



**GROUNDWATER RECHARGE  
EVALUATION**

**MULHOCKAWAY CREEK  
STORMWATER MANAGEMENT AND  
ASSOCIATED WATERSHED RESTORATION PLAN**

**PREPARED FOR:  
NEW JERSEY WATER SUPPLY AUTHORITY**



**PREPARED BY:  
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## **A. Introduction and Overview**

To evaluate ground water recharge, TRC Omni implemented a GIS analysis combining geology, soils, land use, topography, and hydrologic information to determine areas suitable for infiltrating surface water and recharging ground water resources. Ground water recharge is influenced by climate, soil, and vegetation factors. Important climatic factors considered include the amount, intensity, and form of precipitation. Also, soil properties and underlying geology are decisive factors in the recharge process. These soil properties exert strong control on permeability and water holding capacity. In addition, land use and land cover affect the surface condition of the soil, which can enhance or reduce infiltration.

The GSR-32 method developed by The New Jersey Geological Survey (NJGS) quantifies the ground water recharge according to climatic factors, soil types, and land cover distribution on a given site. GSR-32 estimates annual groundwater recharge (in inches) and is the accepted standard for determining groundwater recharge throughout New Jersey.

To determine recharge, the evaluation used the GSR-32 method and applied it separately for each combination of soil type and land use within the watershed. Thus, the use of a Geographic Information System (GIS) to perform this type of analysis was essential, given the number of different combinations of soil type and land use that may arise. The data used for the ground water recharge analysis include land use/land cover layers, the soil type (SSURGO) layer, and the recharge and climatic parameters provided by the GSR-32 database.

Also of significance to groundwater recharge in this region, is the presence of Karst bedrock or Carbonate Geology. These geologic formations develop voids and channels as groundwater gradually dissolves bedrock resulting in extremely rapid and unpredictable groundwater flows. Due to this condition, concentrated recharge in Karst/Carbonate areas can quickly degrade groundwater resources and stimulate the formation of sink holes. As a final step in the recharge analysis, TRC Omni evaluated bedrock geology data and prepared a map overlay within the GIS so that areas likely to contain Karst/Carbonate formations can be identified in relation to recharge capacity.

The values generated from the GSR-32 analysis provide an understanding where recharge occurs and can be used to identify ideal sites that would provide infiltration. The Karst/Carbonate areas overlay map further identifies areas within the watershed likely to contain Karst/Carbonate bedrock formations so that any recommended infiltration BMPs in these areas are more carefully evaluated and appropriate precautions are taken or alternative sites or BMP designs are evaluated. The maps generated rank areas based on suitability for groundwater recharge and Karst/Carbonate formations. Using this suitability map and overlay, staff could then overlay tax parcel information available from Hunterdon County and attempt to locate large and/or contiguous undeveloped parcels that could be potential sites for recharge or mitigation banks. The following summary of the methodology and attached maps provide the work product requested and defined in the scope of work.

**B. Suitability Analysis for Groundwater Recharge BMPs**

To determine suitable sites for recharge BMPs or mitigation banks, the team implemented a GIS analysis that combined tax parcel data, geology, soils, land use, topography, and hydrologic information. Digital Tax Parcel data from Hunterdon County GIS was used as the base data for the analysis since we were attempting to find suitable sites or parcels for infiltrating surface water and recharging ground water resources. The team assigned a suitability value (Table 1) to each tax parcel for each the following characteristics; Tax Parcel Ownership, Tax Parcel Size, Carbonate Rock Geology Areas and GSR-32 Estimated Groundwater Recharge.

**Table 1. Suitability Analysis Values**

<b>Description</b>	<b>Suitability Value</b>
<b><i>Tax Parcel Ownership</i></b>	
Public ownership, recreation/conservation land	3
Private ownership, recreation/conservation land	2
Preserved Farmland	1
Private ownership	0

<b>Description</b>	<b>Suitability Value</b>
<b><i>Tax Parcel Size</i></b>	
Greater than 10 acres	3
5 – 10 acres	2
Less than 5 acres	0
<b><i>Carbonate Rock Geology Areas</i></b>	
Yes	-10
No	0
<b><i>GSR-32 Estimated Groundwater Recharge</i></b>	
10 – 23 inches/year	3
Less than 10 inches per year	0

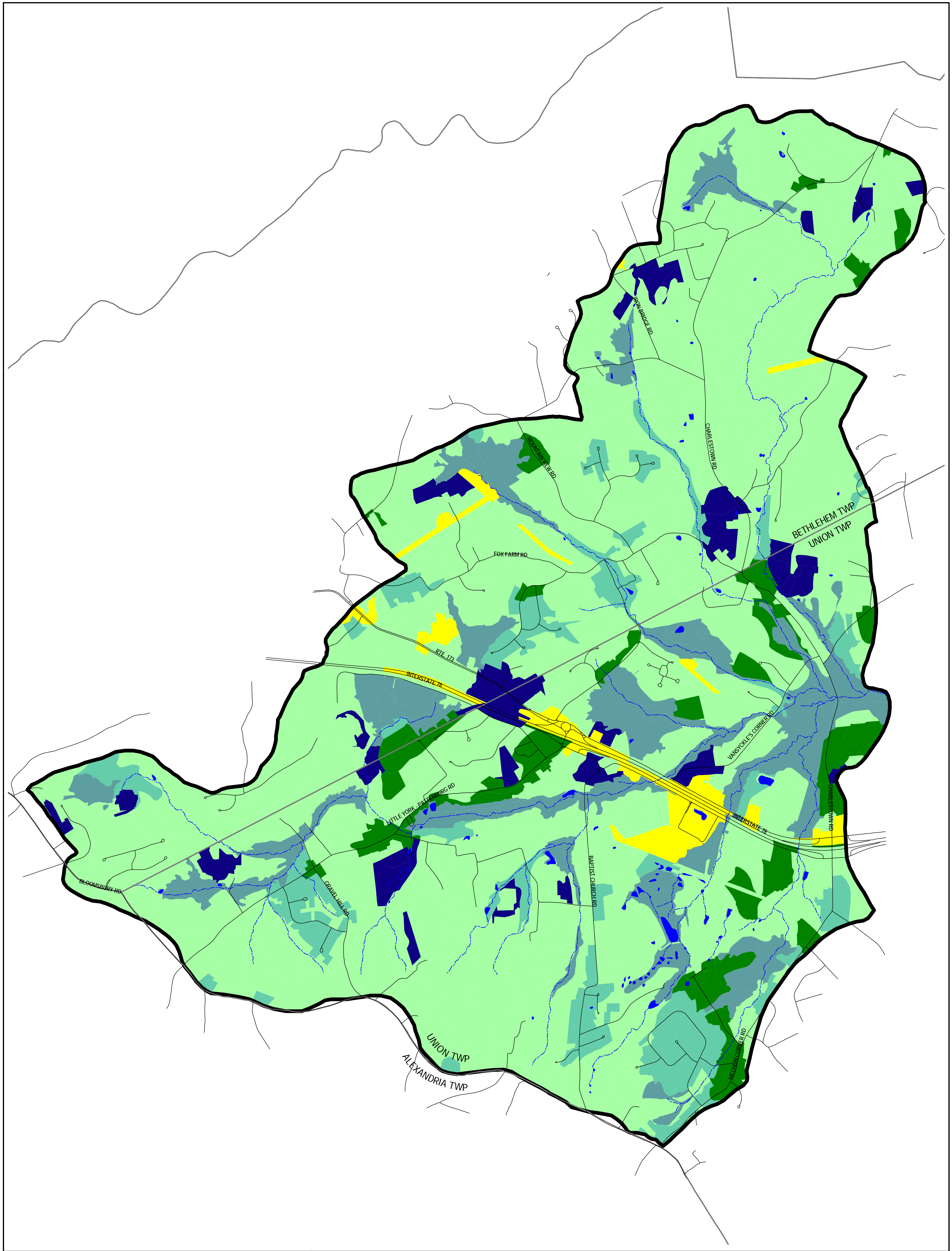
Tax Parcel ownership was determined from attribute information in the tax parcel GIS data. Publicly owned recreation/conservation parcels were considered the most likely parcels where groundwater recharge BMPs could be implemented by NJWSA or local government entities. Tax parcel size was calculated using GIS to determine large and/or contiguous parcels that could be potential sites for groundwater recharge BMPs. Carbonate Rock Geology areas were selected from NJGS Bedrock Geology GIS data. Carbonate Rock areas is similar to Karst areas in that it may develop voids and channels as groundwater gradually dissolves the bedrock. These geologic formations can cause extremely rapid and unpredictable groundwater flows. Due to this condition, concentrated recharge in Carbonate Rock areas can quickly degrade groundwater resources and stimulate the formation of sink holes. All tax parcels that intersected with the Carbonate Rock Geology GIS layer were categorized as Yes. The values generated from the GSR-32 analysis provide an understanding where recharge occurs and can be used to identify ideal sites that would provide infiltration. GSR-32 values were assigned to a tax parcel by determining which GSR-32 value was dominant for the parcel. The suitability values were assigned so that any parcel likely to contain Carbonate Rock bedrock formations would be more carefully evaluated and appropriate precautions taken or alternative sites or BMP designs evaluated.

Using GIS, the four data themes were overlaid and the suitability values were summed. The final suitability values were then allocated into the following 5 categories and mapped.

<b>CATEGORY</b>	<b>VALUE</b>
Most Suitable	7-9
Suitable	4-6
Somewhat Suitable	1-3
Not Suitable	0
Not Suitable (Carbonate Rock Geology)	< 0

Mapping includes:

1. Estimated Groundwater Recharge
2. Karst/Carbonate Geology
3. Open Space
4. Large Parcels
5. Recharge Suitability



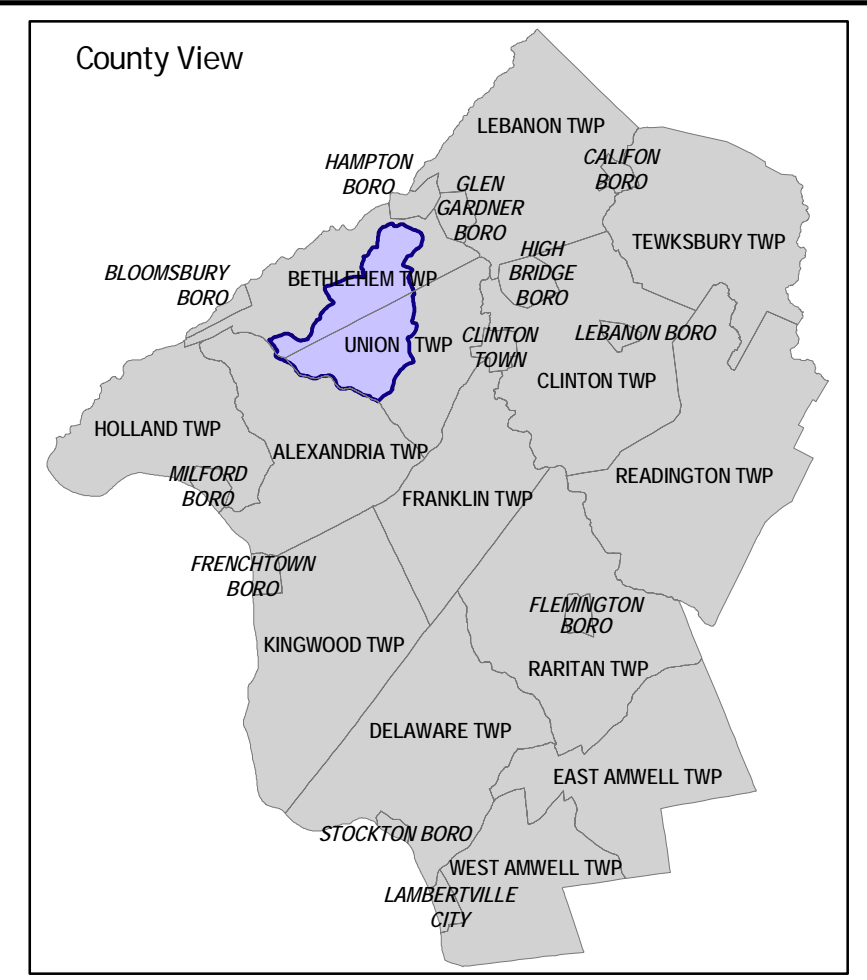
**FIGURE 1:**  
**Groundwater Recharge**

NJWSA - MULHOCKAWAY CREEK  
REGIONAL STORMWATER  
MANAGEMENT PLAN

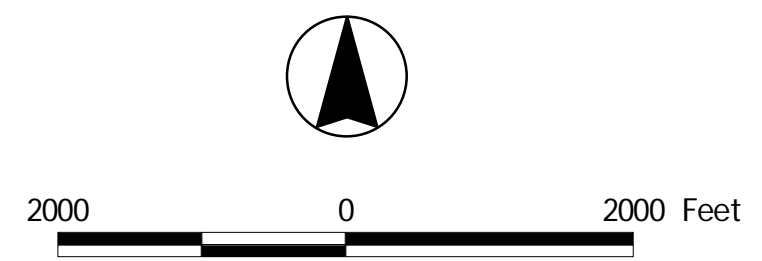
- Groundwater Recharge
- 17 to 23 in/yr
  - 13 to 16 in/yr
  - 10 to 12 in/yr
  - 1 to 9 in/yr
  - 0 in/yr
  - Hydric Soils
  - Wetlands and Open Water
  - No Recharge Calculated

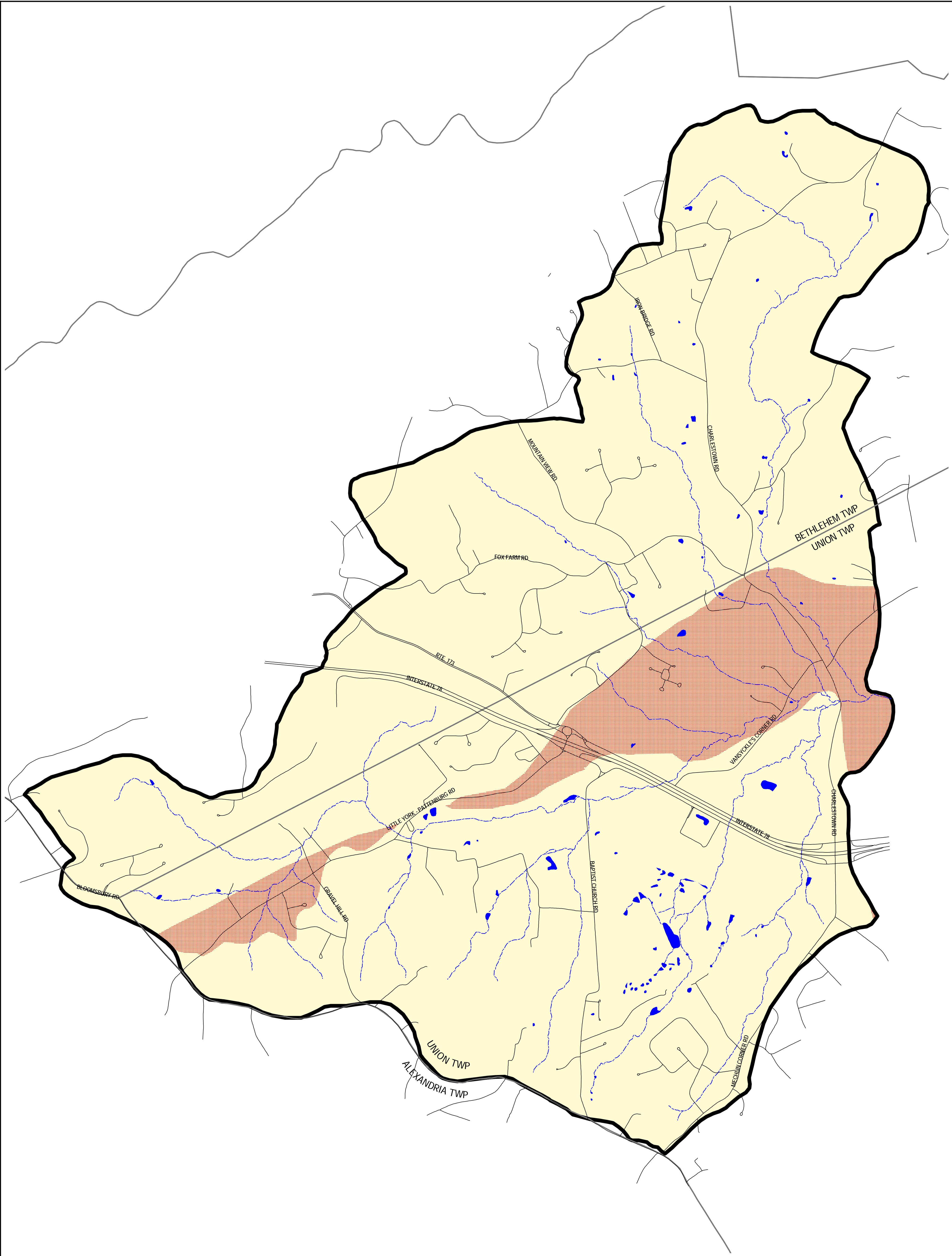
- Mulhockaway Watershed Boundary
- Municipal Boundary
- Stream
- Open Water

DATA SOURCE:  
NJDEP, Hunterdon County GIS



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






**FIGURE 2:**  
**Karst/Carbonate Geology**

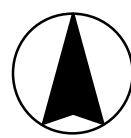
NJWSA - MULHOCKAWAY CREEK  
REGIONAL STORMWATER  
MANAGEMENT PLAN



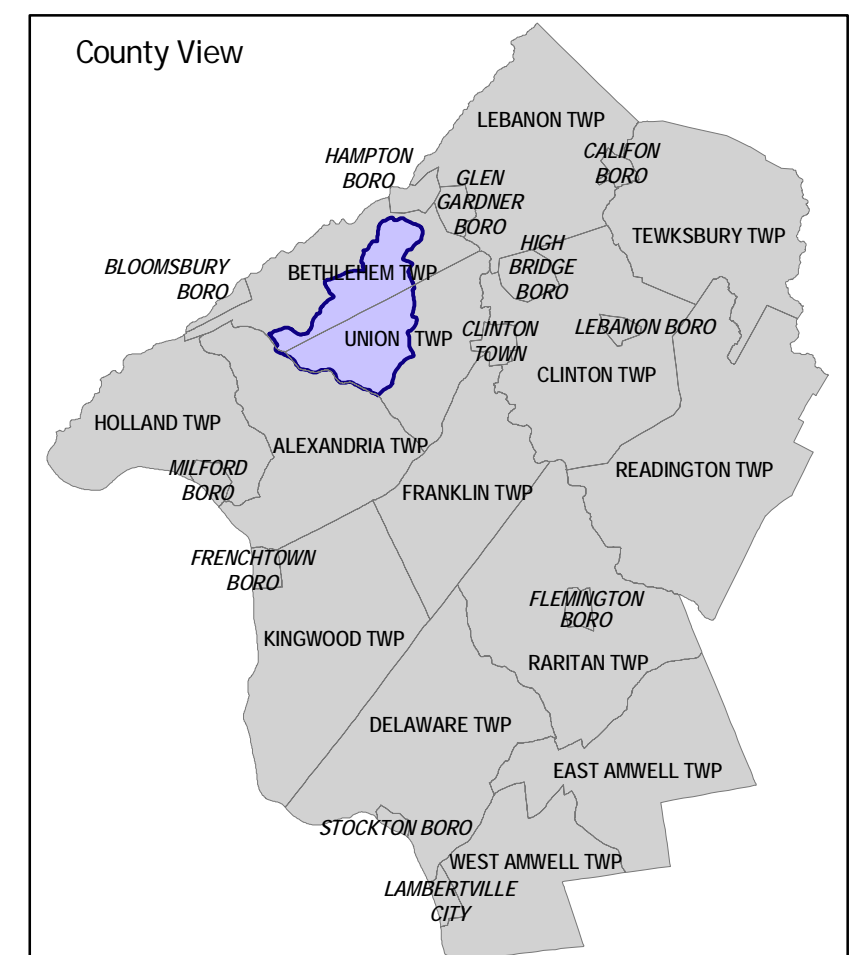
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-  Areas Likely to Contain Karst/Carbonate Geology
-  Mulhockaway Watershed Boundary
-  Municipal Boundary
-  Stream
-  Open Water

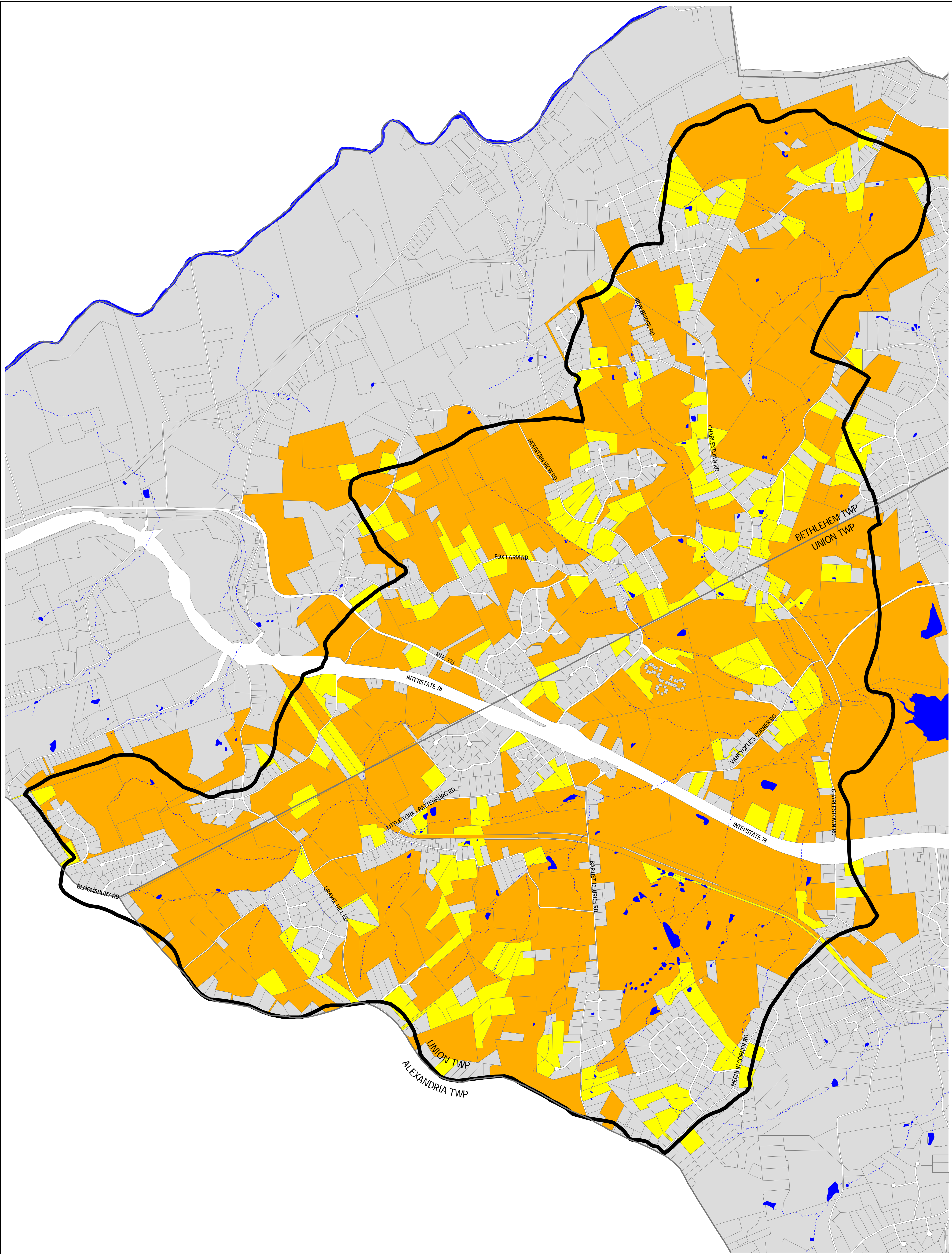
DATA SOURCE:  
NJDEP, NJGS, Hunterdon County GIS



2000 0 2000 Feet







**FIGURE 4:  
Large Parcels**

NJWSA - MULHOCKAWAY CREEK  
REGIONAL STORMWATER  
MANAGEMENT PLAN

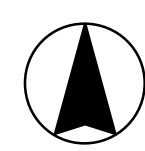


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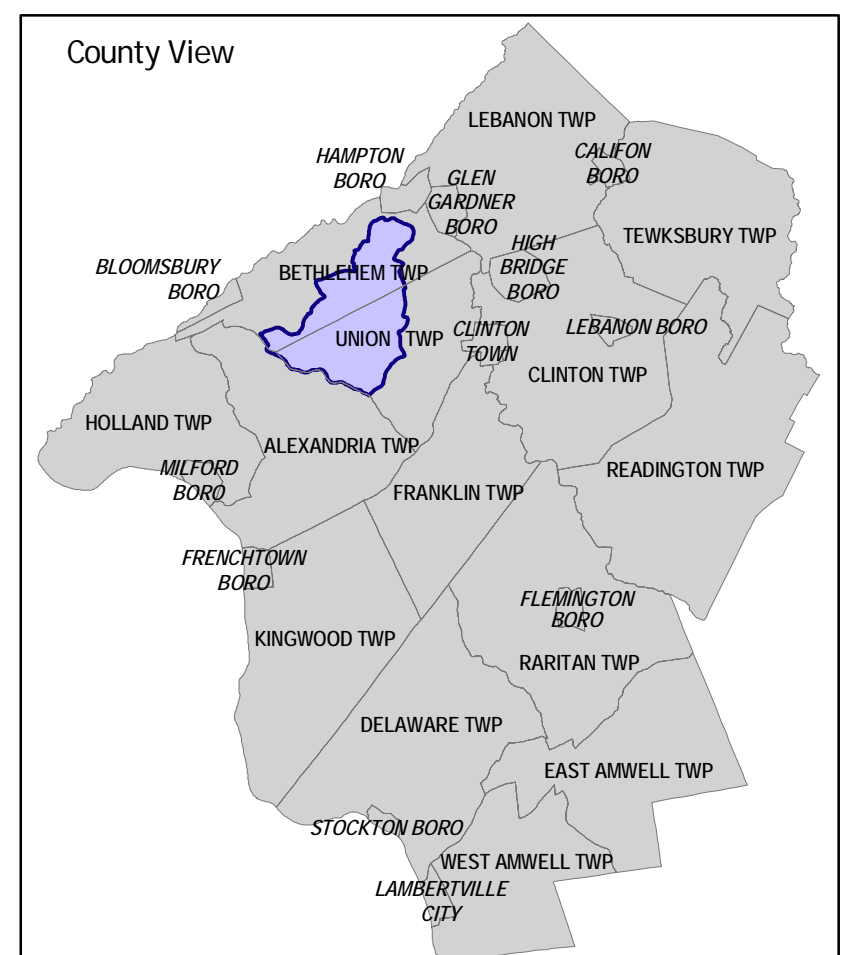
- Parcel Greater Than 5 Acres
- Parcel Greater Than 10 Acres
- Tax Parcel

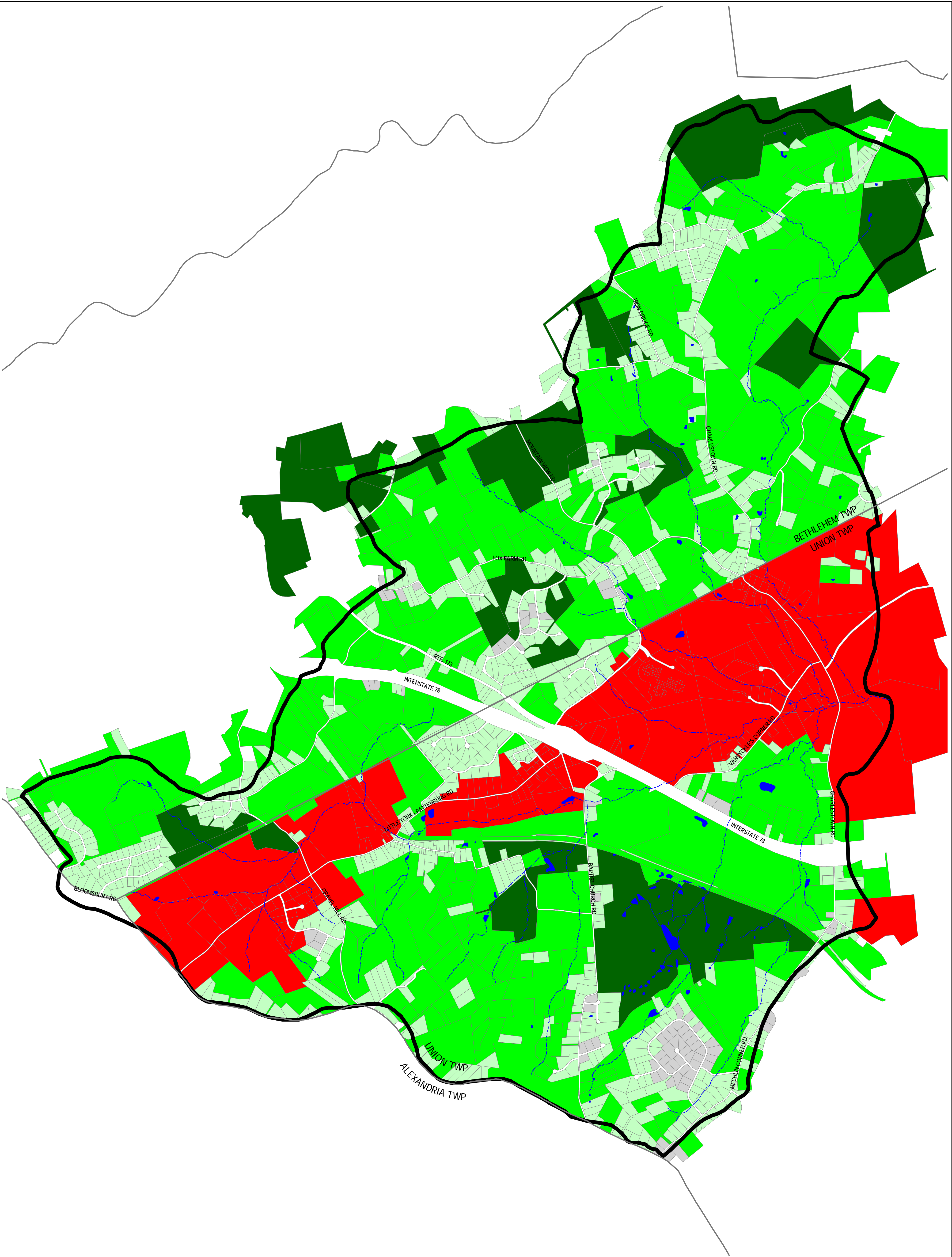
- Mulhockaway Watershed Boundary
- Municipal Boundary
- Stream
- Open Water

DATA SOURCE:  
Hunterdon County GIS



2000 0 2000 Feet





**FIGURE 5:  
Suitability**

NJWSA - MULHOCKAWAY CREEK  
REGIONAL STORMWATER  
MANAGEMENT PLAN

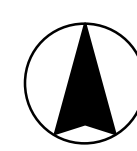


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- Most Suitable
- Suitable
- Somewhat Suitable
- Not Suitable
- Not Suitable (Karst)

- Mulhockaway Watershed Boundary
- Municipal Boundary
- Stream
- Open Water

DATA SOURCE:  
Hunterdon County GIS, TRC Omni



2000 0 2000 Feet

