

# Investigation of the spatial components of surface runoff pollution in the Jamaica Bay Watershed

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**Abstract**

During rainfall, runoff may readily pick up debris and dissolve pollutants from urban surfaces, and deposit these into nearby bodies of water. Runoff contamination is especially likely in regions which have a significant amount of impervious surfaces ( $\geq 10\%$ ). The purpose of this study is to determine which areas source pollutants to Jamaica Bay, based on a geospatial analysis. It is found that the existing land use and land cover, puts the Jamaica Bay estuary at a high risk for water quality issues, and is likely to pose further challenges to the development of a healthy ecosystem there.

**I. Introduction**

Located predominately in Brooklyn and Queens, Jamaica Bay is a wildlife refuge, which is part of the Gateway National Recreation Area. Jamaica Bay is widely used for activities which include but are not limited to: boating, fishing, hiking, picnicking and bird watching [2]. Not only is Jamaica Bay one of the few natural resources currently available in NYC for such activities to take place, but it is the home to 91 species of fish, 325 bird species and many reptiles, mammals and amphibians [3]. For the past 150 years, the Bay has experienced tremendous amount of changes. One of these changes includes degraded water quality within the Bay due to waste water treatment plants, combined sewer outfalls and storm sewers [3]. The importance of restoring this bay will not only benefit the ecosystem, but it will benefit society since it is used for many human activities.

Figure 1 demonstrates some of the sources of nonpoint source pollutants, which include factories, buildings, and agricultural lands that enter a nearby body of water during a rainfall event. The focus of this study is to investigate pollutants that enter a water body due to surface runoff.

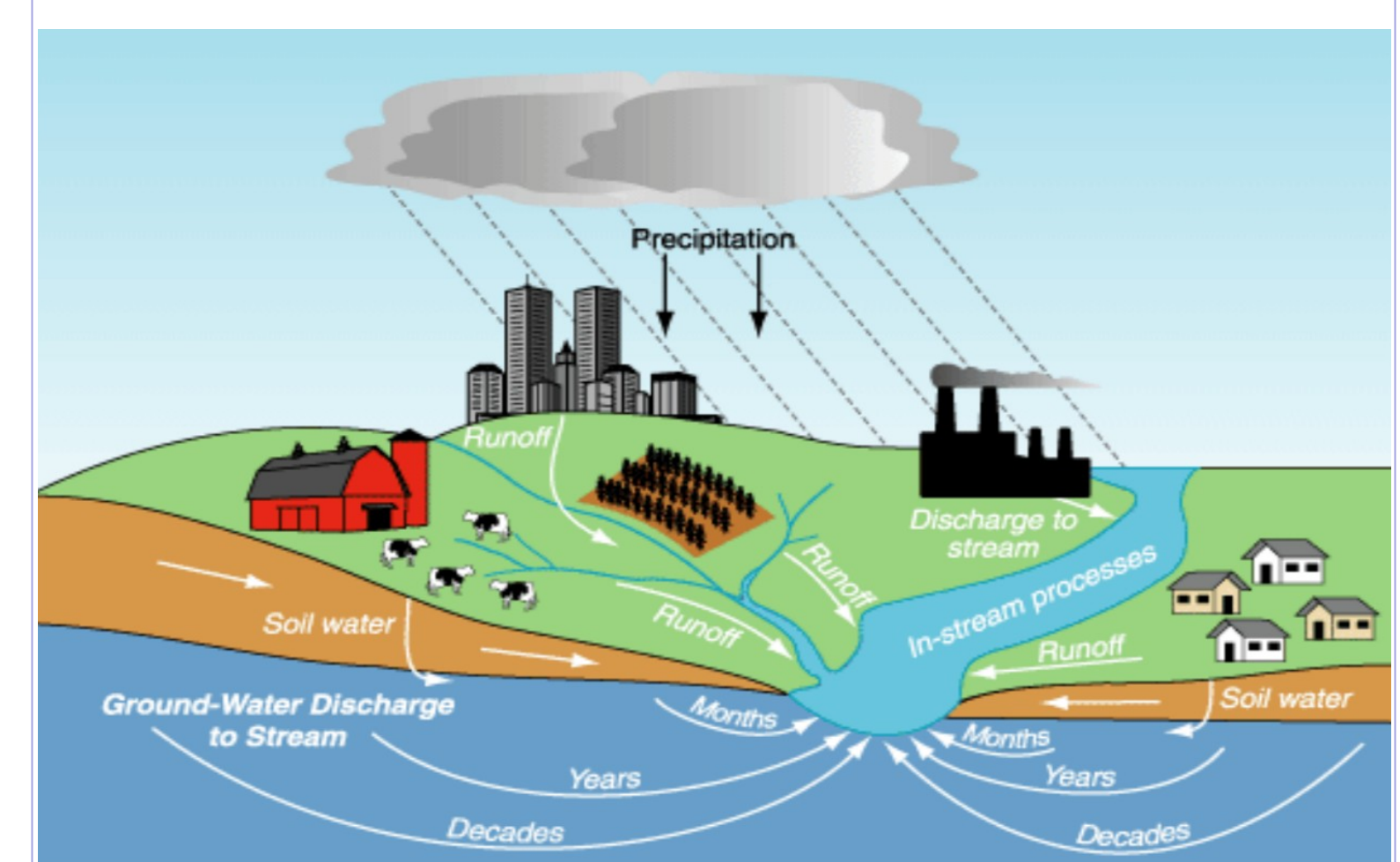


Figure 1. This figure represents different sites of sources of pollutants  
Source: Philips et al. (USGS FS-091-03)

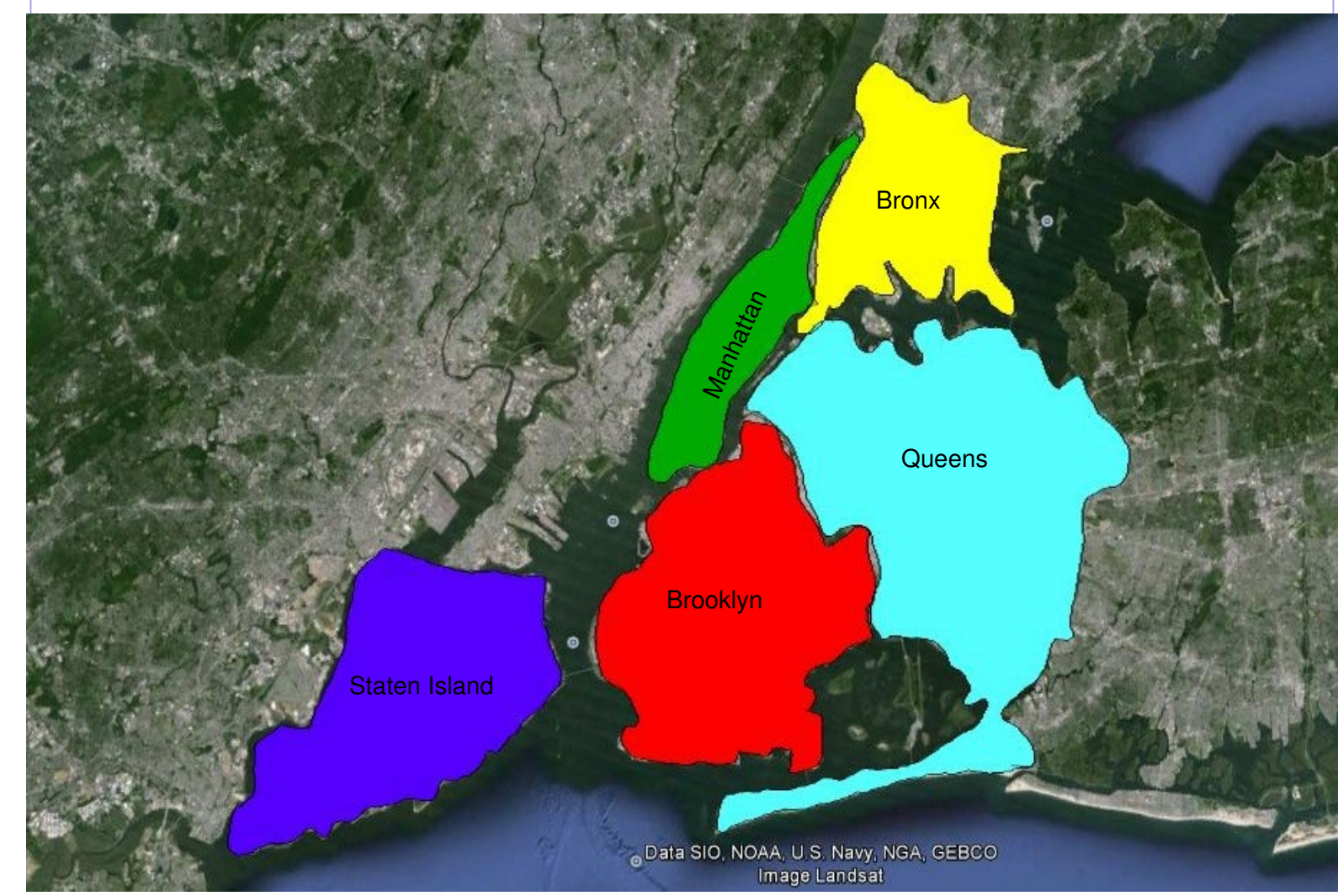


Figure 2. Google Earth image on NYC and its boroughs

**II. Methods**

The following software's were used in this study: ArcGIS, ENVI Classic, Google Earth and MatLab.

A Digital Elevation Model (DEM) was obtained from the USGS National Map Viewer and was cut down to the area of interest by the use of ArcGIS. The National Land Cover Database (NLCD) was downloaded from USGS as well and was cut down to the same area of interest by the use of ArcGIS. A satellite image from the Landsat 8 satellite was downloaded from USGS and cut down to the same study area as the DEM and NLCD maps.

GIS layers for the subway routes and streets were downloaded online.

**III. Results**

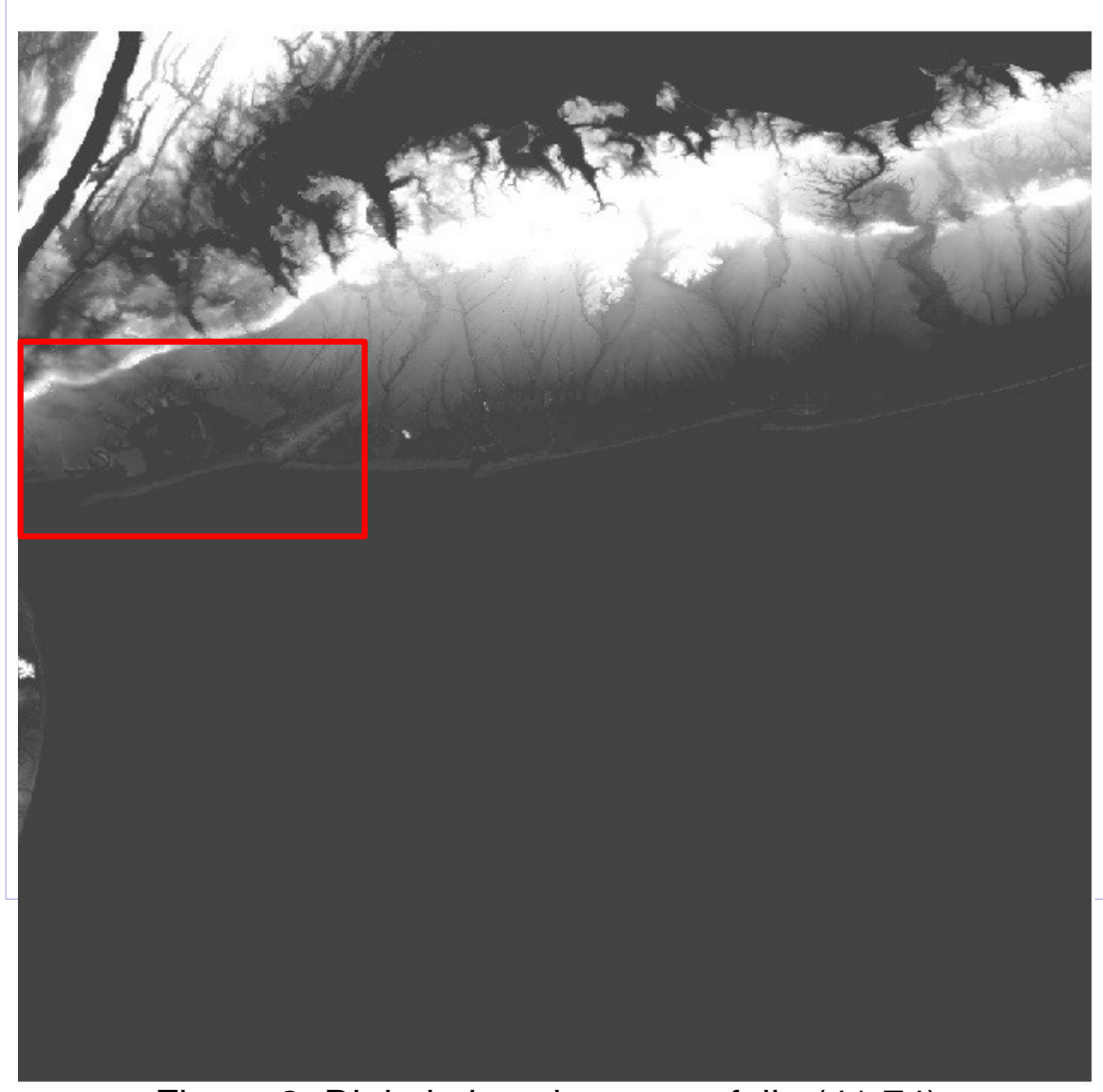


Figure 3. Digital elevation map of tile (41,74)  
Source: USGS, National Atlas

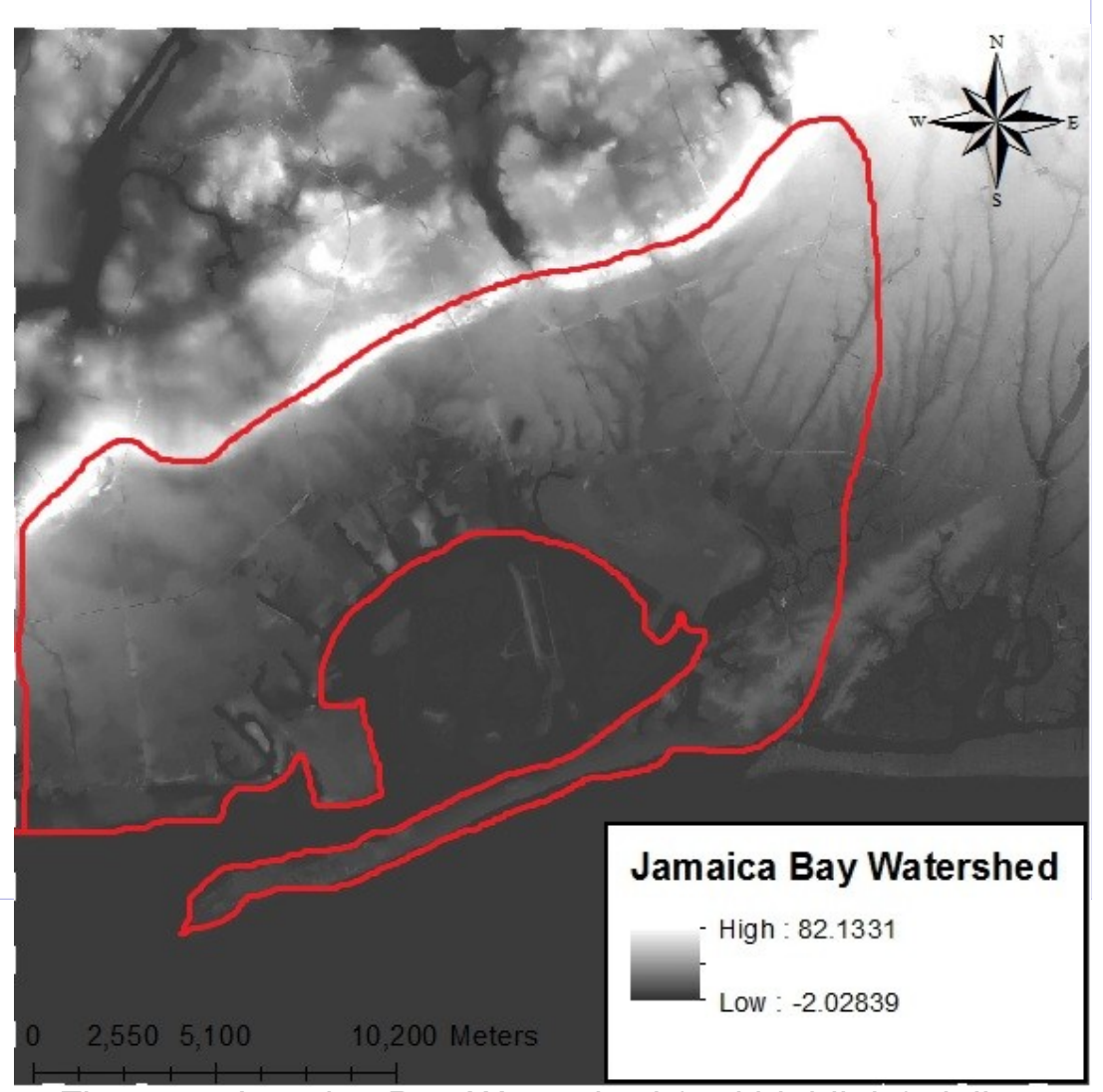


Figure 4. Jamaica Bay Watershed (red highlight) delineated by elevation

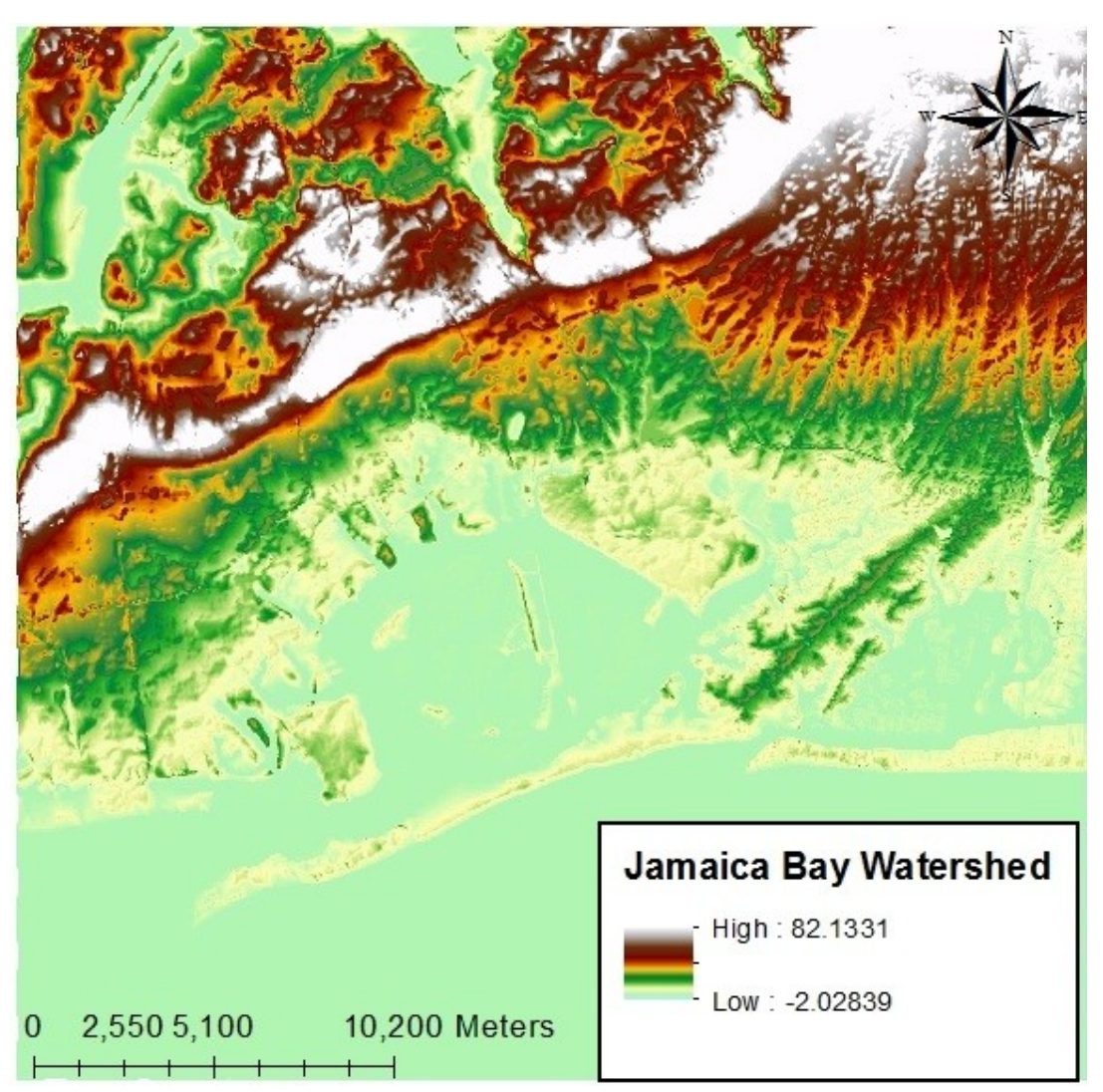


Figure 5. Filled in contour map of Jamaica Bay

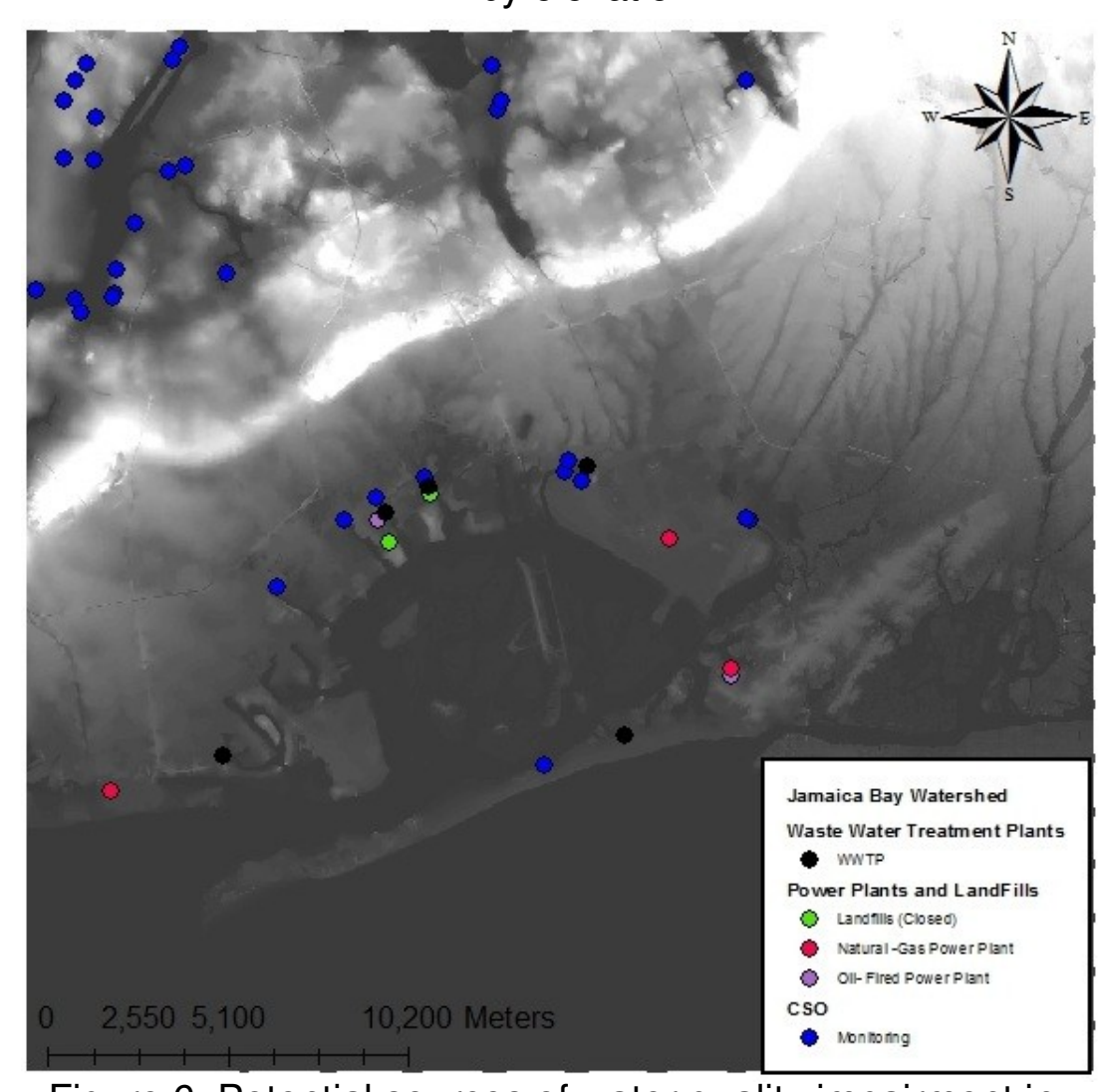


Figure 6. Potential sources of water quality impairment in Jamaica Bay

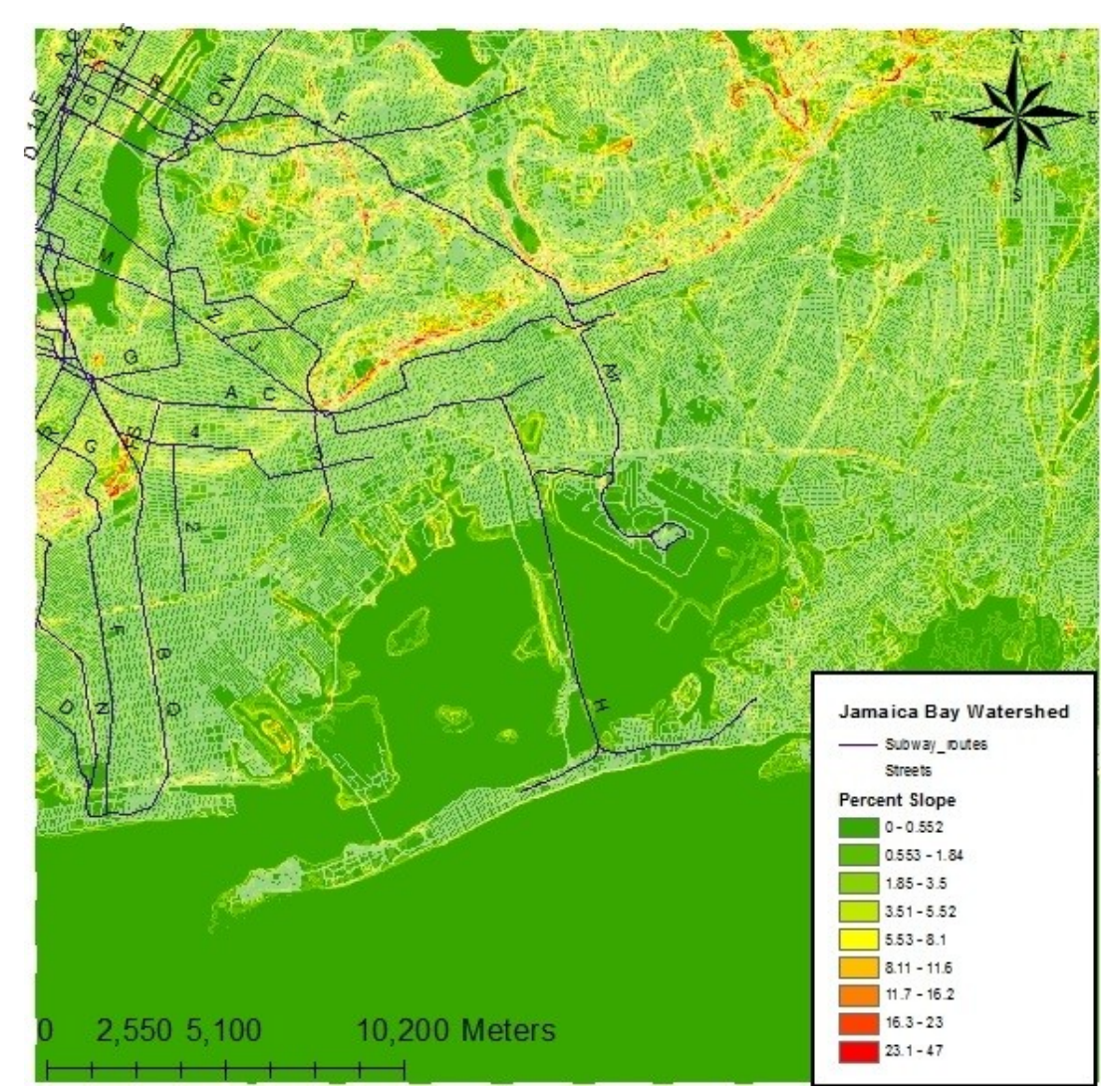


Figure 7. Roads and subway layers overlaid on percent slope for the Jamaica Bay Watershed



Figure 8. The Region of Interest (ROI) generated are used in multispectral- classification

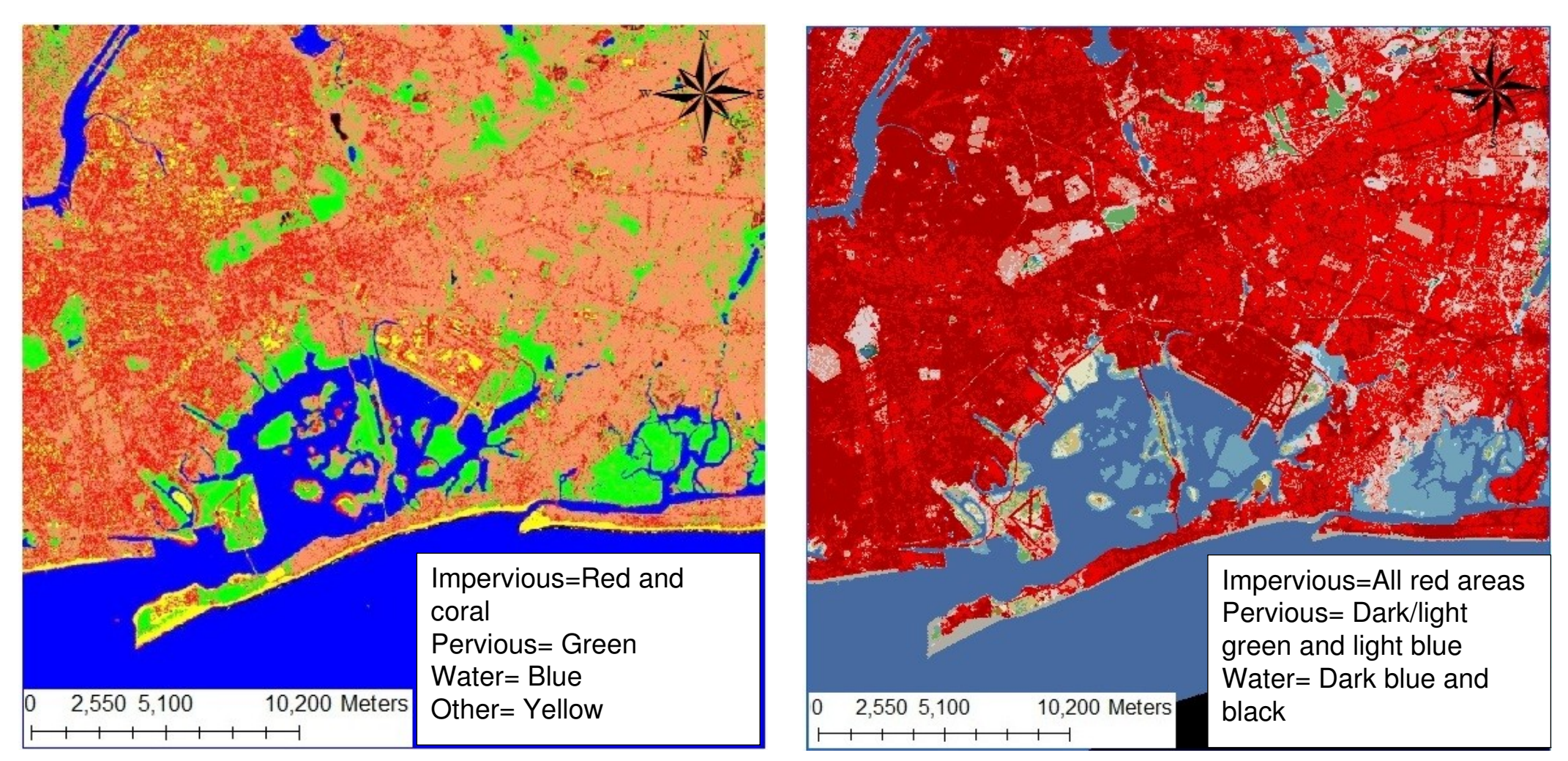


Figure 9. This figure represents the land cover surrounding the study area. The left figure represents land cover from the Landsat 8 satellite image (2014) classified using the supervised Maximum Likelihood algorithm on ENVI classic and the right image represents the land cover from NLCD (2011)

Table1. Comparison of Landsat 8 (2014) and NLCD (2011) land cover statistics

Class (est.)	Landsat 8	NLCD
Impervious	50.5	62.7
Pervious	9.4	0.65
Water	34.5	36.6
Other <sup>1</sup>	5.2	0

<sup>1</sup> High albedo surface which may be impervious or not, i.e. white roof, sand

**IV. Concluding Remarks and Planned Work**

Due to the physical features surrounding the Jamaica Bay Watershed, it becomes clear that because of the high impervious surfaces, and the high amount of sources of pollutants, the Jamaica Bay Watershed can in fact be problematic to water quality, and marine life.

Further research will evaluate the relationship between precipitation and water quality.

Eventually, a model will be developed to assess the pollutants and its surroundings during heavy rainfall events.

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**References**

- [1] Flinker, P(2010). "The Need to Reduce Impervious Cover to Prevent Flooding and Protect Water Quality", 3.
- [2] "Jamaica Bay and CSO Tributaries Waterbody/Watershed Facility Plan Submitted to DEC". Section 3.0. Existing Sewer System Facilities. Prepared for the Department of Environmental Conservation, New York, New York, page 3-19. [http://www.hydroqual.com/projects/ltp/wbws/jamaica\\_bay/jamaica\\_bay\\_section\\_3.pdf](http://www.hydroqual.com/projects/ltp/wbws/jamaica_bay/jamaica_bay_section_3.pdf)
- [3] "Jamaica Bay Watershed Protection Plan Executive Summary". [http://www.nyc.gov/html/dep/pdf/jamaica\\_bay/vol-1-exec-sum.pdf](http://www.nyc.gov/html/dep/pdf/jamaica_bay/vol-1-exec-sum.pdf)