A Method for Identifying Road Segments with High Potential for Aqueous Pollution Transport in the Willamette River Watershed Within the City of Portland

Introduction

Roads in urban areas concentrate the flow of water within the road prism which can lead to an increase in aqueous pollutant transport On the road surface, oil, gas and other byproducts of the combustion from car engines accumulate. Pollutants may also come to the roads from adjacent sources such agricultural or industrial land uses (Krein et al., 2000). In this study we attempt to map flow paths on the road surface by creating a linkage of segments that have varying levels of impact based upon the length and slope of the flow path. Segments with highest gradient and the longest distance to a drainage point are considered to be the most capable of transporting pollutants due to the increase in "stream" power associated with these variables. The final map will be useful for environmental planners looking for areas to focus on for future stormwater or bioswale improvement projects.

Methods

For our analysis, we used shapefiles obtained from B.E.S. (Bureau of Environmental Services), RLIS (Regional Land Information System). A polygon of the street area was derived from a layer of impervious surface in the metro area. A 1-m DEM was used as the basis for analysis. Sewer inlet points were rasterized and then "burned" into the DEM with the "Con" tool,

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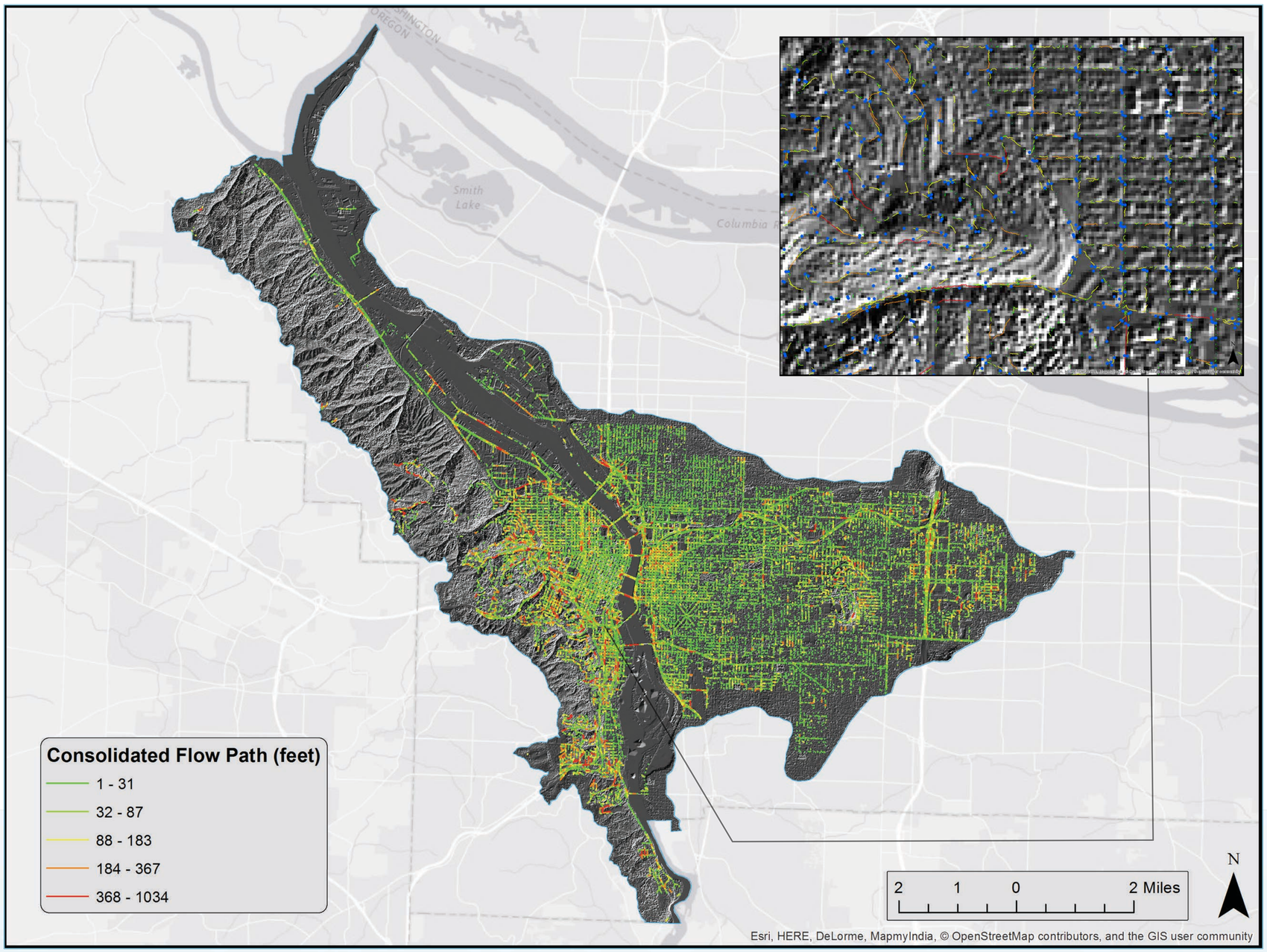
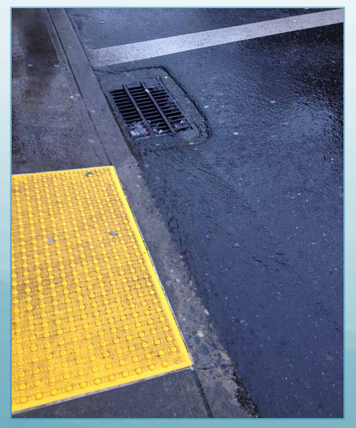
at a level of -100 feet below the DEM surface to provide points of drainage. The ArcMap hydrology toolset was used to derive overland flow characteristics on the road surface. A flow accumulation threshold of 100 was used to create a manageable dataset. These flow segments were turned into polyline features and segments on non municipal properties were removed.





Analysis

The slope of the road determines how well pollutants on the road surface will be transported and the distance between drainage points determines how long water flows before it leaves the surface of the road. The longer the flowpath, the greater the potential for the flowpath to accrue pollutants on the surface. Areas with high pollutant input potential, high road gradient and low drainage are the areas in which we are most concerned with locating.

Results

About 316 miles of potential flow paths were generated in the Willamette watershed. The average segment was 40.6 feet (standard deviation 60.2) and the longest was 1,562 feet. These new segments were then displayed over a map of the Portland area. The density of flowpaths in the study area made detailed analysis with the map somewhat difficult.

Our map details areas of the city where the longest uninterrupted flow paths occur. An analysis of the spatial distribution shows that the West Hills neighborhoods of Arlington Heights, Sylvan Heights and Goose Hollow have the highest density of higher pollutant transport potential streets due to steeper slopes, less developed road networks and fewer drainage inlets in those areas.

Discussion

With an increasing population in the Portland metropolitan area, there will most likely be an increase in traffic and road usage. These additional sources of pollution will put more pressure on the stormwater system and on the ecologies of our streams and rivers. This map and dataset could be used to identify segments of road which could be used in stormwater drainage improvement projects.

Further work could be done to add in factors such as specific traffic, road surface material and proximity to other likely pollutant sources.

This map and analysis were created by Dylan Esmond and Kyle Marenger