

CRYSTAL CITY STATION ACCESS AND SECOND ENTRANCE STUDY



**Final
February 2014**

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Executive Summary

The Crystal City Metrorail Station is located on the Metrorail Blue and Yellow lines in the Crystal City neighborhood in Arlington County, Virginia. The Crystal City Metrorail Station has a single entrance, between Clark and Bell Streets, just north of 18th Street South, see **Figure ES-1**. The Crystal City Metrorail Station is also accessible from the elevator located just north of 18th Street South, reached by a short pedestrian pathway. Crystal City is also served by Virginia Railway Express (VRE) - a commuter rail service that connects the Northern Virginia suburbs to Union Station in Washington, D.C. The Crystal City VRE Station is located within a close proximity of the Metrorail station entrance.

Issues Identification

Based on the review of studies conducted previously and the observations made during site visits, several issues were identified in the vicinity of the Crystal City Metrorail Station. These are listed as follows:

- Lack of a direct route for many users to the station entrance;
- Need for additional signage;
- Inadequate way-finding measures;
- Need for better connections with other modes – bicycles, Metrobuses, etc.; and
- Long-term station facility constraints.

Many of these issues are driving the need to consider construction of a second entrance to the station, as well as to evaluate other actions that would improve multimodal access in the general vicinity of the Crystal City Metrorail Station. The following criteria were developed to evaluate the placement and design of potential second entrance locations and other actions that would address the identified concerns:

- Improve access from Crystal Drive;
- Improve access for all users;
- Improve multimodal connectivity (bicycles, buses, VRE, etc.);
- Integrate with proposed re-development and reinvestment;
- Address long-term growth in ridership (faregates, elevators, and escalators);
- Environmental and community Impacts;
- Constructability; and
- Safety (mobility, evacuation etc.).

Preliminary Second Entrance Alternatives

There were five initial alternatives developed in coordination with the public and project stakeholders in this category. These alternatives are described below and their general locations are shown in **Figure ES-2**.

Alternative A: New entrance west of Crystal Drive, north of 18th Street, connecting to the existing mezzanine.

Alternative B: New entrance west of Crystal Drive, south of 18th Street, connecting to the existing mezzanine.

Alternative C: New entrance east of Crystal Drive, south of Water Park, requiring a new mezzanine.

Alternative D: New entrance east of Crystal Drive, south of 18th Street, requiring a new mezzanine.

Alternative E: Connection to the existing Underground shopping mall, connecting to the existing mezzanine through a new passageway.

Initial Access Improvements

Initial Access Improvements include spot improvements, intersection improvements at three locations along 18th Street (Eads Street, Clark/Bell Street, and Crystal Drive). These include the addition of an ADA ramp to the driveway near the existing elevator and improving lighting at the intersection of Underground and Metrorail station entrance passageways. Way-finding and signage locations are included at strategic points in the vicinity of the Metrorail station. These Initial Access Improvements are shown in **Figure ES-3**.

Figure ES-1: Crystal City Metrorail Station Location Map

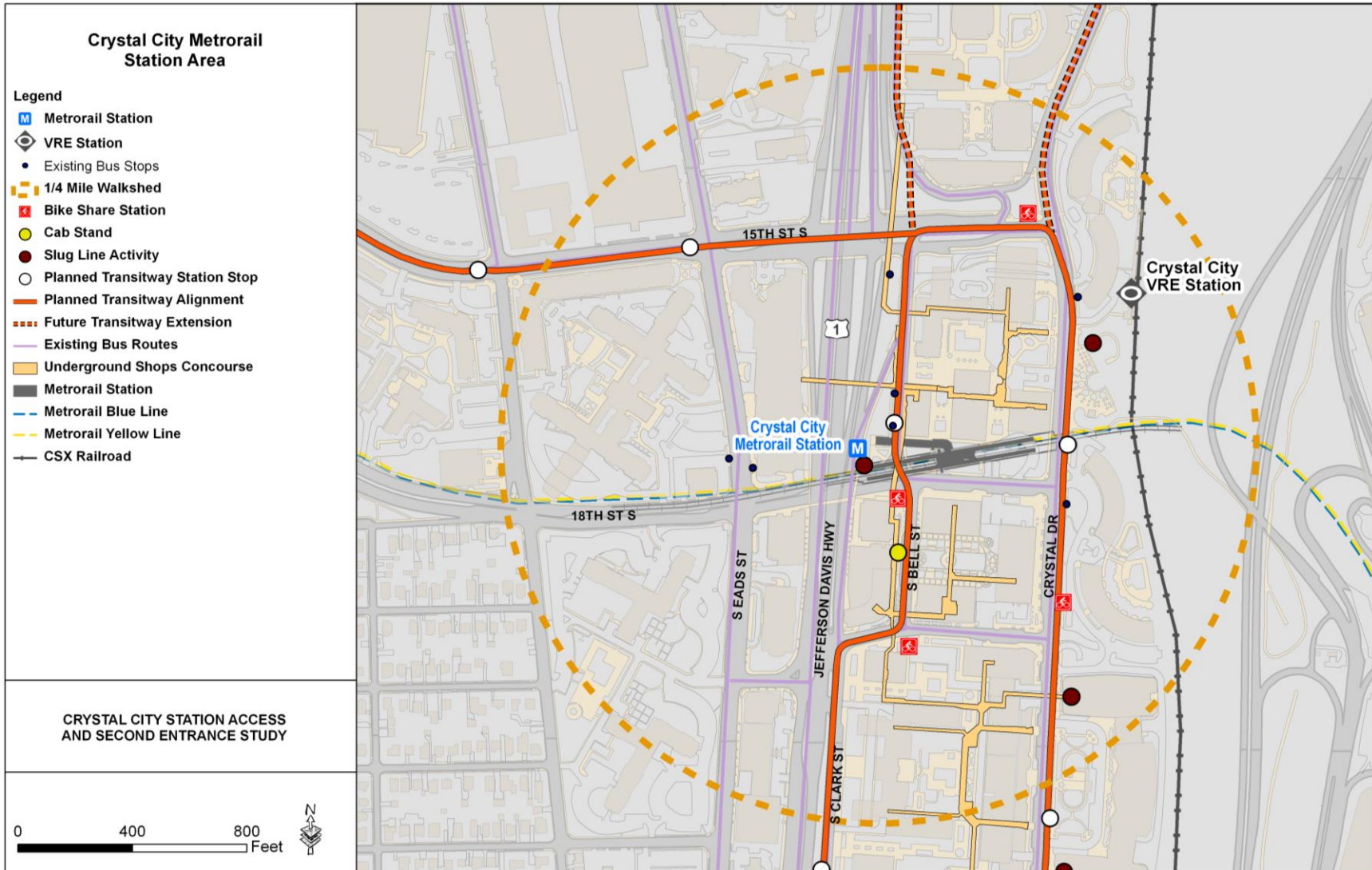


Figure ES-2: Preliminary Alternative Locations for the Crystal City Metrorail Station Second Entrance

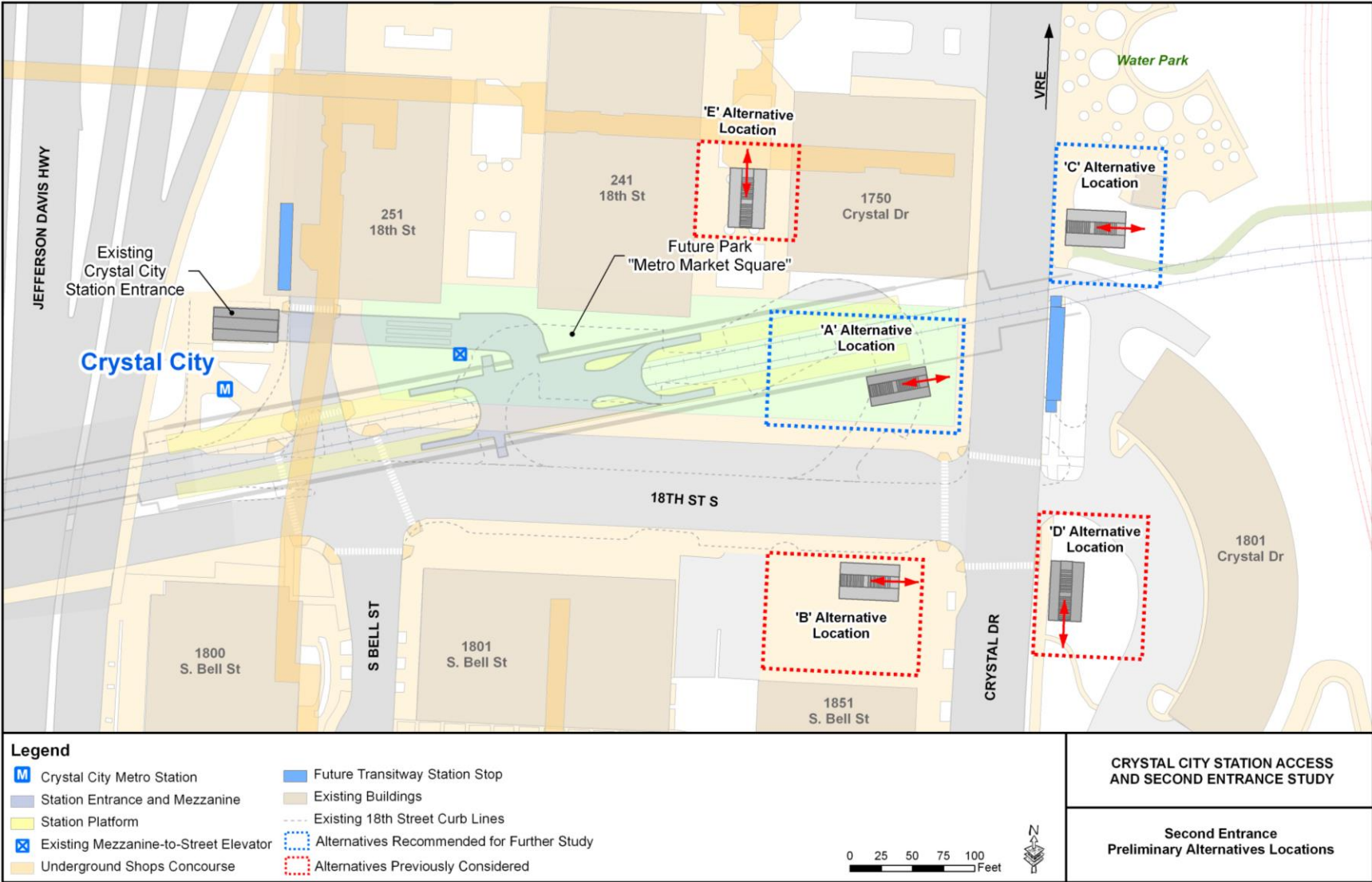
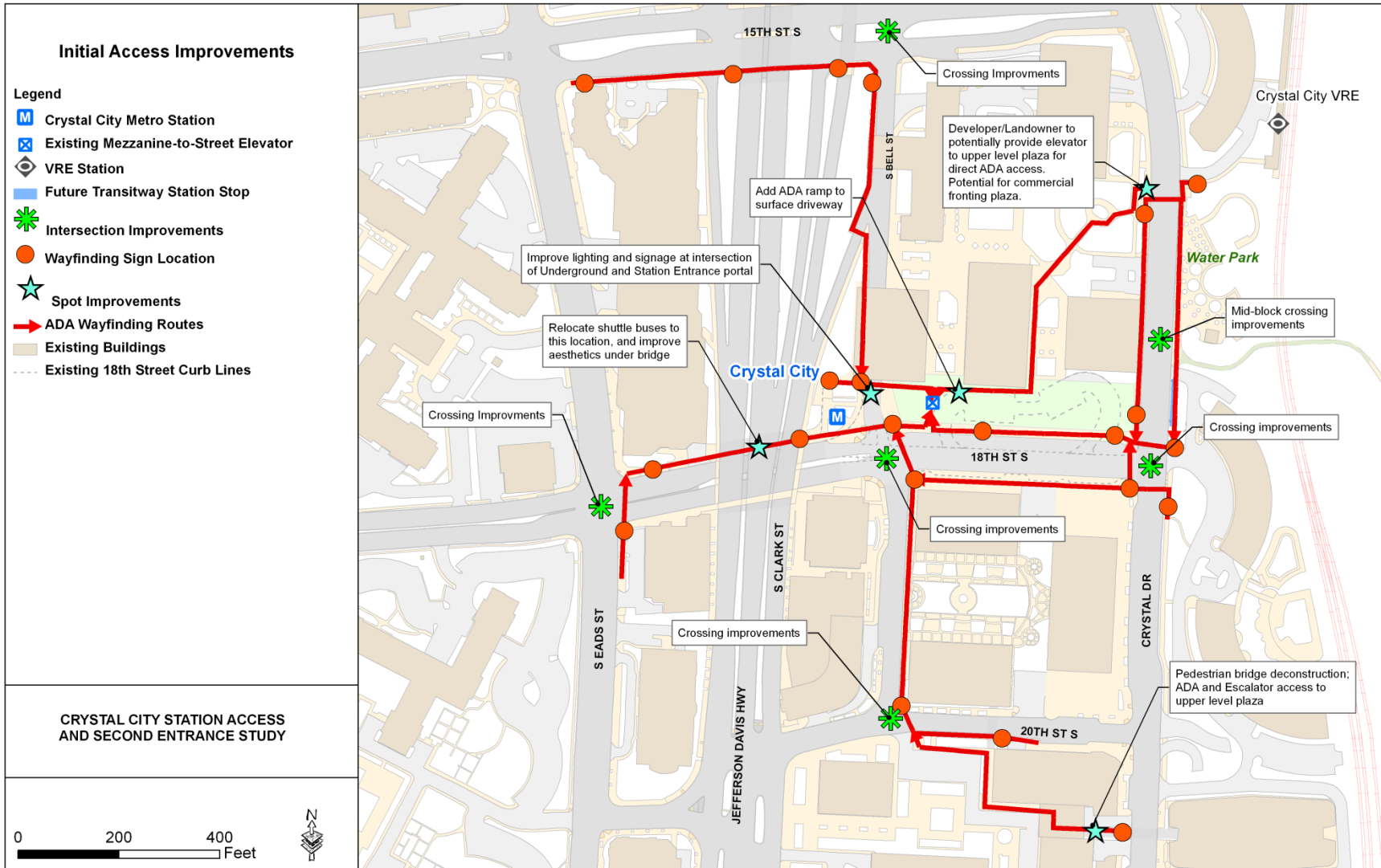


Figure ES-3: Crystal City Metrorail Station – Initial Access Improvements Alternative



Evaluation Findings

Table ES-1 and the narrative below summarize the overall study process and performance for the second entrance alternatives. Each second entrance alternative performance rating was based on the Tier I and Tier II evaluation process as well as the feedback received at stakeholder and public meetings.

Initial Screening: Through the initial screening process, Preliminary Alternatives A and C were advanced for further consideration and development, whereas Alternatives B, D and E received lower ratings and were not analyzed further.

Tier I Evaluation: During this design phase, the project moved from conceptual alternatives to feasible solutions. As a result of this refinement process, new Alternatives A.1, A.2, and C.1 were developed (See **Figures 13 – 22**). The Tier I evaluation focused on the differences between the five refined alternatives: A, A.1, A.2, C, and C.1.

- **Access for All** – Alternatives C and C.1 provide improved access to users on the east side of Crystal Drive (VRE riders and residents east of Crystal Drive), whereas Alternatives A and A.1, although provide improved access, still require users to cross Crystal Drive. Alternative A.2 includes a long tunnel

which may be problematic for users with impaired mobility.

- **Capacity for Future Growth** – Although all alternatives provide future growth capacity, Alternative A.1 provides the added benefit of increased passenger capacity inside the station. Alternative A.2 creates bottleneck and congestion point in the existing mezzanine.
- **Constructability** – All alternatives will require cutting through the end wall of the station tunnel with the exception of Alternative A.2 which requires cutting through the station tunnel vault. Alternatives A and A.1 will also require relocation of station vents and mechanical rooms. Alternatives C and C.1 will impact utilities under Crystal Drive and cause traffic disruptions for Crystal Drive during construction.
- **Contribution to Public Realm** – All alternatives can be designed to complement the future park, as planned for in the Crystal City Sector Plan. The pavilion in Alternative A.1 may constrain the design of the future park space, whereas Alternative C.1 may limit the usable sidewalk space at that location. Alternative C would affect the look and feel of the existing Water Park.

Tier II Evaluation: Following the Tier I Evaluation results, alternatives A, A.1 and

C.1 were recommended for further design development and evaluation. The Tier II evaluation includes an engineering feasibility scan, an east- and west-side entrance demand analysis, pedestrian simulation analysis, and detailed cost estimates.

- **Engineering and Utilities Scan** – Due to the number of known and unknown utility lines underneath Crystal Drive, the “A” alternatives have fewer constructability issues compared to Alternative C.1. Alternative designs were further refined to minimize utility and existing station facility impacts.
- **East- and West-side Demand Analysis** – Based on the demand analysis of future ridership forecasts, there is no preference for the location of the new station entrance on the east or the west of Crystal Drive. However, VRE riders transferring to Metrorail would greatly benefit from an east-side entrance.
- **Pedestrian Simulations** – The MOEs for pedestrian simulation perform similarly between the three alternatives. Alternative A.1 performs slightly better in terms of pedestrian density, particularly in the New Mezzanine area, as pedestrians are more distributed through the passageway and station entrance.

- **Capital Cost Estimates** – Alternatives A and A.1’s costs are estimated at approximately \$66M (\$65.7M and \$66.3M respectively), whereas Alternative C.1 costs approximately \$87.2M. The main drivers in cost difference between the “A” Alternatives and C.1 are the costs associated with tunneling underneath Crystal Drive and the related construction challenges, as well as the extended construction period.

Recommendation and Next Steps

Based on the performance ratings for each evaluation criteria, this study concludes that all three alternatives perform similarly and are the appropriate and feasible design alternatives for a second entrance to the Crystal City Metrorail Station. The two “A” Alternatives provide different designs choices of the entrance at the surface level, either a typical Metrorail entrance canopy or a larger entrance pavilion. It would be beneficial as a next step to gather public and stakeholder opinions for an entrance pavilion and other impacts or benefits to the park design at this location. Alternative C.1 provides the best multimodal connections with its proximity to the northbound transitway stop and allowing for the most direct connection for VRE passengers transferring to the Metrorail system. Additional engineering and design

work may be needed in order to determine the cost effectiveness of this alternative.

After a period of public comment and a decision from WMATA and County officials, the recommended alternative will be carried into the next phase of work, including required environmental analysis

and detailed engineering design. Project funding sources will be more explicitly defined and programmed. Throughout the process, there will be ongoing coordination with key stakeholders, including owners of adjacent property, utility companies, and County officials.

Table ES-1: Second Entrance Alternatives Evaluation Summary Matrix

Alternative	Initial Location Screening	Tier I Evaluation				Tier II Evaluation			
		Access for All	Capacity for Future Growth	Construct-ability	Contribution to Public Realm	Engineering and Utilities Scan	E-W Demand Analysis	Pedestrian Simulations	Capital Cost Estimates
A		◐	●	◐	●	●	◐	◐	◐
A.1	●	◐	●	◐	●	●	◐	●	◐
A.2		◐	◐	◐	●				
B	◐								
C		●	●	○	○				
C.1	●	●	●	○	◐	○	◐	◐	○
D	◐								
E	○								

Performance: ○ → ●
Fair Good



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1.0 Project Background

Over the last decade, the Washington Metropolitan Area Transit Authority (WMATA) and Arlington County have conducted several studies which directly or indirectly relate to development in Arlington County and Crystal City. WMATA's studies have focused on station access and capacity to accommodate projected ridership in the years to come, whereas Arlington County's efforts focused on improving the quality of life in the County, while managing the expectations and challenges emerging from Base Realignment and Closure (BRAC). The data and assessment in these studies provide important insights into the issues and opportunities for the current Crystal City Second Entrance and Station Access Study.

WMATA and Arlington County completed a station access study for the Crystal City Metrorail Station in 2002. The study evaluated specific station and station area improvements to enhance convenience and safety for accessing the station.

In September, 2010, Arlington County adopted a long-range land use plan update for Crystal City. The plan calls for significant increase in density and major changes in the transportation infrastructure in Crystal City.

Since the initial study in 2002, a bus transitway was proposed between Potomac Yard and Crystal City, with the environmental review being completed in 2010. The project is in final design phase with service to begin in 2014. Transitway station stops are to be located at 18th Street South and Crystal Drive, and at 18th Street South and Bell Street. Arlington County is advancing plans to implement streetcar along the transitway in the 2018 time frame.

Observations and recommendations from these previous studies are included in this report to establish the base conditions for evaluation of second entrance alternatives, as well as to apply the relevant research and analysis previously conducted. These studies are briefly summarized below.

WMATA Crystal City Station Access Study, 2002

The Crystal City Station Access Study was conducted in 2002 and proposed station access improvements including additional station entrances and mezzanines, improved traffic conditions on adjacent streets, and improved connections between Metrobus and Metrorail (see **Figure 1**).

Crystal City Sector Plan

In 2005, the Base Realignment and Closure Commission's (BRAC) recommendations

became federal law. The recommendations call for the U.S. Department of Defense (DoD) to relocate 17,000 jobs from Arlington to nearby military bases. As part of the County's response to that recommendation, the Crystal City Sector Plan was recently approved by the County Board and outlines a broad vision for revitalization of the area in the next 40 years. This future vision for Crystal City will help to guide change and is designed to accommodate significant growth and reinvestment. The Crystal City Sector Plan offers a comprehensive vision for the future of Crystal City, with an emphasis on improving the quality of the public realm.

Crystal City Multimodal Transportation Study

The Crystal City Multimodal Transportation Study examines Crystal City's redevelopment in phases and proposes transportation improvements to provide for effective travel and mobility for the area's residents, workers and visitors through the year 2050. This study covers all modes of travel and provides physical and policy recommendations for each of them, consistent with goals and objectives of Arlington County's Master Transportation Plan (MTP).

WMATA Station Access and Capacity Study, 2008

The purpose of the Station Access and Capacity Study was to identify and prioritize the needs of the existing 86 stations and identify stations where more detailed analysis is needed. This study included a capacity analysis of the Metrorail lines and all 86 stations, and an assessment of present and future station access.

The study determined that walking is the predominant access mode for the Crystal City Metrorail Station. In 2012, for an average weekday in the AM peak period, 64 percent of users accessed the Crystal City Metrorail Station by walking, 27 percent transferred from Metrobus, other bus, commuter rail, or shuttle; whereas 5 percent users were dropped off. Four percent of users carpooled or drove to the station and less than 1 percent rode a bicycle.

Crystal City Potomac Yard Transitway – Updated Categorical Exclusion and Conceptual Design Plans

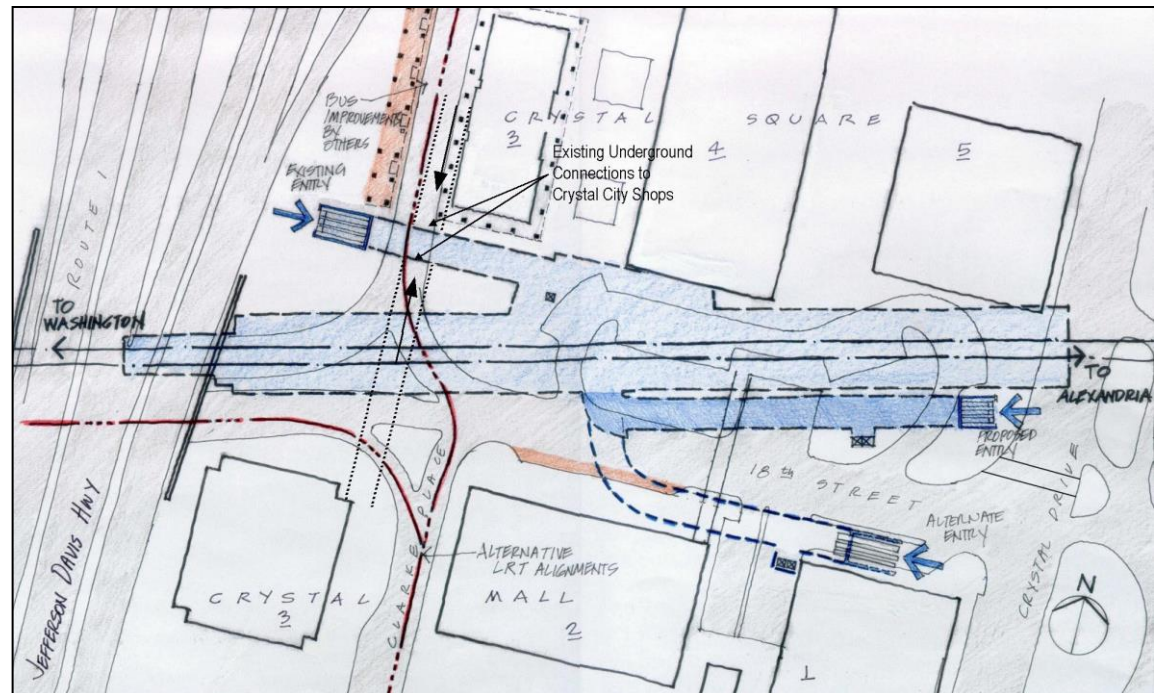
The purpose of the Crystal City Potomac Yard Corridor Transitway Improvements Project was to provide high-capacity and high-quality transit service in the five-mile

corridor between the Pentagon and Pentagon City in Arlington County and the Braddock Road Metrorail Station in the City of Alexandria.

The recommended transitway alignment is described as a “couplet” alignment, where northbound and southbound lines are split between Clark-Bell Street and Crystal Drive. Both lines would follow Crystal Drive south of the 26th Street viaduct, then split to the north, and rejoin at the intersection of

Clark-Bell and 12th Streets. The transitway will connect to Metrorail and the Columbia Pike streetcar in Pentagon City.

Figure 1: Existing and Proposed Entrance, Crystal City Station Access Study, 2002



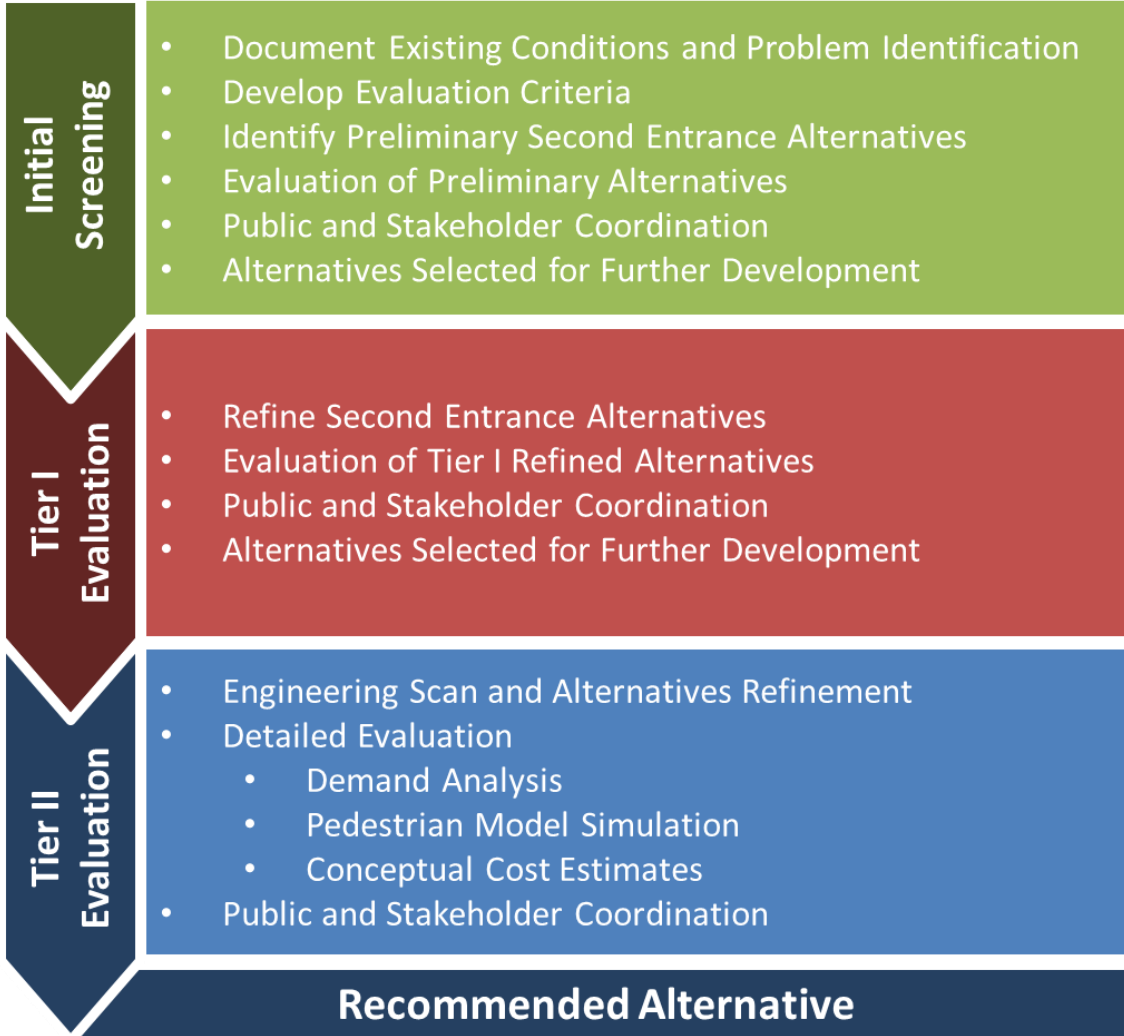
2.0 Purpose & Study Process

The purpose of the Crystal City Second Entrance and Station Access Study is to develop feasible alternatives for enhanced access to the Crystal City Metrorail Station including a potential second entrance. The study followed a three-step process which included differing levels of evaluation and alternatives refinement. **Figure 2** shows the evaluation process of the Second Entrance Study, which involved public and stakeholder engagement throughout.

The initial screening phase of the study included an assessment of existing conditions followed by problem identification. Based on existing conditions, evaluation criteria were developed to address the identified concerns. Several preliminary alternatives were developed to address these concerns. Refinements to the most feasible alternatives occurred as the evaluation process advanced.

The final detailed evaluation in Tier II included an engineering scan to determine potential impacts to existing utilities and station facilities, a ridership demand forecast, pedestrian simulations, and capital cost estimates. The final recommended alternative was determined to be the most feasible second station entrance alternative.

Figure 2: Crystal City Second Entrance Study Evaluation Process



3.0 Stakeholder Coordination & Public Involvement

The project team conducted stakeholder coordination and public meetings during this study to gain feedback on the proposed second station entrance alternatives. Two stakeholder coordination meetings and two public meetings were held. Brief summaries of those meetings are provided below. See **Appendix A** for meeting summaries.

Stakeholder Meeting and Walking Tour – September 2011

The first meeting for stakeholder coordination focused on engaging the core stakeholders and seeking their input for the Crystal City Second Entrance and Station Access Study. The meeting was conducted in three parts – a presentation with discussion, a walking tour, and a debrief discussion. The project team shared with the stakeholders the work done so far including issues identified, study goals, and possible approaches to the design process. The purpose of the meeting was to seek input on the study goals, current conditions at the station, and possible station and station area improvements.

Overall the stakeholders provided the following comments regarding the Crystal City Metrorail Station Access Study:

- The area surrounding the existing entrance is not particularly inviting towards pedestrians, including 15th Street, 18th Street, US Route 1, as well as the intersection crossings.
- Future demand should dictate the location of second entrance.
- Future redevelopment timing could complicate locating the second entrance as redevelopment on the west side of Crystal Drive is uncertain at this time. Any second entrance alternative at this location would need to accommodate the existing building access.
- Construction under Crystal Drive could be difficult due to existing utilities.

Public Meeting #1 – June 2012

Public Meeting #1 for the Crystal City Second Entrance and Station Access Study was held on June 21, 2012 at the Aurora Hills Community Center, Arlington, Virginia. Seventeen (17) members of the public attended the meeting.

The meeting began with a presentation followed by breakout sessions, wherein the members of public were divided into three groups. At the end of the breakout sessions, the project team reported comments and discussion from each breakout group. The meeting concluded with an outline of the next steps in the study.

Overall, members of the public had the following comments related to the Crystal City Metrorail Station Access Study:

- The second entrance should be convenient for streetcar/transitway and VRE users as well as residents who live east of Crystal Drive.
- Include escalators, stairs, and elevators in the new second entrance.
- Minimize the community disruption during construction.

Stakeholder Meeting – Project Update – September 2012

The second meeting for stakeholder coordination focused on providing the stakeholders an update on the project and presented the draft second entrance alternatives for their feedback. The meeting began with a formal presentation to discuss the progress of the study and how the project team developed the second entrance alternatives since the last stakeholder and public meetings. The second entrance draft alternatives were presented to the stakeholders.

Overall the stakeholders had the following comments regarding the second entrance alternatives:

- The alternatives located west of Crystal Drive would have to accommodate the

existing building entrances and access points as redevelopment of that block would be in the 2030 year timeframe.

- The alternatives located east of Crystal Drive might orient towards the Water Park and should be configured for efficient access to and from the VRE station.
- The elevator alternative should explore a potential ADA connection through the existing Underground.

VRE Passenger and Crystal City Day- and Lunch-Time Outreach

In addition to conducting two public meetings and two stakeholder meetings, the project team also held a separate outreach event targeted at VRE passengers and people in the Crystal City area during the day-time and lunch-time hours. The outreach consisted of handing out flyers near the VRE platform during the morning rush period (6:30 – 9:00 am) and a lunch time information session in the Underground. The flyer provided information about the project and proposed alternatives as well as information about the upcoming public meeting and a web address to access more information and to submit comments. Project team members were available to answer questions about the project during these two sessions.

Public Meeting #2 – October 2012

Public Meeting #2 for the Crystal City Second Entrance & Station Access Study was held October 3, 2012 at the Crystal Park Condominiums Meeting Room located at 1805 Crystal Drive, Arlington, Virginia. Twenty eight (28) members of the public attended the meeting.

The meeting began with an open house of project materials followed by a presentation. During the presentation, the participants were encouraged to ask questions about the project. The project team noted the comments and discussion from the public. The meeting concluded with an outline of the next steps in the study.

Meeting participants noted the following regarding the second entrance alternatives:

- Some participants did not support any alternative that encroached upon the Water Park.
- Elevator access from the east side of Crystal Drive may be desirable to assist those with mobility limitations.
- Increased pedestrian traffic crossing Crystal Drive should be a consideration in placing a second station entrance.
- Alternatives on the east side of Crystal Drive could lead to sidewalk congestion.

- The second entrance alternative C could consider direct access to the existing Underground.

Figure 3: Stakeholder Coordination and Walking Tour, September 2011



4.0 Existing Station Characteristics

General Description

The Crystal City Metrorail Station is located on the Metrorail Blue and Yellow lines in Crystal City, Arlington County, Virginia. The Crystal City Metrorail Station has a single entrance near the west end of the platform, which is between Clark and Bell Streets, just north of 18th Street South. The Metrorail station is also accessible from the elevator located just north of 18th Street South, reached by a short pedestrian pathway. Crystal City is also served by Virginia Railway Express (VRE) - a commuter rail service that connects the Northern Virginia suburbs to Union Station in Washington, D.C. The Crystal City VRE Station is located within a close proximity of the Metrorail Station entrance.

The Crystal City Metrorail Station is surrounded by high density residential buildings, office buildings and retail development. The Ronald Reagan National Airport (DCA) is located to the east of Crystal City whereas the Pentagon lies immediately to the north.

For purposes of capacity assessment, the station area may be defined as the portion of Crystal City within a quarter-mile radius of the Crystal City Metrorail Station. However, the Underground pedestrian network extends the reach of the Metrorail Station to include a larger area. Thus the study area for the Crystal City Metrorail Station extends from 12th Street in the north to 26th Street in the south and between the Jefferson Davis Highway on the west and the CSX tracks on the east. Therefore “east of Jefferson Davis Highway” (mentioned in the Crystal City Sector Plan) generally coincides with the Crystal City Station Access Study Area.

Issues Identified

The following issues were identified by the project team and coordination with the public and relevant stakeholders at the beginning of the process:

- Existing Station Capacity Issues
 - Station Usage
 - Vertical Circulation
 - Future Development
 - VRE Ridership
- Access and ADA Issues
- Way-finding and Signage
- Connections with Other Modes

Existing Station Capacity Issues

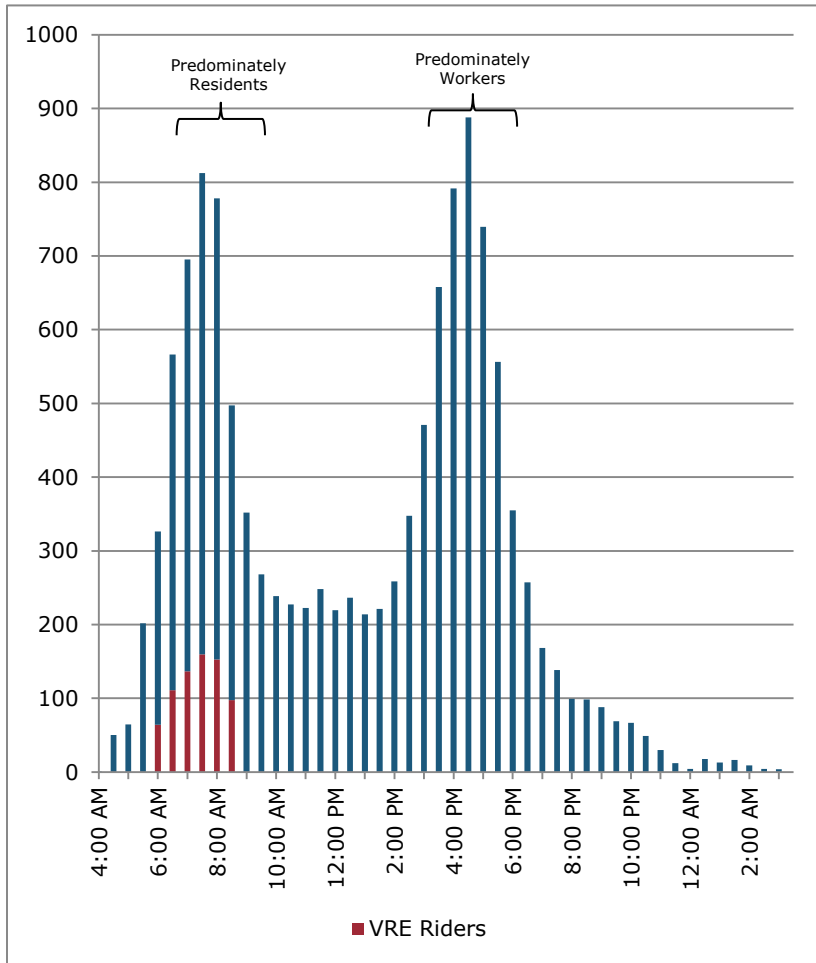
The Metrorail can accommodate the projected growth in ridership. However, the station facilities may become constrained with the increasing number of Metrorail users. The capacity of the existing station was assessed based on the capacity of station facilities – elevators, escalators, and mezzanine and faregates compared to future ridership growth.

Station Usage

Figure 4 and **Figure 5** show typical weekday entries and exits in 2013 from the Crystal City station mezzanine. Metrorail entries shown in the morning peak (6:30AM to 9:30AM) in **Figure 4** includes Crystal City residents taking Metro to work and approximately 720 VRE riders transferring to Metro from the 13 AM trains that stop at Crystal City. VRE riders make up 13 percent of AM entries at the Crystal City Metrorail Station. These groups are shown returning home between 3:30 PM and 7:00 PM in **Figure 5**. Conversely, the AM peak in **Figure 5** shows employees coming to Crystal City (6:30AM to 9:30AM), who then leave between 3:30PM and 6:30PM (**Figure 4**).

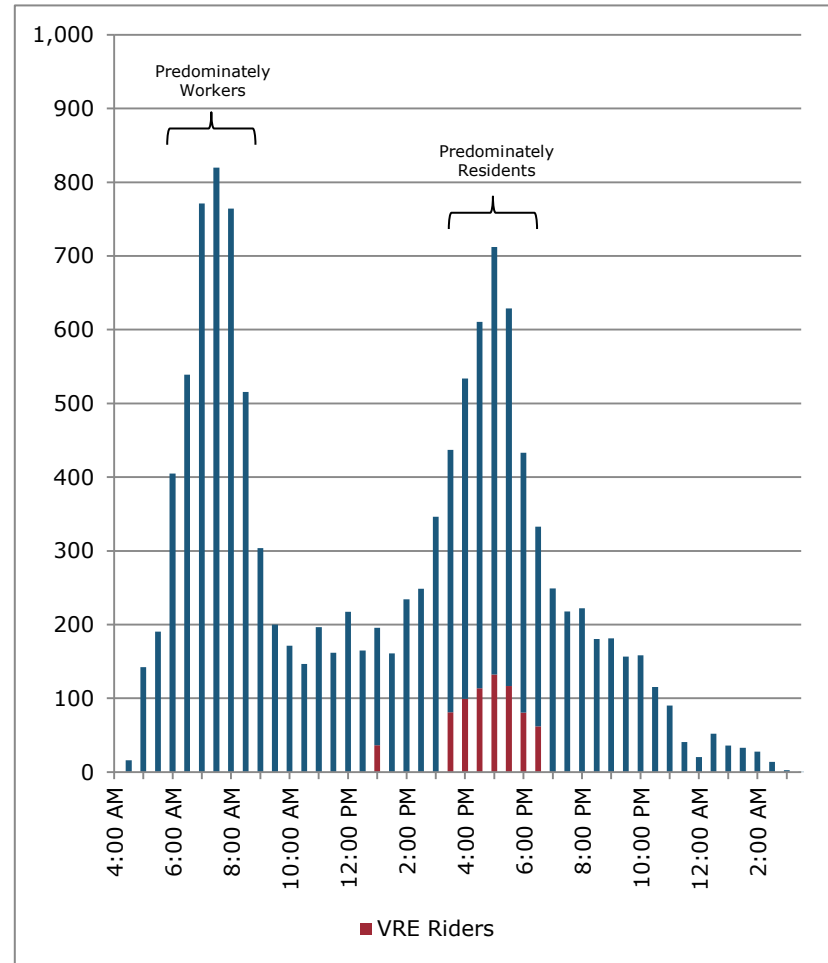


Figure 4: Crystal City Metrorail Station - Entries to Mezzanine on a Typical Weekday in 2013



Source: WMATA Ridership Data, May 2013

Figure 5: Crystal City Metrorail Station - Exits From Mezzanine on a Typical Weekday in 2013



Source: WMATA Ridership Data, May 2013

Vertical Circulation Capacity and Utilization

Station capacity can be measured in several locations, but generally the capacity of vertical circulation elements (escalators, stairs, and elevators) and fare gates tend to be the two most important components to measure for an in-line, non-transfer station such as Crystal City.

As previously shown in **Figures 4** and **5**, the most crowded station conditions can be expected to occur during the AM peak period. 2013 passenger counts found that 1,527 passengers combined to enter and

exit the station during the time period from 7:30 AM to 8:00 AM. Passenger demand for the peak 15-minutes is assumed to be 60% of the peak half hour. The peak 15-minute capacities and overall utilization of each of vertical circulation elements are shown in **Table 1**.

Escalators and elevators have a design capacity for 85 persons per minute and 12 persons per minute, respectively. The vertical elements from the Platform to the Mezzanine have a combined 15-minute capacity of 8,010. The existing capacity utilized is approximately 11%.

Additionally, the vertical elements from the Mezzanine to the Street/Mall have a combined capacity of 4,005, with utilization at approximately 23%.

Faregates accommodate 35 persons per minute. The ten faregates have a combined 15 minute capacity of 5,250 and operate at about 17 percent of their capacity during the peak 15-minutes.

Note that passenger movements are “lumpy” in that passengers alight from a train as a “platoon”, so a theoretical percentage of capacity utilization covering a peak 15-minute period may not represent the peak moment of congestion. As Metrorail trains operate on a combined 3-minute headway during the peak period, approximately 5 trains arrive during the peak 15-minute period. Dividing the peak 15-minute faregate exits among the 5 trains means that 5 platoons of approximately 100 people will exit the station every 3 minutes. Station entries occur more uniformly, except for during passenger transfers from the VRE (approximately an average of 40 people every 15 minutes during the AM peak).

Table 1: Capacity and Utilization of Vertical Circulation Elements at Crystal City

	Design Capacity	Number in Service	Total Peak 15-Minute Capacity	2013 Volumes	
				Peak 15-Minute Period Volume*	Capacity Utilized
Platform to Mezzanine					
Escalator	85 ppl/min	6	7,650		
Elevator	12 ppl/min	2	360	916	11%
			8,010		
Mezzanine to Street/Mall					
Escalator	85 ppl/min	3	3,825		
Elevator	12 ppl/min	1	180	916	23%
			4,005		
Fare Gates	35 ppl/min	10	5,250	916	17%

*Assumed 60% of the peak half-hour total entries and exits

Future Development and Station Utilization

The Crystal City Sector Plan (2010) indicates that the total floor area in the vicinity of the station will grow by approximately 61 percent over the next 40 years, nearly all of it within easy walking distance of the Crystal City Metrorail Station. More specifically the Sector Plan establishes the following targets:

- A 70 percent increase in housing gross floor area (GFA);
- A total retail GFA in the range of 1.27 to 1.4 million square feet; and
- More residential than office GFA.

As proposed development and redevelopment occurs, increasing the percentage of residential and retail uses, ridership peaks will grow considerably but the peaks may be somewhat flattened. In other words, the Crystal City Metrorail Station will be generally busier overall, but busy during a longer period of the day with spikes extending into late morning and evening periods.

WMATA conducted a ridership survey and prepared near-term forecasts based on the Metropolitan Washington Council of Governments (MWCOG) model, adjusted to reflect detailed land use information around stations. **Table 2** shows the most

Table 2: Crystal City Metrorail Station Entries

Count/Forecast Year	Station Entries	Percent Increase over 2013
2013	12,651	-
2020	16,075	27%
2030	16,475	30%

Source: WMATA, Crystal City Multimodal Transportation Study (2010)

recent count information and projections for future entries at the Crystal City Metrorail station.

VRE Ridership

According to the VRE Strategic Plan¹, Crystal City is the destination of 8.8 percent of total riders. VRE reported 4.8 million annual trips in the fiscal year ended June 30, 2012, so an estimated 212,200 VRE trips terminated in Crystal City in 2011-2012, up 36 percent from 2005. The Strategic Plan includes three growth scenarios (constrained, targeted, aggressive) and, by extension, anticipates

up to 968 additional alightings at Crystal City by the Plan's horizon year of 2025. This would represent a total number of VRE riders alighting at the Crystal City VRE Station of approximately 2,025 per day in 2050, representing growth of about 160 percent. Using the same growth rate, it is anticipated that over 1,200 daily VRE passengers would transfer to the Metrorail system at the Crystal City Station during the AM peak period.

¹ Virginia Railway Express Strategic Plan 2004-2025, May 2004.

http://www.vre.org/about/strategic/strategic_plan.htm

Access Issues

The focus of access issues was not limited to ADA (Americans with Disabilities Act of 1990) accessibility concerns but also included the ease and directness of route, pedestrian comfort and minimal conflict between automobiles and pedestrians. The access issues were assessed by observing the elevators, pedestrian facilities and stairs along the access path to the Metrorail Station. These are discussed as follows:

- Elevators – There is one elevator located off of 18th Street South connecting street level to the mezzanine. The elevator is obscured by bushes and the path to the elevator is neither straight nor easily accessible.
- Pedestrian Facilities – 18th Street South is the shortest and most direct connection from Crystal Drive to the Metrorail Station entrance. Although there are sidewalks on both sides of the road, they are interrupted with driveways and delivery entrances, leading to auto-pedestrian conflicts and safety concerns.
- Stairs and Steps – The route to the Metrorail station from the VRE via the Underground is climate-controlled, but it is indirect and involves multiple sets of stairs, making it an inconvenient

choice, particularly for passengers with mobility challenges.

Way-finding and Signage

The following observations were made regarding way-finding and signage in the vicinity of the Crystal City Metrorail Station:

- There are many signs guiding users to the Metrorail Station, the Crystal City shops, and the VRE station. There are signs directing users to the accessible entrances to the Crystal City shops and the Metrorail station. However, the directions are not straightforward or intuitive and there is a lack of visual continuity which may be confusing for new visitors.
- The sign directing users to the accessible station entrance is too high for easy legibility by a person in a wheelchair. The sign says S. Clark Street, whereas it should say 18th Street S. Similar sign(s) are missing on the east side of the entrance.

Connections with Other Modes

The Crystal City Sector Plan aims to strengthen Crystal City's position as a truly multimodal community. Improved connections and enhanced signage directing users to other modes can be beneficial in achieving this objective. Connections with other modes were assessed by observing bicycle parking, Metrobus stops and commuter rail connections. Lack of Kiss & Ride locations was also noted. These are discussed below:

Capital Bikeshare

There are four Capital Bikeshare stations within 1/4-mile of the existing station entrance that provide bicycles on a daily, monthly, or annual membership basis. There are no signs directing passengers to the locations of the Capital Bikeshare stations.

Metrobus Stops

Stops for Metrobuses 23A, 23C, 9A and 9S are located close to the existing station entrance (see **Figure 6**). However, there are no signs directing passengers to the location of Metrobus stops.

Virginia Railway Express (VRE)

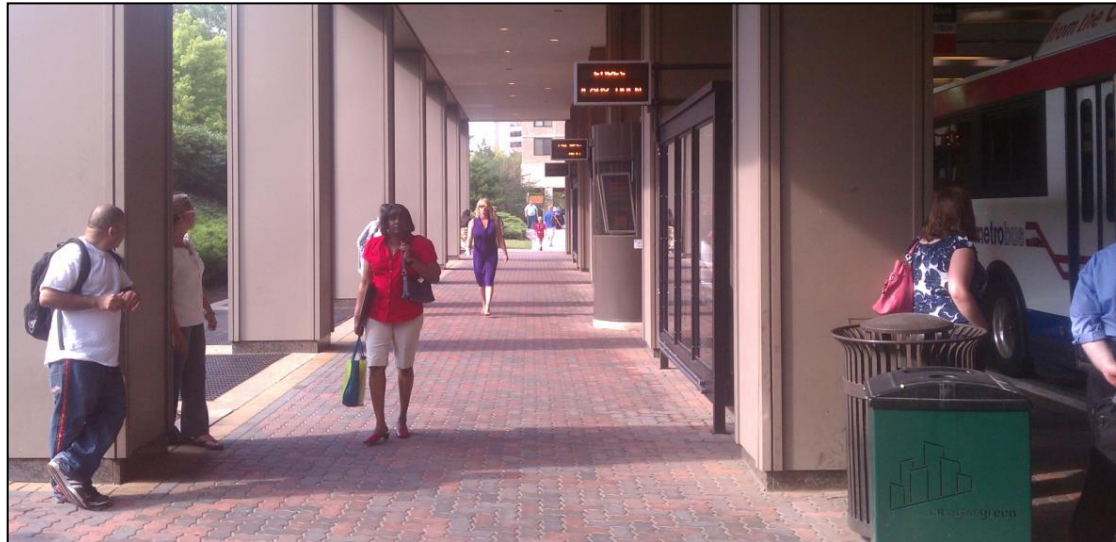
Commuters alighting at the VRE station are directed to the Crystal City Metrorail station via 18th Street South. Although it is possible to reach the station entrance via 15th Street South, the building on the corner

of Crystal Drive and 15th Street South acts as a visual barrier and the route is not intuitive. Most VRE passengers access the Crystal City Metrorail station via the Underground, but this route is not marked on way-finding signs.

Automobile Access

Public parking is readily available in the Crystal City Metrorail Station study area and there are elevators providing direct connections between the parking garage and the Underground. Pick-ups and drop-offs, including slugging activity, occur informally along Crystal Drive and the bus stop area on South Bell Street.

Figure 6: Metrobus stops located adjacent to the Crystal City Station Entrance



5.0 Alternatives Development and Initial Screening

The alternatives development and initial screening was the first step in the evaluation process. Based on the existing conditions, the evaluation criteria were developed to address the identified concerns. Several alternatives were developed and screened through a public and stakeholder coordination process. The feedback obtained from these coordination efforts was incorporated into the alternatives development and evaluation process.

5.1 Initial Screening Evaluation Criteria

The alternatives for improving station access and the alternatives for a second entrance to the Crystal City Metrorail Station were evaluated and compared using the criteria and stakeholder goals defined below:

- Improve access from east;
- Improve access for special needs users ;
- Improve multimodal connectivity (bicycles, transitway, commuter buses);
- Integrate with proposed redevelopment & reinvestment;

- Address long-term growth in ridership (including station facilities, faregates, elevators and escalators);
- Environmental and community impacts;
- Constructability; and
- Safety – mobility and ease of evacuation.

Improve access from Crystal Drive - A large number of Metrorail users access the Crystal City Metrorail Station from the direction of Crystal Drive, and many of them transfer between Virginia Railway Express (VRE) station and the Crystal City Metrorail Station. An additional entrance would better serve the needs of users accessing the station from the direction of Crystal Drive. Alternatives creating station access east of Crystal Drive would be rated more highly than alternatives creating station access west of Crystal Drive, which in turn would be rated more highly than alternatives that do not create station access or improve access far from Crystal Drive.

Improve multimodal connectivity - The station should be safely and comfortably accessible by all modes of transport. The ideal station area would include ample sidewalks with clearly marked pedestrian crossings that follow desire lines, a connected network of bicycle routes and secure bicycle parking, easy transfers to existing and future surface transit

connections, and clear signage directing users from one mode to another. Alternatives that provide enhanced bus stop capacity would be rated more highly. Alternatives that provide ample space for nearby bicycle parking would also be rated more highly.

Improve access for special needs users - The station should be easily accessible by all users including those with special needs (elderly, disabled, people with luggage or strollers etc.) Alternatives that increase elevator capacity, reliability, redundancy, and ease of use and that enhance accessible routes to the station would be rated more highly.

Integrate with proposed redevelopment & reinvestment - The future vision for Crystal City is for significant growth and reinvestment. The ideal station entrance will integrate well with proposed and planned development and redevelopment. Alternatives that can be integrated into redevelopment would be rated more highly than alternatives that interfere with planned redevelopment. Additionally, the Crystal City Sector Plan calls for a new “Metro Market Square” park near the proposed second entrance alternatives. The study team took the planned space into consideration in the development of the alternatives.

Address long-term growth in ridership - The ideal station entrance will have sufficient capacity at faregates, escalators, elevators, platforms and mezzanine to facilitate easy movement of users. Alternatives that enhance capacity of all station elements to address long-term ridership growth would be rated more highly than alternatives that address fewer or no station elements.

Environmental and community impacts - The Crystal City Sector Plan offers a comprehensive vision for the future of the Crystal City, with an emphasis on improving the quality of the public realm. The ideal station entrance would enhance existing and new environmental features, without adverse impacts to the surrounding area. Alternatives that do not impact or that create benefits to water quality, wetlands, floodplains, air quality, hazardous materials, noise, and vibration would be rated more highly. The Crystal City Sector Plan places an emphasis on improving the quality of the public realm. The ideal station entrance would enhance existing and new public facilities such as parks, plazas etc. while providing opportunities for new retail and other private sector benefits. Alternatives with fewer impacts on right-of-way acquisition, community disruption, environmental justice communities, parklands and open space, and traffic would be rated more highly.

Constructability - The construction of a new station entrance may result in conflicts with existing infrastructure requiring the relocation of underground structures and utilities. Construction of the new station entrance may require cutting through the existing tunnel vault, which has significant cost implications. A new station entrance that minimizes impacts on existing infrastructure would be rated more highly. Alternatives with less conflict with utilities or underground structures would be rated more highly. Alternatives that have a lower impact on the streetcar trackway would be rated more highly.

Safety (mobility, evacuation etc.) - The new station entrance should have sufficient capacity for all users at all times to minimize conflicts and crowding; and provide clear routes for egress. Alternatives that enhance emergency egress from the station – by providing redundant egress routes or reduce evacuation time – would be rated more highly.

5.2. Alternatives Identified

Several alternatives have been identified that can improve access to the Crystal City Metrorail Station. Some alternatives may be low-cost or short-term improvements that help users better navigate the station area, and some alternatives are higher cost and include more substantial improvements including elevators, ADA ramps and a new second entrance to the Metrorail station. The alternatives that were identified can be classified into three distinct categories. These are described below:

Second Entrance Alternatives

There are five alternatives in this category. These are described below and are shown in **Figure 7**.

Alternative A: Northwest corner of 18th Street and Crystal Drive; could connect to elevator bank along 18th Street (Short-Term Elevator Alternative “C”) [Recommendation from 2002 Access Study].

Alternative B: Southwest corner of 18th Street and Crystal Drive; could be a part of future development or add a below-ground connection to mezzanine; could connect to Second Entrance Alternative “A”.

Alternative C: Full entrance to connect to new mezzanine on the east side of Crystal Drive, north of future transitway stop.

Alternative D: Full entrance to connect to new mezzanine on the east side of Crystal Drive, south of future transitway stop.

Alternative E: Full entrance to connect from the existing Underground shopping mall (north side) to the existing mezzanine through a new passageway.

Initial Access Improvements – Improved way-finding and signage, and intersection improvements

The various elements of this alternative are described below and are shown in **Figure 8**.

- Improve pedestrian experience underneath US Route 1. Relocate shuttle bus boardings and alightings to this area.
- Improve way-finding and signage at the Underground crossing and the station entrance passage.
- Improve signage and visibility of existing elevator.
- Improve ADA access to existing elevator from surface parking lot.
- Improve pedestrian crossings at intersections in the vicinity of the Metrorail station entrance.

Elevator Improvement Alternatives

There is only one existing elevator between the street and the mezzanine level. In the

event that this elevator is broken or under maintenance, there is no ADA access to the station. Therefore it was recommended that the project team analyze an elevator only option for station entrance. This may also be used as an interim solution until the time a long term high capacity entrance is designed and built. There are four alternatives in this category. Because an elevator option is not considered adequate to handle future rider volumes, these alternatives were not evaluated in detail. They are described and shown in **Appendix B**.

Figure 7: Crystal City Metrorail Station Second Entrance Preliminary Alternatives

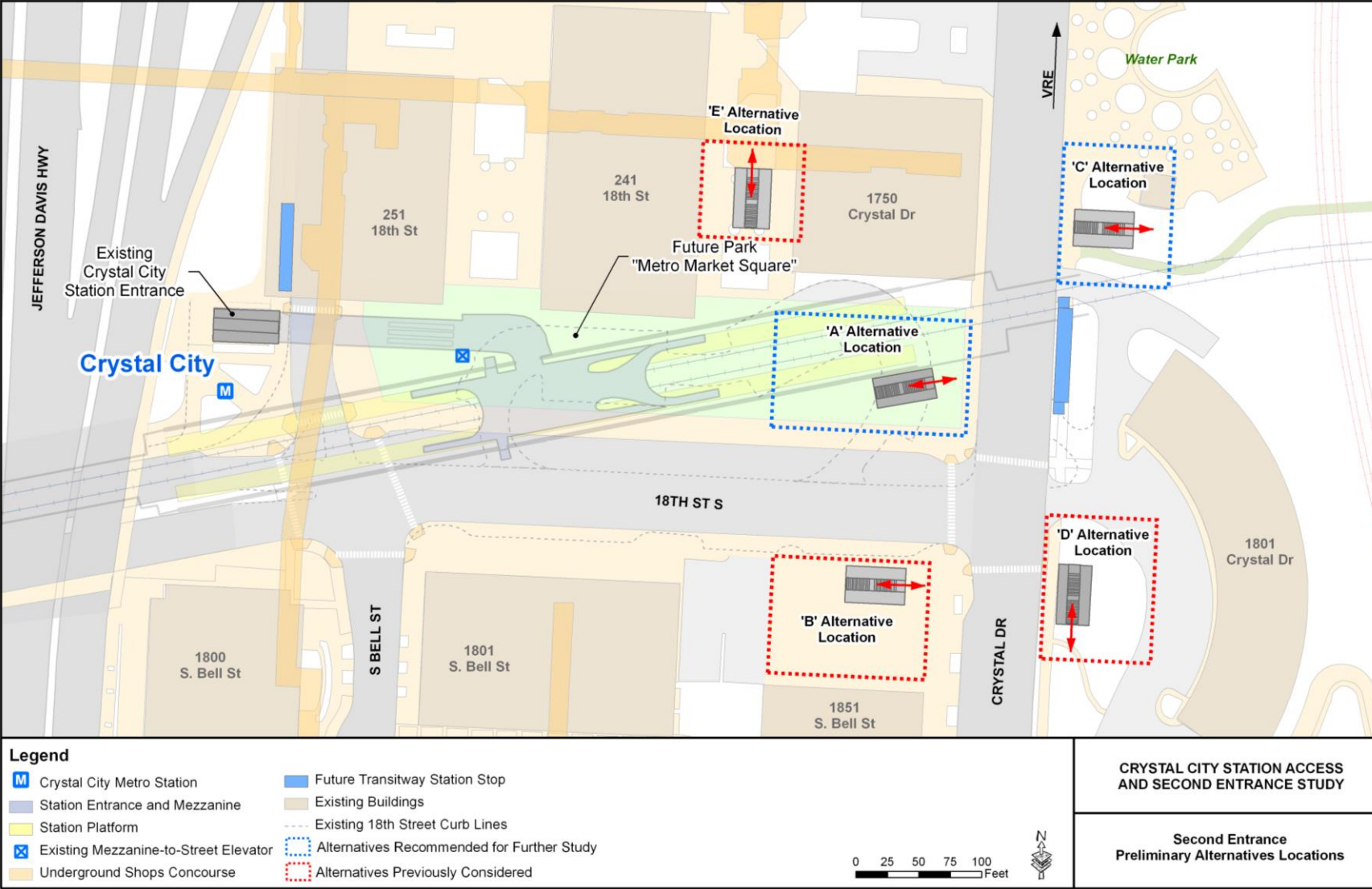
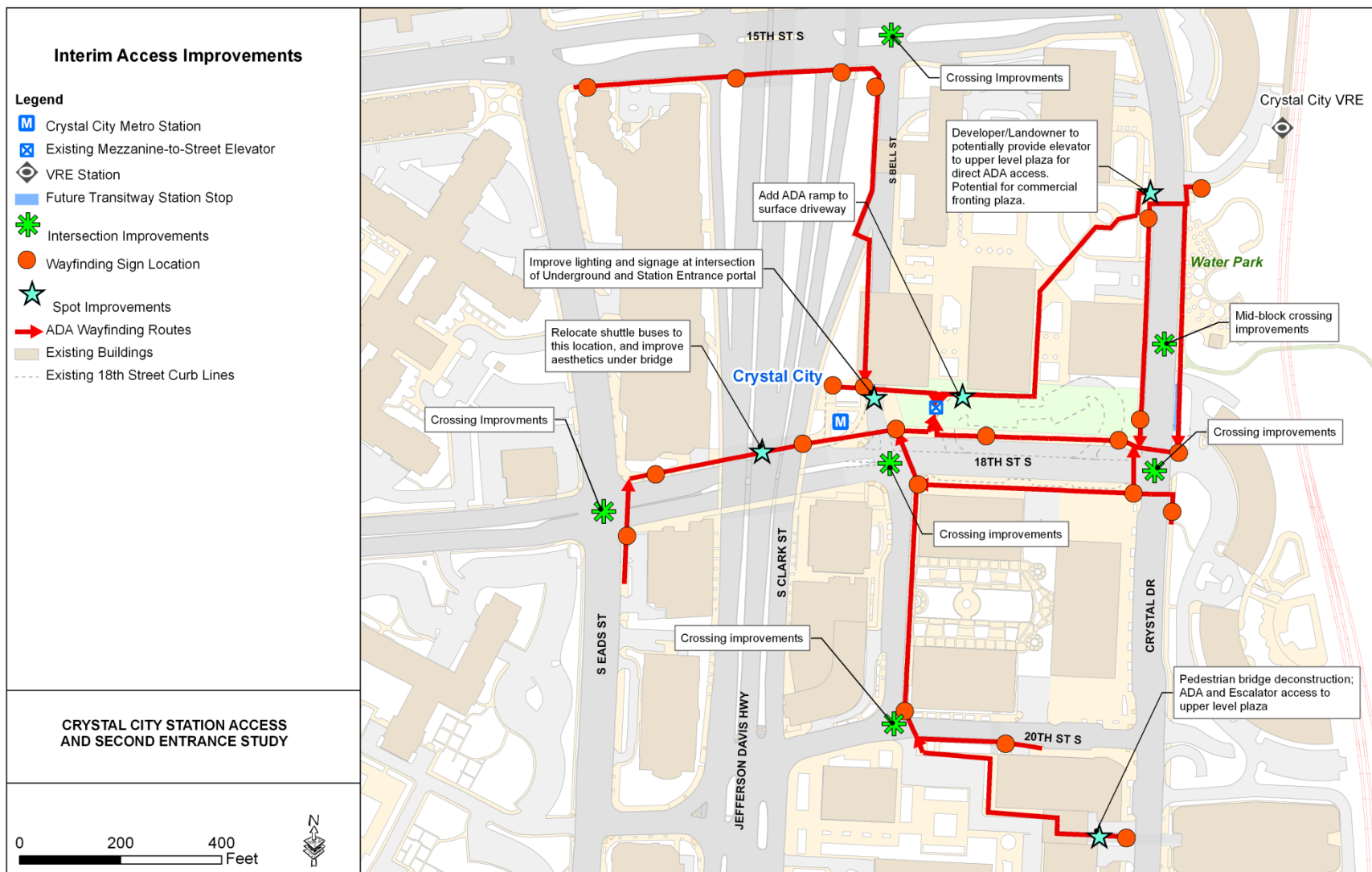


Figure 8: Crystal City Metrorail Station - Initial Access Alternative



5.3. Evaluation of Preliminary Alternatives

The evaluation of preliminary alternatives followed a two-step process. In the first phase of evaluation, an initial screening of all alternatives was conducted using the evaluation criteria identified in Section 5.1. This initial screening was conducted for all alternatives except the Initial Access Improvement alternative. Second Entrance Alternatives A and C were advanced for further consideration and development, whereas Alternatives B, D and E received lower ratings and were not analyzed further. Elevator alternatives were not considered sufficient to handle future rider volumes and were not analyzed in this phase. The detailed analysis for Second Entrance Alternatives is summarized in the Evaluation Matrix in **Appendix C**.

Alternative A performs very well against most evaluation criteria. Alternative A improves access from Crystal Drive and significantly improves the visibility of the station. It also improves capacity, relieves congestion, and has community benefits. Depending upon the exact configuration of the new mezzanine and faregates etc., Alternative A may involve reconfiguring of the existing station service rooms. Alternative A improves multimodal connectivity and has no impacts to the proposed private development.

Alternative B has some noteworthy drawbacks. It requires significant coordination with proposed private development. Alternative B would also require cutting through the tunnel vault of the existing station, and the construction of a long tunnel.

Alternative C has several significant benefits. Its location makes it very convenient for VRE users, the Mount Vernon trail and the proposed transitway/streetcar stops. While it would involve reconfiguring the existing station service rooms in the existing station, a new entrance in Alternative C would include significant improvements to the station facilities, would reduce congestion, and improve mobility.

Alternative D would have some impacts to proposed private development without significant community benefits. It would also entail reconfiguring service rooms in the existing station, and would have significant impacts to utilities under Crystal Drive.

Alternative E received an unfavorable rating primarily because of its location in the Underground. Alternative E location would not be visible from the street, thereby limiting multimodal access. It would also impact Underground retail activities and would not add any capacity to the station facilities.

As a result of the initial screening, the second entrance alternatives that received a lower rating (Alternative B, D, and E) were screened out and those alternatives that received the highest ratings were considered most feasible and advanced for further refinement (Alternatives A and C).

6.0 Tier I Alternatives Refinement and Evaluation

Alternatives A and C were developed further and design improvements were made. The project team ensured that each alternative met the WMATA guidelines for ADA access, and that elevators are provided in pairs for redundancy.

In the process of refinement, the project team considered different orientations for the escalators at the new station entrance; discussed locating the mezzanine and faregates at the street level; and also refined the alternatives for ensuring smooth flow of passengers both on the surface as well as on the station platform, in an effort to improve circulation and minimize congestion. During this design development, the project moved from conceptual alternatives to feasible alternatives. As a result of this refinement process, the new alternatives A.1, A.2, and C.1 emerged.

Figure 9 shows the general location of Second Entrance “A” Alternatives, whereas **Figure 10** shows the general location of Second Entrance “C” Alternatives. The Tier I Refined Alternatives can be found in **Appendix D**.

The refined Second Entrance Alternatives for Tier I Evaluation are as follows:

Alternative A – Alternative A includes new escalators and stairs located near 18th Street South. The new street-to-mezzanine elevators are located close to Crystal Drive. Alternative A also includes new mezzanine complete with new mezzanine-to-platform elevators and stairs, new faregates, kiosk and farecard machines. This second entrance alternative would result in end loading the platform at the east end thereby distributing the passengers and minimizing bottlenecks.

Alternative A.1 – Alternative A.1 is characterized by a new at-grade mezzanine pavilion which includes new escalators and stairs, new faregates, kiosk, farecard machines located on the street level near 18th Street South. The new street-to-passageway elevators are located close to Crystal Drive. Alternative A.1 is designed in a way to integrate with the future park envisioned for this location. This second entrance alternative would result in end loading the platform at the east end thereby distributing the passengers and minimizing bottlenecks.

Alternative A.2 – Alternative A.2 includes new escalators and stairs located near 18th Street South. The new street-to-mezzanine elevators are located close to the intersection of 18th Street South and Crystal Drive. Alternative A.2 includes a new

passageway connecting to the existing mezzanine, with reconfigured faregates. This second entrance alternative would result in center loading the platform thereby concentrating the passengers in one location.

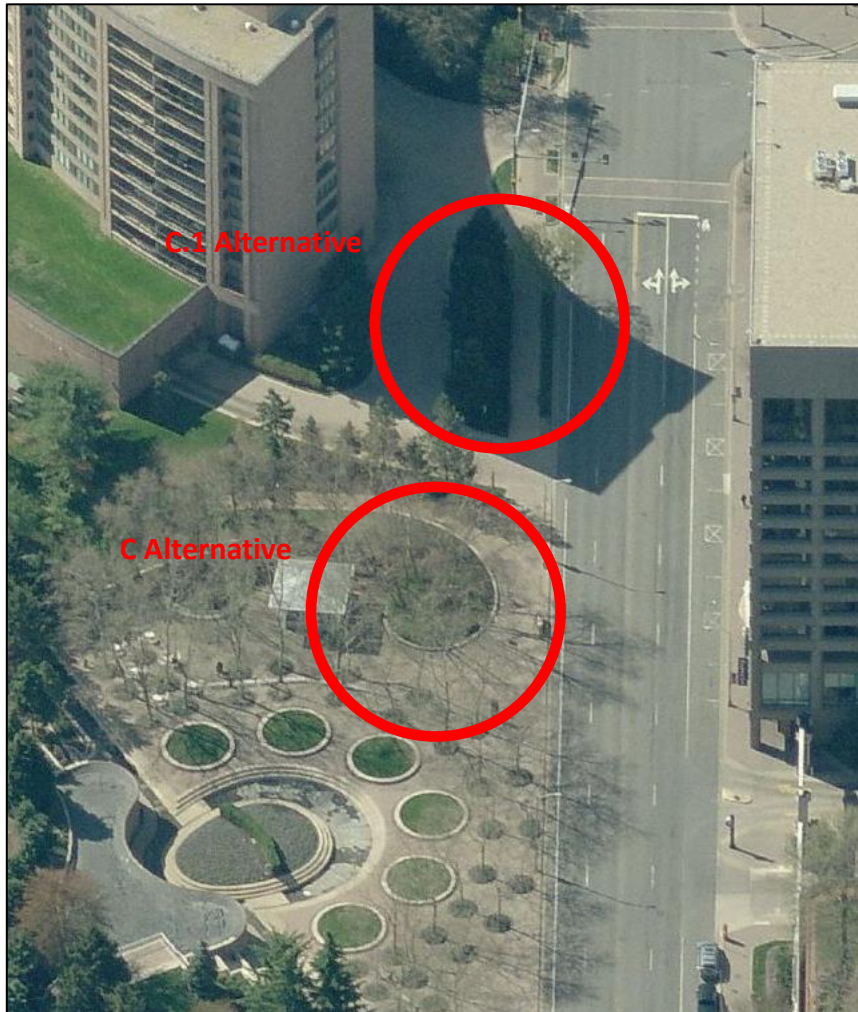
Alternative C – Alternative C includes new escalators and stairs located adjacent to the Water Park along Crystal Drive. The new street-to-passageway elevators are also located close to the Water Park near Crystal Drive. Alternative C also includes a new mezzanine complete with new mezzanine-to-platform elevators and stairs, new faregates, kiosk and farecard machines. This second entrance alternative would result in end loading the platform at the east end thereby distributing the passengers and minimizing bottlenecks.

Alternative C.1 – Alternative C.1 includes new escalators and stairs located south of the Water Park along Crystal Drive. The new street-to-passageway elevators are also located close to the Water Park near Crystal Drive. Alternative C.1 also includes new mezzanine complete with new mezzanine-to-platform elevators and stairs, new faregates, kiosk and farecard machines. This second entrance alternative would result in end loading the platform at the east end thereby distributing the passengers and minimizing bottlenecks.

Figure 9: Crystal City Metrorail Station Second Entrance "A" Alternatives Location



Figure 10: Crystal City Metrorail Station Second Entrance "C" Alternatives Location



6.1 Tier I Evaluation of Refined Second Entrance Alternatives

Each of the refined Second Entrance alternatives - A, A.1, A.2, C, and C.1- was designed to address safety and mobility concerns. All alternatives improve the visibility of the station entrance, thereby improving multimodal access. They also follow ADA accessibility guidelines. Each one of these alternatives has minimal impacts to the proposed private development and reasonable benefits to the community. Since each refined alternative is a product of the evaluation criteria from the initial screening, the Tier I evaluation process focuses mainly on the differences between them. As a result the Tier I evaluation criteria include a shorter list, comprising four elements, which are discussed below:

Access for all – This criterion focuses on the ability of the new entrance to provide improved access for all users, including those who may access the station from VRE and Crystal Drive. Although all alternatives provide multimodal access, the proximity to future transitway stops, Mount Vernon Trail and Metrobus stops is considered favorable. The pros and cons of each alternative with regard to Access are summarized in **Table 3**.



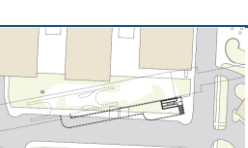
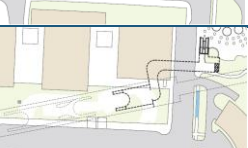
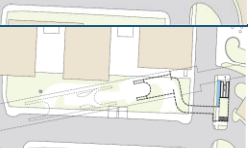
Capacity for future growth – The Crystal City Sector Plan envisions a significant amount of development and redevelopment in Crystal City which will bring new residents, employees and visitors to the area. Therefore the Crystal City Metrorail Station should have enough capacity to serve the future ridership. An alternative that provides another way of accessing the trains at the Metrorail station to disperse the passengers will be considered more favorable with regards to this project goal. If the new entrance includes new station facilities (escalators, elevators, stairs, faregates, farecard machines etc.) then the alternative would have significant benefits with regards to accommodating future growth and ridership. **Table 4** summarizes the pros and cons of each alternative with regard to capacity to accommodate future growth.

Constructability – There are several factors that determine the cost of an alternative. In general, if an alternative is difficult to construct, it will be more expensive to build. Some of the constructability issues in this study occur from relocation of existing station facilities such as elevator machine rooms, vent shafts and service rooms. In some cases, the alternative may require cutting through the tunnel vault of the existing station, which will add to the cost of construction. Any alternative that includes

a tunnel under Crystal Drive would impact the existing utility lines, with associated costs. These constructability issues are summarized in **Table 5**.

Contribution to the public realm – A new station entrance has the potential to enhance the community benefits, serve as a landmark in the area and add to street life. Similarly, an alternative may adversely affect community resources and not blend well with the existing surroundings. An alternative that blends well with the surroundings and contributes to the public realm will be considered favorable. **Table 6** summarizes the pros and cons of each alternative with regard to contribution to the public realm.



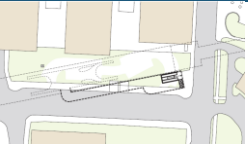
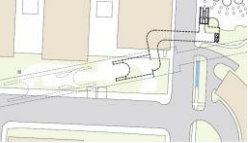

Table 3: Access for All - Pros and Cons of Refined Second Entrance Alternatives

Alternatives	Access for All	
	Pros	Cons
	<ul style="list-style-type: none"> Improves ADA and general access from Crystal Drive Improves multimodal access 	<ul style="list-style-type: none"> Requires crossing Crystal Drive from the east Escalator is not oriented towards the east
	<ul style="list-style-type: none"> Improves ADA and general access from Crystal Drive Improves multimodal access The pavilion increases the visibility of the station 	<ul style="list-style-type: none"> Requires crossing Crystal Drive from the east Escalator is not oriented towards the east
	<ul style="list-style-type: none"> Improves ADA and general access from Crystal Drive Improves multimodal access Escalator oriented toward Crystal Drive 	<ul style="list-style-type: none"> Requires crossing Crystal Drive from the east Long tunnel from surface opening to mezzanine
	<ul style="list-style-type: none"> Improves ADA and general access from the East side of Crystal Drive Improves multimodal access 	<ul style="list-style-type: none"> May constrain sidewalk width on the east side of Crystal Drive
	<ul style="list-style-type: none"> Improves ADA and general access from the East side of Crystal Drive Improves multimodal access 	<ul style="list-style-type: none"> May constrain sidewalk width on the east side of Crystal Drive

In general, Alternatives C and C.1 provide improved access to users on the east side of Crystal Drive (VRE riders and residents east of Crystal Drive). Alternatives A and A.1 provide improved access, however, still require users to cross Crystal Drive, which may be a deterrent to some users. Alternative A.2 includes a long tunnel which may be problematic for users with impaired mobility.




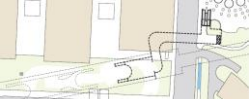



Table 4: Capacity for Future Growth - Pros and Cons of Refined Second Entrance Alternatives

		Capacity for Future Growth	
Alternatives		Pros	Cons
	A	<ul style="list-style-type: none"> Provides additional capacity for future growth Distributes passengers across the length of the platform Provides increased capacity for passengers inside the station 	<ul style="list-style-type: none"> Space constraints; stairs only at east end of platform
	A.1	<ul style="list-style-type: none"> Provides additional capacity for future growth Distributes passengers across the length of the platform Provides increased capacity for passengers inside the station Fare collection infrastructure located at street level reduces congestion at mezzanine 	<ul style="list-style-type: none"> Space constraints; stairs only at east end of platform
	A.2	<ul style="list-style-type: none"> Provides additional capacity for future growth 	<ul style="list-style-type: none"> Creates a bottleneck and congestion point at existing mezzanine Does not distribute passengers across the length of the platform
	C	<ul style="list-style-type: none"> Provides additional capacity for future growth Distributes passengers across the length of the platform Provides increased capacity for passengers inside the station 	<ul style="list-style-type: none"> Space constraints; stairs only at east end of platform
	C.1	<ul style="list-style-type: none"> Provides additional capacity for future growth Distributes passengers across the length of the platform Provides increased capacity for passengers inside the station 	<ul style="list-style-type: none"> Space constraints; stairs only at east end of platform

Although all alternatives provide future growth capacity, Alternative A.1 provides the added benefit of increased passenger capacity inside the station. Alternative A.2 creates bottleneck and congestion point in the existing mezzanine.



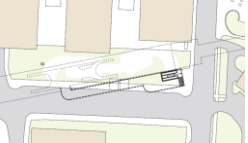
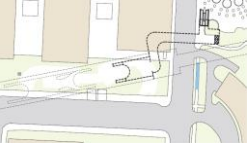

Table 5: Constructability - Key Cost Drivers for Refined Second Entrance Alternatives

Alternatives	Constructability Key Cost Drivers
	<ul style="list-style-type: none"> • Requires cutting through the end wall of the station tunnel • Requires reconfiguration of surface vehicular building access • Requires relocation of station vents and mechanical rooms
	<ul style="list-style-type: none"> • Requires cutting through the end wall of the station tunnel • Requires reconfiguration of surface vehicular building access • Requires relocation of the station vents and mechanical rooms
	<ul style="list-style-type: none"> • Requires cutting through station tunnel vault • Requires the construction of a long passageway
	<ul style="list-style-type: none"> • Requires cutting through the end wall of the station tunnel • Requires reconfiguration of surface vehicular building access • Requires long passageway with impacts to utilities under Crystal Drive • Will cause traffic disruptions for Crystal Drive during construction
	<ul style="list-style-type: none"> • Requires cutting through the end wall of the station tunnel • Requires reconfiguration of surface vehicular building access • Requires long passageway with impacts to utilities under Crystal Drive • Will cause traffic disruptions for Crystal Drive during construction

All alternatives will require cutting through the end wall of the station tunnel with the exception of Alternative A.2 which requires cutting through the station tunnel vault. Alternatives A and A.1 will also require relocation of station vents and mechanical rooms. Alternatives C and C.1 will impact utilities under Crystal Drive and cause traffic disruptions for Crystal Drive during construction.



Table 6: Contribution to the Public Realm - Pros and Cons of Refined Second Entrance Alternatives

Alternatives	Contribution to Public Realm	
	Pros	Cons
	<ul style="list-style-type: none"> The station entrance can be designed to complement the future park 	<ul style="list-style-type: none"> None
	<ul style="list-style-type: none"> New Pavilion enhances station visibility and adds to the street life 	<ul style="list-style-type: none"> May constrain the design of future park
	<ul style="list-style-type: none"> The station entrance can be designed to complement the future park 	<ul style="list-style-type: none"> None
	<ul style="list-style-type: none"> The station entrance can be designed to complement the Water Park 	<ul style="list-style-type: none"> The entrance would affect the look and feel of the Water Park
	<ul style="list-style-type: none"> The station entrance is convenient to the Water Park as well as the Mount Vernon Trail 	<ul style="list-style-type: none"> Competing uses of sidewalk space at this location

All alternatives can be designed to complement the future park. The pavilion in Alternative A.1 may constrain the design of future park, whereas Alternative C.1 may limit the usable sidewalk space at that location. Alternative C would affect the look and feel of the existing Water Park.

7.0 Tier II Alternatives Refinement and Evaluation

Based on the results of the Tier I evaluation process, the study team recommended Alternatives A, A.1, and C.1 for further design refinements and a Tier II evaluation. The Tier II evaluation included an engineering feasibility scan, an east- and west-side entrance demand analysis, pedestrian simulation analysis, and detailed cost estimates.

7.1 Engineering Scan

The Tier II Alternatives Evaluation began with an assessment of constructability of the alternatives, considering the potential impacts to the existing station and existing utilities. The project team coordinated with WMATA engineers to determine the feasibility of alternatives with respect to conflicts with mechanical and ventilation facilities. Additionally, Arlington County water and sewer engineers were consulted to examine existing utilities conflicts as they relate to the second entrance alternatives, particularly the C.1 Alternative which requires tunneling under Crystal Drive. The project team then made refinements to the alternatives based on the results of the engineering scan. This was an iterative process as design refinements were

considered based on discussions with WMATA and County utilities engineers.

The following were the key findings from the engineering scan:

Site Visit and Consultation with Metro Engineers

The purpose of this meeting was to consult with Metro engineers regarding the feasibility of second entrance alternatives for the Crystal City Station with respect to the conflicts with mechanical room, transformer room, A/C switchboard room, stairs, ducts, vent shafts, elevators, escalators and related facilities. The following are the main conclusions of this meeting:

- All of the current second entrance alternatives have very similar reconfigurations of the east mechanical rooms. The new pedestrian passageway to the new east entrance may have to be re-routed around the existing machine rooms. The passageway would require modifications to duct work and standpipes, but relocation of equipment is likely not necessary.
- The void spaces between the platform elevators, the escalator-way, and the passageway provide adequate space for small machine rooms, housing only controllers and not electric motors.

Elevator machine rooms should be immediately adjacent to both elevators. There is a possibility of technological improvements by the time of the construction of a second entrance to allow for “machine room-less” (MRL) hydraulic elevators to use for the platform to mezzanine elevators. Escalator cabinet rooms should be shown for each alternative.

- Restrooms should be added to the station facilities for use by employees.

Meeting with County Utilities Staff - Utility Coordination

The purpose of this meeting was to examine the potential utilities impacts associated with the Crystal City Metro Second Entrance Alternatives, with particular focus on Alternative C.1 that would require an underground pedestrian tunnel underneath Crystal Drive. The following are the key points and discussion on the utility issues in the study area:

Stormwater:

- The relocation of a junction box and the need to replace the single large 60” storm trunk line pipe with smaller pipes would be required for the feasibility of Alternative C.1 as shown.
- The group discussed moving the passageway south to better avoid the

storm junction structure. The group also discussed whether the passageway could be lowered rather than modifying the storm sewer. It was decided that the tunnel would be designed at a lower depth to avoid the stormwater junction structure.

- Additional coordination with Arlington County utility engineers would be required on the feasibility of resizing or modifying the 60" storm trunk line pending a selection of a preferred alternative and future design phases.

Electrical Utilities:

- Electrical utilities would be difficult to move and relocate.
- The study team initiated consultation with PEPCO on the electric transmission lines underneath Crystal Drive and received additional information on the existing electrical facilities in the study area. Additional coordination should occur pending a selection of a preferred alternative and future design phases.

Gas Utilities:

- Gas lines are flexible and are relatively easy to relocate.

Sanitary Utilities:

- The existing sanitary lines use asbestos cement, creating an environmental and safety hazard if required to be moved.

Traffic and Street Lights:

- Traffic and street lighting would have conflicts, but relocation is not an issue.

Unknown Utilities:

- Given the proximity to the Pentagon and the number of secure Department of Defense contractors in the study area, there may be unknown facilities such as fiber optic cables that may present conflicts with the design concepts.

Constructability:

- The "A" Alternatives are more ideal for constructability compared to Alternative C.1.
- There would be potential difficulties in maintaining access to existing buildings and parking during construction for all alternatives.
- Maintenance of Traffic would be substantial as the study area is in a highly active urban environment.

7.2 Alternatives Refinements

All drawings were updated to indicate components of the new alternatives, issues between the existing structure and the new alternatives, and the location of existing ductwork and a chilled water pipe on the second level of the east service rooms. Additionally, the following revisions were made to the concept designs from the Tier I Evaluation:

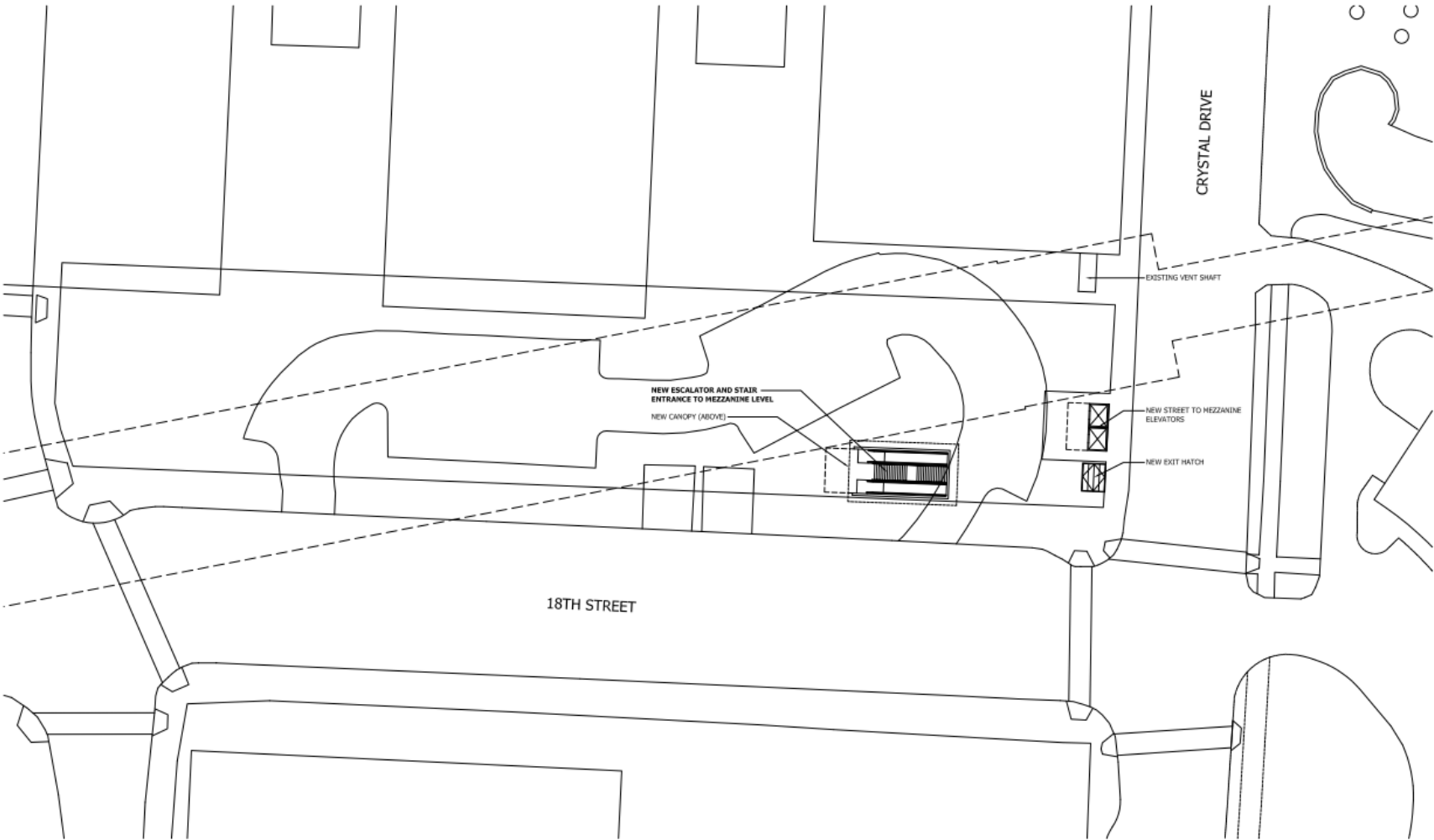
Alternative A – The new passageway was shifted to the east to provide sufficient vertical clearance for the duct shaft. A new elevator machine room (566 square feet) is added so that there is ample space to house the elevator machines. A new escalator cabinet room was also added. The restrooms are now located between the new exit stair and new escalator cabinet room. See **Figures 11 - 14**.

Alternative A.1 – The new passageway was shifted to the east to provide sufficient vertical clearance for the duct shaft. A new elevator machine room (406 square feet) is added and a new escalator cabinet room is provided that is large enough and can accommodate elevator equipment if required. The new passageway-to-platform elevators on the north side encroach slightly into the adjacent parking structure. The duct dimension discussion was identical to Alternative A. See **Figures 15 - 19**.

Alternative C.1 – Similar to “A” Alternatives, the new passageway is shifted to the east to provide sufficient vertical clearance for the duct shaft. New elevator machine room and new restrooms are added and are located near the new exit stair. Since there was not enough horizontal space for a ramp to negotiate the change in elevation, new stairs were added in the passageway to get the passengers to the mezzanine level. A second elevator to the west side of Crystal Drive was added to account for ADA elevator redundancy requirements. Both elevators on the west side are also pass-through elevators. A new corridor at the passageway level was added to provide access from the passageway level up to the new mezzanine level. See **Figures 20 - 23**.



Figure 11: Alternative A Entry Level



SECOND ENTRANCE - ALTERNATIVE A ENTRY LEVEL

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

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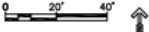


Figure 12: Alternative A Mezzanine Level

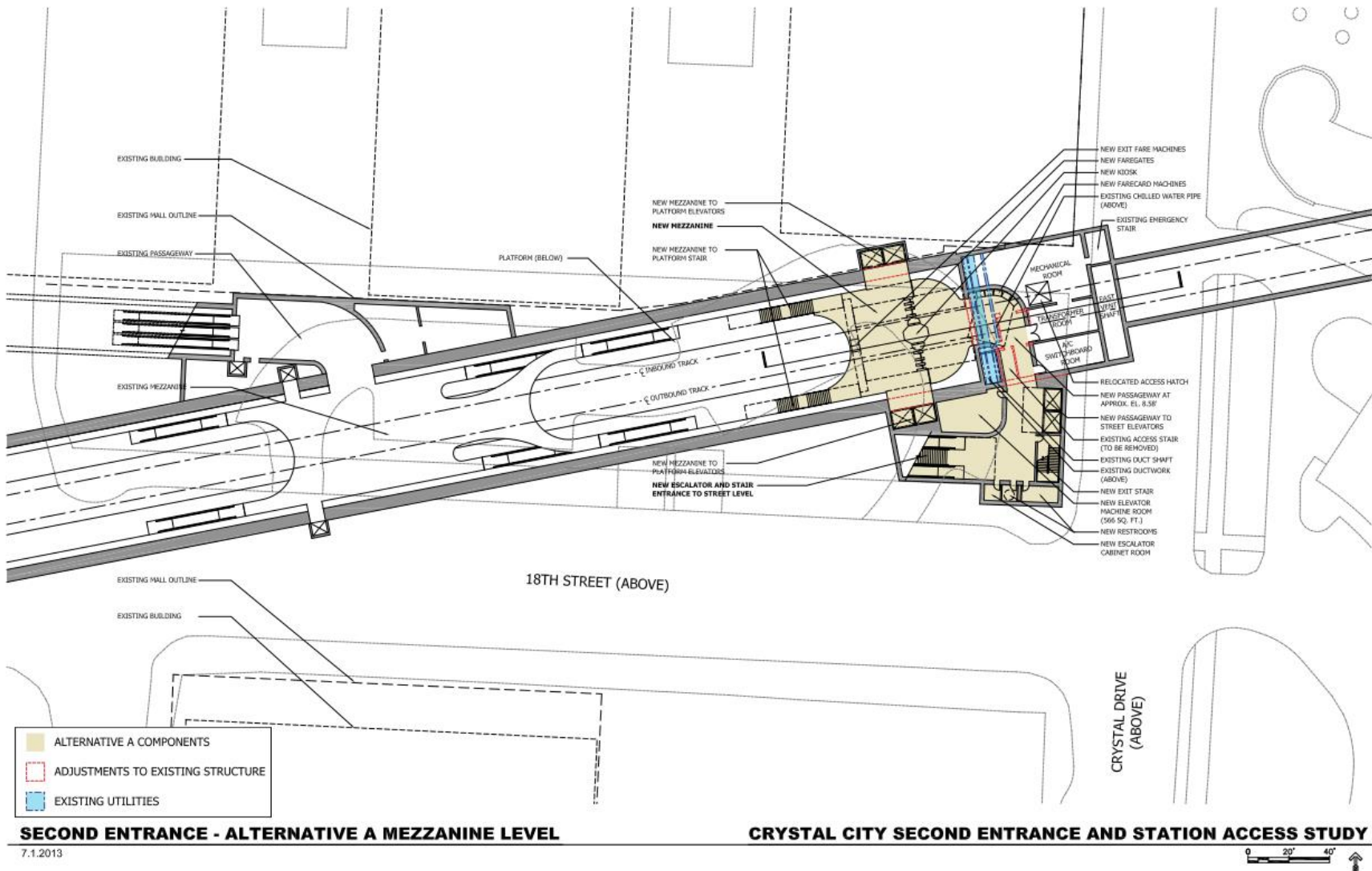
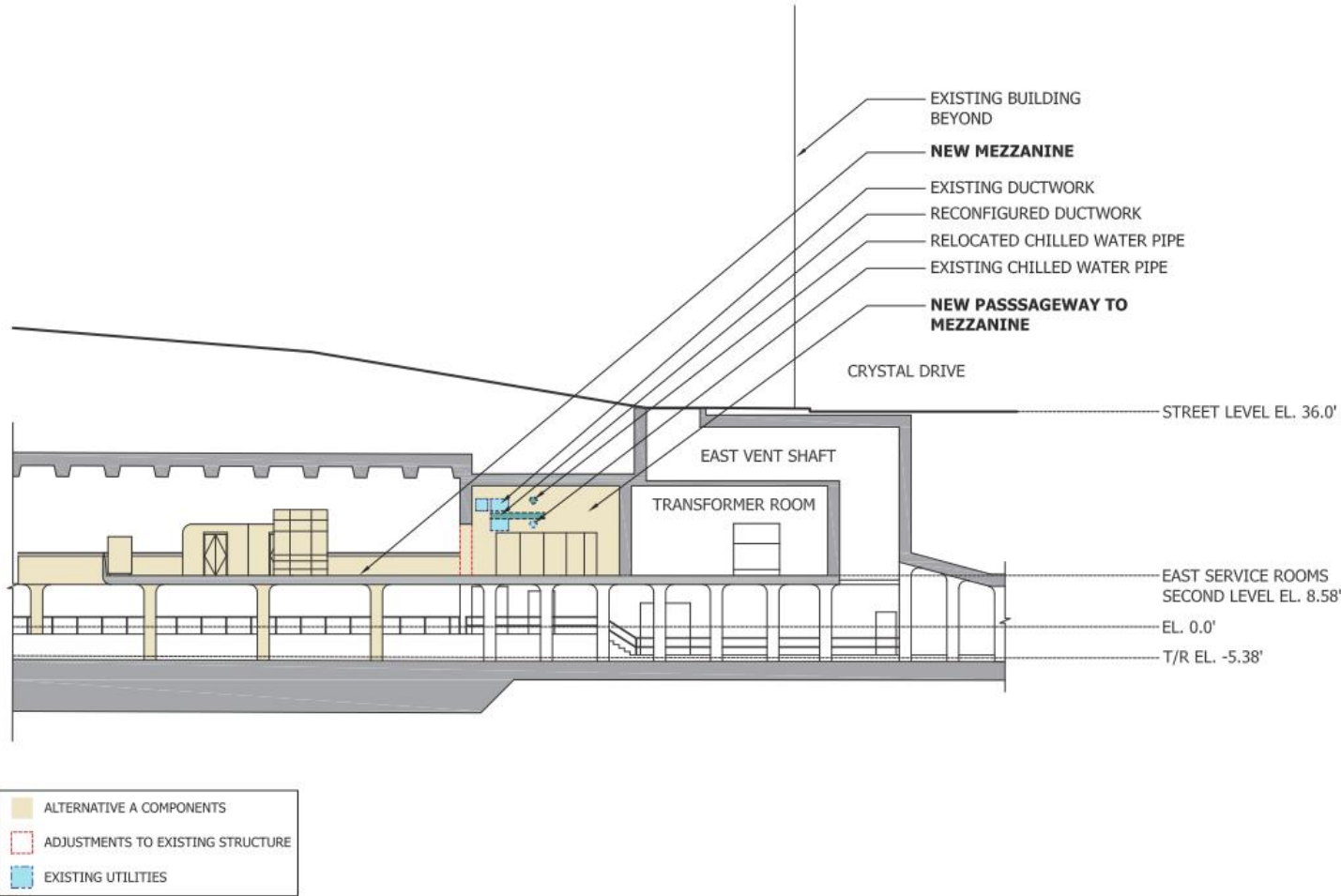


Figure 13: Alternative A Section 1 of 2



SECOND ENTRANCE - ALTERNATIVE A SECTION

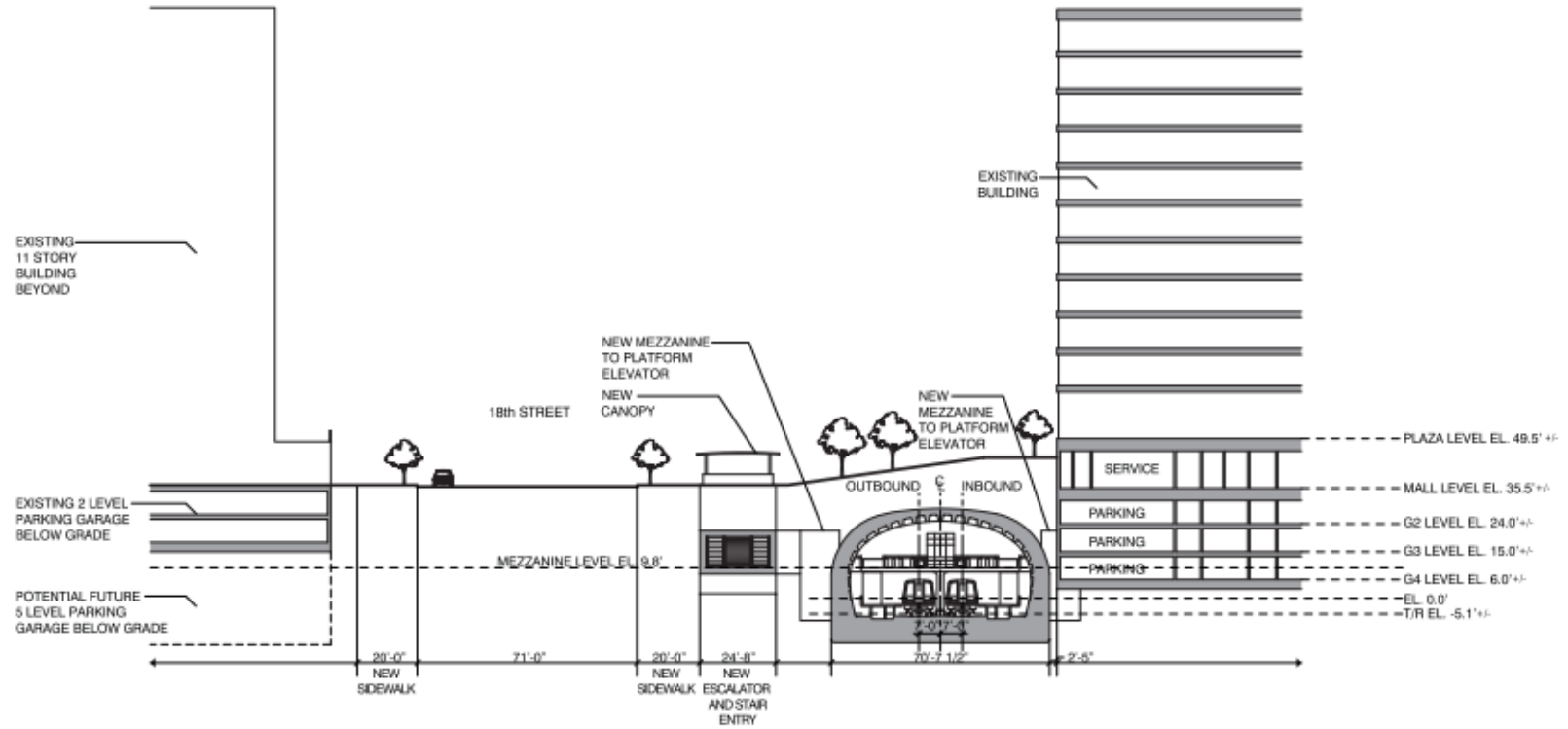
CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

7.1.2013



Figure 14: Alternative A Section 2 of 2

*NOTE: ALL DIMENSIONS ARE APPROXIMATE BASED ON ESTIMATES FROM AVAILABLE DATA AND WMATA AS-BUILT DRAWINGS



SECOND ENTRANCE - ALTERNATIVE A SECTION

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9.25.2012

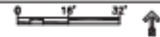
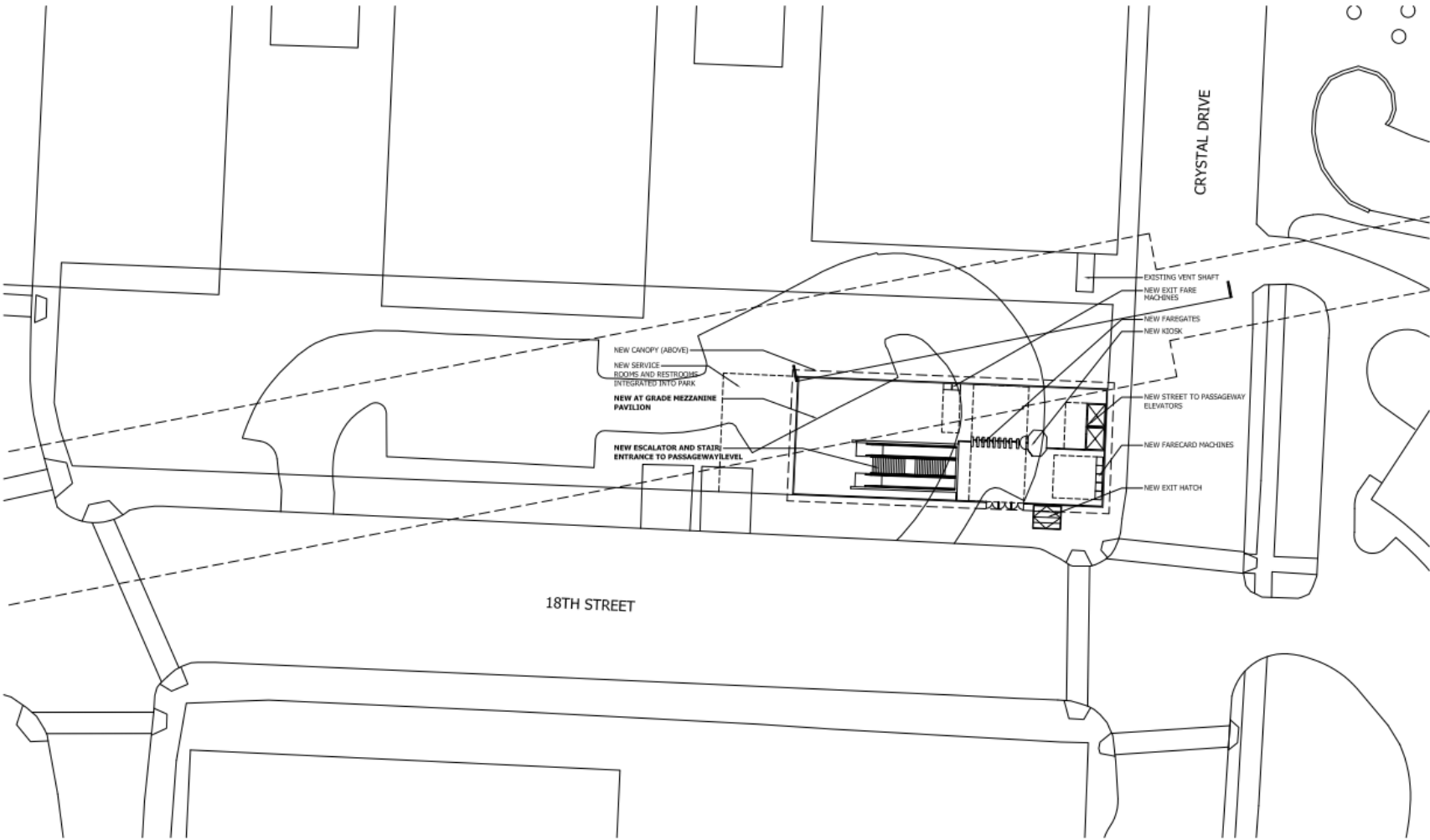


Figure 15: Alternative A.1 Entry Level



SECOND ENTRANCE - ALTERNATIVE A.1 ENTRY LEVEL

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

7.1.2013

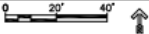


Figure 16: Alternative A.1 Mezzanine Level

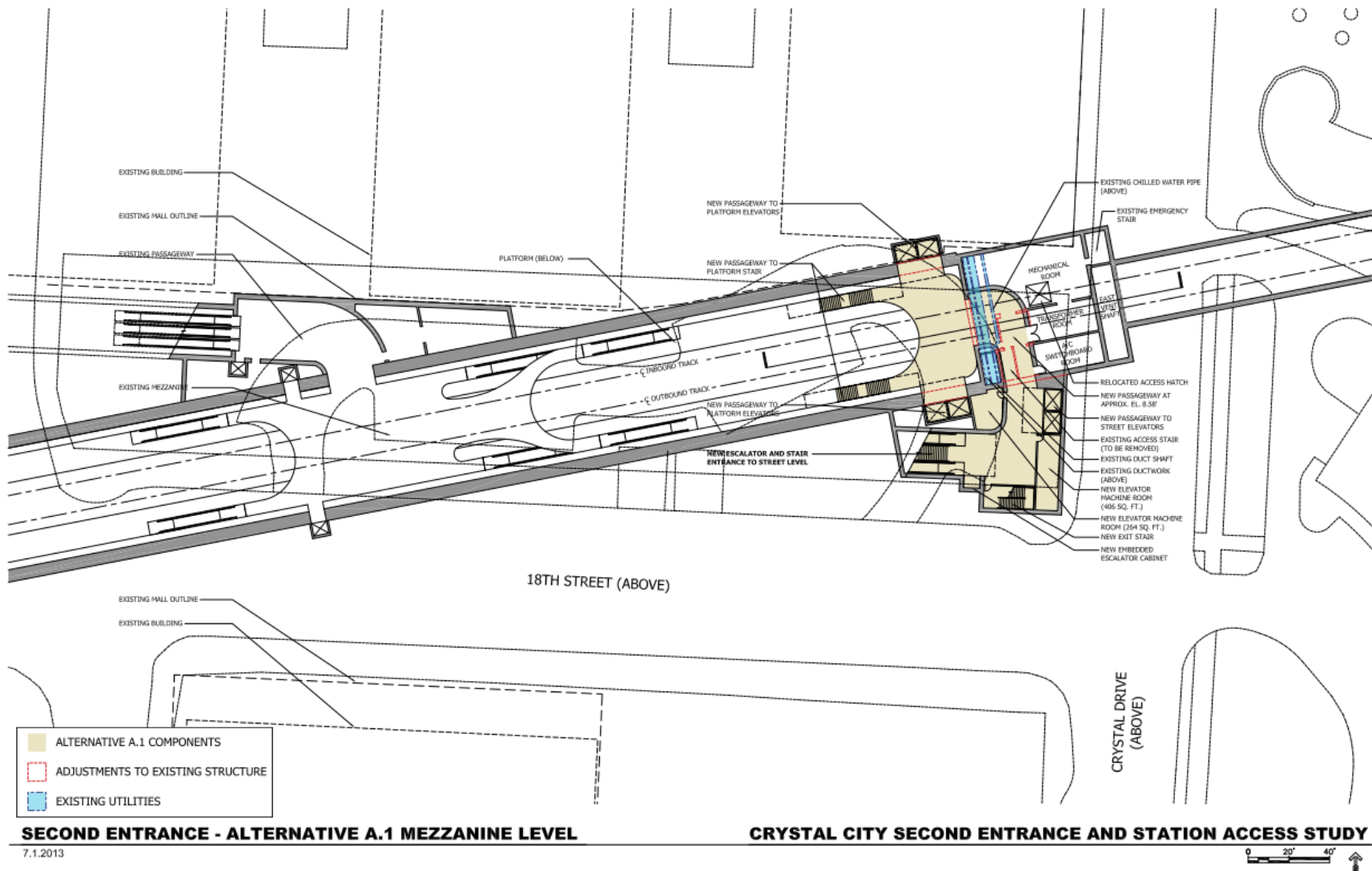
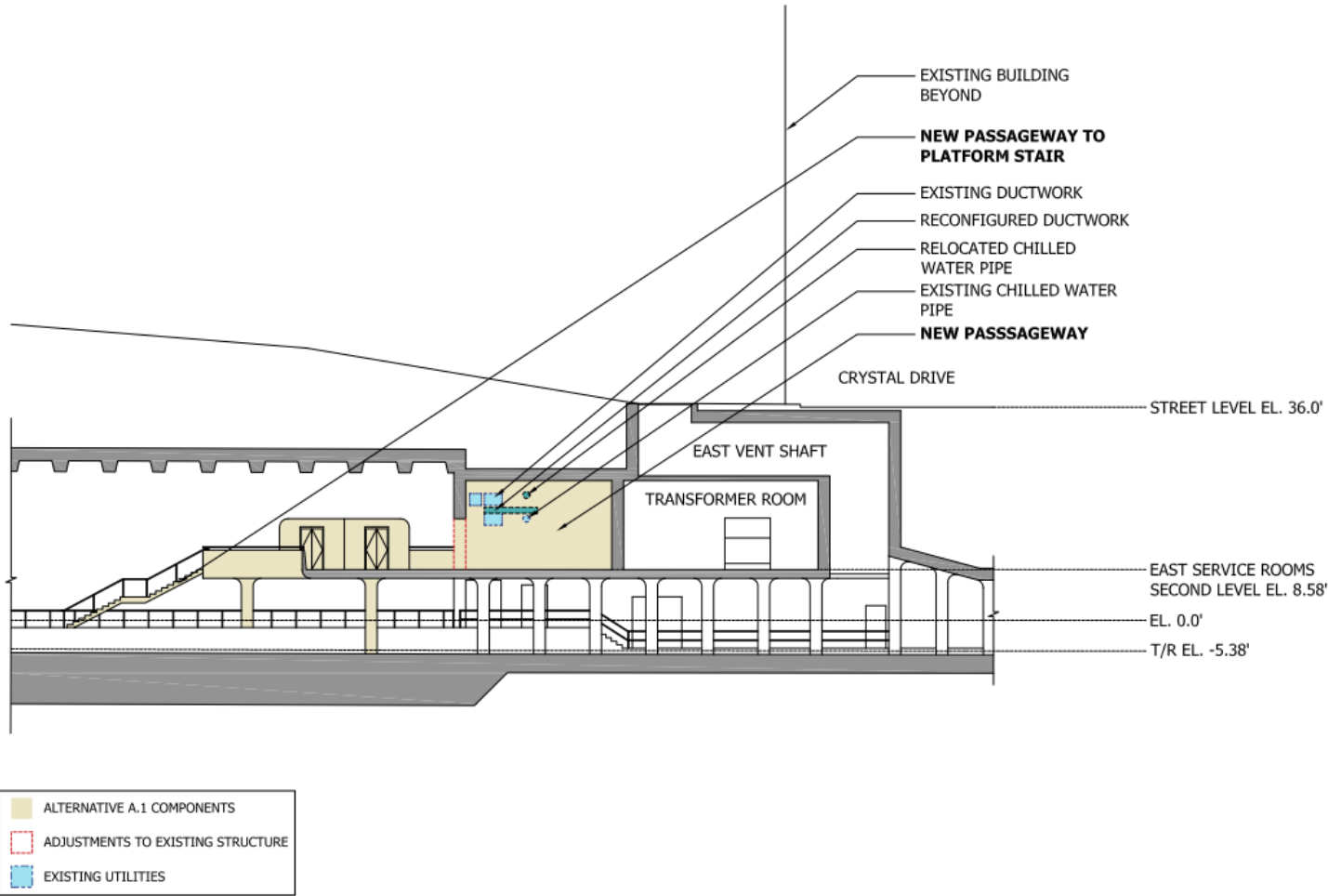


Figure 17: Alternative A.1 Section 1 of 3



SECOND ENTRANCE - ALTERNATIVE A.1 SECTION

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

7.1.2013

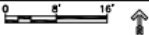


Figure 18: Alternative A.1 Section 2 of 3



SECOND ENTRANCE - ALTERNATIVE A.1 ELEVATION

9.25.2012

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

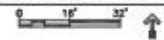
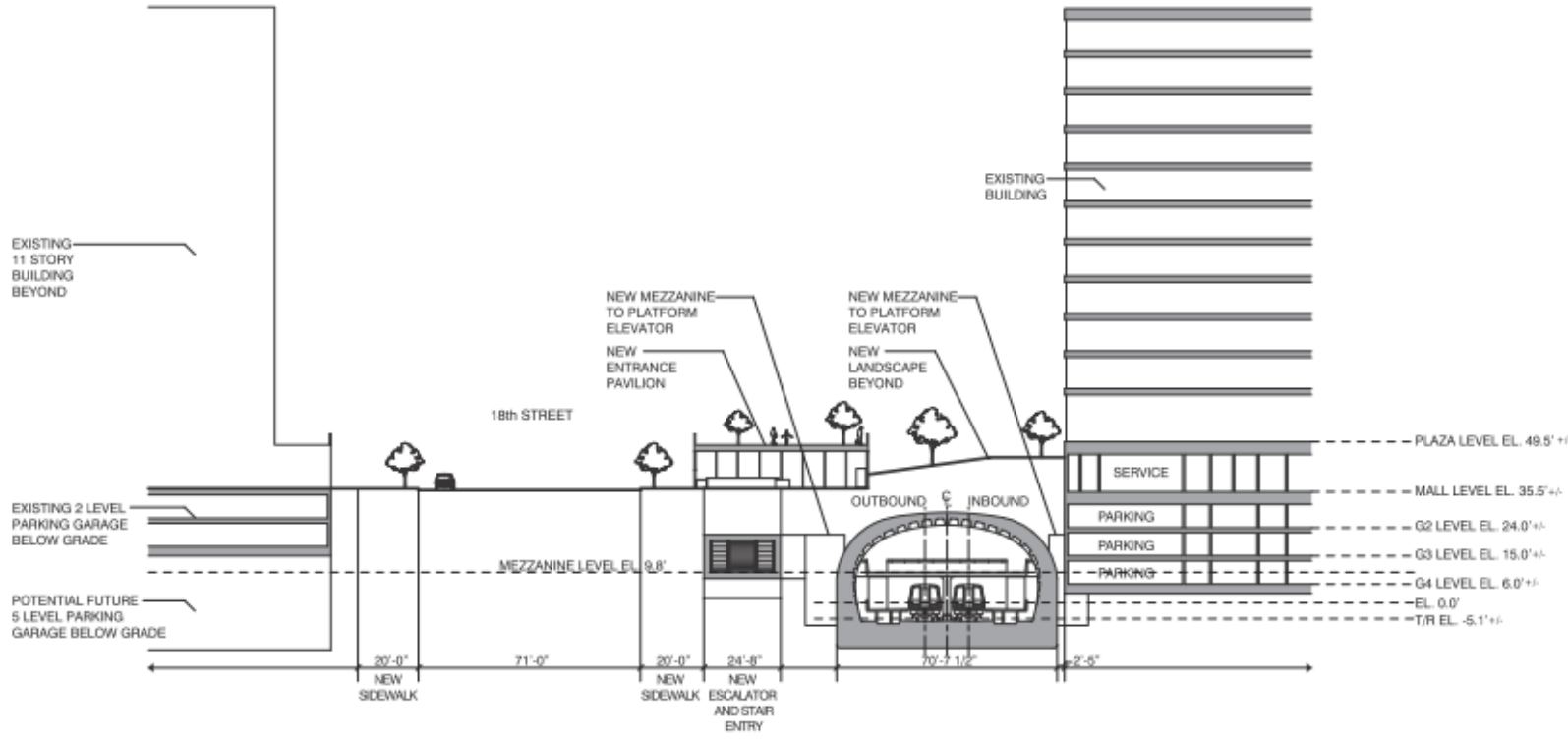


Figure 19: Alternative A.1 Section 3 of 3

*NOTE: ALL DIMENSIONS ARE APPROXIMATE BASED ON ESTIMATES FROM AVAILABLE DATA AND WMATA AS-BUILT DRAWINGS



SECOND ENTRANCE - ALTERNATIVE A.1 SECTION

9.25.2012

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

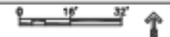
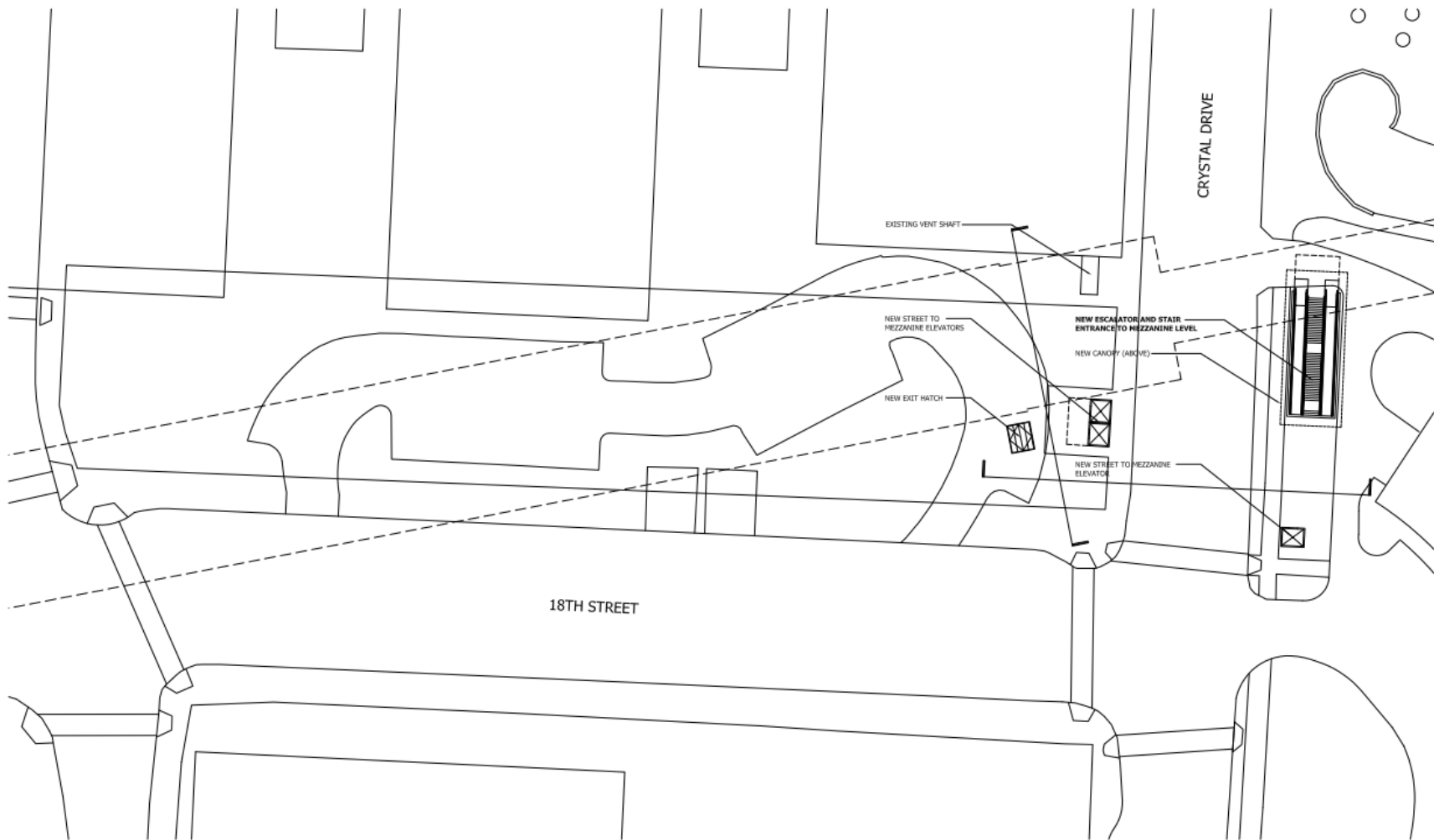


Figure 20: Alternative C.1 Entry Level



SECOND ENTRANCE - ALTERNATIVE C.1 ENTRY LEVEL

7.1.2013

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

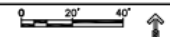
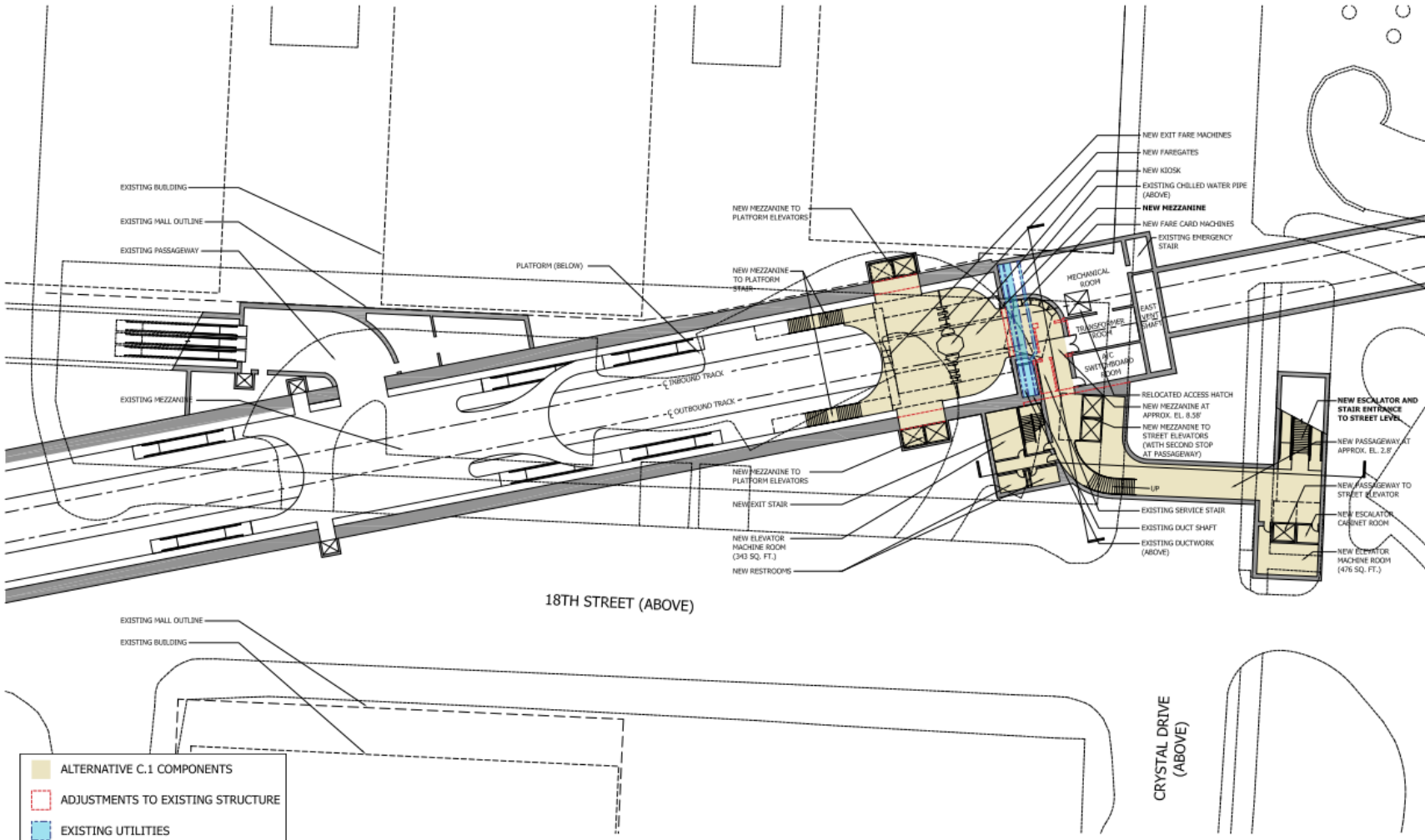


Figure 21: Alternative C.1 Mezzanine Level



SECOND ENTRANCE - ALTERNATIVE C.1 MEZZANINE LEVEL

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

7.1.2013

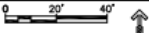
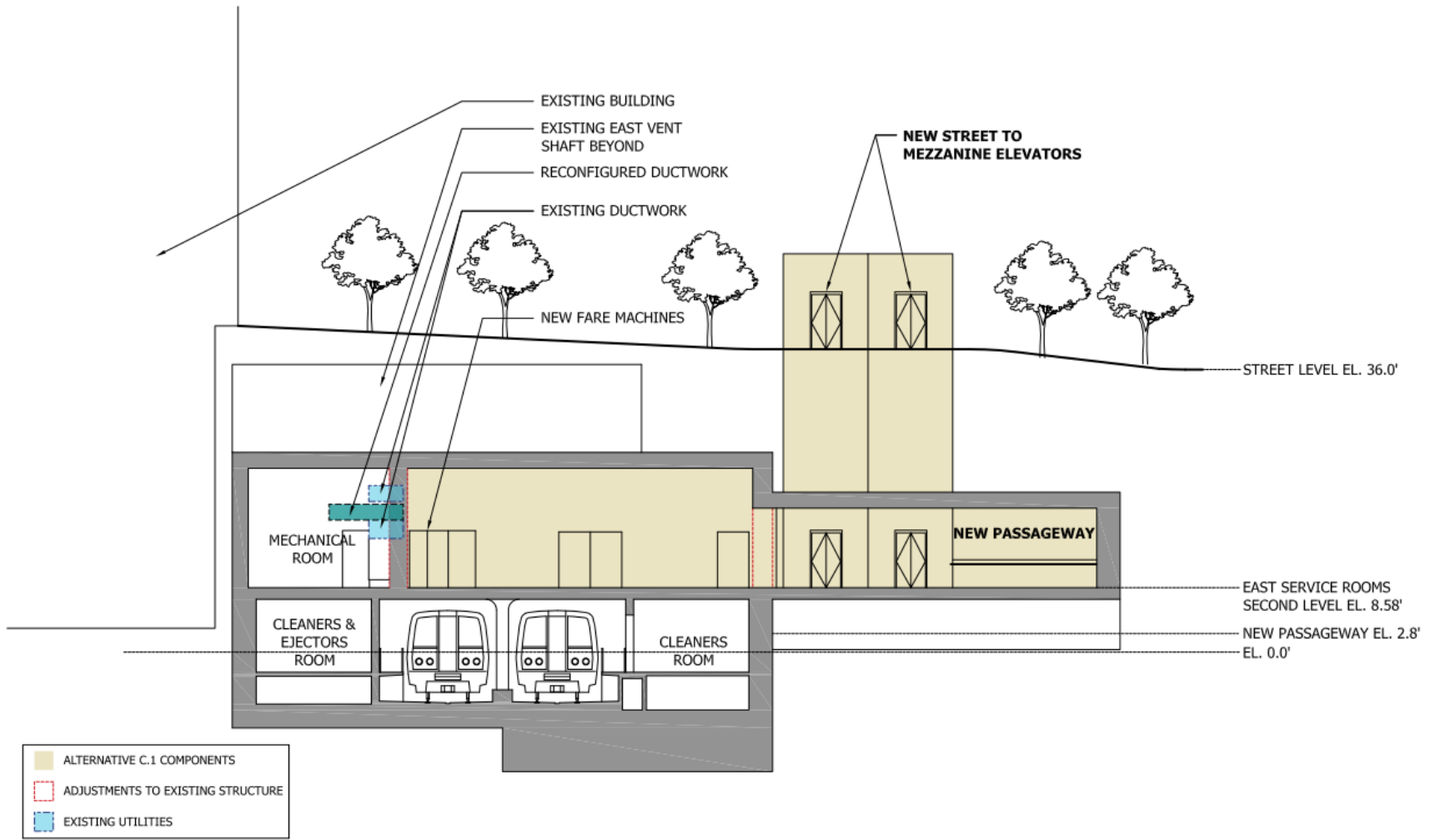


Figure 22: Alternative C.1 Section 1 of 2



SECOND ENTRANCE - ALTERNATIVE C.1 SECTION

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

7.1.2013

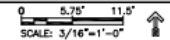
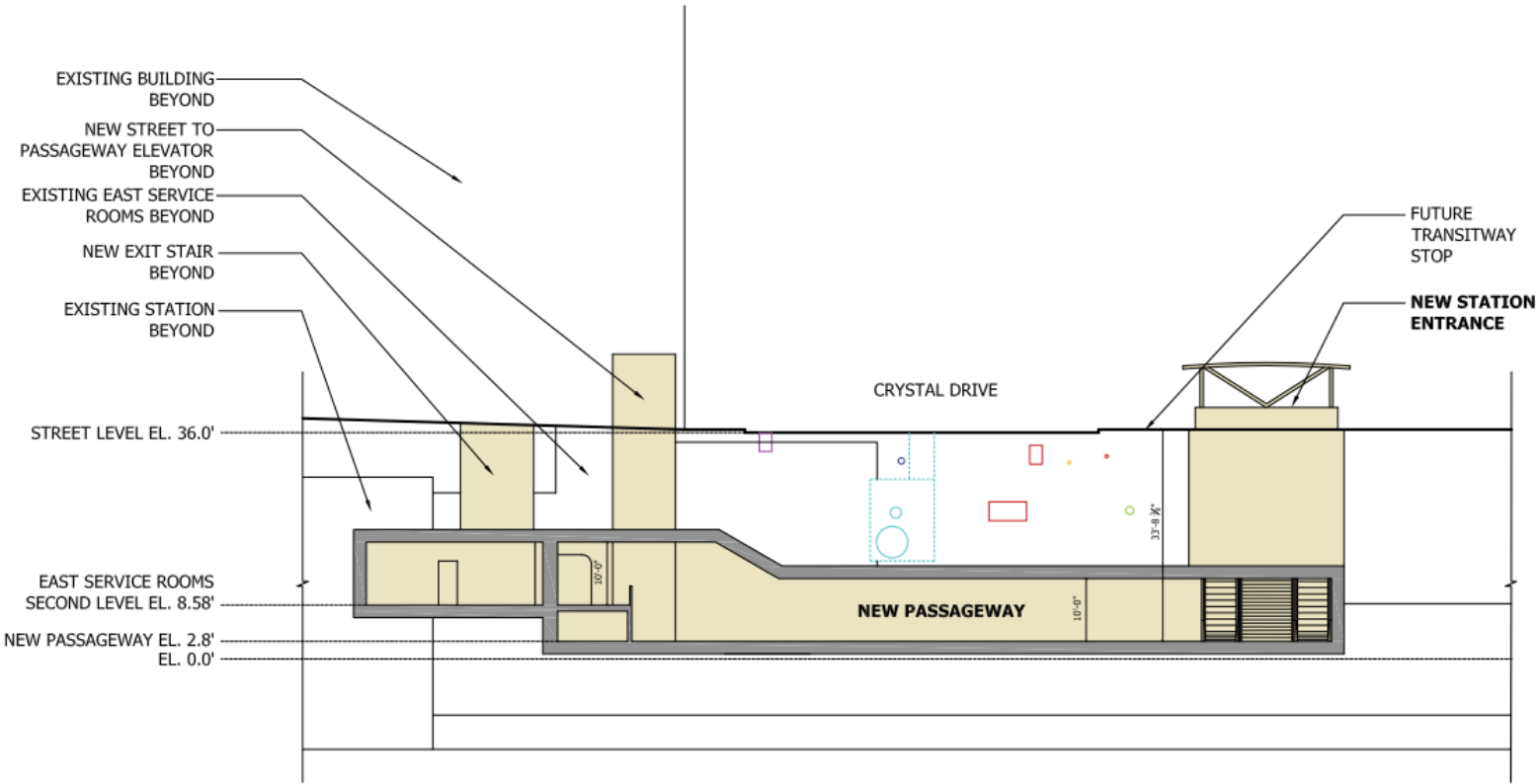


Figure 23: Alternative C.1 Section 2 of 2

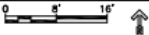


ELECTRIC	□	GAS	□
WATER	□	STORMWATER	□
SEWER	□	TELEPHONE	□

SECOND ENTRANCE - ALTERNATIVE C.1 SECTION

CRYSTAL CITY SECOND ENTRANCE AND STATION ACCESS STUDY

7.1.2013



7.3 Demand for East- or West-side Entrance

The Tier II Evaluation included a demand analysis in order to estimate the number of riders that will enter and exit the Crystal City Metrorail Station during the AM and PM peak hours in 2030. Further, based on the proposed development in the study area and beyond, the study estimates how many of these AM and PM peak riders would use the existing (west) entrance and how many would use a potential new (east) entrance. The following summarizes the results of demand analysis. Additional details on the analysis can be found in **Appendix E**.

Methodology

There are five basic steps in the process of estimating the 2030 ridership and distribution between entrances. These are listed below:

1. Preparing the available existing (2012) data for use;
2. Determining suitable growth assumptions;
3. Determining land use type and square footage in the study area for the year 2030;
4. Applying growth assumptions to estimate 2030 ridership; and
5. Applying land use and square footage estimates to estimate ridership split between the two entrances.

Table 7: Crystal City Ridership Growth 2012 - 2030 and Ridership Split for 2030

Time Period	Entries				Exits			
	2012	2030 Total	2030 West (Existing)	2030 East (New)	2012	2030 Total	2030 West (Existing)	2030 East (New)
8:00 – 9:00 AM Peak Hour	2,047	3,480	2,261	1,219	1,955	2,210	930	1,280
4:00 – 5:00 PM Peak Hour	1,966	2,241	981	1,261	1,664	2,757	1,862	894

Findings

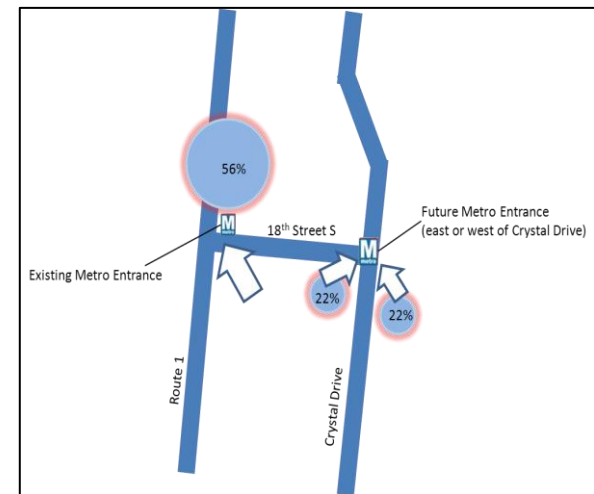
Table 7 shows the 2012 riders entering and exiting from the station during the AM and PM peak hours compared with the estimates for 2030, along with the split of riders between the two entrances for 2030.

As a point of reference, the total daily ridership at the Crystal City station was 13,592² in 2012.

Based on a general analysis of existing and proposed land uses, about 56% of the users are expected to use the existing entrance on the west, whereas 44% of the users are likely to use the new entrance on the east. Of the 44% who will use the new entrance,

there are equivalent percentages of riders who would access the station from east and west of Crystal Drive (see **Figure 24**). This indicates that based on ridership forecasts there is no preference for the location of the new station entrance on the east or the west of Crystal Drive.

Figure 24: Crystal City Ridership Station Entrance Demand



² Metrorail Average Weekday Passenger Boardings, updated June, 2012.

7.4 Pedestrian Simulation Results

The Tier II Evaluation included pedestrian simulations in order to simulate the movement of pedestrians within the proposed station alternatives' environment, taking into account how individuals interact with each other and with the physical obstacles in their environment. Using Legion software, the process combines CAD as-built drawings of the station and outputs from the 2030 Demand Analysis and is verified by passenger faregate data and field observation. To create an accurate representation of how a space will perform, Legion simulations combine accurately modeled space with appropriately defined levels of pedestrian demand and station/train operations. The primary focus of the analysis is on identifying "hot spots", areas where queuing or waiting congestion occurs.

The quantitative component of demand is presented in the form of Origin-Destination (OD) output matrices for both AM and PM peak periods (see **Appendix F**). The OD matrices describe:

- The amount of people that enter and exit the station during the period modeled;
- When and where they enter and exit – broken down into specific train arrivals or spread over 15-minute intervals as is

the case when people enter from the street; and

- The volume of pedestrians going to the respective destinations (train platform and direction or mezzanine faregate exits) via the various possible routes within the station.

The Crystal City Second Entrance models include the platform, mezzanine, and all vertical circulation elements between the two station levels; faregate lines are not included in the model. The models include trains for the purpose of simulating passenger boarding and alighting, but the passenger density has not been produced for passenger circulation or density inside train cars. The models exclude elevator operations due to their relative modeling complexity and very marginal effect on overall pedestrian circulation patterns at the station.

Measures of Effectiveness (MOEs)

Several metrics were established to estimate station effectiveness in accommodating ridership, and to provide a basis of comparison among existing conditions, future conditions, and potential station improvements. Pedestrian MOEs focus on three main areas: passenger density, journey time, and escalator operations.

Passenger Density

Passenger Density, measured in square feet per person, is an estimate of the accessible

Figure 25: Fruin's Walkways LOS Densities

	LOS A = > 35 sq. ft per pax
	LOS B = 25-35 sq. ft per pax
	LOS C = 15-25 sq. ft per pax
	LOS D = 10-15 sq. ft per pax
	LOS E = 5-10 sq. ft per pax
	LOS F = < 5 sq. ft per pax

space within a five-foot radius around each person and the number of people inside that area. Passenger Density is calculated dynamically for each person individually rather than for an entire space and therefore reflects the useful area within a venue, not just its overall size. Level of Service (LOS) densities are shown in **Figure 25**, according to Fruin's Walkways LOS definition. Note that LOS E and F are typically outside of the design maximum target of LOS D and can potentially result in unsafe conditions, particularly if they occur on platforms or at escalator and stair boarding areas.

Passenger density is represented through maps. A Cumulative Mean Density Map displays the mean levels of density registered in an area for a given time period. A Cumulative High Density Map shows how long various areas of a space have registered densities greater than a specified limit. The range of colors represents time. The map is similar to a "temperature" map: areas that have

experienced high levels of density for a long time appear red, those that have experienced shorter periods of density appear blue. This map is best used for identifying “hot-spots” within a site: areas where high levels of density are sustained.

For each model scenario, Cumulative Mean Density Maps and Cumulative High Density Maps are provided at key locations throughout the station during the peak hour and peak 15-minute period (see **Figure 26** through **Figure 31**). The maps focus on the platforms, mezzanines and circulation/transfer areas, and provide results that can be readily used to compare performance across scenarios. The key quantitative MOE relating to Passenger Density is the percentage of passengers experiencing LOS E and F during the peak hour and peak 15-minute period.

Journey Time

Journey Time (JT) is the time taken by a person to complete his or her course through a model. JT is measured two ways; upon alighting a train and ending at the street level, and upon entering at street level and arriving at the destination platform, thus excluding platform waiting. By excluding platform waiting, the times truly represent the circulation routes within the station, rather than being skewed by train headway variability or platform congestion.

Escalator Operations

A zone is established adjacent to each escalator where “boarding” takes place. This zone measures the occupancy time for passengers traveling via each escalator. Times are presented in terms of how long a person in the queue takes to clear for each escalator exhibiting queuing during the station’s AM and PM peak hour. MOEs for escalators are: 1) Time in Queue for each passenger - average, maximum and 95th percentile; and 2) Cumulative Time a queue exists at an escalator boarding area.

Findings

The differences in the pedestrian simulation MOEs between the three second entrance alternatives are fairly insignificant. All three alternatives provide significant improvement over the 2030 No Build with similar benefits. Detailed Pedestrian Simulation MOE findings can be seen in **Appendix F**.

Alternative A.1 provides the best performance of the three alternatives in terms of pedestrian density, particularly in the New Mezzanine area, as pedestrians are more distributed through the passageway and entrance pavilion before queuing occurs at the faregates. In Alternative A.1, faregates are located on the surface level, which allows for the furthest distance from the platform area for pedestrian queuing to occur. See **Table 8** for the combined

average percentages of LOS E and F of all scenarios.

Alternatives A.1 and C.1 have longer average journey times than Alternative A due to the longer passageways upon entering/exiting at the street level. Alternative A provides the most direct route between the platform and street level.

All three alternatives provide the same level of benefits in terms of internal escalator operations.

Table 8: Combined Average Percent LOS E & F

Scenario	Combined Average % LOS E & LOS F
2012 Existing	7%
2030 No Build	18%
2030 Alternative A	6%
2030 Alternative A.1	5%
2030 Alternative C.1	6%

Figure 26: Cumulative Mean Density Map – 2012 AM Existing: Peak 15 Minutes (8:15 AM – 8:30 AM)

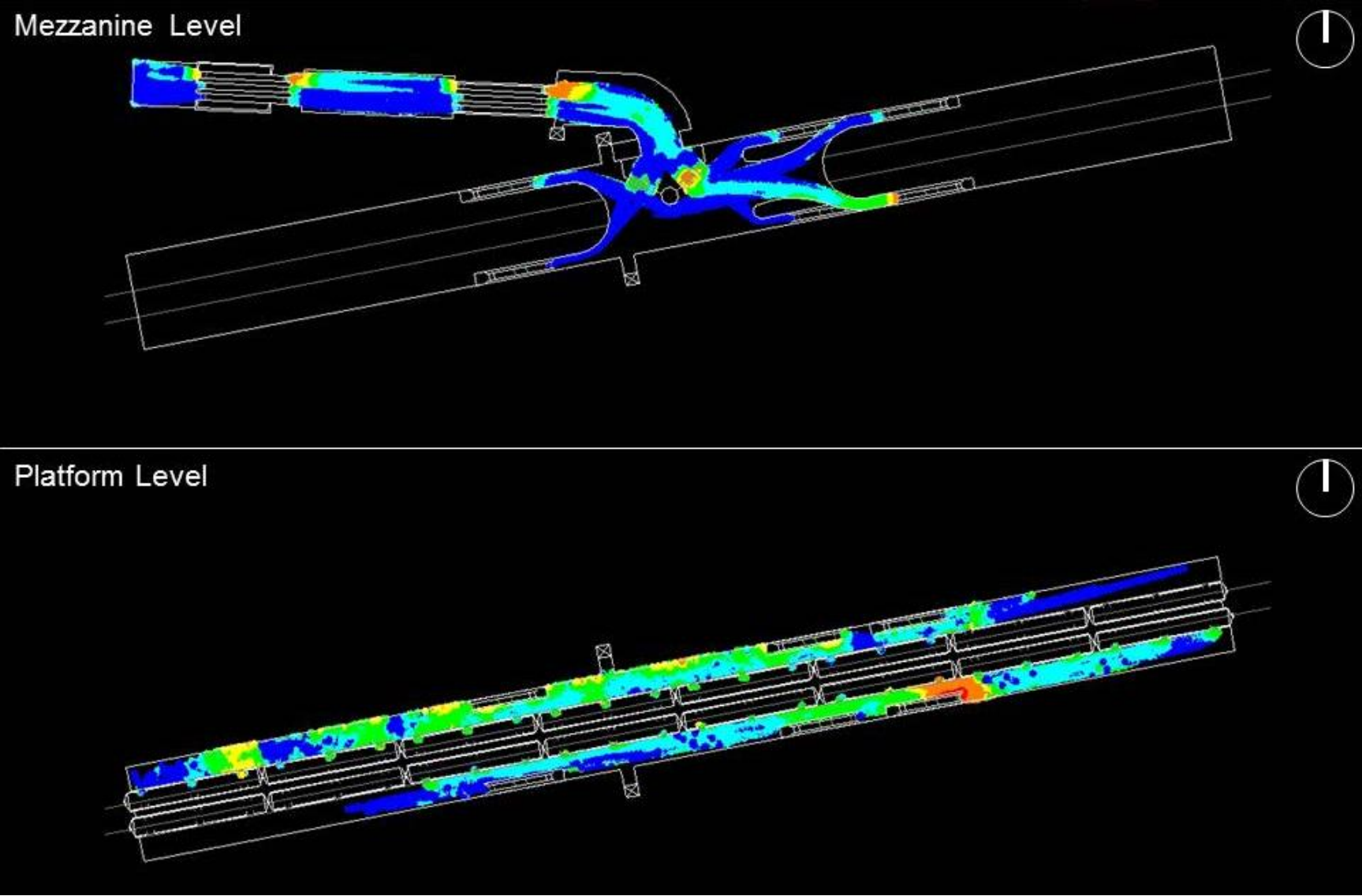


Figure 27: Cumulative Mean Density Map Comparison – Mezzanine Level – AM Peak 15 Minutes (8:15 AM – 8:30 AM)

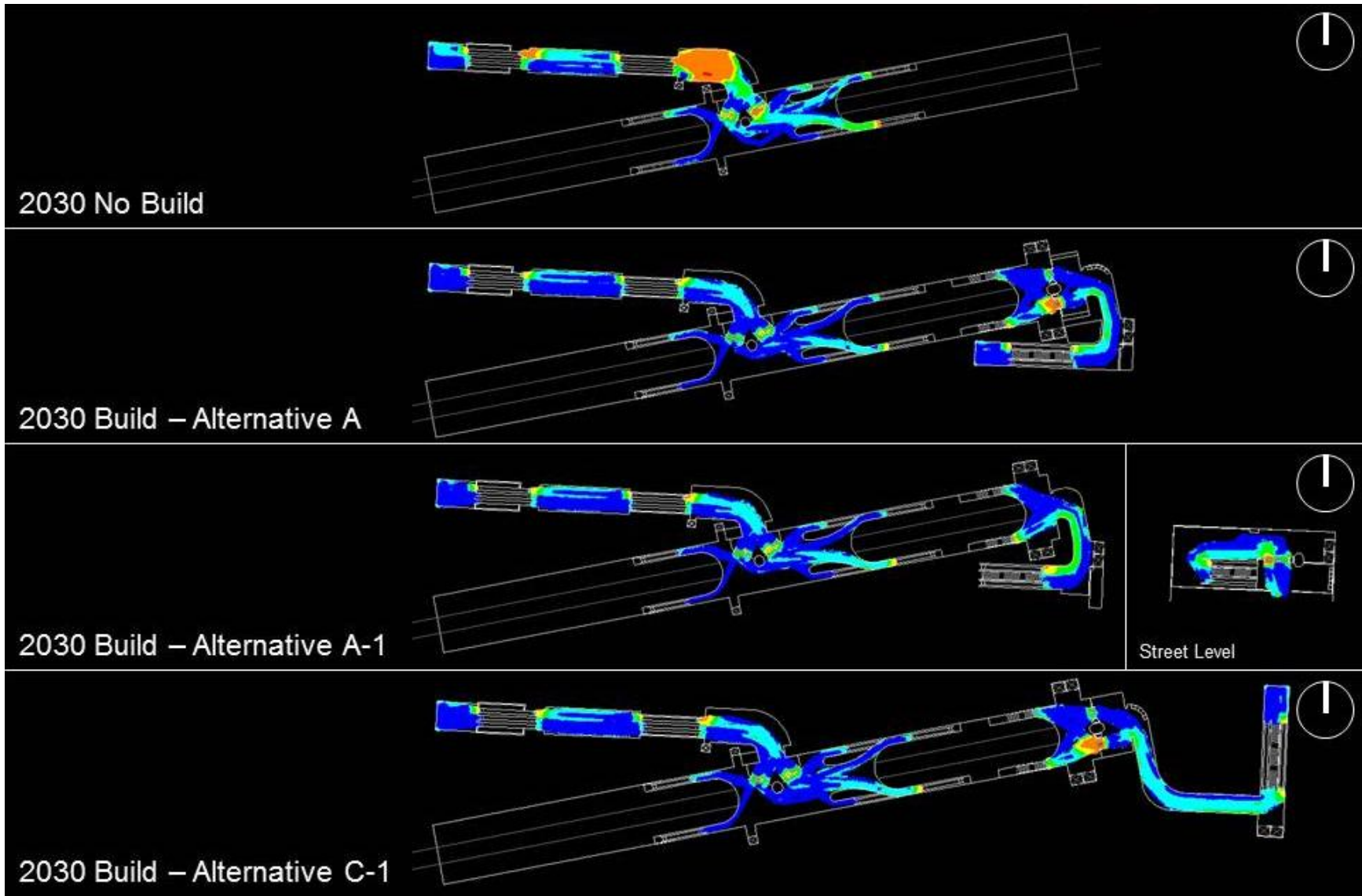
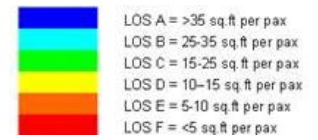
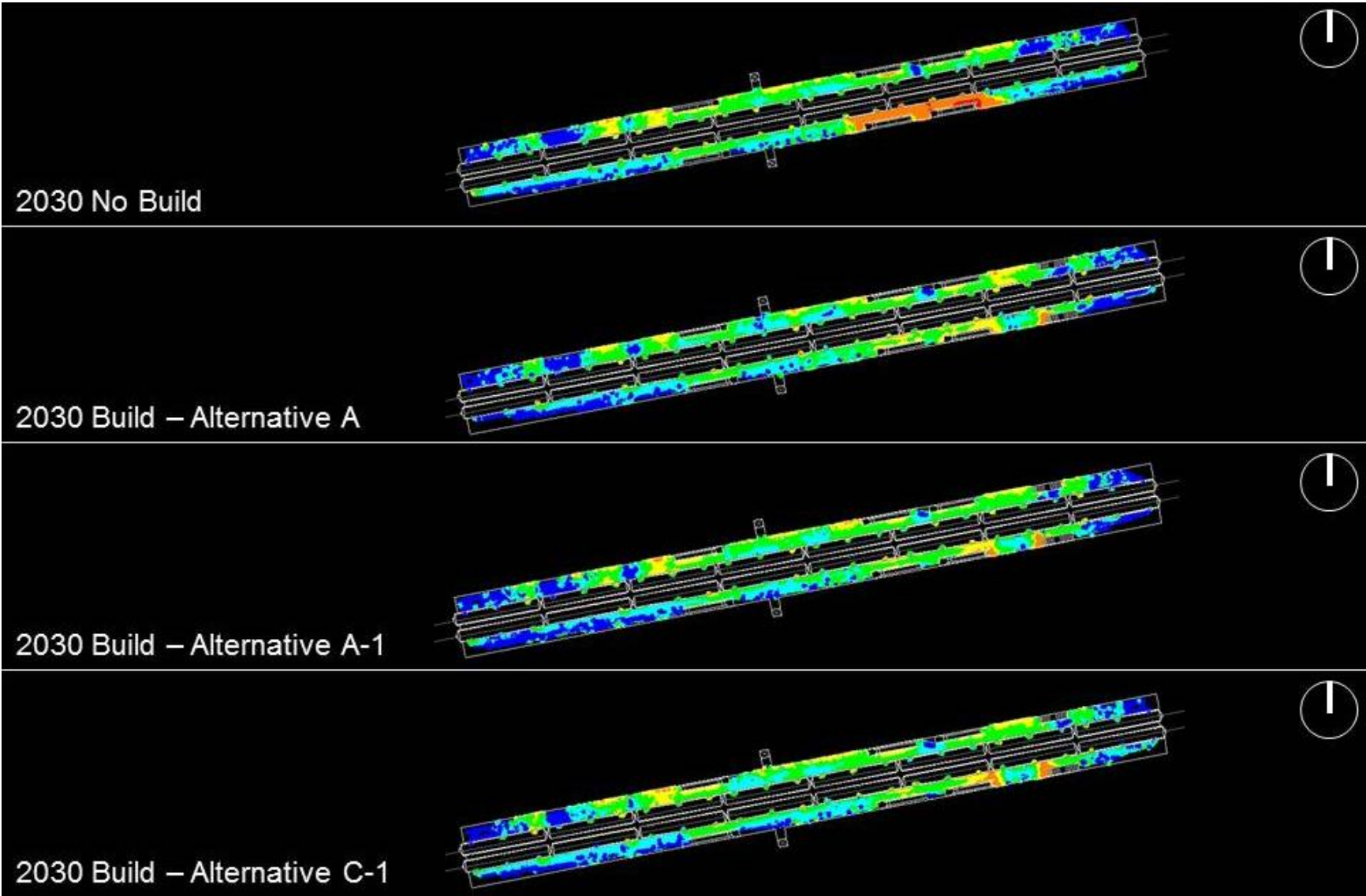




Figure 28: Cumulative Mean Density Map Comparison – Platform Level – AM Peak 15 Minutes (8:15 AM – 8:30 AM)



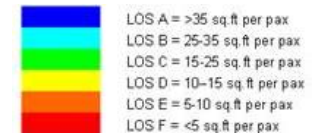


Figure 29: Cumulative Mean Density Map – 2012 PM Existing: Peak 15 Minutes (5:15 PM – 5:30 PM)

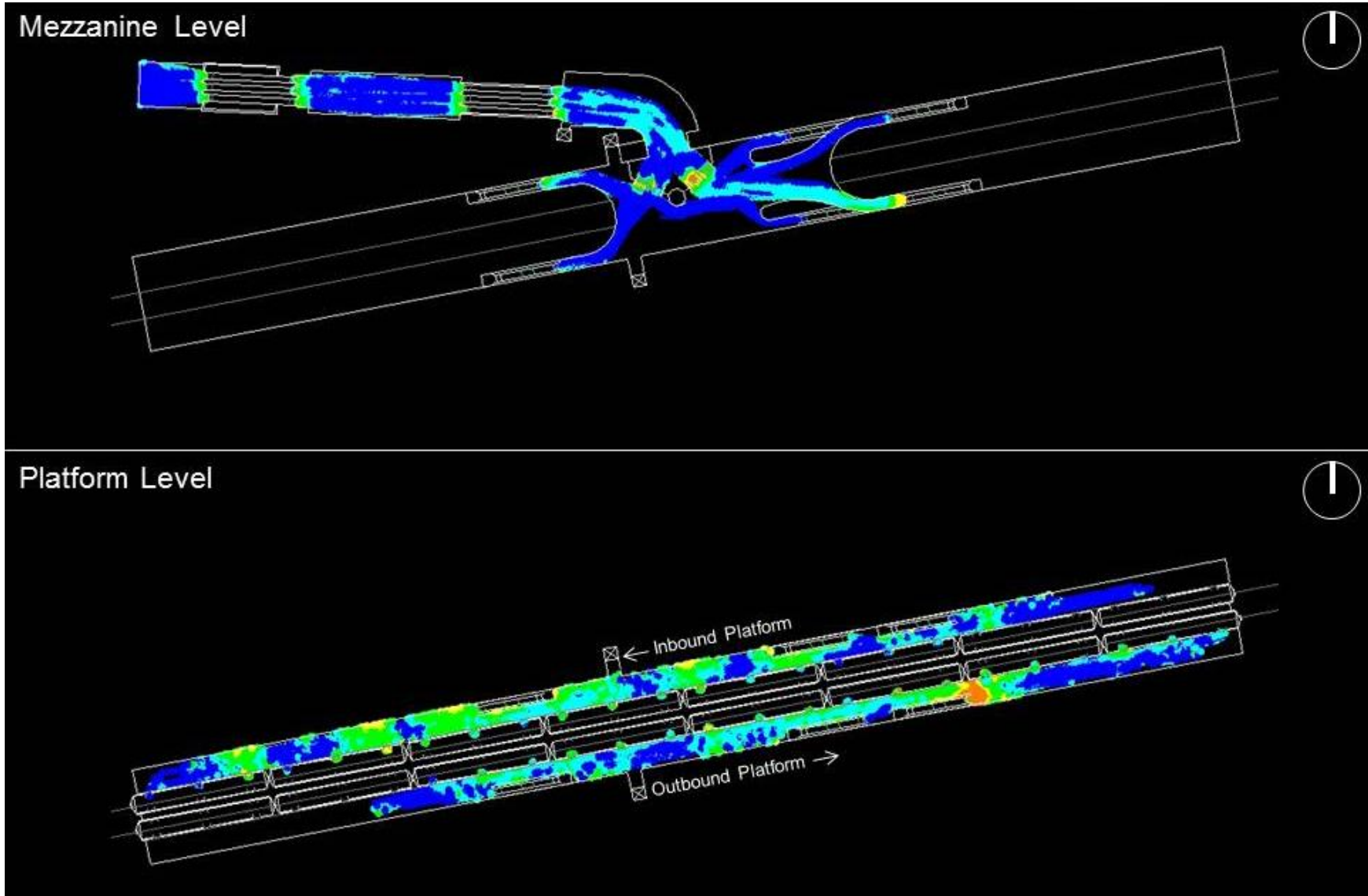




Figure 30: Cumulative Mean Density Map Comparison – Mezzanine Level – PM Peak 15 Minutes (5:15 PM – 5:30 PM)

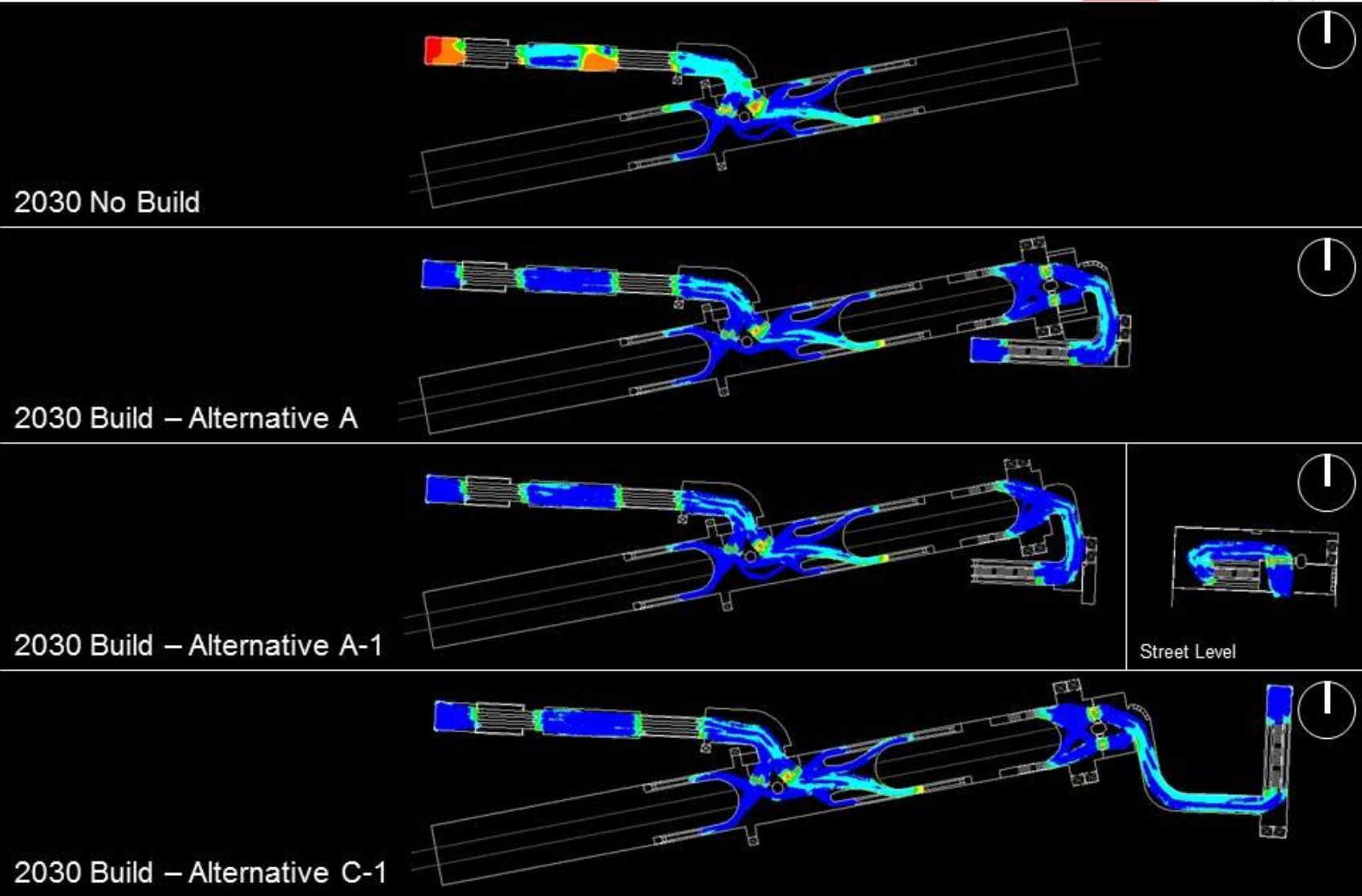
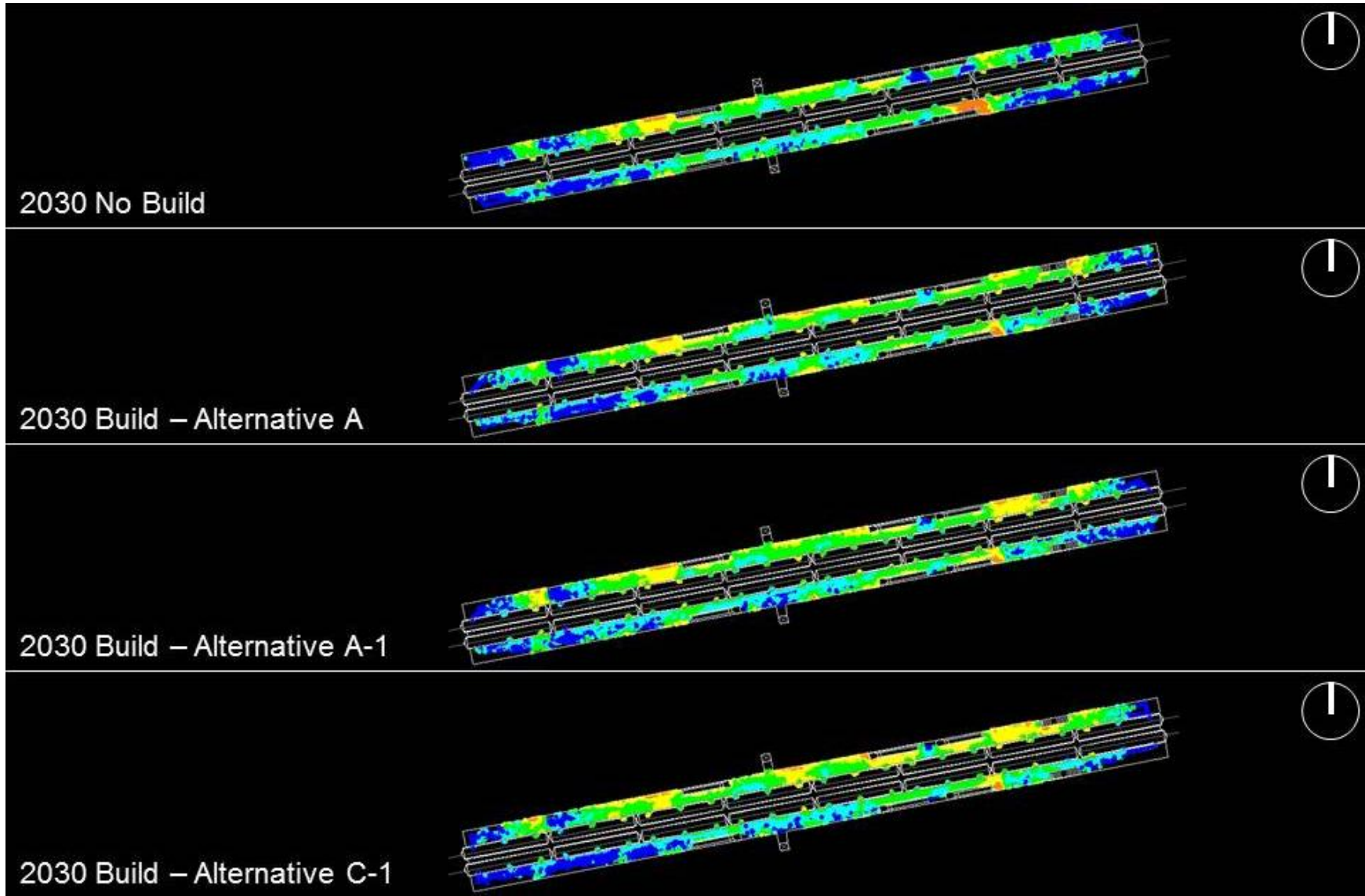
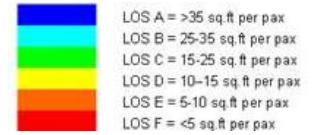


Figure 31: Cumulative Mean Density Map Comparison – Platform Level – PM Peak 15 Minutes (5:15 PM – 5:30 PM)



7.5 Capital Cost Estimates

The study team has developed order of magnitude cost estimates for the three Tier II refined alternatives (A, A.1 and C.1). Capital cost estimates can be seen in **Table 9**.

This estimate includes all direct construction costs, construction mark-ups, 30% contingency, cost escalation, and 50% soft costs (including Design and Engineering, Design Management, and Construction Support). Cost escalation assumes start date of June 2020. Alternatives A and A.1 assume a construction period of 24 months, while Alternative C.1 assumes 36 months.

Alternatives A and A.1’s costs are estimated at approximately \$66M (\$65.7M and \$66.3M respectively), whereas Alternative C.1 costs approximately \$87.2M. The main drivers in cost difference between the “A” Alternatives and C.1 are the costs associated with tunneling underneath Crystal Drive and the related construction challenges, as well as the extended construction period.

Additional details of the capital cost estimates, including definitions and clarifications of cost sub-categories, can be found in **Appendix G**.

Table 9: Order of Magnitude Capital Cost Estimates (shown in \$M)

Cost Sub-Category	Alternative A	Alternative A.1	Alternative C.1
Direct Construction	\$22.3	\$22.5	\$29.1
Construction Mark-ups	\$4.5	\$4.5	\$5.9
Contingencies/Escalation	\$17.0	\$17.2	\$23.1
Soft Costs	\$21.9	\$22.1	\$29.1
Total	\$65.7	\$66.3	\$87.2

8.0 Summary of Findings and Next Steps

Table 10 and the narrative below summarize the overall study process and performance for the second entrance alternatives. Each second entrance alternative performance rating was based on the Tier I and Tier II evaluation process as well as the feedback received at stakeholder and public meetings.

Initial Screening: Through the initial screening process, Preliminary Alternatives A and C were advanced for further consideration and development, whereas Alternatives B, D and E received lower ratings and were not analyzed further.

Tier I Evaluation: During this design phase, the project moved from conceptual alternatives to feasible solutions. As a result of this refinement process, new Alternatives A.1, A.2, and C.1 were developed. The Tier I evaluation focused on the differences between the five refined alternatives: A, A.1, A.2, C, and C.1.

- **Access for All** – Alternatives C and C.1 provide improved access to users on the east side of Crystal Drive (VRE riders and residents east of Crystal Drive), whereas Alternatives A and A.1, although provide improved access, still require users to cross Crystal Drive, which may be a deterrent to some

users. Alternative A.2 includes a long tunnel which may be problematic for users with impaired mobility.

- **Capacity for Future Growth** – Although all alternatives provide future growth capacity, Alternative A.1 provides the added benefit of increased passenger capacity inside the station. Alternative A.2 creates bottleneck and congestion point in the existing mezzanine.
- **Constructability** – All alternatives will require cutting through the end wall of the station tunnel with the exception of Alternative A.2 which requires cutting through the station tunnel vault. Alternatives A and A.1 will also require relocation of station vents and mechanical rooms. Alternatives C and C.1 will impact utilities under Crystal Drive and cause traffic disruptions for Crystal Drive during construction.
- **Contribution to Public Realm** – All alternatives can be designed to complement the future park, as planned for in the Crystal City Sector Plan. The pavilion in Alternative A.1 may constrain the design of the future park space, whereas Alternative C.1 may limit the usable sidewalk space at that location. Alternative C would affect the look and feel of the existing Water Park.

Tier II Evaluation: Following the Tier I Evaluation results, alternatives A, A.1 and C.1 were recommended for further design development and evaluation. The Tier II evaluation includes an engineering feasibility scan, an east- and west-side entrance demand analysis, pedestrian simulation analysis, and detailed cost estimates.

- **Engineering and Utilities Scan** – Due to the number of known and unknown utility lines underneath Crystal Drive, the “A” alternatives are more ideal for constructability compared to Alternative C.1. Alternative designs were further refined to minimize utility and existing station facility impacts.
- **East- and West-side Demand Analysis** – Based on the demand analysis of future ridership forecasts, there is no preference for the location of the new station entrance on the east or the west of Crystal Drive.
- **Pedestrian Simulations** – The MOEs for pedestrian simulation perform similarly between the three alternatives. Alternative A.1 performs slightly better in terms of pedestrian density, particularly in the New Mezzanine area, as pedestrians are more distributed through the passageway and entrance pavilion.

- **Capital Cost Estimates** – Alternatives A and A.1’s costs are estimated at approximately \$66M (\$65.7M and \$66.3M respectively), whereas Alternative C.1 costs approximately \$87.2M. The main drivers in cost difference between the “A” Alternatives and C.1 are the costs associated with tunneling underneath Crystal Drive and the related construction challenges, as well as the extended construction period.

Recommendation and Next Steps

Based on the performance ratings for each evaluation criteria, this study concludes that all three alternatives perform similarly and are the appropriate and feasible design alternatives for a second entrance to the Crystal City Metrorail Station. The two “A” Alternatives provide different design choices of the entrance at the surface level, either a typical Metrorail entrance canopy or a larger entrance pavilion. It would be beneficial as a next step to gather public and stakeholder opinions for an entrance pavilion and other impacts or benefits to the park design at this location. Alternative C.1 provides the best multimodal connections with its proximity to the northbound transitway stop and allowing for the most direct connection for VRE passengers transferring to the Metrorail system. Additional engineering and design

work may be needed in order to determine the cost effectiveness of this alternative.

After a period of public comment and a decision from WMATA and County officials, the recommended alternative will be carried into the next phase of work, including required environmental analysis and detailed engineering design. Project funding sources will be more explicitly defined and programmed. Throughout the process, there will be ongoing coordination with key stakeholders, including owners of adjacent property, utility companies, and County officials.

Table 10: Second Entrance Alternatives Evaluation Summary Matrix

Alternative	Initial Location Screening	Tier I Evaluation				Tier II Evaluation			
		Access for All	Capacity for Future Growth	Construct-ability	Contribution to Public Realm	Engineering and Utilities Scan	E-W Demand Analysis	Pedestrian Simulations	Capital Cost Estimates
A									
A.1									
A.2									
B									
C									
C.1									
D									
E									

Performance: →

Fair Good

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