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DRAFT
WASTEWATER ESTIMATION MODEL
STUDY RESULTS

Prepared For:

MIDDLE TOWNSHIP
CAPE MAY COUNTY, NEW JERSEY
MC Project No. 08000834A

Prepared By:

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EXECUTIVE SUMMARY

Revisions to the Groundwater Quality Standards Antidegradation Policy, (N.J.A.C. 7:9c) and Water Quality Management Planning Rule, (N.J.A.C. 7:15) were adopted by the State of New Jersey on July 8, 2008. The amended antidegradation policy extends the 2 mg/L target nitrate concentration, previously established for groundwater aquifers in Category I watersheds by the existing Antidegradation Policy, to include all Class II-A, Class II-B, and Class III ground water aquifers. The amended Water Quality Management Planning Rule requires zoning statewide to specify average lot sizes that meet the amended antidegradation rule nitrate target concentration in groundwater for all septic system discharges. Required lot sizes to meet the mandated nitrate target concentration are determined on a watershed basis through the use of a nitrate dilution model developed by the NJDEP.

To help in preparation of Water Quality Management Plans that address the requirements of the new rules, the NJDEP developed a Wastewater Estimation Model that provides a process for calculating the allowable number of lots within each municipality based on the lot sizes calculated for that portion of each watershed within the municipality boundaries. This report documents the use and results of the Wastewater Estimation Model to provide a basis for zoning requirements within Middle Township to meet the amended antidegradation rule nitrate target concentration.

Based on the use of the Wastewater Estimation Model in consultation with the NJDEP concerning their current policies, Maser Consulting determined that 801 additional lots could be developed at full buildout within Middle Township within the septic management area. Revised zoning may allow for distribution of lots within the three watersheds within the Township boundaries with a maximum of 102 lots averaging 8.8 acres per lot in the Tributaries and Bays East watershed; 486 lots averaging 7.9 acres per lot in the Tributaries and Bays West watershed; and 212 lots averaging 6.2 acres per lot in the Dennis Creek watershed.

The Water Quality Management Planning Rule does not mandate uniformly zoning minimum lot sizes at the calculated densities across the watershed. Rather, this comparable residential zoning density represents the total number of units that, if built, would not result in a degradation of groundwater quality within a given watershed by exceeding the 2 mg/L nitrate limit. The NJDEP advocates zoning to allow for center-based development, clustering, and protection of environmental features and agriculture land.

INTRODUCTION

Maser Consulting P.A. (*Maser*) was contracted by Middle Township to conduct wastewater/nitrate dilution modeling to address the recently adopted Water Quality Management Planning Rule. The Rule includes a requirement that counties/municipalities prepare an updated Water Quality Management Plan ('WQMP') including zoning to address a proposed septic density that meets the new statewide groundwater antidegradation target nitrate concentration of 2 mg/L. For Middle Township, this information is needed to complete the Master Plan Update, including land use and zoning recommendations. This work is being performed in support of the Township's efforts to complete the Plan Endorsement process and achieve Centers designation with the New Jersey State Planning Commission and CAFRA designation by the NJDEP.

Maser has prepared this report summarizing our modeling efforts to provide documentation on the lot density (minimum lot size) that can be supported in the septic management areas of the Township to meet the nitrate target goal and includes calculations on the allowable number of new lots based on the calculated septic density in that portion of the Township within each of the three HUC11 watersheds within the Township boundaries. A HUC11 watershed or "*hydrologic unit code 11*" is defined in N.J.A.C. 7:15 as an area within which water drains to a particular receiving surface water body, also known as a watershed, which is identified by an 11-digit hydrologic unit boundary. The three HUC11 watersheds within the Township are: 1.) Dennis Creek, 2.) Cape May bays and tributaries East, and 3.) Cape May bays and tributaries West.

BACKGROUND

Maser used the *Wastewater Estimation Model Builder* application (May 2008) developed by the NJDEP for use by counties and municipalities to utilize in the preparation for WQMP updates. According to the model documentation, the application uses septic densities calculated for each HUC11 watershed and compares new development potential, based on local zoning, to regional septic density standards for those lands outside of the sewer service area. The calculated septic density defines the maximum *comparable residential zoning density* that meets the overall watershed groundwater quality goal.

The Water Quality Management Planning Rule does not mandate uniformly zoning minimum lot sizes at the calculated densities across the watershed. Rather, this comparable residential zoning density represents the total number of units that, if built, would not result in a degradation of groundwater quality within a given watershed by exceeding the 2 mg/L nitrate limit. The NJDEP advocates zoning to allow for center-based development, clustering, and protection of environmental features and agriculture land.

To estimate allowable septic densities within each watershed, the *Wastewater Estimation Model Builder* application uses results from a separate nitrate dilution model designed by New Jersey Geological Survey entitled: *A Recharge-Based HUC 11-Scale Nitrate-Carrying-Capacity Planning Tool for New Jersey, v 1.0*. The abstract of this model states:

> "*Nitrate (NO3) is a constituent found in the effluent from individual on-site wastewater disposal systems (septic tanks). Ensuring that nitrate concentrations in groundwater do not exceed targets should be one goal when planning or reviewing proposed developments that will use septic tanks. The method presented here combines a model of nitrate dilution (based on Trela and Douglas, 1978) with one of groundwater recharge on a HUC-11 basis (based on Charles and others, 2003). The goal is a HUC11-scale planning exercise to estimate region-average lot sizes needed to provide enough recharge to dilute nitrate to a specified target. This method is intended to be a guide for estimating the impact of nitrate from septic tanks on HUC11-scale groundwater quality*."

The NJDEP indicates in the *Wastewater Estimation Model Builder* guidance that to refine the use of this modeling tool, counties and municipalities need to provide additional customization to the application by adding local digital data to adjust the application for developed areas after the year 2002 for which statewide data is available. The most current digital zoning with minimum lot size, residential densities (unit/acre) and non-residential Floor Area Ratios are needed to run the model and to improve accuracy as well as local preserved open space and other local environmental constraints. In our current evaluation we utilized the available digital data as compiled and provided by the Township to *Maser* for this study, including the most current digital parcel layer; current zoning; the most current local preserved open space and preserved farm coverages; local regulated environmental features; and other local spatial digital data and database records.

The Water Quality Management Planning Rule provides two approaches to quantifying average lot size. The HUC11-scale nitrate model uses an average watershed-wide recharge for each HUC11 watershed. A separate version of the nitrate dilution model allows the calculation of recharge based on Township-specific soils within each watershed. *Maser* modeled recharge (and resultant lot size) in each of the three HUC11 watersheds within the Township using both methods to determine if use of one of the allowed methodologies is advantageous. In some watersheds, soils can vary widely from the headwaters to the discharge area. However, because of the unique setting of the coastal watersheds within Middle Township along the embayments, the soils do not vary significantly across the area of the watersheds. We found that using the site specific soil model provides no advantage in this locality. As a result, the HUC11 model was used for this evaluation.

Using average lot sizes determined using the HUC11 model for each watershed, the maximum number of available developable lots that could be developed assuming full buildout without exceeding the 2 mg/L nitrate limit is calculated. As provided in N.J.A.C. 7:15, two different approaches can be taken: 1.) using developable parcels only (net) and 2.) using developable parcels plus preserved lands (gross).

MODEL IMPLEMENTATION

The *Wastewater Estimation Model* is implemented in five separate steps:

- **Step 1 – Parcel Select**

  The initial input to the model is the Township parcel map. The first operation in developing the working base map is to overlay the *parcel map* with the *Urban land use* coverage and removing the urbanized area from the base map. The *Urban land use* layer is a State supplied coverage defining the *developed areas* based on air photo interpretation. Since the urban areas do not directly correspond to parcel boundaries, in removing this area from the parcel map, some partial parcels are created. The remainder of Step 1 identifies these partial parcels and removes those that do not meet the minimum lot size as defined by the current zoning. This process also removes "slivers" caused by minor digitizing errors during creation of the map.

  A shortcoming in Step 1 of the Wastewater Estimation Model is that the process also removes existing undeveloped parcels not meeting current zoning minimum lot size requirements. To overcome this problem Maser devised a modified approach to the Step 1 analysis. A separate coverage of non-conforming lots is first created prior to removal of the "urban" area and resultant non-conforming lots from the base map using the Step 1 procedure. The "urban" area is also removed from the separate non-conforming lot coverage. As a last step, the two coverages are merged to produce a final base map.

  The Step1 Selected Parcel Map showing "Urban Areas" and current zoning is provided in Figure 1.

- **Step 2 – Base Data**

  Input to Step 2 is the base map produced in Step 1. In Step 2 additional information to be used in later steps is added to the coverage attribute table. These data are used in the final model evaluation. Information of the following features is added during this step:

  - Existing and proposed sewered areas
  - HUC11 septic density
  - Water purveyor area
  - Preserved lands

  Maps showing the designated sewer area, HUC11 watersheds, water purveyors, and preserved farmland are provided in Figure 2.

- **Step 3 – Environmental Constraints**

  The spatial distribution of mapped environmental constraints are defined in this step and merged into a single coverage for use in Step 5 to define acceptable sewer expansion areas. Environmental constraints include:

  - surface water,
  - wetlands,
  - preserved lands,
  - C1 stream buffers (300 ft), and
  - C2 stream buffers (150 ft).

  Maps showing surface water bodies, wetlands, preserved farmlands, and stream buffers are provided in Figure 3.

- **Step 4 – Septic**

  Input to Step 4 is the Base Data Map created in Step 2. Appropriate septic areas are identified through removal from the base map of sewer coverage areas, surface water bodies, mapped wetlands, and hydric soils. To remove small extraneous areas not appropriate for septic system development, *Maser* also removed those areas designated as "Urban" and "Beach" soils from the Base Data map coverage. The Final Septic Base map created in this step shows those parcels that the NJDEP considers appropriate for individual septic systems. All supporting information is included in the associated database and is used in the final database calculations in the model.

  A map showing final septic-appropriate areas is provided as Figure 4.

- **Step 5 – Sewer**

  Input to Step 4 is the Base Data Map created in Step 2. Appropriate sewer areas are identified through removal from the base map of those environmental constraint areas shown on the coverage created in Step 3. The Final Sewer Base map (Figure 5) created in this step shows those areas that the NJDEP considers appropriate for extension of sewer service. All supporting information is included in the associated database which is used in the final database calculations in the model.

  The "Center Area" coverage, showing those areas currently or proposed to be sewered in the future is superimposed on the available sewer area defined by the model in Figure 5.

Database Calculations/Results

The data base compiled through the modeling effort is brought into Microsoft Access® for final data manipulation, calculations, and reporting. For the septic density portion of the model, the following procedures are followed:

- The Final Septic Appropriate Area database from Step 4 is compared to undeveloped and underdeveloped properties within the Township to create a new coverage. The coverage for undeveloped and underdeveloped properties coverage in the Township (Figure 6) was created by isolating vacant properties, farmlands, preserved lands, and unclassified parcels from the property tax class code records. That portion of subdividable residential properties exceeding the current minimum lot size was also included as undeveloped land. This coverage was overlain on the acceptable septic areas to create new coverage consisting of septic-acceptable, undeveloped properties tracts (Figure 7). These tracts do not necessarily correspond to existing parcels; they are used for the calculation of allowable number of lots.

- The areas within the new septic-acceptable, undeveloped tracts coverage are parsed by watershed. The septic-acceptable acreage within each watershed is calculated to provide an estimate of land area contributing groundwater recharge for nitrate dilution within the watershed using both gross (vacant and preserved lands) and net (vacant land only) methods. Septic-acceptable, undeveloped tracts by watershed (by gross method) are shown in Figure 8. The total acreage of septic-acceptable, undeveloped tracts by watershed is shown on Table 1.

- The total acreage of septic-acceptable, undeveloped tracts within each watershed is divided by the calculated septic density for that watershed to provide the number of allowed lots to meet the requirements of the Antidegradation Policy. The maximum number of allowable lots in Middle Township per watershed that will meet the 2 mg/L nitrate target is shown on Table 1 for both the "net" and "gross" methods.

CONCLUSIONS

Based on the use of the Wastewater Estimation Model in consultation with the NJDEP concerning their current policies, *Maser* determined that 801 lots could be developed at full buildout within Middle Township. Revised zoning must allow for distribution of lots within the three watersheds within the Town boundaries as follows:

- A maximum of 102 lots with an average lot size of 8.8 acres per lot in the Tributaries and Bays East watershed;
- A maximum of 486 lots with an average lot size of 7.9 acres per lot in the Tributaries Bays West watershed;
- A maximum of 212 lots with an average lot size of 6.2 acres per lot in the Dennis Creek watershed.

The Water Quality Management Planning Rule does not mandate uniformly zoning minimum lot sizes at the calculated densities across the watershed. Rather, this comparable residential zoning density represents the total number of units that, if built, would not result in a degradation of groundwater quality within a given watershed by exceeding the 2 mg/L nitrate limit. The NJDEP advocates zoning to allow for center-based development, clustering, and protection of environmental features and agriculture land.

Table 1

Gross Method Results (with preserved space)

	Gross	Res	Total	Septic Density	Allowable Lots
	Acres				
Tribs East	806	95	901	8.8	**102**
Tribs West	3676	167	3843	7.9	**486**
Dennis Cr	1296	20	1316	6.2	**212**
TOTAL	**5778**	**282**	**6060**		**801**

Net Method Results (without preserved space)

	Net	Res	Total	Septic Density	Allowable Lots
	Acres				
Tribs East	774	95	869	8.8	**99**
Tribs West	1953	167	2120	7.9	**268**
Dennis Cr	344	20	364	6.2	**59**
TOTAL	**3070**	**282**	**3352**		**426**

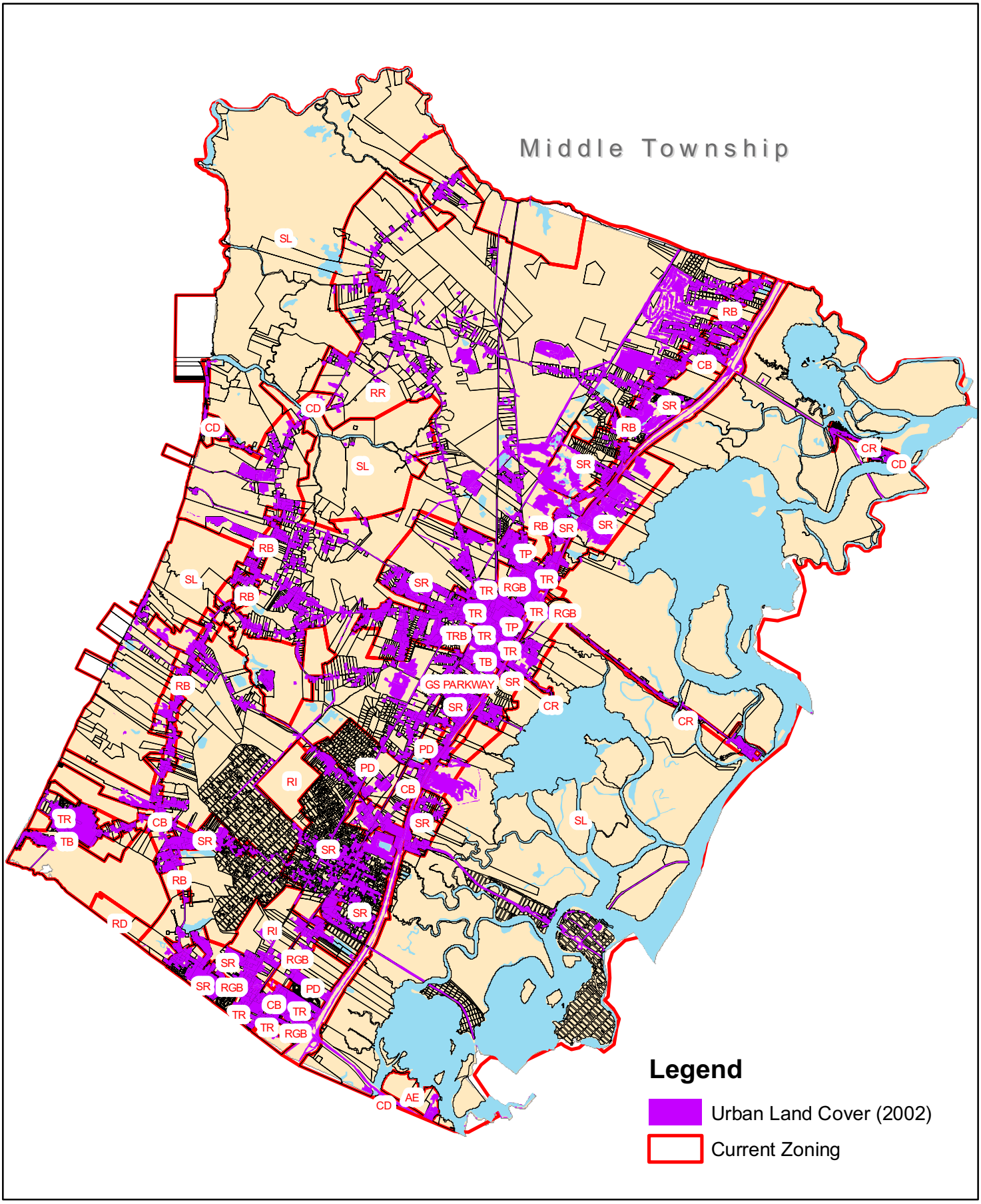

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Figure 1
Model Step 1
Selected Parcels

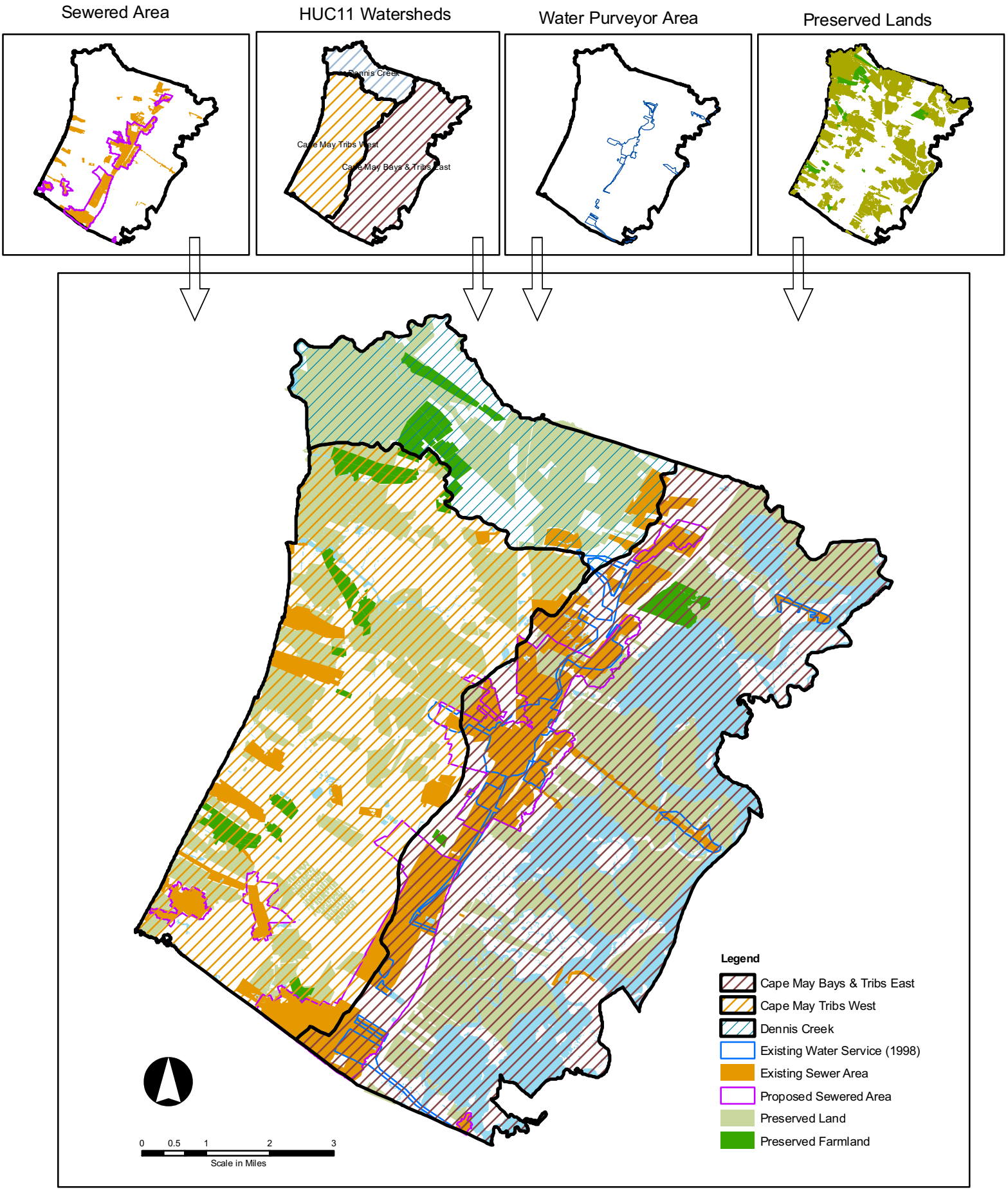

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Figure 2
Model Step 2
Data Inputs

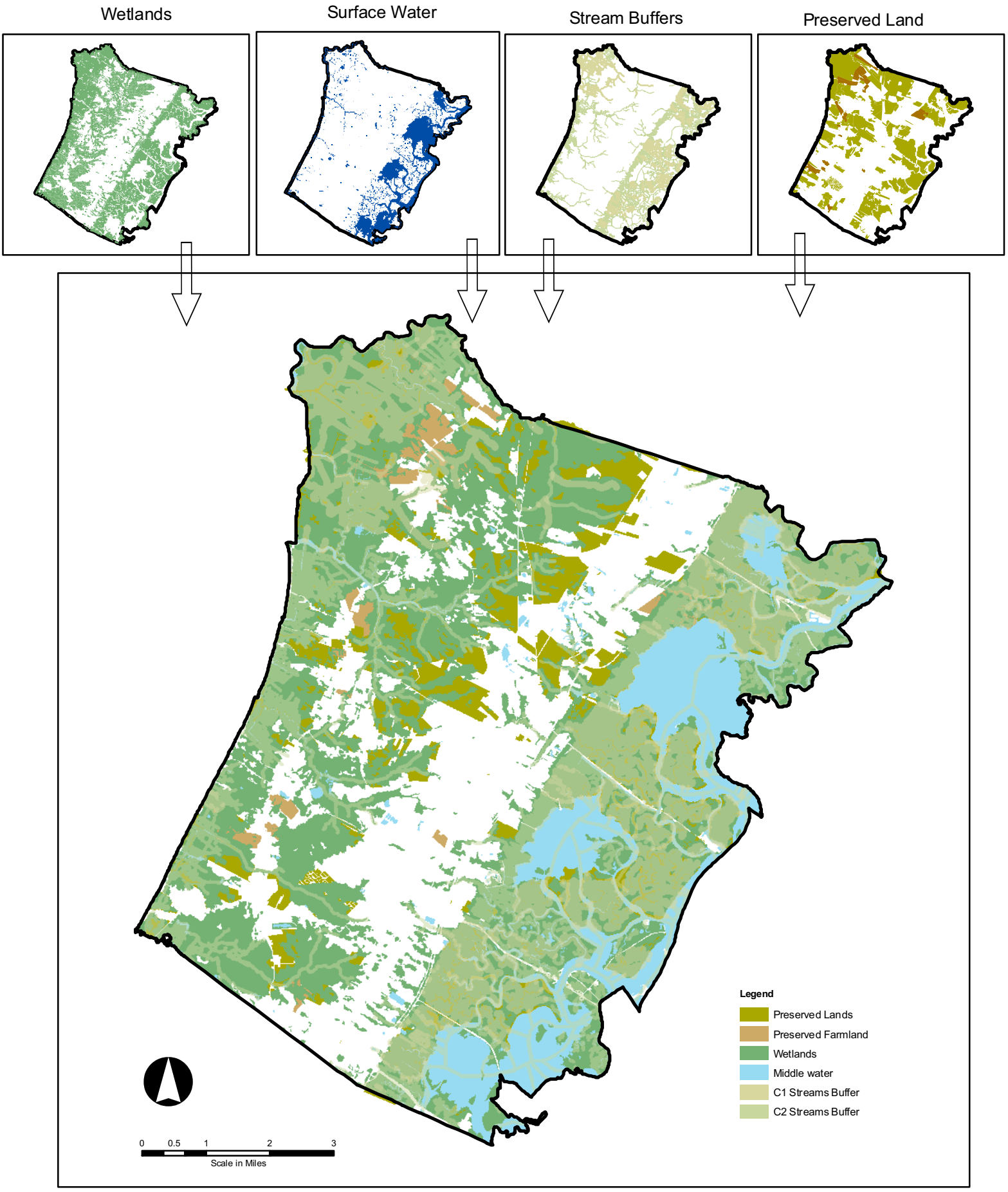

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Figure 3
Model Step 3
Environmental Constraints

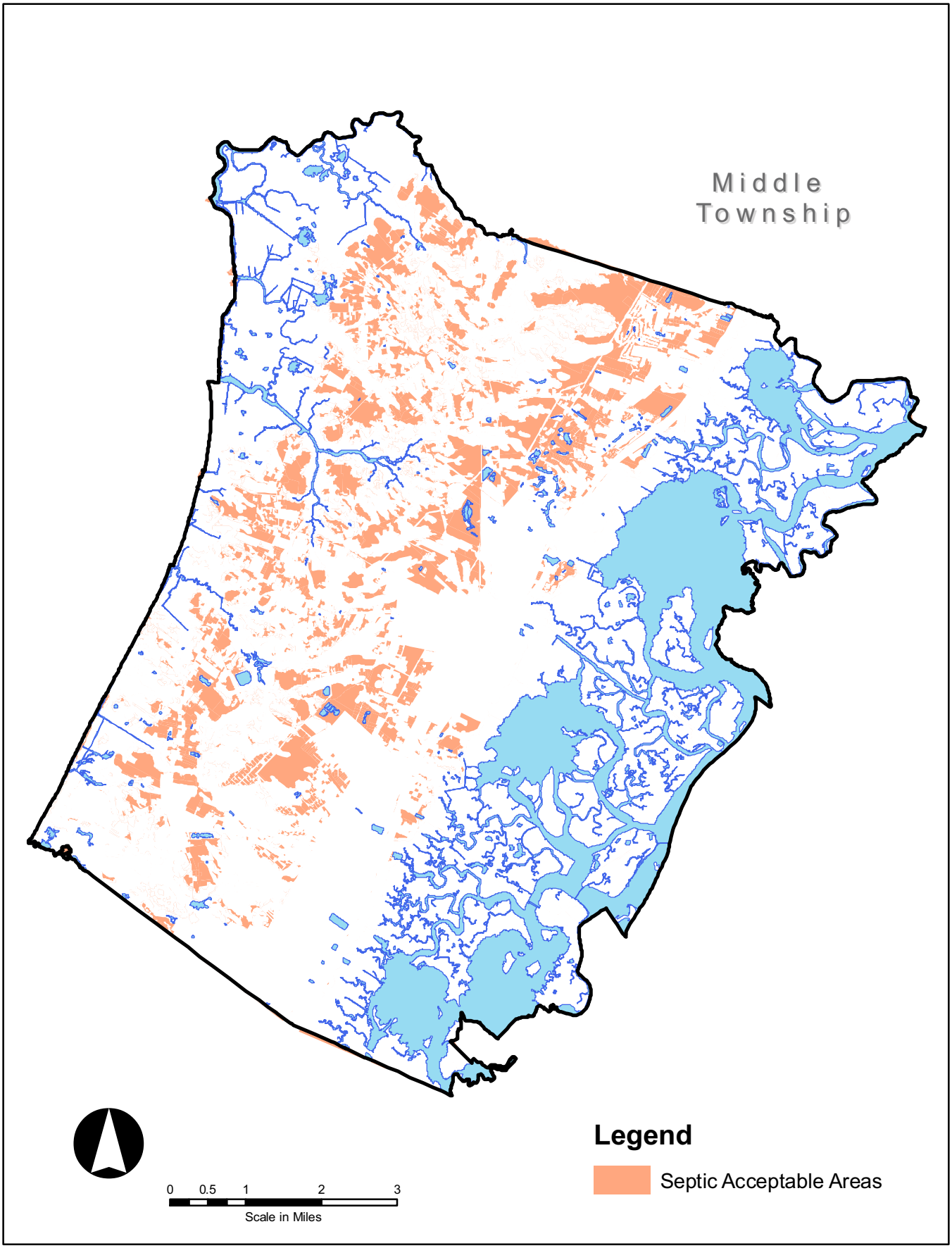

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Figure 4
Model Step 4
Septic Acceptable Areas

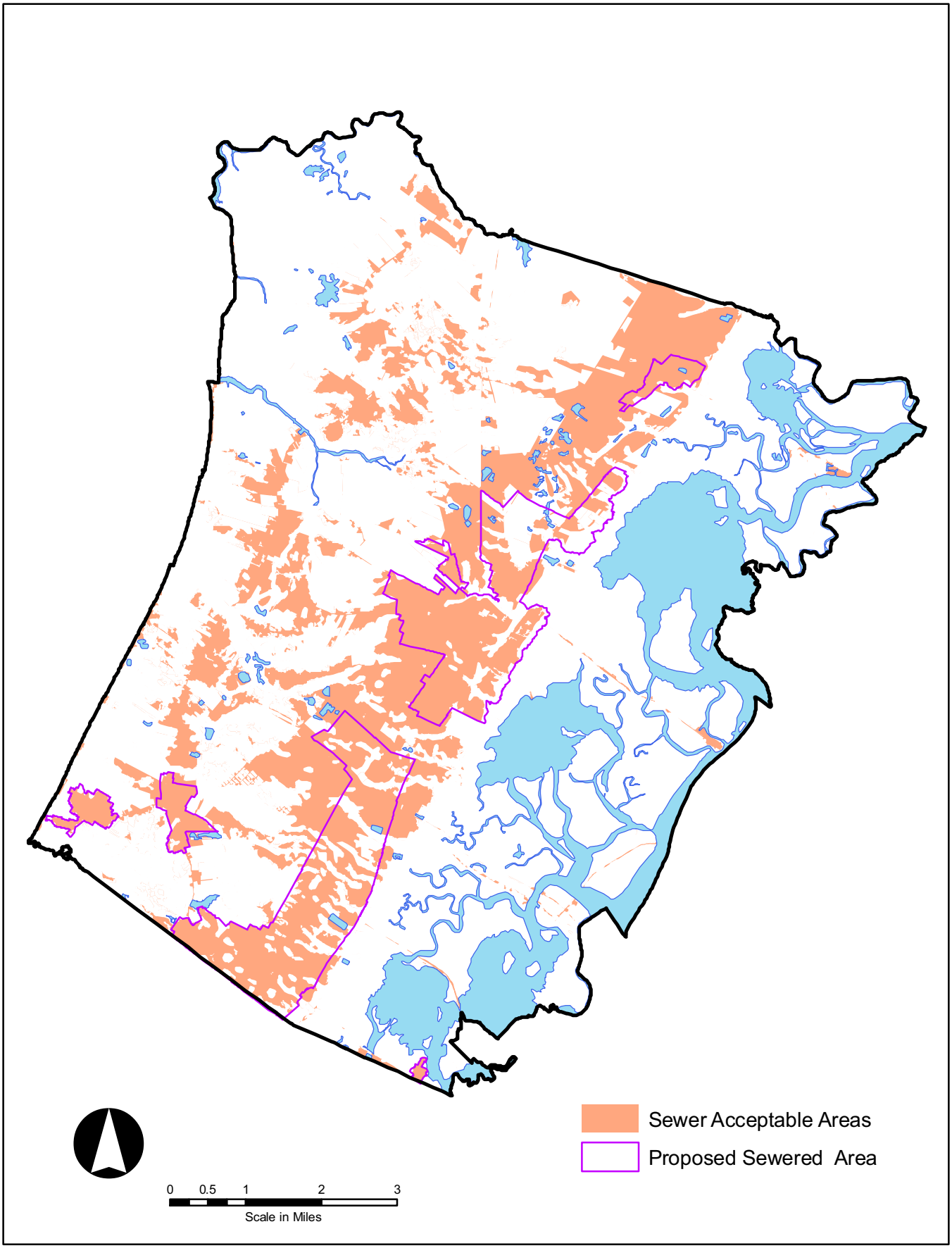

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Figure 5
Model Step 5
Sewer Acceptable Areas

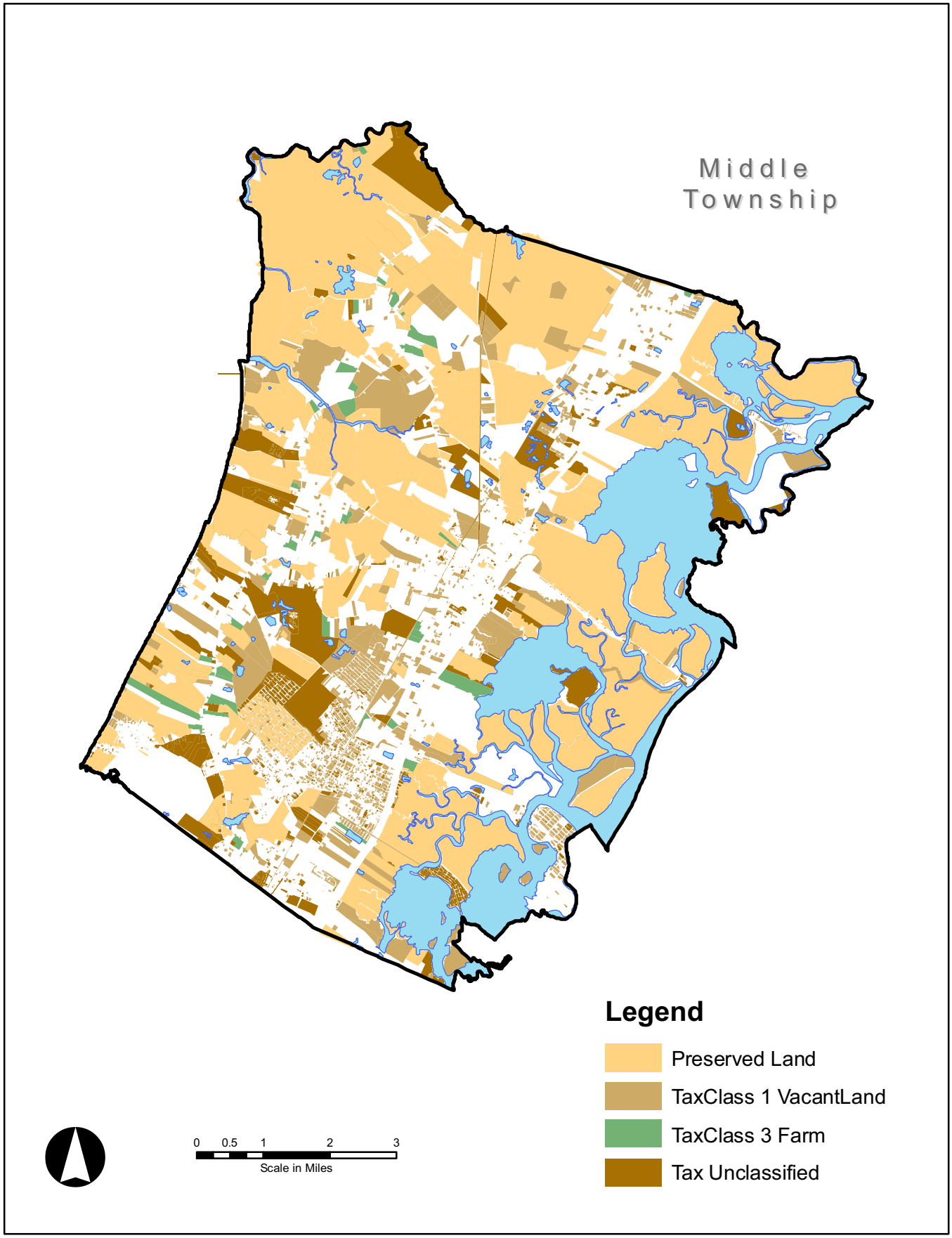

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Figure 6
Undeveloped and
Underdeveloped Properties

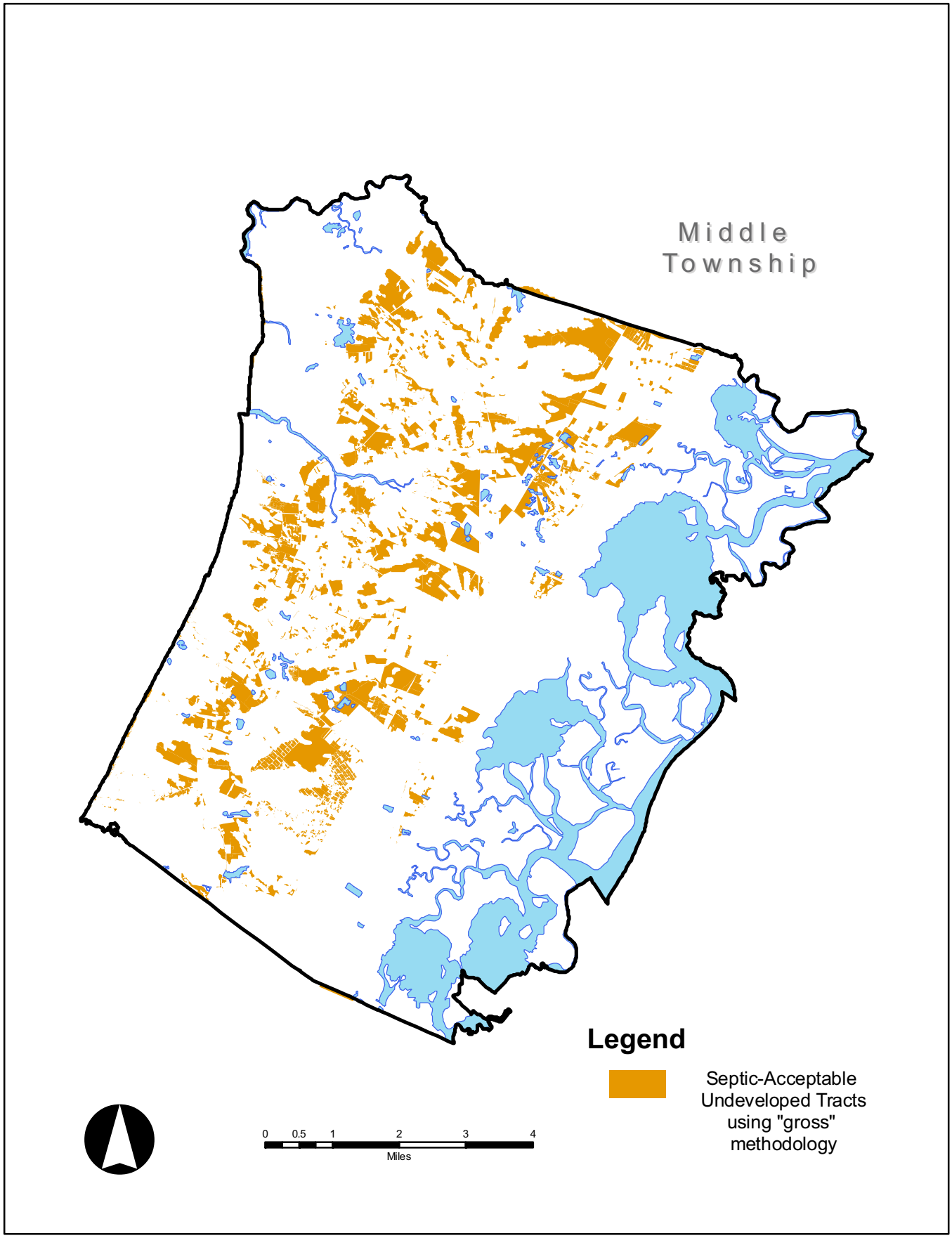

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Figure 7
Septic Acceptable
Undeveloped Tracts

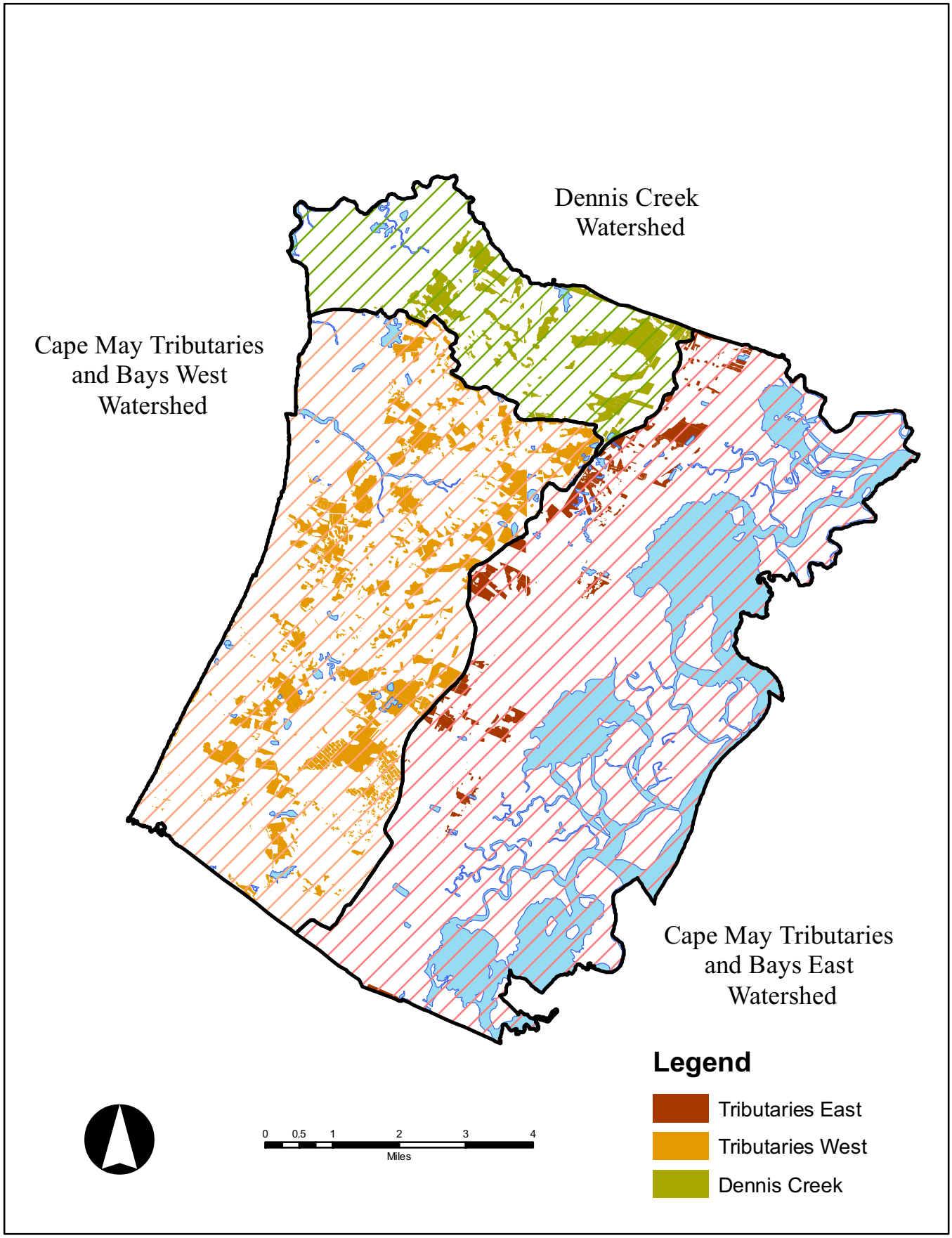

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Figure 8
Septic Acceptable Undeveloped Tracts by Watershed