

# Using GIS to Measure the Effectiveness of the Weed and Seed Initiative in Winston-Salem, North Carolina, 2001 – 2007

Timothy Mulrooney  
Transforming Communities Research  
Laboratory  
Center for Community Safety  
Winston-Salem State University  
[mulrooneyti@wssu.edu](mailto:mulrooneyti@wssu.edu)

Mike Carmichael  
Transforming Communities Research  
Laboratory  
Center for Community Safety  
Winston-Salem State University  
[carmichaelm@wssu.edu](mailto:carmichaelm@wssu.edu)

## 1. Abstract

The Weed and Seed program is a Community Capacity Development Office (CCDO) and Department of Justice (DOJ) initiative to revitalize communities through a holistic approach to law enforcement and crime prevention. The goal of the Weed & Seed program is to reduce recidivism and crime by leveraging public and private resources to support the community in the areas of housing, employment, after-school programs and mentoring. This strategy has two parts: law enforcement essentially ‘weeds out’ violent criminals and drug abusers while human services, neighborhood restoration programs and community-based organizations ‘seed’ these areas to facilitate growth. Policing from both law enforcement and the community help to intervene, prevent and address issues of serious and drug crimes in the inner cities while invoking positive change under the guidance of this program (United States Department of Justice 2004a).

Winston-Salem, North Carolina was one of 12 cities in the United States that implemented a Weed & Seed program in 1999. Other cities included in this early study were Indianapolis, Boston, Cleveland and Philadelphia. The focus of this research will explore the effects of the Weed and Seed initiative in troubled areas of Winston-Salem between 2001 and 2007. Crime rates will be derived from raw crime data provided by the Winston-Salem Police Department and the United States Census Bureau. GIS analysis will be performed on the data to create, query, analyze and eventually map the data to determine if any change in crime rates or patterns has occurred during this time period.

## 2. Study Area

The City of Winston-Salem is located in the Piedmont Region of North Carolina. It is located about 30 miles west of Greensboro and about 85 miles north of Charlotte, the largest city in the state. Current population models place the population at about 213,000, making it the 4<sup>th</sup> largest city in the state of North Carolina. While a 19.4% population increase since 2000 is typical for a city in this region, this population increase can not be attributed solely to migration. In late 2006, the city annexed more than 62 square kilometers of surrounding Forsyth County, increasing its size by more than 22%.

The current (beginning in 2007) Weed and Seed initiative is called the Twin City East-West Partnership and is focused on, among others, the East Winston neighborhood. The East Winston neighborhood is adjacent to the Winston-Salem State University campus. Between 2000 and 2006, the Weed & Seed program focused its efforts on 5 problem areas in Winston-Salem (Figure 1). They are appropriately named South

Winston 1, South Winston 2, North Winston, Southeast Winston and Northeast Winston. Because of the availability of crime data over the relatively long time period in the Weed and Seed program, these graduated Weed and Seed sites will be the focus of this research and serve as the study area. This study area has a total area of 1341 hectares (13.41 km<sup>2</sup>). The largest (393 hectares) of these areas is the South Winston 2 area, composed of the Waughtown, Forest Park, Easton and Goldfloss neighborhoods. The smallest (97 hectares) Weed and Seed area is the South Winston 1 area, mostly composed of the Happy Hill neighborhood. As of 2007, the population of the study area was approximately 16,176 people, representing 7.66% of the total population of Winston-Salem.

Follow-up data from 2007 will be used to determine if the 'seeds' put in place at these five sites have indeed elicited positive change. GIS analysis will overlay crime data with these areas to measure the effectiveness of this initiative over the years. Metrics to express crime rates both inside and outside of Weed & Seed sites over the last 5 years can help determine changes as a result of these programs, perhaps identify future Weed & Seed sites and explain patterns of crime in and around Weed & Seed sites and Winston-Salem as a whole.

### **3. Prior Research**

A Geographic Information System (GIS) serves as the tangible and intangible means by which information about spatially related phenomena can be stored, analyzed and mapped. Experts in many dissimilar fields have seen the utility of GIS as a means of quantifying and expanding their research. GIS is used in disciplines such as business, sociology, justice studies, surveying and the environmental sciences (Steinberg and Steinberg 2006). In fact, most data can have a spatial component applied to it. Crime can be modeled in a variety of different ways. A particular crime incident can be modeled as point and assigned a real world location such as an address or absolute location (latitude and longitude). This point can have a variety of attributes (day/time the crime was committed, address of crime, gang affiliation, type of weapon used, etc.). In addition, crimes can be agglomerated or counted within polygon or areal features such as counties, census tracts, neighborhoods or block groups. The enumeration unit used in this study will be the census block group. Using GIS, these data can be queried spatially to measure distances using the GIS software while the attributes can be queried aspatially using query tools such as Structured Query Language (SQL) under the GIS software umbrella.

Because of the limited capabilities of GIS software and affiliated resources, previous generations of crime analysis focused on the visualization of crime. Various mapping techniques and classification schemes such as quantiles, natural breaks and standard deviations were perfected (Harries 1999). Another early study by Li and Rainwater (1999) used GIS to visualize crime rates on the backdrop of other variables such as commercial land-use, household size and unemployment. Even earlier, Harries (1997) mapped 24 social stressors such as unemployment, poverty and at-risk youth to model and map clusters of areas denoted by this high stress around Baltimore, Maryland. In both cases, however, complex modeling needed to be performed outside of the GIS software. These 'loosely' coupled applications are not intuitive in nature, and therefore alienate basic GIS users.

With the application of statistical methods to spatial data, software vendors have tried to incorporate spatial tools within GIS software for use by crime analysts. Crime analysts have the ability to view and create crime hotspots using their GIS software. Chakravorty (1995) noticed the growing attention given to spatial dimensions of crime and where crime is most apt to occur. He discerned distance based patterns of point locations originally studied by Getis and Ord (1992) to identify crime clusters for a small area (10 km<sup>2</sup>) around downtown Philadelphia. Comparing known aggravated assault locations with a set of random points, he found that most aggravated assaults showed some form of clustering. Chainey et al. (2002) discuss the technical aspects of creating and managing crime hotspots in the digital geospatial environment. The United States Department of Justice (2005) has seen the importance of these hotspots through the publication of a special publication NIJ entitled “Mapping Crime: Understanding Hot Spots.” Most recently, Chainey et al. (2008) have used these hotspots to help predict crime and assess the accuracy of these predictions with a prediction accuracy index.

With advances in computing technologies and the need for statistical methods to be applied to spatial data, GIS software has been created with the sole purpose of calculating these spatial metrics. Environmental Systems Research Institute (ESRI), a popular GIS software package used in the United States, employs a Spatial Statistics Toolbox that has tools to analyze patterns, map clusters, measure geographic distributions and model spatial relationships. The National Institute of Justice, in conjunction with various partners, has created a software package called CrimeStat. CrimeStat is typically used to analyze point pattern phenomena (Levine 2000). It is available free for download at <http://www.icpsr.umich.edu/CRIMESTAT/>. If data are generalized within areal or polygon features such as census blocks or block groups, GEODA can analyze these patterns or even perform spatial regression. It is free for download at the University of Illinois (<http://sal.uiuc.edu/default.php>). Most of the research in this project will be performed using ESRI software.

#### 4. Data

##### ▪ *Crime*

Quantifying crime has been a priority for local universities, researchers and community leaders alike. The perception of a city as crime-ridden has many negative reverberating effects. It is necessary to track changes in crime for a variety of reasons. Winston-Salem has been lucky to employ geospatial analysis with its digital record keeping techniques to not only track the sheer number of offenses that can be queried along a variety of variables, but also visualized spatially.

Since 2001, the Winston-Salem Police Department<sup>1</sup> has provided digital data containing the addresses for offenses that occur within city limits over the course of a year. These offense locations are probably the best quantitative indicators for crime, as an actual arrest may not result from this offense and if it does, the arrest location may occur in a different location from the offense location, such as the Police Station or perpetrator’s home.

Using a process called *Geocoding*, the addresses for the offenses will be assigned a spatial component and expressed as point locations. *Geocoding* looks for a match

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<sup>1</sup> Raw crime data were provided by Julia Conley at the Winston-Salem Police Department, Police Information and Technology Division ([juliac@wspd.org](mailto:juliac@wspd.org) or 336-773-7864)

between the addresses listed in the tabular data and an existing spatial database representing streets that has attributes for road names and house numbers to pinpoint location in 2-D space. In addition to tracking the address in a format compatible with GIS, information about the crime's date, day of the week, time occurred, type of crime, status, weapon and gang affiliation are recorded. Information about the perpetrator and victim are retained by the police department, but this information is not distributed because of privacy concerns.

In terms of crime definitions and taxonomies, the Winston-Salem Police Department employs the FBI definitions of crime as part of the Uniform Crime Reports (UCR) standards employed by most law enforcement agencies. The Winston-Salem Police Department implements the National Incident Based Reporting System (NIBRS) to ensure high-quality data collection and storage for individual crime incidents. Using NIBRS, every offense from a particular crime incident is retained. Using other systems, the worst crime from an incident is retained, while all other associated offenses are thrown out. As a result, cities such as Winston-Salem which implement NIBRS may give the appearance of having higher crime rates because all offenses recorded in the city are retained, not just the most serious offense that results from an incident.

While there are about 30 different classifications for crime, crime can be classified into 2 basic groups. Part I crimes represent violent and property crimes such as murder, robbery, forcible rape, arson, burglary, larceny-theft and motor vehicle theft. Part II crimes are less serious crimes which include drug offenses, simple assault, vandalism, driving under the influence, disorderly conduct and fraud (U.S. Department of Justice 2004b).

The focus of this research will be on all Part I crimes and drug offenses (Part II) that have occurred within the study area between 2001 and 2007. 2001 was the first year that accurate digital data were made available while 2007 will be used to measure after-effects of Weed and Seed initiatives after they have targeted other locations in the City. Point locations representing every offense within city limits for the year are saved within a single feature class or layer. For 2007, this crime feature class is composed of more than 61,000 individual points. Therefore, specific crimes germane to this study via a particular location, part, type and theme must be queried from this large database.

Given the relatively small study area, a *Clip* function was employed to spatially select only those offenses that occur within the study area. A GIS data layer representing this study area was created by the Center for Community Safety at Winston-Salem State University. A *Clip* function is used to create spatial subsets so data can be more manageable. After using the *Clip* command, only crimes that occurred within the study area remained. This subset represents all crimes that occurred in the study area, however, this research will only explore the Part I and drug crimes that occurred in this area. Using the *Select by Attribute* tools in the GIS software, only Part I and drug offenses were selected. This process was repeated for each year of the study. Information about these offenses within the study area and Winston-Salem are summarized in Table 1.

- *Population*

Since crime data are measured as rates (offenses / 10,000 population in this case) on a yearly basis, it is necessary to accurately estimate or predict population for both the

study area and Winston-Salem. Data at the census block group level are provided for the years 2000 and 2007 and were modeled using a Malthusian Growth Model seen below:

$$P_n = P_0 e^{rt}$$

$P_n$  = Population for a desired year  
 $P_0$  = Initial population. In this case,  $P_0$  is equal to the population in the year 2000  
 $e$  = Mathematical constant approximately equal to 2.71828  
 $r$  = Yearly growth rate  
 $t$  = Time (in years) between  $P_n$  and  $P_0$  (2000)  
 (Weeks 2005 )

Block group level data, as opposed to block level data, were chosen for this study because data at the block group level could be interpolated from 2000 and 2007 data provided by the United States Census Bureau. Otherwise, it would need to be extrapolated from 1990 and 2000 data at the block level. These interpolated data would yield more accurate estimates. In addition U.S. Census information from the SF-3 form such as educational attainment, economic disposition and housing information, which may serve as indicators to crime, is readily available at the census block group level.

Using the *Clip* GIS function, all census blocks groups that lay within Winston-Salem and the study area were used for this analysis. 157 of these census block groups lie within Winston-Salem city limits. Populations for census block groups that lie partially within city limits were prorated based off the percentage of area that lies within the city limits using the *Field Calculator* tool. The *Calculate Geometry* tool was used to find the area of the census block group that lie within the city limits and compared with the total area of the census block. Finally, each block group was given a growth rate derived from these population values for 2000 and 2007 and a Malthusian Growth Model was applied to census block group population values to predict mid-year population for 2001 through 2006. For the 2007 population data, the new Winston-Salem city limit was used to clip the census block groups based on the available 2007 data. 170 block groups lie within this new city limit. Once again, partial values were prorated based on the percentage of area that lay within city limits.

A GIS data layer created by the Transforming Communities Research Laboratory at Winston-Salem State University representing the study area was *Clipped* to these census block groups and a separate population was computed for the study area using the process described above. Results for the population data can be found in Table 2.

## 5. Methodology

### ▪ *Measuring Crime Rates*

In this study, crime rates are measured by the number of Part I crime and drug offenses per 10,000 residents. Given the number of crimes and population for the given enumeration unit, these crime rates can be agglomerated at a number of different scales. These raw crime values and populations were created using the processes described above. Given the raw data for crimes and population, crime rates were computed for each census block group, the study area and the city of Winston-Salem using the formula below:

$$CrimeRate = \frac{(10000)(NumberofCrimes)}{Population}$$

These crime rates, broken down by year and type of crime for the study area and Winston-Salem can be found in Table 3. Figure 2 shows a map for drug and Part I crime rates for the entire city of Winston-Salem by census block group for the year 2006 using this metric. They were created using the *Intersect* function with the census block groups and crimes. By doing this, each crime can be assigned a location, in this case the Federal Information Processing Standard (FIPS) code for the census block group in which the crime was located. The FIPS code is a unique identifying 12-digit code used to distinguish it from all other block groups in the United States. Using the *Summarize* function, the sum of all crimes that occur within the same census block group can be tallied. Finally, this resulting table can be *Joined* to the GIS layer representing census block groups using the FIPS code as the primary key and mapped based on the crime rate, which is derived using the formula above using the tallied count and population values for each census block group.

A quintile classification scheme was used to group the values into 1 of 5 groups based on these crime rates where the darker values represent higher crime areas. This scheme makes each color or group represented the same number of times on a map and is used to counteract the effects that outliers may have on the data and subsequently the map. A higher scale map of the study area and current Weed and Seed site is shown on the backdrop of this criminal landscape in Figure 3.

- *Measuring Crime Change*

Changes in these crime rates between 2001 and 2007 can be calculated for both the city and the study area. The results of these computations can be seen in Table 3. These columns represent Part I crime offenses, drug offenses and a column representing the total combined Part I and drug offenses, the focus of the entire Weed and Seed initiative. The percent change of this crime rate during the study year has also been calculated, in addition to the raw change in crime rate. These raw change values will be used in a t-test to determine the significance of change between the two areas (study area and entire city of Winston-Salem).

In addition, this crime change can be mapped at the census block level. As highlighted in previous steps, the crime rate per 10,000 population can be calculated for each census block group on a yearly basis. A crime rate for 2001 and then for 2006 has been calculated. A new field representing this change can to be added to the database and denoted as a double precision number. After doing this, this change is measured as the difference between the 2006 and 2001 rate using the *Field Calculator* tool. While there are a variety of dimensions and time periods that can be mapped (2003 – 2005, for example), the time period between 2001 and 2006 was used to map the general trends shown by the data. Figure 4 shows this crime change during this time period. 2007 was not included in this spatial analysis because crime data for annexed areas did not exist before October 2006. As a result, any trends showing multi-temporal change using 2007 data would prove incomplete for some parts of the city.

## **6. Results**

Like almost any phenomenon, crime is spatial in nature and displays patterns that can be visualized and analyzed on a map. GIS is an effective research tool that can create, analyze and display these patterns on the backdrop of the study area. GIS was used as the

cornerstone for this research to visualize spatial dimensions of the crime and their relationship to the Weed and Seed focus areas over time.

The corridor along U.S. Highways 52 and 421, both of which run through downtown Winston-Salem are crime hotspots (Figure 2). A higher scale version of this map (Figure 3) should highlight the relationship between these high crime areas and the current and past Weed and Seed sites in Winston-Salem. From these maps, it is apparent why these areas were selected as Weed and Seed sites for the city of Winston-Salem.

Using the legacy Weed and Seed site as the study area combined with GIS analysis of crime data provided by the Winston-Salem Police Department, crime decreased in the study area between 2001 and 2007 (Table 1). The number of Part 1 crimes and drug offenses has decreased in this time period. In addition, the study area's share of Part I and drug offenses with respect to the entire city has gone down between 2001 and 2007. In 2001, more than 38% of the city's drug offenses occurred within the study area. By 2007, this number was down to 28%.

Within the study area, Part I crime offenses have decreased by more than 11% while drug offenses have decreased by more than 24% in this time period. When standardized by population, the Part I Crime Rate, Drug Rate and Combined (Part I crime and Drug) all experienced decreases during this time period of 12.29%, 25.33% and 15.89% respectively (Table 3). These numbers are very promising.

However, overall crime rates for the entire city of Winston-Salem have abated during this time period. Part I crime and drug offenses for the entire city have decreased by 18.1% during the study period, slightly more than the study area's 15.89%. A breakdown of these city-wide decreases versus those of the study area can be seen in Table 3. While it is difficult to quantitatively compare these percentages, the raw values derived throughout the years can help discern differences between Winston-Salem and the study area. Using a simple t-test, it was found that the yearly change in drug offenses at the census block level for the study area (N=37) and city of Winston-Salem (N=157) were statistically different from each other at a 95% confidence interval. The same could not be said about Part I crimes and the combined Part I crime/Drug Offenses cohorts when explored for both the study area and Winston-Salem during this time period.

From this, one can surmise that for some reason the decrease in the drug offense rate in the study area is significantly higher than that for the entire city. While not the only one, Weed and Seed is undoubtedly one of these agents for change. Figure 5 displays areas in Winston-Salem with the largest decrease in drug offenses between 2001 and 2006. It should be evident that the study area coincides with the largest decreases in drug offenses during this time period. One census block group encompassing the Southeast Winston portion of the study area saw 322 less offenses from 2001 to 2006. Another small census block group within the South Winston 1 area saw 308 less drug offenses in the same time period. As a matter of fact, drug offenses decreased more than 38% in the study areas between 2001 and 2004, the core time period that Weed and Seed operated in the study area. After increasing slightly in both 2005 and 2006, drug offenses for the study area decreased once again for 2007. From this perspective, the 'seeds' put in place to compel this positive change have indeed worked for the one year that the Weed and Seed program has been gone from the study area. It will be interesting to see how this rate sustains when future data are provided.

Unfortunately, the news is not all good for all of the portions of the study area. As per Figure 4, the South Winston 2 area has experienced increases in Part I and Drug crimes between 2001 and 2006 while most other portions of the study area have experienced significant and moderate decreases in crime. It is difficult to tell why these patterns exist without further analysis. The census provides information about indicators such as age, income and education attainment that may explain these differences. Qualitatively, further research with community leaders, civic officials and non-profit agencies may help shed some light on why this portion of the study area has been more resistant to the efforts of the Weed and Seed initiative.

## **7. Conclusion**

Violent crime and drugs represent the worst that a city has to offer. These crimes undermine a city's quality of life, tear at its moral fabric and discourage growth. The Weed and Seed program focuses on preventing and remediating these types of crimes to inhibit positive change. These types of crimes have been decreasing in the city of Winston-Salem since digital records were made available in 2001. Using GIS analysis, the following conclusions can be made from this study:

- 4 out of the 5 areas of the Weed and Seed study area have seen positive change with respect to Part I and drug offenses between 2001 and 2006.
- Part I and drug offense rates have decreased in the study area since the Weed and Seed initiative has moved to another part of the city.
- Part I and drug crime (both raw and rates standardized by population) have decreased in the study area since 2001
- Part I and combined (Part I and drug) offenses have decreased in the study area and Winston-Salem at about the same rate.
- The entire city experienced a slight increase in drug offenses since 2001, but due to population increase, the rate has decreased.
- *Drug offenses in the study area have significantly decreased compared to the entire city of Winston-Salem since 2001.*

This is encouraging news for Weed and Seed proponents across the country and helps to show that Weed and Seed has had a positive impact on crime, especially drug offenses, in Winston-Salem. Current drug prevention strategies effective in Winston-Salem can be shared with other Weed and Seed cities, while those cities that have experienced significant decreases in Part I crimes can share their experiences with Weed and Seed members in Winston-Salem.

## **8. Discussion**

As with any project of this magnitude, the quality of analysis and ultimately the results are only as good as the data themselves. While data provided by the Winston-Salem police department are the best available data, they may not tell the entire story. Increases in offenses may be indicative of improved suppression efforts in problem areas during the time of Weed and Seed. Studying crime rates in the years after Weed and Seed has left may better adequately portray the long term effectiveness of the program. Data from 2007 are promising and the Center for Community Safety looks forward to quantifying crime rates in these areas in the years to come.

The crime data provided signify only offenses reported by the Winston-Salem Police Department. Incidents that are reported, but are unjustified, unsubstantiated or uncorroborated are not included in this information. Accordingly, this may include criminal activity related to this study that is not included for these reasons. In addition, technical restrictions related to the nature of the raw data may prevent it from being adequately mapped. These data represent a reflection of criminal activity in Winston-Salem processed by the Center for Community Safety. The Winston-Salem Police Department is in no way responsible for the quality of this analysis or the maps created from these analyses. Please contact the Center for Community Safety with any questions about the analyzed data or maps.

Because of the fickle nature of spatial data and the way in which spatial data are created, a number of issues speak to the subject of accuracy and the overall effect of accuracy on analysis. This spatial analysis involves both point (crime location) and polygon (census block group) analysis. Data provided by the Winston-Salem Police Department are originally supplied as addresses and converted to points using a process called *Geocoding*. Issues with *Geocoding* revolve around the fact that house numbers are interpolated based on the values assigned at the beginning and end of the street. If 'Main Street' has a beginning value of 100 and ending value of 200, the *Geocoding* algorithm will assign a crime that occurred at '125 Main Street' as one quarter of the way between 100 and 200. In reality, that may not be the case. Secondly, crimes that may not occur at specific addresses such as parks must ultimately be assigned an address for *Geocoding* purposes. Harada and Shimada (2002) measured the affects of *Geocoding* on the precision of complex analysis. Before them, Ratcliffe and McCullagh (1999) used the terms hotspots and hotbeds to discern the various accuracies at which highly concentrated crime can be identified with statistical certainty. In consultation with these documents and personnel familiar with the data, the researchers are confident that any degradation of the spatial information is minimal.

In that same vein, population data that are used to derive crime rates are estimates based on existing data and trends provided by the United States Census and authoritative data providers. Local population estimates for the city of Winston-Salem are as high as 223,000, but are lower for this study based on the data provided. It is logistically impossible to perform a reliable yearly census on a city the size of Winston-Salem. In addition, fluctuations in population due to employment, housing and other regional events are difficult to quantify with any certainty and further exacerbate one's ability to adequately model population at any scale.

Lastly, care must be taken when determining an appropriate aggregation unit in which to display data. The aggregation unit used in this study is the census block group. It is within these block groups that crimes were counted, rates were calculated and ultimately displayed. It is important to realize that at the polygon level, the levels of aggregation may yield different results depending upon scale. Openshaw (1984) coined this term as the 'Modifiable Areal Unit Problem' (MAUP). For example, there may be a cluster of high crime areas at the census block level that can be detected. However, these blocks may lie in different census block groups and their crime rates' interactions other census blocks within the same block group may obfuscate these high values and more importantly this cluster. If a cluster was calculated or visualized at the census block group level, this clustering pattern would not be apparent. It is important that issues of

MAUP be addressed by using a scale that adequately dictates and explains transparency between results rendered at various scales. In consultation with block level crime information, the researchers are confident the effects of MAUP are minimized and that the general trends shown at the block group level reflect those at other scales.

## References

- Chainey, S.P., S. Reid, and N. Stuart. (2002). *When Is a Hotspot a Hotspot? A Procedure for Creating Statistically Robust Hotspot Maps of Crime*. In *Innovations in GIS 9*. London: Taylor & Francis.
- Chainey, Spencer, L. Tompson. and S. Uhlig. (2008). The Utility of Hotspot Mapping for Predicting Spatial Patterns of Crime. *Security Journal*, 21, 4–28.
- Chakravorty, S. (1995). Identifying Crime Clusters: The Spatial Principles. *Middle States Geographer*, 28, 53–58.
- Getis, A. and Ord, J. K. (1992). The Analysis of Spatial Association by Use of Distance Statistics. *Geographical Analysis*, 24, 189-206.
- Harada, Yutaka and T. Shimada. (2005). Examining the Impact of the Precision of Address Geocoding on Estimated Density of Crime Locations *Computers & Geosciences*, 32, 1096 – 1107.
- Harries, K. (1997). Social Stress and Trauma: Synthesis and Spatial Analysis, *Social Science and Medicine*, 45, 1251–1264.
- Harries, K. (1999). *Mapping Crime: Principles and Practice*. Washington, D.C.: National Institute of Justice.
- Levine, N. (2002). *CrimeStat 2.0, A Spatial Statistics Program for the Analysis of Crime Incident Locations*. Houston, TX: Ned Levine & Associates and Washington, DC: U.S. Department of Justice, National Institute of Justice.
- Li, J. and Rainwater, J. (1999). *The Real Picture of Land-Use density and Crime: a GIS Application*. Retrieved October 5' 2008, from <http://gis.esri.com/library/userconf/proc00/professional/papers/PAP508/p508.html>.
- Openshaw, S. (1984). The Modifiable Areal Unit Problem. *Concepts and Techniques in Modern Geography*, 38, 41.
- Ratcliffe J.H. and McCullagh, M.J. (1999). Hotbeds of Crime and the Search for Spatial Accuracy. *Geographical Systems*, 1, 385–398.
- Steinberg, Steven and S. Steinberg. (2006). *Geographic Information Systems for the Social Sciences: Investigating Place and Space*. Thousand Oaks, CA: Sage Publishing.
- United States Department of Justice. (2004a). *The Weed and Seed Strategy*. Washington D.C.: Office of Justice Programs, Community Capacity Development Office.

United States Department of Justice. (2004b). *Uniform Crime Reporting Handbook*. Washington D.C.: Federal Bureau of Investigations.

United States Department of Justice. (2005). *Mapping Crime: Understanding Hot Spots* (NIJ Special Report). Washington, D.C.: U.S. Department of Justice, Office of Justice Programs

Weeks, John. (2005). *Population: An Introduction to Concepts and Issues, 9<sup>th</sup> Edition*. Belmont, CA: Wadsworth.

**Table 1:** Number of Part I and Drug Offenses in Study Area and Winston-Salem

Year	Study Area	W-S	Percent of Total	Study Area	W-S	Percent of Total
	Part I Crimes			Drug Offenses		
2001	2359	16,447	14.34%	899	2357	38.14%
2002	2309	15,613	14.79%	735	2205	33.33%
2003	2327	15,298	15.21%	705	2240	31.47%
2004	2099	14,086	14.90%	556	2084	26.68%
2005	1938	13,992	13.85%	625	2243	27.86%
2006*	2345	14,044	16.70%	712	2339	30.44%
2007	2099	15,539	13.51%	681	2424	28.09%
RAW CHANGE, 2001 - 2007	-260	-908		-218	67	
% CHANGE 2001 - 2007	-11.02%	-5.52%	-5.82%	-24.25%	2.84%	-26.34%

\* Annexation took place on October 1, 2006. Data using old boundary will be applied for the entire year

**Table 2:** Population in Study Area and Winston-Salem, 2001 – 2007

	Study Area	W-S	
Year	<b>Population</b>		<b>Percent of Total</b>
2001	15945	181139	8.80%
2002	15974	183097	8.72%
2003	16010	185118	8.65%
2004	16039	187226	8.57%
2005	16078	189428	8.49%
2006	16114	191710	8.41%
2007	16176	211274	7.66%
RAW CHANGE, 2001 - 2007	231	30135	
% CHANGE, 2001 - 2007	1.45%	16.64%	

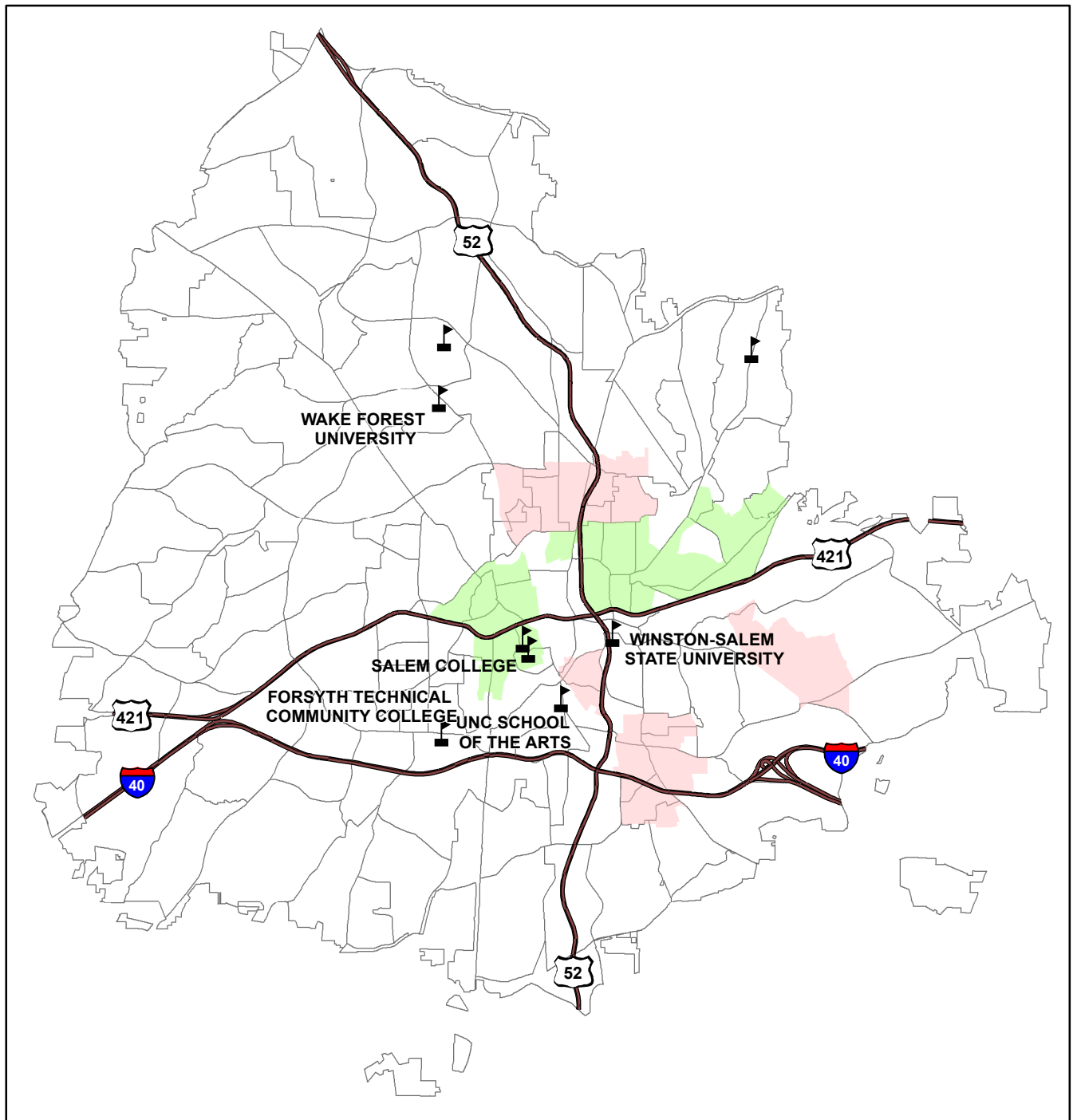
**Table 3:** Standardized Crime Rates for Study Area and Winston-Salem, 2001 - 2007

	Study Area	W-S	Study Area	W-S	Study Area	W-S
Year	<b>Part I Crimes / 10,000</b>		<b>Drug Offenses / 10,000</b>		<b>Violent and Drug Crimes / 10,000</b>	
2001	1479.46	907.98	563.81	130.12	2043.27	1038.1
2002	1445.47	852.72	460.12	120.43	1905.59	973.15
2003	1453.47	826.39	440.35	121	1893.82	947.39
2004	1308.69	752.35	346.66	111.31	1655.35	863.66
2005	1205.37	738.64	388.73	118.41	1594.1	857.05
2006	1455.26	732.56	441.85	122.01	1897.11	854.57
2007	1297.6	735.49	420.99	114.73	1718.59	850.22
RAW CHANGE, 2001 - 2007	-181.86	-172.49	-142.82**	-15.39**	-324.68	-187.88
% CHANGE, 2001 - 2007	-12.29%	-19%	-25.33%	-11.83%	-15.89%	-18.10%

\*\* Values significantly different at  $\alpha = .05$







Figure 1: The Weed and Seed Initiative in Winston-Salem, NC



0 1.5 3 6 Miles

0 2 4 8 Kilometers

SCALE 1:135,000

	Colleges and Universities
	Original Weed and Seed Site (Study Area)
	Current Weed and Seed Site (2007 - Present)
	Census Block Group Boundary



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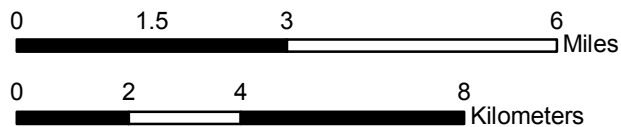
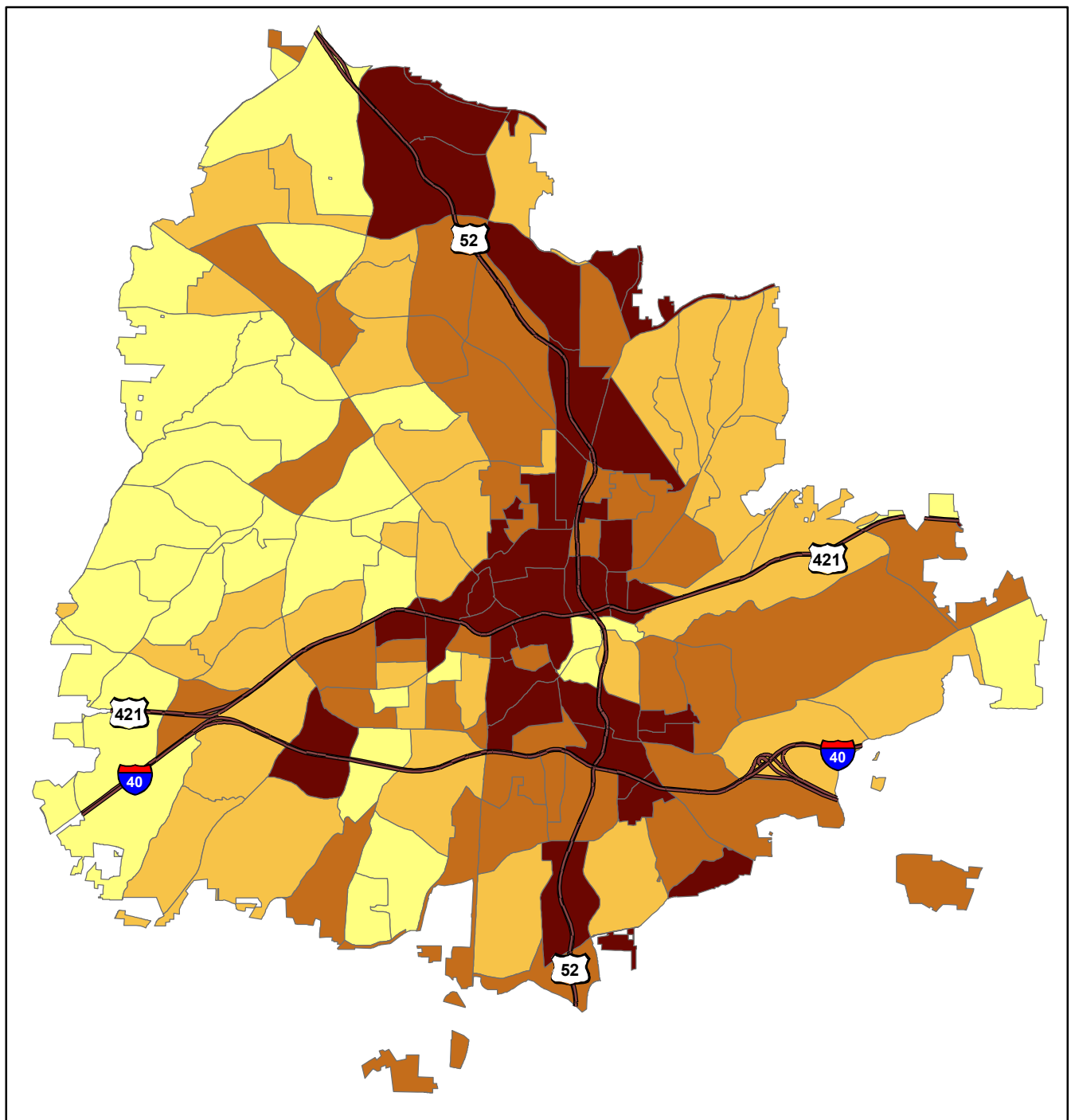
tcr1@wssu.edu  
336-779-7303

Source(s): United States Census Bureau  
City of Winston-Salem

This map represents the Weed and Seed sites for the city of Winston-Salem, North Carolina. The study area for this research is the graduated Weed and Seed sites. They were in existence from 2000 through 2006. These areas are shown in pink. The green areas represent the current Weed and Seed site. This area is called the Twin City East-West Partnership and it was initiated in 2007.

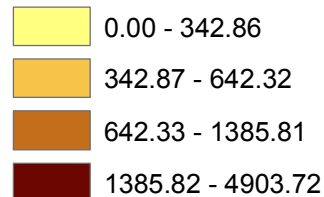


Figure 2: Part I and Drug Crimes in Winston-Salem, 2006



SCALE 1:135,000

**Part I Crime and Drug Offenses /10,000**



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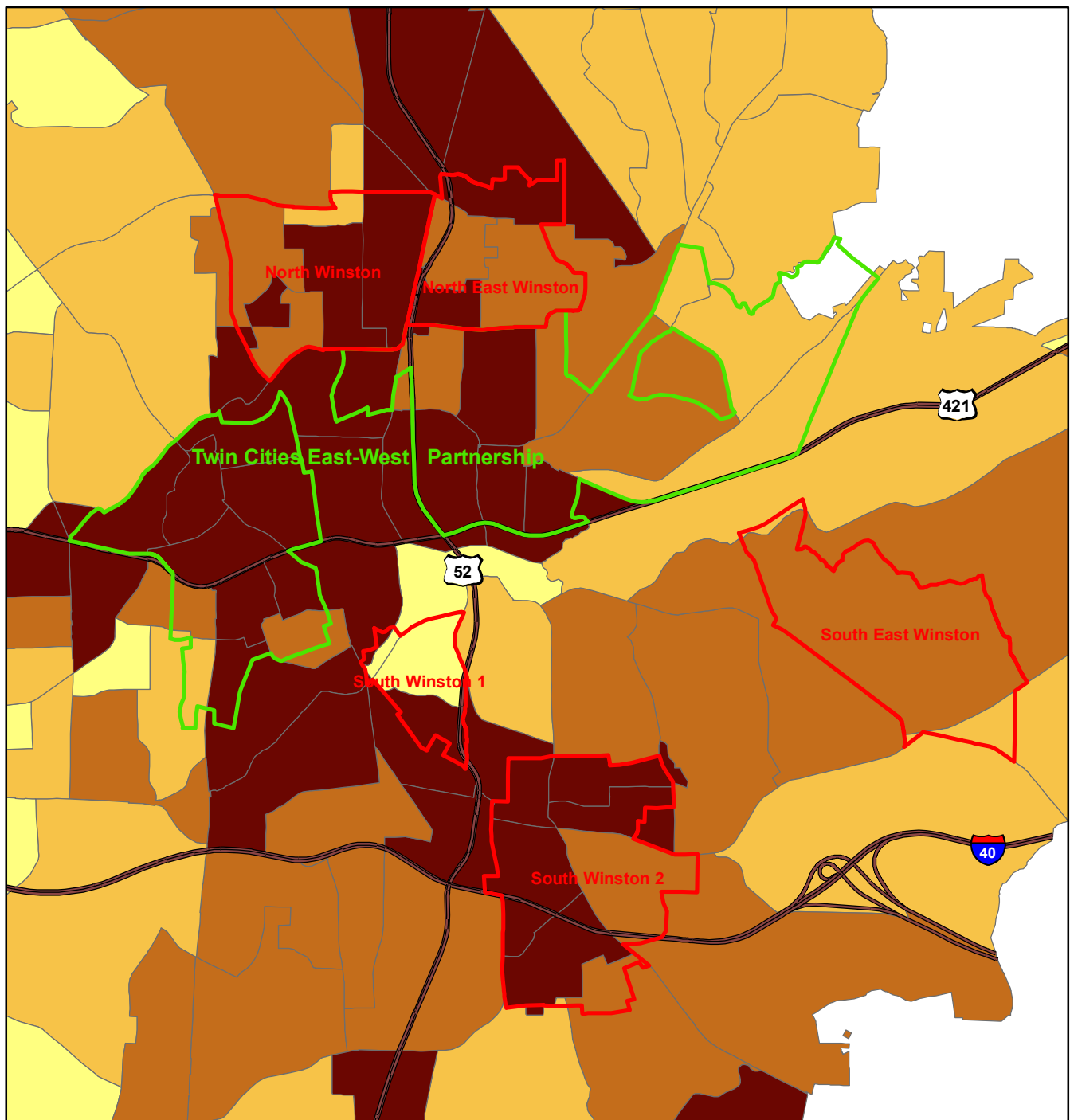
[tcrl@wssu.edu](mailto:tcrl@wssu.edu)  
336-779-7303

Source(s): United States Census Bureau  
Winston-Salem Police Department

This map represents the rate of Part I crime and drug offenses in the City of Winston-Salem, North Carolina for 2006 by census block group. The block group is the second smallest enumeration unit used by the United State Census Bureau. Part I crimes are derived from Part I Crimes according to the FBI Uniform Crime Reports Standards (UCR). Drug crimes are classified as Part II crimes according to the UCR and must be queried out and combined with Part I crimes to create the variables for this map.



Figure 3: Part I and Drug Crimes in Winston-Salem, 2006



0 0.45 0.9 1.8 Miles

0 0.5 1 2 Kilometers

SCALE 1:60,000



Center for Community Safety

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tcr1@wssu.edu  
336-779-7303

Source(s): United States Census Bureau  
Winston-Salem Police Department

Original Weed and Seed Site (Study Area)

Current Weed and Seed Site

**Part I Crime and Drug Offenses /10,000**

0.00 - 342.86

342.87 - 642.32

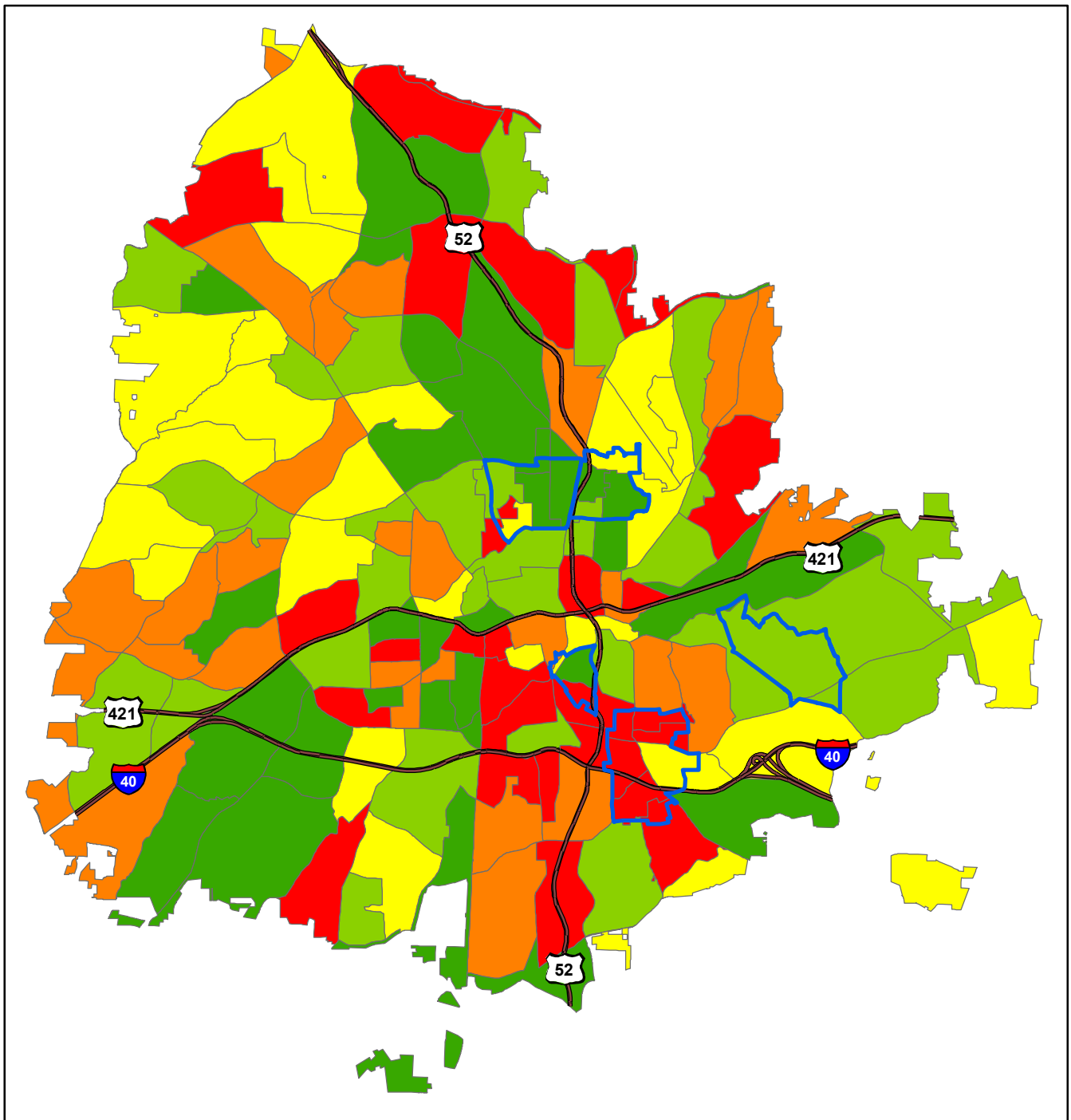
642.33 - 1385.81

1385.82 - 4903.72



This map represents the number of Part I crime and drug offenses in current and graduated Weed and Seed sites for the year 2006. The pre-annexation boundaries are used in this map.

Figure 4: Crime Change in Winston-Salem, 2001 - 2006



SCALE 1:135,000

**Change in Crime, 2001 - 2006**

- Significant Decrease in Crime
- Moderate Decrease in Crime
- Little to No Decrease in Crime
- Moderate Increase in Crime
- Largest Increase in Crime
- Study Area



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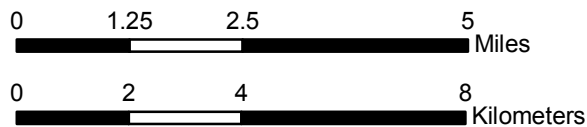
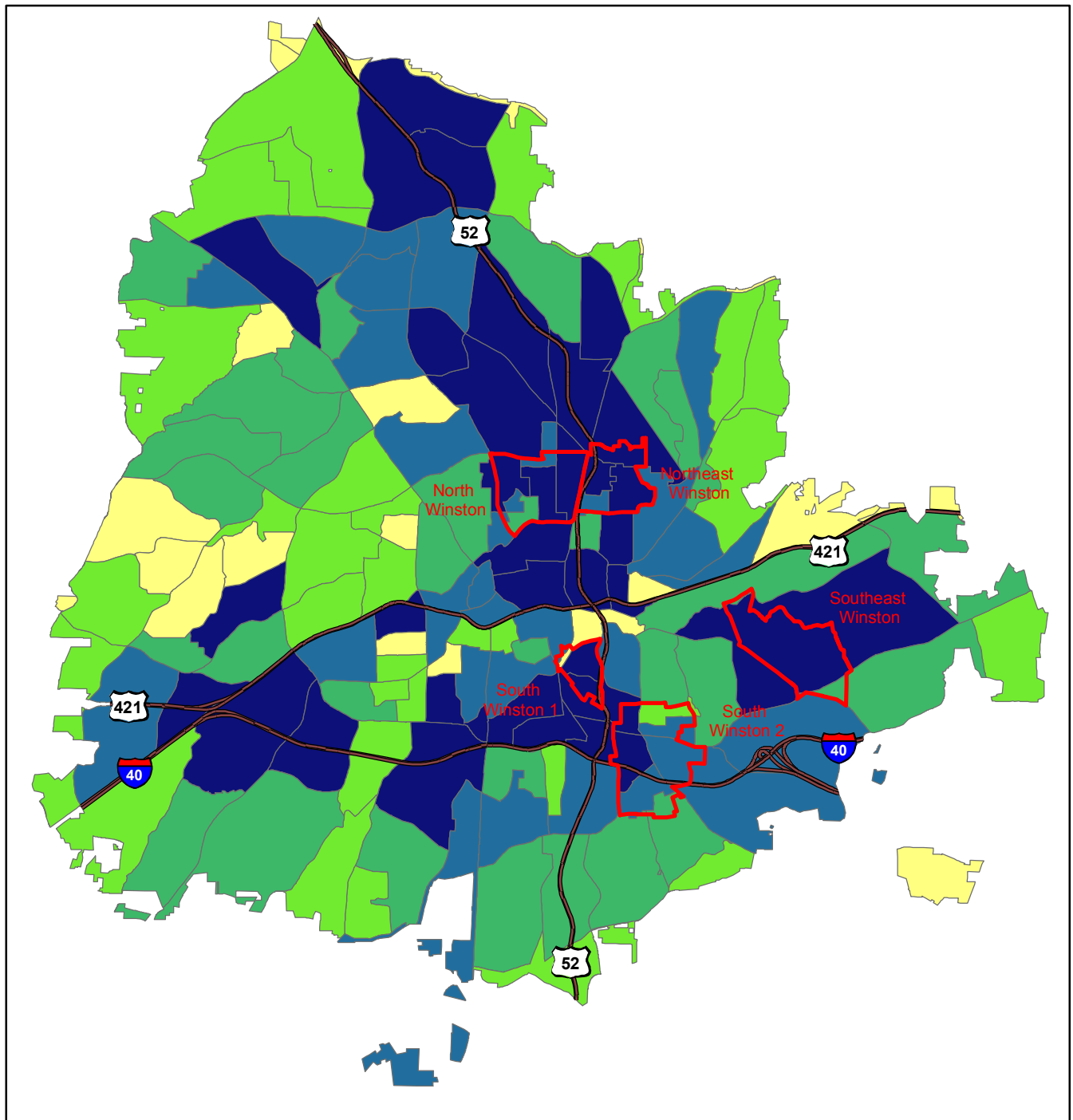
tcr1@wssu.edu  
336-779-7303

Source(s): United States Census Bureau  
Winston-Salem Police Department

This map represents the change in Part I and drug crime offenses rates (offenses per 10,000 population) by block group between 2001 and 2006. 2007 was not included because crime data in areas annexed by Winston-Salem were not available prior to 2007.



Figure 5: Drug Offense Change in Winston-Salem, 2001 - 2006



SCALE 1:135,000








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tcr1@wssu.edu  
336-779-7303

Source(s): United States Census Bureau  
Winston-Salem Police Department

**Change in Drug Offenses, 2001 - 2006**

-  Study Area
-  Biggest Decrease
-  Moderate Decrease
-  Moderate Decrease
-  Smallest Decrease / Increase

This map represents the change drug crime offenses (raw values) by census block between 2001 and 2006. 2007 was not included because crime data in areas annexed by Winston-Salem were not available prior to 2007.

