Suitable location for residence

Multi-criteria Evaluation

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GIS II

Purpose of Evaluation

- Where are the most suitable areas for me to live in Chicago, IL?
  - Considering Preferences and Needs:
    1. Proximity to NEIU
    2. Proximity to place of employment
    3. Proximity to a CTA “L” station
    4. Proximity to a sizeable park
    5. Percentage of tree canopy
    6. Amount of crime

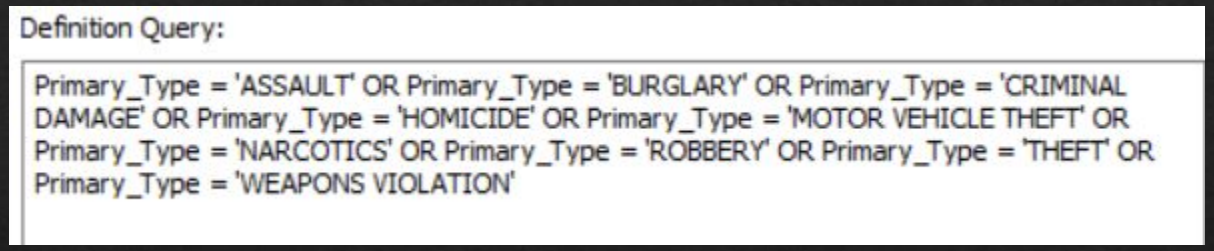
Data Collection

- The study area was the **city limits** of Chicago, IL
  - Data were projected in NAD83 Illinois State Plane East FIPS 1201 Feet

- **Street lines** from *Chicago Data Portal* and *Cook County Data Portal*
- **Chicago neighborhood boundaries** from *Chicago Data Portal*
- **2016 Tree Canopy** raster from the *National Land Cover Database (NLCD)*
- **NEIU campus point** from *class lab material*
- **Work location point** digitized from *latitude and longitude* coordinates
- **CTA stations** from *Chicago Data Portal*
- **Park boundaries** from *Chicago Data Portal*
- **2018-2019 Crime Data** from *Chicago Data Portal*

Data Prep: Points

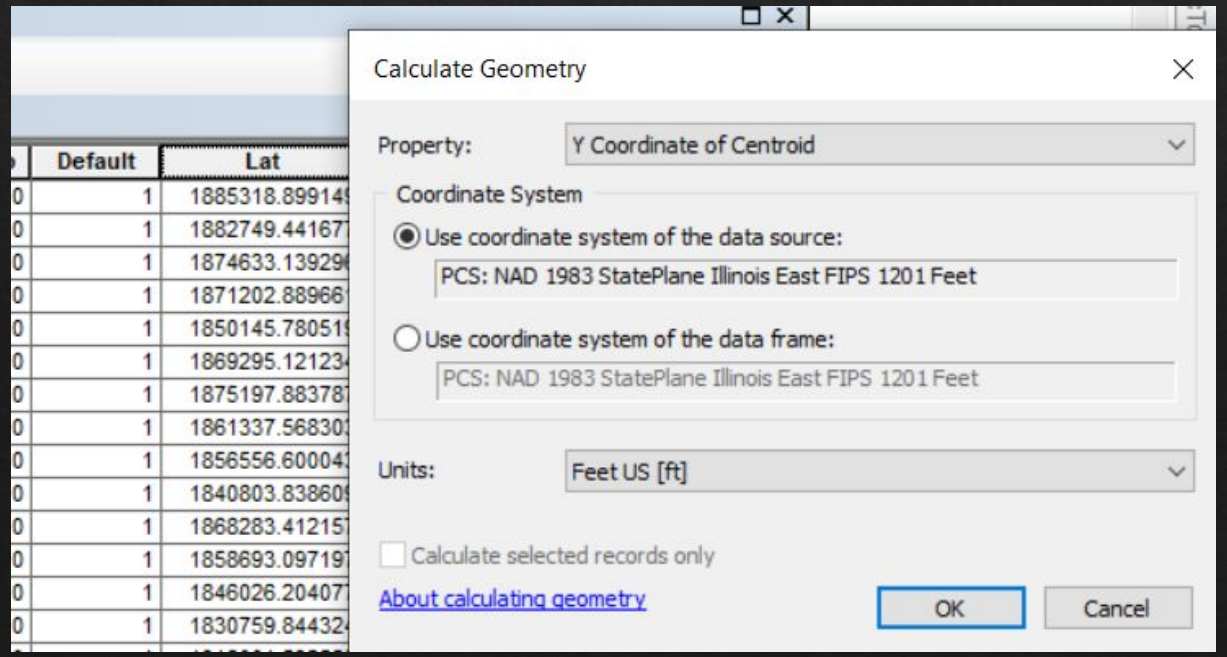
- Data Frame projection was set to NAD83 Illinois State Plane East FIPS 1201 Feet
- CSV files for crime data and CTA Stations were added as Tables
  - XY data were displayed using the Lat/Long coordinates with the NAD83 GCS
    - Both were exported to permanent files, assigning them the projection of the data frame
  - Definition query was used to limit Primary Crime type

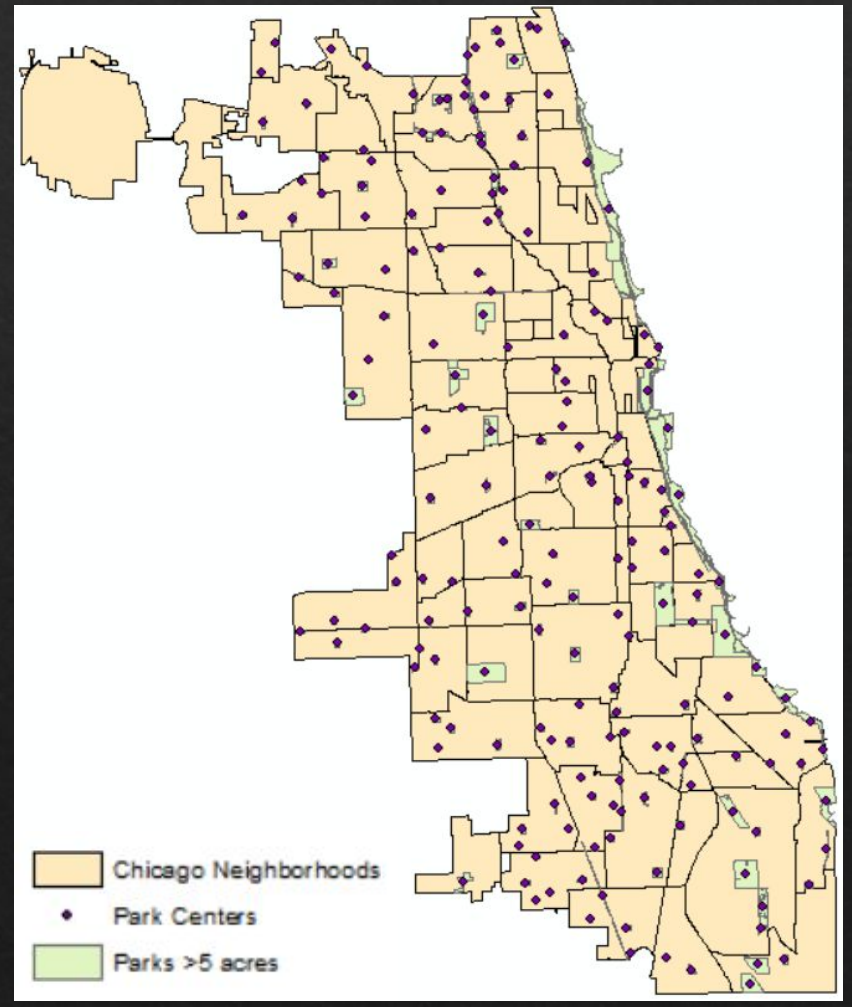


- A new point Feature Class was created for my work location.
- NEIU campus point was imported from existing shapefile

Data Prep: Points

- Definition query was used to limit the Parks polygons to those with an area greater than 5 acres.
- New attribute table fields were created to calculate the lat/long of the polygon centroid to be used for Network Analyst
  - The point data were exported to a new Feature Class



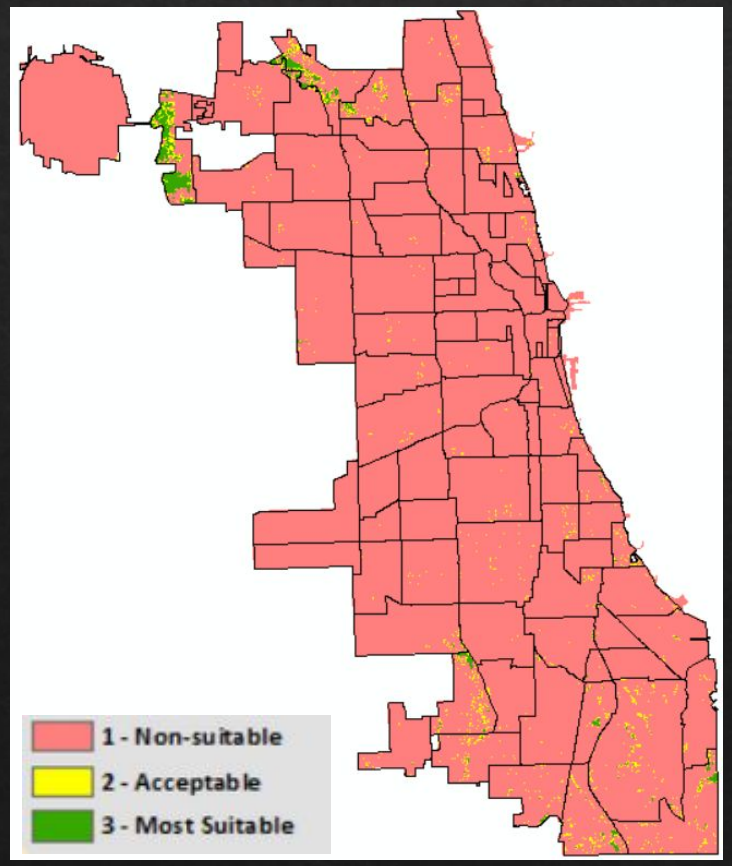


Data Prep: Lines

- Chicago Street Midlines, with directional fields, were obtained from Cook County and Chicago Data Portals and imported into the Network Analyst database
  - The Cook County shapefile had some errors around the NEIU Campus & River so the Chicago Streetlines were used for the majority of the analysis
  - The Cook County file was only used for analysis of the Network to the work location as it fell outside the city street area

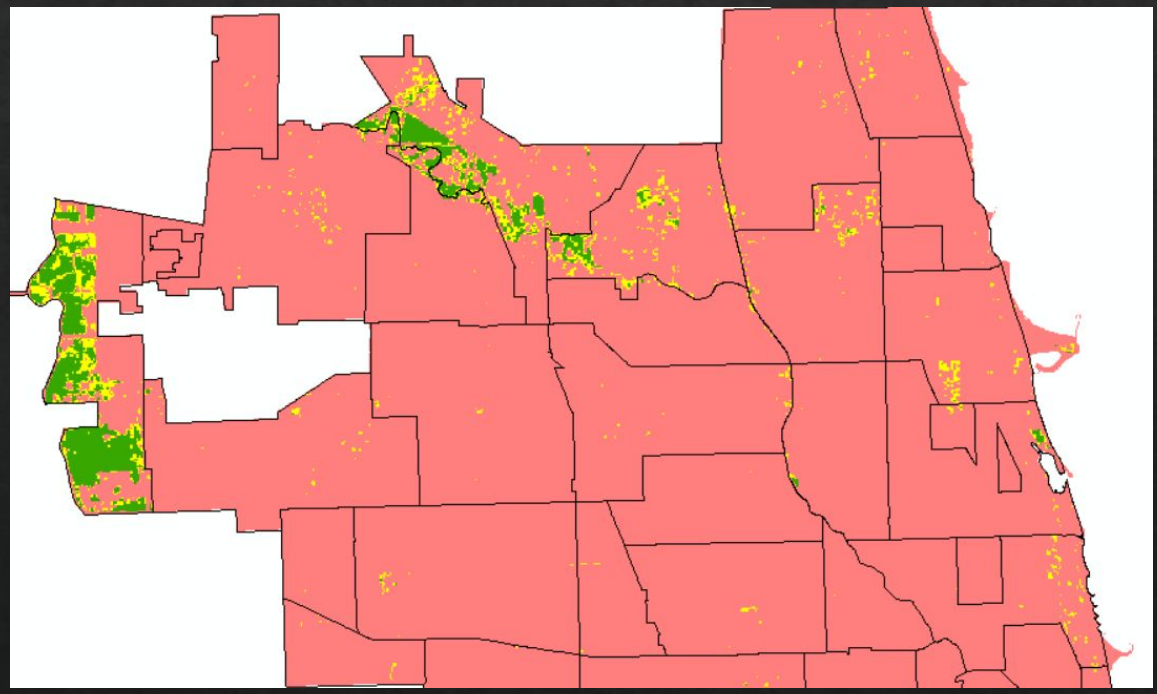
Data Prep: Raster

- The Tree Canopy Raster was resampled to 66 x 66 Feet to give a sub-city block grid and clipped to the Chicago City boundaries



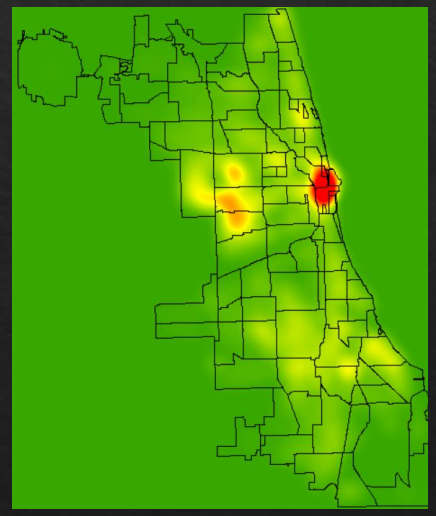
Red = 1 Non-Suitable
Yellow = 2, acceptable
Green = 3, best

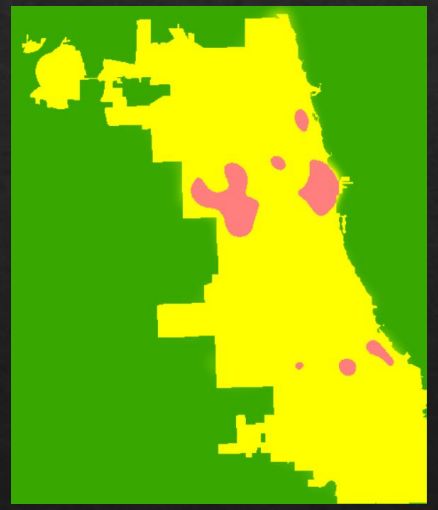
This color scheme is used for all subsequent layers

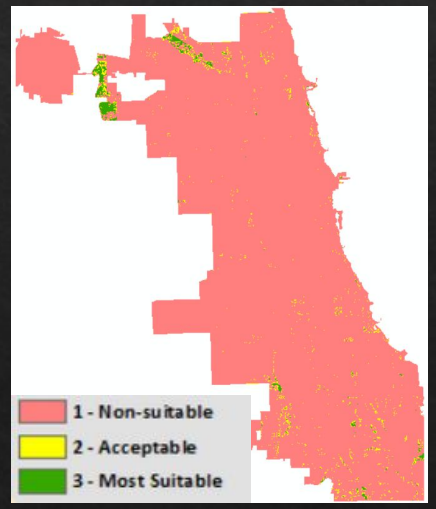


Processing: Crime Density

- *Kernel Density* was computed for the Crime Data
  - one for all 2018 occurrences and one for all 2019
    - both in 66'x66' cells to match other layers
  - The *Minus* tool was used to analyze the change for the two years & the result was reclassified to Weight decreases in crime a 3, increases of less than 1,000 a 2, and increases more than that a 1





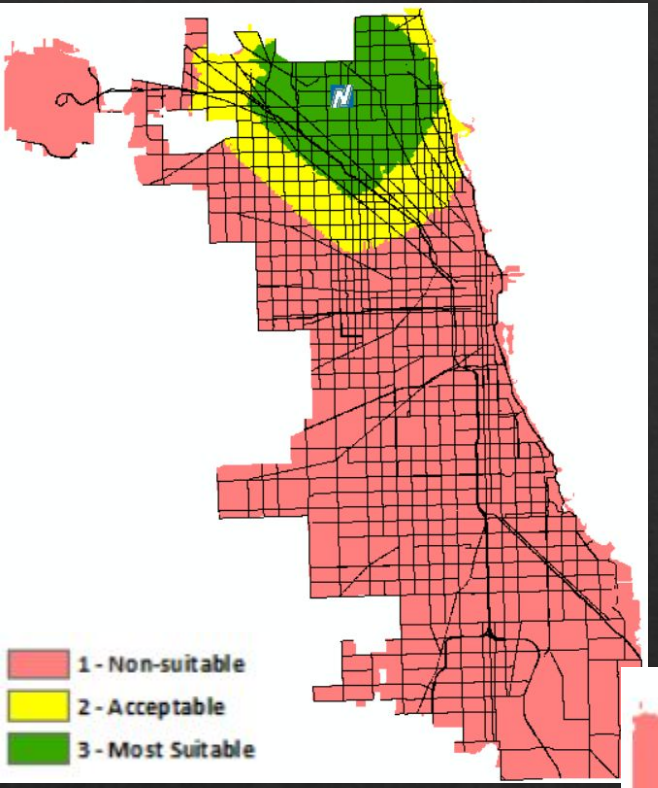


- The Tree Canopy Raster was *reclassified* to weight canopy coverage two times more than city average as a 3, between there to average at a 2, and less than average as a 1

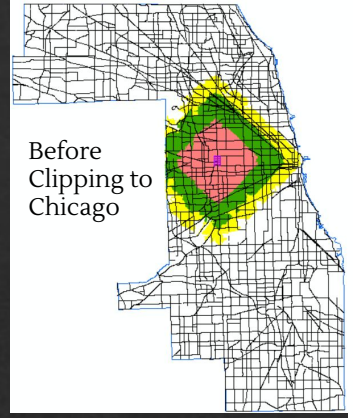
Processing: Distance

- Network Analyst was used to derive the street network distance to NEIU, my work, L Stations, and Parks
  - Each point layer was added as a facility in its own Service Area with the Streets as the network and the *Solve* function was used for each distance input
    - The resulting polygons, of the respective networks, were converted to rasters and joined using *Combine*
    - They were *reclassified* to the 3-scale weights and cell size as previous raster layers
      - processing extent was set to the Chicago boundary
      - no data values were set to reclass as a value of 1, the least/non-suitable category

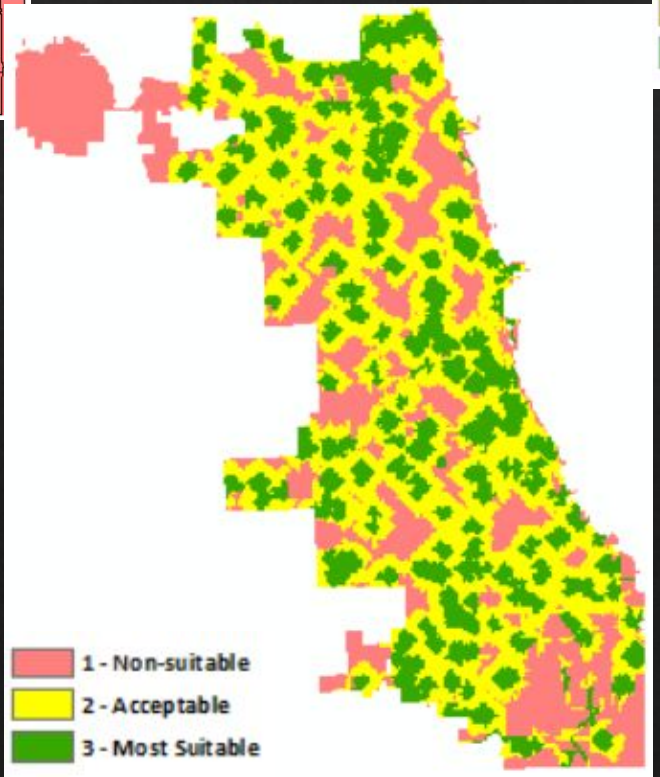
- NEIU: less than 4 Miles = 3 between 4 & 6 = 2 more than 6 = 1
- Parks: less than ½ M = 3 between ½ & 1 M = 2 more than 1 M =1
- Work: between 5 & 8M = 3 between 8 & 10M = 2 less than 5, more than 10 = 1
- CTA L: less than ¼ M = 3 between ¼ & ½ M = 2 more than ½ M=1

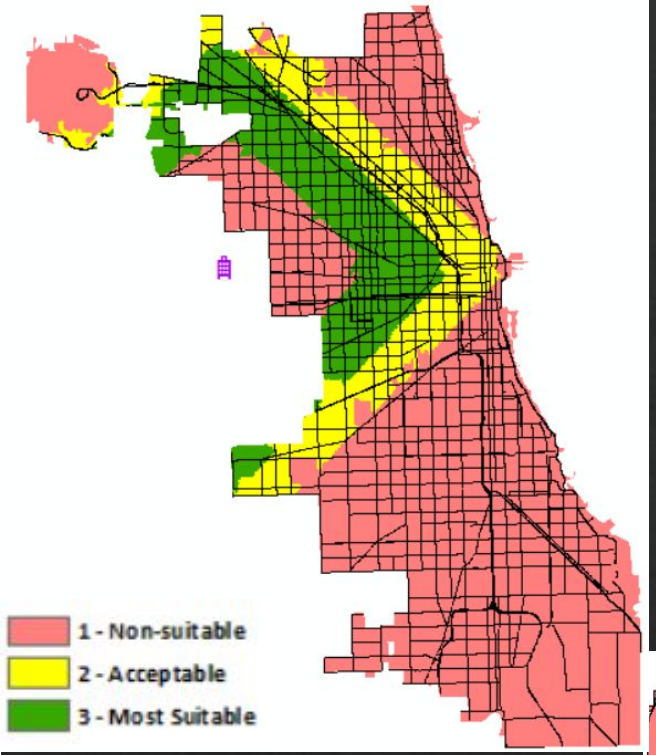


Network to NEIU
4, 6, & 8 Miles



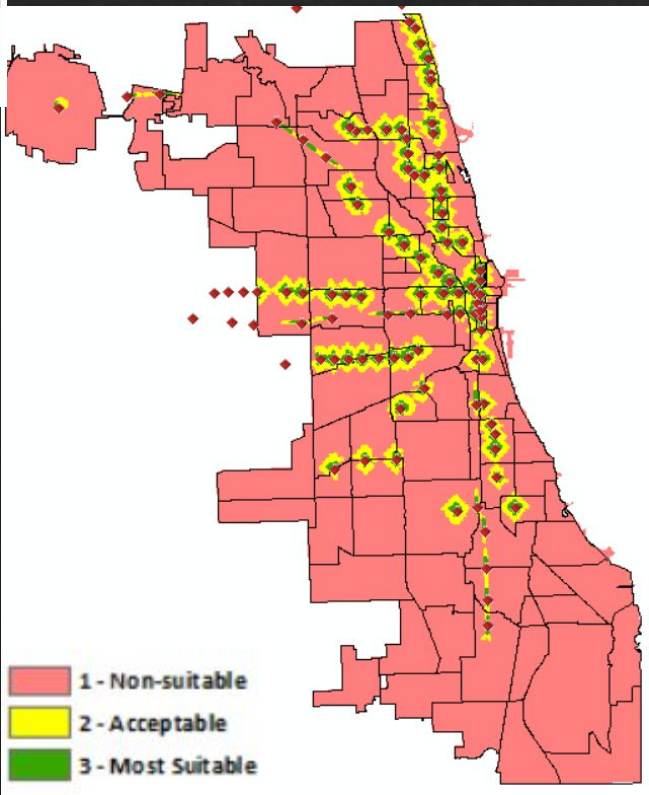
Network to Parks
½ and 1 Mile





Network to Work
5, 8 , & 10 Miles

Network to L Stations
¼ & ½ Mile



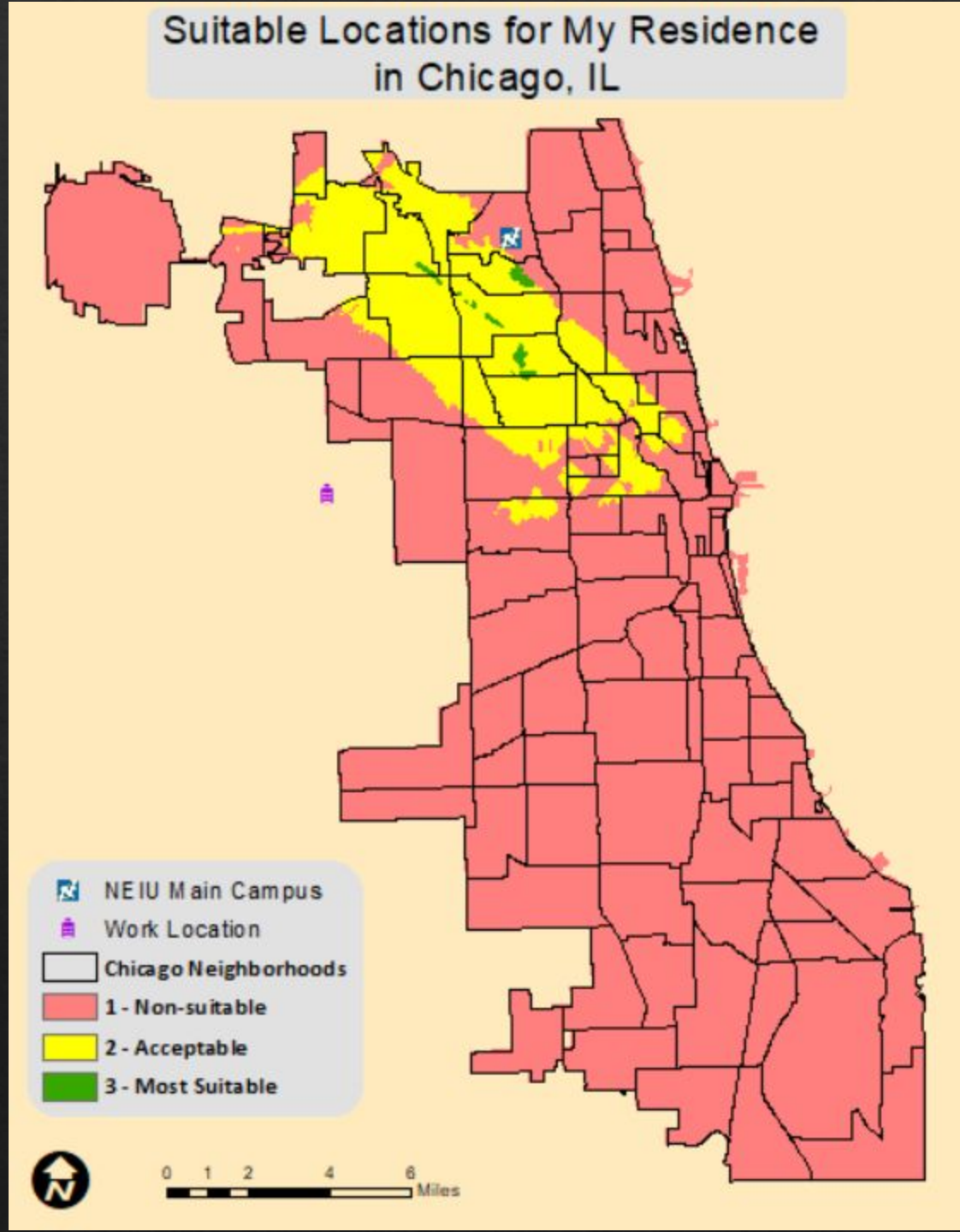
Processing:

- All Raster Layers were combined into the final suitability layer using the *Weighted Overlay* tool
- Layers were weighted by significance to housing location preferences
  - Distance to NEIU 40%
  - Distance to L Station 20%
  - Crime Density 20%
  - Distance to Work 10%
  - Tree Canopy 5%
  - Distance to Parks 5%
- Final Layer was *Clipped* to fit exactly inside the Chicago footprint

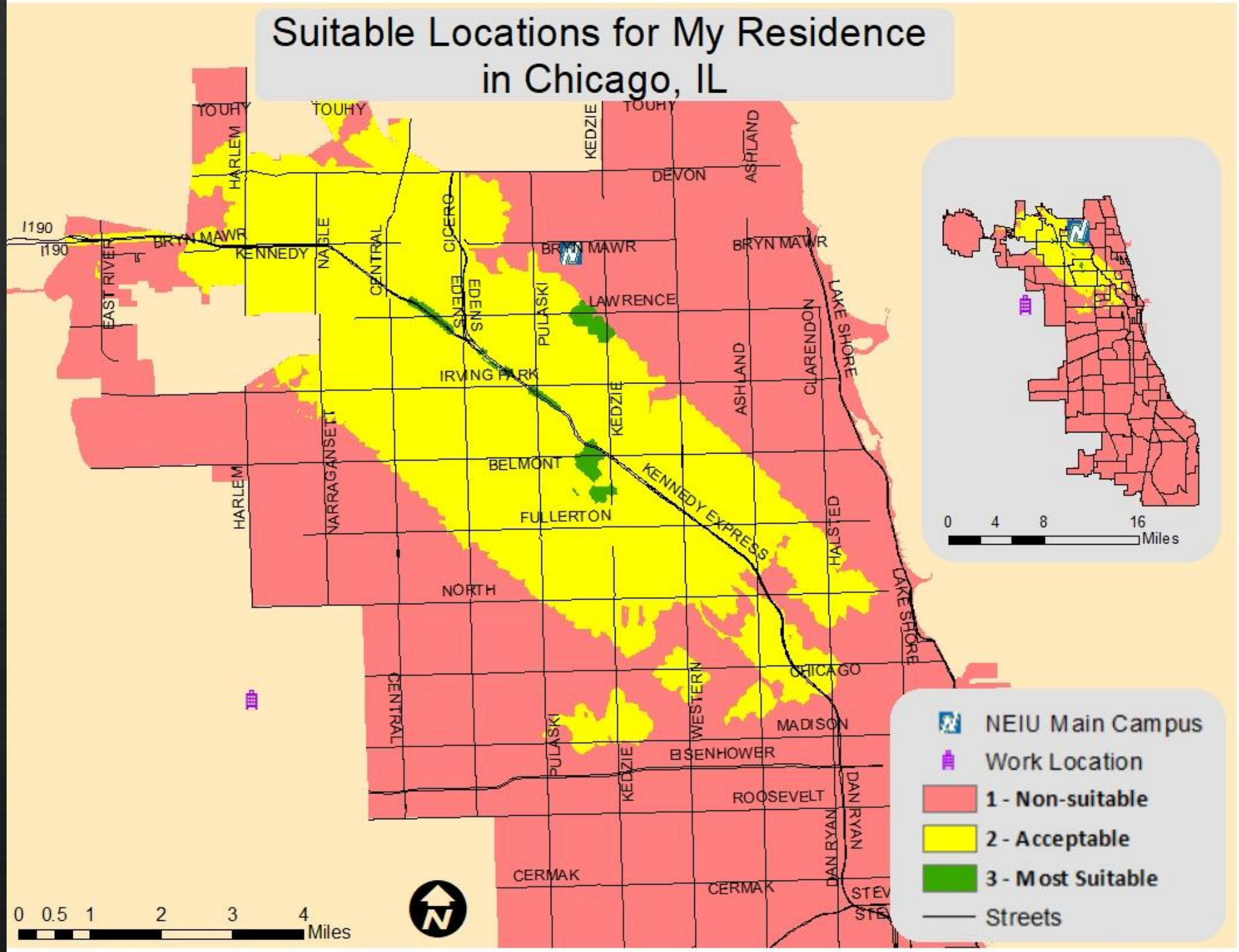
Results

- Less than 1% of study area as the highest class
- 5% was in the second suitability class
- So 94% was the least suitable given the inputs

- .6 square miles in highest suitability class
- 33 square miles second suitability class
- 200.4 square miles least suitable



Suitable Locations for My Residence in Chicago, IL



Discussion: Findings

- The general area, Northwest Chicago, was as expected
  - I did expect the area of highest suitability to be slightly larger around NEIU, but the higher values did not overlap enough
    - a larger area would have been found had the 2 & 3 classes been swapped for the Work criterion, but then it would not be an accurate to actual desired locations of both

- I chose to use the tree canopy as I do not enjoy streets without some tree cover, but found that the overall city coverage is lower than I already thought it was. The number of classes in the original raster and lack of coverage in the city made it somewhat difficult to settle on a division into three classes.
  - This was already a low deciding factor, so it probably could have just been eliminated

Discussion: Potential Changes

- The bulk of this was network analysis & I would have also liked to have incorporated some other non-network metrics such as rental pricing data as that would limit areas further, but did not want to use home pricing
- I would probably eliminate the tree canopy layer and prioritize the parks by those that have off-leash dog areas or use a different form of data for tree canopy, perhaps doing the analysis without trees and then using Lidar data only on the smaller subset to narrow it down further if desired.
- I would also make the networks to NEIU focus on bike-friendly routes only
  - I had a bike ”friendly” layer joined to the main streets for this purpose, but decided not to get that involved

Discussion: Issues

- Another method to use polygons as facilities? The method I used was to create centroids for each polygon. I feel some datasets could suffer major inaccuracies, (e.g. a very large park or larger forest preserve. Accessing the perimeter may be within the threshold while the centroid is not. Creating junction points along the access routes may solve this but be cumbersome to do manually.

- I attempted to use Raster Calculator to combine the weighted rasters, but was never able to get it to produce the desired scaling in the output, weighted overlay worked out well. Not sure if it was the 6 criteria or something about my initial raster extents not lining up.

- I was thinking about the weights for the criteria, mine were personal choices and how much each mattered to me, so they are arbitrary. I wondered if studies not involving personal decisions would require devising some equation or calculations to determine the weights to assign.

Thank You