Final Report

Crime Prevention through Environmental Design (CPTED) for Public Transit Stations

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16. Abstract

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Abstract

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Chapter 1: Project background and motivation

Crime Prevention through Environmental Design (CPTED) uses design principles to engineer safer spaces through the management of both built and natural environmental features. CPTED principles aim to reduce the chances and fear of criminal activity through the design of spaces that both deter criminal activity and build community. Vacant lots, poor lighting, uncontrolled access, and lack of monitoring can be ameliorated by designing spaces in which people feel – and are – safer. CPTED is multi-disciplinary in nature and has evolved from analysis of spaces, to include social relations and overall livability of areas. Public transportation can be an attractor of crime, and safety is cited as one barrier to public transportation.

This project examines CPTED practices in place at transit agencies serving Wilmington, DE, and Philadelphia, PA. As part of the project, the team cataloged CPTED practices already in use by the transit agencies, even if outside of a comprehensive CPTED framework. The team also developed a CPTED checklist for rail and bus stations based on existing literature and assessed CPTED features in place at 12 transit stops/stations in areas chosen through equity mapping tools and in consultation with transit stakeholders. The work was accomplished through site visits, transit agency staff interviews, and a review of transportation station design standards. CPTED and public transit were also the focus of the semester project in an undergraduate civil engineering course at the University of Delaware.

Based on these findings, the team presents a set of practices and priorities for integrating CPTED into transit station design to address the shortcomings identified in the study.

A. Public transit and equity

The movement for transit equity reaches at least as far back as the 1955 Montgomery Bus Boycott. Today, this movement continues and is highlighted annually on the birthday of Rosa Parks with the celebration of Transit Equity Day on February 5 of each year. Today, transportation access remains shaped by Eisenhower-era investments in the federal highway system, which cemented a car-based culture in the US. According to US Census Bureau data accessed on March 6, 2024, 68.7% of US workers aged 16 and over drive to work alone in a car, truck, or van; only 3.1% take public transit.[1]

Unequal access to transportation negatively affects Americans' access to economic, educational, and other opportunities in their neighborhoods. The US Department of Transportation Equity Action Plan, updated in 2023, includes a goal of Expanding Access; DOT is tracking metrics related to increasing “safe, affordable, multimodal access” to key destinations.[2], [3] The following sections present case studies of the impact of transportation on access to food, healthcare, education, and employment opportunities.

Food Access

Inequitable access to transportation is a contributor to unequal access to healthy food options. Food deserts are one product of these inequalities. The Food Empowerment Project describes food deserts as “geographic areas where residents' access to affordable, healthy food options (especially fresh fruits and vegetables) is restricted or nonexistent due to the absence of grocery stores within convenient traveling distance”.[4] A 2021 paper presents the results of a nationally representative survey of 1,612 participants. The survey collected self-reported data on the distances traveled, time spent, and for purchasing food for themselves and their families.[5] From those findings, the Water, Energy, Food Nexus Research Group at Texas A&M University suggests that minority populations nationwide must spend significantly ($p < 0.05$) more time to reach their destinations compared to white populations.

Due to the lack of healthy and accessible food options, the time and distance that minority populations require to reach healthy food options is exacerbated by the lack of public transportation options in these areas. In 2006, researchers from Louisiana State University investigated whether access to public transportation reduces the probability of food insecurity for American households. That study concluded that public transportation has significant effects for all households, and for low-income households, but not for non-low-income households.[6] For example, the study finds that a bus-equivalent vehicle per 10,000 people is associated with a decrease in food insecurity in all households by 1.6%. The positive effect of public transportation for poor households is roughly double that of the national average. The overall effect on food insecurity in the sample stems from the high impact of the effects on poor households rather than the entire sample size. This effect is more prevalent in poor Black households compared to poor white households since Black individuals are statistically less likely to own a car.

Healthcare

Like food access, the lack of equitable access to transportation creates obstacles to accessing healthcare facilities. Particularly during the peak of the COVID-19 pandemic, many transportation barriers worsened as public transit services were cut and social distancing regulations persisted across the United States. In a 2022 web-based survey administered to North Carolina residents aged 18 and older in the UNC Health system who were enrolled in Medicaid or Medicare, 35.3% (N = 114) and 18.3% (N = 59) of respondents reported having delayed or missed medical appointments or treatments in the past year, respectively, because of transportation barriers.[7] Many respondents self-reported arriving late, delaying, or missing care altogether due to transportation-related problems. However, owning a personal vehicle was significantly associated with a reduced probability of having delayed or missed care, unlike the number of clinics in a given zip code, gender, race, or number of appointments in a given year.

Beyond the COVID-19 pandemic, travel-related barriers are still a limit healthcare access at any given time in the United States. In a study that analyzed findings from National Health Interview Surveys from 1997 to 2017, researchers found that in 2017, 5.8 million people across the US (1.8%) delayed medical care because they did not have access to transportation.[8] The only time this proportion increased within the study period was between 2003 and 2009, with no significant trends before or after their studied 20-year window. However, their findings concluded that transportation barriers disproportionately affect poor individuals and those with chronic illnesses more than any other cohort across the country, although social factors like socioeconomic status and health literacy may be factors in poor health as well.

Interestingly, rural and urban communities can exhibit similar transportation barriers despite their demographic differences.[9]

Education

Transportation barriers within the United States pose a significant challenge to educational access in the US. To address this issue, researchers from The Hope Center conducted a quasi-experimental study on the impact of discounted transportation services on academic outcomes, focusing on Rio Hondo College's U-Pass program.[10] In their 2021 findings, The Hope Center confirmed that the U-Pass program increased the likelihood of student enrollment outcomes, such as student retention, credit completion, and credential attainment, at Rio Hondo College, a predominantly Hispanic and Black commuter college that began participating in the program in 2016. The results of this study are particularly relevant, as more than four in five college students live off-campus and only 1% of community college students live on campus, according to 2019 data from the US Department of Education.[11] Completion rates among students of color are also far below national averages, highlighting the success of student commuter passes in erasing socioeconomic barriers to transportation.

Employment Opportunities

Americans nationwide are limited in job opportunities and socioeconomic mobility due to inequitable access to transportation options.[12] Due to the unequal distribution of jobs, housing, and transportation options, the phenomenon called “spatial mismatch” is prevalent across the country.[13] Spatial mismatch occurs when low-income households reside away from suitable job opportunities. Typically, this occurs when traditionally low-income families in urban areas cannot reach higher-paying jobs in suburban areas. For example, according to the US Census Bureau, in the Dallas-Fort Worth metropolitan area, new jobs were far from low-income families who lived in subsidized housing in the city's southern half. These findings were consistent with data from the Houston metropolitan area included in the study. By not having substantial public transportation options to commute to work, those who live far from job opportunities are barred from accessing new job opportunities.

Across the United States, cars are the primary means of transportation for people to reach work. However, across every state and the District of Columbia, car ownership rates decrease with income. This disparity is particularly acute in rural jurisdictions. In 2023, The Federal Reserve Bank of Richmond concluded that, in the vast majority rural counties, less than 3 percent of the population uses public transportation, while the percentage of residents without ownership ranges from zero to 8 percent.[12] This is likely because public transportation options are more limited in those settings, which would make owning a car even more critical.

A 2022 survey by the South Carolina Department of Employment and Workforce concluded that almost 20 percent of South Carolina individuals who could work but were not working cited transportation as a barrier.[12] Due to the car-dependent nature of the country and lackluster availability and scale of public transportation, those who are not able to drive either due to affordability, disability, or license suspensions have limited employment opportunities. Additionally, although remote work has climbed to an all-time high since the COVID-19 pandemic, remote employment is typically only in sectors with high-earning and high-skilled professions. Approximately 75% of jobs in lower-wage industries, such as food and accommodation services, are in-person. In many sectors, lower-skill and lower-paid jobs remain primarily in-person, so a switch to remote work did little to change the commuting needs of lower-income workers.

B. Biden Administration efforts to advance transportation equity

The Biden Administration’s Justice40 Initiative is an effort to knit together climate change initiatives (EO14008) with the pursuit of environmental justice (EO14096). It incentivizes federal investments in climate change mitigation and resilience in areas that are vulnerable to the effects of climate change, have experienced historical disinvestment, or face disproportionate levels of pollution.[14] Much of the administration’s signature legislation, including the Inflation Reduction Act and the Bipartisan Infrastructure Law, directs significant funding to climate and infrastructure projects spearheaded by the US Departments of Labor, Commerce, Energy, Agriculture, Transportation, and others.

US Department of Transportation (DOT) funding under Justice40 is focused on improving transit access for communities across the US that are lacking safe, reliable transportation. The agency has developed an Equity Action Plan that includes Expanding Access and Institutionalizing Equity as two of the Plan’s five pillars.[15] The Institutionalizing Equity pillar is largely focused on DOT internal operations. However, under the Expanding Access pillar, DOT has established performance metrics that are related to this project: reducing transportation cost burden, increasing access to work, school, healthcare, and food, and increasing safety through reduction of roadway fatalities. This pillar also identifies high transportation costs and access and affordability as barriers to transit equity. It also includes an action item related to reducing gender disparities by assessing the needs - including safety needs - of women using transit.

C. Crime Prevention Through Environmental Design (CPTED)

CPTED principles

This project employed Crime Prevention through Environmental Design (CPTED) principles as a framework through which to assess the safety of public transit stops/stations in vulnerable and underserved areas. The principles of CPTED are described by several professional associations.

The International CPTED Association (ICA) was formed in November 1996 initially as a venue to share ideas about CPTED and other crime prevention strategies. It has grown since its founding. Today, the ICA has over 200 members in 33 countries. Since 1996, members of the ICA have expanded CPTED into the broader concept of "urban environments," which include physical and architectural environments designed to prevent crime, neighborhood-based social environments, and most recently, cultural and psychological environments. These concepts are known respectively as First Generation and Second Generation CPTED.[16]

Architect Oscar Newman's 1972 book *Defensible Space* created the original Crime Prevention Through Environmental Design concept, now dubbed First Generation CPTED. Newman's first four CPTED principles were territoriality, natural surveillance, image and milieu, and access control.

Territoriality. By implementing various architectural strategies, including creating semi-public spaces in residential areas, it is possible to empower residents with a sense of informal ownership over public spaces. This, in turn, can deter potential offenders who may otherwise act with impunity. When residents view the spaces around their homes as their own, they are more inclined to take responsibility for them. Additionally, strategically placing safe activities, such as food vendors, can further establish territorial control over previously unsafe areas.

Natural Surveillance. Newman's approach heavily relies on territorial influence. The "eyes-on-the-street" concept optimizes the construction of spaces that allow residents to observe semi-public areas comfortably. This is accomplished through strategic lighting, landscaping, and other design elements that improve visibility, ultimately minimizing potential crime and instilling a sense of security.

Image and Milieu. Newman believed that residents' social lives choices were closely tied to urban safety. To promote safety, he suggested creating mini-neighborhoods and advised against building residential properties in high-crime areas. Image also played a crucial role in urban safety, which could be improved through programs such as graffiti removal, litter cleanups, and beautification.

Access Control. Access control employs architectural tactics to restrict entry into properties and uphold territoriality. The goal was to empower property owners and managers with legitimate purposes to manage access to their properties. This could involve road barriers to regulate street access and landscaping to control entry into building fronts, thereby creating smaller residential neighborhoods.

Through extensive research and modifications between the 1970s and 1990s, a presentation at the annual conference of the International CPTED Association introduced the concept of Second Generation CPTED.[17] In Second Generation CPTED, the focus shifted to smaller-scale and proximal orientation, which links both theories as a singular community-building theory. Second Generation CPTED principles include social cohesion, community culture, connectivity, and threshold capacity.

Social Cohesion. Social cohesion enhances positive interactions between people. This strategy solely focuses on solving local problems. Some examples of this strategy include a "neighborhood watch" to reduce burglary or other groups that tackle quality of life issues in the neighborhood. According to the ICA, social cohesion is proximal—all efforts in a social cohesion strategy are directed at the local community, not the entire city.

Community Culture. Community culture gathers people to create a sense of shared place and purpose. This can be accomplished through cultural events, art and music festivals, and other activities that attract people of all genders, ages, and ethnicities to interact with one another.

Connectivity. Connectivity programs link neighborhoods with one another through physical and social methodologies. Formal and informal communication forms, linked passageways, and shared neighborhood events promote connectivity, which encourages localities to obtain government funding grants to create new programs. This creates a positive feedback loop that invites all ethnic and income groups, for which First Generation CPTED was scrutinized.

Threshold Capacity. Land use and demographic diversity should appear in all neighborhoods. It allows residents to socialize, shop, and engage in recreational activities within their own neighborhood. It also deters land uses that make places unsafe, such an overabundance of establishments that serve alcohol or invite illegal activity.

The ICA's mission statement is "to create safer environments and improve the quality of life through the use of CPTED principles and strategies".[18] It claims that there is no single strategy that will reduce all crime; rather, strategies should be applied in combinations based on a thorough analysis of the local context. Consequently, the ICA believes that both First Generation and Second Generation CPTED should be implemented with respect to local needs.

The National Institute of Crime Prevention (NICP) was founded in 1999 as an organization to train licensed professionals and nonprofit organizations on CPTED across the United States. The NICP CPTED Professional Designation Certification signifies that a professional has developed expertise in the Crime Prevention Through Environmental Design principles, skills, and applications essential for creating safer, healthier, and more sustainable human environments.

According to the NICP, CPTED is based on these key overlapping concepts.

Natural Surveillance. People, physical features, and activities are arranged to optimize visibility. These spaces can be developed by designing landscapes that provide clear, unobstructed views of surrounding areas.

Natural Access Control. Natural access control means controlling access to a site using strategic design of streets. With effective natural access control, people are physically guided through a space by sidewalks, building entrances, landscaping, and other environmental features. This can be achieved by highlighting the main entrance, ensuring that entrances are visible, well-lit, and overlooked by windows, clearly defining entryways, and by controlling other points of access to a site.

Territorial Reinforcement. Territorial reinforcement is the use of physical attributes that express ownership, such as fencing, pavement treatments, signage, and landscaping.

Maintenance. Well-maintained areas allow for the continued use of space for its intended purpose. Maintenance also serves as an additional expression of ownership and prevents visibility reduction from landscaping overgrowth and obstructed or inoperative lighting.

Applications of CPTED

Crime Prevention Through Environmental Design (CPTED) principles are used in a variety of settings. These design elements can be applied to commercial, residential, educational, and other public environments. When CPTED is appropriately implemented, residents experience increased safety and perceive their neighborhoods accordingly. This can effectively increase property values, which in turn heightens retail activity.

The City of Abbotsford has used CPTED as a practical strategy to mitigate opportunities for criminal activity at various public locations.[19] For example, Abbotsford neighborhoods are specifically designed to offer a diverse range of spaces for gathering, seating, observation, and interaction. Not only does this design foster a sense of community ownership among residents, but it encourages accessibility and natural surveillance. One specific effort made by the city was to build a variety of housing options and ownership models across the neighborhood. Catering to these various household compositions bolstered natural surveillance through the promotion of diverse activity patterns and differing sight lines. Similar concepts can be applied to other public realms, such as city centers and pedestrian pathways. Abbotsford has made a specific effort to utilize public art, landmarks, scenic viewpoints, and natural features in these arenas to enhance wayfinding, signage, and activity support.

Another example of residential CPTED implementation can be found in the city of Branson, Missouri.[20] In accordance with CPTED design strategies, the police department created a safety checklist for homeowners to help deter criminal activity. The checklist discusses the CPTED principle of maintenance, recommending that door frames be constructed of solid materials and that glass panels be reinforced to prevent shattering. Another CPTED tactic is the “2 foot-6 foot” rule, which suggests keeping vegetation height under 2 feet or trimming it to above 6 feet in order to avoid obscured sight lines. The Branson checklist encourages this landscaping practice to eliminate potential hiding spots.

Other CPTED design checklists have been created specifically for use by retail and commercial buildings. These checklists take into consideration the overall design of the building, with a specific interest in positive activity generators. For example, retail checklists may promote the use of complementary activity incorporators (such as benches, neighboring parks, and bus stops). These elements are useful for implementing CPTED guidelines by promoting natural surveillance, accessibility, and encouraging authorized access to areas intended for public use.

In addition, CPTED checklists have been developed specifically for school grounds. Assessing and implementing changes to physical school layouts can increase perceptions of safety among students, resulting in less fear and aggressive behavior. A checklist was designed by the Centers for Disease Control and Prevention (CDC) in accordance with certain CPTED principles including territoriality, natural surveillance, and accessibility.[21] For example, the checklist encourages strong, well-defined perimeters, stating that “school property boundaries are delineated from adjacent properties”. The checklist suggests clear signage to direct approaching vehicles and pedestrians and promote authorized access.

Implementing CPTED principles across different types of environments can enhance safety perceptions among residents, potentially increasing property values and promoting greater activity levels in retail businesses. Small changes to design criteria have demonstrated considerable improvements in preventing crime beyond the transportation realm.

Transit-oriented applications of CPTED

There are several documented applications of CPTED in public transit settings. In 2010, the American Public Transit Association (APTA) published guidance on the use of CPTED in public transit.[22] This guidance centers stakeholder (rider) experience and provides a CPTED checklist for transit facilities that includes the principles of natural surveillance, natural access control, territoriality, activity support, and maintenance. This document was the authors’ starting point for a

project-specific CPTED checklist for this report. CPTED principles have also been applied by various transit agencies in the US. For example, in the US, MetroLink in St. Louis, MO, and WMATA in the Washington, DC area explicitly include CPTED considerations in safety and security documents. The Maryland Transit Administration's Baltimore Link Bus Stop Design Guide also explicitly incorporates CPTED principles. More detail is provided in Chapter 2.

D. Connecting CPTED and public transit as a path to more equitable transportation systems

Across the United States, crime and safety are often cited as deterrents for Americans who typically do not use public transit or are not dependent on it. According to a 2023 YouGov poll of 6,776 U.S. adults, the less a person uses public transportation, the more dangerous they perceive it to be.[23] Overall, 39% of all respondents describe public transit as very or somewhat dangerous. Additionally, in any region outside of a city (labeled as a suburb, town, or rural area in the study), at least 43% of surveyed adults from each area perceived public transit to be either very or somewhat dangerous. In cities, this statistic decreases to 28%. However, this means that those who already do not (or choose not to) use public transit are far less likely to use it when it is available.

The trend that most people perceive public transit as dangerous should not be expected to decrease. Violent transit crimes, although rare in comparison to other felonies and offenses, have been increasingly relevant to the media and politicians. Although major crimes in both New York City and Philadelphia transit systems have dropped in recent years, politicians from both cities are applying additional measures to ensure safety is maintained at transit stations. In March 2024, New York Gov. Kathy Hochul deployed 750 members of the National Guard to help local police patrol New York City Subway.[24] Pennsylvania legislators created a special prosecutor to address crimes within transit systems throughout the state. in March 2024, Philadelphia Mayor Cherelle L. Parker vowed to dedicate more city resources to fighting gun violence after three people were killed in the span of three days, all while riding, entering, or leaving a SEPTA bus.[25] In April 2024, SEPTA began surveying visitors to their website about perceived safety while riding transit.

There is a shortage of conclusive evidence to assert that an individual is more likely to be a victim of a crime while utilizing public transit. However, since the COVID-19 pandemic, the perception of safety often determines whether people choose to use transit services. A 2021 article from Vice titled "You Don't Have to Be Afraid of Public Transit" detailed the false narratives of the American media's coverage of crime on public transit.[26] References to vague or inconclusive surveys, anecdotal interviews with individuals espousing their fears about using transit, and reports of homelessness, crimes, illness, and extreme weather events on or near public transit are widely circulated across American media. Even former New York Governor Andrew Cuomo told reporters that he was afraid to ride the New York Subway all-time low ridership towards the conclusion of the COVID-19 pandemic despite record low ridership at the time.[27] These instances and others reflect the complex and often negative relationship between safety perception and transit ridership.[28]-[30]

In addition to negative safety perceptions, transit agencies in the United States must also contend with low post-pandemic ridership. The Bureau of Transportation Statistics reports assault and other crimes on public transit have increased since the pandemic, while other types of crime remain relatively flat.[31] Assaults involving transit workers also increased from 2020-2022.[32] As of April 2024, the American Public Transportation Association (APTA) reported that ridership has recovered to approximately 79 percent of pre-pandemic levels.[33] Most of the recovery in ridership can be attributed to gains in bus ridership; however, as many buses are in service more frequently than trains and serve more essential workers.

As ridership declined in the wake of the pandemic, agencies struggled to maintain services, and those who relied on public transit were further disenfranchised due to service availability. Returning to pre-pandemic ridership requires equitable transit development. This project is motivated by the possibility that safer transit could promote public transit use and

expand access employment, healthcare, food, and education. Applying CPTED principles is one way to improve safety—and perceptions of safety—for riders of public transit.

Figure 1.1: A graphical depiction of the motivation for this study.

E. Project overview

Project team

The 2023-2024 project team consisted of the PI, Dr. Jennie Saxe, and two undergraduate students, Neil Jean-Baptiste and Gabby Jakobsberg, a civil engineering major and a sociology major, respectively. These students were selected to bring diverse viewpoints to this interdisciplinary work. In December 2023, Ms. Jakobsberg completed her degree; in May 2024, Mr. Jean-Baptiste completed his degree. As part of the training for this project, both students completed the National Institute of Crime Prevention (NICP) basic CPTED training course, a 40-hour online course that included exams and a field assessment project. The PI previously completed the 3-day virtual Michigan State University Complete Crime Prevention Through Environmental Design (CPTED) Certificate Training in May 2022.

To ensure safe site visits, the team developed a safety plan (see report Appendix A) which was reviewed by the field safety manager for the Department of Civil, Construction, and Environmental Engineering at the University of Delaware. In addition to developing and reviewing the safety plan prior to site visits, the team was also given a safety briefing by staff from Transit Agency 2 prior to rail site visits.

Project approach

To evaluate the implementation of CPTED principles at public transit stations, enhance safety perceptions, and promote public transit ridership, the project team undertook the following tasks:

- Identification of CPTED practices in use by public transit agencies (Chapter 2)
- Assessment of local public transit stations in underinvested and vulnerable areas for CPTED practices (Chapter 3)
- Identification of gaps between documented plans and practices in use and opportunities to apply CPTED principles (Chapter 4)
- Engagement of civil engineering students in public transit equity via CPTED integration into coursework (Chapter 5)
- Dissemination of findings (Chapter 6)

Additional project-related documents are found in appendices to this report:

- Appendix A: Project Safety Plan
- Appendix B: CPTED Principles Analysis Form

- Appendix C: CPTED Public Transit Checklist
- Appendix D: CPTED Public Transit Checklist - Bus Stops and Shelters
- Appendix E: Site assessment photos
- Appendix F: CPTED site assessment findings from sites B through M
- Appendix G: CPTED Checklist used for CIEG411 (S2024)

Chapter 2: CPTED Practices in Use

A. Case studies of CPTED in use in public transit

The team began the project by compiling CPTED case studies for all land uses (commercial establishments, schools, etc.). Then, the team focused on the application of CPTED principles in public transportation. Although several jurisdictions incorporate CPTED into guidelines for all public spaces, the availability of CPTED checklists specific to public transit was limited.

The American Public Transportation Association (APTA) developed a Recommended Practice (RP) addressing CPTED at transit facilities in 2010, with revisions published in September 2020.[22] The contents of APTA SS-SIS-RP-007-10, Rev. 1 include stakeholder considerations, risk assessment considerations, recommended CPTED principles to apply to public transit facilities, and a survey to utilize as a checklist. The intended purpose of this document is to facilitate transit agency safety and risk assessments and discussions with local governments to enhance overall safety in conjunction with local planning, zoning, and ordinances. This document identifies safety considerations that can be incorporated into a transit facility's planning, design, construction, or renovation.

The Washington Metropolitan Area Transit Authority (WMATA) Station Site and Access Planning Manual, published in May 2008, provides design guidelines based on standard practices in transportation planning and joint development partners.[34] In this document, WMATA recognizes the necessity for patron safety across all systems it operates. At DC Metro stations, WMATA emphasizes the importance of CPTED principles based on natural surveillance, access control, and territoriality.

The Metrolink System-Wide Security Assessment Best Practices Report, conducted by a WSP-led team in 2018, focuses on enhancing the security of transit systems and ensuring the safety of passengers.[35] The team's key recommendations include conducting comprehensive security assessments, implementing CPTED principles into all designs, and using CCTV and other emergency technologies in conjunction with numerous other security improvements. This report included considerations for natural surveillance, territorial reinforcement, and maintenance to deter unwanted users and crime in the system. This publication also includes the CPTED checklist from APTA SS-SIS-RP-007-10 as a design consideration checklist in the appendix.

B. Overview of this project's "principles in use" checklist and site assessment checklist

The existing CPTED checklists for transit and other checklists with transit-related elements noted above were reviewed in order to develop a project-specific checklist. The most comprehensive checklist found was the APTA RP discussed above. The APTA checklist was modified by the project team to remove duplicative elements and to integrate checklist elements listed by APTA under a separate bus and rail section into the body of the project checklist. This checklist was used to first review local transit agency documents for CPTED principles. This checklist is available in Appendix B to this report.

The checklist above was then modified for use as a field checklist (Appendix C) to document CPTED features present at transit stations. This field checklist was used to assess sites B-G, K, and L.

After the team's initial round of site visits, the checklist was streamlined for use at bus stops and shelters. Many of the elements pertaining to waiting areas, stairways, and other "in station" elements of the full checklist were removed. The streamlined bus stop checklist is also available in Appendix D to this report. The streamlined checklist was used to assess sites H-J and M.

C. Evaluation of documents provided by local transit agencies

The project team contacted staff at transit agencies in the region to request documents most relevant to safety and station design. The team acknowledges that these documents may not represent a comprehensive compilation of all transit agency documents that address CPTED elements. The team was supplied with the following documents:

Table 2.1: Documentation provided by transit agencies for this study (transit agency and city names removed).

Transit Agency	Documentation
Transit agency 1	● [TRANSIT AGENCY 1] Site Criteria (excerpt)
Transit agency 2	● [CITY] Complete Streets Design Handbook ● SPP_001 Standard Practice for the Illumination of [TRANSIT AGENCY 2] Facilities ● SPP_002 Standard Practice for Lighting Design and Luminaire Selection at [TRANSIT AGENCY 2] Facilities ● SPP_003 Standard Practice for Lighting Control Systems at [TRANSIT AGENCY 2] Facilities ● Architectural Design Criteria and Guidelines (working draft) ● [TRANSIT AGENCY 2] Wayfinding Narrative (working draft) ● Information Shortfalls are Gendered One Pager (working draft) ● [TRANSIT AGENCY 2] Wayfinding Standards Manual

D. Findings from evaluation of transit agency documents

In preliminary interviews with Transit Agency 1, staff were not familiar with the principles of CPTED. Transit Agency 2 staff had some familiarity with CPTED principles but did not indicate that they explicitly identified or implemented practices related to natural surveillance, territoriality, maintenance, activity support, and access control as part of a comprehensive CPTED strategy.

Despite a lack of familiarity or formal intent to apply CPTED principles, some principles were covered well by transit agency policies/guidelines/standards reviewed by the team. CPTED principles touched upon by Transit Agency 1, but not specifically identified as CPTED principles, were: maintenance (trash receptacles & wear-resistant materials), access control (signage and colorways), natural surveillance (sightlines, direct pathways, lighting), territoriality (signage), and activity support (seating, if stop criteria are met). Covered well by Transit Agency 2 were: maintenance, territoriality (especially signage), and activity support. These principles are not referred to as CPTED practices in Transit Agency 2 documents.

Transit Agency 1 documentation omits discussion of several CPTED elements, including maintenance (reporting maintenance needs, requirements for grounds to be maintained); access control (parking, unauthorized access); natural surveillance (blind corners, ground cover, trees, common areas, comms systems); territoriality (barriers along roadways); and aspects of activity support other than the provision of benches. Similarly, the documentation reviewed from Transit Agency 2 did not cover some CPTED elements. Access control (especially discouraging unauthorized access) and natural surveillance (especially lines of sight) are discussed the least in the documents reviewed.

In the team's review of transit agency documents, there was no expectation that every aspect of CPTED would be covered thoroughly. Rather, the intent of the review was to determine whether CPTED principles were integrated into transit facility design, and, if so, to what extent. The presence of some CPTED elements in these documents indicates that there is overlap between common practices in transit facility design and application of CPTED principles. However, the team's review of the provided documents indicates that additional aspects of CPTED could be integrated into the design of transit facilities by these two transit agencies. During our interviews, transit agencies noted that they are limited in their ability to influence bus stop amenities and design, as those responsibilities typically fall to the jurisdictions (town, city) in which the bus stop or shelter is located.

Chapter 3: Implementation of CPTED principles at transit stations in underinvested and vulnerable areas

To evaluate the implementation of CPTED principles at transit stations in underinvested and vulnerable areas, our team chose to utilize two geospatial mapping tools that provide further detail to isolate census tracts in the national upper percentiles in various social, transportation, housing, and climate change inequities compared to other census tracts across the United States. These tools are the US Department of Transportation (DOT) Equitable Transportation Community (ETC) Explorer and Climate and Economic Justice Screening Tool (CEJST). [36], [37]

A. USDOT Equitable Transportation Community (ETC) Explorer

The US DOT ETC Explorer is a publicly available web application developed funding from the Justice40 Initiative, established by the Biden-Harris Administration through Executive Order 14008, "Tackling the Climate Crises at Home and Abroad."[38] The US DOT ETC Explorer addresses five components: Transportation Insecurity, Climate and Disaster Risk Burden, Environmental Burden, Health Vulnerability, and Social Vulnerability. According to DOT, this tool complements CEJST to provide further contextual background information regarding the transportation equities depicted in CEJST's results.

The US DOT considers a census tract to be "disadvantaged" if the overall index score places it in the 65th percentile (or higher) of all US census tracts. The 65th percentile cutoff is consistent with CEJST, which prioritizes tracts at the 65th percentile or above for CEJST's low-income indicator. To evaluate census tracts in the study area, the research group started by isolating data under the appropriate state and county selectors in the default view. Then, disadvantaged census tracts were selected based on the following two disadvantaged component categories: transportation insecurity and social vulnerability. Under transportation insecurity, our group considered any tracts with any disadvantaged indicators under this category for further identification under our project (transportation access, transportation cost burden, and transportation safety). Additionally, our team analyzed disadvantaged census tracts due to disabled, 65+ age, or 17 & under populations under the social vulnerability category since these groups more frequently depend on public transportation.

B. Climate and Economic Justice Screening Tool (CEJST)

After logging all disadvantaged tracts in the US DOT ETC Explorer, we used the same tracts and assessed them using the CEJST tool from the Council on Environmental Quality (CEQ). The tool uses eight categories to indicate environmental burden: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. Under these eight categories, we considered census tracts flagged in the following categories, some of which require a low-income criterion also to be exceeded.

- Transportation: selected if flagged by CEJST on a transportation indicator AND the low-income indicator
- Workforce development: selected if flagged by CEJST on a workforce development indicator AND the low-income indicator
- Health: selected if any health indicator is flagged (not necessary for low-income criteria also to be exceeded)
- Housing: selected if any housing indicator is flagged (not necessary for low-income criteria also to be exceeded)
- Climate change: selected if any of these indicators exceed thresholds (not necessary for low-income criteria also to be exceeded): building loss, population loss, flood risk
- Energy: selected if any of these indicators exceed thresholds (not necessary for low-income criteria also to be exceeded): energy cost, PM2.5

The Water and Wastewater and Legacy Pollution indicators in CEJST were not used by the research team.

After screening through the DOT ETC Explorer and CEJST, the team tallied the totals of disadvantaged indicators from both online tools and summed the number of exceeded thresholds in each census tract. Based on these rankings, the research team focused on the census tracts exceeding DOT ETC and CEJST thresholds in the greatest number of indicators.

The research group identified transit stops for potential site assessments within the identified census tracts based on local public transportation routes. Transit Agency 1 is an operating division of the state Department of Transportation which provides intrastate commuter bus services. Transit Agency 2 is a state-created authority with the majority of its Board appointed from the 5 counties it serves. Transit Agency 2 provides intrastate bus services and commuter rail across a local metropolitan area.

Using transit maps from these two service providers, the team selected transit stops near public facilities with a high potential for public transit trip generation. These include government buildings, schools, community outreach centers, sports facilities, places of worship, significant route transfers and interchanges, and entertainment centers. To make site assessments easily accessible in a single day due to proximity and parking availability, the group finalized site selections, factoring in timeliness and proximity of other sites.

After selection, sites were screened through appropriate, publicly available crime mapping tools to determine crime rates near the transit stops. For Transit Agency 1 sites, the county police department crime map was used (accessed 12/28/23). For Transit Agency 2 sites, the state crime reporting system was used (accessed 3/6/24 and 6/17/24).

The graphic below summarizes the site selection process.

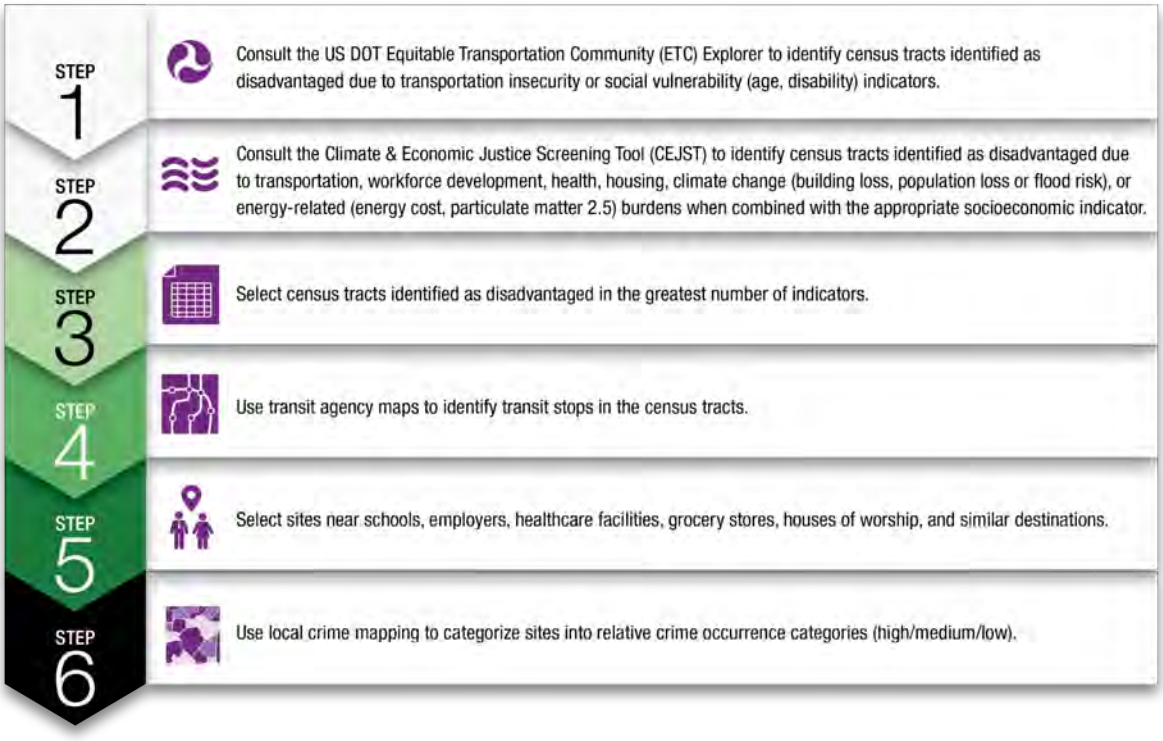


Figure 3.1: Site selection process.

C. Site assessments

Site descriptions

Twelve sites across two transit agencies were selected and assessed for the presence of CPTED features. The sites include bus stops with signposts and shelters, two rail stops, and one surface trolley stop. DOT ETC and CEJST indicators exceeded for the census tract of each transit stop are included in Table 3.1. In addition, each site was referenced against local crime mapping databases and assigned into relative crime occurrence categories based on the number of crimes reported in the default view of the tool over the previous 180 days. [39], [40]

			Indicators exceeded for census tract			
Transit agency	**Site**	**Date assessed**	**DOT ETC**	**CEJST**	**Type of stop**	**Relative crime occurrence (count of crimes reported)**
Transit agency 1	B	1/18/24	1	4	Bus stop with shelter	Medium (2)
	C	1/18/24	1	4	Bus stop (signpost only)	Low (0)
	D	1/31/24	1	0	Bus stop (signpost only)	Medium (1)
	E	1/31/24	1	4	Bus stop (signpost only)	High (4)
	F	1/31/24	1	4	Bus stop (signpost only)	Low (0)
Transit agency 2	G	5/22/24	3	5	Rail with station	Low (0)
	H	5/22/24	3	5	Bus stop (signpost only)	Low (0)
	I	5/22/24	3	4	Bus stop (signpost only)	Medium (2)
	J	7/13/24	3	4	Bus stop with shelter	High (33)
	K	7/13/24	4	4	Rail (platform only; no station)	Medium (2)
	L	7/13/24	1	0	Trolley	Low (0)
	M	7/13/24	5	2	Bus stop with shelter	Low (0)

Site overviews

Sites evaluated included 1 rail stop with a station, 1 rail stop without a station (platform only), 1 surface trolley stop, 3 bus stops with shelters, and 6 bus stops with only a signpost.

Site B. This site is a bus stop with a shelter and bench. The site is near the local transit agency offices and is in an urban area with residential and commercial activity. The site is near a major highway. The site is accessible by the sidewalk network and is adjacent to the parking lot for the transit agency offices.

Site C. This site is a bus stop with only a signpost. The bus stop is in an urban area and very close to a major highway. The bus stop is located near a local shopping center that includes a grocery store. The bus stop is situated below the loading dock for the grocery store. There is no parking associated with this bus stop. The site is accessible by the sidewalk network.

Site D. This site is a bus stop with only a signpost. Located in a mostly residential area, the site is across the street from a local hospital; this side of the hospital has no windows, but does have video surveillance. The site is accessible by the sidewalk network.

Site E. This site is a bus stop with only a signpost. The stop serves multiple bus routes and is located in a commercial downtown area. The site is on a triangular-shaped parcel that is between two downtown thoroughfares. There is no parking associated with this bus stop. The site is accessible by the sidewalk network.

Site F. This site is a bus stop with only a signpost. The site is located on a divided 4-lane road with businesses, fast food, and other commercial activity. One block off of this road is an affordable housing complex which appeared to be boarded up at the time of the site visit. This stop is located adjacent to a low-cost grocery store and across the street from a church. There is no parking specifically for this bus stop, though the nearby grocery store does have a parking lot. The site is accessible by the sidewalk network.

Site G. This site is a stop on a regional rail line that also connects to multiple bus routes. The stop includes a platform and station with a ticket office, ticket kiosk, and restrooms. The stop is located in an urban area with a mix of open and closed small businesses. The rails travel overhead; riders and pedestrians walk under a rail bridge overpass to access the two sides of the tracks. There is no parking specifically for this rail station, though there is a small amount of nearby street parking. The site is accessible by the sidewalk network.

Site H. This site is a bus stop with only a signpost. The site is in an urban area with some small businesses and is across the street from the local government center and adjacent to a small park. There is no parking associated with this bus stop, though there is some on-street parking. The site is accessible by the sidewalk network.

Site I. This site is a bus stop with only a signpost. At the time of the site visit, remnants of a possible former bus shelter were noted. The site is in a mostly residential urban area, across the street from a bodega-type shop and adjacent to an affordable housing complex. There is a school within one block of the site, and a mosque and a church within 2 blocks. There is no parking associated with this bus stop, though there is some on-street parking. The site is accessible by the sidewalk network.

Site J. This site is a bus stop with an old-style, solid-sided metal shelter without windows. The site is located in a residential area, near a major highway, and adjacent to a fire station. Trash and human waste were visible inside the shelter at the time of the site visit. There is no parking associated with this bus stop, though the stop is essentially in the parking lot of the fire station. The site is not served by a sidewalk network and there are no crosswalks to the residential area across the street.

Site K. This site is a stop on a regional rail line. The stop is a platform and has no station building. The site is located in an urban area with a mix of residential and commercial activity. A small parking lot is associated with the rail stop. The area under the platform is easily accessible and partially blocked from view; evidence of human activity (trash, etc.) was visible under the platform. The platform is made of wood; there is a bus stop-type shelter on the inbound side of the platform. The rails travel overhead; riders and pedestrians walk under a rail bridge overpass to access the two sides of the tracks. The site is accessible by the sidewalk network.

Site L. This site is a surface trolley stop at the end of a trolley line. The stop includes a small building with a waiting area; there is no ticket office or kiosk present. The site is located between a commercial area—with strip malls and other businesses on each side of the four-lane road—and a residential area with mostly duplex housing. There is no parking associated with this site. The site is accessible by the sidewalk network.

Site M. This site is a bus stop with a shelter. Damage to the roof of the shelter was noted at the time of the site visit. The site is located on a four-lane road with small businesses and across the street from an affordable housing complex. The site is also adjacent to a community center and across the street from a church. There is no parking associated with this site. The site is accessible by the sidewalk network.

Site assessment checklist

As described in Chapter 2, section B, a field site assessment checklist was developed for use in evaluating CPTED features present at transit stations. The full field checklist (Appendix C) was used to assess sites B-G, K, and L. The streamlined bus stop/bus shelter checklist is provided in Appendix D. The streamlined checklist was used to assess sites H-J and M.

Photographs were taken to document site features. Select photographs are included in Appendix E to this report.

CPTED features at each location were identified as present (P), absent (A), not applicable (N), or unable to assess (U). Rarely, a feature present to some extent was identified as present to some extent (S).

Summary of site assessment findings

Tables of all CPTED element findings are included in Appendix F. Table 3.2 summarizes findings related to CPTED elements in each of the 5 categories present at applicable sites.

Table 3.2: Percent of applicable sites where elements related to maintenance, natural surveillance, access control, activity support, and territoriality were observed.

CPTED Category	Percent of sites where elements of this CPTED category were observed
Maintenance	68.1%
Natural surveillance	51.7%
Access control	37.8%
Activity support	36.4%
Territoriality	24.4%

Across all 12 sites, maintenance and natural surveillance elements were more likely to be observed, while access control, activity support, and territoriality elements were less likely to be observed. The section below addresses in more detail each of the five CPTED elements across the 12 sites assessed.

Maintenance: Buildings and landscaping were generally well-maintained. Turf grass was the dominant landscaping material. Graffiti was rarely found on the many large, flat surfaces (stone walls, etc.), even when they lacked vegetative screens. The team found that long-wearing materials did not necessarily ensure vandal resistance, as some elements, like coated metal shelters, were damaged or scratched. Site L included durable brick and stone walls and glass block windows. The plastic bus shelter roof at site M had a hole. Trash and/or recycling bins were present at all rail and trolley stops, absent at all bus stops (except site H, where a waste bin was associated with an adjacent park), and inconsistently present at bus shelters. The presence of a waste bin did not guarantee the absence of litter. Nine locations included transit agency signage with a hotline or app for maintenance reports; however, the signage did not indicate that the hotline was to be used for reporting maintenance needs. Both rail stations had specific signage for reporting concerns. The bus shelter at site M had no transit agency signage or hotline. Although the adequacy of lighting was not assessed, we noted that the lighting in the underpass at site K was damaged.

Access control: Locking practices, key control, and door alarms were not assessed at any site. Only one site (site K) included station-associated parking; this was a street-level lot with one entrance. At that site, the direction to the train platform was obvious. There was no signage in the parking area that encouraged drivers to lock their cars. Security cameras were not associated with any site in the study, though three (sites B, D, and I) may have been incidentally covered by nearby security cameras not directly associated with the transit stops. Efforts were noted at site G to prevent unauthorized access to non-rider locations: an access tunnel was gated, a bus driver area was secured and unmarked, and locking hardware was visible. There was significant opportunity for unauthorized access below the platform at site K. Across the 12 sites, building window and bus shelter materials varied; glass windows were found at site G while sites K and L had polycarbonate or glass block windows. Sites G and L had architectural or structural features which could allow unauthorized climbing, though no trees were present that would allow similar, unauthorized access at any of the 12 sites.

Natural surveillance (entrances). Bus stops with only a signpost were determined not to have an “entrance.” Blind corners around building entrances were not due to vegetation obstructions, but instead due to the materials used and design of the stations or shelters. The bus shelter at site J was an older design with metal walls and no windows, and the site L trolley station waiting area had blind corners upon entering. The entrances to the platform at rail station site G were

inconsistently marked and could be confusing. At site C, though not associated with the bus stop itself, a nearby grocery store loading dock overlooked the bus stop. This layout meant that anyone behind the solid wall would not be visible to a rider waiting at the bus stop. The adequacy of lighting at entrances was not assessed. No locations included security cameras or human surveillance at entrances.

Natural surveillance (parking areas). Only site K had a station-associated parking lot. This location did not have an emergency call box, mirrors, or any hidden recesses. The adequacy of lighting in the parking lot was not assessed. The bus shelter for site J was located in a large parking lot, though it did not seem that the lot was intended for rider use.

Natural surveillance (inside stations). These elements were deemed not applicable for bus stops with simple signposts. For bus shelters, "inside the station" was considered to be inside the bus shelter. Obstructions to sight lines within stations varied from location to location. The station interior at site G had several obstructions including a stairway that obstructs sight lines and an operator/ticket booth largely covered by blinds and posters. Site G did have two mirrors (convex and half-dome) to improve visibility around obstructions. Additional mirrors could have been useful at this site and at site L to provide visibility upon entrance to the trolley stop shelter building. Where present, stairways and restrooms were open. stairways were generally not enclosed and restrooms, present at site G only, had "zig-zag" entrances to eliminate the need for doors. In-station lighting at sites G and L was adequate to the team and was augmented by light interior paint colors. The team was unable to assess the functionality of the light in the bus shelter at site B. Only one station had a communication system observed during site visits: site B had a visual indicator of arriving buses. If present, wayfinding signage was not lighted. No rail or trolley stations or bus shelters were equipped with emergency call boxes.

Natural surveillance (around stations). The areas around stations and stops were connected to the sidewalk network, but none were connected to other walking or biking trails and no locations had what the team would consider designated "safe routes" other than sidewalks. Sightlines around most stops were clear. At several sites, features were present that blocked sight lines around stations and stops:

- At site L, signage and electrical equipment blocked some sightlines
- At site C, the elevated loading dock adjacent to the bus stop created some blind spots
- Station buildings at sites G and L had some blind spots
- The windowless building near the site F bus stop provided potential hiding locations
- At site K, there were obstructions preventing visibility under the rail platform

No mirrors were used around stations to improve visibility around these obstructions. Landscaping and trees, however, were adequately maintained to not obstruct visibility. A limitation of this work is that site visits were conducted during daytime hours, so the adequacy of lighting around bus stops and rail/trolley stations could not be assessed. No locations included emergency call boxes around the station/stop nor did locations include external building enunciators.

Territoriality. None of the sites assessed included a meaningful transition zone from public areas to the entrance of the bus shelter or rail/trolley station. Full or partial system maps were present at sites G (rail), K (rail), and L (trolley). At the site G rail station, as mentioned previously, the directional signage was inconsistent and confusing. Some locations included signage to deter non-users and non-transit vehicles, though the applicability of "no trespassing" signage at bus stops and shelters in public areas is unclear. Bus stops and shelters were located at typical distances from streets. Only site J included bollards though they did not appear adequate to prevent vehicle ramming.

Activity support. No sites had directly associated restaurants or shops, though several were located near local businesses. Seating was available at bus shelters, rail, and trolley stations. Site G had an indoor seating area that was partially visible to the ticket agent and remained open until mid-day (see "natural surveillance inside stations" above). The seating area at

site L was made somewhat visible to passers-by by removing the doors to the waiting area building; however, the stone building and block glass windows somewhat inhibit visibility into the interior of that building. No facilities had storage lockers. Only one station (site G) had multiple levels, though it was not configured to provide ticket agent visibility from the second level to the waiting areas on the first level.

Comparing policies and design guidelines with site assessment findings

Tables 3.3a and 3.3b compare CPTED elements covered well in transit agency documents with site assessment findings.

Table 3.3a: Comparison of CPTED elements covered well in Transit Agency 1 documents and site assessment findings related to those CPTED elements.

CPTED elements	Site assessment findings related to CPTED elements
Maintenance *Trash receptacles, wear-resistant materials*	Waste receptacles present at 20% of locations Wear-resistant materials present at the only applicable site
Access control *Signage and colorways*	Location/system maps not present at any site Colorways used correspond to the transit agency color scheme
Natural surveillance *Sightlines, direct pathways, lighting*	Sightlines directly associated with the Transit Agency 1 bus shelter and stops were clear; however, nearby non-transit structures can provide hiding locations Pathways were direct (sidewalk network) Street lighting was present near all locations though the adequacy of lighting was not assessed
Territoriality *Signage*	No locations had directional or system signage or “no trespassing signage” 60% of sites had signage to deter non-transit vehicles from the stop area
Activity support *Seating, if stop criteria are met*	Only one site (site B bus shelter) had seating

For Transit Agency 1 sites, there were discrepancies between documented maintenance, access control, and territoriality policies and the actual conditions observed at the 5 sites visited. Facilities not associated with transit stops could impair natural surveillance, though those facilities are likely not in the control of the transit agency. The team did not have ridership information for these sites to assess against transit agency seating criteria. Only the bus shelter at site B included seating.

Table 3.3b: Comparison of CPTED elements covered well in Transit Agency 2 documents and site assessment findings related to those CPTED elements.

CPTED elements	Site assessment findings related to CPTED elements
Maintenance	Where present, buildings were generally well-maintained; landscaping was also well-maintained Bus shelters at sites J and M were damaged or not well-maintained
Territoriality *Signage*	Directional or system signage was present at both rail stations and at the trolley station Standard transit agency colorways were used on signage with the exception of site M which had no transit agency signage Signage to deter non-transit vehicles from stop areas was present at 43% of locations Applicability of “no trespassing” signage at bus stops is not clear
Activity support	No locations included restaurants, food kiosks, newsstands, or similar amenities Seating available at 71% of sites Indoor seating only available at site G; outdoor seating at sites G and H was easily visible; indoor seating at site L not easily visible from outside the building

For sites served by Transit Agency 2, five of the seven sites assessed could be considered well-maintained. Bus shelter structures at sites J and M may be outside the direct control of the transit agency (i.e., they may be the responsibility of the local municipality). Signage is a priority for Transit Agency 1; some transit agency signage was present at all but one location (site M). In most locations, the signage was minimal, consisting only of a standard-sized bus stop sign on a pole or post. System signage at rail and trolley stations was not lighted and may not be helpful at nighttime (though this was not assessed). The installation of signage to deter non-transit vehicles from transit stops/stations may not be at the discretion of the transit agency. Seating was available at five of seven locations. No locations were directly associated with positive activity-supporting facilities.

Tables 3.4a and 3.4b on the following pages compare site assessment findings to CPTED elements found to be unaddressed or not well-addressed in transit agency documents.

Table 3.4a: Comparison of CPTED elements not covered well in Transit Agency 1 documents and site assessment findings related to those CPTED elements.

CPTED elements	Site assessment findings related to CPTED elements
Maintenance *Reporting maintenance needs, requirements for building/ grounds maintenance*	The bus shelter at site B was the only "building"; it was well-maintained; where present at or nearby stops, landscaping was well-maintained The transit agency hotline is posted on standard bus stop signage; the transit agency app was posted at the site B bus shelter; the signage does not explicitly note this is the way to report maintenance needs
Access control *Parking, unauthorized access*	Many aspects of unauthorized access and parking are not applicable to the bus stops and bus shelter assessed No sites had explicit directions on reporting suspicious activity; these reports could be made through the posted transit agency hotline; no sites were susceptible to unauthorized climbing due to nearby columns or trees; aspects of doors, key control, intrusion alarms, emergency access points, and security hardware were not applicable to these sites
Natural surveillance *Blind corners, ground cover, trees, common areas, communication systems*	Blind corners were not an issue at bus stops assessed; nearby non-transit stop-associated structures nearby did provide some blind corners (e.g., sites C and F); ground cover was well-maintained; trees did not impact sight lines at the time of assessments, though in winter, the trees were not in leaf No sites had what the team considered common areas The bus shelter at site B included a visual communication system for arriving buses; the team noted enunciators on buses arriving at sites B, E, and F during site assessments
Territoriality *Barriers along roadways*	No sites incorporated barriers along roadways
Activity support	Site B was near transit agency offices and residences, site C was near a shopping center, site D was in a neighborhood and adjacent to a hospital, site E was between busy downtown roadways, and site F was near businesses along a divided highway (no sites were directly associated with facilities that provided positive activity support)

Despite the lack of information on how to report maintenance needs, sites served by Transit Agency 1 were generally well-maintained. Parking and unauthorized access were generally not applicable to sites served by Transit Agency 1. No requirement was found for the presence of barriers along roadways, and no such barriers were found during site visits. Incidental activity-supporting elements were found at several locations, though these elements were not directly associated with any of the transit stops.

Table 3.4b: Comparison of CPTED elements not covered well in Transit Agency 2 documents and site assessment findings related to those CPTED elements.

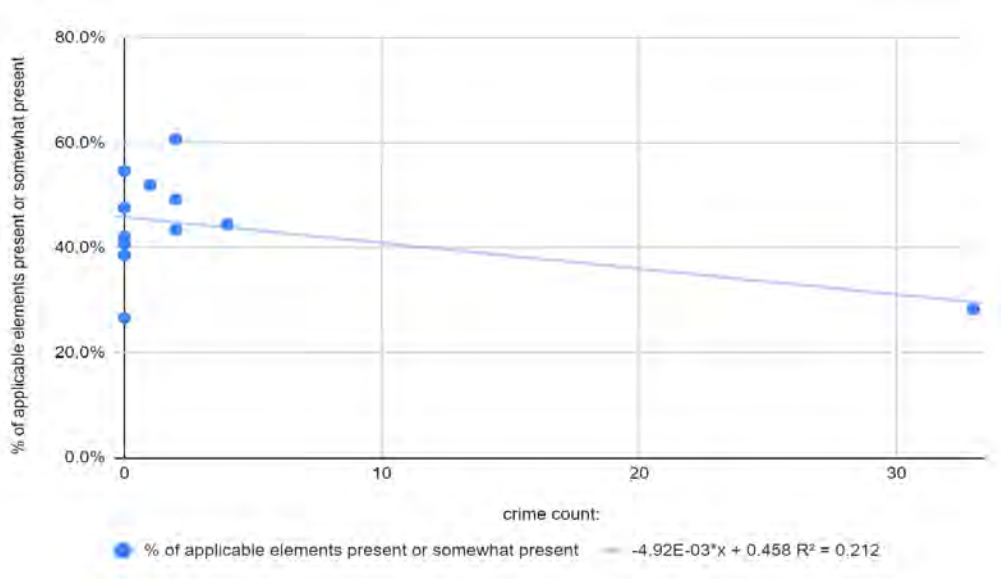
CPTED elements	Site assessment findings related to CPTED elements
Access control *Discouraging unauthorized access*	Sites varied in the presence of CPTED elements that discourage unauthorized access; these elements were deemed not applicable to simple signpost bus stops The site G rail station incorporates signage to discourage unauthorized uses of the station, as well as security hardware in key locations; notably, at site K, people may easily gain unauthorized access to the area under the platform
Natural surveillance *Lines of sight*	In and around stops and stations, there are varying levels of clear sightlines; only one location (site G) used mirrors to assist with interior station sightlines

Though not directly addressed in the documentation provided by Transit Agency 2, features to deter unauthorized access and use of facilities were found. Similarly, the provision of clear sightlines is not required in the documentation provided but some features to enhance sight lines were observed in the field.

Applying CPTED in areas of high and low crime reporting

The team used state and county police crime data to determine the number of reported crimes in the previous 180-day period. All sites but one were characterized by fewer than four reported crimes during this period; half of the sites were in areas with no reported crimes during this timeframe. The site with the highest number of reported crimes (site J) had the second-lowest percentage of applicable CPTED elements "present" or "somewhat present". The correlation between the number of crimes reported and the proportion of applicable CPTED elements present is not particularly strong (Figure 3.2). Removing site J (33 crimes reported in the 180-day period reviewed) weakens the correlation even further.

Figure 3.2: Percent of applicable elements present/somewhat present vs. count of crimes at sites in the study.



Based on the relatively small sample size (12 sites) the team did not find a clear correlation between lack of CPTED elements and higher rates of reported crime. The Pew Research Center notes that violent and property crimes are likely

underreported.[41] Unreported offenses contribute to the “dark figures” of crime; crimes that are unreported cannot be investigated, resolved, or studied. Though exploration of crime reporting rates is beyond the scope of this work, it is important to note that gender, socioeconomic status, varying perspectives on and experiences with law enforcement, an individual’s status as a member of a marginalized group, whether the victim knows the offender, the seriousness of the crime, the cost and benefit of reporting, and additional factors combine to paint a complex picture of willingness to report crimes. [42], [43]

Chapter 4: Gaps in CPTED implementation and opportunities to apply CPTED principles

The findings presented in this chapter should be considered preliminary. Additional sites will be evaluated in the future, adding to the body of knowledge in this area.

A. Opportunities to further implement CPTED principles in public transit infrastructure

Opportunities to further implement CPTED principles are presented within the five CPTED elements used throughout this report. The team understands there are likely financial considerations, local architectural standards, and other real-world considerations that would influence further CPTED implementation. In addition, the team anticipates varying ease of implementation where transit infrastructure and related elements are on public property as compared to private property. Though the team did not investigate these areas, there may also be conflicts between CPTED best practices and traffic safety standards.

These assessments were conducted as part of this SMARTER Center US DOT UTC project. The information contained herein is based on guidelines set by the research group and documents the observations of the individuals conducting the assessments. This work is intended to assist in improving the overall level of security only. It is not intended to imply the existing security measures, or proposed security measures, are absolute or perfect.

Maintenance

At every station, the transit agencies may want to consider providing a clear method for riders to report maintenance needs. Transit Agency 1 staff mentioned that bus drivers are able to report maintenance needs. Riders may also provide additional information not observed by drivers. In addition, the consistent availability of waste and recycling bins, perhaps with signage to encourage their use, could reduce litter and allow transit infrastructure to appear cared for. As noted in Chapter 3 and Appendices E and F, there are specific maintenance needs noted for several of the sites visited.

Access control

Transit agencies may want to provide a clear method for riders to report unauthorized activity. This could be incorporated in standard transit agency signage as signs are updated or replaced. Security cameras were not directly associated with any transit infrastructure; Transit Agency 2 staff mentioned that security cameras are near the top of their “wish list”.

Natural surveillance

Transit agencies, in consultation with local municipalities, may consider decommissioning solid-sided shelters like the one in disrepair and unauthorized use at site J. The additional use of security mirrors could provide additional sight lines around obstructions. To promote additional “eyes on the street”, signage connecting transit infrastructure to local bike trails could be posted.

Territoriality

Transit agencies may wish to review station signage. If the signage has been installed over time, it may be inconsistent, inaccurate, or confusing. System maps or partial route maps could be posted on placards at bus stops, in bus shelters, or promoted on bus stop signage via QR code linking to the transit agency app or route map.

Activity support

None of the transit infrastructure could accommodate “activity support” as envisioned by the CPTED checklist. These elements are more applicable to larger stations that include shopping and restaurants, for example. Transit agencies would need to be creative and work with communities to implement positive activity support at bus stops.

B. CPTED implementation and crime reporting

The data gathered for the 12 sites in this study did not show higher levels of reported crime near transit infrastructure with fewer CPTED features present. However, transit agencies may wish to investigate crime reporting data further in conjunction with local or transit agency police to prioritize additional CPTED elements in areas with higher levels of reported crime. Rider surveys, such as the one underway by Transit Agency 2, may also be valuable in gathering information on rider perception of safety to shine additional light on the “dark figures” of crime.

Chapter 5: Engaging civil engineering students in public transit equity via CPTED integration into coursework

A. Overview of course

CIEG411 (Communicating with Stakeholders in Engineering) has been a required part of the civil engineering undergraduate curriculum at the University of Delaware since Spring 2021. This course, typically taken by second-year undergraduate civil engineering students, follows two other technical communication courses: COMM212 and ENGL410.

By the end of this course, students will be able to:

1. Explain the importance of meaningful communication in civil and environmental engineering
2. Demonstrate a working knowledge of different tools and methods of oral and written communication used by practicing civil and environmental engineers
3. Assess engineering projects to identify stakeholders and appropriate methods of communication
4. Create a variety of communication products to support projects, engage stakeholders, and generally support sound decision-making

The course topics include stakeholder identification, public engagement in civil engineering projects, communicating about risk, crisis communication, and more. Additional background is available on the components and motivation for developing and offering this course.[44], [45] As part of the course, students complete a semester project that requires students, in small groups of 4-5 students, to assemble a communication plan for a simple civil engineering project. The communication plan includes a stakeholder analysis, message maps, a communication schedule, outreach materials, and a plan to evaluate communication effectiveness. Students also present their project in a mock public meeting at the end of the semester.

B. CPTED incorporated into the semester project

In spring semester of 2024, all student group projects focused on CPTED and public transit. Seven bus stops, including stops on University transit routes and local public transit authority bus routes around the UD campus, were evaluated using an abbreviated CPTED checklist (Appendix G). Modifications and potential CPTED improvements related to lighting, accessibility, maintenance, and natural surveillance were identified for each location. All projects are realistic but hypothetical and are referred to in class and in the remainder of this section as “notional.” The notional project assignment included the communication of impacts of the proposed improvements as well as the ancillary impacts on parking and bus routes. Student groups then developed a communication plan for notional work at one of these bus stops.

The choice of bus stops at locations around campus is purposeful. The course was designed to accommodate the limited engineering course experience of second-year students. Bus stop infrastructure is easy to understand, and locations are easy to visit for context.

As a precursor to assigning the project, a lecture module on CPTED principles was presented. CPTED and safety as a means of expanding the use of public transit were key motivational factors for each of these projects.

C. Locations selected

Figure 5.1, below, represents the locations of the bus stops assessed and included in this class project:

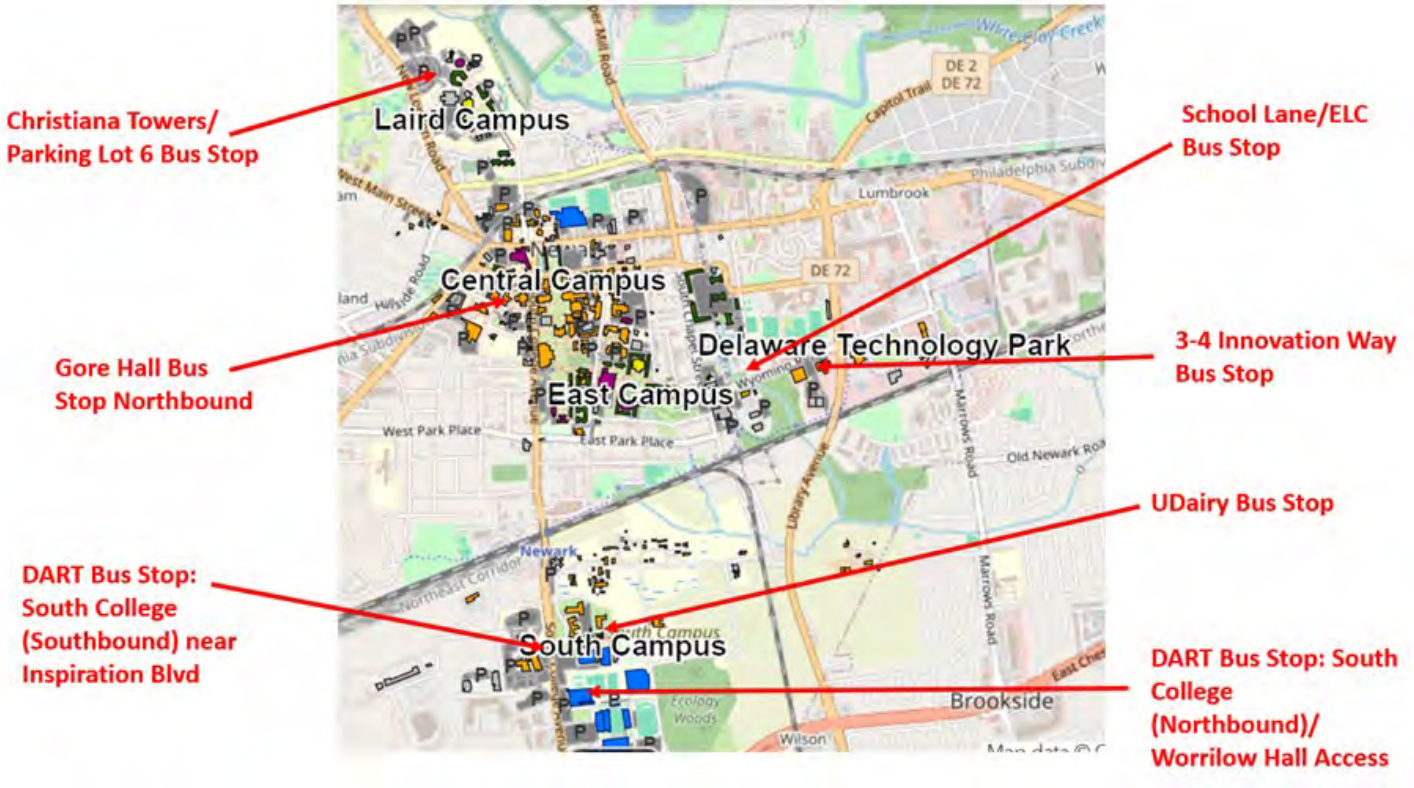


Figure 5.1: Locations used for CIEG411 CPTED communication project.

The following section expands on the proposed work for each location:

1. Bus stop on South College Ave at Gore Hall (northbound side)

A preliminary CPTED assessment was conducted for the bus stop at Gore Hall on the northbound side of South College Avenue. As a result of the assessment, additional lighting will be added, concrete security planters will be added near the curb, and benches will be installed along the wall of Gore Hall. In addition, mirrors will be added to enhance the visibility of areas obscured by partial brick walls and arches. The project is expected to take 6 months, during which time the bus stop will move south on North College Avenue to Kent Way.

2. Bus stop near UDairy

A preliminary CPTED assessment was conducted for the bus stop near the UDairy on South Campus. As a result of the assessment, the shelter will be repaired to improve visibility through the sides of the shelter, additional lighting will be provided, and the site will be made ADA-accessible. Native plants that will not obstruct visibility will be planted around the site. Waste receptacles will be provided and a plaque with a map of South Campus facilities will be installed. The project is expected to take 6 months, during which time the bus stop will move in front of the Rust Ice Arena and the UDairy visitor parking spaces will be unavailable.

3. Bus stop in Christiana Towers lot (parking lot 6)

A preliminary CPTED assessment was conducted for the bus stop in parking lot 6 on Laird Campus near the Christiana Towers. As a result of the assessment, the bus shelter island will be upgraded to include a new shelter with clear walls for improved visibility, repairs to the masonry paths and steps, and inviting landscaping. In addition, the new stop will be made ADA-accessible and safe walking paths to connect the bus stop to the buildings on Laird Campus will be installed. The project is expected to take 6 months, during which time the bus stop will move to the side of George Read Hall that is across from parking lot 8.

4. Bus stop near 3 and 4 Innovation Way

A preliminary CPTED assessment was conducted for the bus stop near buildings 3 and 4 on Innovation Way in Delaware Technology Park off of Wyoming Road. As a result of the assessment, an emergency callbox, lighting, and waste receptacles will be added. In addition, the new stop will be made ADA-accessible and wayfinding signage for Delaware Technology Park will be added. The walking path to the pond will be replaced with permeable pavement and picnic tables will be added nearby. The project is expected to take 6 months, during which time, access to parking lots near buildings 3 and 4 will be interrupted.

5. New bus stop on Wyoming Road to serve School Lane Apartments and Early Learning Center

A new bus stop with a shelter will be built on Wyoming Road across from the Early Learning Center (ELC) near School Lane Apartments. The current bus stop on Wyoming near Yale consists of only a signpost. The new bus stop will be ADA accessible, be equipped with an emergency call box, waste receptacles, and a shelter with seating and USB outlets. Lighting will be added to the pedestrian paths between Wyoming Road and Duke Street. During the 6-month project, access to School Lane apartments via Yale Drive will be limited during work hours; residents will need to enter via Duke Street.

6. Bus stop on S. College near Inspiration Blvd (southbound)

The bus stop on South College near the Newark Train Station lacks a connection to the surrounding buildings. A 6-month long project will provide these connections by installing a safe walking path from the bus stop to the nearby train station parking lot, temporarily interrupting traffic in the parking lot. This path will include bollard lighting to note it as a safe path. A kiosk that includes a map of South/STAR Campus facilities and an emergency call box will also be installed. During the construction, riders will be able to access the bus stop, but will need to take a longer path from the parking lot.

7. Bus stop on S. College near College of Agriculture (northbound)

This project is an upgrade to the bus stop behind Worrilow Hall at College of Agriculture and Natural Resource (CANR) on S. College. The current bus shelter will be upgraded to match the one across the street (see project 6, above) with bench seating and USB charging ports. In addition, the path connecting the stop to Worrilow Hall will be temporarily closed to allow for installation of bollard lighting along the path, which will ensure pedestrian safety. A kiosk that includes a map of South/STAR Campus facilities will be installed near the existing emergency call box. During the 6-month project, riders will need to board at a temporary stop farther north, directly across from the project 6 location mentioned above.

The following disclaimer was included in the project assignment:

Disclaimer: The preliminary surveys were conducted as part of a SMARTER Center DOT UTC project and is intended for use in CIEG411 projects during the Spring 2024 semester. The information contained herein is based on guidelines set by the research group, as modified for this class assignment, and documents the observations of the individuals conducting the survey. CPTED surveys are intended to assist in improving the overall level of security only and are not intended to imply the existing security measures, or proposed security measures are absolute or perfect.

D. Overview of project and presentations

The table below summarizes each part of the project. The project was completed in sections throughout the semester and included both group activities and individual assignments.

Table 5.1: CIEG411 CPTED communication project elements and descriptions.

Project element	Description
1. Stakeholder analysis	Groups create a stakeholder analysis to help identify messages for the message map (element 3) and, ultimately, the outreach materials. As part of the stakeholder analysis, students use American Community Survey Data, the US DOT Equitable Transportation Community (ETC) Explorer, EPA's EJSCREEN, local media reports, stakeholder interviews, and a site visit.
2. Communication schedule	Groups develop a schedule for delivering written products and presentations related to the project.
3. Message maps	Groups develop message map to organize responses to likely stakeholder questions. Message maps then serve as the foundation for written products and presentations (elements 4, 5, and 7).
4. Written products: FAQ, Google site, social media posts	Individually, students create one *frequently asked questions* (FAQ) document, one Google site, and 5 social media posts using messages from the message map, targeted to stakeholders identified in element 1, applying principles of effective communication.
5. Presentation slides & poster for public meeting	Individually, students create a set of slides and a poster for a notional public meeting that are appropriate for expected stakeholders in attendance.
6. Evaluation plan using logic model	Individually, students create a plan to evaluate the effectiveness of communication activities.
7. Group poster presentation	Students give a group poster presentation at a mock public meeting at the end of the semester.

Each element was graded using an "EMRI" mastery-grading rubric, specific to each element of the assignment:

E = Excellent/exceeds expectations
M = Meets expectations
R = Revision needed
I = Significantly incomplete

This project was developed to foster students' communication abilities in engineering projects, with a particular focus on stakeholder engagement. By the end of the project, the seven elements formed a comprehensive, cohesive project communication plan.

Though it was not a formal part of the project assignment, student group presentations were assessed for a correct understanding of CPTED and its centrality to the project. In the presentations:

- Two out of 12 groups noted the connection between improved safety and transit use. Though CPTED was not explicitly mentioned by group 9, an “assessment” was mentioned in the presentation and the group made the connection between improved safety and an “inviting” public transit stop. Group 2 mentioned CPTED specifically and linked it to an increased desire to ride transit.
- Five out of 12 groups specifically mentioned “CPTED” as a motivational factor for these projects.
- One out of 12 groups at least briefly described CPTED principles effectively. Group 1 mentioned CPTED in the context of improved safety, but also expanded upon the role of aesthetics and visibility in CPTED.
- Three out of 12 groups mentioned safety as a motivational factor for these notional projects.
- One of the 12 groups missed the point of the project in their final presentation. The group mentioned visibility in terms of the bus stop being noticed, but not in terms of people being seen by or seeing others while waiting for the bus.

The semester project in this class is intended to give civil engineering undergraduates an intense and immersive communication experience. This semester, the project also introduced students to CPTED as a specific way to improve the safety of—and equitable access to—public transportation. Most presentations included concepts of CPTED and safety in their presentations. This is a contribution to the development of the civil engineering workforce and integration of safety and equity concepts into civil engineering coursework.

Chapter 6: Dissemination of findings

As of the date of this report, dissemination of findings has been limited. The table below summarizes outreach efforts to date. Additional efforts to engage the broader community will continue.

Date	Brief description of dissemination efforts
Various dates October 2023-January 2024	Meetings with transit agency staff to provide background on CPTED and the project
Ongoing February - May 2024	Engagement of civil engineering undergraduate students on CPTED as part of class project as described in Chapter 5
January 18, 2024	Posts on X and LinkedIn about project fieldwork
May 22, 2024	Posts on X and LinkedIn about project fieldwork
May 31, 2024	Submitted article proposal for incorporation in the International CPTED Association (ICA) quarterly newsletter
May-June 2024	Work with graphic designer to develop project graphics for outreach
June 20, 2024	Summary of site assessment findings provided to Transit Agency 1 staff; offered to meet with transit agency staff, managers, and stakeholders
August 26, 2024	Summary of site assessment findings provided to Transit Agency 2 staff; offered to meet with transit agency staff, managers, and stakeholders

References

[1] *DP03 Selected Economic Characteristics*. Available: https://data.census.gov/table?q=DP03.

[2] *Expanding Access*. Available: https://www.transportation.gov/priorities/equity/equity-action-plan/expanding-access.

[3] *US Department of Transportation Equity Action Plan*. Available: https://www.transportation.gov/priorities/equity/equity-action-plan.

[4] *Food Deserts*. Available: https://foodispower.org/access-health/food-deserts/.

[5] G. Sansom and B. Hannibal, "Disparate access to nutritional food; place, race and equity in the United States," *BMC Nutrition,* vol. 7, 2021. Available: https://doi.org/10.1186/s40795-021-00434-2.

[6] D. Baek, "The effect of public transportation accessibility on food insecurity (working paper 2012-02)," January. 2013.

[7] A. L. Cochran *et al*, "Transportation barriers to care among frequent health care users during the COVID pandemic," *BMC Public Health,* vol. 22, 2022. . DOI: https://doi.org/10.1186/s12889-022-14149-x.

[8] M. K. Wolfe, N. C. McDonald and G. M. Holmes, "Transportation Barriers to Health Care in the United States: Findings From the National Health Interview Survey, 1997–2017," *American Journal of Public Health,* vol. 110, pp. 815–822, 20202. DOI: https://doi.org/10.2105/AJPH.2020.305579.

[9] M. E. Cyr *et al*, "Access to specialty healthcare in urban versus rural US populations: a systematic literature review," *BMC Health Services Research,* vol. 19, 2019. DOI: https://doi.org/10.1186/s12913-019-4815-5.

[10] J. R. Clay and J. L. Valentine, "Impact of transportation supports on students' academic outcomes: A quasi-experimental study of the U-pass at Rio Hondo College," Sept. 2021.

[11] US Department of Education, "Profile of undergraduate students: Attendance, distance and remedial education, degree program and field of study, demographics, financial aid, financial literacy, employment, and military status: 2015–16 (NCES 2019-467)," Jan. 2019.

[12] J. Mengedoth, "Transportation access as a barrier to work," 2023.

[13] The Leadership Conference Education Fund, "Getting to work: Transportation policy and access to job opportunities," Jul. 2011.

[14] *Justice40*. Available: https://www.whitehouse.gov/environmentaljustice/justice40/.

[15] US Department of Transportation, "Equity action plan 2023 update," Sept. 2023.

[16] *Primer in CPTED - What is CPTED?*. Available: https://www.cpted.net/Primer-in-CPTED.

[17] G. Saville and G. Cleveland, "2ND GENERATION CPTED: An antidote to the social Y2K virus of urban design," in *21st Century Security and CPTED*, 2008, pp. 79–90.

[18] *A Brief History of the ICA*. Available: https://www.cpted.net/A-brief-history.

[19] City of Abbotsford, "Crime prevention through environmental design (CPTED)," 2013.

[20] City of Branson Missouri, "CPTED Home Security Checklist," n.d.

[21] Centers for Disease Control and Prevention, "Crime prevention through environmental design (CPTED) school assessment (CSA)," May. 2017.

[22] American Public Transit Association, "Crime prevention through environmental design (CPTED) for transit facilities (APTA SS-SIS-RP-007-10, rev. 1)," Sept. 2020.

[23] L. Sanders, "How safe do U.S. adults believe public transportation in cities is from crime?" *YouGov*, 2023. Available: https://today.yougov.com/travel/articles/45079-how-safe-do-us-adults-believe-public-transportatio.

[24] A. Izaguirre, "New York will send National Guard to subways after a string of violent crimes," *Associated Press*, 2024. Available: https://apnews.com/article/new-york-city-subway-national-guard-crime-f046ecaac79601f6113efa8a0c8f25c7.

[25] J. Zeglen, "After rash of shootings, more policing pledged ," *The Philadelphia Inquirer*, 2024. Available: https://www.inquirer.com/newsletters/morning/philadelphia-shooting-septa-bus-northeast-high-school-20240307.html.

[26] A. Gordon, "You Don't Have to Be Afraid of Public Transit," *Vice*, 2021. Available: https://www.vice.com/en/article/3aq948/you-dont-have-to-be-afraid-of-public-transit.

[27] B. Hogan and D. Meyer, "Cuomo says he's 'not telling my child to ride the subway' in slamming MTA safety," *New York Post*, 2021. Available: https://nypost.com/2021/05/03/cuomo-not-telling-my-child-to-ride-the-subway-in-slamming-mta-safety/.

[28] G. Currie, A. Delbosc and S. Mahmoud, "Factors Influencing Young Peoples' Perceptions of Personal Safety on Public Transport ," *Journal of Public Transportation*, vol. 16, 2013. . DOI: https://doi.org/10.5038/2375-0901.16.1.1.

[29] V. Stjernborg, "Triggers for feelings of insecurity and perceptions of safety in relation to public transport; the experiences of young and active travellers," *Applied Mobilities*, 2024. DOI: https://doi.org/10.1080/23800127.2024.2318095.

[30] I. G. Zambrana and S. Khan, "Active Transportation and Perceptions of Safety: A Case Study of a Regional Trail and a Transit Corridor in Salt Lake City, Utah," *Focus*, vol. 14, 2018. Available: https://digitalcommons.calpoly.edu/focus/vol14/iss1/14.

[31] (n.d.). *Security Events of Crime by Transit Mode*. Available: https://www.bts.gov/content/reports-violent-crime-property-crime-and-arrests-transit-mode.

[32] J. A. Kingson, "Violent assaults on transit workers are on the rise," *Axios*, 2024. Available: https://www.axios.com/2024/01/22/crime-violence-public-transportation-statistics-workers.

[33] American Public Transit Association, "APTA public transportation ridership update," Apr. 2024.

[34] Washington Metropolitan Area Transit Authority, "Station Site and Access Planning Manual," May, 2008.

[35] WSP and East-West Gateway Council of Governments, "Metrolink system-wide security assessment best practices report," Nov. 2018.

[36] *ETC Explorer*. Available: https://www.transportation.gov/priorities/equity/justice40/etc-explorer.

[37] (n.d.). *Climate and Economic Justice Screening Tool*. Available: https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.

[38] J. R. Biden Jr., "Executive Order on Tackling the Climate Crisis at Home and Abroad," 27 Jan, 2021.

[39] (n.d.). *NCCPD Crime Map*. Available: https://www.arcgis.com/apps/webappviewer/index.html?id=469b2d2fd85a485783a9caff97f72b3f&extent=-8493087.8465%2C4741104.1949%2C-8339602.2937%2C4872423.0095%2C102100.

[40] (n.d.). *Pennsylvania Uniform Crime Reporting System*. Available: https://www.ucr.pa.gov/PAUCRSPUBLIC/Home/Login?ReturnUrl=%2fPAUCRSPUBLIC%2fCrimeAnalytics%2findex.html.

[41] (April 24,). *What the data says about crime in the U.S.* Available: https://www.pewresearch.org/short-reads/2024/04/24/what-the-data-says-about-crime-in-the-us/.

[42] H. Zaykowski, L. M. Campagna and E. C. Allain, "Examining the Paradox of Crime Reporting: Are Disadvantaged Victims More Likely to Report to the Police? Author(s)," *Law & Society Review*, vol. 53, *(4)*, pp. 1305–1340, 2019. Available: https://www.jstor.org/stable/45284592.

[43] A. A. Asiama and H. Zhong, "Victims rational decision: A theoretical and empirical explanation of dark figures in crime statistics," *Cogent Social Sciences*, vol. 8, *(1)*, 2022. . DOI: 10.1080/23311886.2022.2029249.

[44] J. P. Saxe, "Teaching empathy through a stakeholder-focused engineering communications course," *Paper Presented at Middle Atlantic ASEE Section Spring 2021 Conference, Virtual*, pp. 1–6, 2021. Available: https://peer.asee.org/36321.

[45] J. P. Saxe, "A model for improving stakeholder-focused communication in undergraduate civil engineering," *Paper Presented at 2023 Fall Mid Atlantic Conference: Meeting our Students Where they are and Getting them Where they Need to be, Ewing, New Jersey.*, 2023. . DOI: https://peer.asee.org/45112.

Appendix Contents

CPTED at Public Transit Stations - Site Safety Plan

Non-Facility Specific Safety Plan

- **Wear appropriate Personal Protective Equipment (PPE)**
    - High-visibility vests
    - Closed-toe shoes
    - Sunglasses (if needed)
    - Sunscreen
    - Appropriate attire for weather conditions
    - Water
    - Facemasks (if needed/COVID-19)
    - First aid kit
    - Safety glasses
- **Carry identification**
    - License
    - Student Identification
- **Contact appropriate ownership before conducting the survey**
    - Owners may include transit agencies, state DOTs, universities, and other private entities
- **Always notify the principal investigator when the team will be conducting surveys**
    - Inform PI of departure time, estimated arrival time and survey and anticipated return time. Alert PI upon return to campus.
    - Provide PI or other on campus personnel of phone number for a point of contact on the trip.
    - Alternatively, schedule site visits with the principal investigator present.
- **Schedule site visits preferably when transit is in service.**
    - Use existing timetables and schedules to understand when vehicles are approaching facilities
        - This is for *both* team safety for approaching vehicles and comprehending how transit operators use the facility
- **Carry available principal investigator and project information for law enforcement and transit employees.**
    - Provides context for why the team is on the site if questioned.
    - Wear UD gear, if possible.
- **Have police/facility security hotlines and numbers on record for use, if necessary.**
- **When arriving at the site, note all facility entrances and exits.**
- **Stay in the vicinity of teammates at all times.**
    - Alert others when leaving their proximity to conduct other portions of the survey
- **If other pedestrians are on the site, refrain from taking photographs with them.**
    - If you need to photograph structural elements in their vicinity, **always ask permission to move or take photos first.**
- **Do not walk backwards when taking photos.**
    - This will help you to avoid tripping and other hazards.

Bus Stops/Shelters

- **Do not cross roadways unless at designated crosswalks or when traffic signals permit.**
    - Must wear high-visibility vests if surveying along roadway shoulders
- **When surveying curbs and other elements close to roadways, have one team member be a spotter for oncoming traffic.**
    - Must wear high-visibility vests if surveying along roadway shoulders
- **Keep surveying along roadway pavement as minimally as possible.**
    - If an element of the study needs to be studied from the roadway, plan how it will be conducted with teammates first to monitor traffic properly
- **Keep clear of all boarding and alighting passengers at bus stops at all times.**
    - Refrain from becoming a nuisance to commuters and operators utilizing the facility.

Train Stations & Platforms:

- **DO NOT enter any private spaces without the permission of the transit agency.**
    - ***Includes:***
        - Tracks
        - Land adjacent to track right-of-way, off of platforms
        - Non-public Stationhouse Spaces
- **If transportation or law enforcement workers are around, communicate to ask for permission or provide project and consent documentation.**
    - If there are issues, address all problems to the principal investigator.
- **If surveying requires a team member to be close to active train tracks, always have one teammate monitoring train traffic.**
    - Consult timetables for awareness of when trains may be arriving/departing/passing through.
- **When trains are approaching, be sure to clear at least 20 feet of clearance between you and the edge of the platform**
    - AMTRAK passing trains approach Newark and Claymont at over 120 and 80 mph, respectively.
    - Gravel, dust, and earth may lift from under trains from high winds.
- **Keep clear of all boarding and alighting passengers at train stations at all times.**
    - Refrain from becoming a nuisance to commuters and operators utilizing the facility.

BLANK CPTED "Principles In Use" Analysis Form

* Adapted from APTA SS-SIS-RP-007-10

Use this form to assess transit agency design guidelines against CPTED principles.

Maintenance

Spaces have a sense of ownership and intended purpose through appropriate upkeep; easy-to-maintain materials are selected

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Building is well-maintained.			
□ Landscaping is well-maintained			
□ Wear-resistant materials; avoid flat or porous finishes in areas where graffiti is likely to be a problem. Vegetative screens for large, flat walls.			
□ Common areas and/or street furniture made of long-wearing, vandal-resistant materials and are secured or removed after hours.			
□ Underpass and passageway illuminations are vandal-resistant.			
□ Waste receptacles are available in appropriate locations.			
□ There is a method for riders to report maintenance needs.			

Access control

Entry points are clear, people know where to go, and unauthorized access is deterred

Element*	Found in transit agency design guidelines?	Location/citation	Notes
Wayfinding and signage to promote safety			
□ Location maps (fixed plaque format) and directional signage are provided at public entry points and along internal public routes of travel.			
□ Strong colors, standard symbols and simple graphics are used for informational signs.			
□ Upon entering the parking area, both pedestrians and drivers can get a clear understanding of the direction to stairs, elevators and exits.			
□ In multi-level parking areas, creative signage is used to distinguish among floors to enable users to easily locate their cars.			
□ Users are advised of security measures that are in place and where to find them			
□ Signage is provided in the parking area advising users to lock their cars.			
□ Where exits are closed after hours, this information is indicated at the parking area entrance.			
□ Instructions are posted or broadcast on how to report suspicious activity.			
Entry			
□ The number of pedestrian entry points is			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
minimized.			
□ Vehicle entrances are kept to a minimum.			
Discourage unauthorized access			
□ Consider using thorny plants as an effective barrier.			
□ Large trees, garages, utility structures, fences and gutters are not located next to second-story windows or balconies that could provide a means of access.			
□ There is some kind of active surveillance (CCTV, alarm systems, guard service or police patrols).			
□ Floor-level windows are made of lexan, polycarbonate, etc.			
□ Doors to critical areas are secured, or have access control.			
□ The facility practices key control and/or inventory control; locking systems are tamper-proof			
□ Consider the use of security hardware and/or human measures to reduce opportunities for unauthorized access.			
□ Off-hour waiting areas are clearly marked, visible to customers and equipped with CCTV and intercom system.			
□ Nonpublic facilities are hidden and not identified.			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Intrusion alarms are installed at access points to nonpublic areas.			
□ Access to land below structure is restricted, where possible.			
□ Emergency and maintenance access points are limited.			
□ Emergency and maintenance access points are secured with gates, locks or other access control measures.			
□ Columns are made difficult to climb (by choice of materials, dimensions or barriers such as fences).			

Natural surveillance

Physical features are placed to maximize visibility; appropriate lighting and communication systems are available

Element*	Found in transit agency design guidelines?	Location/citation	Notes
Clear lines of sight			
□ Sight lines around the station are unobstructed.			
□ Entrances are clearly identified (from the street/parking lot/etc.)			
□ Pathways are direct. All barriers along pathways are permeable (see-through), including landscaping, fencing, etc.			
□ Station is connected to walking and/or biking paths/trails.			
□ Consider the installation of mirrors to allow users to see ahead of them and around corners.			
□ Large expanses of parking are avoided. Where large expanses of parking are proposed, provide surveillance such as security cameras.			
□ Access to elevators, stairwells and pedestrian pathways is clearly visible from an adjacent parking area.			
□ Kiosks, ads and other information are positioned so they don’t disrupt sight lines.			
□ Columns and blind corners are minimized.			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Operator booth is positioned for maximum presence and visibility within station.			
□ Hidden recesses are avoided.			
□ Dumpster enclosures are designed and located to screen refuse containers without providing opportunities to hide.			
□ There are no obstructions that prevent visibility through windows.			
□ Entrances are designed to allow users to see into them before entering.			
□ Front fences are predominantly open in design; high solid front fences are designed in a manner that incorporates open elements to allow visibility above the height of 5 feet.			
□ Security bars and security doors should be visually permeable (see-through).			
□ Information centers, ticket vending machines and concessions are placed so as not to obstruct sight lines.			
□ Bathroom doors are locked open during business hours.			
□ Cul-de-sacs and alcoves are avoided.			
□ Transparent materials are used to enhance sight lines and enhance security.			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Appropriate surveillance is provided at entrances, at access points to nonpublic areas and throughout the station.			
□ For elevated structures: clear sight lines are provided under and around the structure.			
Vegetation			
□ Low-growth vegetation is used to prevent blind corners.			
□ Trees with dense, low-growth foliage are spaced, or their crowns are raised to avoid a continuous barrier.			
□ Low groundcover, shrubs a maximum of 24 inches in height, or high-canopied trees (clean trimmed to a height of 8 feet) are used around parking areas and along pedestrian pathways.			
□ Vegetation that conceals the building entrance from the street is avoided.			
Visibility into common areas			
□ Active uses or habitable rooms are positioned with windows adjacent to main common/open space area.			
□ Waiting areas and external entries to elevators/stairwells are located close to areas of active use to make them visible from the building entry.			
□ Parking areas are located in locations that can be observed by adjoining areas.			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Stairways are left open to increase visibility.			
□ Bathrooms are located near a highly traveled part of the station, not in a remote area.			
Lighting			
□ Adequate lighting is provided in hallways, restrooms, stairways and work areas.			
□ Wayfinding signage is lighted.			
□ Lighting plan is prepared in accordance with Illuminating Engineering Society of America (IESA) Standards, which addresses project lighting in a comprehensive manner. Lighting approach is consistent with local conditions and crime problems.			
□ Elevated light fixtures (poles, light standards, etc.) are located in a coordinated manner that provides the desired coverage. The useful ground coverage of an elevated light fixture is roughly twice its height.			
□ For areas intended to be used at night, lighting supports visibility. Where lighting is placed at a lower height to support visibility for pedestrians, it is vandal-resistant.			
□ Inset or modulated spaces on a building façade, access/egress routes and signage are well lit.			
□ In areas used by pedestrians, lighting shines on pedestrian pathways and possible entrapment spaces.			
□ Lighting takes into account vegetation, in both its			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
current and mature forms, as well as any other element with the potential for blocking light.			
□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety. If danger spots are usually vacant at night, then avoid lighting them and close them off to pedestrians.			
□ “Safe routes” are selected and lit so that these become the focus of legitimate pedestrian activity after dark.			
□ Light standards and electrical equipment are located away from walls or low buildings to avoid climbing opportunities.			
□ Photoelectric rather than time switches are used for exterior lighting.			
□ In areas used primarily by older people, higher levels of brightness are provided in public/common areas.			
□ Street entrances are well illuminated.			
□ Walls are painted or tiled in a reflective material to increase illumination.			
□ Where possible, stations/terminals have open shafts or skylights to bring in natural light.			
□ Bright paint colors are used to increase ambient lighting.			
□ Sufficient lighting is provided for nighttime surveillance.			

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Backup emergency lighting is installed.			
□ Adequate lighting is provided for surveillance.			
Communication systems			
□ There is an integrated communication system throughout the building.			
□ Train enunciators, visual and audio, in stations alert customers of arrivals and minimize time spent on isolated platforms or mezzanines.			
□ Communication links to administrative and emergency response centers are provided.			
□ Emergency call boxes are provided to report incidents.			

Territoriality

Users and non-users are aware of the boundaries of a space/area/facility, creating a deterrent to crime

Element*	Found in transit agency design guidelines?	Location/citation	Notes
Signage			
□ There is signage to reinforce transition zones and give direction.			
□ Entrances are easily recognizable through design features and directional signage.			
□ “No Trespassing” signage is provided where applicable.			
□ Signage deters nontransit vehicles from the stop area.			
Transition into controlled area			
□ Transitional zones are clearly marked (for movement into controlled area).			
□ Structures are set back from roads and parking areas, if applicable.			
□ Physical barriers such as bollards, road spikes, and fencing enforce setbacks and/or prevent ramming.			
□ Adjacent roadways are designed to inhibit high-velocity ramming of columns.			

□ Physical barriers such as bollards and fencing are provided … if the stop has a segregated transit way.			

Activity support

The community and ridership understand an area's intended use (authorized activities in a common space), creating a deterrent to criminal acts

Element*	Found in transit agency design guidelines?	Location/citation	Notes
□ Food kiosks, restaurants, etc. are included within parks and parking structures, if applicable.			
□ Open spaces are clearly designated and situated at locations that are easily observed by people. Parks, plazas, common areas and playgrounds are placed in the front of buildings. Shopping centers and other similar uses face streets.			
□ Seating is located in areas of active use.			
□ Storage and baggage lockers are not incorporated in station design.			
□ Where allowed by city code, ticket kiosks and shops are located on lower floors and offices on upper floors. In this way, office workers can observe the businesses after hours, while the office entrances can be observed by the business during business hours.			

CPTED Public Transit Checklist

Version dated December 5, 2023

Adapted from APTA SS-SIS-RP-007-10 and this project's CPTED Principles Analysis Form

Use this form in the field to document application of CPTED principles in public transit stations.

Station name & transit line		**Location** (address/intersection/lat-long)	
Station type (bus stop/ bus shelter/station/other)		**Assessed by**	
Transit agency		**Other team members present**	
Station contact person & date contacted		**Date assessed**	
Timetable secured?	**Yes/No**	**Emergency & facility contact numbers**	

Safety checklist:

- □ High-visibility vests
- □ Closed-toe shoes
- □ Sunglasses and sunscreen (if needed)
- □ Appropriate attire for weather conditions
- □ First aid kit
- □ **UD contact notified of field work: _____**
- □ Water
- □ Facemasks (if needed/COVID-19)
- □ Identification (license, student ID)
- □ Copy of safety plan
- □ Safety glasses

SAFETY IS PARAMOUNT - DO NOT COMPROMISE SAFETY FOR SITE ASSESSMENT DATA

P = Present/meets element | A = Absent/does not meet element | U = Unable to assess | NA = Not applicable

Check-box ☐ indicates photo should be taken to document presence/absence/condition of stated element (additional instructions provided in "photo note" column)

Place additional notes on the designated page near the end of the checklist

A project overview is available on the last page of the checklist

This survey is conducted as part of a SMARTER Center DOT UTC project. The information contained herein is based on guidelines set by the research group and documents the observations of the individuals conducting the survey. This survey is intended to assist in improving the overall level of security only. It is not intended to imply the existing security measures, or proposed security measures are absolute or perfect.

Maintenance

Spaces have a sense of ownership and intended purpose through appropriate upkeep; easy-to-maintain materials are selected

Element	Photo	Photo note	P/A/U/NA	Notes
□ Building is well-maintained.	☐	Photograph sample evidence of maintenance		
□ Landscaping is well-maintained	☐	Photograph sample evidence of landscaping		
□ Wear-resistant materials are used (Avoid flat or porous finishes in areas where graffiti is likely to be a problem.)	☐	Photograph evidence of materials that meet/don't meet this element		
□ Vegetative screens are used for large, flat walls to deter graffiti.	☐	Photograph sample of a large flat wall		
□ Common areas and/or furniture made of long-wearing, vandal-resistant materials.	☐	Photograph sample of common area furniture		
□ Moveable furniture is secured or removed after hours.	☐	Photograph evidence of furniture secured/not secured		
□ Underpass and passageway lighting is vandal-resistant.	☐	Photograph a sample lighting fixture in a passageway/ underpass		

Element	Photo	Photo note	P/A/U/NA	Notes
□ Waste receptacles are available in appropriate locations.	☐	Photograph sample of a waste receptacle		
□ There is a method for riders to report maintenance needs (e.g., phone number or text hotline posted).	☐	Photograph sign of reporting instructions		

Access control

Entry points are clear, people know where to go, and unauthorized access is deterred

Element	Photo	Photo note	P/A/U/NA	Notes
Entry				
□ The number of pedestrian entry points is minimized.				
□ Vehicle entrances are kept to a minimum.	☐	Photograph a representative vehicle entrance		
Signage for wayfinding				
□ Location maps (fixed plaque format) and directional signage are provided at public entry points and along internal public routes of travel.	☐	Photograph a sample map or wayfinding signage		
□ Strong colors, standard symbols and simple graphics are used for informational signs.	☐	Photograph a sample of color scheme		
Parking areas - wayfinding				
□ Upon entering the parking area, both pedestrians and drivers can get a clear understanding of the direction to stairs, elevators and exits.	☐	Photograph a view from the parking area toward the station		

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Element	Photo	Photo note	P/A/U/NA	Notes
□ In multi-level parking areas, creative signage is used to distinguish among floors to enable users to easily locate their cars.	☐	Photograph a sample of parking area wayfinding signage		
Safety-related signage in and around facility				
□ Users are advised of security measures that are in place and where to find them	☐	Photograph a sample of a sign		
□ Signage is provided in the parking area advising users to lock their cars.	☐	Photograph a sample of a sign		
□ Where exits are closed after hours, this information is indicated at the parking area entrance.	☐	Photograph a sample of a sign		
□ Instructions are posted or broadcast on how to report suspicious activity.	☐	Photograph a sample of a sign		
Around facility: physical features that discourage unauthorized access				
□ Consider using thorny plants as an effective barrier.	☐	Photograph a sample of thorny plants, if present		
□ Large trees, garages, utility structures, fences and gutters are not located next to second-story windows or	☐	Photograph the exterior of a second-story building to show P/A of any climbing assists		

Element	Photo	Photo note	P/A/U/NA	Notes
balconies that could provide a means of access.				
□ Columns are made difficult to climb (by choice of materials, dimensions or barriers such as fences).	☐	Photograph a sample column		
□ Floor-level windows are made of lexan, polycarbonate, etc.	☐	Photograph a sample of a ground-floor window		
Surveillance and security systems (no photos for these elements)				
□ There is some kind of active surveillance (CCTV, alarm systems, guard service or police patrols).				
□ Doors to critical areas are secured, or have access control.				
□ The facility practices key control and/or inventory control; locking systems are tamper-proof				
□ Consider the use of security hardware and/or human measures to reduce opportunities for unauthorized access.				

Element	Photo	Photo note	P/A/U/NA	Notes
□ Off-hour waiting areas are clearly marked, visible to customers and equipped with CCTV and intercom system.				
□ Intrusion alarms are installed at access points to nonpublic areas.				
Limiting unauthorized access				
□ Access to land below structure is restricted, where possible.				
□ Emergency and maintenance access points are limited.				
□ Emergency and maintenance access points are secured with gates, locks or other access control measures.				
□ Nonpublic facilities are hidden and not identified.				

Natural surveillance

Physical features are placed to maximize visibility; appropriate lighting and communication systems are available

Element	Photo	Photo note	P/A/U/NA	Notes
Entrance				
□ Entrances are clearly identified (from the street/parking lot/etc.)	☐	Photograph the main entrance of the station		
□ Entrances are designed to allow users to see into them before entering.				
□ Vegetation that conceals the building entrance from the street is avoided.				
□ Front fences are predominantly open in design; high solid front fences are designed in a manner that incorporates open elements to allow visibility above the height of 5 feet.	☐	Photograph a section of front fence		
□ Appropriate surveillance is provided at entrances				
□ Street entrances are well illuminated.	☐	Photograph lighting near entrance		

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Element	Photo	Photo note	P/A/U/NA	Notes
Parking				
□ Large expanses of parking are avoided.	☐	Photograph parking lot; include kiosks, columns, groundcover, etc.		
□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.				
□ Columns and blind corners are minimized.				
□ Low groundcover, shrubs a maximum of 24 inches in height, or high-canopied trees (clean trimmed to a height of 8 feet) are used around parking areas and along pedestrian pathways.				
□ Where large expanses of parking are used, surveillance (e.g. security cameras) are available.				
□ Access to elevators, stairwells and pedestrian pathways is clearly visible from an adjacent parking area.	☐	Photograph view from parking area to intended entry path/stairway		
□ For areas intended to be used at night, lighting supports visibility and is vandal-resistant if placed at a lower height.	☐	Photograph parking lot lighting		

Element	Photo	Photo note	P/A/U/NA	Notes
□ In areas used by pedestrians, lighting shines on pedestrian pathways and possible entrapment spaces.	☐	Photograph a sample entrapment space and associated lighting		
□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety.				
□ Adequate lighting is provided for surveillance, including at night.				
□ Emergency call boxes are provided to report incidents.	☐	Photograph a call box		
□ Mirrors allow users to see ahead of them and around corners.	☐	Photograph a mirror		
□ Hidden recesses are avoided.	☐	Photograph a recess, if present		
In the station				
□ Sight lines around the station are unobstructed.	☐	Photograph a view through the station that includes any kiosks that may be present		
□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.	☐			

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Element	Photo	Photo note	P/A/U/NA	Notes
□ Mirrors allow users to see ahead of them and around corners.	☐	Photograph a mirror		
□ Columns and blind corners are minimized.	☐	Photograph a sample column, if present		
□ Operator booth is positioned for maximum presence and visibility within station.	☐	Photograph the operator booth in context of the station		
□ Hidden recesses are avoided.	☐	Photograph a recess, if present		
□ There are no obstructions that prevent visibility through windows.	☐	Photograph a window (obstructed or unobstructed)		
□ Information centers, ticket vending machines and concessions are placed so as not to obstruct sight lines.	☐	Photograph a sample info desk or ticket kiosk		
□ Bathroom doors are locked open during business hours.				
□ Cul-de-sacs and alcoves are avoided.	☐	Photograph a sample alcove, if present		
□ Transparent materials are used to enhance sight lines and enhance security.	☐	Photograph a sample of this material, if present		

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Element	Photo	Photo note	P/A/U/NA	Notes
□ Appropriate surveillance is provided at entrances, at access points to nonpublic areas and throughout the station.				
□ Active uses or habitable rooms are positioned with windows adjacent to main common/open space area.	☐	Photograph a view from active area of station to waiting area (or vice-versa)		
□ Waiting areas and external entries to elevators/stairwells are located close to areas of active use				
□ Stairways are left open to increase visibility.	☐	Photograph a stairway entrance		
□ Bathrooms are located near a highly traveled part of the station				
□ Adequate lighting is provided in hallways, restrooms, stairways and work areas.	☐	Photograph a light fixture in stairway or hallway		
□ Wayfinding signage is lighted.	☐	Photograph a sample of wayfinding signage		
□ Elevated light fixtures (poles, light standards, etc.) are located in a coordinated manner that provides the desired coverage.	☐	Photograph a view of the station that includes multiple lighting fixtures		

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Element	Photo	Photo note	P/A/U/NA	Notes
The useful ground coverage of an elevated light fixture is roughly twice its height.				
□ For areas intended to be used at night, lighting supports visibility and is vandal-resistant if placed at a lower height.	☐	Photograph a close-up of lighting fixture in station.		
□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety.				
□ Walls are painted or tiled in a reflective material to increase illumination.	☐	Photograph a station wall to show paint/tile color/material.		
□ Where possible, stations/ terminals have open shafts or skylights to bring in natural light.	☐	Photograph a skylight or glass block that provides natural light.		
□ Bright paint colors are used to increase ambient lighting.	☐	Photograph a sample of paint color used in station.		
□ Sufficient lighting is provided for nighttime surveillance, including at night.				
□ There is an integrated communication system throughout the building.				

Element	Photo	Photo note	P/A/U/NA	Notes
□ Train enunciators, visual and audio, in stations alert customers of arrivals and minimize time spent on isolated platforms or mezzanines.				
□ Communication links to administrative and emergency response centers are provided.				
□ Emergency call boxes are provided to report incidents.	☐	Photograph a call box		
Around the station				
□ Dumpster enclosures do not provide opportunities to hide.	☐	Photograph a dumpster in its enclosure		
□ Pathways are direct. All barriers along pathways are permeable (see-through), including landscaping, fencing, etc.	☐	Photograph a view down an exterior pathway		
□ Station is connected to walking and/or biking paths/trails.	☐	Photograph a connection to a walking/etc. trail/path.		
□ Security bars and security doors should be see-through.	☐	Photograph sample of exterior security bar/door		

Element	Photo	Photo note	P/A/U/NA	Notes
□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.	☐	Photograph a sample of kiosk/ad placement outside the station		
□ Mirrors allow users to see ahead of them and around corners.	☐	Photograph a sample of mirror placement outside the station		
□ Columns and blind corners are minimized.	☐	Photograph a sample of column placement outside the station		
□ Hidden recesses are avoided.	☐	Photograph a recessed area outside the station		
□ For elevated structures: clear sight lines are provided under and around the structure.	☐	Photograph a view that shows sight lines underneath station		
□ Low-growth vegetation is used to prevent blind corners.	☐	Photograph a sample of ground vegetation outside of the station		
□ Trees with dense, low-growth foliage are spaced, or their crowns are raised to avoid a continuous barrier.	☐	Photograph a tree around the station		
□ Low groundcover, shrubs a maximum of 24" high, or high-canopied trees (trimmed to a height of 8') are used around				

Element	Photo	Photo note	P/A/U/NA	Notes
parking areas and along pedestrian pathways.				
□ Elevated light fixtures (poles, light standards, etc.) are located in a coordinated manner that provides the desired coverage. The useful ground coverage of an elevated light fixture is roughly twice its height.	☐	Photograph an exterior elevated light fixture		
□ For areas intended to be used at night, lighting supports visibility and is vandal-resistant if placed at a lower height.				
□ Inset or modulated spaces on a building façade, access/ egress routes and signage are well lit.	☐	Photograph lighting on exterior of building near facade insets or entries/exits		
□ In areas used by pedestrians, lighting shines on pedestrian pathways and possible entrapment spaces.	☐	Photograph lighting on exterior of building near pedestrian paths		
□ Lighting takes into account vegetation, in both its current and mature forms, as well as any other element with the potential for blocking light.				
□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety.				

Element	Photo	Photo note	P/A/U/NA	Notes
□ “Safe routes” are selected and lit so that these become the focus of legitimate pedestrian activity after dark.	☐	Photograph any designated “safe route”		
□ Light standards and electrical equipment are located away from walls or low buildings to avoid climbing opportunities.	☐	Photograph lighting on exterior of building to show climbing possibilities		
□ Sufficient lighting is provided for nighttime surveillance, including at night.				
□ Train enunciators, visual and audio, in stations alert customers of arrivals and minimize time spent on isolated platforms or mezzanines.				
□ Emergency call boxes are provided to report incidents.				

Territoriality

Users and non-users are aware of the boundaries of a space/area/facility, creating a deterrent to crime

Element	Photo	Photo note	P/A/U/NA	Notes
Entrance and transition area				
□ Entrances are easily recognizable through design features and directional signage.				
□ There is signage to reinforce transition zones and give direction.	☐	Photograph wayfinding signage from entry or transition area		
□ Transitional zones are clearly marked (for movement into controlled area)				
Indicators for non-users				
□ "No Trespassing" signage is provided where applicable.	☐	Photograph "no trespassing" signage		
□ Signage deters nontransit vehicles from the stop area.	☐	Photograph signage		
Physical features and signage for safety				
□ Structures are set back from roads and parking areas, if applicable.	☐	Photograph exterior of station that show relation to street/parking		
□ Physical barriers enforce setbacks and/or prevent ramming.	☐	Photograph sample physical barrier		

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□ Adjacent roadways are designed to inhibit high-velocity ramming of columns.	☐	Photograph view from station to roadway		
□ Physical barriers such as bollards and fencing are provided … if the stop has a segregated transit way.				

Activity support

The community and ridership understand an area's intended use (authorized activities in a common space), creating a deterrent to criminal acts

Element	Photo	Photo note	P/A/U/NA	Notes
□ Food kiosks, restaurants, etc. are included.	☐	Photograph any food kiosk/ restaurant in station		
□ Open spaces are clearly designated and situated at locations that are easily observed by people.	☐	Photograph view across main station open space		
□ Seating is located in areas of active use.	☐	Photograph sample seating		
□ Storage and baggage lockers are not incorporated in station design.	☐	Photograph lockers, if present		
□ Ticket kiosks and shops are located on lower floors and offices on upper floors, providing additional visibility.	☐	Photograph relation of ground floor transit activity to upper floor uses, if present		

Additional notes:

Maintenance Spaces have a sense of ownership and intended purpose through appropriate upkeep; easy-to-maintain materials are selected	
Access control Entry points are clear, people know where to go, and unauthorized access is deterred	
Natural surveillance Physical features are placed to maximize visibility; appropriate lighting and communication systems are available	
Territoriality Users and non-users are aware of the boundaries of a space/area/facility, creating a deterrent to crime	
Activity support The community and ridership understand an area's intended use (authorized activities in a common space), creating a deterrent to criminal acts	

Not evaluated as part of this work:

□ *Lighting plan is prepared in accordance with Illuminating Engineering Society of America (IESA) Standards, which addresses project lighting in a comprehensive manner. Lighting approach is consistent with local conditions and crime problems.*

□ *In areas used primarily by older people, higher levels of brightness are provided in public/common areas.*

□ *Backup emergency lighting is installed.*

□ *Photoelectric rather than time switches are used for exterior lighting.*

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Crime Prevention through Environmental Design (CPTED) uses design principles to engineer safer spaces through management of both built and natural environmental features. CPTED principles aim to reduce chances and fear of criminal activity through design of spaces that both deter criminal activity and build community. Vacant lots, poor lighting, uncontrolled access, and lack of monitoring can be ameliorated to design spaces in which people feel – and are – safer. This project is examining CPTED practices in place in public transit agencies in several cities in the mid-Atlantic. As part of the project, the team will catalog CPTED practices already in use, develop a CPTED checklist for rail and bus stations, and analyze CPTED features in place at transit stops/stations. The work will be accomplished through site visits, interviews with state DOT staff and local transportation agencies, and review of transportation station design standards.Based on findings, we will develop a set of practices and priorities for integrating CPTED into transit station design to fill gaps identified through the study.

Contact: Jennie Saxe, Ph.D., Associate Professor, Department of Civil and Environmental Engineering, University of Delaware (jpsaxe@udel.edu)

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CPTED Public Transit Checklist - Bus Stops and Shelters

Version dated February 8, 2024

Adapted from APTA SS-SIS-RP-007-10 and this project's CPTED Principles Analysis Form, adapted for bus stops and shelters

Use this form in the field to document application of CPTED principles in public transit stations, specifically bus stops and shelters.

Station name & transit line		**Location** (address/intersection/lat-long)	
Station type	**Bus stop/Bus shelter**	**Assessed by**	
Transit agency		**Other team members present**	
Station contact person & date contacted		**Date assessed**	
Timetable secured?	**Yes/No**	**Emergency & facility contact numbers**	

Safety checklist:

- □ High-visibility vests
- □ Closed-toe shoes
- □ Sunglasses and sunscreen (if needed)
- □ Appropriate attire for weather conditions
- □ First aid kit
- □ **UD contact notified of field work: _____**
- □ Water
- □ Facemasks (if needed/COVID-19)
- □ Identification (license, student ID)
- □ Copy of safety plan
- □ Safety glasses

SAFETY IS PARAMOUNT - DO NOT COMPROMISE SAFETY FOR SITE ASSESSMENT DATA

P = Present/meets element | A = Absent/does not meet element | U = Unable to assess | NA = Not applicable

Check-box ☐ indicates photo should be taken to document presence/absence/condition of stated element

(additional instructions provided in "photo note" column)

Place additional notes on the designated page near the end of the checklist

A project overview is available on the last page of the checklist

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Maintenance

Spaces have a sense of ownership and intended purpose through appropriate upkeep; easy-to-maintain materials are selected

Element*	Photo	Photo note	P/A/U/NA	Notes
□ Landscaping is well-maintained	☐	Photograph sample evidence of landscaping		
□ Wear-resistant materials; avoid flat or porous finishes in areas where graffiti is likely to be a problem. Vegetative screens for large, flat walls.	☐	Photograph evidence of materials that meet/don't meet this element		
□ Common areas and/or street furniture made of long-wearing, vandal-resistant materials and are secured or removed after hours.	☐	Photograph sample of common area furniture		
□ Waste receptacles are available in appropriate locations.	☐	Photograph sample of a waste receptacle		
□ There is a method for riders to report maintenance needs (e.g., phone number or text hotline posted).	☐	Photograph sign of reporting instructions		

Access control

Entry points are clear, people know where to go, and unauthorized access is deterred

Element*	Photo	Photo note	P/A/U/NA	Notes
Wayfinding and signage to promote safety				
□ Location maps (fixed plaque format) and directional signage are provided at public entry points and along internal public routes of travel.	☐	Photograph a sample map or wayfinding signage		
□ Strong colors, standard symbols and simple graphics are used for informational signs.	☐	Photograph a sample of color scheme		
□ Users are advised of security measures that are in place and where to find them	☐	Photograph a sample of a sign		
□ Signage is provided in the parking area advising users to lock their cars.	☐	Photograph a sample of a sign		
□ Instructions are posted or broadcast on how to report suspicious activity.	☐	Photograph a sample of a sign		
Discourage unauthorized access/ entry				
□ The number of pedestrian entry points is minimized. **(Bus shelter only)**	☐	Photograph entry to shelter		
□ Consider using thorny plants as an effective barrier.	☐	Photograph a sample of thorny plants, if present		
□ Large trees, garages, utility structures, fences and gutters are not located next to the bus shelter.	☐	Photograph the exterior of a second-story building to show P/A of any climbing assists		
□ There is some kind of active surveillance (CCTV, alarm systems, guard service or police patrols).				

Element*	Photo	Photo note	P/A/U/NA	Notes
□ Columns are made difficult to climb (by choice of materials, dimensions or barriers such as fences).	☐	Photograph a sample column		

Natural surveillance

Physical features are placed to maximize visibility; appropriate lighting and communication systems are available

Element*	Photo	Photo note	P/A/U/NA	Notes
Clear lines of sight				
□ Sight lines around the station are unobstructed.	☐	Photograph a view that captures relevant sight lines		
□ Entrances are clearly identified (from the street/parking lot/etc.)	☐	Photograph the entry to bus shelter		
□ Pathways are direct. All barriers along pathways are permeable (see-through), including landscaping, fencing, etc.	☐	Photograph a view down an exterior pathway		
□ Station is connected to walking and/or biking paths/trails.	☐	Photograph a connection to a walking/etc. trail/path.		
□ Mirrors allow users to see ahead of them and around corners.	☐	Photograph a sample of mirror placement outside the station		
□ Large expanses of parking are avoided. Where large expanses of parking are proposed, provide surveillance such as security cameras.	☐	Photograph parking lot		
□ Access to pedestrian pathways is clearly visible from an adjacent parking area.	☐	Photograph access to pathways		
□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.	☐	Photograph kiosk/ad placement		
□ Columns and blind corners are minimized.	☐	Photograph features, if present		
□ Hidden recesses are avoided.	☐	Photograph features, if present		
□ Dumpster enclosures are designed and	☐	Photograph features, if present		

located to screen refuse containers without providing opportunities to hide.				
□ There are no obstructions that prevent visibility through windows.	☐	**Photograph obstructions, if present**		
□ Entrances are designed to allow users to see into them before entering.	☐	**Photograph entrance to shelter**		
□ Front fences are predominantly open in design; high solid front fences are designed in a manner that incorporates open elements to allow visibility above the height of 5 feet.	☐	**Photograph features, if present**		
□ Transparent materials are used to enhance sight lines and enhance security.	☐	**Photograph example of materials used**		
Vegetation				
□ Low-growth vegetation is used to prevent blind corners.	☐	**Photograph vegetation present**		
□ Trees with dense, low-growth foliage are spaced, or their crowns are raised to avoid a continuous barrier.	☐	**Photograph trees, if present**		
□ Low groundcover, shrubs a maximum of 24 inches in height, or high-canopied trees (clean trimmed to a height of 8 feet) are used around parking areas and along pedestrian pathways.	☐	**Photograph vegetation present**		
□ Vegetation that conceals the shelter entrance from the street is avoided.	☐	**Photograph vegetation present**		
Lighting				
□ Wayfinding signage is lighted.	☐	**Photograph signage with lighting in view, if present**		
□ Lighting plan is prepared in accordance with Illuminating Engineering Society of America				

(IESA) Standards, which addresses project lighting in a comprehensive manner. Lighting approach is consistent with local conditions and crime problems.				
□ Elevated light fixtures (poles, light standards, etc.) are located in a coordinated manner that provides the desired coverage. The useful ground coverage of an elevated light fixture is roughly twice its height.	☐	**Photograph a view of the station that includes multiple lighting fixtures**		
□ For areas intended to be used at night, lighting supports visibility. Where lighting is placed at a lower height to support visibility for pedestrians, it is vandal-resistant.				
□ Inset or modulated spaces on a façade, shelter access/egress routes and signage are well lit.	☐	**Photograph lighting on exterior of bus shelter near facade insets or entries/exits**		
□ In areas used by pedestrians, lighting shines on pedestrian pathways and possible entrapment spaces.	☐	**Photograph lighting on exterior of building near pedestrian paths**		
□ Lighting takes into account vegetation, in both its current and mature forms, as well as any other element with the potential for blocking light.	☐	**Photograph interaction between vegetation and lighting, if present**		
□ “Safe routes” are selected and lit so that these become the focus of legitimate pedestrian activity after dark.	☐	**Photograph, if present**		
□ Light standards and electrical equipment are located away from walls or low buildings to avoid climbing opportunities.	☐	**Photograph feature**		
□ Photoelectric rather than time switches are used for exterior lighting.				
□ In areas used primarily by older people or				Check DOT ETC tool for data:

younger populations, higher levels of brightness are provided in public/common areas.				• 17 & under: _____ • 65 & over: _____
□ Street entrances are well illuminated.	☐	**Photograph bus shelter with lighting in view**		
□ Walls are painted or tiled in a reflective material to increase illumination.	☐	**Photograph a station wall to show paint/tile color/material.**		
□ Where possible, shelters have open shafts or skylights to bring in natural light.	☐	**Photograph a skylight or glass block that provides natural light.**		
□ Bright paint colors are used to increase ambient lighting.	☐	**Photograph a sample of paint color used in station.**		
□ Sufficient lighting is provided for nighttime surveillance.				
□ Backup emergency lighting is installed.				
□ Adequate lighting is provided for surveillance.				
Communication systems				
□ Train enunciators, visual and audio, in stations alert customers of arrivals and minimize time spent at shelters/stops.				
□ Communication links to administrative and emergency response centers are provided.				
□ Emergency call boxes are provided to report incidents.	☐	**Photograph a call box**		

Territoriality

Users and non-users are aware of the boundaries of a space/area/facility, creating a deterrent to crime

Element*	Photo	Photo note	P/A/U/NA	Notes
Signage				
□ There is signage to reinforce transition zones and give direction.	☐	Photograph wayfinding signage from entry or transition area		
□ Entrances are easily recognizable through design features and directional signage.	☐	Photograph signage		
□ “No Trespassing” signage is provided where applicable.	☐	Photograph signage		
□ Signage deters non transit vehicles from the stop area.	☐	Photograph signage		
Transition into controlled area				
□ Transitional zones are clearly marked (for movement into controlled areas).	☐	Photograph transitional zone, if one exists		
□ Structures are setback from roads and parking areas, if applicable.	☐	Photograph exterior of station that show relation to street/parking		
□ Physical barriers such as bollards, road spikes, and fencing enforce setbacks and/or prevent ramming.	☐	Photograph sample physical barrier		
□ Adjacent roadways are designed to inhibit high-velocity ramming of columns.	☐	Photograph view from station to roadway		
□ Physical barriers such as bollards and fencing are provided … if the stop has a segregated transit way.	☐	Photograph feature, if applicable		

Activity support

The community and ridership understand an area's intended use (authorized activities in a common space), creating a deterrent to criminal acts

Element*	Photo	Photo note	P/A/U/NA	Notes
□ Open spaces are clearly designated and situated at locations that are easily observed by people. Parks, plazas, common areas and playgrounds are placed in the front of buildings. Shopping centers and other similar uses face streets.	☐	Photograph view across main station open space		
□ Seating is located in areas of active use.	☐	Photograph sample seating		

Additional notes:

Maintenance Spaces have a sense of ownership and intended purpose through appropriate upkeep; easy-to-maintain materials are selected	
Access control Entry points are clear, people know where to go, and unauthorized access is deterred	
Natural surveillance Physical features are placed to maximize visibility; appropriate lighting and communication systems are available	
Territoriality Users and non-users are aware of the boundaries of a space/area/facility, creating a deterrent to crime	
Activity support The community and ridership understand an area's intended use (authorized activities in a common space), creating a deterrent to criminal acts	

Not evaluated as part of this work:

□ *Lighting plan is prepared in accordance with Illuminating Engineering Society of America (IESA) Standards, which addresses project lighting in a comprehensive manner. Lighting approach is consistent with local conditions and crime problems.*

□ *In areas used primarily by older people, higher levels of brightness are provided in public/common areas.*

□ *Backup emergency lighting is installed.*

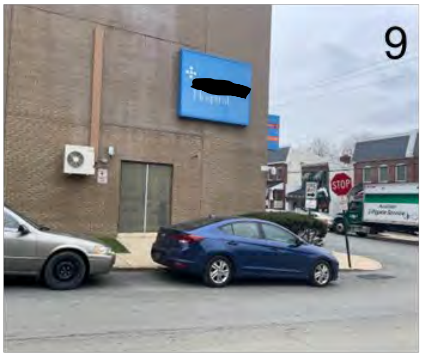
□ *Photoelectric rather than time switches are used for exterior lighting.*

Crime Prevention through Environmental Design (CPTED) uses design principles to engineer safer spaces through management of both built and natural environmental features. CPTED principles aim to reduce chances and fear of criminal activity through design of spaces that both deter criminal activity and build community. Vacant lots, poor lighting, uncontrolled access, and lack of monitoring can be ameliorated to design spaces in which people feel – and are – safer. This project is examining CPTED practices in place in public transit agencies in several cities in the mid-Atlantic. As part of the project, the team will catalog CPTED practices already in use, develop a CPTED checklist for rail and bus stations, and analyze CPTED features in place at transit stops/stations. The work will be accomplished through site visits, interviews with state DOT staff and local transportation agencies, and review of transportation station design standards.Based on findings, we will develop a set of practices and priorities for integrating CPTED into transit station design to fill gaps identified through the study.

Contact: Jennie Saxe, Ph.D., Associate Professor, Department of Civil and Environmental Engineering, University of Delaware (jpsaxe@udel.edu)

Appendix E: Site Photographs

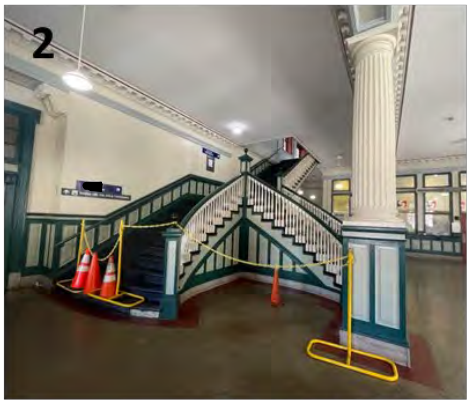
Transit Agency 1

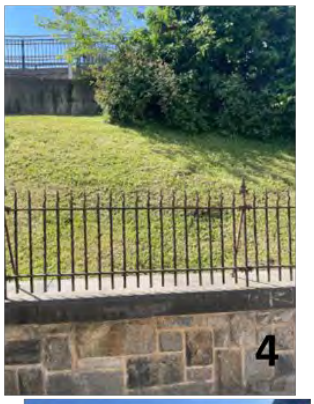


1. Site B – even with advertising, the walls of the shelter provide visibility.
2. Site B – waste receptacle, signage, set-back and sidewalk, advertising visible on back wall of shelter.
3. Site B – signage could also encourage safety or maintenance needs to be reported via app; scratch in paint to right of sign.
4. Site B – a small amount of graffiti.
5. Site B – a view to parking lot with marked pedestrian paths, lights, and low/no groundcover to impede visibility.
6. Site B – we were unable to assess functioning/adequacy of lighting due to daytime assessment.
7. Site C – visible are back of signpost, wall from loading dock which may serve as a hiding area, and trees which could obstruct lighting or signage when in leaf.
8. Site D – standard signage, no parking, and lack of vegetation obstruction.
9. Site D – view across street from bus stop; though no windows for natural surveillance/visibility) there is a sign indicating the area is monitored by security camera.
10. Site E – visible are unobstructed lighting and signage; “bus stop zone” signage is posted.
11. Site E – see-through fencing; no seating or shelter though this stop serves 7 bus routes.

12. Site F – unobstructed signage, proximity to road (posted limit generally not observed by traffic), and lack of shelter (though concrete is present indicating infrastructure may have been present previously).

Transit Agency 2



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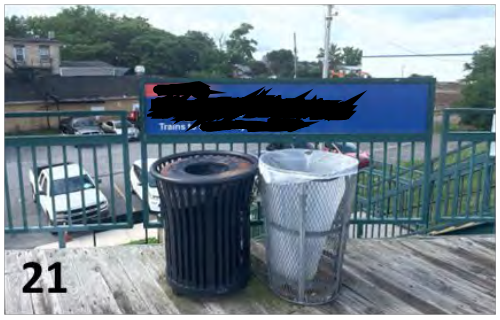
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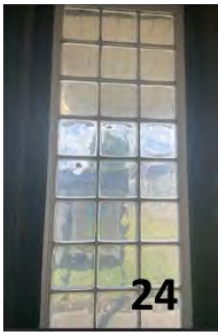
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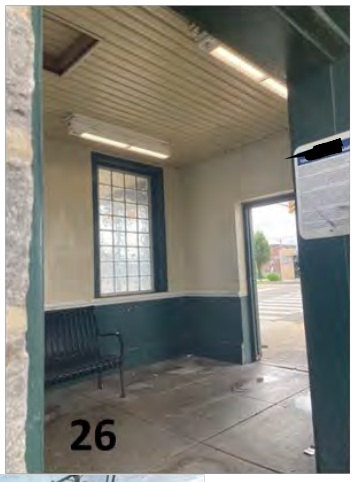
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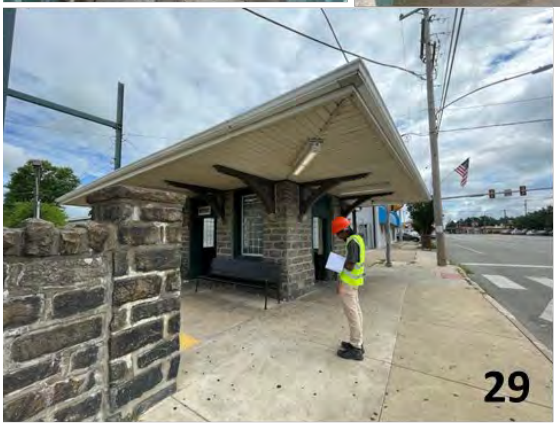
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1. Site G gated tunnel to prevent unauthorized access.
2. Site G interior; this side of the stairway and column are not visible directly from the operator booth (background); an installed mirror provides some visibility; also visible is bright paint and lighting.
3. Site G exterior stairway to southbound platform with maintenance need; lighting adequacy not assessed; some hiding spots due to the central shaft of the stairway.
4. Site G open fencing at street level and platform level on southbound side.
5. Site G lack of doors to restroom limits hiding places; “no loitering” sign to deter unauthorized use; mirror provides visibility near ticket kiosks; this area is visible from the ticket window.
6 and 7. Site G exterior stairway to northbound platform has open railings and lighting (noted, not assessed); underneath of stairway is partially blocked, reducing opportunities to hide.
8. Site G: Clear sightline down northbound side exterior; connections to transit, lighting, signage, and durable, bolted furniture are visible.
9. Site H showing waste bin and vegetation at adjacent park, street lighting, and the bus stop; some seating available on low park wall; there are benches within the park.
10. Site I signage is elevated; Transit Agency 2 phone number is difficult to read.
11 and 12. Site I business across the street and clear sightline from nearby housing could provide additional natural surveillance for the bus stop.
13. Site J: visible are shelter with poor visibility, peeling paint, and rusting roof located in a large parking lot; bollards present but may not be sufficient to prevent vehicle ramming.
14. Site J interior with litter; not shown: rusting roof.
15. Site J signage to deter unauthorized parking.; Transit Agency 2 signage faded, but hotline is visible.
16. Site K: clear signage, open stairway on southbound side.
17. Site K: in foreground, parking lot signage to deter unauthorized use (not shown: “no loitering” signage posted); in background, rail system map.
18. Site K northbound platform seating area with adequate sight-lines; maintenance need related to paint on end of shelter.
19. Site K from street level northbound (parking lot) side of stop showing open fencing at platform level and obscured area beneath platform.
20. Site K sight line beneath track; lighting noted (not assessed); no graffiti present.
21. Site K northbound platform waste receptacles and open fencing; clear view between platform and parking lot.
22. Site K view of southbound platform showing clear sight lines.
23. Site L sightline from street toward approaching track showing mostly clear sight line (signage and electrical provide some obstructions), waste receptacles, bolted-down furniture, and partial system map.
24. Site L station/waiting area includes durable glass block to use natural light to increase visibility.
25. Site L view into waiting area from main road; neither building entrance has a door, enhancing visibility; some blind corners could be addressed with mirrors.
26. Site L view into waiting area from boarding area.
27. Site L interior of waiting area showing bolted-down, durable furniture and litter.
28. Site L is adjacent to a crosswalk to improve safe pedestrian access.
29. Site L stone/masonry wall provides an easy method of unauthorized access to the roof of the station building and provides a hiding area.

30. Site M bus shelter includes waste bin, but litter is present; no Transit Agency 2 signage was present other than the route number and another number which was not the stop ID on the shelter itself; ad on end of shelter blocks visibility.
31. Site M shelter roof is made from translucent material, providing some natural light, but has significant damage.

	MAINTENANCE ELEMENTS													(N/A means element not applicable to any sites)			
	Key: P = present, S = somewhat present, A = absent, N = N/A, U = unable to assess; * streamlined bus stop/shelter checklist used										full checklist	full checklist					
	Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*	percent of sites where			
	Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24	applicable element was present			
	Site:	B	C	D	E	F	G	H	I	J	K	L	M	Transit agency 1	Transit agency 2	both agencies	Notes
1	□ Building is well-maintained.	P	N	N	N	N	P	[redacted]			N	P	[redacted]	100%	100%	100%	Only applied to 1 bus shelter (site B); later in study shelters were not deemed "buildings"
2	□ Landscaping is well-maintained	P	U	N	N	P	P	P	P	N	P	N	N	67%	100%	86%	Mowed turf grass was the dominant landscaping
3	□ Wear-resistant materials are used (Avoid flat or porous finishes in areas where graffiti is likely to be a problem.)	A	N	N	N	N	A	N	N	A	A	P	A	0%	20%	17%	Graffiti, damaged/scratched materials were found; site L included durable brick and glass block; the shelter roof of site M had a hole
4	□ Vegetative screens are used for large, flat walls to deter graffiti.	N	N	N	N	N	N	[redacted]			N	N	[redacted]	N/A	N/A	N/A	No sites used vegetative screens
5	□ Common areas and/or furniture made of long-wearing, vandal-resistant materials.	P	N	N	N	N	P	N	N	A	A	P	N	100%	50%	60%	Long-wearing materials are not necessarily vandal-resistant; furniture and bus shelters were in varying states of repair
6	□ Moveable furniture is secured or removed after hours.	N	N	N	N	N	P	[redacted]			N	N	[redacted]	N/A	100%	100%	Only site G had bolted-down benches
7	□ Underpass and passageway lighting is vandal-resistant.	N	N	N	N	N	P	[redacted]			A	N	[redacted]	N/A	50%	50%	Lighting in rail underpass at site K was damaged
8	□ Waste receptacles are available in appropriate locations.	P	A	A	A	A	P	S	A	A	P	P	P	20%	57%	42%	trash and/or recycling present at all rail and trolley stops; absent at all bus stops (except site H, where associated with nearby park); inconsistent across bus shelters; litter observed at some locations (e.g., L and M) even though waste receptacles present
9	□ There is a method for riders to report maintenance needs (e.g., phone number or text hotline posted).	S	S	S	S	S	P	S	S	S	P	S	A	0%	29%	17%	9 locations had transit agency signage and hotline (or app), but did not indicate it was to be used for reporting maintenance needs (reported as "S"); both rail stations had specific signage; site M had no transit agency signage or hotline
	Maintenance																
	Count of P	4	0	0	0	1	7	1	1	0	3	4	1				
	Count of S	1	1	1	1	1	0	2	1	1	0	1	0				
	Count of A	1	1	1	1	1	1	0	1	3	3	0	2				
	% of *applicable* elements P or S	83.3%	50.0%	50.0%	50.0%	66.7%	87.5%	100.0%	66.7%	25.0%	50.0%	100.0%	33.3%				

	ACCESS CONTROL ELEMENTS														(N/A means element not applicable to any sites)			
	Key: P = present, S = somewhat present, A = absent, N = N/A, U = unable to assess; * streamlined bus stop/shelter checklist used																	
	Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*		percent of sites where			
	Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24		applicable element was present			
	Site:	B	C	D	E	F	G	H	I	J	K	L	M		Transit agency 1	Transit agency 2	both agencies	Notes
1	□ The number of pedestrian entry points is minimized.	N	N	N	N	N	P	N	N	P	A	A	P		N/A	60%	60%	The site K platform could be accessed from many directions; the site L waiting area/building had 2 entry points with no doors; N/A for bus stops
2	□ Vehicle entrances are kept to a minimum.	N	N	N	N	N	N	[redacted]			P	N	[redacted]		N/A	100%	100%	Only applicable to the parking lot at site K
3	□ Location maps (fixed plaque format) and directional signage are provided at public entry points and along internal public routes of travel.	A	A	A	A	A	P	A	A	A	P	S	A		0%	29%	17%	Location maps were not a standard feature at sites visited
4	□ Strong colors, standard symbols and simple graphics are used for informational signs.	P	P	P	P	P	A	P	P	P	P	P	A		100%	71%	83%	Strong colors tended to refer to transit agency colorways
5	□ Upon entering the parking area, both pedestrians and drivers can get a clear understanding of the direction to stairs, elevators and exits.	P	N	N	N	N	N	[redacted]			P	N	[redacted]		100%	100%	100%	At applicable sites, easy for riders to know where to go from parking area; site B parking area was for a nearby office buiiling, not specifically for the bus stop
6	□ In multi-level parking areas, creative signage is used to distinguish among floors to enable users to easily locate their cars.	N	N	N	N	N	N	[redacted]			N	N	[redacted]		N/A	N/A	N/A	No multi-level garages were part of study
7	□ Users are advised of security measures that are in place and where to find them	A	A	N	A	A	A	A	A	A	A	A	A		0%	0%	0%	No signage at any locations in the study
8	□ Signage is provided in the parking area advising users to lock their cars.	A	N	N	N	N	N	N	N	A	A	N	N		0%	0%	0%	No signage at any locations in the study
9	□ Where exits are closed after hours, this information is indicated at the parking area entrance.	N	N	N	N	N	N	[redacted]			N	N	[redacted]		N/A	N/A	N/A	Not applicable to any site in the study
10	□ Instructions are posted or broadcast on how to report suspicious activity.	A	A	A	A	A	P	S	S	A	A	A	A		0%	14%	8%	Sites H and I included general transit hotline; site G included a "see something say something" sign on the platform
11	□ Consider using thorny plants as an effective barrier.	N	P	N	N	N	N	N	A	N	A	N	N		100%	0%	33%	Site B included plants which may deter climbing the wall behind the bus stop
12	□ Large trees, garages, utility structures, fences and gutters are not located next to second-story windows or balconies that could provide a means of access.	N	N	P	N	N	P	N	N	N	N	N	P		100%	100%	100%	None of the facilities with trees would allow a structure to be climbed
13	□ Columns are made difficult to climb (by choice of materials, dimensions or barriers such as fences).	N	N	N	N	N	A	N	N	N	N	A	N		N/A	0%	0%	Two sites (G and L) had columns or similar features which could enable climbing
14	□ Floor-level windows are made of lexan, polycarbonate, etc.	U	N	N	N	N	A	[redacted]			P	P	[redacted]		0%	67%	50%	Sites K and L had polycarbonate or similar windows; site G had glass windows; unable to determine site B window material on bus shelter
15	□ There is some kind of active surveillance (CCTV, alarm systems, guard service or police patrols).	A	A	P	A	A	A	A	A	A	A	A	A		20%	0%	8%	Security camera present across the street from sites D and I, and in adjacent parking lot at site B; none were directly associated with the transit stops
16	□ Doors to critical areas are secured, or have access control.	N	N	N	N	N	P	[redacted]			N	N	[redacted]		N/A	100%	100%	Only applicable at site G
17	□ The facility practices key control and/or inventory control; locking systems are tamper-proof	N	N	N	N	N	N	[redacted]			U	U	[redacted]		N/A	0%	0%	This element was either not applicable (i.e., no facilities to lock) or was not able to be assessed
18	□ Consider the use of security hardware and/or human measures to reduce opportunities for unauthorized access.	N	N	N	N	N	P	[redacted]			U	N	[redacted]		N/A	50%	50%	Element present only at site G
19	□ Off-hour waiting areas are clearly marked, visible to customers and equipped with CCTV and intercom system.	N	N	N	N	N	A	[redacted]			N	N	[redacted]		N/A	0%	0%	Not present in any applicable location
20	□ Intrusion alarms are installed at access points to nonpublic areas.	N	N	N	N	N	U	[redacted]			U	U	[redacted]		N/A	0%	0%	Doors were not assessed for alarms
21	□ Access to land below structure is restricted, where possible.	N	N	N	N	N	N	[redacted]			A	N	[redacted]		N/A	0%	0%	Significant access to below-platform structure was available at site K
22	□ Emergency and maintenance access points are limited.	N	N	N	N	N	P	[redacted]			N	N	[redacted]		N/A	100%	100%	Site G gated an access tunnel to prevent unwanted activity
23	□ Emergency and maintenance access points are secured with gates, locks or other access control measures.	N	N	N	N	N	P	[redacted]			A	N	[redacted]		N/A	50%	50%	Site G was the only site with known access or similar points that were secured.
24	□ Nonpublic facilities are hidden and not identified.	N	A	N	N	N	P	[redacted]			N	N	[redacted]		0%	100%	50%	Site G (rail station with bus route connections) had a bus driver break room which which did not have identifying markings
	Access control																	
	Count of P	2	2	3	1	1	9	1	1	2	5	2	2					
	Count of S	0	0	0	0	0	0	1	1	0	0	1	0					
	Count of A	5	5	2	4	4	6	3	4	5	8	5	5					
	% of *applicable* elements P or S	28.6%	28.6%	60.0%	20.0%	20.0%	60.0%	40.0%	33.3%	28.6%	38.5%	37.5%	28.6%					

	NATURAL SURVEILLANCE ELEMENTS															(N/A means element not applicable to any sites)			
		Key: P = present, S = somewhat present, A = absent, N = N/A, U = unable to assess; * streamlined bus stop/shelter checklist used																	
		Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*	**percent of sites where**			
		Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24	**applicable element was present**			
		Site:	B	C	D	E	F	G	H	I	J	K	L	M	Transit agency 1	Transit agency 2	both agencies	**Notes**
1	Entrance	□ Entrances are clearly identified (from the street/parking lot/etc.)	P	N	N	N	N	A	N	N	P	P	P	P	100%	80%	83%	Bus shelters, rail stations, and the trolley station were deemed to have applicable entrances; site G, a rail station, did not have a clearly marked station entrance; exterior station platform signage was inconsistent and confusing
2		□ Entrances are designed to allow users to see into them before entering.	P	N	N	N	N	A	N	N	A	P	A	P	100%	40%	50%	Deemed not applicable for bus stops without shelters; the bus shelter at site J was old-style with metal walls; the trolley stationi (site L) had blind corners
3		□ Vegetation that conceals the building entrance from the street is avoided.	P	N	N	N	N	N	N	N	N	P	N	P	100%	100%	100%	No sites were obstructed by vegetation.
4		□ Front fences are predominantly open in design; high solid front fences are designed in a manner that incorporates open elements to allow visibility above the height of 5 feet.	N	A	N	P	N	P	N	N	N	P	A	N	50%	67%	60%	The bus stop at site C was near a loading dock with a solid wall that could serve as a hiding place; the trolley station (site L) was characterized by stone/masonry walls
5		□ Appropriate surveillance is provided at entrances	A	N	N	N	N	A	[redacted]			A	A	[redacted]	0%	0%	0%	No sites included security cameras or human surveillance; deemed "N/A" for bus stops due to lack of entrance
6		□ Street entrances are well illuminated.	P	N	N	N	N	P	N	N	U	P	U	U	100%	40%	50%	Deemed not applicable for bus stops without shelters (no entrance); lighting where present near an entrance was noted, but with daytime visits, the adequacy of lighting was not able to be assessed
7	Parking	□ Large expanses of parking are avoided.	N	N	N	N	N	N	N	N	A	P	N	N	N/A	50%	50%	The site J bus shelter was located in a large, empty parking lot; site K had adequately-sized parking specifically associated with the rail station
8		□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.	N	N	N	N	N	N	[redacted]			N	N	[redacted]	N/A	N/A	N/A	No station-associated or nearby parking areas had kiosks or ads
9		□ Columns and blind corners are minimized.	N	N	N	N	N	N				N	N		N/A	N/A	N/A	Sites either lacked station-associated parking or were clear of these obstructions
10		□ Low groundcover, shrubs a maximum of 24 inches in height, or high-canopied trees (clean trimmed to a height of 8 feet) are used around parking areas and along pedestrian pathways.	P	N	N	N	N	N				P	N		100%	100%	100%	No station-associated or nearby parking areas had obstructions from vegetation.
11		□ Where large expanses of parking are used, surveillance (e.g. security cameras) are available.	U	N	N	N	N	N				N	N		0%	N/A	0%	No security cameras were in use specifically for station-associated parking, though surrounding businesses or facilities had security cameras in some locations; parking lot and vehicle parking area near site B had security cameras; unable to assess whether the bus shelter was included in camera coverage
12		□ Access to elevators, stairwells and pedestrian pathways is clearly visible from an adjacent parking area.	N	N	N	N	N	N	N	N	N	P	N	N	N/A	100%	100%	Only site K had station-associated parking and a stariwell
13		□ For areas intended to be used at night, lighting supports visibility and is vandal-resistant if placed at a lower height.	U	U	U	U	U	U				U	U		N/A	N/A	N/A	Daytime site visits meant that lighting adequacy was not able to be assessed
14		□ In areas used by pedestrians, lighting shines on pedestrian pathways and possible entrapment spaces.	U	U	U	U	U	U				U	U		N/A	N/A	N/A	Daytime site visits meant that lighting adequacy was not able to be assessed; though the presence of lighting was noted during site visits
15		□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety.	N	N	N	N	N	N				N	N		N/A	N/A	N/A	All sites are intended for nighttime use; therefore N/A
16		□ Adequate lighting is provided for surveillance, including at night.	U	U	U	U	U	U				U	U		N/A	N/A	N/A	Daytime site visits meant that lighting adequacy was not able to be assessed
17		□ Emergency call boxes are provided to report incidents.	A	A	A	A	A	A				A	A		0%	0%	0%	No site included an emergency call box
18		□ Mirrors allow users to see ahead of them and around corners.	A	N	N	N	N	S				A	A		0%	0%	0%	No mirrors in use in site K parking lot
19		□ Hidden recesses are avoided.	N	N	N	N	N	N				N	N		N/A	N/A	N/A	No hidden recesses in station-adjacent or station-associated parking lots
20		□ Sight lines around the station are unobstructed.	P	N	N	N	N	S	N	N	A	P	A	A	100%	20%	33%	Varying levels of obstructions across stations and bus shelters; site G had some areas with obstructions
21		□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.	P	N	N	N	N	A	N	N	A	P	P	A	100%	40%	50%	Varying levels of obstructions across stations and bus shelters
22		□ Mirrors allow users to see ahead of them and around corners.	A	N	N	N	N	S	N	N	A	A	A	A	N/A	0%	0%	Deemed N/A for bus stops; site G had a mirror in two locations: for stairwell/column coverage and near kiosks ("S" = somewhat present) but would be useful in other locations
23		□ Columns and blind corners are minimized.	N	N	N	N	N	A	N	N	N	P	N	A	N/A	33%	33%	Varying levels of obstructions from columns/blind corners; N/A for bus stops (signpost only)
24		□ Operator booth is positioned for maximum presence and visibility within station.	N	N	N	N	N	A	[redacted]			N	N	[redacted]	N/A	0%	0%	Only site G had an operator booth; it was obstructed by posters and blinds on the station-facing windows
25		□ Hidden recesses are avoided.	P	N	N	N	N	A	N	N	A	A	A	P	100%	20%	33%	Hidden recesses present in several stations/shelters
26		□ There are no obstructions that prevent visibility through windows.	P	N	N	N	N	A	N	N	A	P	A	A	100%	20%	33%	Windows obstructed at several stations/shelters
27		□ Information centers, ticket vending machines and concessions are placed so as not to obstruct sight lines.	N	N	N	N	N	P	[redacted]			N	N	[redacted]	N/A	100%	100%	Only one site (site G) included a station with ticket vending machines and a staffed ticket office.
28		□ Bathroom doors are locked open during business hours.	N	N	N	N	N	P				N	N		N/A	100%	100%	Only one site (site G) included restrooms.
29		□ Cul-de-sacs and alcoves are avoided.	P	N	N	N	N	A				N	N		100%	0%	50%	Some sites had areas that would loosely qualify as an alcove
30		□ Transparent materials are used to enhance sight lines and enhance security.	P	N	N	N	N	S	N	N	A	P	A	P	100%	40%	50%	Varying levels of use of transparent materials

	NATURAL SURVEILLANCE ELEMENTS															(N/A means element not applicable to any sites)			
		Key: P = present, S = somewhat present, A = absent, N = N/A, U = unable to assess; * streamlined bus stop/shelter checklist used																	
		Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*	**percent of sites where**			
		Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24	**applicable element was present**			
		Site:	B	C	D	E	F	G	H	I	J	K	L	M	Transit agency 1	Transit agency 2	both agencies	**Notes**
31		□ Appropriate surveillance is provided at entrances, at access points to nonpublic areas and throughout the station.	A	N	N	N	N	S				A	A		0%	0%	0%	The ticket agent at site G could provide some surveillance, though the window is largely blocked; no station-associated surveillance provided at any other location
32		□ Active uses or habitable rooms are positioned with windows adjacent to main common/open space area.	N	N	N	N	N	N				N	N		N/A	N/A	N/A	Not applicable to sites in this study
33		□ Waiting areas and external entries to elevators/stairwells are located close to areas of active use	N	N	N	N	N	S				N	P		N/A	50%	50%	Somewhat present at site G (inside waiting area near ticket kiosk and station window); present at site L (active street area near trolley station)
34		□ Stairways are left open to increase visibility.	N	N	N	N	N	P				P	N		N/A	100%	100%	Where present (sites G and K), stairwells were open to the platform
35	In the station	□ Bathrooms are located near a highly traveled part of the station	N	N	N	N	N	P				N	N		N/A	100%	100%	Only site G had restrooms; located near ticket kiosk and operator window
36		□ Adequate lighting is provided in hallways, restrooms, stairways and work areas.	U	N	N	N	N	P				N	P		0%	100%	67%	Adequate lighting in stations at sites G and L; unable to assess whether light in site B shelter was functional
37		□ Wayfinding signage is lighted.	N	N	N	N	N	A	N	N	N	A	N	N	N/A	0%	0%	Wayfinding signage was either not present or not lighted
38		□ Elevated light fixtures (poles, light standards, etc.) are located in a coordinated manner that provides the desired coverage. The useful ground coverage of an elevated light fixture is roughly twice its height.	U	N	N	N	N	U	N	N	A	U	P	N	0%	25%	20%	Within station lighting N/A at bus stops; site B (shelter) - unable to assess function of in-shelter light; rail stations (sites G and K) - unable to assess "coordinated manner/desired coverage"; site J shelter - in-shelter lighting is absent; site L in-station lighting appeared adequate even during daylight.
39		□ For areas intended to be used at night, lighting supports visibility and is vandal-resistant if placed at a lower height.	U	N	N	N	N	U	N	N	A	U	U	U	0%	0%	0%	N/A at bus stops (no "station"); unable to assess lighting ability to support visibility due to daytime visits; lighting is absent and therefore would not support visibility at site J
40		□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety.	N	N	N	N	N	N				N	N		N/A	N/A	N/A	N/A - all areas intended for nighttime use
41		□ Walls are painted or tiled in a reflective material to increase illumination.	N	N	N	N	N	P	N	N	N	N	P	N	N/A	100%	100%	Present at both locations with interior, painted-wall stations (sites G and L)
42		□ Where possible, stations/ terminals have open shafts or skylights to bring in natural light.	A	N	N	N	N	A	N	N	A	N	A	P	N/A	25%	20%	N/A at bus stops; site M roof allowed natural light due to translucent material (but also a maintenance issue - shelter roof had a hole)
43		□ Bright paint colors are used to increase ambient lighting.	N	N	N	N	N	P	N	N	A	N	P	N	N/A	67%	67%	N/A at bus stops and most bus shelters; shelter at site J was painted on exterior but not interior; bright paint in stations present at sites G and L
44		□ Sufficient lighting is provided for nighttime surveillance, including at night.	U	N	N	N	N	U	N	N	U	U	U	U	0%	0%	0%	N/A at bus stops (no "station"); unable to assess lghting ability to support visibility due to daytime visits
45		□ There is an integrated communication system throughout the building.	N	N	N	N	N	A				N	A		N/A	0%	0%	Absent at sites G and L, the only sites with station buildings
46		□ Train enunciators, visual and audio, in stations alert customers of arrivals and minimize time spent on isolated platforms or mezzanines.	P	N	N	N	N	A	N	N	A	N	A	A	100%	0%	20%	Visual aid for arriving buses only present at site B bus shelter
47		□ Communication links to administrative and emergency response centers are provided.	U	N	N	N	N	U	N	N	U	U	U	U	0%	0%	0%	Presumed absent, but unable to fully assess; deemed N/A for bus stops
48		□ Emergency call boxes are provided to report incidents.	A	N	N	N	N	A	N	N	A	A	A	A	0%	0%	0%	No stations or shelters were equipped with emergency call boxes
49		□ Dumpster enclosures do not provide opportunities to hide.	N	N	N	N	N	N	N	N	N	N	N	N	N/A	N/A	N/A	No sites had dumpsters or enclosures associated with the station
50		□ Pathways are direct. All barriers along pathways are permeable (see-through), including landscaping, fencing, etc.	P	A	P	P	P	S	S	P	P	P	A	A	80%	43%	58%	Pathways primarily referred to sidewalk access to stations/stops; variety of barriers; some were see-through; some were not
51		□ Station is connected to walking and/or biking paths/trails.	S	S	S	S	S	S	S	S	S	S	S	S	0%	0%	0%	All sites assessed as "somewhat" connected to walking/biking paths by virtue of connection to sidewalks; no other walking/biking trails connected to these sites
52		□ Security bars and security doors should be see-through.	P	N	N	N	N	P				N	N		100%	100%	100%	Present where applicable
53		□ Kiosks, ads and other information are positioned so they don't disrupt sight lines.	P	N	P	P	P	P				N	A		100%	50%	83%	Absent at site L; some signage blocks sight lines outside of station
54		□ Mirrors allow users to see ahead of them and around corners.	A	A	A	A	A	A				A	A		0%	0%	0%	No mirrors in use around stations or stops
55		□ Columns and blind corners are minimized.	P	A	P	P	A	A				A	A		60%	0%	38%	Site C beneath adjacent loading dock (blind); rail and trolley stations had blind corners; site F bus stop near a building which presented blind corners
56		□ Hidden recesses are avoided.	P	A	P	P	P	A				A	A		80%	0%	50%	Site C beneath adjacent loading dock (hiding location); rail and trolley stations had hidden recesses
57		□ For elevated structures: clear sight lines are provided under and around the structure.	N	N	N	N	N	N				A	N		N/A	0%	0%	Rail station site K notably had obstructed sight lines beneath the platform where unauthorized human activity was observed
58		□ Low-growth vegetation is used to prevent blind corners.	P	P	P	N	N	N	A	P	N	P	P	P	100%	80%	88%	Most locations with vegetation did not have vegetation obscuring sight lines; vegetation in park adjacent to site H obscured some sight lines
59		□ Trees with dense, low-growth foliage are spaced, or their crowns are raised to avoid a continuous barrier.	P	P	P	P	N	N	P	P	N	N	N	N	100%	100%	100%	Trees appropriately maintained where present
60		□ Low groundcover, shrubs a maximum of 24" high, or high-canopied trees (trimmed to a height of 8') are used around parking areas and along pedestrian pathways.	P	P	P	P	P	N	A	P	N	P	P	P	100%	80%	90%	Turf grass used in most locations; park adjacent to site H had shrubs approaching/exceeding 24" high

	NATURAL SURVEILLANCE ELEMENTS														(N/A means element not applicable to any sites)			
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		Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*	**percent of sites where**			
		Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24	**applicable element was present**			
		Site:	B	C	D	E	F	G	H	I	J	K	L	M	Transit agency 1	Transit agency 2	both agencies	**Notes**
61	Around the station	□ Elevated light fixtures (poles, light standards, etc.) are located in a coordinated manner that provides the desired coverage. The useful ground coverage of an elevated light fixture is roughly twice its height.	U	U	U	U	U	U				U	U		N/A	N/A	N/A	Daytime visits mean we were unable to assess desired lighting coverage
62		□ For areas intended to be used at night, lighting supports visibility and is vandal-resistant if placed at a lower height.	U	U	U	U	U	U				U	U		N/A	N/A	N/A	Daytime visits mean we were unable to assess whether lighting supported visibility
63		□ Inset or modulated spaces on a building façade, access/ egress routes and signage are well lit.	U	U	U	U	U	U	U	U	U	U	U	U	N/A	N/A	N/A	Daytime visits mean we were unable to assess whether area around the station was "well lit"
64		□ In areas used by pedestrians, lighting shines on pedestrian pathways and possible entrapment spaces.	U	U	U	U	U	U	U	U	U	U	U	U	N/A	N/A	N/A	Daytime visits mean we were unable to assess lighting of pedestrian pathways around the station.
65		□ Lighting takes into account vegetation, in both its current and mature forms, as well as any other element with the potential for blocking light.	U	U	U	U	U	U	U	U	U	U	U	U	N/A	N/A	N/A	Daytime visits mean we were unable to assess whether lighting took vegetation into account.
66		□ Areas not intended for nighttime use are not lit, to avoid giving a false impression of use or safety.	N	N	N	N	N	N				N	N		N/A	N/A	N/A	All areas intended for nighttime use.
67		□ “Safe routes” are selected and lit so that these become the focus of legitimate pedestrian activity after dark.	S	A	A	A	A	A	A	A	A	A	A	A	0%	0%	0%	No sites had a connection to a route that the team considered a "safe route"; site B was connected to a nearby parking lot with a crosswalk and deemed "somewhat present"
68		□ Light standards and electrical equipment are located away from walls or low buildings to avoid climbing opportunities.	P	P	N	N	P	P	N	P	P	A	P	P	100%	83%	89%	Only site K had lighting/electrical equipment near the rail station platform/associate buildings
69		□ Sufficient lighting is provided for nighttime surveillance, including at night.	U	U	U	U	U	U				U	U		0%	0%	0%	Daytime visits, therefore unable to assess lighting
70		□ Train enunciators, visual and audio, in stations alert customers of arrivals and minimize time spent on isolated platforms or mezzanines.	P	U	U	P	P	A				N	A		60%	0%	43%	Where present, enunciators were on buses, not integrated into stations
71		□ Emergency call boxes are provided to report incidents.	A	A	A	A	A	A				A	A		0%	0%	0%	No locations included emergency call boxes.
		Natural surveillance																
		Count of P	22	4	7	8	6	12	1	5	3	17	10	9				
		Count of S	2	1	1	1	1	8	2	1	1	1	1	1				
		Count of A	9	8	4	4	5	21	3	1	15	15	23	9				
		% of *applicable* elements P or S	72.7%	38.5%	66.7%	69.2%	58.3%	48.8%	50.0%	85.7%	21.1%	54.5%	32.4%	52.6%				

	TERRITORIALITY ELEMENTS														(N/A means element not applicable to any sites)			
		Key: P = present, S = somewhat present, A = absent, N = N/A, U = unable to assess; * streamlined bus stop/shelter checklist used																
		Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*	**percent of sites where**			
		Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24	**applicable element was present**			
		Site:	B	C	D	E	F	G	H	I	J	K	L	M	Transit agency 1	Transit agency 2	both agencies	**Notes**
1	Entrance and transition area	□ Entrances are easily recognizable through design features and directional signage.	P	N	N	N	N	A	N	N	A	P	A	P	50%	25%	33%	Bus stops assessed as not applicable; bus shelters assessed as "present" (easy to determine entrance); site G (rail) had inconsistent and confusing directional signage; site K rail station had simple yet adequate signage.
2		□ There is signage to reinforce transition zones and give direction.	A	A	A	A	A	S	A	A	A	P	S	A	0%	14%	8%	Partial or full system maps were present at sites G, K, and L; site G had inconsistent and incorrect directional signage around the station; bus stops had no directional signage
3		□ Transitional zones are clearly marked (for movement into controlled area)	A	N	N	A	N	N	N	A	A	A	N	A	0%	0%	0%	Sites did not include any notable "transitional zones" to let riders and non-riders know they were approaching a transit stop
4	Indicators for non-users	□ "No Trespassing" signage is provided where applicable.	A	A	N	A	A	P	A	A	S	A	A	A	0%	14%	9%	Applicability of "no trespassing" signage was not clear for bus stops and shelters. Bus stops are public places and are unlikely to have "no trespassing" signs. Site J had a sign to the effect of no trespassing, but more targeted to illegal parking near the bus stop.
5		□ Signage deters nontransit vehicles from the stop area.	A	N	P	P	P	A	A	A	P	P	A	A	50%	43%	45%	"No parking" and "bus only" signs present at some locations
6	Physical features and signage for safety	□ Structures are set back from roads and parking areas, if applicable.	P	A	A	N	A	P	N	N	P	N	P	P	25%	75%	50%	Bus shelter setbacks were typically the width of a sidewalk
7		□ Physical barriers enforce setbacks and/or prevent ramming.	A	A	A	A	A	A	A	A	P	A	A	A	0%	14%	8%	Site J included bollards, though they did not appear to be sufficient to prevent ramming
8		□ Adjacent roadways are designed to inhibit high-velocity ramming of columns.	A	A	A	A	A	A	A	A	A	A	A	A	0%	0%	0%	No protection against ramming at any location
9		□ Physical barriers such as bollards and fencing are provided … if the stop has a segregated transit way.	N	N	N	N	N	N	N	N	N	N	N	N	0%	N/A	0%	No sites had segregated transit areas.
		Territoriality																
		Count of P	2	0	1	1	1	2	0	0	3	3	1	2				
		Count of S	0	0	0	0	0	1	0	0	1	0	1	0				
		Count of A	6	5	4	5	5	4	5	6	4	4	5	6				
		% of *applicable* elements P or S	25.0%	0.0%	20.0%	16.7%	16.7%	42.9%	0.0%	0.0%	50.0%	42.9%	28.6%	25.0%				

	ACTIVITY SUPPORT ELEMENTS													(N/A means element not applicable to any sites)			
	Key: P = present, S = somewhat present, A = absent, N = N/A, U = unable to assess; * streamlined bus stop/shelter checklist used																
	Station type:	Bus shelter	Bus stop	Bus stop	Bus stop	Bus stop	Rail station	Bus stop*	Bus stop*	Bus shelter*	Rail station	Trolley stop	Bus shelter*	percent of sites where			
	Date of visit:	1/18/24	1/18/24	1/31/24	1/31/24	1/31/24	5/22/24	5/22/24	5/22/24	7/13/24	7/13/24	7/13/24	7/13/24	applicable element was present			
	Site:	B	C	D	E	F	G	H	I	J	K	L	M	Transit agency 1	Transit agency 2	both agencies	Notes
1	□ Food kiosks, restaurants, etc. are included.	A	A	N	N	N	A	[redacted]			A	A	[redacted]	0%	0%	0%	No sites had restaurants, etc. as part of the station; some had nearby businesses not associated with the transit agency
2	□ Open spaces are clearly designated and situated at locations that are easily observed by people.	N	A	N	N	N	P	P	N	N	N	A	N	0%	67%	50%	Site G had an indoor seating area, as well as outdoor seating; the site H bus stop was next to a city park; seating area at site L not easily observed from outside
3	□ Seating is located in areas of active use.	P	A	A	A	A	P	P	A	A	P	P	P	20%	71%	50%	Bus shelters, rail, and trolley stations had seating; site H, a bus stop, had seating associated with the adjacent park
4	□ Storage and baggage lockers are not incorporated in station design.	N	N	N	N	N	N	[redacted]			N	N	[redacted]	N/A	N/A	N/A	No facilities had storage/baggage lockers
5	□ Ticket kiosks and shops are located on lower floors and offices on upper floors, providing additional visibility.	N	N	N	N	N	A	[redacted]			N	N	[redacted]	N/A	0%	0%	Only one site (site G) had a station with multiple levels.
	Activity support																
	Count of P	1	0	0	0	0	2	2	0	0	1	1	1				
	Count of S	0	0	0	0	0	0	0	0	0	0	0	0				
	Count of A	1	3	1	1	1	2	0	1	1	1	2	0				
	% of *applicable* elements P or S	50.0%	0.0%	0.0%	0.0%	0.0%	50.0%	100.0%	0.0%	0.0%	50.0%	33.3%	100.0%				

Appendix G

Page 1 of CPTED Checklist used for CIEG411 (S2024)
(adapted from the APTA checklist and the MSU SMARTER Center CPTED Project)

Natural Surveillance: allow people to see what is happening in spaces

□ Entrances are clearly identified
□ Vegetation does not obstruct sight lines
□ Clear visibility should be maintained to the street, sidewalk and parking areas.
□ Blind corners are minimized
□ Any fences are open in design
□ Kiosks and ads do not block sight lines
□ Recesses should not create hiding places.
□ Waiting areas are close to areas of active use
□ Adequate lighting is in place
□ Annunciators or other PA systems are used
□ Emergency call boxes are present
□ Station is connected to walking/biking trails.
□ Safe routes are specified for pedestrian activity after dark

Notes:

Territorial Reinforcement: demonstrate that spaces are used and valued

□ Entrances are easily recognized
□ Directional and "no trespassing" signage is present
□ Structures are set back from the road and/or physical barriers are present to prevent ramming

Notes:

Access Control: use formal & informal means to indicate who should access spaces

□ Walkways and landscaping should direct riders to the proper area and away from private areas.
□ Maps and clear color schemes are used for wayfinding.
□ Safety signage is present
□ Surveillance system (e.g., CCTV) is in place.

Notes:

Maintenance: unmaintained spaces are crime attractors

□ Building and landscaping are well-maintained (trim bushes to 36" high and trees up 7' from the ground).
□ Keep all lighting fixtures in good operating condition.
□ Secure movable furniture.
□ Waste receptacles are present.

Notes:

Activity Support: intended use of area is clear; other uses are deterred

□ Seating is available for areas of active use
□ Food kiosks or restaurants are nearby
□ Open spaces are easily observed

Notes:

Page 2 of CPTED Checklist used for CIEG411 (S2024)
(adapted from the APTA checklist and the MSU SMARTER Center CPTED Project)

Recommendations

Natural Surveillance

- □ Clarify entrances
- □ Improve visibility
- □ Vegetation
- □ Blind corners
- □ Fending
- □ Kiosks
- □ Improve lighting
- □ Provide nearby waiting areas
- □ Provide PA system
- □ Install emergency call box
- □ Connect to sidewalk/walking trails
- □ Other: _____
- □ Other: _____

Territorial Reinforcement

- □ Enhance entrances
- □ Provide signage
- □ Protect riders via setbacks/barriers
- □ Other: _____
- □ Other: _____

Access Control

- □ Provide clear path
- □ Provide maps
- □ Provide signage
- □ Safety
- □ Wayfinding
- □ Install surveillance system
- □ Other: _____
- □ Other: _____

Maintenance

- □ Maintenance needed
- □ Building
- □ Landscaping
- □ Other: _____
- □ Repair lighting fixtures
- □ Secure movable furniture
- □ Provide waste receptacles
- □ Other: _____
- □ Other: _____

Activity Support

- □ Provide seating
- □ Encourage food kiosks or other nearby activity
- □ Improve visibility of stop from nearby open space
- □ Other: _____
- □ Other: _____