Objectives:

- ✓ Recognize how spatial analysis can be utilized for real-life applications
- ✓ Understand how to combine vector operations to perform analysis
- ✓ Develop spatial methods and solutions to answer questions

VECTOR SPATIAL ANALYSIS

FAIRFAX COUNTY CRIME

Emma Von Hoene

4/7/2022

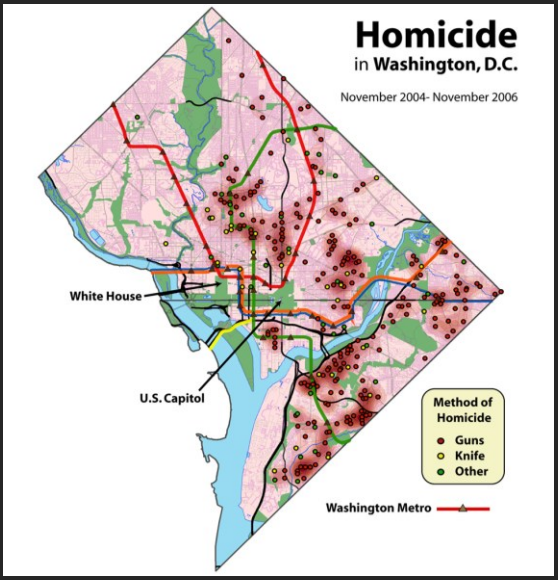
George Mason University: GGS 311

Lecture Plan

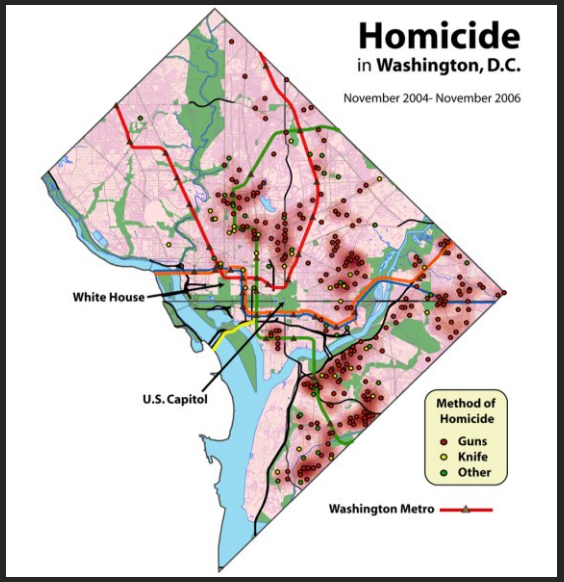
- Discuss how GIS analysis can be used for a real-life application
  - Law Enforcement and Crime!
- Introduce the task for the class
- Brief overview of analysis tools being used
- Review and complete the task
  - ***Finish whatever is not completed outside of class***

GIS and Law Enforcement

- Law enforcement heavily relies upon GIS analysis
- GIS assists police agencies in many ways:

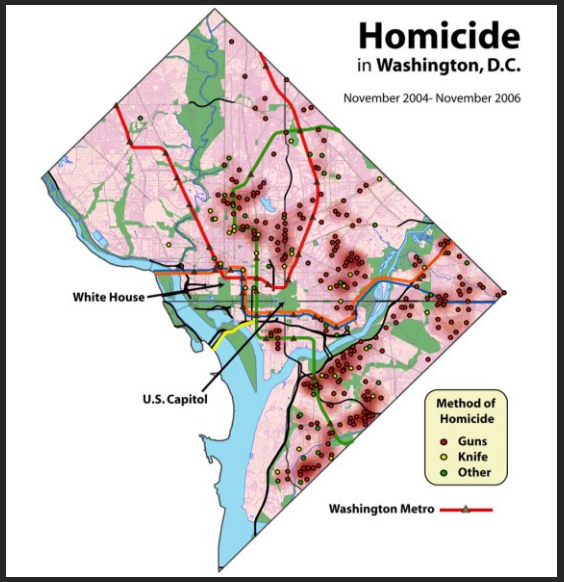


GIS and Law Enforcement



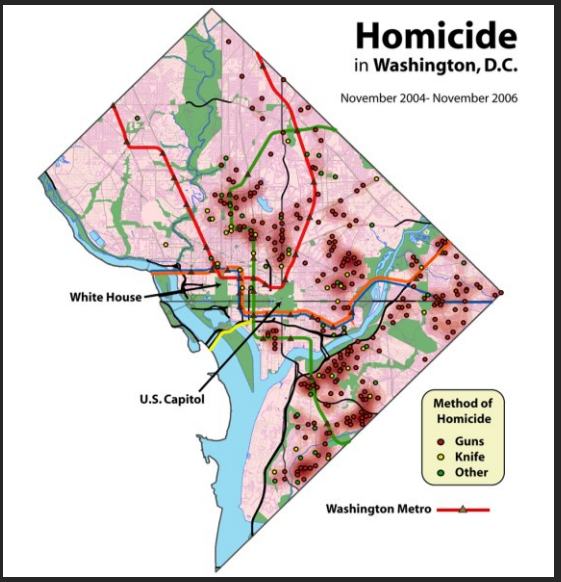
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  - Exploring the distribution of crime
    - Investigates why a specific crime occurs in a certain area
    - Examines when and where a crime occurred with what type of weapon was used, demographics of the victim, etc.

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  - **Identifying crime hotspots**
    - **Assists with intervention methods, such as situating officers at specific locations**

Challenge

The Fairfax County Police Department has found that there has been an increase in crimes around shopping centers in 2021. The department would like to decrease the number of crimes in 2022, so they assign you a task to ***locate specific areas where additional officers should be situated for surveillance***. The department provides the following details:

- Shopping centers are a recent hotspot for criminal activity
- Crime follows and thrives around major transportation routes
- Closest stations are responsible for providing additional surveillance to areas of interest

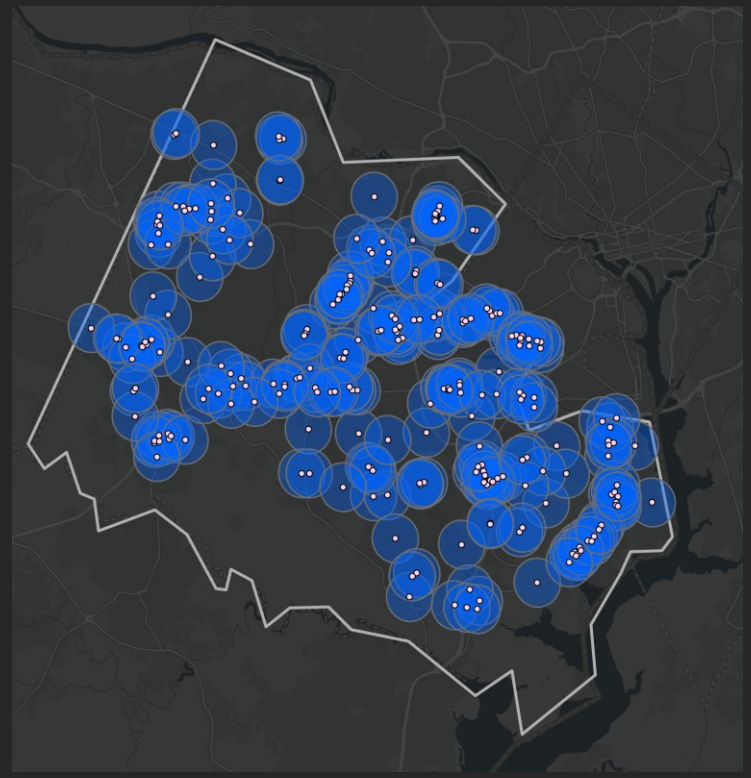
Objective:

Produce a map showing where the FCPD should situate additional officers, and what stations are responsible for each location.

** Represents a real-life example, but not an actual task by the FCPD*

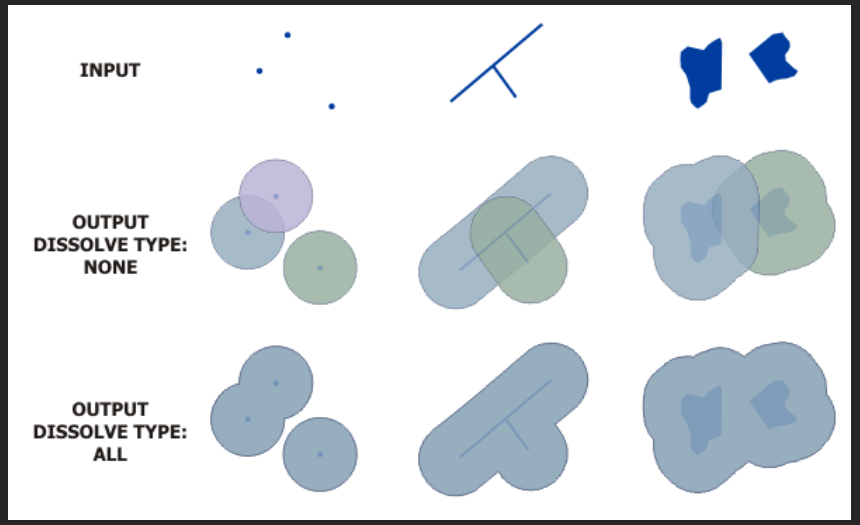
How to approach the task?

- Spatial analysis with vector operations!
- Specific operations:
  - *Buffers*
  - *Spatial Join*
  - *Clip*
  - *Intersect*
  - *Dissolve Boundaries*



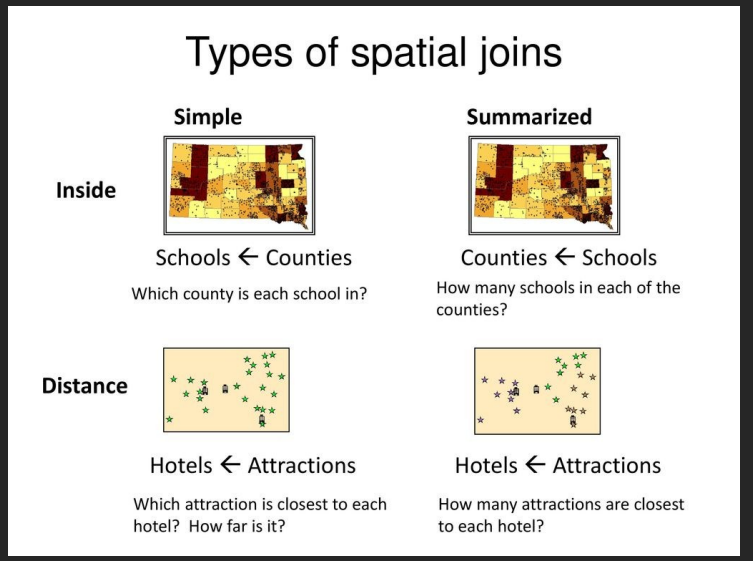
Buffers

- One of the most common vector analysis tools
- Regularly used to address questions of proximity
- The process of creating an output polygon layer containing a zone of a specified width around an input
- Important to note dissolve type:
  - *No Dissolve* — An individual buffer for each feature will be maintained, regardless of overlap
  - *Dissolve all output features into a single feature* — All buffers will be dissolved together into a single feature, removing any overlap



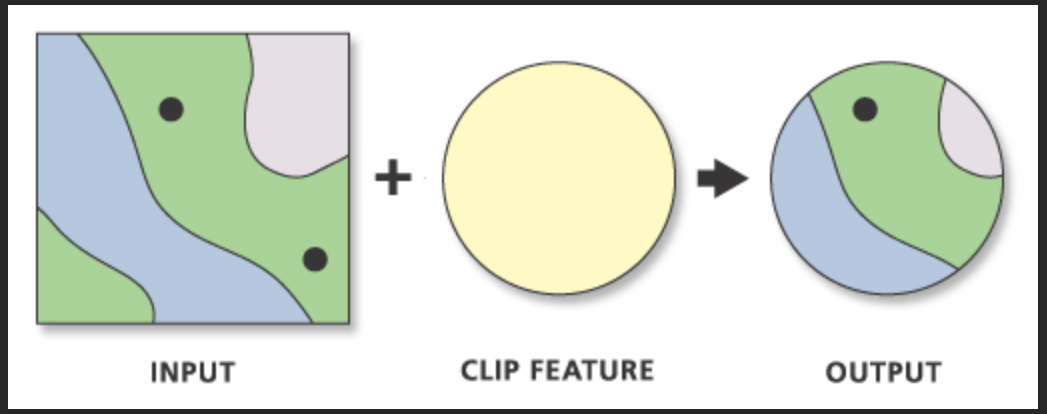
Spatial Join

- A combination between an attribute operation and a vector overlay operation
- Like an attribute join with the combination of two feature dataset tables by a common field
- Different to an attribute join by determining which fields from a source layer's attribute table are appended to the destination layer's attribute based on the *relative locations of selected features*
    - Explicitly based on *proximity or containment* between the source and destination layers, rather than the primary or secondary keys



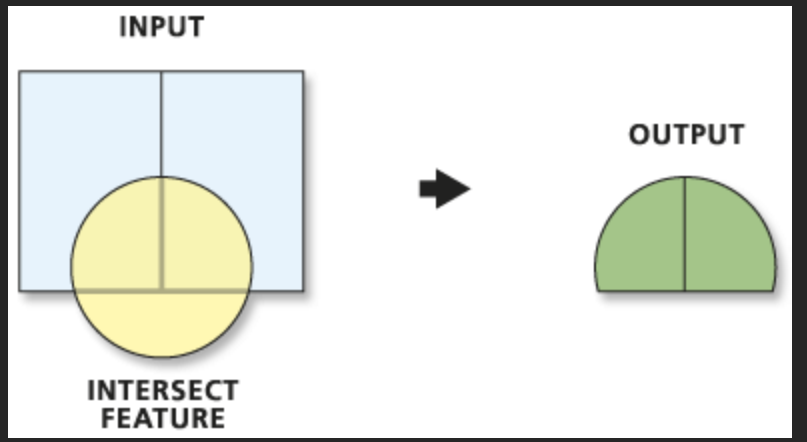
Clip

- A vector overlay method
- Works like a cookie cutter- cuts out parts of a layer with another dataset acting as the cookie cutter
- Used to extract features from an input layer that falls within the spatial extent of the clip layer



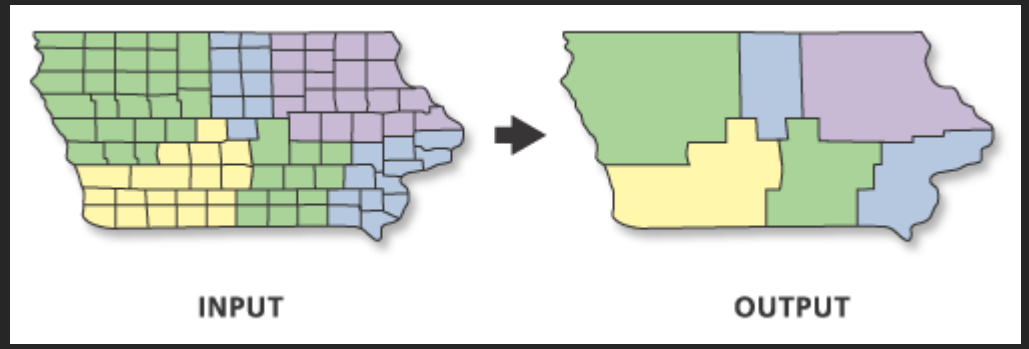
Intersect

- Another vector overlay method
- Computes a geometric intersection of the input features
  - Uses the AND operator
- The output layer covers the spatial extent of the overlay and contains features and attributes from both the input and overlay



Dissolve Boundaries

- Similar to dissolve method, which aggregates features based on an attribute
- Slightly differs because it dissolves based on an overlap of boundaries
- Merges areas that overlap or share a common boundary into a single area



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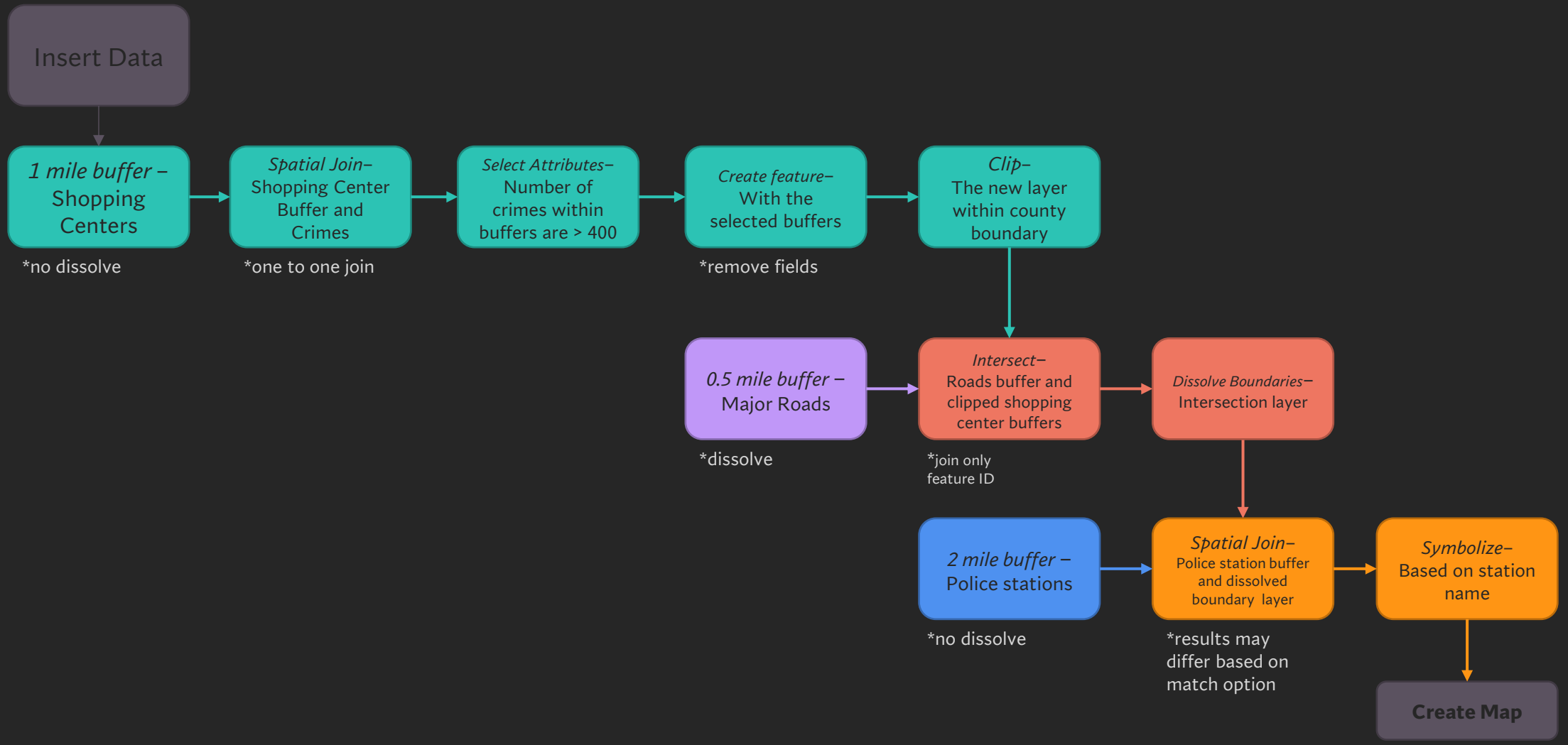
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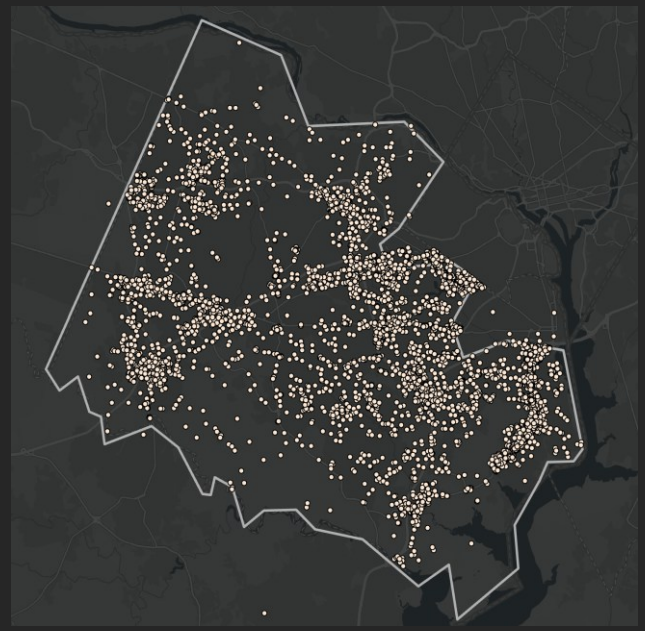
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- Closest stations are responsible for providing additional surveillance to areas of interest →
  - assign each region of interest to a certain police station nearby

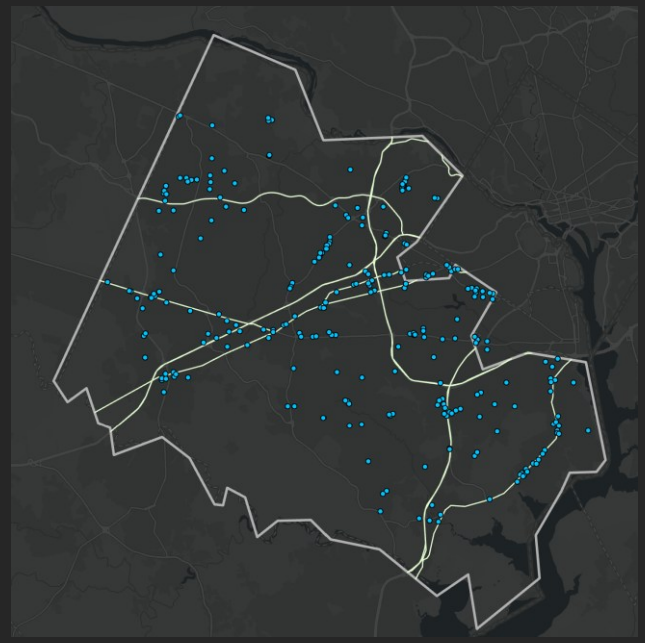
Overall Workflow



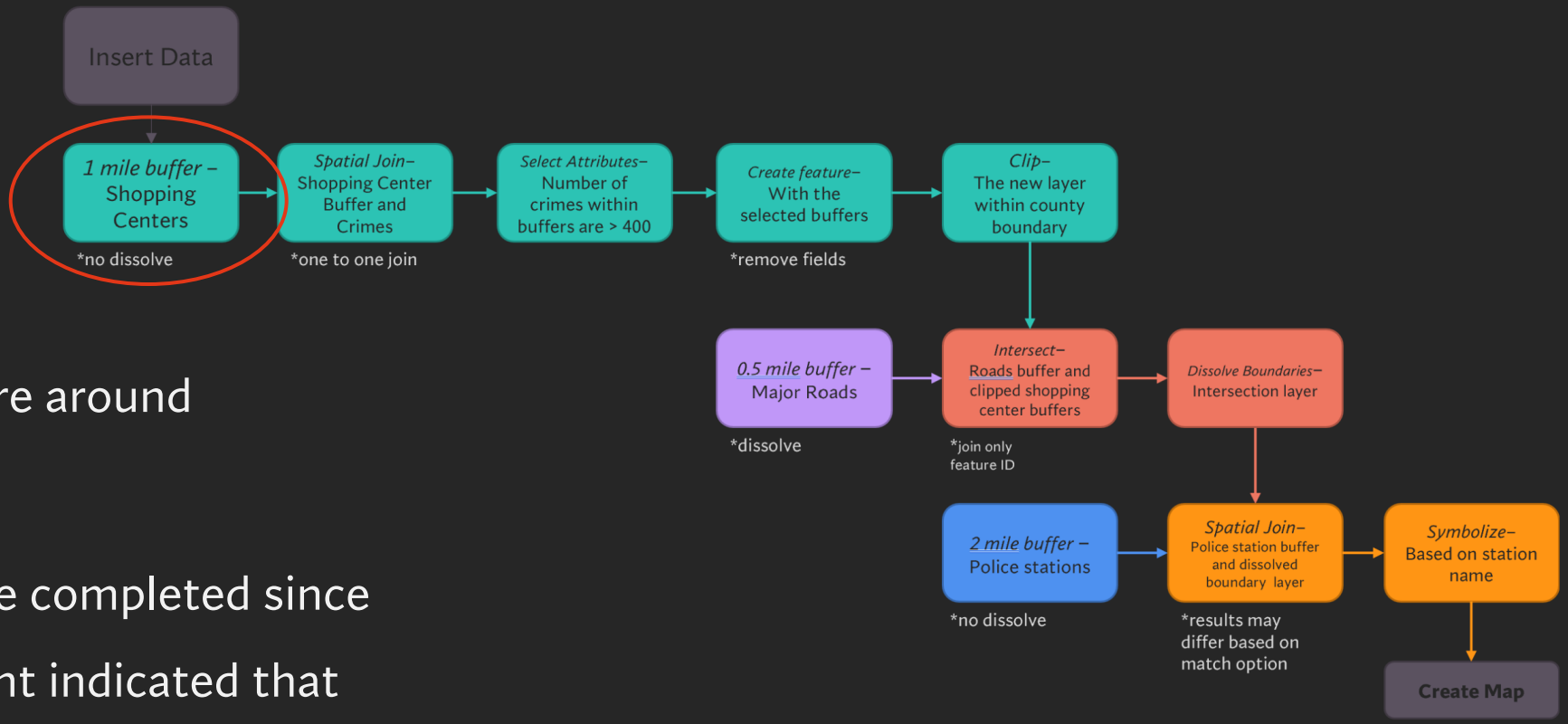
Data

- Import the following data:
  - *Fairfax County Boundary*
  - *2021 Fairfax County Crimes*
  - *Fairfax County Shopping Centers*
  - *Fairfax County Major Roads*
  - *Fairfax County Police Stations*



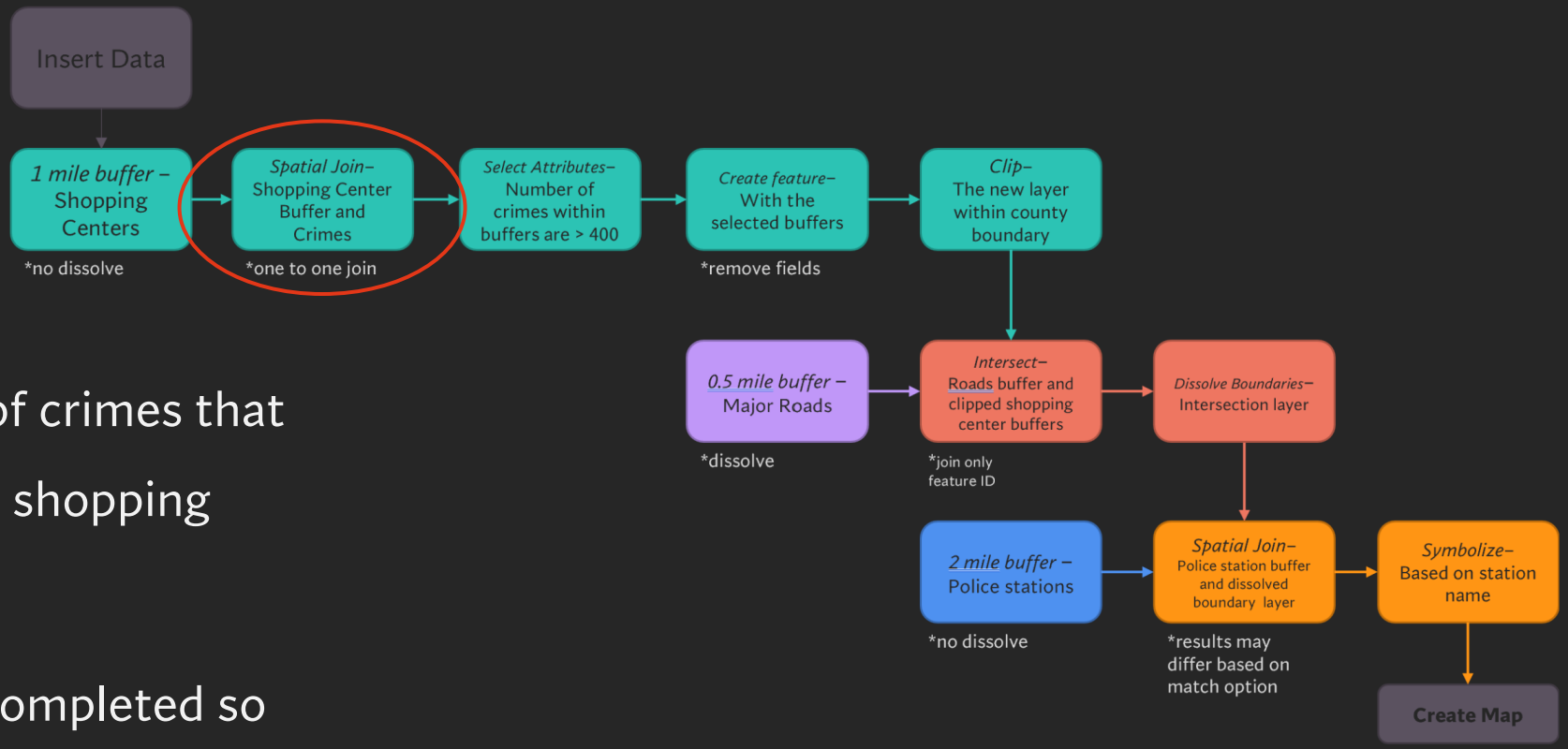


Step 1:



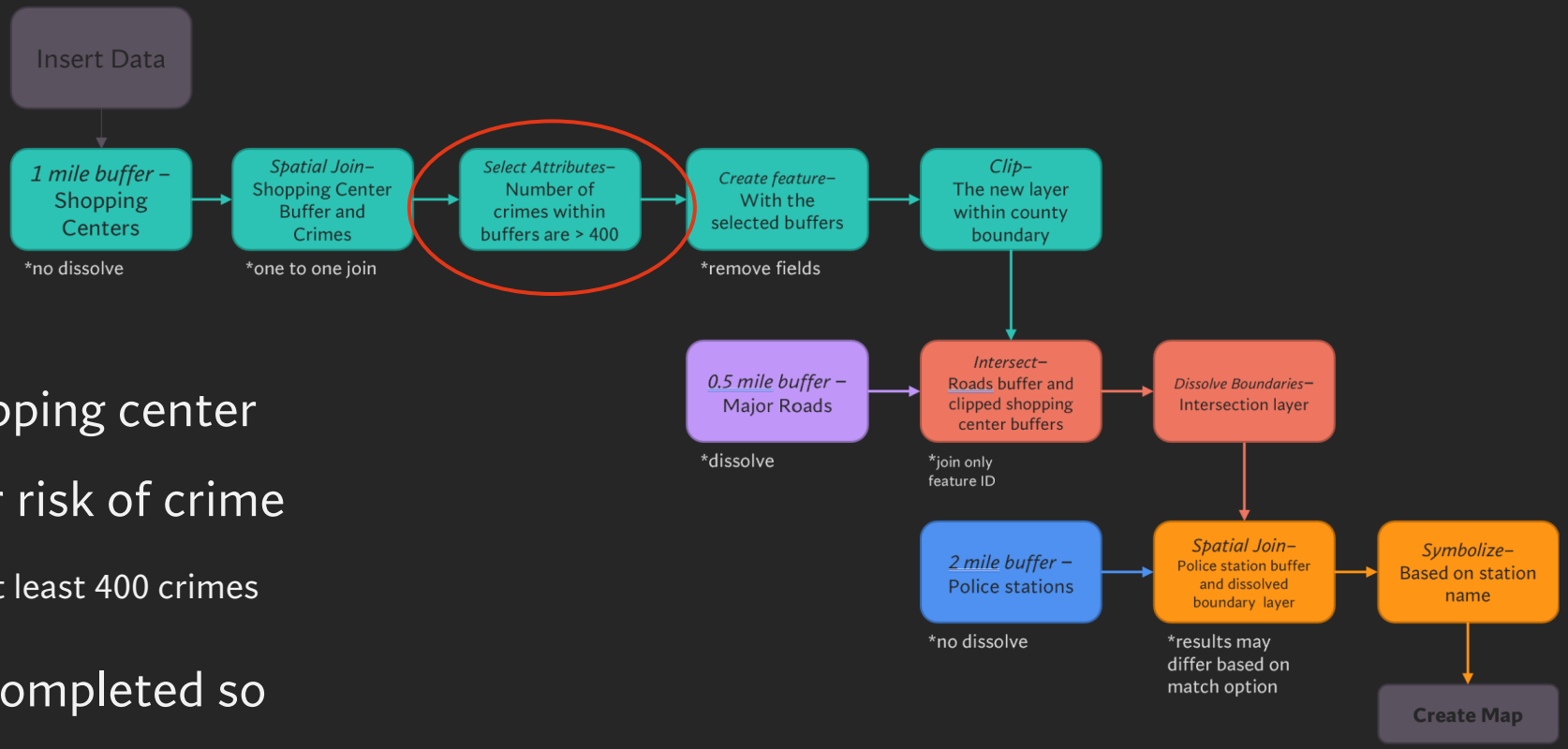
- Identify areas that are around shopping centers
- This step needs to be completed since the police department indicated that many crimes occurred near shopping centers

Step 2:



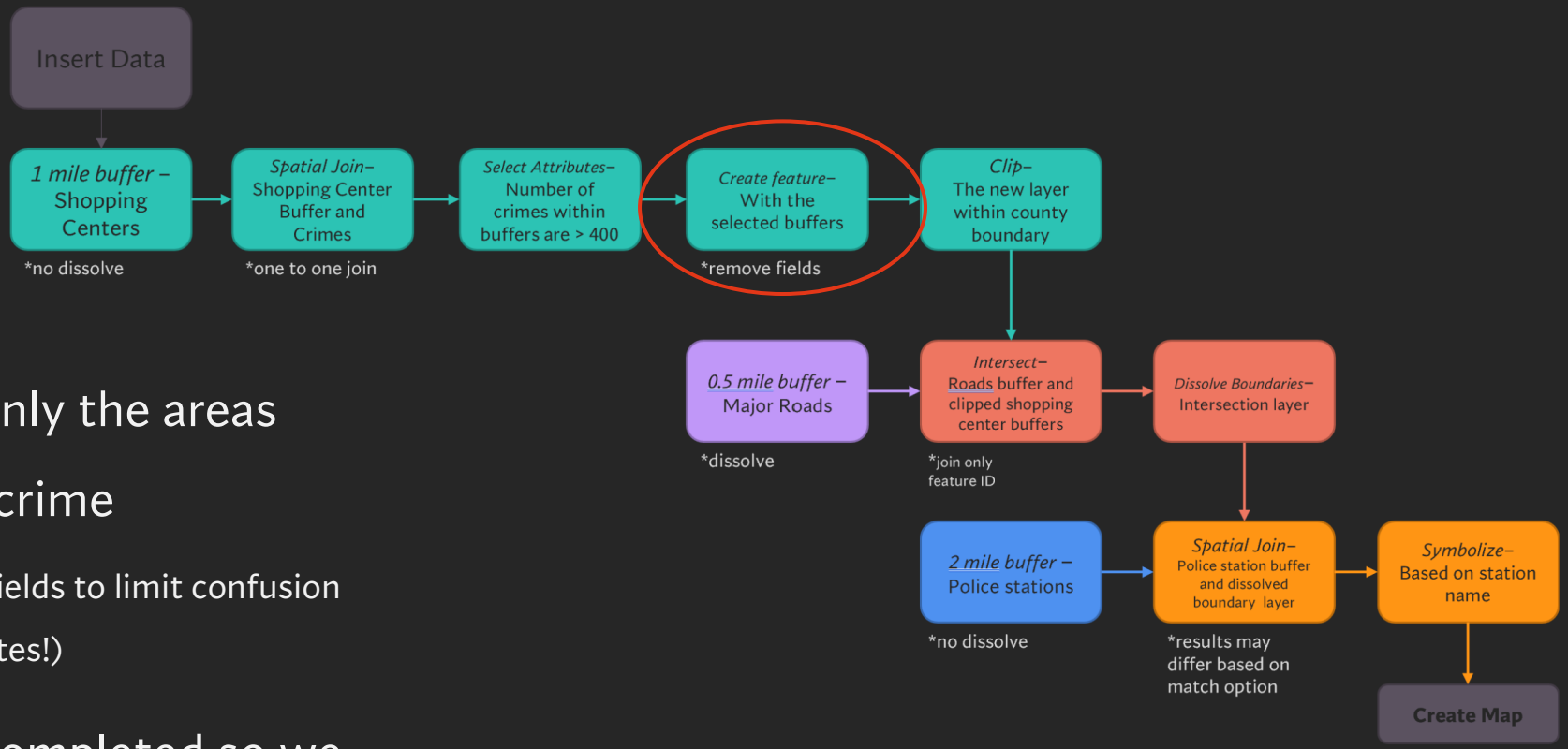
- Calculate the number of crimes that have occurred near the shopping centers
- This step needs to be completed so that we see how many crimes happened around each shopping center

Step 3:



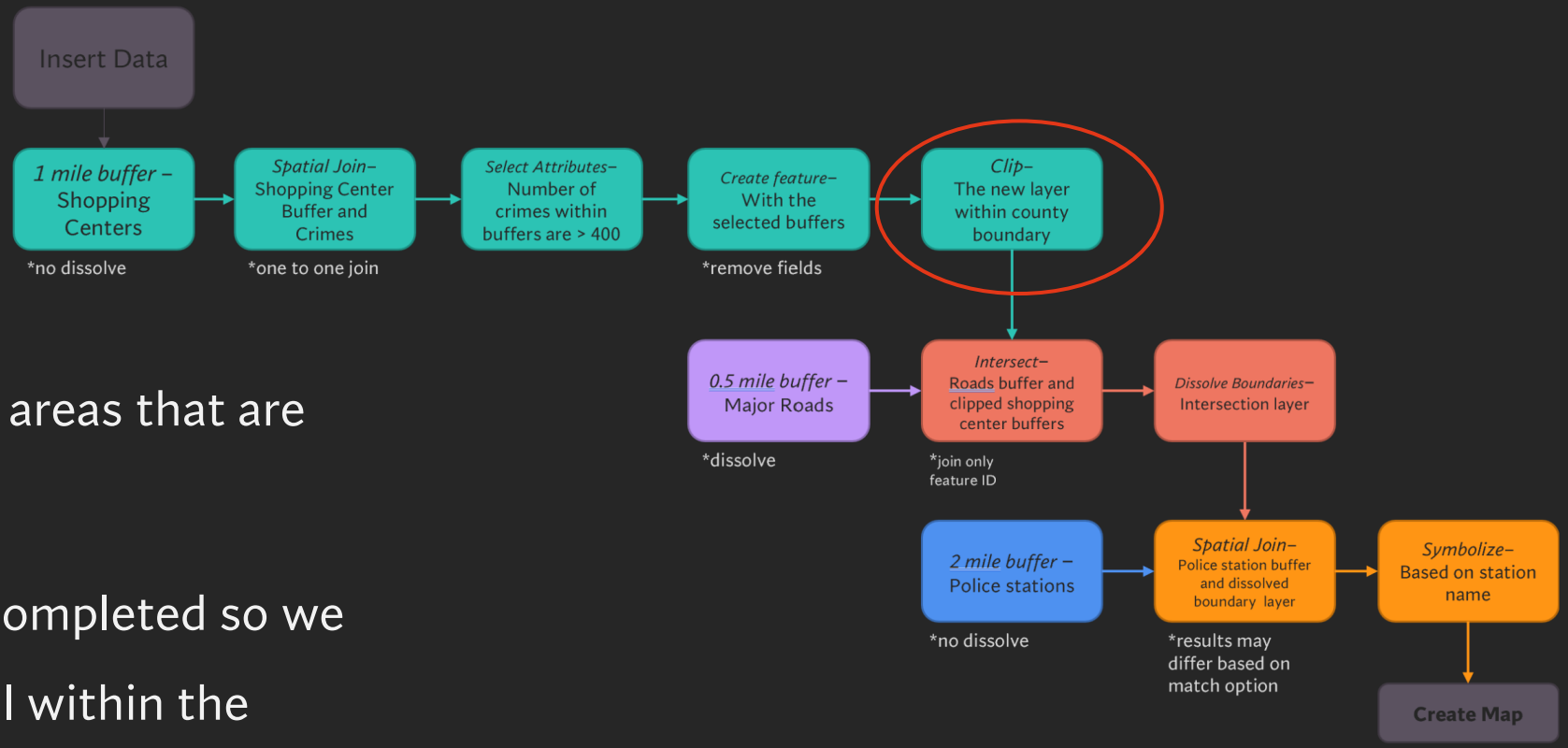
- Select the specific shopping center areas that are at higher risk of crime
  - Select the polygons with at least 400 crimes
- This step needs to be completed so that we can filter out only the shopping centers we are interested in, which would be the ones at the highest risk of crime

Step 4:



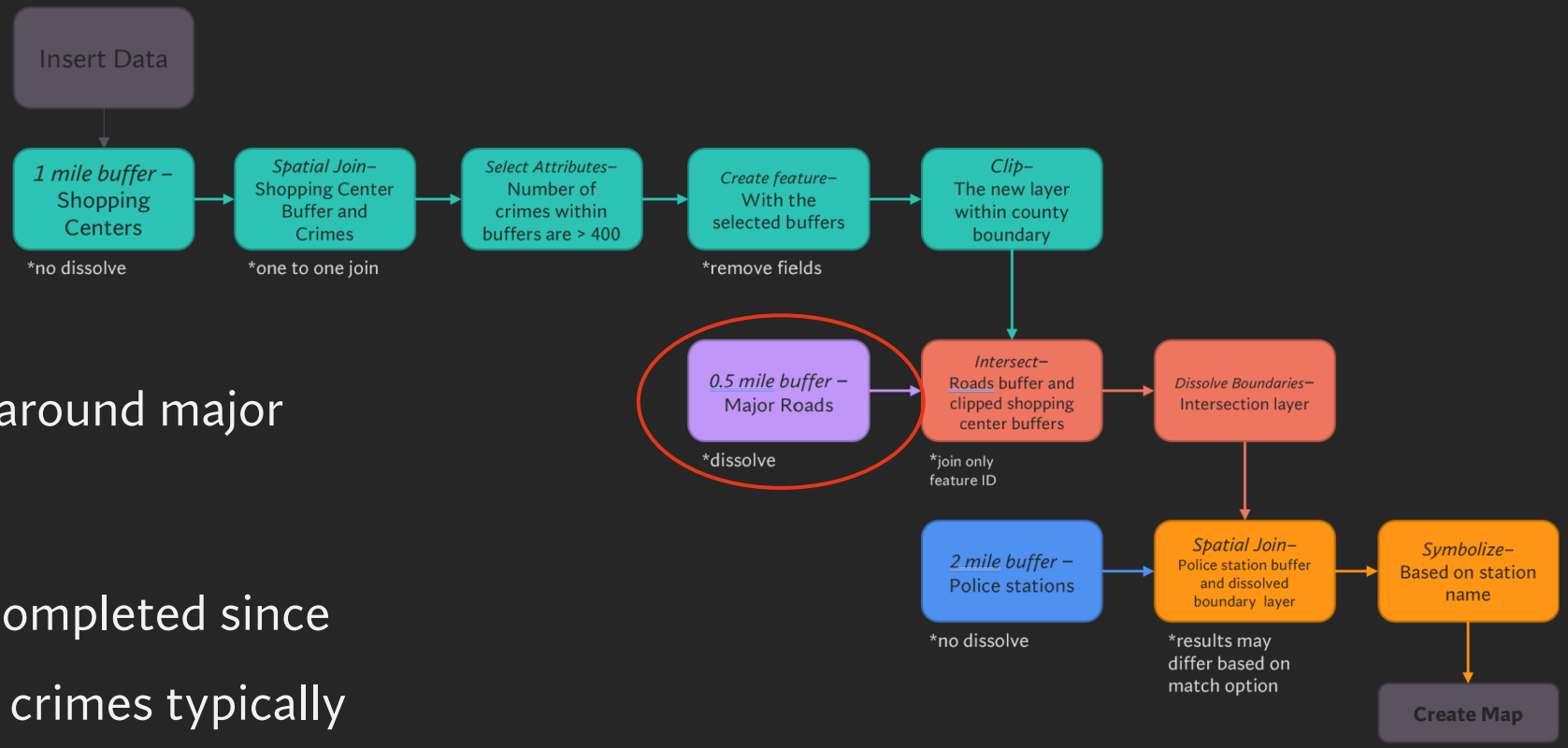
- Create a new layer of only the areas that are at high risk of crime
  - Remove any unnecessary fields to limit confusion (there will be many attributes!)
- This step needs to be completed so we can identify only the areas that need extra police attention

Step 5:



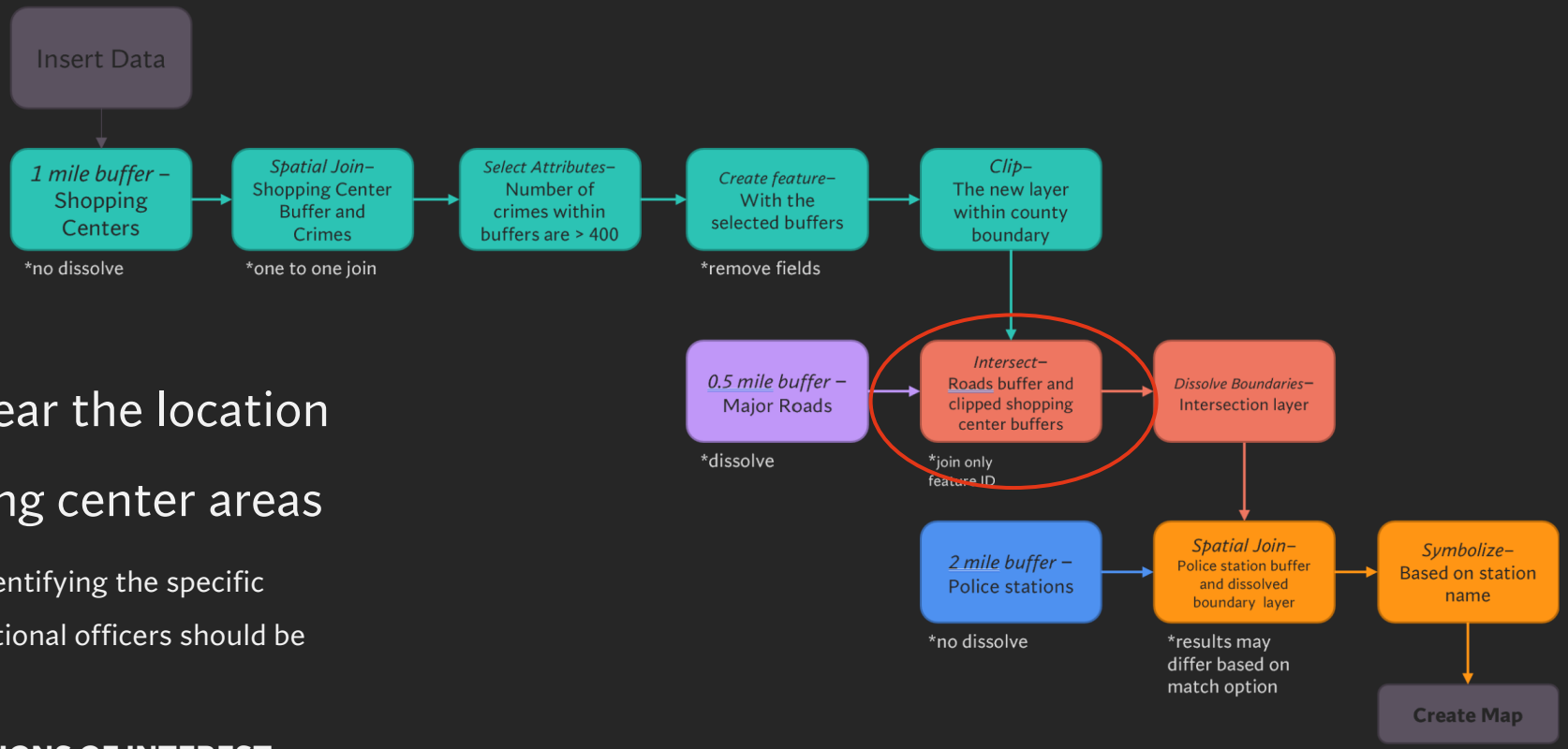
- Clip the new layer (the areas that are at high risk of crime)
- This step needs to be completed so we know that the areas fall within the county boundary

Step 6:



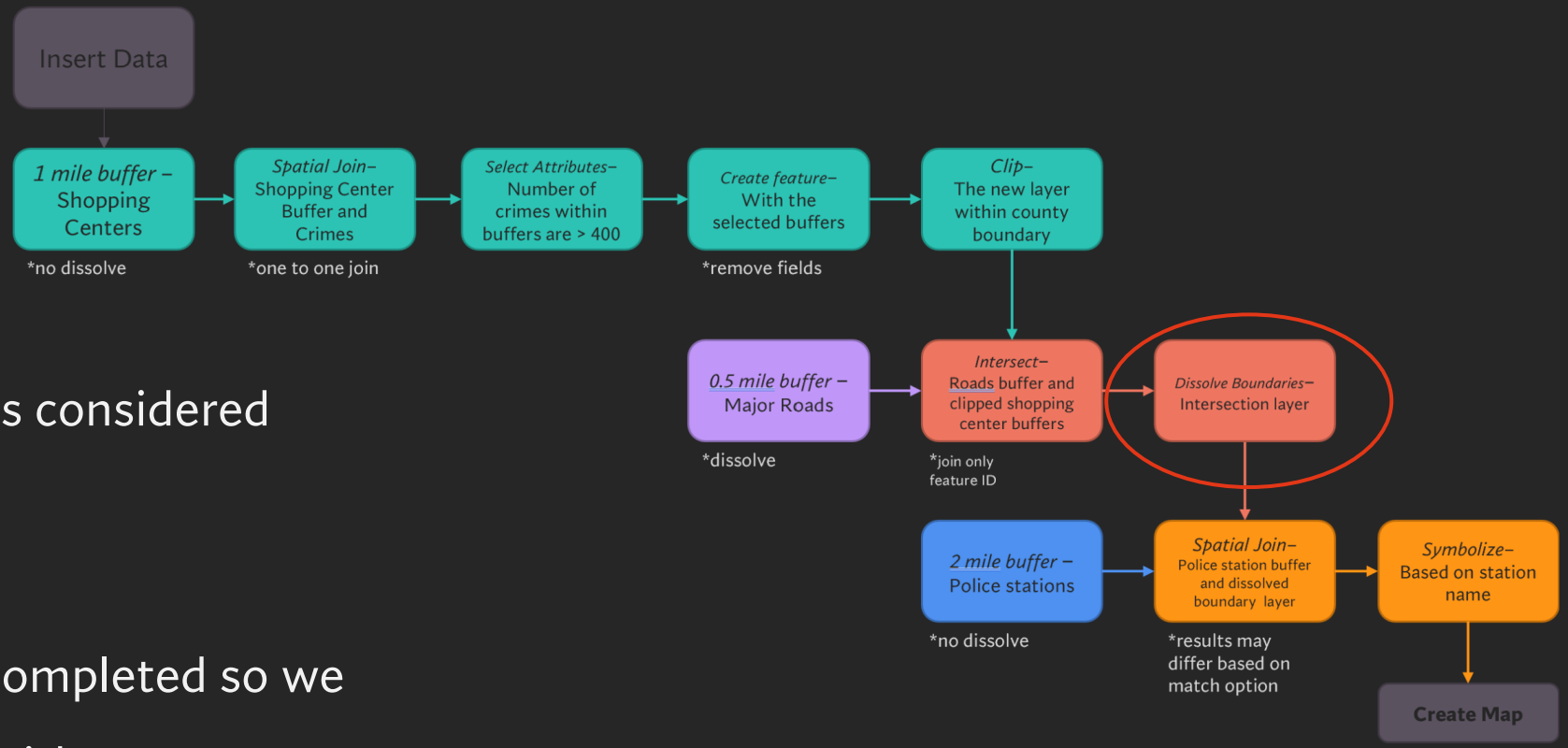
- Identify areas that are around major roads
- This step needs to be completed since research indicates that crimes typically occur near major transportation routes

Step 7:



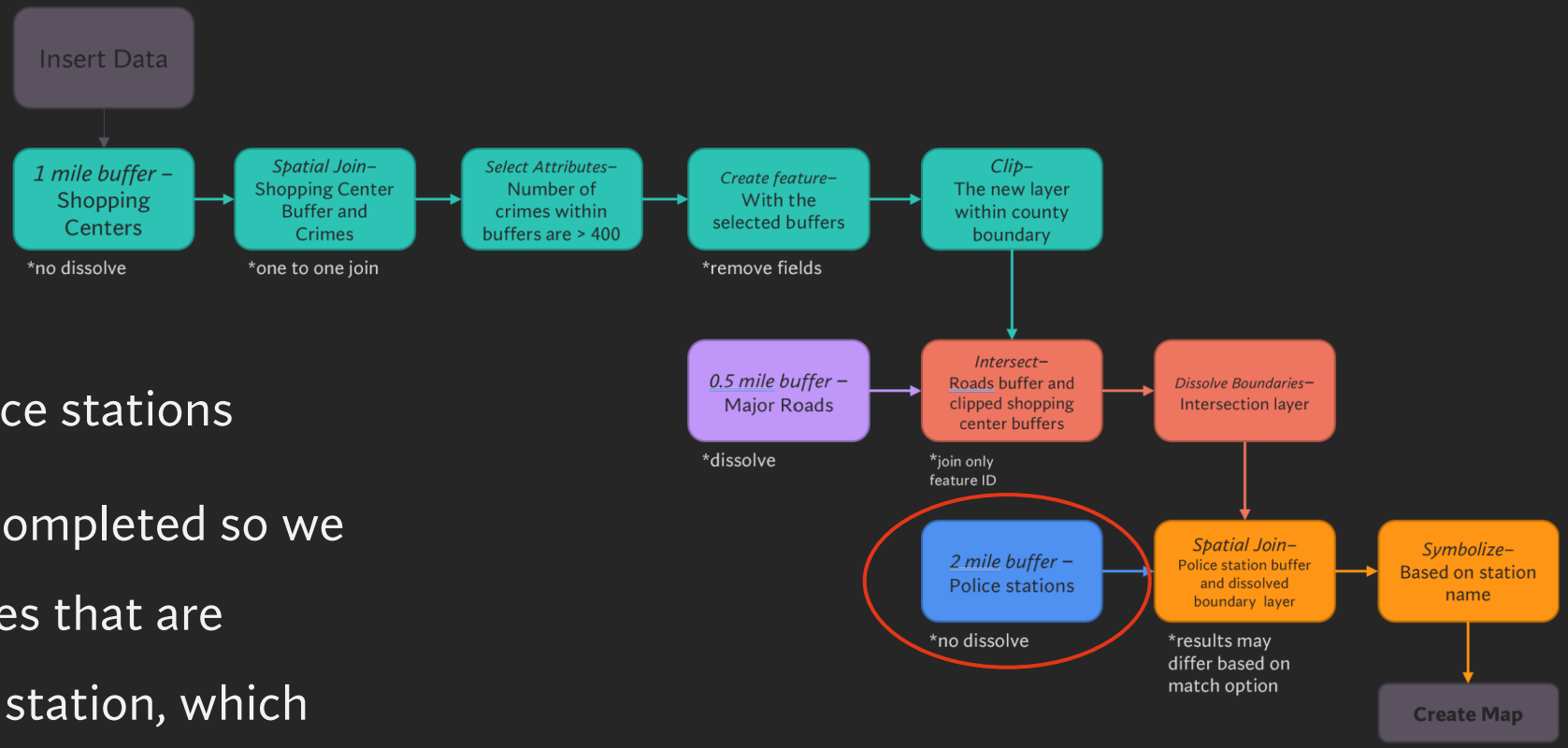
- Find which roads are near the location of the specified shopping center areas
  - The most important part for identifying the specific regions of interest- where additional officers should be placed
  - Will be the utilized layer – **REGIONS OF INTEREST**
- This step needs to be completed so we can produce regions that require extra attention by the police

Step 8:



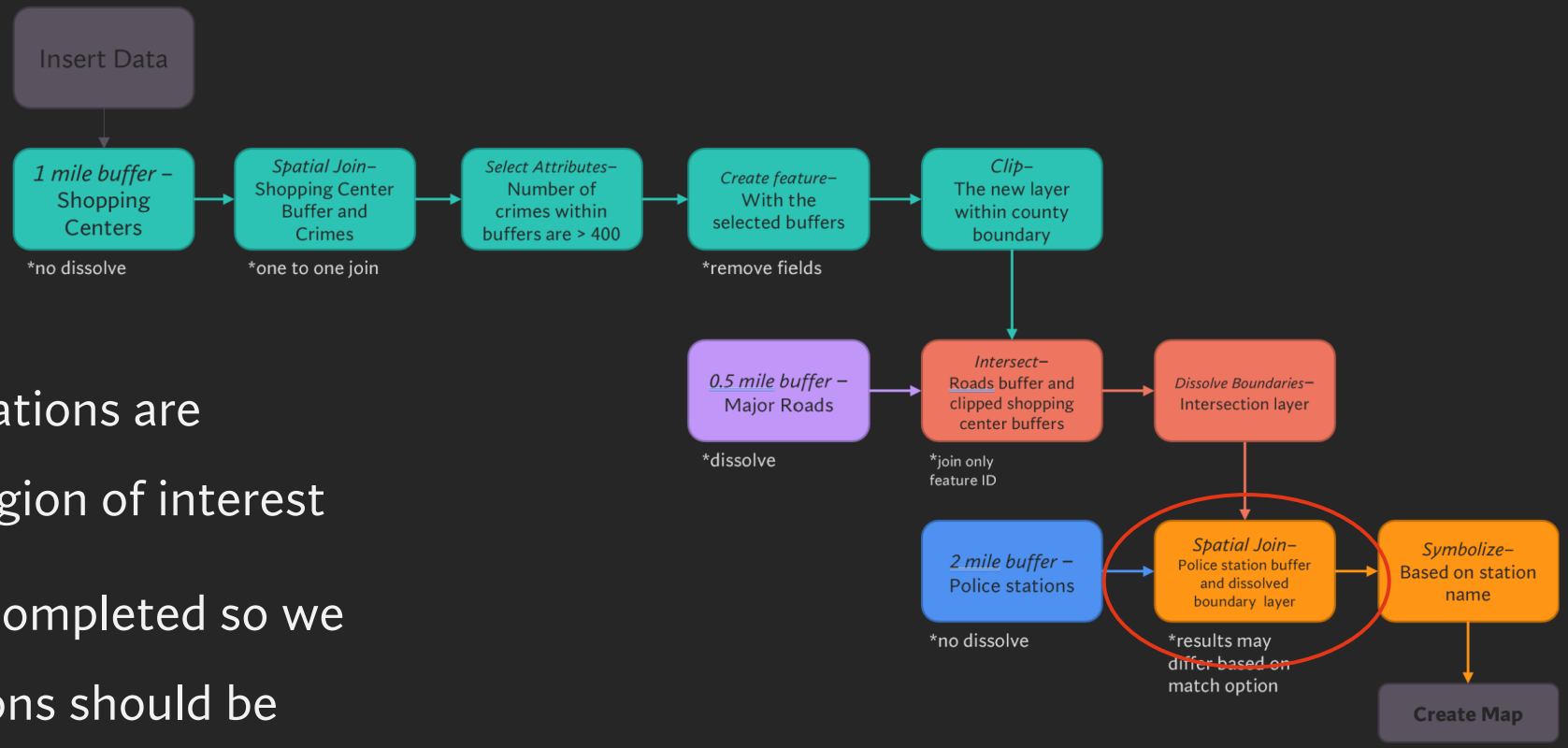
- Ensure that each area is considered one polygon
  - More of a data management step
- This step needs to be completed so we ensure that each area with a common boundary is considered as one polygon, which will ease future steps

Step 9:



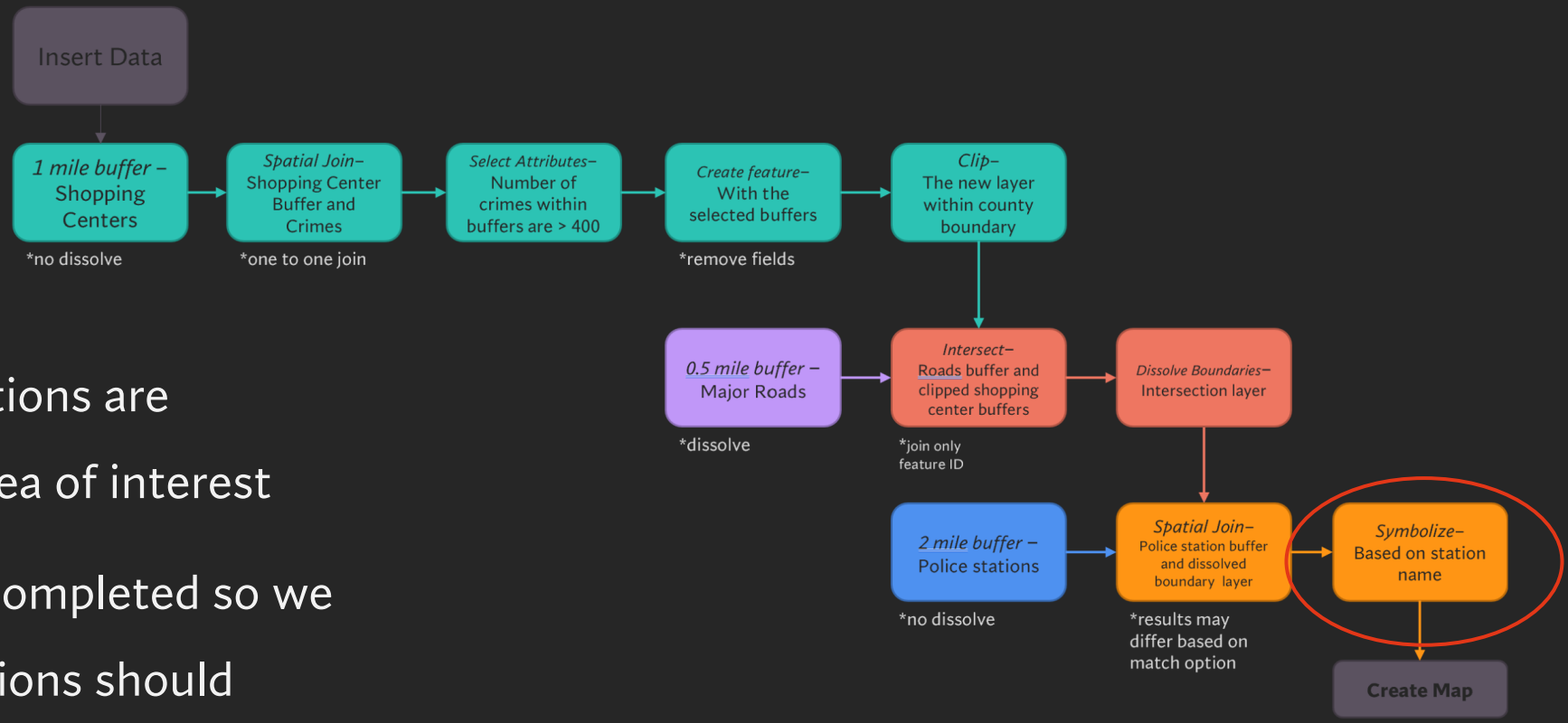
- Identify areas near police stations
- This step needs to be completed so we create polygons of zones that are covered by each police station, which will be important for the next step

Step 10:



- Detect which police stations are responsible for each region of interest
- This step needs to be completed so we find which police stations should be used for placing additional officers at the regions of interest

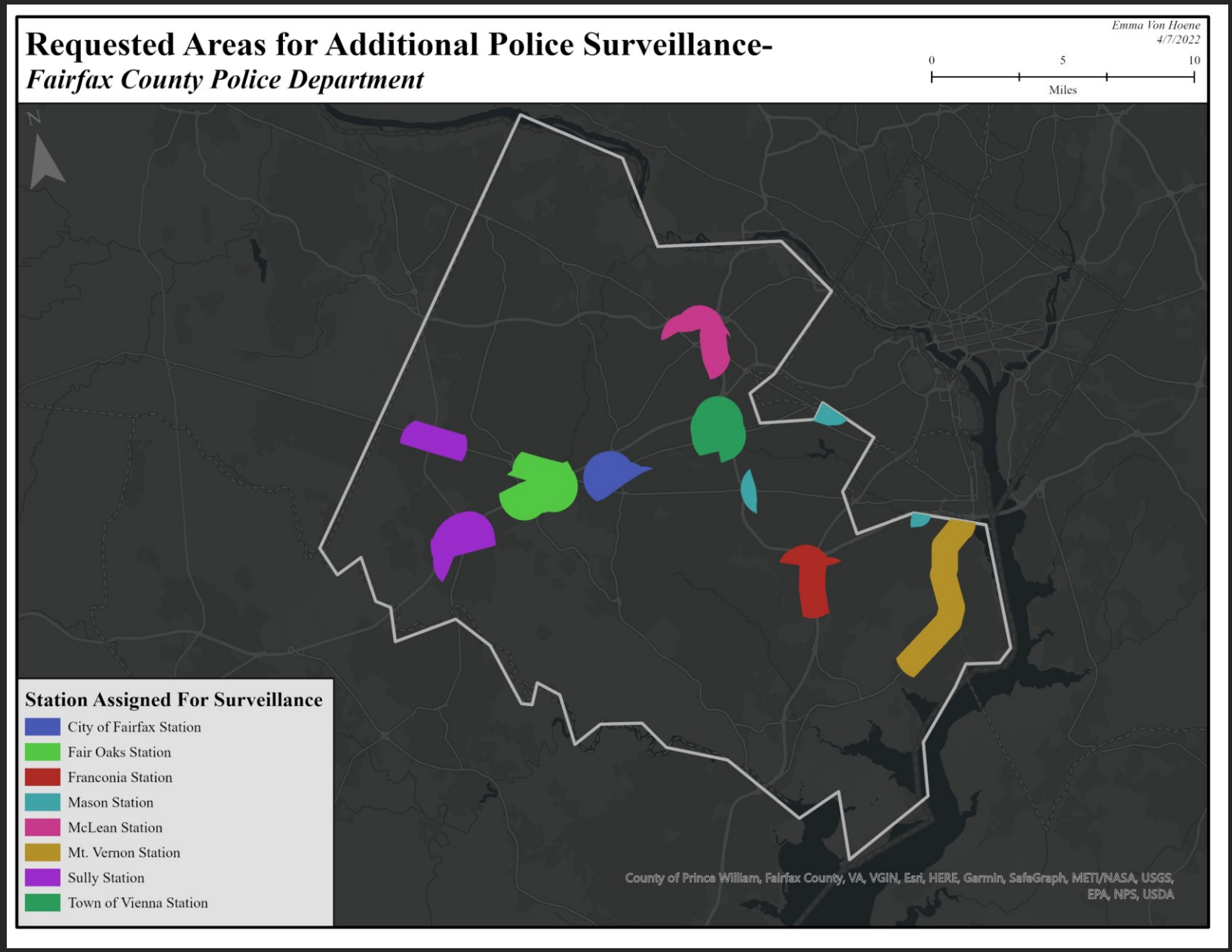
Step 11:



- Show which police stations are responsible for each area of interest
- This step needs to be completed so we can present which stations should place additional officers at each region of interest

Expected Results

- *Submit a final map with your results and the supplementary document!*
  - Make sure the map is created with effective cartographic principles
  - *Results may differ based on match option chosen with Spatial Join*



Takeaways

- From this lecture, we discussed...
  - How spatial analysis could be used to address real-life issues
  - How vector operations are combined to perform full analysis
    - Utilizing *buffers* and *spatial* join to create a new layer for shopping centers with high criminal activity
    - Ensuring that the data falls within the study area by *clipping* data
    - Utilizing *intersect* to identify regions that require additional attention
    - Determining who is responsible for the regions of interest by utilizing *buffers* and *spatial join*

Thank you!

- Feel free to email me with any questions!

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