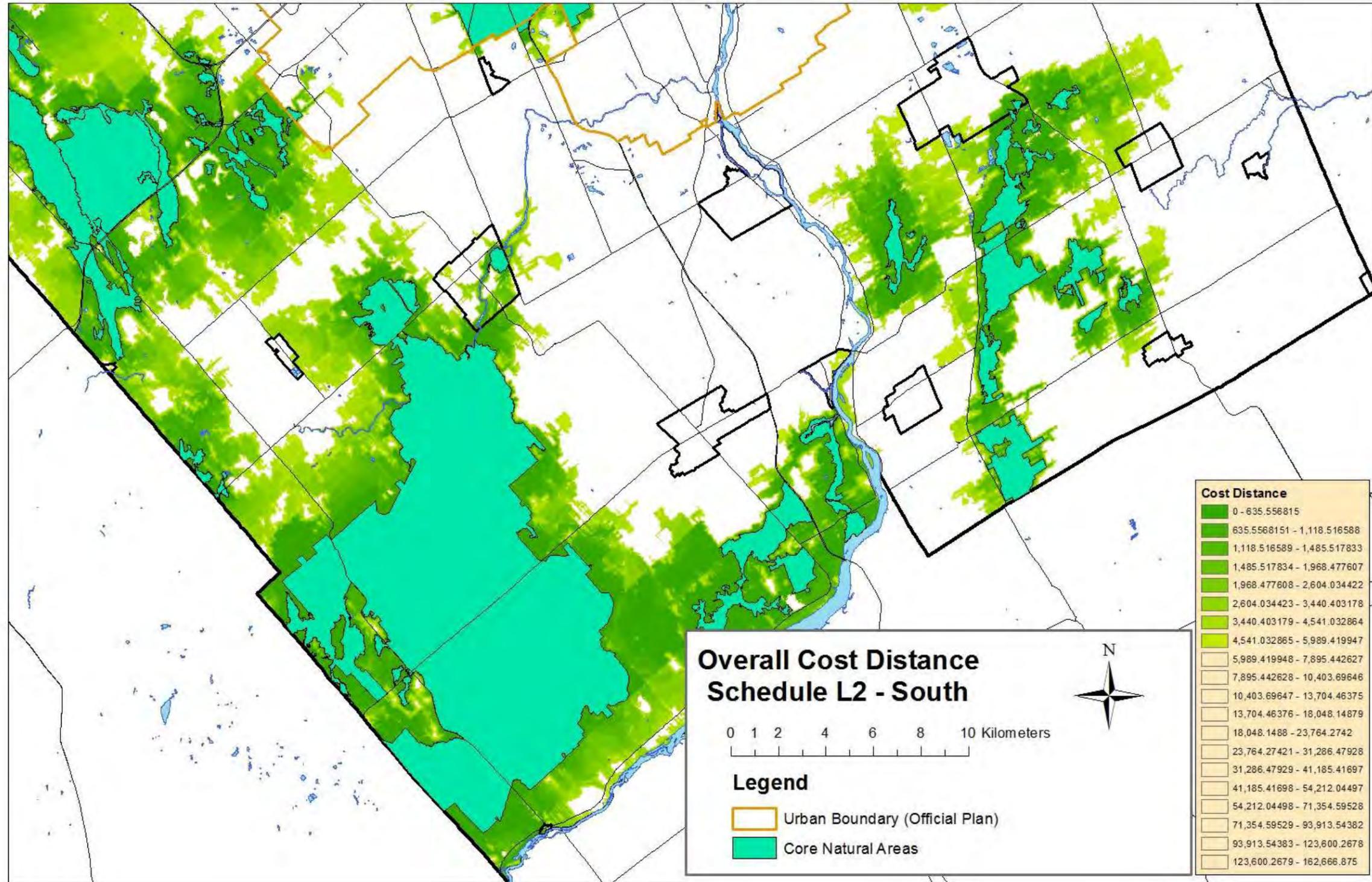


Figure 4b: Cost Distance Map for the area of Schedule L2 – South

(Display limited to lower cost pixels)

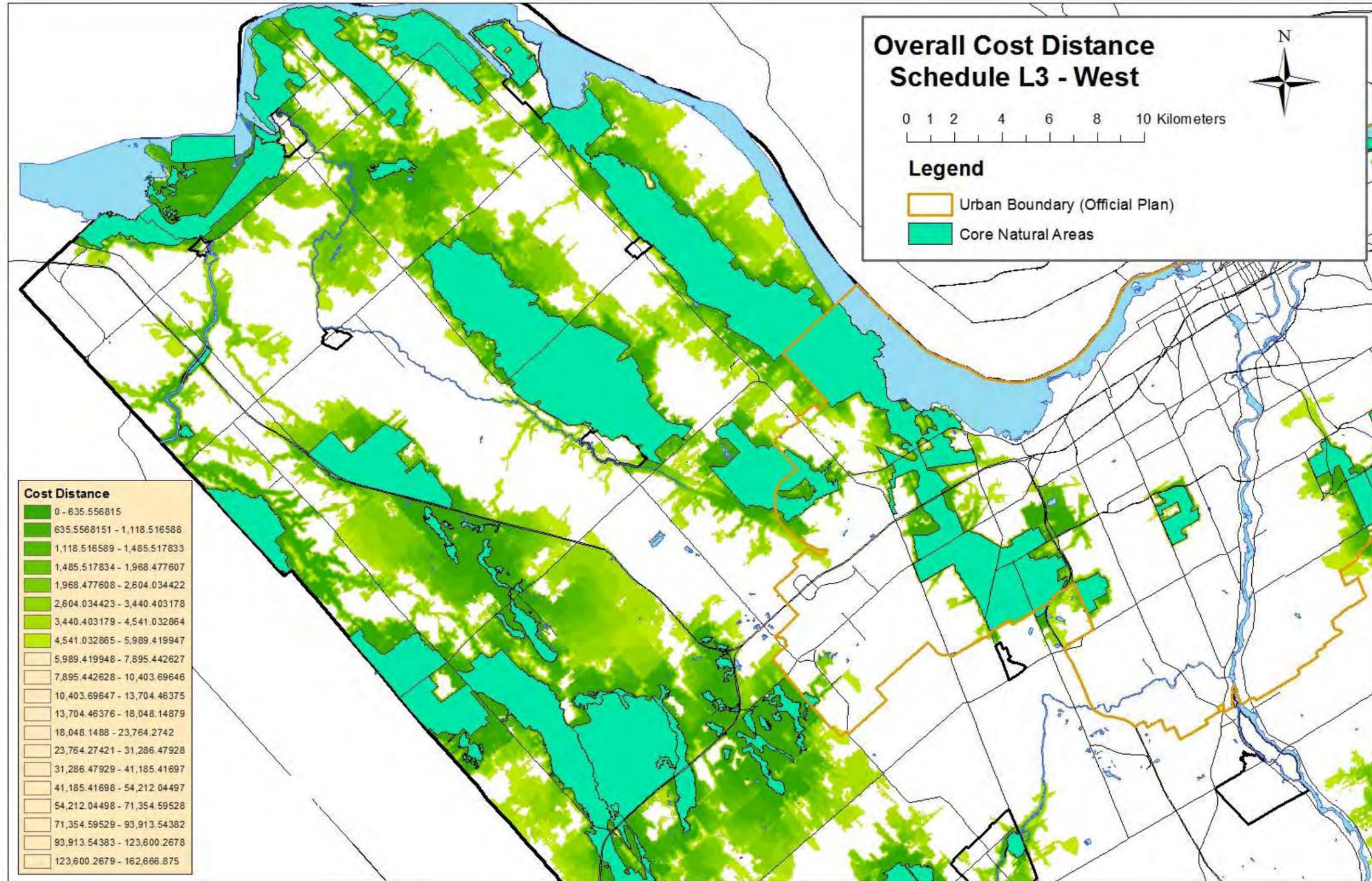


Figure 4c: Cost Distance Map for the area of Schedule L3 – West

(Display limited to lower cost pixels)

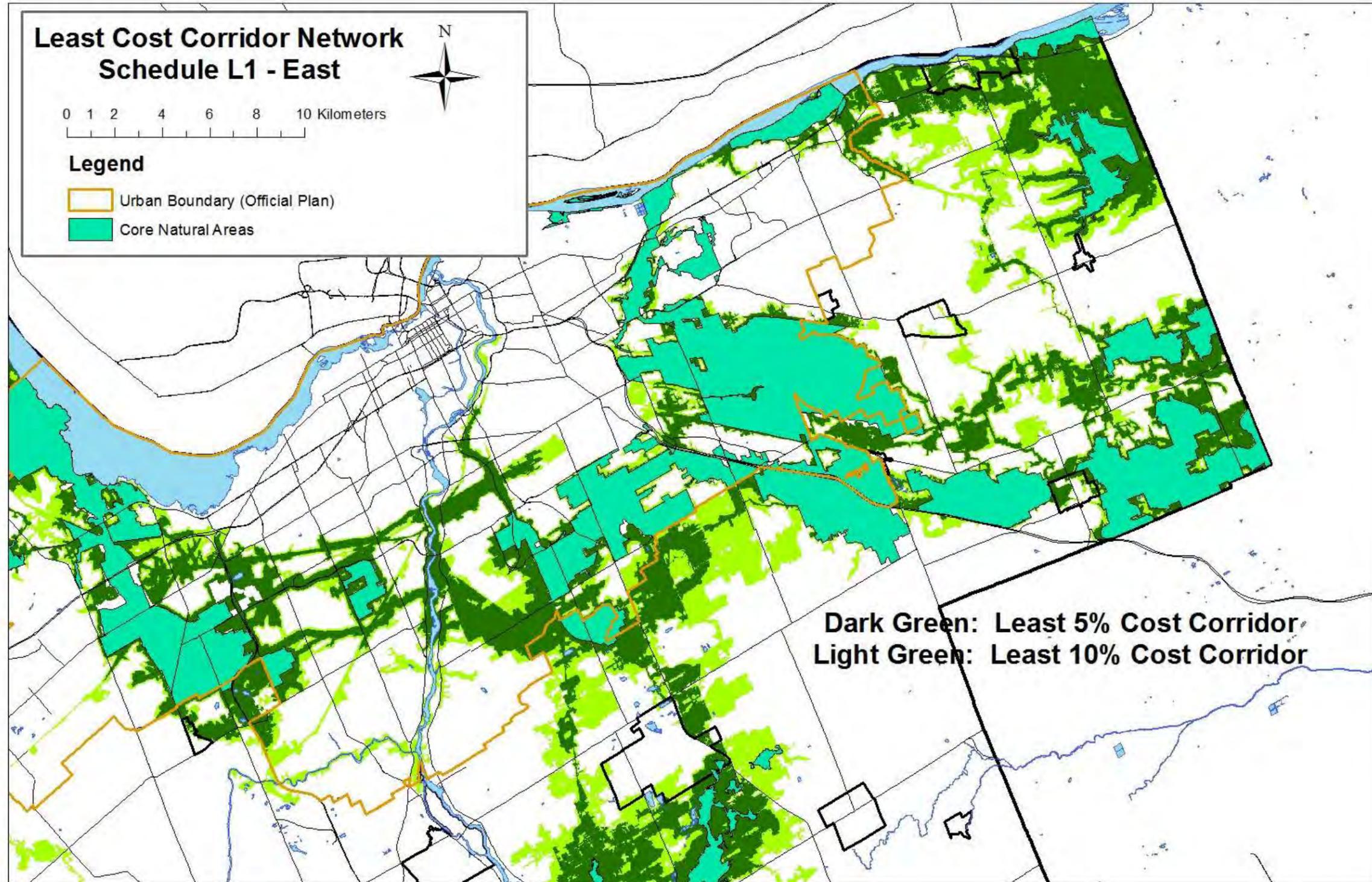


Figure 5a: Least Cost Corridor Map for the area of Schedule L1 – East

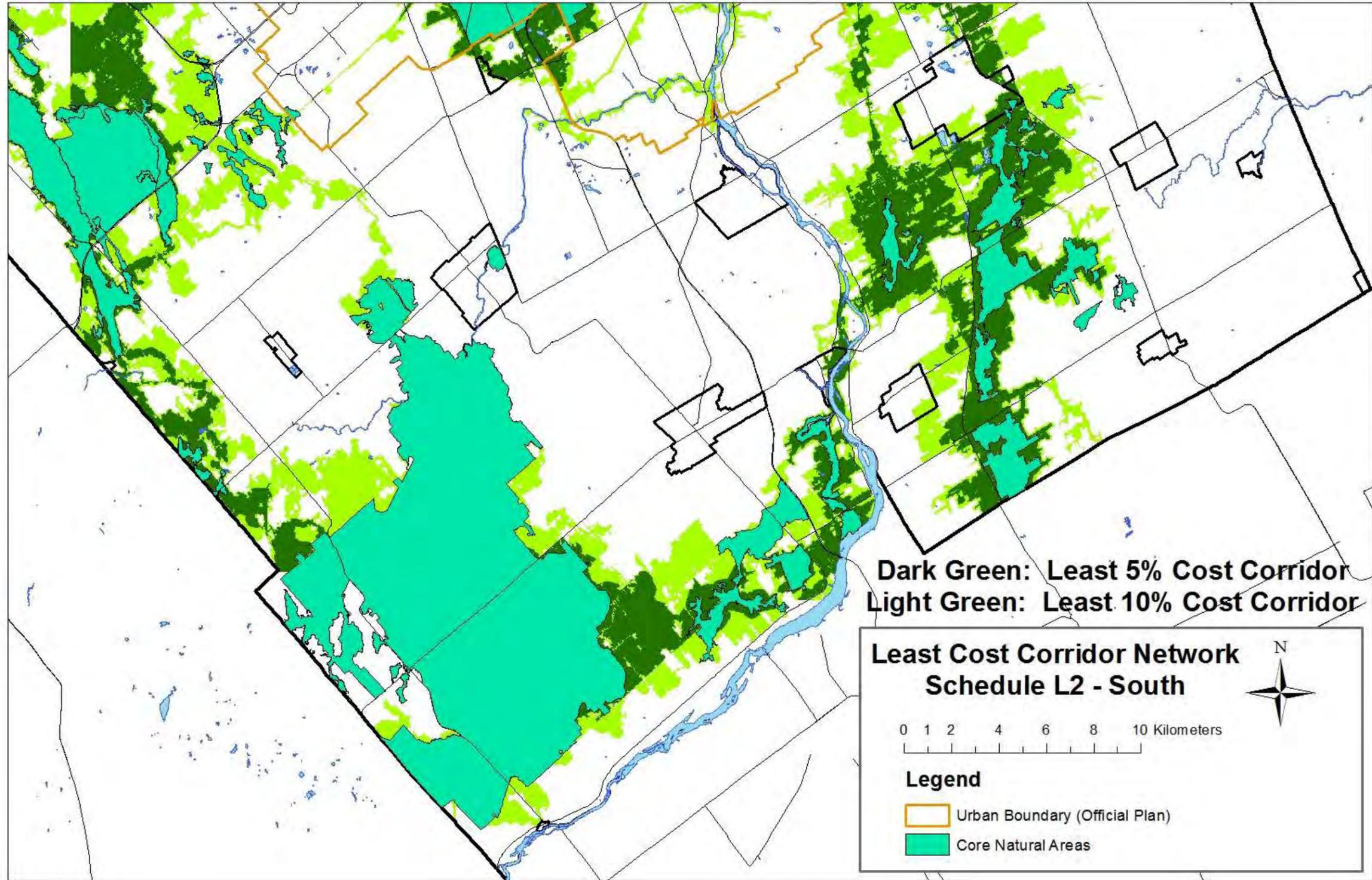


Figure 5b: Least Cost Corridor Map for the area of Schedule L2 - South

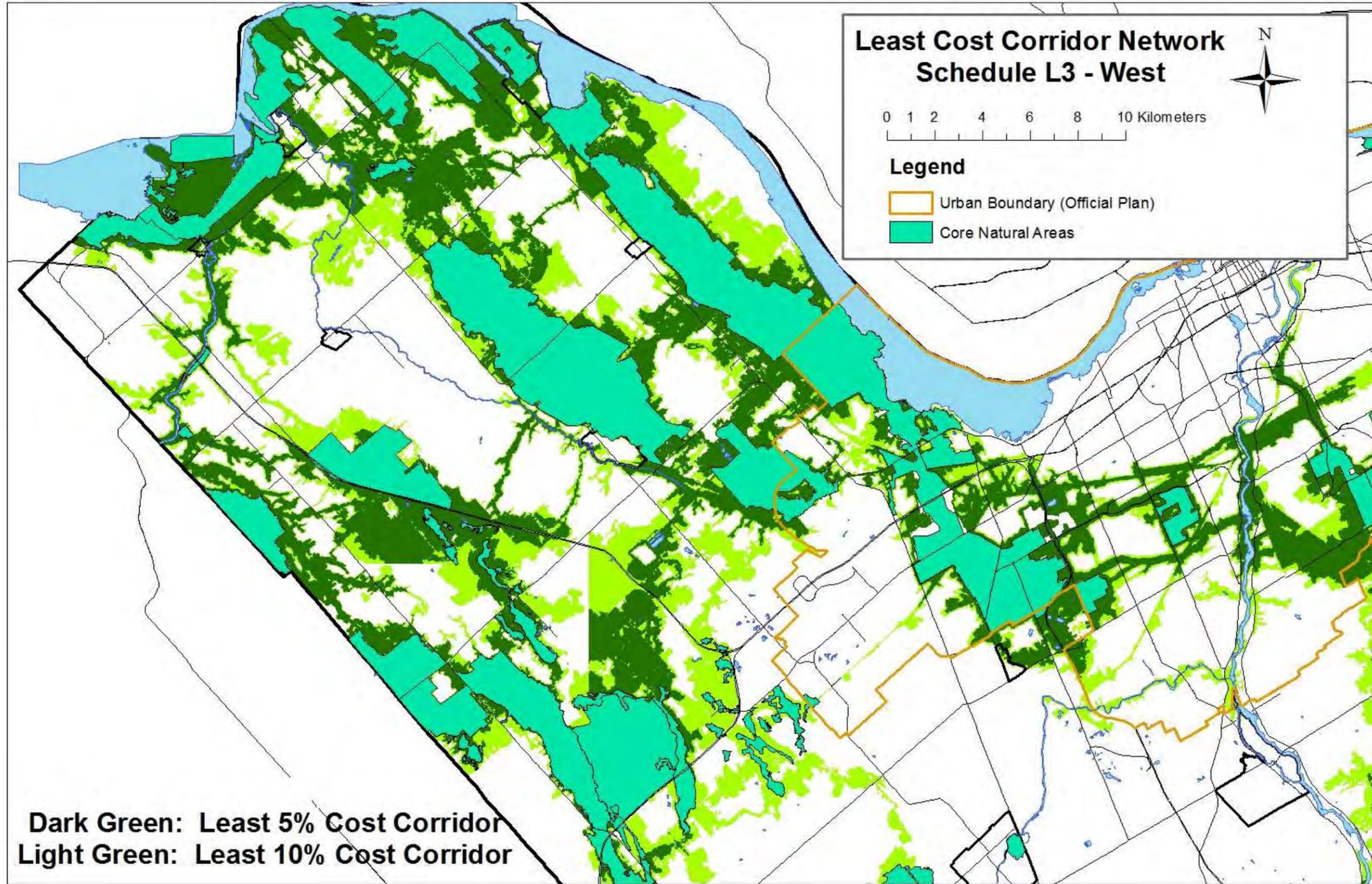


Figure 5c: Least Cost Corridor Map for the area of Schedule L3 – West

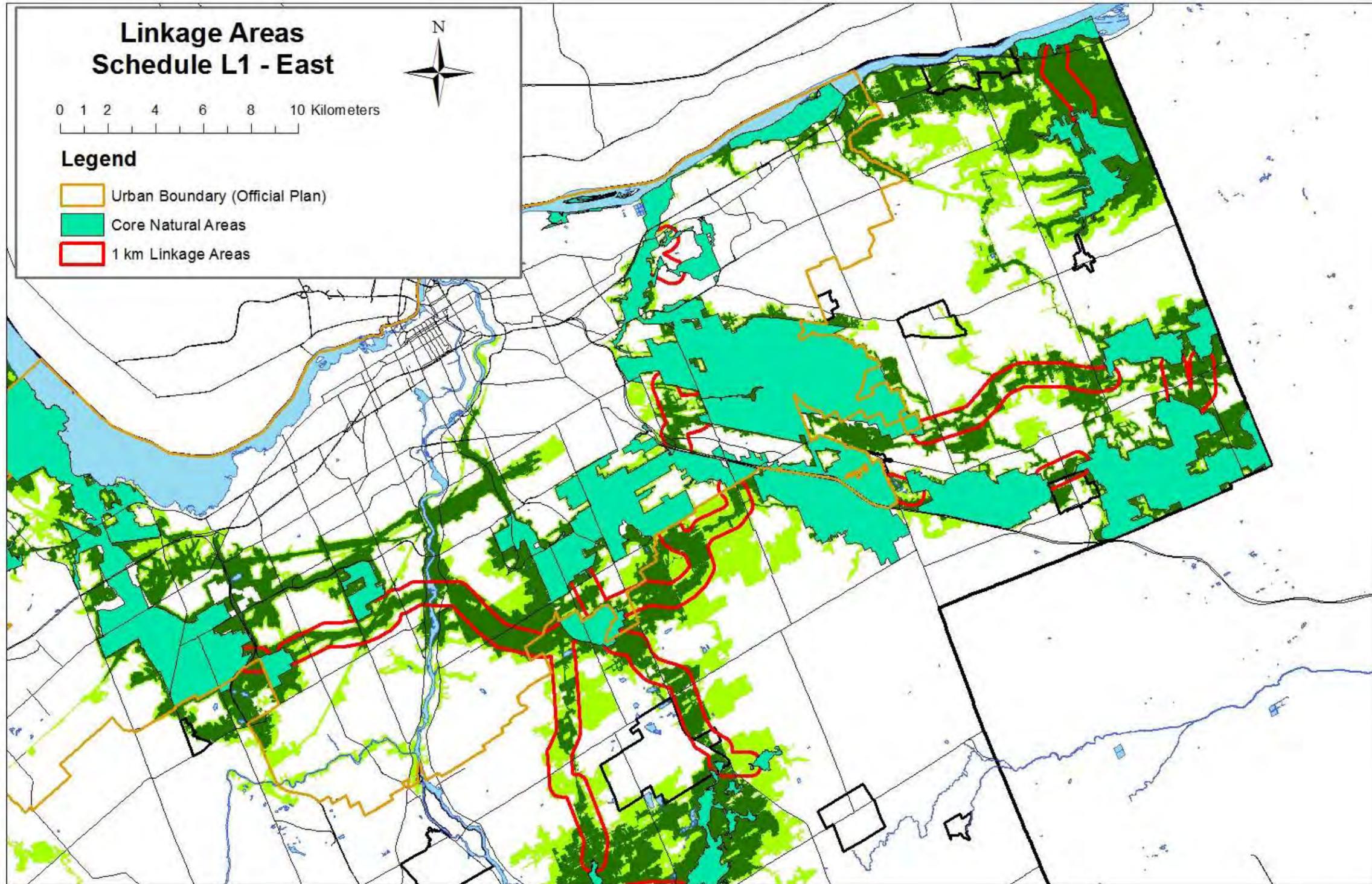


Figure 6a: Recommended Natural Landscape Linkage Network for Area of Schedule L1 – East

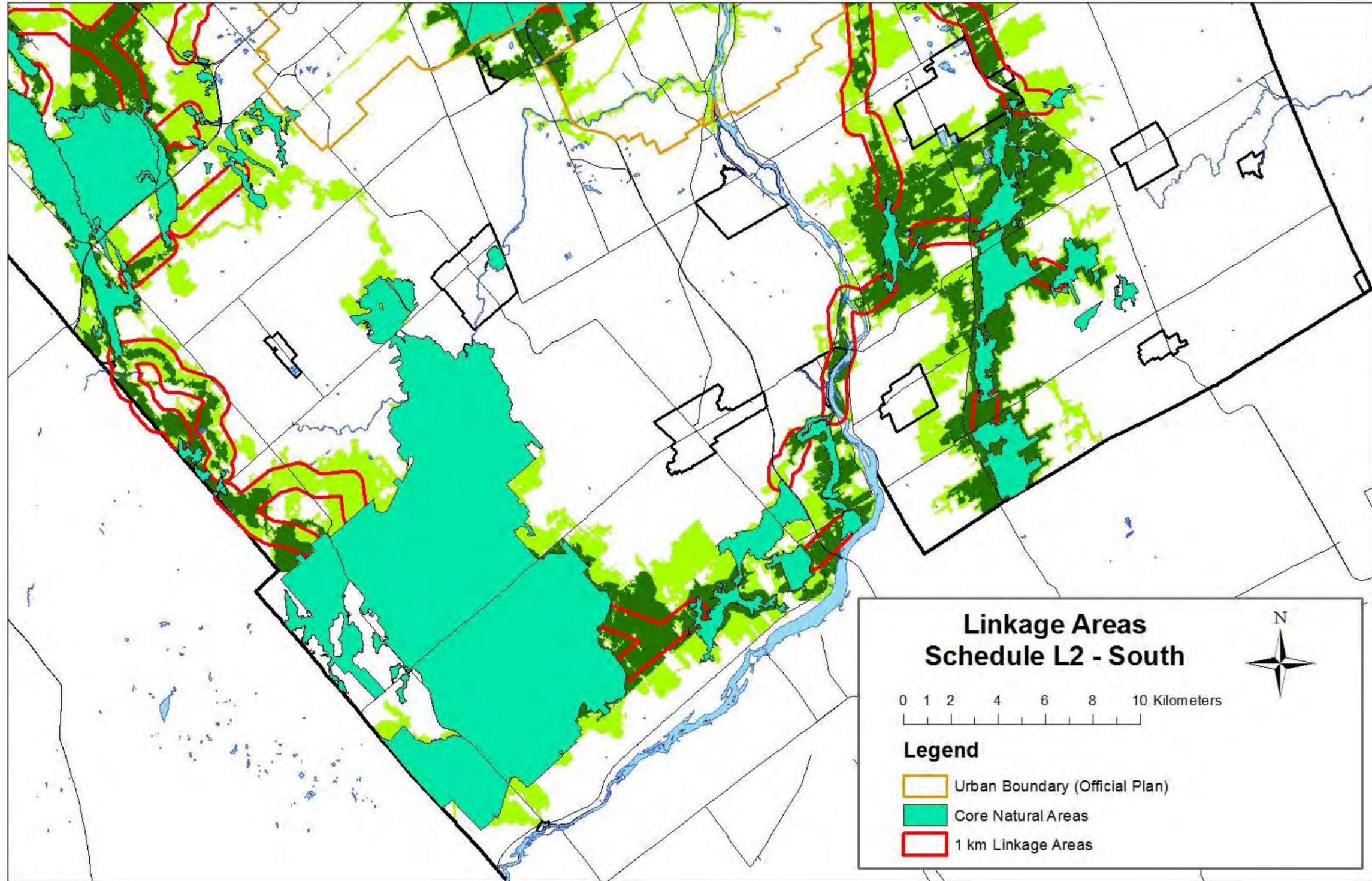


Figure 6b: Recommended Natural Landscape Linkage Network for Area of Schedule L2 – South

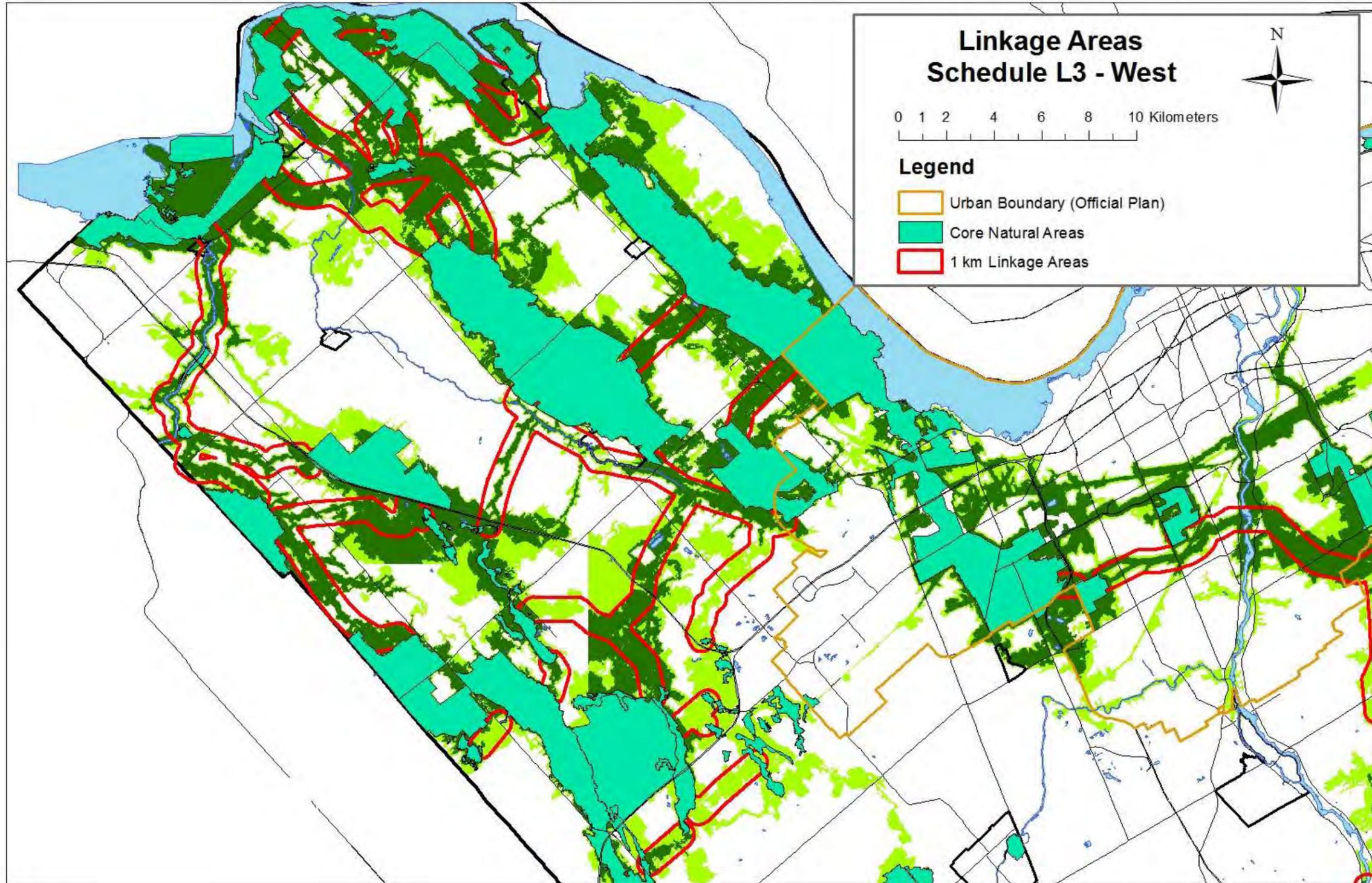


Figure 6c: Recommended Natural Landscape Linkage Network for Area of Schedule L3 – West

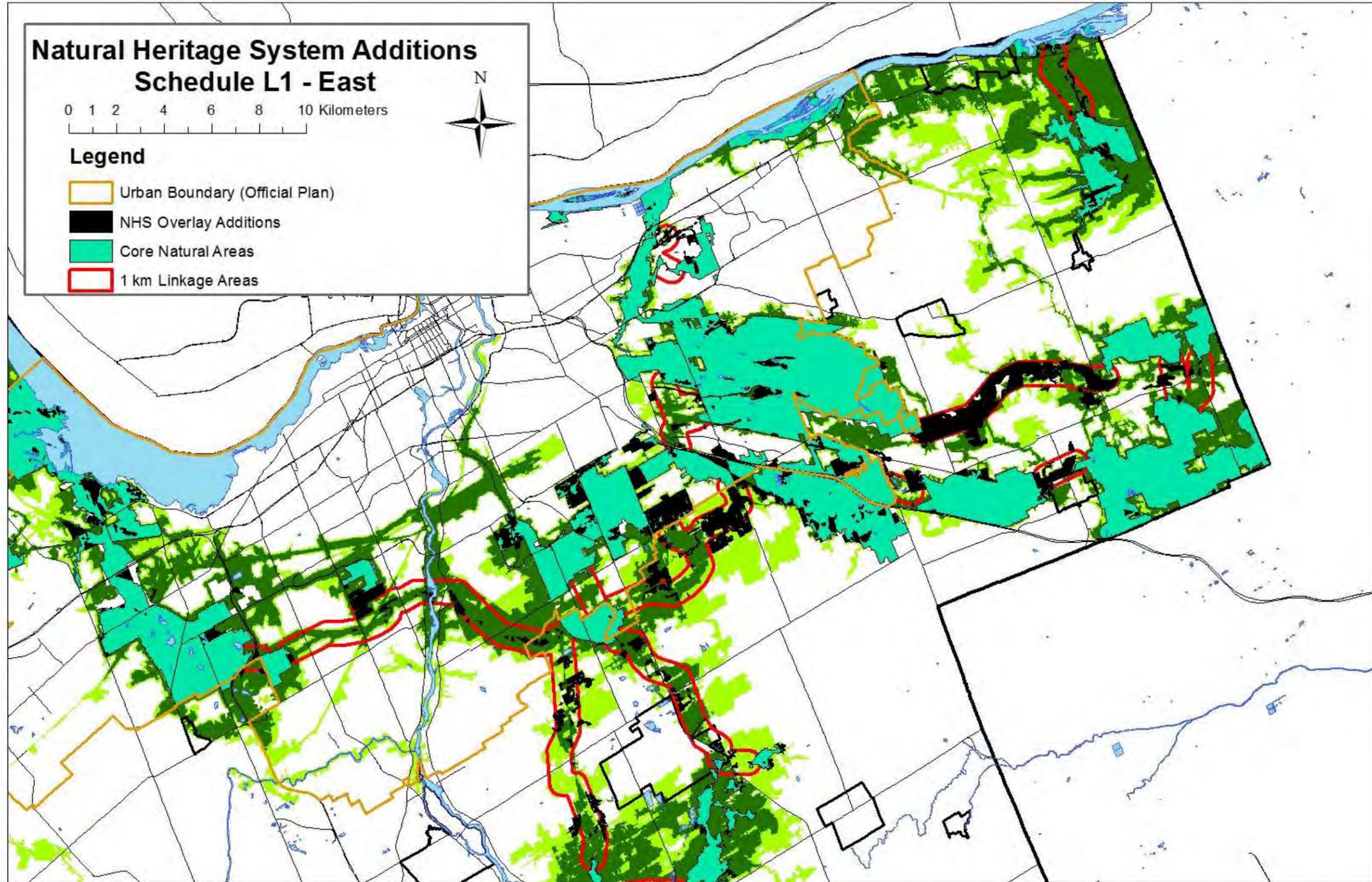


Figure 7a: Recommended Additions to the Natural Heritage System Overlay for Area of Schedule L1 – East

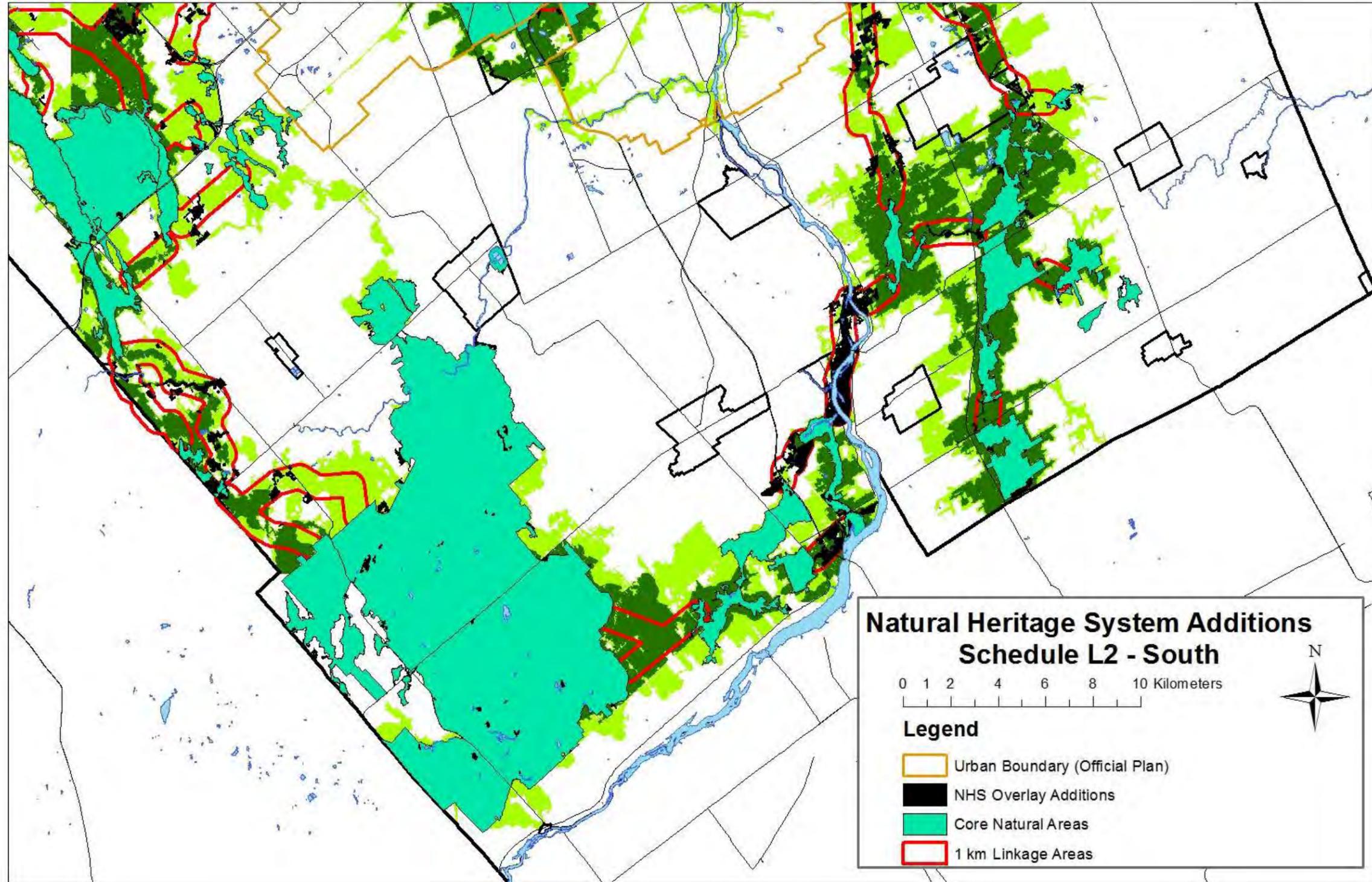


Figure 7b: Recommended Additions to the Natural Heritage System Overlay for Area of Schedule L2 – South

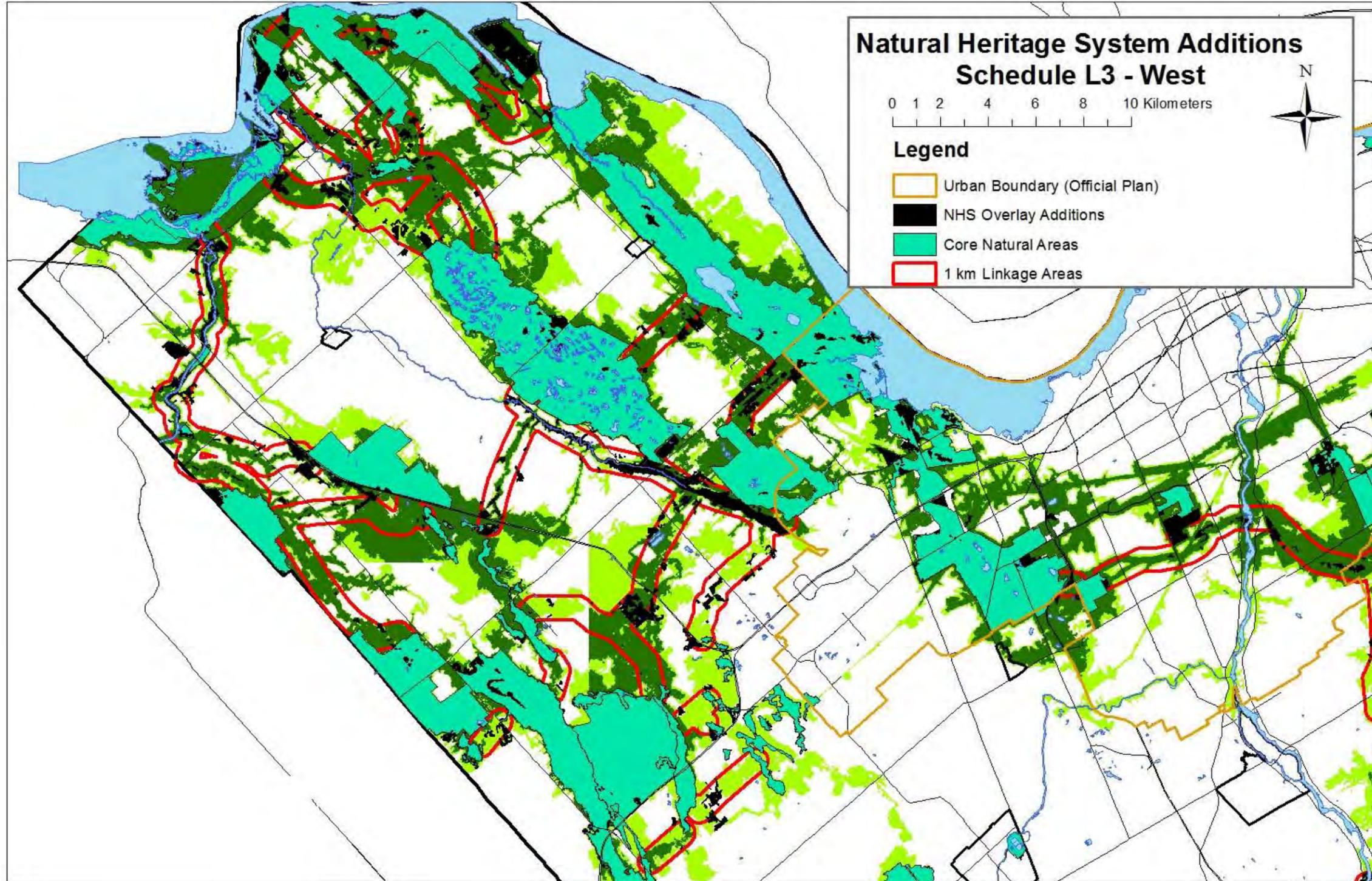


Figure 7b: Recommended Additions to the Natural Heritage System Overlay for Area of Schedule L3 - West