Increasing Student and Community Safety Partnership

A Researcher-Practitioner Partnership between West Virginia University Department of Geology and Geography, the West Virginia University Police Department and the Morgantown Police Department

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ABSTRACT

Increasing Student and Community Safety (ISaCS) Partnership
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This collaboration between the West Virginia University Police Department, academic researchers, and the city of Morgantown PD supports the adoption of geospatial crime analysis across police jurisdictions to provide intelligence-led decision making capabilities, which focus on enhancing the safety and security of college students, both on- and off- campus. Increased knowledge of the distribution of crime in time and space increases the capacity for law enforcement agencies (LEAs) to share information across boundaries, and to develop crime reduction and prevention strategies to benefit the larger community. This crime mapping and analysis partnership represents the first such initiative in the state of West Virginia. Traditional community-oriented policing methods are enhanced through the creation of cross-jurisdictional partnerships, while the research component supports and contributes to the literature on the value of geospatial information to campus police and surrounding law enforcement agencies.

The goal of the Increasing Student and Community Safety (ISaCS) partnership was to develop an information system for law enforcement agencies, university leaders and private citizens. The overall objective was to use spatial data to identify emerging crime trends, enabling law enforcement agencies to develop crime reduction strategies for safer campuses and communities. The principal objectives were: 1) Establish a cross-jurisdiction crime mapping and crime analysis capability in support of a safer campus and community; 2) Utilize geospatial technologies to provide spatial and non-spatial information for problem-oriented, intelligence-led decision making and resource allocation by law enforcement agencies and policy makers; 3) Enhance community crime reduction participation through increased awareness and information dissemination with a multi-faceted combination of in-person and online solutions, including an interactive map server; and 4) Promote and encourage coordination and cooperation among additional law enforcement agencies and researchers.

Law enforcement partners provided crime incident reports to generate daily cross-jurisdictional pin maps and weekly intensity maps. The maps provided the different LEAs with a holistic view of offenses across the study area and were published online for the community through a web mapping application. To provide practitioners with the ability to create their own maps, the researchers created automated models capable of extracting and geocoding crime incidents. This step improved efficiency and promotes continued analysis after the formal project ends.

Highlights of significant findings are:

1. Initial research results suggest that there are numerous spatial and temporal hot spot areas in each police jurisdiction, as well as numerous hot spots that are cross-jurisdictional.
2. Observed crime clusters have identifiable space-time relationships, enabling the development of proactive crime reduction methods.
3. Preliminary cumulative assessments suggest student victimization is random, based on crimes of opportunity, and consistent with current environmental criminology theories.
4. Campus and municipal crime rates of ten priority offenses had a consistent decline during the 2010-2011 study period, however crime rates of other offenses increased. This increase may be attributed to proactive measures resulting in more offenses being reported or observed by law enforcement officers deployed to hot spot areas.

5. Different reporting agencies use different offense classification schemes, which result in different crime counts. Therefore official crime statistics may provide inconsistent or inaccurate crime rate assessments.
6. This researcher-practitioner partnership had several strengths and weaknesses, which should be taken into consideration by future researcher-practitioner partners.

The research-practitioner partnership has established facilities in an environment previously unable to perform crime mapping and analysis. The partnership provided researchers with insight into the needs and practices of the practitioners, while giving the practitioners access to the skills of the researchers, thus supporting continuing crime reduction efforts in future.

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EXECUTIVE SUMMARY

Crime prevention has become a preferred enhancement to enforcement by most law enforcement agencies. Police departments around the world are now taking proactive measures to reduce and prevent crime. Crime fighting does little to reduce crime and this fact is particularly relevant to college campuses striving to maintain and project a safe public image. Once a crime is committed and reported on campus, it becomes a Clery statistic subject to wide dissemination. Additionally, violent crimes on campus often receive excessive media coverage (Bromley 1995; Fisher 1995; Volkwein et al. 1995). As a result crime prevention becomes preferable to crime fighting.

In an effort to enhance the quality of life and reduce the fear of crime through the creation of safer campuses and communities, this partnership used daily criminal activity reports to analyze and identify spatial and temporal crime patterns across campus and municipal law enforcement jurisdictions, facilitated information exchange through the creation of a Geographic Information System (GIS), and enhanced collective crime reduction measures resulting from spatial and temporal analyses of the data. While criminal activity varied across jurisdictions, the partnership was forged to identify and reduce risks to university students on- and off- campus. The collaboration between the West Virginia University Police Department (WVUPD), Morgantown Police Department (MPD) and West Virginia University (WVU) Department of Geography researchers demonstrated the viability of cross-jurisdictional, problem-oriented crime analysis for potential victim groups other than students to facilitate an overall safer community. Through a problem-oriented approach, the crime reduction and prevention strategies benefited the larger community and increased the capacity for law enforcement agencies to share information across jurisdictional boundaries. This crime mapping and analysis partnership was the first such initiative in the state of West Virginia. The Increasing Student and Community Safety (ISaCS) partnership demonstrates the feasibility of researcher-practitioner partnerships in a cross-jurisdiction crime mapping and analysis effort addressing a national problem resulting from the vast majority of incidents involving students occur off-campus. Traditional community-oriented policing methods were enhanced through additional cross-jurisdictional community-oriented efforts and partnerships stemming from this project. Furthermore, the research component addressed several identified gaps in the literature, providing additional future research directions.

According to the National Center for Victims of Crime (2011), nearly 91,000 crimes occurred on college campuses in 2009. Of these crimes, 97% were property crimes. However, this report further identified 93% of all crimes committed against college students had occurred off-campus. Baum and Klaus (2005) also reported 93% of the crimes against college students occurred off-campus between 1995 and 2002 with an annual rate of 60.7 per 1,000 students. In general, college campuses experience less crime then the surrounding communities (Bromley 1995; Henson and Stone 1999; National Center for Victims of Crime 2009; Volkwein et al. 1995). Furthermore, Bromley (1995) cited a correlation between on-campus crime and crime rates of the surrounding city. McPheters (1978) catalyzed campus crime research when he associated higher crime rates at 38 college campuses with both on- and off- campus variables. These observations suggest that a measure of total potential crime risk to students attending college should consider crime rates for both the campus and adjacent off-campus community. They also suggest a need for campus officials and police to work with municipal officials and police to protect students and provide a safer community. Brower and Carroll (2007) demonstrated the importance of collaboration when they used GIS to map high density locations of students off-campus and their spatial relationship to calls for service made to the Madison Police Department. Additionally they analyzed temporal characteristics of crimes to identify patterns of when different types of crimes were being reported and found that most incidents occurred near bars and shortly after closing hours. The results of that mapping effort led directly to changes in campus policy and policing activities, demonstrating that crime mapping and analysis has the potential to influence decision makers and reduce crime.

The goal of this research was to develop an information system for law enforcement agency (LEA) leaders, college administrators, public officials, citizen organizations, and private citizens that would provide a cross-jurisdictional crime risk assessment. The overall objective was to identify emerging crime trends, enabling law enforcement agencies to quickly inform the public and solicit community participation while developing crime reduction strategies tailored to providing a safer campus and residential community. The objectives identified to provide for increased safety were:

1. Establish a cross-jurisdiction crime mapping and crime analysis capability in support of a safer campus and community;
2. Utilize geospatial technologies to provide spatial and non-spatial information for problem-oriented, pro-active intelligence-led decision making and resource allocation by law enforcement agencies and policy makers;
3. Enhance community crime reduction participation through increased awareness and information dissemination with a multi-faceted combination of in-person and online solutions, including an interactive map server; and
4. Promote and encourage coordination and cooperation among additional law enforcement and researchers. Responsibilities for objectives and goals were divided among the two LEAs and two researchers (a research faculty member and a graduate student).

The applied research project, Increasing Student and Community Safety partnership took place in Morgantown, WV from 2010 to 2011. West Virginia University consists of three campuses: the Downtown campus, the Evansdale campus, and the Health Sciences campus. The campus population for 2010 was approximately 29,000 students, 2,300 faculty, and 3,300 staff employees. The resident population of the city of Morgantown had grown over the last decade at a rate of 17% to a 2010 total of 30,000 with an additional 70,000 residents in smaller towns throughout the county. The relatively low crime rates and populations of both WVU and Morgantown provided an ideal study area for demonstrational cross-jurisdictional researcher-practitioner collaboration.

Project implementation resulted from the convergence of several initiatives, including interest of the WVU and the Morgantown Chiefs of Police in the integration of information and the increased use of crime analysis. This interest was complemented by the establishment of a course in crime mapping and analysis in the geography program at WVU and by support for Researcher-Practitioner Partnerships from the National Institute of Justice, Office of Justice Program (National Institute of Justice 2009). Campus police, municipal police and spatial science researchers reported and mapped daily crime incidents and weekly trends. The maps provided the different jurisdictions with a holistic view of offenses across the study area and were published online for the community to examine through an interactive web mapping application. Based on Clery Act reporting requirements, practitioners identified ten offenses of interest as an initial starting point for the partnership: murder, sex offenses, robbery, aggravated assault, burglary, vehicle theft, arson, destruction of property, theft/larceny, and simple assault/battery. Researchers explored spatial and temporal trends in the data which guided resource allocation, decision-making, and community crime and awareness prevention and reduction methods used by the practitioners. To improve efficiency and promote continued analysis, researchers created automated models and templates capable of compiling data records, geocoding locations, and producing maps from crime incidents. This automation will enable practitioners to continue to create their own maps beyond the two-year project period.

Key Researcher-Practitioner Partnership Accomplishments

The proposed project outlined twelve major tasks needed to support the four objectives. Completion of the major tasks represented major accomplishments in the overall project implementation. While research and dissemination were identified as project outcomes and not as major tasks, the work

involved could be considered a major accomplishment for contributing knowledge to the project. The twelve major tasks and accomplishments were:

1. Set-up and established a computer server and geo-database and associated hardware and software.
2. Populated the geodatabase with spatial information required to perform spatial analysis of crime. This included building footprints, aerial photographs, alcohol outlets, restaurants, public transportation routes and stops, and selected lodging and shopping facilities, as well as a variety of other local areas of interest.
3. Verified and increased the accuracy of spatial data. Some information, such as streets, was available but not complete and contained numerous inaccuracies. Additional attribute fields were assigned to data and populated to support practitioner information needs.
4. Populated the geodatabase with non-spatial information (i.e.: crime incidents) as the information became available from each LEA. Crime incident data was exported from LEA record management systems to the geodatabase.
5. Automated geocoding of crime incidents with 99% verified accuracy achieved through the use of composite geocoding references and alias tables.
6. Created and distributed daily conventional crime pin maps, displaying a composite of all crime across jurisdictions, and enabling visual identification of offense locations.
7. Created weekly crime trend problem-solving hot spot maps using a point density method to identify problem areas in order to allocate resources needed to provide a safer community.
8. Planned and conducted regular operational and planning meetings between researchers and practitioners. In addition to being problem-solving forums, theses meetings assessed progress, recommended additional information and analysis needs, and identified additional problems to address.
9. Developed a Flex-based Internet mapping website to provide crime maps to the public. The crime mapping website was designed to serve primarily as a public awareness and information dissemination program congruent with the philosophy of community-oriented policing which builds trust between the police and the community.
10. Maps will be available and provided to the public through the Internet.
11. Expanded the previous network of LEAs, researchers, and community leaders to identify community problems, research and funding opportunities, and strategic regional planning, resulting in the submission of additional collaborative grants between researchers and practitioners.
12. The project principal investigator has sought additional research funding as part of a team investigating crime mapping and analysis techniques at the neighborhood scale. The Morgantown Police Department additionally received a three year COPS grant to fund a Prevention Resource Officer and additional officers to engage in crime reduction activities through citizen engagement.

Research-Practitioner Research Contributions

The focal point of research was to identify and characterize the causal relationships existing between crime incidents and geographic environmental variables. Analyses were accomplished via numerous standard statistical techniques used in crime analysis, including exploratory spatial data analysis (ESDA), spatial regression analysis, and spatial time modeling. Highlights of significant findings follow:

1. Research results suggest that there are numerous spatial and temporal hot spot areas in each police jurisdiction as well as numerous hot spots that are cross-jurisdictional. Morgantown and WVU displayed relatively similar temporal crime characteristics at

daily, weekly, and monthly resolutions. Although the geographic distribution of the ten locations with the largest number of offenses was dispersed throughout the cross-jurisdictional study area, most locations were near the common boundaries of the LEA jurisdictions. Analyses suggest the existence of a shared boundary problem for several offense categories.

2. Observed crime clusters have identifiable space-time interaction, enabling the development of proactive crime reduction methods. A Knox space-time interaction test was used to calculate space-time clusters for the two LEA jurisdictions separately. A third Knox test was used to calculate space-time clusters for the entire cross-jurisdictional study area. Various distance and time measures were used for comparison. Results indicated that analysis of the jurisdictions separately omitted space-time clusters over formed over common boundaries, providing an inaccurate assessment of risk potential and demonstrating the statistical difficulties posed by geographic boundary effects in data analyses.
3. Preliminary cumulative assessments suggest student victimization is random, based on crimes of opportunity, and consistent with current environmental criminology theories.
4. Campus and municipal crime rates of offenses that were considered to be a priority had a consistent decline during the 2010-2011 study period, however, crime rates of other offenses increased and resulted in a net increase of nine incidents in total. This increase may be attributed to random variation, proactive measures resulting in more offenses being reported or observed by law enforcement officers deployed to hot spot areas. Furthermore, the change in spatial hot spots suggests crime diffusion.
5. Official crime statistics may provide inaccurate crime rate assessments. Different offense classification schemes and reporting agencies result in different crime counts. Official crime statistics reported to the Federal Bureau of Investigation, Department of Education, and West Virginia State Police were compared and found to have inconsistent crime counts. The crime counts based on UCR classification (FBI and Clery) were identified as providing the lowest crime counts while NIBRS based classifications (WVSP and ISaCS) resulted in much larger crime counts for the majority of offense categories. The small size of both numerators and denominators results in unstable rate estimates.
6. Although crime analysis across multiple jurisdictional implies that a cross-jurisdictional approach to crime analysis is appropriate, separate LEA spatial and temporal analyses are also an important component in understanding crime patterns as unique characteristics contribute to the overall assessment.

This research problem has the potential to significantly advance criminal justice policy and practice across the country. The goals and objectives address campus safety from a cross-jurisdictional aspect. There is clearly a gap in the literature when it comes to addressing student safety off-campus. Any identifiable causal relationships that can be empirically demonstrated have the potential to influence decision makers at colleges and within college towns throughout the country. Reports and publications from this research can be used to establish best practice policies and procedures for institutions interested in maintaining and improving student safety. Not only did this research project address campus crime, cross-jurisdictional analysis, and the implementation researcher-practitioner partnerships, it explicitly considered space-time interaction in the analysis of crime incidents. Most criminology research focuses on space alone, either completely ignoring the interaction with time or considering time as a separate dimension.

The availability of a new and rich dataset of crime incidents will enable future researchers to apply their specialty skills toward a diverse set of problems. Such research is difficult without available datasets and local cooperation. These data will also serve important roles in the education of future researchers and practitioners. This data is being used in a WVU crime mapping class to visualize patterns

and theorize new hypothesis to test. Such data could also easily be used at a multi-disciplinary level between criminal justice practitioners and geographers.

This research examined and addressed aspects of the current ineffectiveness of the Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act. Through combining community-oriented policing methods, which emphasize crime prevention and awareness, with daily incident maps and safety maps, students and parents can make decisions beyond whether or not a school is safe. Just as important are factors such as how safe the town is, residential location options, dining/shopping districts, and routes between those locations. By being proactive, problem-oriented, and through the mapping and analysis of crime incident locations and attributes, it can be demonstrated that behavior changes by students, administrators, and law enforcement can lead to increased student and overall community safety- the original intent of the Clery Act.

This researcher-practitioner partnership had several strengths and weaknesses which should be taken into consideration by future researcher-practitioner partnerships. The strengths of the crime mapping and analysis for problem-oriented policing can be evaluated from the practical and academic outcomes of the research. However, the following lessons emerged as the project was being evaluated:

1. The partnership was an 8 am - 5 pm arrangement; originally, it was envisioned that LEA supervisors and personnel working the night shift would be involved.
2. Researchers did not become sufficiently involved in community relationships held publicly. All interaction between community members and researchers took place through arranged meetings with LEA leaders in conference room settings. Researchers had anticipated attending LEA community outreach events.
3. LEA personnel had little familiarity with the RMS they used. This resulted in crime incident data being entered inconsistently. Although many useful features of the RMS began to emerge with greater familiarity with the software, advantage was not fully taken of these features owing to limited staffing and training. The police chiefs recognized a need for additional funding to provide training to all personnel using the RMS.
4. Although the pin maps were created from a script and map template, points where two or more incidents occurred at the same location would be visually displayed as one incident (overposting). The researchers were able to manually manipulate the points so multiple incidents would be represented; the process was too complex for regular use by practitioners. An easier and more efficient solution for overposting needs to be developed and implemented.
5. Researchers relied heavily on CrimeStats and GeoDa software for spatial and temporal analyses. However, emphasis was given to ArcGIS for LEA personnel. Researchers considered familiarity with ArcGIS to be a priority. The result is unfamiliarity with other valuable analytical software by LEA personnel.
6. While documentation of meetings, activities, software, data, etc. may appear to be routine and adequate at the time of recording, compilation for reports such as this serves to illustrate the need for rigorous detail. Daily operation, research activities, articles and presentations may be more appealing, but nothing substitutes for good office practice.
7. Although university administrators are aware of the partnership and objectives, there is a need to devote more time and effort to presenting them with empirical results and implications for student safety. Dialog between the researchers and practitioners with administrators should be given priority, now that the proposed objectives have been accomplished and tangible research results have emerged.

When generalized beyond the specifics of ISaCS these lessons should be valuable considerations for future partnership proposals.

With the support of the research-practitioner partnership, this applied research project has provided the opportunity to establish the foundation for crime mapping and analysis in a university police department. The partnership provided the researchers with insight into daily data management practices and geospatial information needs of the practitioners, meanwhile, giving the practitioners access to researchers who are able to support analysis leading to crime reduction efforts. Geographic Information System infrastructure has been installed and operated through the cooperation of the WVU police department and WVU researchers. The automated cartographic model developed under this project will enable the practitioner to continue crime mapping and analysis independently beyond the end of the current project. Having established the capacity to perform cross-jurisdictional crime mapping, practitioners will be able to derive data-based evidence for proactive, problem-oriented crime reduction efforts. The mutual trust developed between researchers and practitioners demonstrates LEAs and researchers can successfully work together and has laid the groundwork for future development.

INTRODUCTION

The Increasing Student and Community Safety (ISaCS) partnership was an applied researcher-practitioner project. A major component of the project was to establish a capacity for the law enforcement agencies (LEAs) in the partnership to use geospatial technologies. With the establishment of geospatial technologies, the LEAs would be able to perform routine crime mapping activities, while the researchers would assist with establishing the infrastructure, initiate crime mapping analyses, and conduct research in support of the project goals. Throughout this report, there will be a discussion of achieving objectives of the partnership and contributing to research literature. Both aspects are vital to the intent of a researcher-practitioner partnership.

This report will first discuss the purpose, goals, and objectives of the ISaCS Partnership. A brief literature review is followed by a description of the partnership and study area for the context of the project, which leads to a statement of our rationale A detailed discussion of major tasks accomplished to support the project objectives over the study period will then be presented. Research objectives, methods, results, and conclusions and implications will precede a final discussion of the cross-jurisdiction researcher-practitioner partnership's strengths and weaknesses.

Purpose

The purpose of this research project was to build a working collaboration between local law enforcement agencies in university and municipal jurisdictions and academic researchers in an effort to perform intelligence-led analysis and response to crime incidents using geospatial technology. The partnership between practitioners and researchers was designed to enhance community-oriented and problem-oriented policing efforts by providing common crime incident maps to the participating law enforcement agencies and the community.

In an effort to enhance the quality of life through the creation of a safer campus and local community, the partnership used daily criminal activity reports to analyze and identify spatial and temporal crime patterns across both the campus and municipal law enforcement jurisdictions. Analyses and information exchange were facilitated through a Geographic Information System (GIS) designed to enhance collective crime reduction measures resulting from analysis of cross-jurisdictional crime data. The research component sought to identify and reduce risk of victimization to university students on- and off-campus. The collaboration between the West Virginia University Police Department (WVUPD), Morgantown Police Department (MPD) and West Virginia University (WVU) Department of Geography researchers demonstrates the viability of cross-jurisdictional, problem-oriented crime analysis, and researcher-practitioner partnerships in a campus community characterized by low crime rates.

Goals

The shared vision of the partners was an improved crime analysis capacity leading to continued collaborations by combing skills and sharing resources. By virtue of an objective and systematic approach to crime mapping and analysis, the goal of this research project was to develop an information system capable of informing decision-makers, to include college administrators, public officials, and citizen organizations in addition to law enforcement agency leaders and private citizens. The partnership resulted in local law enforcement agencies gaining an understanding of the operational benefits of crime mapping and analysis while providing researchers with the ability to apply their skills and knowledge to an applied research problem capable of creating safer communities and informing policy.

Objectives

The overall objective of the ISaCS partnership was to identify emerging crime trends, enabling law enforcement agencies to inform the public and solicit community participation while developing crime reduction strategies tailored to providing a safer campus and community. The four specific objectives of the partnership were: 1) Establish a cross-jurisdiction crime mapping and crime analysis capability in support of a safer campus and community; 2) Utilize geospatial technologies to provide spatial and non-spatial information for pro-active intelligence-led decision-making and resource allocation by law enforcement agencies and policy makers; 3) Enhance community crime reduction participation through increased awareness and information dissemination with a multi-faceted combination of in-person and online solutions, including an interactive map server; and 4) Promote and encourage coordination and cooperation among additional law enforcement agencies and researchers.

LITERATURE REVIEW

Campus Crime

Crime is prevalent across the U.S. and has a large impact on university campuses, typically involving violence, protests, drug and alcohol use, sexual assault, identity theft, fraud, and theft of expensive equipment (Stafford and Rittereiser 2007). According to the National Center for Victims of Crime (2009; 2010; 2011; 2012), campus crime increased annually from over 88,000 reported cases in 2007 to nearly 93,000 reported cases in 2010. Of these crimes, a consistent 97% were property crimes. However, these reports further identified that 93% of all crimes committed against college students had occurred off-campus. The Tennessee Bureau of Investigation (2007) additionally identified an increase in college student victimization off-campus, while Baum and Klaus (2005) reported 93% of the crimes against college students occurred off-campus between 1995 and 2002 with an annual rate of 60.7 per 1,000 students. Although there was little statistical difference in crime rates between students living on- or off- campus, Baum and Klaus (2005) further identified that students aged 18-25 were less frequently victimized than non-students within the same age cohort. In general, it has been acknowledge that college campuses experience lower crime rates than the surrounding communities (Bromley 1995; Henson and Stone 1999; National Center for Victims of Crime 2009; Volkwein et al. 1995). However, Bromley (1995) cited a correlation between on-campus crime and crime rates of the surrounding city. He recommended additional research to further understand campus crime and prevention strategies.

Research results examining campus crime and its relationship to internal and external factors vary from study to study. McPheters (1978) catalyzed campus crime research when he associated higher crime rates at 38 college campuses with higher proportions of on-campus student residents, and proximity to urban areas with high unemployment rates. His research linked campus crime to both on- and off-campus variables. Fox and Hellman (1985) identified relationships between crime rates and tuition costs for 222 campuses. They further revealed that crime rates on campuses with larger police staff were significantly lower. Volkwein et al. (1995) correlated campus crime rates for 416 institutions with 23 various community, organizational and student measures. They identified an increased likelihood of both violent and property crimes at medical schools and health science centers. Bromely (1995) linked increased crime for 265 institutions to total student population and total male student population. Other significant factors included number of buildings, acreage size, amount of fraternity activity, and total female population. In an examination of 546 universities, Sloan (1992a) found strong correlation between campus crime rates and seven variables, including tuition costs, total student population, resident population, fraternities/sorority presence, and student to security ratio. Sloan (1994) continued his work and also associated violent crime with minority enrollment. Overall, previous research indicates higher campus crime rates are associated with higher on-campus student residency, student wealth (as implied by higher tuition costs), and student-police staff ratio.

Research suggests college campuses are relatively safe communities, having lower crime rates than surrounding communities (Henson and Stone 1999). At the same time, the majority of crimes against college students occurred off-campus (Baum and Klaus 2005; National Center for Victims of Crime 2009). These observations suggest that a measure of total potential crime risk to college students should consider crime rates for both the campus and adjacent off-campus community. They also suggest a need for campus officials and police to work in conjunction with municipal officials and police to protect students and provide a safer community. Although prior research correlates crime rates with different variables, it does little to explain or reduce crime. While dorms may be considered "hotspots" of crime on campus (Bromley 1995), large universities have numerous dorms which experience different rates and types of crime. Additional research should examine why rates and types of crime vary between dormitories across campus.

Publications examining campus crime are limited, with most research coinciding with federal campus crime disclosure acts in the 1990's, which received significant national attention through legislative action and high profile court rulings. More recent interest in campus crime has been spurred by media reports of high profile campus incidents, such as the Virginia Tech incident in 2007 which killed 32 people and wounded 25 others (Virginia Tech Review Panel 2007). Published research has limitations stemming from the quantity and quality of available data and the lack of spatially explicit references and methods. Furthermore, theory, practice and technology are dynamically changing entities. Recent advances in police strategy and crime reduction efforts as well as criminology theory, technology, campus infrastructure and student demographic changes, and a wide variety of additional factors are not reflected in the early campus crime literature, necessitating further examination into the issue of campus crime and safety.

Student Victimization and the Clery Act

In a survey conducted by Janosik (2001), only 29% of college students were aware of the Campus Crime Awareness Act designed to require colleges and universities to openly report campus crime statistics and allow students to make informed decisions during college selection. Furthermore, of the students who remembered receiving crime statistics from their institution, 79% admitted to not reading the material, while fewer than 4% of respondents considered campus crime statistics relevant to college selection. In contrast, on-campus crime awareness and prevention programs reached over half the respondents with most of them reporting changes in their behavior as a direct result. Although many different conclusions could be drawn, the research indicates crime awareness and prevention programs are more effective than simply providing statistical summaries.

Under its official name, the "Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act" (US Code 20 USC 1092 (f)), part of the Higher Education Act of 1965, the Clery Act has received mixed reviews. Although never designed to prevent crime, the Clery Act is an attempt to set crime reporting standards among campuses that receive federal financial aid money, while recognizing differences between campuses and permitting flexibility in compliance. Institutions failing to comply with Clery Act standards are subject to several civil penalties, including large fines and loss of federal financial aid funds. The Clery Act has been amended four times to address some limitations and clarify ambiguous definitions. Declines in campus crime since 1985 suggest the legislation has prompted institutions to take preventative measures (Volkwein et al. 1995) and has increased confidence in campus police (Fisher 1995; Janosik 2001). However, as Janosik (2001) stated, reports of themselves do little to protect students or change behavior. Volkwein et al. (1995) suggested the reporting requirements actually overestimate campus crime directed toward students while Bruno (2009) has highlighted inconsistencies in enforcement and reporting of various criminal activities. For example, the distinction between theft (a non-reportable statistic) and burglary (a reportable statistic) is sometimes difficult to make and there may be a propensity to classify burglaries as theft in an effort to achieve lower reportable crime rates.

Despite the intent and subsequent revisions of the Clery Act, limitations exist. Clery statistics (adapted from the FBI's Uniform Crime Reporting handbook) are not directly comparable to other reporting measures (e.g., the more comprehensive National Incident Based Reporting System/NIBRS) used by federal agencies and other law enforcement agencies (US DoEd 2005). Therefore comparisons between campus crime and off-campus crime can be difficult. According to the Clery Act, campus police are required to request crime statistics from local LEAs responding to incidents within the campus geography. However, local LEAs are not obligated to satisfy the request. In instances that local LEAs do provide crime statistics, there may be a propensity to misunderstand the request and provide either too much or too little data that matches the Clery statistics because of the differences between UCR and Clery definitions. An additional limitation of Clery Act statistics is the limited spatial content. Incidents are vaguely classified as occurring on-campus, in residence halls, or within public spaces. The locations of the incidents could be more detailed to be meaningful. As many students are in new and unfamiliar locations when they move to a college campus, visual representations of crime locations such as maps would be advantageous to crime prevention efforts. While students may not know the names of all campus buildings listed in daily campus police crime logs, they can easily recognize a point on a map and its relationship to their activity space. Mapping both on- and off-campus incidents together would provide a more holistic assessment of student victimization risk. The effectiveness of crime maps as visual aids for campus crime awareness and crime prevention programs provide an area of research with a great deal of potential implications for policy and student safety.

Environmental Criminology

Concentrating on "*the study of criminal activity and victimization and how factors of space influence offenders and victims*", environmental criminology offers many theories useful to examining the spatial relationships between offenders, victims and their environment (see Chainey and Ratcliffe 2005: 79-113). For example, the routine activity theory attempts to explain the context for crime. This theory surmises that offenders, targets, guardians, handlers, and place managers all have a degree of control over interacting variables influencing crime. The offender, under the rational choice theory, considers the pros and cons of risk and benefit before committing a crime. Basically the offender decides if the risk is worth the effort. Crime opportunity is considered lowest when targets are directly supervised by guardians, offenders controlled by handlers, and places protected by managers. Crime pattern theory is a blending of the routine activity theory and rational choice theory. Under crime pattern theory, offenders have certain "awareness areas". These are areas they frequently visit and are familiar with. As offenders move between awareness areas, they seek criminal opportunity by identifying targets without guardians or place managers. Awareness areas are highly influenced by the locations of nodes, pathways and edges. Nodes are places such as home, work, bars, and stores. Pathways are routes (e.g., road, bike path) and edges are both physical and perceptual boundaries (e.g., parks, municipal/university land, or affluent neighborhoods).

Nodes, pathways and edges are particularly relevant to campus crime research. Nodes are relevant in terms of their spatial relationship and proximity to both campus and students. However, offenders utilize pathways to seek criminal opportunity. Open campuses have several transportation routes surrounding and intersecting them and these may serve as jurisdictional boundaries between campus and municipal police. Offenders can utilize pathways in and around campuses to locate criminal opportunities and rapidly retreat out of campus police jurisdiction. Similarly, edges provide unique criminal opportunities. Edges are places where criminals do not stand out. A large university has many edges. There may be edges with many uniquely different neighborhoods and edges with separate police jurisdictions. There is an opportunity and need for research which explores the unique relationship between nodes, edges, and pathways and their contribution to both crime and fear of crime for different places, especially campuses.

Policing Methods

Campus and municipal police departments alike have employed various policing philosophies, practices, and strategies over time in pursuit of crime reduction (see Sloan 1992b and Uchida 1997 for campus and municipal police histories respectively). Since the 1980's, the vast majority of campus police and many police departments have embraced a community-oriented policing (COP) strategy (Fyfe 1991; Rengert et al. 2001; Roberg et al. 2008). The Office of Community Oriented Policing Services (2009: 3) defined community-oriented policing as "*a philosophy that promotes organizational strategies, which support the systematic use of partnerships and problem-solving techniques, to proactively address the immediate conditions that give rise to public safety issues such as crime, social disorder, and fear of crime."* Organizational strategies are strategies which transform agency management (e.g., transparency and strategic planning), organizational structure (e.g., resources and finances), personnel (e.g., recruitment and training), and information systems (e.g., accuracy and quality of data) needed to support problem-solving and community partnerships. Partnerships are essential in order to develop solutions to problems as well as increasing public trust in police. Problem solving involves a *"proactive and systematic examination of the identified problems to develop and rigorously evaluate effective responses"* (COP 2009: 4). As Chainey and Ratcliffe (2005) stressed, the community serves a vital role in reporting crime and deciding how crime problems can be solved. COP recognizes that vital role provided by the community.

There are several important differences between traditional policing methods and COP. First, the emphasis shifts from law enforcement to crime prevention (Rengert et al. 2001). While there will continue to be a law enforcement component to policing, crime fighting does little to reduce crime. This is particularly relevant to college campuses striving to maintain and project a safe public image. Once a crime is committed on campus, it becomes a Clery statistic. Violent crimes on campus often receive excessive media coverage (Bromley 1995; Fisher 1995; Volkwein et al. 1995). Therefore, crime prevention becomes preferable to crime fighting. Second, COP is human-oriented (Rengert et al. 2001). This involves interactions between police officers and the community. One such method of interaction has been through reduced automobile security patrols in favor of increased foot patrols into community neighborhoods. This allows police to talk with and listen to the community (Roberg et al. 2008). Fyfe (1991) emphasized the importance of neighborhood police presence on crime prevention, citing a British study suggesting that for over 90% of serious crimes committed police received crucial information supplied by the public which enable them to solve the crimes. And third, problem-solving is important to COP (Roberg et al. 2008). Problem-solving reduces crime, social disorder, and the fear of crime and guides decision-making efforts (COPS 2009). However, problem-solving requires innovative thinking (COPS 2009) and robust analysis capabilities (Scalisi 2008). As COP methods vary widely among different police departments there is no standard, which poses a problem in measuring the effectiveness of the concept (Roberg et al. 2008).

Problem-oriented policing (POP) is another method of crime reduction used by many police departments. POP seeks more solutions to common and unique problems but unlike COP, it does not necessitate community input (Roberg et al 2008) or organizational changes (Goldstein 1979). Consistent with COP, POP (Roberg et al. 2008) involves a deeper analysis of community problems. By focusing on problems, police are able to deal with the causes rather than symptoms and therefore achieve a greater impact (Cordner and Biebel 2003).

Spatial Science Tools

Stimulated by new ideas and new innovations, police research on crime control has advanced rapidly and benefited immensely from powerful research methods and databases which have provided new insight (Sherman 1992). Defined as "a computer system for capturing, managing, integrating, manipulating, analyzing, and displaying data which is spatially referenced to the Earth", a geographic

information system (GIS) provides an environment where crime data can be combined with other geographic data representing the landscape with which the crime data is associated (Chainey and Ratcliffe 2005: 38). In a GIS, location becomes a common denominator between disparate datasets, enabling them to be merged together and managed to explore relationships between data. Although non-GIS mapping software can be utilized to map and analyze crime, crime mapping commonly implies the use of GIS (Police Foundation 2006). GIS can be applied to crime data to map and analyze spatial patterns and trends (Boba 2005; Bruce 2001). GIS crime mapping and analysis in turn can lead to crime reduction and efficiency (Getis et al. 2000; Hirschfield and Bowers 2001; Markovic et al. 2006). Effective and efficient crime reduction is increasingly dependent on spatial analysis (McCarthy and Ratcliffe 2005). A growing percentage of police departments routinely use GIS to map and analyze their crime data (Mamalian and LaVigne 1999; Wang 2004; Wartell 2003) in diverse ways for different purposes (Markovic et al. 2006; Nelson 1999). GIS crime mapping and analysis has become a problem-solving strategy using a place-based approach (LaVigne et al. 2008).

Crime mapping and analysis has traditionally been confined to large metropolitan areas (Paulsen 2003; Walker 2008; Wing and Tynon 2006;). Relatively few published articles report on mapping and analysis in college campus settings. Brower and Carroll (2007) used GIS to map high density locations of students off campus and their spatial relationship to calls for service made to the Madison Police Department. They also analyzed temporal characteristics of crimes to identify patterns of when different types of crimes were being reported. Although it may not seem surprising, most incidents occurred near bars and shortly after closing hours. The results of that mapping analysis, however, led directly to changes in campus policy and policing activities. Dailey et al. (2005) reported on their experience with establishing a GIS for campus crime mapping. Although they did not report on any specific application, they detailed many of the obstacles and methods they employed to overcome those obstacles as well as partnership formations they were able to undertake. Rengert and Lowell (2005) and Rengert et al. (2001) developed a GIS at Temple University as a problem solving tool to analyze threats to student safety. Unlike most crime mapping and analysis work, Rengert et al. (2001) considered and mapped separate floors and rooms within campus buildings in what they termed a "high definition GIS". They credit increased security and response time on college campuses to a growing use of GIS and crime analysis.

Research-Practitioner Partnerships

In recent years the National Institute of Justice has funded many projects that support researcher-practitioner partnerships. (Backes 2009). In a typical partnership, a researcher works within an LEA to develop, conduct and evaluate needed criminal justice research (see also McEwan 1999 and McEwan 2003). Encouraging the researcher and practitioner to work closely with one another over a prolonged period is anticipated to lead to a better understanding of the roles and relations of research, practice, and policy within a particular LEA. The importance of the practitioner's involvement is acknowledged throughout the research process — from formulating the initial objective, research questions and accessing data, to advising a study as it progresses and helping to ensure practical perspectives in the analysis of data and report writing. In one documented collaborative effort between law enforcement agencies, researchers, community representatives, victim advocate groups, city government, and social service agencies in the Memphis Strategic Approaches to Community Safety Initiative (SACSI), participants viewed the researchers as most effective in identifying the problem and assessing the impact of sexual assault victimization among teenage girls (Coldren and Forde 2010).

Relationships between practitioners and the researchers have not always been harmonious, stemming from or leading to misunderstandings on both sides. Beal and Kerlikowske (2010) indicated researchers generally have projects in mind that seldom match practitioner's needs. Research needs to be meaningful to the LEA (Buerger 2010) and should not simply be a determinate of what police do (Scott 2010) It is evident that two widely different cultures, academic researchers and police practitioners, have

different goals and objectives with respect to reward frameworks and measures of success leading to a 'Dialogue of the Deaf' (Bradley and Nixon 2009). However, the attainment of more effective policing requires researchers and LEAs to work together (Scott 2010). Criminological police studies provide neutral feedback and scientific rational for policy (Das 2010). Although challenging, Wood and Bradley (2009) adamantly proclaimed that partnerships matter and Rosenbaum (2010) viewed partnerships as critical to learning "a tremendous amount from each other". Cordner and White (2010) suggested LEAs believe researchers can offer them something useful. Davis (2010) argued that the gap between research and practice exists in every field and the tendency to put research to use in policing was much better than other areas. Citing successes from community policing to hot spot policing, Rosenbaum (2010) demonstrated that researchers have made valuable contributions to police policy. Similarly, Ikerd (2010) cited references highlighting research contributions in problem-oriented poling efforts and Scott (2010) provided a long list of successful partnerships that have helped shaped effective problem-oriented policing efforts.

BACKGROUND: The ISaCS PARTNERSHIP

The Increasing Student and Community Safety (ISaCS) partnership, an applied research project funded by the National Institute of Justice, Office of Justice Programs, brought together university researchers (a geography research faculty member and a graduate student), campus police, and municipal police to accomplish four mutually beneficial objectives stated previously in the introduction. The project resulted from the convergence of several initiatives, including interest of the WVU and the Morgantown Chiefs of Police in the integration of information and the increased use of crime analysis. This interest was supplemented by the establishment of a course in crime mapping and analysis in the geography program at WVU and by support for Researcher-Practitioner Partnerships from the National Institute of Justice, Office of Justice Programs (National Institute of Justice, 2009). The partnership resulted in local law enforcement agencies gaining an understanding of the operational benefits of crime mapping and analysis while providing researchers with the ability to apply their skills and knowledge to an applied research problem capable of creating safer communities and informing policy.

Study Area

The ISaCS partnership took place in Morgantown, WV. West Virginia University consists of three campuses: the Downtown campus, the Evansdale campus, and the Health Sciences campus. The campus population for 2010 was approximately 29,000 students, 2,300 faculty, and 3,300 staff employees. The resident population of the city of Morgantown had grown during the previous decade at a rate of 17% to a 2010 total of 30,000 with an additional 70,000 residents in smaller towns throughout the county. Morgantown has five police jurisdictions: Morgantown police department, Star City police department, Westover police department, Granville police department, and West Virginia University police department (Figure 1). All three WVU campuses are adjacent to the Morgantown police jurisdiction.

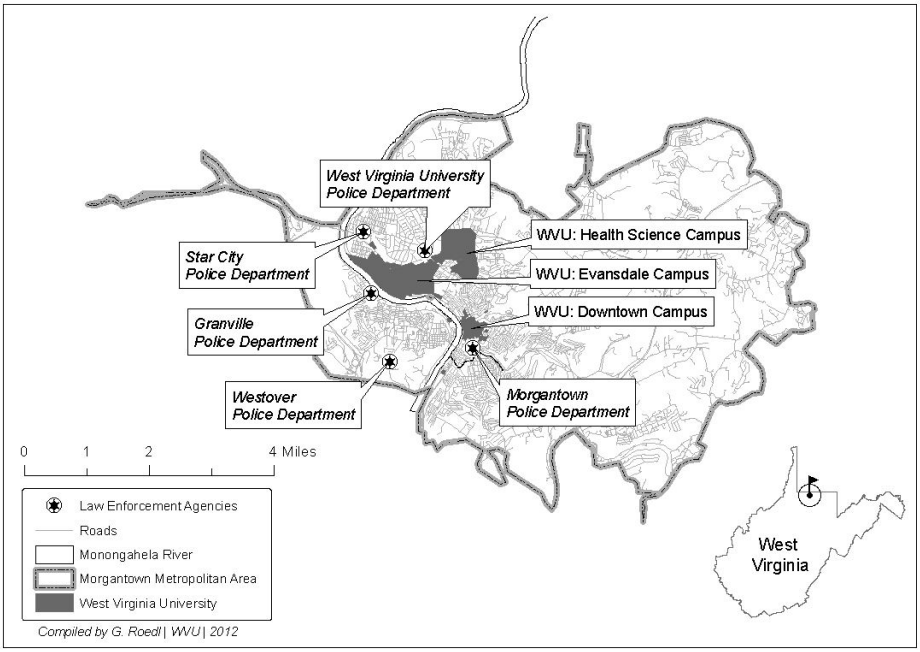

Figure 1. West Virginia University and Morgantown Law Enforcement Agencies

Statement of Rationale

The ISaCS research-practitioner partnership provided local law enforcement agencies in university and municipal jurisdictions with the capacity to perform spatial analysis for problem-oriented, intelligence-led policing and response to crime incidents. The partnership between practitioners and researchers furthermore enhanced community-oriented policing efforts by providing current crime incident maps utilizing an Internet mapping server. With a goal to identify emerging crime trends, enabling law enforcement agencies to inform the public and solicit community participation while developing crime reduction strategies tailored to providing safer campuses and communities, the four specific goals required to accomplish the objectives were mutually developed by the researchers and practitioners. Outlined in a Memorandum of Understanding (MOU), both researchers and practitioners had specific responsibilities necessary to accomplish project tasks and goals, resulting in local law enforcement agencies and researchers working together on a continual basis for the duration of the project.

During the two year course of the project study period (January 2010-December 2011), researchers utilized the knowledge and experience gained from the partnership to hypothesize and explore campus-municipal crime relationships. While a discussion of activities which occurred throughout the duration of the project may hold merit for potential new researcher-practitioner collaborations, an overview of the general process is presented here. Additional details of the routine activities will gladly be discussed with any interested parties. This report will instead focus on the initial project implementation tasks and preliminary research findings revealed through analyzes of crime data collected during the two-year project period.

METHODS

Researcher-Practitioner Partnership Project Implementation

There were initially twelve tasks jointly created by the researchers and practitioners needed to accomplish the objectives of the project. Responsibility of completing various tasks was given to the partner most capable of achieving results. The following discussion details the tasks and methods associated with accomplishing each of the four objectives. Figure 2 provides a conceptual overview of relationships between task and objectives as envisioned prior to the start of the partnership. The conceptual flow of tasks essentially combines disparate datasets (e.g., crime records, socio-demographic data, street networks) into a single spatial database which facilitates the creation of crime maps and spatial analyses of crime problems for operational and strategic planning activities for the involved law enforcement agencies.

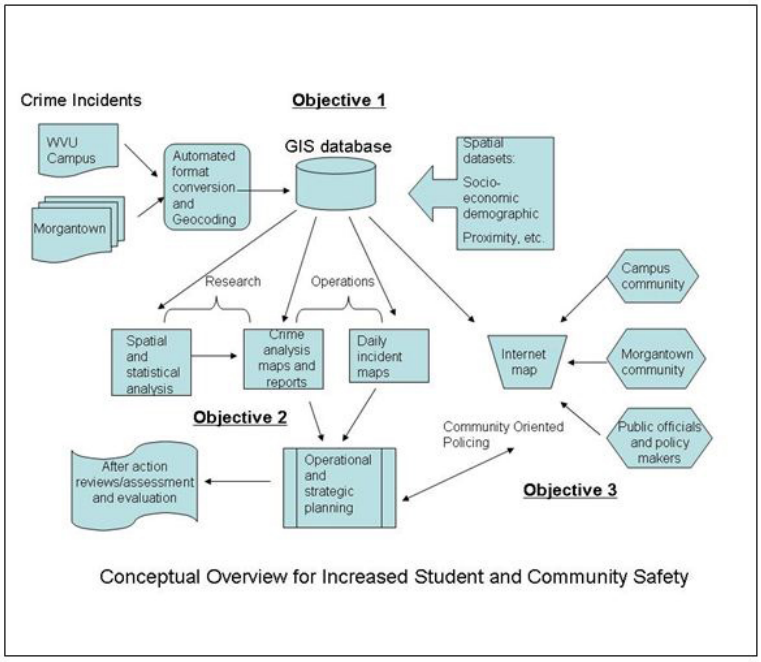

Figure 2. Conceptual Overview

Objective one: Establish cross-jurisdiction crime mapping and crime analysis capability in support of a safer campus and community. Travis and Hughes (2002) identified expertise, data, and equipment as the major barriers to crime mapping implementation within law enforcement agencies. Before the research phase could be carried out, the capacity to perform any cross-jurisdictional crime mapping and analysis needed to be established.

1) ***Procure equipment and software***. The first task was to set-up and implement a computer server and database. Project support funding was used to purchase a computer with sufficient power, memory, and storage capacity to perform computationally-intensive analyses and deliver reliable networking service. Due to the perceived potential of security breaches on police department networks, the server was isolated on its own network. ESRI ArcGIS version 10.0 software, licensed by the university, was installed to support GIS analysis, geodatabase creation, and to serve GIS data and maps. Open-source software used to support various crime mapping analyses included CrimeStat, OpenGeoDa and STARS. Microsoft Internet Information Services (IIS) provided the web service platform, while

Adobe Flex and the complimentary ArcGIS Viewer for Flex was utilized to develop the web content. Crystal Reports also had to be installed, which will be discussed further in task 4. Over the course of the project period, several software applications were upgraded to newer versions to take advantage of additional features. Upgrading, however, had the disadvantage of requiring changes to previously completed work; especially scripting and map analysis. Adobe Flex, and consequently the ArcGIS Viewer framework, changed dramatically, which necessitated rebuilding all web content from scratch as a result instead of migrating content. In addition to the server, a laptop was purchased to allow portability between researcher and practitioner locations and for developing and testing applications as well as demonstrating to partners before installing them to the server. The same software that was installed to the server was installed on the laptop. An external hard drive was used to periodically back-up all data. For simplicity, the server hard drive was initially partitioned into two data partitions. All data related to the project was stored on one partition while the operating system operated on the second partition.

2) ***Identify data needs and populate the geospatial database.*** Task two required populating the database with the spatial information necessary to perform spatial analysis of crime incidents. Paulsen (2003) elaborated on the physical, conceptual and logical designs of a GIS database for law enforcement which provided a useful template for this research project. Much of the base data used (e.g., TIGER, DEM's, NAIP) was available through government clearinghouses, such as Geospatial One Stop. Other useful spatial information was created specifically for this project. Building footprints were created from aerial images. The locations and attributes of alcohol outlets were supplied by state alcohol control agents who marked the locations on printed maps. Public transportation routes and stops were digitized from brochures. Additionally, some data was provided by city and county agencies which were very supportive of the ISaCS partnership. While a great deal of spatial data now exists to support crime analyses, there remains a great deal of geographic data features and attributes that would compliment analyses if produced.

3) ***Assess data integrity***. Concurrently with task two, task three involved verifying and increasing the accuracy of spatial data. The old adage, "garbage in, garbage out" summed up the rationale for devoting a great deal of time and effort to identify and correct problems. Some spatial data, such as streets, were available but incomplete, contained numerous inaccuracies, or were spatially misaligned with complementary datasets. Local knowledge and site visits were primarily used to verify attributes and locations. In addition to ensuring spatial features and attributes were correct, additional attributes were assigned to features to support analyses or to provide accessible information to practitioners.

4) ***Access RMS records***. A variety of police record management systems (RMS) are used to collect and manage non-spatial crime report data, as different law enforcement agencies are situated in different stages of information technology development (Harris 2007; see also Law Enforcement Information Technology Standards Council 2009 for standard functional specifications). Both WVUPD and MPD used the same commercial RMS provider (Mobile/In-Synch). Populating the GIS database with crime incident data occurred on a regular basis as the information became available from each of the LEAs. The original intent was to export RMS crime data into a GIS readable format since the RMS had several export options, however the RMS had a functionality problem and the export feature did not work. The RMS provider did not address the issue, but was willing to develop a custom export feature for a fee. Therefore, instead of a direct export, Crystal Reports software was used to extract crime reports and then the reports were exported from Crystal Reports into an accessible GIS readable format. A database file (dbf) format was used as it offered the most flexibility for accessibility by additional software and hardware platforms as well as maintaining proper date-time format of the attribute data.

5) ***Automate mapping processes.*** To streamline the efficiency for LEAs, an automated geocoding and mapping script was developed using Python. Non-spatial crime records exported to a database file format were geocoded and imported into the geodatabase and displayed as pin and point

density maps. The Python script performed a variety of actions to prepare the data; the steps illustrated by the cartographic model (Appendix A). The major features of the script were to geocode the non-spatial data, convert state statute codes into major crime categories, cleanse addresses for public data, fix RMS discrepancies, and store the results to the geodatabase. Geocoding was accomplished via a custom developed geocoder, which consisted of a composite of several geocoders: one for street addresses, one for campus locations and one for municipal locations. Many places were known by alternative names and alias tables were developed for each geocoder. Accuracy was visually verified to be 99% with the 1% error accounted for by incomplete/non-mappable input addresses (see also Chainey and Ratcliffe 2005 for common geocoding issues). Both law enforcement agencies recorded crime incidents using the appropriate West Virginia crime code, which was often found to be not directly comparable to either UCR or NIBRS crime categories. Initially, each state code relevant to this project were categorized to ten crime categories of interest to the Clery Act. As the partnership progressed, all WV crime codes were eventually classed into an appropriate NIMBRS category (see Appendix B). The Python script also masked actual addresses for a version of the data made accessible to the public. Campus locations were reported by building, street addresses were rounded to the nearest 100 block and municipal locations were relocated to the nearest street intersection. Several inherent errors were discovered in the RMS (e.g., incorrect statute codes or missing parentheses). When the data was exported, the errors would persist. As these errors were identified, they were incorporated into the Python script which would look for those specific errors and fix them. The final task of the script was to place the geocoded results into the geodatabase to become accessible to researchers and practitioners as well as the Internet mapping application.

Objective two: Utilize geospatial technologies to provide spatial and non-spatial information for problem oriented, pro-active intelligence-led decision-making and resource allocation by law enforcement agencies and policy makers. After establishing the capacity to perform spatial analysis, the focus was on mapping applications. A great deal of literature exists (Boba 2000; Boba 2005; Chainey and Ratcliffe 2005; Harries 1999; Higgins 2003; Hirschfield and Bowers 2001; LeBeau 2000; Levine 2006; Police Foundation 2006; Ratcliffe 2001; Velasco and Boba 2000; Wang 2004) which deals explicitly with crime mapping and analysis principals and provided practical example case studies useful to the ISaCS partnership.

6) ***Develop daily crime incident maps.*** Daily crime pin maps were created showing the geocoded locations (Bichler and Balchak 2007) of crimes incidents. Daily crime maps were a composite of all crime across both jurisdictions which enabled LEAs to identify visually all activity within and outside their respective jurisdiction. A default map template was used to display base layer data and daily crime incidents generated by the Python script discussed in task 5. Standard crime symbols were used to represent various crime types.

7) ***Develop weekly hotspot maps.*** The generation of weekly crime trend, problem-solving maps (Travis and Hughes 2002), and reports were also used to aid in information exchange and allow the practitioners to identify problem areas in order to allocate resources needed to provide a safer community (Wartell and McEwan 2001a; Wartell and McEwan 2001b).These weekly maps were based on a template displaying the last seven days of crime data. The maps were point density maps used to highlight spatial crime clusters. Crime clusters occurring near or between LEA jurisdictions were areas LEAs could collaborate on joint crime reduction efforts. Map annotations labeled the type of crime and date of occurrence for each point incident used to generate the density map. Turton and Openshaw (2001) demonstrated and concluded that with very little GIS knowledge and a minimal effort, practitioners could produce crime maps once an automated system was established. Because of the script (task 5) and map templates, LEAs have the capability to generate daily pin maps (task 6) and weekly density maps (task 7). However, there are two caveats: 1) the initial database file must be named "report" because the Python script expects to find that file and 2) the initial database file must contain the same field structure so the

Python script knows which fields to update and geocode. In the future, these two issues could be addressed through user defined input. However, it should be noted that the researchers did address and resolve both issues only to discover that the script would sometimes work and sometimes not work without any logical consistency.

8) ***Partnership meetings and planning.*** In order to promote and exploit the full potential of the trend analysis maps, all the partners tried to meet for weekly operational and planning meetings to allow for dialog to address trends and discuss preventative strategies that could occur collectively from the information-driven analysis of crime (Hirschfield 2001). Addressing Ratcliffe's (2004) and Markovich et al. (2006) challenge, the underlying motive of these meetings was to provide the LEA chiefs with the ability to understand and act upon results from the mapping and analysis in order to prevent and reduce crime. In addition to being a problem-solving forum, the meetings served to assess previous progress, provide recommendations for additional analysis, and to collectively identify additional problems. Initially, these meetings included most key personnel from each LEA. As the project proceeded into the second year, the need for regular meetings ceased. Brief discussions followed by e-mail conversations or phone calls served as effective as regular meetings that were no longer as productive as they were initially. Instead, meetings were arranged as needed when new tasks were started or completed and they included only key personnel who were relevant to the discussion topic or wanted to participate.

Objective three: Enhance community crime reduction participation through increased awareness and information dissemination. Wartell (2003) described the process of sharing crime maps on the Internet as the ultimate sharing method and Chainey (2001) recognized public information as an important component to any crime prevention program. Tasks under objective three were designed to inform the public and promote community participation in crime prevention and awareness.

9) ***Crime maps and safety awareness programs.*** Transparent website and awareness programs are congruent with the philosophy of community-oriented policing which builds trust between the police and the community (Mericle and Clontz 2003). After much discussion, LEA partners ultimately decided to present only crime information for their individual police jurisdictions on their department websites. Cross-jurisdiction information developed from this project would be disseminated through a separate and independent website. The advantage of separate crime maps for each jurisdiction was that fewer crimes were represented. Fewer mapped crime incidents resulted in more readable and understandable public crime maps with less overprinting of symbols. Individual LEAs updated their websites to include crime prevention information, daily crime statistics, amber alerts, and additional crime reporting options reflecting current technology trends (e.g., Twitter and Facebook). WVUPD additionally provided online safety brochures, emergency information procedures, Clery statistics and links to sex offender registries. Static weekly crime maps have been displayed and archived to provide public access to crime history. LaVigne and Groff (2001) described the application of maps as a trend providing forums into the discussion of real and perceived crime problems. As yet, there has been no effort to evaluate the effectiveness of the online information. However, residents and parents of students have repeatedly provided positive comments on the accessibility of current and relevant information. A goal that was planned for this project, but never materialized was to evaluate and document the usage of the web based crime information and prevention resources. Researcher partners ended efforts to evaluate website effectiveness after it was decided each jurisdiction would be responsible for their own content. Furthermore, research partners ended efforts to produce an online community forum since each LEA partner established their own efforts for interacting with community members and had contact methods and staffing in place to respond. .

10) ***Internet mapping server.*** Cross-jurisdictional crime incidents became available through the Internet mapping website (Figure 3). ESRI ArcServer was used to provide the service, accessing the data stored in the geodatabase. ArcGIS Viewer API for Flex was used as the core mapping application and

customized for this project. A Flex-based map viewer was used due to the advantages of Flex being fast and efficient, an open source framework provided by Adobe, and a cross-platform development application. While the API permitted rapid deployment of map services, adding the customized details required a substantial amount of time learning Flex. Additionally, both Flex and the API were relatively new when first implemented in the project. During the course of the project, both applications evolved to offer additional features desirable in Internet maps. Upgrades to newer versions of Flex or the API did not permit simple migration of previously developed content. Although it was possible to make changes to the developed content, the vendor recommendations were to start anew.

The primary goal of the cross-jurisdictional Internet map was to provide public awareness of crime events throughout the campus and municipal communities in order to promote continual community participation in crime awareness and prevention. Users of the Internet map (http://157.182.211.138/crime) are first required to acknowledge data limitations and restrictions prior to accessing the maps. Crime incidents are initially displayed in a density map draped over a Bing Maps background. Bing maps were chosen due to a consistently quick and reliable online rendering compared to other map service providers and internally produced backgrounds. Users are then allowed to decide which crime types to display. The default display shows a seven day composite of events. Crime type, case number, date and time, reporting jurisdiction, and location are provided when the user selects a point incident on the map. Users are also permitted to search any of the attributes for specific information. In the near future, researchers would like to allow for the generation of customized reports, to include charts and graphs of user defined requests.

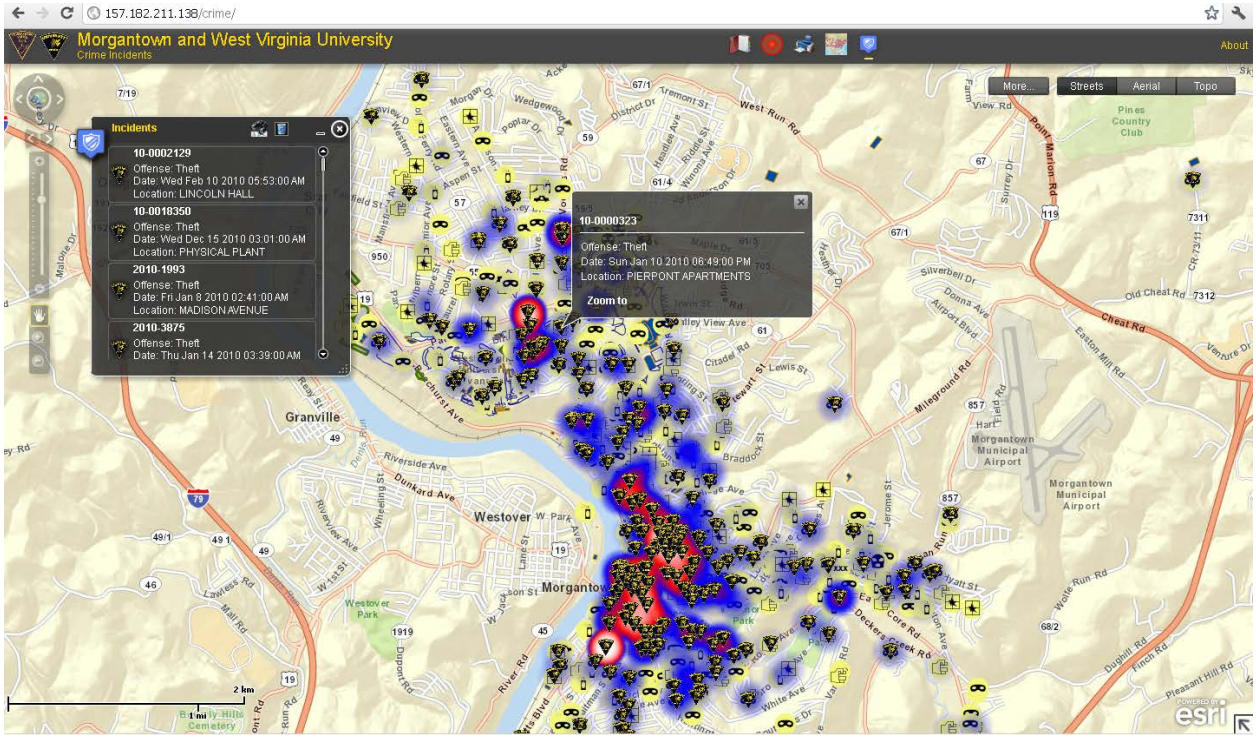

Figure 3. Cross-jurisdiction Internet Crime Map

Objective four: Promote and encourage coordination and cooperation among additional law enforcement agencies and with researchers. The capacity to perform crime mapping and analysis was established through the first three partnership objectives. The ISaCS partnership envisioned future growth in terms of partnerships, resources, crime data sharing, community partnerships, and research. The

intent was to build upon the progress of the research-practitioner partnership by adding additional law enforcement agencies, researchers, and community members.

11) ***Identify additional LEAs, researchers, community partners and agendas.*** During the course of the project, both partners were able to discuss the goals and objectives with additional LEAs, researchers and community members. Regrettably, there was a lack of effort to focus on underrepresented community groups, resulting in a project weakness that should have been addressed. With the continuation of the partnership and the involvement of more personnel, more effort will be spent on including underrepresented community members. A variety of community problems were identified for future collaborative efforts. Some identified problems included: a growing homeless population, increased drug use, traffic problems / road rage, rental property issues, foot patrol limitations and pedestrian safety. Although not unique to Morgantown, these problems require proactive problem-oriented policing measures and innovative solutions if they are to be resolved. The continued use of crime mapping and analysis will provide analytical support for any future problem-oriented approaches while the breadth of researchers from several disciplinary backgrounds will be instrumental in developing innovative solutions. The involvement of community members to identify, prioritize, and become involved in solutions will continue to be part of the community-oriented policing agenda of the LEAs and of special interest to researchers.

12) ***Identify and pursue additional collaborative funding opportunities.*** Although the opportunities were limited, researchers and practitioners utilized partnership experiences to apply for additional funding from a variety of sources, collaborating with additional researchers from different disciplines. As of writing (June 2012), two proposals are submitted and in review. The proposals for which funding was declined will be strengthened and resubmitted in the future. However, with the capacity to independently perform crime mapping and analysis established, sustainability should require very little additional funding. As previously mentioned, changes in software versions are most likely to necessitate system maintenance. Further expansion of the project goals and research would require additional funding. Newly funded research and policing efforts should easily be able to build upon the experiences and results of the ISaCS partnership.

Researcher-Practitioner Research

The focal point of applied research was the spatio-temporal relationship between crime incidents and geographic environmental variables. Analyses were accomplished via standard statistical techniques used in crime analysis, including exploratory spatial data analysis (ESDA) (Cohen and Tita 1999; Messner et al. 1999), spatial regression analysis (Cahill and Mulligan 2003; Ceccato and Haining 2005; Lockwood 2007) and spatial time modeling (Kamarianakis and Prastacos 2005). The research combined exploratory spatial data analysis methods with spatial regression analysis and space-time modeling techniques to explore simple and complex relations within the study area. ESDA permitted hypothesizing about relationships and trends observable in the data that could then be statistically confirmed or rejected using statistical regression methods.

Data

Crime data for the ISaCs partnership was collected from daily incident reports generated from each LEA's RMS. The data does not reflect official crime data and does vary from official UCR and Clery statistics. This discrepancy stems from classification differences and the lack of updates to the geodatabase when crime incidents were modified or unfounded. One example observed on numerous occasions is the report of theft, which was later found to be unfounded after "stolen" items were later found (e.g., lost and found). Because the data from the ISaCS partnership was classified via NIBRS definitions and rules in an effort to overcome weaknesses associated with UCR definitions and rules, many of the typical classifications discrepancies will continue to exist in the ISaCS data (e.g., UCR conforms to a hierarchy rule in which only the most serious offense is reportable). However, some classification discrepancies also emerged from the conversion of WV state codes to NIBRS classification. Appendix B details the NIBRS category each state crime code was assigned to for the ISaCS partnership. Crime data was collected from the project start date of 01 January 2010 through 31 December 2011. Crime incidents of special interest to the ISaCs partnership, as expressed by the LEA chiefs of police, include: arson, assault, burglary, destruction of property, forgery, murder, robbery, sexual assault, theft, and motor vehicle theft. Most of the proceeding discussion will deal with those priority incidents; however, additional crime categories are also explored. Furthermore, while the intent of the ISaCS partnership is a cross-jurisdictional analysis, summaries of separate jurisdictions are provided to illustrate similarities and differences.

West Virginia University Crime

WVUPD reported 1,324 total offenses in 2010 and 1,686 in 2011 (Table1). Liquor, drug, and theft offenses (Figure 4) ranked as the three most prominent offenses during the two years. Both the total number of offenses and the number of offenses expressed as categories of interest did increase. However, in terms of percentage, categories of interest decreased. Table 2 provides a count of the offense categories of interest for 2010 and 2011. Theft accounted for the majority of incidents in both years with an increase in total reported offenses.

Table 1. WVUPD Incidents

	WVUPD 2010	WVUPD 2011
All Incidents	1,324	1,686
Categories of Interest	400	468
Percent Categories of Interest	30.21%	27.76%

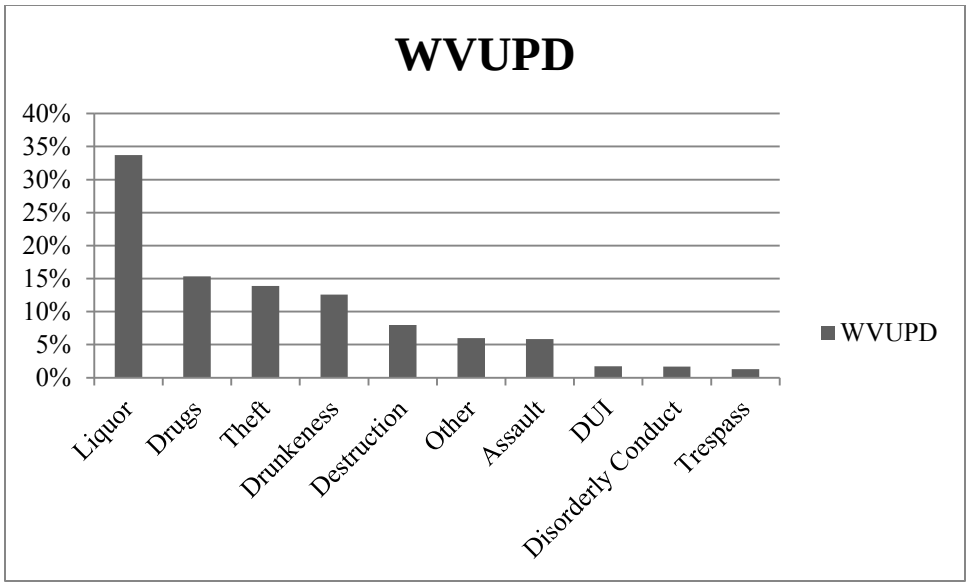

Figure 4. Top 10 WVUP Offenses 2010-2011

Table 2. WVUPD Offenses

	WVUPD 2010	2010 (%)	WVUPD 2011	2010 (%)
Arson	2	0.5%	3	0.6%
Assault	83	20.8%	88	18.8%
Burglary	16	4.0%	15	3.2%
Destruction	102	25.5%	131	28.0%
Forgery	3	0.8%	3	0.6%
Murder	0	0.0%	0	0.0%
Robbery	4	1.0%	1	0.2%
Sexual Assault	5	1.3%	5	1.1%
Theft	184	46.0%	222	47.4%
Vehicle Theft	1	0.3%	0	0.0%

Morgantown Crime

MPD reported 3,279 total offenses in 2010 and 2,916 in 2011 (Table3). Theft, destruction of property, and assault offenses (Figure 5) ranked as the three most prominent offenses during the two years. Both the total number of offenses and the number of offenses expressed as categories of interest decreased. However, in terms of percentage, categories of interest remained comparable. Table 4 provides a count of the offense categories of interest for 2010 and 2011. Similar to WVUPD, theft accounted for the majority of incidents in both years with a noticeable decrease in total reported offenses.

Table 3. MPD Incidents

	MPD 2010	MPD 2011
All Incidents	3279	2916
Categories of Interest	2007	1787
Percent Categories of Interest	61.21%	61.28%

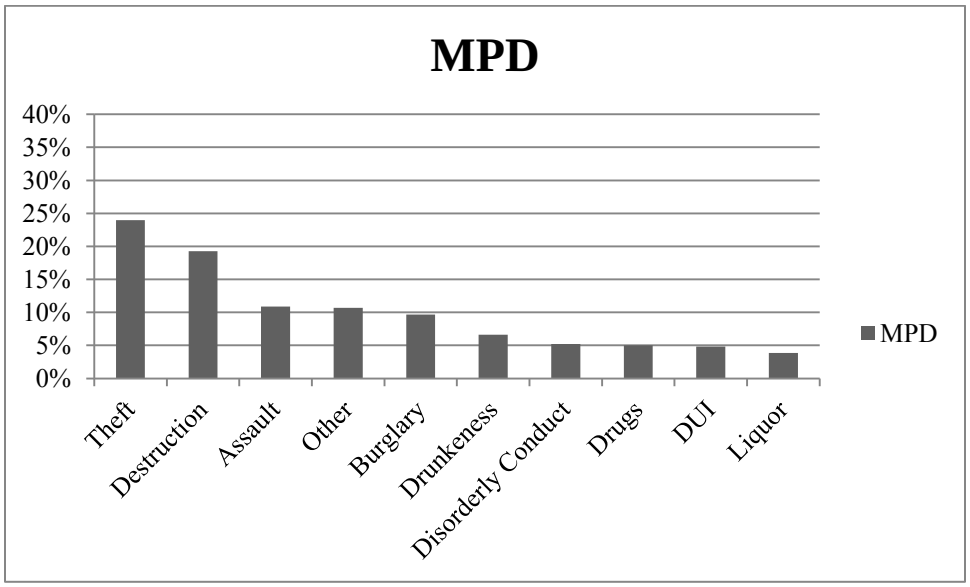

Figure 5. Top 10 MPD Offenses 2010-2011

Table 4. MPD Offenses

	MPD 2010	2010 (%)	MPD 2011	2010 (%)
Arson	4	0.2%	11	0.6%
Assault	310	15.4%	294	16.5%
Burglary	250	12.5%	286	16.0%
Destruction	584	29.1%	485	27.1%
Forgery	60	3.0%	54	3.0%
Murder	2	0.1%	1	0.1%
Robbery	30	1.5%	35	2.0%
Sexual Assault	21	1.0%	26	1.5%
Theft	744	37.1%	585	32.7%
Vehicle Theft	2	0.1%	10	0.6%

Cross-jurisdictional crime

Together, both jurisdictions reported 4,582 total offenses in 2010 and 4,591 in 2011. Twenty six offenses could not be geocoded due to imprecise location being provided (e.g., 'walking trail'). Overall, there was a net increase of nine reported offenses. Table 4 provides a count of the offenses for 2010 and 2011. Theft, liquor law violations, and destruction of property consistently comprised the largest number of reported offenses across jurisdictions. Theft and destruction of property both displayed a decrease in total offenses while liquor law incidents increased. Noticeably, drunkenness and drug offenses increased during the two years examined. Together, the ten offense categories of interest result in 50.8% of all incidents. Crime rates for violent crimes and property crimes were consistently higher in the MPD jurisdiction than they were on WVU campus.

Table 5. All Offenses across WVUPD and MPD jurisdictions

	2010	2011	Change		2010	2011	Change
Arson	6	14	8	Liquor	566	632	66
Assault	393	382	-11	Loitering	10	8	-2
Burglary	266	301	35	Murder	2	1	-1
Destruction	686	616	-70	Other	408	361	-47
Disorderly Conduct	171	166	-5	Pornography	0	2	2
Drugs	315	411	96	Prostitution	0	1	1
Drunkenness	335	398	63	Robbery	34	36	2
DUI	161	158	-3	Sexual Assault	26	31	5
Embezzlement	12	12	0	Stolen Property	27	20	-7
Extortion	2	1	-1	Theft	928	807	-121
Family	4	3	-1	Trespass	38	41	3
Forgery	63	57	-6	Vehicle Theft	3	10	7
Fraud	95	85	-10	Weapons	30	36	6
Kidnapping	1	1	0				

Temporal crime analysis

One of the first steps in crime prevention is to reveal temporal patterns associated with crime in an effort to allocate resources and plan reduction strategies. While a temporal examination of reported incidents can provide insight into when future events are likely to occur, caution in interpreting the results is merited. Although some events (e.g., disorderly conduct) have a high degree of certainty associated with when the event occurred due to a law enforcement officer witnessing the event, other events, (e.g., burglary) often contain uncertainty and only reflect when the incident was reported. Nevertheless, staffing concerns are of vital interest to responding to peak crime times and peak crime reporting times. Figures 6-7 graphically illustrate crime volumes of all reported offenses over a 24-hour time period for each LEA jurisdiction. MPD displays a bimodal distribution of crime which is similar for both years examined. Reported crime has an identifiable peak between 3 pm and 4 pm. A second peak is observable around 2 am, corresponding with the time alcohol outlets are required to close. WVUPD displays a similar temporal profile. Although the same two identifiable peaks are observable, more variation is also observable with abrupt increases and decreases throughout the day. Figure 8 compares incidents by day

of week. WVUPD crime peaks during both years on Friday with the least number of reported events occurring on Tuesday. In contrast, MPD experiences more incidents on Sunday followed by Saturday with the least number of events occurring on Wednesday. Although Sunday appears to be a day with high volumes of crime, caution in interpretation is again warranted. The increase in offenses on Sunday could correspond to a variety of factors, such as the early morning closing of alcohol establishments are the return of victims to their homes from a weekend of absence. Figure 9 suggests a unique offense pattern based on monthly comparisons. Noticeably, offenses decrease with observed university recess across both jurisdictions, particularly summer and winter recesses. As stated in the study area description, the student population is approximately the same as the resident population of Morgantown. This decrease in crime could suggest a decline in offenders, a decline in victims, or most probably, both. However, the decrease does demonstrate a strong relationship between campus events and cross-jurisdictional crime, which further demonstrates the need for campus and municipal LEAs to work together in crime reduction efforts. Although not presented here, temporal analyses of the various offenses independently reveal daily, weekly, and monthly trends that are similar to the overall trends.

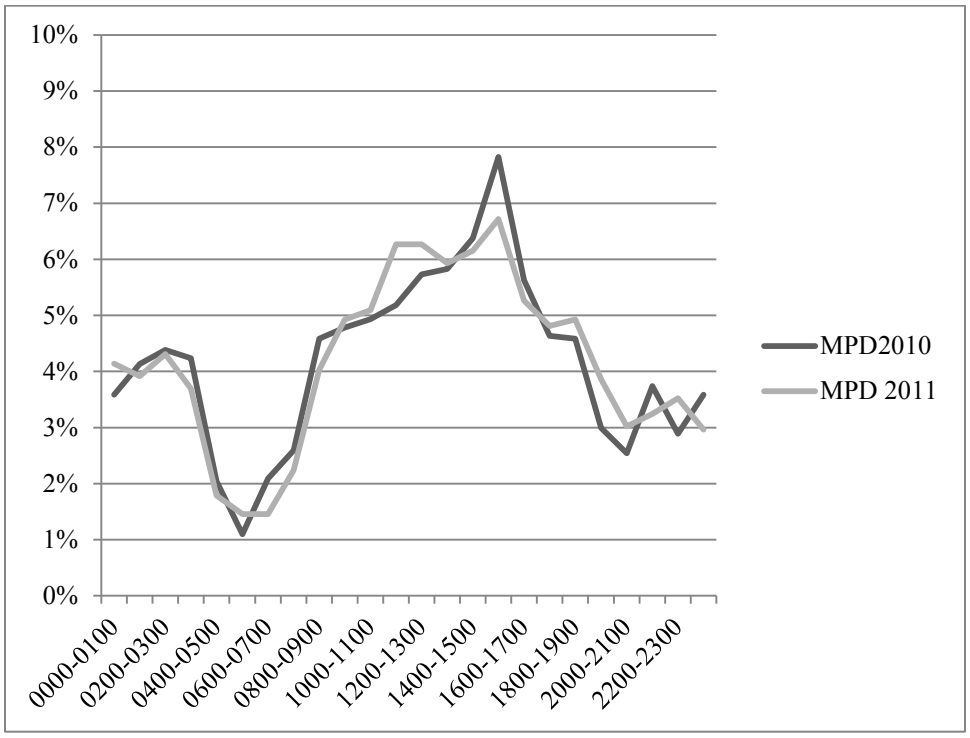

Figure 6. MPD Offenses Reported by Time

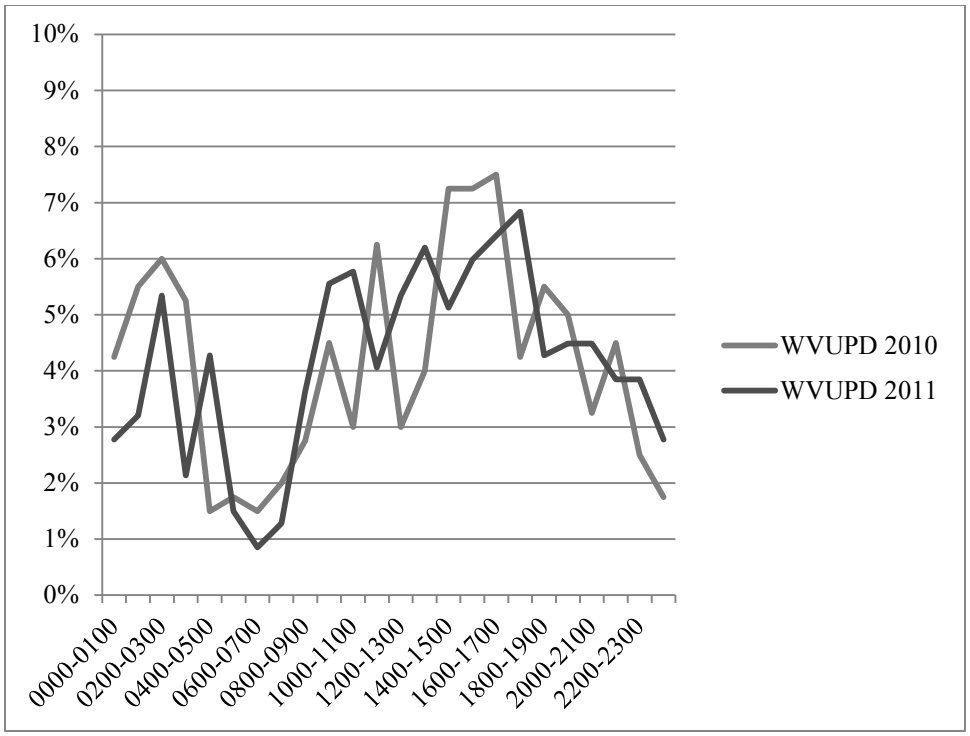

Figure 7. WVUPD Offenses Reported by Time

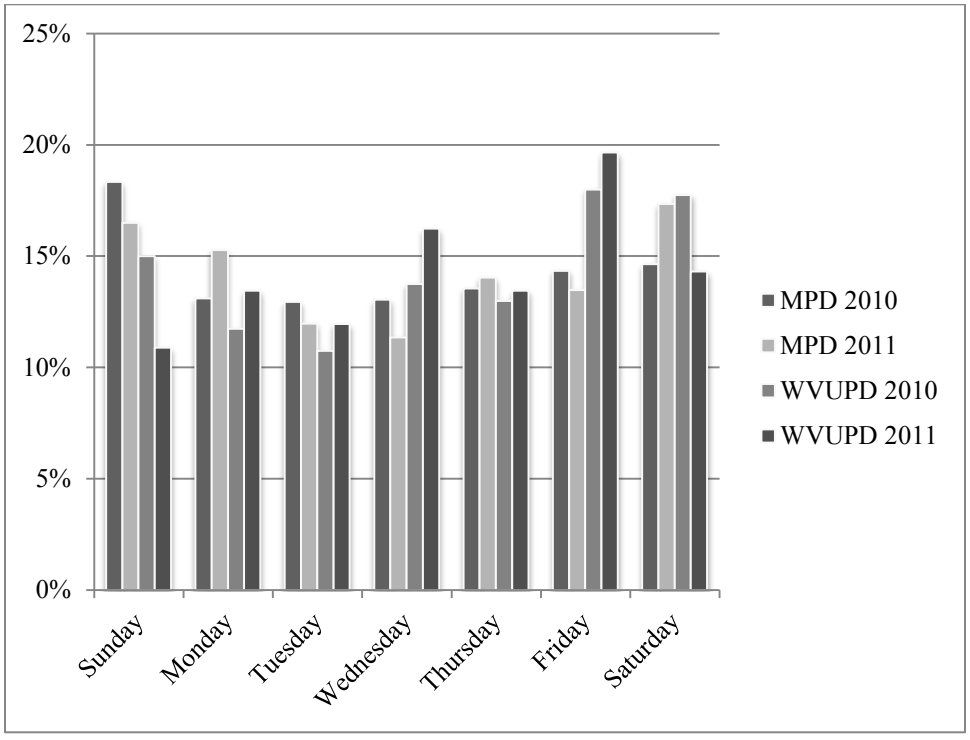

Figure 8. MPD and WVUPD Offenses Reported by Day of Week

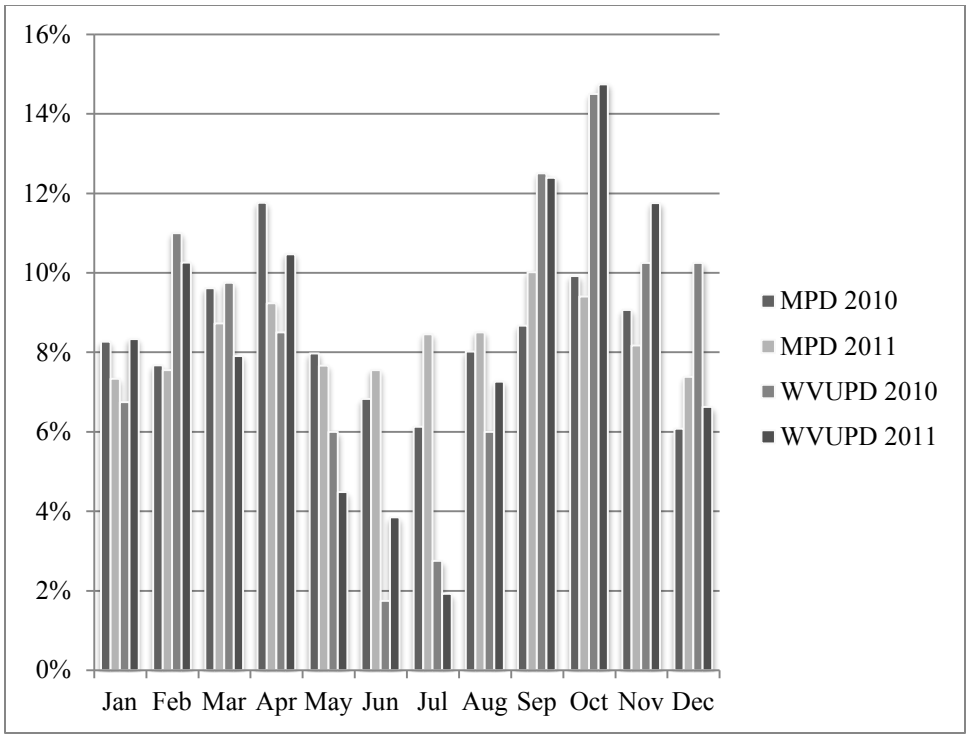

Figure 9. MPD and WVUPD Offenses Reported by Month

Spatial crime analysis

In conjunction with temporal analysis, spatial analysis of crime locations is essential to resource allocation and reduction strategies. Under certain conditions, times, or locations, crime exceeds the average or expected rates to for distinct hot spots (Anselin et al. 2000, Clarke and Eck 2003; Eck et al. 2005; Rivero and Pepper 2010). These hot spots are represented as significant clustering of crime events with small geographic areas or time spans (Braga 2005; Braga 2006). Sherman et al. (1989) observed crime clustered into hot spots in only a relatively few discrete areas, even in the most crime ridden neighborhoods. Although WVU and Morgantown are relatively small geographic areas with experienced law enforcement officers employing knowledge-based policing strategies, hot spot maps are graphical means of showing changing patterns. Additionally, although law enforcement officers may be familiar with their own beat or shift, they may be less familiar with hot spots in other beats, shifts, or across jurisdictions. There are a variety of ways to measure crime intensity. One way is to use GIS to perform a Kernel Density Estimation (KDE). The following KDE map (Figure 10) displays the two-year composite of crime incidents across both jurisdictions using a 100 meter bandwidth. Figure 10 not only reveals incidents are concentrated within a few discrete areas, but also indicates that hot spot locations occur across jurisdictional boundaries in several locations, creating a shared boundary problem between the two jurisdictions (see Eck 2002). Additional spatial clustering and shared boundary problems can be observed in the KDE maps generated from specific offenses (Appendix C). The KDE maps of each specific offense additionally reveal unique spatial distributions, demonstrating the continual need to analyze spatial patterns by offense category.

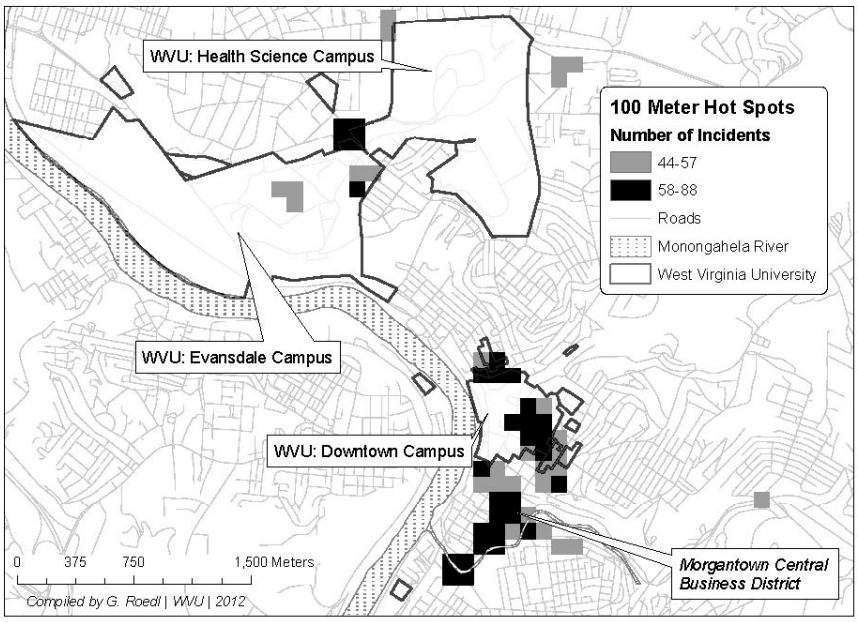

Figure 10. Cross-jurisdictional KDE hot spot map depicting areas with large clusters of crime incidents

Additional analysis of the top ten addresses from the geodatabase reveal additional spatial clustering in a relatively few discrete locations. Tables 6 and 7 summarize the locations for each jurisdiction by year of analysis. For clarity, the physical addresses have been changed to proper place names. The MPD locations accounted for 12.1% of all 2010 incidents and 10.4% of all 2011 incidents. The WVUPD locations accounted for 50.8% of all 2010 incidents and 44.0% of all 2011 incidents. However, both WVUPD and MPD respond to incidents at the WVU hospital. When both jurisdictions are analyzed together across both years, WVU hospital accounts for 1.83% of all offenses, followed by Wal-mart with 1.76% of all offenses. The spatial distribution of the top ten locations across jurisdictions is presented in Figure 11. Although there is a spatial dispersion of locations across the study area, the proximity of many locations to jurisdictional boundaries is evident. The decline in percentages and displacement of locations suggests proactive measures addressing hot spot locations presents a viable strategy.

Table 6. MPD Top Ten Hot Spot Locations

MPD 2010	MPD 2011
Public Safety Building	Wal-mart
Wal-mart	Kroger Supermarket Earl Core Road
Kroger Supermarket Earl Core Road	WVU Hospital
High Street- Downtown	Bent Willey's Night Club
Dairy Mart Convenience Store	Public Safety Building
Shell Gas Station	Dairy Mart Convenience Store
WVU Hospital	Grant Avenue
Sunnyside Commons Apartments	Kroger Supermarket Patterson Drive
Morgantown High School	Morgantown High School
Dragonfly Night Club	Augusta Apartment Complex

Table 7. WVUPD Top Ten Hot Spot Locations

WVUPD 2010	WVUPD 2011
Mountainlair	Student Recreation Center
Student Recreation Center	Health Sciences Center
Boreman Hall South	Coliseum
Health Sciences Center	Mountainlair
Coliseum	Arnold Hall
Football Stadium	Boreman Hall South
Phi Delta Theta Fraternity	Summit Hall
Brooke Tower	Vandalia Hall (Blue)
Mountainlair Parking Garage	Wise Library
Boreman Hall North	Dadisman Hall

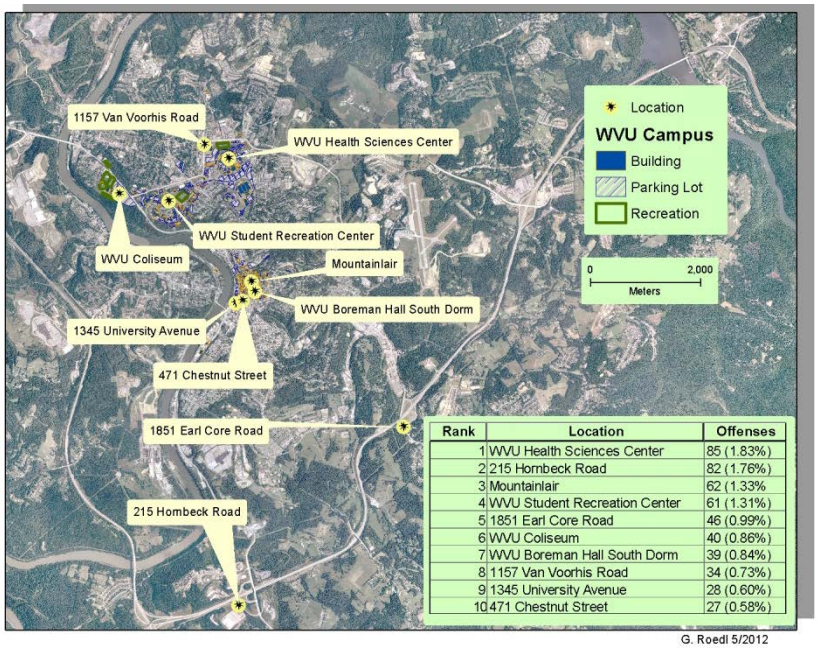

Figure 11. Spatial Distribution of Top Ten Locations 2010-2011

Spatio-temporal data analysis

Despite the recognition of both space and time as relevant hot spot dimensions, most crime analyses treat space and time as separate entities (Assunção et al. 2007; Bernasco and Block 2009; Bernasco and Elffers 2010; Grubesic and Mack 2008; Ratcliffe 2006). Researchers (Johnson and Bowers 2004; Johnson et al. 2007; Johnson et al. 2009a; Johnson et al. 2009b; Townsely et al. 2003) conducting space-time crime analyses concluded crime incidents are likely to happen within defined spatial and temporal proximity of previous incidents within jurisdictions of study. The Knox spatio-temporal interaction test is a complementary and alternative method to hot spot cluster analysis, well suited to quantifying both space and time interactions of crime data (Grubesic and Mack 2008; Johnson and Bowers 2004; Townsley et al. 2003).

The Knox index measures space-time interaction between discrete data points in terms of specified time and distance (Levine 2004; Knox 1964; Knox 2002; Kuldorf and Hjalmars 1999). To assess the statistical significance of Knox space-time interactions, a Monte Carlo simulation with 1,000 permutations was performed. The Knox index calculates observed clusters while the Monte Carlo simulation calculates expected clusters based on probabilities derived from the simulation distributions (See also Johnson et al. 2007 for a full description of the Monte Carlo simulation and permutation method).

For the analysis of ISaCS crime data, observed and expected spatio-temporal clusters were calculated for a threshold of one, two, and seven days, and a distance of 100 meters for MPD and WVUPD crime incident data, first as separate jurisdictions (Table 8) and then together (Table 9). Significant space-time interaction was observed to occur in each of the one, two, and seven day analyses; only the one day results will be presented here as an illustration. The two and seven day results can be viewed in Appendix D. As large buildings and parking lots are geocoded by their geometric center, a distance of threshold of 100 meters was selected based on a similar interval used by other researchers (Johnson and Bowers 2004; Johnson et al. 2007; Johnson et al. 2009a; Townsley et al. 2003). The choice of 100 meters ensured that large features located next to each other were analyzed as being spatially nearby. Ideally, spatial and temporal threshold distance values would be selected empirically from prior research; however, issues such as the effects of the spatial or temporal scale of features used in space-time interaction analyses have, as yet, received little recognition in the literature. Analyses often use a range of space-time bandwidths to identify thresholds (e.g., Johnson and Bowers 2004; Johnson et al. 2007; Johnson et al. 2009a; Townsley et al. 2003).

This space-time analysis quantifies the spatio-temporal dimensions of clusters across jurisdictions to advance research and reaffirm the importance of cross-jurisdictional analyses. Due to the low number of observances of extortion, kidnapping, murder, prostitution, and family offenses, they have been omitted from the analysis. Additional offenses can be observed in Tables 8 and 9 that have a low number of observations and these should be interpreted accordingly. Despite the low number of observations for some offenses, it is intriguing to find significant spatio-temporal interaction across the study area and two-year observation period. Furthermore, it is also worth emphasizing that offense time used in the analyses represents reported time, not necessarily occurrence time.

Table 8. Knox Space-Time Interaction Test Results

	WVUPD			*MPD*		
Offense	**n=**	**Observed**	**Expected**	**n=**	**Observed**	**Expected**
Arson	5	0	0	15	1***	0.07619
Assault	170	28***	7.96923	602	81***	25.12313
Burglary	30	7***	0.88966	535	89***	9.42924
Destruction	232	21	10.8867*	1068	91***	35.46442
Disorderly Conduct	49	2	0.95068	286	39	31.61997
Drugs	445	138***	82.08041	278	92***	6.24375
Drunkenness	367	119***	76.44145	366	54*	42.81386
Embezzlement	3	0	0	21	0	0.02381
Forgery	6	0	0	114	11***	2.08151
Fraud	18	2***	0.36601	160	5**	2.14843
Liquor	984	771***	543.9836	213	30**	15.86323
Loitering	0	n/a	n/a	18	1***	0.17647
Other	172	26***	8.27132	591	117***	26.14762
Robbery	5	0	0	65	0	0.18462
Sexual Assault	10	0	0	46	3***	0.2029
Stolen Property	4	0	0	43	1***	0.05537
Theft	402	64***	32.90431	1328	110***	56.5439
Trespassing	37	3***	0.27928	42	0	0.12195
Vehicle Theft	1	n/a	n/a	12	0	0.01515
Weapons	3	0	0	63	2***	0.29391

* p=0.1 **p=0.01 ***p=0.001

Table 9. Knox Space-Time Interaction Test Results

		WVUPD & MPD	
Offense	**n=**	**Observed**	**Expected**
Arson	20	1***	0.0421
Assault	772	111***	33.352
Burglary	565	96***	10.099
Destruction	1300	121***	51.363
Disorderly Conduct	335	43*	35.493
Drugs	723	230***	72.467
Drunkenness	733	176***	107.73
Embezzlement	24	0	0.018
Forgery	120	11***	2.379
Fraud	178	7***	2.39
Liquor	1197	813***	531.73
Loitering	18	1***	0.17647
Other	763	147***	35.135
Robbery	70	0	0.176
Sexual Assault	56	3***	0.208
Stolen Property	47	1***	0.046
Theft	1730	181***	85.412
Trespassing	79	3***	0.31159
Vehicle Theft	13	0	0.01282
Weapons	66	2***	0.274

* p=0.1 **p=0.01 ***p=0.001

Next, the MPD and WVUPD clusters observed seperately were summed and compared with the expected number of clusters (Knox 2002). The difference between the summed values and the expected values is accounted for by the space-time clusters that are not captured when doing spatio-temporal analyses of each LEA jurisdiction separately. Table 10 shows that the cross-jurisdictional analysis identified more space-time interaction for assault, destruction, disorderly conduct, drunkenness, liquor, other, and theft incidents. The difference between the separate jurisdictional analyses and the cross-jurisdictional analysis demonstrates empirically the limitations imposed by geographic boundary effects. Practitioners, policy-makers, and criminologists performing analyses on spatial data should be aware that there are numerous statistical issues arising from geographic boundaries. The implication is that when jurisdictions share crime patterns along common borders, separate LEA jurisdictional analyses may result in an inaccurate assessment of crime risk; potentially resulting in inappropriate resource allocation and intervention strategies.

Table 10. Separate vs. Combined Analyses

Offense	WVUPD & MPD Together	WVUPD and MPD Observed Separate	Difference (# of additional space-time clusters observed in a cross-jurisdiction analysis)
Arson	1	1	0
Assault	111	109	2
Burglary	96	96	0
Destruction	121	112	9
Disorderly Conduct	43	41	2
Drugs	230	230	0
Drunkenness	176	173	3
Embezzle	0	0	0
Forgery	11	11	0
Fraud	7	7	0
Liquor	813	801	12
Loitering	1	1	0
Other	147	143	4
Robbery	0	0	0
Sexual Assault	3	3	0
Stolen Property	1	1	0
Theft	181	174	7
Trespassing	3	3	0
Vehicle Theft	0	0	0
Weapons	2	2	0

Effects of classification differences

Nolan et al. (2011) examined police records from twelve large metropolitan LEAs and determined misclassification of offenses into UCR categories greatly undercounted some offenses while over counting others. In an examination of West Virginia LEA records, Nolan et al. (2006) determined misclassification did exist and was systematic based on a variety of reasons. The WV study found violent crime to be "significantly undercounted". Recognizing that offenses are subject to classification error, this research draws further upon the works of Nolan et al. (2006; 2011) to demonstrate differences in official reporting statistics provided to different agencies with differing classifications. Both WVUPD and MPD provide crime statistics to the WV state police (WVSP), which now publish the statistics under the NIBRS classification. WVUPD also provides crime statistics to the U.S. Department of Education as a Clery Act requirement, which is published using a UCR classification. MPD additionally provides crime statistics to the Federal Bureau of Investigation (FBI) for dissemination under a UCR classification. Table 11 is a compilation of the official 2010 crime statistics reported to each of the previously mentioned agencies, compared to the ISaCS geodatabase records. Results show a large inconsistency in statistics

between agencies. With few exceptions, statistics based on UCR classification (Clery and FBI) provide the lowest number of reported offenses for each category. Conversely, the WVSP NIBRS classification provides the highest number of offenses. The unofficial data collected for the ISaCS project, utilizing a NIBRS classification, shows an overall count that is larger than the UCR classifications but less than the WVSP NIBRS classification (8% in both cases). While additional research will be needed to determine discrepancies, the results confirm classification differences manifest as differences in official crime reports.

Table 11. Comparison of Crime Statistics

	WVUPD			MPD		
	Clery	***WVSP***	***ISaCS***	***FBI****	***WVSP***	***ISaCS***
Arson	3	3	2	3	3	4
Assault	68	96	83	68**	310	310
Burglary	20	7	16	187	265	250
Destruction	96	119	102	*	572	584
Forgery	N/A	5	3	N/A	41	60
Murder	0	0	0	1	2	2
Robbery	5	4	4	22	28	30
Sexual	7	5	5	9	18	21
Theft	148	196	184	*	914	744
Vehicle Theft	1	3	1	22	33	2
Total	348	438	400	312	2186	2007

* Incomplete data
** Aggravated assault only

CONCLUSIONS

One of the primary outcomes of the ISaCS partnership has been to use GIS as an analytical tool for identifying and setting up responses to crime trends; and as a research tool for identifying the potential underlying causes of crime. As such, campus and municipal LEAs have benefited from greater data sharing between agencies, increased information for crime reduction collaborations, and a greater appreciation of spatial technologies and mapping. Additionally, the researchers have gained a better understanding of both campus and municipal LEA practices, from daily operations to tactical and strategic planning. Conversely, LEA partners have demonstrated an increased trust and willingness to maintain an ongoing partnership with researchers, once it became evident the crime mapping and analysis research was not only useful for supporting and enhancing routine knowledge-led policing activities but was a beneficial contribution to problem-oriented decision making.

This applied research project has established geospatial technology in an LEA environment unlikely to have been able to do so without the creation of the research-practitioner partnership. The physical infrastructure, data acquisition, mapping and analysis protocols, and establishment of researcher-practitioner trust are important steps in facilitating further integration of the derived spatial information into the daily practice of law enforcement. The ISaCS partnership has provided researchers with valuable insight into the analytical needs and daily operations of the practitioners while also giving the

practitioners access to researchers predisposed to addressing the practitioners' overall desire for crime reduction. Additionally, students have had the opportunity to employ the crime mapping facilities, engage in additional research, and gain practical experience with LEAs. Thus far, knowledge-led decision making has been supplemented with intelligence-led decision making through the addition of cross-jurisdictional geospatial data in the operational routines of campus and municipal LEA jurisdictions. This crime mapping and analysis project has provided a valuable tool to LEA practitioners previously well-informed about the utility of crime maps for problem-oriented policing efforts, but without the capacity to initiate their own crime mapping and analysis program. Furthermore, community members and public officials are able to maintain a sense of security and confidence in the LEAs that embrace new technologies to reduce crime and victimization as well as providing the additional transparency in reporting, evident on online maps.

Weisburd et al. (2002) described crime mapping across borders as a major issue for LEA problem-solving due to technological, organizational, political, and social barriers. The ISaCS partnership between LEA practitioners and researchers has demonstrated cross-jurisdictional collaboration can be achieved for relatively small LEAs, resulting in an applied example of crime mapping and analysis across borders, which can be scaled-up to surrounding jurisdictions. Furthermore, the ISaCS partnership highlights a successful relationship between researchers and practitioners which has led to a mutually improved understanding of the role of research in LEA, bridging the gap between theory and practice. The culmination of a collaboration between a municipal LEA, campus LEA, and academic researchers identifying and solving problems together has led to an exploratory analysis of crime incidents recorded during a two-year study period and has strengthened the overall understanding of crime patterns within the cross-jurisdictional study area. Although weaknesses in data, statistical assumptions, and the execution of the collaboration exist, the gaps between an effective and productive researcher-practitioner partnership and cross-jurisdictional collaborations are being narrowed while contributions to theory and practice have begun to emerge.

Spatio-temporal crime pattern is an under-researched area (Ratcliffe 2010) with some notable exceptions (e.g., Johnson and Bowers 2004; Johnson et al. 2007; Johnson et al. 2009a; Johnson et al. 2009b Townsely et al. 2003). Efforts to reduce victimization are dependent upon the empirically-validated existence of spatio-temporal clusters which can be used to anticipate increased risk (Johnson et al. 2007). A greater understanding of the factors contributing to when and where crime has and potentially will occur has profound implications for criminological theories and policing efforts directed toward crime reduction. This research has demonstrated the utilization of a typical crime dataset (Townsley et al. 2003) in a progressive series of analyses that examined temporal, spatial, and spatio-temporal patterns of crime for a community with a large student population to gain further insight into local crime patterns. Unlike much of the published research, ISaCS used a cross-jurisdictional approach that examined campus and municipal crime with the expressed objective of exploring risk across the community instead of within artificially created areal units. However, the uniqueness of independent LEA jurisdictions is also a vital consideration for interpreting offense patterns, and should not be dismisses in a cross-jurisdictional collaboration. A temporal analysis of crime events using ESDA graphing revealed campus and municipal crime patterns were similar in seasonal, daily, and hourly variations. Understanding when crime events are likely to occur across three temporal scales is relevant for LEA tactical and strategic planning in this partnership. From a criminological perspective, temporal insight into preferred activity times of offenders offers insight into understanding the underlying factors leading to crime. In this study, aggregated monthly crime statistics displayed decreases which coincided with periods of university recesses, suggesting the presence of college students could be an underlying contributor of crime either directly or indirectly. Additional research into the relationship between low or high periods of crime and the presence of college students is needed and could contribute to theories on offender motivation. An examination of spatial clusters using a simple point density and KDE maps confirmed visually that WVUPD and MPD have a shared boundary problem. Researchers and practitioners need to be keenly

aware of and understand the effects of common geographic problems, such as boundary effects, on analyses and interpretation. With crime rates well below national averages, an analysis of Morgantown and WVU crime is presented as a case study which may or may not be applicable to other geographic locations. Many more case studies need to be conducted for similar crime rate communities to be compared. Johnson et al. (2007), for example, examined burglaries in ten different cities from five countries, revealing both consistencies and inconsistencies, and suggested local differences have an important effect on spatio-temporal patterns. Their findings, like the findings here, emphasize the need for additional work to identify and validate factors contributing to spatio-temporal clustering across different types of crime as important contributions to criminological theory.

In retrospect, there are undoubtedly many things that could have been done differently which may or may not have strengthened the researcher-practitioner partnership. McEwan (2003) addressed the loss of key personnel as a major contributor to researcher-practitioner partnerships. This partnership was fortunate. The MPD police chief retired after the first year of the project concluded. However, the police chief took a new position with the WVUPD and continued to be a valuable contributor to the project. The new MPD police chief enthusiastically embraced the LEA practitioner partnership role and provided fresh insight and ideas gained from his previous LEA experiences. The transition period between MPD police chiefs did result in a delay of project objectives. The interim police chief preferred to defer MPD decision to the new police chief although all previous partnership and project arrangements remained intact during the transitional period. Despite the adversity, the major tasks were accomplished and objectives of the partnership achieved.

This researcher-practitioner partnership had several strengths and weaknesses which should be taken into consideration by future researcher-practitioner partnerships. The strengths of the crime mapping and analysis for problem-oriented policing can be evaluated from the practical and academic outcomes of the research. However, the following lessons emerged as the project was being evaluated:

1. The partnership was an 8 am - 5 pm arrangement; originally, it was envisioned that LEA supervisors and personnel working the night shift would be involved.
2. Researchers did not become sufficiently involved in community relationships held publicly. All interaction between community members and researchers took place through arranged meetings with LEA leaders in conference room settings. Researchers had anticipated attending LEA community outreach events.
3. LEA personnel had little familiarity with the RMS they used. This resulted in crime incident data being entered inconsistently. Although many useful features of the RMS began to emerge with greater familiarity with the software, advantage was not fully taken of these features owing to limited staffing and training. The police chiefs recognized a need for additional funding to provide training to all personnel using the RMS.
4. Although the pin maps were created from a script and map template, points where two or more incidents occurred at the same location would be visually displayed as one incident (overposting). The researchers were able to manually manipulate the points so multiple incidents would be represented; the process was too complex for regular use by practitioners. An easier and more efficient solution for overposting needs to be developed and implemented.
5. Researchers relied heavily on CrimeStats and GeoDa software for spatial and temporal analyses. However, emphasis was given to ArcGIS for LEA personnel. Researchers considered familiarity with ArcGIS to be a priority. The result is unfamiliarity with other valuable analytical software by LEA personnel.
6. While documentation of meetings, activities, software, data, etc. may appear to be routine and adequate at the time of recording, compilation for reports such as this serves to illustrate the need

for rigorous detail. Daily operation, research activities, articles and presentations may be more appealing, but nothing substitutes for good office practice.

7. Although university administrators are aware of the partnership and objectives, there is a need to devote more time and effort to presenting them with empirical results and implications for student safety. Dialog between the researchers and practitioners with administrators should be given priority, now that the proposed objectives have been accomplished and tangible research results have emerged.

When generalized beyond the specifics of ISaCS these lessons should be valuable considerations for future partnership proposals.

In consideration of the intent of the NIJ's researcher-practitioner partnership, this partnership found personnel time constraints as an impediment. Daily interaction or *ad hoc* discussions were extremely limited in part because of the separation of researcher and practitioner by virtue of space consideration. Scheduling time to arrange meetings was essential and certainly resulted in some delayed action. One possible solution offered as a recommendation for future research-practitioner partnerships is to involve experienced but retired law enforcement officers as a key component of the practitioner relationship to serve as a primary contact under at least a part-time schedule. With no additional duties, this contact would be ideal in devoting time to ensuring objectives are being met on time and to standard while also serving as a knowledgeable mentor.

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DISSEMINATION OF RESEARCH FINDINGS

Gregory Elmes and George Roedl, *Increasing Student and Community Safety Partnership* (poster) Association of American Geographers Annual meetings, Washington DC, April 16 2010.

George Roedl and Gregory Elmes, *Geography, Crime, Spatial Technology, and Safe Campuses* Paper Session: Crime Modeling and Mapping, AAG Annual meetings, Washington DC, April 15 2010.

George Roedl, Eberly College of Arts and Sciences, Research Horizons Day, March 2010 (poster)

George Roedl "Crime maps for increased student and community safety" AAG Annual Meetings, Seattle 2011 (presentation)

George Roedl "Crime maps for increased student and community safety" Applied Geography, in preparation.

George Roedl, "WVU and Morgantown: A spatio-temporal view of crime incidents" Eberly College of Arts and Sciences, Research Horizons Day, April 2011 (poster)

Gregory Elmes and George Roedl "The use of geospatial information technology to advance safer campus communities" in Crime Modeling and Mapping Using Geospatial Technologies, Edited by Dr. Michael Leitner, Department of Geography and Anthropology, Louisiana State University, Baton Rouge, Louisiana, USA. Springer: NY. Manuscript accepted April 2012.

George Roedl and Gregory Elmes "Increased student and community safety partnership (ISaCS)" Crime Mapping Research Conference, October 2011, Miami FL.

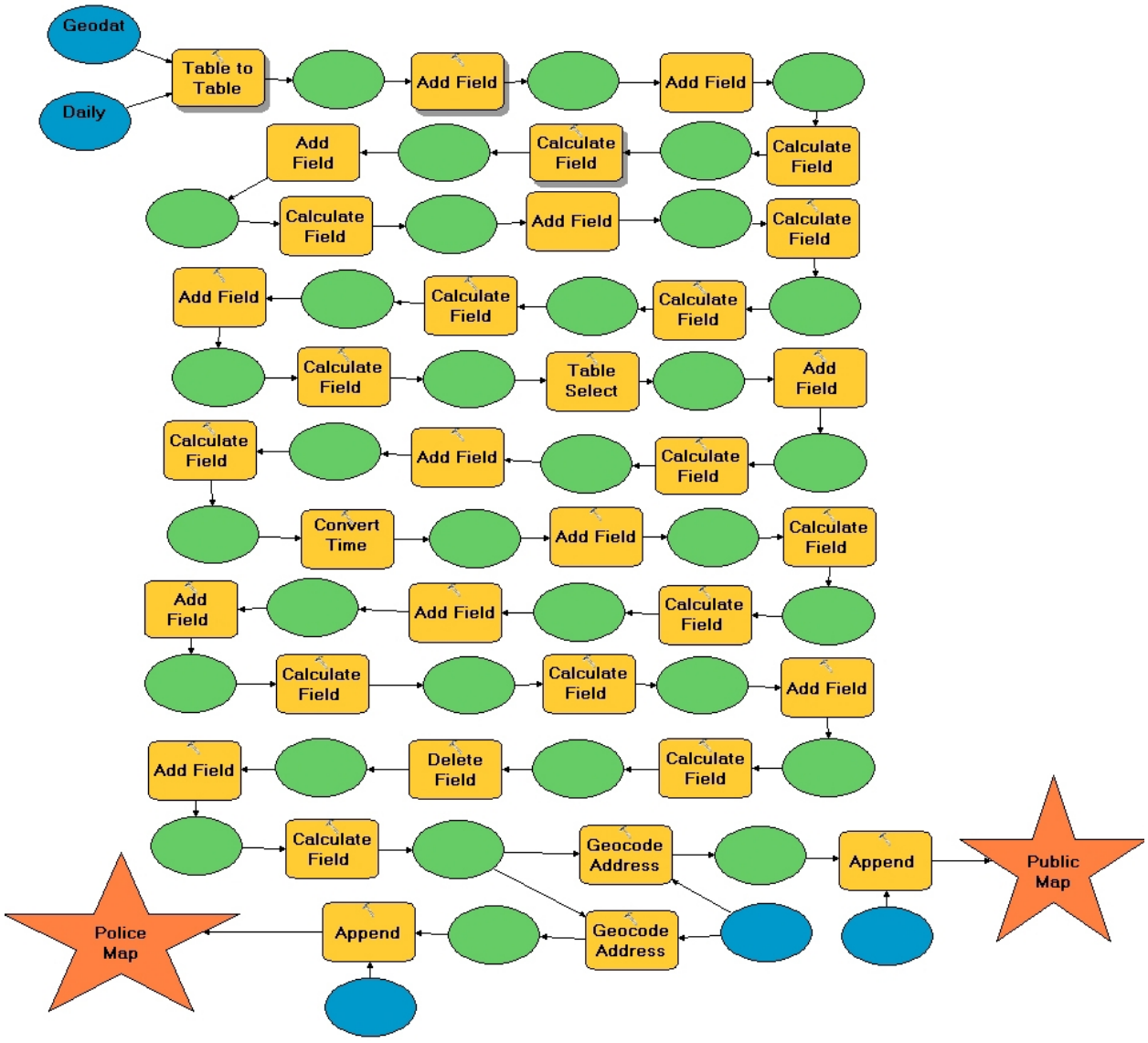
George Roedl South Eastern Division American Association of Geographers, November 2011, Savanna, GA.

Eberly Magazine, Grant Money Allows for Crime Mapping Collaboration, Eberly College, WVU Summer 2010.

George Roedl and Gregory Elmes, *Safer College Campuses and Communities Through the Use of Geospatial Information Technology.* WV GIS conference, Morgantown WV, May 2012 (poster)

George Roedl and Gregory Elmes, *Safer College Campuses and Communities Through the Use of Geospatial Information Technology.* WV GIS conference, Morgantown WV, May 2012 (presentation)

APPENDIX A: Cartographic Model to Automate Mapping Processes



APPENDIX B: Classification of WV Code to NIBRS Categories

Arson

61-3-1 ARSON 1ST-BURN,AID ETC. DWELLING, OUTHOUSE
61-3-2 ARSON 2ND-BURN, AID ETC. OTHER BUILDING, STRUCTURE
61-3-3 ARSON 3RD-BURN,AID ETC. PERSONAL PROP =>$500 OF ANOTHER
61-3-4 ARSON 4TH-ATTEMPT, AID ETC. TO COMMIT
61-3-6 ARSON-STARTING A FIRE
ILLEGAL BURNING
MALICIOUS BURNING

Assault

48-2A-9 DOMESTIC CALL -VERBAL OR UNFOUNDED
50-5-11 INTIMIDATING A WITNESS
61-2-10B(B) UNLAWFUL ASSAULT OF AN OFFICER
61-2-10B(C) 1ST BATTERY OF OFFICER (W/O SERIOUS INJURY OR W/O WEAPON DISPLAYED)
61-2-10B(E) ASSAULT OF OFFICER (W/O SERIOUS INJURY & W/O DISPLAY OF WEAPON)
61-2-15 BATTERY OF SCHOOL EMPLOYEE (W/O SERIOUS INJURY OR WEAPON DISPLAYED)
61-2-28(a) DOMESTIC BATTERY
61-2-28(B) 1ST/2ND DOM ASSAULT (BY THREATS, W/O SERIOUS INJURY & W/O DISPLAY OF WEAPON)
61-2-28(B) 1ST/2ND DOM ASSAULT (W/ SERIOUS INJURY OR W/ DISPLAY OF WEAPON)
61-2-28(B) 1ST/2ND DOM ASSAULT (W/O SERIOUS INJURY & W/O DISPLAY OF WEAPON)
61-2-7 ATTEMPT TO KILL, INJURE BY POISON
61-2-9(A) BATTERY ON POLICE OFFICER
61-2-9(A) MALICIOUS ASSAULT
61-2-9(A) UNLAWFUL WOUNDING
61-2-9(A)UNLAWFUL ASSAULT
61-2-9(B) ASSAULT &/OR BATTERY (W/O SERIOUS INJURY & W/O DISPLAY OF WEAPON)
61-2-9(B) ASSAULT (MISDEMEANOR)
61-2-9(B) ASSAULT (W/ SERIOUS INJURY OR W/ DISPLAY OF WEAPON)
61-2-9(B) ASSAULT AND BATTERY
61-2-9(B) ASSAULT BY THREATS
61-2-9(B) ASSAULT-VERBAL ABUSE
61-2-9(B) ASSAULT-VERBAL ASSAULT
61-2-9(C) 61-2-9(C) BATTERY (W/O SERIOUS INJURY & W/O DISPLAY OF WEAPON)
61-2-9(c) BATTERY
61-2-9(C) BATTERY (NO SERIOUS INJURY AND NO WEAPON DISPLAYED)
61-2-9(C) BATTERY (W/O SERIOUS INJURY & W/O DISPLAY OF WEAPON)
61-2-9(c) BATTERY-VIOLENT INJURY
61-2-9(c) BODILY INJURY
61-2-9(c) FIGHTING

61-2-9(C)BATTERY (W/ DISPLAY OF WEAPON OR W/ SERIOUS INJURY)
61-2-9A STALKING (HARASS OR CREDIBLE THREAT)
61-5-17 OBSTRUCTING OFFICER (THREAT TO OFFICER)
61-5-17(A) OBSTRUCTING OFFICER BY THREATS
61-6-24(B) TERROIST-THREATEN TO COMMIT ACT W/O INTENT TO COMMIT
61-8D-3 BODILY INJURY FROM CHILD ABUSE
61-8D-3(C) CHILD ABUSE-CRUELTY
REPEATEDLY HARASSES OR REPEATEDLY MAKES CREDIBLE THREATS: 1ST OFFENSE THREATS
VIOLATION OF PROTECTIVE ORDER: HARASSING OR MAKING CREDIBLE THREATS OR STALKING (REPEATEDLY FOLLOWING)

Burglary
61-3-11(A) BURGLARY DAYTIME, BREAK & ENTER
61-3-11(A) BURGLARY NIGHTIME
61-3-11(B) BURGLARY DAYTIME, BREAK W/O ENTERING
61-3-11(B) BURGLARY DAYTIME, ENTERING W/O BREAK
61-3-12 B&E BUILDING OTHER THAN DWELLING
61-3-12 B&E OF AUTO, MOTORCAR, BUS
61-3-12 B&E R/R CAR, BOAT, VESSEL, TRACTION CAR, STEAMBOAT
61-3-12 BREAKING & ENTERING AUTO
61-3-12 BREAKING & ENTERING-ATTEMPT
61-3-12 BURGLARY ENTER W/O BREAKING -NON DWELLING
61-3-12 ENTERING WITHOUT BREAKING
61-3-12 ENTERING WITHOUT BREAKING AUTO

Destruction of Property
61-3-30 DESTRUCTION, VANDALISM, INJURY OF PROPERTY
61-3-31 DAMAGE, DESTRUCTION OF PROPERTY BY BAILEE FOR HIRE, LOAN
61-3-48(A) DAMAGE SHRUBBERY, TREES, TIMBER
INJURY OR DESTRUCTION OF PROPERTY
REMOVAL, INJURY TO, OR DESTRUCTION OF PROPERTY <= $2500
REMOVAL, INJURY, OR DESTRUCTION OF PROPERTY >=$2500

Disorderly Conduct
61-6-1b DISORDERLY CONDUCT

Drugs
60A-4-401 1ST POSSESSION OF MARIJUANA <15GM
60A-4-401 NARCOTIC OFFENSES-OTHER
60A-4-401 OTHER DRUG VIOLATION
60A-4-401 POSSESSION OF MARIJUANA (2ND)
60A-4-401 SALE & DELIVERY OF CONT SUBS

60A-4-401(A)(I) (NARCOTIC) SCH I, II MANUFACTURE, DELIVER, POSSESS W/ INTENT CONT SUB

60A-4-401(a)(i) POSS AND DEL OF A CONT SUBS

60A-4-401(a)(i) POSS W/INTENT SALE-DEL CONT SUBSTANCE

60A-4-401(A)(I) POSSESSION AND DELIVERY OF A CONTROLLED SUBSTANCE

60A-4-401(a)(i) POSSESSION W/INTENT MARIJ

60A-4-401(A)(I) POSSESSION W/INTENT MARIJUANA

60A-4-401(A)(I) POSSESSION W/INTENT SALE-DELIVERY CONT COCAINE BASE

60A-4-401(A)(I) POSSESSION W/INTENT SALE-DELIVERY CONTROLLED SUBSTANCE

60A-4-401(a)(i) POSSESSION W/INTENT TO DELIVER NARCOTICS

60A-4-401(a)(i) SALE OF CONTROLLED SUBSTANCE

60A-4-401(A)(I) SIMPLE POSSESSION OF MARIJUANA

60A-4-401(A)(II) (MARIJUANA) SCH I MANUFACTURE, DELIVER, POSSESS W/ INTENT, CONT SUB

60A-4-401(A)(II) (STIMULANTS) SCH I, II, III MANUFACTURE, DELIVER, POSSESS W/ INTENT CONT SUB

60A-4-401(A)(III) SCH IV MANUFACTURE, DELIVER, POSSESS W/ INTENT CONT SUB

60A-4-401(C) (DEPRESSANTS) POSSESS CONT SUB UNLESS FROM VALID PRESCRIPTION

60A-4-401(C) (NARCOTIC) POSSESS CONT SUB UNLESS FROM VALID PRESCRIPTION

60A-4-401(C) (STIMULANTS) POSSESS CONT SUB UNLESS FROM VALID PRESCRIPTION

60A-4-401(c) POSS OF COCAINE

60A-4-401(c) POSS OF CONTROLLED SUBSTANCE

60A-4-401(c) POSSESSION OF MARIJUANA

60A-4-402(2) MANUFACTURE, DISTRIBUTE, DISPENSE AUTHORIZED CONTROLLED SUBSTANCE (REGISTRANT)

60A-4-403A POSSESSION OF MARIJ PARAPHERNALIA

60A-4-406 DEL OF CONT SUB W/IN 1000FT OF SCHOOL

60A-4-408 CULTIVATION OF MARIJUANA

ATTEMPTED (TO FRAUDULENTLY OBTAIN CONTROLLED SUBSTANCE)

HUFFING, BREATHING, INHALING OR DRINKING CERTAIN INTOXICATING COMPOUND

Drunkenness

60-6-9(1) PUBLIC INTOXICATION

INTOXICATION/DRINKING IN PUBLIC PLACES/ ILLEGAL POSSESSION

DUI

17C-5-2 DUI 1ST OFFENSE

17C-5-2 DUI 2ND OFFENSE

17C-5-2 DUI UNDER 21 YOA

17C-5-2(D) DRIVE WITH MEASURABLE ALCOHOL

17C-5-2(D) DUI (1ST OFFENSE) (ALCOHOL)

17C-5-2(D,E,F,G) OTHER DUI OFFENSES

17C-5-2(H) DUI (2ND OFFENSE)

17C-5-2(H) DUI UNDER 21
17C-5-2(I) DUI (3RD OFFENSE)
17C-5-2C DUI WITH INJURY
DRIVING UNDER THE INFLUENCE-ENHANCED (GREATER THAN .15%)
DRIVING UNDER THE INFLUENCE
DRIVING UNDER THE INFLUENCE-ENHANCED (GREATER THAN .15%)
DUI WITH BAC GREATER THAN .15 (AGGRAVATED)
DUI: SECOND OFFENSE FOR VIOLATING PROVISION OF SUBSECTION B,C,D,E,F,G, OR I
DUI: THIRD OR SUBSEQUENT OFFENSE FOR VIOLATING PROVISION OF SUBSECTION B,C,D,E,F,G, OR I
DUI: UNDER THE INFLUENCE OF DRUGS

Embezzlement
61-3-20 <$1000 EMBEZZLEMENT
61-3-20 =>$1000 EMBEZZLEMENT
61-3-20 =>$1000 EMBEZZLEMENT BY BANKING INSTITUTION EMPLOYEE
61-3-21 <$1000 EMBEZZLEMENT BY CARRIER

Extortion

61-2-13 ATTEMPTED EXTORTION

Family Offenses
61-2-29 NEGLECT-INCAPACITATED ADULT
61-8D-4(e) CHILD NEGLECT-GROSS-CREATE RISK OF INJURY
CONTRIBUTING TO DELIQUNECY/NEGLECT OF MINOR

Forgery
20-2-30A(D) FORGE/UTTERING-CERTIFICATE OF TRAINING
61-3C-13(B) POSSESS COUNTERFEIT, UNAUTHORIZED ACCESS DEVICE
61-3C-13(C) POSSESS COUNTERFEIT ETC ACCESS DEVICE W/ INTENT TO DEFRAUD
61-4-1 FORGERY
61-4-1 POSSESSION OF FAKE IDENTIFICATION
61-4-3 COUNTERFEIT CURRENCY / UTTER COUNTERFEIT CURRENCY
61-4-3 COUNTERFEITING/FORGERY
61-4-5 FORGE, UTTER OTHER WRITING
61-4-5 UTTERING (PASS COUNTERFEIT DOCUMENTS)
61-4-6 POSSESSION OF COUNTERFEIT CURRENCY W/ INTENT TO UTTER
61-4-6 POSSESSION OF COUNTERFEIT MONEY
61-4-8 PASS, RECEIVE UNAUTHORIZED CURRENCY
ATTEMPTED (TO UTTER)
FORGE PUBLIC RECORD, COURT
POSSESSION OF FALSIFIED DRIVERS LICENSE

Fraud

12-3-10b: FRAUDULENT OR UNAUTHORIZED USE OF PURCHASING CARD
60A-4-403(A)(3) FRAUDENTLY OBTAIN POSSESSION OF CONTROLLED SUBSTANCE
60A-4-403(a)(3) FRAUDULENT PRESCRIPTION
61-1-9 IMPERSONATE LAW ENFORCEMENT OFFICER
61-2-29 NEGLECT-INCAPACITATED ADULT
61-3-14(d) FALSE PRETENSE/FRAUD SCHEMES <$1000
61-3-14(d) FALSE PRETENSE/FRAUD SCHEMES >$1000
61-3-24 CREDIT FRAUD BY EMPLOYEE
61-3-24 FRAUD/DECEPTION
61-3-24(a)(b) FRAUDULENT USE OF A CREDIT CARD <$1000
61-3-24(a)(b) FRAUDULENT USE OF A CREDIT CARD >$1000
61-3-24(a)(b) FRAUDULENT USE OF A STATE PURCHASE CARD
61-3-24(D) <$1000 (FALSE PRETENSES) FRAUDULENT SCHEMES
61-3-24(D) =>$1000 (FALSE PRETENSES) FRAUDULENT SCHEMES
61-3-24A(6)(2) =>$1000 FALSE, FRAUDULENT USE TELEPHONIC SERVICES
61-3-24d FRAUDULENT SCHEMES
61-3-54 TAKING IDENTITY OF ANOTHER PERSON TO MAKE FINANCIAL OR CREDIT PURPOSES
61-3C-4(A) COMPUTER FRAUD
ATTEMPTED (CREDIT CARD FRAUD)
COMPUTER FRAUD
FRAUD WITH ACCESS DEVICE
FRAUDULENT IDENTIFICATION
FRAUDULENTLY OBTAINING FOOD OR LODGING
USE OF FALSE IDENTIFICATION, ETC., BY PERSON UNDER AGE
USED A FALSE OR FICTITIOUS NAME

Kidnapping

61-2-14(a) ABDUCTION

Liquor

11-16-19(9) BEER PROHIBIT OBSTRUCTION OF PREMISES
11-16-19(A) BEER <21YOA MISREPRESENT AGE (OR POSS FALSE ID) TO ATTEMPT TO PURCHASE
11-16-19(A) BEER <21YOA PURCHASE, CONSUME, POSSESS, SELL, SERVE
60-3A-24(a) LIQUOR-MINOR-PURCHASE AND POSSESSION
60-6-9(2) OPEN CONTAINER
60-8-20(a) WINE-MINOR-POSSESS/CONSUME/PURCHASE
60-8-20A(A) <21YOA PURCHASE, CONSUME, SELL, POSSESS, SERVE WINE, LIQUOR
60A-3A-24: UNDERAGE CONSUMPTION/POSSESSION OF LIQUOR

Loitering

18-18-2 18 YOA OR > FAILS TO ATTEND

SCHOOL

18-8-1A TRUANCY

49-5-1A CURFEW VIOLATION

BEGGING

Murder

61-2-1 1ST DEGREE MURDER

2ND DEGREE MURDER

Other

11-16-19(B) BEER BUY, FURNISH BEER <21YOA

11-9-11(1) ENGAGE IN BUSINESS W/O POSTING BUSINESS FRANCHISE REGISTRATION CERTFICATE

15-12-8 FAILURE TO REGISTER SEX OFFENDER

15-2-24(J) OFFICER NEGLECT, REFUSE TO FINGERPRINT

17A-8-6(A) AUTO TAMPERING

20-11-8(A) UNLAWFUL TO DISPOSE OF WASTE TIRES IN SOLID WASTE LANDFILL

20-3-5 ILLEGAL BURNING

20-7-26 LITTERING VIOLATION (HIGHWAY)

20-7-26 LITTERING VIOLATION (PRIVATE/PUBLIC PROPERTY)

20-7-26(A)(1) UNLAWFUL DISPOSAL OF LITTER

29-3-12 FIRE SAFETY VIOLATIONS

29-3-21 FALSE FIRE ALARM

29-3-24 FIREWORKS - UNLAWFUL POSS SALE, USE

48-27-903 PROTECTIVE ORDER-VIOLATION

48-2A-9 DOMESTIC CALL -VERBAL OR UNFOUNDED

49-5-1A CURFEW VIOLATION

5-1-07 FUGITIVE FROM JUSTICE

61-10-31(1) CONSPIRACY TO COMMIT FELONY OFFENSE AGAINIST THE STATE

61-10-31(1) CONSPIRACY TO COMMIT MISDEMEANOR OFFENSE AGAINST THE STATE

61-11-6 ACCESSORY BEFORE OR AFTER THE FACT - FELONY OFFENSE

61-11-6 PRINCIPLE IN 2ND DEGREE & ACCESSORY

61-11-7 ACCESSORY BEFORE OR AFTER THE FACT - FELONY OFFENSE

61-2-9A VIOLATION OF PROTECTION ORDER

61-3C-14a COMPUTER-HARASS & THREATEN

61-3C-5 UNAUTHORIZED ACCESS TO COMPUTER SERVICES

61-5-10 ESCAPE (ATTEMPT) OF ONE CHARGED W/ FELONY

61-5-14 REFUSE TO AID OFFICER IN CASE OF ESCAPE, RESCUE

61-5-17 FAIL TO OBEY POLICE OFFICER

61-5-17 FAILURE TO SUBMIT TO BOOKING

61-5-17 OBSTRUCT OFFICER

61-5-17 OBSTRUCTING OFFICER (W/O THREAT, INJURY TO OFFICER)

61-5-17 WITHHOLDING INFO FROM OFFICER

61-5-17(C) FLEE (ATTEMPT) (OTHER THAN BY VEHICLE) FROM OFFICER
61-5-17(d) ELUDING
61-5-17(D) FLEE (ATTEMPT) FROM OFFICER
61-5-17(E) FLEE (ATTEMPT) FROM OFFICER IN VEHICLE
61-5-17(F) FLEE (ATTEMPT) & CAUSE PROPERTY DAMAGE FROM OFFICER
61-5-17(I) FLEE (ATTEMPT) WHILE UNDER THE INFLUENCE - FROM OFFICER
61-6-17(a) FALSE BOMB REPORT 1ST
61-6-20 FALSELY REPORTING AN EMERGENCY INCIDENT
61-6-21(b) HARASSMENT
61-6-21(b) HAZING
61-8-16 TELEPHONE- OBSCENE, ANONYMOUS, HARRASSING, REPEATED, THREATENING CALLS
61-8-19(A) 61-8-19(A) CRUELTY TO ANIMALS
61-8-28 1ST CRIMINAL INVASION OF PRIVACY
61-8-9 INDECENT EXPOSURE
62-1C-17B(C) BOND VIOLATION
ALL OTHER OFFENSIVES
AUTO TAMPERING
CAPIAS
CONSPIRACY
DRUG/NARCOTIC EQUIPMENT VIOLATION: IBR ONLY
FALSELY REPORTING AN EMERGENCY INCIDENT
FLEES OR ATTEMPTS TO FLEE IN A VEHICLE FROM OFFICER
FLEES OR ATTEMPTS TO FLEE IN A VEHICLE FROM OFFICER WHILE UNDER THE INFLUENCE
FURNISHING TO UNDERAGE
HINDERING OR OBSTRUCTING OFFICER OR ATTEMPTS TO HINDER OR OBSTRUCT OFFICER
INDECENT EXPOSURE
INVASION OF PRIVACY BY LOOKING (PEEPING TOM)
LITTER FREE PREMISES
LITTER IN PUBLIC PLACES
LITTER ON OCCUPIED PRIVATE PROPERTY
LITTERING: PERMITTING PREMISES TO BECOME UNSANITARY
LOUD & UNNECESSARY NOISES PROHIBITED
NUISANCE PARTY
OBEDIENCE TO POLICE OFFICERS; FLEEING
OBSTRUCTING AN OFFICER
OBSTRUCTING OFFICER; FLEEING FROM OFFICER
PROTECTIVE ORDER-VIOLATION
SOLICITING W/O PERMIT
TRUANCY
VIOLATION OF PROTECTIVE ORDER
WARRANT SERVICE FOR OTHER JURISDICTION

Pornography
61-8C-3 DISTRIBUTE & EXHIBIT MATERIALS W/ MINOR ENGAGED IN SEXUALLY EXPLICIT CONDUCT

Prostitution
61-8-5(B) 1ST SOLICIT, PANDER ETC PROSTITUTION

Robbery
61-2-12(A) ROBBERY - 1ST DEGREE
61-2-12(a) ROBBERY-AGGRAVATED
61-2-12(B) ROBBERY - 2ND DEGREE
61-2-12(B) ROBBERY-NON-AGGRAVATED
61-2-12(B) UNARMED ROBBERY
61-2-12(C) BANK ROBBERY/ASSAULT OR PUT PERSON IN JEPORADY
61-2-12(C) ROBBERY BY FORCE OR VIOLENCE
61-2-12(C) ROBBERY-ARMED
61-2-12(C) ROBBERY-BANKING-TYPE INST

Sexual Assault
61-8B-3 SEXUAL ASSAULT 1ST DEGREE
61-8B-4 SEX ASSAULT 2ND (GENITAL INTERCOURSE)
61-8B-4 SEXUAL ASSAULT-2ND DEGREE
61-8B-7 SEXUAL ABUSE 1ST
61-8B-9 FONDLING
61-8B-9 SEXUAL ABUSE 3RD
SEXUAL ABUSE BY PARENT, GUARDIAN, CUSTODIAN OR PERSON IN POSITION OF TRUST
SEXUAL ASSAULT-3RD DEGREE

Stolen Property
17A-8-5 RECEIVE STOLEN VEHICLE
61-3-18 <$1000 RECEIVE, TRANSFER STOLEN GOODS
61-3-18 61-3-18 <$1000 RECEIVE, TRANSFER STOLEN GOODS
61-3-18 POSSESSION OF STOLEN VEHICLE
61-3-18 RECEIVING/TRANS STOLEN PROPERTY>$1000
61-3-19 INTERSTATE TRANSPORT STOLEN VEHICLE
61-3-19 RECEIVING/TRANSFERRING STOLEN GOODS
CONCEALING STOLEN PROPERTY
DEALING WITH STOLEN GOODS
RECOVERED STOLEN PROPERTY
RECOVERED STOLEN PROPERTY FOR OTHER JURISDICTION

Theft

61-11-20 2ND P LARC (FROM BUILDING)(<$1000)
61-11-20 2ND P LARC (FROM VEHICLE) (=>$1000)
61-11-20 2ND P LARC (OTHER LARCENY) (<$1000)
61-3-13(A) G LARC (ALL OTHER LARCENY) (=>$1000)
61-3-13(A) G LARC (FROM BUILDING)(=>$1000)
61-3-13(A) G LARC (FROM VEHICLE) (=>$1000)
61-3-13(A) GRAND LARCENY AUTO
61-3-13(B) 1ST P LARC (FROM BUILDING) (<$1000)
61-3-13(B) 1ST P LARC (FROM COIN OPERATED MACHINE/DEVICE) (<$1000)
61-3-13(B) 1ST P LARC (FROM VEHICLE) (<$1000)
61-3-13(B) 1ST P LARC (MOTOR VEHICLE PARTS & ACCESSORIES) (<$1000)
61-3-13(B) 1ST P LARC (OTHER LARCENY)
61-3-13(B) 1ST P LARC (POCKETPICKING) (<$1000)
61-3-13(B) 1ST P LARC (PURSE SNATCHING) (<$1000)
61-3-13(B) GAS DRIVEOFF FROM SELF SERVICE STATION
61-3-13(B) P LARC (OTHER LARCENY)
61-3-14 (<$1000) THEFT FROM BUILDING OF BANK NOTES, BOOK ACCOUNTS, WRITINGS OF VALUE
61-3-24(D) <$1000 THEFT OF SERVICES
61-3-55 FAILURE TO PAY FOR GASOLINE (SELF-SERVE STATION)
61-3A-1(B) 2ND SHOPLIFTING
61-3A-1(B) SHOPLIFTING-ATTEMPT
61-3A-3(A) 1ST OFF SHOPLIFTING
61-3A-3(A) 1ST OFFENSE SHOPLIFTING
61-3A-3(b) SHOPLIFTING-2ND OFFENSE
61-3A-3(c) SHOPLIFTING-3RD OFFENSE

Trespass

61-3B-2 TRESPASS IN STRUCTURE, CONVEYANCE
61-3B-3(A) TRESPASS ON PROPERTY OTHER THAN STRUCTURE, CONVEYANCE
61-3B-3(B) TRESPASS ETC & DEFY ORDER TO LEAVE
61-3B-4 TRESPASS ON STUDENT RESIDENCE, FACILITY OF AN INSTITUTION OF HIGHER LEARNING

Vehicle Theft

17A-8-4(A) 1ST-(JOY RIDING) UNLAWFUL TAKING OF VEHICLE
17A-8-5 RECEIVE OR TRANSFER STOLEN VEHICLE(S)
17A-8-9 UNLAWFULLY POSSESS RENTED, LEASED VEHICLE

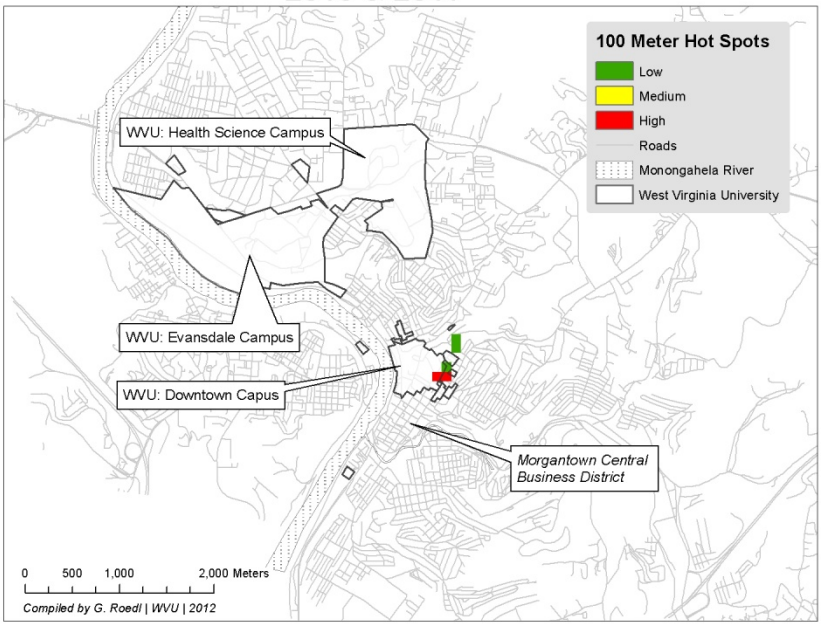
Weapons

61-3E-4 CRIMINAL USE OF DESTRUCTIVE, EXPLOSIVE, INCENDIARY DEVICE
61-7-11 BRANDISHING
61-7-11a(b) POSSESSION OF FIREARM ON EDUC FACILITY
61-7-3 1ST CARRY CONCEALED WEAPON W/O LICENSE

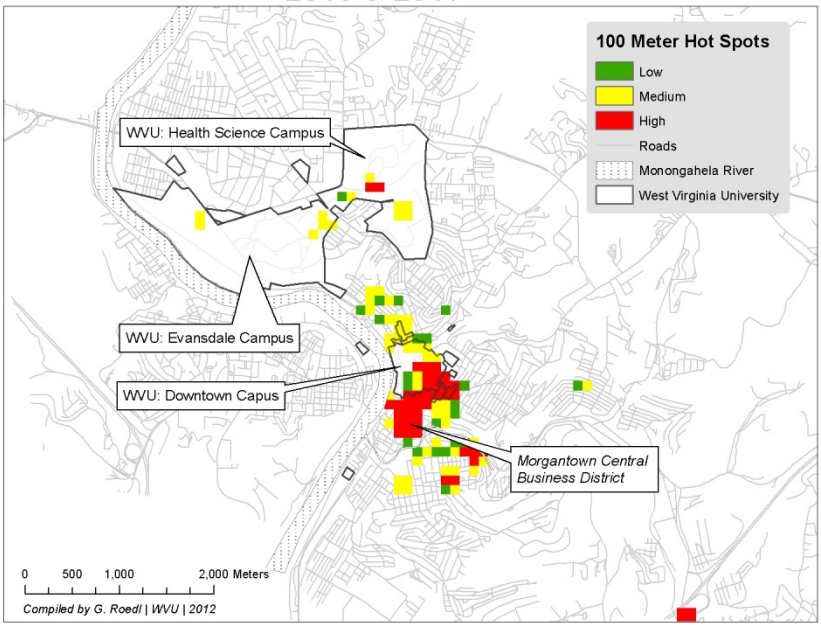
61-7-7 PROHIBITED PERSON POSSESS DEADLY WEAPON
61-7-7(B) PROHIBITED PERSON CONVICTED OF FELONY CRIME POSSESSING FIREARMS OFFENSE
61-7-8 1ST POSSESS DEADLY WEAPON BY MINOR
AIR GUNS AND SPRING GUNS
BRANDISHING DEADLY WEAPON
DISCHARGING FIREARMS
SHOOT ACROSS PUBLIC ROAD OR NEAR BUILDING OR CROWD
THROWING OR SHOOTING MISSILES
WANTON ENDANGERMENT W/ FIREARM

APPENDIX C: 2010-2011 Cross-Jurisdiction Kernel Density Maps

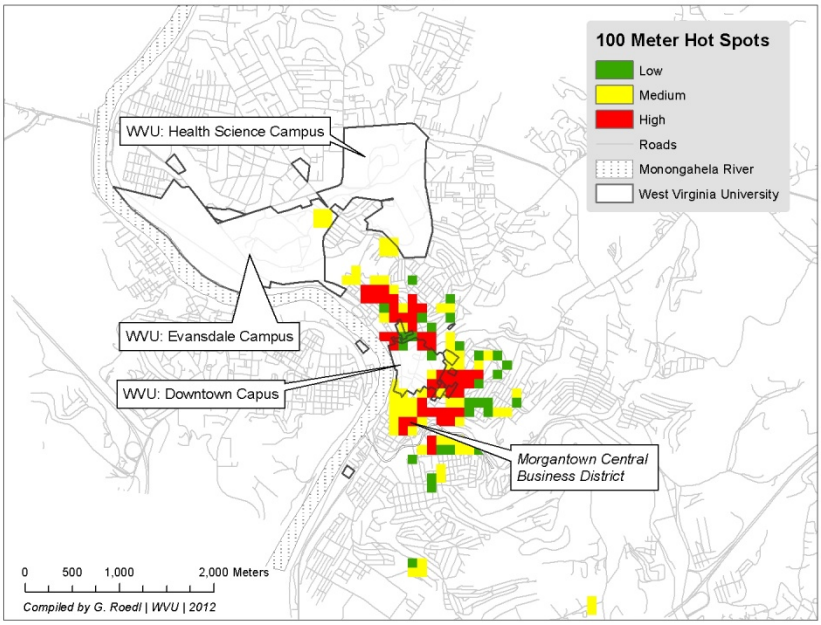
Arson
2010 & 2011



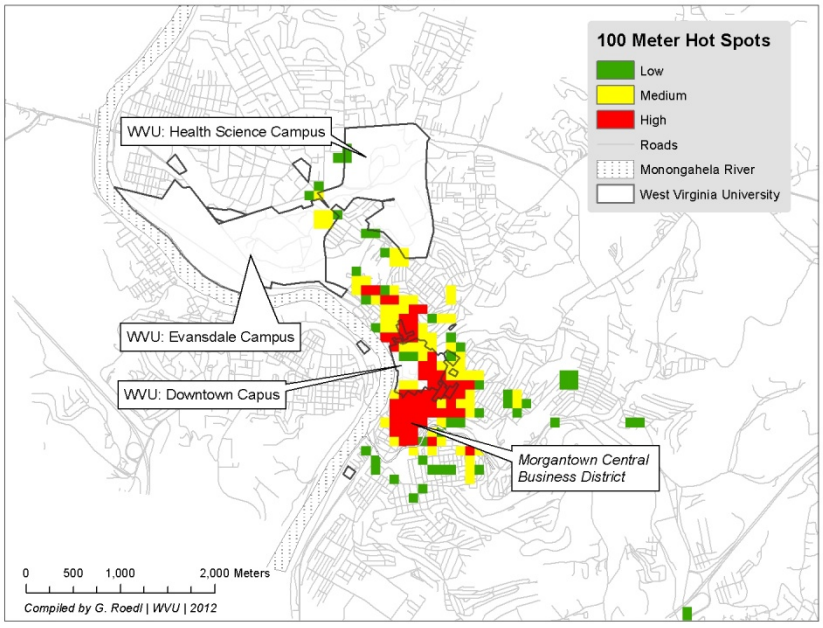
Assault
2010 & 2011



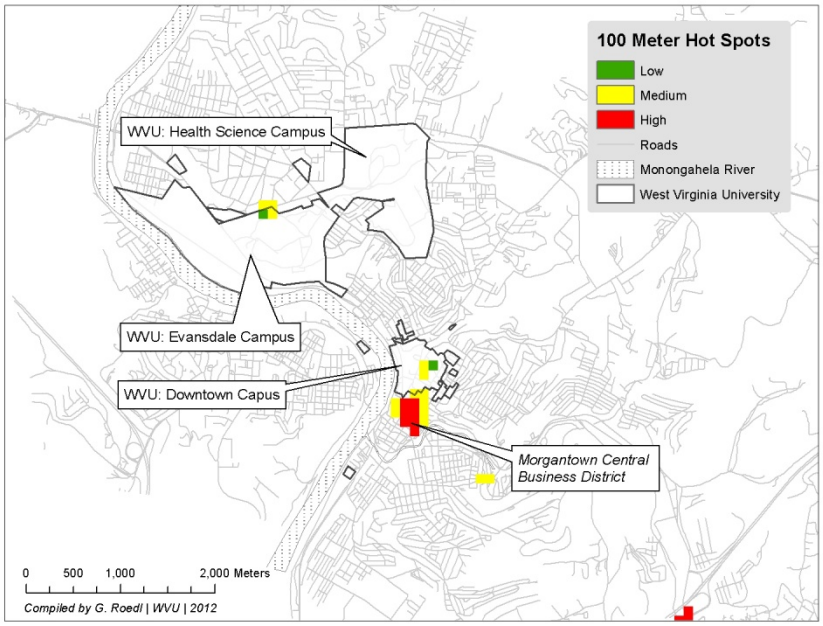
Burlary
2010 & 2011



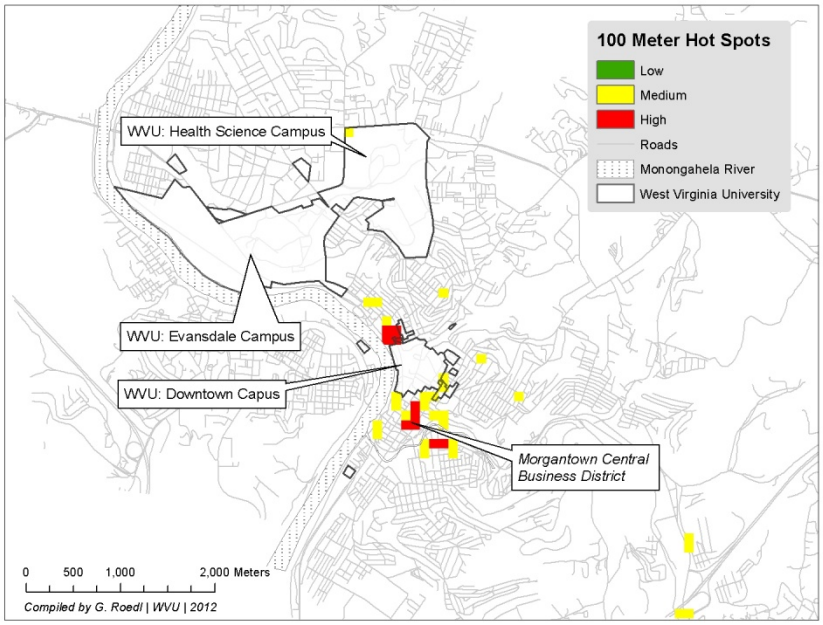
Destruction of Property
2010 & 2011



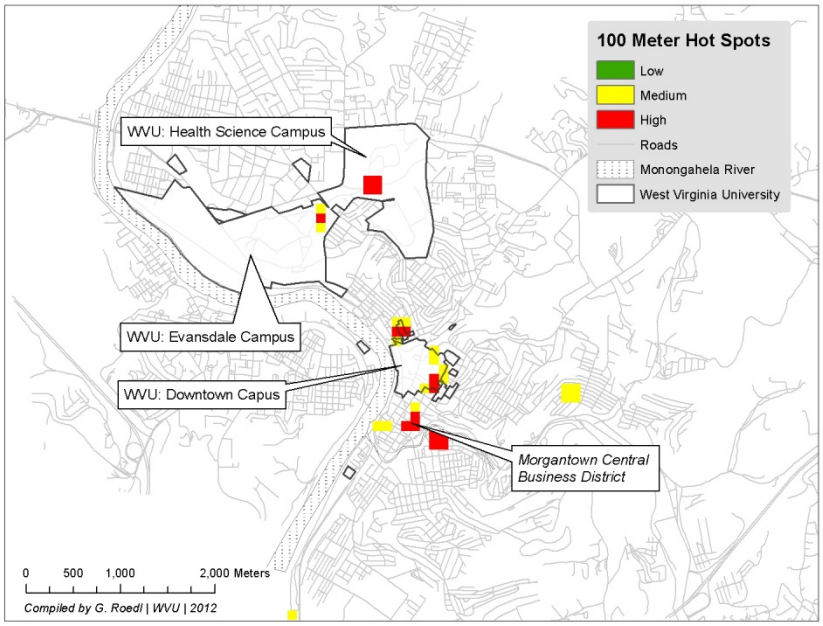
Forgery/Counterfeiting
2010 & 2011



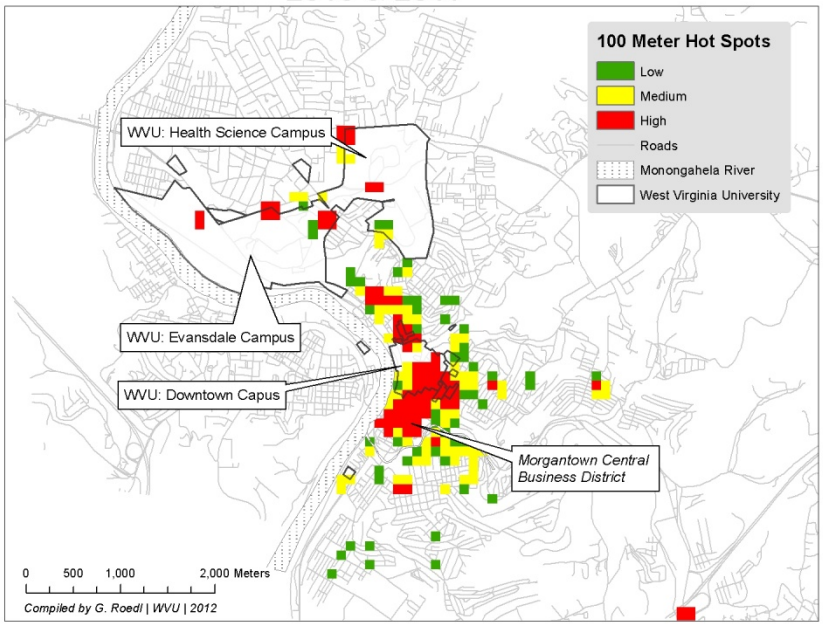
Robbery
2010 & 2011



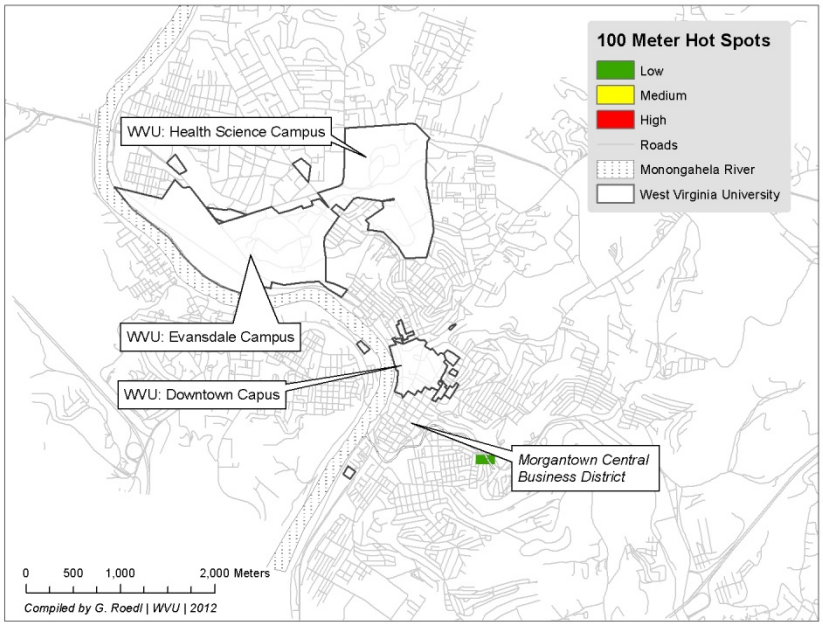
Sexual Assault
2010 & 2011



Theft
2010 & 2011



Vehicle Theft
2010 & 2011



APPENDIX D: Additional Knox Space-Time Interaction Test Results

Results of Two Day/100 meter Bandwidth

	WVUPD			*MPD*			*WVUPD & MPD*		
Offense	**n=**	**Observed**	**Expected**	**n=**	**Observed**	**Expected**	**n=**	**Observed**	**Expected**
Arson	5	0	0	15	1***	0.07619	20	1***	0.0632
Assault	170	37***	11.78643	602	99***	39.06446	772	140***	51.683
Burglary	30	7***	0.98851	535	109***	15.16172	565	116***	16.056
Destruction	232	33**	17.99507	1068	117***	56.23555	1300	162***	82.103
Disorderly Conduct	49	2	1.02381	286	51	43.63146	335	55	47.401
Drugs	445	203***	134.83875	278	96***	8.31161	723	299***	113.084
Drunkenness	367	142***	103.04814	366	75**	61.32291	733	222***	149.355
Embezzle	3	0	0	21	0	0.02381	24	0	0.018
Forgery	6	0	0	114	12***	3.24918	120	12**	3.591
Fraud	18	2***	0.36601	160	6**	3.29937	178	8*	3.633
Liquor	984	970***	743.29441	213	38**	21.34325	1197	1022***	727.506
Loitering	0	n/a	n/a	18	1***	0.23529	18	1***	0.23529
Other	172	29***	11.89909	591	129***	40.08769	763	164***	53.465
Robbery	5	0	0	65	0	0.20769	70	0	0.207
Sexual Assault	10	0	0	46	3***	0.31884	56	3***	0.338
Stolen Property	4	0	0	43	1***	0.06645	47	1***	0.074
Theft	402	84***	52.70208	1328	147***	94.06424	1730	244***	141.736
Trespassing	37	4***	0.60511	42	0	0.15679	79	4***	0.5297
Vehicle Theft	1	n/a	n/a	12	0	0.01515	13	0	0.01282
Weapons	3	0	0	63	3***	0.52483	66	3**	0.529

* p=0.1 **p=0.01 ***p=0.001

Results of Seven Day/100 meter Bandwidth

	WVUPD			*MPD*			*WVUPD & MPD*		
Offense	**n=**	**Observed**	**Expected**	**n=**	**Observed**	**Expected**	**n=**	**Observed**	**Expected**
Arson	5	0	0	15	1	0.34286	20	1**	0.2105
Assault	170	61***	28.3276	602	172***	115.69864	772	240***	150.325
Burglary	30	7***	1.28506	535	164***	41.66351	565	176***	44.109
Destruction	232	89***	49.18227	1068	226***	161.44047	1300	339***	233.819
Disorderly Conduct	49	6***	3.21769	286	113	105.94744	335	125	113.205
Drugs	445	473***	373.05387	278	98***	21.66239	723	571***	308.328
Drunkenness	367	273*	244.42258	366	164	155.45732	733	463***	375.608
Embezzle	3	0	0	21	1***	0.11905	24	1***	0.109
Forgery	6	0	0	114	26***	9.49371	120	26**	9.654
Fraud	18	2***	0.64052	160	16**	10.05157	178	18*	10.452
Liquor	984	2166***	1852.4558	213	69*	53.21393	1197	2277***	1868.452
Loitering	0	n/a	n/a	18	2***	0.5294	18	2***	0.5294
Other	172	50***	30.40072	591	210***	111.06742	763	279***	146.765
Robbery	5	0	0	65	0	0.56538	70	0	0.538
Sexual Assault	10	0	0	46	3***	0.75362	56	3***	0.805
Stolen Property	4	0	0	43	1***	0.23256	47	1***	0.21277
Theft	402	225***	147.13812	1328	365***	279.06114	1730	611***	420.629
Trespassing	37	4***	1.02402	42	2***	0.29617	79	6***	1.09056
Vehicle Theft	1	n/a	n/a	12	0	0.0303	13	0	0.02564
Weapons	3	0	0	63	4***	1.51152	66	4***	1.469

* p=0.1 **p=0.01 ***p=0.001

APPENDIX E: Data Archived at National Archive of Criminal Justice Data

1) ISACS is an ArcGIS data map package file (.mpk). This file contains all the data, but not the address geocoders, python scripts, or scratch geodatabase used by the python script

2) ISACS.zip is the complete project file which contains all the data in ArcGIS 10 file geodatabases form.

3) Shapefiles.zip contains standalone shape files used in the project for use in other GIS programs other than ArcGIS 10

4) Reported_crime.zip contains an Excel (.xls) spreadsheet of all crime incidents reported during the 2010-2011 study period. X and Y coordinates are projected in UTM zone 17N. This spreadsheet was used to generate the shapefiles contained in the shapefile.zip folder. Blank incidents are typically unfounded reports, such as a report of smell of drugs, or records which were later found to be incorrect, such as theft items which were later discovered to be not missing by the reporter. The 76 incidents with coordinates 0, 0 are unmappable to exact locations (unknown or too vague).

5) Documents.zip contains a copy of the Excel spreadsheet of all crimes reported during the 2010-2011 study period. In addition, keys to WV statutes and NIBRS codes are provided along with a spreadsheet listing which NIBRS code each WV state statute was assigned to when re-categorizing incidents.