Lane Position

This document focuses on which lane of the street is preferable for Kansas City's Main Street streetcar extension, describing the multi-step process taken to identify the "best lane" position.

Background

For the original Downtown Streetcar line, determining lane positioning for the tracks was a largely "internal" project-team effort. Because the curb-to-curb cross-section of the route was fairly narrow (approximately 54 feet through the Crossroads District, and much narrower in other sections), the choice was often obvious:

- Circling the River Market, only one vehicle lane per direction existed, so there was only one lane in which the streetcar could operate.
- Throughout the Crossroads, the project team determined that a "road diet", converting the existing four-lane undivided roadway to a three-lane section (one lane per direction plus a turn lane) was warranted by the traffic volumes and would improve traffic flow and safety. Once this decision was made, there was only one lane in each direction in which the streetcar could operate.
- Within the CBD, the situation was more complicated due to varying corridor widths. Generally, a road-diet strategy was used south of 10th Street, resulting in only one lane choice for the streetcar. North of 10th Street to Independence Avenue, the four-lane section was retained. Based on available widths for station-stops, the fact that the remainder of the station-stops were on the outside, and other factors, the study team decided to position the streetcar in the outside lane through this five-block section.

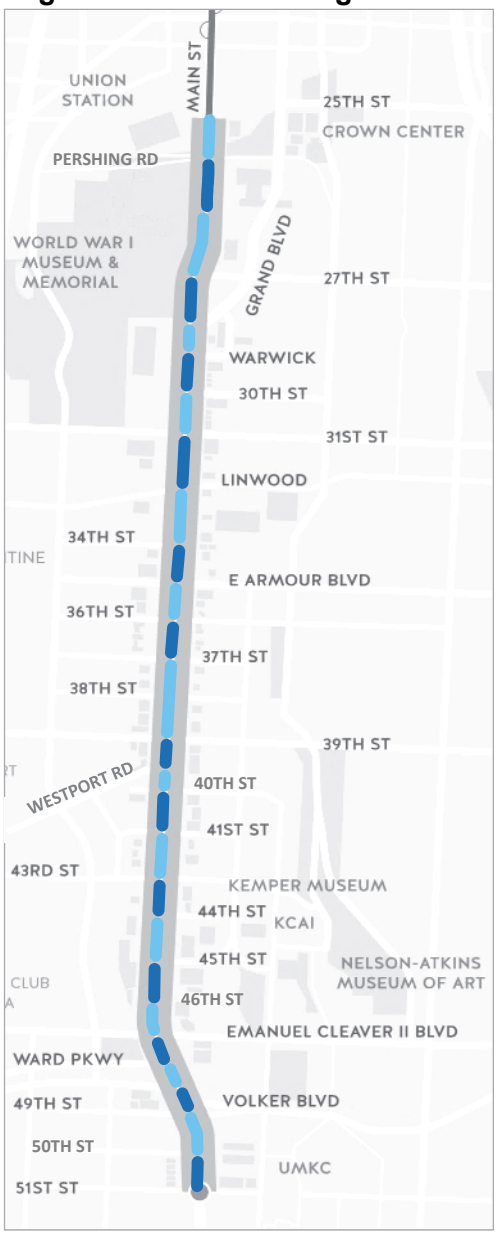
More options exist for the proposed Main Street extension, largely because the majority of the proposed extension corridor is wider curb-to-curb than the Downtown corridor. Main Street is a four- to six-lane roadway, with turn lanes in many portions, and will generally need to retain at least two travel lanes in each direction. Thus, there is a very real question of which lane the streetcar should use – the "best lane".

The process to select the "best lane" differed somewhat from the station-stop decision-process. It more broadly encompassed evaluations of the overall cross-section of each segment of Main Street, considering how the ultimate design of the street could facilitate not just the streetcar, but also the other modes of transportation along this key Midtown artery.

As with the station-stop analysis, the lane-position analysis involved the study team, a Working Group composed of key stakeholders, and the public.

To facilitate the “best lane” analysis, the corridor was divided into 26 segments as shown in **Figure X-1**.

Figure X-1: Corridor Segments



Step 1: Initial Segment Needs Identification

The starting point for the lane-position analysis was an examination of the cross-sectional "needs" of each segment. Because the street will need to be restriped (and to some extent, repurposed) to accommodate the streetcar, the elements competing for street width – parking, vehicles, turn lanes, non-motorized modes – need to be considered. Because needs vary along the corridor, the study team felt that an initial segment-by-segment analysis would be a good starting point. It was acknowledged up front that these needs would, in many cases, represent trade-offs; and those trade-offs were what the team was eager to identify and discuss, both internally and publicly.

The following criteria were evaluated in determining segment needs:

Parking/Loading | Through Lanes | Driveway Access | Intersection Left Turns
Utilities | Bike Integration | Pedestrian Space | Curb Stop Needed

For each intersection, needs relating to each of the criteria were evaluated on a 1-5 scale, with a rating of "5" indicating a high need for the given element (e.g., parking/loading) and a rating of "1" indicating a low need. The evaluation criteria, and the segment-by-segment needs evaluation for each, are described below.

Parking/Loading

Along much of the streetcar extension route, on-street parking is currently allowed in the outside lane during most of the day. During peak times, in the peak direction (northbound in the AM, southbound in the PM), parking is prohibited to allow the outside lane to be used by Main MAX (and turning vehicles). In contrast to buses, streetcars cannot operate in a lane that allows parking, even time-of-day restricted parking. If parking is to be maintained once the streetcar extension is constructed, it will need to be separate from the streetcar travel-way.

For the initial analysis, parking/loading needs were evaluated based on existing on-street parking/loading patterns. This included a parking inventory that covered the entire corridor over several parts of a typical weekday. The study team acknowledged that existing parking usage is not likely reflective of future parking usage, for several reasons:

- The streetcar is expected to spur redevelopment, potentially increasing parking demand in some areas.
- There is a large number of off-street parking spaces in surface lots immediately adjacent to the corridor. Surface parking is not considered the "highest and best" use for many such locations, meaning these lots could someday be replaced by buildings, potentially relying more heavily on on-street parking.

The geographic specifics of these considerations are not easily predictable. Therefore, as a starting point, current areas of high parking occupancy were used as indicators of higher need. **Table X-1** summarizes the parking needs evaluation, which was conducted separately for each side of the street.

Table X-1: Initial Segment Need Evaluation Criterion: Parking

Location			Need Score		Composite Parking Occupancy	
			W. Side	E. Side	W. Side	E. Side
1	"24th"	Pershing	1	4	NA	*
2	Pershing	"25th"	1	1	NA	NA
3	"25th"	27th	1	5	NA	35-40%
4	27th	Grand	1	1	0-5%	0-5%
5	Grand	Warwick	1	1	0-5%	0-5%
6	Warwick	30th	1	1	0-5%	0-5%
7	30th	31st	1	3	0-5%	10-15%
8	31st	Linwood	1	1	0-5%	0-5%
9	Linwood	E 34th	1	1	0-5%	0-5%
10	E 34th	Armour	1	4	0-5%	25-30%
11	Armour	36th	1	1	0-5%	0-5%
12	36th	37th	2	1	5-10%	0-5%
13	37th	39th	3	3	10-15%	10-15%
14	39th	Westport	3	3	10-15%	10-15%
15	Westport	40th	1	1	0-5%	0-5%
16	40th	41st	1	5	0-5%	30-35%
17	41st	43rd	1	1	0-5%	0-5%
18	43rd	44th	1	1	0-5%	0-5%
19	44th	45th	1	4	0-5%	25-30%
20	45th	46th	4	2	20-25%	5-10%
21	46th	Cleaver II	1	1	NA	NA
22	Cleaver II	Ward	1	1	NA	NA
23	Ward	Volker	1	1	NA	NA
24	Volker	49th	1	1	NA	NA
25	49th	"50th"	1	1	NA	NA
26	"50th"	51st	1	1	NA	NA

** Segment not counted but known to be high occupancy.*

Through Lanes

As mentioned above, the original Downtown Streetcar project resulted in a "road diet" on portions of Main Street, reducing the number of automobile through lanes on a large portion of the corridor. This was done to improve corridor safety and better accommodate the streetcar by providing dedicated left-turn lanes for autos (reducing traffic friction) – but it was also supported by traffic volume data indicating that the lane reduction was appropriate.

A similar investigation was made for the Main Street Extension. To allow the paved street width to be put to its best use, the study team evaluated traffic flows along the corridor and computed the minimum number of through lanes that would allow traffic to flow at acceptable levels. The evaluation centered on intersection capacity, using level-of-service (LOS) analysis to determine intersection performance, with LOS D or better considered acceptable.

Table X-2:
Initial Segment Need Evaluation Criterion:
Auto Through Lanes (per Direction)

Location			Need Score (per direction)		Lanes needed per direction
			Need >1 thru lanes	Need >2 thru lanes	
1	"24th"	Pershing	5	1	2
2	Pershing	"25th"	1	1	1
3	"25th"	27th	1	1	1
4	27th	Grand	1	1	1
5	Grand	Warwick	1	1	1
6	Warwick	30th	1	1	1
7	30th	31st	5	1	2
8	31st	Linwood	5	1	2
9	Linwood	E 34th	5	1	2
10	E 34th	Armour	5	1	2
11	Armour	36th	5	1	2
12	36th	37th	5	1	2
13	37th	39th	5	1	2
14	39th	Westport	5	1	2
15	Westport	40th	5	1	2
16	40th	41st	5	1	2
17	41st	43rd	5	1	2
18	43rd	44th	5	1	2
19	44th	45th	5	1	2
20	45th	46th	5	1	2
21	46th	Cleaver II	5	5	3
22	Cleaver II	Ward	5	1	2
23	Ward	Volker	5	1	2
24	Volker	49th	5	1	2
25	49th	"50th"	5	1	2
26	"50th"	51st	5	1	2

The majority of the corridor is currently striped with three through lanes in each direction. However, as mentioned previously, the outside lane is used for on-street parking during off-peak times and is a dedicated bus lane during the peak hours. Therefore, through traffic is essentially limited to two lanes per direction (for most of the corridor) in its current configuration.

Table X-2 summarizes the evaluation. To facilitate computations in later steps, the needs were divided into binary categories ("Does the segment need more than one through lane?" and "Does the segment need more than two through lanes?"). As the table indicates, several segments in the northern portion of the corridor could operate acceptably with one lane per direction, while the majority of the corridor would need two lanes per direction. The segment near Cleaver II Parkway was found to need three lanes per direction, as the intersection of Main Street and Cleaver II Parkway is a major intersection with congestion issues during peak hours.

Driveway Access

Driveway access is prevalent along much of the corridor, and is viewed as important by many of the business owners and operators. Certain portions of the corridor include a center two-way left-turn lane, while others do not. The potential need for a center turn lane is an important part of cross-section evaluation. As an indicator of existing areas where access needs are high, the study team assessed the current number of driveways per mile, or "driveway density."

The study team acknowledged that this snapshot of existing access conditions may not reflect the long term. With a streetcar in place, properties may redevelop, and access points may be moved, consolidated, or closed. Furthermore, the fact that numerous driveways exist does not necessarily mean that they are all needed. However, as a starting point for examining desirable cross-sections, driveway density was felt to be a reasonable proxy for access needs.

Table X-3 summarizes the results of the analysis. Ironically, the central portion of the corridor (34th Street to 44th Street) has the highest driveway density but also is the portion without a center turn lane.

Table X-3: Initial Segment Need Evaluation Criterion: Mid-block Driveway Access

Location			Score	Driveway Density (per mi)
1	"24th"	Pershing	1	0
2	Pershing	"25th"	1	6.6
3	"25th"	27th	1	4.1
4	27th	Grand	1	0
5	Grand	Warwick	2	37.1
6	Warwick	30th	2	22.6
7	30th	31st	2	39.8
8	31st	Linwood	2	32.5
9	Linwood	E 34th	4	62.1
10	E 34th	Armour	3	50.1
11	Armour	36th	3	56.3
12	36th	37th	4	64.2
13	37th	39th	4	76.5
14	39th	Westport	2	35.0
15	Westport	40th	2	37.2
16	40th	41st	3	48.3
17	41st	43rd	5	89.5
18	43rd	44th	4	77.3
19	44th	45th	2	36.6
20	45th	46th	2	34.8
21	46th	Cleaver II	2	20.5
22	Cleaver II	Ward	1	0
23	Ward	Volker	1	0
24	Volker	49th	1	0
25	49th	"50th"	1	0
26	"50th"	51st	1	8.0

Intersection Left Turns

Currently, at the northern and southern extremities of the corridor (north of 34th Street and south of 43rd Street), left-turn lanes are provided on Main Street at signalized intersections. However, through the middle section of the corridor, where the street is narrower, there are no exclusive turn lanes and left turns are generally restricted during certain times of the day. In addition to street width considerations, the need for left-turn lanes imposes an operational constraint: if the streetcar tracks were to occupy the inside lanes, left turns could no longer be allowed from a non-exclusive lane at any time of day.

In determining this semi-qualitative need score, the study team assessed the existing left-turn lane provisions, peak-hour left-turn traffic counts, and other demand factors. At locations where left turns are currently prohibited, violations also helped indicate demand. **Table X-4** summarizes the results of the analysis; intersection left-turn lane needs were found to be fairly high for much of the corridor.

Table X-4: Initial Segment Need Evaluation Criterion: Intersection Left-Turn Lanes

	From	To	Score	Existing Conditions	Peak-Hour Left-Turn Volume: AM(PM)
1	"24th"	Pershing	5	Signal & turn lane @ Pershing	
2	Pershing	"25th"	4	Signal & turn lane @ Pershing	Pershing NB: 65 (108)
3	"25th"	27th	4	Signal & turn lane @ 27th	27th SB: 75 (17)
4	27th	Grand	3	Unsignalized left-turn lane @ Memorial	*Not available*
5	Grand	Warwick	3	SB signalized LT lane @ Warwick	Warwick SB: 13 (11)
6	Warwick	30th	4	Ex signalized LT lane @ Warwick, unsignalized LT lane @ 30th	Warwick NB: 169 (0)
7	30th	31st	4	Existing signalized LT lanes at both ends	31st SB: 30 (262)
8	31st	Linwood	5	Existing High-demand SB LT @ Linwood	31st NB: 168 (161)
9	Linwood	E 34th	5	Existing High-demand NB LT @ Linwood	Linwood NB: 180 (158)
10	E 34th	Armour	4	Armour provides important connection to US-71	Armour SB: 1 (11)
11	Armour	36th	2	Neighborhood connection	Armour NB: 3 (0)
12	36th	37th	2	Neighborhood connection	36th NB: 18 (15)
13	37th	39th	4	39th an important E-W connection including US-71	37th NB: 10 (25)
14	39th	Westport	4	39th an important E-W connection	39th NB: 1 (1)
15	Westport	40th	3	Violations indicate demand	Westport NB: 17 (8)
16	40th	41st	2	Neighborhood/school connections	40th NB: 5 (8)
17	41st	43rd	3	43rd an important cross-street (hospital)	"41st" NB: 50 (9)
18	43rd	44th	4	43rd an important cross-street (hospital); High SB LT at QuikTrip	43rd NB: 11 (8) 44th SB: 38 (71)
19	44th	45th	4	Existing signalized lefts at 45th	44th NB: 20 (10)
20	45th	46th	3	45th = American Century entrance	45th NB: 19 (11)
21	46th	Cleaver II	5	High-demand signalized SB LT lane @ Cleaver	Cleaver SB: 87 (127)
22	Cleaver II	Ward	5	High-demand signalized NB LT lane @ Cleaver	Cleaver NB: 171 (155)
23	Ward	Volker	5	High-demand signalized LT lanes @ both ends	Ward NB: 497 (508)
24	Volker	49th	1	No intersection left-turns needed; need some shadowing of NB LT lane @ 49th	NA
25	49th	"50th"	4	Existing NB LT lane @ 49th	49th NB: 58 (39)
26	"50th"	51st	4	Recent addition of left-turn lanes at 51st	51st SB: 30 (75)

Utilities

Construction in general, and specifically placement of the track slab for the streetcar, may have an impact upon shallow or large utilities, and therefore the location of utilities is potentially an important consideration in the best lane analysis. Although utility information has begun to be gathered, at the initial stage of the evaluation there was not sufficient information to conclusively identify areas of potential concern, especially down to the granularity of potential conflicts in specific lanes. Thus, initially, all segments were ranked as “unknown” for utilities.

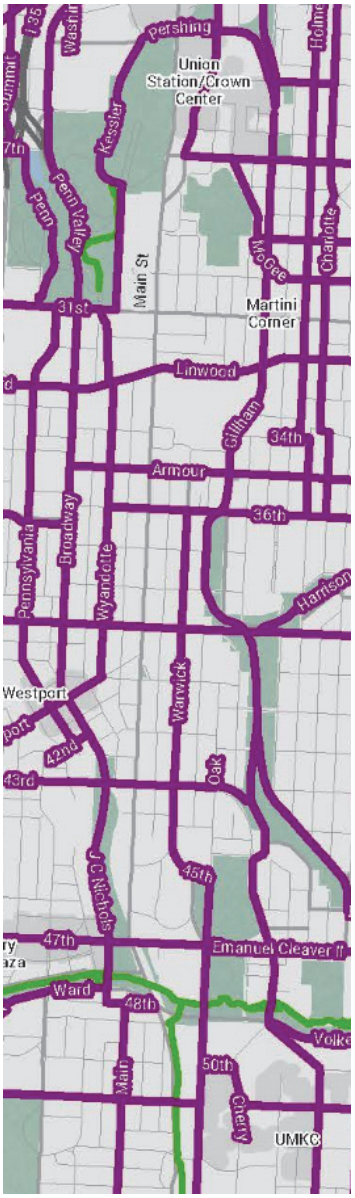
Bike Integration

Two policy documents were considered in the evaluation of bike needs:

- The City’s adopted Complete Streets Policy indicates that all transportation projects should strive to meet Complete Streets goals. With regard to bicycles, this often means including bike lanes or other dedicated facilities – but in some cases, it means designing to facilitate bicyclists to the extent possible.

- Bike KC, the City’s Bike Plan, is expected to be completed in the summer of 2018. A preliminary bike facility map from the plan development (see excerpt at right) shows a robust bicycle network surrounding the Main Street corridor, but does not show facilities on Main Street itself. This is intentional, as the framers of the plan recognize the expectation of a streetcar on Main Street and its potential conflicts with bicycle traffic.

Given the exclusion of explicit bicycle facilities on Main Street in Bike KC, the study team decided to rate bike needs along the segments as “low/unknown” at this stage. It was felt that, as the project moved into detailed design, logical segments for bicycle facilities might emerge, and the team would strive to accommodate bicycle travel as much as feasible.



Two additional criteria were proposed by the team at the beginning of the initial screening.

Pedestrian Space

The availability of adequate holding space either along the curb or in a center median for waiting riders, as well as pass-by pedestrians, could conceivably impact which lane is best suited for the streetcar. For example – if room is unavailable for an adequately sized center platform, then an inside-running option could be unsupportable. (Similar issues could exist with a curb platform.) However, these issues are highly localized and it was difficult to identify specific potential issues early in the evaluation. Thus, this criterion was not evaluated initially, but was carried forward as an issue to keep in mind as the evaluation progressed.

Curb Stop Needed

Along certain blocks, a curb stop could potentially be required due to outside influences including local development, shared bus stops, or system considerations. If a stop must be located along the curb, then the streetcar must also operate in the curb lane in that location. As with pedestrian space, this issue is highly localized. Thus, this criterion was also not evaluated initially, but was carried forward as an issue to keep in mind as the evaluation progressed.

Initial Evaluation Summary

Figure X-2 presents a graphical roll-up of the evaluation described above.

Figure X-2: Initial Evaluation of Segment Needs

RideKC STREETCAR

Step 2: Initial Segment-by-Segment Cross-Section Selection

The previous step established a basis of need for each study segment. The next steps broadly involved identifying potential street cross-sections for each segment, evaluating how well each would meet that need, and developing an initial set of recommended cross-sections for the corridor. The detailed steps are described below.

Development of Potential Cross-Sections. Curb-to-curb widths along the corridor vary from 50 feet to 90 feet. The study team graphically developed a series of potential cross-sections for street widths throughout this range, using blocks of color to represent different uses of the street (parking, automobile lane, exclusive streetcar lane, etc.). **Figure X-3** illustrates this visual approach along with an example of how the elements can be configured to represent a cross-section.

Figure X-3: Cross-Section Visual Representation Method

Rating of Potential Cross-Sections vs. Need Criteria. The study team scored each of the potential cross-sections against each of the need criteria described in Step 1 (Parking, Driveway Access, etc.). For example, **Figure X-4** shows the ratings for a series of 60-foot cross-sections.

Figure X-4: Sample Ratings (60-foot Cross-Sections)

Cross-Section	Need Criteria Rating*										
	Parking: W. Side	Parking: E. Side	Need >1car thru lanes/dir	Need >2car thru lanes/dir	Mid-block Business Access Needs	Intersection Left Turn Needs	Utility Issues - W. Curb	Utility Issues - Center	Utility Issues - E. Curb	Bike Needs	Stops must be at curb?
8 11 11 11 11 8	●	●	●	○	◕	◔	◑	●	◑	○	●
8 10 11 10 11 10	●	○	●	○	●	●	●	◑	●	◔	○
10 11 10 11 10 8	○	●	●	○	●	●	●	◑	●	◔	○
8 11 10 10 10 11	●	○	●	○	●	●	◑	●	○	○	●
11 10 10 10 11 8	○	●	●	○	●	●	○	●	◑	○	●
8 11 11 11 11 8	○	○	●	○	◑	○	●	○	●	◕	○
8 10 24 10 8	○	○	○	○	○	○	●	○	●	◕	○
8 10 24 10 8	●	●	○	○	○	○	●	○	●	◔	○
8 11 11 11 11 8	●	●	○	○	◕	◔	◑	●	◑	◔	●
11 10 10 10 11 8	○	●	○	○	●	●	○	●	◑	◔	●
6 11 10 6 10 11 6	○	○	○	○	◕	◔	○	●	○	◑	●
11 38 11	○	○	○	○	○	○	●	○	●	◔	○
11 10 18 10 11	○	○	○	○	●	●	○	●	○	◔	●

**Ratings on a 1-5 basis; darker colors represent higher needs.*

Scoring of Potential Cross-Sections vs. Segment Needs. Unlike the station-stop evaluation, in which the evaluation criteria could be summed to determine the highest score, the cross-section analysis needed to determine how well each cross-section met the needs of each criterion for a given segment. For example, a cross-section that provided on-street parking would score very highly for a street segment that had a high identified parking need, but would score lower for a segment on which parking was not identified as a priority – and this needed to be considered for each criterion. This evaluation resulted in a single combined score for each potential cross-section on every segment

Selection of Cross-Sections and Smoothing. Based on the cross-section analysis, the study team's algorithm selected the top two scoring cross-sections for each segment and assembled them into two initial "raw" corridor layouts. As anticipated, these layouts did not always represent a rational streetcar lane-position strategy: the streetcar was found to switch from outside to center several times throughout the raw layouts, resulting in an inefficient design. The team worked to manually "smooth" the corridor layout based on the highest-scoring cross-sections that made sense from a system operations standpoint. This led to the two alternatives shown in **Figure X-5**, and briefly described below:

- Alternative 1 was center-running throughout, meaning the streetcar would generally travel in the inside (left) lane – with an automobile travel lane to its right, and either a left-turn lane or median to its left.

- Alternative 2 was outside-running throughout, meaning the streetcar would generally travel in the outside (right) lane – with an automobile travel lane to its left, and either an on-street parking lane or a curb to its right.

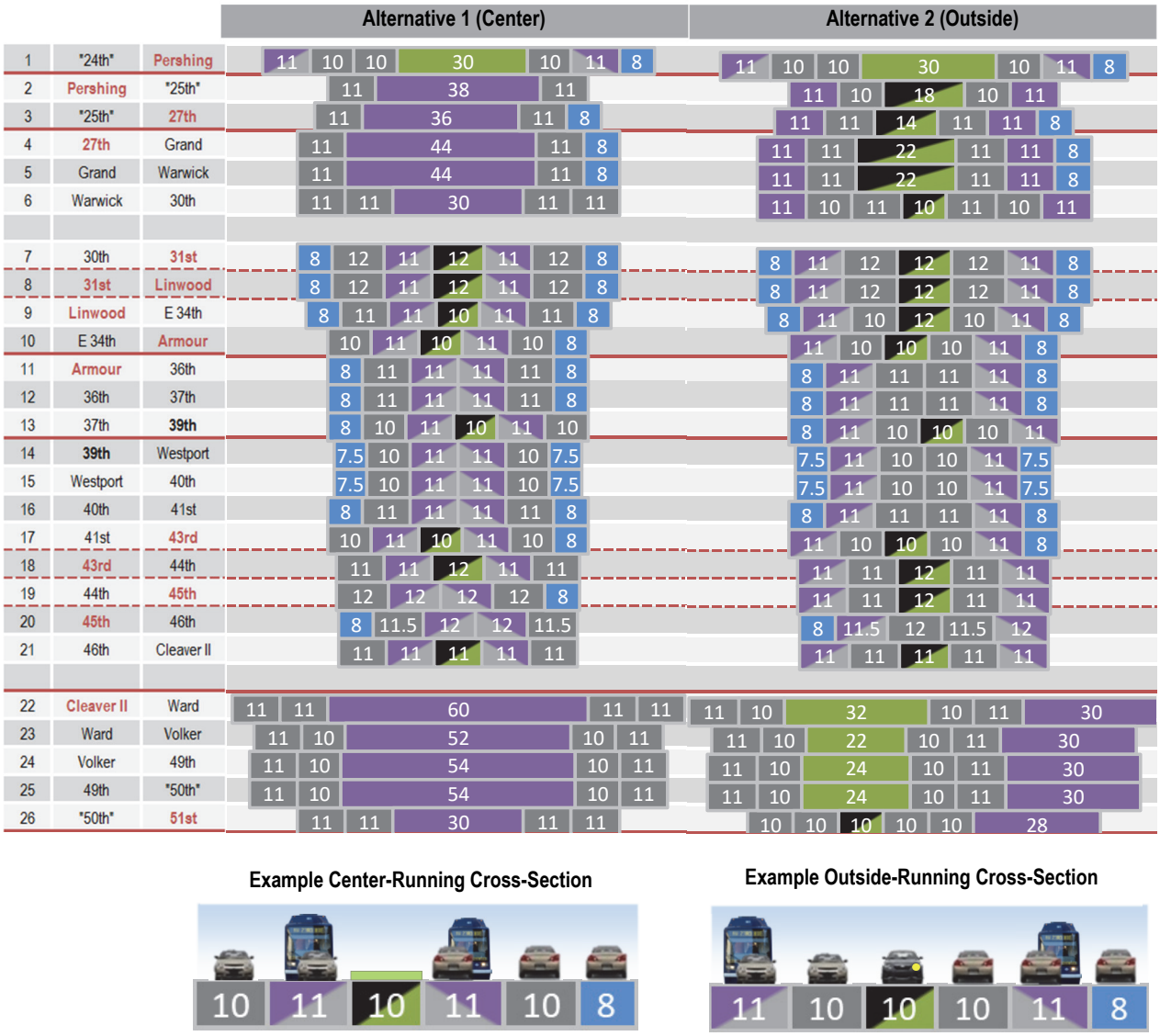
The algorithm tended to recommend dedicated streetcar lanes wherever width would allow, since such a configuration minimizes traffic conflicts with the streetcar, and therefore can improve the streetcar's overall travel time through the corridor. In fact, the results divided the corridor into three natural segments – segments that are very reasonable to those who know the corridor:

- *North End:* Between Pershing Boulevard and roughly 30th Street, the corridor is generally fairly wide with very few driveways and cross-streets. It also has some of the lowest traffic demand on the corridor. Given the available width and the other needs through these segments, a dedicated streetcar lane is potentially feasible in this portion of the corridor. Note that there is currently a long stretch of "missing" sidewalk on the east side of Main Street north of Grand Boulevard. Even at this early point in the process, it was assumed that the street would be narrowed to allow construction of such a sidewalk.

- *Middle:* The middle portion of the route, from 30th Street to Cleaver II Boulevard (roughly two miles long), is characterized by narrower cross-sections, frequent business access (driveways), and generally higher demand for on-street parking. In this section, running the streetcar in mixed traffic is likely the most logical way to allow the needed cross-section elements to fit.

- *South End:* South of Cleaver II Boulevard, there are no driveways along the route, no on-street parking is allowed, and the street is fairly wide except for the segment south of what could be considered "50th Street." As with the north end, the available width and the limited need for other cross-section elements make the south end a candidate for a dedicated streetcar lane. In addition, this section features the Country Club right-of-way, a linear swath of land owned by the Kansas City Transportation Authority (KCATA), generally preserved with the intention of reintroducing rail transit. This right-of-way figures in to street width assumptions south of Volker Boulevard.

Figure X-5: "Smoothed" Initial Generated Alternative Cross-Sections



Step 3: Public Meeting #1

To present these lane-positioning ideas to the public, the study team developed a set of hybrid maps – conceptual diagrams somewhere between the colored block maps of Step 2 and a full-blown set of scaled concept drawings. The purpose of these maps was to begin to convey the types of trade-offs that might be involved with different streetcar lane positioning options and the associated effects on other cross-section elements, given existing street-width constraints.

Figure X-6 illustrates the maps of the two alternatives. The maps use continuous line segments to indicate traffic lanes (some shared with streetcar tracks), parking/loading (or other curb space use), potential center turn lanes and medians, and dedicated streetcar lanes. Stop locations (as proposed at the time these maps were created) are also illustrated.

These maps were presented to the public on April 3, 2018. The maps were divided into the three sub-sections described in Step 2 (north, middle, south) – with the idea that these sub-sections each had a measure of operational independence and could possibly be interchanged in a final concept. Both the northern and southern portions included dedicated streetcar lanes regardless of lane position; the middle portion assumed mixed-traffic operations for either lane-position option.

The three maps were accompanied by the three evaluation matrices shown in **Tables X-5a through X-5c**, which examined the criteria described in Step 1 and provided a brief narrative comparison of the two alternatives. Where one alternative appeared to be clearly superior to the other with respect to a particular criterion, this distinction is highlighted in the tables.

Figure X-6: Public Meeting #1 Evaluation Maps (Collage)

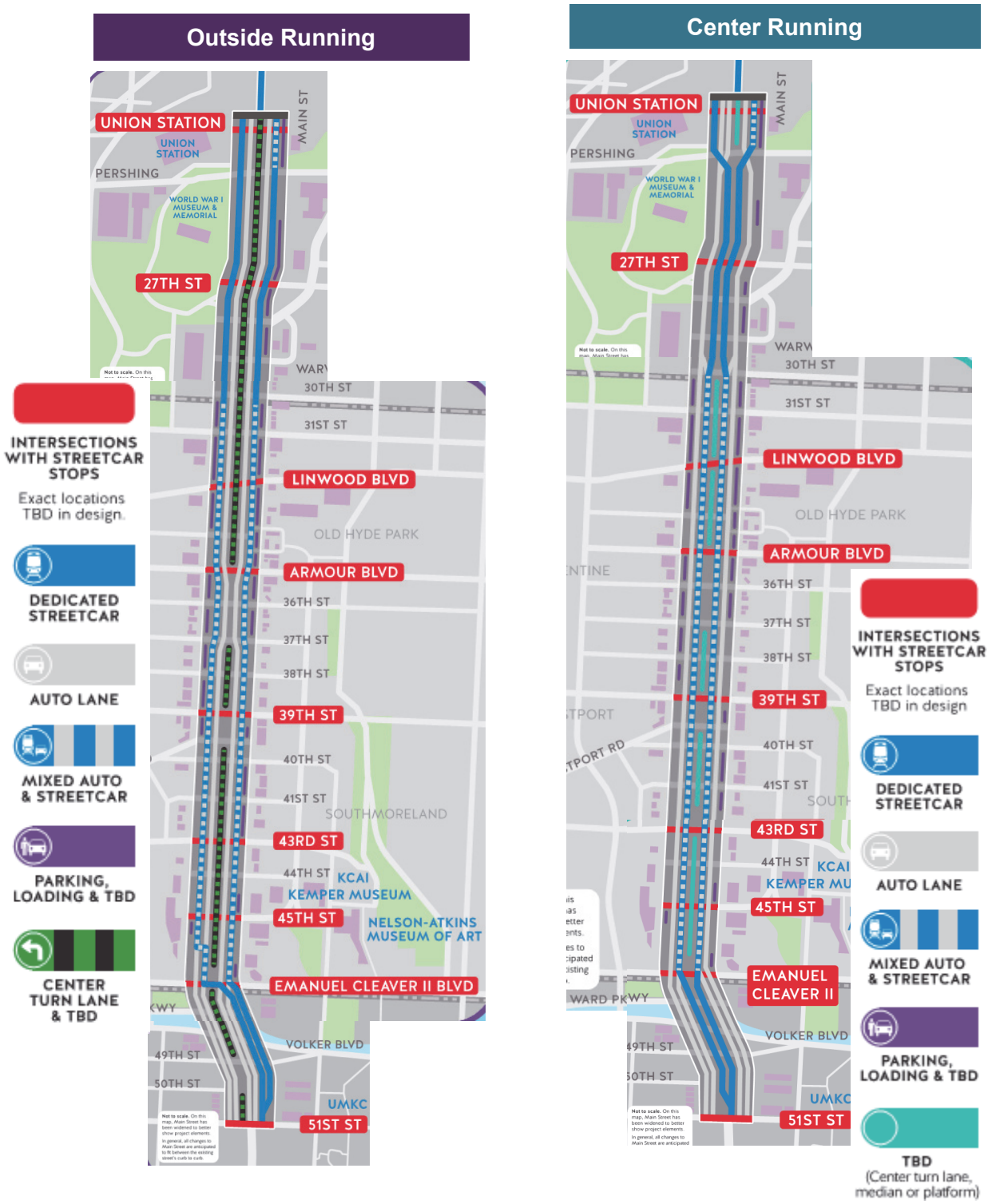


Table X-5a: Public Meeting #1 Evaluation Matrix – North Section (Pershing Rd to 30th St)

CRITERIA RANKING: FAIR GOOD BETTER

CRITERIA	CENTER RUNNING in a Dedicated Lane	OUTSIDE RUNNING in a Dedicated Lane
ON-STREET PARKING/LOADING Is there a need for on-street parking and/or loading on one or both sides of the street?	On-street parking is currently limited in this section and the need is therefore lower. However, opportunities are available.	On-street parking is currently limited in this section and the need is therefore lower. However, opportunities are available. **Policy decisions could restrict parking adjacent to the dedicated lane.**
THROUGH LANES How many auto through lanes are needed?	Both alternatives can provide one through lane for auto traffic in each direction. **A road diet, or elimination of through lanes, is being recommended for this section under both alternatives.**	Both alternatives can provide one through lane for auto traffic in each direction. **A road diet, or elimination of through lanes, is being recommended for this section under both alternatives.**
DRIVEWAY ACCESS & INTERSECTION LEFT TURNS Is there a need to access businesses or driveways?	**Less** conducive to left-turn movements onto & off Main Street. Overall, the effect of these alternatives on access and turns in this section is not large, due to the limited number of driveways & intersections.	**More** conducive to left-turn movements onto & off Main Street. Overall, the effect of these alternatives on access and turns in this section is not large, due to the limited number of driveways & intersections.
PEDESTRIAN NEEDS Does the alternative meet pedestrian needs?	**Center stop platforms may not provide adequate space for waiting passengers during busy events; may not be able to share bus stops.** Both options add a sidewalk on the east (where none currently).	Stops are accessed from the sidewalk & typically accommodated via a curb "bump-out." Both options add a sidewalk on the east side between Pershing & Grand (where it does not currently exist).
UTILITIES Would existing utilities create conflicts with streetcar tracks in a given lane?	Based on preliminary inventory, neither alternative would have greater conflict with utilities. A detailed utility assessment will occur during Design.	Based on preliminary inventory, neither alternative would have greater conflict with utilities. A detailed utility assessment will occur during Design.
SYSTEM CONSIDERATIONS		
OPERATIONAL EFFICIENCY How is travel time impacted?	On-street parking/loading & left turns are not a significant factor on this section due to limited parking & fewer driveways. **Center running may offer less delay from illegal on-street parking.**	On-street parking/loading & left turns are not a significant factor on this section due to limited parking & fewer driveways.
COST Does either alternative pose significant cost considerations for this section of the corridor?	Alternatives relatively equal in this respect. Variances will be due to final design & policy decisions.	Alternatives relatively equal in this respect. Variances will be due to final design & policy decisions.
CONSTRUCTABILITY Are there any significant characteristics that would impact construction?	None identified during this Project Development Phase.	None identified during this Project Development Phase.

Table X-5b: Public Meeting #1 Evaluation Matrix – Middle Section (30th St to Cleaver II Blvd)

CRITERIA RANKING: FAIR GOOD BETTER

CRITERIA	CENTER RUNNING in Mixed Traffic	OUTSIDE RUNNING in Mixed Traffic
ON-STREET PARKING/LOADING Is there a need for on-street parking and/or loading on one or both sides of the street?	On-street parking is currently available along many blocks of this section; some is time restricted for bus use. **Center running may provide more where stop platforms are in the center of the street (vs. curb).**	On-street parking is currently available along many blocks of this section; some is time-restricted for bus use. **Outside running may provide more in areas where a center lane is not necessary.**
THROUGH LANES How many auto through lanes are needed?	Both alternatives can provide two through lanes for auto traffic in each direction.	Both alternatives can provide two through lanes for auto traffic in each direction.
DRIVEWAY ACCESS & INTERSECTION LEFT TURNS Is there a need to access businesses or driveways?	**Less** conducive to left turns onto & off Main Street. Center stop platforms are slightly wider & must connect to crosswalks - this can reduce space for turn lanes at intersections.	**More** conducive to left turns onto & off Main Street. May preserve more access to existing driveways. Provides more opportunity for left turns at intersections.
PEDESTRIAN NEEDS Does the alternative meet pedestrian needs?	Center stop platforms at high-demand stops may not be able to provide adequate waiting space for passengers during peak times.	Curbside stop platforms allow pedestrians to wait on sidewalks during peak times.
UTILITIES Would existing utilities create conflicts with streetcar tracks in a given lane?	Based on preliminary inventory, neither alternative would have greater conflict with utilities. A detailed utility assessment will occur during Design.	Based on preliminary inventory, neither alternative would have greater conflict with utilities. A detailed utility assessment will occur during Design.
SYSTEM CONSIDERATIONS		
OPERATIONAL EFFICIENCY How is travel time impacted?	**Left-turn restrictions would be necessary in areas to maximize streetcar reliability**; preventing streetcar delays from left-turning cars. Center platforms cannot share bus stops or support a bus bridge.	**Streetcar could be delayed by illegally parked/ loading cars**; restrictions & buffer likely necessary in areas to minimize delays. More potential for reduced streetcar speeds due to cars turning right.
COST Does either alternative pose significant cost considerations for this section of the corridor?	Alternatives relatively equal; however center running may result in fewer stop platforms (**center platforms can be shared for travel in either direction**) potentially reducing costs.	Alternatives relatively equal in this respect.
CONSTRUCTABILITY Are there any significant characteristics that would impact construction?	None identified during this Project Development Phase.	None identified during this Project Development Phase.

Table X-5c: Public Meeting #1 Evaluation Matrix – South Section (Cleaver II Blvd to 51st Street)

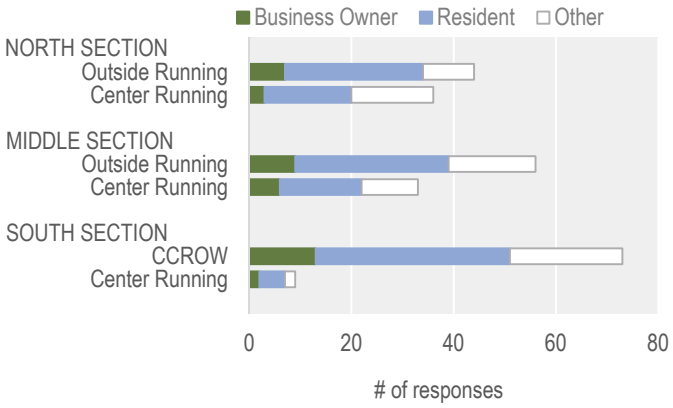
CRITERIA RANKING: FAIR GOOD BETTER

CRITERIA	CENTER RUNNING in a Dedicated Lane	COUNTRY CLUB R.O.W. in a Dedicated Lane
ON-STREET PARKING/LOADING Is there a need for on-street parking and/or loading on one or both sides of the street?	N/A - No on-street parking/loading is currently available on this section of the extension.	N/A - No on-street parking/loading is currently available on this section of the extension.
THROUGH LANES How many auto through lanes are needed?	**Requires reconstruction within the Country Club Right-of-Way** (widening Brookside Boulevard) to maintain needed lanes. Both alternatives can provide two through lanes for auto traffic.	**No widening of Brookside Boulevard required.** Both alternatives can provide two through lanes for auto traffic.
DRIVEWAY ACCESS & INTERSECTION LEFT TURNS Is there a need to access businesses or driveways?	No driveways on this segment. Both alternatives can accommodate left turns at the intersections.	No driveways on this segment. Both alternatives can accommodate left turns at the intersections.
PEDESTRIAN NEEDS Does the alternative meet pedestrian needs?	**Center stop platforms may not provide adequate space for waiting passengers during busy events; may not be able to share bus stops.** The Trolley Track Trail would remain under both alternatives.	Streetcar stops are accessed via sidewalk/Trolley Track Trail. **Sidewalk platforms provide passenger convenience to nearby retail.** The Trolley Track Trail would remain under both alternatives.
UTILITIES Would existing utilities create conflicts with streetcar tracks in a given lane?	Based on preliminary inventory, neither alternative would have greater conflict with utilities. A detailed utility assessment will occur during Design.	Based on preliminary inventory, neither alternative would have greater conflict with utilities. A detailed utility assessment will occur during Design.
SYSTEM CONSIDERATIONS		
OPERATIONAL EFFICIENCY How is travel time impacted?	Since limited, on-street parking/loading & left turns are not a significant factor. Both alternatives will have to be carefully designed through the congested intersections along this segment.	**Building in the Country Club Right-of-Way provides additional opportunities for maintenance and temporary streetcar storage.**
COST Does either alternative pose significant cost considerations for this section of the corridor?	Additional costs would be required to widen Brookside Boulevard.	Potential cost savings by utilizing the existing Country Club Right-of-Way.
CONSTRUCTABILITY Are there any significant characteristics that would impact construction?	None identified during this Project Development Phase.	None identified during this Project Development Phase. Less reconstruction required (widening Brookside Boulevard)

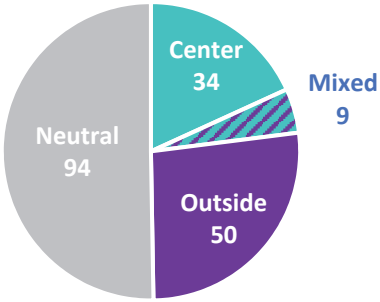
Meeting Feedback: The majority of participating attendees expressed a preference for an outside-running streetcar option for all three sections of the extension (for the south section, outside-running would be in the Country Club Right-of-Way, CCROW). **Figure X-7** summarizes the responses. As the figure shows, there was a clear preference among attendees to run in the CCROW on the southern section. In the middle section, outside running edged out center running. In the northern section, outside running appeared to be slightly preferred to center running, but the margin was thin. On-line, respondents tended to prefer the same lane position in all three sections, when they had a preference. Outside running was slightly more popular than center running in the on-line responses.

Figure X-7: Public Meeting #1 - Lane Preference Expressions

In person/email, 120+ attendees



On-Line, 187 responses



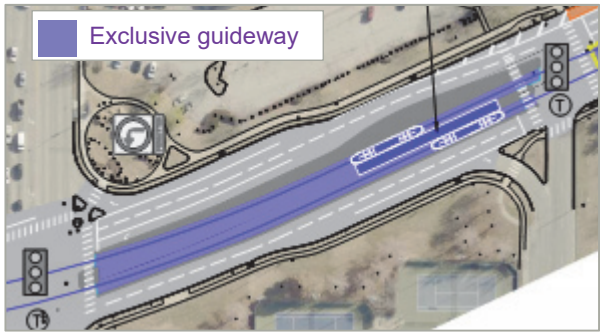
Step 4: Concept Drawings

With the general feedback from the first public meeting in hand, the study team developed two scaled concept drawings (line on aerial) showing streetcar track centerlines, station-stop platforms, and potential associated re-striping of the corridor. The concepts retained the "Outside Running" and "Center Running" designations, although these distinctions did not hold at the south end (as discussed later). The team held several lengthy working meetings to develop these concepts, and worked through the specific issues on the corridor to develop conceptual alignments and station-stop locations that were reasonable – but by no means the final alignments. The concepts were developed to provide a basic comparison of tradeoffs and to ultimately form a basis for a concept-level cost estimate.

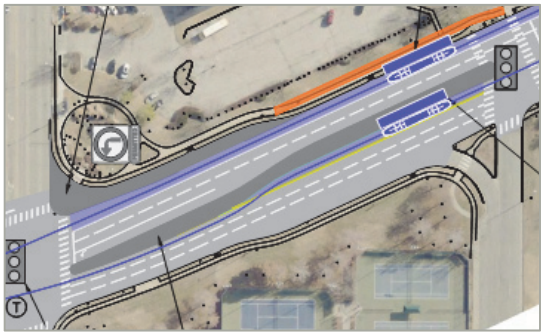
General Design Principles. The concepts were generally laid out using the design principles of the Kansas City Downtown Streetcar Design Criteria Manual (Starter Line). The alignments assumed a design speed of 35 mph. Compared to the Downtown line, the design incorporated additional buffer between the streetcar and parked cars, as well as the curb, where appropriate. Far-side station-stops were assumed whenever possible.

A few additional specifics of the concepts follow:

- *Mixed vs. Exclusive:* Both concepts positioned the streetcar in dedicated lanes south of Emanuel Cleaver II Boulevard. The center-running option transitioned the southbound tracks into a dedicated lane just south of 45th Street.



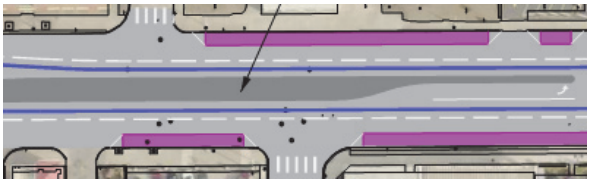
Center-running



Outside-running
(southbound has transitioned to center)

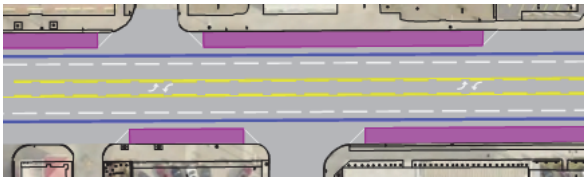
Everywhere else except the locations described above, both concepts positioned the streetcar in mixed traffic. On the north end, this was a change from what was shown at the first public meeting. The study team had determined that a dedicated streetcar lane might not afford a high advantage on this segment, given that traffic volumes and conflicts are fairly low.

- *Medians and Turn Lanes:* The center-running concept included a raised median for most of the corridor's length, to minimize turning conflicts with the streetcar on this higher-speed (35-mph) portion of the streetcar line. Dedicated left-turn lanes were provided at and between intersections where possible to prevent turning vehicles from blocking the streetcar.



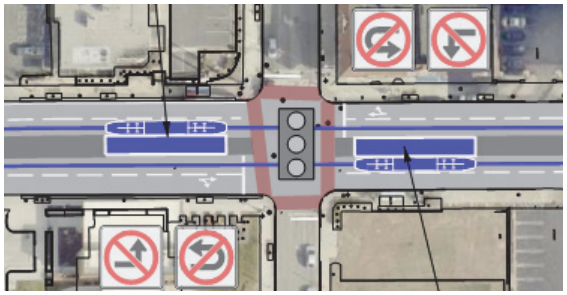
Center-running

In contrast, the outside-running concept featured almost no medians. Business access and intersection turns would be much like they are today – a center two-way left-turn lane in some locations, and a double-yellow line in some locations. At some signalized intersections, left-turns would continue to be allowed from a shared through/left lane (although with time-of-day restrictions), because stopped left-turning vehicles would not block an outside-running streetcar.

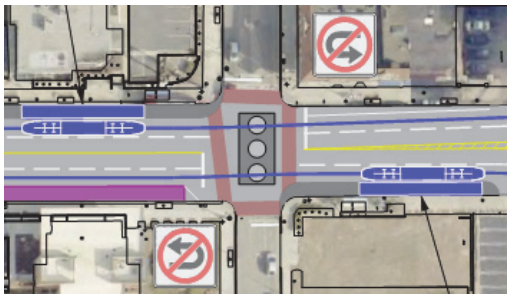


Outside-running

- *Station-stop Effects on Turn Lanes:* With the center-running option, station-stop platforms would prevent left turns at several locations. Under the outside-running option, these left-turn movements would still be allowed, although often from shared through/left lane.



Center-running (43rd St)



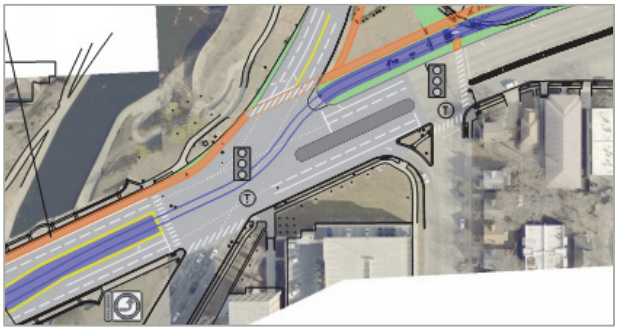
Outside-running (43rd St)

- *Parking:* Potential on-street parking areas were shown along the corridor in each concept, but they were clearly identified as "potential" with the knowledge that parking provisions would be refined as the selected concept moved forward in the planning and design process.

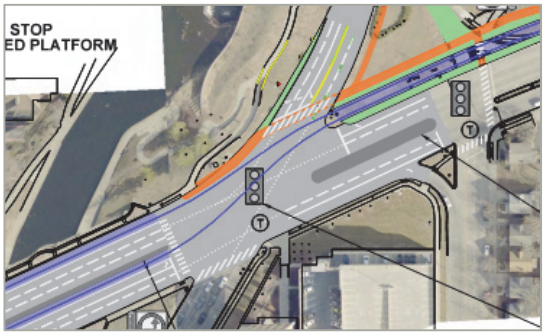
Outside-running

Center-running

- *Country Club Right-of-Way (CCROW):* Both concepts transitioned the streetcar to the CCROW south of Volker Boulevard. The public had strongly supported this option in the first public meeting, and the study team also noted the costs and difficulties associated with the streetcar remaining in the street in this area.



Center-running



Outside-running

- *New Sidewalk and Active Transportation Connections:* Both concepts showed construction of a sidewalk on the east side of Main Street between Pershing Boulevard and 27th Street. On the west side of the same segment, both concepts showed a potential area for bicycle and/or pedestrian improvements.

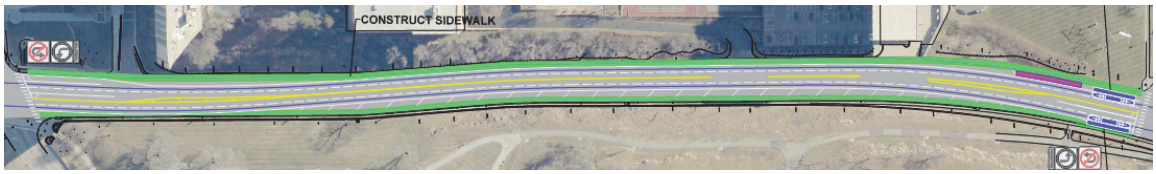
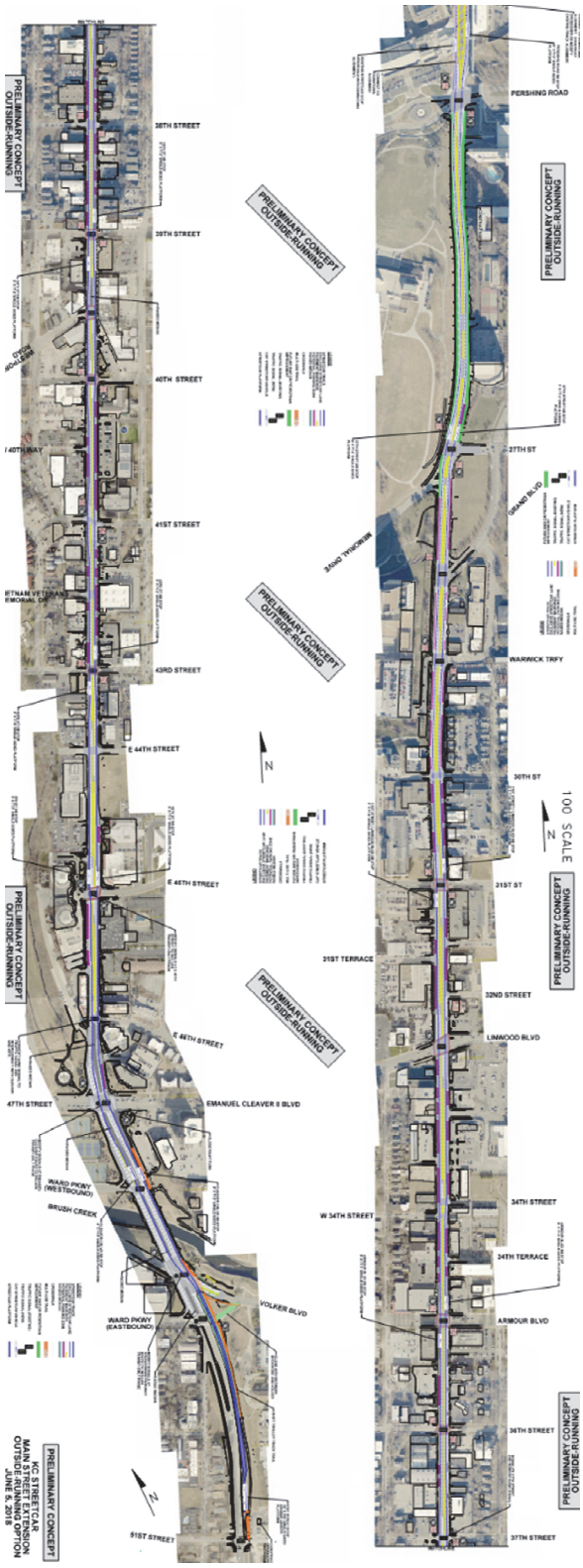


Figure X-8 shows an overview of the concept drawings; **Figure X-9** includes zoomed-in maps of each station-stop area.

Figure X-8: Overview of Corridor Concepts

Outside Running



Center Running

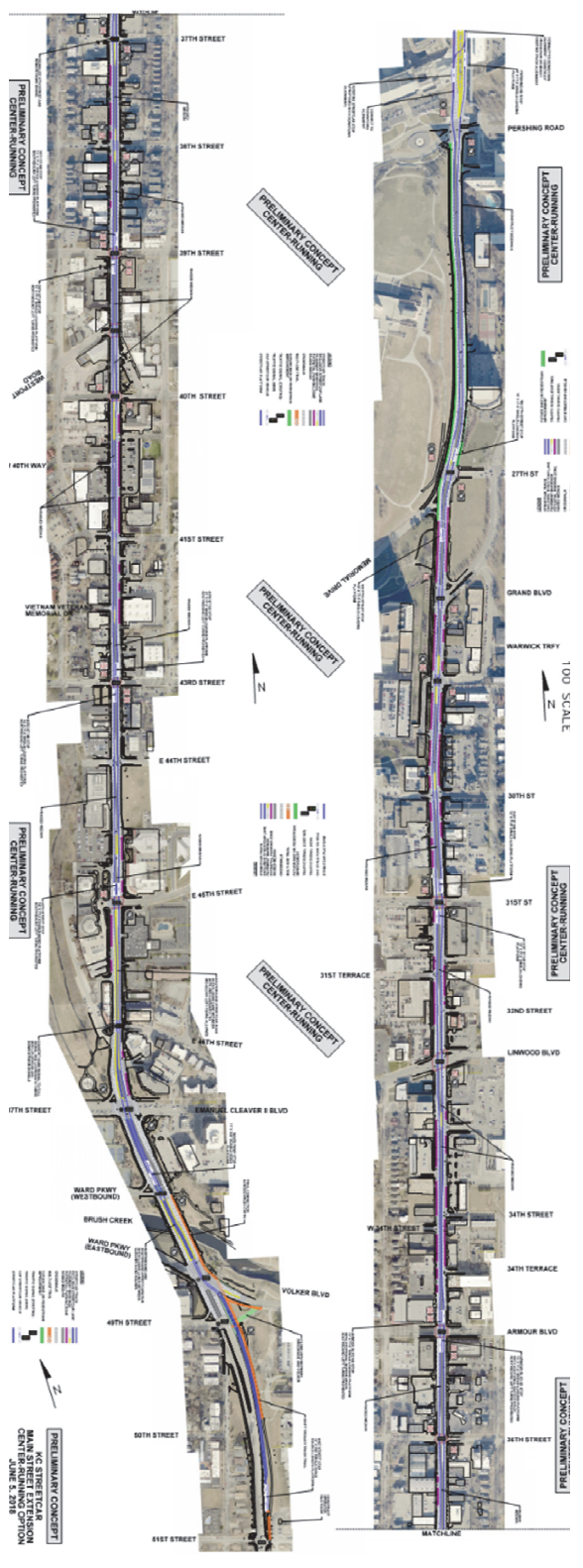
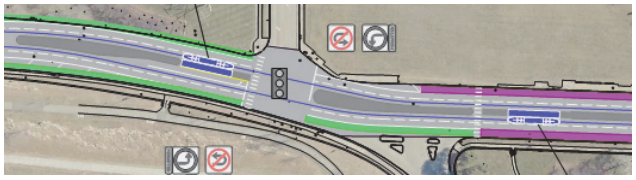
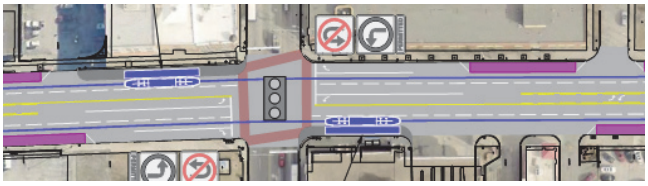
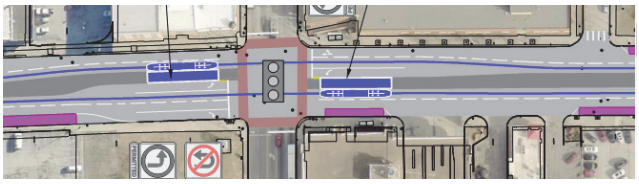
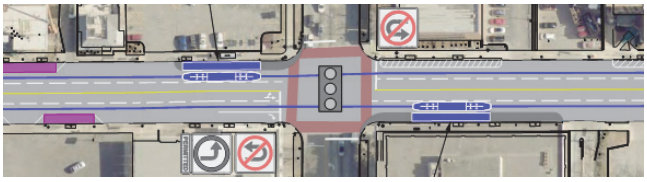
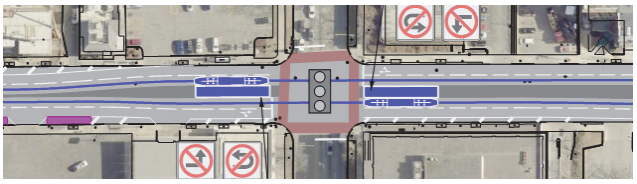
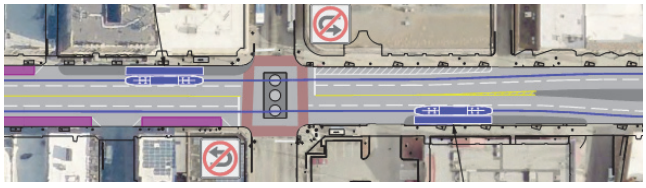
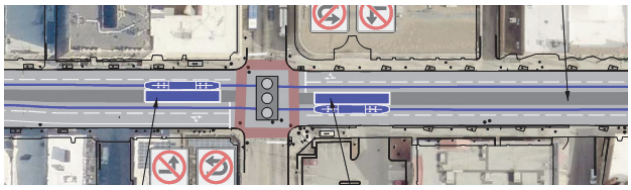
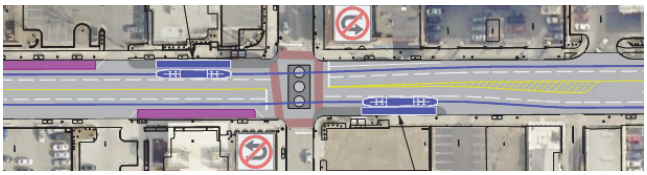
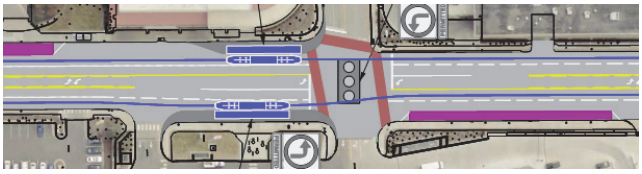
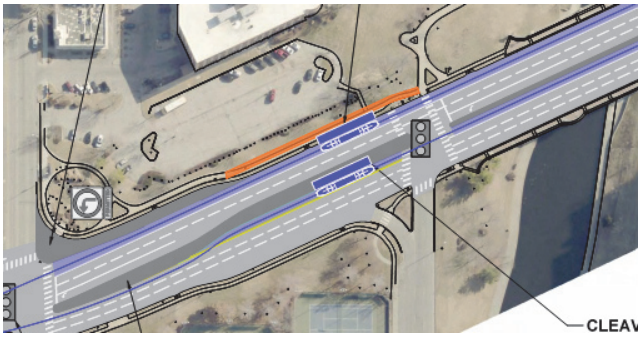
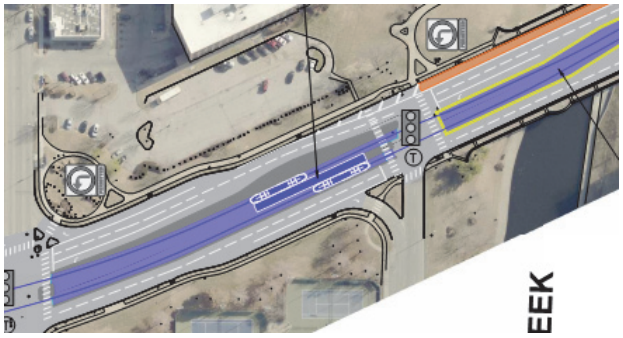
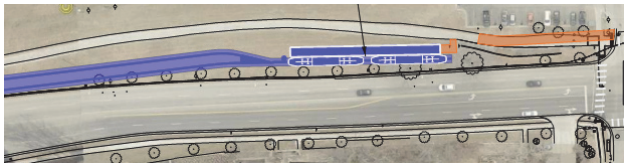


Figure X-9: Corridor Concepts | Zoom-Ins of Station-Stop Areas

	Outside Running	Center Running
27th Street		
31st Street		
Armour Blvd		
39th Street		
43rd Street		
45th Street		
Plaza		
UMKC		

Step 5: Public Meeting #2

Roll-plot maps of the two concepts were unveiled at a public meeting on June 5, 2018. The study team also produced a refined matrix, shown in **Table X-6**, comparing the two alternatives against key evaluation criteria and highlighting tradeoffs. The public meeting materials were also provided on-line until June 17, 2018.

The feedback focus of the second public meeting was to receive input on why participants preferred one of the two alternatives. A key focus of many participants was access to driveways and/or left-hand turns at key intersections. Study Team members gathered feedback via sticky-notes requesting participants describe "why" they prefer, placing their note on either the Outside- or Center-Running poster boards. The summaries below indicate that the public expressed a strong preference for outside-running operations.

75% Outside Running Preference

- Business operations (economic development, less disruptive to access/ left-hand turns)
- Safe and efficient access for riders
- Accessibility
- Consistency with current route

Better flow for both traffic and pedestrians, parking, and operations experience were also noted.

46 public meeting, 40 on-line

25% Center Running Preference

- Better for bicyclists
- Ability to dedicate lanes for streetcar, automobiles and bicyclists
- Organizing traffic

Safety, speed (faster running), and traffic calming were also noted.

16 public meeting, 14 on-line

Table X-6: Public Meeting #2 Evaluation Matrix

GENERAL CHARACTERISTICS		
	CENTER RUNNING in Mixed Traffic	OUTSIDE RUNNING in Mixed Traffic
Where does the streetcar run?	In the inside, or center lanes of the street. Tracks are separated from parking lanes and sidewalks by one or more lanes of vehicle traffic.	In the outside lanes of the street, next to the curb or on-street parking space.
Where are the station stops?	Station stops, or platforms, are in the center of the street and accessed via signalized crosswalk.	Station stops are usually "bumped out" from the curb. Stops are adjacent to a single flow of traffic.
CRITERIA & TRADEOFFS		
HOW WILL IT AFFECT OTHER TRAFFIC?		
Turning On & Off Main Street	More restrictions on how cars can turn on and off Main Street. i.e., raised, concrete medians will be added and left turns will be restricted along much of the corridor.	Little restriction on traffic turning on to and off of Main Street. ★
Driveway Access	90-95% of the driveways on Main Street would be restricted by a median.	1-5% of the driveways restricted by a median. ★
Intersection Left-Turn Lanes	9 complete left-turn prohibitions.	No complete left-turn prohibitions; some time-of-day left-turn restrictions (similar to current conditions). ★
Bikes & Trails	Bicyclists typically travel at the curb, or outside lane. Center-running track separates the streetcar from bicycles. ★	Bicyclists would be encouraged to use alternative designated bike routes.
Bus Integration	Buses cannot share the station stop with streetcar because bus doors and the platforms are on opposite sides.	Streetcar stops can be designed to accommodate buses and bus bridging. ★
HOW IS ON-STREET PARKING IMPACTED?		
On-Street Parking / Loading	290-310 on-street parking spaces available.	350-375 on-street parking spaces available. ★
HOW DO THE PASSENGER EXPERIENCES DIFFER?		
Pedestrian Needs	Platforms are in the middle of the street (accessed via crosswalk), and platform capacity is limited.	Passengers can "spill" onto the adjacent sidewalks, creating overflow capacity. Passengers access the platform directly from the sidewalk. ★
HOW ARE STREETCAR OPERATIONS AFFECTED?		
Reliability	Turn restrictions permit the possibility of more efficient operations (e.g., no waiting behind a left-turning vehicle). Operating away from parked vehicles reduces potential for delay due to vehicles parked "over the line." ★	Vehicles parked over the white line will impact streetcar operations.
Travel Time / Efficiency	One-way travel time from Union Station to UMKC: 15-17 minutes. Potential to convert to dedicated lane in the future.	One-way travel time from Union Station to UMKC: 15-17 minutes.

Recommendations: Outside-Running

Based on the technical analyses, the public feedback, and further team discussion of the merits of each option, the study team has chosen to carry forward the outside-running alternative. The decision was not easy, as each option has both advantages and drawbacks. The primary factors that led to the selection of outside-running include the following:

- *Business Access – Autos:* An outside-running alignment would much better preserve left-turn vehicular access to/from businesses and properties along Main Street. In contrast, with the implementation of a median, a center-running alignment would dramatically curtail such access.
- *Turn Restrictions:* An outside-running alignment would allow intersection left-turn movements to be made much as they are today on Main Street, whereas a center-running alignment – with medians and center platforms – would have the potential to completely prohibit intersection left-turns at up to nine locations.
- *Bus Integration:* Station-stops on the outside of the street can be designed for shared-use with buses (as was done on the starter line). A center-running alignment would generally preclude such sharing because buses only have doors on their right sides.
- *Pedestrian Needs:* An outside-running alignment, with station-stops on the outside of the street, would have a much larger "reservoir" for storing pedestrians in "surge cases". Pedestrians could spill onto the existing sidewalks. Pedestrians would also have quicker, safer access to adjacent businesses (e.g., to grab a cup of coffee) while waiting. Finally, public meeting attendees generally expressed a greater sense of comfort with standing on the outside of the 35-mph roadway waiting for a streetcar than with standing in the middle.
- *On-Street Parking/Loading:* Preliminary concepts indicate that an outside-running alignment could allow for as much as 20 percent more on-street parking/loading capacity than a center-running alignment, due to the inclusion of a raised median in the center-running option. The raised median consumes width within some portions of the corridor where the outside-running alternative can operate without a width-consuming center turn lane.
- *Consistency:* Station-stops on the outside of the street are consistent with the existing system and with passenger expectations.

The two largest concerns with an outside–running alignment are operational reliability (potential for blockage by parked/stopped vehicles, frequent turns to/from driveways) and bicycle accommodations. The study team will work to mitigate these concerns through careful, iterative planning and design that continues to involve the community and integrates national best practices.

Future Refinement of South Segment

As the initial alignment concepts were developed, it became clear that the portion of the route south of 45th Street will need a great deal more conversation and refinement to arrive at the optimum design. Issues include the following:

- South of Emanuel Cleaver II Boulevard, the streetcar will transition to the Country Club Right-of-Way (CCROW), and while a potential location for that transition has been identified, more analysis and refinement is needed to determine the optimum location.
- Consideration is being given to a potential transit hub on the southeast corner of the intersection of Main Street / Cleaver II Boulevard, and the streetcar's lateral position in the street must be carefully coordinated with this hub.
- This stretch of Main Street / Brookside Boulevard is the most congested along the proposed extension, and is also more congested than the Downtown corridor. The interaction with the streetcar needs to be carefully thought through.
- A 270-foot-long section of Main Street in the vicinity 46th Street is the narrowest on the corridor (less than 55 feet wide), and appreciably constrains options.
- Several large office towers and hotels (as well as local businesses and institutions) have access needs between 45th Street and Emanuel Cleaver II Boulevard; these needs must be balanced against streetcar operational considerations.
- Main Street just north of Emanuel Cleaver II Boulevard has a significant grade (over 7 percent in some portions), complicating streetcar operations.
- One-way east-west streets (Volker Boulevard and Ward Parkway North) in the area tend to complicate and concentrate traffic circulation issues. They affect intersection operations as well as bus access to the potential transit hub, both of which ultimately affect streetcar operations.

As the project moves forward in planning and design, the study team will continue to scrutinize these technical issues, and work closely with the public and stakeholders, to pursue a concept that addresses the issues and extends the benefits of the Downtown starter line.