California High-Speed Train Project

TECHNICAL MEMORANDUM

High-Speed Train Passenger Station Site Design Guidelines TM 2.2.3

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Prepared by PB

for the California High-Speed Rail Authority

System Level Technical and Integration Reviews

The purpose of the review is to ensure:

- Technical consistency and appropriateness
- Check for integration issues and conflicts

System level reviews are required for all technical memorandums. Technical Leads for each subsystem are responsible for completing the reviews in a timely manner and identifying appropriate senior staff to perform the review. Exemption to the System Level technical and integration review by any Subsystem must be approved by the Engineering Manager.

System Level Technical Reviews by Subsystem:

Systems:	*Signed document on file*_________ Print Name: Eric Scotson	30 Mar 09 Date
Infrastructure:	*Signed document on file*_________ Print Name: John Chirco	06 Feb 09 Date
Operations:	*Signed document on file*_________ Print Name: Paul Mosier	03 Apr 09 Date
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ABSTRACT

This technical memorandum identifies the programming and design guidelines for site design at high-speed train passenger stations. This information is intended to provide technical direction in order to advance the design of the passenger station sites and associated access and service facilities to the 15% Design Level. It is also present design guidance for the layout and configuration of high-speed train passenger station sites so that these facilities can be fully considered during the project level environmental assessment.

Design elements addressed in this technical memo include:

- Passenger Station Site Design and Layout Principles
- Passenger Station Typologies
- Facility Programming and Sizing Considerations
- Access Hierarchy and Multimodal Connectivity
- Facility Design Requirements, including those for pedestrians, bicycles, transit, pick-up/drop-off, parking, vehicular circulation and access for all modes.
- Site Infrastructure

Station sites and site facilities will vary by type of station (intermediate or terminal), location, category of station, and patron ridership. The quantitative guidance in this document is based on the currently available information and will require refinement during subsequent design phases as more information about patron demand and policy direction becomes available.

This document does not contain the following elements:

- Quantitative requirements for site shape and minimum site size
- Specific guidance concerning adjacency relationships
- Prototype site layouts and facility relationship diagrams

Guidelines and standards for high-speed passenger station programmatic requirements are presented in a separate document.

1.0 INTRODUCTION

1.1 PURPOSE OF TECHNICAL MEMORANDUM

The purpose of the technical memorandum is to provide design guidance for the functional layout of station area site facilities needed to promote safe, efficient and high quality high-speed train service. This memorandum identifies and describes the extent and type of station area facilities required for HST stations and provides site design standards and guidelines for station areas.

1.2 STATEMENT OF TECHNICAL ISSUES

The following technical issues are addressed in this memorandum:

a. Identification of internal high-speed train policy issues that will shape station area facilities and site design. The memorandum identifies for topics for policy consideration related to travel market factors, parking pricing, hierarchy of station area access, station area development and other considerations.

b. Determination of type and size of station area facilities. Based on the diverse range of cities served by proposed high-speed train stations, stations are classified into six groups are distinguished from each other by general programmatic differences, such as whether intermodal connections are within stations or arranged in the site design outside of the station; differences in distribution of mode of access to stations; amount, type and pricing of parking; and other station access and site facility considerations.

c. Provision of flexible design guidance. General design objectives and guidelines are established that can provide consistency system-wide, yet are flexible to adapt to the unique conditions at each station area. Site design guidelines focus on the relationships of program elements and activities, and how program elements are to be prioritized and organized to encourage positive relationships and reduce conflicts. The intent is to provide sufficient program-level information to give direction to the design team.

This manual contains design standards and guidelines that will be used in the design of high-speed train passenger station site facilities. The distinction between standards and guidelines is summarized in Section 1.2.1.

1.2.1 Definition of Terms

The following technical terms and acronyms used in this document have specific connotations with regard to this technical memorandum.

Accessibility	The ease with which a site or facility may be reached by passengers and others necessary to the facility's intended function. Also, the extent that a facility is usable by persons with disabilities, including wheelchair users.
Connectivity	Describes the degree of "connectedness" of a transportation system such as a transit network, and the ease with which passengers can move from one point to another within the network, or points outside the network.
Dedicated Corridor	Segment along the high-speed train alignment where high-speed trains operate on tracks that are exclusive of other passenger or freight railroads with the exception of other HST-compatible equipment used for long distance commuter service or high-speed freight
Design Guidelines	A preferred but not necessarily required direction for a particular design feature.
Design Standards	A requirement for a particular design feature.
Feeder Route	Branch routes that feed into main (arterial) routes.

Footprint	Area of the ground surface covered by a facility, or affected by construction activities.
Frequency	The number of trains, flights, or other transportation service occurring in a given time period.
Headway	The time between buses, trains, or other transit vehicles at a given point. For example, a 15-minute headway means that one bus arrives every 15 minutes.
High-Speed Train	Refers to a train designed to operate safely and reliably at speeds near 200 mph (350 kph).
Intermediate Station	A station between two terminal stations. Intermediate HST stations will include additional tracks to allow for through running express services.
Intermodal	Describes transportation that involves more than one means (walk, bike, auto, transit, taxi, train, bus, air, etc.) during a single journey.
Kiss-and-Ride	Facility for private vehicles to drop-off or pick-up high-speed train patrons.
Level of Service (LOS)	A scaled rating system using quantitative measures to characterize operational conditions within a traffic stream that correspond to qualitative gradations in motorists', passengers', and/or pedestrians' perceptions of the degree of congestion present.
Modal	A transportation system defined on the basis of specific rights-of-way, technologies, and operational features.
Park and Ride	Facility where high-speed train patrons can park and leave personal vehicles prior to transfer to high-speed train.
Pick-Up and Drop-Off	Facility for private and semi-private vehicles to drop-off or pick-up high-speed train patrons, could include facilities for taxis, private shuttles, rental cars
Public Transportation	Includes bus, trolley bus, streetcar or trolley car, subway or elevated, railroad, ferryboat, and taxicab service.
Ridership	Number of passengers using high-speed trains over a certain period of time
Right-of-Way (ROW)	A legal right of passage over a defined area of real property used for highway, railway, public utility services, or other purposes. In transit usage, refers to the corridor along a roadway or track alignment that is controlled by a transit or transportation agency/authority and is usually the access control line.
Shared Corridor	A high-speed train alignment where high-speed trains operate adjacent to other passenger railroads (e.g., Caltrain, Metrolink, and Amtrak).
Shared Track	Segment along the CHSTP alignment where rail operations are conducted by high-speed trains and another railroad on common track.
Terminal Station	A station located at the end of a line.
Transportation Demand Management	The operation and coordination of various transportation system policies and programs to manage travel demand to make the most efficient and effective use of existing transportation services and facilities.

Transportation System Management
: Actions that improve the operation and coordination transportation services and facilities to realize the most efficient use of the existing transportation system.

Travel Time
: The time spent on the road, in the air, or on a train from a place of origin to a place of destination. Total travel time includes the time required to reach a station or an airport, time spent waiting for the next scheduled train or flight, time spent getting to the boarding area, time spent checking and retrieving luggage, time spent getting a rental car or taxi, as well as time spent to reach the final destination.

Acronyms

AASHTO ....American Association of State Highway and Traffic Officials
ADA ....Americans with Disabilities Act (ADA)
AREMA ....American Railway Engineering and Maintenance of Way Association
BRT..................Bus Rapid Transit
Caltrans............California Department of Transportation
CBC ....California Building Code
CCTV ....Closed Circuit Television
CFR ....Code of Federal Regulations
Authority...........California High Speed Rail Authority
CHST ....California High Speed Train
CHSTP ....California High Speed Train Project
CPTED.............Crime Prevention Through Environment Design
EIR...................Environmental Impact Report (CEQA)
EIS...................Environmental Impact Statement (NEPA)
FRA..................Federal Railroad Administration
FTA..................Federal Transit Administration (Federal)
HOV ....High-Occupancy Vehicle
HST..................High Speed Train
IBC...................International Building Code
LOS..................Level of Service
LRT..................Light Rail Transit
MOU ....Memorandum of Understanding
MPH/mph ....Miles per hour
NFPA ....National Fire Protection Association
ROW ....Right of Way
THSR ....Taiwan High Speed Rail
TGV ....Train à Grande Vitesse
TM....................Technical Memorandum
TVM ....Ticket Vending Machine
WMATA............Washington Metropolitan Area Transit Authority

1.2.2 Units

The California High-Speed Train Project is based on U.S. Customary Units consistent with guidelines prepared by the California Department of Transportation and defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the United States, and are also known in the U.S. as “English” or “Imperial” units. In order to avoid confusion, all formal references to units of measure should be made in terms of U.S. Customary Units.

Guidance for units of measure terminology, values, and conversions can be found in the Caltrans Metric Program Transitional Plan, Appendix B U.S. Customary General Primer (http://www.dot.ca.gov/hq/oppd/metric/TransitionPlan/Appendice-B-US-Customary-General-Primer.pdf). Caltrans Metric Program Transitional Plan, Appendix B can also be found as an attachment to the CHSTP Mapping and Survey Technical Memorandum.

2.0 DESIGN STANDARDS AND GUIDELINES

2.1 GENERAL

This document provides initial guidance on various elements of station site design in order to establish a station site footprint for environmental assessment and develop station site plans to the 15% Design level. These guidelines are based on currently available information for other rail transportation services and general guidelines.

It is recognized that the site design guidelines and associated design elements will be refined in subsequent stages of design. Specifically, Policy Considerations as set out in Section 2.4 include assumptions about certain station site design policies which inform design standards and guidelines and will be confirmed by the Authority.

2.2 LAWS AND CODES

Design criteria for the CHSTP are under development. When completed, a CHSTP Design Manual will present design standards specifically for the construction and operation of high-speed railways based on international best practices. Initial high-speed rail design criteria will be issued in technical memoranda that provide guidance and procedures to advance the design of project-specific elements. Criteria for design elements not specific to high-speed train operations will be governed by existing applicable standards, laws and codes. Since the stations will be located within multiple municipal jurisdictions, state rights-of-way, and/or unincorporated jurisdictions, local building, planning and zoning codes and laws shall be considered.

The CHSTP design standards and guidelines may differ from local jurisdictions' codes and standards. Because the Authority is an agency of the state government, development of facilities within the state's right-of-way should fall under the jurisdiction of the Division of the State Architect (DSA) and the State Fire Marshall along with input and coordination with local jurisdictions. In the case of differing values on work outside of the state-owned right-of-way, conflicts in the various requirements for design, or discrepancies in application of the design standards, the criteria followed shall be that which results in the highest level of satisfaction for all requirements or that is deemed as the most appropriate by the California High-Speed Rail Authority (Authority). The standard shall be followed as required for securing regulatory approval. Approvals may also be required from the Army Corps of Engineers, Division of the State Architect, Office of the State Fire Marshall, California Coastal Commission, Caltrans, and other agencies and authorities at specific locations.

Applicable codes, rules and guidelines may include but are not limited to:

- ADA and ADAAG: ADA Guidelines for Buildings and Facilities
- National Fire Protection Association (NFPA) 130
- CCR, Title 24, California Building Standards Code
- California Public Utility Commission (CPUC) General Orders
- California Disabled Accessibility Guidebook (CalDAG)
- Local Energy Codes
- Local Street Improvements Manuals
- Local Traffic Signal Design Guides
- Local Building Codes
- Other City and County Ordinances and Design Criteria
- American Association of State Highway and Transportation Officials (AASHTO)
- American Railway Engineering and Maintenance-of-Way Association (AREMA)
- Crime Prevention Through Environmental Design (CPTED)
- International Building Code (IBC)
- Uniform Building Code(UBC)

- TSI: Technical Specifications for Interoperability for the Trans-European Transport Network.
- CHSTP Adopted HST Station Development Policy (2008)

The Technical Specifications for Interoperability (TSI) are a set of standards required of all railroad systems in the European Union. The TSI are defined and published by subject matter, described as “subsystems”. The TSI that is primarily relevant to this TM is that for the Infrastructure Subsystem, current version dated 19 March 2008 based on a Commission Decision of 20 December 2007. The Infrastructure TSI does not directly address station site layout.

2.3 APPLICABILITY TO FEDERAL REGULATIONS

To follow.

2.4 POLICY CONSIDERATIONS

Policy considerations can significantly influence the size and functionality of high-speed train station site. In developing this document, design assumptions were made that will require confirmation based on Authority policy. In order to advance the design of station areas, several key policy issues shall be confirmed. These issues are summarized in the following sections. For the purpose of this document, multiple policy assumptions were made. These assumptions are stated in the follow sections and are reflected in the design guidelines and criteria presented within this document. Assumptions will be confirmed with the Authority.

2.4.1 Station Parking Pricing and Payment Mechanism

Although the CHSTP will include the conceptual design and environmental clearance for parking facilities, parking facilities will be constructed and operated by others. Therefore, this document assumes that all parking will be provided at market rates. The level of station parking pricing will influence the demand for parking at high-speed train stations. If pricing discourages parking, demand for other modes of access may increase accordingly. The method of payment and payment control may also change station site and parking garage sizing and layout. Automobile parking is further addressed in Section 3.4.7.

2.4.2 Station Access Hierarchy

In order to develop a station site plan, it is necessary to determine a hierarchy of access between available modes. This determination may take into account patron safety, station site efficiency or other policy directions such as land use development in station areas. This document assumes that access priority is as follows, from highest to lowest: Pedestrian, Transit, Bicycle, Pick-Up and Drop-Off, and Park-and-Ride. Station site access hierarchy is further addressed in Section 3.4.1: Station Site Access Guidelines which informs design standards and guidelines for Section 3.4: Design Standards and Guidelines for Station Site Facilities.

2.4.3 Passenger Station Area Development

The Authority’s *Adopted HST Station Development Policies* (May 14, 2008) has the potential to significantly shape the site design of high-speed train stations. This policy as well as those of affected local jurisdictions shall be considered when developing plans and footprints for station sites.

2.4.4 Level of Service for Station Site Facilities

The acceptable amount of congestion and density of users in certain station site facilities will influence the size of these areas. In order to evaluate facility sizing, a methodology can be implemented that uses standards for acceptable level-of-service (LOS). This document assumes a required pedestrian LOS of B or better and automobile LOS of D or better under peak period conditions. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, HST pedestrian facilities may be designed for a peak LOS C.

2.4.5 Provision of Facilities for Other Transportation Operators

The level of facilities provided for other transportation operators at high-speed train stations will significantly influence station site footprints. Some of these services may be private concessions – such as rental car companies—while others are provided by public agencies. Facilities for other transportation operators could include but are not limited to: right-of-way, parking spaces, offices or information booths, layover space and operator relief stations. Facilities for public agencies may be based on agreements or between the Authority and the public agency or jurisdiction. It is assumed that no specific accommodations will be included in the site plan for private concessions.

2.4.6 Sustainability

Station sites should be designed to be sustainable including the location of the site, habitat and wetland conservation, reduced automobile dependence, energy efficiency, reduced water use, reuse and recycling of materials and buildings and many other factors. Site layout and development will support LEED Silver or better certification for station facilities in line with the Authority's policies.

Sustainability goes beyond the architectural design of buildings and structures on station sites. Station site plans are intended to be sufficiently flexible to accommodate potential future growth and changes in travel patterns and traveler behavior. This will contribute to sustainability by reducing the likelihood that high-speed train station sites or facilities will become functionally obsolete and require replacement or reconstruction before the end of the useful life expectancy of the physical assets. Station sites that are designed to be appealing and convenient to use by the travelling public will help the system achieve the highest level of potential ridership. This in turn will maximize the benefits of CHSTP by reducing the consumption of energy resources by the passenger transportation sector.

3.0 ASSESSMENT / ANALYSIS

3.1 BACKGROUND

Design criteria for international high-speed train systems were reviewed along with criteria for stations used by Caltrain, Metrolink and Amtrak as several stations will be served by both high-speed trains and conventional passenger train systems. It is recognized that there will be a high degree of variability between stations due to different station locations, ridership demands, potential intermodal connections, different trip purposes and local land use and building codes.

Several levels of guidance are provided to address station site design:

- Variability between stations is addressed generally by identifying “Station Category” types. These types lead to different sets of functional requirements.
- Different types of facilities to be included at a station site are identified along with general guidance for sizing of these spaces.
- Specific design guidelines and standards for each facility type and the interactions between facilities are presented.

Standards and guidelines are informed by the policy assumptions in Section 2.4 – Policy Considerations.

3.2 STATION CATEGORIES

The high-speed train system will have a wide range of stations types along its alignment. Some HST stations will be located in bustling downtowns at the center of internationally-known cities while others will be located in heart of suburban communities or near airports or universities.

Each station will serve a significant number of riders, commuters and tourists on daily basis. Based on their ridership volumes, intermodal access, location and regional context the HST stations can be categorized into six broad categories – Global Center, Regional Center, City Center, Suburban Center, Town Center, and Special/Airport.

The programming of station site facilities varies by station categories. In addition to descriptions below, *Appendix A: Station Categories* further outlines station category characteristics. Additionally, design and functionality requirements vary by Station Category as outlined in *Appendix B: Station Facility Programming by Station Type*.

3.2.1 Global Center Station

These stations are primarily located within centers of economic and cultural activity in a region. Global centers are regional downtowns and are characterized by a dense mix of housing, employment, retail and entertainment that cater to the regional market. The area is served by a mix of transit modes that support this activity, including high capacity regional rail and bus, and local buses.

3.2.2 Regional Center Station

These stations are primarily located in regional hubs which are somewhat smaller than global centers in prominence. Regional centers typically evolved from suburban edge cities, are located within larger metropolitan areas and are centers of regional commute patterns. Regional Center Stations are well connected to global centers and other destinations within the region, and are served by a mix of transit modes including high capacity regional rail, light rail and various types of bus services.

3.2.3 City Center Station

Although these stations serve centers typically outside the metropolitan regions, they are established urban areas with traditional grid-based downtowns. Such centers contain a mix of residential, employment, retail and entertainment uses, usually at slightly lower densities and intensities than regional centers. Destinations draw residents from surrounding neighborhoods. Generally these centers serve as employment centers for the surrounding areas. City Center Stations are served by multiple transit options, often high-frequency regional bus or bus rapid transit (BRT), as well as local bus. Many city centers retain their historic character, having preserved both historic buildings and street networks.

3.2.4 Suburban Center Station

Suburban center stations are located in areas which contain a mix of residential, employment, retail and entertainment uses, usually at intensities similar to that found in city centers but lower than that in regional centers. Suburban Center Stations can serve as both origins and destinations for commuters. Suburban centers are typically connected to the regional transit network and include a mix of transit types — regional rail and bus, BRT, and local bus — with high-frequency service. Development in suburban centers surrounding station sites may be more recent than that found in city centers, and there are more single-use employment areas and residential neighborhoods.

3.2.5 Town Center Station

Town center stations are located in traditional towns or small cities which are on the fringes of large metropolitan areas. Town centers are not very urban in character and do not have a large employment base. However, these centers are beginning to attract residential and commercial growth from the larger metropolitan region. Town Center Stations are generally served by express or local bus services, and may be connected by commuter rail to the global and regional centers.

3.2.6 Special Station - Airport

Stations located near airports along HST are somewhat different than the types described above as the station sites are primarily focused around a single major activity. The area surrounding an airport station is generally not very urban in character. Although an airport station might not have a very large ridership catchment area, significant ridership originates from the connection made in the transportation network. High-speed train stations serving airports are likely connected with airport terminals directly or with high frequency transit to the terminals. There may also be other modes like regional rail or bus transit connecting to high-speed train stations and the airport. An Airport Station could potentially share parking, rental car and other modal facilities with the airport.

3.2.7 Rail-to-Rail Transfer Station

In addition to the station classifications identified above, there is an important distinction to be made among the various types of HST stations that also serve other rail operators, such as Amtrak, Metrolink or Caltrain. Many of the planned HST stations, falling within any of the possible station categories, will serve other trains besides high-speed trains. Three sub-categories of stations serving multiple railroads are useful for the programming of station site facilities. Each sub-category requires a different type of solution for station siting and facility sizing/layout.

3.2.7.1 Separate Sites

In this configuration, the HST station is located within walking distance but separate from the conventional rail station; new "landside" transportation facilities (parking, taxi stands, bus bays, etc) and connections (pedestrian and transit) are provided for the HST separate from those for the other rail services; passengers transferring between HST and other rail services must walk from one station to the adjacent station via a connecting passageway or sidewalk; HST site and facility requirements at the HST station would be based mainly on the projected level of HST ridership.

3.2.7.2 Same Site, Adjacent Facilities

This configuration would provide a single station with common access and major landside facilities, but the operational facilities within the station are kept separate between the HST and other operators, resulting most likely in a larger building/site footprint. The railroad facilities may occupy different levels of the station, or the facilities of the different railroads may be separated horizontally from each other. Railroads may share a common main entrance or may have separate entrances. Similarly, parking may be shared or may be provided at multiple locations serving the site.

3.2.7.3 Integrated Facilities

The preferred configuration from the passenger service point of view, would provide a single rail station serving all railroad operators: CHST, Amtrak and/or commuter rail. From the street and from any off-site transit facilities, there would be a single train station with a common entrance service all of the railroads. Facility and site requirements would need to be estimated based on the cumulative estimated patronage and peaking characteristics of all of the railroads operating at the station (CHST plus Amtrak and/or commuter).

3.3 STATION FACILITIES

Specific station site needs will vary based on ridership, surrounding land uses, available access modes, different trip purposes and other factors. Each available mode of access shall be accommodated at the station site. Although the areas of each of these spaces will vary by local codes and design standards, common data sources, methodologies and guidelines will inform these decisions. The most important elements to consider when determining demand, and therefore sizing, for a station area space include station ridership and station access/egress mode splits.

Peak period station ridership should be determined following the methodology outlined in the CHSTP Station Program Design Guidelines Technical Memorandum- Section 3.2.3 Peak Period Passengers. Annual and daily ridership estimates by trip purpose are produced by the CHSTP ridership model. Designs should reflect the most recent ridership estimates available. Estimates for access/egress mode share are to be provided by station and trip type by the Authority. Mode shares applied to ridership estimates provide values which indicate demand on each type of station facility. The length of the peak period to be evaluated varies based on the facility type. Mode share data will include factors for vehicle activity calculations including: drop-off party size, parking accumulation, rental car party size and taxi party size.

3.3.1 Pedestrian Facilities

Pedestrian facilities should be sized to provide level of service (LOS) B at the height of the peak period on a typical busy day of the year, as defined in Section 3.4.3.2. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, HST pedestrian facilities may be designed for a peak LOS C. Peak period ridership should be distributed along station area walkways according to expected station patron destinations. Peak period pedestrian flows should include all station area patrons; not only those that access the station on foot, and not only those who are high-speed train passengers. This will ensure that total pedestrian flows are accounted for, including those moving between station area facilities, such as between the station entrance and a parked car or between bike lockers and bus bays.

3.3.2 Transit Facilities

Connecting transit facilities will vary based on the needs and plans of area transit agencies. Sizing and design of intermodal transit parking and circulation will require extensive input from these agencies, which shall be solicited. The local transit agencies and CHSTP design will also be based on estimated local transit demand at stations as well as high-speed train ridership and mode choice models.

3.3.3 Bicycle Facilities

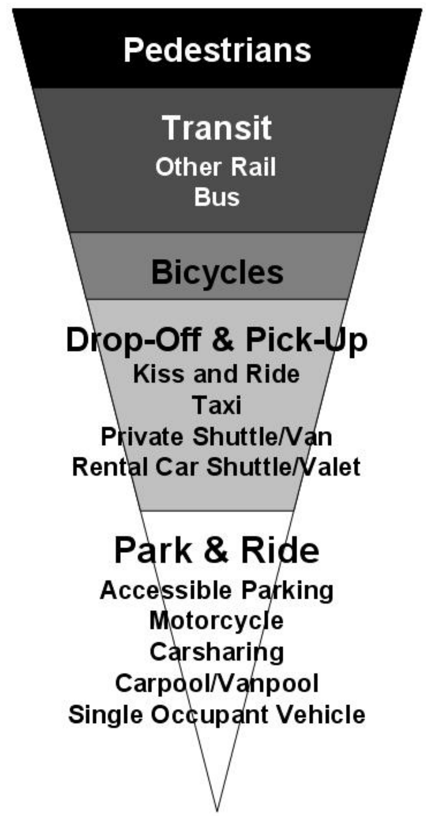
Bicycle facilities should be designed to accommodate expected peak bicycle flows and bicycle parking demands. System ridership, bicycle mode share and trip type dwell times may inform this, but it is important to acknowledge that trip type breakdowns with bicycle as an access mode may vary from that of the station at large. Bicycles are more likely to be used to access the high-speed train for short trips which do not require luggage. In addition to bicycle storage racks and/or lockers, space should be provided for bicycle-sharing pick-up and return facilities, where appropriate, based on those systems that have proven to be successful in the U.S. and internationally.

3.3.4 Pick-Up and Drop-Off Facilities

The number of Kiss-and-Ride spots provided at a high-speed train station will be dependant on demand determined through mode split, ridership and average dwell time figures. Market analysis should consider whether taxi service—and what level of taxi service (Section 3.4.6.2)—will be necessary at each station. Similar processes will evaluate demand for private shuttles and rental car facilities.

3.3.5 Park-and-Ride Facilities

The number of parking spots planned is dependent on demand for parking. Parking demand will vary based on the variables described in Section 3.4. Access mode share will be highly dependant on parking cost. Pricing may also influence the ratio of longer term stays. A full-scale market analysis may be necessary to determine demand and elasticises with regard to price. In addition, markets for specific park-and-ride modes, such as carshare, carpool and motorcycle, should be identified and quantified.



3.3.6 Roadways and Vehicle Circulation

Vehicle circulation space will vary based on demand for the above spaces along with how circulation within the site is designed. Local codes corresponding emergency access and egress Traffic analysis should ensure that roadways are designed to function at LOS D or better during the peak period.

3.3.7 Station Area Systems

In addition to supporting access and egress modes, the station area could require landscaping, drainage facilities, on-site environmental mitigation, HST system support buildings and other spaces. These spaces will be site-specific and defined by local codes, regulations or by the Authority.

3.3.8 Facility Programming by Station Category

Since many of the factors described above are common among station categories, design standards and guidelines can be established by station category. Variations in station programming by station category are outlined in *Appendix B – Station Facility Programming by Station Category*.

3.4 DESIGN STANDARDS AND GUIDELINES FOR STATION SITE FACILITIES

3.4.1 Station Site Access Hierarchy

Mode of access is the way a high-speed train patron travels to or from the passenger station site. A hierarchy of travel mode of access to and from high-speed train stations is presented to provide a balance of travel modes and offer guidance to resolve potential conflicts among travel modes. The following modes of access shall be considered in high-speed train station site planning. These modes are listed based on the assumed highest to lowest priority: *Pedestrian, Transit, Bicycle, Drop-Off & Pick-Up and Station Parking*.

The layout, organization, and associated access routes of transportation facility sites shall ensure that provisions are made for HST patrons using any mode to access the station.

Station sites where conventional rail services (such as Amtrak service or commuter rail) are not integrated within the high-speed train station, but instead are located adjacent to or remote from the passenger station, will need to account for rail passengers transferring between high-speed and conventional trains. Where HST and conventional rail stations are situated adjacent to one another, sidewalk or covered passageway connections will be sufficient. Where walk distances are in excess of 500 feet, and where transfer volumes are projected to be significant, consideration should be given to the provision of moving walkways or other methods of facilitating rail-to-rail transfers.

3.4.2 Site Design Objectives

- Promote person trip accessibility to the station. This objective prioritizes the sizing of site facilities and site design to encourage the highest level of total person trips.
- Ensure multi-modal access and egress to high-speed train stations to ensure all trip types are adequately served.
- Facilitate simplicity, ease, directness and safety of the movement of people and vehicles.

  Site design should aim to make the passenger's total journey as seamless and convenient as possible. Station area sites shall be:

  - Operationally efficient to facilitate clear, safe and direct intermodal connectivity;
  - Publicly visible and accessible from public right-of-ways;
  - Easily navigable within the site and to and from each mode of access to the station; and
  - Designed to minimize conflicts between modes.

- Promote connectivity to existing and planned pedestrian, bicycle, transit and street networks. The design of high-speed train station areas should facilitate connectivity and multi-modal circulation to and from high-speed train stations.
- Coordinate site facilities and site design with local jurisdictions and regional transit providers to ensure a site layout that supports CHST project objectives, as well as local government and regional transit provider objectives and requirements.
- Ensure system-wide consistency in site design. Aspects that should be considered include:

  - Signage
  - System identity
  - Ease of use
  - Site infrastructure which lends itself to system-wide use due to economies of scale in acquisition and maintenance costs.

3.4.3 Pedestrian Facilities

3.4.3.1 Pedestrian Network

- Pedestrian routes should be simple, comfortable, direct, well lit, visually unobstructed and along or visible from public streets. Pedestrians will seek the shortest route and the site plan should anticipate this behavior.
- Pedestrian routes should be contiguous and separated from motorized vehicles wherever possible. Pedestrian conflicts with other travel modes are to be avoided.
- Pedestrian routes shall connect the station entrance, transit services, passenger drop-off, parking, adjacent right-of-ways and other station area facilities together.
- Pedestrian routes shall connect the station area and station entrance to key intersections and pedestrian routes adjacent to the site in order to provide ease of pedestrian access to and from off-site destinations.
- Station area buildings should open directly to sidewalks with windows and public entrances facing passing pedestrians. There should be minimal front or side setbacks, blank walls and surface parking lots that abut sidewalks.
- Pedestrian access and circulation should address actual and perceived potential security concerns.
- Pedestrian routes, where feasible, should avoid unnecessary turns or dead-ends, routes through parking lots and isolated or hidden segments,
- All elements shall conform to ADA Guidelines. Accessible routes will connect all site facilities and destinations. Site furniture and stairs will be located outside of this route

- Multiple pathways should be concentrated where possible to improve passenger safety however care should be taken to not compromise directness or emergency egress.
- Assume and design for right-hand pedestrian flows where possible.
- Consider existing and planned pedestrian and bicycle routes within a minimum half of a mile

of the station when designing routes on the station site itself.

3.4.3.2 Walkways and Sidewalks

Walkways and sidewalks encompass the majority of pedestrian circulation. Guidelines for these facilities are as follows:

- Steps or abrupt changes in level shall be avoided.
- Layout of walkways shall provide maximum visibility of and by oncoming vehicular traffic. Avoid routing walkways adjacent to columns or walls that will reduce pedestrian visibility to vehicle operators.
- Where pedestrian-vehicle conflicts are unavoidable, crosswalks and pathways are to be marked and be clearly visible to motorists. Use finish, color or other elements of design to differentiate pedestrian paths and crossings and increase patron safety and security.
- Sidewalks are required next to stations or other structures when vehicle circulation or parking is adjacent to the building.
- Weather protection, such as canopies, is encouraged in transfer walkways or other high pedestrian traffic areas.
- Walkway widths should be determined by peak pedestrian flows and done to maintain a pedestrian level of service (LOS) of B or better. LOS B provides minimum capacity requirement. Greater walkway widths may be provided to improve the pedestrian environment. Where space is constrained by physical conditions that cannot be mitigated cost effectively, high-speed train facilities should be designed for a peak LOS

- Walkway LOS is determined by walkway width, accounting for walls and other obstructions, and the volume of pedestrians. Walkway width can be determined using the following methodology (which is outlined in Fruin's *Pedestrian Planning and Design* and used by the Washington Metropolitan Area Transit Authority):
- Estimate Estimate peak five-minute pedestrian demand for walkway, based on overall station demand on a typical busy day, distributed among access modes. Design pedestrian flow is the average condition occurring over the peak five minute period (i.e., five-minute demand/5).
- Establish maximum pedestrian flow rate. LOS B = 7- 10 pedestrians/foot/minute (LOS C = 10-15 pedestrians/foot/minute).
- Effective walkway width = Design Pedestrian Flow/Max Pedestrian Flow Rate
- Total walkway width shall include buffers for walls (1.5 feet) and otherobstructions.

3.4.3.3 Pedestrian Bridges and Underpasses

Ground-level pedestrian paths are preferable in order to reduce costs, increase safety and activate the street. Grade-separated pedestrian crossings are necessary at some high-speed train station sites. This could include when passengers are required to cross tracks to reach the station, in order reduce major conflicts with other modes, to take advantage of site topography or to significantly improve directness of circulation. In the case of bridges, protective screens are to be used to prevent objects from being dropped from the bridge. Continuous kick plates along the length of the bridge should be considered. If required, tunnel design shall carefully consider patron security including being well lit, having security monitoring and a wide cross section for visibility. Underpasses should have as open an aspect as practical at each side. Bridge and underpass widths shall be determined by the methodology described in Section 3.4.3.2 or NFPA 130, whichever is greater.

3.4.3.4 Vertical Circulation

Although site planning seeks to reduce changes in grade and corresponding vertical circulation needs, nearly all stations will need vertical circulation elements. Stairways should be wide enough to allow faster moving pedestrians room to pass those who walk more slowly, generally a minimum of 6.0 feet wide. Depending on location, stairs shall meet station emergency egress requirements. Elevators and stairways are to be provided in multi-level parking garages. Elevators, escalators, ramps and stairs shall meet applicable building code and ADA requirements. In addition, elevator cabs and hoist-way enclosures in above-grade shafts should be constructed of glass to the maximum extent possible in order to enhance both actual and perceived security of the elevator and passengers. Clear queuing and run-off clear space should be provided at the top and bottom of all stairs and escalator and elevator landings. Required space is defined in the Station Program Design Guidelines Technical Memorandum.

All escalators provided at high-speed train stations shall be full-size, two-lane models with a tread width of 40 inches – for ease of pedestrian movement and to facilitate travel by passengers carrying luggage. Escalators should be designed to accommodate the wear and tear associated with heavy public use with a high degree of operational reliability. Escalators should be operable at a speed of 90 feet per minute. The installation of variable speed units, with capability for higher-speed operation at 120 feet per minute in addition to the standard speed of 90 feet per minute, is desirable to provide for future operational flexibility. For purposes of analysis, 40-inch wide escalators should be assumed to have a maximum carrying capacity of 70 pedestrians per minute, unless local survey data are available to provide a processing rate more reflective of actual location conditions.

In addition to NFPA 130 standards which may be used to size some stairways for high-speed train station evacuation, stairway width should be sized to accommodate peak pedestrian demand at Pedestrian LOS B or better. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, HST facilities should be designed for a peak LOS C. Because pedestrians move more slowly on stairways, sizing follows a similar methodology to that used to size walkways in Section 3.4.3.2. However, the maximum pedestrian flow rate is 5-7 pedestrians/ft/minute to obtain LOS B (7-10 for LOS C). Stairway widths should be increased by 30-inches when the stairway includes reverse pedestrian flows. For escalators in general public areas not directly serving rail or transit station platforms or boarding/alighting zones, LOS B corresponds to flow rates in the range of 20-30 pedestrians per minute, whereas LOS corresponds to flow rates between 30 and 40 pedestrians per minute. Escalators subject to heavy pulses of passenger loads associated with the boarding or alighting of passengers on individual trains or transit vehicles (such as transit station platform escalators), should be planned to carry passengers at the peak flow rate of 70 people per minute without the creation of excessive queues at escalators.

3.4.4 Transit Facilities

CHST stations will operate as multi-modal transportation hubs that provide links to local and regional transit. Bus and rail systems have the potential to serve as extensive feeders of patrons to high-speed train stations. Locating fixed route transit stops on station property will reduce walking distances and promote the use of local, fixed-route transit services.

Provision of transit facilities at station sites are subject to agreement between the Authority and applicable transit agencies.

At the station site, facilities are required to allow access and boarding and alighting of transit. With multiple transit modes and routes converging at a high-speed train station site, the station sites have potential to be transfer points for non-users of the high-speed train system. Additional operational facilities may be necessary on a station-by-station basis. These non-HST passenger volumes will need to be estimated and used to determine the appropriate sizes and configuration of pedestrian circulation facilities at and adjacent to the station.

Information from transit providers shall be considered in the station design. This information may include, but is not limited to: the number of routes servicing the station (through and terminal), vehicle sizes and passenger-carrying capacities, operating schedules and the transit provider's own projected ridership, including boardings and alightings by time of day at the HST station.

Transit zones should be sited to reduce patron travel times, both on the transit vehicle and as a pedestrian. Maximum walking distance to the high-speed train station entrance from a transit boarding or alighting area should be 500 ft (standard used by WMATA). Where possible, transit facilities should be visible from the high-speed train station, arterial streets and nearby activity areas to increase visibility and security of waiting patrons. Pedestrian links to other areas of the station site should have no or minimal at-grade crossing of vehicle lanes.

Facilities for transit vehicles - including access, circulation and boarding and alighting areas - should be separated from other traffic where it is practicable.

Waiting areas will be provided at transit loading areas and will be sized according to peak period demand at a pedestrian LOS B or better. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, HST facilities should be designed for a peak LOS C.

Required space for pedestrian waiting areas is determined using the following methodology:

1) Estimate maximum demand for waiting area during the peak period.
2) Effective waiting area required = Maximum passenger demand x Average passenger space (10-13 square feet for LOS B)
3) Required waiting area = effective waiting area with a 1.5 foot buffer along any roadways, walls or other obstructions.
4) Waiting area does not include circulation spaces. Pedestrian circulation shall be included in addition to waiting spaces. Pedestrian circulation sizing is outlined in Section 3.4.3.2.

3.4.4.1 Rail

Many stations sites will connect with other rail services—ranging from Amtrak or commuter rail to streetcar services. Amtrak and commuter trains generally will serve a greater number of stations than the HST system and will serve an important function as feeders to the HST network. Therefore, the passenger experience associated with transferring between high-speed trains and other rail services should be as seamless and convenient as possible. Walking distances and the number of required vertical level changes should be minimized.

Integration of HST and other rail services at a single station facility is preferable from the standpoint of passenger convenience and orientation, and this may be possible at certain locations. In other cases, however, a separate HST station may need to be constructed adjacent to or a short walk away from the Amtrak or commuter station. In these circumstances, the pedestrian walkway to the Amtrak/commuter station should be located as close to the HST station entrance as practical. This walkway connection should avoid pedestrian crossings of vehicle traffic lanes and provide a canopy or other cover. Specific location and requirements will depend on local/regional guidelines and codes.

3.4.4.2 Bus

The sizing of bus facilities depends on the number of routes serving the facility, bus operational plans, expected ridership and other factors. These facilities should provide a safe, accessible place for bus boarding and alighting while providing an efficient operating space for bus routes. Bus facilities should be designed to make efficient use of the station site area. In company with operational plans, the area should be sized and planned to remain active and busy throughout the day—avoiding vacant, underutilized space during off-peak periods.

Transit waiting and loading areas should be co-located and concentrated in as compact a configuration as practical – to make transit-transit connections easier, promote efficiency (both for passengers and the site) and encourage active public use of the area.

Bus facilities should be located with easy access from major bus routes to reduce out-of-direction travel. Where feasible, the site should be designed to accommodate future bus service growth.

Bus facilities should be laid out for one-way operations with right-hand drop-off/pick-up directly onto bus waiting areas and corresponding pedestrian paths. At some high-traffic stations, the separation of boarding and alighting areas could speed bus operations at the stations by insuring an alighting area free of boarding passengers. There should be weather protection or shelter the length of the bus platform with a canopy which extends to cover bus doorways. Boarding zones should also have lighting, seating and service information, including schedules and maps. Light poles, bollards, fire hydrants, and other site furniture shall be placed at least 4 feet back from the curb edge.

<u>Passenger Station Site Access</u>

The segregation of buses from other traffic entering the facility prevents delay to transit vehicles as congestion builds during the peak hours. When exclusive right-of-way is not available, controlled access may facilitate free movement of transit vehicles in and out of the station. Controlled access can range from a protected left turn lane out of the station to exclusive bus right-of-way accessing and within the station to queue jump phases into and out of the station.

<u>Bus Facility Geometry</u>

Bus bays may be designed as saw tooth bus bays or tangent bus bays. Minimum dimensions for each are dictated by local codes. Saw tooth bays are generally preferable because this type of bay requires less curb space than tangent bays. In no situation should bus bay geometry require backing (as in angled or diagonal bays). Bus lanes should have a minimum width of 12 feet (or as dictated by local codes) and should be configured to allow buses to pass each other.

<u>Layovers</u>

For routes that terminate at the station, the operator will need to “layover” either on station property or on the street adjacent to the station. A layover occurs because an operator needs to either take a break or allow for time in the schedule to account for variations in traffic patterns. If layovers occur at the station, layover parking should be located to reduce recirculation needed to re-enter service and corresponding congestion. The station will need at least one bus bay or other bus parking space for each route that will layover. Multiple bays are required if the scheduled headway is less than or equal to the layover duration.

3.4.4.3 Intercity Bus

Facilities for intercity buses shall be provided on a station-by-station basis depending on existing facilities in the surrounding community and estimated potential future demand in that community for intercity bus service.

Design standards and guidelines should follow intracity bus guidelines (3.4.4.2) generally with more specific guidance to follow.

3.4.4.4 Driver Relief Station/Restrooms

Driver relief stations and restrooms provide facilities for transit operators during breaks in their operating responsibilities. Driver relief station may not be provided at all high-speed train stations. In some cases, high-speed train staff facilities may be used by employees of connecting transit services. Where there is sufficient need, driver’s restroom facilities will be provided for exclusive use of specific transit agencies. This determination can be made based on the level of transit service provided at the station and local transit operational plans by the Authority with the input of local transit agencies. These facilities are not open to the general public.

3.4.5 Bicycle Facilities

Where possible, bicycle circulation should be segregated from vehicle and pedestrian flows through the provision of bicycle-only paths. In most cases however, bicycles will need to make the most effective use of roadways and curb cuts. If bicycle routes are shared with roadways, bicycle lanes should be designated. All bicycle user types, from recreational users to daily commuters, should be considered in site design.

Bicycle racks and lockers shall be provided at all station sites. The quantity of bicycle storage will vary based on demand which depends on surrounding land uses, terrain, bicycle facilities and other factors. Bicycle parking should be located as close to the station entrance as practicable given site constraints and other design guidelines. Where possible, bicycle parking should be within sight of station staff and general station pedestrian traffic for natural surveillance. From the bicycle parking area, it should be easy to access the station entrance and the surrounding bike network and street system. The area should be covered, well-lit, secure and highly visible.

In addition to bicycle storage racks and lockers, space should be provided for bicycle-sharing pick-up and return facilities, where appropriate. Space and facility requirements should be based on those systems that have proven to be successful in the U.S. and internationally.

3.4.6 Pick-Up and Drop-Off Facilities

Passenger pick-up and drop-off facilities are used by multiple modes including, private automobile kiss and ride, taxi stands, paratransit, private shuttle buses, and rental car pick-up or drop-off.

Facility design should encourage vehicle turnover, reduce conflicts and facilitate traffic flow. The location of these facilities is important and shall be close in proximity and have a direct connection with the station entrance. It shall be convenient for system patrons and drivers in order to encourage motorists to use the specified area and not another location which could cause conflicts with surrounding uses and modes. Convenient recirculation of vehicles within the station site should be provided where feasible in order to reduce congestion on the road network surrounding the site.

Pedestrian routes between station entrance and vehicle drop-off should be direct with no vehicle lanes to cross. Walking distance from this area to the station entrance should be less than 600 feet (standard used by WMATA). Lane widths should allow vehicles to pass those who are stopped. Facilities should be separated from park-and-ride facilities and located to not interfere with transit operations. Access roads for park-and-ride facilities may be shared provided operation of either facility is not interrupted. However, pick-up/drop-off traffic should not be routed through parking facilities. Facility design should ensure right-hand drop-off and pick-up and recirculation without leaving the station site in order to reduce congestion on surrounding streets.

Depending on the demand for pick-up and drop-off facilities, some station sites may segregate the two uses by having a pick-up area and a drop-off area. If the curb length required to service demand exceeds station frontage by 200%, then separate arriving and departing areas with a loading island in front of building are necessary (AREMA).

Private automobiles, taxis, private shuttles and vans and other vehicles using these facilities may be mixed or have segregated facilities by mode. This depends on site configuration and demand for each mode.

Waiting areas should be sized according to the methodology described in 3.4.4 Transit Facilities.

At stations with high demand for pick-up and drop-off, it may be appropriate to provide a waiting area for automobiles outside of the pick-up and drop-off zone so that automobiles are not waiting at the curb for the train to arrive and therefore blocking other patrons' access or circulating resulting in increased congestion.

3.4.6.1 Kiss and Ride

Passenger kiss-and-ride areas are set aside for private automobile drivers to pick-up and drop-off of high-speed train customers. Design of these areas should consider:

- Stalls and aisles for passenger drop-off areas should be larger than those in long-term parking areas due to the frequent turnover.
- Preferred parking arrangements for passenger drop-off areas are as follows, in order of preference (and outlined in Sound Transit's (Seattle area) Design Standards and Guidelines):
    - Parallel to curb
    - 45 degrees to the drive aisle
    - 60 degrees to the drive aisle
    - 90 degrees to the drive aisle
- Pedestrian crosswalks should leave a minimum of 20 foot zones on either side of parallel parking stalls, or greater if directed by local codes.

- If drop-off areas are provided in a park-and-ride lot or garage, placement should avoid conflicts with entering and exiting traffic.

3.4.6.2 Taxi

The number of passengers arriving by taxi will determine the operational characteristics of the taxi areas. Once taxi activity passes a threshold level of operations, taxis begin to interrupt other pick-up/drop-off area operations. Further increases in taxi activities may require segregation of taxi pick-up and drop-off areas. Design of taxi facilities should follow the following guidelines based on magnitude of taxi activity:

- Low – Taxi operations mix with shuttle vans and kiss-and-ride
- Medium – Taxi operations are segregated from other non-SOV modes of arrival, may consider leaving taxi operations mixed with other modes if pick-up and drop-off areas are segregated
- High – Taxi operations are segregated from other non-SOV modes of arrival; further segregation of taxi pickup and drop-off areas

In all cases, stalls or pick-up/drop-off areas should be marked according to whether the stalls are "Taxi Only" or shared with other pick-up/drop-off modes. Space shall be provided for taxi queuing or corralling prior to pick-up of arriving high-speed train patrons. The queuing space size should correspond to projected waiting taxi demand, and it should be located near to but not at the taxi pick-up area in order to provide quick service but not interfere with operations at the station entrance. Where analysis indicates significant potential demand for taxi service, and passenger queuing at the taxi pick-up location, consideration should be given to the provision of a staffed taxi dispatcher booth or desk.

3.4.6.3 Private Shuttle/Van

Shuttle van access may also be located in the pick-up and drop-off area. Shuttle vans may include private paratransit, parking shuttles, hotel shuttles, and other services. Separation from other modes would depend on demand.

3.4.6.4 Rental Car

Rental car drop-off or pick-up service may be integrated into the kiss-and-ride area. Scale of facilities varies by demand and Authority policy.

3.4.7 Automobile Parking

Station parking would allow people who are unable to use other modes to access high-speed train stations. These facilities may include short-term, all-day or long-term parking facilities. Local codes shall be considered.

If parking is developed, the following standards ensure adequate access and performance of parking facilities:

- On-site parking should be provided within an easy walking distance to the station entrance. The maximum distance, by actual travel route, a parking space can be from the station entrance is 1,500 feet or a 5- to 7 minute walk. This standard is used by WMATA and also similar to the maximum curb-side to plane-side walking distance at a selection of major US airports (Fruin).
- For stations where adequate on-site parking cannot be provided adjacent to the station or within a short walking distance, off-site facilities may be developed which are served by parking shuttle services.
- Connections between the parking areas and station entrances should be direct and obvious. Parking should be designed so that those leaving their cars should be "fed" onto primary pedestrian routes.
- Parking facilities should be located as close as possible to the streets serving the site.
- Parking structures should be sized and located in order to encourage shared use of parking.

- Where possible, the first floor of garages should have actives uses to increase natural surveillance and improve the appearance of pedestrian routes.
- Parking garages should be sited so as to not impair the pedestrian circulation between stations and the surrounding community. The driveways that serve parking should avoid crossing main pedestrian routes in the station area.

Parking Garage Facilities should be designed to include the following standards:

- Layout oriented to reduce the walking distance to the station entrance for station patrons once they leave their automobiles. Where possible, parking lot aisles should be oriented perpendicular to the station to facilitate access and to avoid the need for passengers to walk between parked cars.
- Configured to provide access to emergency vehicles including fire equipment and ambulances in the event of an emergency.
- Ninety degree parking with two-way aisle traffic and no dead ends where feasible.
- Parking aisles in parking garages shall be designed to consider pedestrian needs and safety, as well as lot capacity. Pedestrian movements within park-and-ride areas will normally occur within the drive aisles. However, pedestrian walkways may also be required to reduce vehicular interference, to reduce the number of points where pedestrians cross aisles, and/or to shorten irregular routes through successive aisles. Where practical, speed bumps may be considered to reduce vehicle speeds for pedestrian safety.

- Continuous covered walkways will connect parking structures and station entrances.

3.4.7.1 Motorcycle Parking

Motorcycle/scooter parking stalls should be provided as part of station parking at all sites. Local codes shall be considered in facility design. Motorcycle parking stalls should be added in spaces created by the site layout that would otherwise not be used. Stall sizes should be 4 feet by 8 feet with maneuvering lanes of at least 10 feet in width. Motorcycle parking is not allowed at station entrances, in bicycle parking area, on sidewalks, or other walkways.

3.4.7.2 Carpool/Vanpool

When appropriate, reserved parking stalls should be provided for people who arrive at the station in vanpools and carpools. Initial planning and environmental assessment for the facility should identify potential need for these stalls. If implemented, the stalls should be located closer to the station entrance than general parking. Local codes shall be considered in design.

3.4.7.3 Carsharing/Station Car Parking

Where appropriate, reserved parking stalls for car-sharing vehicles (i.e., ZipCar, CityCarShare, etc.) vehicles should be provided. Initial planning and environmental assessment for the facility should identify potential need for these stalls. If implemented, the stalls should be located closer to the station entrance than general parking. Local codes shall be considered in design.

3.4.7.4 Parking for People with Disabilities

Accessible parking shall be provided at all facilities where parking is provided, in accordance with requirements of ADA and state building code. ADA parking should be located closest to the station entrance. A direct, accessible path should lead to the station entrance. Spaces should be sited so that people using this parking do not have to walk or wheel behind parked cars.

3.4.7.5 Staff Parking

Parking stalls used by high-speed train and transit partner staff that need convenient and accessible parking at station facilities shall be consistent with functional needs yet should not pre-empt convenient passenger spaces. Employee parking should be situated so that high-speed train patrons do not use employee spaces.

3.4.7.6 Parking Management System

As parking will be provided at market rates (Section 2.4.1), control at access and egress points may be necessary. Facilities shall be designed to allow for queuing for pay-on-entry or pay-on-exit systems. The number of entrance and exit lanes will vary by demand but at least two lanes in each direction are required in the case of maintenance or a stalled vehicle at one gate. Therefore parking design should consider the number, size and location of these points along with queuing at potential gates. Also, requirements for traffic loop sensors, traffic gates, and antennas in order to implement a gate cashiering, "pay on foot", Smart Card, conventional multi-space meter, or other revenue collection systems should be considered. In addition, the system might differentiate between different types of customers by type of vehicle, length of stay and other factors. Pre-exit payment facilities should be considered which would allow for payment at the station before accessing a parked automobile. This could significantly reduce queuing and therefore corresponding space and facilities at exit points. Pre-exit payment has been implemented in many garages and extensively at airports. Real time information on parking availability, parking reservation systems and other "smart parking" technologies and systems should be considered in order to maximize the efficiency of the provided spaces.

3.4.8 Roadways and Vehicle Access and Circulation

Auto access to the station site should be provided in a way that meets all codes and does not interfere with access modes of higher priority. The location and design of vehicle entrances and exits should take into account the following factors:

- Extending and interconnecting with the existing and planned street network.
- Supporting the existing and/or planned hierarchy of streets, including identification d primary and secondary streets, such that primary station site vehicular access is along higher capacity streets (such as arterial streets) providing direct connections to local destinations and to protect adjacent neighborhoods from excessive vehicle congestion. Direct links to high-speed arterial roadways should be avoided where possible to reduce travel speeds within the site.
- Reduce interference with street traffic.
- Consider adjacent land uses and avoid large unplanted or paved areas that are out of scale with those uses. Curb cuts should be avoided where possible.
- Access roadways should be designed to contain sufficient traffic storage capacity to meet expected patronage at peak times and to prevent traffic backing up onto public streets.
- Constrain number of access roads to reduce confusion and increase efficiency. The number and geometry of intersections should be such that traffic operates at LOS D or better.
- Locate access points to reduce crossing movements for inbound traffic (on the right-side of the roadway) where possible.
- Exclusive turn lanes should only be provided where necessary to maintain acceptable traffic operations. Additional lanes will increase pedestrian crossing length which should be avoided where possible.

Standards and guidelines for roadways are as follows:

- Street and intersection dimensions designed to facilitate pedestrian and vehicular movement. Street widths and intersection dimensions should be minimized while providing adequate levels of service.
- Roadways should circulate counter-clockwise and be configured to allow for recirculation within the site allowing passengers to drop off a passenger and then park or retrieve a car from the parking area and then pick up an arriving passenger at the station curb.
- One-way traffic operation should be provided if adequate right-of-way is available.
- The width of a street or lane dictates the travel speed. In order to control speeds, roadways should be no wider than necessary for "design" travel speeds and emergency vehicle access and egress.
- On-street parking should be considered in order to slow traffic and buffer pedestrians.

- Roadways intended to provide access to bus zones, park-and-ride stalls, and passenger drop-off areas should be designed in accordance with local codes and the “AASHTO Policy on Geometric Design of Highways and Streets.”
- Unless dictated otherwise by code, a single lane driveway or access lane has a minimum width of 11.5 feet. When there are multiple lanes, each lane can be reduced to 10 feet.
- Provisions for passing a stalled vehicle should be made along roadways exiting from public streets.
- Where there are main sidewalks and crosswalks, there should be no wide turning radii, driveways, garage entrances or dedicated turning lanes which require pedestrian refuge islands.

3.4.8.1 Service and Maintenance Vehicle Access

All station sites should have loading and parking spaces with special access routes separate from other traffic provided for delivery trucks, service trucks, garbage trucks and other maintenance vehicles. Designated access route for cash handling vehicles to cash handling facilities should be considered. Loading and unloading zones for delivery trucks should be located to not interrupt station operation. Consider access route for installation or future replacement of station equipment and facilities.

Specific information about requirements and sizing for service and maintenance vehicles will be developed at a later date.

3.4.8.2 Emergency Access

Access for emergency response by fire department and paramedic equipment/personnel, shall be provided, consistent with local codes. Fire lanes shall be clearly marked on the pavement.

3.5 SITE INFRASTRUCTURE

3.5.1 Drainage

Guidance will be developed at a later date.

3.5.2 Grading

Guidance will be developed at a later date.

3.5.3 Lighting

Guidance will be developed at a later date.

3.5.4 Landscaping

Guidance will be developed at a later date.

3.5.5 Signage

Guidance will be developed at a later date.

3.5.6 Security

Guidance will be developed at a later date.

3.5.7 Site Furnishings

Guidance will be developed at a later date.

3.5.8 Additional Site Layout Considerations

3.5.8.1 Location of Communication and Electrical Buildings

If additional communication and electrical buildings are needed on the station site outside of the station the buildings should be collocated with service vehicle parking. Also, ancillary buildings should be located close to train tracks and away from general vehicle circulation—to avoid collisions. As a security measure, communications and electrical buildings should be located away from passenger areas and not be identified with signage.

3.5.8.2 Station Plaza

A station area plaza should be considered as an outdoor entrance to the station and a place for pedestrians to congregate. Size and design will vary by site.

4.0 SUMMARY AND RECOMMENDATIONS

The recommended criteria for station site layout and design is presented in Section 6.0.

5.0 SOURCE INFORMATION AND REFERENCES

1. CHSRA Final Program EIR/EIS (August 2005)
2. CHSTP Technical Memorandum TM 2.2.2 – Station Program Design Guidelines, R0 (April 2008)
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14. Taiwan High-Speed Rail Station Design Criteria. December 2000.
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16. Caltrain Design Criteria. Chapter 3 – Station and Facilities. April 15, 2007.
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18. CHSTP Design Basis Document – California High Speed Rail Program – High Speed Rail System Design Comparison
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6.0 DESIGN MANUAL CRITERIA

6.1 DESIGN GUIDELINES FOR STATION SITE FACILITIES

6.1.1 Access Hierarchy

To ensure a safe, efficient and high quality high-speed train service, a hierarchy of travel mode of access to and from high-speed train stations is presented to offer guidance to resolve potential conflicts among travel modes. The criteria for establishing the hierarchy of station access as follows:

- Promote efficiency of person trip access to high-speed train stations
- Ensure multimodal balance of station area access
- Ensure safe multi-modal access

The following modes of access shall be considered in high-speed train station site planning. Access modes are listed from highest to lowest priority.

- Rail-to-rail transfers (HST, Amtrak and/or commuter)
- Pedestrians (walk trips to and from the station)
- Transit
- Bicycles
- Drop-Off & Pick Up
- Automobile Parking

6.1.2 Site Design Objectives

- Promote person trip accessibility to the station. This objective prioritizes the sizing of site facilities and site design to encourage total person trips.
- Ensure multi-modal access and egress to high-speed train stations to ensure all trip types are adequately served.
- Facilitate simplicity, ease, directness and safety of the movement of people and vehicles.

  Site design should aim to make the passenger’s total journey as seamless and convenient as possible. Station area sites shall be:

  - Operationally efficient to facilitate clear, safe and direct intermodal connectivity;
  - Publicly visible and accessible from public right-of-ways;
  - Easily navigable within the site and to and from each mode of access to the station; and
  - Designed to minimize conflicts between modes.
- Promote connectivity to existing and planned pedestrian, bicycle, transit and street networks.

  The design of high-speed train station areas should facilitate connectivity and multi-modal circulation to and from high-speed train stations.
- Coordinate site facilities and site design with local jurisdictions and regional transit providers to ensure a site layout that supports high-speed train project objectives, as well as local government and regional transit provider objectives and requirements.
- Ensure system-wide consistency in site design. Aspects that should be considered include:
  - Signage
  - System identity
  - Ease of use
  - Site infrastructure which lends itself to system-wide use due to economies of scale in acquisition and maintenance costs.

6.2 STATION SITE SPACES AND FACTORS INFLUENCING SIZING

Category	Included Facilities	Factors Influencing Sizing
Pedestrian	Sidewalks; walkways; crosswalks; pedestrian bridges; pedestrian tunnels; stairs; ramps; elevators; escalators	Total station ridership as all patrons will use some element of pedestrian facilities; Pedestrian LOS; Pedestrian origins and destinations within the site and to/from the site in order to distribute trips among pedestrian facilities
Transit	Transit right-of-way; Transit waiting areas; Rail stations; Bus bays; Transit Station Access	Station ridership; transit mode share; transit operating plans including headways, layovers, intra-transit transfers
Bicycles	Bicycle lanes; bicycle lockers; bicycle racks; bicycle-sharing systems	Station ridership; bicycle mode share; expected stay at station (for parking); connecting facilities
Drop-Off & Pick Up	Drop-off & Pick-up Lane (potentially separated); Taxi Facilities; Private Van/Shuttle Facilities; Rental Car facilities	Station Ridership; Station mode share; vehicle occupancy in terms of system users per vehicle; taxi market analysis; van/shuttle market analysis; Rental Car Market Analysis; Vehicle LOS
Automobile Parking	Accessible parking; Motorcycle Parking; Carpool/Vanpool Parking; CarShare Parking; Staff Parking	Station Ridership; Parking mode share; Parking pricing; Vehicle occupancy in terms of system users per vehicle; Parking in surrounding area; Parking payment mechanism
Roadways and Vehicle Access and Circulation	Roadways for intra-station circulation and access from external roadways; Emergency vehicle routes; Maintenance Vehicle Routes	Peak station vehicle access based on ridership, mode shares, vehicle occupancy; Level of separation between vehicle facilities; Site Specific; Vehicle LOS
Site Infrastructure	Drainage; Grading; Lighting; Landscaping; Signage; Security; Site Furnishings; Auxiliary Buildings; Station Plazas	Site Specific; Local Codes; future Authority decisions

6.2.1 Pedestrian Facilities

6.2.1.1 Pedestrian Network

- Pedestrian routes should be simple, comfortable, direct, well lit, visually unobstructed and along or visible from public streets. Pedestrians will seek the shortest route and the site plan should anticipate this behavior.
- Pedestrian routes should be contiguous and separated from motorized vehicles wherever possible. Pedestrian conflicts with other travel modes are to be avoided.
- Pedestrian routes shall connect the station entrance, transit services, passenger drop-off, parking, adjacent right-of-ways and other station area facilities together.
- Pedestrian routes shall connect the station area and station entrance to key intersections and pedestrian routes adjacent to the site in order to provide ease of pedestrian access to and from off-site destinations.
- Station area buildings should open directly to sidewalks with windows and public entrances facing passing pedestrians. There should be minimal front or side setbacks, blank walls and surface parking lots that abut sidewalks.

- Pedestrian access and circulation should address actual and perceived potential security concerns.
- Pedestrian routes, where feasible, should avoid unnecessary turns or dead-ends, routes through parking lots and isolated or hidden segments,
- All elements shall conform to ADA Guidelines. Accessible routes will connect all site facilities and destinations. Site furniture and stairs will be located outside of this route
- Multiple pathways should be concentrated where possible to improve passenger safety however care should be taken to not compromise directness or emergency egress.
- Assume and design for right-hand pedestrian flows where possible.
- Consider existing and planned pedestrian and bicycle routes within a minimum half of a mile of the station when designing routes on the station site itself.

6.2.1.2 Walkways and Sidewalks

Walkways and sidewalks encompass the majority of pedestrian circulation. Guidelines for these facilities are as follows:

- Steps or abrupt changes in level shall be avoided.
- Layout of walkways shall provide maximum visibility of and by oncoming vehicular traffic. Avoid routing walkways adjacent to columns or walls that will reduce pedestrian visibility to vehicle operators.
- Where pedestrian-vehicle conflicts are unavoidable, crosswalks and pathways are to be marked and be clearly visible to motorists. Use finish, color or other elements of design to differentiate pedestrian paths and crossings and increase patron safety and security.
- Sidewalks are required next to stations or other structures when vehicle circulation or parking is adjacent to the building.
- Weather protection, such as canopies, is encouraged in transfer walkways or other high pedestrian traffic areas.
- Walkway widths should be determined by peak pedestrian flows and done to maintain a pedestrian level of service (LOS) of B or better. LOS B provides minimum capacity requirement. Greater walkway widths may be provided to improve the pedestrian environment. Where space is constrained by physical conditions that cannot be mitigated cost effectively, high-speed train facilities should be designed for a peak LOS C. Walkway LOS is determined by walkway width, accounting for walls and other obstructions, and the volume of pedestrians. Walkway width can be determined using the following methodology (which is outlined in Fruin's *Pedestrian Planning and Design* and used by the Washington Metropolitan Area Transit Authority):
  - Estimate peak five-minute pedestrian demand for walkway, based on overall station demand on a typical busy day, distributed among access modes. Design pedestrian flow is the average condition occurring over the peak five minute period (i.e., five-minute demand/5).
  - Establish maximum pedestrian flow rate. LOS B = 7- 10 pedestrians/foot/minute (LOS C = 10-15 pedestrians/foot/minute).
  - Effective walkway width = Design Pedestrian Flow/Max Pedestrian Flow Rate
  - Total walkway width shall include buffers for walls (1.5 feet) and other obstructions

6.2.1.3 Pedestrian Bridges and Underpasses

Ground-level pedestrian paths are preferable in order to reduce costs, increase safety and activate the street. Grade-separated crossings are necessary at some high-speed train station sites. This could include when passengers are required to cross tracks to reach the station, in order reduce major conflicts with other modes, to take advantage of site topography or to significantly improve directness of circulation. In the case of bridges, protective screens are to be used to prevent objects from being dropped from the bridge. Continuous kick plates along the length of the bridge should be considered. If required, tunnel design shall carefully consider patron security including being well lit, having security monitoring and a wide cross section for visibility. Underpasses should have as open an aspect as practical each side. Bridge and underpass widths shall be determined by the methodology described in Section 6.2.1.2 or NFPA 130, whichever is greater.

6.2.1.4 Vertical Circulation

Although site planning seeks to reduce changes in grade and corresponding vertical circulation needs, nearly all stations will need vertical circulation elements. Stairways should be wide enough to allow faster moving pedestrians room to pass those who walk more slowly, generally a minimum of 6.0 feet wide. Depending on location, stairs shall meet station emergency egress requirements. Elevators and stairways are to be provided in multi-level parking garages. Elevators, escalators, ramps and stairs shall meet applicable building code and ADA requirements. In addition, elevator cabs and hoist-way enclosures in above-grade shafts should be constructed of glass to the maximum extent possible in order to enhance both actual and perceived security of the elevator and passengers. Clear queuing and run-off clear space should be provided at the top and bottom of all stairs and escalator and elevator landings. Required space is defined in the Station Program Design Guidelines Technical Memorandum.

All escalators provided at CHST stations shall be full-size, two-lane models with a tread width of 40 inches – for ease of pedestrian movement and to facilitate travel by passengers carrying luggage. Escalators should be designed to accommodate the wear and tear associated with heavy public use with a high degree of operational reliability. Escalators should be operable at a speed of 90 feet per minute. The installation of variable speed units, with capability for higher-speed operation at 120 feet per minute in addition to the standard speed of 90 feet per minute, is desirable to provide for future operational flexibility. For purposes of analysis, 40-inch wide escalators should be assumed to have a maximum carrying capacity of 70 pedestrians per minute, unless local survey data are available to provide a processing rate more reflective of actual location conditions.

In addition to NFPA 130 standards which may be used to size some stairways for high-speed train station evacuation, stairway width should be sized to accommodate peak pedestrian demand at Pedestrian LOS B or better. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, HST facilities should be designed for a peak LOS C. Because pedestrians move more slowly on stairways, sizing follows a similar methodology to that used to size walkways in Section 6.2.1.2. However, the maximum pedestrian flow rate is 5-7 pedestrians/ft/minute to obtain LOS B (7-10 for LOS C). Stairway widths should be increased by 30-inches when the stairway includes reverse pedestrian flows. For escalators in general public areas not directly serving rail or transit station platforms or boarding/alighting zones, LOS B corresponds to flow rates in the range of 20-30 pedestrians per minute, whereas LOS corresponds to flow rates between 30 and 40 pedestrians per minute. Escalators subject to heavy pulses of passenger loads associated with the boarding or alighting of passengers on individual trains or transit vehicles (such as transit station platform escalators), should be planned to carry passengers at the peak flow rate of 70 people per minute without the creation of excessive queues at the escalator.

6.2.2 Transit Facilities

High-speed train stations will operate as multi-modal transportation hubs that provide links to local and regional transit. Bus and rail systems have the potential to serve as extensive feeders of patrons to high-speed train stations. Locating fixed route transit stops on station property will reduce walking distances and promote the use of local, fixed-route transit services.

Provision of transit facilities at station sites are subject to agreement between the Authority and applicable transit agencies.

At the station site, facilities are required to allow access and boarding and alighting of transit. With multiple transit modes and routes converging at a high-speed train station site, the station sites have potential to be transfer points for non-users of the high-speed train system. Additional operational facilities may be necessary on a station-by-station basis. These non-HST passenger volumes will need to be estimated and used to determine the appropriate sizes and configuration of pedestrian circulation facilities at and adjacent to the station.

Information from transit providers shall be considered in the station design. This information may include, but is not limited to: the number of routes servicing the station (through and terminal), vehicle sizes and passenger-carrying capacities, operating schedules and the transit provider's own projected ridership, including boardings and alightings by time of day at the HST station.

Transit zones should be sited to reduce patron travel times, both on the transit vehicle and as a pedestrian. Maximum walking distance to the high-speed train station entrance from a transit boarding or alighting area should be 500 ft (standard used by WMATA). Where possible, transit facilities should be visible from the high-speed train station, arterial streets and nearby activity areas to increase visibility and security of waiting patrons. Pedestrian links to other areas of the station site should have no or minimal at-grade crossing of vehicle lanes.

Facilities for transit vehicles —including access, circulation and boarding and alighting areas— should be separated from other traffic where it is practicable.

Waiting areas will be provided at transit loading areas and will be sized according to peak period demand at a pedestrian LOS B or better. Where space is constrained by physical conditions that cannot be mitigated cost-effectively, HST facilities should be designed for a peak LOS C.

Required space for pedestrian waiting areas is determined using the following methodology:

1) Estimate maximum demand for waiting area during the peak period.
2) Effective waiting area required = Maximum passenger demand x Average passenger space (10-13 square feet for LOS B)
3) Required waiting area = effective waiting area with a 1.5 foot buffer along any roadways, walls or other obstructions.
4) Waiting area does not include circulation spaces. Pedestrian circulation shall be included in addition to waiting spaces. Pedestrian circulation sizing is outlined in Section 6.2.1.2.

6.2.2.1 Rail

Many stations sites will connect with other rail services—ranging from Amtrak or commuter rail to streetcar services. Amtrak and commuter trains generally will serve a greater number of stations than the HST system and will serve an important function as feeders to the HST network. Therefore, the passenger experience associated with transferring between high-speed trains and other rail services should be as seamless and convenient as possible. Walking distances and the number of required vertical level changes should be minimized.

Integration of HST and other rail services at a single station facility is preferable from the standpoint of passenger convenience and orientation, and this may be possible at certain locations. In other cases, however, a separate HST station might need to be constructed adjacent to or a short walk away from the Amtrak or commuter station. In these circumstances, the pedestrian walkway to the Amtrak/commuter station should be located as close to the HST station entrance as practical. This walkway connection should avoid pedestrian crossings of vehicle traffic lanes and provide a canopy or other cover. Specific location and requirements will depend on local/regional guidelines and codes.

6.2.2.2 Bus

The sizing of bus facilities depends on the number of routes serving the facility, bus operational plans, expected ridership and other factors. These facilities should provide a safe, accessible place for bus boarding and alighting while providing an efficient operating space for bus routes. Bus facilities should be designed to make efficient use of the station site area. In company with operational plans, the area should be sized and planned to remain active and busy throughout the day—avoiding vacant, underutilized space during off-peak periods.

Transit waiting and loading areas should be co-located and concentrated in as compact a configuration as practical – to make transit-transit connections easier, promote efficiency (both for passengers and the site) and encourage active public use of the area.

Bus facilities should be located with easy access from major bus routes to reduce out-of-direction travel. Where feasible, the site should be designed to accommodate future bus service growth.

Bus facilities should be laid out for one-way operations with right-hand drop-off/pick-up directly onto bus waiting areas and corresponding pedestrian paths. At some high-traffic stations, the separation of boarding and alighting areas could speed bus operations at the stations by insuring an alighting area free of boarding passengers. There should be weather protection or shelter the length of the bus platform with a canopy which extends to cover bus doorways. Boarding zones should also have lighting, seating and service information, including schedules and maps. Light poles, bollards, fire hydrants, and other site furniture shall be placed at least 4 feet back from the curb edge.

Station Site Access

The segregation of buses from other traffic entering the facility prevents delay to transit vehicles as congestion builds during the peak hours. When exclusive right-of-way is not available, controlled access may facilitate free movement of transit vehicles in and out of the station. Controlled access can range from a protected left turn lane out of the station to exclusive bus right-of-way accessing and within the station to queue jump phases into and out of the station.

Bus Facility Geometry

Bus bays may be designed as saw tooth bus bays or tangent bus bays. Minimum dimensions for each are dictated by local codes. Saw tooth bays are generally preferable because this type of bay requires less curb space than tangent bays. In no situation should bus bay geometry require backing (as in angled or diagonal bays). Bus lanes should have a minimum width of 12 feet (or as dictated by local codes) and should be configured to allow buses to pass each other.

Layovers

For routes that terminate at the station, the operator will need to “layover” either on station property or on the street adjacent to the station. A layover occurs because an operator needs to either take a break or allow for time in the schedule to account for variations in traffic patterns. If layovers occur at the station, layover parking should be located to reduce recirculation needed to re-enter service and corresponding congestion. The station will need at least one bus bay or other bus parking space for each route that will layover. Multiple bays are required if the scheduled headway is less than or equal to the layover duration.

6.2.2.3 Intercity Bus

Facilities for intercity buses shall be provided on a station-by-station basis depending on existing facilities in the surrounding community and estimated potential future demand in that community for intercity bus service.

Design standards and guidelines should follow intracity bus guidelines (Section 6.2.2.2).

6.2.2.4 Driver Relief Station/Restrooms

Driver relief stations and restrooms provide facilities for transit operators during breaks in their operating responsibilities. Driver relief station may not be provided at all high-speed train stations. In some cases, high-speed train staff facilities may be used by employees of connecting transit services. Where there is sufficient need, driver’s restroom facilities will be provided for exclusive use of specific transit agencies. This determination can be made based on the level of transit service provided at the station and local transit operational plans by the Authority with the input of local transit agencies. These facilities are not open to the general public.

6.2.3 Bicycle Facilities

Where possible, bicycle circulation should be segregated from vehicle and pedestrian flows through the provision of bicycle-only paths. In most cases however, bicycles will need to make the most effective use of roadways and curb cuts. If bicycle routes are shared with roadways, bicycle lanes should be designated. All bicycle user types, from recreational users to daily commuters, should be considered in site design.

Bicycle racks and lockers shall be provided at all station sites. The quantity of bicycle storage will vary based on demand which depends on surrounding land uses, terrain, bicycle facilities and other factors. Bicycle parking should be located as close to the station entrance as practicable given site constraints and other design guidelines. Where possible, bicycle parking should be within sight of station staff and general station pedestrian traffic for natural surveillance. From the bicycle parking area, it should be easy to access the station entrance and the surrounding bike network and street system. The area should be covered, well-lit, secure and highly visible.

In addition to bicycle storage racks and lockers, space should be provided for bicycle-sharing pick-up and return facilities at appropriate stations. Space and facility requirements should be based on those systems that have proven to be successful in the U.S. and internationally.

6.2.4 Pick-Up and Drop-Off Facilities

Passenger pick-up and drop-off facilities are used by multiple modes including, private automobile kiss and ride, taxi stands, paratransit, private shuttle buses, and rental car pick-up or drop-off.

Facility design should encourage vehicle turnover, reduce conflicts and facilitate traffic flow. The location of these facilities is important and shall be close in proximity and have a direct connection with the station entrance. It shall be convenient for system patrons and drivers in order to encourage motorists to use the specified area and not another location which could cause conflicts with surrounding uses and modes. Convenient recirculation of vehicles within the station site should be provided where feasible in order to reduce congestion on the road network surrounding the site.

Pedestrian routes between station entrance and vehicle drop-off should be direct with no vehicle lanes to cross. Walking distance from this area to the station entrance should be less than 600 feet (standard used by WMATA). Lane widths should allow vehicles to pass those who are stopped. Facilities should be separated from park-and-ride facilities and located to not interfere with transit operations. Access roads for park-and-ride facilities may be shared provided operation of either facility is not interrupted. However, pick-up/drop-off traffic should not be routed through parking facilities. Facility design should ensure right-hand drop-off and pick-up and recirculation without leaving the station site in order to reduce congestion on surrounding streets.

Depending on the demand for pick-up and drop-off facilities, some station sites may segregate the two uses by having a pick-up area and a drop-off area. If the curb length required to service demand exceeds station frontage by 200%, then separate arriving and departing areas with a loading island in front of building are necessary (AREMA).

Private automobiles, taxis, private shuttles and vans and other vehicles using these facilities may be mixed or have segregated facilities by mode. This depends on site configuration and demand for each mode.

Waiting areas should be sized according to the methodology described in Section 6.2.2 Transit Facilities.

At stations with high demand for pick-up and drop-off, it may be appropriate to provide a waiting area for automobiles outside of the pick-up and drop-off zone so that automobiles are not waiting at the curb for the train to arrive and therefore blocking other patrons’ access or circulating resulting in increased congestion.

6.2.4.1 Kiss and Ride

Passenger kiss-and-ride areas are set aside for private automobile drivers to pick-up and drop-off of high-speed train customers. Design of these areas should consider:

- Stalls and aisles for passenger drop-off areas should be larger than those in long-term parking areas due to the frequent turnover.
- Preferred parking arrangements for passenger drop-off areas are as follows, in order of preference:
    - Parallel to curb
    - 45 degrees to the drive aisle
    - 60 degrees to the drive aisle
    - 90 degrees to the drive aisle

- Pedestrian crosswalks should leave a minimum of 20 foot zones on either side of parallel parking stalls, or greater if directed by local codes.
- If drop-off areas are provided in a park-and-ride lot or garage, placement should avoid conflicts with entering and exiting traffic.

6.2.4.2 Taxi

The number of passengers arriving by taxi will determine the operational characteristics of the taxi areas. Once taxi activity passes a threshold level of operations, taxis begin to interrupt other pick-up/drop-off area operations. Further increases in taxi activities may require segregation of taxi pick-up and drop-off areas. Design of taxi facilities should follow the following guidelines based on magnitude of taxi activity:

- Low – Taxi operations mix with shuttle vans and kiss-and-ride
- Medium – Taxi operations are segregated from other non-SOV modes of arrival, may consider leaving taxi operations mixed with other modes if pick-up and drop-off areas are segregated
- High – Taxi operations are segregated from other non-SOV modes of arrival; further segregation of taxi pickup and drop-off areas

In all cases, stalls or pick-up/drop-off areas should be marked according to whether the stalls are “Taxi Only” or shared with other pick-up/drop-off modes. Space shall be provided for taxi queuing or corralling prior to pick-up of arriving high-speed train patrons. The queuing space size should correspond to projected waiting taxi demand, and it should be located near to but not at the taxi pick-up area in order to provide quick service but not interfere with operations at the station entrance. Where analysis indicates significant potential demand for taxi service, and passenger queuing at the taxi pick-up location, consideration should be given to the provision for a staffed taxi dispatcher booth or desk.

6.2.4.3 Private Shuttle/Van

Shuttle van access may also be located in the pick-up and drop-off area. Shuttle vans may include private paratransit, parking shuttles, hotel shuttles, and other services. Separation from other modes would depend on demand.

6.2.4.4 Rental Car

Rental car drop-off or pick-up service may be integrated into the kiss-and-ride area. Scale of facilities varies by demand and Authority policy.

6.2.5 Automobile Parking

Station parking would allow people who are unable to use other modes to access high-speed train. These facilities may include short-term, all-day or long-term parking facilities. Local codes shall be considered.

If parking is developed, the following standards ensure adequate access and performance of parking facilities:

- On-site parking should be provided within an easy walking distance to the station entrance. The maximum distance, by actual travel route, a parking space can be from the station entrance is 1,500 feet or a 5- to 7 minute walk. This standard is used by WMATA and also similar to the maximum curb-side to plane-side walking distance at a selection of major US airports (Fruin).
- For stations where adequate on-site parking cannot be provided adjacent to the station or within a short walking distance, off-site facilities may be developed which are served by parking shuttle services.
- Connections between the parking areas and station entrances should be direct and obvious. Parking should be designed so that those leaving their cars should be “fed” onto primary pedestrian routes.
- Parking facilities should be located as close as possible to the streets serving the site.

- Parking structures should be sized and located in order to encourage shared use of parking.
- Where possible, the first floor of garages should have actives uses to increase natural surveillance and improve the appearance of pedestrian routes.
- Parking garages should be sited so as to not impair the pedestrian circulation between stations and the surrounding community. The driveways that serve parking should avoid crossing main pedestrian routes in the station area.

Parking Garage Facilities should be designed to include the following standards:

- Layout oriented to reduce the walking distance to the station entrance for station patrons once they leave their automobiles. Where possible, parking lot aisles should be oriented perpendicular to the station to facilitate access and to avoid the need for passengers to walk between parked cars.
- Configured to provide access to emergency vehicles including fire equipment and ambulances in the event of an emergency.
- Ninety degree parking with two-way aisle traffic and no dead ends where feasible.
- Parking aisles in parking garages shall be designed to consider pedestrian needs and safety, as well as lot capacity. Pedestrian movements within park-and-ride areas will normally occur within the drive aisles. However, pedestrian walkways may also be required to reduce vehicular interference, to reduce the number of points where pedestrians cross aisles, and/or to shorten irregular routes through successive aisles. Where practical, speed bumps may be considered to reduce vehicle speeds for pedestrian safety.

- Continuous covered walkways will connect parking structures and station entrances.

6.2.5.1 Motorcycle Parking

Motorcycle/scooter parking stalls should be provided as part of station parking at all sites. Local codes shall be considered in facility design. Motorcycle parking stalls should be added in spaces created by the site layout that would otherwise not be used. Stall sizes should be 4 feet by 8 feet with maneuvering lanes of at least 10 feet in width. Motorcycle parking is not allowed at station entrances, in bicycle parking area, on sidewalks, or other walkways.

6.2.5.2 Carpool/Vanpool

When appropriate, reserved parking stalls should be provided for people who arrive at the station in vanpools and carpools. Initial planning and environmental assessment for the facility should identify potential need for these stalls. If implemented, the stalls should be located closer to the station entrance than general parking. Local codes shall be considered in design.

6.2.5.3 Carsharing/Station Car Parking

Where appropriate, reserved parking stalls for car-sharing vehicles (i.e., ZipCar, CityCarShare, etc.) vehicles should be provided. Initial planning and environmental assessment for the facility should identify potential need for these stalls. If implemented, the stalls should be located closer to the station entrance than general parking. Local codes shall be considered in design.

6.2.5.4 Parking for People with Disabilities

Accessible parking shall be provided at all facilities where parking is provided, in accordance with requirements of ADA and state building code. ADA parking should be located closest to the station entrance. A direct, accessible path should lead to the station entrance. Spaces should be sited so that people using this parking do not have to walk or wheel behind parked cars.

6.2.5.5 Staff Parking

Parking stalls used by high-speed train and transit partner staff that need convenient and accessible parking at station facilities shall be consistent with functional needs yet should not pre-empt convenient passenger spaces. Employee parking should be situated so that high-speed train patrons do not use employee spaces.

6.2.5.6 Parking Management System

Because parking will be provided at market rates, control at access and egress points may be necessary. Facilities shall be designed to allow for queuing for pay-on-entry or pay-on-exit systems. The number of entrance and exit lanes will vary by demand, but at least two lanes in each direction are required in the case of maintenance or a stalled vehicle at one gate. Therefore parking design should consider the number, size and location of these points along with queuing at potential gates. Also, requirements for traffic loop sensors, traffic gates, and antennas in order to implement a gate cashiering, "pay on foot", Smart Card, conventional multi-space meter, or other revenue collection systems should be considered. In addition, the system might differentiate between different types of customers by type of vehicle, length of stay and other factors. Pre-exit payment facilities should be considered which would allow for payment at the station before accessing a parked automobile. This could significantly reduce queuing and therefore corresponding space and facilities at exit points. Pre-exit payment has been implemented in many garages and extensively at airports. Real time information on parking availability, parking reservation systems and other “smart parking” technologies and systems should be considered in order to maximize the efficiency of the provided spaces.

6.2.6 Roadways and Vehicle Access and Circulation

Auto access to the station site should be provided in a way that meets all codes and does not interfere with access modes of higher priority. The location and design of vehicle entrances and exits should take into account the following factors:

- Extending and interconnecting with the existing and planned street network.
- Supporting the existing and/or planned hierarchy of streets, including identification of primary and secondary streets, such that primary station site vehicular access is along higher capacity streets (such as arterial streets) providing direct connections to local destinations and to protect adjacent neighborhoods from excessive vehicle congestion. Direct links to high-speed arterials should be avoided where possible to reduce travel speeds within the site.
- Reduce interference with street traffic.
- Consider adjacent land uses and avoid large unplanted or paved areas that are out of scale with those uses. Curb cuts should be avoided where possible.
- Access roadways should be designed to contain sufficient traffic storage capacity to meet expected patronage at peak times and to prevent traffic backing up onto public streets.
- Constrain number of access roads to reduce confusion and increase efficiency. The number and geometry of intersections should be such that traffic operates at LOS D or better.
- Locate access points to reduce crossing movements for inbound traffic (on the right-side of the roadway) where possible.
- Exclusive turn lanes should only be provided where necessary to maintain acceptable traffic operations. Additional lanes will increase pedestrian crossing length which should be avoided where possible.

Standards and guidelines for roadways are as follows:

- Street and intersection dimensions designed to facilitate pedestrian and vehicular movement. Street widths and intersection dimensions should be minimized while providing adequate levels of service.
- Roadways should circulate counter-clockwise and be configured to allow for recirculation within the site allowing passengers to drop off a passenger and then park or retrieve a car from the parking area and then pick up an arriving passenger at the station curb.
- One-way traffic operation should be provided if adequate right-of-way is available.
- The width of a street or lane dictates the travel speed. In order to control speeds, roadways should be no wider than necessary for “design” travel speeds and emergency vehicle access and egress.

- On-street parking should be considered in order to slow traffic and buffer pedestrians.
- Roadways intended to provide access to bus zones, park-and-ride stalls, and passenger drop-off areas should be designed in accordance with local codes and the "AASHTO Policy on Geometric Design of Highways and Streets."
- Unless dictated otherwise by code, a single lane driveway or access lane has a minimum width of 11.5 feet. When there are multiple lanes, each lane can be reduced to 10 feet.
- Provisions for passing a stalled vehicle should be made along roadways exiting from public streets.
- Where there are main sidewalks and crosswalks, there should be no wide turning radii, driveways, garage entrances or dedicated turning lanes which require pedestrian refuge islands.

6.2.6.1 Service and Maintenance Vehicle Access

All station sites should have loading and parking spaces with special access routes separate from other traffic provided for delivery trucks, service trucks, garbage trucks and other maintenance vehicles. Designated access route for cash handling vehicles to cash handling facilities should be considered. Loading and unloading zones for delivery trucks should be located to not interrupt station operation. Consider access route for installation or future replacement of station equipment and facilities.

Specific information about requirements and sizing for service and maintenance vehicles will be developed at a later date.

6.2.6.2 Emergency Access

Access for emergency response by fire department and paramedic equipment/personnel, shall be provided, consistent with local codes. Fire lanes shall be clearly marked on the pavement.

6.3 SITE INFRASTRUCTURE

6.3.1 Drainage

Guidance will be developed at a later date.

6.3.2 Grading

Guidance will be developed at a later date.

6.3.3 Lighting

Guidance will be developed at a later date.

6.3.4 Landscaping

Guidance will be developed at a later date.

6.3.5 Signage

Guidance will be developed at a later date.

6.3.6 Security

Guidance will be developed at a later date.

6.3.7 Site Furnishings

Guidance will be developed at a later date.

6.3.8 Additional Site Layout Considerations

6.3.8.1 Location of Communication and Electrical Buildings

If additional communication and electrical buildings are needed on the station site outside of the station the buildings should be collocated with service vehicle parking. Also, ancillary buildings should be located close to train tracks and away from general vehicle circulation to avoid collisions. As a security measure, communications and electrical buildings should be located away from passenger areas and not be identified with signage.

6.3.8.2 Station Plaza

A station area plaza should be considered as an outdoor entrance to the station and a place for pedestrians to congregate. Size and design will vary by site.

Appendix A: Station Categories

high-speed train Typology	Global Center	Regional Center	City Center	Suburban Center	Town Center	Special Center – Airport,
Ridership	Highest	High	Moderate to low	Moderate	Moderate to low	High
Economic and Travel Characteristics	Primary center of economic and cultural activities, Center of regional commute patterns	Significant center of economic and cultural activity with regional-scale destinations	Center of local economic and cultural activity and travel patterns	Center of local economic activity and travel patterns	Center of localized economic and cultural activity and travel pattern	Intermodal center based on travel and tourism activity
Density	Highest Density	High density	Moderate to low density	Moderate to low density	Moderate to low density	NA
Land Use Mix	Highest intensity of employment and commercial uses, mixed with high density.	High intensity of employment and residential use	Medium to low intensity of employment, retail and residential activities.	High or medium intensity residential uses with medium to low employment density	Medium to low intensity of employment, retail and residential activities.	NA
Urban Form	Dense street grid with small block sizes. Mix of high rise and mid rise buildings	Dense street grid with small blocks. Mix of mid rise and low rise buildings.	Traditional urban grid pattern. Low or mid rise built form	Relatively larger street grid. Mix of low rise with some mid rise buildings	Large suburban grid pattern. Primarily low built form	NA
Mode of access	Highest access by Transit and Taxis		Highest access by Private Vehicle	Highest access by Private Vehicle	Highest access by Private Vehicle	
Transit Connectivity	Stations with highest access to regional and local transit systems. Modes include commuter/heavy rail, light rail, BRT, express and local bus etc.	High access to regional and local transit systems. Modes include commuter/heavy rail, light rail, BRT, express and local bus etc.	Access to local transit and shuttle services. Transit modes primarily include express or local bus transit.	Access to regional and local transit with moderate frequency. Modes include express and local bus or BRT. Can also have access to commuter/heavy rail or LRT	Access to local transit and shuttle services. Transit modes primarily include express or local bus transit.	Access to people mover/shuttle buses directly connecting with airport facilities. Can also have other transit connecting to the city or region
Peak Transit Frequency	<5 minutes	5-15 minutes	5-15 minutes	15 - 30minutes	15 - 30minutes	5-15 minutes
Parking	Market rate. Highest cost	Market rate. High cost	Market rate Relatively low cost	Market rate. Moderate cost	Market rate. Relatively low cost	Market Rate. Option to share with airport parking

Appendix B: Station Facility Programming By Type

Station category	Pedestrian Access	Bike Access	Rail Transit	Bus Transit	Drop off & Pick Up	Automobile Parking
Global Center	High pedestrian access volumes require wide sidewalks and walkways connecting to adjacent pedestrian facilities.	Well connected with city and regional bike network; High volume bike storage facility	Part of multimodal station structure with direct, covered pedestrian connection	Part of multimodal station structure with direct, covered pedestrian connection	Very high volume of drop-off; Separate drop-off and pick-up bay or lane, separation of modes required	Moderate volume facility with structured parking; Strong prospects for shared parking, provision by other group.
Regional Center				Part of the station site or near the entrance with direct pedestrian connection	High volume of drop-off & pick -up; Separate drop-off and pick-up bays or lanes and separation of modes desirable	
City Center	Moderate to low pedestrian volumes require moderate size sidewalks and walkways, fewer entrances & connections	Well connected with city and regional bike network; Moderate volume bike storage facility	Part of the station site or near the entrance with direct pedestrian connection		Moderate volume of drop off & pick up; Location for drop-off and pick-up may be combined; Modes may be combined, especially lower volume modes	Moderate capacity structured parking;
Suburban Center	Sidewalks and walkways mostly serve to connect facilities within station site				Moderate/low volume of drop off & pick up; Combined location for drop-off and pick-up, Modes combined	
Town center		Well connected with city and regional bike network; Low volume bike storage facility				Moderate to low capacity structured parking;
Special Center – Airport	Wide sidewalks and walkways to accommodate high pedestrian volumes; Multiple entrances and connections	Well connected with city and regional bike network; Moderate volume bike storage facility	Part of multimodal station with direct, covered pedestrian connection		Very high volume of drop-off; Separate drop-off and pick-up bay or lane required; modes separated	High volume facility with structured parking; Separate short-term and long-term parking. Potential for shared parking with airport.

APPENDIX C: **Station Development Policies**

HST Station Development Policies

The Authority is proposing to build a high-speed train system to provide intercity and interregional mobility to the California residents that will inhabit the state in 2020 and for decades thereafter. For the high-speed train to be more useful and yield the most benefit, it is important that the stations be placed where there will be a high density of population, jobs, commercial activities, entertainment and other activities that generate personal trips. The success of HST is highly dependent on land use patterns that also reduce urban sprawl, reduce conversion of farm land to development, reduce vehicle miles traveled by automobiles, and encourage high-density development in and around the HST station.

As part of the statewide program EIR/EIS process preferred HST station locations have been selected, and as part of the Bay Area to Central Valley Program EIR/EIS process, preferred HST station locations have been identified. HST station locations were selected based in part on their ability to provide linkage with local and regional transit, airports, and highways – each station would be a multi-modal transportation hub. Most of the potential stations identified for further evaluation are located in the heart of or near the downtown/central city areas of California's major cities. By eliminating potential *greenfield* sites[1], the Authority has selected a proposed HST system that meets the objectives of minimizing potential impacts on the environment and maximizing connectivity with other modes.

The Authority's objectives for station location and development around stations are similar to those who advocate for more transit-oriented development and higher density urban cores around the train station. This offers an opportunity for the Authority to work cooperatively with local governments, environmental and public interest groups, developers and others to pursue these common development objectives.

In pursuing a profitable and successful HST system, the Authority will utilize its resources, both financial and otherwise, to encourage the characteristics listed below for land use development in and around its station. The Authority recognizes that the actual land use decisions will be made by local communities and the real estate market. HST stations, by their nature will be the most effective and powerful tool to create the market conditions that attract basic sector jobs to the station areas and will encourage the following development patterns:

- Higher density development in relation to the existing pattern of development in the surrounding area, along with minimum requirements for density.
- A mix of land uses (e.g., retail, office, hotels, entertainment, residential) and a mix of housing types to meet the needs of the local community.
- A grid street pattern and compact pedestrian-oriented design that promotes a walking, bicycle and transit access with streetscapes that include landscaping, small parks, and pedestrian spaces.
- Context-sensitive building design that considers the continuity of the building sizes and that coordinates the street-level and upper-level architectural detailing, roof forms, and

[1] Sites in rural areas with very limited or no existing infrastructure.

the rhythm of windows and doors should be provided. New buildings should be designed in relation to public spaces, such as streets, plazas, other open space areas, and public parking structures.

- Limits on the amount of parking for new development and a preference that parking be placed in structures. TOD areas typically have reduced parking requirements for retail, office, and residential uses due to their transit and bicycle access and walkability. Sufficient train passenger parking would be essential to the system viability, but this should, as appropriate, be offered at market rates (not free) to encourage the use of access by transit and other modes.