Generating Multiple Scale Model for the Cadastral Map using Polygon Generalization Methodology

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Contents

Introduction

Needs for the study

- Few studies on automatic generation of multi-scale spatial database for cadastral map
- Cadastral map is a kind of polygon dataset like puzzle
  → Different methodology from topographic map generalization

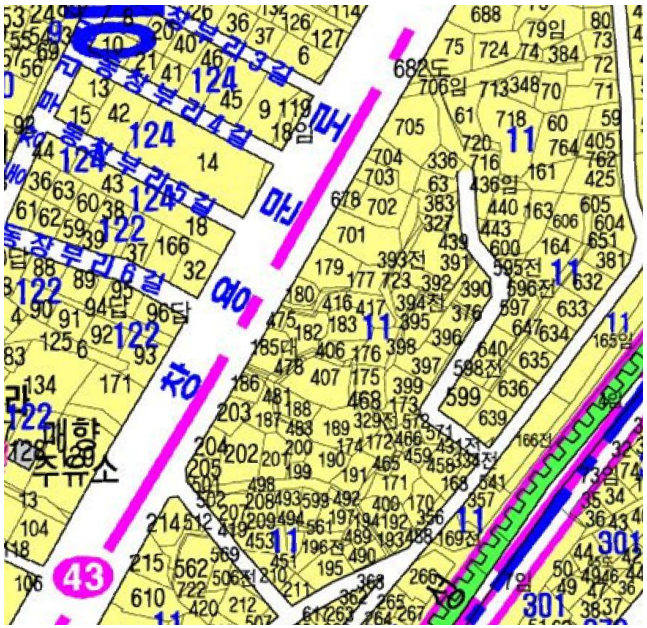
<Korean Cadastral Map>

Introduction

Needs for the study

- Shapes of parcel polygons are not refined and irregular (Cha, et al., 2009)
- Shape and land use attributes of parcel polygon has inconsistency with real world (Shin, et al., 2006)
- → Difficult to generalize cadastral map using by itself

<Cadastral map>



<Manually edited version of cadastral map>

<Aerial photo>

Introduction

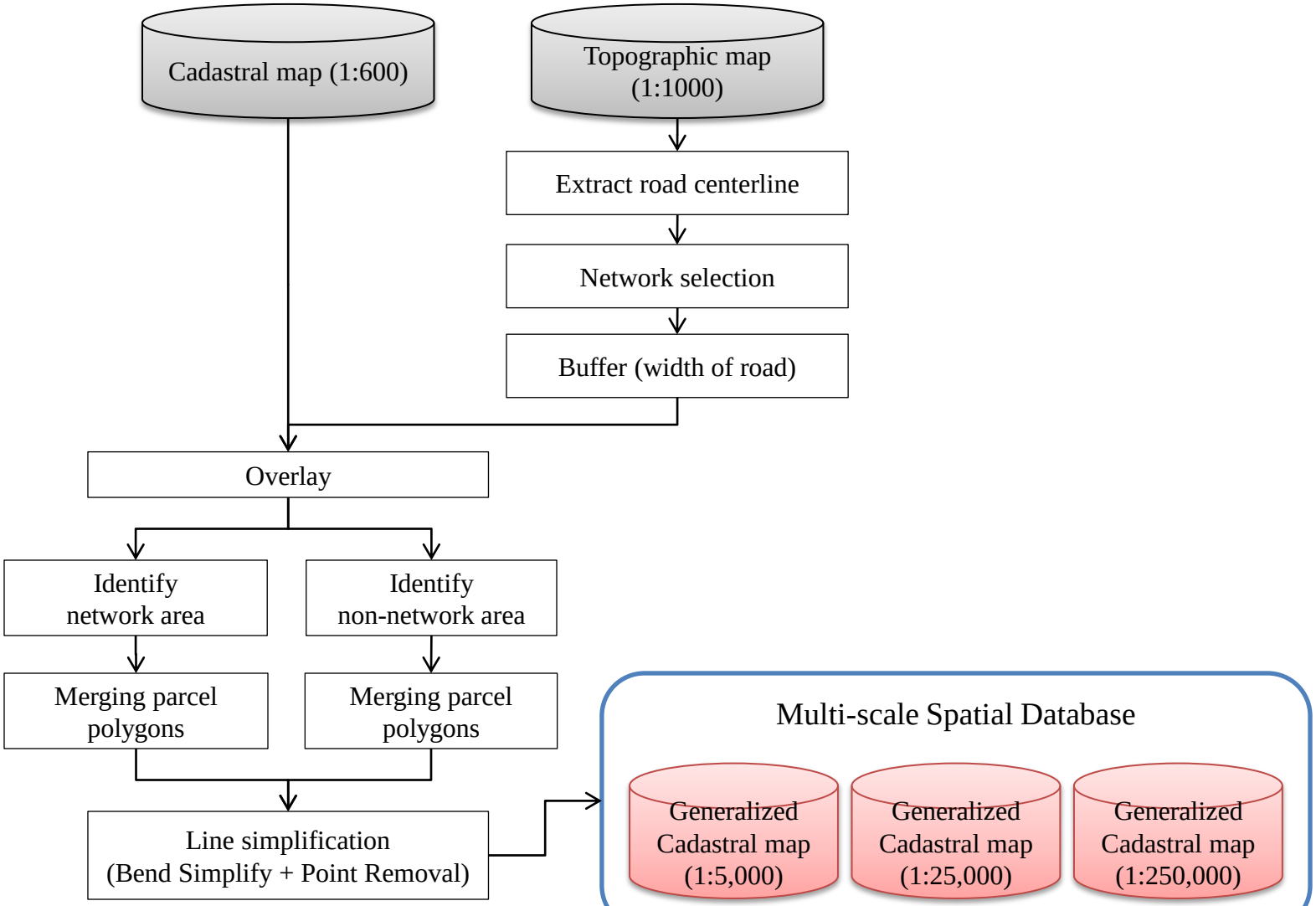
Objectives

- Providing the public with cadastral map data in internet or mobile service
- Enhancing the legibility and service efficiency of cadastral map
- Generating a multi-scale model of cadastral map by polygon map generalization

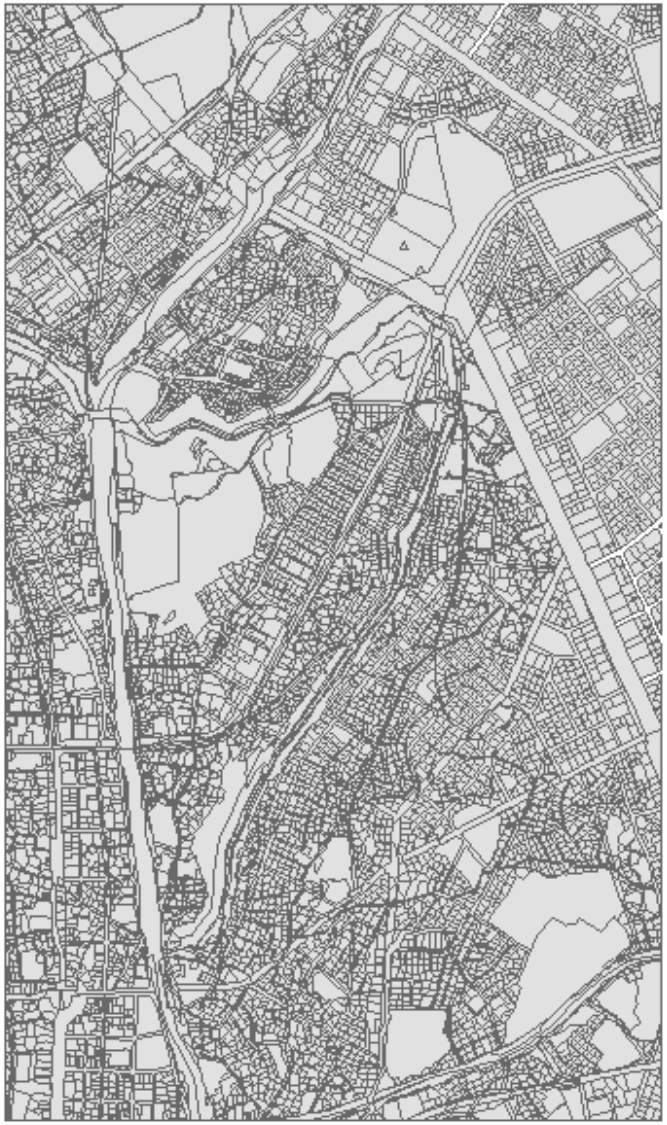
Methodology

- Merging and reclassifying parcel polygon set considering geometric, topological, and thematic attributes
- Overlaying road network data of topographic map to use as a auxiliary
- Applying line simplification algorithms to eliminate the unnecessary bendings and superfluous vertices

Flow Diagram



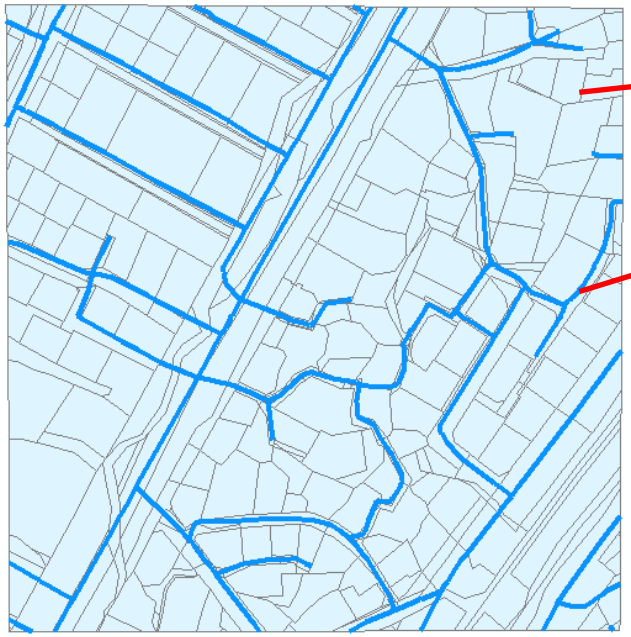
Input data



<Cadastral map>

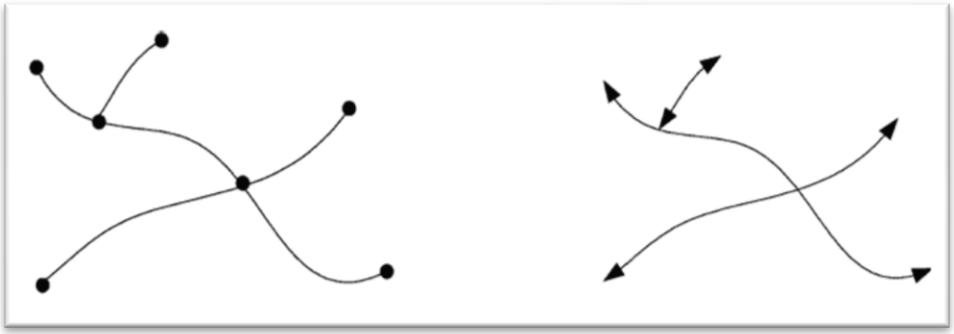
<Road network data>

Reconstruction of Road Network



Parcel lines

Road centerline



<Concept of the 'stroke' (Thomson and Richardson, 1999)>

- Reconstruct road network data using 'Stroke' concept and considering geometric, topological and thematic attributes
- If two adjacent road segment have a deflection angle less than 15˚ and similar width and attributes, they are imposed a one stroke id.
- Calculate four properties: The average road width, length of stroke, degree of stroke, mode value of road class

Reconstruction of Road Network

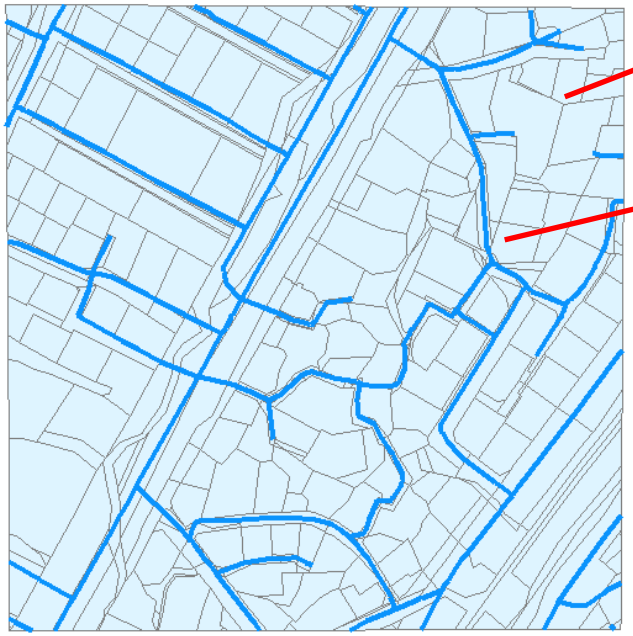
- **Selection of network data in accordance with the scale level using Töpfer's radical law**
- **As criteria of selection, Importance Index(II) is calculated for each stroke**
- **II is weighted sum of standardized attributes (stroke degree, stroke length, average width, class**

$$II = c_1 \times \frac{[strk\_deg]}{\max(strk\_deg)} + c_2 \times \frac{[strk\_leng]}{\max(strk\_leng)} + c_3 \times \frac{[width]}{\max(width)} + c_4 \times \frac{[class]}{\max(class)}$$

Töpfer's radical law : $l_f = l_a \times \sqrt{M_a / M_f}$:

Merging parcel polygons

<separation of parcel polygons>



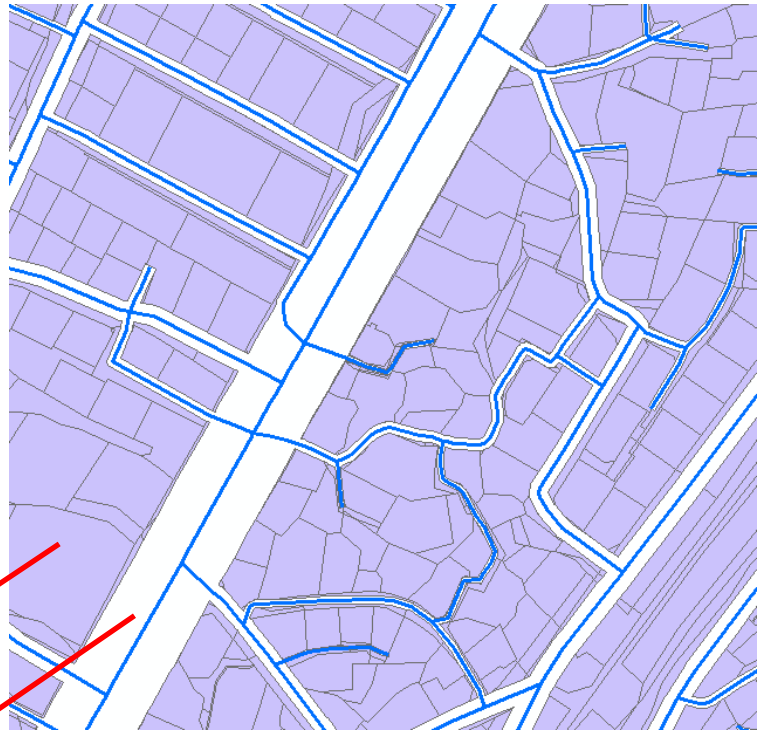
Parcel lines in cadastral map

Road centerline

Buffering and Clipping

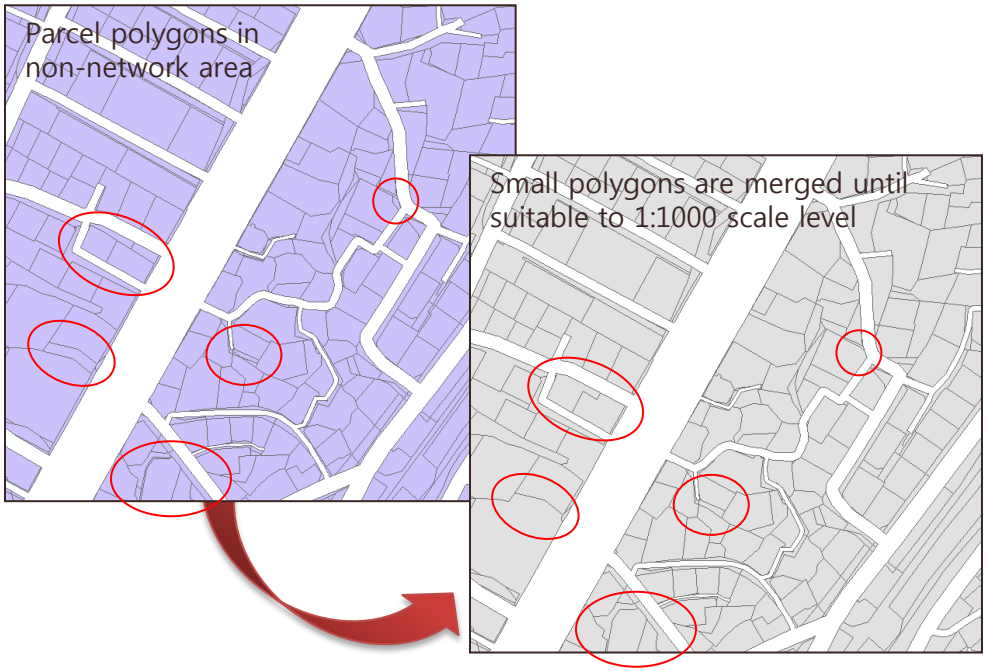
Non-network area (block)

Network area



- **Selected network data for each scale level is overlaid on the cadastral map**
- **The Network data is buffered with the average width attributes**
- **Areas in cadastral map overlaid with buffered network data are clipped (Network area)**
- **Areas not clipped are assigned as non-network area**

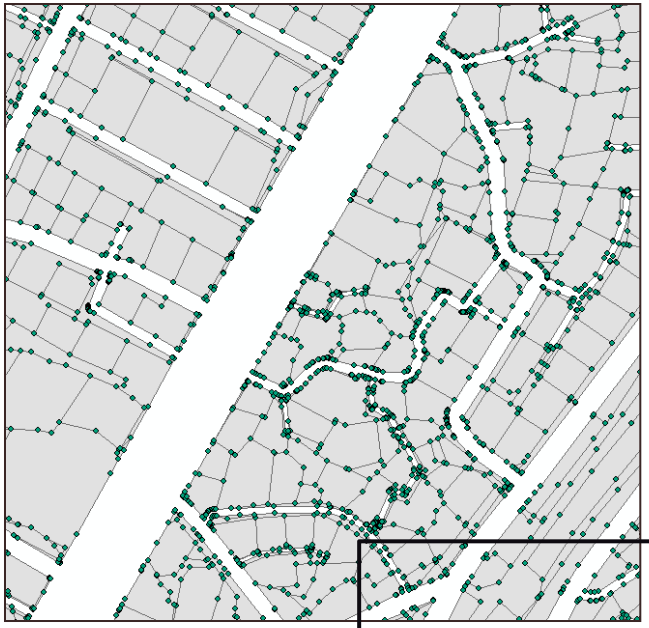
Merging parcel polygons



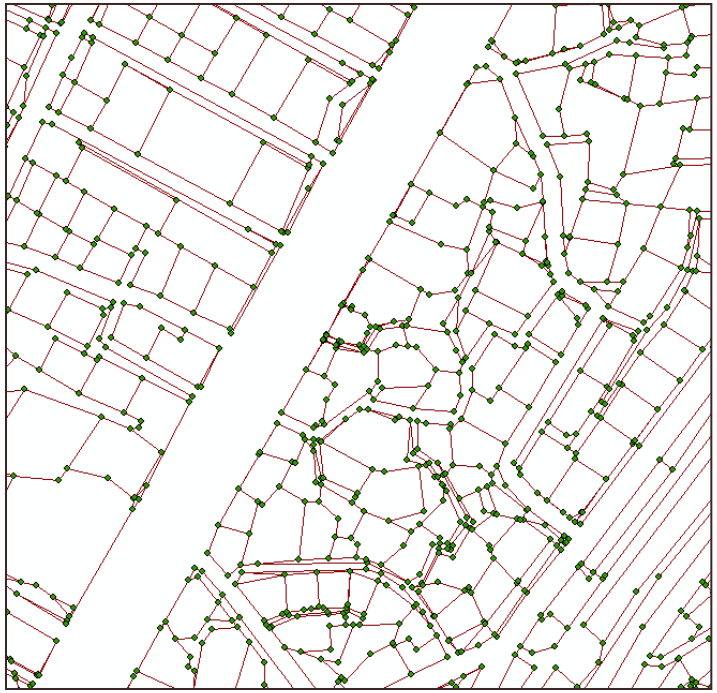
Töpfer's radical law : $l_f = l_a \times \sqrt{M_a / M_f}$:

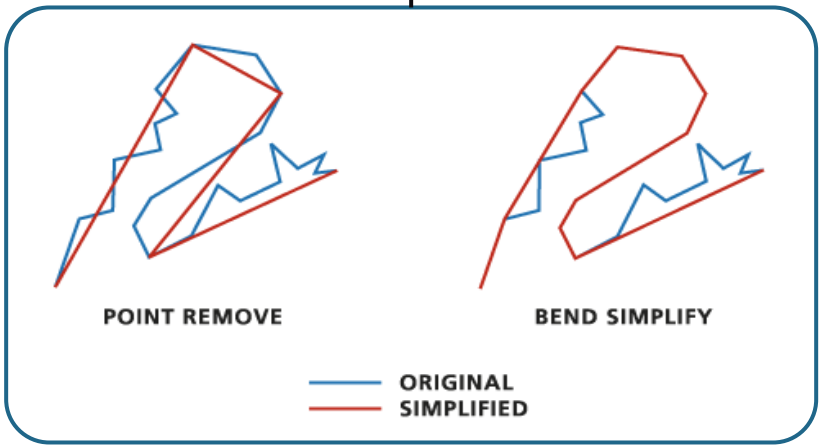
- **Parcel polygons with small area are merged to the adjacent and with same land cover**
- **Polygons are merged successively and iteratively until the number of left polygons satisfies the Töpfer's law**

Line Simplification



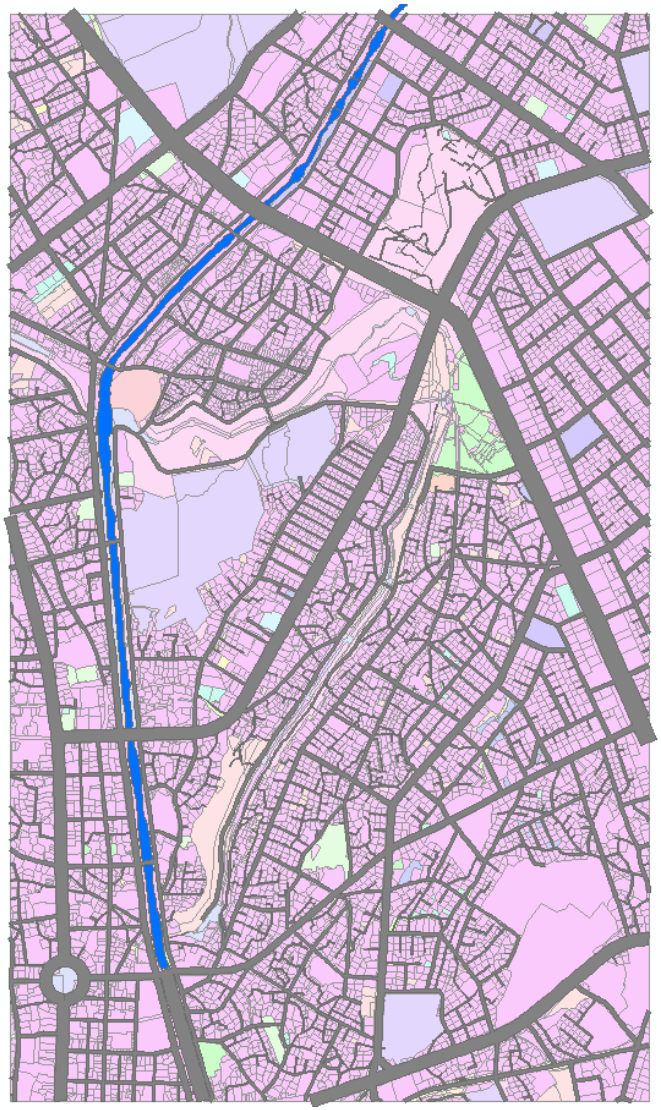
Line simplification





- Unnecessary bendings and vertices are removed using line simplification algorithm
- Bend simplify and Point Remove algorithm are applied successively
- Legibility is enhanced and the amount of data is reduces

Result of Generalization



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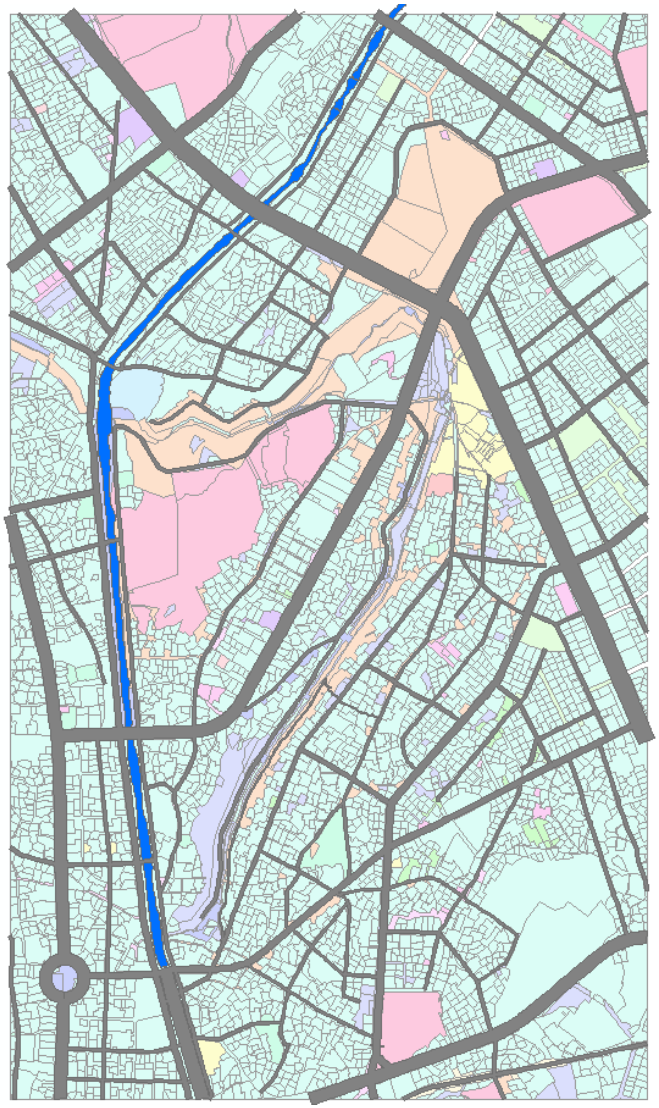

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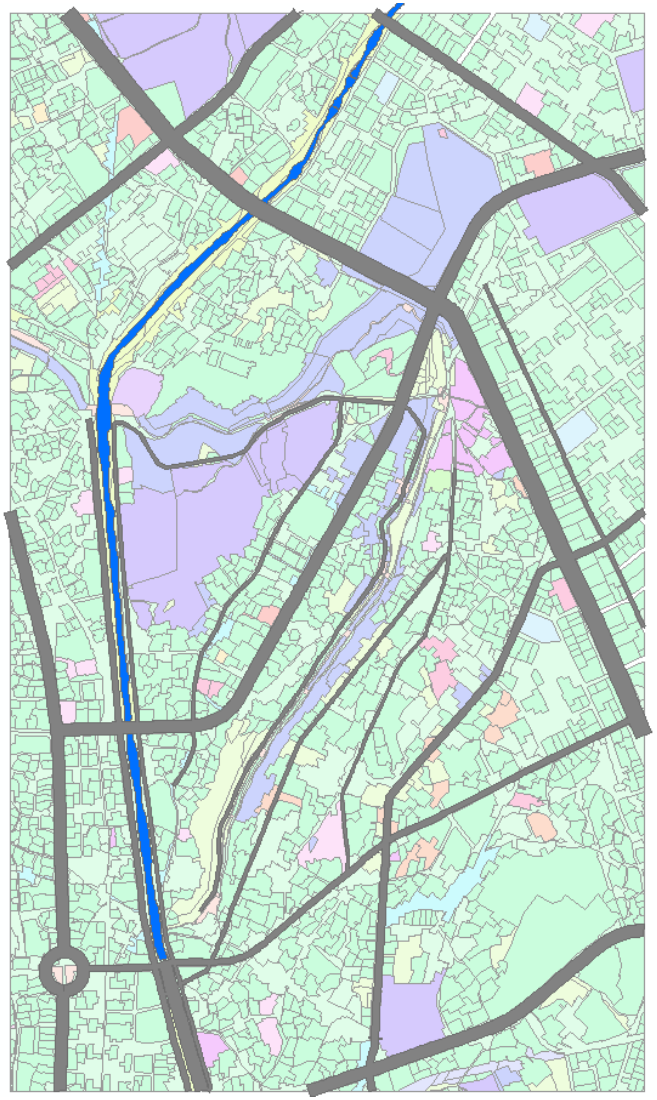
Result of Generalization (2)



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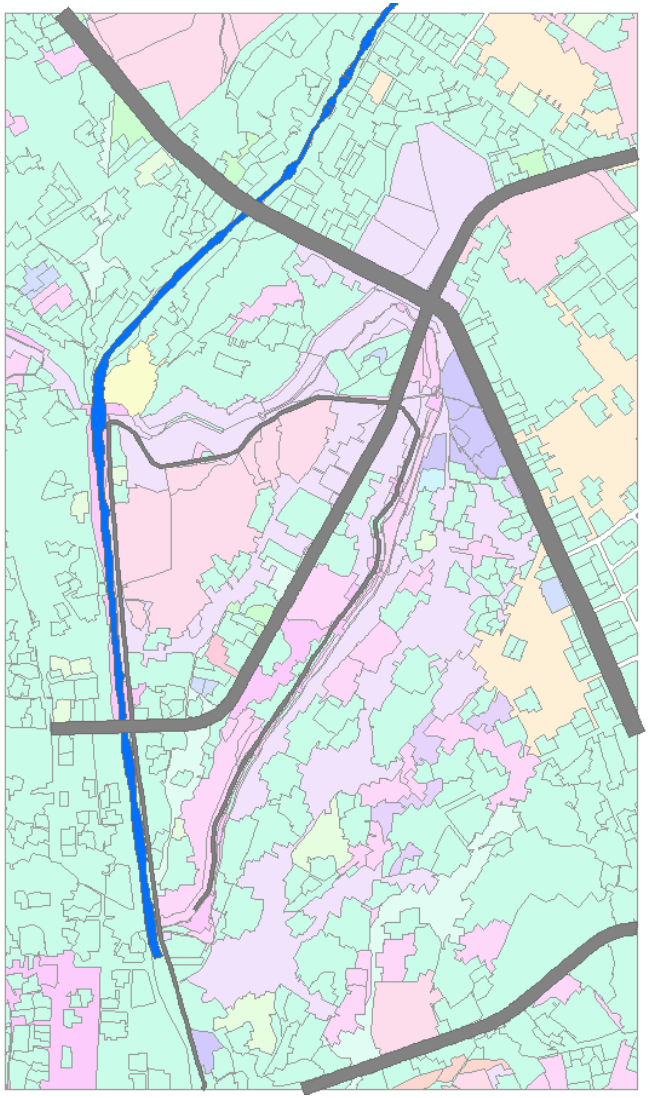

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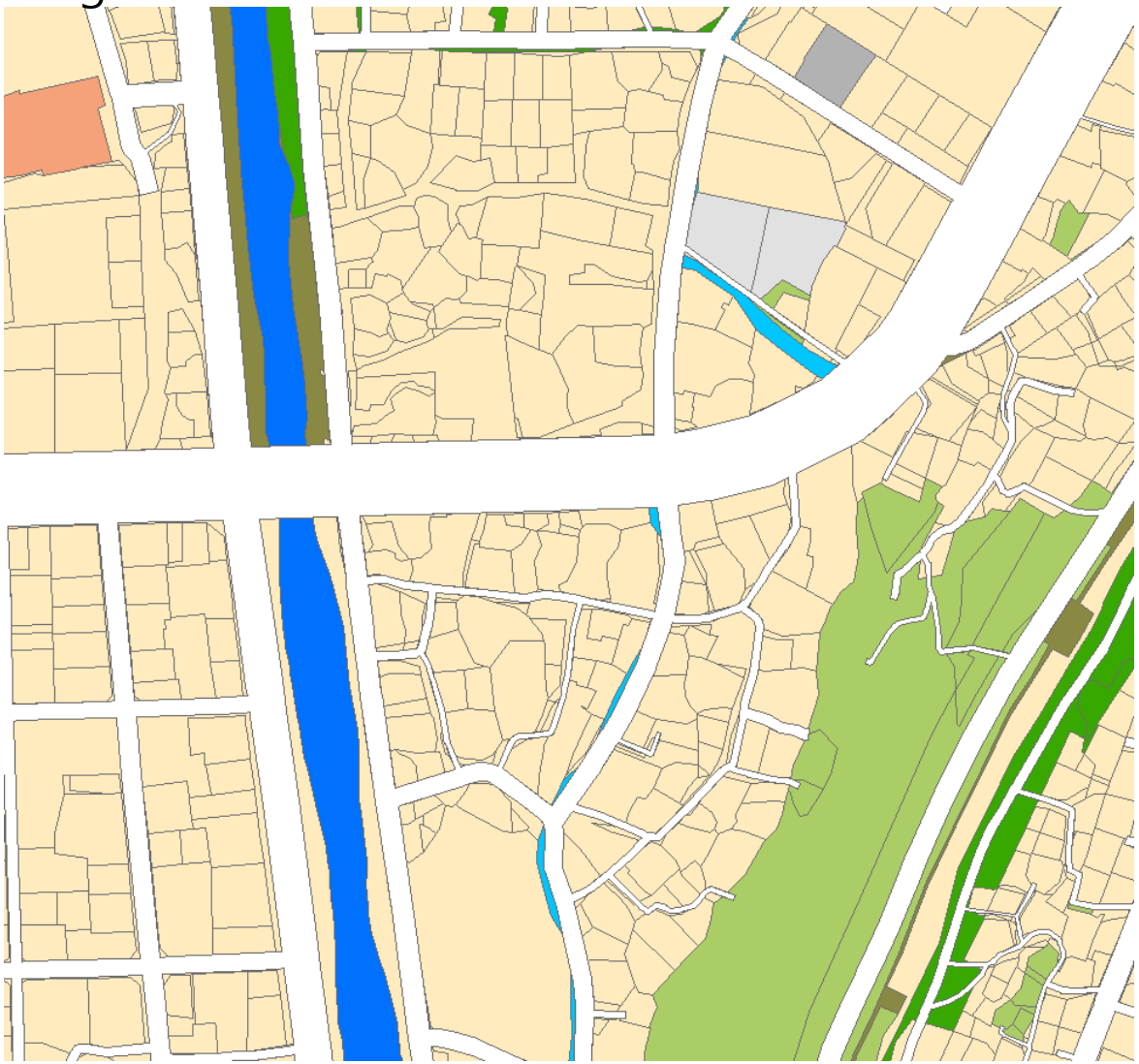
Result of Generalization (3)

<Zooming in>

<1:25,000>

Result of Generalization (4)

<Zooming in>



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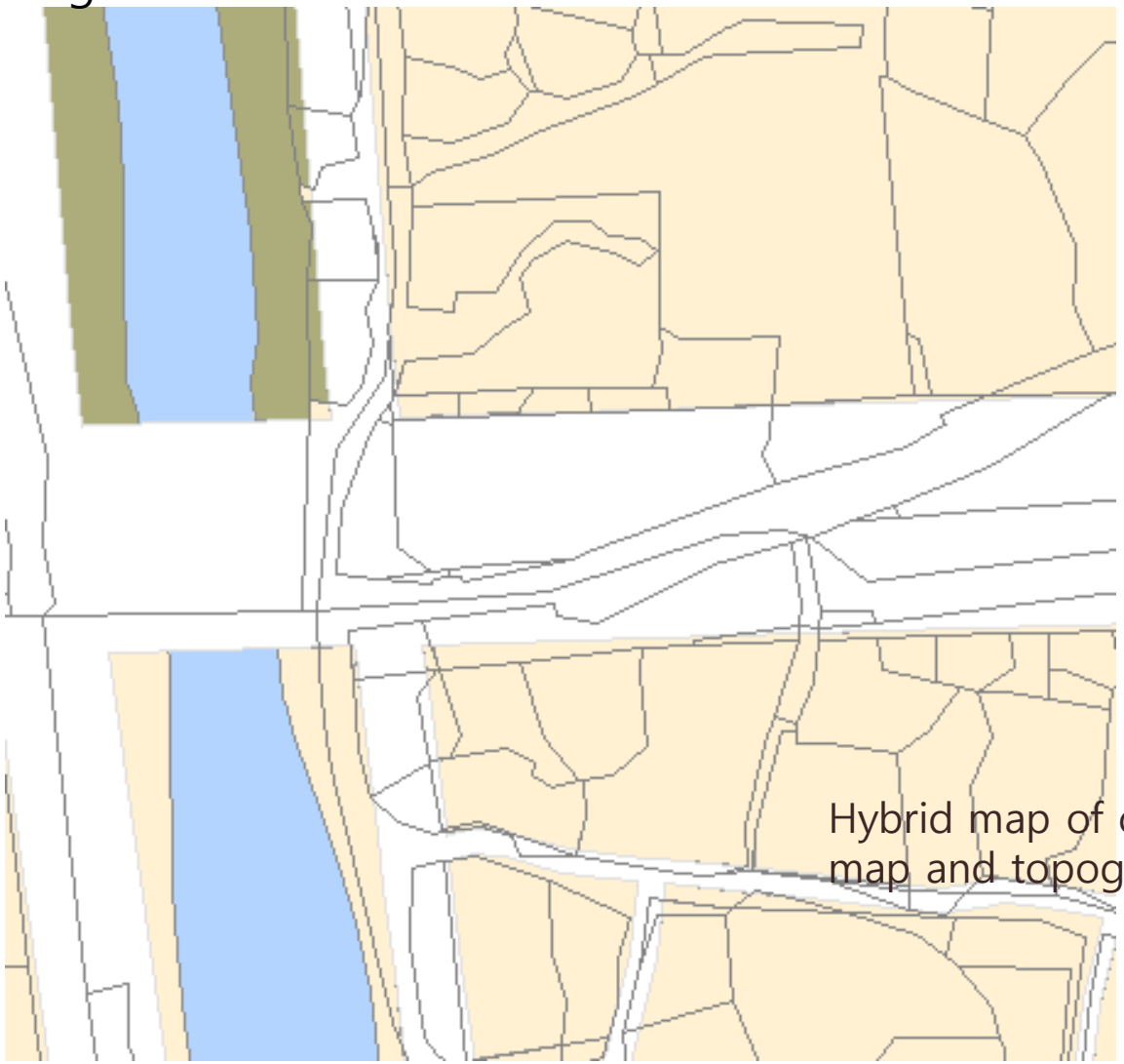
Result of Generalization (5)

<Zooming in>



Hybrid map of cadastral map and topographic map

<1:1,000>

Conclusions

1. The automatic merging methodology of parcel polygons in cadastral map for generating multiple scale model is examined
2. As criteria for merging the parcel polygon, road network data is used to consider the geometric, topological and thematic attributes of each polygon
3. Network data is generalized for several scale level using stroke concept and importance index
4. The parcel polygons are separated into network area and non-network area and merged in accordance with each scale level
5. Merged parcel lines are simplified by line simplification algorithms (‘point remove’ and ‘bend simplify’)

THANK YOU