From Waste to Energy: Siting Municipal Anaerobic Digestion/Combined Heat and Power Facilities in Massachusetts

Introduction

In order to meet its goal of decreasing organic materials in landfills by one million tons per year by 2020, the Commonwealth of Massachusetts is putting in place a commercial food waste ban in July 2014. The ban will prevent institutions that discard at least one ton of organic material per week from disposing of such material in landfills. These large institutions will be searching for ways to dispose of food waste, and codigesting it with other feedstocks in anaerobic digesters is a promising method for disposal. The resulting biogas can be a source of electricity as well as heat. The Commonwealth of Massachusetts is already encouraging development of anaerobic digestion/combined heat and power (AD/CHP) facilities by offering financial and technical assistance for both public and private entities.

Five potential types of locations for AD/CHP facilities have been identified: wastewater treatment plants, industrial/food manufacturing facilities, cattle/pig farms, closed/inactive landfills, and industrial land use. The first three show potential because a large portion of the necessary feedstock is already on site, and the last two because their land use is appropriate for development of an industrial facility.

For municipalities interested in developing their own AD/CHP facilities, municipal wastewater treatment plants and closed/inactive landfills are the most relevant, since they are generally on municipally owned land. This project analyzes the suitability of these sites based on three major factors: competing facilities, sources of food waste, and the impact of traffic on nearby residents.
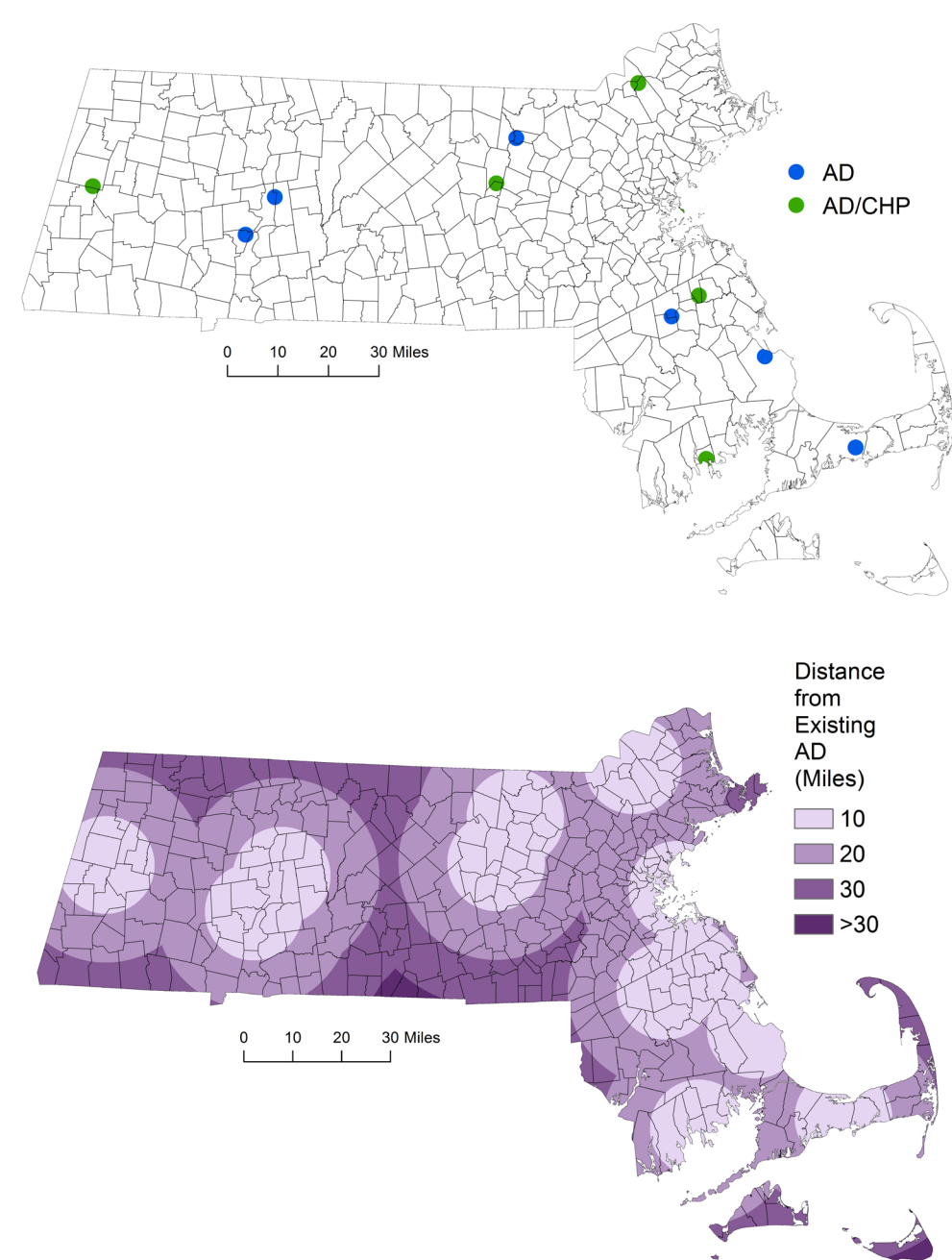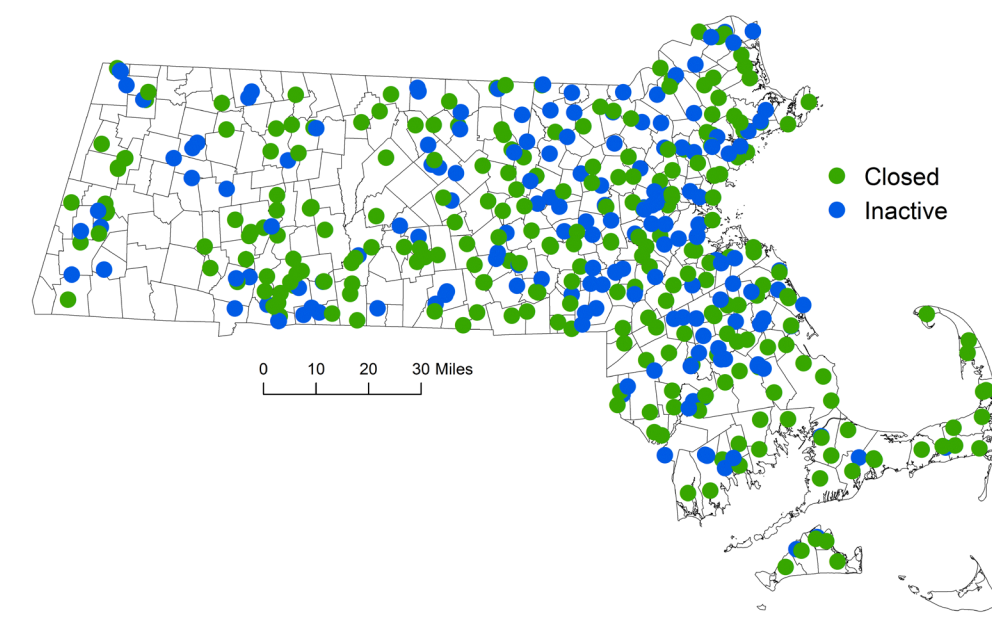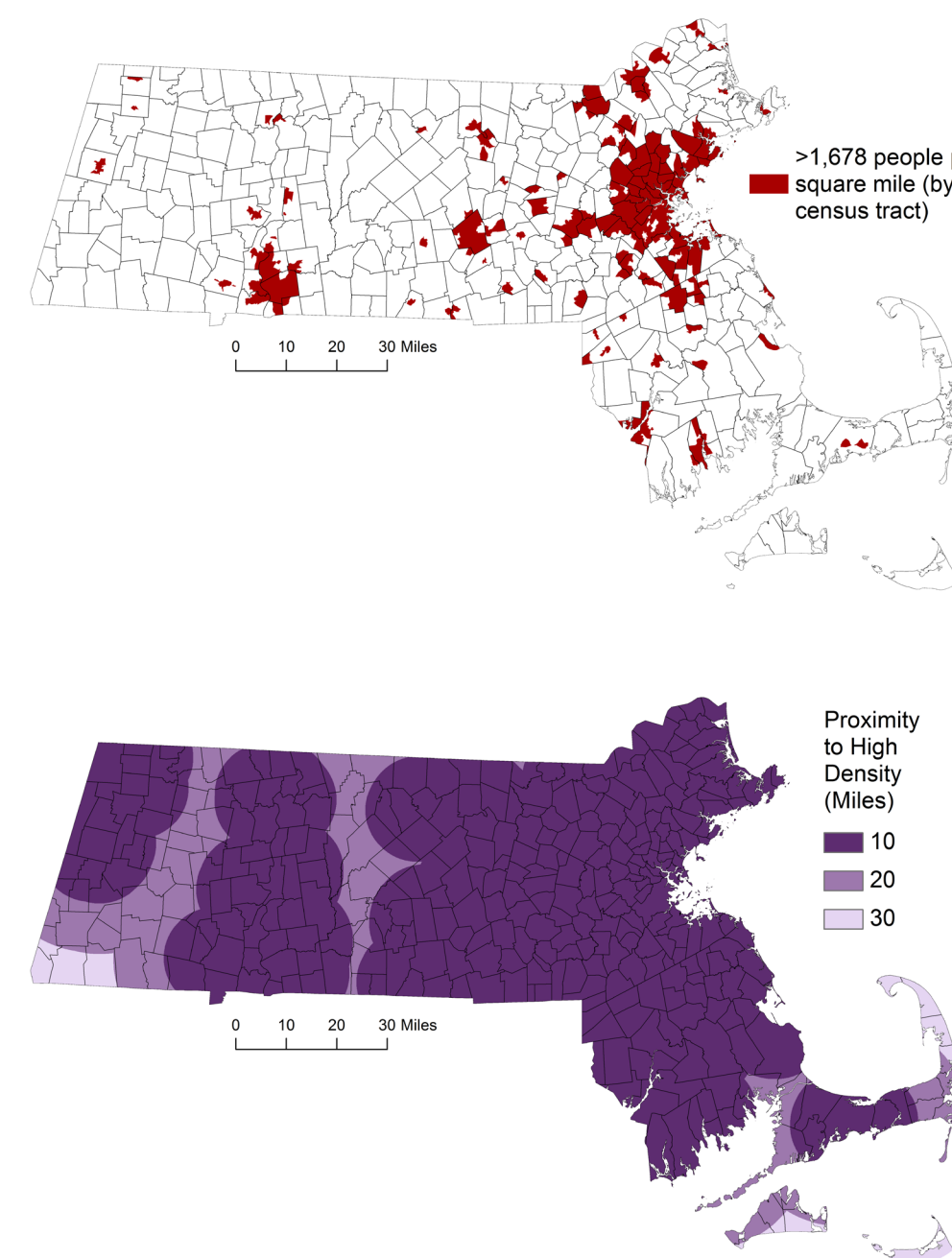
Wastewater Treatment Plants
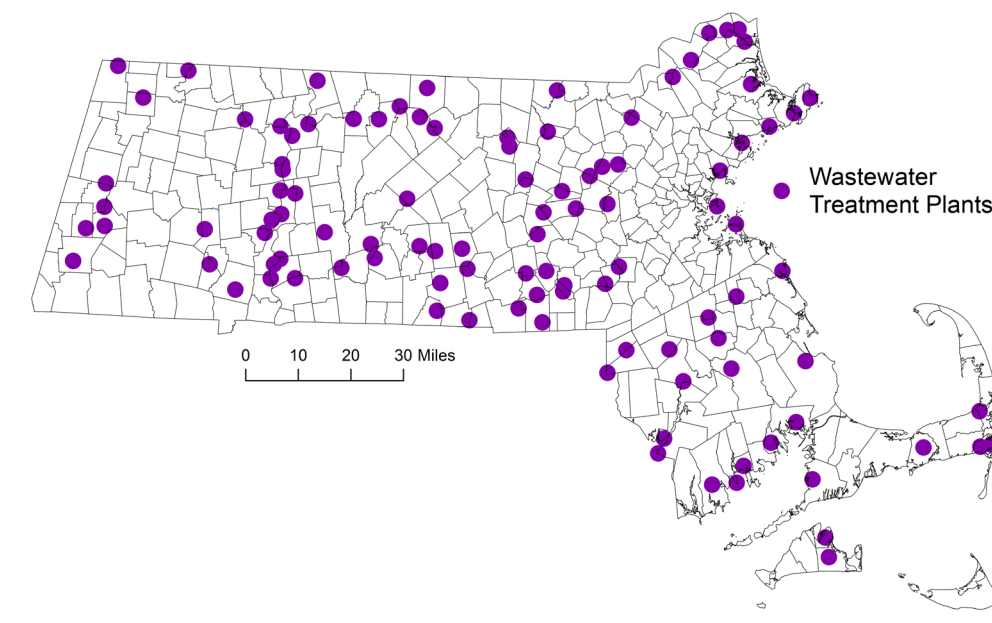
Landfills Larger than 4 Acres

Methodology

1. To avoid overlap with the collection areas of existing AD facilities, a series of 10-, 20-, 30-, and 30-plus-mile rings were calculated around such facilities and assigned increasing values. Food waste is one of the more transportable feedstocks, because its relatively high energy content offsets the energy used to transport it. However, the maximum efficient distance to transport it is still only 25 to 30 miles. Only three of the existing facilities are currently codigesting food waste, but since it is much easier to retrofit an existing AD facility to codigest food waste and/or generate energy than it is to build an entirely new facility, this future potential should be considered when siting new facilities.
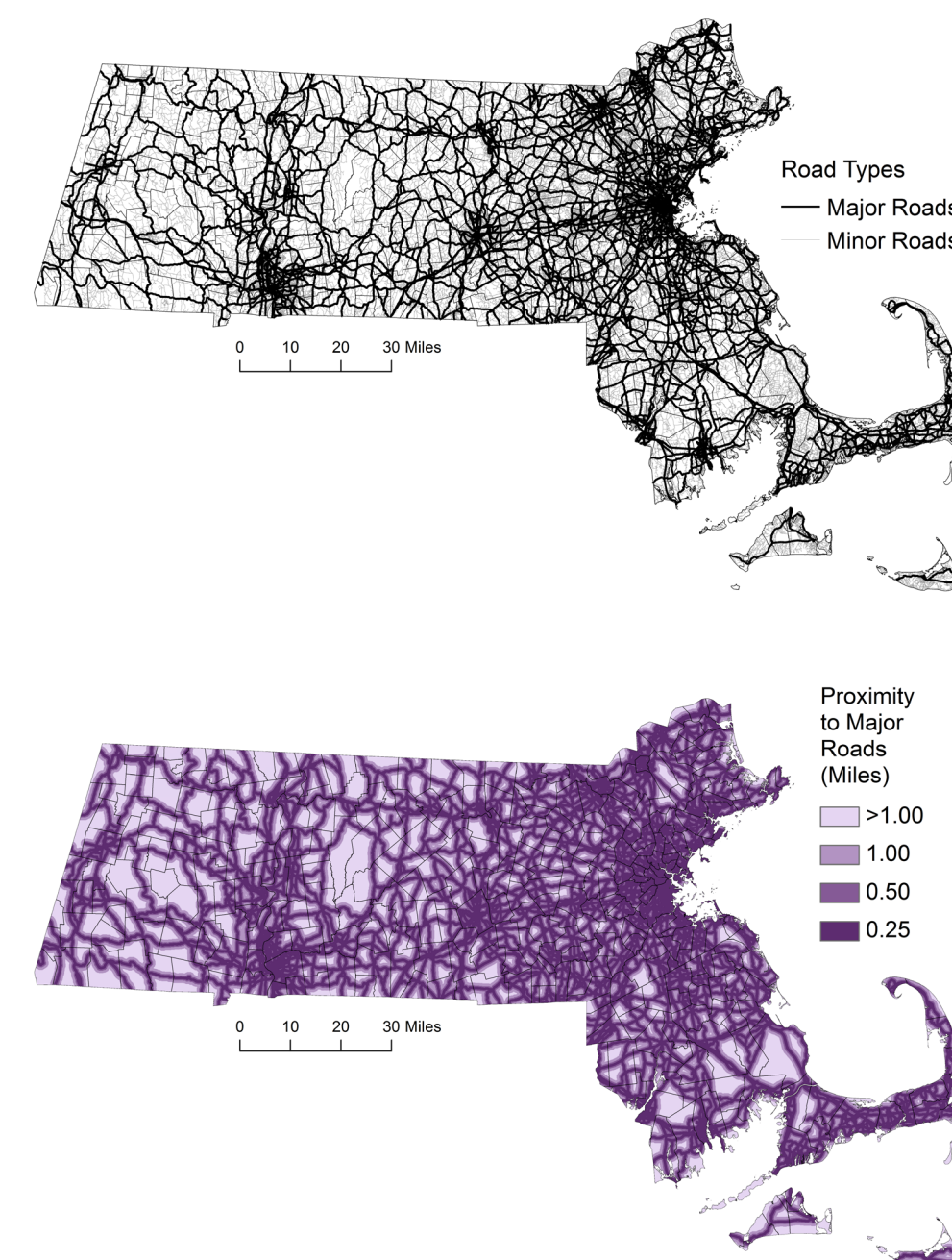
2. In order for a facility to gather a significant amount of food waste from its surroundings, it should be near a population center. Again, a series of 10-, 20-, 30-, and 30-plus-mile rings were calculated around high density census tracts (defined as twice the Massachusetts average of 839 people per square mile) and assigned decreasing values.

3. Since a major concern of nearby residents to a potential AD/CHP facility is the number of trucks delivering feedstock to the site, traffic to the facility should remain off minor roads as much as possible. Major roads (defined as limited access highways, multi-lane highways, other numbered routes, and arterials and collectors by MassDOT) were selected, and a series of quarter-mile, half-mile, mile, and mile-plus rings were calculated around them and assigned decreasing values.

4. The three rasters were combined, weighting distance from existing AD facilities the highest (0.50) and proximity to population density and major roads slightly lower (0.25). The final ratings were transferred to the wastewater treatment plants and landfill sites.

Results

Of the 530 original sites, 287 were identified as the best choices for new AD/CHP facilities. Most of these were found in south-central Massachusetts, north-central Massachusetts, the North Shore, and just outside the I-95 ring around Boston. The number of appropriate sites was surprising, especially the number of landfills. While wastewater treatment plants might be more appropriate sites (and possibly should be weighted higher in the future), the sheer availability of landfill sites may increase their attractiveness.

Distance from Existing AD Facilities
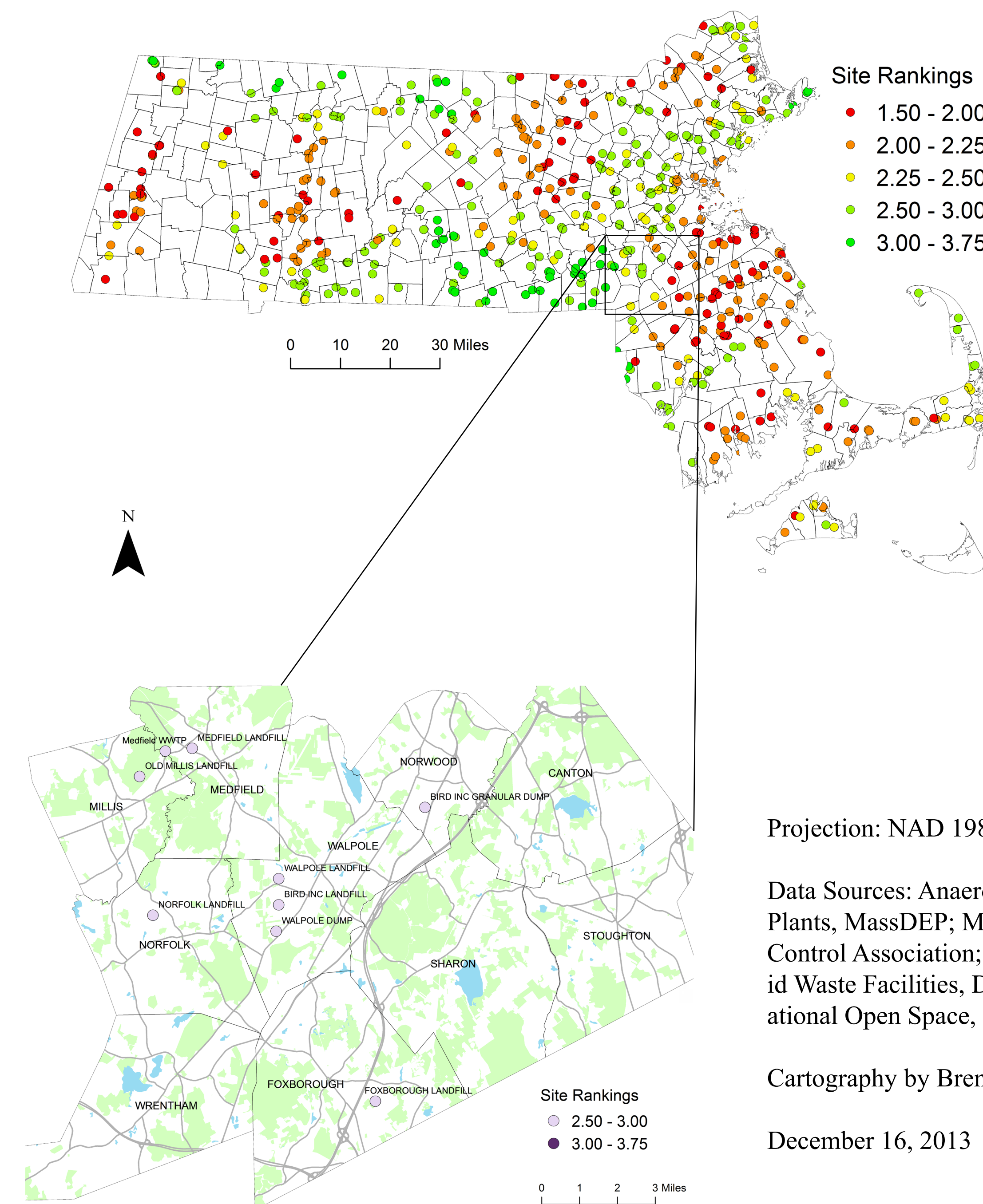

Proximity to Population Density

Proximity to Major Roads

Most Suitable Areas
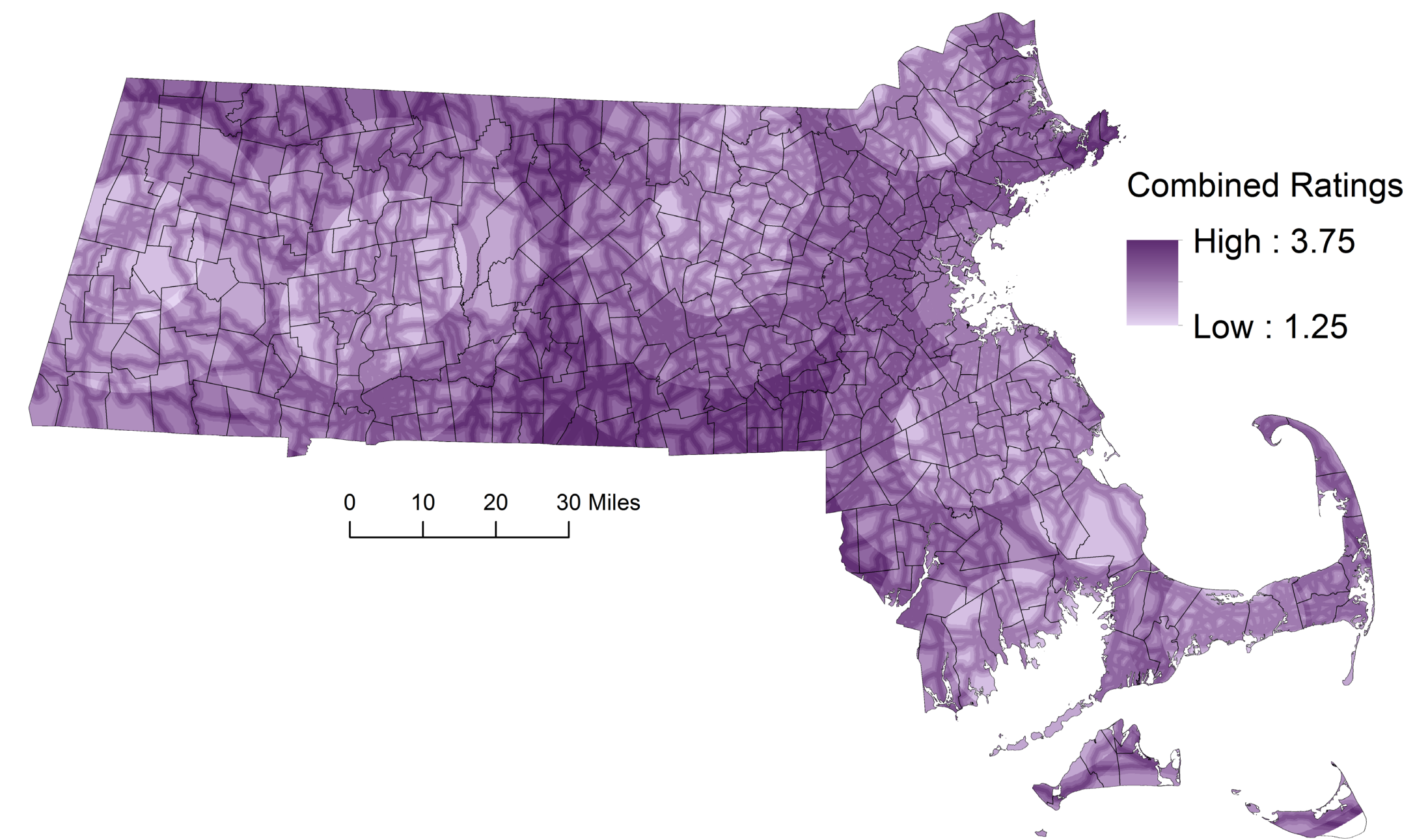
Most Suitable Sites

Limitations

Wastewater Treatment Plants
A complete, up-to-date list of publicly owned wastewater treatment plants is difficult to find. MassDEP's list of Graded Wastewater Treatment Plants by Town was originally used; however, even reducing that list to just municipal facilities resulted in 337 facilities, many of which were no longer in operation or seemed to belong to businesses. Instead, MWPCA's list of municipal facilities was used, the same list referenced by MassDEP in its writing on the subject. However, there are only 118 facilities in this list, rather than the 133 wastewater treatment plants that MassDEP quotes, so there are still data quality issues. There doesn't seem to be a complete, publicly available list of municipal wastewater treatment plants. Going forward, MassDEP should be consulted to find a more accurate, complete list.

Food Waste
For this project, it is assumed that food waste in amounts high enough to support an AD/CHP facility is available in areas of population density. However, to estimate the amount of food waste available, average food waste per person could be multiplied by population.

Traffic
The method used to calculate distance from major roads was essentially as-the-crow-flies. More useful would be finding the closest major road by following the road network. Further, finding the number of residential parcels along the minor roads connecting the facility to major roads would give a more accurate estimation of traffic impact on local residents.

Further Condsiderations
Other considerations for future projects would be total availability of various feedstocks, not just food waste. Distance from residential parcels, wetlands, and other protected areas are all factors that should be considered, as well.

Projection: NAD 1983 State Plane Massachusetts FIPS 2001 (Meters)

Data Sources: Anaerobic Digestion at Massachusetts Wastewater Treatment Plants, MassDEP; Massachusetts Facilities, Massachusetts Water Pollution Control Association; 2010 Census, TIGER Lines, American Factfinder; Solid Waste Facilities, DOT Roads, USGS Hydrography, Protected and Recreational Open Space, Community Boundaries, MassGIS

Cartography by Brenda Pike

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