Section 6: Pedestrian Target Safeguarding

Section 6.1: Executive Summary



Executive Summary PRINCIPLES OF DESIGNING SAFER PUBLIC SPACES

The Pedestrian Target Safeguarding Plan (Plan) provides building perimeter and public space security design solutions intended to protect against threats resulting from unauthorized vehicles entering public spaces.

Based on stakeholder interviews the Plan identifies and provides design recommendations for six high priority areas within the City of Riverside including:

- Main Street Pedestrian Mall
- Ryan Bonaminio Park
- University Village
- Riverside Convention Center
- Martha McLean- anza Narrows Park
- Special Event Street Closure Program

OBJECTIVES

The overall objective of the Plan is to complete the following tasks:

- Identify six sites, which are representative of various locations throughout the City, for this Plan's assessment based on high levels of pedestrian activity and high risk for accidental/intentional vehicular collisions.
- Identify historic areas of concern.
- Identify what Pedestrian Safeguarding means to City staff and what is intended from the recommendations and this Plan.
- Identify prioritized locations where public safety should be addressed based on vulnerability and risk.

The approach of this Plan factors in the following considerations and safety methods typically employed:

- Where are special event sites and/or areas with frequent daily use by pedestrians?
- What is the frequency of use? How is a space being used?
- Where might accidental incidents occur related to public space?
- Where can intentional attacks occur as a result of barrier deficiencies?
- What is the density of the surrounding built environment?

GOALS

Based on a series of interviews with City staff and public safety officials in Riverside, the design team developed the following goals to guide the Plan development.

- Provide security in the context of streetscape enhancement and public realm beautification.
- Work within the framework of street furniture elements that currently exist in the City of Riverside.
- Produce a coherent strategy for deploying specific types of streetscape and security elements that also improve lighting, attractiveness of space, and function of public gathering when possible.
- Provide perimeter security in a manner that does not impede the City's commerce and vitality, excessively restrict or impede operational use of sidewalks or pedestrian and vehicular mobility, nor impact the health of existing trees.
- Identify an implementation strategy that can be efficiently coordinated in the most cost effective manner.

BEST PRACTICES

The Plan addresses the need to provide design solutions that will promote vibrant public spaces and support a variety of pedestrian experiences while seamlessly integrating security into existing and future development.

Crime Prevention Through Environmental Design CPTED strategies provided guidance when analyzing priority areas and developing recommendations. These strategies recommend using natural, visually pleasing passive surveillance elements to deter crime and the fear of crime.

Assessment of Soft Targets

Soft target areas are typically easily accessible and exposed, accommodate a high density of people, and frequently hold events. The Plan identifies vulnerable sites where protective measures should be strategically implemented and security should be increased.

Mitigation Plan

Hostile vehicle mitigation measures, such as vehicle barriers around a perimeter, can protect outdoor venues. The City should evaluate a site layout, and consider possible vehicle approach scenarios to determine mitigation measures that can reduce the vulnerability to both intentional and accidental vehicle ramming.

Vehicle Barrier Standards

Vehicle barrier standards must be understood to guide selection and procurement of an anti-ram vehicle barrier based on the specification of vehicle weight, impact speed and dynamic penetration distance.

Vehicle Barrier Design Elements

Vehicle barriers should be utilized in situations where site configuration is vulnerable and pedestrian activity is high. The placement of barriers should consider function, budget, design aesthetics, and proximity to other elements. Barrier systems can vary widely to provide a range of security from visual deterrents, engineered solutions that calculate weight and resistance, to the most robust and reliable anti-ram barriers.

Barriers can be permanent or temporary and passive or active. They should be strategically chosen to fit the needs of the location.

Accommodate Pedestrian and Vehicle Access

Circulation patterns of the site should be monitored under normal conditions and during large gathering events. Barrier placement should not impede desired travel patterns and should facilitate the funneling of pedestrians out of harm's way. Barrier selection and layout should allow for maintenance and emergency vehicle access.

PEDESTRIAN SAFEGUARDING DESIGN GUIDELINES

Street furnishings such as bollards, boulders, light poles, benches, and public art can act as pedestrian safeguarding elements. The Plan provides guidance on placement of safeguarding elements with respect to ADA compliance and best practices.

The guidelines provide installation and design parameters for pedestrian safeguarding standards in public spaces.

SECURITY ZONES

It is important to understand the best approach to support and facilitate movement of pedestrians and maintenance and emergency vehicles while maintaining a safe and secure public space. Security zone types and the functions and design elements associated within each should be identified. Examples of security zones include curb lanes (or furnishing zones) and sidewalks.

STREETSCAPE SECURITY ELEMENTS

The goal is to achieve a well-designed, secure and aesthetically pleasing street design by incorporating streetscape security elements into existing streetscape conditions. Appropriate elements should be selected based on recommended dimensions and placement with consideration given to existing underground systems, utilities and street trees. A variety of elements to select from and utilize allows for flexibility in creating a safe and comfortable pedestrian space, including the following:

- Street furniture (includes hardened benches, waste receptacles, etc)
- Benches
- Bollards
- Seat bollards
- Retractable bollard
- Gate arms
- Fences and walls
- Planters
- Precast concrete or stone seat planter
- Street trees
- Deciduous or evergreen plantings
- Street light standards
- Pedestrian light standards
- Heavy objects (boulders, art, etc.)

Section 6.2: Principles of Designing Safer Public Space



Introduction

DESIGNING FOR PEDESTRIAN SAFEGUARDING

The Pedestrian Target Safeguarding Plan addresses increasingly varied strategies that potentially impact the character of the City of Riverside. The City of Riverside can have both good urban design and good security related to public spaces. As money is invested to make Riverside's streets and public spaces safer, it can also be invested in making them more beautiful. The City's goal is to seamlessly integrate building perimeter security into consistent, coherent, and welcoming streetscapes that are celebrated by the residents, businesses, and community of Riverside.

The Plan provides design solutions for public space security intended to protect against threats resulting from unauthorized vehicles entering public spaces. The Plan focuses exclusively on perimeters of public spaces designed to protect visitors, residents, and property from threats generated by unauthorized vehicles. It does not address other kinds of security measures, such as building hardening, operational procedures, or surveillance. To develop the appropriate security response the design team interviewed stakeholders from key agencies to determine the high priority areas and the magnitude of potential security threats. The responses guided the basis for further analysis and subsequent recommendations.

In conjunction with determining the most appropriate design interventions for each area, the required strength of the barrier system must also be determined. Some barriers must be designed to stop larger vehicles at high rates of speed, while others might be designed for smaller cars at lower speeds. Barriers of lesser strength may be used for protection at lower costs as more of a deterrent and vehicle approach angle. More robust protection will be required when an approach is unimpeded, allowing vehicles direct access at higher speeds.

The Plan includes six high priority areas within the City of Riverside including:

- Riverside Convention Center
- Main Street Pedestrian Mall
- Ryan Bonaminio Park
- University Village
- Martha McLean-anza Narrows Park
- Special Event Street Closure Program

Design recommendations for these areas include an array of streetscape elements that incorporate security components, such as walls and fences, planters, bollards, and hardened street furniture (e.g. light posts and seating).

Best Practices

"proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime and an improvement in the quality of life." ¹

The Plan recognizes that a vibrant downtown and public space must provide space for a variety of pedestrian experiences. Therefore, the Plan incorporated a thorough review of the Municipal Zoning Code, other specific plans adopted in the City of Riverside, as well as streetscape manuals of the City of Riverside, as a framework for identifying streetscape elements that seamlessly integrate security with existing and future development and potential City-led trails or park projects. Additionally, there are two unique areas in downtown Riverside, which warrant custom designed solutions due to their civic importance and special events status.



Photo Caption: Festival of Lights photo from The Press Enterprise

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

Crime Prevention Through Environmental Design (CPTED) strategies are a guiding best practice related to public space design. CPTED strategies include the physical design, social management, and law enforcement directives that seek to positively influence human behavior as people interact with their environment. One of the key goals of CPTED is to reduce opportunities for crime that may be inherent to the design of an existing public space.

Four specific CPTED principles provided guidance during the design process for this Plan. Each of these strategies is important to consider when analyzing each priority area and when developing recommendations for protection, aesthetics, and accessibility of a space.

¹ International CPTED Association."https://www.cpted. net/



Natural Surveillance

The design and placement of physical features in a way that maximizes visibility, and creates unobstructed views of surrounding areas. Natural surveillance avoids the creation of building entrapment areas and prioritizes unobstructed doors and windows, transparent building materials, pedestrian-friendly sidewalks and streets, and good night time lighting.



Territorial Reinforcement

Physical design can also create or extend a sphere of influence. Territorial reinforcement is the use of physical features that express ownership such as bollards, fencing, pavement treatments, signage, and landscaping.



Natural Access Control

Design concept that ensures entrances are clearly defined, visible, and well lit. People are physically guided through a space by the strategic design of streets, sidewalks, building entrances, landscaping, and neighborhood gateways. Design elements are very useful tools that clearly indicate public routes and discourage access to private areas and structural elements.



Maintenance

Maintenance allows for the continued use of a space for its intended purpose. Deterioration and blight indicate less control by the intended users of a site and a level of disorder. Proper maintenance encourages visibility and limits inoperative lighting, and serves as an expression of ownership.

ASSESSMENT OF SOFT TARGETS

Soft Targets and Crowded Places (ST-CPs), such as entertainment venues, transportation hubs, outdoor parks and plazas, are destinations that are easily accessible to the public where they congregate in large crowds with limited security or protective measures in place making them vulnerable to attack. Limited security measures include a lack of recognizable security professionals controlling access to a venue as well as electronic means of monitoring and recording an area such as closed-circuit television cameras (CCTV). Protective measures would include the use of barriers that would prevent unauthorized access to an area and channel people and vehicles to designated access points with a security screening process.

Soft target areas are typically:

- Easily accessible and exposed
- Accommodate a high density of people
- Where frequent events are held



Photo Caption: Rhythm of Riverside Summer Nights Concert Series in Fairmount Park from Riversideca.gov

MITIGATION MEASURES

Attacks involving intentional vehicle ramming of soft-target, densely populated outdoor areas have become increasingly common (See Table 6-1). These events have predominately occurred at public parks and pathways, shopping districts and outdoor events where large crowds of people have congregated in an open, easily accessible setting. These events have propelled both public and private sector decision makers to implement hostile vehicle mitigation measures to protect these outdoor venues by means of installing vehicle barriers around the perimeter of a gathering space (i.e., plaza, outdoor theater, etc.), along the street side of heavily trafficked sidewalks and other vulnerable areas.

Implemention of a mitigation plan involves an initial assessment that evaluates the existing or proposed site layout considering possible vehicle approach scenarios, and determines mitigation measures to reduce the vulnerability to both intentional and accidental vehicle ramming. Vulnerabilities lie where vehicles can obtain high speeds through a direct (straight) path of travel to impact densely populated areas. Mitigation can be achieved by providing obstacles to limit a direct approach (curved roadways, lane dividers and/or curbs) and/or implementing rated or non-rated barriers to stop or deter vehicle access.

Year	Attacks	% Attacks	Fatalities	FPA
2014	11	8.8	62	5.6
2015	19	15.2	13	0.7
2016	11	8.8	102	9.3
2017	36	28.8	63	1.8
2018	35	28.0	61	1.7
2019	13	10.4	19	1.5
Total/Averages	125	100	320	2,6

Table 1.Vehicle Ramming Attacks/Incidents Fall in2019, Mineta Transportation Institute - San Jose StateUniversity, Nov 26 2019)

VEHICLE BARRIER STANDARDS

Risk associated with an intentional vehicle impact can be expressed in terms of barrier crash ratings, also termed anti-ram. There are a number of industry standards for determining the barrier capacity with respect to a vehicle impact, the most common of which is ASTM-F2656 Standard Test method for Vehicle Crash Testing of Perimeter Barriers (See Figure 6-1 at right). This standard is used for the selection and procurement of an anti-ram vehicle barrier based on the specification of vehicle weight, impact speed, and dynamic penetration distance (i.e., distance past the impact point that a vehicle is stopped). Other similar standards include ISO - IWA 14-1:2013 Vehicle security barriers - Part 1: Performance requirement, vehicle impact test method and performance rating, and BSI – PAS 68 impact test specifications for vehicle security barrier systems.

Crash-ratings are dependent on the vehicle type: Small Passenger Cars (2430-lb), Pickup



ASTM-F2656 highlights the impact of different types of vehicles based on weight.

Trucks (5070-lb), or Medium-duty Trucks (15,000 lb). Of these vehicle sizes, a pickup truck is the most commonly used for design of barriers domestically, including government, airports and other facilities, unless their target attractiveness and asset value warrants a larger vehicle. Once the vehicle size is determined the impact speed and dynamic penetration distance is specified for procurement of an anti-ram rated barrier.

There are also vehicle barrier standards and selection guides developed by the U.S. Department of Transportation and affiliated research groups that are used for accidental events, however, their objective is to redirect a vehicle with the aim of protecting the driver, rather than render the vehicle inoperable and stop them at a specific distance from an intended target. In the context of an intentional event, these guidelines generally do not provide a barrier design with the needed protection and should only be used with the knowledge of their limitations.

VEHICLE BARRIER DESIGN ELEMENTS

The most effective approach for mitigating a hostile vehicle threat is to configure the site to prevent a direct path of travel to densely populated areas. Where the site design cannot accommodate redirecting roadways or relocating public access away from vulnerable areas, vehicle barriers may be considered. The placement of barriers should be coordinated with other physical security measures such as signage that makes it clear where vehicles and pedestrians should and should not be, as well as vehicle and pedestrian access points with active access controls. Barrier placement and design should also consider the aesthetics and function of an area, including pedestrian paths of travel. Most importantly, a clear zone along the line of barriers that provides significant distance between large crowds and vehicles should be implemented to protect bystanders from crash debris as well as facilitate detection, intervention, and response by the security force.

Barrier selection is highly dependent on the given site vulnerability, risk of an attack occurring, and existing conditions that would affect the installation and performance of the barrier. When considering barrier types, budget constraints may limit the best of



The comparison of images above highlights how the simple addition of bollards can act as a visual and effective physical barrier against vehicle penetration.

intentions. Anti-ram barriers are much more costly than non-rated elements (i.e., street furniture, bushes, boulders, etc.). Therefore, highly vulnerable areas with frequent, large-crowd events may warrant anti-ram barriers while less vulnerable areas with a lighter population density may warrant a more cost-effective approach of installing 'robust' non-rated barriers that would serve as an effective deterrent. As a part of this Plan process, recommendations for barrier design include both the visual aesthetic and effectiveness in stopping vehicle penetration. At right are some examples of design solutions for specific public space areas.

Barriers, whether they be anti-ram or a deterrent system, discussed in the next section, should always be spaced close

enough such that a vehicle cannot drive between them. The industry standard of practice is a 4-foot clear distance, however, the wheelbase distance of the design vehicle type (i.e., compact, sedan, light-duty truck, etc.), can range from 4 to 6 feet. Additionally, the bumper height should be considered to prevent a vehicle from vaulting over a barrier. Minimum barrier heights are typically 30 inches for a sedan and 36 inches for a truck.

Deterrent, Engineered & Anti-Ram

The appearance of a robust security presence, both operational and fixed, serves as a powerful visual deterrence to a potential attacker. This can be accomplished by means of stationing police vehicles at heavily populated perimeter zones as well as the placement of engineered barriers or other vehicle deterrents. Means to deter vehicles without using rated barriers include boulders, planters, benches, or non-rated bollards.

While these solutions are not technically rated, they do have capacity to stop or slow a vehicle. Additionally, engineered solutions that rely on the calculated barrier weight and frictional resistance, such as jersey barriers and water-filled barriers, have some capacity to stop a vehicle, but are more commonly used to defend against an accidental vehicle ramming.

The most robust and reliable barrier is an

anti-ram barrier, such as bollards, heavily reinforced concrete knee-walls and planters, and cable and steel post systems with substantial foundations. These systems are specifically designed with the strength and stiffness to stop a vehicle traveling at speeds of up to 50 mph with validation by crash testing.

Permanent & Temporary

Barriers can be permanent or temporary. Permanent barriers are ideally designed and installed to fit within the context of



Wall Street, NY: An example of how bollards can serve as public art, lighting, and contribute to both security and streetscape character.



National Museum of American Indian, Washington DC: Grade and retaining walls can be used to create public seating and provide physical separation for vehicle travel lanes and pedestrian spaces.

the setting, not disrupt or conflict with the pedestrian and vehicle paths of travel, while remaining substantially anchored and robust to resist a vehicle impact. Temporary barriers typically serve a more transient purpose, with selection priorities based on ease of installation, weight, and factors other than aesthetic appeal. Additionally, crash resistance of temporary barriers is often much less than more permanent solutions, as demontrated by jersey and water-filled barriers.

Temporary barrier products that offer substantial resistance, include the Meridian Archer 1200 and Ameristar Surface Guard



Temporary barrier: Jersey barrier



Temporary barrier: Water filled barrier

products. Both products were specifically designed as modular, unanchored, rapid deployment systems for roadway closure during mass gatherings. When selecting a temporary barrier product, there are many factors that should be considered, including the following:

- Crash Rating
- Weight
- Installation Time
- Storage Space
- Specialized Equipment for Transport & Installation
- Cost

Passive & Active

There are two types of barriers, passive and active. Passive barriers are always in a fixed state of deployment with non-moving parts. These include (see images at right):

- Bollards
- Kneewalls
- Planters
- Cables
- Jersey Barriers

Passive anti-ram rated barriers typically require substantial foundations that often times conflict with underground utilities, therefore, a civil survey should be performed



Temporary barrier: Meridian Archer 1200



Temporary barrier: Ameristar Surface Guard







Examples of passive barriers including kneewalls, planters, and public seating integrated into low retaining walls

prior to final design and placement. Alternatively, there are 'shallow mount' bollards and other rated barriers with foundations that extend no more than 12 inches into the subgrade and can be cast within an existing sidewalk.

Active barriers are those that retract or raise to allow the passage of a vehicle along a roadway, such as wedge and plate barriers that rotate up out of the ground and when retracted are flush with the roadway surface. Other types of active barriers include lift-out or retractable bollards, overhead drop arm with cable and dead man, and sliding or swing crash gates. There are several factors to be considered in the selection of active barriers, including:

- Crash Rating
- Control Mechanism (manual hydraulic, pneumatic or electro-mechanical)
- Failure Mode (aised or closed)
- Cycle Time (rate of operation)
- Safety & Security
- Durability, Maintenance and Environmental Resistance
- Maintenance
- Cost



Image above shows a shallow mount foundation



Example of active barrier: "pop up" or retractable bollards shown above



Examples of active barrier: surface plate shown above

ACCOMMODATE PEDESTRIAN AND VEHICLE ACCESS

One of the most important considerations in the layout of permanent vehicle barriers is an understanding of how a specific area functions, both under normal (i.e. daily) conditions as well as during large gathering events. Barriers should be placed such that they do not impede paths of travel for pedestrians, bicyclists and permitted vehicles, and facilitate the funneling of pedestrians out of harm's way. For example, often barriers are positioned along roadways directly adjacent to curbs, which can impede the ability of a passenger to exit a parked vehicle.

Barrier selection and layout should consider allowance for maintenance and emergency vehicle access, as well as event set-up and break-down. In these instances, specific points of access should be coordinated with emergency responders with provisions for active barrier control by them. Manually removable barriers are also an option, however, they are heavy and would ideally be equipped with a tamper-proof locking device, use of which may impact emergency response time.

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Section 6.3: Design Guidelines



PEDESTRIAN SAFEGUARDING

- a). Street furnishings shall be placed within the furnishing zone. Street furnishings such as bollards, boulders, light poles, benches, and public art can act as pedestrian safeguarding elements.
 - The location of fixed objects, such as utility poles, light fixtures, and other street furniture should not impinge on or restrict the adjacent walkway and shall maintain a minimum 5 foot clear path of pedestrian travel.
 - Walkways or pedestrian zones must be clear of fixed objects in coordination with ADA accessibility guidelines.
 - iii. Install pedestrian-scale lighting (typically lamps less than 25 feet high), with an average illumination level of 10 Lux

(1.0 FC) to increase comfort and safety in the furnishing zone adjacent to the pedestrian zone. The uniformity ratio should be designed for 3:1.

- b). Street furnishings along streets can serve as deterrents to accidental vehicle intrusions to sidewalks.
 - Streets furnishings including light standards, seating, waste receptacles, and wayfinding signage can act as pedestrian safeguarding elements. These street furnishings shall be placed a maximum of 4 feet on center.
 - Street furnishings can be clustered to conserve space. The objective is to create a rhythm of spacing to avoid any gaps larger than 4 feet.



1. Public Space Standards

- All new projects that include a public space such as a plaza or other active park amenities (excluding passive park features, such as open space, preserves, habitat, etc.) in excess of 2,500 square feet or 200 linear feet abutting a public right of way shall include pedestrian safeguarding design.
 - i. There shall be no more than 4 feet of space between any of the street furnishing elements
 - Project shall incorporate two layers of linear street furnishings in linear alignments along the public space adjacent to roadways.
 - iii. No pedestrian safeguarding element shall be less than 33 inches in height.
 - iv. With the exception of light poles, no pedestrian safeguarding element shall exceed 40 inches in height.
- b) Projects with a 0 foot lot line setback may provide required short-term bike parking within the sidewalk area in front of the project as long as a permit has been obtained from the Public Works Director/ Department.
 - i. The rack element should keep the bike upright, supporting the frame in two places and allowing one or both wheels to be secured.
 - Install racks with sufficient space between adjacent parked bicycles to enable easy locking of bicycles.
 - Empty racks should not pose a tripping hazard for visually impaired pedestrians. Position racks out of the walkway's clear zone.

c) Consider opportunities to include seating and/or art elements within the sidewalk area. Projects seeking to include such amenities shall utilize the Public Works Encroachment Process. Information regarding the process can be found at: https://riversideca.gov/PWSurvey/forms/ EncroachmentPermit.pdf

2. Security Zones

- a) Curb Lane (or Furnishing Zone): The curb lane is the portion of the right-of-way between the sidewalk and the curb.
 - i. Streetscape security components should be placed at least 2 feet from the edge of the curb to allow for the opening of car doors and to facilitate passenger vehicle pick-ups and dropoffs.
 - Protect street trees. Before a final ii. design solution can be implemented, a survey will be required to determine the location of underground structures and utilities, and an evaluation will be conducted to determine the impact of nearby trees and root systems. The type of structural system must be carefully considered and alternative structural systems and installation techniques investigated, such as core drilling for pile footing, when determining the final design and location of the security components. Care must be taken to protect existing trees for both aesthetic and security reasons.
 - iii. Locate security elements at curb with consideration to health of street trees. If damage occurs to existing street trees, new street trees are recommended throughout.
- b) Sidewalk: The sidewalk zone is located between the building or site and the curb or parking lane. In this context, the sidewalk serves as the common space for pedestrian interaction, movement, and activity. It is therefore important to allow for and to promote active public use of the sidewalk.

- To the greatest extent possible, sidewalks should be left open and accessible to pedestrian movement. Generally, streetscape security elements should be excluded from this zone.
- Use bollards, planters, or bench furnishings to secure intersections and access to building pedestrian entrances.
- Use careful consideration to allow free and easy pedestrian movement, including handicap and wheelchair access to the sidewalk and building entrances.
- Ensure the design accommodates emergency vehicles and maintenance equipment such as utility trucks and motorized cleaners, and allows easy access to bus stops.

3. Streetscape Security Elements

- a) Considerations
 - Incorporate site perimeter security seamlessly into a well-designed and aesthetically pleasing streetscape. A broad palette of security elements, to arrange and incorporate, allows for more flexibility in the design solution for perimeter security.
 - Some of the street furnishings may require "hardening" to ensure they function as both amenities and as structural barriers.
 - Proposed security elements should meet the City standards of any required engineering or testing to ensure they satisfy security requirements.



Streetscape elements suitable for hardening as security elements.

- iv. Locate underground systems. Some security elements may require substantial below-grade structural systems that will compete with the location of underground structures, utilities, and tree roots. In some cases, the feasibility of installing streetscape components for security will be affected by these underground conditions and will significantly influence the location of the security elements, and the cost of installation.
- v. Implement traffic calming measures deemed appropriate by Public Works Department to reduce vehicular travel speeds along corridors adjacent to sites identified as vulnerable.
- vi. Secured vehicle entrances require removable or retractable bollards, gates, or plate barriers. These elements must be able to accommodate highly repetitive usage.
- vii. Monotonous repetition of a single element should be avoided. When a continuous line of bollards approaches 50 feet, they should be interspersed with other streetscape elements, such as hardened benches, planters or trees.
- viii. Landscape materials can soften and naturalize the appearance of many types of constructed barriers, improving appearance and compatibility with the surrounding streetscape.
- b). Street furniture (includes hardened benches, waste receptacles, etc).
- c). Benches
 - Dimensions (2 feet 6 inches high, 2 feet wide, 7 feet long). Bench is sized specifically for pedestrian safeguarding.

- d). Bollards
 - Recommended at entries and corners to maintain the free movement of pedestrians. A bollard is a vehicle barrier consisting of a cylinder, usually made of steel and filled with concrete placed on end in a deep concrete footing in the ground to prevent vehicles from passing, but allowing the entrance of pedestrians and bicycles.
 - Use removable bollards (and/or gate arms) for emergency vehicle and service entrances.
 - iii. A typical fixed anti-ram bollard consists of a ½-inch thick steel pipe, 8 inches in diameter projecting about 30 inches above grade and buried about 48 inches in a continuous strip foundation.
 - iv. In no case shall bollards exceed a height of 38 inches.
 - v. Note: Commonly used decorative bollards without deep foundations do not have anti-ram capacity, though they may provide some deterrence value by making the building look more protected than it is.
- e). Seat bollards provide additional outdoor seating options which can include a bench with reinforced hidden bollards or a larger concrete bollard that serves as a seating surface.
- Retractable Bollard (3 feet high, 8 inches in diameter, at 42 inches clearance between bollards).in diameter, at 42 inches clear between bollards).
- g). Bollard system guidelines are:
 - Space between 36 and 48 inches depending on the kind of traffic expected with consideration to the needs of pedestrians, persons with

strollers, wheelchair users, and the elderly.

- In long barrier systems, the bollards should be interspersed with other streetscape elements such as hardened benches, light poles, or decorative planters.
- iii. Keep clear of ADA access ramps and the corner quadrants at intersections.
- iv. Arrange in a linear fashion in which the center of the bollards is parallel to the center line of existing streets.
- v. If underground utilities make the installation of conventional bollard foundations too difficult, a possible solution is to use bollards with a wide shallow base and a system of beams below the pavement to provide resistance against overturning.
- h). Gate Arms (as per manufacturer's specification).
- i). Fences and Walls
 - i. Decorative metal fence: (minimum 2 feet 6 inches high, length may vary).
 - ii. Fence and Wall (see page 6-28).
 - iii. Fence and bollard: Can be engineered as an anti-ram system. A typical solution is to use cable restraints to stop the vehicle: these can be placed at bumper height within the fence, hidden in planting. The cable needs to be held in place using bollards and anchored to the ground at the ends.
 - iv. Plinth Wall (Low retaining wall):Dimensions: (minimum 2 feet 3 inches high, 2 feet wide, length may vary).
 - j) Planters
 - i. Well-designed planters can form an effective vehicle barrier. Engineered planters need considerable reinforcing

and below-grade depth to be effective and become fixed elements in the landscape design.

- Rectangular planters should be no more than 2 feet wide, and circular planters should be no more than 3 feet wide. The horizontal dimension of rectangular planters should not exceed 6 feet.
- iii. Landscaping within planters should be kept below 2-1/2 feet, except when special use requirements call for increased foliage. In addition, planters should not have enough vegetation to hide a package 6 inches thick, such as a briefcase.
- Planters should contain live
 landscaping at all times and be
 regularly cleaned of trash and debris.
- v. Planters should not be used in high pedestrian traffic areas as determined by City staff. In these locations, bollards or other less obtrusive objects are appropriate.
- vi. Planter design, location, and maintenance should create viable conditions for healthy plants. These include adequate water or irrigation, appropriate soil mixture, and selection of plants appropriate to be grown in planters. Seasonal characteristics and ultimate size of plant material shape the choices.
- k) Pre-Cast Concrete or Stone Seat Planter
 - i. Dimensions: (2 feet 6 inches high, 9 feet 6 inches wide, 24 feet long)
 - ii. 42 inches between planters



Pedestrian Target Safeguarding streetscape elements depicted in the above images are for illustrative purposes only. The actual design and layout should be approved by an engineer to ensure safety protocols are met.

- l) Street Trees (as a security element)
 - i. Size: minimum 8 inch caliper
 - ii. Spacing: minimum 20 feet on-center, maximum 40 feet on-center
 - iii. Tree enclosures are to be installed on the inside of the tree planting bed
- m) Deciduous or Evergreen Plantings
 - i. Size 3 foot balled and burlapped (BB), full to ground
- n) Street Light Standards
 - i. 40 feet on-center
- o) Pedestrian Light Standards
 - i. 20 feet on-center
- p) Heavy Objects (boulders, art, etc.)
 - Heavy objects, such as large sculptural objects, massive boulders, earthen berms or concrete forms with unassailable slopes, and dense planting and trees can be used in a similar way to bollards to prevent vehicles from passing, while allowing the passage of pedestrians and bicycles. To ensure that such barriers can effectively reduce the threat level, engineering design and/or evaluation is necessary.