

***Cryptosporidium* and *Giardia* in Surface Water: A Case Study from Michigan, USA to Inform Management of Rural Water Systems**

Creation of Case Information Database Using ArcGIS

A case information table with cases of cryptosporidiosis and cases of giardiasis summed by ZIP code was created based on information from the MDCH (MDCH, personal communication). In ArcGIS, the census tract information for Kent, Ottawa, Lenawee, and Hillsdale counties was combined with the 2001 land cover of Michigan's Lower Peninsula to produce an output file containing the land cover of Kent, Ottawa, Lenawee, and Hillsdale counties. Land cover was reclassified following the reclassification decision tree shown in Figure S1 and reclassification scheme shown in Table S1 to allow hypothesis testing of the differences between urban and rural land cover. One exception to the reclassification scheme shown in Table S1 is the "Parks / Golf courses" category. This is an ambiguous category as parks could range from city parks well connected to sewer infrastructure and drinking water distribution networks located in high population density areas to remote parks with limited sewerage and drinking water access. In this case, "Parks / Golf courses" was reclassified as "urban" because this category is associated with human activity rather than agricultural livestock.

The reclassified file was combined with census tract information and the Census 2000 5-Digit ZIP Code Tabulation Areas (ZCTA). The case information from the MDCH table was added to the output file based on the ZCTA field. The land cover file and the output containing the case information were used to produce a field with information on the percentage of "rural", "urban", and "other" land cover for each ZIP code in the counties of interest, this information was then added to the database. The end product was a database with records of ZIP codes, percentage of "rural" area, percentage of "urban" area, percentage of "other" area, and numbers of cases of giardiasis and numbers of cases of cryptosporidiosis during the period from January 2000 to December 2008. ZIP codes that were $\geq 50\%$ rural by area were designated as rural ZIP codes. ZIP codes that were $\geq 50\%$ urban by area were designated as urban ZIP codes. Information on data files used in the creation of the ArcGIS database is shown in Table S2. Figure S2 shows the data model of the analysis process.

Figure S1. Land cover reclassification decision tree

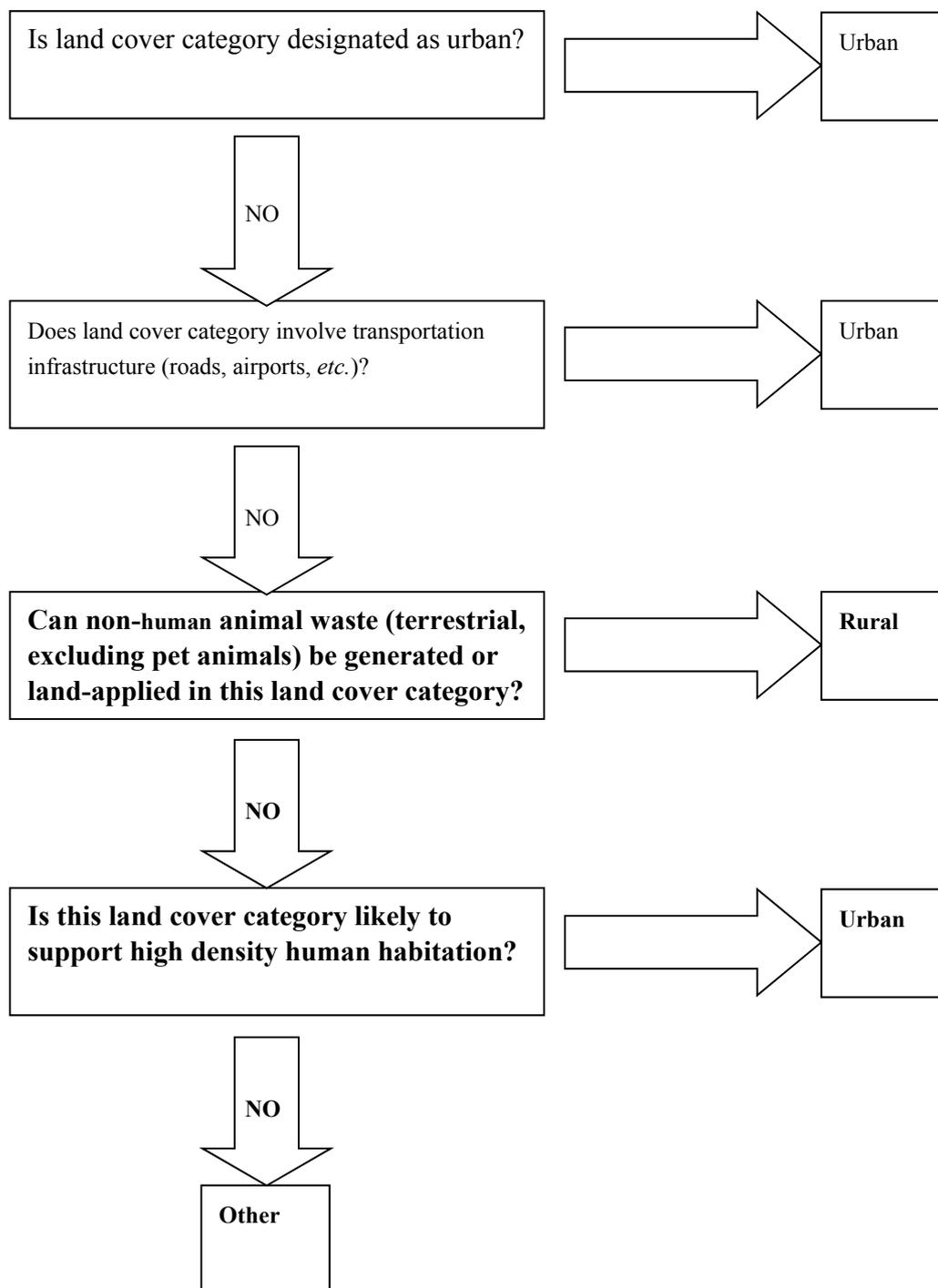


Table S1. Land cover reclassification scheme.

| 2001 Land cover category | Reclassified category |
|--|------------------------------|
| Non-vegetated Farmland | Rural |
| Forage Crops/Non-tilled Herbaceous Agriculture | Rural |
| Orchards/Vineyard/Nursery | Rural |
| Herbaceous Openland | Rural |
| Upland Shrub / Low density Trees | Rural |
| Oak Association | Rural |
| Aspen Association | Rural |
| Other Upland Deciduous | Rural |
| Mixed Upland Deciduous | Rural |
| Pines | Rural |
| Other Upland Conifers | Rural |
| Mixed Upland Conifers | Rural |
| Upland Mixed Forest | Rural |
| Lowland Deciduous Forest | Rural |
| Lowland Coniferous Forest | Rural |
| Lowland Mixed Forest | Rural |
| Lowland Shrub | Rural |
| Emergent Wetland | Rural |
| Mixed Non-Forest Wetland | Rural |
| Low Intensity Urban | Urban |
| High Intensity Urban | Urban |
| Airport | Urban |
| Road / Parking Lot | Urban |
| Parks / Golf Courses | Urban |
| Floating Aquatic | Other |
| Sand / Soil | Other |
| Water | Other |
| Exposed Rock | Other |
| Mud Flats | Other |
| Other Bare / Sparsely vegetated | Other |

Table S2. ArcGIS database source files.

| Data Type | Coordinate System | | Age of Dataset | Reference |
|--|---------------------------------|--------------------|---|-----------|
| | Geographic | Projection | | |
| Case information by ZIP code | N/A | N/A | 01/01/2000–12/31/2008 | 34 |
| 2001 Land cover Lower Peninsula (Raster) | North American Datum of 1983 | Michigan GeoRef | Constructed from image dates 1997–2001 | 36 |
| River Raisin Watershed | North American Datum of 1983 | Michigan GeoRef | 1998 | 36 |
| Grand River Watershed | North American Datum of 1983 | Michigan GeoRef | 1998 | 36 |
| Census 2000 5-Digit ZIP Code Tabulation Areas (ZCTAs) | North American Datum of 1983 | Michigan GeoRef | 1/1/2000 | 51 |
| Census 2000 Tracts Hillsdale county | North American Datum of 1983 | Michigan GeoRef | 5/1/2009 | 36 |
| Census 2000 Tracts Ottawa county | North American Datum of 1983 | Michigan GeoRef | 5/1/2009 | 36 |
| Census 2000 Tracts Kent county | North American Datum of 1983 | Michigan GeoRef | 5/1/2009 | 36 |
| Census 2000 Tracts Lenawee county | North American Datum of 1983 | Michigan GeoRef | 5/1/2009 | 36 |

Figure S1. Ives.2 ArcGIS analysis process data model.

