ESTIMATE OF THE QUALITY AND QUANITY OF RIVERINE FISH HABITAT IN THE CHARLES RIVER

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Introduction:

River restoration is a major environmental issue today. One of the first steps in restoring a river is to determine the existing conditions within the river. This project lays out a methodology using Geographic Information Systems (GIS) to locate and quantify the current habitat quality of a river. I applied this methodology to the Charles River Watershed, in eastern Massachusetts.

Objective:

The purpose of my project was to show that GIS can be used as low cost and easily implemented method for conducting a preliminary survey of fish habitat within riverine environments. This method can be used for large scale planning and resource allocation.

Methods:

The existing water quality and land use within the Charles River Watershed were the two principle sources of data used for this evaluation. The water quality information was obtained from the 2002 Integrated List of Waters (305(b)/303(d)). This data layer identified impaired waters and listed their impairments. For this analysis the water quality score, based on the total number of impairments, was used to represent the water quality in each stream segment. The total number of impairments for each section of the Charles River is shown in Figure 1. Land use near the stream plays an important role in determining the overall health of the stream. This land can act as a buffer to filter pollutants, provide flood control, alleviating stream bank erosion, mitigating stream warming, and providing room for lateral movement of the stream channel. For this analysis I used the 21 category land use from 1999 and reclassified this information based on what type of land use I considered to provide the best riparian habitat. The result of my reclassification is shown on Figure 3. To isolate the riparian habitat from the lands outside of the river area, I created a buffer around the river. I used a four tiered buffer with each ring representing 15 meters (~50 ft) from the stream as shown in Figure 3. This created a 120 meter (~200 ft) buffer around the river. The multi-leveled buffer allowed me to weight the development level of the lands by adding more weight to the lands that are closer to the river banks.

Water quality and development level layers were summed to create a single water quality score. I did not weight this calculation because riparian habitat and water quality are equally important in determining the quality of fish habitat.

Results:

The locations of different potential fish habitat quality are shown on Figure 4. By comparing the different habitat qualities to the water quality and development levels, as depicted in Figure 1 and Figure 2 respectively, one can see that more heavily developed areas tend to have lower water quality and less potential fish habitat. The percentage of each habitat quality type within the Charles River and its major tributaries are provided in Figure 5. Based on the data in Figure 5, the Charles River provides substantial high-quality fish habitat.

Data: MassGIS (http://www.mass.gov/mgis/)
Map Projections: NAD 1983 State Plane Massachusetts Mainland FIPS 2001
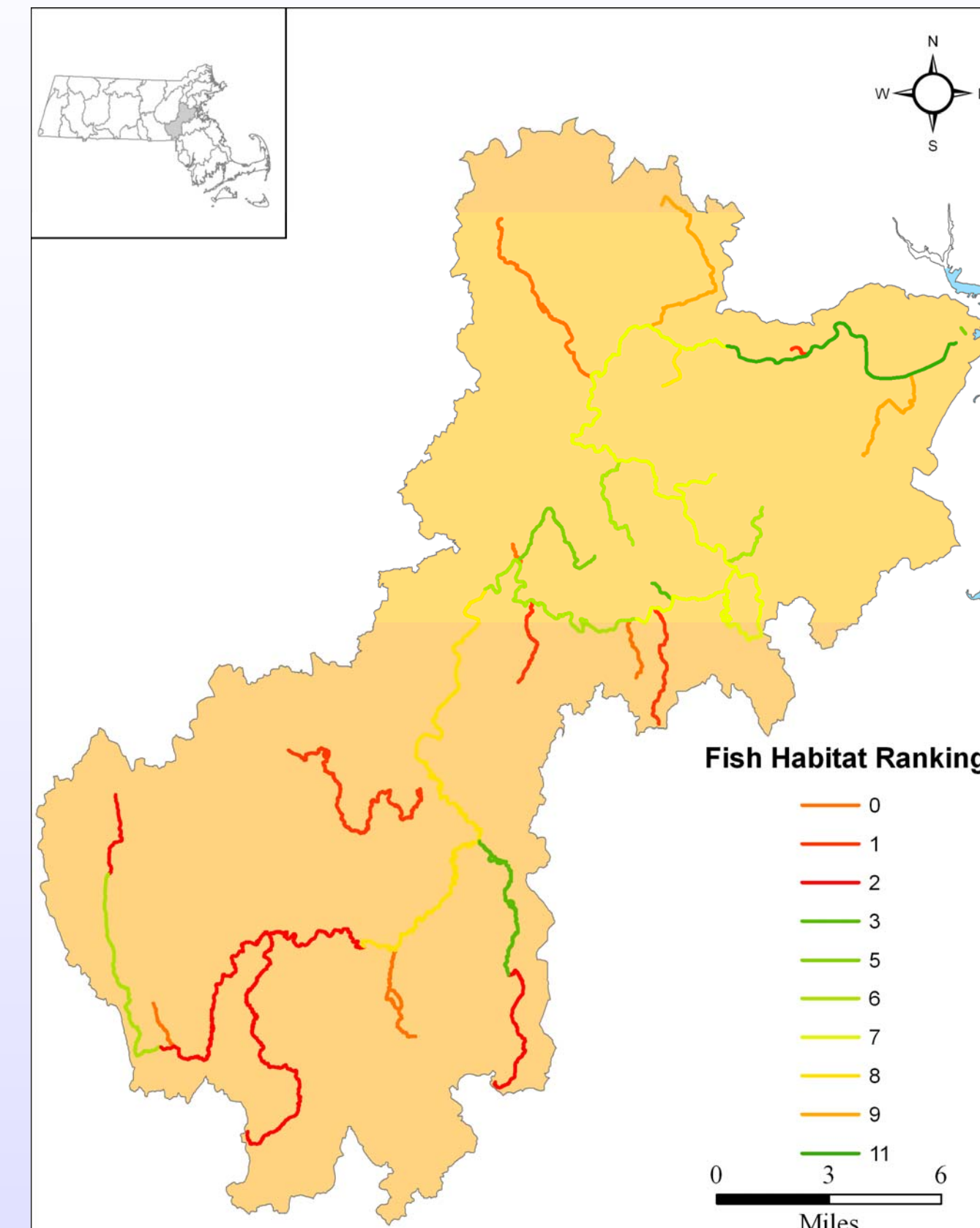

Figure 1: Water Quality of the Charles River, Based on the Number of Impairments within Each Reach.
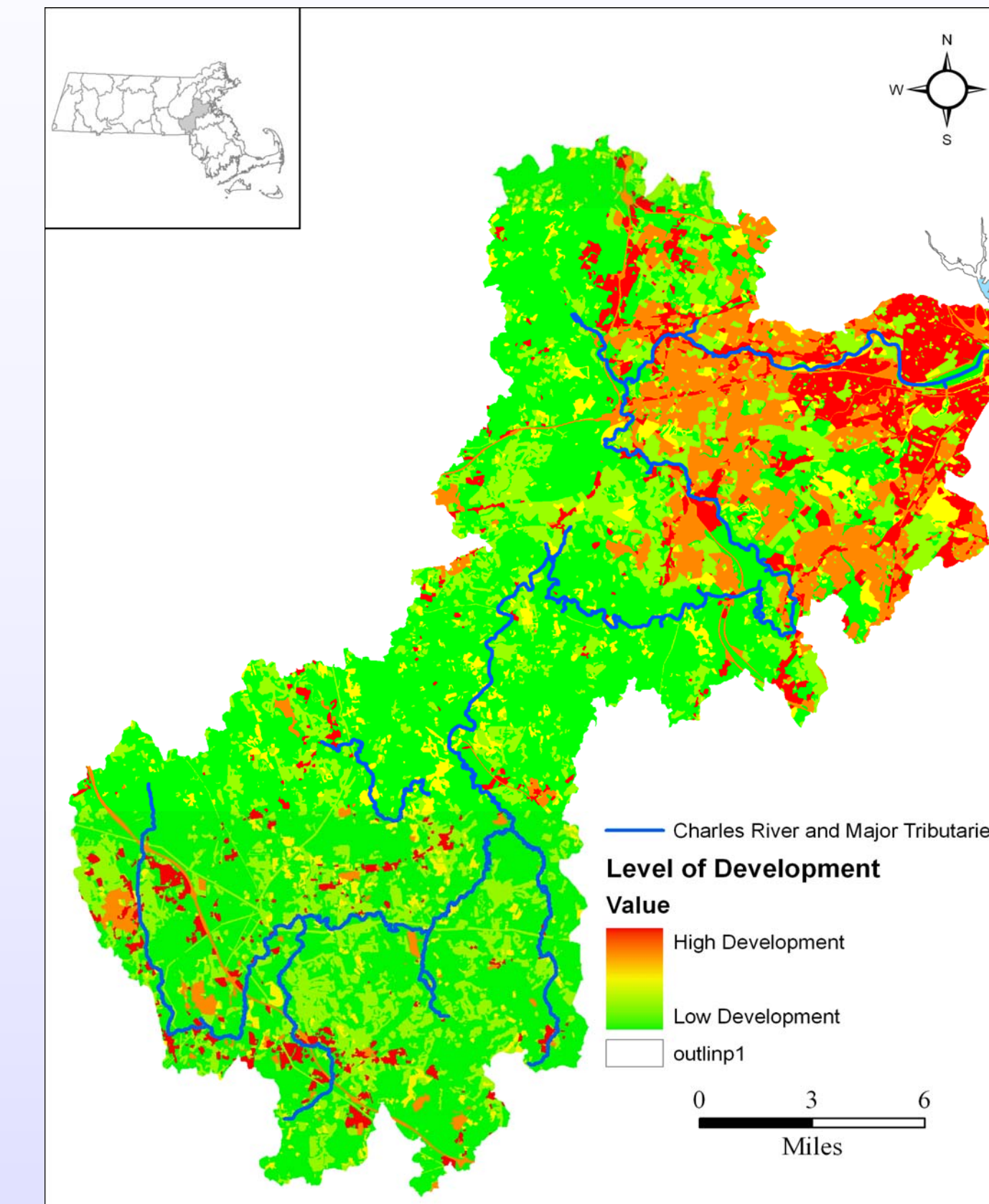

Figure 2: Level of Development within the Charles River Basin, based on the 1999 survey.
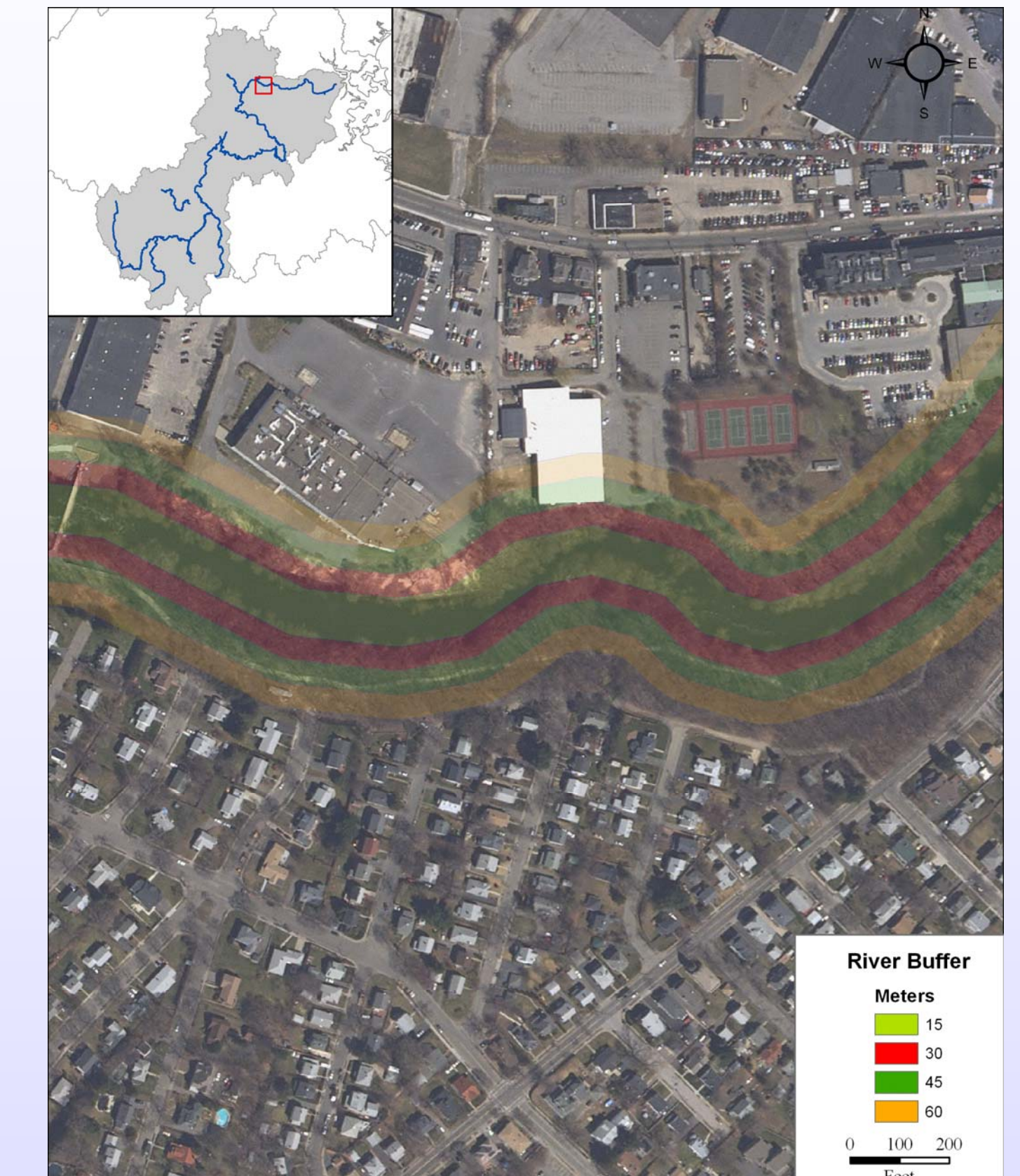

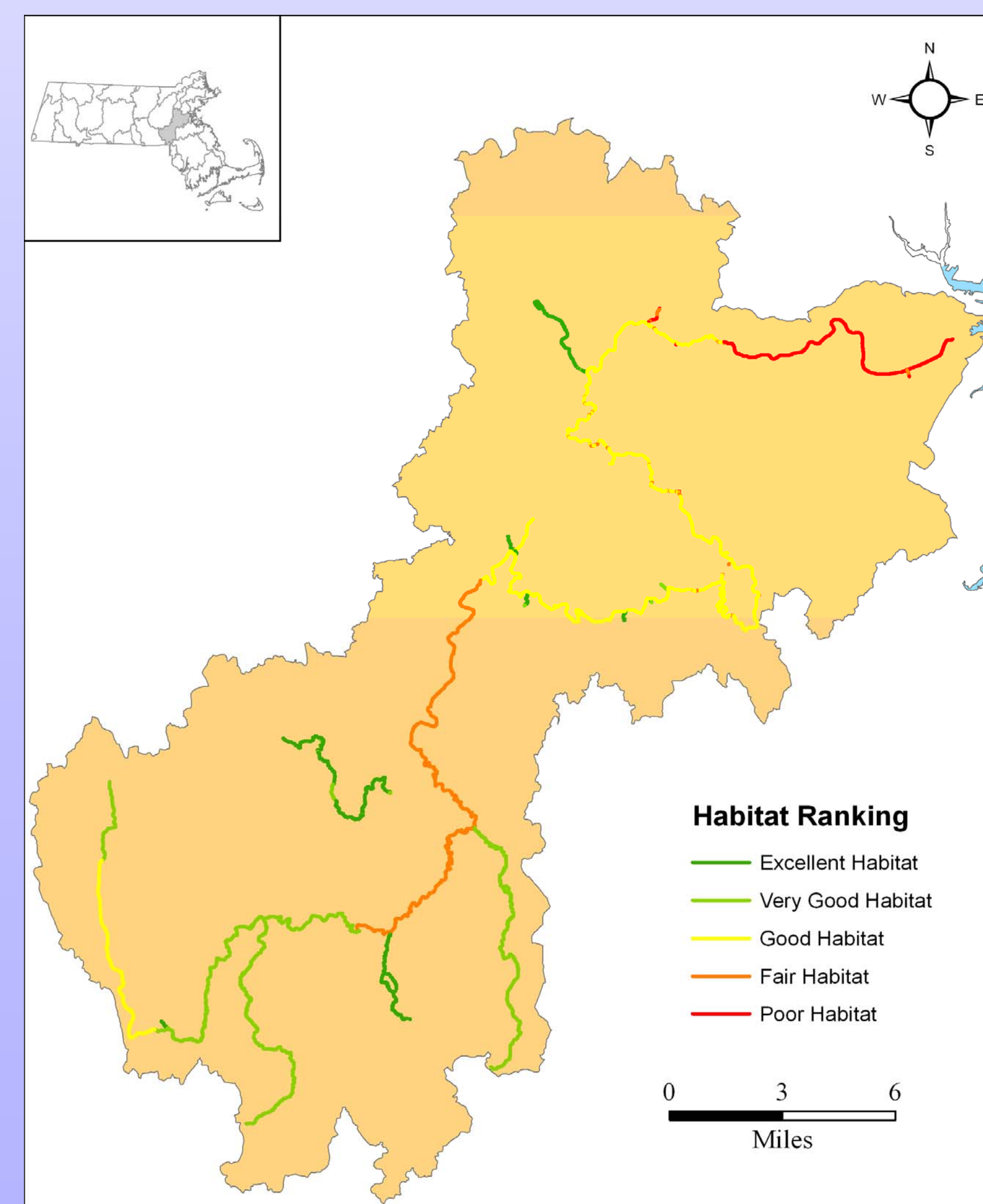Figure 3: Stream buffers used for the Habitat Analysis (Callout exaggerated for clarity).

Figure 4: Habitat Quality of the Charles River Based on the Synthesis of Water Quality and Land Use.

Discussion:

The results of this analysis conform to what would be expected if a field survey was used to determine the habitat quality within the Charles River. While the results provided by this analysis may not be as detailed or accurate as what would be achieved though field survey, they are sufficient for large scale planning and resource allocation. In addition, the results of this analysis could be used to target areas of concern for future field surveys, thus substantially reducing the costs of untargeted basin-wide sampling.
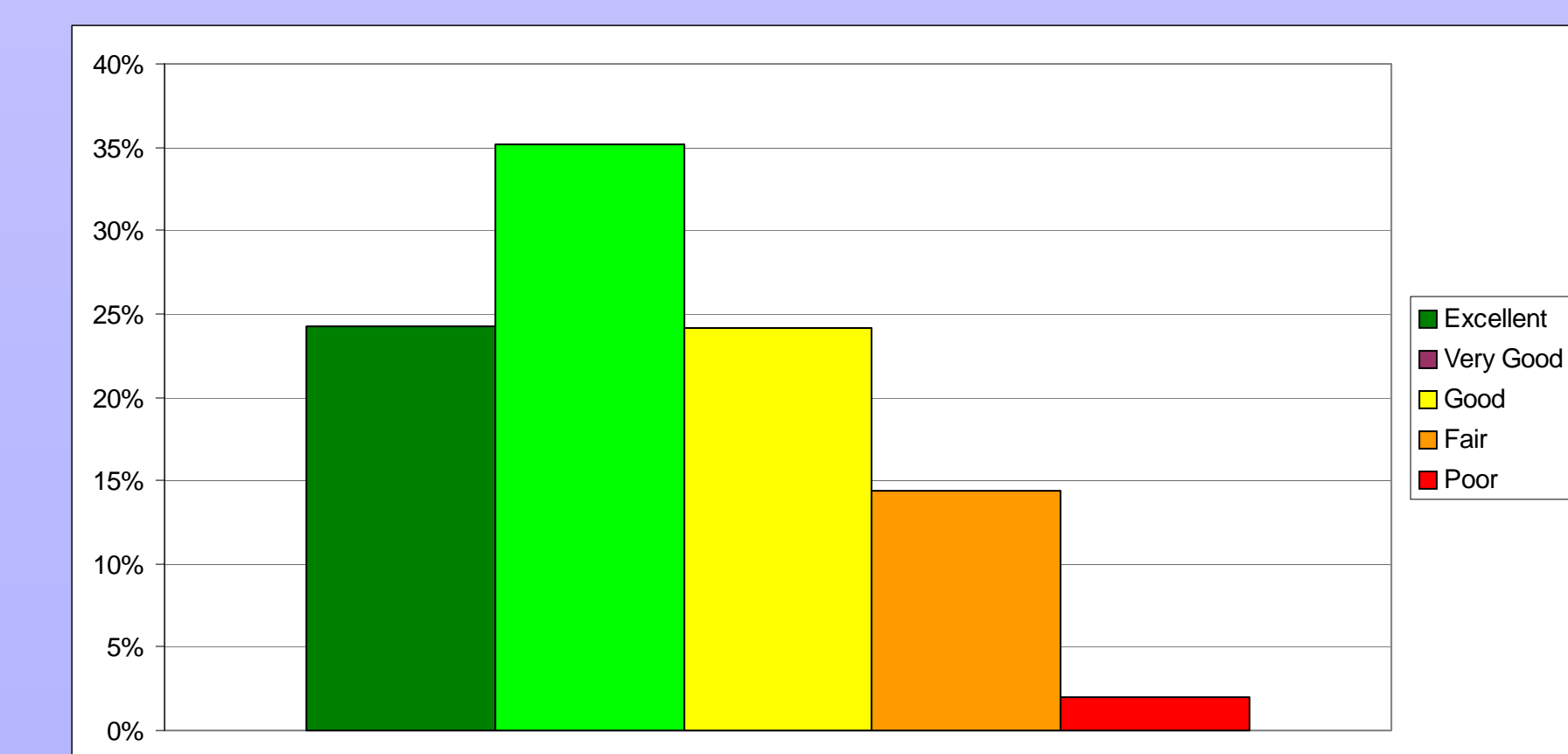

Figure 5: Total Amount of Each Habitat Quality Type available within the Charles River (expressed as percentage of the total habitat).