Appendix A

20% Preliminary Engineering Plans and Design Reports

A-3

20% Preliminary Engineering Design Report

Preliminary Engineering Design Report

Dallas CBD Second Light Rail Alignment (D2)

PRELIMINARY 20% DRAFT (IN-PROGRESS)

NOT FOR CONSTRUCTION

NOT AN APPROVED DOCUMENT

Dallas, Texas
March 6, 2020

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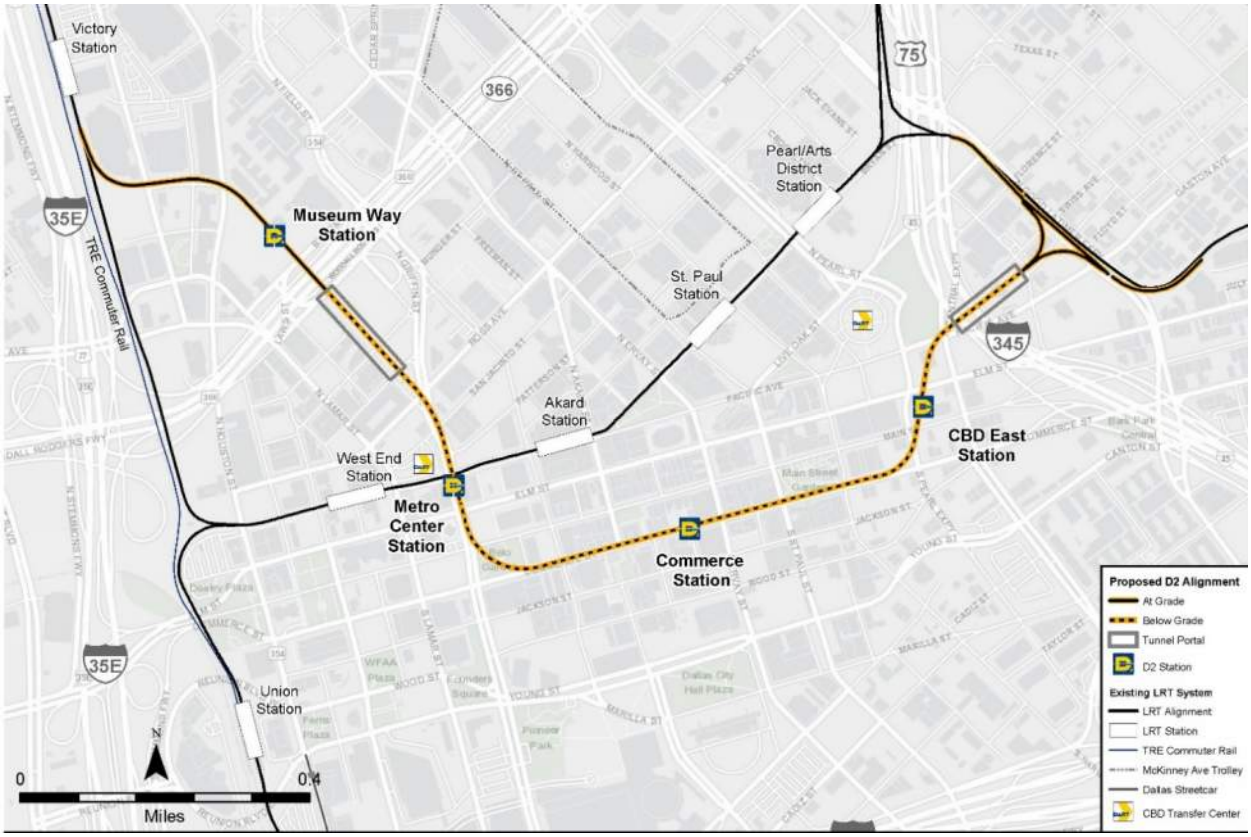
1 INTRODUCTION

Dallas Area Rapid Transit (DART) is advancing the design of the Dallas Central Business District (CBD) Second Light Rail Alignment (D2). D2 will establish an additional light rail transit (LRT) line through downtown Dallas to increase core capacity and operational flexibility of the DART system.

1.1 Overview of the D2 Project

The D2 alignment begins south of Victory Station. It then proceeds within DART ROW in the center of Museum Way. The alignment crosses under Woodall Rodgers then begins it transition to below grade. It remains underground under Griffin Street and Commerce Street then transitions back to at-grade after the intersection of Pacific Avenue and Cesar Chavez Boulevard. It remains at-grade roughly parallel and south of Swiss Avenue. It then ties to the existing Green Line in the median of Good-Latimer. See Figure 1-1 for a map of the D2 alignment.

FIGURE 1-1. D2 Subway Alignment



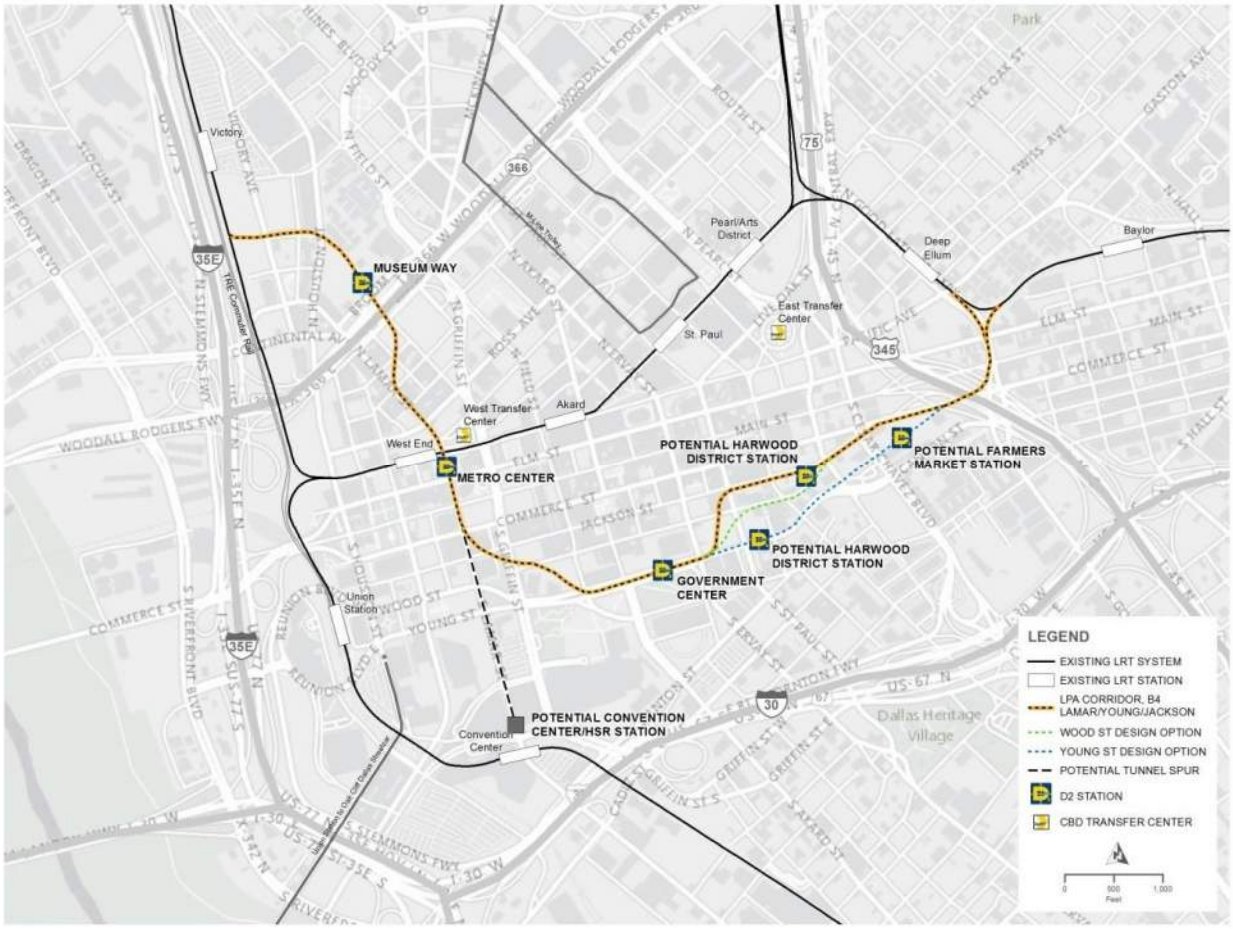
1.1.1 Project History

In May 2007, DART launched a study for the Dallas CBD Second Light Rail Alignment (D2 Subway). Between 2007 and 2010 a large variety of alignment options were investigated by the DART team to find the best second alignment through downtown. This three year effort resulted in the Alternative Analysis/Draft Environmental Impact Statement (AA/DEIS) in May 2010. The AA/DEIS presented four alignment options. At this point the project slowed down due to the recession in the country and the outlook that funding would not be available for the project. By the beginning of 2013 the next phase began to select a Locally Preferred Alternative (LPA). This phase incorporated public comments from the AA/DEIS as well as other local changes. Between 2010 and 2013 the City of Dallas began to move forward with a streetcar system with plans for future extensions into downtown. The Downtown Dallas 360 Plan was published and discussions about a high speed rail station in or near downtown were occurring. With this new information the DART team evaluated the four alignments and any possible refinements. The process resulted in a LPA being selected in late 2015.

In September 2015, the Dallas City Council and the DART Board selected and approved LPA B4 Lamar-Young/Jackson with two design alternatives based on the work that was done between 2007 and 2015. Upon selection of the LPA B4, the project moved into Project Development where the Environmental Impact Statement and Preliminary Engineering plans are prepared.

The Sept 2015 D2 LPA B4 begins south of Victory Station. It then proceeds within DART ROW in the center of Museum Way and through the parking lot adjacent to the Perot Museum. The alignment crosses under Woodall Rodgers then begins it transition to below grade. It remains underground under Lamar Street then transition back to at-grade before the intersection of Young Street and Field Street. It remains at-grade along Young Street to Ervay Street. From this point the alignment follows one of three alternatives; generally following Jackson, Wood or Young Streets before running down Good Latimer Expressway and joining the existing LRT alignment. See Figure 1-2 for a map of the Sept 2015 LPA B4.

FIGURE 1-2. Sept 2015 Locally Preferred Alternative B4



Source: DART

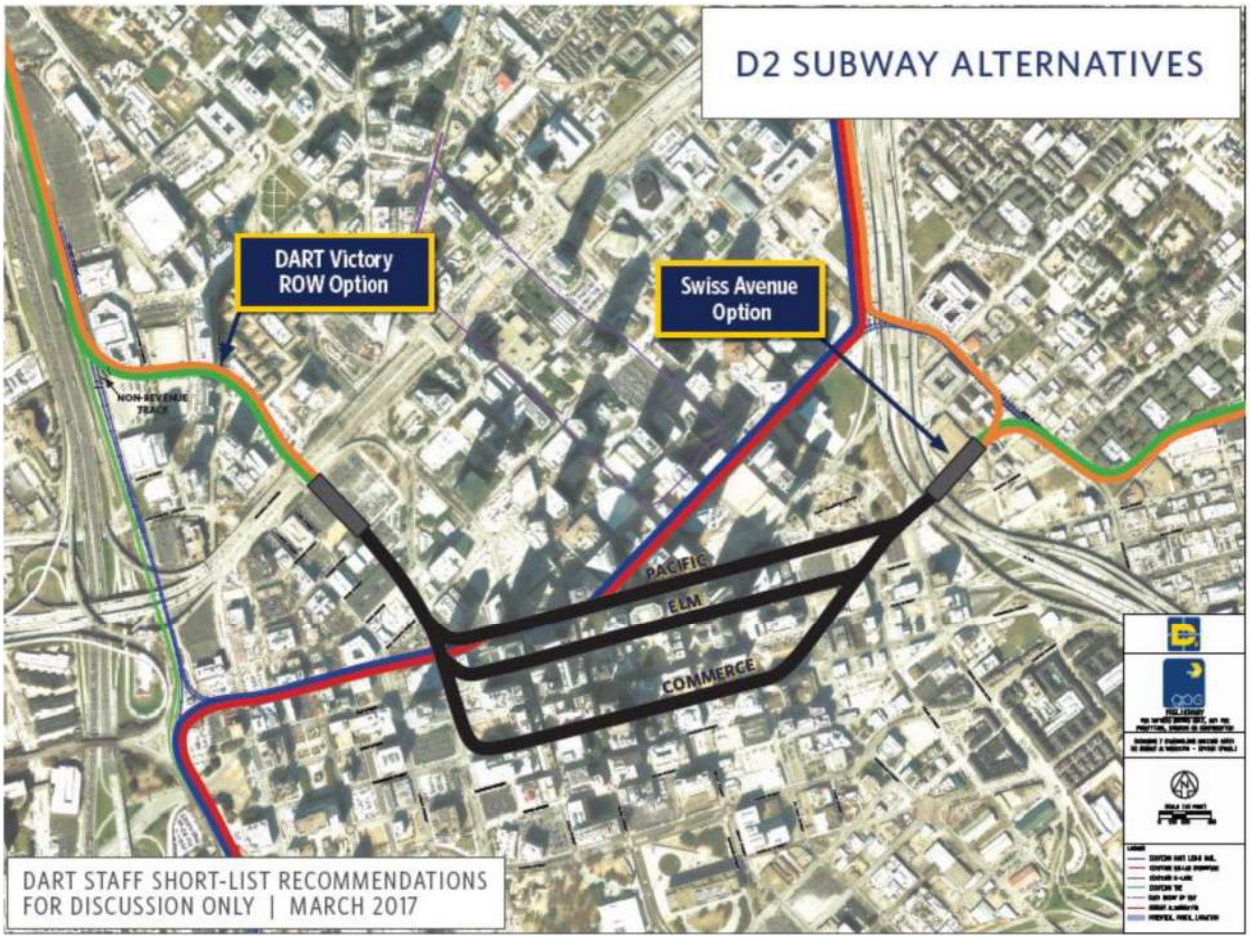
During Project Development additional research of the corridor was conducted and it was determined that shifting the alignment from Lamar Street to Griffin Street would result in less impacts. The Lamar Street corridor has a narrower ROW as well as many Oncor transformer vaults that would need to be relocated. There are utility services that were directly below the underground pedestrian crossing connecting to the Bank of America tower that would be in conflict with the tunnel. Geological conditions also improved marginally with the move from Lamar to Griffin. The Austin Chalk layer tends to thicken as you move east through downtown away from the river. Additionally, the shift would remove the impact to a future museum that was planned at the time at McKinney Avenue and Old Griffin Street. Due to a change in property owners, the future museum is no longer planned. Coordination with the current property owners and developers has been established and is ongoing.

Beyond providing capacity and operational flexibility improvements, the D2 alignment would provide the Victory area with another light rail station. This additional station would provide light rail service to the museums and residents in the area. Additionally, it would provide another transportation option for events at American Airlines Center.

Between September 2015 and October 2016, the DART team advanced project development for the LPA B4 and two design alternatives. During this time period there was significant stakeholder and community input about the LPA. It was acknowledged that parts of downtown and the surrounding areas have changed or are changing significantly since the completion of the AA/DEIS in 2010.

In October 2016, direction from the Dallas City Council and DART Board was to pursue the D2 alignment as a tunnel from Woodall Rodgers to IH 345. This direction lead to the LPA Refinement phase to develop D2 as a primarily-subway light rail line through Downtown Dallas. This phase took place from December 2016 to June 2017 and resulted in the approval of the D2 Subway LPA. During this phase, the DART team worked with stakeholders and the community to define the best location for the underground alignment and connection points to the existing light rail system. Many stakeholder meetings and workshops were held to identify issues and opportunities for the corridor. The LPA Refinement phase resulted in three alignment alternatives to be advanced. The alternatives shared the same alignment in the Victory area, proceeded south along Griffin Street then turned east along Pacific, Elm or Commerce with a connection at Swiss Avenue and Good Latimer Expressway. See Figure 1-3 for a map of the three alternatives from the LPA Refinement phase.

FIGURE 1-3. LPA Refinement Alignments



Source: DART

In September 2017, the Dallas City Council and the DART Board selected the Victory/Commerce/Swiss alignment as the D2 Subway LPA. See Figure 1-1 for a map of the D2 Subway LPA. The Project Development phase recommenced in May 2018. The DART team is advancing the Preliminary Engineering and Environmental Impact Statement with completion by August 2020.

The D2 Subway will add capacity and operational flexibility to the DART light rail system. It will allow two of the light rail lines to move to the new alignment and two light rail lines to remain operating on the existing alignment, allowing more trains to move through downtown and increasing capacity in the entire system. The D2 Subway alignment will provide new stations in downtown giving riders more access opportunities in downtown.

1.2 Purpose and Organization of Design Report

This design report for D2 documents the Preliminary Engineering (PE) design and clarifies any issues which may not be evident in the attached preliminary engineering drawings. The report is divided into the following sections:

- Horizontal and Vertical Alignment,
- Right-of-Way,
- Utilities,
- Tunnel and Structural Design,
- Drainage,
- Station Design,
- Street Impacts and Modifications,
- Environmental Considerations,
- Geotechnical Considerations and
- Systems.

The PE design is a 30% design effort with the tunnel engineering done to a 10% level. This Design Report accompanies the March 2020 20% PE Design documents.

2 HORIZONTAL AND VERTICAL CONTROL

2.1 Base Mapping

Bearings for this survey are based on LTRA control provided in May 2018 with updates from NDM in Summer/Fall 2018. New Traverse points were set by NDM in 2019. See the DART D2 Survey Report for additional information. Aerial photography is from TNRIS, Texas Google Imagery and is referenced in the TX83-NCF (NAD83 Texas State Planes, North Central Zone, US Foot) coordinate system.

2.2 Overview

The proposed LRT guideway alignments conform to the DART Light Rail Design Manual Volume 1, January 2003 Revision 10, except as noted in the following sections.

The major design constraints for the alignments are as follows:

- Connect to existing LRT at each end of the project;
- Remain in DART ROW from Victory Station to Museum Way Station along Museum Way;
- Configure Live Oak Station along the Good Latimer Expressway median, including minimizing impacts to the historic church property. See Street Impacts and Modifications, Section 8.1.33 Good Latimer Expressway for more information.;
- Provide adequate space for LRT consist to stop between at-grade crossings that doesn't block crossing pedestrian and vehicle traffic;

- Navigate guideway through CBD while maintaining LRT Design Criteria;
- Navigate guideway through columns of IH 345, and
- Minimize impacts to right of way, existing street configurations, traffic operations, drainage, and utilities.

This design is preliminary and additional coordination will be required through final design. Such as:

- Coordination with TxDOT in the areas of Woodall Rodgers Freeway and IH-345 for temporary and permanent impacts.
- Coordination with the City of Dallas for potential limitations on the use of Commerce Street and Main Street during construction

2.3 Horizontal Alignment

The LRT guideway is designed as a double track alignment with 15'-6" track centers in at-grade locations. Track center spacing varies in tunnel and at subway stations from 36'-2" to 45'-0". The alignment consist of at-grade, retained cut, cut-and-cover and tunnel boring machine (TBM) or sequential excavation method (SEM) sections. The centerline of the CBD-2 eastbound (EB) and SE-1 southbound (SB) tracks are used for alignment control.

Currently the horizontal alignment from Victory Station through Victory Avenue exceeds the existing DART right-of-way and will be revised for the next preliminary engineering design submittal.

TABLE 2-1. HORIZONTAL DESIGN EXCEPTIONS

Description	Alignment(s)	DART DCM	Criteria	Design Value

TABLE 2-2. HORIZONTAL DESIGN ELEMENTS REQUIRING DART APPROVAL

Description	Alignment(s)	DART DCM	Criteria	Design Value
Curve WYE-A Tangent Lengths	WYE	1.7.2.a	Desirable Min T = 200' Absolute Min T = 15'	75' EB 72' WB
Curve CBD2-B Eu	CBD-2	1.7.2.b	Desirable Max Eu = 1.5" Absolute Max Eu = 3.0"	1.78" EB 1.73" WB
Curve CBD2-H Eu	CBD-2	1.7.2.b	Desirable Max Eu = 1.5" Absolute Max Eu = 3.0"	1.65" EB
Curve SE1-C	SE-1	1.7.2.b	Desirable Max Eu = 1.5" Absolute Max Eu = 3.0"	2.63" SB 2.82" NB
Curve CBD2-A Ls	CBD-2	1.7.2.c	Desirable Min Ls = 60' Absolute Min Ls = 30'	45' EB 50' WB

Curve SE1-A Ls	SE-1	1.7.2.c	Desirable Min Ls = 60' Absolute Min Ls = 30'	45' SB 45' NB
Curve WYE-A Ls	WYE	1.7.2.c	Desirable Min Ls = 60' Absolute Min Ls = 30'	30' EB 30' WB

2.4 Vertical Alignment

The profile grade line (PGL) in tangent track are along the centerline of track between the two running rails and in the plane defined by the top of the two rails. In curved track, the inside rail (low rail) of the curve will remain at the PGL and superelevation is achieved by raising the outer rail above the inner rail (low rail).

Progressing from west to east, the vertical alignment begins at-grade on ballasted track, then changes to at-grade embedded track at the Victory Avenue crossing and continuing within the Museum Way median. It remains at-grade through the Museum Way Station, then begins to cut below existing grade under Woodall Rodgers Freeway. The alignment descends into a retained cut portal section on direct fixation (DF) track south of McKinney Avenue. The retained cut portal leads to a cut-and–cover section south of Corbin Street and continuing through Metro Center Station below Griffin Street. TBM or SEM tunneling begins at the south end of Metro Center Station and continues under Griffin Street and Commerce Street to Harwood Street (just south and west of the CBD East Station). Just south of CBD East Station, the cut-and-cover section begins and proceeds to the intersection of Pacific Avenue and Cesar Chavez Boulevard. The alignment continues to ascend through a retained cut portal section. The alignment crosses Hawkins Street at-grade on embedded track, then connects to the exiting Green Line with embedded track continuing through the proposed project limits.

For the D2 double-track alignment, the PGL of the CBD-2 westbound (WB) and SE-1 northbound (NB) alignments are equivalent to the CBD-2 eastbound (EB) and SE-1 southbound (SB) vertical alignments, respectively. Final Designer will verify and develop a standalone CBD-2 WB and SE-1 NB profile as needed during the final design phase.

On the west end of the project, the vertical alignment will need to be revised to remove the vertical curve from the within the limits of the turnout, approximately 20' from last long tie and remove the vertical curve from within the limits of the diamond. Similarly the vertical alignment will need to be adjusted to remove the vertical curve from the diamond on the east end of the project. This will be addressed for the next preliminary design submittal.

A key design and operations aspect of the proposed alignment is the crossing of Broom Street and McKinney Avenue, while crossing underneath the elevated Woodall Rodgers Freeway, traveling south from the proposed Museum Way Station to the Metro Center Station. The track was pushed down under Woodall Rodgers to aid in pushing Metro Center Station deeper and improving the grade from at-grade to tunnel. This adjustment also provided the guideway enough vertical clearance to avoid impacts to the Woodall Rodgers

Freeway entrance ramp. The westbound on-ramp to Woodall Rodgers Freeway at the crossing of the Build Alternative is currently at low clearance less than desirable for the needed overhead catenary contact wire providing electrical power to the LRT vehicles. The preliminary engineering design has resulted in a minor lowering of the current profile crossing of Broom Street and McKinney Avenue providing the needed minimum 15' 0" clearance under the westbound on-ramp, as well as 15'-0" catenary clearance over Broom Street. The City of Dallas has reviewed and approved this low clearance of Broom Street, with the installation of appropriate low clearance warning signage and devices for vehicular and pedestrian traffic. Coordination with Texas Department of Transportation (TxDOT) will continue throughout final design with the execution of right-of-way crossing agreement for Woodall Rodgers Freeway documenting the final design feature of the low clearance and catenary wire connections underneath the freeway.

The profile in the Commerce Street Station area was pushed as deep as possible to provide maximum rock cover over the mined station.

TABLE 2-3. VERTICAL DESIGN EXCEPTIONS

Description	Alignment(s)	DART DCM	Criteria	Design Value
VPI 99+95.00 Curve Length	CBD-2	1.8.7	500'	400'
Tangent Proceeding CBD East Station Platform Minimum Tangent Length	CBD-2	1.8.2	40'-0"	39.16'

TABLE 2-4. VERTICAL DESIGN ELEMENTS REQUIRING DART APPROVAL

Description	Alignment(s)	DART DCM	Criteria	Design Value
Vertical Clearance at Woodall Rodgers	CBD-2	1.9.3	22'-0"	15'-0"
Absolute Maximum Grade	CBD-2	1.8.3	6.0%	6.0%
Minimum Length of Vertical Curve, Sta. 99+95.00	CBD-2	1.8.4.1 & 1.8.7; 1.8.4.2 & 1.8.7	1425' (LVC=200*A)*1.5 500' (LVC=70A)*1.5	400.00'
Absolute minimum distance for vertical curve ahead of point of switch	CBD-2	2.7	20'	20'

3 RIGHT-OF-WAY

3.1 Existing Conditions

See Right-of-Way plans for identification of existing parcels lines and property owner information.

3.2 ROW Requirements

Proposed ROW limits shown are based on engineering need and are subject to change. These limits may include acquisitions, agreements, easements, etc. and can be either above or below existing ground. These limits do not include construction needs. Final Designer responsible for coordinating with DART to determine final dispositions.

3.3 As-Built information

During design information was collected for existing elements (as-built information) throughout the project area. See Appendix A - As-built Summary Table for listing of information available. Final Designer responsible for verifying available information and for obtaining additional information as needed.

4 UTILITIES

4.1 Utility Investigations

Existing Utility Composite plans have been prepared using record drawings, and by Geographic Information Systems data obtained from the City of Dallas, Dallas Water Utilities, AT&T, Spectrum, Atmos Energy, Oncor Electric, Century Link, Sprint, Verizon and other identified utility owners.

The completeness and accuracy of all information obtained regarding existing utilities have not been fully verified. This information should be used for planning purposes only. The Final Designer should verify and obtain accurate horizontal and vertical information for existing utilities using subsurface utility engineering or other methods as required to obtain appropriate information necessary for the design. Also, the contractor is responsible for the verification of the location and elevation of all existing utilities affected by the project prior to construction.

See Technical Memorandum #16 Utility Conflicts at Portals and Underground Stations for existing utilities conflicts summary and utility companies' coordination table. Storm sewer utilities conflicts are not included in the summary table. Known utility data are shown in the Existing Utility Composite plans. For additional as-built information for existing utilities, see Appendix A – As-Built Summary. Coordination

Coordination by the Final Designer will be required with DWU. DWU is planning a 1.5 miles water/Wastewater replacement project along Commerce Street from Houston Street to Harwood Street over a 21 months-period in the near future.

There are existing public and franchise utility mains, ducts, and vaults on Akard Street that may get impacted with the construction of the Muck house. It is the responsibility of the contractor to verify the location and elevation of existing utilities prior to construction and coordinate with utilities for appropriate protection and relocation as necessary.

4.1.1 Franchise Utility Owners Coordination

The coordination process with franchise utility owners was started by providing plans for the franchise utilities to review. The Final Designer will be responsible for coordinating required utility relocations with the franchise utilities. DART will continue to provide assistance as required to facilitate the process.

Below is the list of the franchise utility contacts. Please note that the contact list is not all-inclusive, and it is the contractor's responsibility to provide further coordination and to verify that the listed contacts are current and specific to the project needs.

TABLE 4-1. FRANCHISE UTILITY CONTACTS

Franchise	Contact Name	Phone	Email
Oncor	Keith Williams	972.816.7039	Keith.williams@oncor.com
AT&T	Robert Aldape	972.660.0446	Ra8642@att.com
Charter	Jorge D Barrera	214.320.5443	jorge.barrera@charter.com
Sprint	James B. Stuart	972.791.8556	James.stuart@sprint.com
Verizon	John Bachelder	469-886-4219	john.bachelder@verizon.com
Level 3/ Century Link	Ken Huckabee	469.426.4005	ken.huckabee@centurylink.com
Atmos	Stan Breckenridge	817.375.7921	stan.breckenridge@atmosenergy.com

4.1.2 Locate Underground Utilities

The Contractor and the Owner's Representative shall meet prior to commencement of work to determine which utilities will be located. The Contractor will notify the Owner's Representative and vice-versa of any additional utility locates immediately. The utility line or lines shall be exposed and located in such manner that the Contractor can make accurate horizontal and vertical measurements to determine and record the exact location of the utility.

The Contractor shall submit a spreadsheet with field notes to the Owner's Representative for verification of the locations including name of the existing utility, type and site of existing utility line, offset, depth below pavement or elevation, name of proposed improvement in

conflict, type and size proposed improvement in conflict, name of project, City project number, and plan/profile sheet number.

The Contractor shall immediately notify the Owner's Representative of conflicts. The Contractor shall not begin construction of proposed underground work prior to verification of the utility locations by the Owner's Representative.

4.2 Mitigation Measures

In the event utilities must be rebuilt or new construction is warranted, the Project will be designed in conformance with requirements of the owning/operating utility company and the jurisdictional agency. Locations and elevations of all existing utilities will be field verified during final design and the proposed improvements would be coordinated with all utility companies prior to construction to avoid conflicts.

Mitigation measures for potential utility impacts as a result of the Project will include, but may not be limited to, the following:

- Prior to construction, all area utility companies will be contacted through One Call and requested to provide line location measures.
- Businesses and residences affected by utility disruptions during construction of the proposed project will be notified of the disruption at least two weeks in advance, unless there is an emergency situation requiring immediate attention.
- Disruptions in service to businesses will be scheduled during off-business hours and never exceed a 24-hour period except during unusual circumstances.
- 7-FT. horseshoe stormwater utility line on Commerce Street: stormwater line would be supported by temporary structures during boring or mining operations. If necessary portions of line may be rebuilt.
- To the extent possible, businesses such as restaurants, grocery stores or food preparation/manufacturing facilities will be accommodated to protect food preparation and storage mechanisms.
- Should utilities be discovered during construction that were not previously identified, work will cease in that area and the appropriate utility companies and agencies will be contacted to identify the line(s). The newly identified utilities will not be disrupted until businesses and residences are notified and the utility owner/operator has approved or made the required adjustment.

Utility relocation would be required for underground or overhead utilities depending on the location. Utilities to be relocated would include storm drains, sanitary sewers, water mains, electricity and electrical, gas lines, and communication lines. Utilities within the vicinity of cut-and-cover excavations that are in physical conflict with the permanent or temporary structures (cut-and-cover boxes for the portals and stations, station entrances, ventilation shafts, temporary roadway decking, and bored tunnels) would require relocation. A list of

existing major utilities along the alignments is included in Table 5-9. Utility relocation and decking of streets may occur months before major construction activities, as described above. Utility relocation would apply to all options.

Utilities that would not require temporary or permanent relocation would be uncovered during the early stages of excavation. These buried utilities, with the possible exception of sewers, are generally found within 10 feet of the street surface (e.g., telephone, traffic, electric). These utilities would be reinforced, if necessary, and supported during construction by hanging from support beams spanning across the excavation.

In addition, an allowance will be included within the project budget to cover adjustment, protection and/or consolidation of all utilities along the alignment. Utility adjustment and protection will be closely coordinated with impacted companies and designed to avoid any disruption in service.

Strong consideration should be given to utilizing trenchless technologies during mitigation or utility relocation of public water & wastewater utilities. Dallas Water Utilities (DWU) design manual provides guidance on commonly acceptable Trenchless Technologies utilized by DWU. These technologies are primarily divided into two major categories as Trenchless Construction Methods (TCM) and Trenchless Rehabilitation Methods (TRM). TCM can be used for new utility installation where TRM is used for renewing, rehabilitating, and/or renovating an existing utility main.

High pressure gas mains relocation, if needed, will need to be prioritized for scheduling impacts. Should it become necessary to change the feed point of electrical utilities to private businesses, thoughtful scheduling and owner approval will be required in advance of any utility relocation work. It is possible that excavation for utility relocation within some areas might encounter environmentally sensitive soil conditions. Potentially impacted soils, if encountered during construction shall be screened regularly. In such instances, Contractor shall be responsible for having an Environmental Professional who may provide insight on evaluating the hazards and determining appropriate health and safety measures as applicable. The Contractor shall be solely responsible for the means and methods of managing utility work within impacted zones and for all costs associated with such work.

4.2.1 General Guidelines Regarding Underground Utilities

EXISTING MAINS AND SERVICES

DALLAS WATER UTILITIES (DWU) DISPATCHER (214) 670-5700

All water and wastewater facilities must be protected during all phases of the construction operations. The Contractor is responsible for the cost to repair damage to existing water or wastewater main, water services, and/or wastewater laterals. Repairs will be made by DWU and the Contractor will be billed for the cost. The Contractor will not be permitted to make repairs unless authorized by the Engineer.

In the event of damage to a water facility that requires closing a water valve in the existing system, the Contractor must contact the DWU dispatcher. DWU personnel will shut off the valve. If the Contractor plans to damage, cut, or alter the existing system in any manner, the means and methods must be approved by the DWU Construction Engineer.

Temporary Wastewater Main: If a temporary main is required to accomplish continuous wastewater service or if a wastewater pumping bypass operation is used, the work will be done by the Contractor at his expense

Cut Water Service: The service shall not be intentionally cut if the Resident or business Proprietor objects to the discontinued service. In no case will the service be cut for more than four (4) hours unless prior approval is obtained from the Construction Engineer and the Resident or Proprietor. The Contractor is responsible to coordinate this effort.

Cut Wastewater Service: Repair shall be made per Dallas Water Utilities approved methods shown in Dallas Water Utilities Standard Drawings for Water & Wastewater Construction (latest edition). All materials and workmanship shall be in accordance with the North Central Texas Council of Governments Standard Specifications for Public Works Construction (NCTCOG), the City of Dallas Addendum to the NCTCOG Specifications, DWU Drawings, Details & Standard Appurtenances, DWU Special Details, and the details shown on Paving Standard Drawing 251D-1.

The Contractor shall be responsible for all construction staking associated with the Water and Wastewater facilities on this project. Staking shall be performed by qualified personnel. Contact 214-671-9530 for staking requirements.

4.2.2 Television Inspection

In order to ensure that the mains perform the function for which it was designed and constructed; television inspection will be performed by the Contractor. This inspection of the installed mains shall be made after construction of the project is substantially complete, at a time directed by the Owner's Representative. Generally, this operation shall take place prior to the make ready inspection and final acceptance of the project.

If, in the opinion of the Engineer, there is a potential for movements, settlement, or damage to the main for any reason, the television inspection may be delayed up to 30 calendar days after the backfill operations. A second Television Inspection of the installed main shall be conducted at a time as directed by the Engineer.

4.2.3 Temporary Paving

The Contractor is responsible to place, maintain, and remove all temporary paving required for the project. If, in the opinion of the Engineer, the temporary paving placed by the Contractor is not adequate, either in placement or maintenance of the work, the Engineer shall require specific correction, which shall be performed by the Contractor at no additional cost to the City.

4.2.4 Coordinate Tie-In Connections

Tie-in connections affecting curtailment of quality or quantity of water to an area, businesses, etc. must be performed during the weekend or off-hours. All work must be coordinated through the Owner and its representatives. Delay costs due to shut down and connection issues are considered incidental work and shall be borne by the Contractor.

The Contractor is advised that point repairs may be required on private property. Point repairs on private property shall be hand excavated using small equipment to cause as little damage as may be necessary to accomplish the work. If fences must be removed to accomplish the work, the Contractor shall install temporary fencing of like size and construction until permanent fence replacement is accomplished.

4.2.5 Shutdown of Water Mains 20" Diameter and Larger

Construction that requires the shutdown of any water mains size 20" and larger shall only be done during the winter months between October 1 and May 1, unless otherwise approved by the Project Engineer. The schedule of these shutdowns must be coordinated with DWU Distribution and DWU Pumping Divisions and by the Project Engineer.

4.2.6 Temporary Water Mains

Temporary water mains shall be installed as specified by the plans or as required by the Construction Engineer. If temperatures fall, the Contractor shall take steps to prevent temporary mains and services from freezing. If flushing is done, the run-off shall be directed such that street icing does not occur.

4.2.7 Water Meter Boxes

Install new Water Meter Boxes on all new and reconnected existing water services shown on the Drawings and specified herein. Water Meter Boxes shall conform to Dallas Water Utilities Approved Materials List. Install Water Meter Boxes according to DWU Standard Drawings for Water and Wastewater Construction, Latest Edition, pages 201 thru 206A.

5 TUNNEL AND STRUCTURAL DESIGN

5.1 Tunnel Design

See the following reports for additional information on tunnel and geotechnical analysis for underground structures:

- Methods of Construction Report
- Geotechnical Inventory and Concept Design Report

Specifically, the Methods of Construction Report provides feasible potential approaches to the development and construction of underground structures. The Geotechnical Inventory and Concept Design Report presents relevant evaluations such as assessment of minimum rock cover required over the cavern and rock loading on station cavern final lining.

The means-and-methods for temporary shoring and other structural considerations during design and construction of east portal under IH-345 requires coordination between the Final Designer and TxDOT. Specific logistical issues to be addressed include existing bridge columns located in close proximity. Modification of the excavation support system (reduced bolt length, see DWG No. SC8-4022 – Construction Stages) for the mined Commerce Station cavern and passenger/ventilation adits to avoid potential damage to buried storm sewer and other utilities overlying tunnel alignment under Commerce Street.

5.2 Retaining Wall Design

Preliminary engineering design of retaining wall systems for retained cut (U-wall) portal approach and headwall structures as well as shafts for station entrances and ventilation structures has been based on project-specific geotechnical information and site constraints (See GDM #11 – Geotechnical Design Memorandum for Critical Structures and Summary of Criteria. Specific recommendations include:

- Use of non-driven/pre-drilled elements for support-of excavation (SOE) systems to mitigate potential noise and vibration damage impacts on nearby existing structures at future portal cut and shaft excavation locations.
- Use of internal bracing support systems to accommodate limited existing roadway right-of-way and avoid easement requirements associated with tieback anchor systems.
- Use of rigid support of excavation systems (i.e. slurry wall or secant-pile wall) keyed into top of rock with grouted groundwater cut-off to mitigate potential damage to existing building foundations susceptible to settlement induced by excessive dewatering.
- Coordination with TxDOT during design of retaining walls to ensure compatible wall heights that accommodate future street crossings.

As a result of lowering Broom Street at the LRT grade crossing, retaining walls along Broom Street are required to maintain the existing parking lot grades under Woodall Rodgers Freeway. Final designer will coordinate with the street modifications group to develop final design plans, specifications, etc. for this any other required retaining walls during the final design phase.

6 DRAINAGE

6.1 Overview

The proposed improvements will be overlaid on drainage areas and conceptual drainage designs will be developed for the proposed guideway, tunnel pump station locations, street improvements and station sites.

This preliminary engineering drainage report includes information about the existing delineated drainage areas and flow pattern.

With the use of collected drainage data described above, drainage area maps will be developed that define drainage divide boundaries for the corridor. Relationships to adjacent land use will be coordinated with local governments and watershed runoff calculated for each sub-basin.

There will be 5 proposed stations that run along the General Planning Consultant Six (GPC6) D2 Subway alignment. They include:

- Museum Way Station
- Metro Center Station
- Commerce Station
- CBD East Station
- Live Oak Station

Museum Way Station and Live Oak Station are the only two at-grade stations and subsequently are the two stations that will be included in the surface drainage analysis.

6.2 Research and Assumptions

The GPC6 has collected necessary drainage data from existing as-built plans, technical reports, studies, and private development record plans on existing storm sewer system which can be provide upon request. More specifically, data collection consists of:

- Collected drainage area maps from City of Dallas identifying the watershed that includes the project alignment.
- Collected the storm drainage system from City of Dallas serving the watershed and identify those within the corridor right-of-way.
- Conducted field surveys to review the location, size and flow line of existing drainage systems, and tied their locations to nearby control survey points.
- The City of Dallas Public Works department requires the 1993 City of Dallas Drainage Manual for projects that began design before October 1, 2019.

- All drainage areas are calculated for the 100 – Year frequency storm, per Section II: 2. Methods of Determining Design Discharge.
- Intensities were obtained from the Table: Rainfall Intensity Chart, page 2 of the 1993 City of Dallas Drainage Manual Appendix.
- Runoff Coefficients are from the Table: Runoff Coefficients and Maximum Inlet Times, page 1 of the 1993 City of Dallas Drainage Manual Appendix.
- A Time of Concentration (Tc) for the minor drainage areas of 10 minutes was used for the 30% submittal.
- Existing inlet locations were field verified through site visits, survey, existing as-builts, and Google Earth.
- A table has been created which list all the as-builts obtained from the City of Dallas. See Appendix A - As-built Summary Table.

6.3 Drainage at Specific Locations

Surface drainage is currently collected via existing drainage structures along the corridor. These existing structures connect to many existing drainage systems throughout this downtown area, which are all connected to a larger system that outfalls into the Trinity River. At Woodall Rogers there is an existing 12-foot horseshoe culvert that runs underneath the road and outfalls at the Trinity River. McKinney Avenue has an existing 10 ft by 10 ft box culvert that outfalls at the Trinity River as well. Along Commerce Avenue there is an existing seven-foot horseshoe culvert system. This system continues to the Pearl St. inter-section and runs north under Pearl St until Pacific Ave. Then it turns east and runs underneath Pacific Ave until it is east of Interstate 30. This system is known at the Town Branch Storm Sewer system and eventually also outfalls into the Trinity River.

With the use of collected drainage data described above, drainage area maps will be developed that define drainage divide boundaries for the corridor. Relationships to adjacent land use will be coordinated with local governments and watershed runoff calculated for each sub-basin. The grouping below is used to create sub-basins for each section of the corridor based on existing drainage flow patterns. Groups may change after 30% design based upon further investigation and additional underground utility information.

- **GROUP A** -From the beginning of project (CBD-2 EB Sta 10+00) to the Woodall Rogers Overpass (CBD-2 EB Sta 34+85)
- **GROUP B** - From Woodall Rogers to Pacific Ave (~CBD-2 EB Sta 51+60)
- **GROUP C** - From Pacific Ave (~CBD-2 EB Sta 51+60) along Commerce to turning north will stop at Main St. (~CBD-2 EB Sta 93+80)
- **GROUP D** - From CBD-2 EB Sta 93+80 to CBD-2 EB Sta 100+55 at Pacific Ave.

- **GROUP E** – From CBD-2 EB Sta 100+55 to CBD-2 EB STA 113+70, including WYE, and from SE-1 SB STA 9+62 to SE-1 SB STA 23+80, including Live Oak Station.
- **GROUP F**- SE-1 SB STA 9+62 (=CBD-2 EB Sta 113+70) to end of track construction at SE-1 SB Sta 32+93.41

By establishing the existing flow (Q_{WP}) at the West portal at CBD-2 EB Station 35+30 to CBD-2 EB Station 41+50 and establishing the existing flow (Q_{EP}) at East portal CBD-2 EB Station 101+65 to CBD-2 EB Station 107+60, we can provide the flow data needed to provide preliminary design of a sump pump system design at the underground station.

- Q_{WP}= 4.64 CFS
- Q_{EP}= 4.64 CFS

In the subway section there will be minimal drainage and underdrains will be utilized and collected at the pump station. The portal section drainage will be collected using grate inlets and underdrains and collected at the nearest tunnel pump station.

6.4 Drainage Anticipated Work

Time of Concentration (Tc) for the minor drainage areas of 10 minutes was used for the preliminary submittal. In the next phase of evaluation (Tc) may have higher times based on the evaluation of the existing drainage system and should be quantified using the Rational Formula from the City of Dallas Drainage Design Manual.

The survey used for the preliminary design was useful but did not include all the areas that are captured within the GPC6. Additional survey, especial at the beginning and end of the project along with any TXDOT data involving Klyde Warren Park will be needed to support the proposed design.

Based on our investigations, we established the existing Q's flowing into the two (2) -Tunnel Portals. While this information can be utilized to assist in the sump pump design, it is equally imperative that proposed flows (Q's) be identified in the next phase. Refer to Technical Memorandum #14 – Tunnel Drainage for more detailed information on collecting drainage in the tunnel.

The City of Dallas was helpful in providing as-built data which resulted in older plans. There will need to be additional visits and request to the city to make available the more recent project that have been built in the past five years near project area.

7 STATION DESIGN

7.1 General

The stations design effort has been based on Chapters 19, 20, 21, 22 and 24 of DART Design Criteria Manual (DCM). Station designs reflect functional and spatial assumptions, constraints, and opportunities.

Station Circulation System Hierarchy

Station circulation systems may include pedestrian, bicycle, bus, auto/taxi pick-up and drop-off, park-and-ride, and bus layover facilities. A hierarchy should be followed to give priority of access – directness of route and proximity to platforms – to transit customers in the following order:

- Pedestrians
- Bicyclists
- Feeder buses and shuttles
- Taxi and auto pick-up/drop-off
- Auto park-and-ride

Station platform design is based on DART regional rail design vehicle standards. Clearance at station platforms take into account the dynamic envelopes of work trains and maintenance equipment; ballast and rail trains; and double-stacked freight trains in some sections of the corridor.

7.1.1 Passenger Capacity / Ridership

See Appendix C - Architectural for Station Capacity Analysis Matrix and Email from DART.

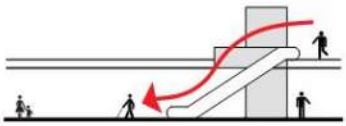
7.1.2 Level of Service

Level of Service (LOS) refers to a classification scheme developed by John J. Fruin, in which classes A to F are applied according to the space available for individuals. Class A corresponds to the situation where people have plenty of space around them, and at the other extreme, class F means congestion.

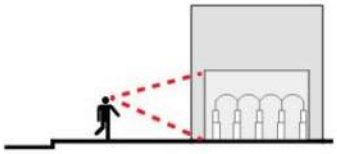
For the downtown Dallas stations, LOS B - generally accepted to be about 10 ft2 per person, has been used as a starting point for the calculations.

7.2 Design

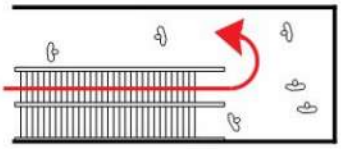
7.2.1 Station Planning Principles



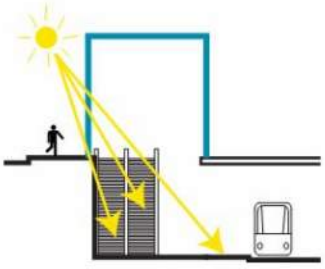
Seamless path of travel



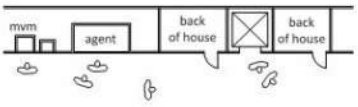
High visible entries



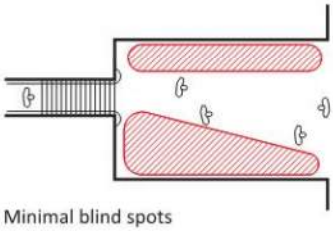
No dead-ends



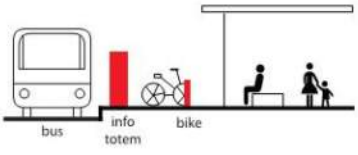
Daylight below grade



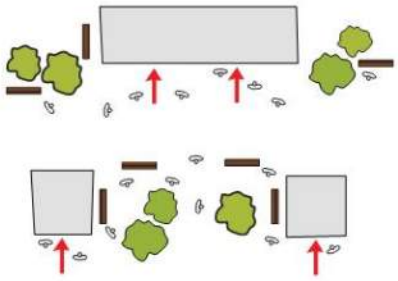
Clearly organized passenger information



Minimal blind spots



Inter-modal integration



Enhanced Urban Realm

7.2.2 Architectural Design Vision

The architectural goals expressed in the current design iteration are:

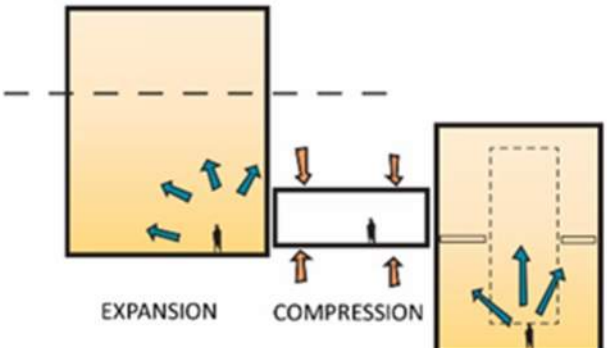
- A strong, discernable and coherent architectural expression focused on elevating the quality of the passenger experience.
- An architectural approach based on high functionality and simple design language without unnecessary formal gestures.
- A clear architectural strategy for applying elements of continuity (common to all stations) and elements of variability (responding to specific stations contextual relationships).
- Scale, massing and exterior treatments informed by civic considerations that provide positive presence in the urban realm and generate a sense of civic pride among the Dallas community.

7.2.3 Line and System Identity

- Distinct and recognizable station entrances of glass, steel, stone and concrete across the line.
- Highly functional architecture that is modular and based on logical form making.
- Standardized materials and construction systems.
- Systematic use of architectural volumes, colors, materials and artworks as wayfinding strategies.
- Sustainability features including (but not limited to) skylights, water management strategies and facade shading treatments.
- Climatic design of station entrances to maximize daylight and fresh air movement.
- Seamless integration of services into the building.
- Building scale and materiality that respond to context, the Dallas urban realm vocabulary and existing light rail infrastructure.
- Plaza spaces and station aprons that seamlessly bridge into the station interiors.

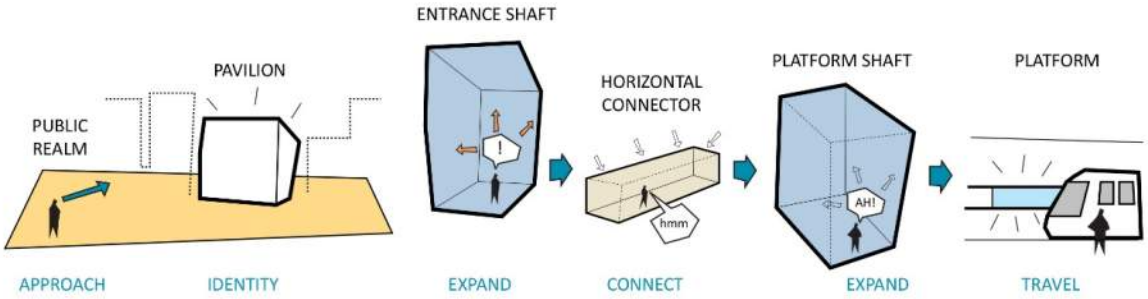
7.2.4 Wayfinding & Navigation: Experiential Travel

The quality of a passenger experience hinges upon the intuitive understanding and navigation of stations, informed by architectural and spatial qualities, rather than applied signage. Defined by movement through a series of volumes, a hierarchy of architectural ‘elements’ are deployed above and below ground—connecting the street to platform. The expansion and compression of these key volumes, combined with modulation of artificial and natural light, delineate boundaries, inform directional travel and create a sense of place. The sequence of volumes, or architectural experience, reinforces the user’s mental map.



Passenger Space Experience

Entrance shaft – Horizontal connector or mezzanine – Platform shaft



The ability to communicate service updates through digital and analog tools have created opportunities for more efficient and widespread service knowledge. Fixed information accommodates permanent content such as system identifiers or route displays. Variable information includes content that changes over time such as service updates or real-time arrival notices. New technology has enabled transportation authorities to convey information more frequently through different media.

For the new Downtown Dallas Subway Stations, we consider the following information components as part of a future Passenger Information Plan (PIP). The PIP should be a comprehensive set of guidelines that includes fixed, static and digital web information needs, based upon user statistics and real life conditions.

Station Signifiers

Totems, beacons, façade treatments and appliqués that are visible, predictable and identify the stations at street level as part of the Green and Orange Lines.

Digital Products

Electronic signage boards, ADA accessible kiosks, programmable information displays, etc. as identified and developed in Passenger Information Plan.

Static Products

These products include: statutory signage, emergency egress signage, station specific navigational signage, system map, line map, etc. Locations should be minimal and distributed only as required, informing the passenger the right content at the right time and place.

Totem at street level displays maps and other wayfinding information.

Signage on a platform column conveys static information with white text and braille.

Digital dashboard can be easily updated to display consolidated train arrival times, service updates and system maps.

On the go screens encourage users to customize journey planning with interactive displays.

Smartphone apps with maps and service information at any point along the journey.

7.2.5 Station Zones

Station Threshold Zone

The downtown Dallas Subway station entrances should be highly visible, predictable, inviting and accessible. As passengers enter the system, entrances should provide service updates and confirm journey information though digital tools. For passengers departing the system, this zone should provide information about subsequent journeys (area map) and inter-modal connection options.

Direct visual connections with the urban realm should be fostered but, for maintainability and liability reasons, this access should be balanced with a clear delineation of “ownership” between DART and the adjacent properties. DART police office is located where there is a direct visual connection to the turnstile.

Control Zone

As a necessary interstitial space between the station entry and vertical circulation elements, the control area should be clear and welcoming to facilitate efficient decision-making through the fare array, around information products and to the elevator/escalator/stair

connections. This design prioritizes elements and features that reduce visual and physical clutter, improve passenger circulation and provide visible sight lines at this zone.

Fare collection and information components shall be clearly separated. Information dashboards consolidate station agent booths with entry and exit information that contain wayfinding and service related announcements. These locations are based on the geometry of the station, placed within an optimal path of vision for passengers arriving to and/or departing from the station.

In future design iterations, placement of art or advertising in the Control Zone should be carefully coordinated as not to compromise the operational functionality of this space.

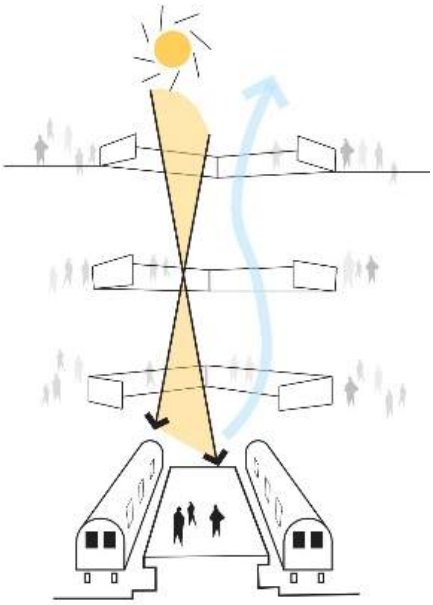
Entrance Shaft Zone – Vertical Circulation A

This zone includes passenger facing spaces associated with elevators, stairs, escalators and their related queuing areas. As a paid area where the user is already engaged with the system, the introduction of artwork, advertising and concessions are possible.

The entrance shaft benefits from a sense of "grandeur" commensurate to civic minded buildings. Natural light penetrating to the lower levels of the stations has been pursued.

Entrance shaft natural lighting– MBTA Government Center Station

Vertical circulation elements are clustered together to facilitate intuitive wayfinding and streamline passenger flow.



Horizontal Connector/ Concourse Zone

The Horizontal Connector (or Concourse) is known as a "fast space", different from the Control Zone or Platform. It is a public passenger area function, purpose limited to linking the entrance shaft (VC- A) to platform shaft (VC-B).

The Horizontal Connector differentiates itself from the Concourse as the former is usually a single corridor passageway with no decision making points within itself, while the latter allows a passenger the selection of options between multiple destinations and vertical

circulation points. A Concourse might also have small concession opportunities, seating areas, entertainment areas and/or passenger amenities.

Additional DART police areas are included for additional surveillance.

Horizontal connector with intuitive wayfinding – Munich subway

Mezzanine – 2nd Avenue NYC subway

Platform Shaft Zone - Vertical Circulation B

This zone includes passenger facing spaces associated with elevators, stairs, escalators and their related queuing areas between the Horizontal Connector/Concourse areas and the platform.

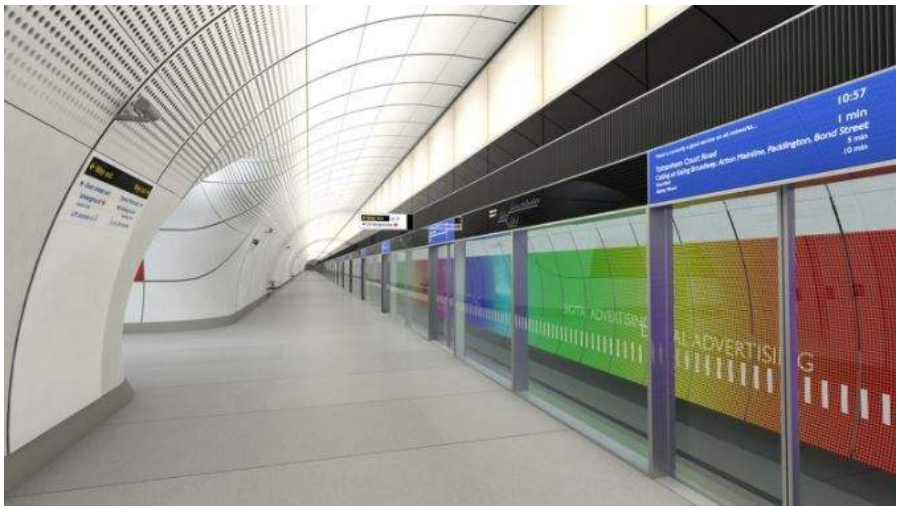
The platform shaft benefits from a sense of "grandeur" when natural light penetrates from the upper levels, advancing intuitive wayfinding and improving the passenger experience.

Platform shaft natural lighting– MBTA Government Center Station

Platform Zone

Platform Zones are qualified as "slow spaces" and are excellent locations for artwork and advertising. Passenger shall be informed in the Zone using overhead PA system, digital real time train displays, static system signage and line maps. It is recommended to provide station area maps where the passenger needs to choose between different station exits.

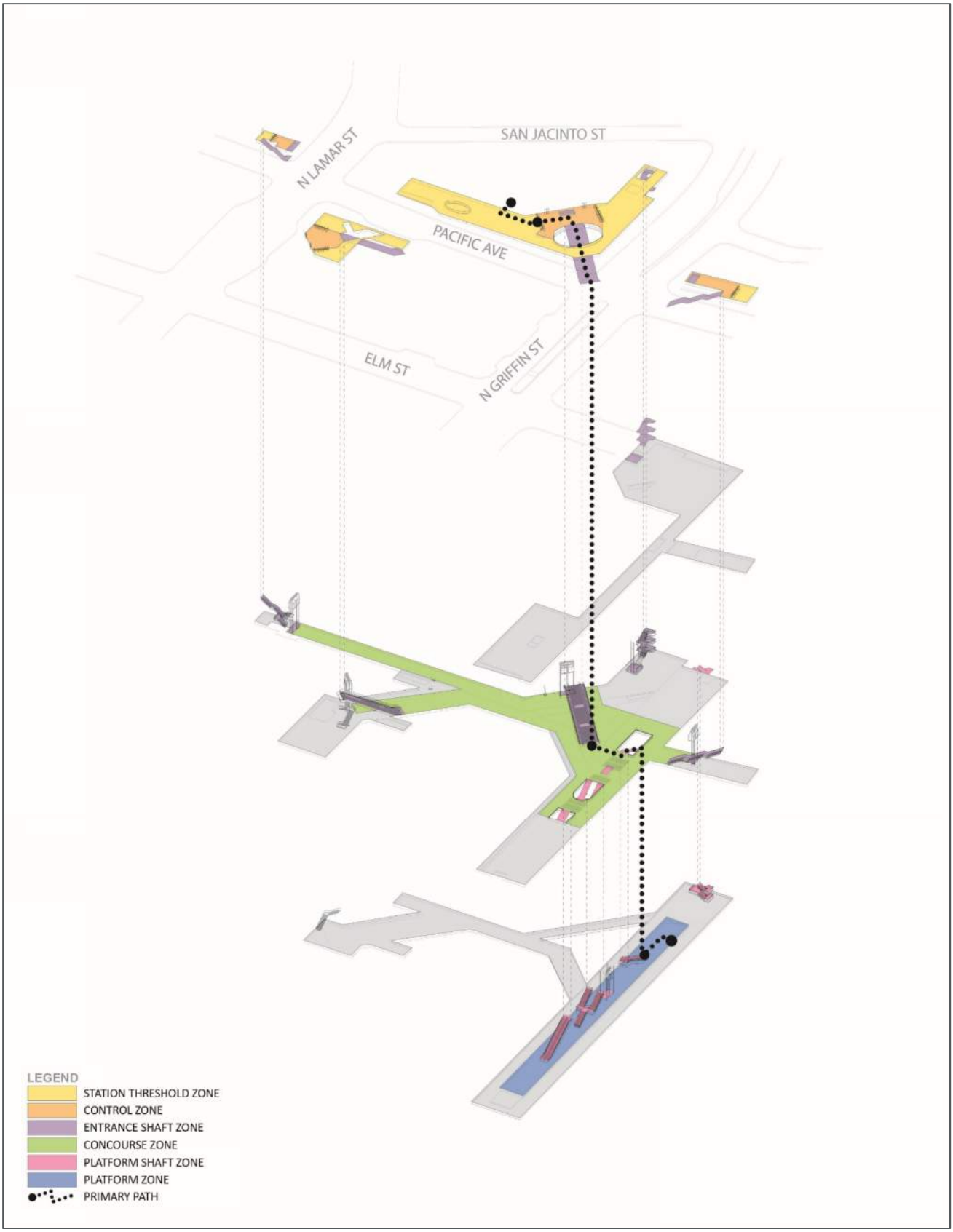
The design of the Platform Zone should be “calm”, bright and airy, and provide a sense of security. When possible, natural light is to be used to help indicate locations of vertical circulation elements (Platform Shaft) to intuitively signal to passengers how to get to the street. The basis of design for all underground stations include Platform Edge Doors (PED’s). These element provide additional security from the platform to the train tunnels, allow the stations to be secure after hours, prevent accidental passenger falls, and provide environmental control to the stations.



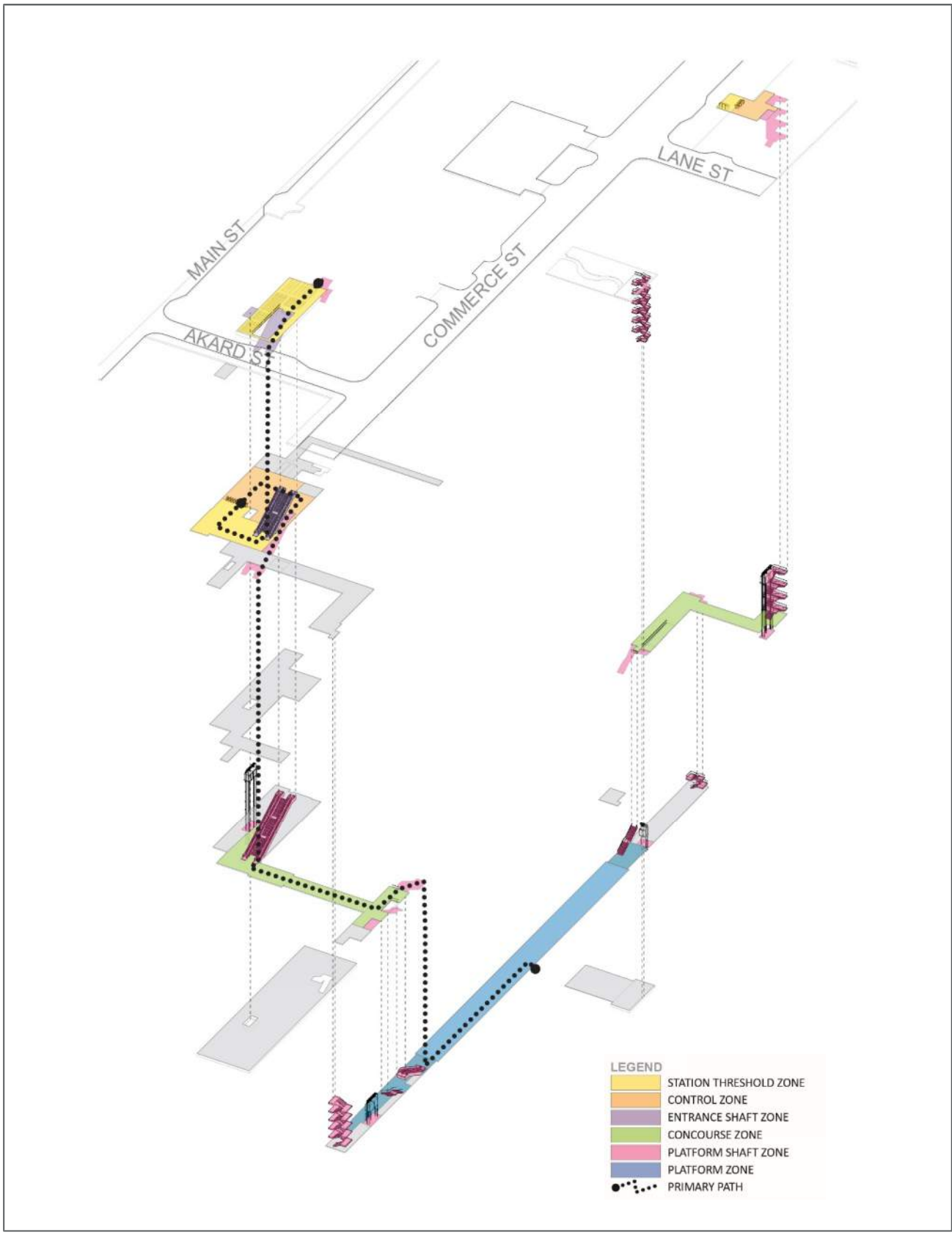
Platform edge doors with integrated signage, utilities and lighting – Crossrail UK

Furniture, amenities, security cameras, elements providing navigation and wayfinding and/or elements needing power/data requirements shall be closely coordinated between the disciplines of the Design Builder. Doing so will help provide all raceways, conduits, outlets, as an integrated design and hide industrial elements out of the public realm.. Using platform elements such as the edge of the PEDs can provide other opportunities for integrated building system raceways.

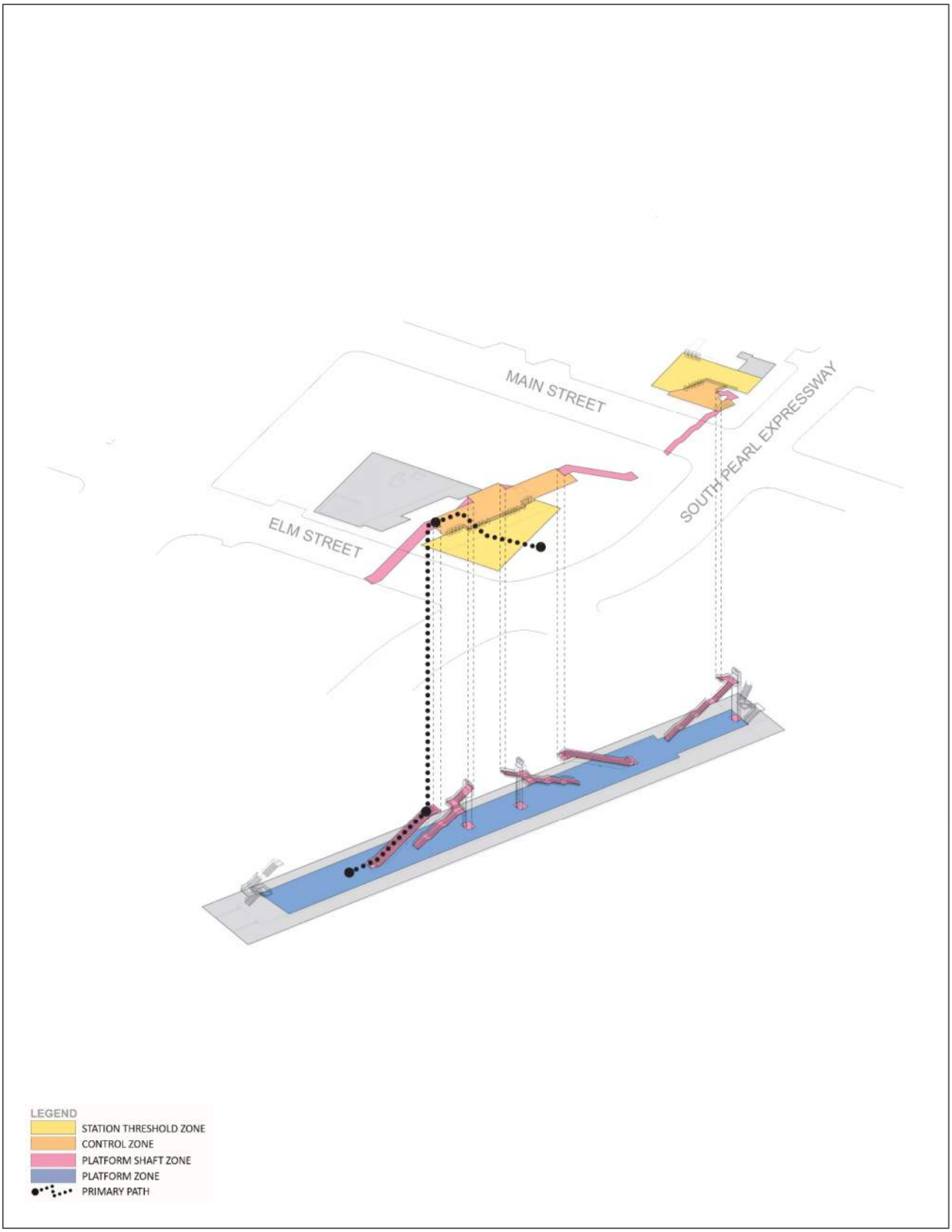
Metro Center Station Zone Diagram



Commerce Station Zone Diagram



CBD East Station Zone Diagram



7.2.6 Specific Architectural Station Considerations

Museum Way Station

Museum Way Station is an at-grade, gull-wing, side platform station, 386'-0" in length. It is adjacent to the Perot Museum of Nature and Science. Broom Street is being realigned to accommodate the Museum Way platforms and allow a connection of River Street to the north of the station. The station is situated so the platform will grade out to the surrounding site. Only one accessible ramp will be needed on the North/East corner. The platform will have easy access to the cross-walks across Broom Street to the Museum parking under the Bridge. This area will have embedded at-grade track to enhance the urban feel of the area.

Metro Center Station

Metro Center Station has two sets of tracks centered on a single platform. Total length of the platform is 472'-6" by 30'-8" which includes the ancillary spaces at either end of the platform and the distance from train to train. The area allocated for the train boarding and deboarding, and allocated space passenger waiting is 384'-10" by 26'-0". Tracks run north and south in line with Griffin Street. Platforms are accessed from the street level at four primary entrances located along Pacific Avenue; the East Headhouse between N. Field and N. Griffin Streets; the Main (Central) Headhouse between San Jacinto Street, North Griffin

Street and Pacific Ave; the South Headhouse at the southeast corner of Pacific Ave and Lamar Street; and the West Headhouse located at the northwest corner of Pacific Ave and Lamar Street. One additional location provides emergency egress out of the station, at the center median at Griffin Street and Elm St. The platform level has three primary vertical circulation elements leading to the concourse level, which connect to their respective headhouses/stations. Additional emergency exiting is provided at the far north and south ends of the platform, which leads to emergency egress locations only. Due to the depth of the station and the remote locations of the headhouses/stations, the concourse level is designated as a point of safety. Access to the platform from the Main and South Headhouses are provided by elevators, escalators and stairways. Access to the station from the East Headhouse is provided by stairways and elevators. Access to the station from the West Headhouse is provided by elevators only.

Commerce Station

Commerce Station has two sets of tracks centered on a single platform. Total length of the platform is 733'-0" by 26'-10" which includes the ancillary spaces at either end of the platform and the distance from train to train. The area allocated for the train boarding and deboarding, and allocated space passenger waiting is 385'-00" by 20'-10", while the total public length of the platform with circulation is 574'-6". Tracks run east and west parallel with Commerce Street. Platforms are accessed from the street level at two primary

entrances located at the southeast corner of S Akard Street and Main Street (within Pegasus Plaza), and in the Jack Boles Parking Facility near the Commerce and Lane Street intersection. The platform level has two primary exits to the lower mezzanine levels, which connect to their respective headhouses/stations. Additional emergency exiting is provided at the far west end of the platform, which leads to an emergency egress only headhouse on the west side of Akard Street, midway between Commerce and Main Streets. Due to the depth of the station and the remote locations of the headhouses/stations, horizontal exiting was used to provide points of safety at the lower mezzanine levels. Access to the platform from the Pegasus Plaza (Main) Headhouse is provided by elevators, escalators and stairways. Access to the platform from the East Headhouse is provided by stairways and escalators.

CBD East Station

CBD East Station has two sets of tracks centered on a single platform. Total length of the platform is 550'-0" by 35'-8" which includes the ancillary spaces at either end of the platform and the distance from train to train. The area allocated for the train boarding and deboarding, and allocated space passenger waiting is 385'-0" by 29'-4", while the total public length of the platform with circulation is 448'-6". Tracks run in a northeast and southwest alignment between South Pearl Expressway on the west and Cesar Chavez Boulevard on the east. There are 3 egress locations (North Egress, Main, and South Head houses) located between Main Street on the South and Pearl Avenue to the East and Elm Street to the North. The two primary headhouses (Main and South) are located along Main Street and South Pearl Expressway, and they are the main entrances to the station. Access to the platform from the South Pearl Expressway (Main Headhouse) is provided by elevators, escalators and stairways. Access to the platform from Main Street (South Headhouse) is provided by stairways and elevators. The platform level has four primary vertical circulation elements (stairs and escalators) that exit at the Main Headhouse. Additional emergency exiting is provided at the far north and south ends of the platform, which leads to exits at the North Egress and South headhouse. The station is relatively shallow, which allows for shorter travel times to a point of safety outside the station.

Live Oak Station

Live Oak Station is an at-grade, gull-wing, center platform station, 385' in length. It will be placed in the median of N. Good Latimer Expressway, just south of Live Oak Street intersection. This area will have embedded at-grade track to enhance the Urban Design feel of the area. This station will replace the Deep Ellum Station that will be displaced by the D2 exit portal wye connection. The Live Oak Station will be the hub to the Deep Ellum neighborhood. It will be directly across the street from the Latino Cultural Center. It will be several blocks from the new Uber Dallas Corporate Campus. It will be walking distance to the area restaurants and clubs, along with many new apartment buildings that are being built.

7.3 Egress Analysis and Code Compliance

A preliminary Egress and Building Code Review of the stations has been performed using the Dallas Building Code (2015) and the nationally recognized Standard for Fixed Transit and Rail Systems, per NFPA 130-2014.

The Dallas Building Code states that transit and commuter rail stations shall comply with all chapters of NFPA 130-2014, except for Chapter 5 regarding egress, deferring instead to Chapter 10 of the Dallas Building Code for egress compliance. This approach is more restrictive than other engineered performance options and does not take into consideration many of the inherent safety provisions provided within NFPA 130 that are not included in the building codes. A request for equivalency should be requested from the Dallas Chief Building Code Administrator before proceeding with any design concepts. All references in NFPA 130 to NFPA 101 and NFPA 220 shall mean reference to the Dallas Building Code.

An egress analysis was performed based on the provisions of NFPA 130-5.3. The analysis indicates that evacuation from the platforms can be achieved in 4 minutes or less in accordance with the provisions of NFPA 130-5.3.3.1. However, the amount of time required to evacuate the station to a point of safety outside the stations will exceed the 6 minutes or less criteria required by NFPA 130-5.3.3.2. Further analysis indicates that the inclusion of a horizontal exiting and engineering analysis will be required to meet the performance requirements of NFPA 130 by providing points of safety at the concourse and mezzanine levels. All calculations are preliminary and the final design will need to be verified by the design build contractor through engineering analysis to maintain a tenable environment and protect the points of safety from exposure to the effects of fire at the platform levels.

The preliminary Egress Analysis is included in Appendix C_12.4 of this report and is intended for proof of the design concept only. Additional Building Code and Egress Analysis for each of the designs is not provided in this report.

7.3.1 Metro Center Station

In-depth analysis of the egress of Metro Center Station is provided in Appendix C_12.4.1.

7.3.2 Commerce Station

In-depth analysis of the egress of Commerce Station is provided in Appendix C_12.4.2.

7.3.3 CBD East Station

In-depth analysis of the egress of CBD East Station is provided in Appendix C_12.4.3.

7.4 Materials and Finishes

In line with the *Forward Dallas!* and *Downtown Dallas 360* Urban Design Guidelines, choices for station materials and finishes should strengthen community and neighborhood identity

by maintaining and complementing its scale and character. They should embrace contemporary architecture and the interpretation of styles where context appropriate, while strengthening the unique identity of the district through innovative façade design, passive and active design elements responding to the Dallas climate, use of materials and forms distinct to the area, etc.

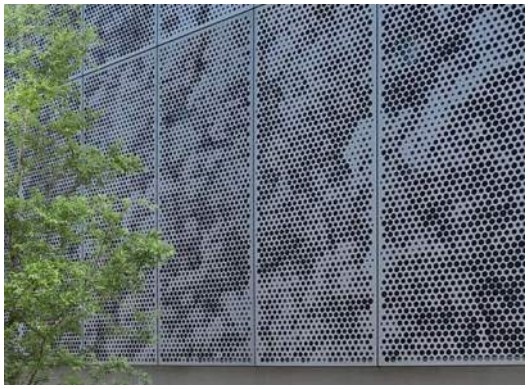
7.4.1 Exterior Cladding

Scale, massing and exterior treatments are informed by civic considerations, local context and maintainability considerations.

Assumptions of the current design include:

- Fully conditioned stations environment.
- Modular, rectilinear and contemporary form language with a “sincere” structural logic.
- Representative of a common line and system wide identity.
- Common palette of materials with consistent modulation. These include metal, glass curtain wall system (some fritted), terracotta panels/louvers, granite panels, and perforated metal screens.
- Scale difference between primary and secondary entrances.
- Urban realm sensitivity.
- Secondary external surfaces can vary to respond to adjacent buildings and local context.

RPBW - Curtainwall modulation



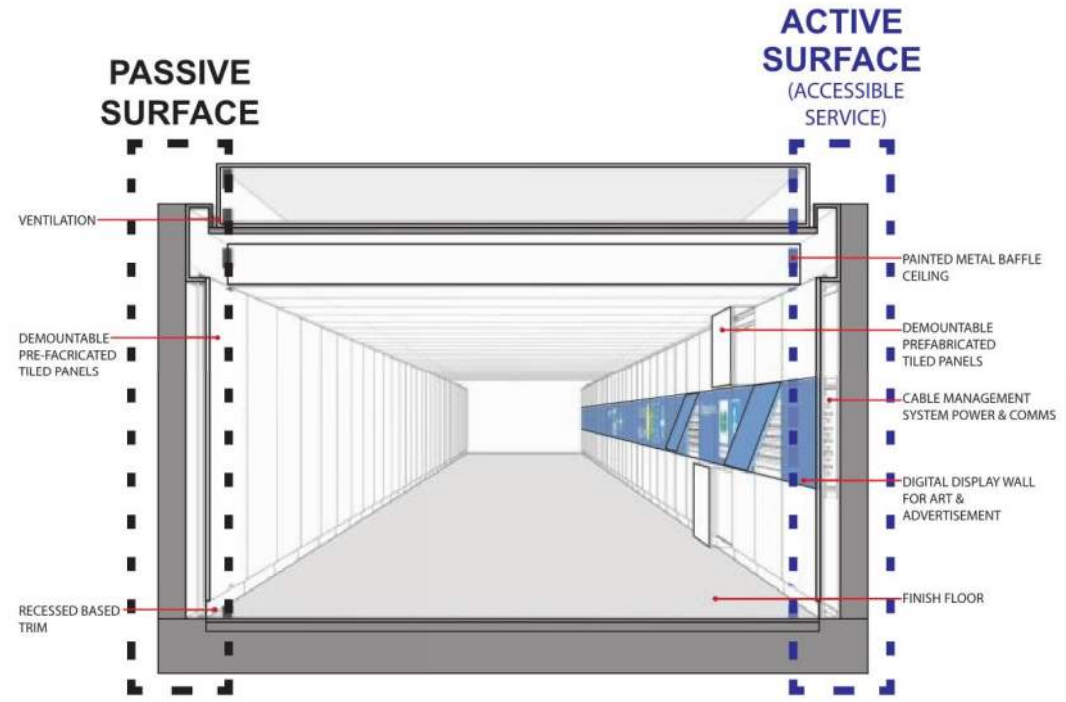
TERRACOTTA PANEL SAMPLE
Color: Varies per station
Size: TBD
Surface Finish: Smooth with vandal proof coating
BOD Product: NBK Terracotta

PERFORATED METAL SCREEN SAMPLE
Color: Grey
Size: TBD
Pattern: TBD
Surface Finish: Stainless steel with vandal proof coating
BOD Product: Imagewall

7.4.2 Walls

Interior wall finishes are organized to include signage, advertising, and artwork that promote spatial wayfinding. There are two kinds of wall types to achieve this: *active* and *passive*.

See attached exhibit for examples of active and passive wall locations.



WAYFINDING AND ADVERTISING LOCATED IN CORRIDORS ALONG THE CONTINUOUS ACTIVE WALL

7.4.3 Entrance Shaft Zone

Active wall - These are clad in panels with a distinct glossy finish to make them easily distinguishable from other adjacent surfaces. Organized along a continuous ribbon, the active wall leads passengers along a path between the entry and platform. It may contain integrated signage, wayfinding, advertising, and digital art.

Passive wall - Passive walls have a clean, smooth, matte and muted appearance. They are free of non-essential signage, color, advertising, or artwork to emphasize the presence of the active wall.

CBD EAST STATION RENDERING SHOWING AN ACTIVE WALL EXAMPLE

Horizontal Connector and Concourses

Active wall - These are clad in panels with a distinct glossy finish to make them easily distinguishable from other adjacent surfaces. Organized along a continuous ribbon, the active wall leads passengers along a path between the entry and platform. It may contain integrated signage, wayfinding, advertising, and digital art.

Passive wall - Passive walls have a clean, smooth, matte and muted appearance. They are free of non-essential signage, color, advertising, or artwork to emphasize the presence of the active wall.

7.4.4 Platform Shaft Zone

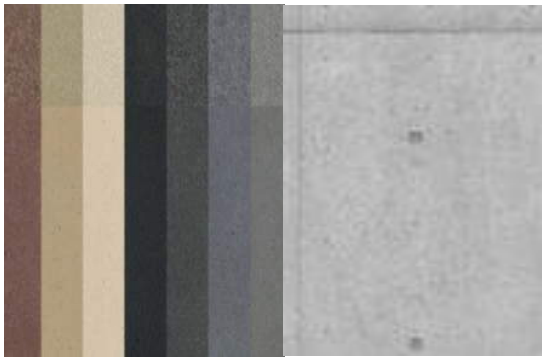
The inner surface of the platform shaft has to appear as a singular, continuous surface of large-scale opaque and clear glass panels.

7.4.5 Platform Zone

Active wall - Distinctive color, artwork or advertising applied to surface.

Passive wall - Muted finish to match horizontal connector passive walls

WALL FINISH 01
ENTRY SHAFT TYPICAL WALL
Material: GFRC cladding
Color: Neutral concrete color
Size: TBD
Surface Finish: Smooth
BOD Product: FibreC



WALL FINISH 02
ENTRY SHAFT ART WALL
Material: GFRC cladding
Color: Varies at each station
Size: TBD
Surface Finish: Smooth
BOD Product: FibreC
Alternate: Architectural cast-in-place concrete

7.4.6 Flooring

WALL FINISH 03
HORIZONTAL CONNECTOR ACTIVE WALL
Material: GFRC cladding
Color: Varies at each station
Size: TBD
Surface Finish: Smooth, glossy
BOD Product: FibreC
Alternate: Opaque low iron glass

WALL FINISH 04
HORIZONTAL CONNECTOR PASSIVE WALL
Material: GFRC cladding
Color: Natural concrete color
Size: TBD
Surface Finish: Smooth
BOD Product: FibreC
Alternate: Architectural cast-in-place concrete

WALL FINISH 05
PLATFORM SHAFT
Material: Opaque & clear low iron glass
Color: TBD
Size: TBD
Surface Finish: Smooth, glossy
Alternate: Glossy fluted/molded GFRC

WALL FINISH 06
PLATFORM
Material: Vitreous enamel steel
Color: Varies at each station
Size: TBD
Surface Finish: Smooth, glossy
BOD Product: PG Bell
Alternate: UHPC

Floor materials used in stations are to be homogeneous and consistent throughout the line. Varying finish textures are to be used as required for slip resistance.

Floor Finish 1: Interior Flooring Typical

- Entry pavilions
- Horizontal connectors
- Platforms
- Stairs

Floor Finish 2: Interior Flooring Accents

- Required area demarcations

Floor Finish 3: Floor Lites

- Entry pavilion at street level where additional daylight needs to be brought down to the lower levels of the platform shaft.

Floor Finish 4: Tactile Surface

- Platform edge
- Wayfinding paths for the visually-impaired

Floor Finish 5: Exterior Tactile Flooring

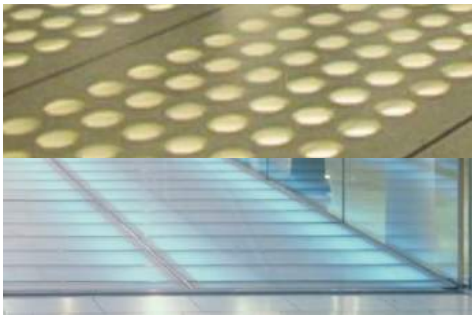
- Wayfinding paths for the visually-impaired

Floor Finish 6: Exterior Flooring

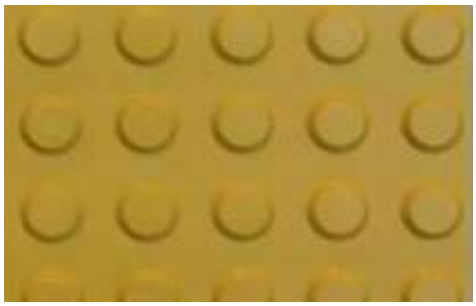
- Areas adjacent to entry pavilion
- Entry pavilion walk-off mat
- Urban realm & plazas

FLOOR FINISH 01
TYPICAL INTERIOR FLOORING
Material: Terrazzo
Color: Grey (Matrix aggregate TBD)
Surface Finish: Smooth, slip-resistant
Precast stair treads & risers in same finish with cast-in metal tread abrasives.
BOD Product: Wasau precast terrazzo

FLOOR FINISH 02
INTERIOR FLOORING ACCENT
Material: Terrazzo
Color: White (Matrix aggregate TBD)
Surface Finish: Smooth, slip-resistant



FLOOR FINISH 03
FLOOR LITES
Material: Translucent low iron glass
Color: None
Surface Finish: Anti-slip texture
BOD Product: Seves Glassblock, Circle Redmont, Glass Flooring Systems



FLOOR FINISH 04
INTERIOR TACTILE FLOORING
Material: FRP
Color: Yellow
Surface Finish: Dots

FLOOR FINISH 05
EXTERIOR TACTILE FLOORING
Material: GFRC
Color: Grey
Surface Finish: Dots

FLOOR FINISH 06
TYPICAL EXTERIOR FLOORING / STREET LEVEL ENTRY FLOORING
Material: Granite
Color: Grey
Surface Finish: TBD
Filed Tile Size: TBD

7.4.7 Ceilings

Typical ceilings throughout the system are designed to incorporate lighting and services in a clean, well-organized fashion.

Typical primary and secondary entrance structures are not to have applied ceiling finishes, only exposed architectural concrete and skylights.

The module and arrangement of ceiling finish modules are to align with adjacent surface joints and patterns.

7.4.8 Entrance Pavilion

No applied finishes. Exposed architectural concrete surfaces structure that has adequate weather barrier and insulation for the Dallas climate.

7.4.9 Horizontal Connector and Concourse

- A uniform plane of horizontal baffles.
- Services run above the baffles.
- Lighting fixtures, signage and other suspended elements sit between the baffles

7.4.10 Platform Shaft

- A molded, illuminated surface
- Integrated lighting

7.4.11 Platform

- A uniform plane of horizontal baffles.
- Services run above the baffles.
- Lighting fixtures, signage and other suspended elements sit between the baffles.

CEILING FINISH 01
ENTRY PAVILION CEILING (MAIN & SECONDARY)
Material: Exposed architectural concrete structure
Color: White
Surface Finish: Smooth
BOD: BPDL white precast
Alternate: Molded GFRC over steel structure

CEILING FINISH 02
HORIZONTAL CONECTOR CEILING
Material: Suspended acoustic metal baffle ceiling
Color: Grey
Surface Finish: Smooth, perforated
BOD Product: Linder baffle ceiling, Certainteed Tavola

CEILING FINISH 03
PLATFORM SHAFT CEILING
Material: Molded GFRC
Color: White
Surface Finish: Smooth, matte, perforated option
BOD Product: Formglas GFRC

CEILING FINISH 04
PLATFORM CEILING
Material: Suspended acoustic metal baffle ceiling
Color: Grey
Surface Finish: Smooth, perforated
BOD Product: Linder baffle ceiling, Certainteed Tavola

7.4.12 Architectural Lighting

Illumination is an important element in successful building and passenger experience design. To perform efficiently, it should provide clarity for wayfinding, improve safety and security, delineate station boundaries and elevate the station environment. Successive design iterations should allow for additional elements such as ambient and task lighting with a combination of different color temperatures to further enhance the passenger experience.

Here are the general lighting goals:

- Establish a secure space.
- Provide a welcoming and comfortable environment.
- Clarify signage and wayfinding.
- Complement station architecture and details.
- Enhance or become part of the Art Program.
- Be energy efficient, durable and easily maintainable.
- Encourage natural lighting.
- Reduce light pollution, glare and unnecessary brightness.
- Include non-illuminated solutions such as phosphorescent signs and emergency strips.
- Be coordinated with all design trades such as security and safety, signage, communications, maintenance, environmental control systems, sustainability, etc.
- Compliant with minimum illumination levels required for emergency egress.

Station Artwork – Stockholm Subway

7.4.13 Art Integration

Art is an important element in Transportation Architecture and an important tool to improve wayfinding and passenger experience. Art should be considered at the early stages of station planning. Art should be integral, and not be limited by prescribed locations or modes.

See attached exhibit for examples of appropriate integrated art locations.

7.4.14 Concessions Program

The basis of design for the underground stations do include locations that have been identified as possible concessions spaces. Currently, DART does not have a concessions program and has yet to tap into this highly lucrative revenue stream.

In the U.S., food and beverage concessions generally occupy the majority of the areas allocated to concessions and are the most productive in terms of sales and revenue.

The types of food and beverage that could be offered in the stations include:

• Quick-serve – These spaces usually offer specialized meals, snacks, and nonalcoholic beverages, typically using counter service.

• Specialty coffee – These spaces usually offer premium coffee and espresso drinks, tea, pastries, juices, and, in most cases, packaged sandwiches and salads. These locations are perfect for the passenger on their way in and out of the station.

On average, 73% of passengers will on average make a purchase at a concessions location if provided. Of that group, 68% make a food and beverage purchase, 25% make a newsstand purchase, and 11% make a specialty retail purchase.

7.5 HVAC and Climate Design

HVAC design parameters for the stations shall be in accordance with the following:

- Systems shall be high efficiency to meet ASHRAE standards and, where required by code, to exceed ASHRAE requirements for energy efficiency.
- Rooms subject to infiltration of dust from Train movements shall have systems that provide positive room pressure.
- Rooms containing equipment that requires condition control shall be designed to suit the equipment in accordance with the manufacturer's recommendations or the occupancy requirements, whichever are the most stringent.
- Rooms that are occupied or frequently occupied shall be provided with outside air requirements per person as defined in ASHRAE, and, if found to be applicable, air conditioning, based on the number of occupants, and heated, all to suit staff comfort conditions.
- Rooms that are infrequently occupied and do not require condition control for equipment shall have a minimum air change rate as determined to suit the room functions.
- Rooms that contain equipment that may give off airborne particles or odors shall be exhausted to outside.
- Washrooms shall be exhausted to outside.

- Battery rooms shall be exhausted to outside via run and standby exhaust fans.
- Make-up air shall be provided as required to suit room HVAC design.
- Room maximum design temperatures shall be selected to suit the room function and occupancy.
- Where feasible, cooling shall be provided by introducing ambient (outside) air and economizer cycles. Where the use of outside air results in unacceptable air change and flow rates, Project Co shall provide mechanical air conditioning.
- Outside air intakes shall be located to avoid the introduction of dirt, debris, fumes, odors, noise, irritants and biological agents from traffic and other external sources.
- The air filters shall be standardized in type and sizes to the extent possible. Filtration efficiencies shall be selected based on the facility or room the equipment is serving
- Natural gas-fired equipment shall not be permitted inside underground facilities.
- Daylighting and skylight performance to be verified for heat gain conditions and openness in subsequent design iterations.
- Provide temperature, ventilation, and draft control that provides maximum comfort with minimum capital and maintenance costs.
- Provide necessary conditions for the proper operation of all mechanical, train control, electrification, lighting and auxiliary electrical systems.
- Provide for public and employee safety.

Indoor Air Quality (IAQ) shall meet the requirements of ASHRAE Standards 62-89.

7.6 Building Systems Integration

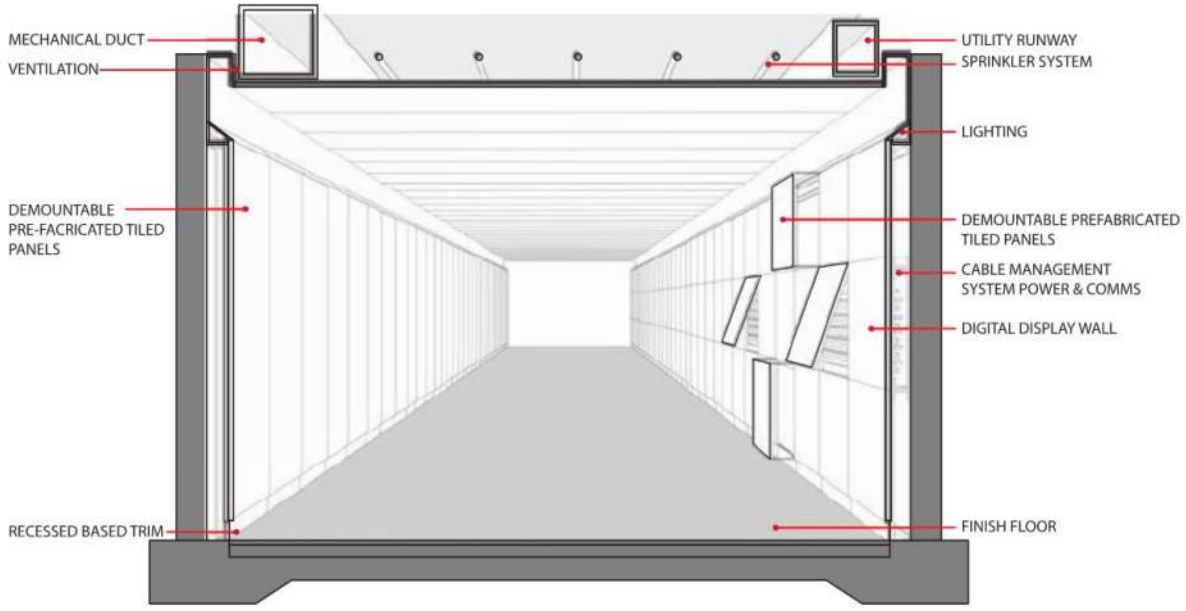
While HVAC, public address systems, lighting and acoustics are essential to the stations environment, further design iterations should be cautious about providing extraneous elements that may cause distracting information.

Visual clutter from the proliferation of materials, advertising, signage, HVAC, sprinklers, conduits, and service equipment cause passenger confusion and should be addressed by careful coordination of work. Intuitive wayfinding through architecture, materials, or art can be an effective navigational tool. They can help with learning the system and building mental maps as long as the services are seamlessly coordinated with building structures and finishes.

We have proposed and considered the following strategies for building systems integration:

- Cavity Ceilings
- Cavity Walls
- Subflooring raceways

- Consolidated ceiling plan raceways
- Top of edge of platform doors raceway



INTEGRATED SERVICES

7.7 Station Furniture

Urban streets shall encourage rich and exciting urban interrelations. Furnishings and equipment shall provide added passenger comfort and convenience, reduce maintenance and help ensure functional efficiencies. They shall be strategically located to be protected with awnings, trees and other shading devices from the strong Dallas sun.

Provide durable, functional, theft-resistant and attractive street and onsite furniture. These include (but not limited to): benches, leaning rails, drinking fountains, transparent trash and recycling receptacles, emergency help point units, illuminated bollards, bike racks, planters, grating, etc. All shall comply with applicable local code and ADA accessibility requirements.

8 STREET IMPACTS AND MODIFICATIONS

8.1 Streets within D2 Alignment Corridor

The D2 alignment impacts nine streets at-grade from Victory Avenue to McKinney Avenue. In order to achieve the minimum vertical clearance under Woodall Rodgers Freeway, the D2 vertical alignment drops the elevation of McKinney Avenue impacting the intersections of Old Griffin Street and Laws Street along McKinney Avenue. After crossing McKinney Avenue,

the D2 alignment transitions from at-grade to subway via an open-cut portal and cut-and-cover tunnel impacting nine streets from Corbin Street to Elm Street, including N. Griffin Street. The D2 alignment continues in a mined/bored tunnel, below the N. Griffin Street and Commerce Street corridors from south of Elm Street to Harwood Street. This segment of the alignment does not impact the nine streets from Main Street to Harwood Street. However, Akard Street and Commerce Street, between Lane Street and Ervay Street, have impacts associated with the Commerce Station facilities. After Harwood Street, the D2 alignment transitions from subway to at-grade via cut-and-cover tunnel and open-cut portal impacting seven streets from Harwood Street to west of Hawkins Street, including Commerce Street. Special attention to the IH-345 bridge foundations along the open-cut portal is critical, including coordination with TXDOT. The D2 alignment, including the wye and realigned SE-1 (or Green Line), impacts eight streets at-grade, including N. Good Latimer Expressway (northbound and southbound) from Live Oak Street to Monument Street. Existing conditions of each street within the D2 alignment guideway are described below. Streets over the mined/bored tunnel segment are listed below as No Impact. See **Error! Reference source not found.**B - **Error! Reference source not found.** for the impacts and modifications for each street.

8.1.1 Victory Avenue

Victory Avenue is a two-way concrete roadway that runs north and south parallel to the DART/ TRE track. Victory Avenue is located between the American Airlines Center and the TRE tracks. Victory Avenue has four lanes.

Reconstruction of roadway with at-grade crossing. Intersection to become signalized.

8.1.2 Victory Park Lane

Victory Park Lane is a two-way concrete roadway that runs north and south. Victory Park Lane is a two lane road with recessed parking along the curb and gutter and sidewalk.

Reconstruction of intersection for pedestrian only through movements. Vehicular traffic limited to right hand turns only at this intersection utilizing curb and signage.

8.1.3 Houston Street

Houston Street is a four lane, one-way northbound traffic concrete roadway that runs north and south parallel to the DART/ TRE track. The traffic flow for Houston Street is toward the north.

Reconstruction of roadway with at-grade crossing. Intersection to become signalized.

8.1.4 Museum Way

Museum Way is a two-way concrete roadway that runs east and west. Museum Way is a four lane divided street with raised median. The raised median is approximately twelve feet

wide, it contains several trees, ground cover and grass. There is residential parking along the raised median.

Reconstruction of roadway with alignment located within median. Cross-section change (1x10' lane in each direction plus bike/parking lane) between face of sidewalk curbs only.

Due to varying track spacing within curved double track alignments, the existing curbs along the curved track alignment may need to be replaced. Final civil designer will coordinate with final track designer to eliminate or minimize the limits of impact beyond the existing back of curb.

8.1.5 River Street

New street to be added in future. Width and traffic direction to be determined in next phase of project. In coordination with local stakeholders, DART will be providing a crossing for River Street at the north end of the Museum Way Station platform. The reconstruction and connection of River Street to the new crossing will be done by others.

Coordination with developers will be needed.

8.1.6 Broom Street (Woodall Rodgers Southbound Frontage Road)

The Southbound Frontage Road is a one-way roadway. It is a concrete roadway with three lanes of traffic.

Broom Street is proposed to be realigned to accommodate the placement of the Museum Way Station platform. Additionally, the profile will be pushed down to provide clearance under the Woodall Rodgers entrance ramp. Signage and active clearance sensors to be added for low clearance of catenary wires. Gates and flashers will be added.

8.1.7 McKinney Avenue (Woodall Rodgers Northbound Frontage Road)

The Northbound Frontage Road is a one-way roadway. It is a concrete roadway with three lanes of traffic.

The McKinney Ave profile is being pushed down, signage and active clearance sensors to be added for low clearance of catenary wires. Gates and flashers will be added.

8.1.8 Old Griffin Street

Old Griffin Street is a 1-lane 1-way with street parking along both sides of the roadway. It tees into McKinney Avenue.

Old Griffin Street to be reconstructed to tie in proposed McKinney Avenue with the same pavement configuration.

8.1.9 Laws Street

Laws Street is 1-lane 1-way with one side-street parking roadway. It tees into Mckinney Avenue.

Laws Street to be reconstructed to tie in proposed Mckinney Avenue with the same pavement configuration.

8.1.10 Corbin Street

Corbin Street to be permanently closed due to location of portal.

8.1.11 Hord Street

Hord Street is a 2-lane, 2-way roadway to be reconstructed over the cut and cover section of the guideway.

8.1.12 Ross Avenue

Ross Ave is a 4-lane, 2-way w/ 1- left turn lane roadway to be reconstructed over the cut and cover section of the guideway.

8.1.13 San Jacinto Street

San Jacinto Street is a 3-lane, 1-way roadway to be reconstructed over the cut and cover section of the guideway.

8.1.14 Patterson Street

Patterson Street is a 2-lane, 1-way w/ 1-side-street parking roadway to be reconstruct to tie in Griffin Street over cut & cover Metro Center Station

8.1.15 Griffin Street

Griffin Street is a 6-lane 2-way roadway to be reconstructed over the cut and cover section of the guideway.

8.1.16 Pacific Avenue

Pacific Ave to be reconstructed over the cut and cover section of the guideway.

8.1.17 Elm Street

Elm Street to be reconstructed over the cut and cover section of the guideway.

8.1.18 Main Street

No impact to Main Street is expected.

8.1.19 Field Street

No impact to Field Street is expected.

8.1.20 Akard Street

Akard Street is a two lane two way road that ends at Commerce Street. Akard Street consists of HMAC and has concrete curb and gutter with concrete sidewalk adjacent to the curb.

Akard Street to be reconstructed over the cross passage access from the Pegasus Headhouse to the underground Commerce Street Station platform.

Final Designer should coordinate with the City of Dallas to accommodate pedestrians in this area to allow them access from Main Street to Commerce Street. This access doesn't necessarily need to be maintained at Akard Street. In addition, during any closures of this block of Akard Street for construction, accommodations should be provided for the ability for waste pick-up currently done on Akard Street to be completed somewhere in the area.

8.1.21 Brower Street

Brower Street is a brick-paver street. Over mined track tunnel; no impact to the street

8.1.22 Lane Street

Lane Street is a 2-lane, 2-way w/ 2-side-street parking roadway. Over mined track tunnel; no impact to the street

8.1.23 Ervay Street

Ervay Street is a three lane one-way road that runs north. Ervay Street consists of HMAC and has concrete curb and gutter with concrete sidewalk adjacent to the curb.

Over mined track tunnel; no impact to the street

8.1.24 St. Paul Street

St. Paul Street is a three lane one-way the runs south. St. Paul Street consists of HMAC and has concrete curb and gutter with concrete sidewalk adjacent to the curb.

Over mined track tunnel; no impact to the street

8.1.25 Harwood Street

Harwood Street is a four lane two-way roadway. Harwood Street consists of HMAC and has concrete curb and gutter with concrete sidewalk adjacent to the curb.

Over mined track tunnel; no impact to the street

8.1.26 Commerce Street

Commerce Street is a 5-lane, 1-way roadway and consists of HMAC and concrete curb and gutter with concrete sidewalks adjacent to the curbs.

The street to be rebuild in existing configuration over cut and cover track portion and modify lane configuration between Harwood Street and Pearl Street to 3 thru lanes, bumping out curb one lane on each side to allow for stop and go bus stop. Bump out curb one lane on south side of Commerce east of Pearl Street from intersection to first driveway for stop and go bus stop. Installing necessary signings and marking prior to approaching Hardwood Street for lane reduction.

8.1.27 Pearl Street

Traffic on Pearl Street runs south. It is five lanes north of Commerce Street and four lanes south of Commerce Street. Pearl Street consists of HMAC and has concrete curb and gutter with concrete sidewalk adjacent to the curb.

Pearl Street to be reconstructed over the cut and cover section of the guideway.

8.1.28 Main Street

Main Street is a 4-lane, 2-way with 2-side-street parking roadway and consists of HMAC, concrete curb and gutter with concrete sidewalk adjacent to the curb. The street to be reconstructed over the cut and cover section of the guideway w/ same the configuration.

8.1.29 Elm Street (Pearl Street to Cesar Chavez Boulevard)

Elm Street is a 4-lane 1-way with 1-side-street parking roadway and consists of HMAC and concrete curb and gutter with concrete sidewalks adjacent to the curbs. The street to be reconstructed with existing configuration over the cut and cover section of the guideway but add a one lane width curb bump out from Pearl Street intersection east for 3 bus lengths on the north side for stop and go bus stop.

8.1.30 Cesar Chavez Boulevard

Cesar Chavez Boulevard is a 6-lane divided, 2-way w/ 1-left turn lane roadway on south side of Pacific Ave and a 6-lane divided, 2-way w/ 1-left & 1-right turn lane roadway on north side of Pacific Ave.

Cesar Chavez Boulevard to be reconstructed over the cut and cover section of the guideway with the same configuration except the right turn lane from EB Pacific Ave to NB Cesar Chavez Blvd will be closed.

8.1.31 IH 345

Portal to be built adjacent to bridge foundations. Coordination with TxDOT required by Final Designer. Final designer responsible for coordination with TxDOT in the area of IH-345 for temporary and permanent impacts.

8.1.32 Live Oak Street

Miranda Street is a 5-lane 2-way roadway consists of HMAC and concrete curb and gutter with concrete sidewalks Reconstruction of roadway with at-grade crossing, removing Southbound Good Latimer Expressway left turn movement onto Live Oak St. Intersection to remain signalized.

8.1.33 Good Latimer Expressway

Good-Latimer Expressway is a four-lane two-way roadway separated by a curbed median. Good-Latimer Expressway consists of HMAC and has concrete curb and gutter with sidewalk adjacent to the outer curbs and some street parking bays along SB.

Good Latimer Expressway to be reconstructed with the same configuration and some new alignments.

During the Final Design and Construction of the D2 Subway Project and associated reconstruction of Good Latimer Expressway, all efforts must be expended to minimize impacts to the St. James AME Temple located at 624 North Good Latimer Expressway. The St. James AME Church building, recognized as Dallas Landmark in 2000, was constructed in 1919-1921 in Neoclassical style, designed by African-American architect William Sydney Pittman and constructed entirely by African American contractors, workers, and electricians. It housed the St. James congregation for sixty-four years and now owned by the Meadows Foundation and Mental Health America-Dallas for office space. Due to the limited right-of-way within Good Latimer Expressway, a 5-foot-wide portion of property on the west/front side of the church would be acquired to accommodate necessary right-of-way for the Live Oak Station, needed ADA access, street and sidewalk reconstruction. The proposed design would require removing the concrete steps in front of the gate/fence, and raising the proposed sidewalk to meet the profile of the fence. In addition, one tree and the historical marker on the northwest corner of the church property would need to be removed and relocated at location to be determined by City of Dallas. Particular care must be afforded during construction to minimize any further impact and disruption to this resource during construction.

Good Latimer Expressway Southbound (from Live Oak Street to Pacific Avenue) – Gates and flashers to be installed at Southbound Good Latimer Expressway prior to approaching Swiss Avenue.

Good Latimer Expressway Northbound (East of Pacific Avenue) – reconstruction of roadway and at-grade crossing including reconstruction of gates and flashers.

8.1.34 Swiss Avenue

Swiss Avenue is a 2-lane 2-way w/ 2-side-street parking roadway and consists of HMAC and concrete curb and gutter with concrete sidewalks adjacent to the curbs.

Swiss Avenue between Hawkins St and SB Good Latimer Expressway -- reconstruction of roadway with at-grade crossing to become one-way westbound.

Swiss Avenue East of NB Good Latimer Expressway - reconstruction of roadway with the existing roadway configuration.

8.1.35 Florence Street

Florence Street is a 2-lane 2-way w/ some street parking roadway and consists of HMAC and concrete curb and gutter. Reconstruction of Florence Street approaches.

8.1.36 Miranda Street

Miranda Street is a 2-lane 2-way roadway consists of HMAC and 1-side concrete curb and gutter with concrete sidewalk adjacent to the curb

Miranda Street to be closed and removed between Hawkins and Good Latimer

8.1.37 Gaston Avenue / Pacific Avenue

Miranda Street is a 4-lane 2-way w/1-left turn lane roadway and consists of concrete pavement with concrete sidewalks

Pavement to be reconstructed with at-grade crossing. Intersection to remain signalized

8.2 Methodology and Analysis

A Traffic Operations Analysis Technical Memorandum, including No-Build and Build AM & PM Models, will be prepared for the next preliminary engineering design submittal.

9 GEOTECHNICAL CONSIDERATIONS

9.1 Geotechnical Data

Design of DART D2 underground structures incorporated geotechnical considerations. Refer to Preliminary Engineering Geotechnical Inventory and Concept Design Report for a summary of currently available project-specific geotechnical information. Specifically, this concept design report consists of a compilation of four memoranda including two geotechnical design memoranda addressing geotechnical issues associated with ground characterization and geotechnical evaluation of critical structures.

9.2 Key Geotechnical Site Features

Passing beneath the densely congested Central Business District of Dallas, the DART D2 alignment presents site constraints to be considered during design of underground structures. See TM #16 – Utility Conflicts at Portals and Underground Stations, AMCR and Existing Utility Composite plans to identify utility conflicts. Specific site constraints affecting the design of underground structures include:

- Buried storm sewer under Commerce Street
- Sanitary sewer under Commerce Street within the future station footprint

The running tunnel alignment will be mined predominantly through limestone (Austin Chalk formation more than 50% of the alignment length) and Eagle Ford Shale. Design excavation and support of underground structures must account for the following adverse geotechnical features associated with these rock formations:

- Presence of near horizontal, low-angle bedding in chalk which may pose potential excavation instability. This could result in overhead roof slabbing in crown and possible overbreak in arches of openings.
- Slaking of the marl and shale when exposed to air.
- Spalling potential of chalk resulting exposure to air.
- Presence of Karstic features in the Austin Chalk, including solution cavities and soil filled cavities.
- Natural combustible gases (methane) within the Austin Chalk and underlying Eagle Ford Shale requiring increased tunnel ventilation requirements.

10 SYSTEMS

Final Designer to coordinate with DART on systems requirements that are currently in development.

Refer to the following documents for additional information:

- Basis of Design Report for Systems that includes:
    - Signals -In-depth summary
    - OCS - High Level summary for Overhead Conductor Rail (OCR) to be considered as an option along with Auto-tension & Fixed Termination configurations
    - Communications - high level, 1 paragraph
- Technical Memorandum - Overhead Conductor Rail
- DC Traction Power Loadflow Report

Appendix A. As-built Summary Table

As-built files are separate.

As-Built Summary

	Description	Source	Notes
1	Jett Way - Design Plans, Preliminary Plat	Westdale	20190506_CAD File.dwg C-102_RTF4 Replace.pdf
2	Browder Mall - Design Plans	City of Dallas	April 2012 (Browder St Mall.pdf)
3	Dallas Water Utilities - Commerce Street	City of Dallas	W-WW Plans - April 2018; 21-month Reconstruction beginning Spring 2019
4	Storm Drainage plans	City of Dallas	Refer to D2_CofD-Drainage As builts list.xlsx
5	Drainage information	City of Dallas	See City of Dallas - Drainage Information table
6	Street information	City of Dallas	See City of Dallas - Street Information table
7	DART System information	DART	See DART Information table
8	Existing Building Plans	Various	Refer to Existing Building Plans Location Map and Table
9	Existing Utilities As Builts	Various	See Various Folders by Company. Files marked with ! indicate they were used in creation of composite drawings.
10	IH 345 survey information	TxDOT	3D DTM file , .tin file, and planimetrics file
11	Woodall Rogers / Perot Parking		.dwg and .pdf
12	Hines Development (Victory One in Victory Park)	Hines	Development plans

City of Dallas Drainage Information
Filename
421Q-716_2 Harwood Canton.tif
421Q-716_1 Harwood Canton.tif
421Q-5671-Woodall Rodgers -Storm Drainage.pdf
421Q-479-Street Storm Sewer Eakin to Pacific.pdf
421Q-4264 - Houston Street (Elm St -Lamar St).pdf
421Q-3679 Storm Sewer Relocation (Lamar St from Commerce to Main).pdf
421Q-2518_2518A - Akard, Ervay, Young, Marilla, East Service.pdf
421Q-186_1 (Field St From Pacific to Young).tif
421Q-165_1 (River & Broom).tif
421Q-1019 Griffin St (Ross to Jackson).pdf
421Q-1005_1-1.tif
421Q-1005 - Town Branch Storm Sewer - (Mrkt to Harwood).pdf
421P-94.tif
421P-137_1-1.tif
421P-134_1-2.tif
421B-3_1-1.tif
421-89_1-1.tif
421-87_1-1.tif
421-72-Storm Sewer Pacific.pdf
421-70_1-1.tif
421-69_1-1.tif
421-37_1-1.tif
421-364_1-1.tif
421-21 (1-6).pdf
421-195_1-1.tif
421-106_2-2.tif
421-106_1-2.tif
421 17 - Commerce Street.pdf

City of Dallas Street Information
Filename
311-33_1-1.tif
311-44_1-1.tif
311-47_1-1.tif
311-94_1-1.tif
311-123_ (Wood St between Ervay & Harwood).pdf
311-124 Young Street (Harwood St. to Akard).pdf
311-132_1-1 (Harwood St -Jackson & Main).tif
311-133_1-1 Harwood St (Jackson & Forrest Ave).tif
311-151-(Lamar St. Paving Plat).pdf
311-152 Lamar Plat (McKinney Ave & Pacific).pdf
311-814.tif
311-815.pdf
311D-742_1-2 Young at Harwood Paving.tif
311D-742_2-2 Young at Harwood Paving.tif
311D-1414_1-2 (Young at Wood Paving).tif
311D-1414_2-2 (Young at Wood Paving).tif
311D-1857_1-1 (Griffin Street - Commerce to Jackson St).tif
311D-1993 - Griffin St (Jackson St to Young St).pdf
311D-2669_1-1 (Young Street Parking Lot).tif
311D-2736_1-14-Akard, Ervay, Young, Marilla, East Service.pdf
311D-2736A_1-1 Lamar Park Improvements.tif
311D-3038- Young Street.pdf
311D-3038-Lamar St to Griffin-Cross sections.pdf
311D-3038-Young St. (From Houston St. to Ervay St).pdf
311D-3038(Young and Wood) Drainage-Street Mod.pdf
311D-3038_1-1.tif
311D-3038_1-1a.pdf
311D-3038_1-2 Young Street Improvements (Laterals).pdf
311D-3038_1-3.tif
311D-3038_1-10.tif
311D-3038_1-10sht.pdf
311D-3038_3sht.pdf
311D-3038_E (Young St-Wood St. Connection Landscape & Pavement).pdf
311D-3038_E (Young St-Wood St. Connection Landscape Lighting).pdf
311D-3038_E (Young St-Wood St. Connection Mechanical Plans).pdf
311D-3038_E (Young St-Wood St. Connection Traffic).pdf
311D-3038_I (Young St-Wood St. Connection Irrigation Plan).pdf
311D-3038_Young Street Development Arch Plans.pdf
311D-3038E_12-14.tif
311D-3161-Houston Street (Elm St -Lamar St).pdf
311D-3889_3-4.tif
311D-3889_24-Southport Improvements - Lagoon, Bonnie View.pdf
311D-4108- Centeral Blvd from Young St to Pacific Ave.pdf
311D-4120 - Field St (Pacific St to Wood).pdf
311D-4121_Houston Street Four Intersections Street Improvement.pdf
311D-4164 - Streetscape Improvements (Akard-Commerce-Elm).pdf
311D-4167-St. Mary Avenue From Terry to Garland.pdf
311D 3161A - San JacintoSt, Pacific Ave & Lamar st.pdf
316Q-7 (Forrest Ave Cross Sections).pdf
321R-44_1-1.tif
331Q-87_1-1.tif
331Q-198.tif
331R-7_1-1.tif

City of Dallas Street Information
Filename
331W-25.pdf
332-118 Wood Street Extension.pdf
332-118.pdf
332P-23.pdf
332Q-189.pdf
333Q-15.tif
334B-23_1-1.tif
334B-33_1-1.tif
334B-77_1-1.tif
334Q-4_1-1.tif
336Q-95_1-1.tif
D2-Museum Way Stn plans2016-04-21-152439.pdf
Lamar Street Paving Improvements.pdf

DART Information	
Folder	***Filename***
Bryan-Hawkins Civil and Track	Bryan-Hawkins Plan and Profile.pdf
	Bryan Hawkins Trackwork.pdf
CityPlace	CityPlace As-Builts.pdf
I-3 Specification	Attachment 9.c.1 - Introduction for Design Criteria Standards Specifications.pdf
	Attachment 9.c.10 - Facilities Standard Specifications.pdf
	Attachment 9.c.11 - Supplemental Standard Specifications (Facilities).pdf
	Attachment 9.c.12 - Standard Specifications (Systems).pdf
	Attachment 9.c.13 - Standard Supplements to Systems Standard Specifications.pdf
NC1A Plan and Profile	NC-1A Guideway Plan and Profile.pdf
	NC-1A Horizontal Alignment.pdf
	NC-1A NB Track Chart.pdf
NC1B Plan and Profile	NC-1B 1 to 244.pdf
	NC-1B 245 to 370AA.pdf
	NC-1B 370AB to 473.pdf
	NC-1B 474 to 680Q.pdf
Subfolder **Reports, Bore Logs and Specs**	Boring Logs Vol. 2.pdf
	Drainage Tunnel.pdf
	NC-1 Design Report.pdf
	NC-1B Final Ventilation Report.pdf
	Test Results Vol. 1.pdf
	Test Results Vol. 2.pdf
	Vol 1.pdf
	Vol 2.pdf
	Vol 3.pdf
	Vol. 1 Boring Logs.pdf
NW1 Civil and Track	NW-1 Plan and Profile.pdf
	NW-1 Trackwork.pdf
NW1A	Houston St to Turtle Creek Drawings.pdf
	Paving Drainage and Landscape Improvements for Lamar Street Extension Drawings.pdf
	TRE Continental Ave Bridge Drawings.pdf
NW1B	NW-1B Volume A.pdf
	NW-1B Volume B.pdf
	NW-1B Volume C.pdf
	NW-1B Volume D.pdf
	NW-1B Volume E.pdf
	NW-1B Volume F.pdf
	NW-1B Volume G.pdf
	Volume H Drawings.pdf

DART Information	
Folder	***Filename***
NW2 Civil and Track	NW-2 Plan and Profile.pdf
	NW-2 Trackwork.pdf
NW3 Civil and Track	NW-3 to NW Hwy Plan and Profile.pdf
	NW-3 to NW Hwy Trackwork.pdf
OC1 Civil and Track	OC-1 Guideway Plan and Profile.pdf
	OC-1 Horizontal Alignment.pdf
	OC-1 SB Track Profile.pdf
	OC-1 Track Drawings.pdf
SE1	SE-1 Volume A As-Builts.pdf
	SE-1 Volume B As-Bulits.pdf
	SE-1 Volume C As-Builts.pdf
	SE-1 Volume D As-Builts.pdf
	SE-1 Volume E As-Builts.pdf
	SE-1 Volume F As-Builts.pdf
	SE-1 Volume G As-Builts.pdf
SE1 Civil and Track	SE-1 Plan and Profile.pdf
	SE-1 Trackwork.pdf
TPSS	Attachment C - TPSS Information.pdf
	Nameplate Drawings.pdf
Subfolder **Arena TPSS**	0001.tif.pdf
Subfolder **Baylor TPSS**	0007.tif.pdf
	0138.tif.pdf
Subfolder **Fair Park TPSS**	0007.tif.pdf
	0138.tif.pdf
Subfolder **Portal TPSS**	1047.TIF.pdf
	1066.TIF.pdf
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	0007.tif.pdf
Subfolder **Viaduct TPSS**	0001.tif.pdf

Appendix B. Street Impacts and Modifications Matrix

Street Within D2 Alignment Corridor	Impact	Modifications	G/F Recommended based on Safety and Operations
Victory Ave	CBD-2 track alignment crosses street alignment at-grade.	Reconstruction of roadway with at-grade crossing. Intersection to become signalized.	No
Victory Park Lane	CBD-2 track alignment crosses street alignment at-grade.	Reconstruction of intersection for pedestrian only through movements. Vehicular traffic limited to right hand turns only at this intersection utilizing curb and signage.	No
Houston St	CBD-2 track alignment crosses street alignment at-grade.	Reconstruction of roadway with at-grade crossing. Intersection to become signalized. Coordination with City of Dallas bikeway project required.	No
Museum Way	CBD-2 track alignment is street median-running.	Reconstruction of roadway with alignment located within median. Cross-section change (1x10' lane in each direction plus bike/parking lane) between face of sidewalk curbs only.	No
River St	Future at-grade crossing.	Gates and flashers are NIC as they will be installed for the future at-grade crossing. Future roadway outside embedded track slab to be designed and constructed by others.	Yes (Future)
Broom St (Woodall Rodgers Southbound Frontage Road)	CBD-2 track alignment crosses street alignment at-grade.	Reconstruction of roadway with at-grade crossing in lowered and shifted alignment. Gates and flashers to be added. Signage and active clearance sensors to be added for low clearance of catenary wires.	Yes
McKinney Ave (Woodall Rodgers Northbound Frontage Road)	CBD-2 track alignment crosses street alignment at-grade.	Reconstruction of roadway with at-grade crossing in lowered alignment. Gates and flashers to be added. Signage and active clearance sensors to be added for low clearance of catenary wires.	Yes
Old Griffin St	Elevation drop at McKinney Ave intersection due to McKinney Avenue profile adjustment	Reconstruction of roadway, sidewalks and ramps to accommodate lowered alignment of McKinney Ave.	-
Laws St	Elevation drop at McKinney Ave intersection due to McKinney Avenue profile adjustment	Reconstruction of roadway, sidewalks and ramps to accommodate lowered alignment of McKinney Ave.	-
Corbin St	Portal location.	Closed due to location of portal.	-
Hord St	CBD-2 track alignment crosses below-grade via cut and cover tunnel.	Reconstruct in existing configuration over cut and cover track.	-
Ross Ave	CBD-2 track alignment crosses below-grade via cut and cover tunnel.	Reconstruct in existing configuration over cut and cover track. Intersection to remain signalized.	-
Old Griffin St	CBD-2 track alignment crosses below-grade via cut and cover tunnel.	Reconstruct in existing configuration over cut and cover track.	
San Jacinto St	CBD-2 track alignment runs parallel and below N. Griffin St. via cut and cover tunnel. DART decision pending for temporary and permanent disposition of San Jacinto between Griffin and Lamar.	Reconstruct intersection on west and east sides of N. Griffin St. in existing configuration over cut and cover track. Intersection to remain signalized.	-

Street Within D2 Alignment Corridor	Impact	Modifications	G/F Recommended based on Safety and Operations
Patterson St	CBD-2 track alignment runs parallel and below N. Griffin St. via cut and cover tunnel.	Reconstruct intersection on east side of N. Griffin St. in existing configuration.	-
N. Griffin St	CBD-2 track alignment runs parallel and below N. Griffin St. via cut and cover tunnel, including Metro Center Station. Alignment continues below N. Griffin St. via mined (or TBM) tunnel south of the Elm Street intersection.	Reconstruct street, sidewalks and ramps in existing configuration outside Metro Center Station limits over cut and cover track portion. Construct street, sidewalks and ramps modifications within Metro Center Station limits. No impacts above mined (or TBM) tunnel portion south of Elm Street intersection.	-
Pacific Ave	CBD-2 track alignment runs parallel and below N. Griffin St. via cut and cover tunnel.	Reconstruct intersection on west and east sides of N. Griffin St. in existing configuration over cut and cover track. Intersection to remain signalized.	-
Elm St	CBD-2 track alignment runs parallel and below N. Griffin St. via cut and cover tunnel.	Reconstruct intersection on west and east sides of N. Griffin St. in existing configuration over cut and cover track. Intersection to remain signalized.	-
N. Griffin St	No impacts over mined (or TBM) track tunnel, south of Elm St.	-	
Main St	No impacts over mined (or TBM) track tunnel.	-	-
Commerce St	CBD-2 track alignment runs parallel and below Commerce St. via mined (or TBM) tunnel, including Commerce Station, between N. Griffin St and Harwood St. No impacts over mined (or TBM) track tunnel.	Bus lane, between Lane St. and Ervay St., to be changed to sidewalk. Reconstruct street, sidewalks and ramps at cut and cover tunnel limits between Harwood St. and Pearl St.	-
Field St	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
Akard St	Cut and cover for station/pedestrian access between Main St. and Commerce St.	Reconstruct in existing configuration over cut and cover construction.	-
Browder St	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
Lane St.	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
Ervay St	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
Prather St.	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
St. Paul St	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
Harwood St	No impacts over CBD-2 mined (or TBM) track tunnel.	-	-
Commerce St	CBD-2 track alignment continues parallel and below Commerce St. via cut and cover tunnel from Harwood St. to Pearl St.	Reconstruct in existing configuration over cut and cover track portion and modify lane configuration between Harwood Street and Pearl Street to 3 thru lanes, bumping out curb one lane on each side to allow for stop and go bus stop. Bump out curb one lane on south side of Commerce east of Pearl Street from intersection to first driveway for stop and go bus stop.	-
Pearl St	CBD-2 track alignment crosses below-grade via cut and cover tunnel.	Reconstruct in existing configuration over cut and cover track. Intersection to remain signalized.	-

Street Within D2 Alignment Corridor	Impact	Modifications	G/F Recommended based on Safety and Operations
Main St	CBD-2 track alignment crosses below-grade via cut and cover tunnel, including CBD East Station.	Reconstruct in existing configuration over cut and cover track. Intersection to remain signalized.	-
Elm St	CBD-2 track alignment crosses below-grade via cut and cover tunnel, including CBD East Station.	Reconstruct in existing configuration over cut and cover track but add a one lane width curb bump out from Pearl Street intersection east for 3 bus lengths on the north side for stop and go bus stop.	-
Pacific Ave	CBD-2 track alignment crosses below-grade via cut and cover tunnel at Pacific Ave/Cesar Chavez Blvd intersection.	Reconstruct in existing configuration over cut and cover track. Intersection to remain signalized.	-
N. Lamar St	Metro Center Station Intermodal Transportation Center Facilities constructed below grade	Reconstruct in existing configuration over the underground facilities	
Cesar Chavez Blvd	CBD-2 track alignment crosses below-grade via cut and cover tunnel at Pacific Ave/Cesar Chavez Blvd intersection.	Reconstruct in existing configuration over cut and cover track. WB Pacific Ave to NB Cesar Chavez Blvd turn lane to be closed.	-
IH 345	CBD-2 track alignment in portal crosses under IH 345.	Portal U-Walls to be built adjacent to bridge foundations.	-
N Central Expy	CBD-2 track alignment in portal.	Closed due to location of portal U-Walls.	-
Hawkins St	CBD-2 and Wye track alignments cross street alignment at-grade.	Reconstruction of roadway with at-grade crossing in revised alignment to align with Jett Way. Gates and flashers to be added.	Yes
Miranda St	CBD-2 and Wye track alignments cross street alignment at-grade.	Close and remove street between Hawkins St. and N. Good Latimer Expy.	-
N. Good Latimer Expy - Southbound (beween Live Oak St and Pacific Ave)	SE-1 (Green Line) realignment is median-running. Wye and CBD-2 track alignments cross at-grade.	Reconstruct of roadway with at-grade crossings. Gates and flashers to be added.	Yes
N. Good Latimer Expy - Northbound (between Swiss Ave and Live Oak St)	SE-1 (Green Line) realignment is median-running. Live Oak Station impacts roadway. ROW will be needed along east side of the road to accomdate the roadway realignment	Reconstruct of roadway to accommodate Live Oak Station.	No
Live Oak St	SE-1 track realignment crosses street alignment at-grade.	Reconstruction of roadway with at-grade crossing, removing SB Good Latimer Expy left turn movement onto Live Oak St. Intersection to remain signalized.	No
Florence St	SE-1 track realignment crosses existing street alignment at-grade. Through-traffic movements across N. Good Latimer Expy to be eliminated due to Live Oak Station location.	Approaches to N. Good Latimer Expy to be reconstructed.	-
Swiss Ave	Wye track alignment crosses street alignment at-grade.	Reconstruction of roadway with at-grade crossing. Swiss Ave between Hawkins St and N. Good Latimer Expy to become one-way westbound. Gates and flashers to be added for SB Good Latimer Expy approaching Swiss Avenue.	Yes
Pacific Ave / Gaston Ave	CBD-2 and SE-1 track alignments cross street alignment at-grade.	Reconstruction of roadway with at-grade crossing. Intersection to remain signalized	No

Street Within D2 Alignment Corridor	Impact	Modifications	G/F Recommended based on Safety and Operations
N. Good Latimer Expy - Northbound (between Monument St and Gaston Ave)	SE-1 track realignment crosses street alignment at-grade.	Reconstruction of roadway and at-grade crossing including reconstruction of gates/flashers.	Existing to be reconstructed

Appendix C. Architectural

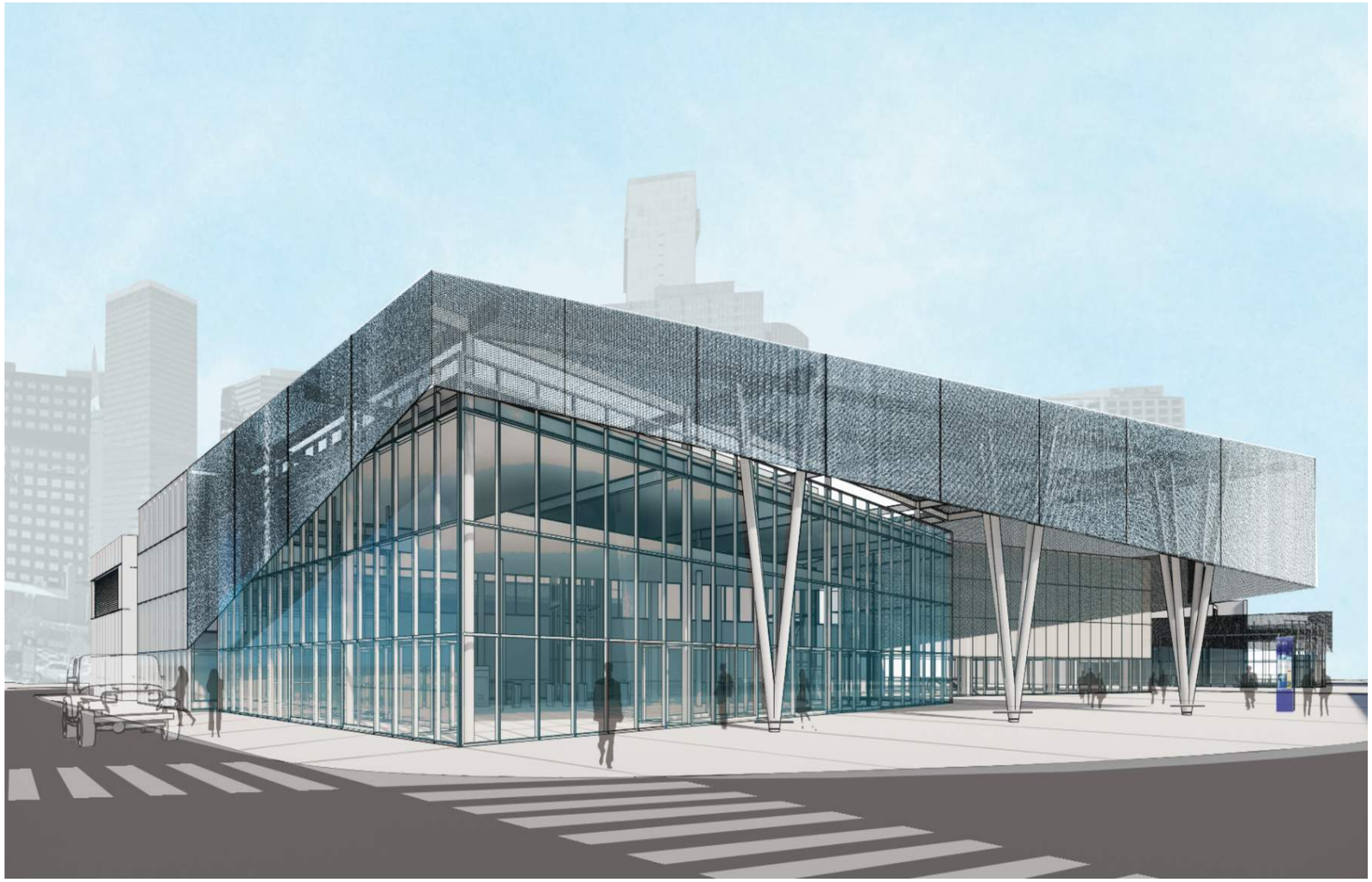
See TM #1 for architectural considerations and platform sizing.

See the following Architectural Reports for additional information.

- Emergency Exiting Analysis for Metro Center Station
- Emergency Exiting Analysis for Commerce Station
- Emergency Exiting Analysis for CBD East Station
- Station Capacity Analysis Matrix and Email from DART
- Station Room Schedule

APPENDIX C - Architectural

March 6, 2020



CONTENT

12 Architectural Tech Memo

12.1 Architectural Diagrams
12.1.1 Metro Center Station Amenities Diagram
12.1.2 Commerce Station Amenities Diagram
12.1.3 CBD East Station Amenities Diagram

12.2 Architectural Drawings (Supplemental)
12.2.1 Metro Center Station Presentation Drawings
12.2.2 Commerce Station Presentation Drawings
12.2.3 CBD East Station Presentation Drawings
12.2.4 Metro Center Station Axonometric Plans
12.2.5 Commerce Station Axonometric Plans
12.2.6 CBD East Station Axonometric Plans
12.2.7 Metro Center Station Axonometric Sections
12.2.8 Commerce Station Axonometric Sections
12.2.9 CBD East Station Axonometric Sections

12.3 Architectural Renderings
12.3.1 Metro Center Station Renderings
12.3.2 Commerce Station Renderings
12.3.3 CBD East Station Renderings

12.4 Architectural Reports
12.4.1 Emergency Exiting Analysis for Metro Center Station
12.4.2 Emergency Exiting Analysis for Commerce Station
12.4.3 Emergency Exiting Analysis for CBD East Station
12.4.3 Station Capacity Analysis Matrix and Email from DART
12.4.3 Station Room Schedule

DRAFT Memorandum

Date:	Friday, March 06, 2020
Project:	Downtown Dallas Second Light Rail Alignment Project (D2)
To:	Ernie Martinez, D2 Project Manager
From:	Gregory Tallos, HDR Engineering Inc.
Subject:	D2 Subway Technical Memorandum – Architectural Considerations

Purpose

This Technical Memorandum is intended to be used as the initial basis of design for tunnel, structural, architectural, ventilation, MEP, systems, civil, utility, ROW and MOT designs. This memorandum will include the following architectural items:

1. Passenger Capacity / Ridership
2. Level of Service
3. Station
4. Station sizing, including station length, min and max platform length and width, based upon patronage data
5. NFPA 130 Draft Analysis
6. IBC Code Requirements
7. Station facility space planning used for configuration and space proofing.

Passenger Capacity / Ridership

Reference Preliminary Engineering Design Report (20 % Submittal) Appendix C_1.4.4 for Station Capacity Analysis Matrix and Email from DART.

Level of Service

Level of Service (LOS) refers to a classification scheme developed by John J. Fruin, in which classes A to F are applied according to the space available for individuals. Class A corresponds to the situation where people have plenty of space around them, and at the other extreme, class F means congestion.

It was decided during the September 14th, 2018 meeting with DART officials, that Level of Service B (LOS B) will be used as a starting point for the calculations. For queuing, this LOS B is generally accepted to be about 10 ft^2 per person.

Underground Station Descriptions

Metro Center Station

Metro Center Station has two sets of tracks centered on a single platform. Total length of the platform is 472’-6” by 30’-8” which includes the ancillary spaces at either end of the platform and the distance from train to train. The area allocated for the train boarding and deboarding, and allocated space passenger waiting is 384’-10” by 26’-0”. Tracks run north and south in line with Griffin Street. Platforms are accessed from the street level at four primary entrances located along Pacific Avenue; the East Headhouse between N. Field and N. Griffin Streets; the Main (Central) Headhouse between San Jacinto Street, North Griffin Street and Pacific Ave; the South Headhouse at the southeast corner of Pacific Ave and Lamar Street; and the West Headhouse located at the northwest corner of Pacific Ave and Lamar Street. One additional location provides emergency egress out of the station, at the center median at Griffin Street and Elm St. The platform level has three primary vertical circulation elements leading to the concourse level, which connect to their respective headhouses/stations. Additional emergency exiting is provided at the far north and south ends of the platform, which leads to emergency egress locations only. Due to the depth of the station and the remote locations of the headhouses/stations, the concourse level is designated as a point of safety. Access to the platform from the Main and South Headhouses are provided by elevators, escalators and stairways. Access to the station from the East Headhouse is provided by stairways and elevators. Access to the station from the West Headhouse is provided by elevators only.

Commerce Station Description

Commerce Station has two sets of tracks centered on a single platform. Total length of the platform is 733’-0” by 26’-10” which includes the ancillary spaces at either end of the platform and the distance from train to train. The area allocated for the train boarding and deboarding, and allocated space passenger waiting is 385’-00” by 20’-10”, while the total public length of the platform with circulation is 574’-6”. Tracks run east and west parallel with Commerce Street. Platforms are accessed from the street level at two primary entrances located at the southeast corner of S Akard Street and Main Street (within Pegasus Plaza), and in the Jack Boles Parking Facility near the Commerce and Lane Street intersection. The platform level has two primary exits to the lower mezzanine levels, which connect to their respective headhouses/stations. Additional emergency exiting is provided at the far west end of the platform, which leads to an emergency egress only headhouse on the west side of Akard Street, midway between Commerce and Main Streets. Due to the depth of the station and the remote locations of the headhouses/stations, horizontal exiting was used to provide points of safety at the lower mezzanine levels. Access to the platform from the Pegasus Plaza (Main) Headhouse is provided by elevators, escalators and stairways. Access to the platform from the East Headhouse is provided by stairways and escalators.

CBD East Station Description

CBD East Station has two sets of tracks centered on a single platform. Total length of the platform is 550'-0" by 35'-8" which includes the ancillary spaces at either end of the platform and the distance from train to train. The area allocated for the train boarding and deboarding, and allocated space passenger waiting is 385'-0" by 29'-4", while the total public length of the platform with circulation is 448'-6". Tracks run in a northeast and southwest alignment between South Pearl Expressway on the west and Cesar Chavez Boulevard on the east. There are 3 egress locations (North Egress, Main, and South Head houses) located between Main Street on the South and Pearl Avenue to the East and Elm Street to the North. The two primary headhouses (Main and South) are located along Main Street and South Pearl Expressway, and they are the main entrances to the station. Access to the platform from the South Pearl Expressway (Main Headhouse) is provided by elevators, escalators and stairways. Access to the platform from Main Street (South Headhouse) is provided by stairways and elevators. The platform level has four primary vertical circulation elements (stairs and escalators) that exit at the Main Headhouse. Additional emergency exiting is provided at the far north and south ends of the platform, which leads to exits at the North Egress and South headhouse. The station is relatively shallow, which allows for shorter travel times to a point of safety outside the station.

Station Sizing Based on Patronage Data

The values used in the spreadsheet are based on NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems, 2018. This NFPA is used internationally for new and existing transit systems as a baseline for which calculations to use, and a standard way to apply them, to common situations found in the design of fixed guideway transit stations. It focuses on fire and life safety within stations.

Commerce Station was chosen as the location to base the initial typical calculations upon, partly because it is expected to have the least available platform width within the existing right of way. As the station is also in the center of the Central Business District, it is assumed that the AM peak load arriving to the station is expected be close to identical to the PM peak load of passengers leaving the station.

- **Headway Interval (LOS B Matrix):** As was supplied from ridership data from DART (See Passenger Capacity / Ridership section for additional information). The design team was asked to assume 15 minute headways as a worse case. In the future, DART expects up to 4 train lines to all converge into this singe track. So the chart uses 15 ÷ 4 = 3.75 min as the assumed headway interval between trains for a single track.

  DART is planning to use 3-car consists for their future lines. This is one car longer than the 2-car trains which DART is currently using for most lines. Therefore the maximum crush load capacity is listed as 495 people for one of these longer cars, as supplied by DART (See Passenger Capacity / Ridership section for additional information).

- **Platform Length (LOS B Matrix):** As was provided by DART in the Design Criteria Manual as 410 feet. This allows additional space at the ends of the trains for stopping. The preferred platform length has been designed the 410-foot requirement.

- **Platform Occupant Load (LOS B Matrix):** This category examines how many people are leaving the platform traveling via light-rail. NFPA 130 indicates that all lines can be combined, within a 15 minute period. The NFPA 130 calculations also account for service disruptions and system reaction times**.** Examining the Link Loads, the calculations result in 16 trains per hour on one track (4 trains per hour for 4 lines), equaling 7920 people in one direction, and 7920 people in the other direction. Assuming that of the 7920 people pass through in an hour, 50% will get off a train onto the platform, while 25% of people already on the platform get into a train and leave.

- **Platform Width (LOS B Matrix):** This group examines the areas occupied by all occupants who will be on the Platform (for LOS level B). It then uses Platform Length to figure out the required width of platform which should be allowed for. In this case, for Commerce Station, it is 33.4 feet wide.

  Please see Chart 5 of the attached LOS B Matrix. This chart shows that if the same number of people are packed tighter, such as in an emergency situation, then at 11.4 feet wide platform can be accommodated, allowing three times as many people in an LOS D emergency situation vs a LOS B. This width is not recommended as a safe alternative to the recommended width of 33.4 feet wide.

- **Egress Requirements (LOS B Matrix):** This part of the matrix examines how passengers located on the subway platform are able to exit the platform within an appropriate amount of time. Of all the available width of vertical exit provided, how much can actually be assigned as accounting for usable egress in the calculations. For example, of all available escalators, one escalator cannot be used for egress calculations, since it is assumed that one might be out of service.

  It also figures out how much width of Vertical Transportation (VTE) is required for the amount of people on the platform. This is a calculation provided by the NFPA, which looks at width, and travel speed of a person climbing stair/leaving by an escalator.

  The escalator size using for this planning exercise is an escalator of 48" as stated in the DART Design Manual, with an additional width added to include the operational equipment and maintenance requirements.

  Please see Charts 7 &8: These charts are used to calculate the space required for vertical circulation that is used on the take up on the platform, and subtract it from the platform area. This gives the actual spaces left for people minus space taken up by stairs and escalators.

NFPA 130 Analysis

See Appendix 12.4.1, 12.4.2 & 12.4.3 for NFPA 130 Analysis.

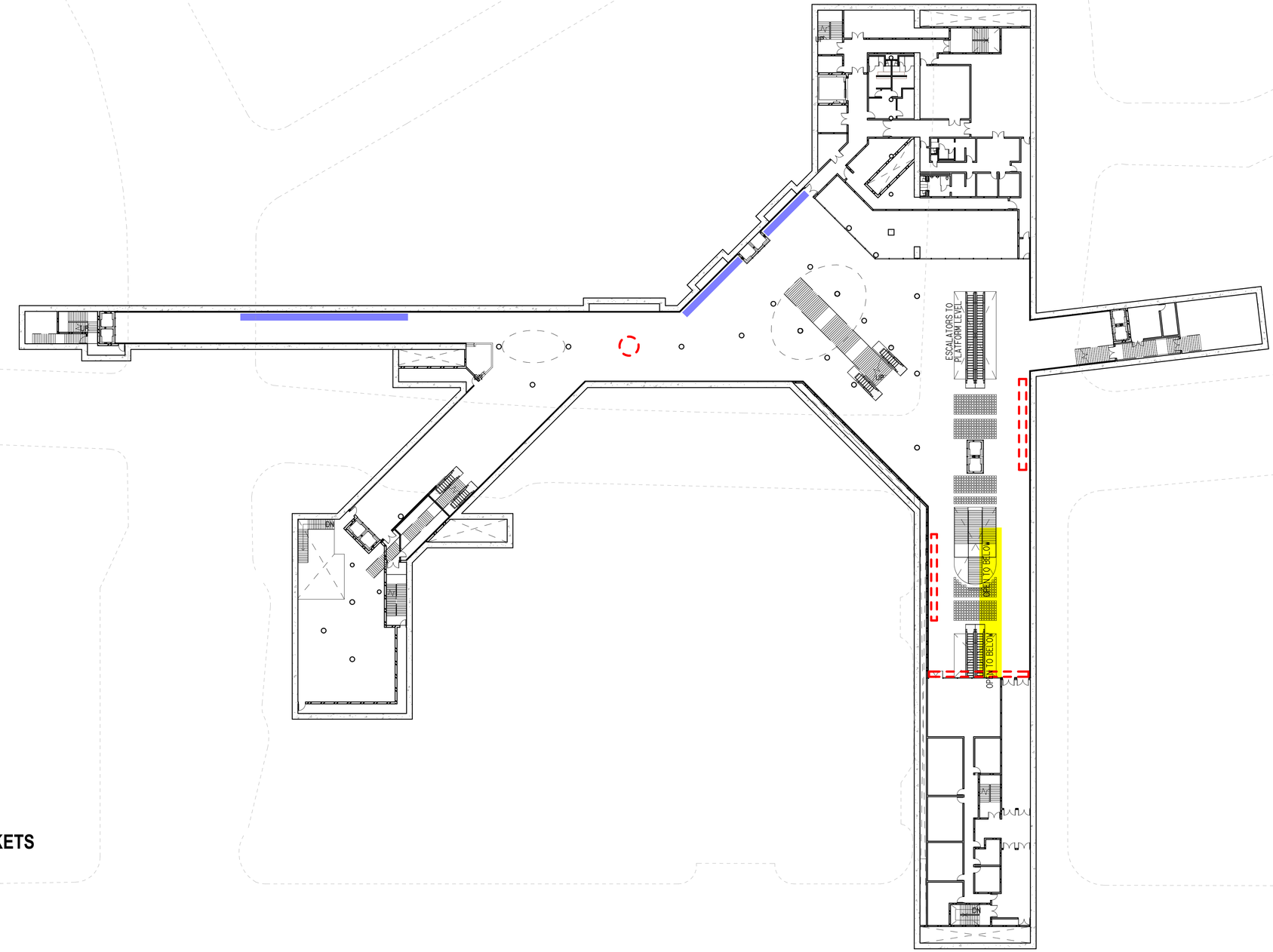
Facility Space Planning

See Appendix 12.4.5 for Facility Space Planning Matrix.

DART D2 SUBWAY

METRO CENTER STATION - STREET LEVEL DIAGRAM

03/06/2020

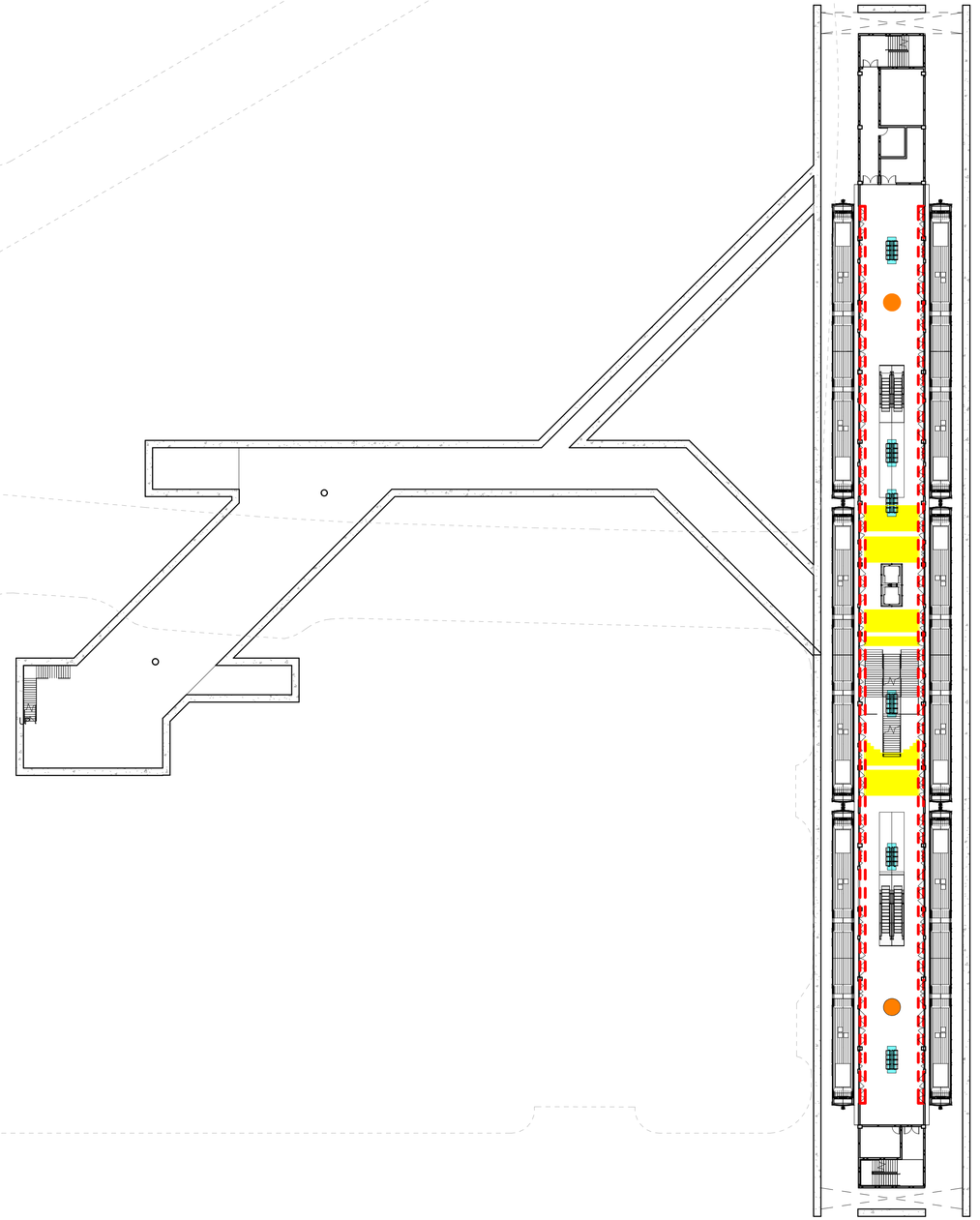


- STATION SIGNIFIER
- DIGITAL BOARD
- STATION MAP / INFO
- FARE COLLECTION / TICKETS
- SEATING / FURNITURE
- ADVERTISING
- SKYLIGHTS
- ARTWORK

DART D2 SUBWAY

METRO CENTER STATION - CONCOURSE LEVEL DIAGRAM

03/06/2020

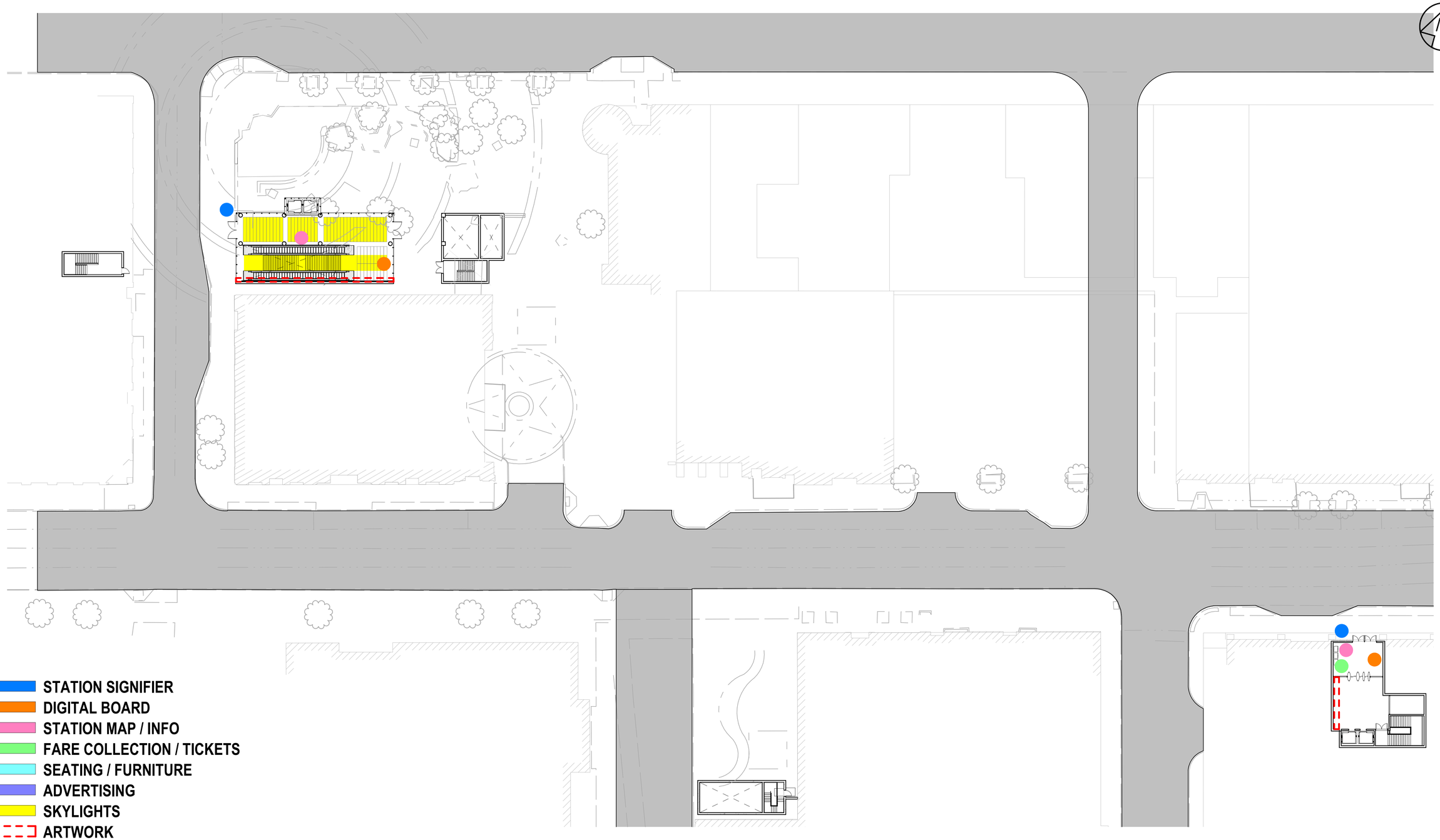


- STATION SIGNIFIER
- DIGITAL BOARD
- STATION MAP / INFO
- FARE COLLECTION / TICKETS
- SEATING / FURNITURE
- ADVERTISING
- SKYLIGHTS
- ARTWORK

DART D2 SUBWAY

METRO CENTER STATION PLATFORM LEVEL DIAGRAM

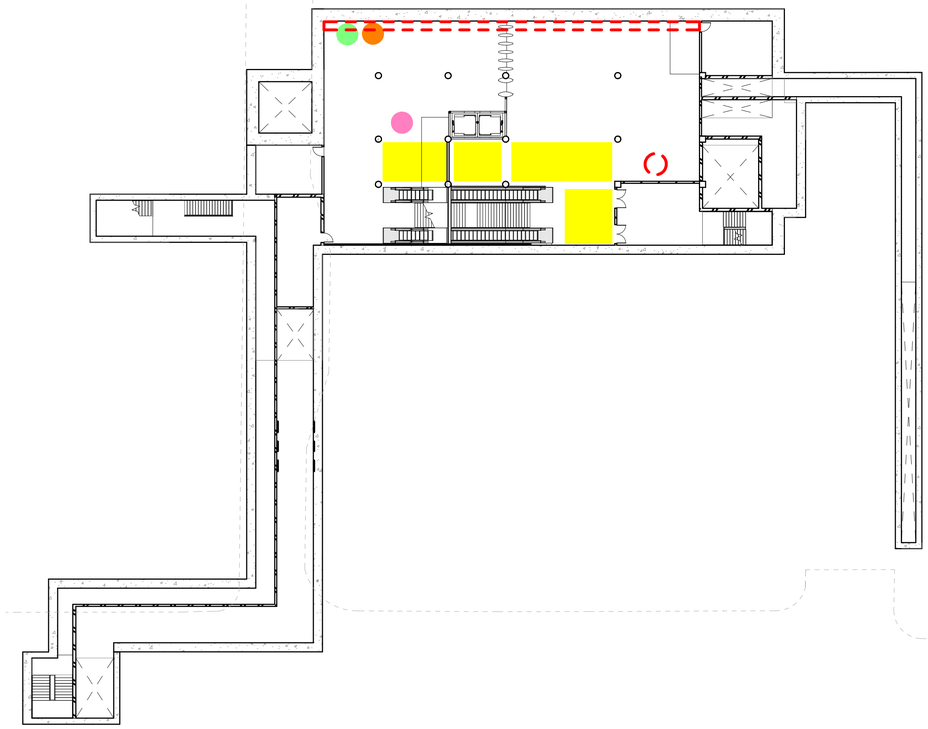
03/06/2020



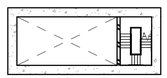
DART D2 SUBWAY

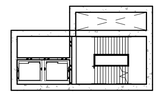
COMMERCE STATION - STREET LEVEL DIAGRAM

03/06/2020



STATION SIGNIFIER
DIGITAL BOARD
STATION MAP / INFO
FARE COLLECTION / TICKETS
SEATING / FURNITURE
ADVERTISING
SKYLIGHTS
ARTWORK

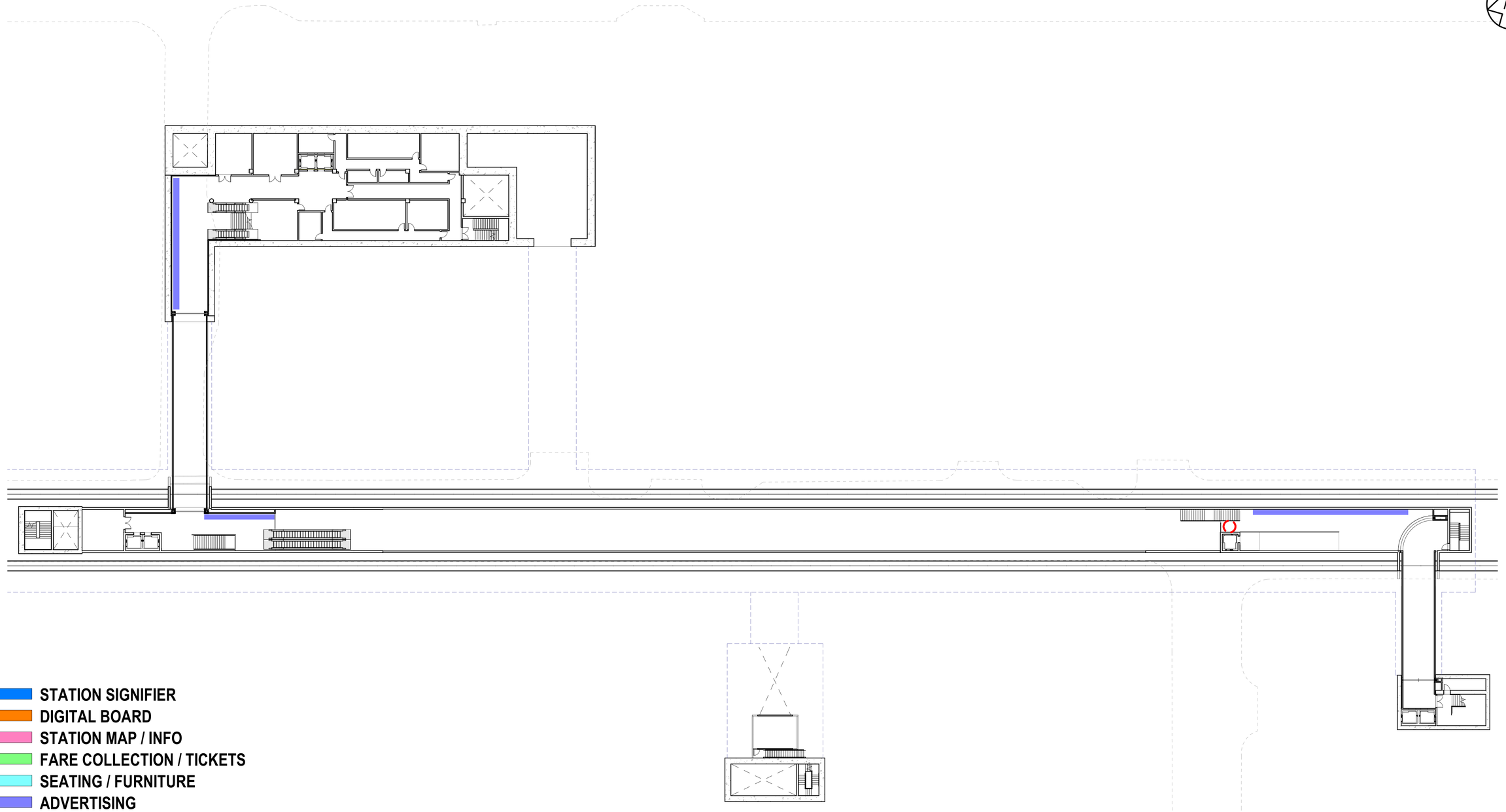




DART D2 SUBWAY

COMMERCE STATION - UPPER MEZZANINE DIAGRAM

03/06/2020

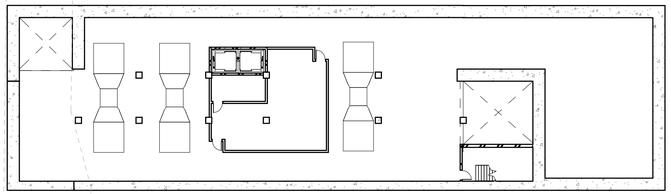


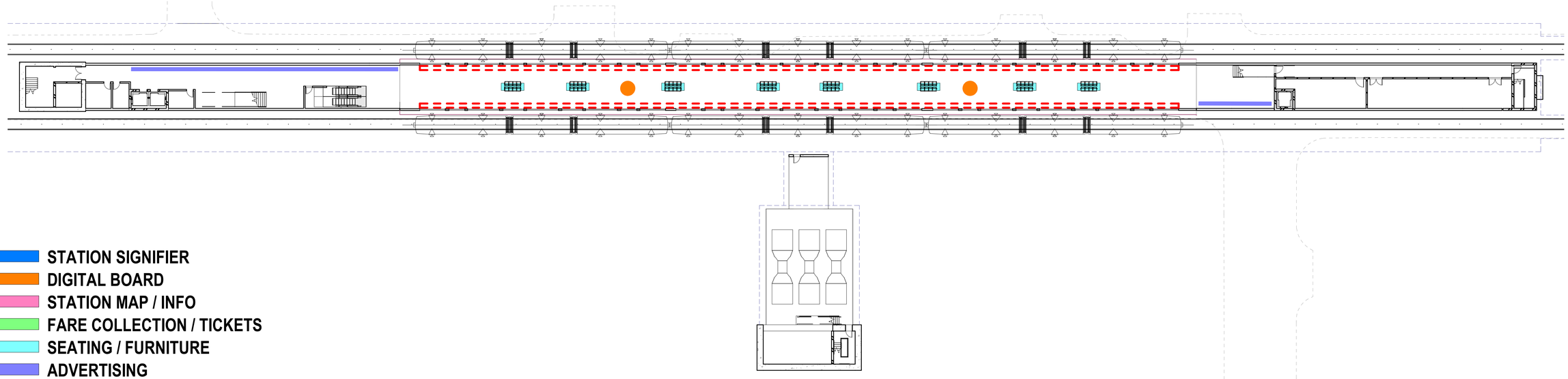
- STATION SIGNIFIER
- DIGITAL BOARD
- STATION MAP / INFO
- FARE COLLECTION / TICKETS
- SEATING / FURNITURE
- ADVERTISING
- SKYLIGHTS
- ARTWORK

DART D2 SUBWAY

COMMERCE STATION - LOWER MEZZANINE DIAGRAM

03/06/2020



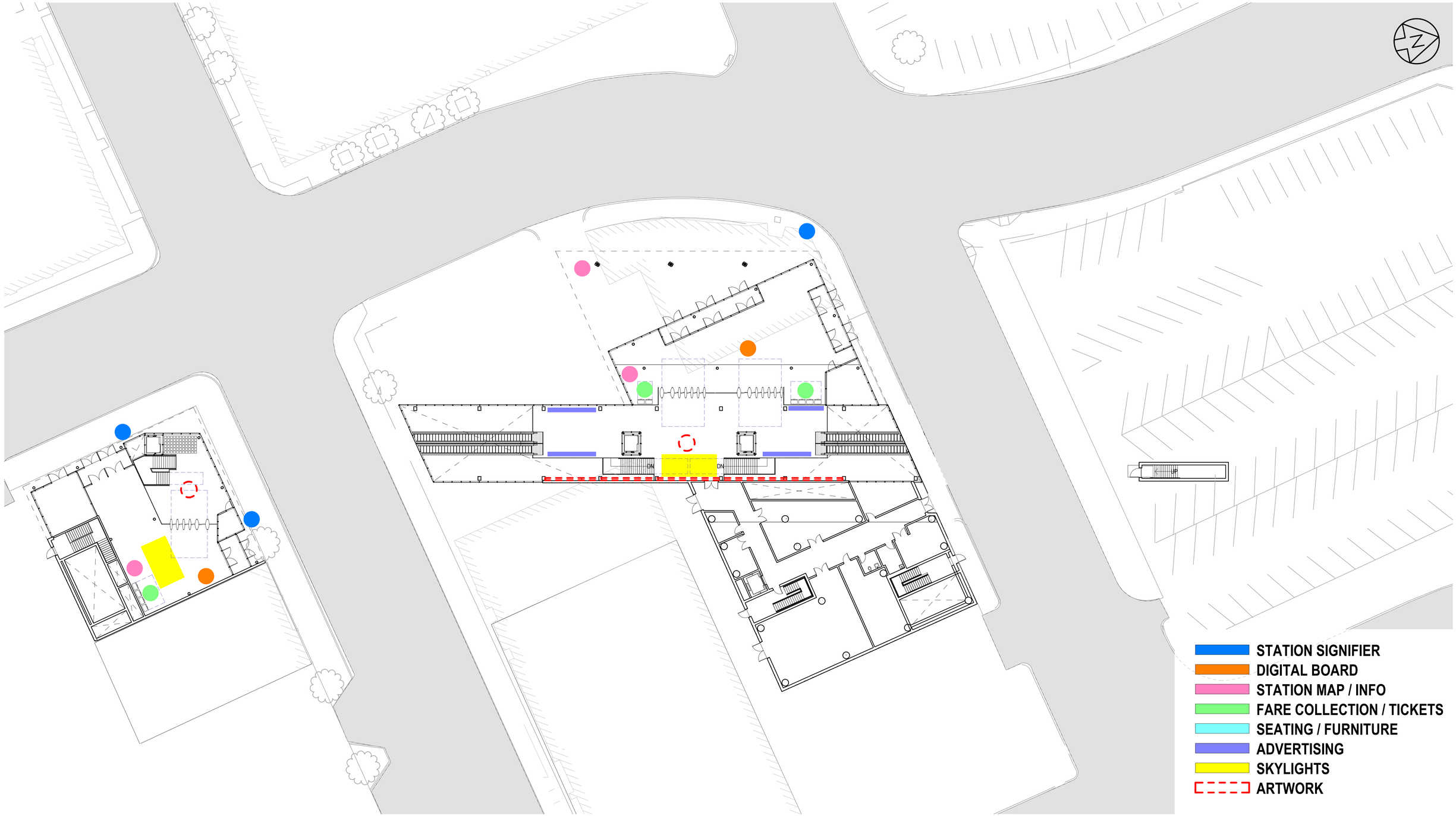


- STATION SIGNIFIER
- DIGITAL BOARD
- STATION MAP / INFO
- FARE COLLECTION / TICKETS
- SEATING / FURNITURE
- ADVERTISING
- SKYLIGHTS
- ARTWORK

DART D2 SUBWAY

COMMERCE STATION - PLATFORM LEVEL DIAGRAM

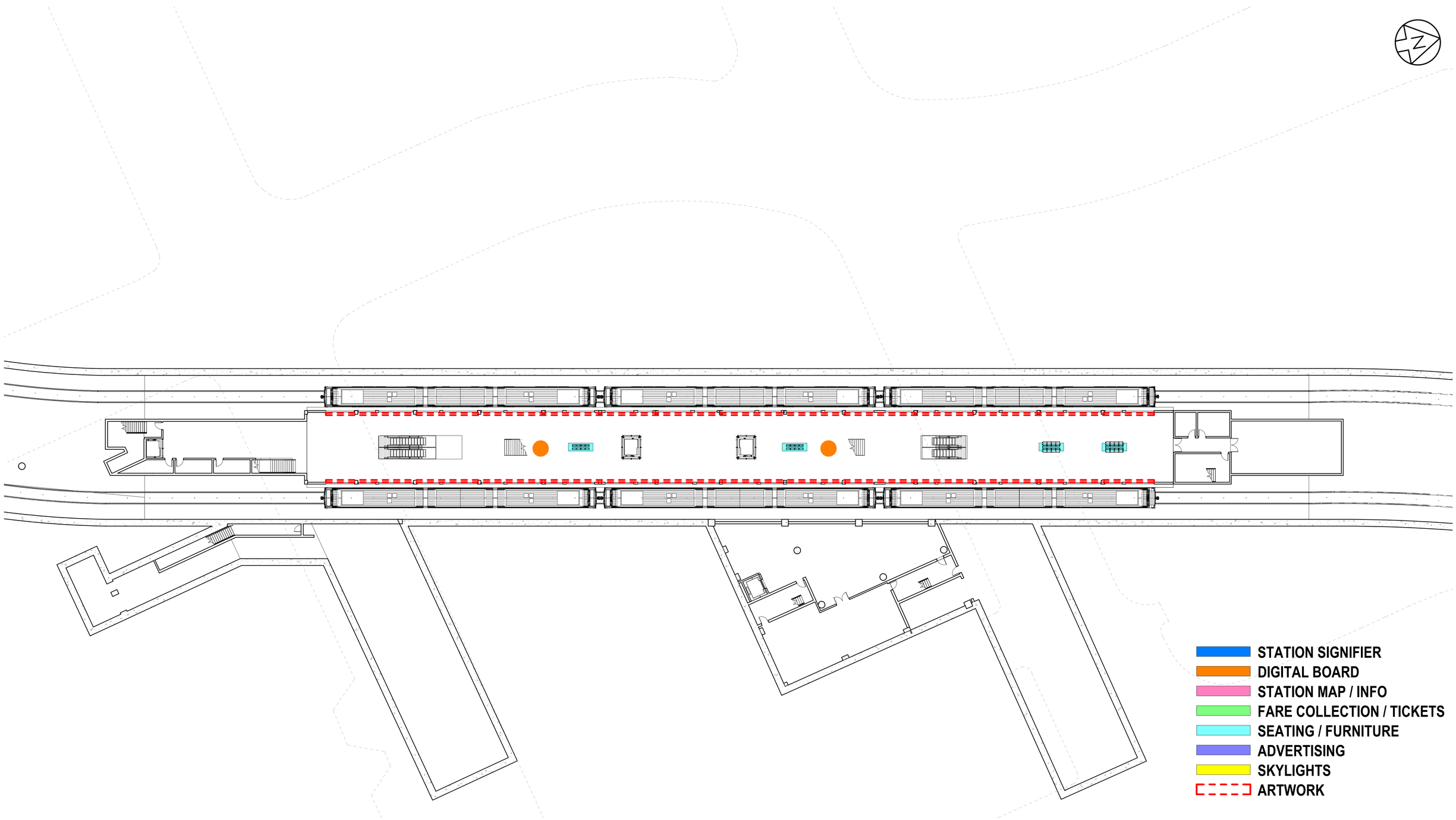
03/06/2020



DART D2 SUBWAY

CBD EAST STATION - STREET LEVEL DIAGRAM

03/06/2020



DART D2 SUBWAY

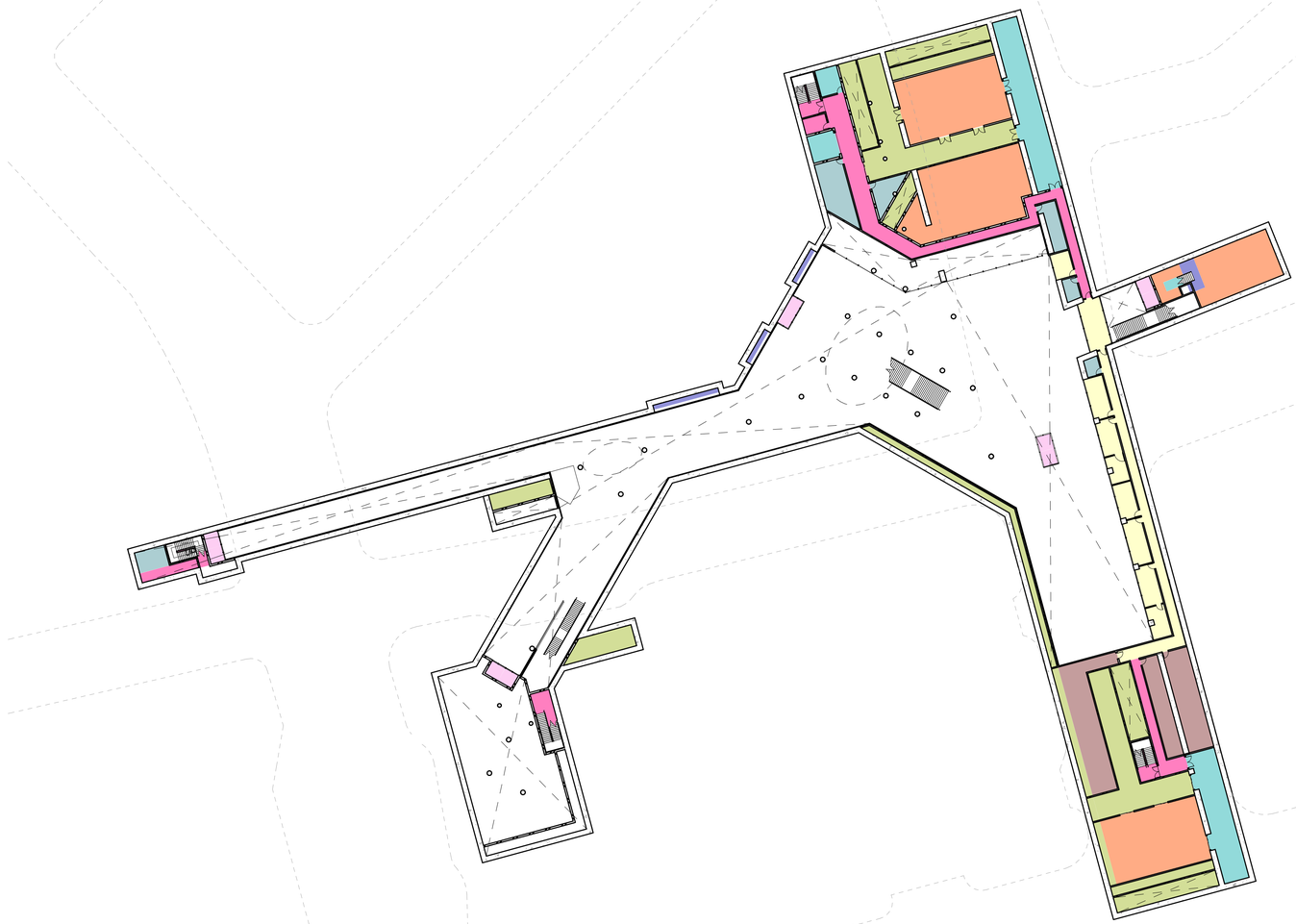
CBD EAST STATION - PLATFORM LEVEL DIAGRAM

03/06/2020

DART D2 SUBWAY

METRO CENTER STATION - STREET PLAN

03/06/2020

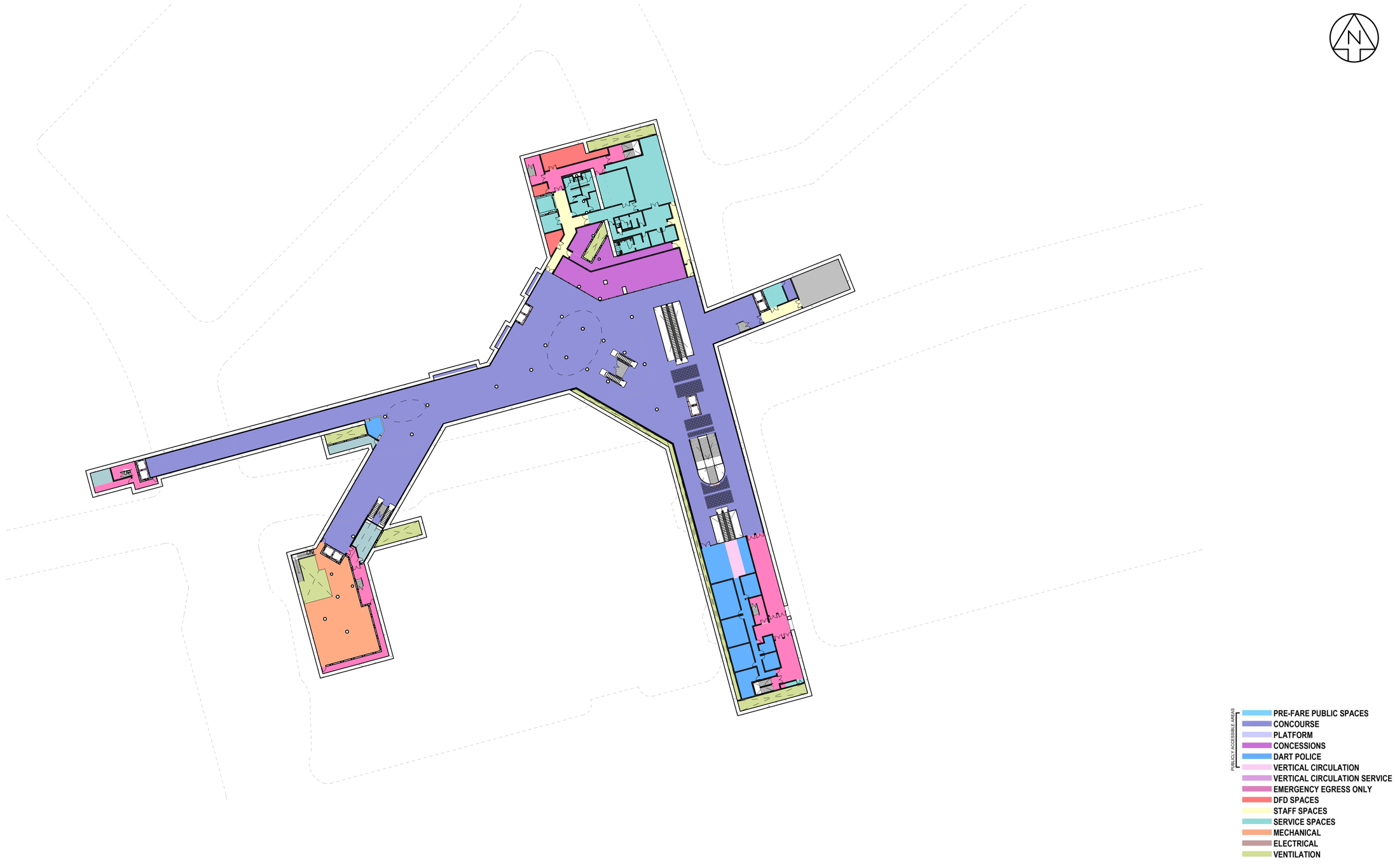


PUBLICLY ACCESSIBLE AREAS
- PRE-FARE PUBLIC SPACES
- CONCOURSE
- PLATFORM
- CONCESSIONS
- DART POLICE
- VERTICAL CIRCULATION
- VERTICAL CIRCULATION SERVICE
- EMERGENCY EGRESS ONLY
- DFD SPACES
- STAFF SPACES
- SERVICE SPACES
- MECHANICAL
- ELECTRICAL
- VENTILATION

DART D2 SUBWAY

METRO CENTER STATION - MEZZANINE LEVEL

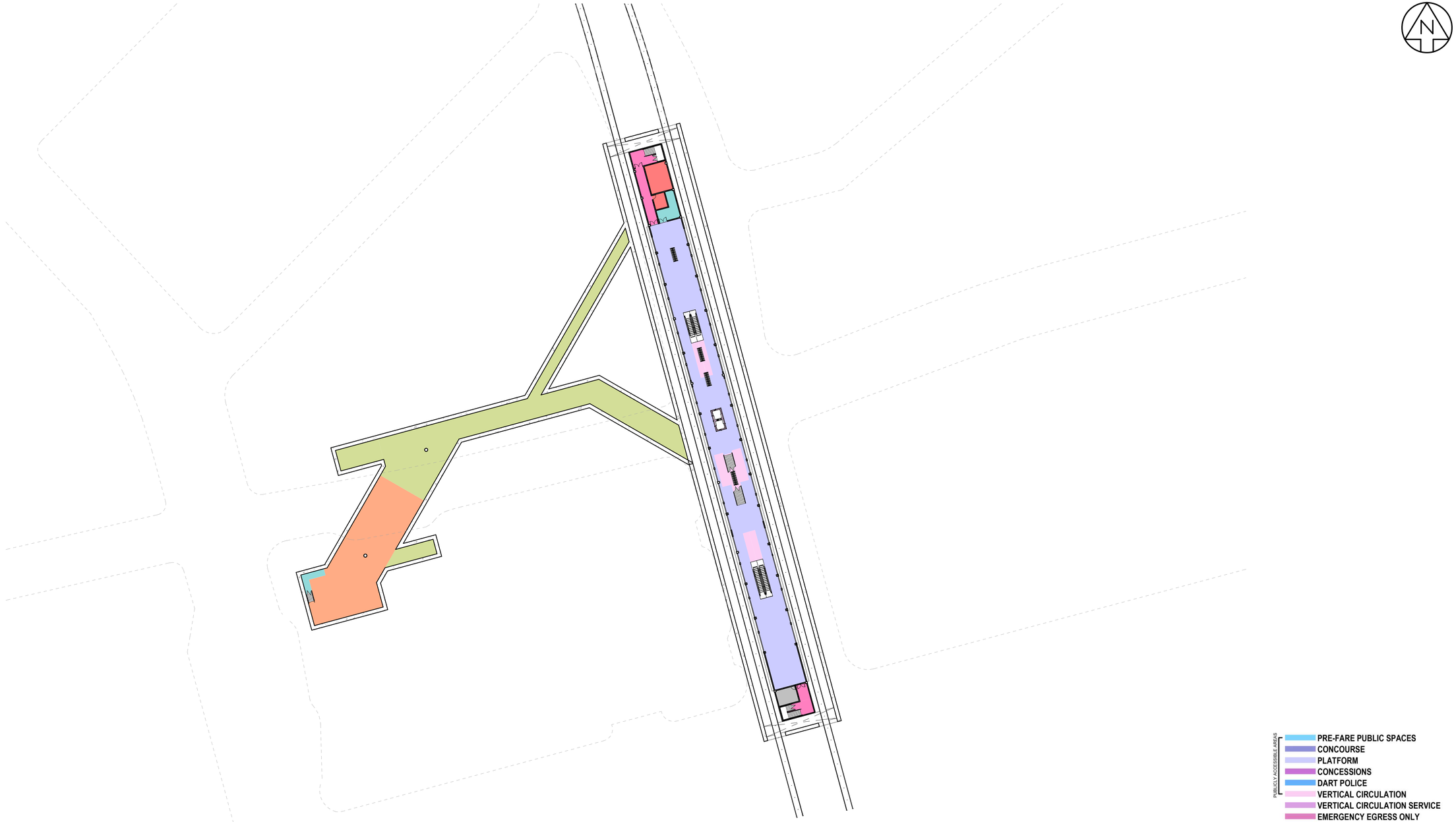
03/06/2020



DART D2 SUBWAY

METRO CENTER STATION - CONCOURSE LEVEL

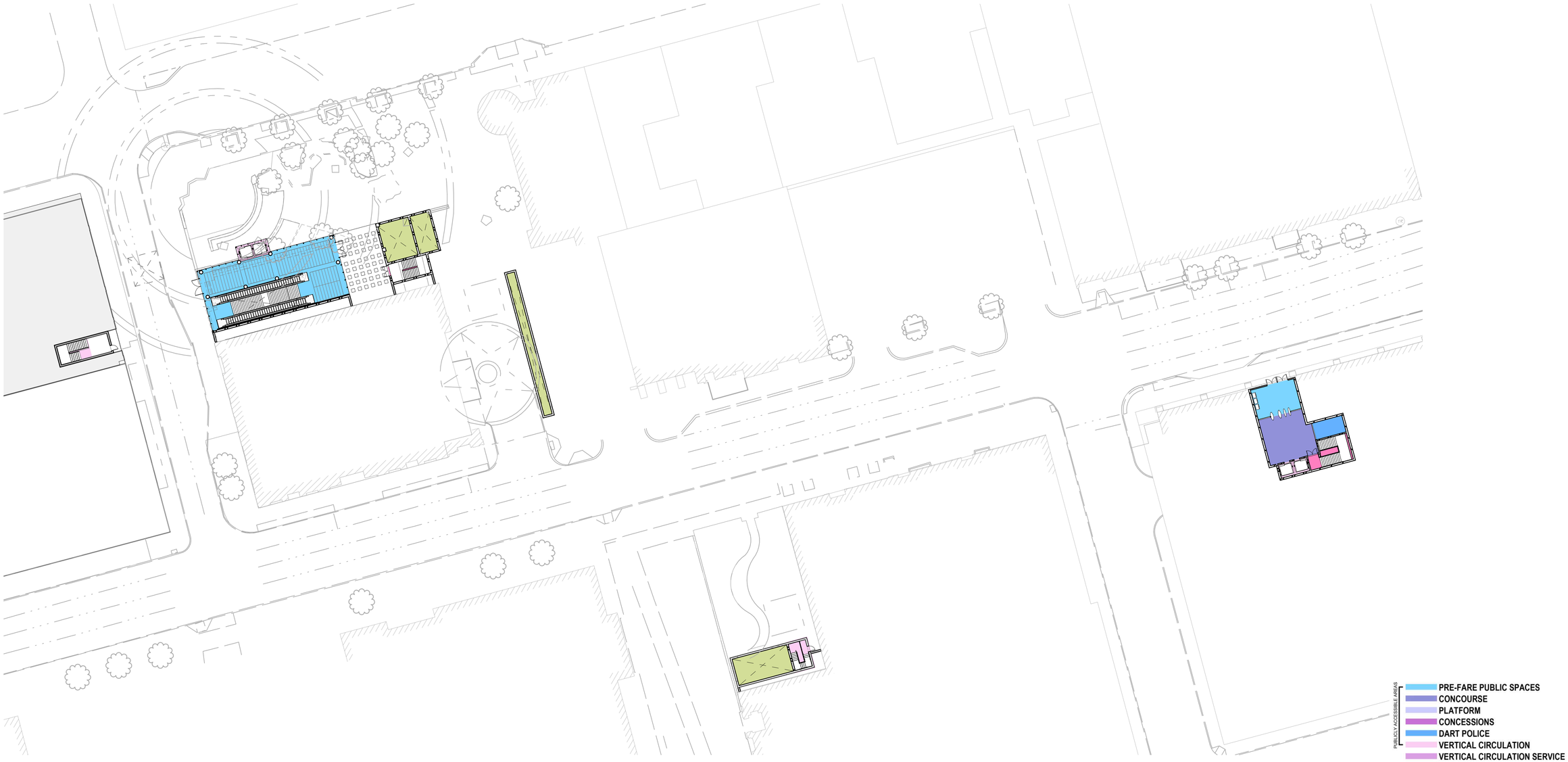
03/06/2020



DART D2 SUBWAY

METRO CENTER STATION - PLATFORM LEVEL

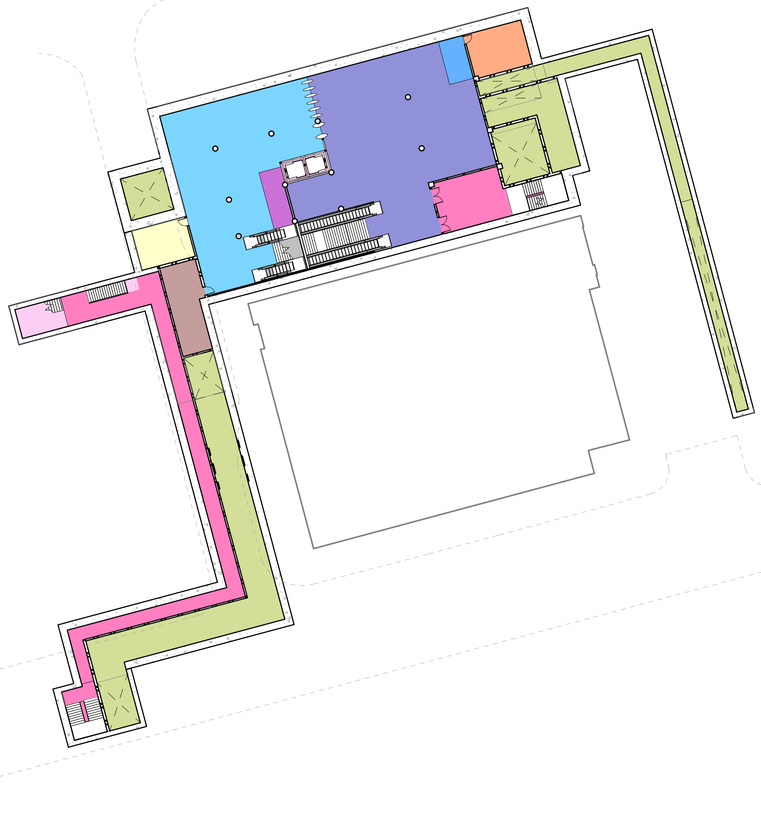
03/06/2020

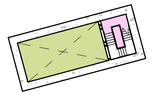


DART D2 SUBWAY

COMMERCE STATION - STREET LEVEL

03/06/2020





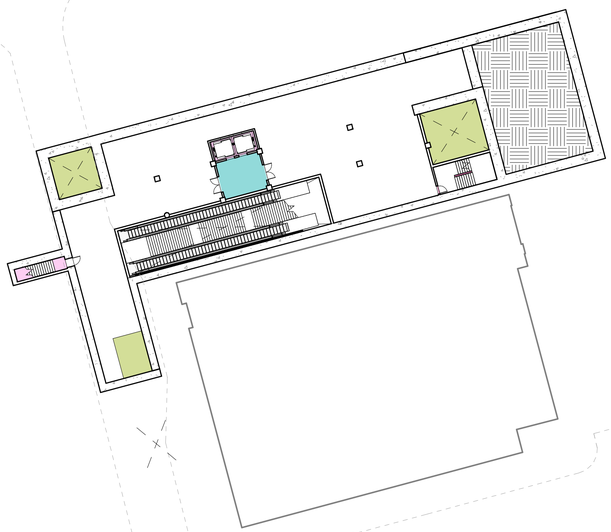
PUBLICLY ACCESSIBLE AREAS
- PRE-FARE PUBLIC SPACES
- CONCOURSE
- PLATFORM
- CONCESSIONS
- DART POLICE
- VERTICAL CIRCULATION
- VERTICAL CIRCULATION SERVICE
- EMERGENCY EGRESS ONLY
- DFD SPACES
- STAFF SPACES
- SERVICE SPACES
- MECHANICAL
- ELECTRICAL
- VENTILATION

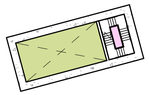
HDR DART

DART D2 SUBWAY

COMMERCE STATION - UPPER MEZZANINE LEVEL

03/06/2020





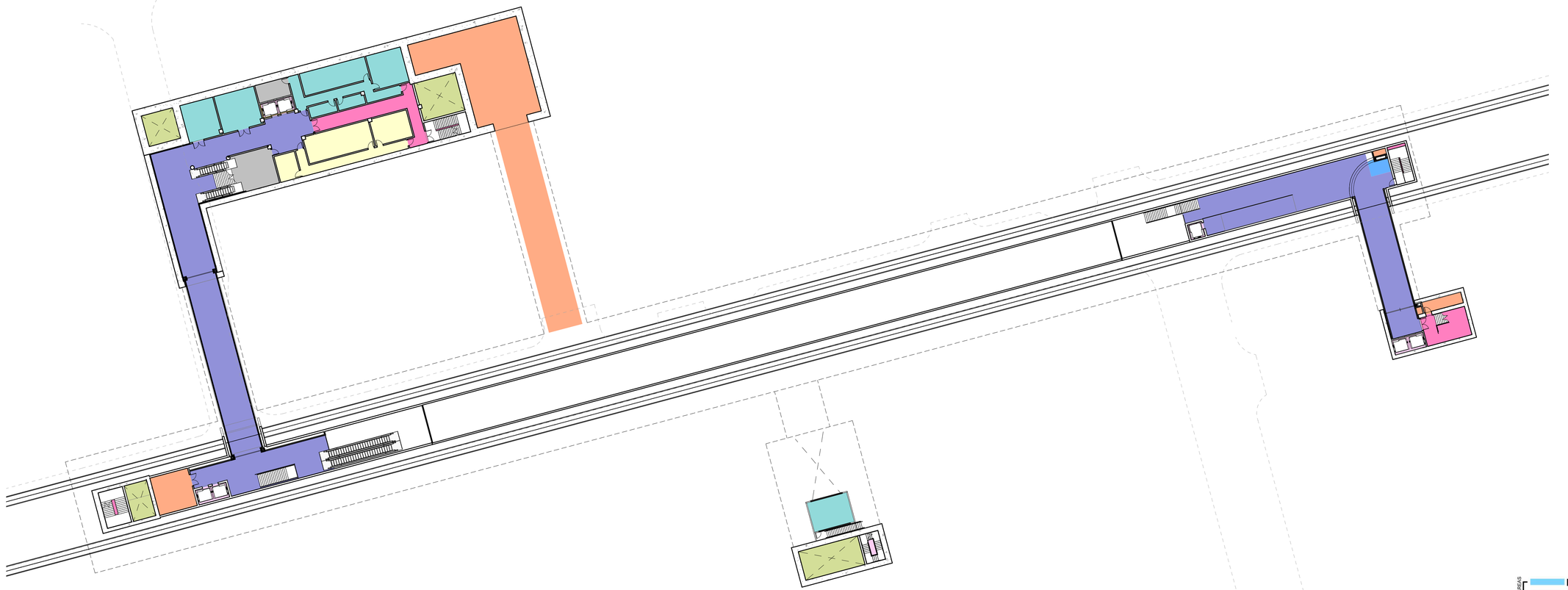
PUBLICLY ACCESSIBLE AREAS
- PRE-FARE PUBLIC SPACES
- CONCOURSE
- PLATFORM
- CONCESSIONS
- DART POLICE
- VERTICAL CIRCULATION
- VERTICAL CIRCULATION SERVICE
- EMERGENCY EGRESS ONLY
- DFD SPACES
- STAFF SPACES
- SERVICE SPACES
- MECHANICAL
- ELECTRICAL
- VENTILATION

HDR DART

DART D2 SUBWAY

COMMERCE STATION - MIDDLE MEZZANINE LEVEL

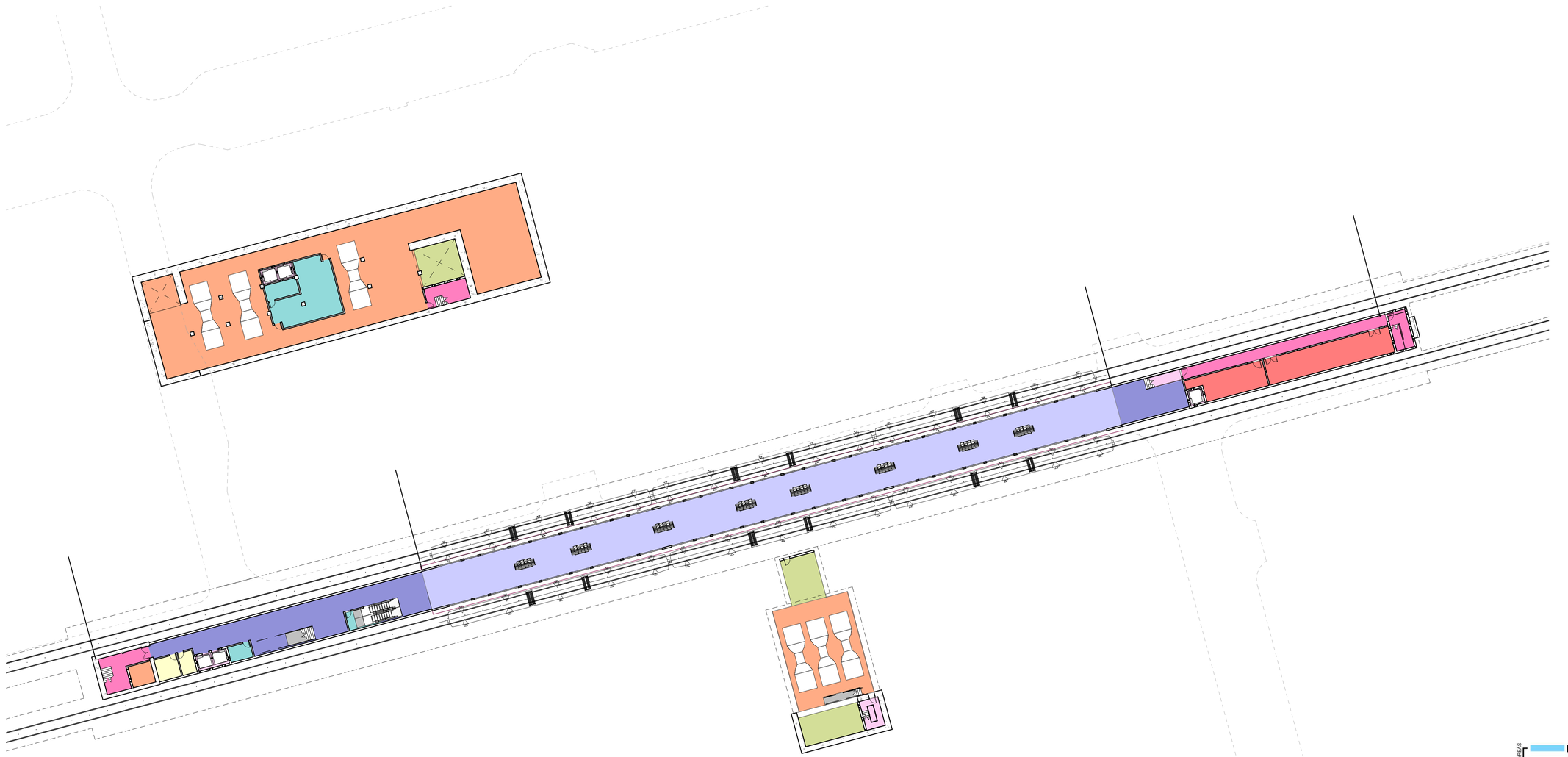
03/06/2020



DART D2 SUBWAY

COMMERCE STATION - LOWER MEZZANINE LEVEL

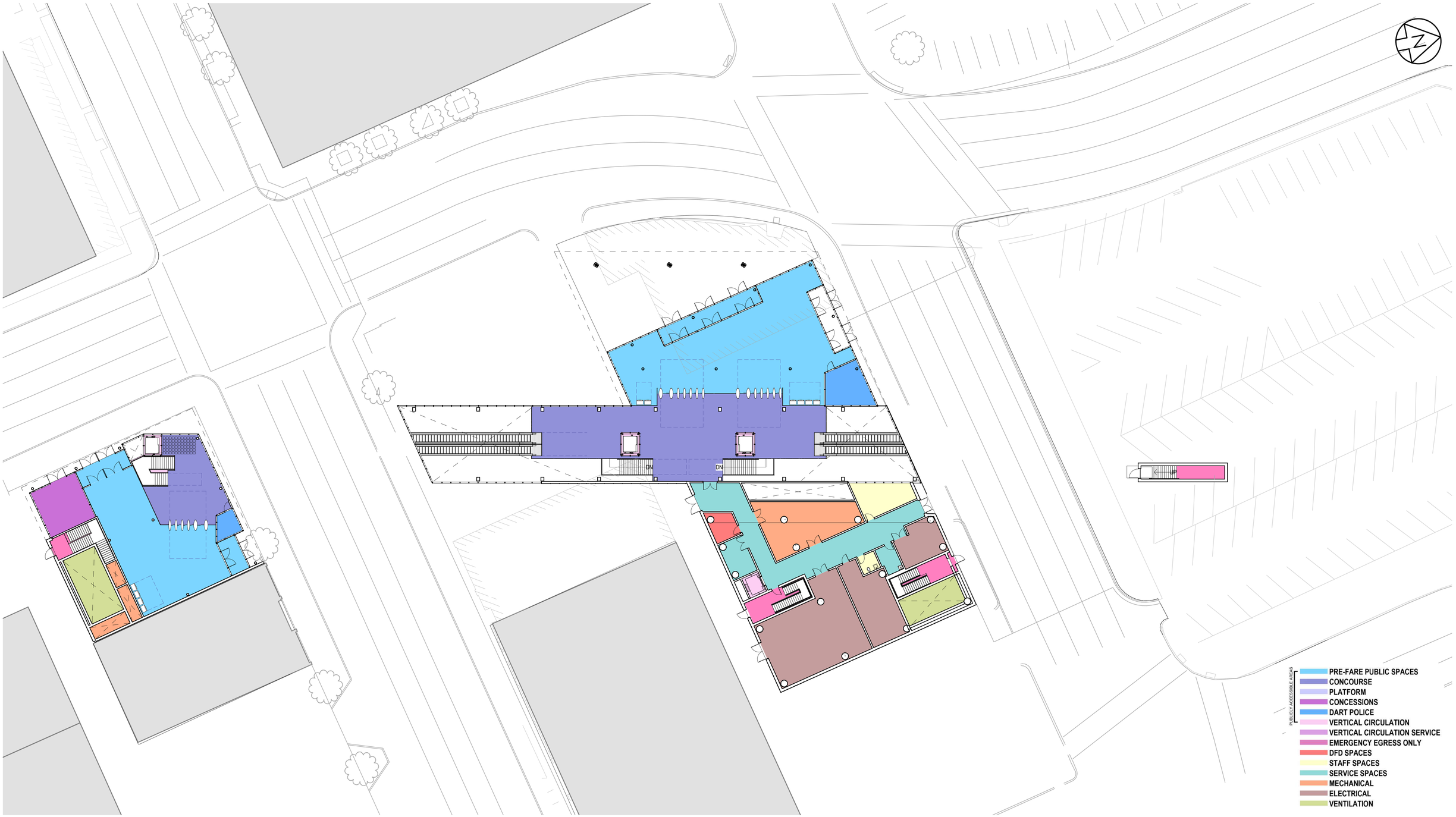
03/06/2020



DART D2 SUBWAY

COMMERCE STATION - PLATFORM LEVEL

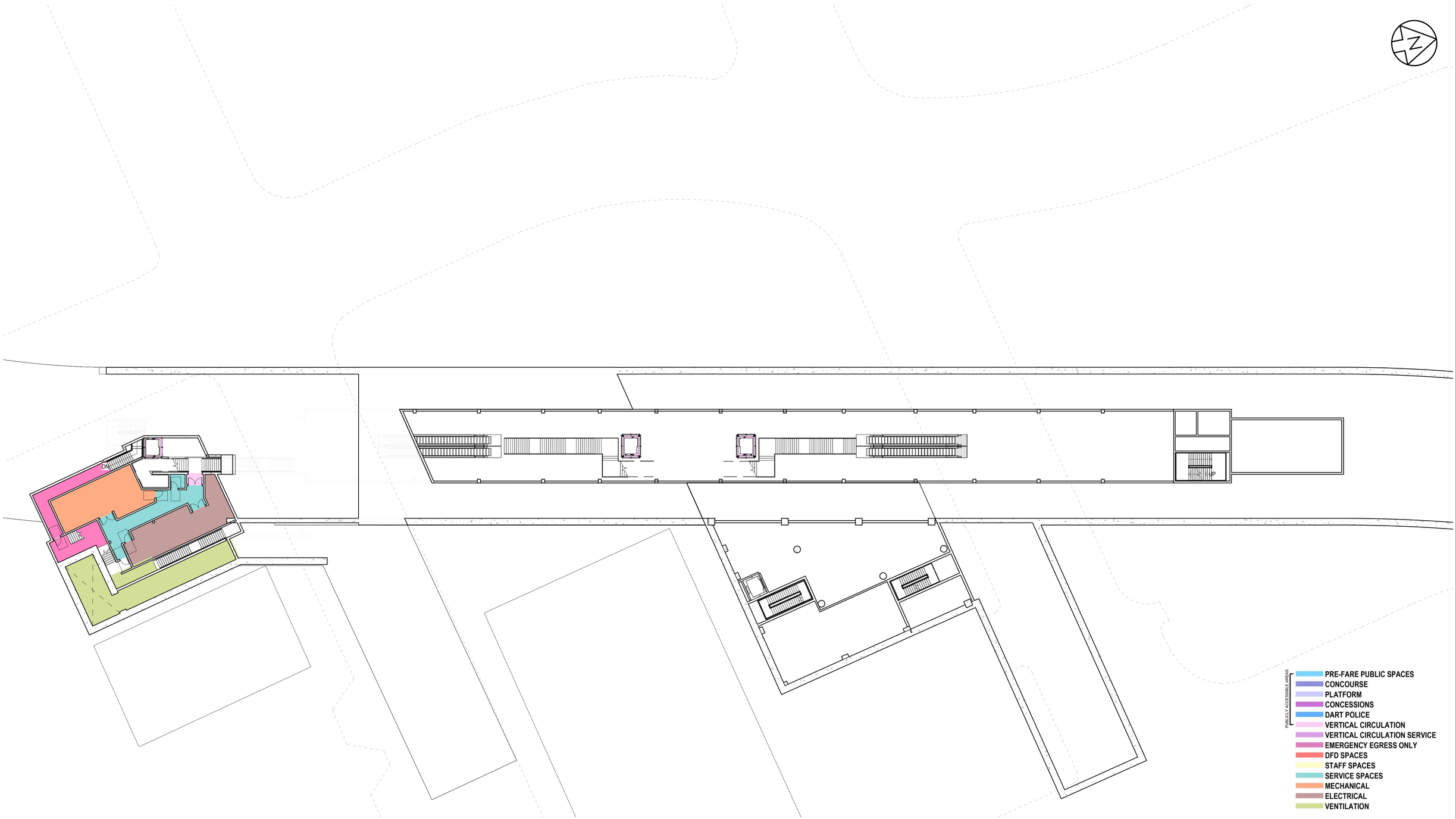
03/06/2020



DART D2 SUBWAY

CBD EAST STATION - STREET LEVEL

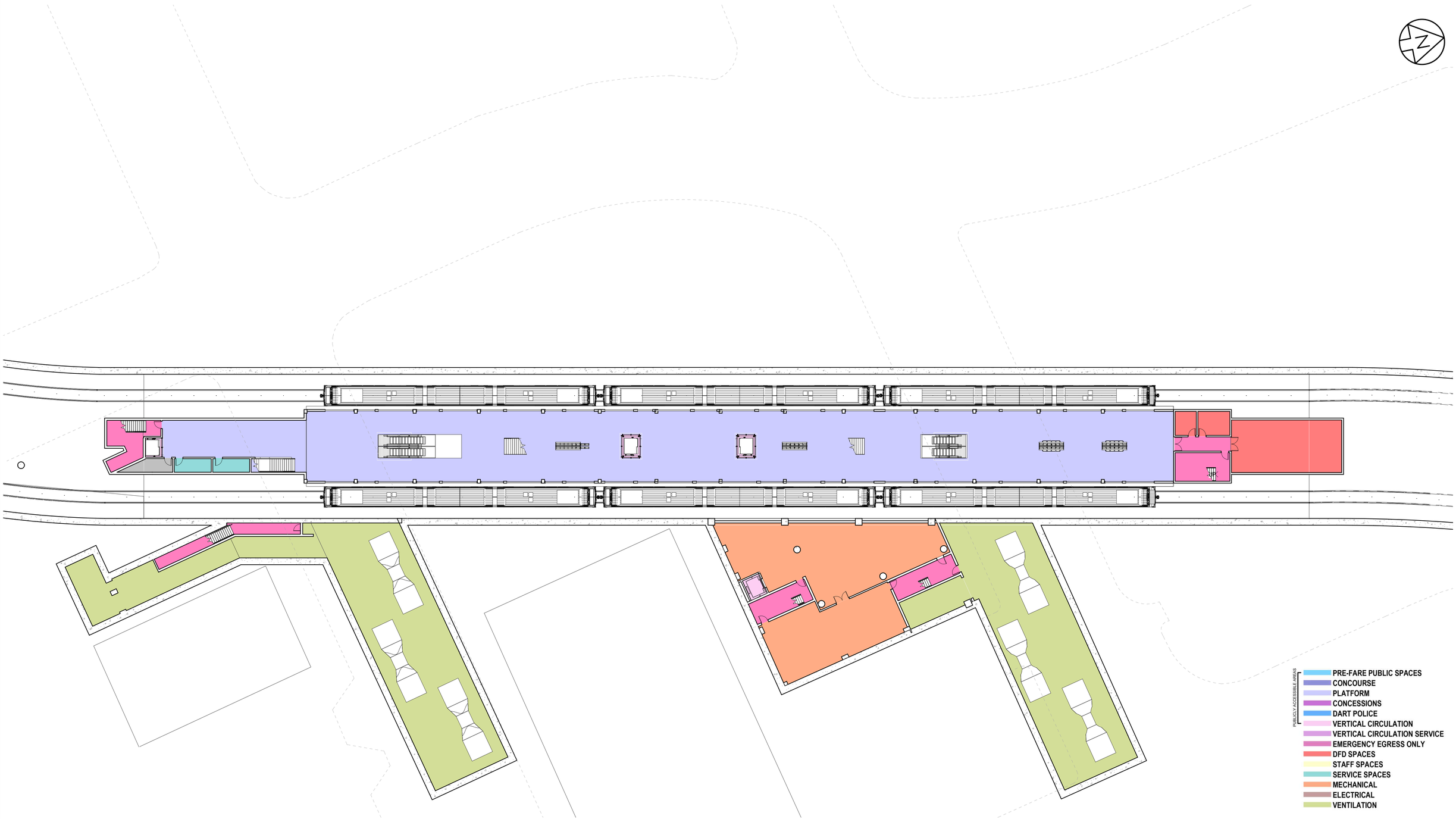
03/06/2020



DART D2 SUBWAY

CBD EAST STATION - MEZZANINE LEVEL

03/06/2020

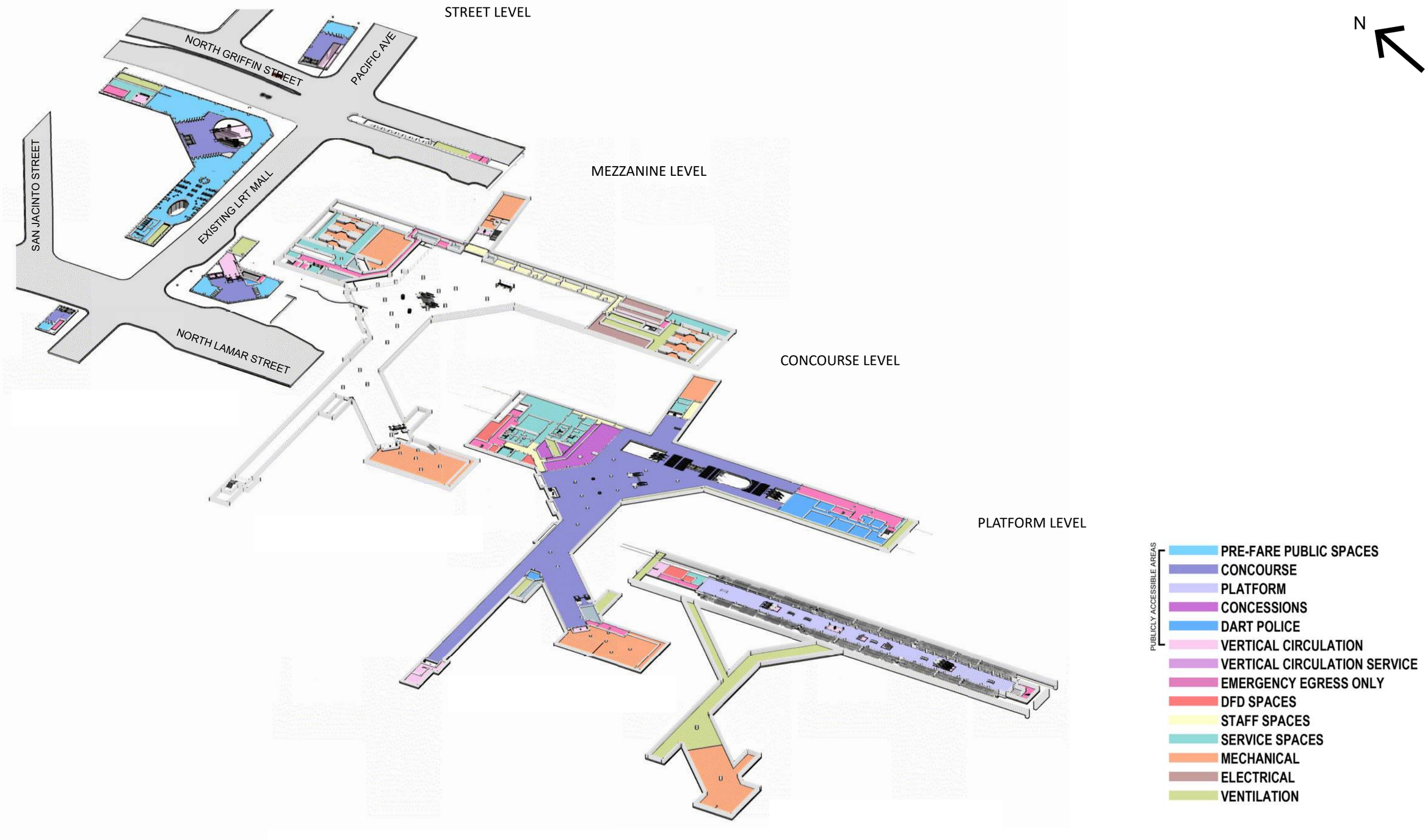


DART D2 SUBWAY

CBD EAST STATION - PLATFORM LEVEL

03/06/2020

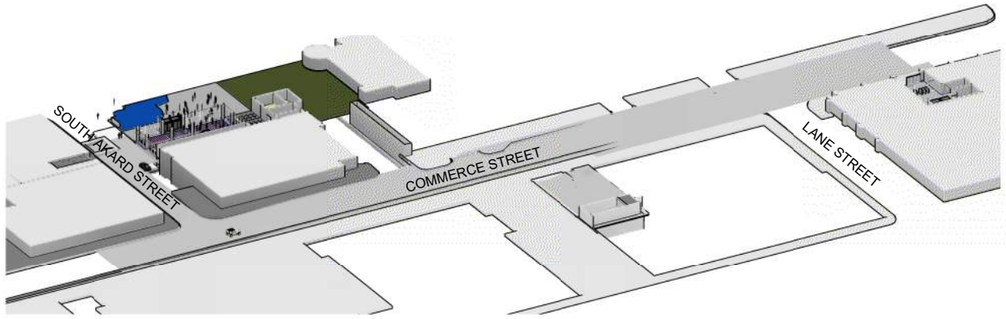
12.2.4 Metro Center Station Axonometric Plans



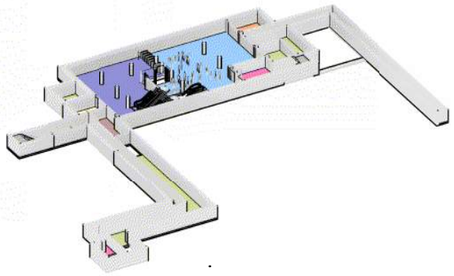
12.2.7 Metro Center Station Axonometric Section

DART D2 Subway
12.2 Architectural Drawings (Supplemental)

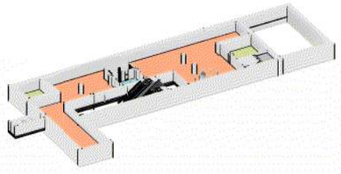
12.2.5 Commerce Station Axonometric Plans



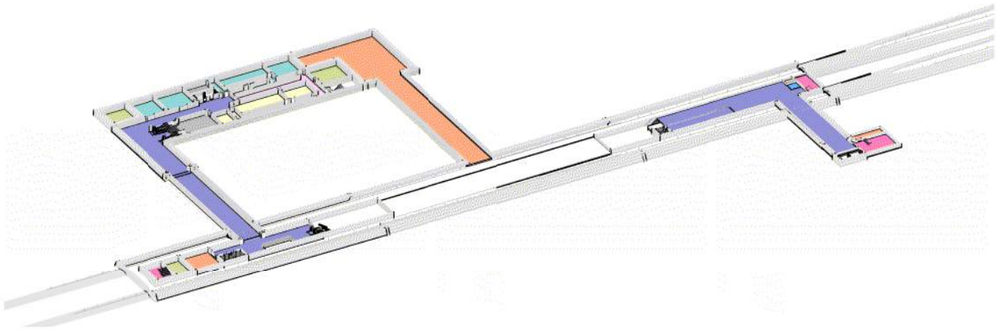
STREET LEVEL



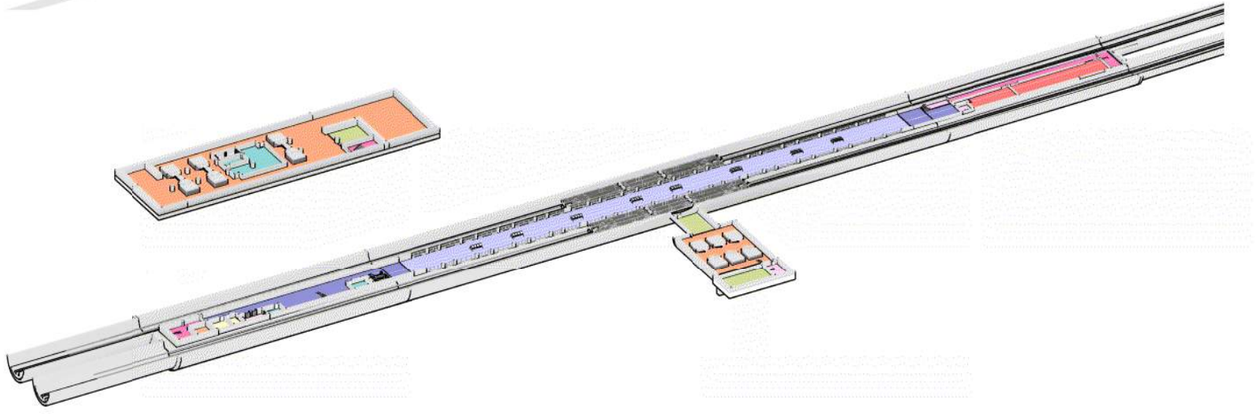
UPPER MEZZANINE



MIDDLE MEZZANINE



LOWER MEZZANINE



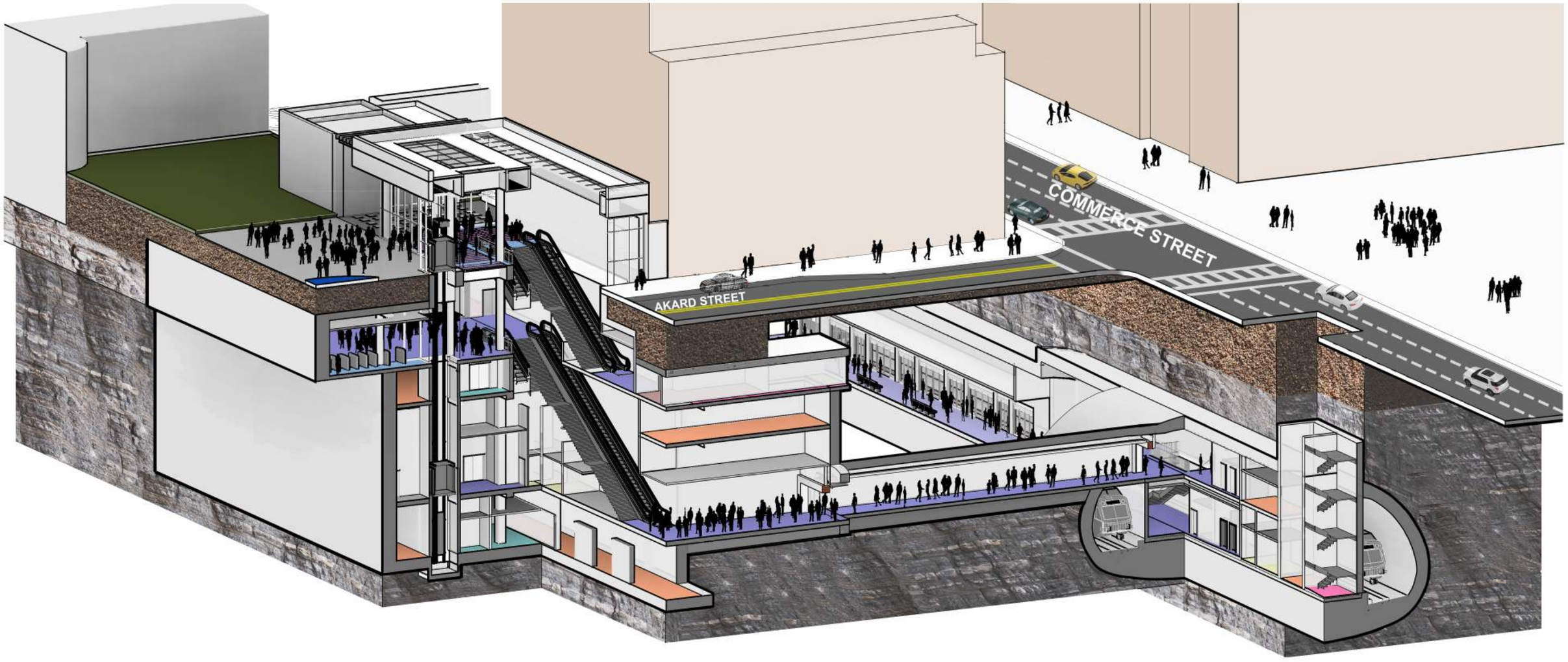
PLATFORM LEVEL

N

PUBLICLY ACCESSIBLE AREAS

- PRE-FARE PUBLIC SPACES
- CONCOURSE
- PLATFORM
- CONCESSIONS
- DART POLICE
- VERTICAL CIRCULATION
- VERTICAL CIRCULATION SERVICE
- EMERGENCY EGRESS ONLY
- DFD SPACES
- STAFF SPACES
- SERVICE SPACES
- MECHANICAL
- ELECTRICAL
- VENTILATION

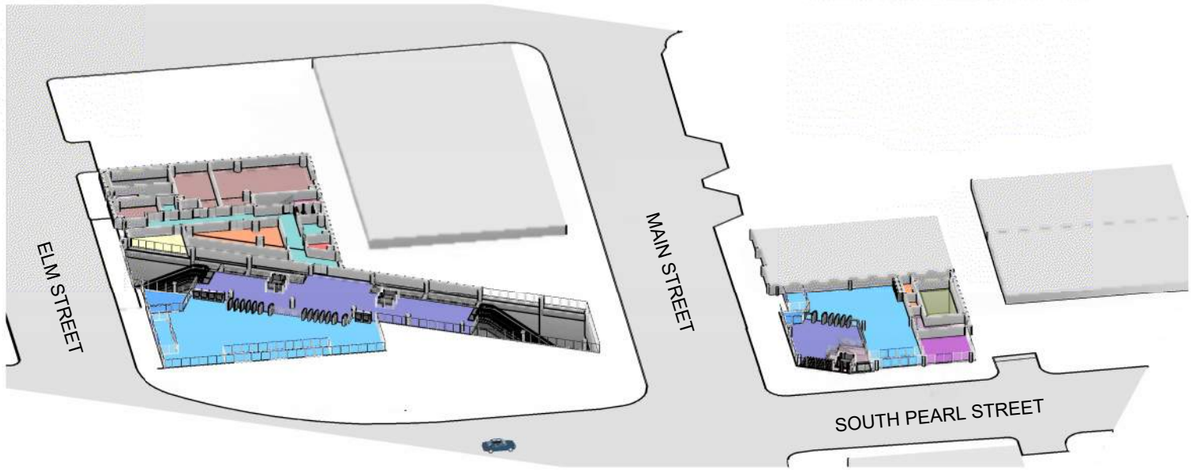
12.2.8 Commerce Station Axonometric Section



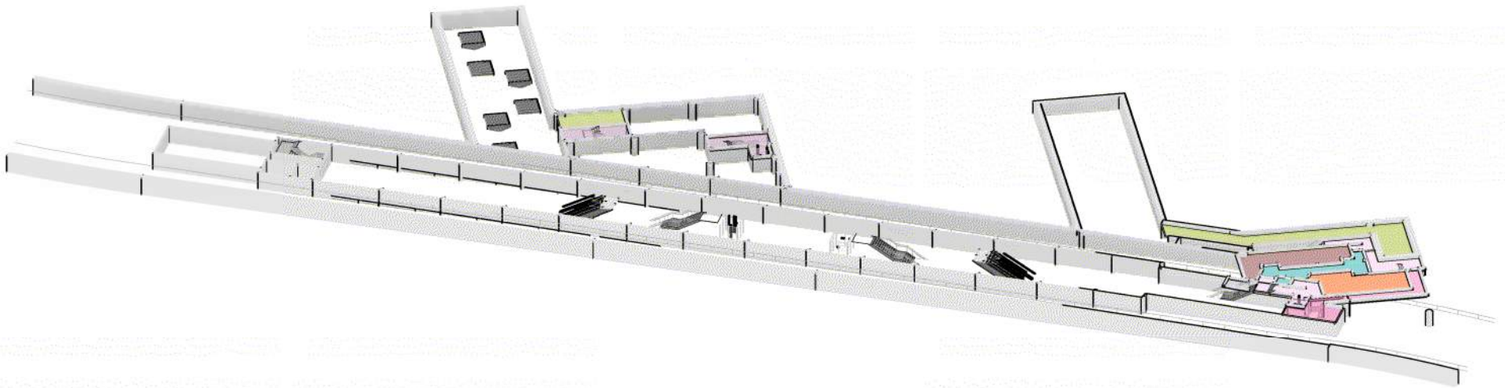
DART D2 Subway
12.2 Architectural Drawings (Supplemental)

12.2.6 CBD East Station Axonometric Plans

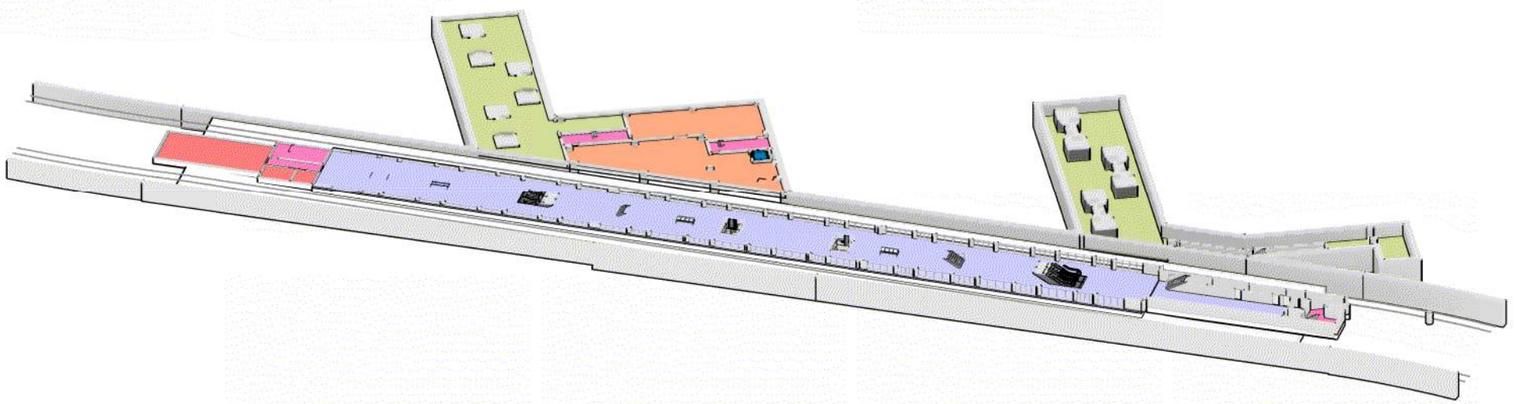
STREET LEVEL



MEZZANINE LEVEL



PLATFORM LEVEL



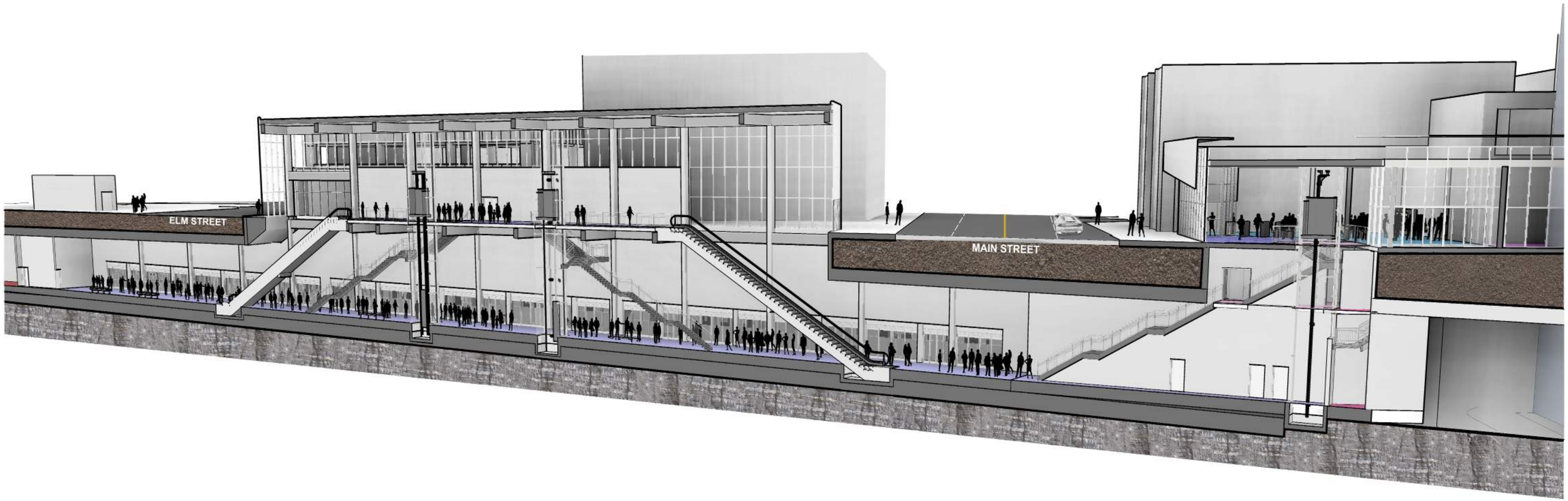
N

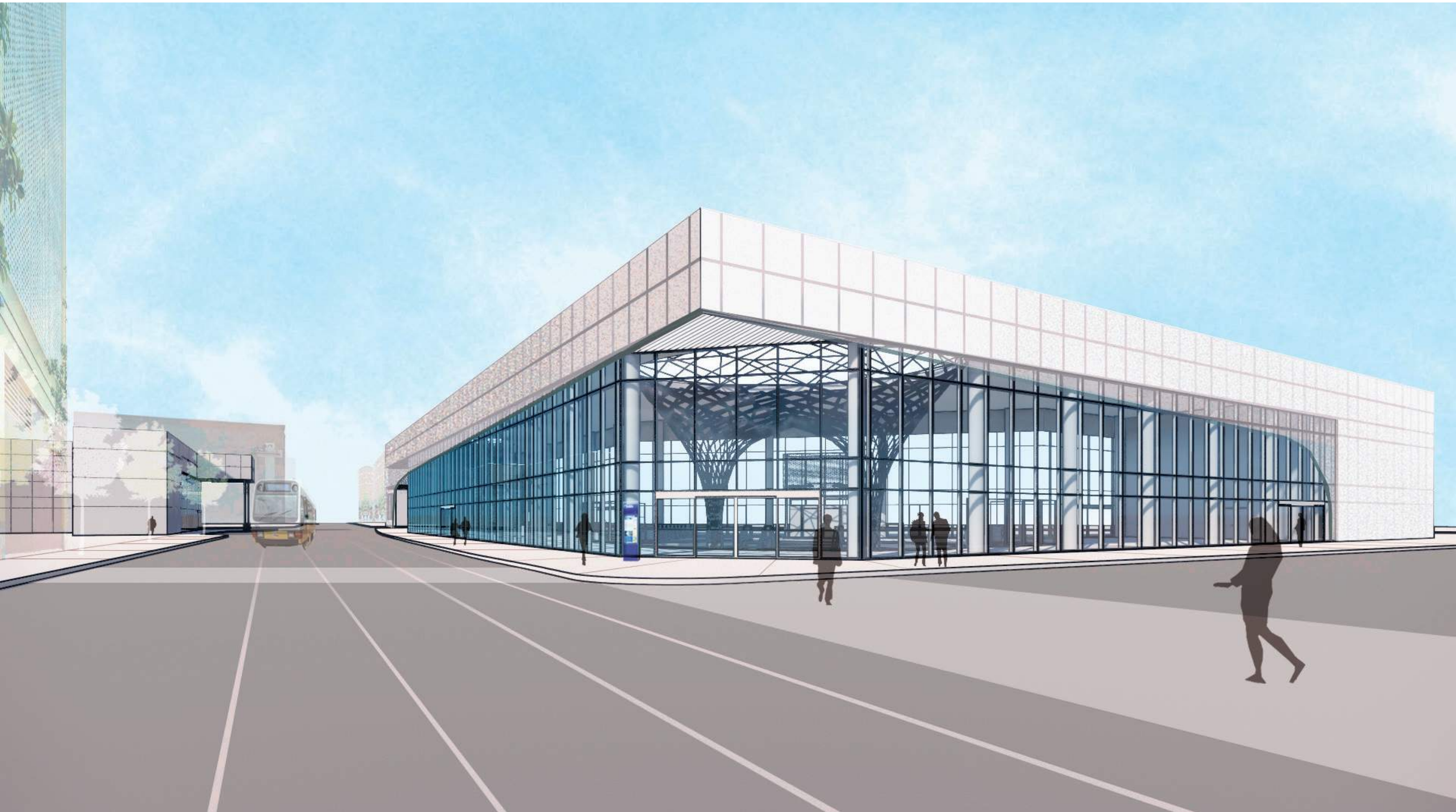
PUBLICLY ACCESSIBLE AREAS

- PRE-FARE PUBLIC SPACES
- CONCOURSE
- PLATFORM
- CONCESSIONS
- DART POLICE
- VERTICAL CIRCULATION
- VERTICAL CIRCULATION SERVICE
- EMERGENCY EGRESS ONLY
- DFD SPACES
- STAFF SPACES
- SERVICE SPACES
- MECHANICAL
- ELECTRICAL
- VENTILATION

DART D2 Subway
12.2 Architectural Drawings (Supplemental)

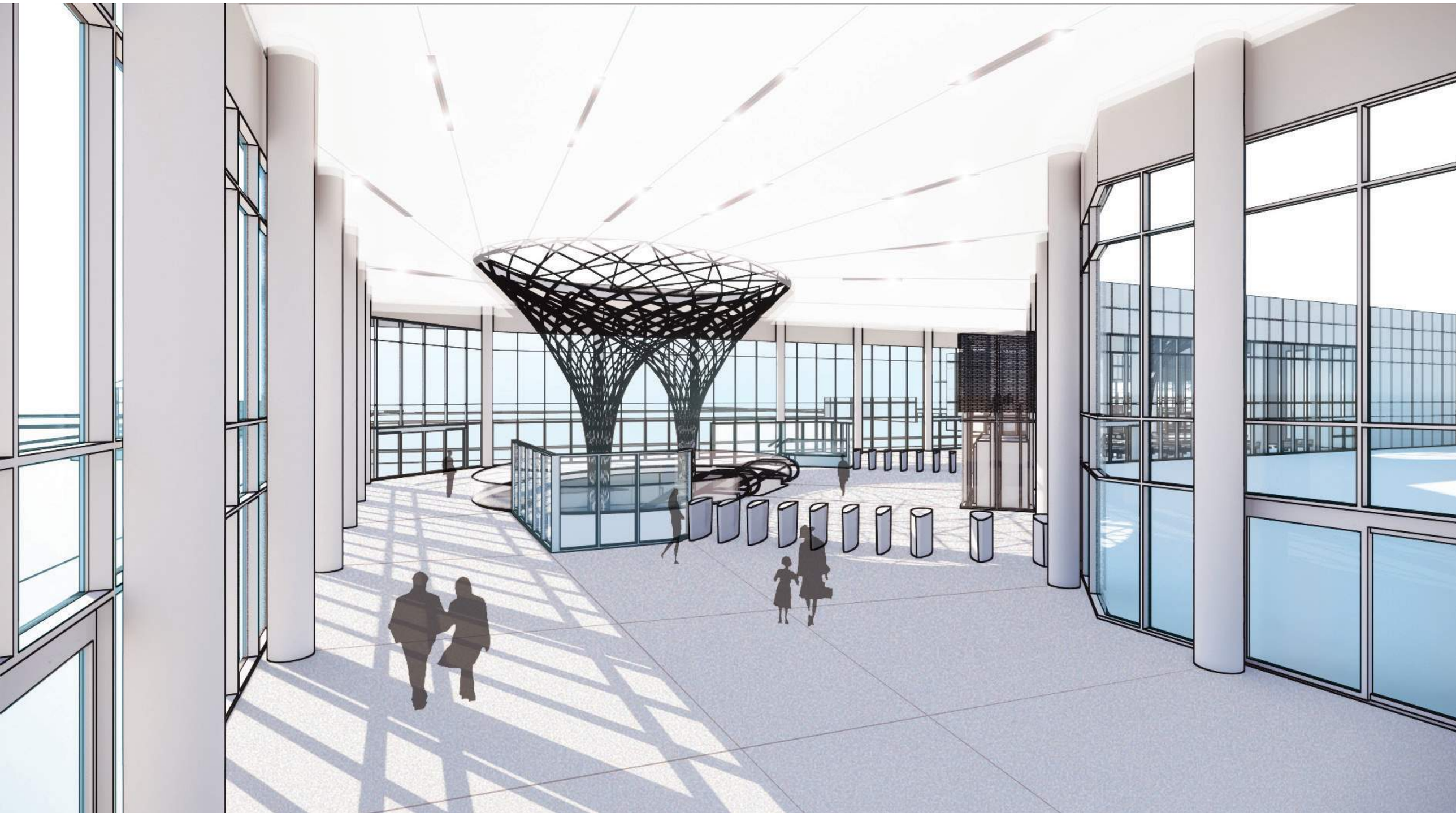
12.2.9 CBD East Station Axonometric Section

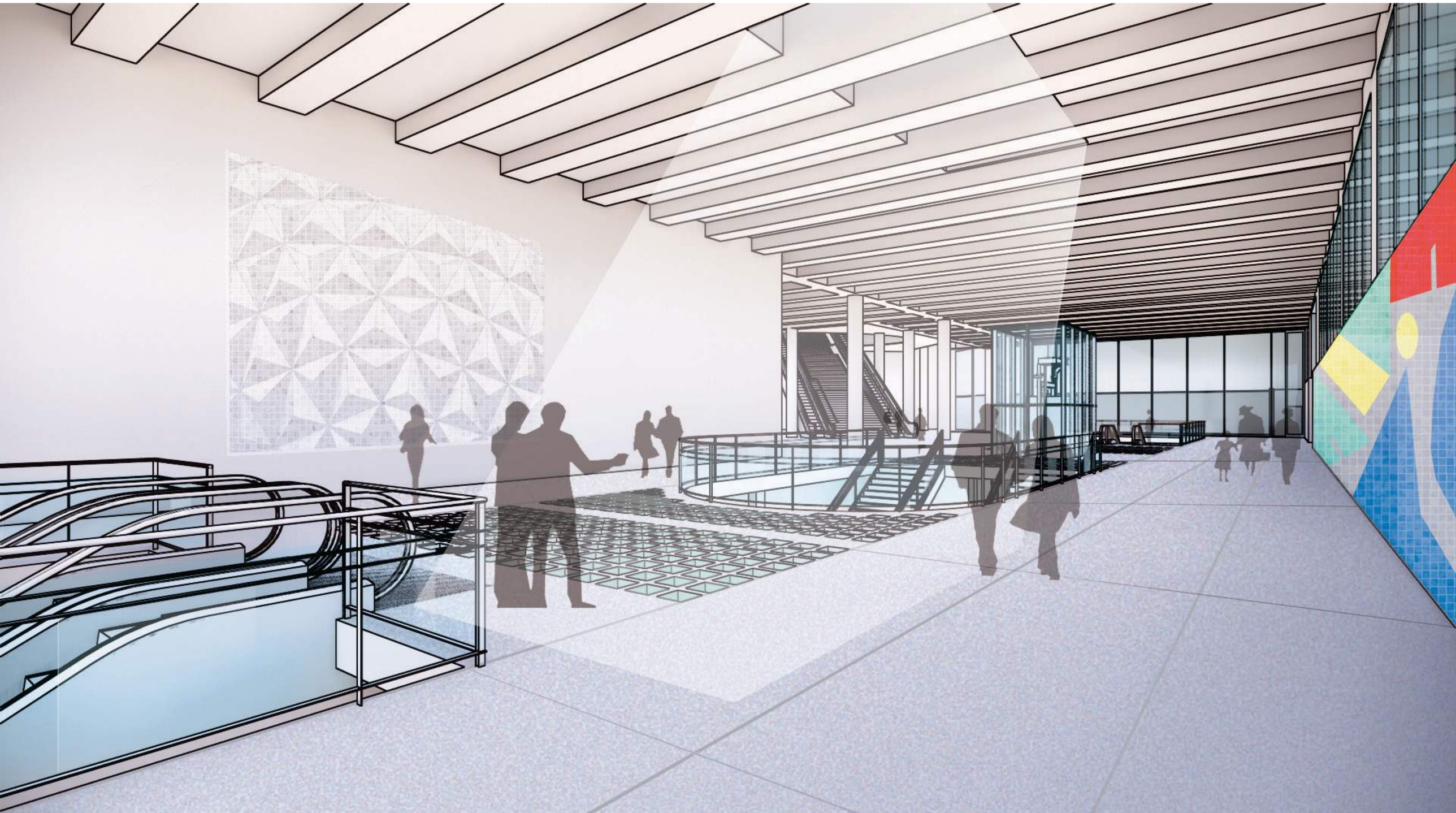




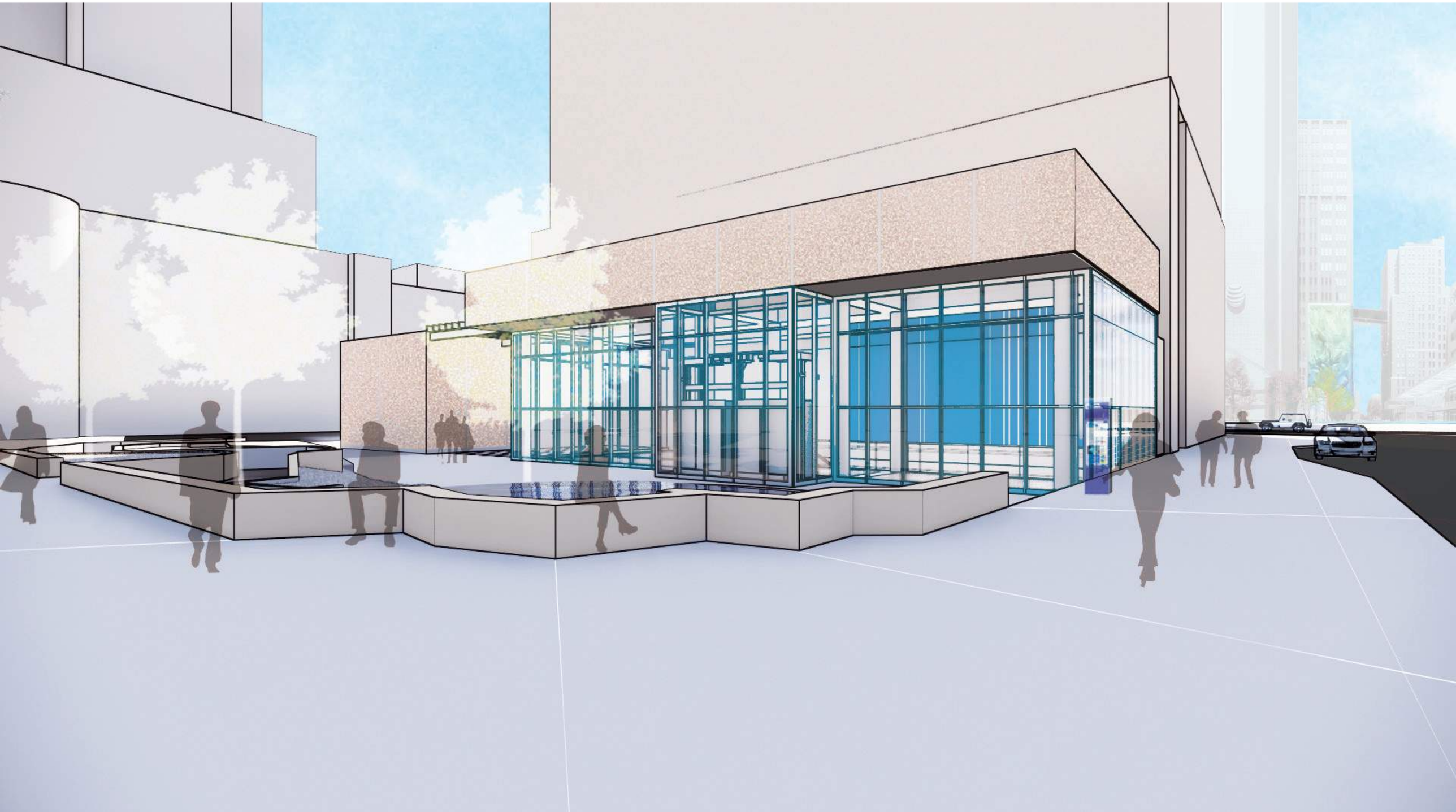
12.3.1 Metro Center Station Rendering - Lobby

12.3.1 Metro Center Station Rendering - Lobby

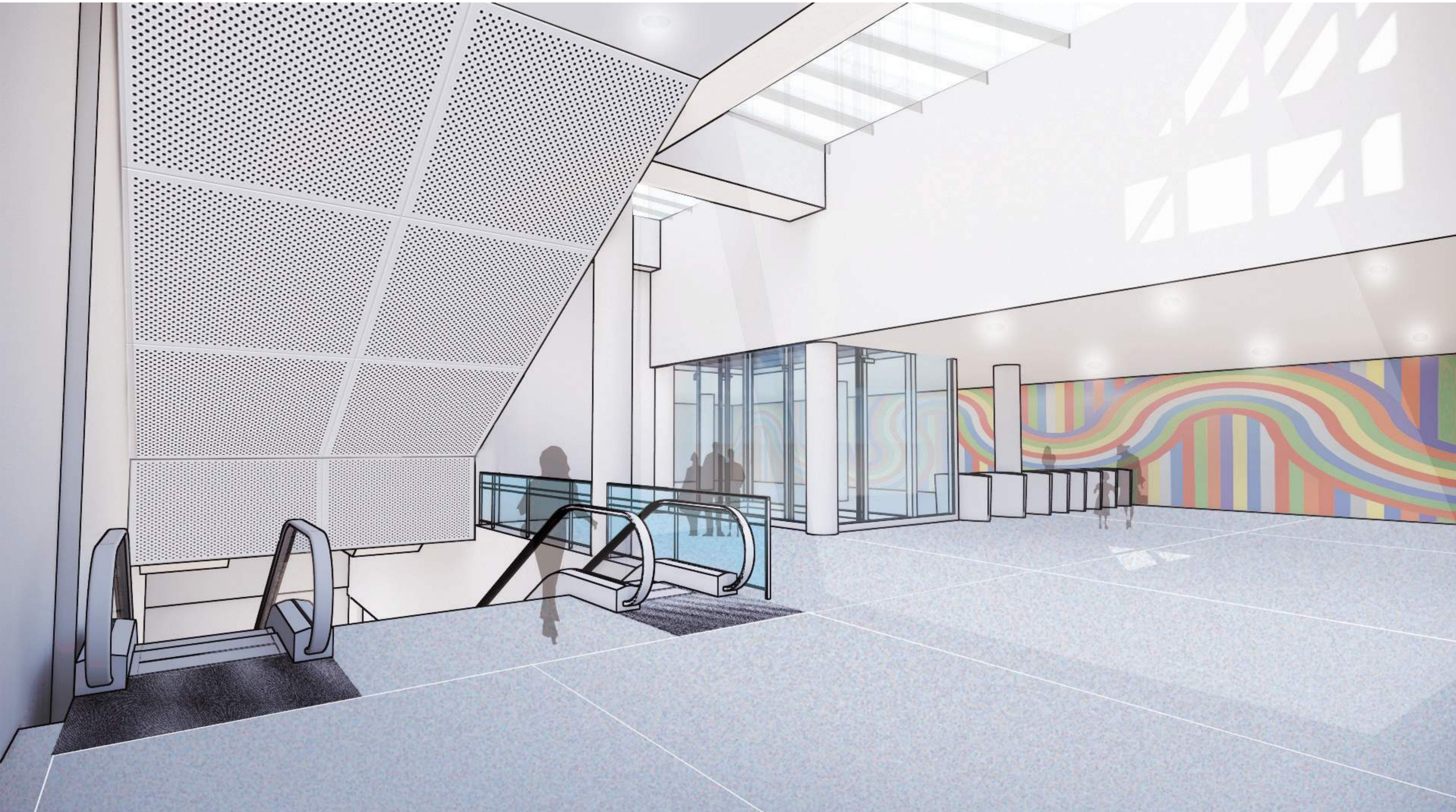




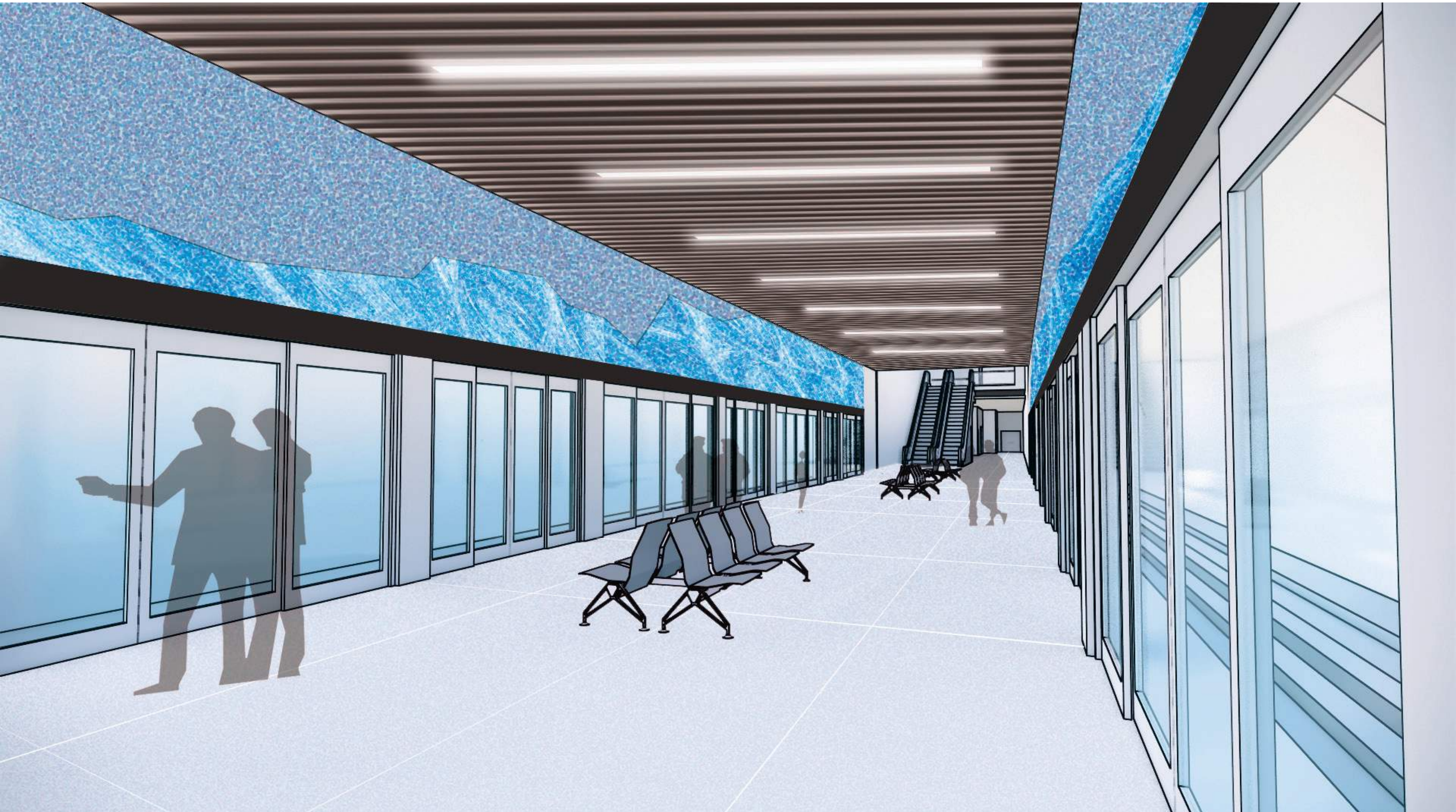
12.3.1 Metro Center Station Rendering - Platform

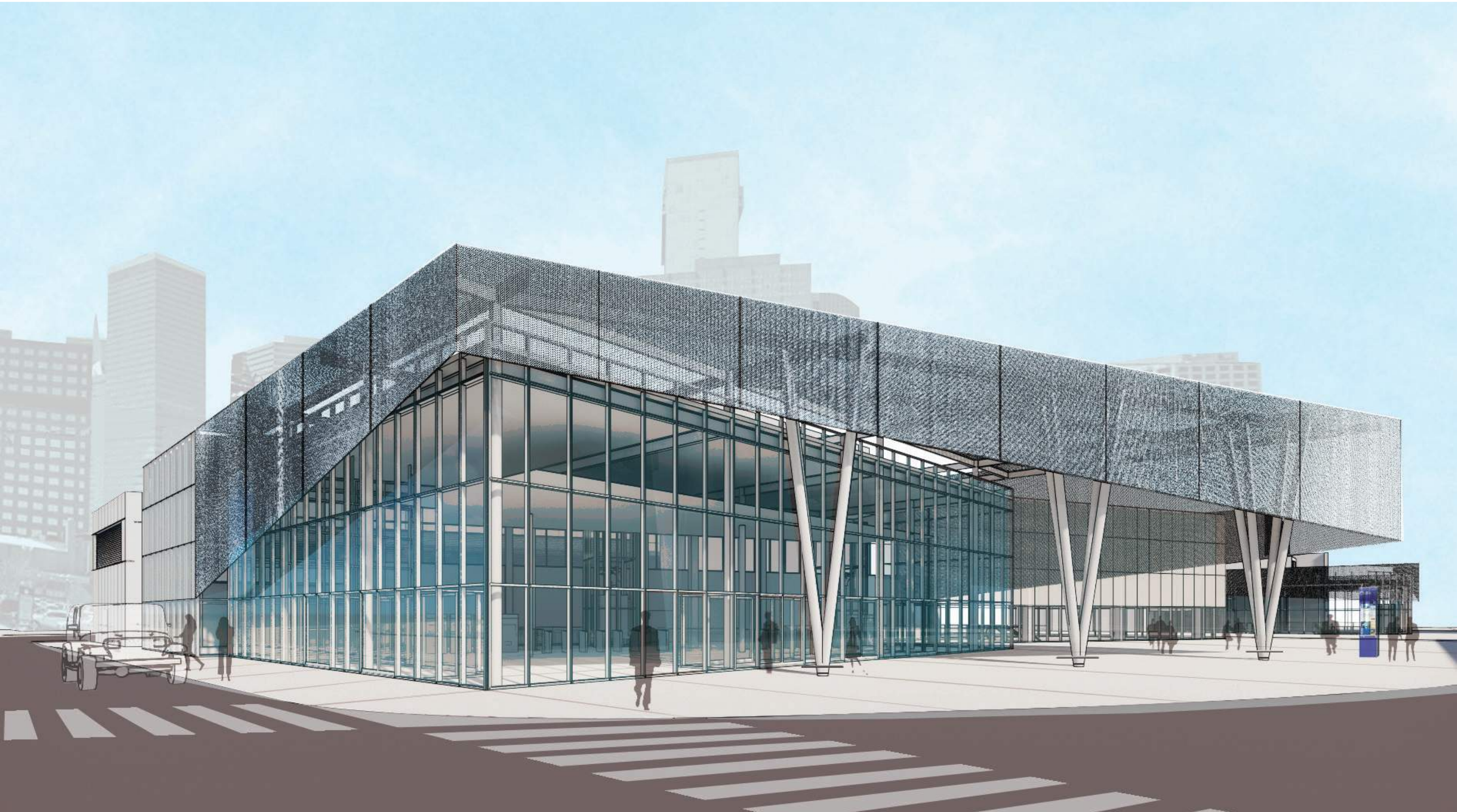


12.3.2 Commerce Station Rendering - Ticketing / Lobby



12.3.2 Commerce Station Rendering - Platform





12.3.3 CBD East Station Rendering - Lobby

12.3.3 CBD East Station Rendering - Platform

EXITING ANALYSIS

DALLAS AREA RAPID TRANSIT (DART)

Dallas, Texas

Emergency Exiting Analysis Report for Metro Center Station

Prepared by HDR Engineering Inc.
March 6, 2020

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1.0 Executive Summary

This report provides analysis of the means of egress based on DART projected ridership data for the CBD East, Commerce and Metro Center stations. The analysis utilizes NFPA 130-2014, a nationally recognized Standard for Fixed Guideway Transit and Passenger Rail Systems to provide a prescriptive review of the egress elements under emergency evacuation conditions and document existing non-conforming deficiencies. The City of Dallas has amended the Dallas Building Code (IBC 2015), to reference the adoption of NFPA 130 (§3112.1), with exception of Section §5.3 for means of egress to comply with Chapter 10 of the Dallas Building Code.

Due to the uniqueness and complexity associated with underground transit stations and trainways there would be significant practical and structural difficulties involved in carrying out the provisions of Chapter 10 of the Dallas Building Code; therefore this analysis utilized Section §5.3 of NFPA 130. At the time of this report, the Dallas Building Department has not been consulted and collaboration with the building department will be required to obtain an approval for an alternative, or equivalent options, which would allow for the application of NFPA 130 Section §5.3 or egress and smoke modeling to demonstrate compliance in lieu of Chapter 10, Building Code egress compliance.

The analysis within this report is primarily focused on NFPA 130 requirements as it relates to the computation of the egress demand and an assessment of whether the exits are sufficient to meet the 4- and 6- minute (platform and point of safety) egress criteria. Requirements regarding the arrangements of exits (e.g. maximum common path requirement) were reviewed for each station, with emphasis on points of safety, continuity of exiting components, and proof of concept.

Preliminary calculations revealed that due to long travel distances, providing the point of safety at street level outside of the station headhouse is not feasible as egress times exceeded 7 minutes. In order to reduce the travel distance and time to comply with the 6 minute egress criteria, per §5.3.3.3, the concourse level will need to be protected from exposure from the effects of fire at the platform level as determined by engineering analysis, thereby establishing a point of safety for a total required exit time that does not exceed 6 minutes.

Based on the worst case egress calculations the platform and point of safety evacuation times do not exceed the prescriptive egress criteria of NFPA 130 as identified below:

> **Egress Calculation Summary – A.M.**
>
> *The required time to exit the west platform is 2.82 minutes which is less than the allowable 4 minutes and the total required exit time to a point of safety at the concourse level is 4.00 minutes which is less than the allowable 6 minutes.*

In the event the point of safety (horizontal exit) is not approved by the Dallas Building Department and the results of the egress evacuation times exceed the prescriptive requirements it is recommended that fire hazard engineering analysis (e.g. computer fire smoke

modeling and egress modeling) be performed to ensure a tenable path of egress is maintainable during a fire event.

2.0 Scope of Work

As part of DART schematic development, only the means of egress for peak ridership were evaluated for compliance with NFPA 130 to validate the design concept.

Calculations and point of safety were based on the assumption that emergency ventilation system(s) at all stations are presumed to be compliant with all applicable codes and standards and will maintain a tenable environment sufficient to allow for full emergency evacuation of the station. Evaluation of the emergency ventilation system is not included under the scope of work of this project.

3.0 Codes and Standards

The egress analysis and code assessment for the DART stations is evaluated to Chapter 5 of NFPA 130-2014 for compliance with national standards in lieu of compliance with the Dallas Building Code's egress requirements which are significantly more restrictive.

DBC	Dallas Building Code (IBC 2015)
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Systems (2014);

The City of Dallas code adoption process has not been fully reviewed, and the adoption of newer code editions and their amendments may impose additional requirements that were not considered at the time of this report.

4.0 Ridership Data

Ridership information was provided by DART based on data projected for 2040/2050.The peak period ridership was used as the basis for calculating detraining and entraining loads for the station. The calculated Detraining/Entraining Passenger Loads used for the egress analysis are included in Appendix A – Calculated Detraining/Entraining Passenger Loads.

5.0 Code Assessment

General

The following assessment was based on preliminary design drawings of the station.

Station Description

Metro Center Station has two sets of tracks centered on a single platform. Tracks run north and south in line with Griffin Street. Platforms are accessed from the street level at three primary

entrances located along Pacific Avenue; the east headhouse between N. Field and N. Griffin Streets, the main (central) headhouse between San Jacinto, North Griffin streets and Pacific Ave, and the west headhouse southeast of Pacifica Ave and Lamar Street. Two additional emergency egress only headhouses are located north and south of Pacific Avenue along N. Griffin Street. The platform level has three primary vertical circulation elements leading to the concourse level, which connect to their respective headhouses/stations. Additional emergency exiting are provided at the far north and south ends of the platform, which lead to emergency egress only headhouses. Due to the depth of the station and the remote locations of the headhouses/stations, the concourse level is designated as a point of safety. Access to the platform from the main and west headhouses is provided by elevators, escalators and stairways. Access to the platform from the east headhouse is provided by stairways and elevators.

Egress Analysis

Egress analysis of the data assumes that at the time of the emergency fire event, there will be no trains inside the station. A temporary service disruption, or “failure period” (function of train frequency), will prevent peak inbound and outbound direction trains from entering the station. During this failure period, passengers will continue to enter the station according to their peak-period entry rate and accumulate on the platform to which they are destined under normal conditions. Peak direction passengers will remain on the platforms while passengers traveling in the off-peak direction are able to board trains arriving at regular headways. After the duration of the failure period, trains are assumed to enter the station simultaneously “on all tracks in normal traffic direction.” Due to a missed headway, trains operating in the peak direction are either filled to “crush capacity” or are carrying twice their normal peak loads to account for the missed train. Trains operating in the off-peak direction are assumed to carry their average peak 15-minute passenger volumes. The fire source is located onboard one (and only one) of the trains entering the station (i.e., “incident train”). The number of passengers to be evacuated includes those who have accumulated on all platforms as well as those on board all trains.

For exiting calculations a crush capacity of 495 persons for 3 cars per train was used. DART’s 2040/2050 ridership operations indicate 3.75-minute headway. This report will determine compliance for the emergency evacuation of the existing station based on the following requirements:

- 4 minute evacuation time off the platform level.
- 6 minute evacuation time to a Point of Safety (POS).
- Calculate occupant load based on station ridership data and pedestrian hydraulic formulas.
- Evaluate maximum travel distance conditions and minimum means of egress capacity per platform and at points of convergence.
- No more than one train will unload at any one track to a platform during a fire event.
- The load on any single train is limited to the maximum crush capacity of the train.

- Not more than 50% of escalators are utilized for egress capacity and the worst case egress condition shall be deemed as out of service for purposes of calculations.
- Egress calculations assume a maximum travel distance from the most remote point on the platform to the point of safety during a single fire event.
- Point of Safety (POS) for egress calculations shall mean a point outside of the station and not below an attached canopy or roof with sufficient space for egress capacity.

Egress calculations are preliminary and the final design will need to be verified by the design build contractor through engineering analysis.

Passenger Load Distribution

A single platform is located between the Inbound and Outbound tracks, respectively. The platform is served by two sets of open escalators centered on an open stair. Additional exiting is located at the far ends of the platform providing exit enclosures discharging directly to the street level. The concourse level provides open access to three vertical circulation elements, which lead to the east, central and west headhouses. The west headhouse and the south emergency only exit passageway, which connects to the south exit stair enclosure, are not calculated in the passenger load distribution due to the long travel distances and limited egress capacity. Egress at the concourse level is optimized between the east and central headhouses, which provide egress to the exterior of the station (See Appendix B – Egress Analysis for calculated platform and station loads). Where only one escalator was provided for egress from a level, the escalator was considered to be “not in service” and was not included in the calculations. Where more than one escalator was provided, the escalator which created the worst egress conditions was considered to be “not in service” and was not included in calculations.

Special Events

There have been no special event conditions designated by DART for Metro Center Station that would require additional analysis. Special events, typically, are not regularly scheduled activities, but do take place a number of times per year and often result in an increased peak ridership.

Egress Components

Compliance with the requirements for general means of egress components such as corridors, escalators, platforms, stairs, and ramps as defined in NFPA 130.

6.0 Conclusions

The requirements of NFPA 130 are intended to address the occupant protection systems and their effectiveness for maintaining egress, or defending in place, during a single emergency or fire event. While the station geometry and egress capacity is shown as conforming with the prescriptive requirements of the 2014 edition of NFPA 130, it is recommended that an engineering analysis be performed to ensure warning and evacuation systems, fire separations, smoke control systems and structural adequacy will maintain a tenable environment in the facility during a fire event. A preliminary meeting should be conducted with the Dallas Building Department to confirm the use of NFPA 130 for egress calculations in lieu of Building Code requirements.

APPENDIX A – Calculated Detraining/Entraining Passenger Load

PROVIDED ON NEXT SHEET

NFPA 130 SUMMARY REPORT: PEAK HOUR PATRONAGE DATA (LOS C MATRIX)

CENTER PLATFORM CONCEPT

Name of Station	Metro Center Station	
Design Year	Assumed Full System - Date 2040/2050	
Assumed Headway Interval	3.75 minutes	*Provided by DART. Four future Lines (per track)*
Maximum Calculated Train Load	495 passengers (Crush Load)	*Per train. 3-Car consist SLRV*
Platform Length	410 Feet	*DART standard for Below-grade station*
	(This is from inside face of PED doors to other side)	*Assumed minimums: 8' clear from plaftorm edges 16' Two adjacent escalators.*
Platform Width	25 Feet	
Standard Stair Width	8 Feet	
Number of Escalators	4	
Escalator Nominal Width	4 Feet = 100 pedestrians per minute	
Level of Service - Normal	C = 7.00 ft² per person	
- Emergency	D = 3.00 ft² per person	

Entraining / hour	Detraining / hour	Link Load / hour	
1,980	3,960	7,920	*Assuming at AM peak.*
25% of link	50% of link	<--16 Trains/Hr at 495 people each	*Since Commerce is in centre of the line, people are mostly detraining. But some are also getting on.*

Peak Direction* — **Southbound**

PLATFORM

Assuming combination of 4 all 4 future LRT lines

Off Peak Direction — **Northbound**

Link Load / hour	Detraining / hour	Entraining / hour	
7,920	3,960	1,980	*Assuming at AM peak.*
16 Trains/Hr --> at 495 people each	50% of link	25% of link	*25% and 50% of link are assumed values*

NOTES: * Peak Direction is the direction with the largest sum of Link and Entraining loads.
Generate results for both am and pm peak periods to determine worst case scenario

APPENDIX B – Egress Analysis

PROVIDED ON NEXT SHEET

Dallas Area Rapid Transit (DART)

EGRESS ANALYSIS: METRO CENTER STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

EXECUTIVE SUMMARY

THE REQUIRED TIME TO EXIT THE PLATFORM(S) IS **2.82 MINUTES** (WORST CASE SCENARIO) WHICH IS MORE THAN THE ALLOWABLE 4 MINUTES PER NFPA 130, 2017. THE TOTAL REQUIRED EXIT TIME FROM THE STATION TO THE PUBLIC WAY IS **7.42 MINUTES** (WORST CASE SCENARIO) WHICH IS MORE THAN THE ALLOWABLE 6 MINUTES PER NFPA 130, 2017. PER §5.3.3.3, THE CONCOURSE LEVEL WILL NEED TO BE PROTECTED FROM EXPOSURE FROM THE EFFECTS OF FIRE AT THE PLATFORM LEVEL AS DETERMINED BY ENGINEERING ANALYSIS TO ESTABLISH A POINT OF SAFETY FOR A TOTAL REQUIRED EXIT TIME OF **4.00 MINUTES** (WORST CASE SCENARIO). REFER TO EGRESS DRAWING FOR A GRAPHIC ILLUSTRATION OF THE ASSOCIATED EGRESS ELEMENTS, THEIR WIDTHS AND TRAVEL DISTANCES BETWEEN AS INCLUDED IN THE CALCULATIONS BELOW.

STATION OCCUPANT LOADS: DART

		ENTRAINING LOAD	DETRAINING (TRAIN LOAD)	PLATFORM OCCUPANT LOAD
INBOUND TRAIN CALCULATED OCCUPANT LOAD	=	322	495	817
OUTBOUND TRAIN CALCULATED OCCUPANT LOAD	=	322	495	817

NOTES:
1. INBOUND TRAIN EXITING OPENS TO CENTER PLATFORM.
2. OUTBOUND TRAIN EXITING OPENS TO CENTER PLATFORM.
3. IN CALCULATING THE EGRESS CAPACITY OF ESCALATORS, ONE ESCALATOR AT EACH LEVEL SHALL BE CONSIDERED AS BEING OUT OF SERVICE.

CALCULATED OCCUPANT LOAD MATRIX:

PLATFORM OCCUPANT LOAD: INBOUND & OUTBOUND*	**1634 PEOPLE**
PLATFORM OCCUPANT LOAD: EXITING NORTH*	**584 PEOPLE**
CALCULATED OCCUPANT LOAD (5'-0" NORTH STAIR)	236 PEOPLE
CALCULATED OCCUPANT LOAD (NORTH ESCALATOR - 2 COUNTED @ 44" PER)	348 PEOPLE
	584
PLATFORM OCCUPANT LOAD: EXITING AT CENTER STAIR*	**662 PEOPLE**
CALCULATED OCCUPANT LOAD (7'-0" CENTER STAIR; NORTH)	331 PEOPLE
CALCULATED OCCUPANT LOAD (7'-0" CENTER STAIR; SOUTH)	331 PEOPLE
	662
PLATFORM OCCUPANT LOAD: EXITING SOUTH*	**388 PEOPLE**
CALCULATED OCCUPANT LOAD (4'-6" SOUTH STAIR)	214 PEOPLE
CALCULATED OCCUPANT LOAD (SOUTH ESCALATORS - ONLY 1 COUNTED @ 44" PER)	174 PEOPLE
	388

EGRESS ANALYSIS: METRO CENTER STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

TRAVEL CALCULATIONS:

A-A TO POS-1

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-1): WORST CASE SCENARIO*

DISTANCE FROM:	T1 TO SECTION A - A		52 FEET
DISTANCE FROM:	SECTION A - A TO SECTION A1 - A1	*ESCALATORS (OFF OF PLATFORM)*	57 FEET
DISTANCE FROM:	SECTION A1 - A1 TO SECTION A2 - A2 / POS-1	*CONCOURSE (POINT OF SAFETY)*	178 FEET
DISTANCE FROM:	SECTION A2 - A2 TO SECTION A3 - A3	*STAIRS*	69 FEET
DISTANCE FROM:	SECTION A3 - A3 TO SECTION A4 - A4		21 FEET
DISTANCE FROM:	SECTION A4 - A4 TO SECTION A5-A5		22 FEET
DISTANCE FROM:	SECTION A5 - A5 TO STATION EXIT		5 FEET
		OVERALL TOTAL DISTANCE (T1 TO POS-1):	404 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-1): SOUTH END OF PLATFORM*

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T1 TO SECTION A - A	(DISTANCE / WALKING SPEED)	0.419 MINUTES
TRAVEL TIME FROM:	SECTION A - A TO SECTION A1 - A1	(DISTANCE / WALKING SPEED)	1.188 MINUTES
TRAVEL TIME FROM:	SECTION A1 - A1 TO SECTION A2 - A2 / POS-1	(DISTANCE / WALKING SPEED)	1.435 MINUTES
TRAVEL TIME FROM:	SECTION A2 - A2 TO SECTION A3 - A3	(DISTANCE / WALKING SPEED)	1.438 MINUTES
TRAVEL TIME FROM:	SECTION A3 - A3 TO SECTION A4 - A4	(DISTANCE / WALKING SPEED)	0.169 MINUTES
TRAVEL TIME FROM:	SECTION A4 - A4 TO SECTION A5-A5	(DISTANCE / WALKING SPEED)	0.177 MINUTES
TRAVEL TIME FROM:	SECTION A5 - A5 TO STATION EXIT	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T1 TO POS-1):	**4.87 MINUTES**

B-B TO POS-2

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T2) TO POINT OF SAFETY (POS-2): WORST CASE SCENARIO*

DISTANCE FROM:	T2 TO SECTION B - B		70 FEET
DISTANCE FROM:	**SECTION B - B TO SECTION B1 - B1**	*STAIRS (OFF OF PLATFORM)*	54 FEET
DISTANCE FROM:	SECTION B1 - B1 TO SECTION B2 - B2 / POS-2	*CONCOURSE (POINT OF SAFETY)*	82 FEET
DISTANCE FROM:	**SECTION B2 - B2 TO SECTION B3 - B3**	*STAIRS (FROM CONCOURSE TO HEADHOUSE)*	76 FEET
DISTANCE FROM:	SECTION B3 - B3 TO SECTION B4 - B4	*EMERGENCY EXIT DISCHARGE DOORS ONLY*	44 FEET
DISTANCE FROM:	SECTION B4 - B4 TO SECTION B5-B5	*EGRESS PATH NOT UTILIZED*	0 FEET
DISTANCE FROM:	SECTION B5 - B5 TO STATION EXIT		5 FEET
		OVERALL TOTAL DISTANCE (T2 TO POS-2):	331 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T2) TO POINT OF SAFETY (POS-2): NORTH END OF PLATFORM*

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T2 TO SECTION B - B	(DISTANCE / WALKING SPEED)	0.565 MINUTES
TRAVEL TIME FROM:	**SECTION B - B TO SECTION B1 - B1**	(DISTANCE / WALKING SPEED)	1.125 MINUTES
TRAVEL TIME FROM:	SECTION B1 - B1 TO SECTION B2 - B2 / POS-2	(DISTANCE / WALKING SPEED)	0.661 MINUTES
TRAVEL TIME FROM:	**SECTION B2 - B2 TO SECTION B3 - B3**	(DISTANCE / WALKING SPEED)	1.583 MINUTES
TRAVEL TIME FROM:	SECTION B3 - B3 TO SECTION B4 - B4	(DISTANCE / WALKING SPEED)	0.355 MINUTES
TRAVEL TIME FROM:	SECTION B4 - B4 TO SECTION B5-B5	(DISTANCE / WALKING SPEED)	0.00 MINUTES
TRAVEL TIME FROM:	SECTION B5 - B5 TO STATION EXIT	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T2 TO POS-2):	**4.33 MINUTES**

EGRESS ANALYSIS: METRO CENTER STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

FLOW CALCULATIONS:

EXITING TO THE NORTH OF PLATFORM

PLATFORM EGRESS
North Escalotors

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	348 PEOPLE
CLEAR GROSS WIDTH:	*(2) Escalotors (44" per escalator)*	88 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	88 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	124 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.81 MINUTES
	TOTAL FLOW TIME ACROSS ESCALOTORS	**2.81 MINUTES**

PLATFORM EGRESS
North Door(s)

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	236 PEOPLE
CLEAR GROSS WIDTH:	*(1) DOUBLE EGRESS FIRE DOORS (6'-0")*	72 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	68 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	141 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.67 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**1.67 MINUTES**

PLATFORM EGRESS
North Stair(s); Egress to Street Level

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	236 PEOPLE
CLEAR GROSS WIDTH:		60 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	60 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	84 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.81 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**2.81 MINUTES**

EXITING AT THE CENTER OF PLATFORM

PLATFORM EGRESS
Center Stair (7'-0"; North) **B - B**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	331 PEOPLE
CLEAR GROSS WIDTH:		84 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	84 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	118 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.81 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS SECTION B -B:	**2.81 MINUTES**

PLATFORM EGRESS
Center Stair (7'-0"; South) **B - B**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	331 PEOPLE
CLEAR GROSS WIDTH:		84 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	84 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	118 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.81 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS SECTION B - B:	**2.81 MINUTES**

EXITING TO THE SOUTH OF PLATFORM

PLATFORM EGRESS
South Escalators **A - A**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	174 PEOPLE
CLEAR GROSS WIDTH:	*(2) Escalotors (only 1 counted towards egress per §5.3.5.6)*	44 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	44 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	62 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.81 MINUTES
	TOTAL FLOW TIME ACROSS ESCALOTORS SECTION A - A:	**2.81 MINUTES**

PLATFORM EGRESS
South Door(s)

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	214 PEOPLE
CLEAR GROSS WIDTH:	*(1) DOUBLE EGRESS FIRE DOORS (6'-0")*	72 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	68 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	141 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.52 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**1.52 MINUTES**

PLATFORM EGRESS
South Stair(s); Staggered Stair to Street Level

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	214 PEOPLE
CLEAR GROSS WIDTH:		54 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	54 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	76 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.82 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**2.82 MINUTES**

EGRESS ANALYSIS: METRO CENTER STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

CONCOURSE EGRESS
Main (Central) Stair(s) — **B2 - B2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	600	PEOPLE
CLEAR GROSS WIDTH:		144	INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2014)	144	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	1.41	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	203	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.96	MINUTES
	TOTAL FLOW TIME ACROSS STAIRS SECTION B2 - B2:	**2.96**	**MINUTES**

CONCOURSE EGRESS
Main (Central) Escalator(s) — **B2 - B2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	183	PEOPLE
CLEAR GROSS WIDTH:	*(2) Escalators (only 1 counted towards egress per §5.3.5.6)*	44	INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	44	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	62	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.95	MINUTES
	TOTAL FLOW TIME ACROSS ESCALOTORS SECTION B2 - B2:	**2.95**	**MINUTES**

CONCOURSE EGRESS
East Stairs — **A2 - A2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	401	PEOPLE
CLEAR GROSS WIDTH:		96	INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2014)	96	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	1.41	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	135	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.97	MINUTES
	TOTAL FLOW TIME ACROSS SECTION A2 - A2:	**2.97**	**MINUTES**

CONCOURSE EGRESS
West (Remote) Stair(s) — *Component not calculated due to long travel times*

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	0	PEOPLE
CLEAR GROSS WIDTH:		60	INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2014)	60	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	1.41	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	84	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.00	MINUTES
	TOTAL FLOW TIME ACROSS SECTION C3 - C3:	**0.00**	**MINUTES**

MAIN (CENTRAL) HEADHOUSE — *Only Exit Doors Calculated*
Emergency Exit Discharge Doors & Fare Barriers — **B4 - B4**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	783	PEOPLE
CLEAR GROSS WIDTH:	*(2) DOUBLE LEAF DOORS (EMERGENCY EGRESS ONLY)*	144	INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2014)	136	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	2.08	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	282	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.78	MINUTES
OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	0	PEOPLE
NUMBER OF FARE BARRIERS:	*18 NEW FARE BARRIERS (INCLUDING 4 ACCESSIBLE FARE BARRIERS)*	18	FARE BARRIERS
CAPACITY PER FARE BARRIER:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	50	PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER FARE BARRIER x NUMBER OF FARE BARRIERS)	900	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.00	MINUTES
	TOTAL FLOW TIME ACROSS SECTION B4 - B4:	**2.78**	**MINUTES**

EAST HEADHOUSE
Fare Barriers — **A4 - A4**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	401	PEOPLE
NUMBER OF FARE BARRIERS:	3 NEW FARE BARRIERS (INCLUDING 1 ACCESSIBLE FARE BARRIER)	5	FARE BARRIERS
CAPACITY PER FARE BARRIER:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	50	PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER FARE BARRIER x NUMBER OF FARE BARRIERS)	250	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.60	MINUTES
	TOTAL FLOW TIME ACROSS SECTION A4 - A4:	**1.60**	**MINUTES**

EAST HEADHOUSE
Emergency Exit Discharge Doors — **A5 - A5**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	401	PEOPLE
CLEAR GROSS WIDTH:	(2) DOUBLE LEAF DOORS	96	INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2014)	84	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	2.08	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	174	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.30	MINUTES
	TOTAL FLOW TIME ACROSS SECTION A5 - A5:	**2.30**	**MINUTES**

TOTAL REQUIRED TIME TO EXIT THE PLATFORM(S): WORST CASE SCENARIO

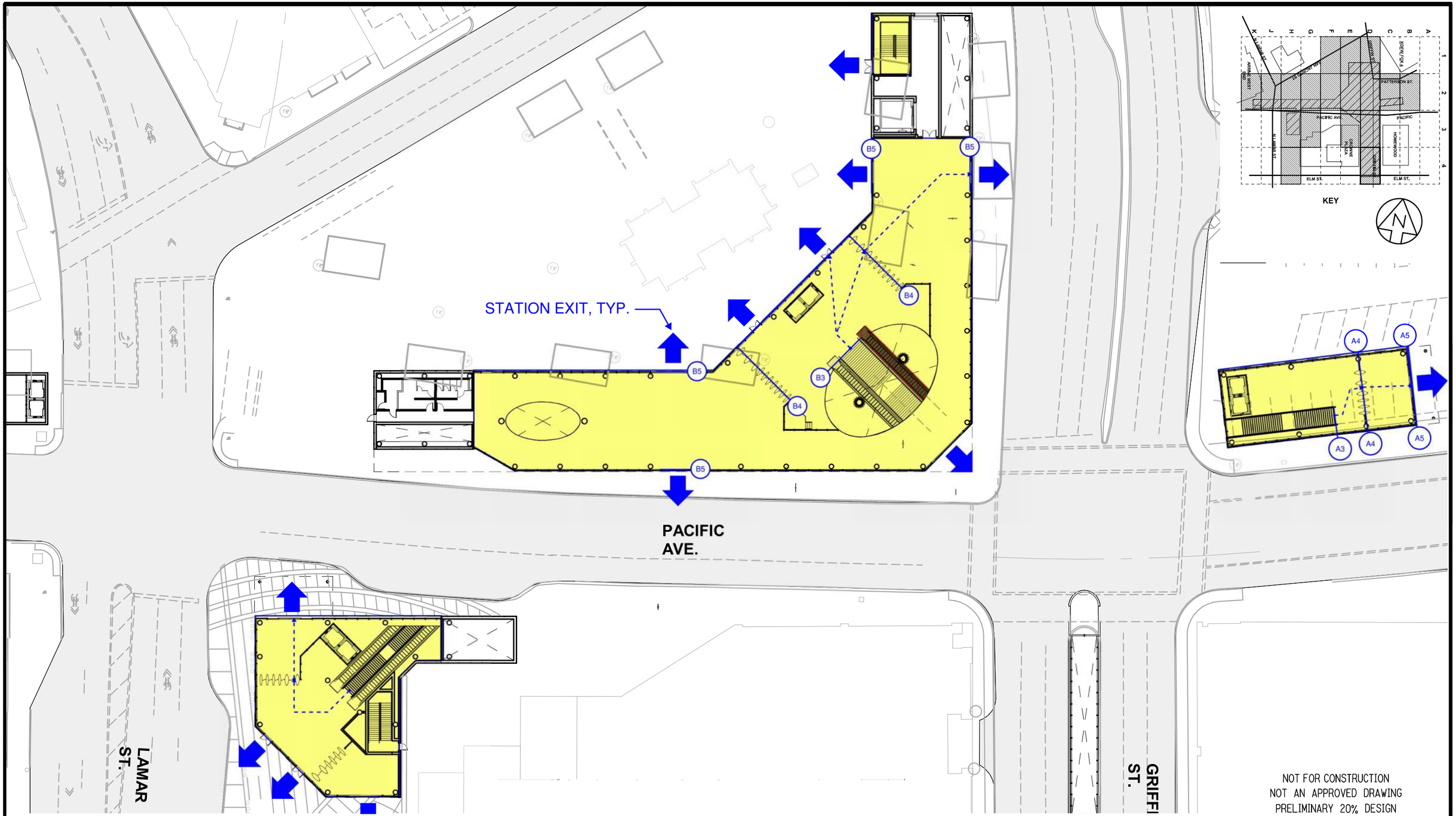
PASSENGER FLOW TIME (WORST CASE SCENARIO) ON THE CENTER PLATFORM EQUALS =	**2.82**	**MINUTES**

TOTAL REQUIRED TIME TO EXIT STATION FROM PLATFORM (S) (PER NFPA 130, 2017): WORST CASE SCENARIO

TOTAL FLOW TIME (A - A) + TRAVEL TIME (WORSE CASE SCENARIO TO EXIT STATION) =	**7.42**	**MINUTES**

TOTAL REQUIRED TIME TO EXIT TO A POINT OF SAFETY (POS) FROM PLATFORM (S) (PER NFPA 130, 2017): WORST CASE SCENARIO

TOTAL FLOW TIME (A - A) + TRAVEL TIME (WORSE CASE SCENARIO TO POINT OF SAFETY AT CONCOURSE A) =	**4.00**	**MINUTES**



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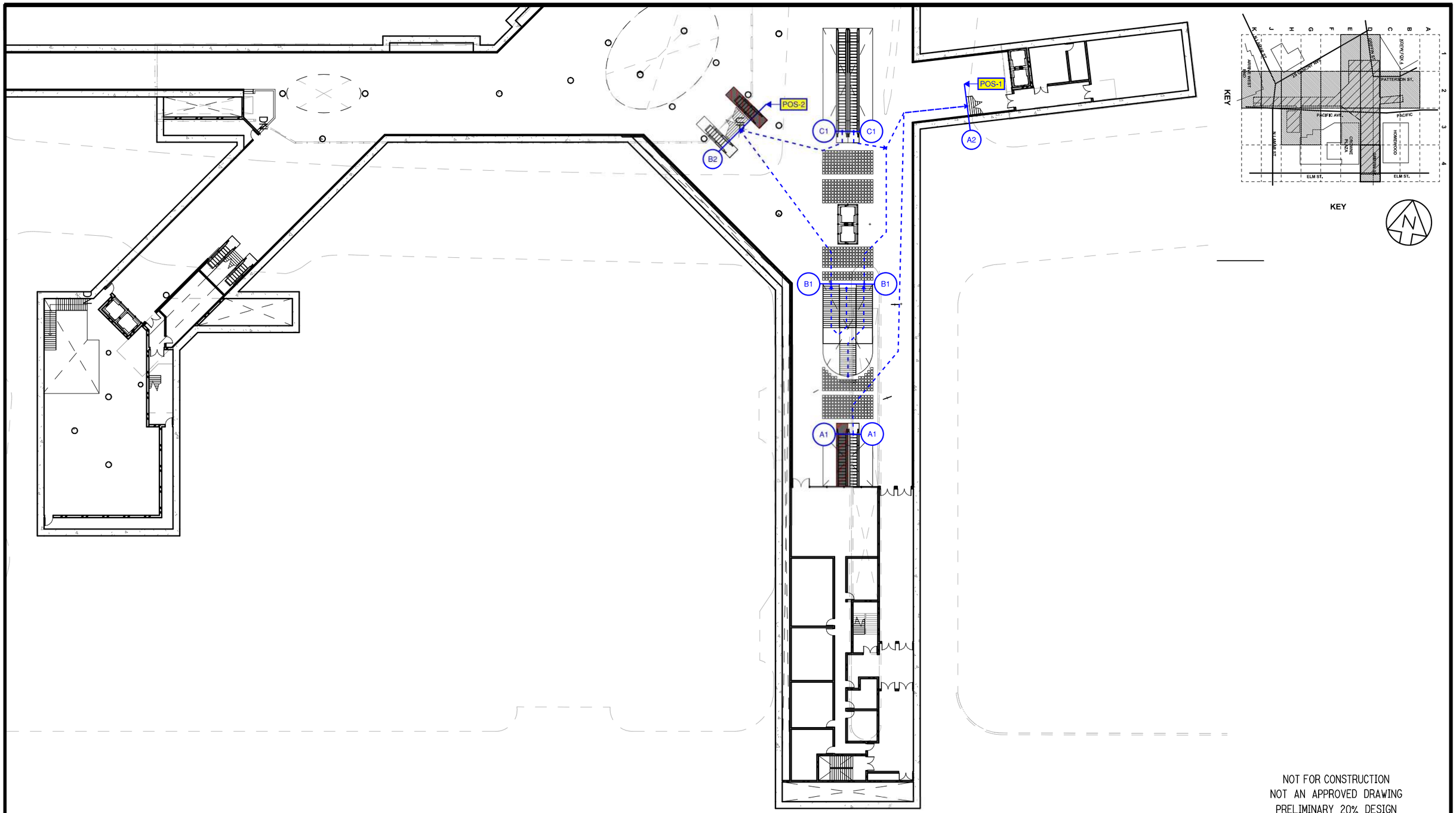
LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

METRO CENTER

STREET LEVEL
OVERALL EGRESS PLAN



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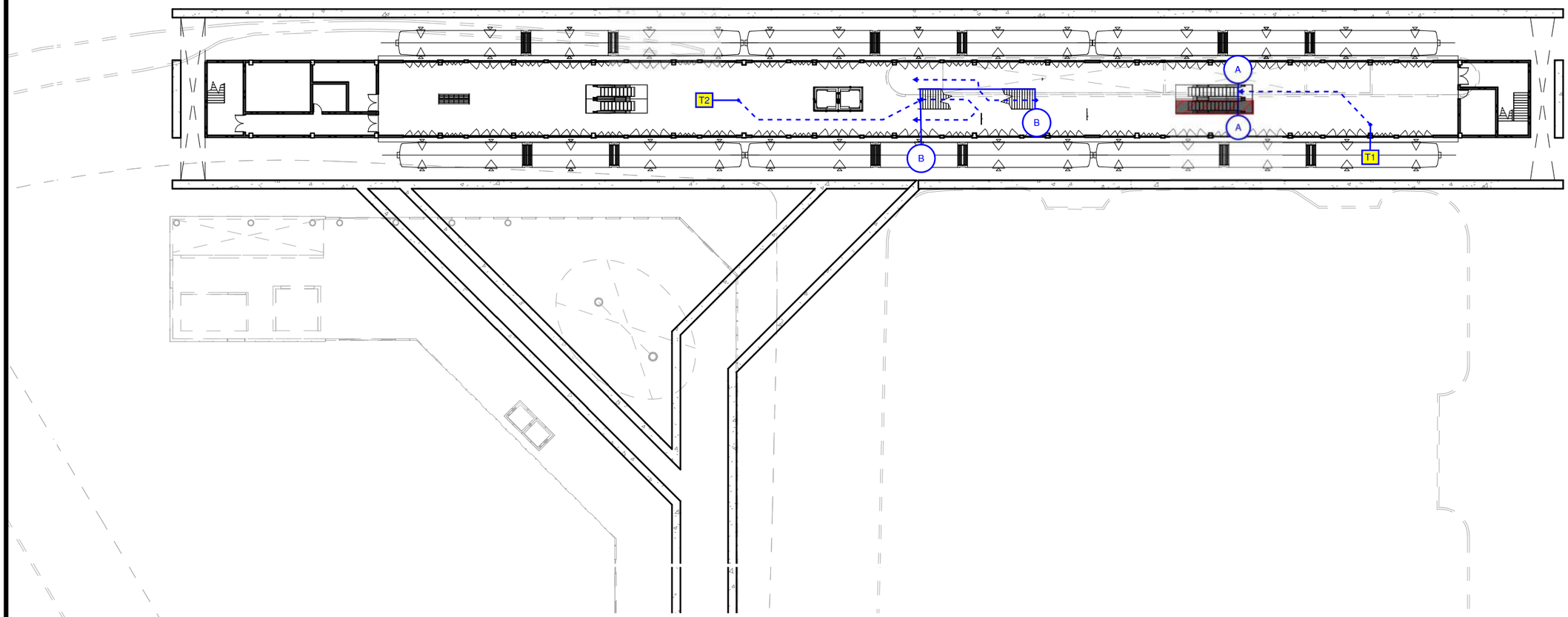
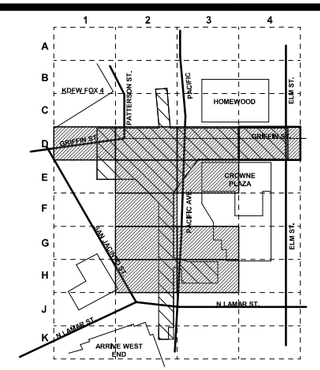
LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

METRO CENTER

CONCOURSE LEVEL
OVERALL EGRESS PLAN





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LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

METRO CENTER

PLATFORM LEVEL
OVERALL EGRESS PLAN

EXITING ANALYSIS

DALLAS AREA RAPID TRANSIT (DART)

Dallas, Texas

Emergency Exiting Analysis Report for Commerce Station

Prepared by HDR Engineering Inc.
March 6, 2020

DART | Project No. 10024656
EMERGENCY EXITING ANALYSIS FOR COMMERCE STATION

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1.0 Executive Summary

This report provides preliminary analysis of the means of egress based on DART projected ridership data for the CBD East, Commerce and Metro Center stations. The analysis utilizes NFPA 130-2014, a nationally recognized Standard for Fixed Guideway Transit and Passenger Rail Systems to provide a prescriptive review of the egress elements under emergency evacuation conditions and document existing non-conforming deficiencies. The City of Dallas has amended the Dallas Building Code (IBC 2015), to reference the adoption of NFPA 130 (§3112.1), with exception of Section §5.3 for means of egress to comply with Chapter 10 of the Dallas Building Code. Due to the uniqueness and complexity associated with underground transit stations and trainways there would be significant practical and structural difficulties involved in carrying out the provisions of Chapter 10 of the Dallas Building Code; therefore this analysis utilized Section §5.3 of NFPA 130. At the time of this report, the Dallas Building Department has not been consulted and collaboration with the building department will be required to obtain an approval for an alternative, or equivalent options, which would allow for the application of NFPA 130 Section §5.3 or egress and smoke modeling to demonstrate compliance in lieu of Chapter 10, Building Code egress compliance.

The analysis within this report is primarily focused on NFPA 130 requirements as it relates to the computation of the egress demand and an assessment of whether the exits are sufficient to meet the 4- and 6- minute (platform and point of safety) egress criteria. Requirements regarding the arrangements of exits (e.g. maximum common path requirement) were reviewed for each station, with emphasis on points of safety, continuity of exiting components, and proof of concept.

Preliminary calculations revealed that due to long travel distances, providing the point of safety at street level outside of the station headhouse is not feasible as egress times exceeded 9 minutes. In order to reduce the travel distance and time to comply with the 6 minute egress criteria, horizontal exiting (§5.3.9) was applied to create a point of safety at the mezzanine levels in their respective corridor.

Based on the worst case egress calculations, the platform and point of safety (horizontal exit) evacuation times do not exceed the prescriptive egress criteria of NFPA 130 as identified below:

Egress Calculation Summary – A.M.

The required time to exit the west platform is 3.63 minutes which is less than the allowable 4 minutes and the total required exit time from the station to the public way, or point of safety, is 5.19 minutes which is less than the allowable 6 minutes.

In the event the point of safety (horizontal exit) is not approved by the Dallas Building Department and the results of the egress evacuation times exceed the prescriptive requirements it is recommended that fire hazard engineering analysis (e.g. computer fire smoke modeling and egress modeling) be performed to ensure a tenable path of egress is maintainable during a fire event.

2.0 Scope of Work

As part of DART schematic development, only the means of egress for peak ridership were evaluated for compliance with NFPA 130 to validate the design concept.

Calculations and point of safety were based on the assumption that emergency ventilation system(s) at all stations are presumed to be compliant with all applicable codes and standards and will maintain a tenable environment sufficient to allow for full emergency evacuation of the station. Evaluation of the emergency ventilation system is not included under the scope of work of this project.

3.0 Codes and Standards

The egress analysis and code assessment for the DART stations is evaluated to Chapter 5 of NFPA 130-2014 for compliance with national standards in lieu of compliance with the Dallas Building Code's egress requirements which are significantly more restrictive.

DBC	Dallas Building Code (IBC 2015)
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Systems (2014);

The City of Dallas code adoption process has not been fully reviewed, and the adoption of newer code editions and their amendments may impose additional requirements that were not considered at the time of this report.

4.0 Ridership Data

Ridership information was provided by DART based on data projected for 2040/2050.The peak period ridership was used as the basis for calculating detraining and entraining loads for the station. The calculated Detraining/Entraining Passenger Loads used for the egress analysis are included in Appendix A – Calculated Detraining/Entraining Passenger Loads.

5.0 Code Assessment

General

The following assessment was based on preliminary design drawings of the station.

Station Description

Commerce Station has two sets of tracks centered on a single platform. Tracks run east and west in line with Commerce Street. Platforms are accessed from the street level at two primary entrances located at the southeast corner of S Akard Street and Main Street, and in the Jack Boles Parking Facility near the Commerce and Lane Street intersection. The platform level has two primary exits to the mezzanine levels, which connect to their respective

headhouses/stations. Additional emergency exiting is provided at the far west end of the platform, which leads to an emergency egress only headhouse on the west side of Akard Street, midway between Commerce and Main Streets. Due to the depth of the station and the remote locations of the headhouses/stations, horizontal exiting was used to provide points of safety at the mezzanine levels. Access to the platform from the Main Street Headhouse is provided by elevators, escalators and stairways. Access to the platform from the Commerce Street Headhouse is provided by stairways and escalators.

Egress Analysis

Egress analysis of the data assumes that at the time of the emergency fire event, there will be no trains inside the station. A temporary service disruption, or “failure period” (function of train frequency), will prevent peak inbound and outbound direction trains from entering the station. During this failure period, passengers will continue to enter the station according to their peak-period entry rate and accumulate on the platform to which they are destined under normal conditions. Peak direction passengers will remain on the platforms while passengers traveling in the off-peak direction are able to board trains arriving at regular headways. After the duration of the failure period, trains are assumed to enter the station simultaneously “on all tracks in normal traffic direction.” Due to a missed headway, trains operating in the peak direction are either filled to “crush capacity” or are carrying twice their normal peak loads to account for the missed train. Trains operating in the off-peak direction are assumed to carry their average peak 15-minute passenger volumes. The fire source is located onboard one (and only one) of the trains entering the station (i.e., “incident train”). The number of passengers to be evacuated includes those who have accumulated on all platforms as well as those on board all trains.

For exiting calculations a crush capacity of 495 persons for 3 cars per train was used. DART’s 2040/2050 ridership operations indicate 3.75-minute headway. This report will determine compliance for the emergency evacuation of the existing station based on the following requirements:

- 4 minute evacuation time off the platform level.
- 6 minute evacuation time to a Point of Safety (POS).
- Calculate occupant load based on station ridership data and pedestrian hydraulic formulas.
- Evaluate maximum travel distance conditions and minimum means of egress capacity per platform and at points of convergence.
- No more than one train will unload at any one track to a platform during a fire event.
- The load on any single train is limited to the maximum crush capacity of the train.
- Not more than 50% of escalators are utilized for egress capacity and the worst case egress condition shall be deemed as out of service for purposes of calculations.
- Egress calculations assume a maximum travel distance from the most remote point on the platform to the point of safety during a single fire event.
- Point of Safety (POS) for egress calculations shall mean a point outside of the station and not below an attached canopy or roof with sufficient space for egress capacity.

Egress calculations are preliminary and the final design will need to be verified by the design build contractor through engineering analysis.

Passenger Load Distribution

A single platform is located between the Inbound and Outbound tracks, respectively. The platform is served by two sets of stairs and an escalator at the west exit, while the east end has two sets of stairs. The west mezzanine level provides a long corridor (horizontal exit) connecting to two escalators centered on a single open stair which discharges to the Main Street Headhouse. A second emergency only exit is located below the west mezzanine at the platform level, and includes two separate exit stair enclosures connected by an exit passageway which discharge at an emergency only headhouse on Akard Street. The east mezzanine connects to a corridor (horizontal exit), which leads to an exit stair enclosure that elevator and escalator at the north exit, while the south exit provides a single stairway for emergency egress and discharges at the Commerce Street Headhouse. (See Appendix B – Egress Analysis for calculated platform and station loads). Egress through the head house stations is either open, or provided by multiple side-hinged doors and gates that lead directly to grade at the exterior. Where only one escalator was provided for egress from a level, the escalator was considered to be “not in service” and was not included in the calculations. Where more than one escalator was provided, the escalator which created the worst egress conditions was considered to be “not in service” and was not included in calculations.

Special Events

There have been no special event conditions designated by DART for Commerce Station that would require additional analysis. Special events, typically, are not regularly scheduled activities, but do take place a number of times per year and often result in an increased peak ridership.

Egress Components

Compliance with the requirements for general means of egress components such as corridors, escalators, platforms, stairs, and ramps as defined in NFPA 130.

6.0 Conclusions

The requirements of NFPA 130 are intended to address the occupant protection systems and their effectiveness for maintaining egress, or defending in place, during a single emergency or fire event. While the station geometry and egress capacity is shown as conforming with the prescriptive requirements of the 2014 edition of NFPA 130, it is recommended that an engineering analysis be performed to ensure warning and evacuation systems, fire separations, smoke control systems and structural adequacy will maintain a tenable environment in the facility during a fire event. A preliminary meeting should be conducted with the Dallas Building Department to confirm the use of NFPA 130 for egress calculations in lieu of Building Code requirements.

APPENDIX A – Calculated Detraining/Entraining Passenger Load

PROVIDED ON NEXT PAGE

NFPA 130 SUMMARY REPORT: PEAK HOUR PATRONAGE DATA (LOS C MATRIX)

CENTER PLATFORM CONCEPT

Name of Station	Commerce Station	
Design Year	Assumed Full System - Date 2040/2050	
Assumed Headway Interval	3.75 minutes	*Provided by DART. Four future Lines (per track)*
Maximum Calculated Train Load	495 passengers (Crush Load)	*Per train. 3-Car consist SLRV*
Platform Length	410 Feet	*DART standard for Below-grade station*
	(This is from inside face of PED doors to other side)	*Assumed minimums: 8' clear from plaftorm edges 16' Two adjacent escalators.*
Platform Width	25 Feet	
Standard Stair Width	8 Feet	
Number of Escalators	4	
Escalator Nominal Width	4 Feet = 100 pedestrians per minute	
Level of Service - Normal	C = 7.00 ft² per person	
- Emergency	D = 3.00 ft² per person	

Entraining / hour	Detraining / hour	Link Load / hour	
1,980	3,960	7,920	*Assuming at AM peak.*
25% of link	50% of link	<--16 Trains/Hr at 495 people each	*Since Commerce is in centre of the line, people are mostly detraining. But some are also getting on.*

Peak Direction* — **Southbound**

PLATFORM

Assuming combination of 4 all 4 future LRT lines

Off Peak Direction — **Northbound**

Link Load / hour	Detraining / hour	Entraining / hour	
7,920	3,960	1,980	*Assuming at AM peak.*
16 Trains/Hr --> at 495 people each	50% of link	25% of link	*25% and 50% of link are assumed values*

NOTES: * Peak Direction is the direction with the largest sum of Link and Entraining loads.
Generate results for both am and pm peak periods to determine worst case scenario

APPENDIX B – Egress Analysis

PRELIMINARY CALCULATIONS PROVIDED ON NEXT PAGE

Dallas Area Rapid Transit (DART)

EGRESS ANALYSIS: COMMERCE STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

EXECUTIVE SUMMARY

THE REQUIRED TIME TO EXIT THE PLATFORM(S) IS **3.63 MINUTES** (WORST CASE SCENARIO) WHICH IS MORE THAN THE ALLOWABLE 4 MINUTES PER NFPA 130, 2014. THE TOTAL REQUIRED EXIT TIME FROM THE STATION TO THE PUBLIC WAY IS **9.70 MINUTES** (WORST CASE SCENARIO) WHICH IS MORE THAN THE ALLOWABLE 6 MINUTES PER NFPA 130, 2017. PER §5.3.3.3, THE LOWER MEZZANINE LEVEL WILL NEED TO BE PROTECTED FROM EXPOSURE FROM THE EFFECTS OF FIRE AT THE PLATFORM LEVEL AS DETERMINED BY ENGINEERING ANALYSIS, OR PROVIDE A HORIZONTAL EXIT, IN ORDER TO ESTABLISH A POINT OF SAFETY FOR A TOTAL REQUIRED EXIT TIME OF **5.19 MINUTES** (WORST CASE SCENARIO). REFER TO EGRESS DRAWING FOR A GRAPHIC ILLUSTRATION OF THE ASSOCIATED EGRESS ELEMENTS, THEIR WIDTHS AND TRAVEL DISTANCES BETWEEN AS INCLUDED IN THE CALCULATIONS BELOW.

STATION OCCUPANT LOADS: DART

		ENTRAINING LOAD	DETRAINING (TRAIN LOAD)	PLATFORM OCCUPANT LOAD
INBOUND TRAIN CALCULATED OCCUPANT LOAD	=	322	495	817
OUTBOUND TRAIN CALCULATED OCCUPANT LOAD	=	322	495	817

NOTES:
1. INBOUND TRAIN EXITING OPENS TO CENTER PLATFORM.
2. OUTBOUND TRAIN EXITING OPENS TO CENTER PLATFORM.
3. IN CALCULATING THE EGRESS CAPACITY OF ESCALATORS, ONE ESCALATOR AT EACH LEVEL SHALL BE CONSIDERED AS BEING OUT OF SERVICE.

CALCULATED OCCUPANT LOAD MATRIX:

PLATFORM OCCUPANT LOAD: INBOUND & OUTBOUND*			**1634 PEOPLE**
PLATFORM OCCUPANT LOAD: EXITING EAST*			**642 PEOPLE**
CALCULATED OCCUPANT LOAD (6'-0" EAST OPEN STAIR)			366 PEOPLE
~~CALCULATED OCCUPANT LOAD (6'-0" EAST DOORS)~~	~~(OPTIMIZED FOR STAIR CAPACITY)~~		~~276 PEOPLE~~
CALCULATED OCCUPANT LOAD (4'-6" EAST BACK STAIR)	(OPTIMIZED FOR STAIR CAPACITY)		275 PEOPLE
			641
PLATFORM OCCUPANT LOAD: EXITING WEST*			**993 PEOPLE**
CALCULATED OCCUPANT LOAD (WEST ESCALATORS - ONLY 1 COUNTED @ 44" PER)			225 PEOPLE
CALCULATED OCCUPANT LOAD (9'-0" WEST OPEN STAIR)			551 PEOPLE
CALCULATED OCCUPANT LOAD (WEST DOORS)	(OPTIMIZED FOR DOOR CAPACITY)		217 PEOPLE
~~CALCULATED OCCUPANT LOAD (WEST BACK STAIR)~~	~~(OPTIMIZED FOR DOOR CAPACITY)~~		~~217 PEOPLE~~
			993

TRAVEL CALCULATIONS:

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-1): WORST CASE SCENARIO*

DISTANCE FROM:	T1 TO SECTION C - C		260 FEET
DISTANCE FROM:	SECTION C - C TO SECTION C1 - C1	STAIRS/ESCALATORS	18 FEET
DISTANCE FROM:	SECTION C1 - C1 TO SECTION C2 - C2		46 FEET
DISTANCE FROM:	**SECTION C2 - C2 TO SECTION C3 - C3 (POS-1)**	**HORIZONTAL EXIT / POINT OF SAFETY**	**102 FEET**
DISTANCE FROM:	SECTION C3 - C3 TO SECTION C4 - C4		20 FEET
DISTANCE FROM:	SECTION C4 - C4 TO SECTION C5-C5	STAIRS/ESCALATORS	75 FEET
DISTANCE FROM:	SECTION C5 - C5 TO SECTION C6 - C6		67 FEET
DISTANCE FROM:	SECTION C6 - C6 TO SECTION C7-C7		85.5 FEET
DISTANCE FROM:	SECTION C7 - C7 TO SECTION C8 - C8	STAIRS/ESCALATORS	52.5 FEET
DISTANCE FROM:	SECTION C8 - C8 TO SECTION C9-C9		27 FEET
DISTANCE FROM:	SECTION C9 - C9 TO EXIT STATION		5 FEET
		OVERALL TOTAL DISTANCE (T1 T0 POS-1):	**758 FEET**

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-1): WORST CASE SCENARIO*

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T1 TO SECTION C - C	(DISTANCE / WALKING SPEED)	2.10 MINUTES
TRAVEL TIME FROM:	SECTION C - C TO SECTION C1 - C1	(DISTANCE / WALKING SPEED)	0.38 MINUTES
TRAVEL TIME FROM:	SECTION C1 - C1 TO SECTION C2 - C2	(DISTANCE / WALKING SPEED)	0.37 MINUTES
TRAVEL TIME FROM:	**SECTION C2 - C2 TO SECTION C3 - C3 (POS-1)**	**(DISTANCE / WALKING SPEED)**	**0.82 MINUTES**
		OVERALL TOTAL TRAVEL TIME (T1 TO POS-1):	**3.67 MINUTES**
TRAVEL TIME FROM:	SECTION C3 - C3 TO SECTION C4 - C4	(DISTANCE / WALKING SPEED)	0.16 MINUTES
TRAVEL TIME FROM:	SECTION C4 - C4 TO SECTION C5-C5	(DISTANCE / WALKING SPEED)	1.56 MINUTES
TRAVEL TIME FROM:	SECTION C5 - C5 TO SECTION C6 - C6	(DISTANCE / WALKING SPEED)	0.54 MINUTES
TRAVEL TIME FROM:	SECTION C6 - C6 TO SECTION C7-C7	(DISTANCE / WALKING SPEED)	0.69 MINUTES
TRAVEL TIME FROM:	SECTION C7 - C7 TO SECTION C8 - C8	(DISTANCE / WALKING SPEED)	1.09 MINUTES
TRAVEL TIME FROM:	SECTION C8 - C8 TO SECTION C9-C9	(DISTANCE / WALKING SPEED)	0.22 MINUTES
TRAVEL TIME FROM:	SECTION C9 - C9 TO EXIT STATION	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T1 TO POS-1):	**7.97 MINUTES**

FLOW CALCULATIONS:

EXITING TO THE EAST OF PLATFORM

PLATFORM EGRESS
East Open Stair

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	366 PEOPLE
CLEAR GROSS WIDTH:		72 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	72 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	101 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.62 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**3.62 MINUTES**

PLATFORM EGRESS
East Doors

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	276 PEOPLE
CLEAR GROSS WIDTH:	*(1) DOUBLE EGRESS FIRE DOORS (6'-0")*	72 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	68 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	141 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.96 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**1.96 MINUTES**

PLATFORM EGRESS
East Back Stair

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	276 PEOPLE
CLEAR GROSS WIDTH:		54 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	54 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	76 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.63 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**3.63 MINUTES**

EAST MEZZANINE EGRESS
East Corridor Doors (Horizontal Exit)

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	642 PEOPLE
CLEAR GROSS WIDTH:	*(2) DOUBLE EGRESS FIRE DOORS (6'-0")*	144 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	136 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	282 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.28 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**2.28 MINUTES**

EXITING TO THE WEST OF PLATFORM

EGRESS ANALYSIS: COMMERCE STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

PLATFORM EGRESS
West Escalotors

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	225 PEOPLE
CLEAR GROSS WIDTH:	*(2) ESCALATORS (only 1 counted towards egress per §5.3.5.6)*	44 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	44 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	62 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.63 MINUTES
	TOTAL FLOW TIME ACROSS ESCALOTORS	**3.63 MINUTES**

PLATFORM EGRESS
West Open Stair — C - C

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	551 PEOPLE
CLEAR GROSS WIDTH:	9 feet	108 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	108 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	152 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.63 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**3.63 MINUTES**

PLATFORM EGRESS
West Door(s)

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	217 PEOPLE
CLEAR GROSS WIDTH:	*(1) SINGLE LEAF EGRESS FIRE DOOR (3'-6")*	42 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	38 INCHES
NUMBER OF DOOR(S):		1 DOOR(S)
CAPACITY PER DOOR:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	60 PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER GATE x NUMBER OF GATES)	60 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.62 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**3.62 MINUTES**

PLATFORM EGRESS
West Back Stair

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	217 PEOPLE
CLEAR GROSS WIDTH:		108 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	108 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	152 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.43 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**1.43 MINUTES**

EXITING TO THE WEST

WEST LOWER MEZZANINE EGRESS
West Corridor Doors (Horizontal Exit) — C3 - C3

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	776 PEOPLE
CLEAR GROSS WIDTH:	*(2) DOUBLE EGRESS FIRE DOORS (6'-0")*	144 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	136 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	282 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.75 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**2.75 MINUTES**

WEST LOWER MEZZANINE EGRESS
West Escalotors — C4 - C4

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	236 PEOPLE
CLEAR GROSS WIDTH:	*(2) ESCALATORS (only 1 counted towards egress per §5.3.5.6)*	44 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	44 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	62 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.81 MINUTES

West Open Stair — C4 - C4

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	540 PEOPLE
CLEAR GROSS WIDTH:	9 feet	100 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	100 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	141 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.83 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**3.83 MINUTES**

EGRESS ANALYSIS: COMMERCE STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

EXITING TO THE WEST

WEST UPPER MEZZANINE EGRESS

Fare Barriers			**C6 - C6**
~~OCCUPANTS:~~	~~(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)~~	~~0~~	~~PEOPLE~~
~~CLEAR GROSS WIDTH:~~	~~(1) DOUBLE LEAF GATES~~	~~72~~	~~INCHES~~
~~CLEAR NET WIDTH:~~	~~(INCLUDES REDUCTION PER NFPA 130, 2014)~~	~~68~~	~~INCHES~~
~~RATE:~~	~~PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014~~	~~2.08~~	~~PIM~~
~~CAPACITY:~~	~~PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)~~	~~141~~	~~PPM~~
~~FLOW TIME:~~	~~(OCCUPANTS/CAPACITY)~~	~~0.00~~	~~MINUTES~~
OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	776	PEOPLE
NUMBER OF FARE BARRIERS:	3 NEW FARE BARRIERS (INCLUDING 1 ACCESSIBLE FARE BARRIER)	6	FARE BARRIERS
CAPACITY PER FARE BARRIER:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	50	PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER FARE BARRIER x NUMBER OF FARE BARRIERS)	300	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.59	MINUTES
	TOTAL FLOW TIME ACROSS SECTION B - B:	**2.59**	**MINUTES**

WEST UPPER MEZZANINE EGRESS

West Escalotors			**C7 - C7**
OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	236	PEOPLE
CLEAR GROSS WIDTH:	*(2) ESCALATORS (only 1 counted towards egress per §5.3.5.6)*	44	INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	44	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	62	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.81	MINUTES

West Open Stair			**C7 - C7**
OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	540	PEOPLE
CLEAR GROSS WIDTH:	9 feet	100	INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	100	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	141	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.83	MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**3.83**	**MINUTES**

WEST (MAIN STREET) HEADHOUSE EGRESS

Door(s)			**C9 - C9**
OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	776	PEOPLE
CLEAR GROSS WIDTH:	(2) DOUBLE LEAF DOORS	216	INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2014)	204	INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	2.08	PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	424	PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.83	MINUTES
	TOTAL FLOW TIME ACROSS SECTION A1 - A1:	**1.83**	**MINUTES**

TOTAL REQUIRED TIME TO EXIT THE PLATFORM(S): WORST CASE SCENARIO

PASSENGER FLOW TIME (WORST CASE SCENARIO) ON THE CENTER PLATFORM EQUALS =	**3.63**	**MINUTES**

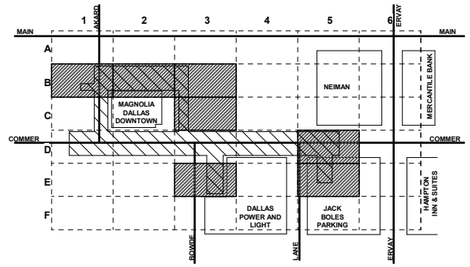
TOTAL REQUIRED TIME TO EXIT STATION FROM PLATFORM (S) (PER NFPA 130, 2017): WORST CASE SCENARIO

TOTAL FLOW TIME (C4 - C4) + TRAVEL TIME (WORSE CASE SCENAIRO TO POINT OF SAFETY) =	**9.70**	**MINUTES**

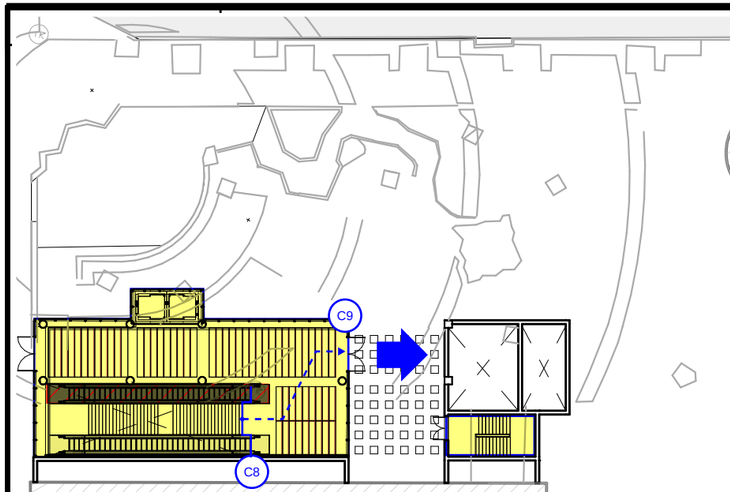
TOTAL REQUIRED TIME TO EXIT TO A POINT OF SAFETY (POS) FROM PLATFORM (S) (PER NFPA 130, 2014): WORST CASE SCENARIO

TOTAL FLOW TIME (C -C) + TRAVEL TIME (WORSE CASE SCENAIRO TO POINT OF SAFETY) =	**5.19**	**MINUTES**

MAIN STREET



KEY PLAN



MAGNOLIA PASS-THROUGH

COMMERCE STREET

STATION EXIT, TYP.

ANE STREET

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ON 03/06/2020

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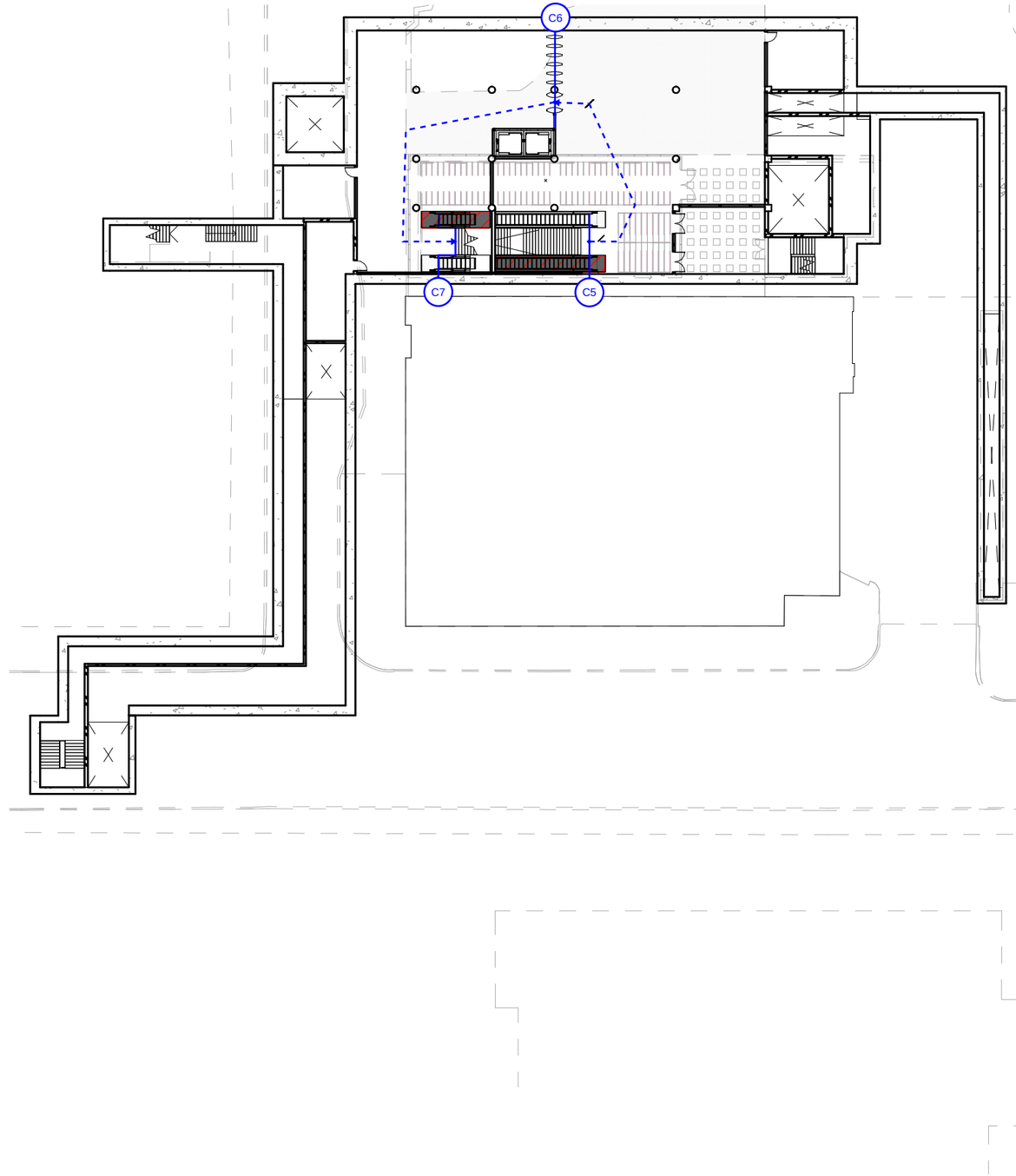
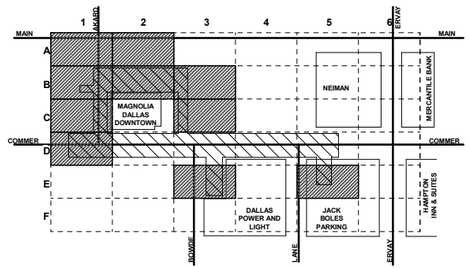
LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

COMMERCE

STREET LEVEL
OVERALL EGRESS PLAN





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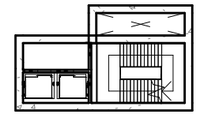

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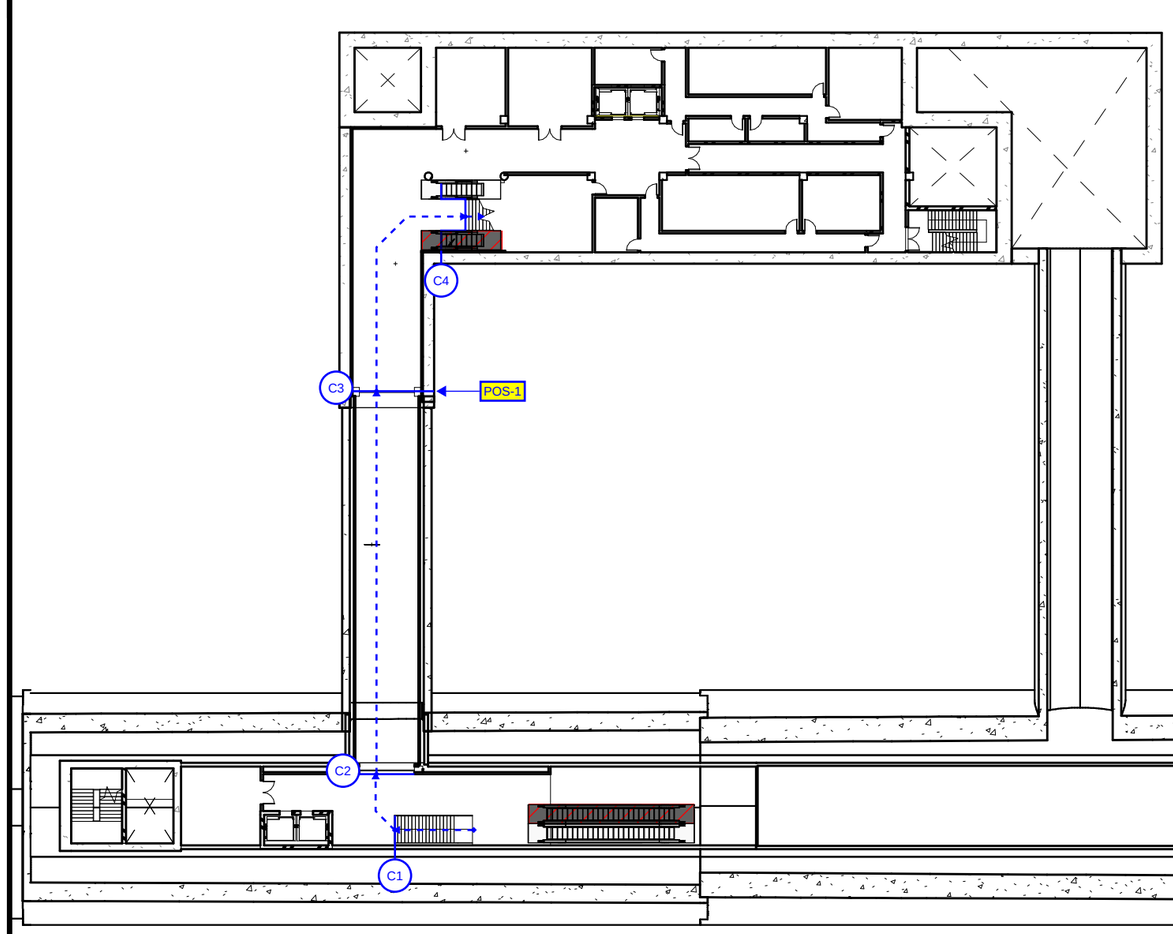
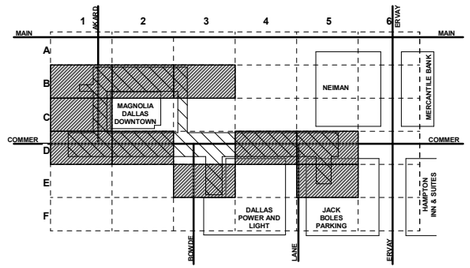
LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

COMMERCE

UPPER MEZZANINE LEVEL
OVERALL EGRESS PLAN





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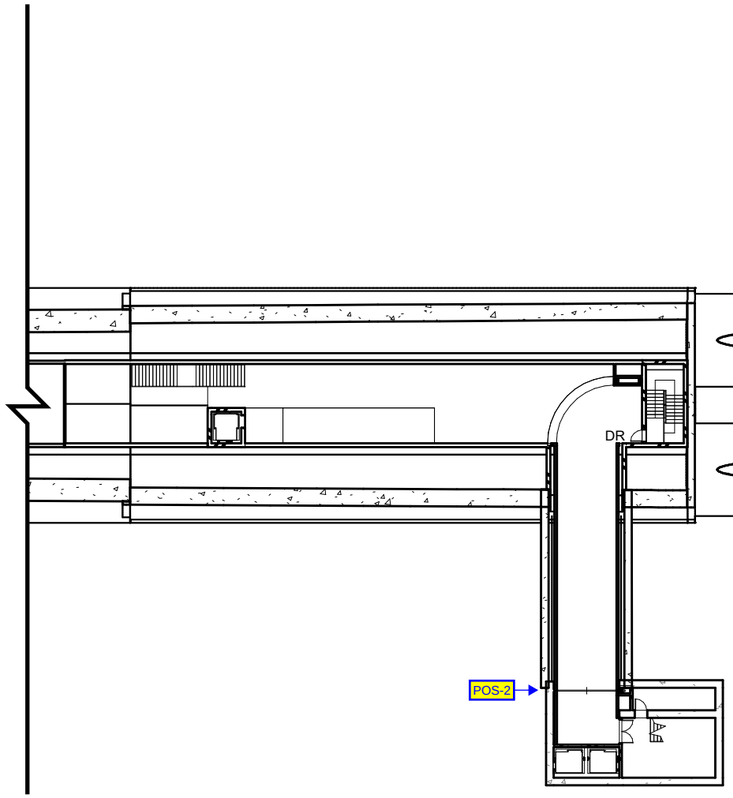

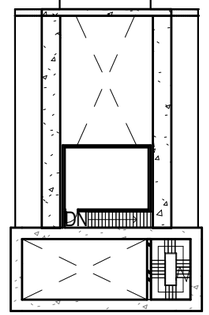

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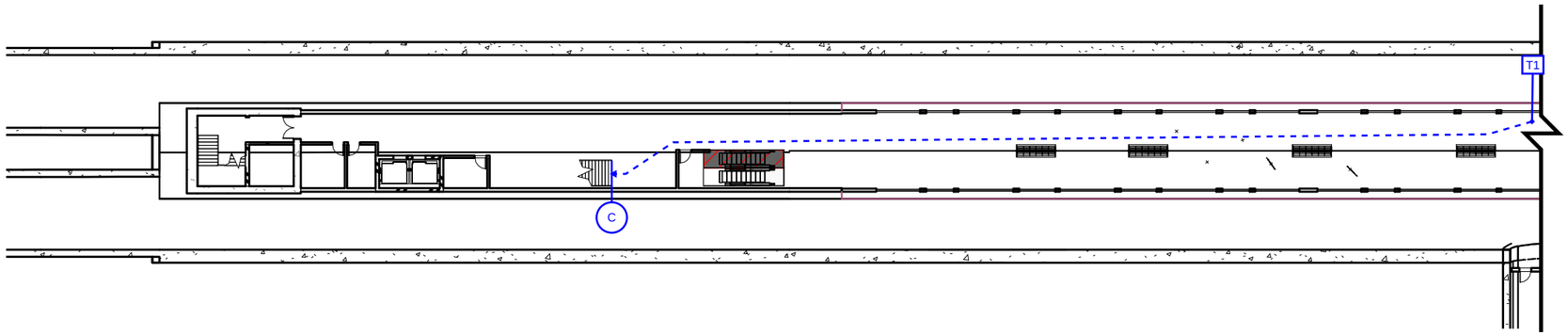
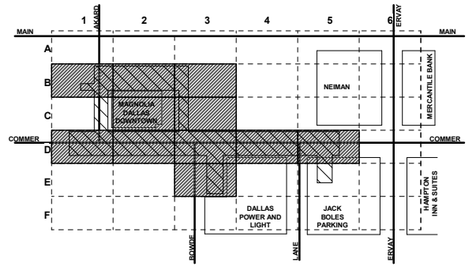
LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

COMMERCE

LOWER MEZZANINE LEVEL
OVERALL EGRESS PLAN





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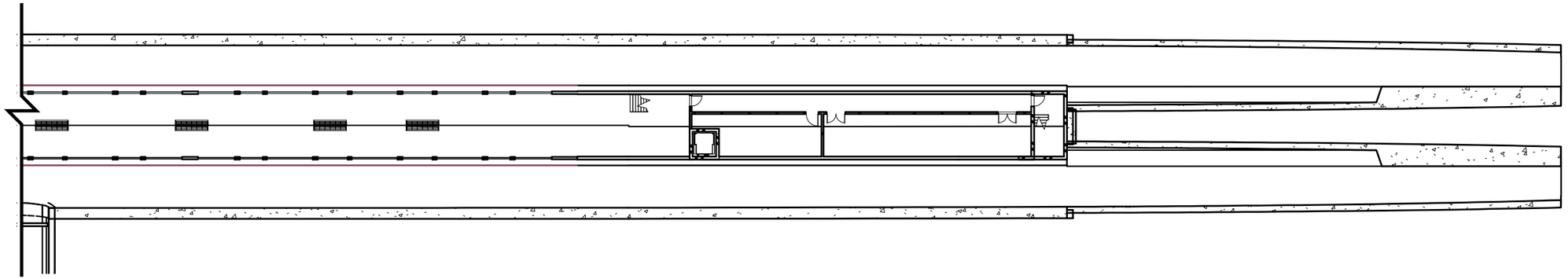

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LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

COMMERCE

PLATFORM LEVEL
OVERALL EGRESS PLAN

EXITING ANALYSIS

DALLAS AREA RAPID TRANSIT (DART)

Dallas, Texas

Emergency Exiting Analysis Report for
CBD East Station

Prepared by HDR Engineering Inc.
March 6, 2020

DART | Project No. 10024656
EMERGENCY EXITING ANALYSIS FOR CBD EAST STATION

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1.0 Executive Summary

This report provides analysis of the means of egress based on DART projected ridership data for the CBD East, Commerce and Metro Center stations. The analysis utilizes NFPA 130-2014, a nationally recognized Standard for Fixed Guideway Transit and Passenger Rail Systems to provide a prescriptive review of the egress elements under emergency evacuation conditions and document existing non-conforming deficiencies. The City of Dallas has amended the Dallas Building Code (IBC 2015), to reference the adoption of NFPA 130 (§3112.1), with exception of Section §5.3 for means of egress to comply with Chapter 10 of the Dallas Building Code. Due to the uniqueness and complexity associated with underground transit stations and trainways there would be significant practical and structural difficulties involved in carrying out the provisions of Chapter 10 of the Dallas Building Code; therefore this analysis utilized Section §5.3 of NFPA 130. At the time of this report, the Dallas Building Department has not been consulted and collaboration with the building department will be required to obtain an approval for an alternative, or equivalent options, which would allow for the application of NFPA 130 Section §5.3 or egress and smoke modeling to demonstrate compliance in lieu of Chapter 10, Building Code egress compliance.

The analysis within this report is primarily focused on NFPA 130 requirements as it relates to the computation of the egress demand and an assessment of whether the exits are sufficient to meet the 4- and 6- minute (platform and point of safety) egress criteria. Requirements regarding the arrangements of exits (e.g. maximum common path requirement) were reviewed for each station, with emphasis on points of safety, continuity of exiting components, and proof of concept.

Based on the worst case egress calculations the platform and point of safety evacuation times do not exceed the prescriptive egress criteria of NFPA 130 as identified below:

Egress Calculation Summary – A.M.

The required time to exit the west platform is 3.00 minutes which is less than the allowable 4 minutes and the total required exit time from the station to the public way, the point of safety, is 5.49 minutes which is less than the allowable 6 minutes.

In the event there are changes to the egress evacuation times that result in exceeding the prescriptive requirements it is recommended that fire hazard engineering analysis (e.g. computer fire smoke modeling and egress modeling) be performed to ensure a tenable path of egress is maintainable during a fire event.

2.0 Scope of Work

As part of DART schematic development, only the means of egress for peak ridership were evaluated for compliance with NFPA 130 to validate the design concept.

Calculations and point of safety were based on the assumption that emergency ventilation system(s) at all stations are presumed to be compliant with all applicable codes and standards and will maintain a tenable environment sufficient to allow for full emergency evacuation of the station. Evaluation of the emergency ventilation system is not included under the scope of work of this project.

3.0 Codes and Standards

The egress analysis and code assessment for the DART stations is evaluated to Chapter 5 of NFPA 130-2014 for compliance with national standards in lieu of compliance with the Dallas Building Code's egress requirements which are significantly more restrictive.

DBC	Dallas Building Code (IBC 2015)
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Systems (2014);

The City of Dallas code adoption process has not been fully reviewed, and the adoption of newer code editions and their amendments may impose additional requirements that were not considered at the time of this report.

4.0 Ridership Data

Ridership information was provided by DART based on data projected for 2040/2050. The peak period ridership was used as the basis for calculating detraining and entraining loads for the station. The calculated Detraining/Entraining Passenger Loads used for the egress analysis are included in Appendix A – Calculated Detraining/Entraining Passenger Loads.

5.0 Code Assessment

General

The following assessment was based on preliminary design drawings of the station.

Station Description

CBD East Station has two sets of tracks centered on a single platform. Tracks run in a northeast and southwest alignment between South Pearl Expressway on the west and Cesar Chavez Boulevard on the east. There are 3 egress headhouses (North, Central, and South) located between Commerce Street on the South and Pacific Avenue on the North. The two primary headhouses (Central and South) located along Main Street are the main entrances to the platform. Access to the platform from the Main Street (Central) headhouse is provided by elevators, escalators and stairways. Access to the platform from the Main Street (South) headhouse is provided by stairways and elevators. The platform level has four primary vertical circulation elements (stairs and escalators) that exit at the main (Central) headhouse. Additional emergency exiting is provided at the far north and south ends of the platform, which leads to

exits at the North and South headhouses. The station is relatively shallow, which allows for shorter travel times to a point of safety outside the station.

Egress Analysis

Egress analysis of the data assumes that at the time of the emergency fire event, there will be no trains inside the station. A temporary service disruption, or “failure period” (function of train frequency), will prevent peak inbound and outbound direction trains from entering the station. During this failure period, passengers will continue to enter the station according to their peak-period entry rate and accumulate on the platform to which they are destined under normal conditions. Peak direction passengers will remain on the platforms while passengers traveling in the off-peak direction are able to board trains arriving at regular headways. After the duration of the failure period, trains are assumed to enter the station simultaneously “on all tracks in normal traffic direction.” Due to a missed headway, trains operating in the peak direction are either filled to “crush capacity” or are carrying twice their normal peak loads to account for the missed train. Trains operating in the off-peak direction are assumed to carry their average peak 15-minute passenger volumes. The fire source is located onboard one (and only one) of the trains entering the station (i.e., “incident train”). The number of passengers to be evacuated includes those who have accumulated on all platforms as well as those on board all trains.

For exiting calculations a crush capacity of 495 persons for 3 cars per train was used. DART’s 2040/2050 ridership operations indicate 3.75-minute headway. This report will determine compliance for the emergency evacuation of the existing station based on the following requirements:

- 4 minute evacuation time off the platform level.
- 6 minute evacuation time to a Point of Safety (POS).
- Calculate occupant load based on station ridership data and pedestrian hydraulic formulas.
- Evaluate maximum travel distance conditions and minimum means of egress capacity per platform and at points of convergence.
- No more than one train will unload at any one track to a platform during a fire event.
- The load on any single train is limited to the maximum crush capacity of the train.
- Not more than 50% of escalators are utilized for egress capacity and the worst case egress condition shall be deemed as out of service for purposes of calculations.
- Egress calculations assume a maximum travel distance from the most remote point on the platform to the point of safety during a single fire event.
- Point of Safety (POS) for egress calculations shall mean a point outside of the station and not below an attached canopy or roof with sufficient space for egress capacity.

Passenger Load Distribution

A single platform is located between the Inbound and Outbound tracks, respectively. The platform is served by two sets of stairs and two sets escalators centered longitudinally, with a fifth open stair located at the south end of the platform. Emergency only exits are provided at

the far north and south ends of the platform, with the south stair being offset and connected by an exit passageway at its intermediate level. (See Appendix B – Egress Analysis for calculated platform and station loads). Egress through the head house stations is either open, or provided by multiple side-hinged doors and fare barriers that lead directly to grade at the exterior. Where only one escalator was provided for egress from a level, the escalator was considered to be “not in service” and was not included in the calculations. Where more than one escalator was provided, the escalator which created the worst egress conditions was considered to be “not in service” and was not included in calculations.

Special Events

There have been no special event conditions designated by DART for CBD East Station that would require additional analysis. Special events, typically, are not regularly scheduled activities, but do take place a number of times per year and often result in an increased peak ridership.

Egress Components

Compliance with the requirements for general means of egress components such as corridors, escalators, platforms, stairs, and ramps as defined in NFPA 130.

6.0 Conclusions

The requirements of NFPA 130 are intended to address the occupant protection systems and their effectiveness for maintaining egress, or defending in place, during a single emergency or fire event. While the station geometry and egress capacity is shown as conforming with the prescriptive requirements of the 2014 edition of NFPA 130, it is recommended that an engineering analysis be performed to ensure warning and evacuation systems, fire separations, smoke control systems and structural adequacy will maintain a tenable environment in the facility during a fire event. A preliminary meeting should be conducted with the Dallas Building Department to confirm the use of NFPA 130 for egress calculations in lieu of Building Code requirements.

APPENDIX A – Calculated Detraining/Entraining Passenger Load

NOT PROVIDED FOR THIS REPORT

NFPA 130 SUMMARY REPORT: PEAK HOUR PATRONAGE DATA (LOS C MATRIX)

CENTER PLATFORM CONCEPT

Name of Station	CBD East Station	
Design Year	Assumed Full System - Date 2040/2050	
Assumed Headway Interval	3.75 minutes	*Provided by DART. Four future Lines (per track)*
Maximum Calculated Train Load	495 passengers (Crush Load)	*Per train. 3-Car consist SLRV*
Platform Length	410 Feet	*DART standard for Below-grade station*
	(This is from inside face of PED doors to other side)	*Assumed minimums: 8' clear from plaftorm edges 16' Two adjacent escalators.*
Platform Width	25 Feet	
Standard Stair Width	8 Feet	
Number of Escalators	4	
Escalator Nominal Width	4 Feet = 100 pedestrians per minute	
Level of Service - Normal	C = 7.00 ft² per person	
- Emergency	D = 3.00 ft² per person	

Entraining / hour	Detraining / hour	Link Load / hour	
1,980	3,960	7,920	*Assuming at AM peak.*
25% of link	50% of link	<--16 Trains/Hr at 495 people each	*Since Commerce is in centre of the line, people are mostly detraining. But some are also getting on.*

Peak Direction* — **Southbound**

PLATFORM

Assuming combination of 4 all 4 future LRT lines

Off Peak Direction — **Northbound**

Link Load / hour	Detraining / hour	Entraining / hour	
7,920	3,960	1,980	*Assuming at AM peak.*
16 Trains/Hr --> at 495 people each	50% of link	25% of link	*25% and 50% of link are assumed values*

NOTES: * Peak Direction is the direction with the largest sum of Link and Entraining loads.
Generate results for both am and pm peak periods to determine worst case scenario

APPENDIX B – Egress Analysis

SEE ATTACHED.

Dallas Area Rapid Transit (DART)

EGRESS ANALYSIS: CBD EAST STATION

PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS

CHECKER: MM

PROJECT MANAGER: GT

EXECUTIVE SUMMARY

THE REQUIRED TIME TO EXIT THE PLATFORM(S) IS **3.00 MINUTES** (WORST CASE SCENARIO) WHICH IS MORE THAN THE ALLOWABLE 4 MINUTES PER NFPA 130, 2017. THE TOTAL REQUIRED EXIT TIME FROM THE STATION TO THE PUBLIC WAY IS **5.49 MINUTES** (WORST CASE SCENARIO) WHICH IS LESS THAN THE ALLOWABLE 6 MINUTES PER NFPA 130, 2017. REFER TO EGRESS DRAWING FOR A GRAPHIC ILLUSTRATION OF THE ASSOCIATED EGRESS ELEMENTS, THEIR WIDTHS AND TRAVEL DISTANCES BETWEEN AS INCLUDED IN THE CALCULATIONS BELOW.

STATION OCCUPANT LOADS: DART

		ENTRAINING LOAD	DETRAINING (TRAIN LOAD)	PLATFORM OCCUPANT LOAD
INBOUND TRAIN CALCULATED OCCUPANT LOAD	=	322	495	817
OUTBOUND TRAIN CALCULATED OCCUPANT LOAD	=	322	495	817

NOTES:

1. INBOUND TRAIN EXITING OPENS TO CENTER PLATFORM.
2. OUTBOUND TRAIN EXITING OPENS TO CENTER PLATFORM.
3. IN CALCULATING THE EGRESS CAPACITY OF ESCALATORS, ONE ESCALATOR AT EACH LEVEL SHALL BE CONSIDERED AS BEING OUT OF SERVICE.

CALCULATED OCCUPANT LOAD MATRIX:

PLATFORM OCCUPANT LOAD: INBOUND & OUTBOUND*	**1634 PEOPLE**
PLATFORM OCCUPANT LOAD: EXITING NORTH*	**347 PEOPLE**
CALCULATED OCCUPANT LOAD (6'-0" NORTH STAIR)	197 PEOPLE
CALCULATED OCCUPANT LOAD (NORTH ESCALATOR - 1 COUNTED @ 36" PER)	150 PEOPLE
	347
PLATFORM OCCUPANT LOAD: EXITING AT CENTER STAIRS*	**706 PEOPLE**
CALCULATED OCCUPANT LOAD (7'-0" CENTER STAIR; NORTH)	353 PEOPLE
CALCULATED OCCUPANT LOAD (7'-0" CENTER STAIR; SOUTH)	353 PEOPLE
	706
PLATFORM OCCUPANT LOAD: EXITING SOUTH*	**581 PEOPLE**
CALCULATED OCCUPANT LOAD (5'-6" SOUTH STAIR)	279 PEOPLE
CALCULATED OCCUPANT LOAD (5'-0" SOUTH STAIR)	0 PEOPLE
CALCULATED OCCUPANT LOAD (SOUTH ESCALATORS - 2 COUNTED @ 36" PER)	302 PEOPLE
	581

TRAVEL CALCULATIONS:

A-A TO POS-1

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-1):

DISTANCE FROM:	T1 TO SECTION A - A		53 FEET
DISTANCE FROM:	**SECTION A - A TO SECTION A1 - A1**	*ESCALATORS (OFF OF PLATFORM)*	59 FEET
DISTANCE FROM:	SECTION A1 - A1 TO SECTION A2 - A2		50 FEET
DISTANCE FROM:	SECTION A2 - A2 TO SECTION A3 - A3		38 FEET
DISTANCE FROM:	SECTION A3 - A3 TO SECTION A4 - A4		8 FEET
DISTANCE FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T1 T0 POS-1):	213 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-1):

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T1 TO SECTION A - A	(DISTANCE / WALKING SPEED)	0.43 MINUTES
TRAVEL TIME FROM:	**SECTION A - A TO SECTION A1 - A1**	(DISTANCE / WALKING SPEED)	1.23 MINUTES
TRAVEL TIME FROM:	SECTION A1 - A1 TO SECTION A2 - A2	(DISTANCE / WALKING SPEED)	0.40 MINUTES
TRAVEL TIME FROM:	SECTION A2 - A2 TO SECTION A3 - A3	(DISTANCE / WALKING SPEED)	0.31 MINUTES
TRAVEL TIME FROM:	SECTION A3 - A3 TO SECTION A4 - A4	(DISTANCE / WALKING SPEED)	0.06 MINUTES
TRAVEL TIME FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T1 TO POS-1):	**2.47 MINUTES**

B-B TO POS-1

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T2) TO POINT OF SAFETY (POS-1):

DISTANCE FROM:	T2 TO SECTION B - B		95 FEET
DISTANCE FROM:	**SECTION B - B TO SECTION B1 - B1**	*STAIRS (OFF OF PLATFORM)*	73 FEET
DISTANCE FROM:	SECTION B1 - B1 TO SECTION A2 - A2		44 FEET
DISTANCE FROM:	SECTION A2 - A2 TO SECTION A3 - A3		38 FEET
DISTANCE FROM:	SECTION A3 - A3 TO SECTION A4 -A4		8 FEET
DISTANCE FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T2 T0 POS-1):	263 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T2) TO POINT OF SAFETY (POS-1):

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T2 TO SECTION B - B	(DISTANCE / WALKING SPEED)	0.77 MINUTES
TRAVEL TIME FROM:	**SECTION B - B TO SECTION B1 - B1**	(DISTANCE / WALKING SPEED)	1.52 MINUTES
TRAVEL TIME FROM:	SECTION B1 - B1 TO SECTION A2 - A2	(DISTANCE / WALKING SPEED)	0.35 MINUTES
TRAVEL TIME FROM:	SECTION A2 - A2 TO SECTION A3 - A3	(DISTANCE / WALKING SPEED)	0.31 MINUTES
TRAVEL TIME FROM:	SECTION A3 - A3 TO SECTION A4 -A4	(DISTANCE / WALKING SPEED)	0.06 MINUTES
TRAVEL TIME FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T2 TO POS-1):	**3.05 MINUTES**

EGRESS ANALYSIS: CBD EAST STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

C-C TO POS-1

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T2) TO POINT OF SAFETY (POS-1):

DISTANCE FROM:	T2 TO SECTION C - C		102 FEET
DISTANCE FROM:	**SECTION C - C TO SECTION C1 - C1**	*STAIRS (OFF OF PLATFORM)*	77 FEET
DISTANCE FROM:	SECTION C1 - C1 TO SECTION A2 - A2		44 FEET
DISTANCE FROM:	SECTION A2 - A2 TO SECTION A3 - A3		38 FEET
DISTANCE FROM:	SECTION A3 - A3 TO SECTION A4 -A4		8 FEET
DISTANCE FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T2 T0 POS-1):	274 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T2) TO POINT OF SAFETY (POS-1):

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T2 TO SECTION C - C	(DISTANCE / WALKING SPEED)	0.82 MINUTES
TRAVEL TIME FROM:	**SECTION C - C TO SECTION C1 - C1**	(DISTANCE / WALKING SPEED)	1.60 MINUTES
TRAVEL TIME FROM:	SECTION C1 - C1 TO SECTION A2 - A2	(DISTANCE / WALKING SPEED)	0.35 MINUTES
TRAVEL TIME FROM:	SECTION A2 - A2 TO SECTION A3 - A3	(DISTANCE / WALKING SPEED)	0.31 MINUTES
TRAVEL TIME FROM:	SECTION A3 - A3 TO SECTION A4 -A4	(DISTANCE / WALKING SPEED)	0.06 MINUTES
TRAVEL TIME FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T2 TO POS-1):	**3.19 MINUTES**

D-D TO POS-1

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T3) TO POINT OF SAFETY (POS-1):

DISTANCE FROM:	T3 TO SECTION D - D		52 FEET
DISTANCE FROM:	**SECTION D - D TO SECTION D1 - D1**	ESCALATORS (OFF OF PLATFORM)	65 FEET
DISTANCE FROM:	SECTION D1 - D1 TO SECTION A2 - A2		77 FEET
DISTANCE FROM:	SECTION A2 - A2 TO SECTION A3 - A3		38 FEET
DISTANCE FROM:	SECTION A3 - A3 TO SECTION A4 -A4		8 FEET
DISTANCE FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T3 T0 POS-1):	245 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T3) TO POINT OF SAFETY (POS-1): SOUTH END OF PLATFORM*

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T3 TO SECTION D - D	(DISTANCE / WALKING SPEED)	0.42 MINUTES
TRAVEL TIME FROM:	**SECTION D - D TO SECTION D1 - D1**	(DISTANCE / WALKING SPEED)	1.35 MINUTES
TRAVEL TIME FROM:	SECTION D1 - D1 TO SECTION A2 - A2	(DISTANCE / WALKING SPEED)	0.62 MINUTES
TRAVEL TIME FROM:	SECTION A2 - A2 TO SECTION A3 - A3	(DISTANCE / WALKING SPEED)	0.31 MINUTES
TRAVEL TIME FROM:	SECTION A3 - A3 TO SECTION A4 -A4	(DISTANCE / WALKING SPEED)	0.06 MINUTES
TRAVEL TIME FROM:	SECTION A4 - A4 TO POS-1 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T3 TO POS-1):	**2.81 MINUTES**

E-E TO POS-2

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T4) TO POINT OF SAFETY (POS-2): WORST CASE SCENARIO*

DISTANCE FROM:	T4 TO SECTION E - E		34 FEET
DISTANCE FROM:	**SECTION E - E TO SECTION E1 - E1**	ESCALATORS (OFF OF PLATFORM)	93 FEET
DISTANCE FROM:	SECTION E1 - E1 TO SECTION E2 - E2		30 FEET
DISTANCE FROM:	**SECTION E2 - E2 TO SECTION E3 - E3**	STAIRS	25 FEET
DISTANCE FROM:	SECTION E3 - E3 TO SECTION E4 - E4		8 FEET
DISTANCE FROM:	SECTION E4 - E4 TO POS-2 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T4 T0 POS-2):	195 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T4) TO POINT OF SAFETY (POS-2): WORST CASE SCENARIO*

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T4 TO SECTION E - E	(DISTANCE / WALKING SPEED)	0.27 MINUTES
TRAVEL TIME FROM:	**SECTION E - E TO SECTION E1 - E1**	(DISTANCE / WALKING SPEED)	1.94 MINUTES
TRAVEL TIME FROM:	SECTION E1 - E1 TO SECTION E2 - E2	(DISTANCE / WALKING SPEED)	0.24 MINUTES
TRAVEL TIME FROM:	**SECTION E2 - E2 TO SECTION E3 - E3**	(DISTANCE / WALKING SPEED)	0.20 MINUTES
TRAVEL TIME FROM:	SECTION E3 - E3 TO SECTION E4 - E4	(DISTANCE / WALKING SPEED)	0.06 MINUTES
TRAVEL TIME FROM:	SECTION E4 - E4 TO POS-2 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T4 TO POS-2):	**2.76 MINUTES**

EGRESS ANALYSIS: CBD EAST STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

F-F TO POS-2

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T4) TO POINT OF SAFETY (POS-2):

DISTANCE FROM:	T4 TO SECTION F - F		82 FEET
DISTANCE FROM:	**SECTION F - F TO SECTION F1 - F1**		7 FEET
DISTANCE FROM:	SECTION F1 - F1 TO SECTION F2 - F2	*STAIRS*	44 FEET
DISTANCE FROM:	**SECTION F2 - F2 TO SECTION F3 - F3**		53 FEET
DISTANCE FROM:	SECTION F3 - F3 TO SECTION F4 - F4	*CORRIDOR*	6 FEET
DISTANCE FROM:	**SECTION F4 - F4 TO SECTION F5 - F5**	*STAIRS*	29 FEET
DISTANCE FROM:	SECTION F5 - F5 TO SECTION F6 - F6		12 FEET
DISTANCE FROM:	SECTION F6 - F6 TO POS-2 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T4 T0 POS-2):	238 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T4) TO POINT OF SAFETY (POS-2):

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T4 TO SECTION F - F	(DISTANCE / WALKING SPEED)	0.66 MINUTES
TRAVEL TIME FROM:	**SECTION F - F TO SECTION F1 - F1**	(DISTANCE / WALKING SPEED)	0.06 MINUTES
TRAVEL TIME FROM:	SECTION F1 - F1 TO SECTION F2 - F2	(DISTANCE / WALKING SPEED)	0.92 MINUTES
TRAVEL TIME FROM:	**SECTION F2 - F2 TO SECTION F3 - F3**	(DISTANCE / WALKING SPEED)	0.43 MINUTES
TRAVEL TIME FROM:	SECTION F3 - F3 TO SECTION F4 - F4	(DISTANCE / WALKING SPEED)	0.05 MINUTES
TRAVEL TIME FROM:	**SECTION F4 - F4 TO SECTION F5 - F5**	(DISTANCE / WALKING SPEED)	0.60 MINUTES
TRAVEL TIME FROM:	SECTION F5 - F5 TO SECTION F6 - F6	(DISTANCE / WALKING SPEED)	0.10 MINUTES
TRAVEL TIME FROM:	SECTION F6 - F6 TO POS-2 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T4 TO POS-2):	**2.85 MINUTES**

G-G TO POS-3

TRAVEL DISTANCE FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-3):

DISTANCE FROM:	T1 TO SECTION G - G		57 FEET
DISTANCE FROM:	SECTION G - G TO SECTION G1 - G1		25 FEET
DISTANCE FROM:	SECTION G1 - G1 TO SECTION G2 - G2		12 FEET
DISTANCE FROM:	**SECTION G2 - G2 TO SECTION G3 - G3**	STAIRS	82 FEET
DISTANCE FROM:	SECTION G3 - G3 TO POS-3 (POINT OF SAFETY)		5 FEET
		OVERALL TOTAL DISTANCE (T1 T0 POS-3):	181 FEET

TRAVEL TIME FROM REMOTE POINT OF PLATFORM (T1) TO POINT OF SAFETY (POS-3):

WALKING SPEED (PER NFPA 130, 2017) - PLATFORMS, CORRIDORS, RAMPS			124 FEET PER MINUTE (FPM)
WALKING SPEED (PER NFPA 130, 2017) - STAIRS AND ESCALATORS			48 FEET PER MINUTE (FPM)
TRAVEL TIME FROM:	T1 TO SECTION G - G	(DISTANCE / WALKING SPEED)	0.46 MINUTES
TRAVEL TIME FROM:	SECTION G - G TO SECTION G1 - G1	(DISTANCE / WALKING SPEED)	0.20 MINUTES
TRAVEL TIME FROM:	SECTION G1 - G1 TO SECTION G2 - G2	(DISTANCE / WALKING SPEED)	0.10 MINUTES
TRAVEL TIME FROM:	**SECTION G2 - G2 TO SECTION G3 - G3**	(DISTANCE / WALKING SPEED)	1.71 MINUTES
TRAVEL TIME FROM:	SECTION G3 - G3 TO POS-3 (POINT OF SAFETY)	(DISTANCE / WALKING SPEED)	0.04 MINUTES
		OVERALL TOTAL TRAVEL TIME (T1 TO POS-3):	**2.51 MINUTES**

EGRESS ANALYSIS: CBD EAST STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

FLOW CALCULATIONS:

PLATFORM EGRESS
North Door(s); Corridor — **G - G**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	197 PEOPLE
CLEAR GROSS WIDTH:	*(1) DOUBLE EGRESS FIRE DOORS (6'-0")*	72 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	68 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	141 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.40 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**1.40 MINUTES**

PLATFORM EGRESS
North Door(s); Exit Enclosure — **G1 - G1**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	197 PEOPLE
CLEAR GROSS WIDTH:	*(1) SINGLE LEAF EGRESS FIRE DOOR (3'-0")*	36 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	32 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	66 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.98 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**2.98 MINUTES**

PLATFORM EGRESS
North Stair(s); Enclosed Exit Stairs (6'-0") — **G2 - G2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	197 PEOPLE
CLEAR GROSS WIDTH:		72 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	72 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	101 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.95 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**1.95 MINUTES**

PLATFORM EGRESS
North Escalators — **A -A**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	150 PEOPLE
CLEAR GROSS WIDTH:	*(2) Escalators (only 1 counted towards egress per §5.3.5.6)*	36 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	36 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	50 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.00 MINUTES
	TOTAL FLOW TIME ACROSS ESCALOTORS	**3.00 MINUTES**

PLATFORM EGRESS
Center Stair (7'-0"; North) — **B -B**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	353 PEOPLE
CLEAR GROSS WIDTH:		84 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	84 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	118 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.99 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**2.99 MINUTES**

PLATFORM EGRESS
Center Stair (7'-0"; South) — **C - C**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	353 PEOPLE
CLEAR GROSS WIDTH:		84 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	84 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	118 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.99 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**2.99 MINUTES**

PLATFORM EGRESS
South Escalators — **D - D**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	302 PEOPLE
CLEAR GROSS WIDTH:	*(2) Escalators (36" per escalator)*	72 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	72 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	101 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	2.99 MINUTES
	TOTAL FLOW TIME ACROSS ESCALOTORS	**2.99 MINUTES**

PLATFORM EGRESS
South Stair(s); Open (5'-6") — **E - E**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	279 PEOPLE
CLEAR GROSS WIDTH:		66 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	66 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	93 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	3.00 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**3.00 MINUTES**

EGRESS ANALYSIS: CBD EAST STATION
PEAK PASSENGERS: INBOUND & OUTBOUND - AM

ORIGINATOR: ZS
CHECKER: MM
PROJECT MANAGER: GT

PLATFORM EGRESS
South Door(s); Exit Enclosure — **F - F**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	0 PEOPLE
CLEAR GROSS WIDTH:	*(1) DOUBLE EGRESS FIRE DOORS (6'-0")*	36 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	32 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	66 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.00 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**0.00 MINUTES**

PLATFORM EGRESS
South Stair(s); Enclosed Exit Stairs (5'-0") — **F1 - F1 / F4 - F4**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	0 PEOPLE
CLEAR GROSS WIDTH:		60 INCHES
CLEAR NET WIDTH:	(NO REDUCTION REQUIRED PER NFPA 130, 2017)	60 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	1.41 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	84 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.00 MINUTES
	TOTAL FLOW TIME ACROSS STAIRS	**0.00 MINUTES**

PLATFORM EGRESS
South Stair(s); Enclosed Exit Corridor (3'-0") — **F2 - F2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	0 PEOPLE
CLEAR GROSS WIDTH:	*(1) DOUBLE EGRESS FIRE DOORS (3'-0")*	60 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2017)	36 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2017	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	74 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.00 MINUTES
	TOTAL FLOW TIME ACROSS DOORS	**0.00 MINUTES**

PLATFORM EGRESS
South Stair(s); Enclosed Exit Doors (3'-0") — **F3 - F3 / F6 - F6**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	0 PEOPLE
NUMBER OF GATES:		1 GATES
CAPACITY PER GATE:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	60 PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER GATE x NUMBER OF GATES)	60 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.00 MINUTES
	TOTAL FLOW TIME ACROSS SECTION D - D:	**0.00 MINUTES**

MAIN (CENTRAL) HEADHOUSE
Fare Barriers — **A2 -A2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	1158 PEOPLE
NUMBER OF FARE BARRIERS:	*18 NEW FARE BARRIERS (INCLUDING 4 ACCESSIBLE FARE BARRIERS)*	12 FARE BARRIERS
CAPACITY PER FARE BARRIER:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	50 PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER FARE BARRIER x NUMBER OF FARE BARRIERS)	600 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.93 MINUTES
	TOTAL FLOW TIME ACROSS SECTION B - B:	**1.93 MINUTES**

MAIN (CENTRAL) HEADHOUSE
Exit Discharge Doors — **A3 - A3 / A4 -A4**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	1158 PEOPLE
CLEAR GROSS WIDTH:	(2) DOUBLE LEAF DOORS	432 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2014)	408 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	848 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.37 MINUTES
	TOTAL FLOW TIME ACROSS SECTION A1 - A1:	**1.37 MINUTES**

MAIN (SOUTH) HEADHOUSE
Fare Barriers — **E2 -E2**

OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	279 PEOPLE
NUMBER OF FARE BARRIERS:	*18 NEW FARE BARRIERS (INCLUDING 4 ACCESSIBLE FARE BARRIERS)*	5 FARE BARRIERS
CAPACITY PER FARE BARRIER:	PEOPLE PER MINUTE (PPM) PER NFPA 130, 2014	50 PPM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (CAPACITY PER FARE BARRIER x NUMBER OF FARE BARRIERS)	250 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	1.12 MINUTES
	TOTAL FLOW TIME ACROSS SECTION B - B:	**1.12 MINUTES**

MAIN (SOUTH) HEADHOUSE
Exit Discharge Doors — **E3 - E3 / E4 -E4**

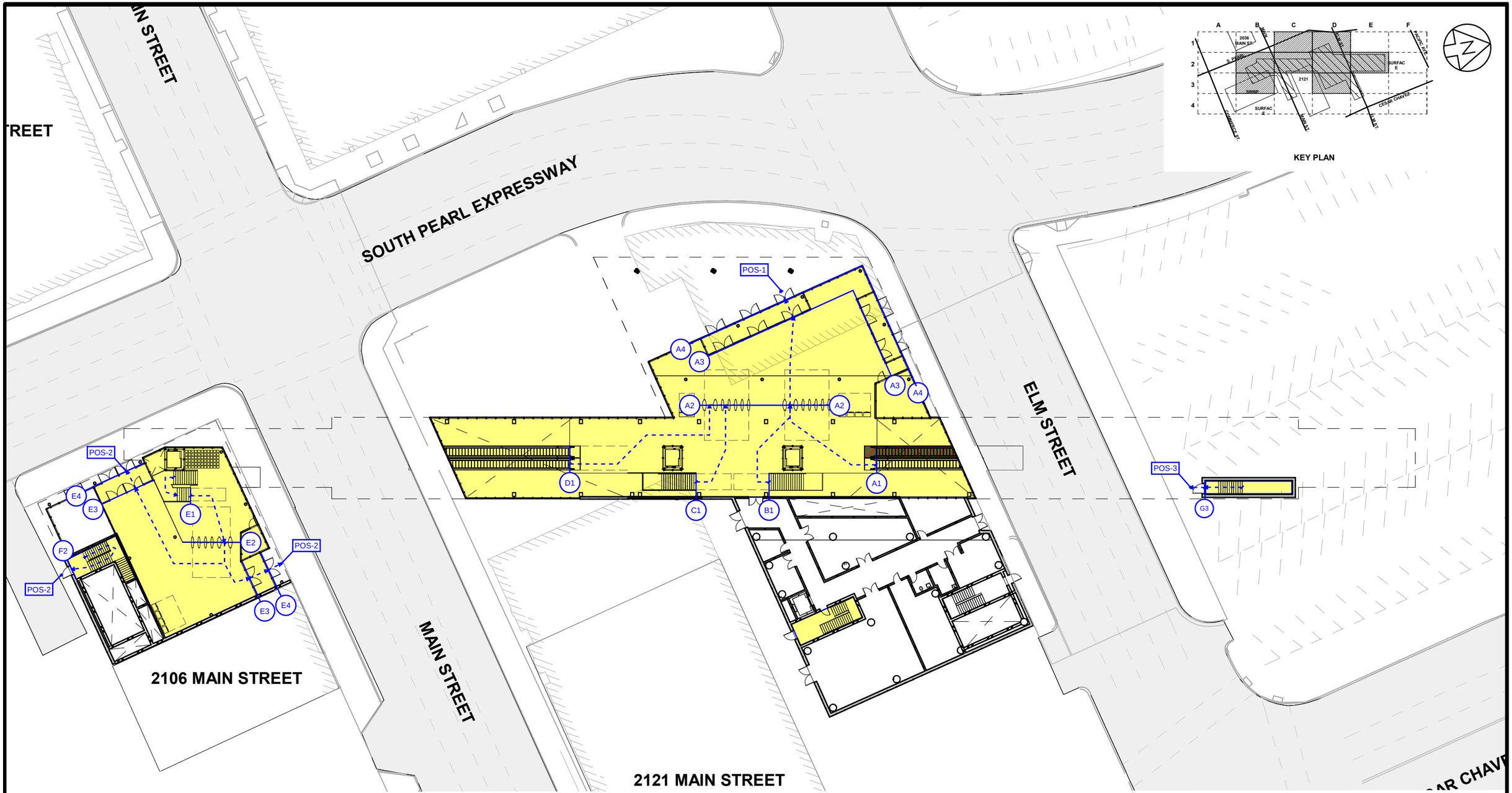
OCCUPANTS:	(OCCUPANT LOAD DISTRIBUTED (PASSENGERS OUTBOUND) TO EQUALIZE FLOW TIME)	279 PEOPLE
CLEAR GROSS WIDTH:	(2) DOUBLE LEAF DOORS	216 INCHES
CLEAR NET WIDTH:	(INCLUDES REDUCTION PER NFPA 130, 2014)	204 INCHES
RATE:	PEOPLE PER INCH PER MINUTE (PIM) PER NFPA 130, 2014	2.08 PIM
CAPACITY:	PEOPLE PER MINUTE (PPM) = (RATE x CLEAR NET WIDTH)	424 PPM
FLOW TIME:	(OCCUPANTS/CAPACITY)	0.66 MINUTES
	TOTAL FLOW TIME ACROSS SECTION A1 - A1:	**0.66 MINUTES**

TOTAL REQUIRED TIME TO EXIT THE PLATFORM(S): WORST CASE SCENARIO

PASSENGER FLOW TIME (WORST CASE SCENARIO) ON THE CENTER PLATFORM EQUALS =	**3.00 MINUTES**

TOTAL REQUIRED TIME TO EXIT TO A POINT OF SAFETY (POS) FROM PLATFORM (S) (PER NFPA 130, 2017): WORST CASE SCENARIO

TOTAL FLOW TIME (E - E) + TRAVEL TIME T4/E TO E4/POS-2(WORSE CASE SCENAIRO TO POINT OF SAFETY) =	**5.49 MINUTES**



KEY PLAN

NOT FOR CONSTRUCTION
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PRELIMINARY 20% DESIGN

IN-PROGRESS

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GREGORY T. D. TALLOS, AIA NCARB
LEED AP BD+C, TX LICENCE NO. 26520

ON 03/06/2020

HDR ENGINEERING, INC.
TBPE FIRM NO. F-754

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HDR ENGINEERING, INC.
17111 PRESTON RD SUITE 300, DALLAS, TX 75248

DART PROJECT

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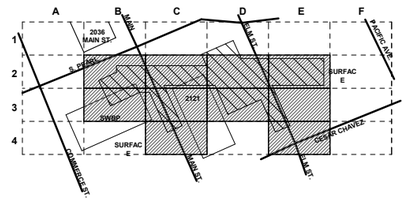
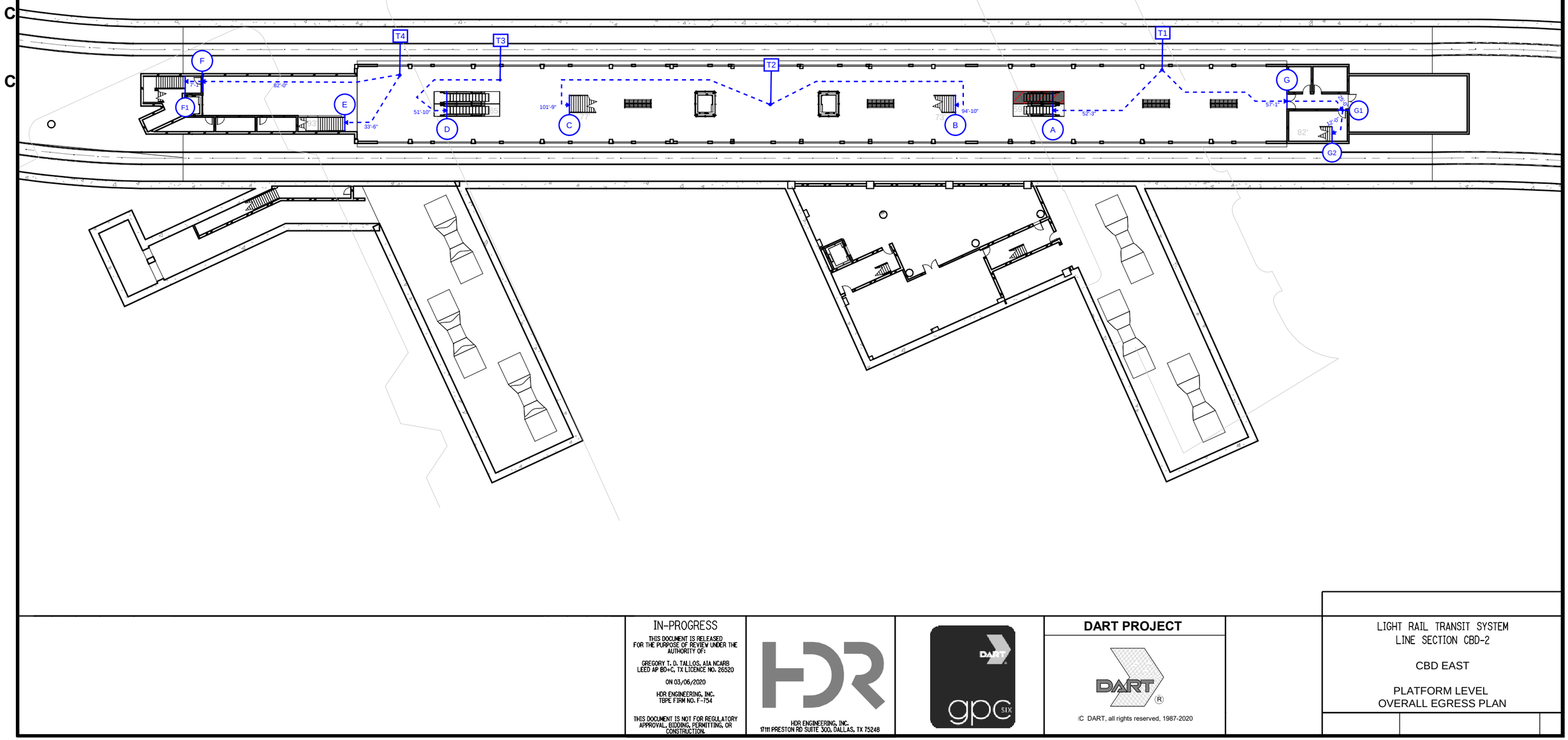
LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

CBD EAST

STREET LEVEL
OVERALL EGRESS PLAN



KEY PLAN



IN-PROGRESS

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LIGHT RAIL TRANSIT SYSTEM
LINE SECTION CBD-2

CBD EAST

PLATFORM LEVEL
OVERALL EGRESS PLAN

Tallos, Gregory

From: Chad Edwards <CEdwards@dart.org>
Sent: Thursday, August 30, 2018 3:56 PM
To: Tallos, Gregory
Cc: Kay Shelton
Subject: D2 Subway passenger calculation
Attachments: Station Capacity Analysis.xlsx

Gregory,

Here is a copy of the worksheet Kay and I showed you today regarding the ridership calculation for the D2 Subway Stations. Please let me know if you have any questions.

Thanks,
Chad

Chad Edwards
Assistant Vice President

Capital Planning
Dallas Area Rapid Transit |1401 Pacific Avenue | Dallas TX 75202
Office 214-749-3277 | cedwards@dart.org

		Opening Day Single Train	Opening Day Orange and Green Lines at 15/20 HDWY	Future Option Assume 4 routes at 15/20 HDWY
	Number of Routes on D2 Subway	1	2	4
	Peak HDWY	60	15	15
	Average HDWY	60.0	7.5	3.8
	Number of trains per hour per direction	1	8	16
	Number of trains per hour BOTH directions	2	16	32
	Capacity per car (based on 1.75 peak load factor)	165	165	165
	Number of cars per train	3.0	3.0	3.0
	Capacity per train	495	495	495
	Passengers per hour per direction	495	3,960	7,920
Maximum link load	Passengers per hour BOTH directions	990	7,920	15,840
	Metro Center Station			
Entraining load	Passengers Boarding	50%	50%	25%
	Passengers Alighting	0%	0%	50%
	Trains and waiting passengers total	1,485	11,880	27,720
	Commerce Station			
	Passengers Boarding	25%	25%	25%
	Passengers Alighting	50%	50%	50%
	Trains and waiting passengers total	1,733	13,860	27,720
	CBD East Station			
	Passengers Boarding	25%	25%	25%
	Passengers Alighting	50%	50%	50%
	Trains and waiting passengers total	1,733	13,860	27,720

SUBWAY STATION ARCHITECTURAL SPACE PLANNING PROGRAM

Room/Design Element	Metro Center Subway Stn	Commerce Stn	CBD East Stn	Area	Grade Level	Concourse Level	Platform Level	Location Notes	Adjacency	Purpose	Approximate Area	Dimensions	Finishes	Room Critical Assessment
1.0 PUBLIC AREAS: FARE UNPAID														
Main Entrance	x	x	x	Public Areas	x			Grade			Varies.	varies		
Secondary Entrance	x	x	x	Public Areas	x	x		Grade/Concourse			Varies.	varies		
Automatic Entrance	x	x	x	Public Areas	x	x		Grade			Varies.	varies		
Emergency (2nd) Exit				Public Areas	x			Grade			Varies.	varies		
1.5 PUBLIC AREAS: FARE PAID														
Fare Control Areas	x	x	x	Public Areas	x			Grade/Concourse	At surface level		Varies.	varies	Floor: Poured terrazzo Wall: Non-combustible Material; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
LRT Platforms	x	x	x	Public Areas			x	Platform			Varies.	varies	Floor: Poured terrazzo Wall: Non-combustible Material; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
2.0 STAFF ROOMS														
Staff Spaces	x	x	x	Staff Rooms	x	x	x	Varies	Varies	Varies	Varies.	varies	Floor: LVT Wall: Non-combustible Material; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
2.5 DART POLICE														
DART Police Small Office		x	x	Staff Rooms		x		Concourse. Specified stations, at major transfer and terminal stations. Preferred In proximity/same level as Collector's Booth.	In proximity/ same level as Collector's Booth	To provide room for report/admin, communication, investigation and lunch. Requested by DART	Varies.	Varies.	Floor: LVT Wall: Non-combustible Material; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
DART Police Large Office	x			Staff Rooms		x		Concourse. Specified stations, at major transfer and terminal stations. Preferred In proximity/same level as Collector's Booth.	In proximity/ same level as Collector's Booth	To provide room for report/admin, communication, investigation and lunch. Requested by DART	Varies.	Varies.	Floor: LVT Wall: Gypsum; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
Multipurpose Room	x			Staff Rooms		x		Concourse	Next to Large Office	To provide room for training/meetings, communication, and lunch. Requested by DART	Varies.	Varies.	Floor: LVT Wall: Gypsum; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
Restrooms and Locker Rooms	x			Staff Rooms		x		Concourse	In proximity to Multipurpose Room	To provide space for male and female officers to change. Requested by DART	Varies.	Varies.	Floor: LVT Wall: Gypsum; Ceiling: Gypsum. LED Lighting .	
Secured Storage Room	x			Staff Rooms		x		Concourse	In proximity to Multipurpose Room	To provide secured storage. Requested by DART	Varies.	Varies.	Floor: LVT Wall: Gypsum; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
Interview Room	x			Staff Rooms		x		Concourse	In proximity to Multipurpose Room	To provide to interview people. Requested by DART	Varies.	Varies.	Floor: Solid Epoxy Wall: Gypsum; Ceiling: Metal Ceiling Tile/panels (accoustical). LED Lighting .	
IT Room				Staff Rooms		x		Concourse	In proximity to Multipurpose Room		Varies.	Varies.	Floor: Sealed Concrete Wall: Plywood Ceiling: None. LED Lighting .	
4.0 ELECTRICAL SPACES														
Passenger Station Electrical Room	x			Service Rooms - Electrical	x	x		Grade/ Concourse	Next to and on the same level as the Switchgear Room		Varies.	Varies	Floor: Sealed and hardened concrete Wall: Unpainted concrete/ concrete block Ceiling: Exposed structure - unpainted	
Switchgear Room	x	x	x	Service Rooms - Electrical	x	x		At all stations. Grade or concourse level.	Must be located adjacent to, and on the same level as the Passenger Station Electrical Room. Access to common equipment removal hatch must be provided.	To transfer incoming 27.6 kV/13.8kV power to 750 V/208 V for use in the station power distribution system.	915 ft2		Floor: Painted trowel finished cement topping Wall: Painted concrete/ concrete block Ceiling: Exposed structure - painted grey	Security requirements to be included in design by Designer
Emergency Power / UPS Room	x	x	x	Service Rooms - Electrical	x	x		At all stations. Grade or concourse level.	Next to the Passenger Station Electrical Room.	To supply emergency power to supervisory circuitry control, lighting and communication.	According to the equipment. Between 162 to 323ft². (Under Review)		Floor: Concrete curb around battery bank. Trowel finished cement topping and acid resistant paint finish. Wall: Painted concrete/ concrete block Ceiling: Exposed structure - painted grey	Security requirements to be included in design by Designer
Communication Equipment Room	x	x	x	Service Rooms - Electrical		x		All stations. Grade or concourse level.	Next to Emergency Power Room	To contain supervisory control and communications equipment in a station.	According to the equipment. 560 ft² (max.)	23 X 25ft2 (max.)	Floor: Painted trowel finished cement topping Wall: Painted concrete/ concrete block Ceiling: Exposed structure – painted grey	Security requirements to be included in design by Designer.
Telephone Equipment Room	x			Service Rooms - Electrical	x	x		All stations. Grade level or concourse level.	Next to Communication Equipment Room	To provide telephone communication service to the station.	48 ft2	5 X 10ft	Floor: Painted trowel finished cement topping Wall: Painted concrete/ concrete block Ceiling: Exposed structure - painted grey	Security requirements to be included in design by Designer.
Communication maintenance Room				Service Rooms - Electrical			x							

SUBWAY STATION ARCHITECTURAL SPACE PLANNING PROGRAM

5.0 MECHANICAL SPACES														
HVAC Room	x	x	x	Service Rooms - Mechanical	x	x	x	All station. Platform and/or concourse and/or bus platform levels.		To contain station ventilation equipment.	According to equipment.	Varies	Floor: Sealed and hardened concrete Wall: Unpainted concrete/ concrete block Ceiling: Exposed structure - unpainted	
Ventilation Rooms	x	x	x	Service Rooms - Mechanical		x	x	Concourse/ Track			Varies.	Varies	Floor: Sealed and hardened concrete Wall: Unpainted concrete/ concrete block Ceiling: Exposed structure - unpainted	
Subway ventilation room				Service Rooms - Mechanical		x	x	• All stations. • At concourse level or at track level.		To contain subway ventilation equipment (emergency ventilation, fan/silencer assemblies and associated electrical panels, dampers, etc.).	According to equipment. Track level 1830 sq ft - (contains 1 fan assembly). Concourse level 5380 sq ft - (contains 2 fan assemblies).	Varies	Floor: Sealed and hardened concrete. Wall: Unpainted concrete/ concrete block. Ceiling: Exposed structure - unpainted	
Valve room				Service Rooms - Mechanical		x	x	• All stations. • Grade or concourse level. • Local to existing city water supply.	Next to Janitor Service Room. Could be part of HVAC room.	To contain sprinkler valves, standpipe valves, backflow preventers, and water meter and, if required, fire booster pump.	To be determined during design to suit equipment specific to each contract.		Floor: Hardened concrete, sealed. Wall: Unpainted concrete/ concrete block. Ceiling: Exposed structure – unpainted	
6.0 SERVICE ROOMS - MECHANICAL														
Sump Pump Rooms	x	x	x	Service Rooms - Mechanical			x	Platform Level. All stations. Lower than elevator or sewage pit.		To locate the sanitary pump sump where sanitary drainage will collect prior to discharge to city sewers.	To be determined during design to suit equipment specific to each contract.		Floor: Hardened concrete, sealed. Wall: Unpainted concrete/ concrete block Ceiling: Exposed structure – unpainted Sump pit: Cementitious waterproofing for walls and floor.	
Plumber's maintenance room				Service Rooms - Mechanical		x	x	• At terminal and transfer stations. • Concourse level.		To contain workshop and storage for plumbing devices.	130 sp ft		Floor: Hardened concrete, sealed. Wall: Painted concrete/ concrete block. Ceiling: Exposed structure - painted grey	
Mechanical maintenance shop				Service Rooms - Mechanical		x	x	• At any station, one per line. • Grade or concourse level.		To provide workshop and storage for mechanics.	130 sq ft		Floor: Hardened concrete, sealed. Wall: Painted concrete/ concrete block. Ceiling: Exposed structure - painted grey	
7.0 SERVICE ROOMS - MISCELLANEOUS														
Janitor Closet	x	x	x	Service Rooms - Miscellaneous	x	x		Concourse/ Bus Platform	Next to washrooms, where applicable		varies	varies		
Water Meter Vault	x	x	x	Service Rooms - Miscellaneous	x	x								
Building Maintenance Storage Room	x			Service Rooms - Miscellaneous		x			Located only in one station	Requested by DART	Varies.	varies	varies	
Maintenance Offices	x			Service Rooms - Miscellaneous		x			Located only in one station	Requested by DART	Varies.	varies	varies	
Maintenance Locker rooms - male and female	x			Service Rooms - Miscellaneous		x	x	• All stations. • At concourse level.		To provide a lockable room for the maintenance to change from street clothes to working	Varies.	Varies.	Floor: Sealed and hardened concrete. Wall: Painted concrete/ concrete block. Ceiling: Exposed structure - painted grey	
Janitor change rooms - male and female	x			Service Rooms - Miscellaneous		x	x	• All stations. • At concourse level.		To provide a lockable room for the station janitors to change from street clothes to working	varies	varies	Floor: Sealed and hardened concrete. Wall: Painted concrete/ concrete block. Ceiling: Exposed structure - painted grey	
Janitor service room	x			Service Rooms - Miscellaneous		x	x	• All stations. • At platform level.	Next to washrooms, where applicable.	To store janitor's equipment, and tools and washroom supply.	107 sq ft		Floor: Hardened concrete, sealed. Wall: Painted concrete/ concrete block Mop sink backsplash: Ceramic tiles.	
Scrubber Machine Room	x	x	x	Service Rooms - Mechanical		x	x	Concourse or platform level. One per station.		To store Scrubber Machine.	129		Floor: Hardened concrete, sealed. Wall: Painted concrete block Ceiling: Exposed structure - painted grey	
Scrubber Machine Battery Room	x	x	x	Service Rooms - Mechanical		x	x	At any station, one per line, preferably in mid line. Platform or concourse level.	Near Scrubber Machine Room	To charge scrubber machine batteries.	108	10x11 ft	Floor: Concrete curb around battery bank. Acid resistant paint finish. Wall: Acid resistant concrete/ block Ceiling: Exposed painted grey	
Refuse Storage Room	x	x	x	Ancillary Rooms	x	x		All stations. Street level. Level accessible by packer truck.	Close to access road/street and station elevator.	To store station refuse until collection.	260 ft2	10ft x 26ft	Floor: Hardened and sealed concrete with coved concrete base. Wall: Painted concrete/ concrete block Ceiling: Exposed structure - painted grey	
8.0 ANCILLARY ROOMS														
Elevator Machine Room	x	x	x	Ancillary Rooms	x	x	x	Up to 100' away if using a remote closet	Near/Close to elevator	Provide a location for electrical and security panels	Varies.	Varies		
Main Conveyance Storage	?	?	?	Ancillary Rooms		x	x	At specified station, one per line. Grade or concourse or platform level.	Next to elevators/ escalators	To store spare parts and equipment for elevator and	160 sq ft		Floor: Sealed and hardened concrete; Wall: Unpainted concrete/ concrete block; Ceiling: Exposed structure - unpainted	
Escalator Storage Room	x	x	x	Ancillary Rooms			x	At every station. At platform level only.	Close to escalator (if free standing escalator)	To store equipment and maintenance products for escalators.	270 ft2	4ft x escalator width and adjacent stair width. Headroom of 6.8ft to be provided inside the room.	Floor: Sealed and hardened concrete Wall: Unpainted concrete/ concrete block Ceiling: Exposed structure - unpainted	

SUBWAY STATION ARCHITECTURAL SPACE PLANNING PROGRAM

9.0 EMERGENCY SUPPORT ROOMS														
Fire Command Center	x	x	x	Ancillary Rooms		x	x	One per station. Location TBD by DFD			Varies.	Varies	Floor: Hardened concrete, sealed.	
Fire Command Secure Storage	x	x	x	Ancillary Rooms			x	Train platform. One per station.	Access from the Fire Command Triage		450 sq ft	varies	Wall: Painted concrete/ concrete block	
Fire prevention room	x			Service Rooms - Miscellaneous		x	x	• At any station, one per line. • Concourse level.		To contain workshop and storage for fire extinguishers and hoses.	215 sq ft		Floor: Hardened concrete, sealed. Wall: Painted concrete/ concrete block Ceiling: Exposed structure -painted grey	
Emergency Response Room (ERR)	x	x	x	Ancillary Rooms			x	Train platform. One per station platform. Ideally located in mid platform.	Close to Emergency Phone.	To provide a storage of body following sudden death, usually at track level, to await attendance of body removal.	100 sq ft	10 x 10	Floor: Ceramic tile w/epoxy grout; Wall: Ceramic Tile w/epoxy grout; Ceiling: Clean Room Ceiling; Negative Air, hose bib with floor drain.	
Fire Command Triage	x	x	x	Ancillary Rooms			x	Train platform. One per station.			1900 sq ft	varies	Ceiling: Exposed structure -painted grey	
Valve Room	x			Service Rooms - Mechanical	x	x		All stations. Grade or concourse level. Local to existing city water supply.	Next to Janitor Service Room, could be part of HVAC Room	To contain sprinkler valves, standpipe valves, backflow preventers, and water meter and, if required, fire booster pump.	To be determined during design to suit equipment specific to each contract.		Floor: Hardened concrete, sealed Wall: Unpainted concrete/ concrete block Ceiling: Exposed structure – unpainted	