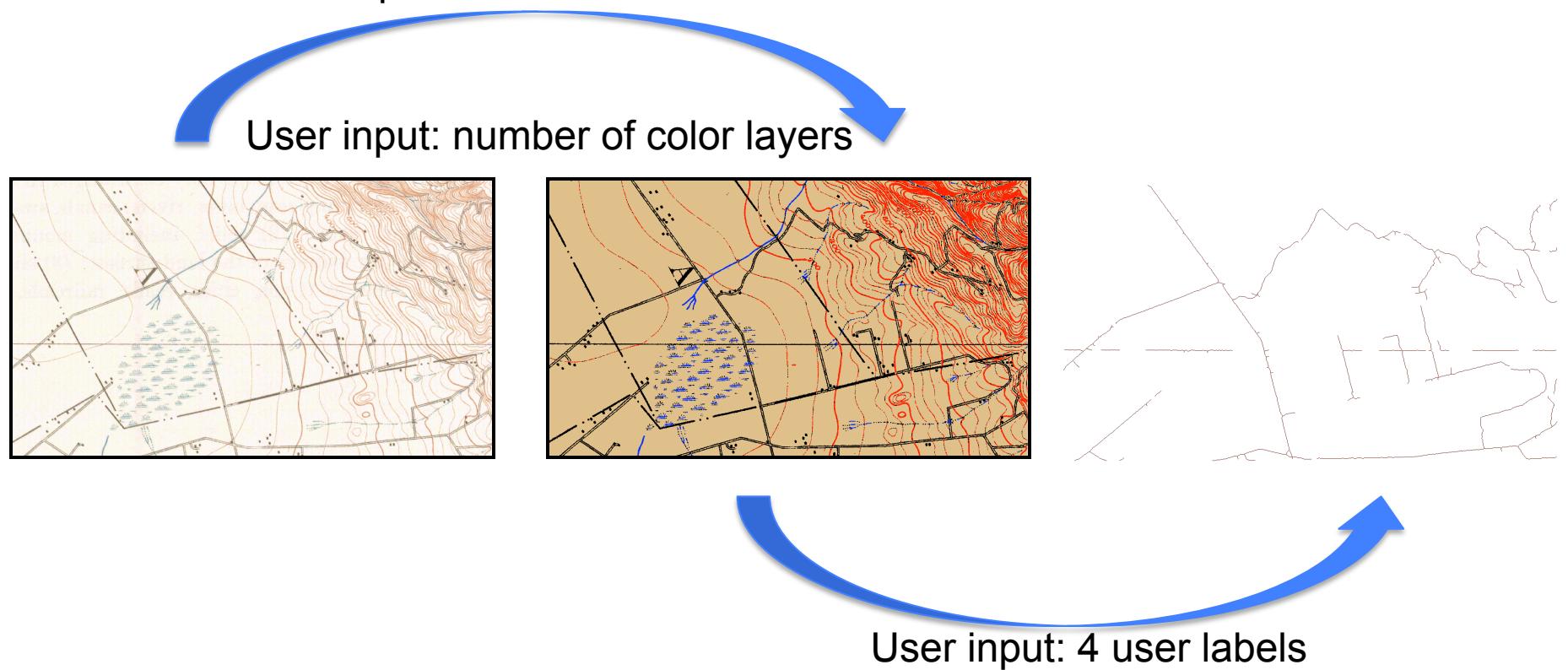


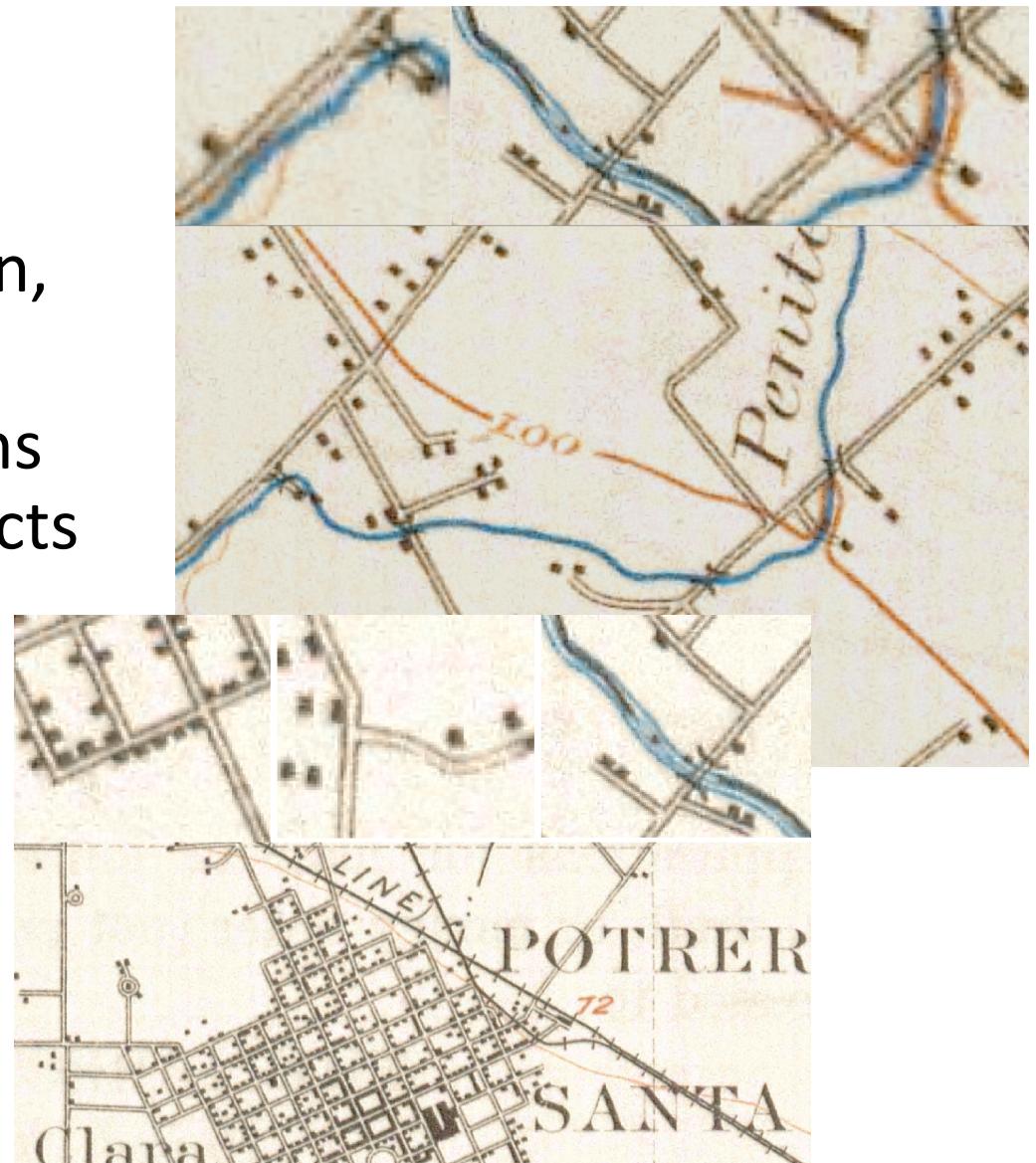
# Integrating Color Image Segmentation and User Labeling for Efficient and Robust Graphics Recognition from Historical Maps

Summary: the integration of a Color Image Segmentation (CIS) step with an interactive road-layer extraction process that consists of an image cleaning and a vectorization step.



# Historic USGS Topographic Maps

- National map series (1895-1945): buildings, roads, railways, elevation, hydro, wetlands, text
- Imperfect quality of scans of archived paper products
- Map objects in different colors

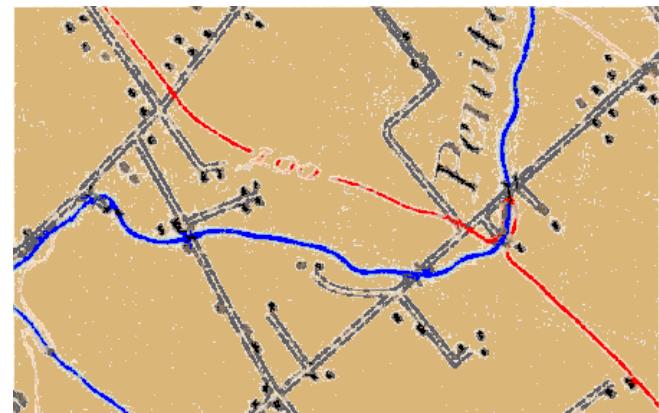


# Color Image Segmentation

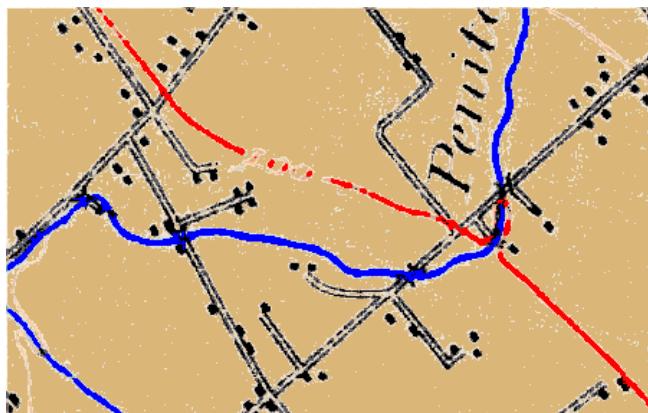
Determining initial color seeds  
using global color layer prototypes



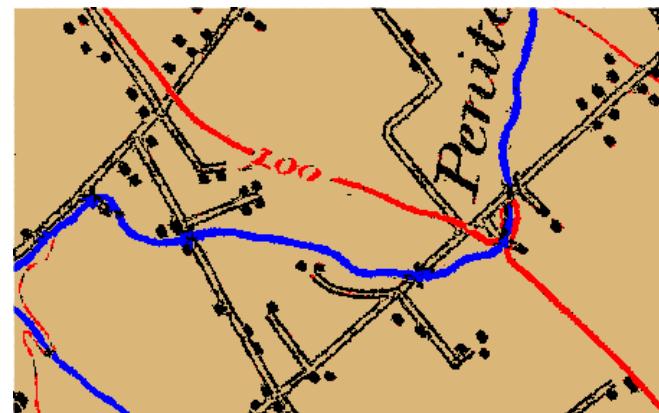
Identifying homogeneous regions  
(plane) of different color layers



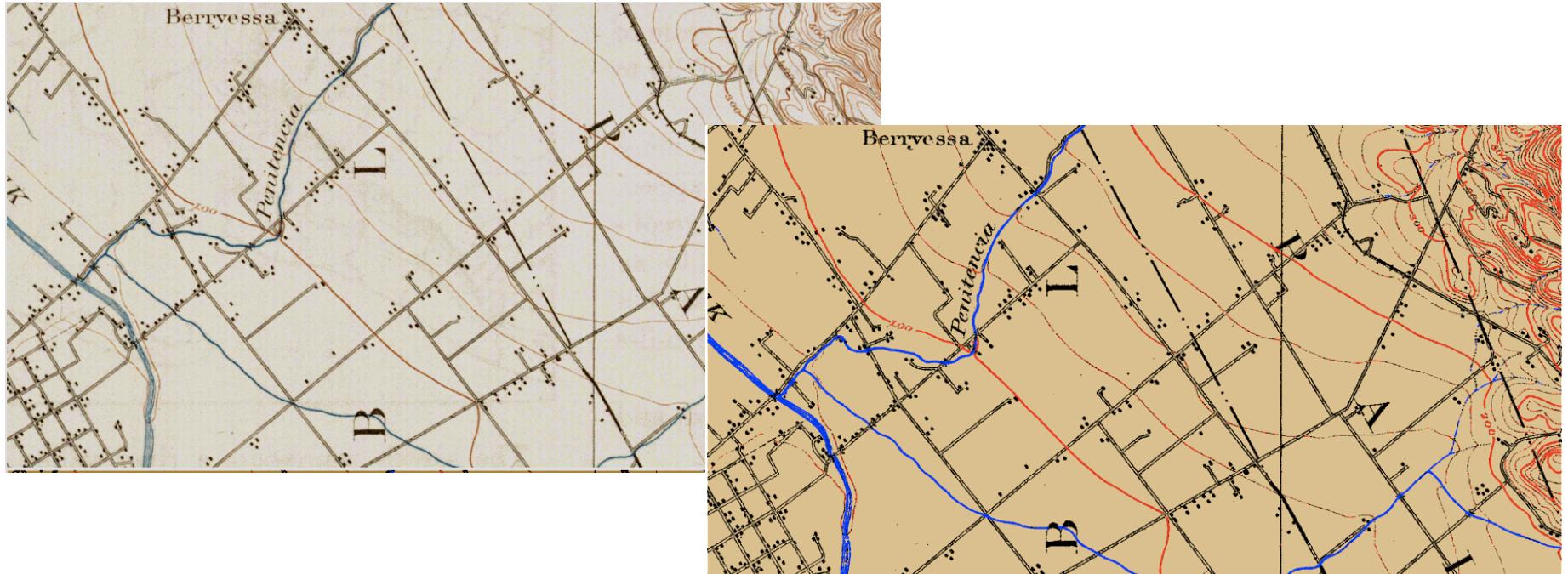
Prototype adjustment: Local color sampling  
along margins of homogeneous areas



Final segmentation using constrained  
region growing and connectivity tests

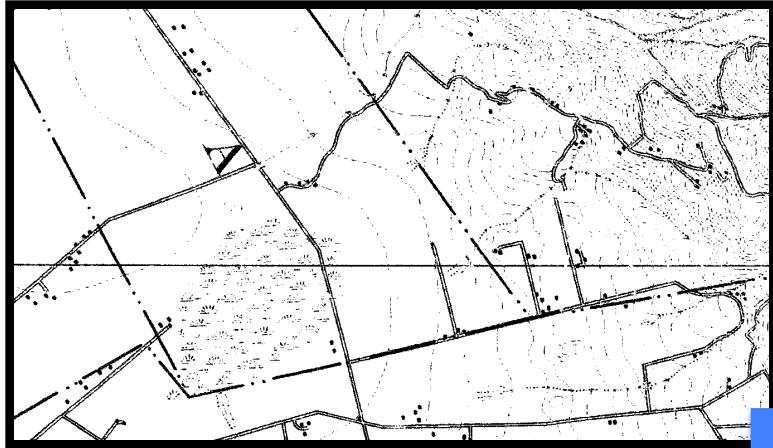


# CIS Results in Low-Quality Maps

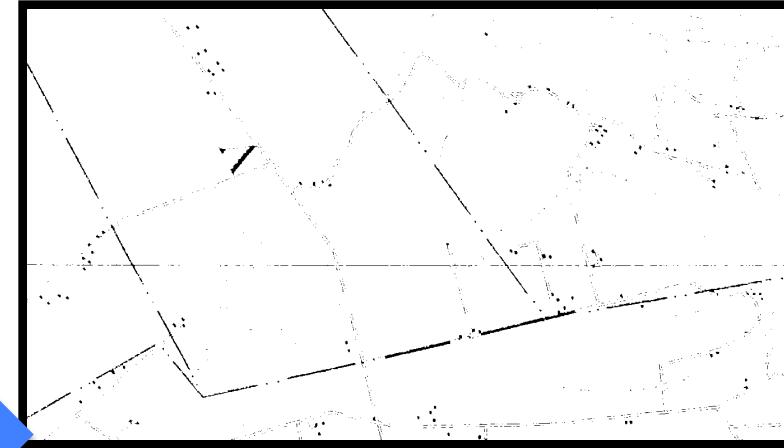


- Successful and robust separation of color layers
- Only input parameters: map layer color extremes (Red: 255,0,0 in RGB color space)
- Limitations: Remaining merging effects (dense elevation contours and roads), and mixed colors at intersections
- Rigid performance test: “Raw and unrepaired” segmentation as input to cleaning and the road vectorization

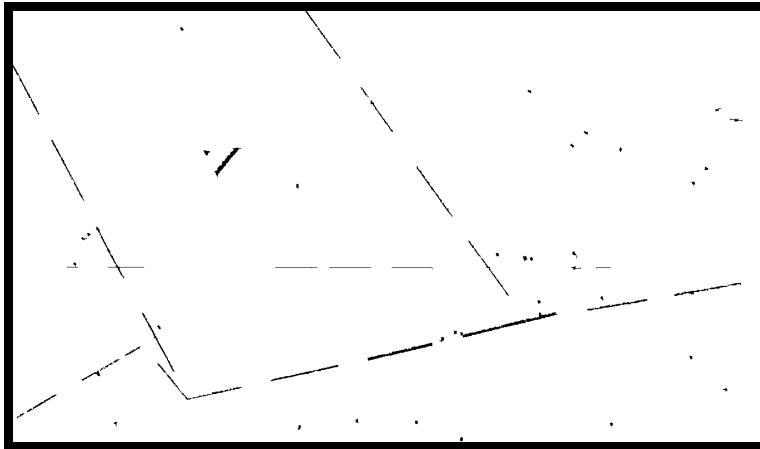
# Interactive Cleaning



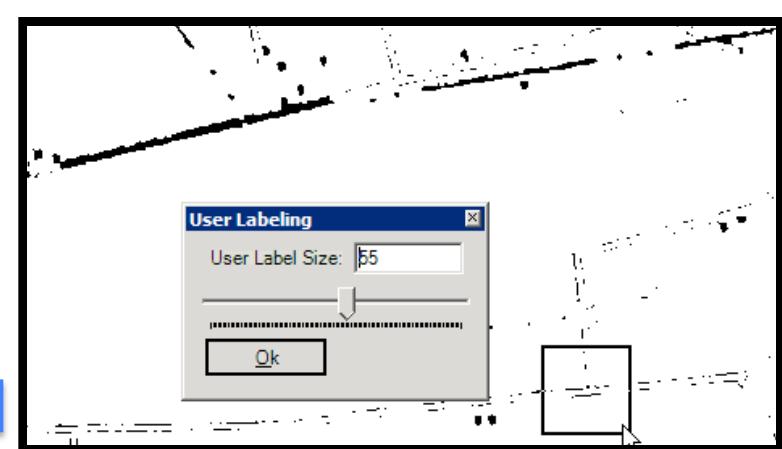
Input for the cleaning process



Erosion operator to remove most road pixels

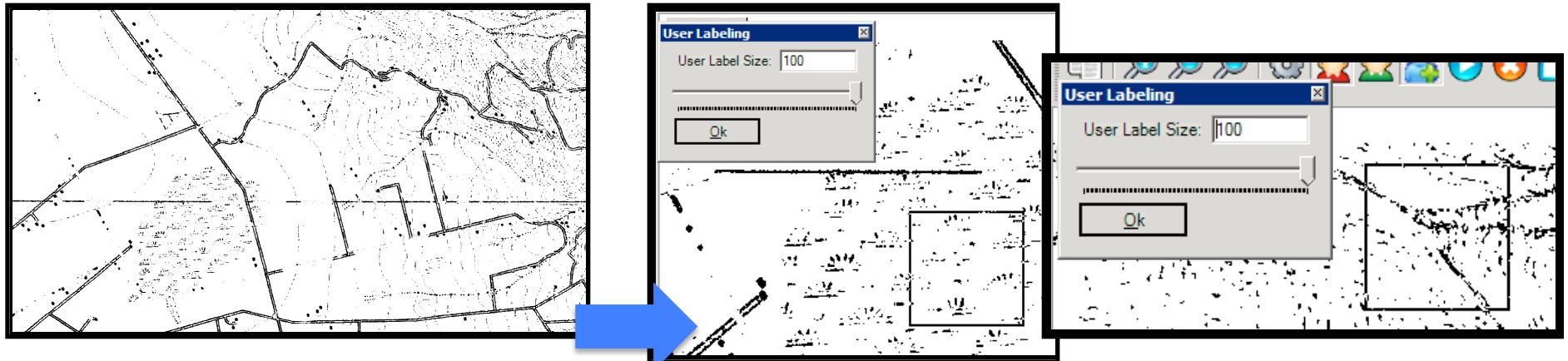


Large noise objects i.e., thicker than road lines



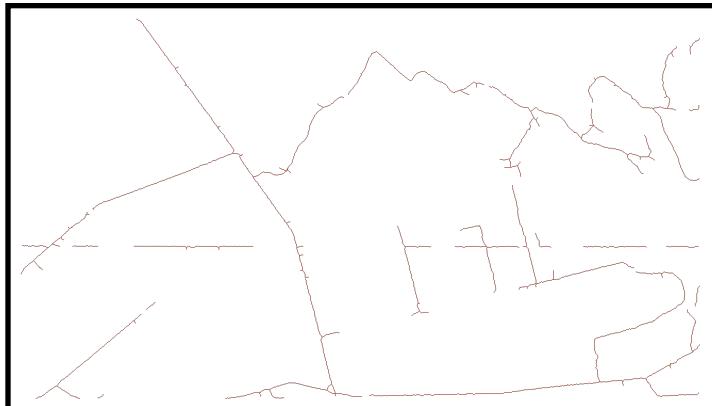
User provides examples of remaining road pixels

# Interactive Cleaning (Cont'd)

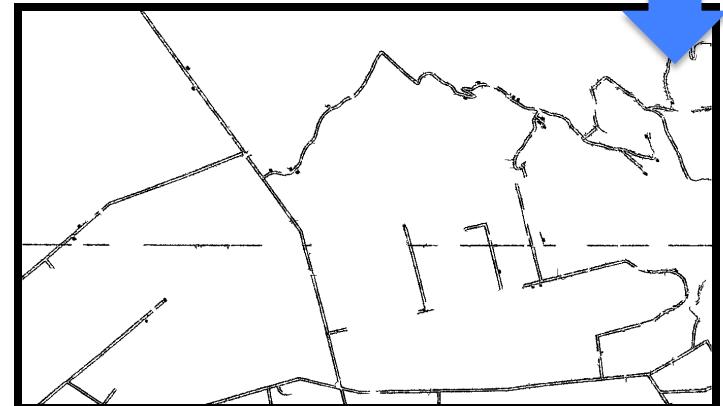


Large noise objects are removed

User provides examples of small noise objects



Raw road vectorization results



Cleaning result: noise objects are removed