# A Study of CPTED Principles and their Relationship to Crime Risk in Beaumont, Texas

By

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## DEDICATION

To my parents Allen and Leesa, and to Jessica, for your assistance, insight, and support.

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**TABLE OF CONTENTS**

**Page**

## TABLE OF CONTENTS (CONTINUED)

**Page**

## LIST OF TABLES

**Table** **Page**

## LIST OF FIGURES

**Figure** **Page**

## LIST OF FIGURES (CONTINUED)

**Figure** **Page**

## ABSTRACT

Crime Prevention Through Environmental Design (CPTED) is an approach to understanding crime which focuses on the built environment and geography instead of simply a potential offender's behavior or socio-economic characteristics. The theory of CPTED proposes that characteristics of the built environment can lower or increase the risk of crime at a location, based on the principles of Natural Surveillance, Natural Access Control, Territoriality, and Image. For this study, I investigated how CPTED characteristics had an impact on the property crime rate in Beaumont, Texas. I observed six Beaumont neighborhoods, and their houses and other buildings were rated according to an audit list I developed, consisting of 12 quantifiable CPTED characteristics based on the four principles. The houses and buildings of the six neighborhoods were rated by their individual parcels, according to a 0-4 based scale. These rated parcels were aggregated to a combined total of 134 residential blocks in ArcGIS, with each block being assigned the average of the CPTED ratings of the combined parcels. Maps of the six neighborhoods and their blocks were created which showed their vulnerability to crime, based on CPTED characteristic ratings. In addition to the CPTED vulnerability maps, I also developed maps which showed actual crime rates, which rated residential blocks within neighborhoods based on the number of crimes per 1,000 houses. The maps and spreadsheet data from the audit were used to determine the relationship of CPTED characteristics to crime rate. The research hypothesis was that neighborhoods that exhibit comparatively more CPTED characteristics will have fewer instances of crime than neighborhoods that exhibit fewer CPTED characteristics. The null hypothesis was that

neighborhoods that exhibit more CPTED characteristics will not show a significant difference in crime rate compared to neighborhoods with fewer CPTED characteristics. The data was collected by slowly traversing each neighborhood by car, and using high-definition video cameras to record each individual house. The recorded video was later played back, and the CPTED residential audit was completed for each house. Information from the audit was documented in a spreadsheet, and also entered into ArcGIS software in order to create the CPTED vulnerability maps. ArcGIS was also used to create crime rate maps, based on data from the Beaumont Police Department. The neighborhoods were ranked from highest CPTED rating down to lowest CPTED rating; and from lowest crime count to highest crime count, to see if there were similar rankings in which high CPTED rating is closely paired with low crime-count. In addition to the ranking method, the CPTED ratings and crime counts for each block of the six neighborhoods were also plotted on a graph, to determine if there is a valid linear regression in which crime rate is determined by the CPTED rating. The results show that the neighborhood with the highest CPTED rating had the second lowest crime density, and the neighborhood with the lowest CPTED rating had the highest crime density. The ranks of the neighborhoods according to CPTED rating and crime count show that there likely is some relationship between these two variables. A regression analysis shows that there is an inverse relationship ($y = -550.49x + 1254.5$) in which an increase in the CPTED rating corresponds to a decrease in crime rate per 1,000, with an $R^2$ value of .1805. The Spearman-Rho test indicates that there is a moderate correlation ($R = .447$) between CPTED rating and crime rate per 1,000, at the .05 significance level with a P value of 0.00000007. When looking at the CPTED rating maps of these neighborhoods alongside

the crime count maps, many values of blocks in the CPTED maps correspond to similar values in the crime count maps. This phenomenon can better be illustrated by determining where similar rank values in CPTED rating and crime rating "overlap." Although this process is more subjective compared to other methods, it is helpful in illuminating the areas in which the CPTED rating procedure most strongly predicted areas which are most at risk for crime, and which areas are most defended against crime. Even though this process of finding overlap was somewhat subjective, it was able to correctly predict 85 out of 134 blocks (63%) while the remaining 49 blocks (37%) do not show the relationship being sought, according to the hypothesis. The regression analysis and Spearman's test showed this relationship in a more objective manner than the maps, illustrating that crime rate falls as CPTED ratings rise.

## I. Introduction

There are several competing theories that attempt to describe the cause of crime. For many years, criminologists have looked at socio-economic factors, usually on the individual scale, to predict crime. These factors are important in understanding crime, but they do not adequately describe the totality of the phenomenon. Since the 1970s, a broad approach to understanding crime has emerged, known as environmental criminology. This approach emphasizes the built environment and geography, rather than an individual's behavior or socio-economic characteristics. Within the environmental criminology framework are two similar theories, Defensible Space Theory (DST), and Crime Prevention Through Environmental Design (CPTED). Both of these theories were developed in the early 1970s, and because they have been building off of each other, their principles overlap in several ways. The main points of both of these theories are that crimes are connected to locations, they are not randomly distributed, and most importantly, characteristics of the built environment can lower or increase the risk of crime at a location. Elements of CPTED and DST have been used to modify and improve communities and buildings, and these modifications have been shown in studies to reduce crime and make residents feel safer.

CPTED and DST principles can be applied to GIS in order to create predictive maps, which can illustrate the risk of crime in specific locations. If high-risk crime areas can be predicted based on these principles, then more resources can be placed in those areas, and residents can make appropriate changes to the spaces they are responsible for, in order to reduce the risk of crime.

Despite the existence of CPTED since the 1970s, it has never been used as an approach for crime analysis in Beaumont, which is widely considered one of the most dangerous cities in Texas. In this study, I observed six Beaumont neighborhoods, and their houses and other buildings were rated according to a list of CPTED characteristics, based on four basic principles. These principles are Natural Surveillance, Natural Access Control, Territoriality, and Image. The houses and buildings were rated according to their individual parcels, and then these rated parcels were aggregated to a combined total of 134 residential blocks in ArcGIS in order to create maps of vulnerability for crime, which were compared to actual crime data.

**Hypothesis**

The research hypothesis is that neighborhoods that exhibit comparatively more CPTED characteristics will have fewer instances of crime than neighborhoods that exhibit fewer CPTED characteristics. This was assessed by looking at the crime density of neighborhoods in terms of property crimes per 1,000 houses, and comparing these to the predicted CPTED vulnerability map. The null hypothesis is that neighborhoods that exhibit more CPTED characteristics will not show a significant difference in crime rate compared to neighborhoods with fewer CPTED characteristics.

## II. Background

Defensible Space Theory (DST) and Crime Prevention Through Environmental Design (CPTED) both are within the environmental criminology framework, and several of their principles overlap. While C. Ray Jeffery first coined the term CPTED and laid its foundational principles, Oscar Newman developed his similar Defensible Space Theory in the early 1970s. While Jeffery's work faded into obscurity, Newman's work received praise from other urban planners and criminologists, and eventually, he received government funding to test his Defensible Space principles by using them to revamp and modify government-assisted housing projects. Scholars as well as criminologists incorporated DST principles into Jeffery's CPTED theory, and with this, CPTED continued to evolve over the years with different criminologists publishing several books detailing the most up to date and complete theories and principles of CPTED. Eventually, CPTED came to be more associated with Oscar Newman rather than C. Ray Jeffery, even though Jeffery built its foundation. This is because Newman's idea of what constitutes the overall concept of "CPTED" was more closely linked to the built environment, while Jeffery's CPTED had more emphasis on sociological and psychological factors in addition to concern over the built environment (Crowe 1994).

CPTED has been evolving over the years, and it is shifting more toward emphasizing the physical environment instead of the "mental environment" that concerned Jeffery. The principles of the most updated form of CPTED have been used to improve residential communities, buildings, and other facilities all over the world, and have even been used as guidelines for new development projects. These principles are

Natural Surveillance, Natural Access Control, Territoriality, and Image (Crowe, 2013). Each of these four principles are equally important parts of CPTED that work in unison to reduce the crime potential of an area.

Natural Surveillance, as a concept within the framework of CPTED, is described as the ability for one location to be seen from another, and it is usually affected by lighting level, window visibility, and line of sight. Obstructions in front of windows and entrances lead to poor Natural Surveillance. Natural Access Control is a term used to describe the way in which movement is restricted or permitted within a boundary. This can be through barriers, or pathways such as walkways or roads. Not all access control barriers are hard, absolute barriers that prevent movement. Some are symbolic barriers, such as low level brick walls and hedges which delineate public and private space, and direct movement around these areas. Territoriality is described as the use of physical attributes that express ownership of an area. These are “personal touches” that promote social control and give cues that the area belongs to an individual or community who have taken an interest in the safety, security, and maintenance of the property. Examples of Territoriality include yard signs, flags, lawn decorations, landscape features, and porch or patio furniture. The fourth component of CPTED being observed in this study is Image, which describes the level of upkeep of an area, and it is meant to show that residents and the greater community have taken a sense of pride and interest in what happens in the area. This can simply be measured by the level of house as well as landscape maintenance and the overall tidiness of the area and lack of graffiti, litter, or trash.

## III. Literature Review

This study examines certain characteristics of the latest incarnation of CPTED and applies those characteristics to existing residential neighborhoods, in order to determine the influence of CPTED principles on crime. To best understand the most recent characteristics of environmental criminology and more specifically, CPTED, 22 relevant literature sources were studied which describe how CPTED and similar concepts have been applied to the real world, and how CPTED is evolving for future use. Among these are articles describing specific *Defensible Space* research, *CPTED* in general, as well as *Situational Crime Prevention*. All three of these bodies of literature belong to the broader category of environmental criminology theory. For simplification of this review, because there is so much overlap between DST and CPTED, studies which focus more narrowly on Territoriality and ownership of space will be grouped within the Defensible Space body of literature. The more broad, multidisciplinary studies, and studies which focus more specifically on surveillability, will be placed in the CPTED category, even though in modern times, Defensible Space Theory is considered to be a part of CPTED.

### Defensible Space

Credited solely to Oscar Newman, Defensible Space Theory was first built around two central principles: firstly, a "defensible space" should allow people to see and be seen continually and secondly,  people within a defensible space must be willing to

intervene when they see a crime occurring or report it after it occurs. These two principles increase the sense of security of areas within a community, and they encourage residents to take control of these areas and assume an ownership role. These principles proposed by Newman have their roots in the works of activist and journalist Jane Jacobs, author of *The Death and Life of Great American Cities* (Jacobs 1961). In this book, Jacobs described how the ideal neighborhood could be created, and she emphasized that the safest neighborhoods would have crowded, lively streets with people interacting with each other. Her "eyes on the streets" concept was very influential in the development of Defensible Space Theory, and much like Newman, she rejected the "new urban design" of the 1960s. She also believed that "crime flourishes when people do not meaningfully interact with their neighbors" (Jacobs 1961). Newman and Jacobs both agreed that it was important for there to be a clear demarcation of private and public space, and this idea became part of the "territoriality" factor of Defensible Space Theory.

Over the years, researchers have put Defensible Space Theory to the test in several case studies and experiments. By appropriating their near-home spaces, residents of a community can deter crime, as was shown in a study by Brunson et al (2001) which examined residents' willingness to intervene during a crime, as well as their level of awareness of their surroundings. The residents who showed a greater sense of ownership of space compared to other residents, were more likely to feel secure. This study, however, does not offer empirical evidence that the Territoriality described in Defensible Space Theory actually reduces the risk of crime and makes a community safer. Instead, this study only confirms that Territoriality in this instance improved peoples' *feeling* of safety. This does not refute DST, however, because much of DST is like a self-fulfilling

prophecy; community members that *feel* safer often *are* safer, because feelings of safety promote more community interaction, gatherings in communal areas, as well as community policing and “eyes on the street,” as Jacobs would call it. These behaviors do likely reduce the risk of crime.

Defensible Space does not always work in practice, especially when obstacles prevent space from being defended. In a particularly relevant study, Sally E. Merry (Merry 1981) demonstrated that even government housing facilities that show many characteristics of Defensible Space still have problems with crime. This was determined to be due to social factors, such as ethnic conflict and fear of retaliation overpowering Defensible Space factors by discouraging residents from intervening to stop crime, or preventing them from developing Territoriality traits.

Another study by Ned Levine and colleagues ( Levine 1986) determined that while many crime hotspots can be caused by social factors, some can be caused by environmental design factors. In this study, narrow sidewalks with small bus stops were subjected to overcrowding of waiting passengers. This limited the line of sight, from passenger to passenger, leaving them vulnerable to pick pocketing and purse snatching. This shows the importance of surveillability, a concept common to both Defensible Space Theory and CPTED. The lack of surveillability grants an offender the major advantage of anonymity.

Defensible Space Theory can also be used to describe traits that make specific locations more vulnerable to crime. Using DST as a guide, buildings and homes can be assessed and rated from most vulnerable to burglary to least vulnerable, as shown in experiments by Julia MacDonald and Robert Gifford (MacDonald 1989) as well as a

similar follow-up study by Kathleen Ham-Rowbottom (Ham-Rowbottom 1999). The earlier study showed that the most vulnerable homes were those that had a poor line of sight from other homes or from the street, meaning they had poor surveillability by DST standards. The "Territoriality" aspect that was also tested in this study was shown to have no affect on crime deterrence, which is contrary to DST principles. The later study showed nearly the same results. These studies are useful in answering the research question on whether or not CPTED and DST can be used to predict the crime risk of neighborhoods.

**CPTED**

While CPTED can be used to modify residential communities and individual buildings, it can also be used with modern technology and computer simulations to predict crime-vulnerable areas in order to make them safer. The concept of "Natural Surveillance" is common to both DST and to Jane Jacob's idea of "eyes on the street." It can best be described as the ability for one location to be seen from another, such as in the ability for an observer inside a building to be able to peer out a window to see the front door of the building across the street, or the ability of a pedestrian on a street corner to gaze into the windows of a gas station across the intersection. Natural Surveillance is a simple concept to understand, but it is hard to quantify. With advances in technology, spatial science, and new measuring techniques, more obscure concepts such as this are finally able to be measured. Simulations can be performed which place view arcs on certain points on a map, such as on a building's front door or window. These view arcs can calculate visibility and line of sight in relation to other structures, in order to create a

map showing “blind spots” of an area, which make that area more vulnerable to crime (Desyllas 2003). There are other methods that essentially do the same thing using different processes, such as mounting laser scanners to vehicles and taking measurements of the visibility index of an urban environment, as was done in a study by Hideto Tanaka (Tanaka 2007). These studies are in line with the theories of Oscar Newman and Jane Jacobs; showing that symmetrical street environments with evenly spaced buildings facing each other better accommodate natural surveillance than modernist, more freeform urban layouts do. The model developed by Desyllas in particular can be very useful in designing neighborhoods, buildings and other urban facilities according to the principles of CPTED.

GIS programs are being used to compare CPTED principles with crime patterns, although this methodology is still in its infancy, as it is finding its way into the “big data” framework. Some criminologists and other researchers are using GIS in order to create a positivist, empirical approach to policing, as opposed to the “gut feeling” traditional approach. GIS can be used to understand crime’s relationship to the environment, and instead of looking at crime at the suburb level, it should be analyzed more at the street level (Veenendaal 2000). Other uses of GIS are being discovered as well, such as building simulations to determine if access control modifications to a public place, such as a street closure, actually diminishes crime, or if these modifications simply displace crime to a new location (Winslow 2016).

For years, CPTED has only been described in writing or used to modify existing residential areas. Some urban designers in China are even proposing using CPTED principles to renovate and renew the oldest parts of cities (Liu 2014). More recent

developments in CPTED around the world involve designing buildings and entire cities from the ground up, using CPTED principles as a guide. This has shown promising results in crime reduction (Ha et al 2015).

**Situational Crime Prevention**

A third body of literature, similar to CPTED and DST, is Situational Crime Prevention (SCP). While CPTED and DST focus on the general environment that a crime might take place in, SCP is a new approach that focuses more on the specific target of the crime, which can be a person, place, or an object. This approach is also more focused on reducing opportunities for a crime to take place, instead of focusing on the anonymity and detection of an offender. SCP is more specific in its emphasis on types of crime than CPTED and DST are, and it is based on the concept of risk vs. reward.

The main guiding principle behind SCP is that "obstacles" should be in place around a target, which increases the potential offender's difficulty in reaching that target. These obstacles can be physical barriers, locks, gates, or people in positions of authority, as well as people simply at the right place at the right time, called "guardians" (Felson 1995). SCP closely examines the roles of "guardians" fulfilling specific roles, such as security guards tasked with watching over a parking lot, or managers working at a small store. The most important characteristic about these guardians is that they deter crime by diminishing a potential perpetrator's sense of anonymity, which is an important asset to criminals, according to CPTED and DST. If a potential perpetrator feels he or she will be identified while committing a crime at a certain area, they are less likely to target it (Welsh and Farrington 2009). Recent studies have shown, however, that while security

guards have proven effective in most situations, the effectiveness of guardians in the form of place managers is less understood, as there is little data on this topic (Welsh et al 2010).

SCP, along with a closely tied crime theory called Routine Activities Theory, places more emphasis on the victim or witnesses of a crime, rather than on the offender themselves. For victims, responsibility is placed more solely on them, in that they must take precautions to lower their risk of being targeted for a crime, such as hiding valuables left inside a car. Other components of SCP are "target hardening," such as placing locks on areas of entry, placing gates at all entry points into a facility or a community.

While CPTED and DST focus on the built environment more exclusively, there are some SCP proponents who want to integrate CPTED and DST into SCP, along with Routine Activities Theory. The motivation behind this re-conceptualization of CPTED and DST is that the routine activities model may have an impact on the Territoriality component found in DST (Reynald and Elffers 2009).

Most applications of CPTED have been focused more on the design stages of a building, commercial facility, or neighborhood. Some studies have been focused on intervening to modify the environments of housing projects or neighborhoods, following the principles of CPTED, in order to reduce the amount of crime. Few studies have used CPTED as a guideline to examine crime in residential neighborhoods which have not had any type of modification or intervention. The application of a CPTED based examination of Beaumont can help residents and policy-makers better understand why property crimes occur more frequently in some parts of town than in others.

## IV. Research Methods

### Study Area

Beaumont, Texas is a city within Jefferson County, and has a population of approximately 120,000. It sits on the Neches River and is in the southeast corner of the state, near the Louisiana border. Beaumont is a relatively small town with quite a rich history going back to 1835, and is best known for being home to the famous Spindletop oil well. However, it is also known to be one of the most dangerous cities in Texas, with a very high crime density. The murder rate in Beaumont is 13.57 per 100,000, the robbery rate is 248.52 per 100,000, and property crimes such as burglary are 49 per 100,000 (statistics taken from Houston-CriminalAttorney.com). According to City-Data.com, the average median household income for Beaumont, as of 2016, is $42,077. Forty-eight percent of the population is African American, thirty-three percent is white, fifteen percent is Hispanic, and five percent of the population is “other.”

### Methodology

While CPTED was developed for the purpose of building or modifying existing residential neighborhoods or housing facilities, the effectiveness of CPTED principles can still be tested in residential areas that happen to adhere to CPTED guidelines, even when the adherence is not intentional.

This project takes an empirical, positivist approach. It consists of testing CPTED characteristics within the categories of Natural Surveillance, Natural Access Control, Territoriality, and Image. Six different residential neighborhoods (consisting of a

combined total of 134 blocks) within Beaumont were selected for this study (**Figure 1** on page 14), all of which have a similar makeup of ethnicity, and the average median household income range for these neighborhoods is $35,000-$40,000. It is important to compare similar demographics in this study, in order to ensure the differences between the neighborhoods are more based on the structural environment, and less based on socio-economic factors. The neighborhoods and their information are as follows:

- Caldwood: $42,717 median household income, 53% white, 43% African American, 4% other.

- Sunnyside: $42,717 median household income, 53% white, 43% African American, 4% other.

- Washington Manor: $42,717 median household income, 53% white, 43% African American, 4% other.

- Gulf Terrace: $37,013 median household income, 47% white, 46% African American, 7% other.

- Mayfair: $38,625 median household income, 46% white, 39% African American, 15% other.

- Blanchette: $39,449 median household income, 38% white, 36% African American, 26% other.

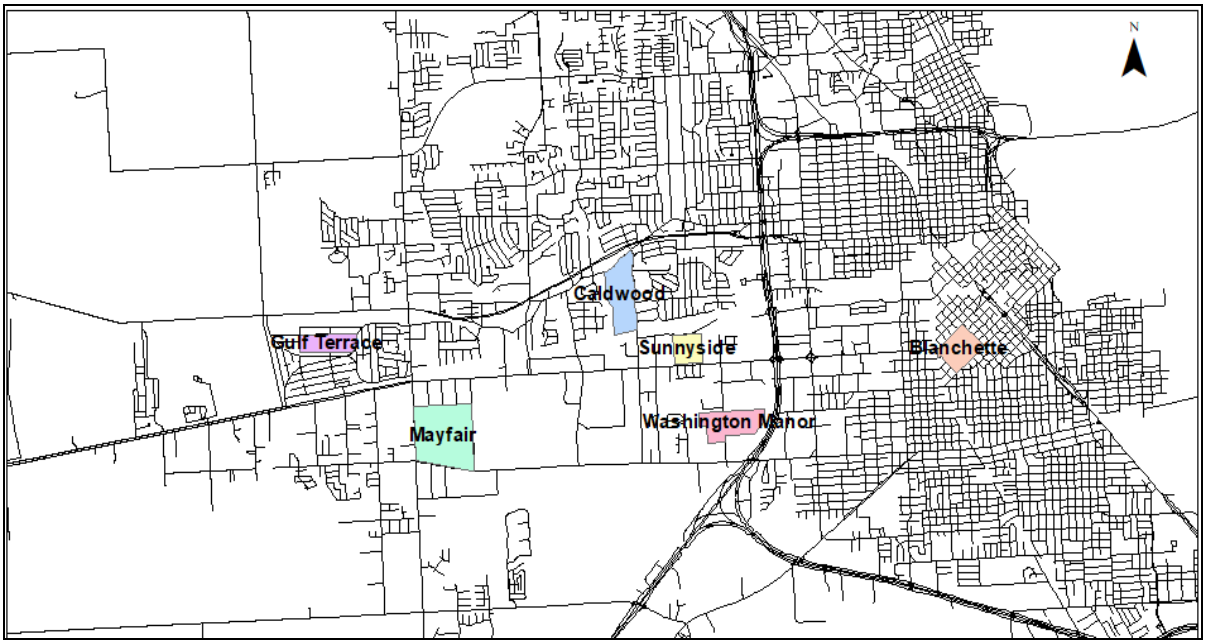


**Figure 1** Study area in Beaumont, Texas

A CPTED audit was developed with 12 measureable, quantifiable characteristics (**Table 1** on page 15). The audit has characteristics listed within each of the 4 CPTED categories of Natural Surveillance, Natural Access Control, Territoriality, and Image. It consists of a simple rating column for quantifiable characteristics of each house, based on a scale of 0-4, which were used to document observations about the individual houses within each neighborhood. The audit was then used to determine the overall defensibility (the ability to deter crime) of the neighborhood.

| | Rating (0-4) |
|---|---|
| **Natural Surveillance** | |
| Front of house has visible light fixtures w/ effective placement | |
| Windows and doors unobstructed | |
| Entrances clearly visible from street | |
| | |
| **Natural Access Control** | |
| Well maintained pathways (walkway/driveway) | |
| Visible alarm system sign | |
| Fence type | |
| | |
| **Territoriality** | |
| Personal touches/decorations visible | |
| Symbolic barriers/landscaping to delineate public/private space | |
| Front porch or benches/chairs to view street | |
| | |
| **Image** | |
| House adequately maintained | |
| Landscape adequately maintained | |
| Lot is free from visible debris, trash, and graffiti | |
| | |
| **Rating:** | |
| 0: Fail | |
| 1: Below adequate | |
| 2: Adequate | |
| 3: Above Adequate | |
| 4: Excellent | |
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**Table 1** CPTED residential audit

The CPTED residential audit was obtained by travelling to each of the six neighborhoods, slowly traversing each street by car, and using high definition video cameras on each side of the car to record footage of each house. The footage for each neighborhood was later played back and closely examined while the audit sheet was completed, and CPTED ratings in each of the four principles were recorded for each house. The audit works on a point based system, with the ratings for the characteristics as follows:

- 0: Failing. The CPTED characteristic is not present, or is very inadequate.
- 1: Below adequate. The CPTED characteristic is poorly executed or is barely visible.
- 2: Adequate. The CPTED characteristic is present, but is not to a very high standard.
- 3: Above adequate. The CPTED characteristic is present, and is well executed.
- 4: Excellent. The CPTED characteristic is present, and shows nearly perfect execution.

The above rating system was based on guidelines which can be found in **Table 4** on page 48. The recorded CPTED characteristics were chosen from careful review of literature focused on CPTED and Defensible Space. In theory, the four main components of CPTED, which are Natural Surveillance, Natural Access Control, Territoriality, and Image, work together to deter crime and to make residents feel safer. Each of the four components can be broken down into characteristics, which were measured in this study.

The component category of Natural Surveillance is described as the ability for one location to be seen from another, and it is usually affected by lighting level, window visibility, and line of sight. Obstructions in front of windows and entrances lead to poor Natural Surveillance. An adequate level of Natural Surveillance can be achieved by having well placed, unobstructed lighting fixtures to illuminate building entrances. The goal of lighting, according to CPTED, is to make an area unattractive to potential offenders, while making legitimate users feel safe and comfortable (Atlas 2009).

Another characteristic of Natural Surveillance is trimming vegetation such as bushes, shrubs, and trees. A typical rule, according to CPTED, is that bushes and shrubs should be trimmed down to 3 feet or lower, while tree canopies should be trimmed at the seven foot level, or higher (City of Virginia Beach, 2000). This ensures that windows and doors of buildings are not obstructed, and it also minimizes the footprints of shadows. It is also important that a residence has enough windows around the house, in order to effectively observe the street and the surrounding space, without any "blind spots." Natural Surveillance can also be achieved by using see-through fences, such as vertical wrought-iron fences or picket fences, instead of typical wooden plank fences or walls. Although chain-link fencing is considered "see-through," it is not as effective because potential offenders can easily climb it, and it also creates a feeling of "fortressing," which diminishes other aspects of CPTED such as Territoriality and Image.

Natural Access Control is a term used to describe the way in which movement is restricted or permitted within a boundary. This can be through barriers, or pathways such as walkways or roads. Not all access control barriers are hard, absolute barriers that prevent movement. Some are symbolic barriers, such as low level brick walls and hedges

which delineate public and private space, and direct movement around these areas (Crowe, 1994). Natural Access Control, in this study, is measured by several characteristics. Walkways or landscaping should direct visitors towards the entrance to a building, and away from private or dangerous areas. A home with a well maintained, solidly defined front walkway is more effective than a home without a front walkway, or with a poorly maintained or more obscurely defined front walkway, according to the Natural Access Control component of CPTED. It is also beneficial to have an alarm system installed in the home, with visible signage, so that potential offenders know that they do not belong there and that if they trespass, they are at risk of being caught. Walls or fences along properties can be beneficial in directing pedestrian traffic away from private areas, and keeping out potential offenders. This is most effective if the fence is "see-through," or if the wall is a low-level barrier of some sort, instead of a tall wall, hedge or other barrier, which can lead to the "fortressing" effect.

The third component of CPTED, Territoriality, is the use of physical attributes that express ownership of an area. These are "personal touches" that promote social control and give cues that the area belongs to an individual or community who have taken an interest in the safety, security, and maintenance of the property. Examples of Territoriality in this study include yard signs, flags, lawn decorations, and porch or patio furniture. At the larger neighborhood scale, this effect of Territoriality can be exhibited by having special landscape features or gates at the entrances to neighborhoods, such as large sign features or unique pavement (Crowe 1994). Territoriality can also be exhibited by having symbolic barriers to delineate public space from private space, such as small hedges, low-level fences, and other landscaping features. Another characteristic of

Territoriality being observed in this study is the presence of patios furnished with chairs and benches, to provide cues that the residence is cared for, that the area is being watched, and to extend the owner's influence out onto the street and other public areas. The presence of furnished patios will make residents and other community members feel safe and experience a sense of belonging. This will make potential offenders feel unwelcome, as they will develop a sense of being watched and will lose their feeling of anonymity (Newman 1996). The width of streets in residential areas can be a characteristic of Territoriality, as residents typically extend their influence and sense of ownership beyond their property and onto the edges of streets, where their cars would normally be parked. Residents feel responsible for what happens in the few feet of street space near the curb lining their property, while the central portion of the street is seen as being more "public space," without ownership. This is important, because with narrow streets, the entire street width takes on the influence, responsibility, and sense of ownership from residents, while the middle, more public part of the street is eliminated (Newman 1996).

The fourth component of CPTED being observed in this study is Image, which is the concept of upkeep of an area. This is meant to show that residents and the greater community have taken a sense of pride and interest in what happens within the area. This can simply be measured by the level of house and landscape maintenance, and the overall tidiness of the area and lack of graffiti, litter, and trash. This component of CPTED is very similar to the "Broken Windows Theory," as areas with vandalism and poor upkeep tend to be further targeted by crime, because the areas create a sense that no one is in control of the space, and no one cares about what occurs in that space (Ryan 2010).

Every house in each neighborhood was observed and rated according to these four CPTED principles and their characteristics. When each house was recorded in the audit, the total points were averaged for each neighborhood, with higher points signifying a more defensible neighborhood.

Although the residential CPTED audit was used to assign a rating for the neighborhood defensibility as a whole, it was also used to create a crime vulnerability map. Since each house is individually rated based on its total CPTED characteristic points, each house can be classified into groups of ratings. Within ArcMap, the parcels for each house were assigned different colors, based on the house's rating, to indicate vulnerability to crime. Higher rated houses, which show more CPTED characteristics, were given brighter colors, such as yellow, and lower rated houses were given darker colors such as red, to indicate these houses are more at risk for crime. The end result was a color-coded map made in ArcMap which shows each neighborhood's predicted vulnerable areas.

Another goal of this project was to develop an actual crime map of the study area, showing real crime concentrations instead of predicted risk areas. The overall objective was to compare the actual crime concentrations with the predicted vulnerability map to determine the correlation and to see if areas with high CPTED rating "overlap" on the map with areas which have low crime counts.

The Beaumont Police Department keeps a daily log of crime incidents online, which includes time of occurrence and address information. After obtaining logs from 365 days, the incidents were filtered down to show only property crimes such as burglary, theft, and vandalism. Because crime data only has block-level accuracy, the individual

parcels of each neighborhood needed to be assigned to their own specific blocks, and aggregated into block polygons. In order to compare crime at the block level to CPTED ratings at the block level, the same process was done for CPTED ratings as well. Instead of individual parcel ratings, the parcels were aggregated into blocks which contain the combined average CPTED ratings of each parcel. This process can be better understood by examining **Figure 2** below, and **Figure 3** on page 22.

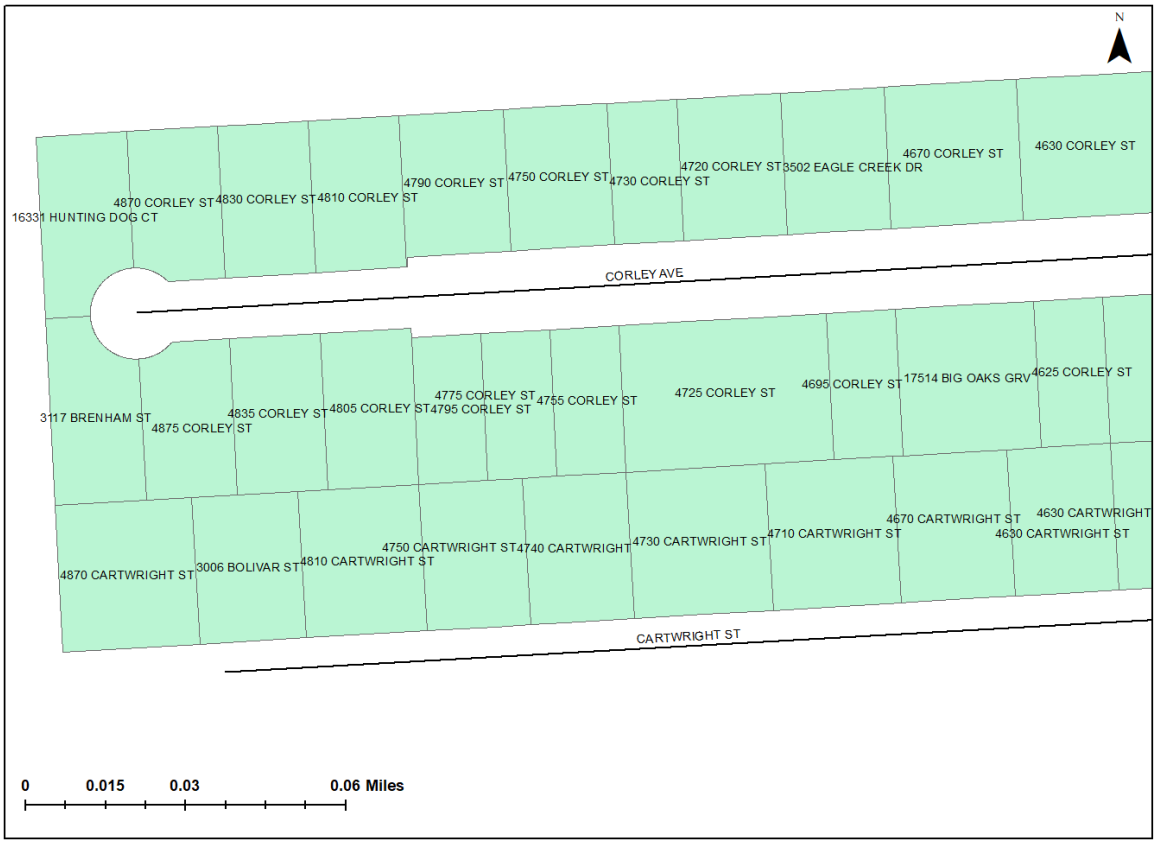


**Figure 2** Neighborhood Parcels

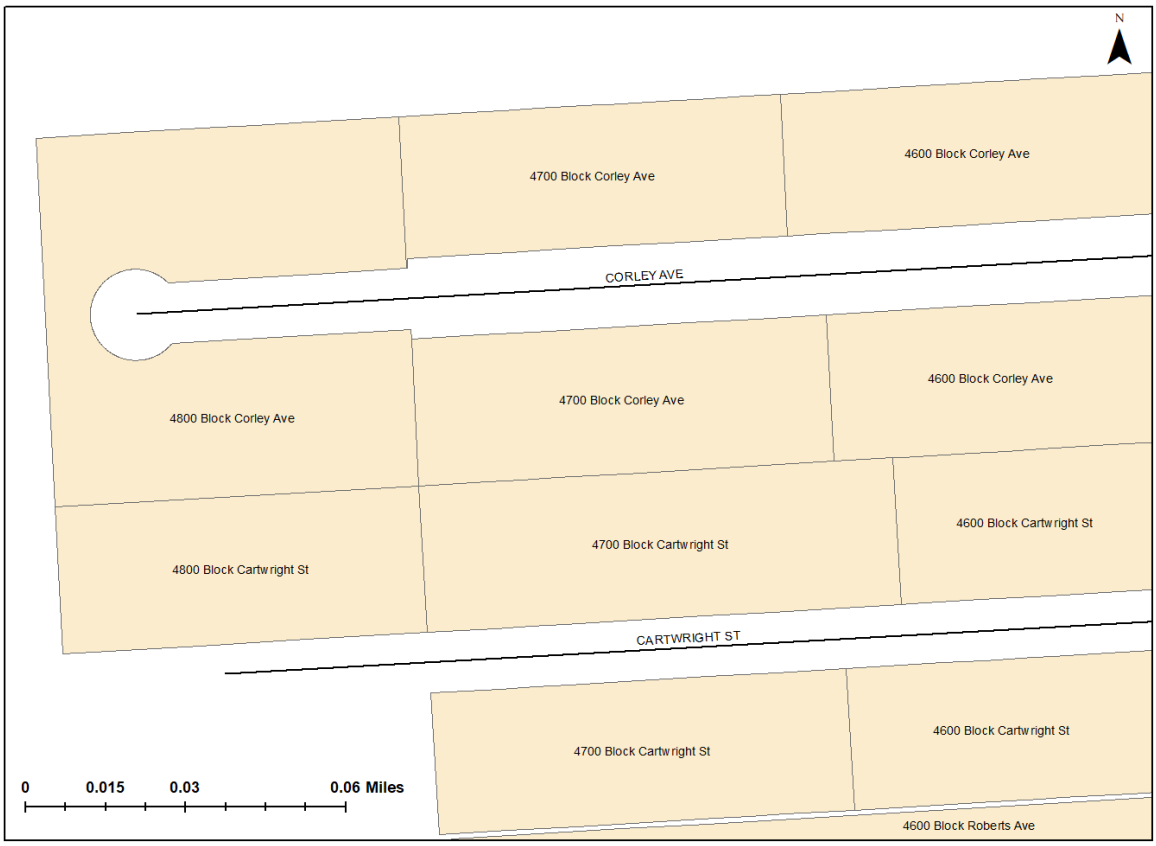


**Figure 3** Parcels aggregated to blocks

In the above figure, the lines between blocks represent divisions between address ranges, such as between the 4700 range of Corley Avenue, and the 4600 range of Corley Avenue.

Property crime incidents were plotted in ArcMap, in the form of point data. The points were then spatially joined to their appropriate blocks. The spatial join tool provided a crime count for each block, and the blocks were color coded based on the number of crimes, creating a crime concentration map. This crime concentration map was combined with the CPTED-based predicted vulnerability map, and selection tools were run to determine if the crime concentrations overlap with the predicted vulnerable areas within each neighborhood.

The overall crime rate for each neighborhood was calculated by dividing the number of crime incidents in each neighborhood by the number of houses in each neighborhood polygon, in order to determine the number of crimes per 1,000 houses for each neighborhood. When this was done, the neighborhoods were then ranked from highest CPTED rating down to lowest CPTED rating; and from lowest crime count to highest crime count, to see if there were similar rankings in which high CPTED rating is closely paired with low crime-count.

The CPTED ratings and crime counts for each block of the six neighborhoods were plotted on a graph, to determine if there is a valid linear regression in which crime rate is determined by the CPTED rating.

**Data**

Beaumont GIS data such as boundaries, roads, and other features were obtained from the City of Beaumont government website (http://beaumonttexas.gov/city-interactive-maps). Parcel data was obtained from Texas Parcel Data (https://www.texascountygisdata.com), and census block data came from Census.gov. Crime incident data is from the City of Beaumont Police Department daily crime bulletin log, which can be found at (https://p2c.beaumonttexas.gov/p2c/dailybulletin.aspx).

# V. Results

## CPTED Rating

The average CPTED rating for each neighborhood was determined, and the neighborhoods were ranked in order from highest CPTED rating to lowest CPTED rating. As can be seen in **Table 2** on page 25, the neighborhood with the highest CPTED rating was Caldwood, with a rating of 2.343. The second highest CPTED rating belonged to Washington Manor, which had a rating of 2.178. Gulf Terrace had the third highest CPTED rating, which was 1.884. Mayfair was ranked fourth, with a CPTED rating of 1.671. Blanchette was ranked fifth, with a CPTED rating of 1.598. The lowest scoring neighborhood was Sunnyside, which had a CPTED rating of 1.466.

## Crime Rate

The number of crimes per 1,000 houses was calculated from the crime count of each neighborhood, and the neighborhoods were ranked from lowest number of crimes per 1,000 houses, to highest number of crimes per 1,000 houses. The neighborhood with the lowest crime density was Washington Manor, with 46.980 crimes per 1,000 houses. The second lowest crime density was found in Caldwood, which had 59.829 crimes per 1,000 houses. Gulf Terrace has the third lowest crime density, with 79.545 crimes per 1,000 houses. Mayfair is ranked fourth, with 100.671 crimes per 1,000 houses. Blanchette is ranked fifth, with 346.405 crimes per 1,000 houses, and in the last rank is Sunnyside, with the highest crime density of 447.761 crimes per 1,000 houses.

| Neighborhood | Area (square miles) | Number of houses | Crimes | Crimes per 1000 houses | Crimes per square mile | CPTED rating |
|---|---|---|---|---|---|---|
| Washington Manor | 0.118180831 | 149 | 7 | 46.980 | 59.231 | 2.178 |
| Caldwood | 0.149563391 | 117 | 7 | 59.829 | 46.803 | 2.343 |
| Gulf Terrace | 0.079299286 | 176 | 14 | 79.545 | 176.546 | 1.884 |
| Mayfair | 0.275364814 | 149 | 15 | 100.671 | 54.473 | 1.671 |
| Blanchette | 0.093950455 | 153 | 53 | 346.405 | 564.127 | 1.598 |
| Sunnyside | 0.065891385 | 67 | 30 | 447.761 | 455.295 | 1.466 |

**Table 2** Neighborhood Crime Count/CPTED rating

**Relationship of CPTED rating rank to crime rate rank**

As can be seen in **Table** 2 above, the neighborhood with the highest CPTED rating, Caldwood, also had the second lowest crime density. The neighborhood with the lowest CPTED rating, Sunnyside, had the highest crime density. With the exception of Washington Manor and Caldwood, the neighborhoods' CPTED ratings correspond with the same ranks in crime density, as shown in **Table 3** below.

| Rank by crimes per square mile (lowest to highest number of crimes per square mile) | Rank by crimes per 1,000 houses (lowest to highest number of crimes per 1,000 houses) | Rank by CPTED rating (highest rating to lowest rating) |
|---|---|---|
| 1. Caldwood | 1. Washington Manor | 1. Caldwood |
| 2. Mayfair | 2. Caldwood | 2. Washington Manor |
| 3. Washington Manor | 3. Gulf Terrace | 3. Gulf Terrace |
| 4. Gulf Terrace | 4. Mayfair | 4. Mayfair |
| 5. Sunnyside | 5. Blanchette | 5. Blanchette |
| 6. Blanchette | 6. Sunnyside | 6. Sunnyside |

**Table 3** Neighborhood Ranks

**Map Observations by CPTED rating**

The CPTED rating system was based on a natural breaks classification, with 6 classes. The legend for this system is in **Figure 4** below. The lowest CPTED rating class was 0.582 - 1.165, and was assigned dark red. The next rating class was 1.166 - 1.500, which was assigned a lighter red. The next class was 1.501 - 1.729, which was assigned dark orange. The third highest rating class, 1.730 - 1.979, was assigned medium orange. The second highest rating class, 1.980 - 2.321, was given light orange. The highest rating class, 2.322 - 2.778, was assigned yellow.

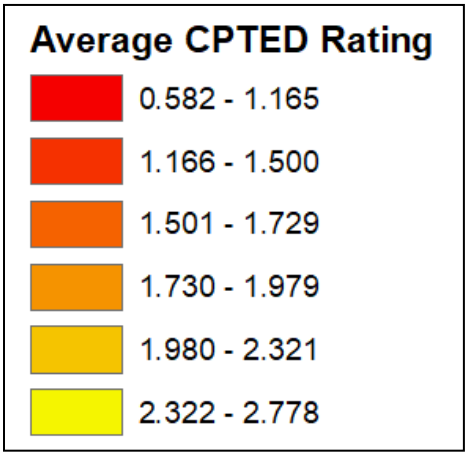


**Figure 4** CPTED rating legend

When looking at CPTED rating by block, many blocks in Caldwood are yellow, indicating a higher CPTED rating, between 2.322 - 2.778, as seen in **Figure 5** below. There are blocks composed of medium orange and light orange in the southern region of the neighborhood, indicating lower CPTED ratings (1.7-2.3).

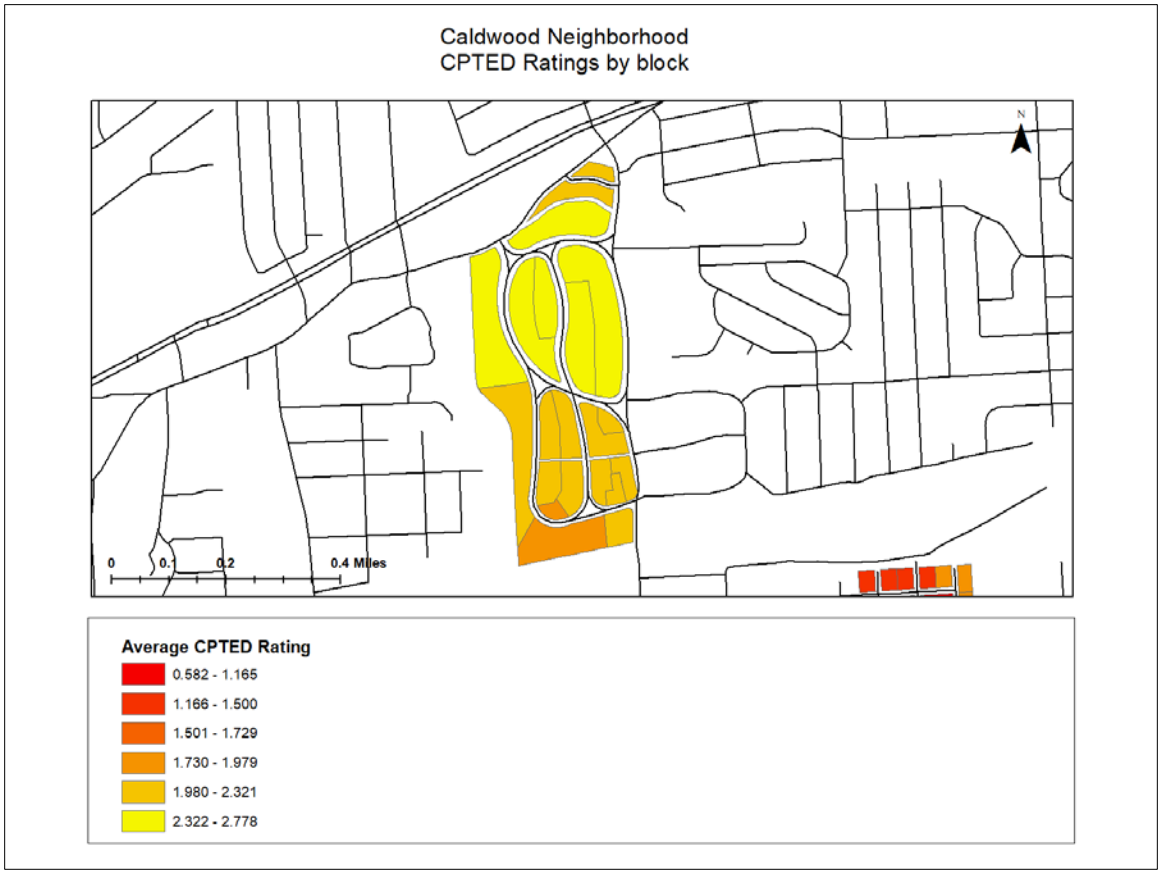


**Figure 5** Caldwood CPTED rating by block

Most of Sunnyside (**Figure 6**, below) is red or dark orange, indicating low to moderately low CPTED ratings (.58-1.5) although there are a few medium orange blocks (1.730 - 1.979) and one light orange block (2.195) scattered throughout. This neighborhood also has several empty lots.

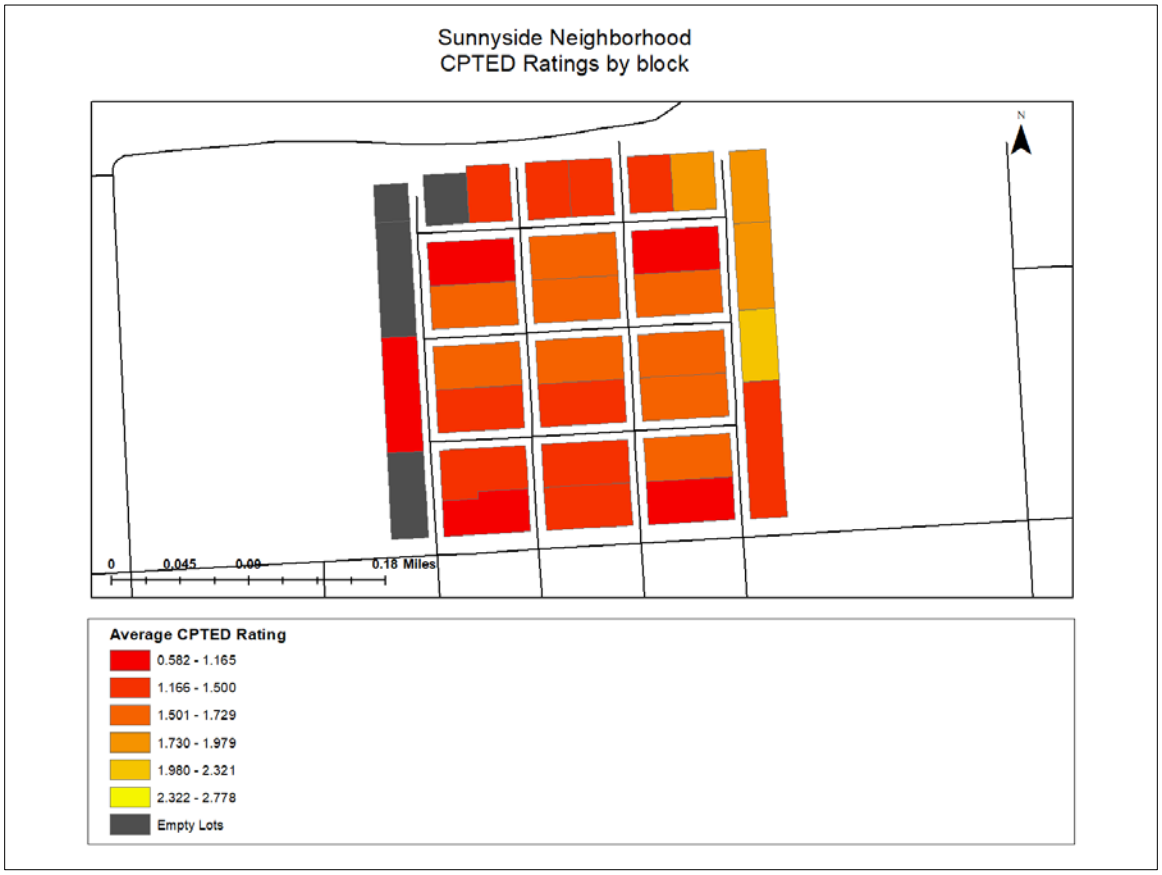


**Figure 6** Sunnyside CPTED rating by block

Washington Manor (**Figure 7**, below) is mostly light orange (1.980 - 2.321), with several medium orange and yellow blocks.

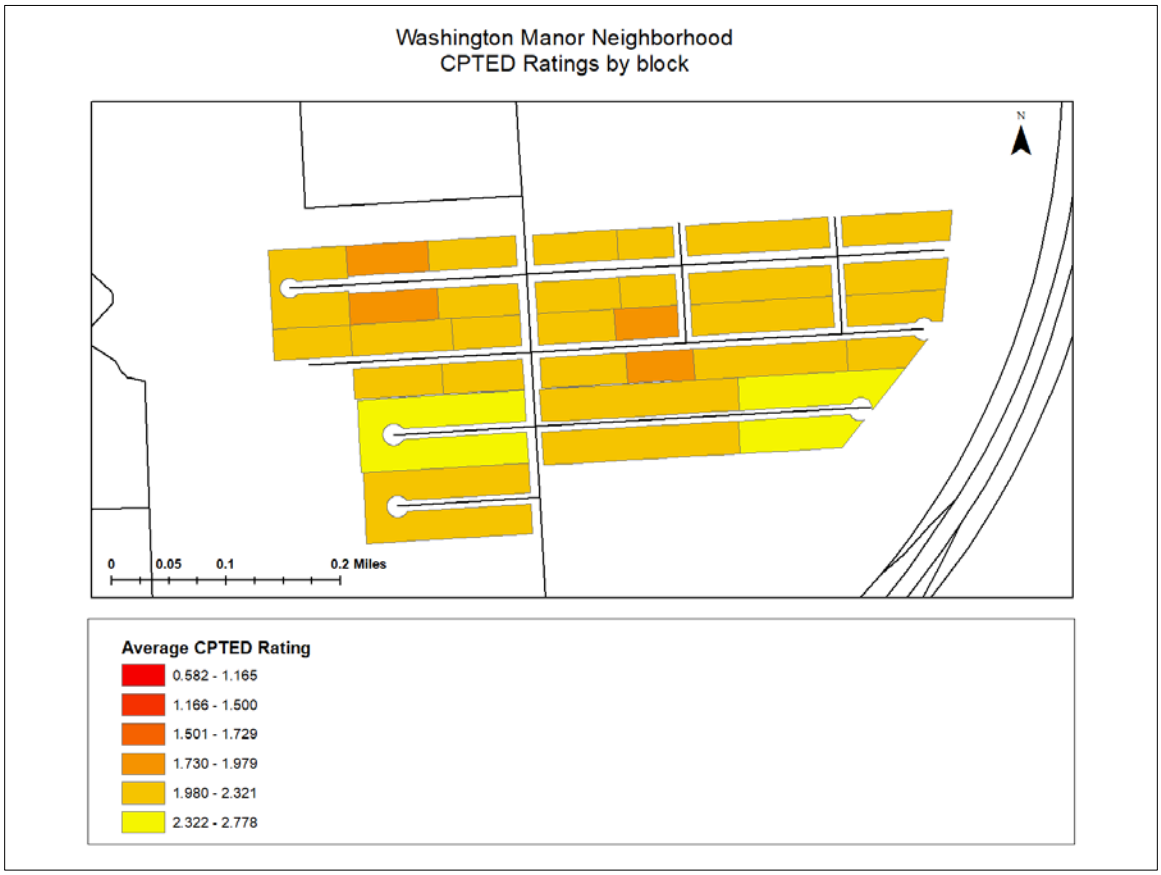


**Figure 7** Washington Manor CPTED rating by block

Gulf Terrace (**Figure 8**, below) contains many medium orange blocks (1.730 - 1.979), as well as a few dark orange blocks (1.501 - 1.729) and a few light orange blocks (1.980 - 2.321). There are only two yellow blocks (2.322 - 2.778).

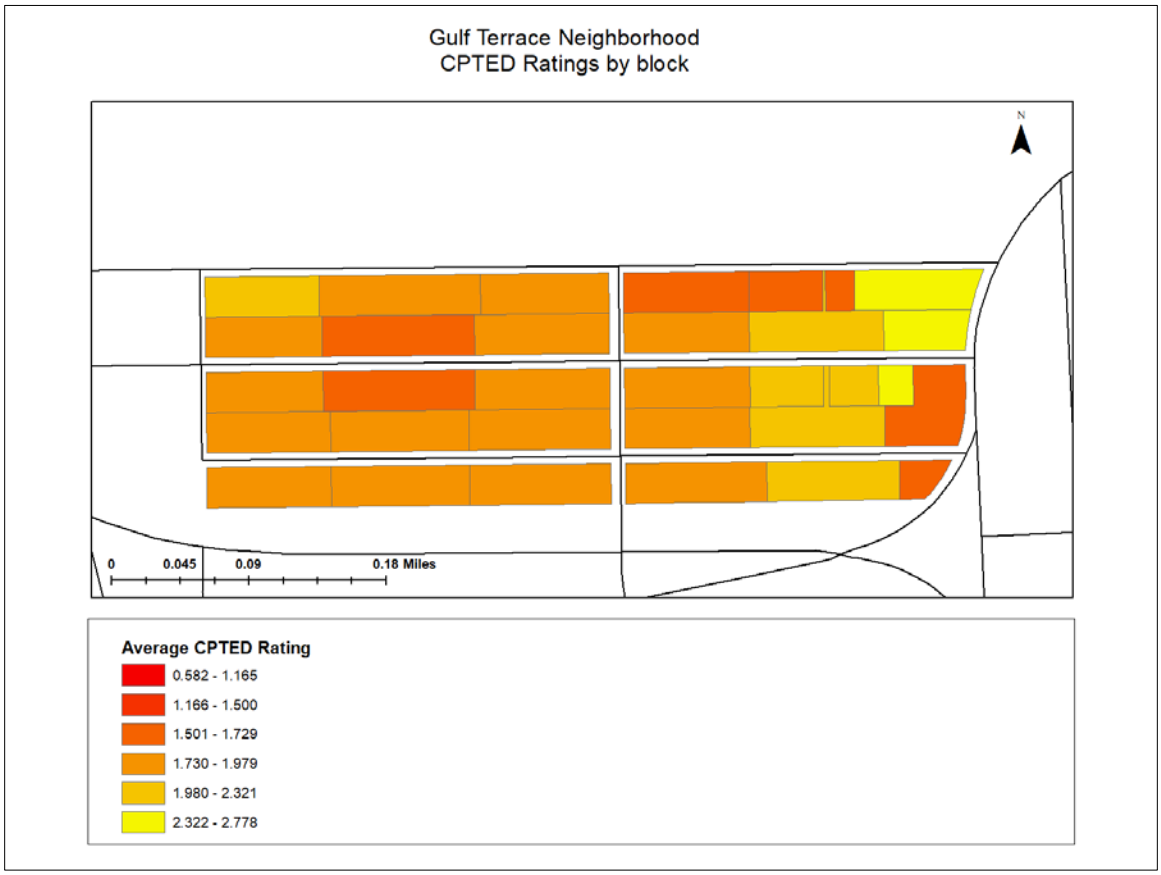


**Figure 8** Gulf Terrace CPTED rating by block

Mayfair (**Figure 9**, below**)** is mostly medium orange (1.980 - 2.321) and red (1.166 - 1.500), indicating moderately low CPTED ratings. Many of the red blocks are clustered in the middle of the neighborhood. There are several empty lots.

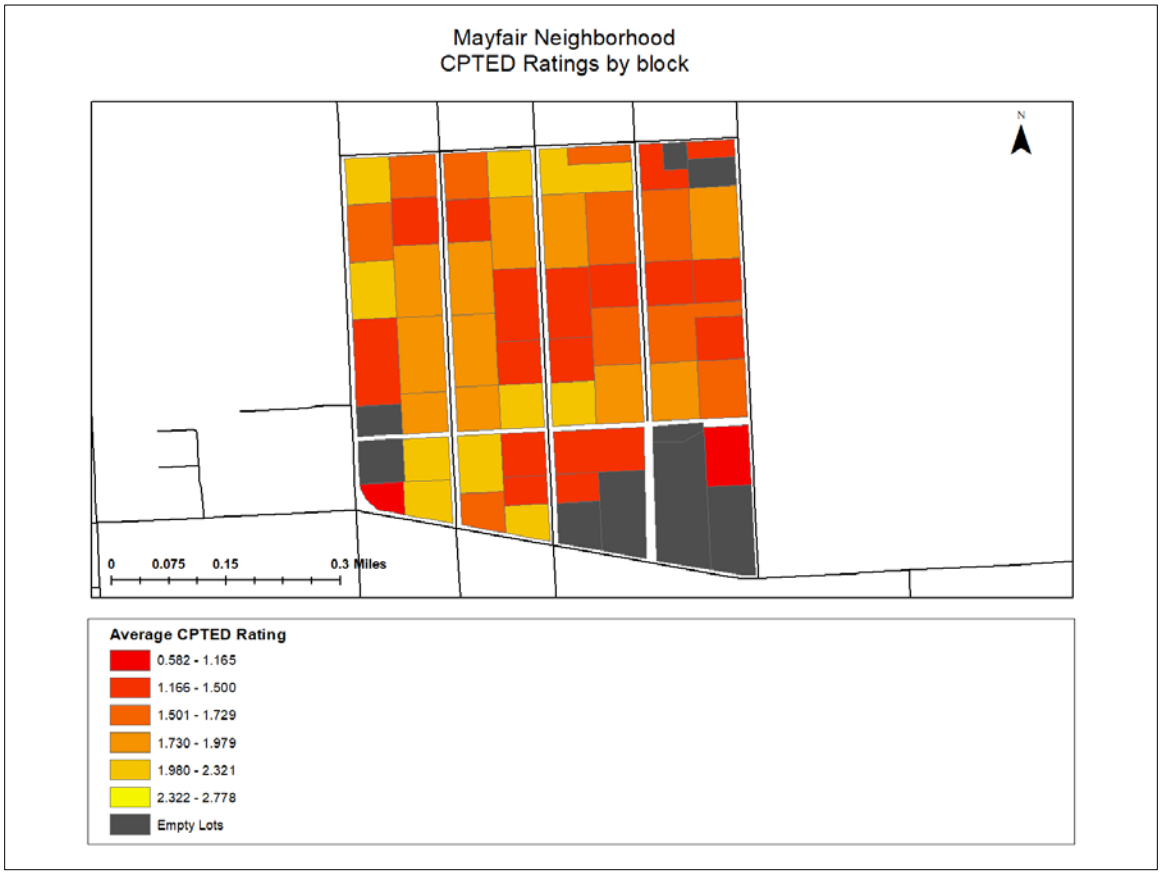


**Figure 9** Mayfair CPTED rating by block

The final neighborhood, Blanchette (**Figure 10**, below) contains mostly orange (1.730 - 2.321) and several red blocks (1.166-1.500). The lighter orange blocks are found toward the middle of the neighborhood, and the reds are found around the outer edges of the neighborhood.

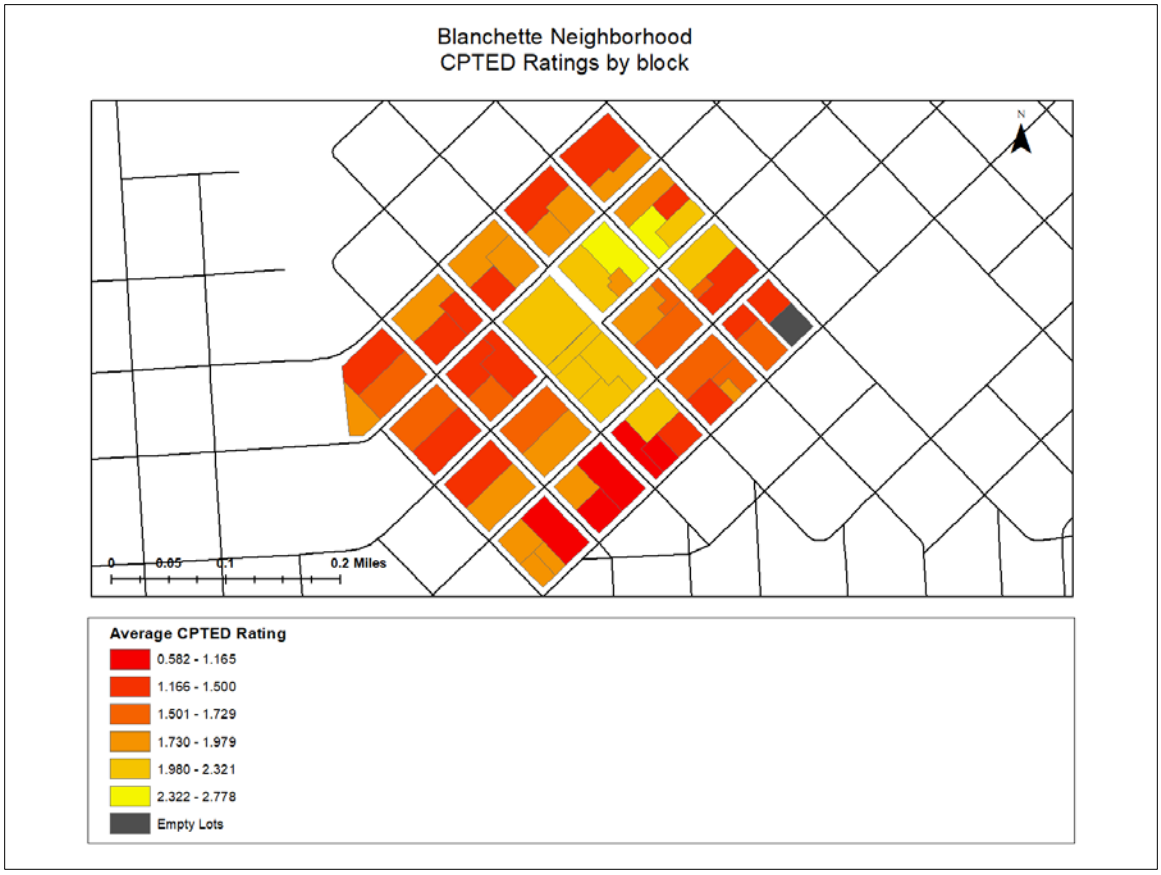


**Figure 10** Blanchette CPTED rating by block

**Map Observations by Crime rate**

The crime rate system is based on the number of crimes per 1,000 houses, and is broken down into 6 classes, with natural breaks, as can be seen in **Figure 11** below. The highest crime rate, 2001 – 3000 crimes per 1,000 houses, was assigned dark red. The next highest crime rate, 1001 – 2000, was assigned medium red. The third highest crime rate, 668 – 1000, was given dark orange. The next crime rate class, 376 – 667, was assigned medium orange. The second lowest crime rate class, 78 – 375, was given light orange. The lowest crime rate class, 0 – 77, was assigned yellow.

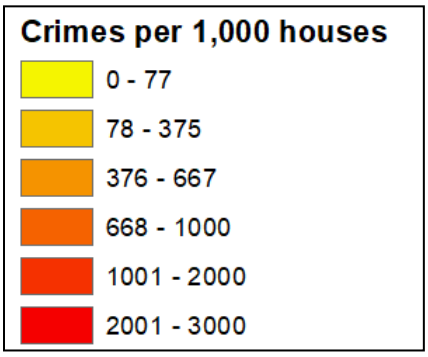


**Figure 11** Crime rate legend

Caldwood (**Figure 12**, below) only contains seven crimes total, which is 59.83 crimes per 1,000 houses. Most of the individual blocks are yellow, indicating a crime rate of zero to seventy-seven crimes per 1,000 houses.

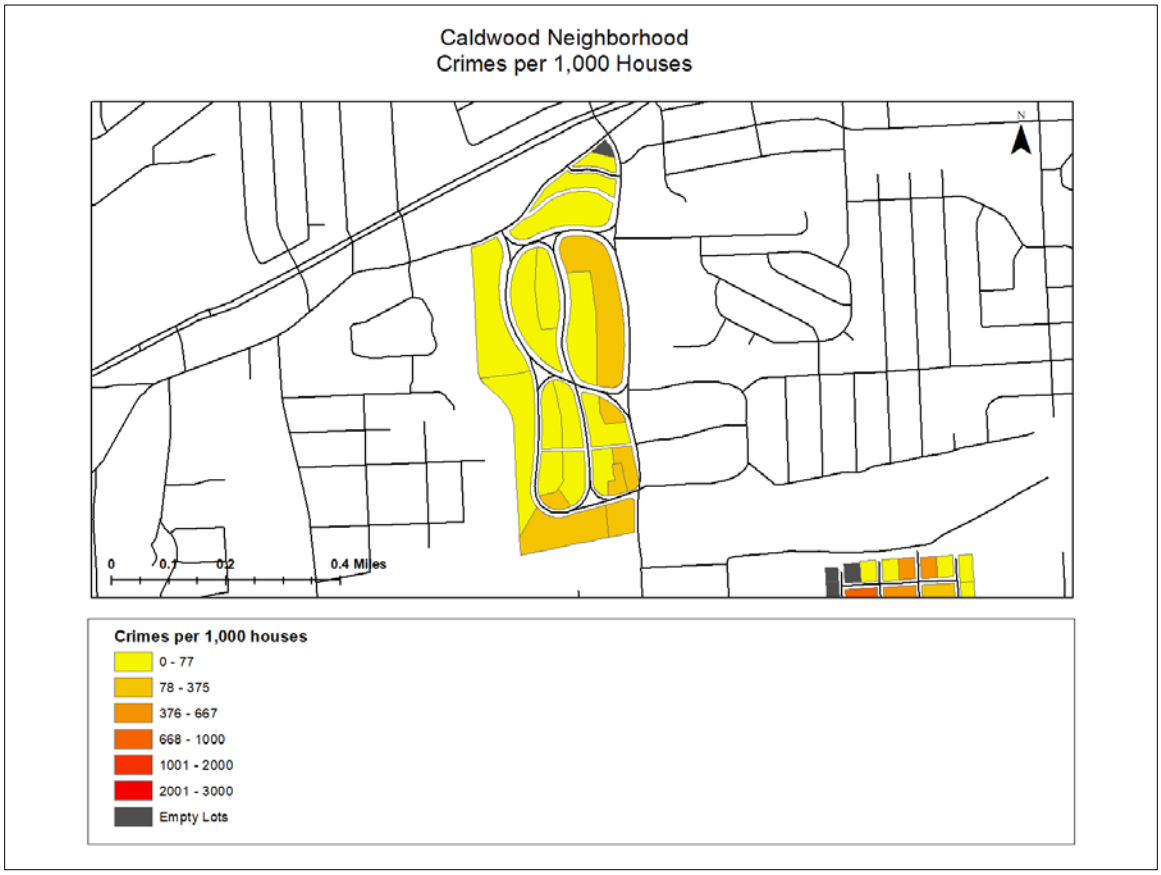


**Figure 12** Caldwood crime rate

Sunnyside (**Figure 13**, below) has a total of 30 crimes (447.8 crimes per 1,000 houses) and much of the middle region is yellow, indicating zero to seventy-seven crimes per 1,000 houses for these blocks. There are several orange blocks scattered around, as well as some red blocks.

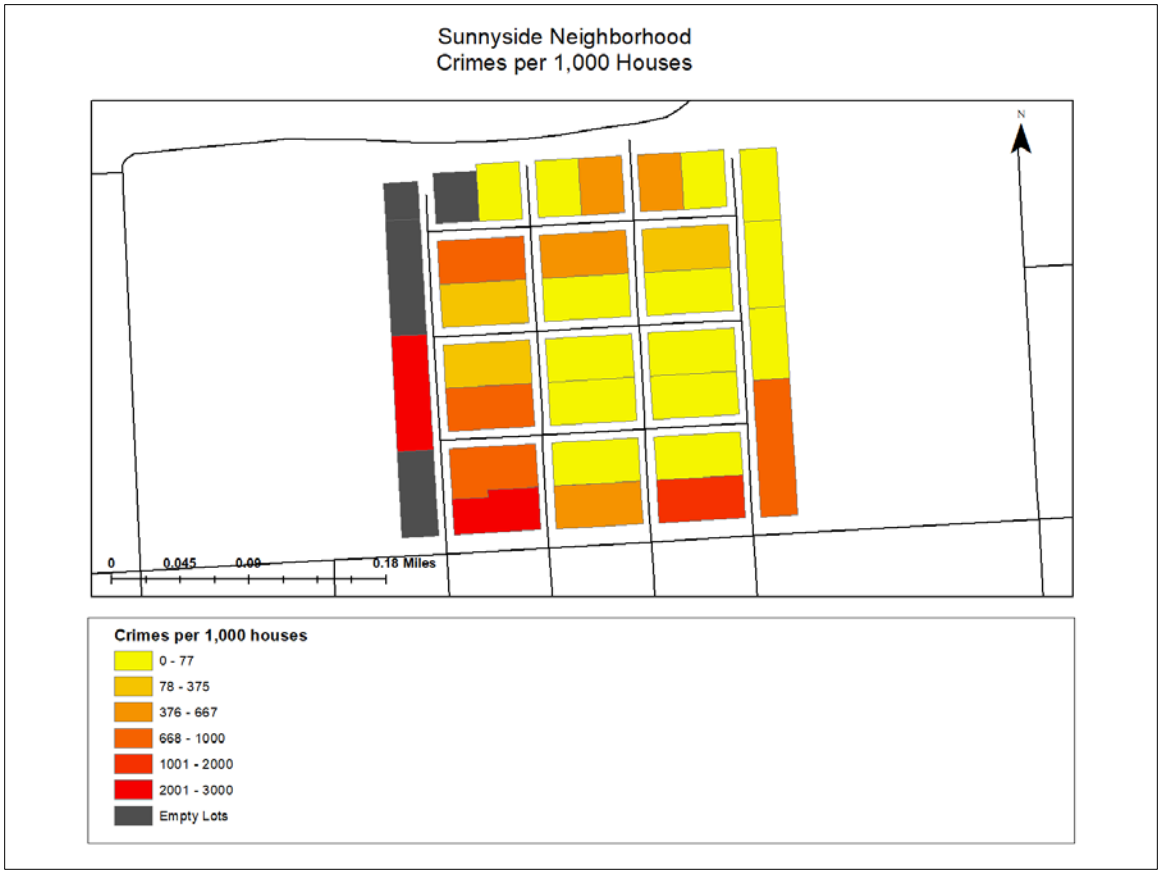


**Figure 13** Sunnyside crime rate

Washington Manor (**Figure 14**, below) has a total of 7 crimes (47 crimes per 1,000 houses), and appears mostly yellow throughout, meaning between zero and seventy seven crimes per 1,000 houses, for these individual blocks. There are a few light orange blocks (78-375 crimes per 1,000 houses) evenly spread throughout.

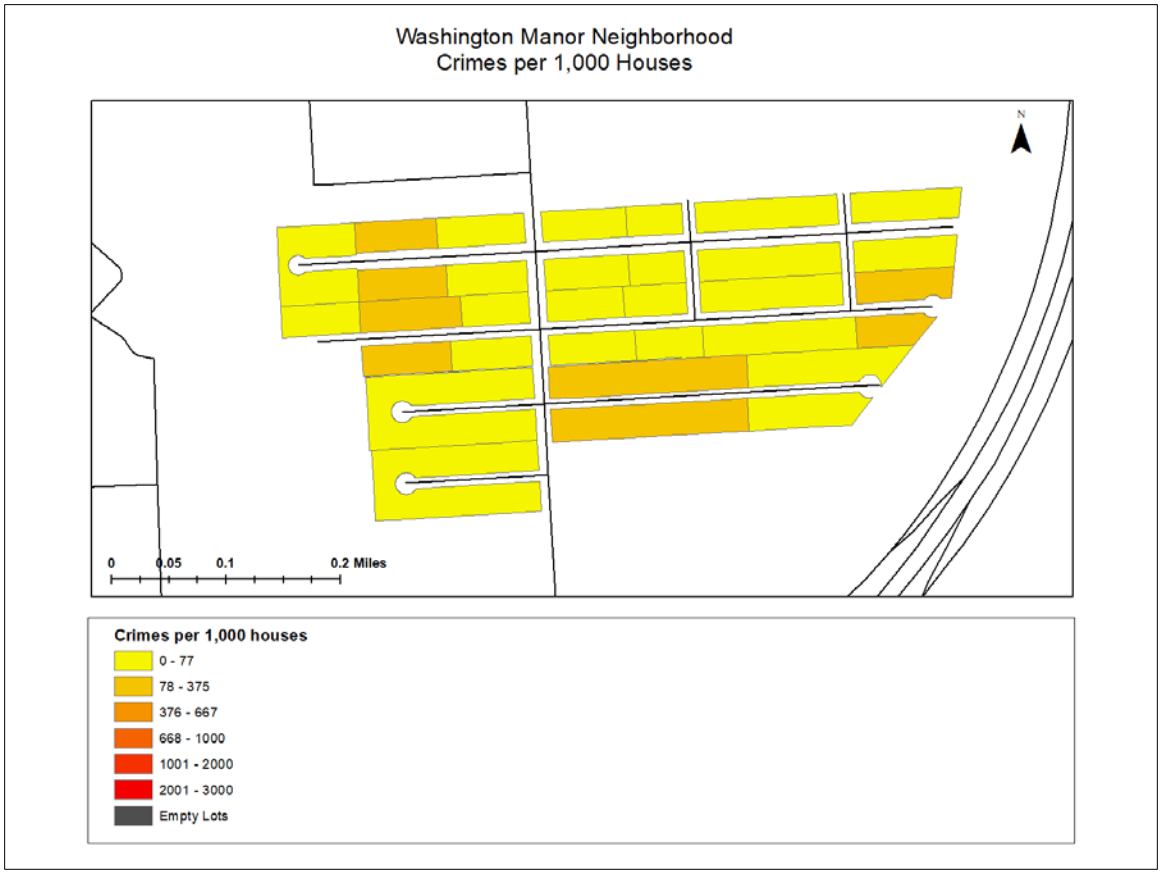


**Figure 14** Washington Manor crime rate

Gulf Terrace (**Figure 15**, below) has a total of 14 crimes (79.5 crimes per 1,000 houses), and appears mostly yellow throughout (0-77 crimes per 1,000 houses), with a few orange blocks.

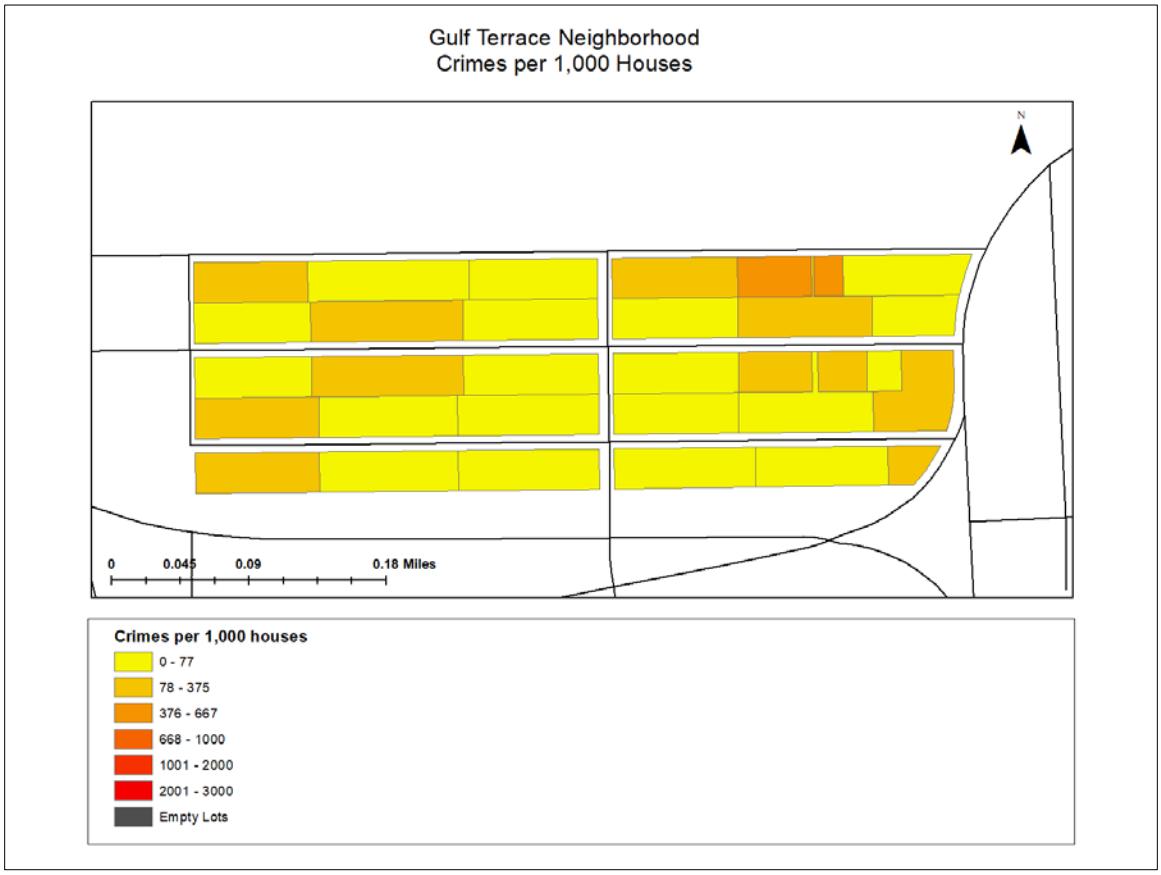


**Figure 15** Gulf Terrace crime rate

Mayfair (**Figure 16**, below) which contains a total of 15 crimes, (100.7 crimes per 1,000 houses) is mostly yellow indicating between zero and seventy-seven crimes per 1,000 houses. There are a few orange and red blocks spread throughout.

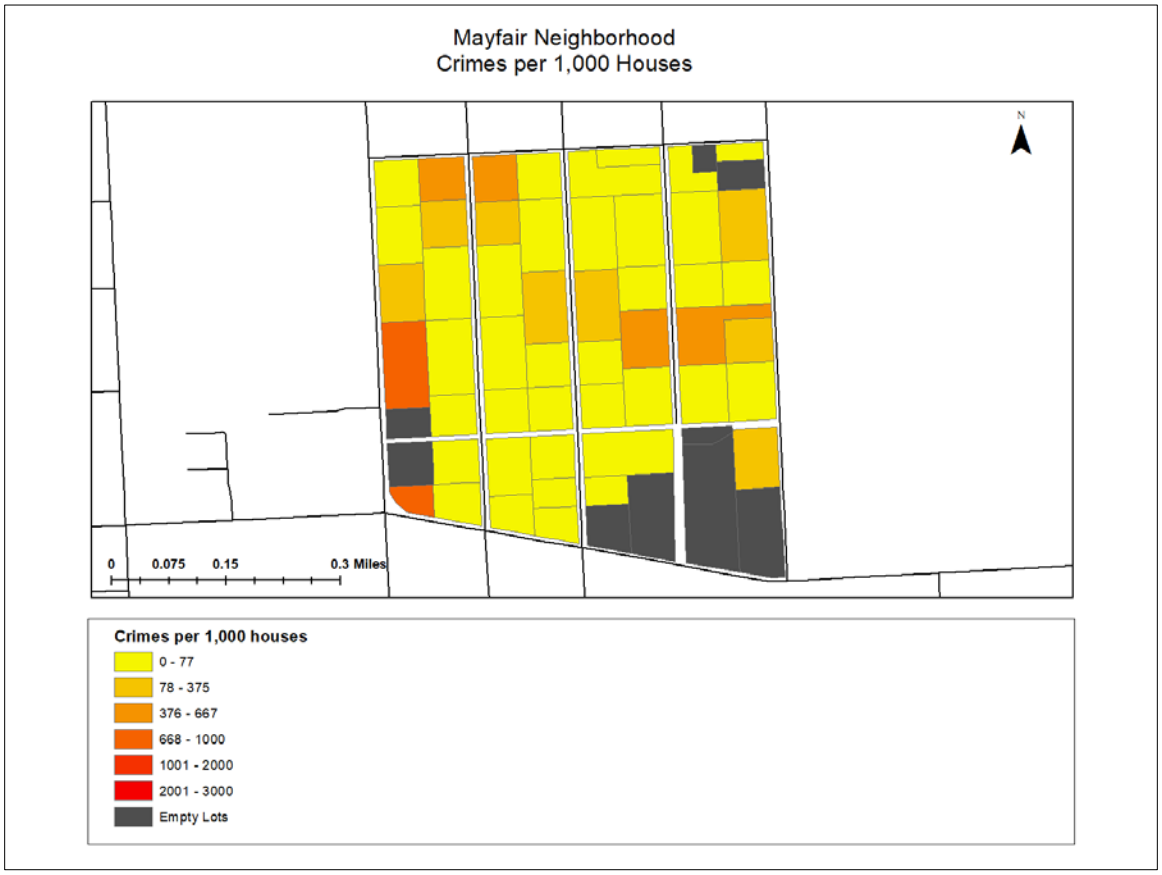


**Figure 16** Mayfair crime rate

Blanchette (**Figure 17**, below) has a total of 53 crimes (346.4 crimes per 1,000 houses). Most of the middle of the neighborhood is yellow, while it has dark red and medium red blocks, as well as light and dark orange blocks, near and around the perimeter of the neighborhood.

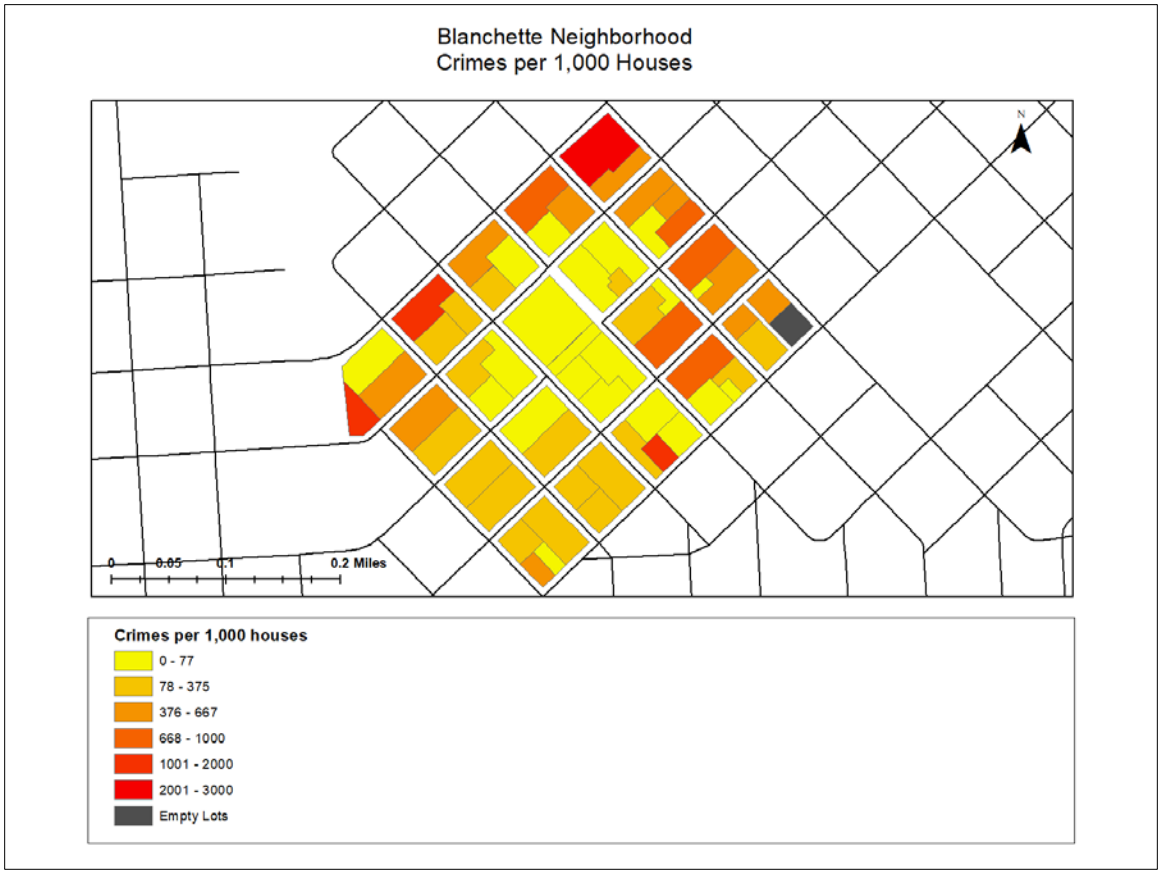


**Figure 17** Blanchette crime rate

**Analysis**

Out of the 134 neighborhood blocks, the CPTED ratings ranged from .583 to 2.778. The mean CPTED rating was 1.774, and the standard deviation for CPTED rating was .408. The crime rate per 1,000 houses ranged from 0 to 3,000. The mean was 277.5 crimes per 1,000. The Standard Deviation for crime rate was 529.007.

The distribution is not normal, and shows a negative monotonic relationship, although some outliers are present. A regression analysis (**Figure 18**, below) shows that there is an inverse relationship, (y = -550.49x + 1254.5) in which an increase in the CPTED rating corresponds to a decrease in crime rate per 1,000, with an $R^2$ value of .1805.

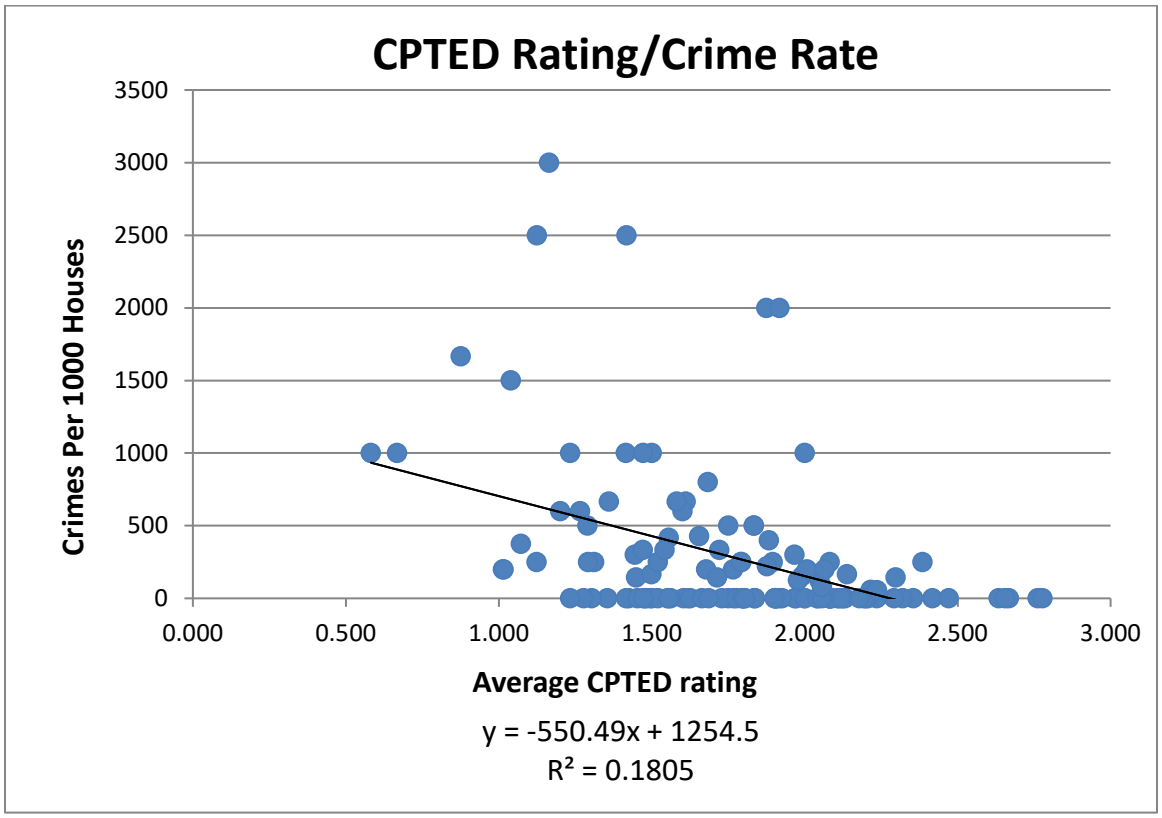


**Figure 18** CPTED rating/crime rate regression

Furthermore, the Spearman-Rho test indicates that there is a moderate correlation (R = .447) between CPTED rating and crime rate per 1,000, at the .05 significance level with a P value of 0.00000007.

## VI. Discussion

The ranks of the neighborhoods according to CPTED rating and crime count show that there likely is some relationship between these two variables. When looking at the CPTED rating maps of these neighborhoods alongside the crime count maps, we can see that many values of blocks in the CPTED maps (i.e. light oranges and yellows) correspond to similar values in the crime count maps, although they are not always the same shade. For example, when comparing the CPTED rating map for the neighborhood of Blanchette (**Figure 10**, page 32) with the crime rate map for Blanchette (**Figure 17**, page 39), we can see that the middle of this neighborhood contains mostly light orange blocks in the CPTED map (denoting a moderately high CPTED rating), and contains many yellow blocks in this area in the crime count map (denoting a very low crime count).

This phenomenon can better be illustrated by determining where similar rank values in CPTED rating and crime rating "overlap." Although this process is more subjective compared to other methods, it is helpful in illuminating the areas in which the CPTED rating procedure most strongly predicted areas which are most at risk for crime, and which areas are most defended against crime.

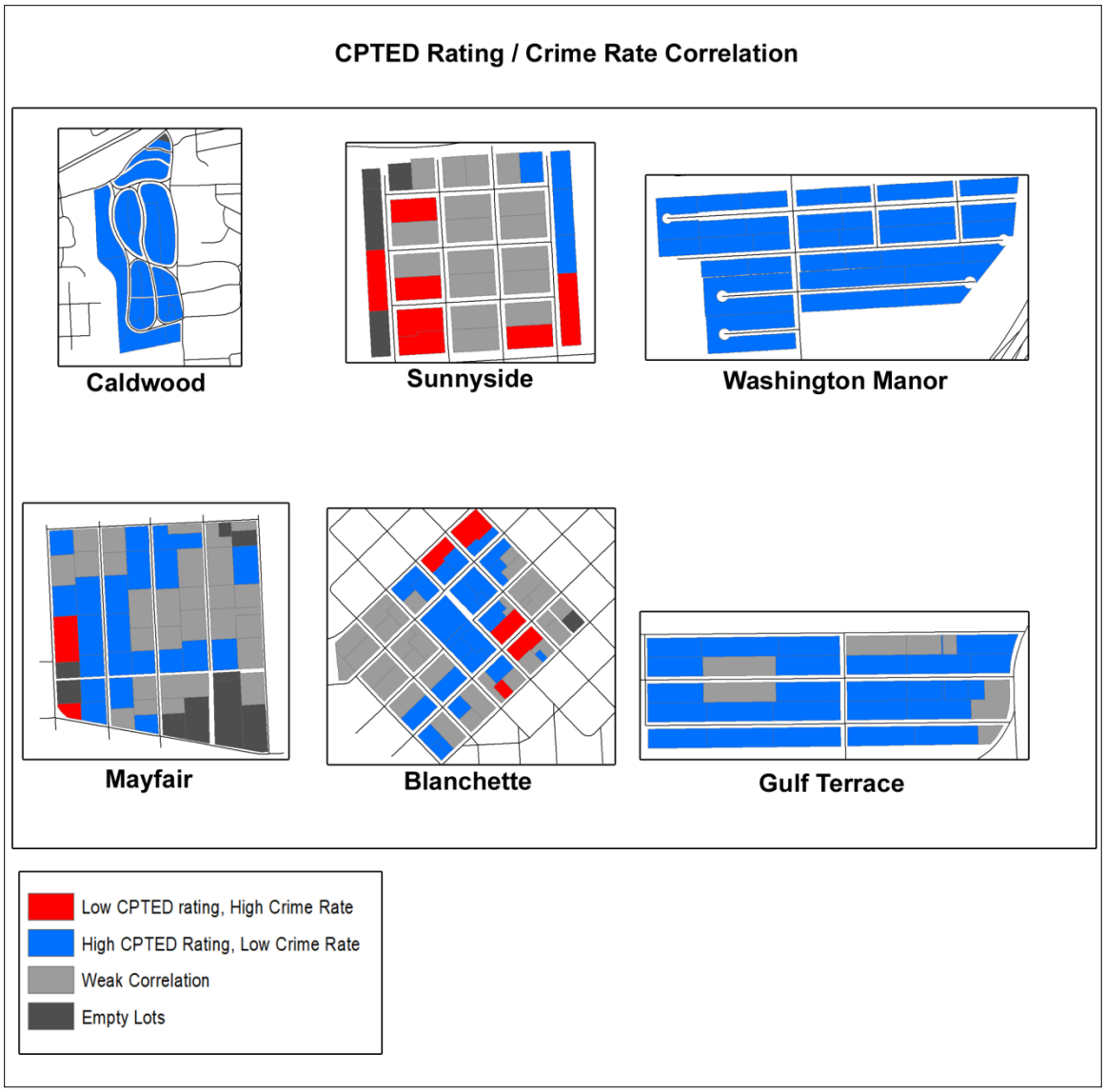


**Figure 19** CPTED rating/crime rate correlation maps for 6 Beaumont neighborhoods

The blue areas in **Figure 19** above are blocks which have a high CPTED rating, and a low crime rate. There are 73 of these blue blocks throughout the entire six neighborhoods. The red areas are blocks which have a low CPTED rating, and a high crime count. There are 12 red blocks throughout the six neighborhoods. The light grey areas are blocks which have no correlation, or a weak correlation. This means that they

either had a high CPTED rating with a high crime count, or a low CPTED rating with a low crime count. The dark grey areas are empty blocks, meaning that they are empty fields with no buildings occupying them. Even though this process of finding overlap was somewhat subjective, it was able to correctly predict 85 out of 134 blocks (63%) while the remaining 49 blocks (37%) do not show the relationship being sought, according to the hypothesis. The regression analysis and Spearman's test showed this relationship in a more objective manner than the maps, illustrating that crime rate falls as CPTED ratings rise. However, the maps are important in their own right, because they show where, spatially, these relationships are strongest. CPTED rating/crime rate correlation maps of all of the individual neighborhoods can be found starting on page 55 of Appendix B.

**Limitations**

This project is unusual in that it examines existing residential areas to see if they by happenstance adhere to CPTED principles, and if, by doing so, they are less vulnerable to crime. The majority of CPTED research is aimed more at changing the environment, or building it from the ground up to follow CPTED guidelines. Because this project is not making modifications to the environment, it is hard to control certain variables. Perhaps the best way to test CPTED is to compare a residential community, which by design follows CPTED, to another residential community, which by design rejects all principles of CPTED. However, this would be a very difficult, time consuming, and expensive undertaking. For this project, the neighborhoods already exist as is, and small differences in CPTED characteristics between them may be the key to understanding the differing vulnerability of the neighborhood to crime. However, because

the neighborhoods are not completely controlled under ideal research conditions, this study may just be another example of an instance whereby correlation does not imply causation. A significant limitation in this study is the limited accuracy of crime data, because the Beaumont police department, like most police departments in the U.S, only provided crime incident information at the block level. This means specific addresses were not given, and thus, all data had to be aggregated and examined on the block level.

While the effort was made to compare similar demographics, other socioeconomic factors and complex land use dynamics may influence crime more than the CPTED principles. Also, this study lacks the intimacy of personally interacting with residents and observing the interior spaces of buildings. While not as important, part of CPTED is about how the built environment can affect the social environment as well.

**Conclusion**

This study successfully developed a straightforward auditing scheme for rating neighborhoods according to the CPTED characteristics of Natural Surveillance, Natural Access Control, Territoriality, and Image. The neighborhood with the highest CPTED rating, Caldwood (2.34) happened to have the second-lowest crime rate (60 per 1,000 houses). The neighborhood with the lowest CPTED rating was Sunnyside (1.47) and it was also the neighborhood with the highest crime rate (448 per 1,000 houses). The regression shows an inverse relationship in which there is decreasing crime rate with increasing CPTED rating, with a moderate coefficient of determination ($R^2 = .1805$) and a moderate Spearman-Rho correlation coefficient (R = -.45 at the .05 significance level).

Taking a more subjective approach, the maps show the areas in which “high” CPTED ratings correlated with “low” crime counts, and vice versa. All of this evidence gives support for the research hypothesis, that neighborhoods which exhibit comparatively more CPTED characteristics will have fewer instances of crime than neighborhoods which exhibit fewer CPTED characteristics.

This knowledge can help make community members more aware of areas that are at risk for crime. Knowing these risk areas, residents can modify their environment, adopt effective crime deterrence and safety practices, and take ownership of their environment in order to discourage crime. They can also become more engaged in community planning and let their concerns be known to their local police department and policy makers. This type of study could also be slightly modified to help residents, urban planners, police departments, architects and policy-makers understand which principles of CPTED are most important to implement, and which specific components of those principles are most effective in deterring crime and increasing the sense of community and ownership of an area. Most importantly, this study will allow for individual homeowners to make small changes to their property in order to help them feel safer. When all individuals in a community feel safe, the safety of that community as a whole usually elevates due to improved community relations, watchfulness, and personal responsibility over the territory.

# Appendix A: Tables

**Table 4** CPTED Audit Guidelines

| **CPTED Characteristics** | **Rating and Description** | | | | |
|---|---|---|---|---|---|
| **Natural Surveillance** | 0 | 1 | 2 | 3 | 4 |
| **"Front of house has visible light fixtures, with effective placement."** | Fail. Crucial entrances (such as, most importantly, the front entrance, as well as the garage) are unlit. There are no light fixtures that can be seen by the entrances, garage, or any other places along the front of the house. | Below adequate. Crucial entrances **unlit** or **very poorly** lit. Ex: there are only one or two visible light fixtures, and they are poorly placed and spaced far apart. Ex: on far ends of house façade, instead of by entrance. Or they are obstructed by vegetation. | Adequate. Crucial entrances **moderately** lit. Ex: there is a large lighting fixture over the front door, OR there are individual lighting fixtures on both sides of the front door or both sides of the two front entrance pillars. No obstruction. | Above adequate. Front entrance is **well** lit, and other areas are **moderately** lit. Ex: there is a large lighting fixture above the front door, in addition to the two lighting fixtures on either side of the entrance, as mentioned above. No obstruction. | Excellent. Front entrance and all other crucial areas, such as garage, are **very well lit.** Ex: there is a large lighting fixture above the front door, in addition to the two lighting fixtures on either side of the entrance, as mentioned above. Additional lighting fixtures are visible along the front façade, landscaping, and/ or garage (such as floodlight). |
| **"Windows and doors unobstructed."** | Fail. **All** windows and doors are over 75% obstructed by vegetation. | Below adequate. **Most** windows are around 50% obstructed, even though 1 or 2 may be clear from obstruction. | Adequate. **Most** windows have around 25% obstruction from vegetation, or less. | Above adequate. **Nearly all** windows are 100% clear from obstruction, except for **minor partial obstructions.** Ex: one or two small tree branches, vines, clusters of ground cover or weeds, or something similar. | Excellent. **All** windows and doors are perfect and completely, 100% free from obstruction. Not even a single leaf can be seen in front of any window or door. |

| **Natural Surveillance (Continued)** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **"Entrances clearly visible from street."** | Fail. **No** front entrances are able to be seen from the street. This means there is a wall or vegetation blocking view of the front door, or the door is perpendicular to the street, instead of parallel. Other entrances such as the garage are ALSO completely blocked from view in a similar manner. | Below adequate. Only **some** entrances are visible. Ex: Front doorway is visible, but hard to see, even though it appears parallel to street. This is due to the entrance being recessed, creating some shadow. It would be hard to identify a person standing in the doorway, from the curb of the street. Garage or carport also completely blocked from view. | Adequate. **All** entrances **at least partially visible.** Front doorway may be recessed, or slightly shrouded by shadow from porch, but persons standing at the door could be easily identified from curb. Garage or carport significantly obstructed by objects, but still partially visible. | Above adequate. Not 100% perfect, but **all entrances are visible.** No recessed front doorway, or shadow cast on entrance area. There might be a slight obstruction such as the edge of a shrub being slightly in the line of sight between the curb and the front door. Garage is visible, but may be somewhat offset from the driveway so that a small portion is cut off from view. | Excellent. 100% visibility of **all** entrances. No shadows or obstructive vegetation at front door, and garage is 100% visible from the curb. |

**Table 4** continued

| CPTED Characteristics | Rating and Description | | | | |
|---|---|---|---|---|---|
| **Natural Access Control** | 0 | 1 | 2 | 3 | 4 |
| **"Well maintained pathways (front walkway, sidewalk, driveway, etc)"** | Fail. There are no visible pathways at all. There may be a worn dirt path in the grass leading toward the front door, but it is not a well defined, discrete walkway. | Below adequate. There **is a pathway** leading to the front door, but it is in very **poor condition**. Ex: broken up concrete, completely grown over with weeds, etc. Driveway is in similar condition. | Adequate. The driveway is in **moderate to good** condition, and the walkway leading to the front door is in **decent** condition, but it **does not span from the curb to the front door**, bisecting the yard. Instead, it runs alongside the base of the house front or by the flower beds, connecting with the driveway. | Above adequate. The driveway is in good condition. The front walkway is in good condition, and it spans from the curb to the front entrance, bisecting the yard. | Excellent. The driveway and front walkway are in **good condition**, and the walkway spans from the curb to the front entrance, bisecting the yard. The front walkway has unique touches, such as landscaping features and lighting, or unique pavement. |
| **"visible alarm system sign"** | Fail. **No** alarm system sign present | Below adequate. Sign is there, but it is **completely obstructed** by vegetation | Adequate. Sign is **visible**. May be slightly hard to see because it is so small, is slightly obstructed by weeds or other plants, is placed too far back or is shrouded by shadows. A partially broken or chipped sign would also get this rating. | Above adequate. Sign is **very visible**, in good condition, and has no obstruction. Does not get a perfect rating of 4, however, because it may have been placed in a less effective spot such as the edge of a property instead of the middle or near the entrance. | Excellent. Sign is **very visible**, in perfect condition, and has no obstruction. It is placed in a very effective location, such as near the front entrance or a flower bed near the middle of the property. |
| **"Fence type"** | Fail. **No** fence is visible. | Below adequate. Fence is chain link or some other type of wire fence. Although chain link offers natural surveillance characteristics, it is a poor choice because it can easily be climbed over, and gives a perception of "fortressing" and is considered by many to have poor aesthetics. | Adequate. Wood panel / stockade style fencing. Shows some signs of wear and deterioration. | Above adequate. High quality wood panel / stockade style fencing in good condition. | Excellent. wrought iron or similar fence with **vertical bars**. Sturdy, durable, aesthetically pleasing and offers natural surveillance by being "see-through." Vertical bars instead of horizontal bars prevents climbing. |

**Table 4** continued

| CPTED Characteristics | Rating and Description | | | | |
|---|---|---|---|---|---|
| **Territoriality** | 0 | 1 | 2 | 3 | 4 |
| **"Personal touches/decorations visible"** | Fail. **No** decorations, signs, or unique landscaping items visible. These include water fountains, bird baths, garden sculptures, flags, swings, etc. The space lacks character and gives no cues about its ownership. | Below adequate. The space only has **one** "personal touch" item, such as a flag or school yard sign. | Adequate. The space has **2** decorations or personal touch items. | Above adequate. The space has 3 personal touch or decoration items. | Excellent. The space has **4** or more personal touch or decoration items. |
| **"Symbolic barriers and landscaping used to delineate public and private space"** | Fail. There are **no** special landscaping features or barriers that help define space. | Below Adequate. There are only **minimal** features. The property has a loosely defined boundary, such as a row of small trees or shrubs, on either side of the lot to distinguish the property line from the neighbor's property line. | Adequate. The property has a loosely defined boundary, such as a row of small trees or shrubs, on either side of the lot to distinguish the property line from the neighbor's property line, and the property **also** makes use of garden or flowerbed barriers, such as bricks or stones. | Above adequate. The property has a loosely defined boundary, such as a row of small trees or shrubs, on either side of the lot to distinguish the property line from the neighbor's property line, **and** the property makes use of garden or flowerbed barriers, such as bricks or stones. The property **also** makes use of low level barriers such as hedges or small decorative fences | Excellent. The property has a loosely defined boundary, such as a row of small trees on either side of the lot to distinguish the property line from the neighbor's property line. The property also makes use of garden or flowerbed barriers, such as bricks or stones. In addition to these two items, the property also makes use of low level barriers such as hedges or small decorative fences. There are unique paving treatments which distinguish the private property from the surrounding area. The walkway is lined with unique lighting and / or landscape features. The flower bed or area against the base of the house contains dense ground cover, extending outward several feet, in order to discourage visitors or potential offenders from coming into the flower beds or walking up to the windows. |

| **Territoriality (Continued)** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **"Front porch or benches and chairs to view street."** | Fail. The property has **no** visible patio, porch, balcony, or even furniture visible. | Below adequate. The property has just a very **rudimentary** or makeshift small sitting area, such as a chair or two by the front entrance or garage. | Adequate. The property has a **fully realized** furnished front patio or porch, but it is somewhat **obscured** by plants, architecture, or other features. | Above adequate. The property has a patio or porch with chairs, and it is **not very obscured** by plants, but visibility and field of view might be slightly limited by architecture. | Excellent. The property has a front patio or porch, with furniture. There is **no obstruction** by plants, and it gives a **180 degree view** of the entire front yard. (Ex: balcony patio). |

**Table 4** continued

| CPTED Characteristics | Rating and Description | | | | |
|---|---|---|---|---|---|
| **Image** | 0 | 1 | 2 | 3 | 4 |
| **"House adequately maintained"** | Fail. Parts of the house seem nearly uninhabitable. Roof caving in or warped in spots, rotting wood visible, paint peeling off, mold or mildew present, broken windows, damaged or missing roof shingles. | Below adequate. Rotting wood visible, some areas where paint is peeling off, some missing shingles. **Overall structure is intact**, no broken windows. | Adequate. No visible structural damage, only moderate cosmetic damage visible, such as peeling paint and mold or mildew. | Above adequate. **No** structural damage, and only a few **minor** visible blemishes. | Excellent. No structural damage, no visible blemishes. House maintenance looks immaculate or like new. |
| **"Landscape adequately maintained"** | Fail. Lot looks **abandoned** and uncared for. Grass is completely overgrown, and/or has many dead patches. Vegetation such as trees and shrubs overgrown and unkempt in appearance. Weeds have **completely** taken over flower beds. | Below adequate. Grass at a **moderate** length, as if cut within past 2 weeks. Grass is dull green or brown and has several dead patches. Vegetation **very** overgrown, and some weeds in flower beds. | Adequate. Grass is **well groomed** as if cut in past week. Only a few dead patches or dull / brown patches. Vegetation is asymmetrical and **moderately overgrown** from not being pruned recently. Just a **few** weeds spread throughout flower beds. | Above adequate. Grass **well groomed**, **bright green**, and only has a **few** brown patches. Vegetation pruned but slightly overgrown and asymmetrical in some spots. Only **one or two** weeds visible in each flower bed. | Excellent. Yard is **perfect**. Grass is **bright green**, **well groomed**, and has **no patches**. Vegetation has been neatly pruned and is symmetrical. **No weeds visible** anywhere. |
| **"Lot is free from visible debris, trash, and graffiti"** | Fail. The lot looks like a **garbage dump** or junkyard. There are **piles** of trash, debris, and/ or clutter **evenly distributed** throughout the property. There may be graffiti and other forms of vandalism present. | Below adequate. There are still a **few** piles of garbage, clutter, or trash, but they are **not evenly distributed.** There may be graffiti or signs of vandalism. | Adequate. Property is **mostly trash free**, except for a **few** scattered individual items. Unsightly objects (ex: car parts, lawn maintenance equipment parts, wagons, childrens' toys,) might be visible in some places. No graffiti or vandalism present. | Above adequate. The property is **mostly** tidy and clean, with only **minor** trash or clutter items, such as paper cups lying by the curb, or paper products tangled in tree branches. No graffiti is present. | Excellent. The property is 100% clean and tidy. No visible trash, junk or clutter anywhere. No graffiti present. |

## Appendix B: Figures

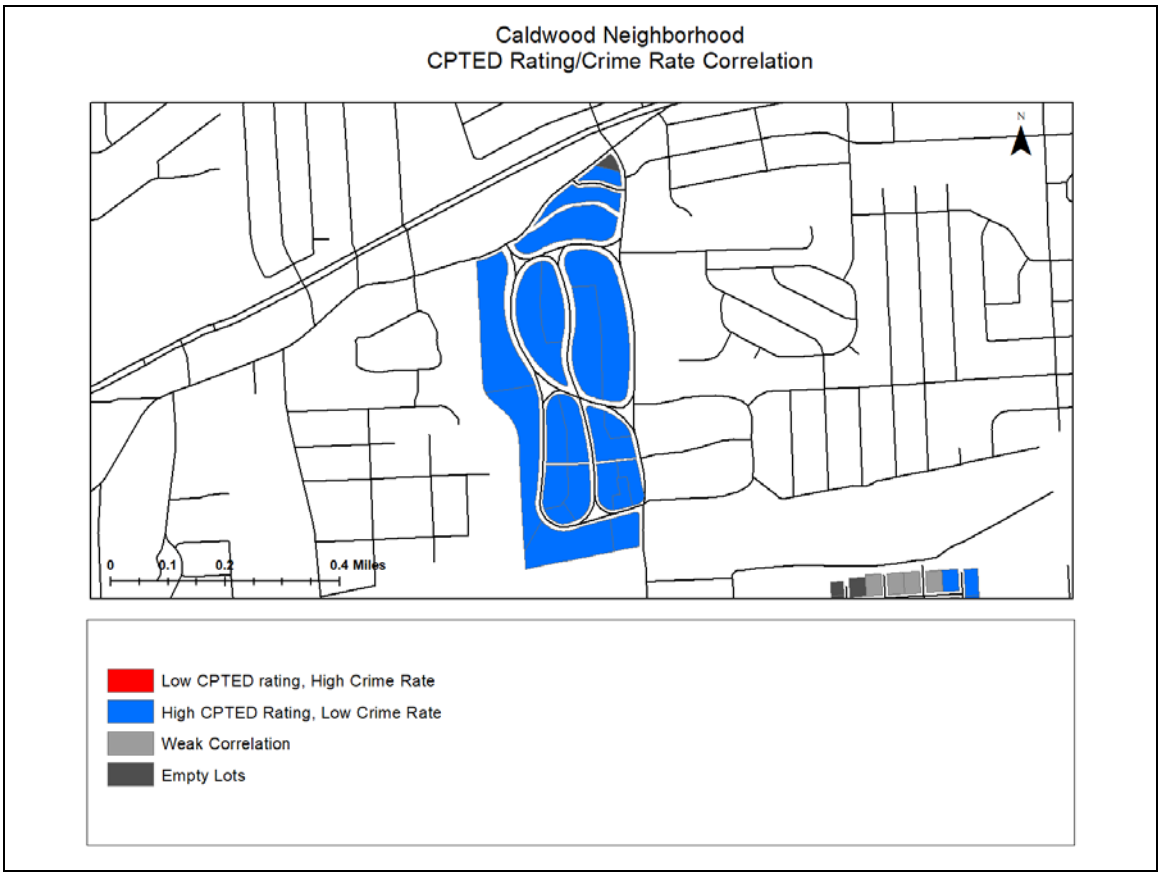


**Figure 20** Caldwood CPTED rating/crime rate correlation

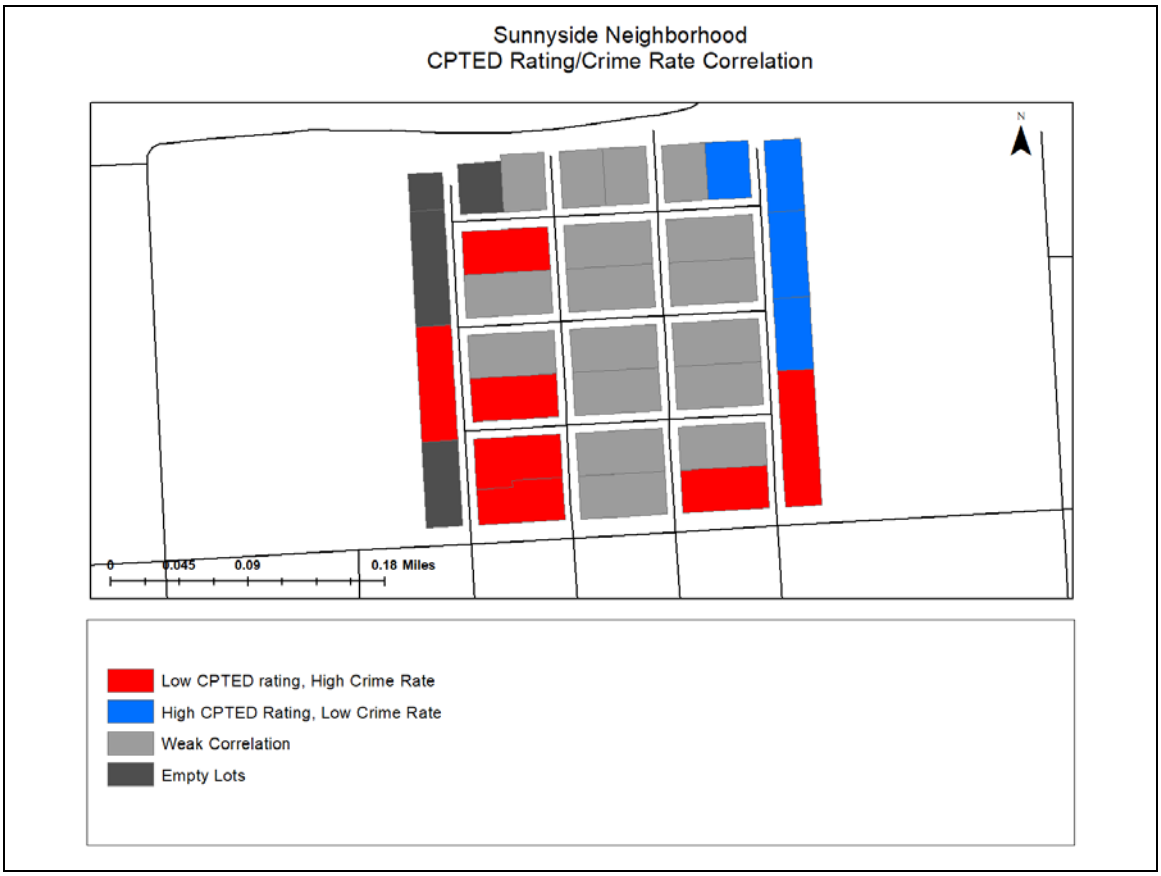


**Figure 21** Sunnyside CPTED rating/crime rate correlation

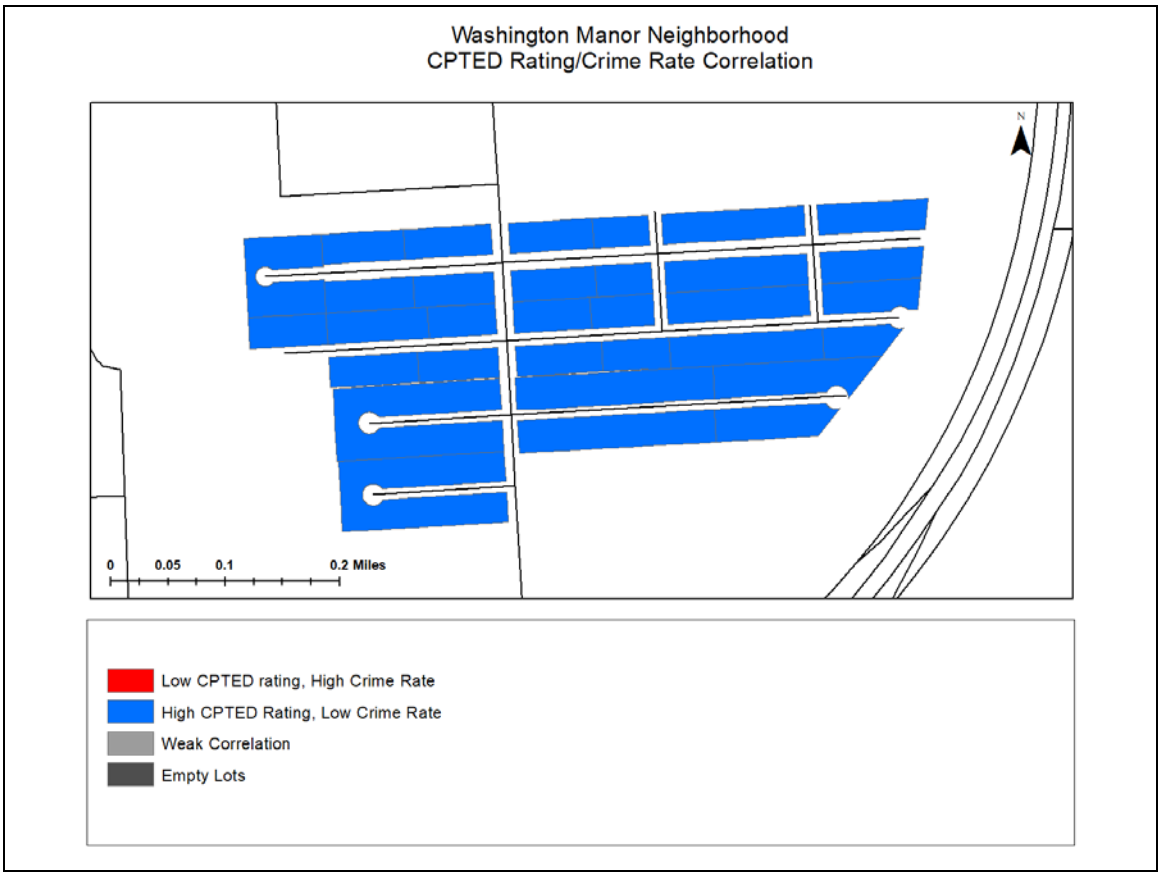


**Figure 22** Washington Manor CPTED rating/crime rate correlation

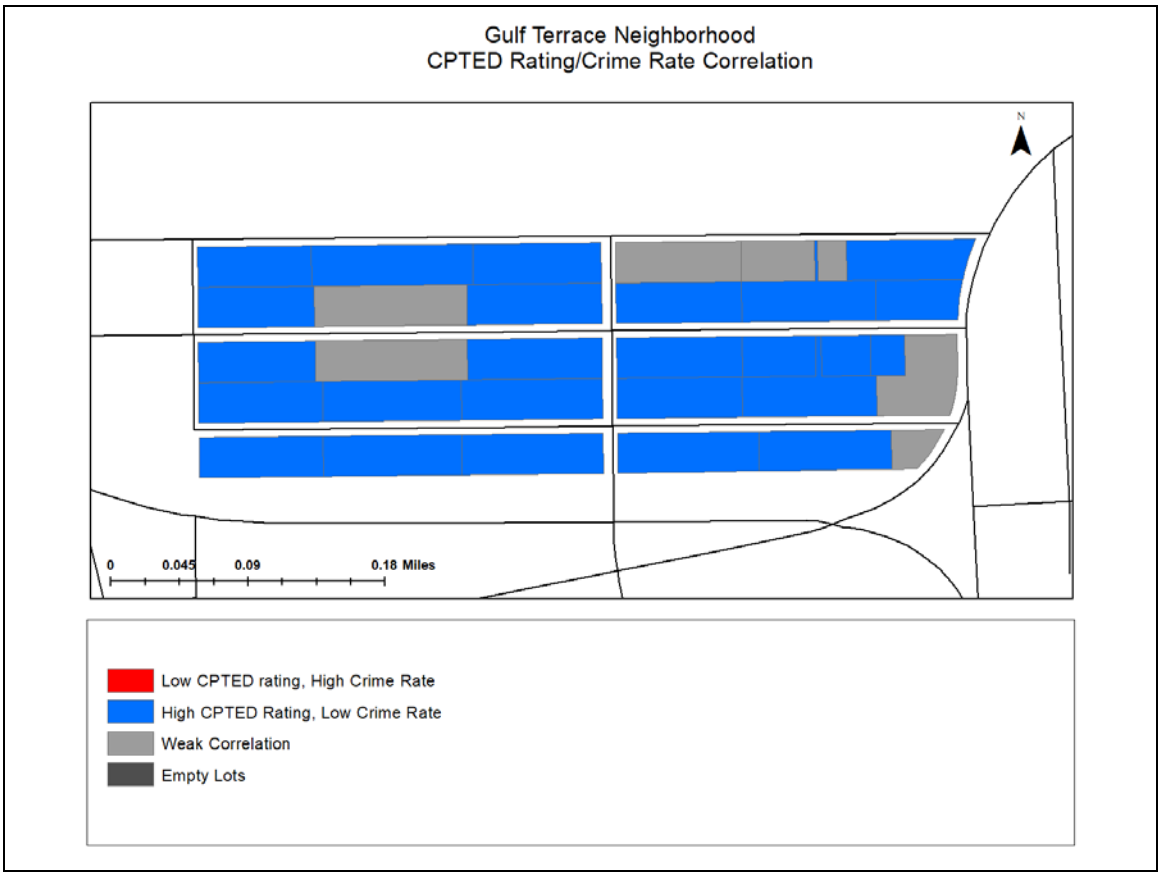


**Figure 23** Gulf Terrace CPTED rating/crime rate correlation

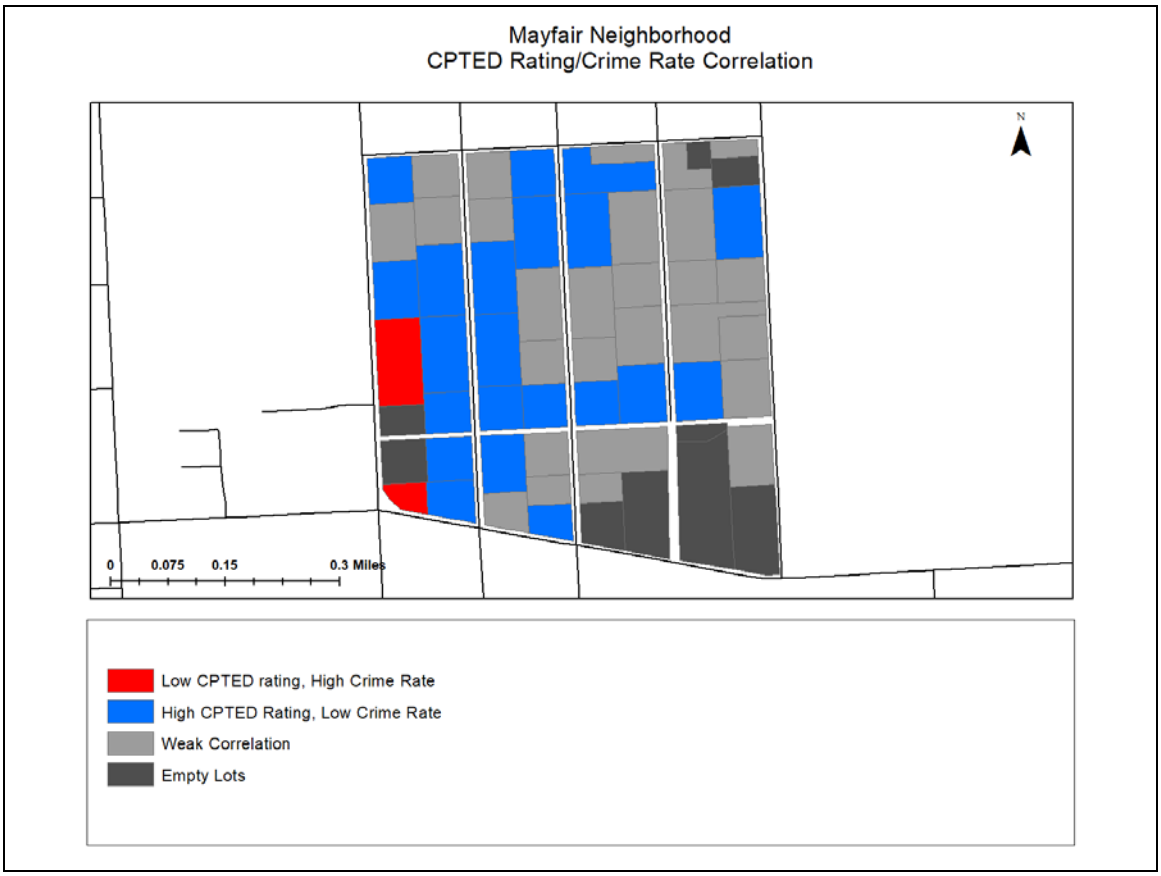


**Figure 24** Mayfair CPTED rating/crime rate correlation

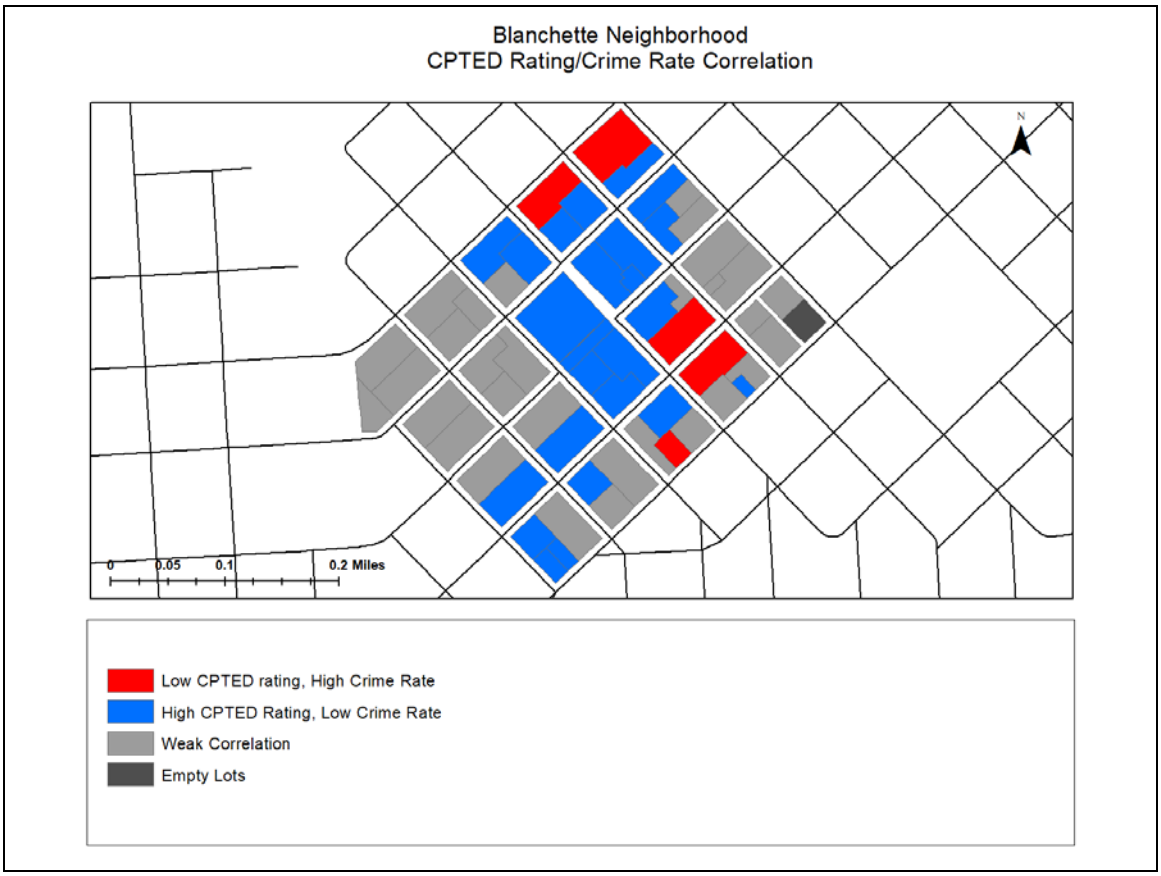


**Figure 25** Blanchette CPTED rating/crime rate correlation

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