NorthRail Streetcar Study

Burlington Corridor Dedicated Lane Planview

Conceptual Design
Burlington Dedicated Lane
HOA Bridge to 29th Avenue

NorthRail Streetcar Study

Capital Costs

River Crossing Cost Estimates

Alternative 1A - New Transit Bridge On Independent Alignment				
Description	**Quanity**	**Unit**	**Unit Cost**	**Total Est. Cost**
River Bridge				
Southern Approach Spans	36720	SF	$200	$7,344,000
Main River Spans	27702	SF	$450	$12,465,900
Norther Approach Spans	20520	SF	$200	$4,104,000
Bridge Over Railroad	24300	SF	$200	$4,860,000
Total Estimated Construction Cost =				**$28,773,900**
Construction Cost Contingency @ 15% =				**$4,316,085**
Kansas City, Missouri Internal Costs @ 10% =				**$2,877,390**
Final Design @ 10% =				**$2,877,390**
Construction Services @10% =				**$2,877,390**
Total Estimated Project Costs =				**$41,722,155**

Inclusions: barriers, deck, girders, track embedded on structure, bridge piers, foundations, and professional services following FTA averages.

Exclusions: right of way, embankment, special, non-standard architectural treatments for the structure, systems elements (OCS), signals, lighting, track on bridge approach, items not specifically included in inclusions (above).

Assumptions: weathering steel plate girders on approach and river spans, 23’-6” clearance over railroad, 52-0” navigation clearance over river navigation channel, river navigation channel consistent with Heart Of America Bridge, direct fixation track, no other modes on structure other than streetcar, maximum span over river is 412’-0”, nominal approach span is 190’-0”, one 5’-0” wide emergency walkway is provided down the center of the structure versus two (one on each side), vehicle is assumed to be a 2.65M wide vehicle (CAF vehicle for the base project).

All costs are in 2013 dollars.

Alternative 1B - New Transit Bridge On Independent Alignment With Bike/Ped Facility				
Description	**Quanity**	**Unit**	**Unit Cost**	**Total Est. Cost**
River Bridge				
Southern Approach Spans	53040	SF	$200	$10,608,000
Main River Spans	40014	SF	$450	$18,006,300
Norther Approach Spans	29640	SF	$200	$5,928,000
Bridge Over Railroad	35100	SF	$200	$7,020,000
Total Estimated Construction Cost =				**$41,562,300**
Construction Cost Contingency @ 15% =				**$6,234,345**
Kansas City, Missouri Internal Costs @ 10% =				**$4,156,230**
Final Design @ 10% =				**$4,156,230**
Construction Services @10% =				**$4,156,230**
Total Estimated Project Costs =				**$60,265,335**

Inclusions: barriers, deck, girders, track embedded on structure, bridge piers, foundations, and professional services following FTA averages.

Exclusions: right of way, embankment, special, non-standard architectural treatments for the structure, systems elements (OCS), signals, lighting, track on bridge approach, items not specifically included in inclusions (above).

Assumptions: weathering steel plate girders on approach and river spans, 23’-6” clearance over railroad, 52-0” navigation clearance over river navigation channel, river navigation channel consistent with Heart Of America Bridge, direct fixation track, bike & pedestrian modes in dedicated 10' to 12' wide walkway on structure, maximum span over river is 412’-0”, nominal approach span is 190’-0”, one 5’-0” wide emergency walkway is provided down the center of the structure versus two (one on each side), vehicle is assumed to be a 2.65M wide vehicle (CAF vehicle for the base project).

All costs are in 2013 dollars.

Alternative 2 - Single Track Widening Along East Edge Of Existing Bridge				
Description	**Quanity**	**Unit**	**Unit Cost**	**Total Est. Cost**
Widening - Ramp 3N & South Approach	25399	SF	$235	$5,968,765
Widening Main River Spans	24862	SF	$485	$12,058,070
Widening North Approach	12932	SF	$235	$3,039,020
Widening Bridge Over Railroad	13500	SF	$235	$3,172,500
Total Estimated Construction Cost =				**$24,238,355**
Construction Cost Contingency @ 15% =				**$3,635,754**
Kansas City, Missouri Internal Costs @ 10% =				**$2,423,836**
Final Design @ 10% =				**$2,423,836**
Construction Services @10% =				**$2,423,836**
Total Estimated Project Costs =				**$35,145,617**

Inclusions: barriers, deck, girders, track embedded on structure, bridge piers, foundations, and professional services following FTA averages.

Exclusions: right of way, embankment, special, non-standard architectural treatments for the structure, systems elements (OCS), signals, lighting, track on bridge approach, items not specifically included in inclusions (above).

Assumptions: weathering steel plate girders on approach and river spans, 23’-6” clearance over railroad, 52-0” navigation clearance over river navigation channel, river navigation channel consistent with Heart Of America Bridge, direct fixation track, vehicle is assumed to be a 2.65M wide vehicle (CAF vehicle for the base project). Removal & Reconstruction of existing structure necessary for widening is not directly quantified but included in unit cost as $35/sf increase in new construction. Approximated as 3' removal and reconstruction.

All costs are in 2013 dollars.

Alternative 3 - No Widening, Remove One NB Lane, Dedicated Streetcar At East Edge				
Description	**Quanity**	**Unit**	**Unit Cost**	**Total Est. Cost**
Barrier	3923	LF	$80	$313,840
Fencing & Railing	7846	LF	$150	$1,176,900
Expansion Joint Modifications	135	LF	$2,500	$337,500
Rail & Plinth Block Construction	3923	LF	$1,316	$5,160,924
Miscellaneous Strengthening & Repair	58845	SF	$35	$2,059,575
Drainage Modifications	1	LS	$500,000	$500,000
Relocate Pedestrian Walkway to West Edge	1	LS	$6,471,676	$6,471,676
(Based On Prior Project Adjusted To 2013)				
Total Estimated Construction Cost =				**$16,020,415**
Construction Cost Contingency @ 15% =				**$2,403,063**
Kansas City, Missouri Internal Costs @ 10% =				**$1,602,042**
Final Design @ 10% =				**$1,602,042**
Construction Services @10% =				**$1,602,042**
Total Estimated Project Costs =				**$23,229,604**

Inclusions: barriers, deck, girders, track embedded on structure, bridge piers, foundations, and professional services following FTA averages.

Exclusions: right of way, embankment, special, non-standard architectural treatments for the structure, systems elements (OCS), signals, lighting, track on bridge approach, items not specifically included in inclusions (above).

Assumptions: weathering steel plate girders on approach and river spans, 23’-6” clearance over railroad, 52-0” navigation clearance over river navigation channel, river navigation channel consistent with Heart Of America Bridge, direct fixation track, vehicle is assumed to be a 2.65M wide vehicle (CAF vehicle for the base project).

All costs are in 2013 dollars.

Preliminary Cost Estimates for Initial Alternatives

(Burlington, Swift, Armour)

Preliminary Capital Costs From North Bridge Abutment to Stop at 29th

Corridor	Route Miles	Cost Per Route Mile	Total Cost In 2020
1 Burlington St Mixed Traffic	1.82	$ 59,988,050	$ 132,187,822
1A Burlington Dedicated Lanes	1.82	$ 61,671,050	$ 135,896,429
2 Swift Ave	1.91	$ 59,960,523	$ 139,008,787
5A Armour Rd	1.50	$ 59,568,344	$ 108,018,487

Preliminary Capital Costs by Segment

Corridor	Route Miles	Cost Per Route Mile	Total Cost In 2020
1 Burlington St Mixed Traffic	1.82	$ 59,988,050	$ 132,187,822
10th to Armour	1.00	$ 59,906,204	$ 72,879,123
Armour to 32nd	0.81	$ 60,088,930	$ 59,308,699
1A Burlington Dedicated Lanes	1.82	$ 61,671,050	$ 135,896,429
10th to Armour	1.00	$ 61,671,050	$ 75,026,153
Armour to 32nd	0.81	$ 61,671,050	$ 60,870,275
2 Swift Ave	1.91	$ 59,960,523	$ 139,008,787
10th to Armour	1.21	$ 59,960,523	$ 87,930,627
Armour to 32nd	0.70	$ 59,960,523	$ 51,078,159
5A Armour Rd	2.80	$ 59,568,344	$ 225,176,313
10th to Armour	1.00	$ 59,906,204	$ 72,879,123
Burlington to Iron	0.49	$ 58,879,631	$ 35,139,364
Iron to Walker	1.31	$ 73,971,896	$ 117,157,827

Preliminary Cost Burlington Mixed Traffic to Armour

Base Cost	**$54,204,545**
Base Cost / Track Mile	$27,000,000
Route Length (ft)	5,300.00
Route Length (mi)	1.00
Single (1) or Double (2) Track	2
Track feet	10,600.00
Track miles	2.01
Additional Cost Allowances	**$5,928,576**
Pedestrian Upgrades for Stations	$500,000
Utilities - Water	$2,600,000
Utilities - Sewer	$600,000
Utilities - Fiber	$221,000
Utilities - Unknown	$2,007,576
Total Cost	**$60,133,121**
Cost per Route Mile	**$59,906,204**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$1,803,994
Total	$61,937,115
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$1,858,113
Total	$63,795,228
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$1,913,857
Total	$65,709,085
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$1,971,273
Total	$67,680,358
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$2,030,411
Total	$69,710,768
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$2,091,323
Total	$71,802,091
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$1,077,031
Total	**$72,879,123**

Preliminary Cost Burlington Mixed Traffic Armour to 29th Stop

Base Cost				**$43,977,273**
Base Cost / Track Mile				$27,000,000
Route Length (ft)				4,300.00
Route Length (mi)				0.81
Single (1) or Double (2) Track				2
Track feet				8,600.00
Track miles				1.63
Additional Cost Allowances				**$4,958,788**
Pedestrian Upgrades for Stations				$500,000
Utilities - Water				$1,650,000
Utilities - Sewer				$270,000
Utilities - Fiber				$390,000
Utilities - Unknown				$1,628,788
Transit-only signal 32nd Ave				$20,000
Lane add north leg 32nd Ave				$500,000
Total Cost				**$48,936,061**
Cost per Route Mile				**$60,088,930**
Escalated Project Costs (Project Dollars)				
	Inflation to Mid Year of Construction Allow 3% per year	2014	Escalation	$1,468,082
			Total	$50,404,142
	Inflation to Mid Year of Construction Allow 3% per year	2015	Escalation	$1,512,124
			Total	$51,916,267
	Inflation to Mid Year of Construction Allow 3% per year	2016	Escalation	$1,557,488
			Total	$53,473,755
	Inflation to Mid Year of Construction Allow 3% per year	2017	Escalation	$1,604,213
			Total	$55,077,967
	Inflation to Mid Year of Construction Allow 3% per year	2018	Escalation	$1,652,339
			Total	$56,730,306
	Inflation to Mid Year of Construction Allow 3% per year	2019	Escalation	$1,701,909
			Total	$58,432,215
	Inflation to Mid Year of Construction Allow 3% per year	2020	Escalation	$876,483
			Total	**$59,308,699**

Preliminary Cost Burlington Dedicated Lanes to 29th Stop

Base Cost	**$98,181,818**
Base Cost / Track Mile	$27,000,000
Route Length (ft)	9,600.00
Route Length (mi)	1.82
Single (1) or Double (2) Track	2
Track feet	19,200.00
Track miles	3.64
Additional Cost Allowances	**$13,947,364**
Median Reconstruction	$2,000,000
Pedestrian Upgrades for Stations	$1,000,000
Utilities - Water	$4,250,000
Utilities - Sewer	$870,000
Utilities - Fiber	$611,000
Utilities - Unknown	$3,636,364
New signal (9 intersections)	$1,080,000
Lane add north leg 32nd Ave	$500,000
Total Cost	**$112,129,182**
Cost per Route Mile	**$61,671,050**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$3,363,875
Total	$115,493,057
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$3,464,792
Total	$118,957,849
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$3,568,735
Total	$122,526,584
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$3,675,798
Total	$126,202,382
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$3,786,071
Total	$129,988,453
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$3,899,654
Total	$133,888,107
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$2,008,322
Total	**$135,896,429**

Preliminary Cost Swift to 32nd Stop

Base Cost	**$103,295,455**
Base Cost / Track Mile	$27,000,000
Route Length (ft)	10,100.00
Route Length (mi)	1.91
Single (1) or Double (2) Track	2
Track feet	20,200.00
Track miles	3.83
Additional Cost Allowances	**$11,401,758**
Restripe angle parking as back-in	$100,000
Bike Accomodations	$40,000
Utilities - Water	$5,350,000
Utilities - Sewer	$720,000
Utilities - Fiber	$1,196,000
Utilities - Unknown	$3,825,758
Signal 32nd Ave	$120,000
Tree trimming	$50,000
Total Cost	**$114,697,212**
Cost per Route Mile	**$59,960,523**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$3,440,916
Total	$118,138,128
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$3,544,144
Total	$121,682,272
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$3,650,468
Total	$125,332,741
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$3,759,982
Total	$129,092,723
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$3,872,782
Total	$132,965,504
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$3,988,965
Total	$136,954,470
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$2,054,317
Total	**$139,008,787**

Preliminary Cost Armour to Iron

Base Cost	**$26,590,909**
Base Cost / Track Mile	$27,000,000
Route Length (ft)	2,600.00
Route Length (mi)	0.49
Single (1) or Double (2) Track	2
Track feet	5,200.00
Track miles	0.98
Additional Cost Allowances	**$2,402,848**
Transit-only signal Iron	$20,000
Utilities - Water	$1,300,000
Utilities - Sewer	$0
Utilities - Fiber	$78,000
Utilities - Unknown	$984,848
Restripe angle parking as back-in	$20,000
Total Cost	**$28,993,758**
Cost per Route Mile	**$58,879,631**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$869,813
Total	$29,863,570
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$895,907
Total	$30,759,477
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$922,784
Total	$31,682,262
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$950,468
Total	$32,632,730
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$978,982
Total	$33,611,711
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$1,008,351
Total	$34,620,063
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$519,301
Total	**$35,139,364**

Preliminary Cost Armour: Iron to Walker

Base Cost	**$70,568,182**
Base Cost / Track Mile	$27,000,000
Route Length (ft)	6,900.00
Route Length (mi)	1.31
Single (1) or Double (2) Track	2
Track feet	13,800.00
Track miles	2.61
Additional Cost Allowances	**$26,099,636**
I-35/29 Interchange Reconstruction	$20,630,000
Utilities - Water	$2,300,000
Utilities - Sewer	$270,000
Utilities - Fiber	$286,000
Utilities - Unknown	$2,613,636
Transit-only signal Walker Rd	$0 *
Total Cost	**$96,667,818**
Cost per Route Mile	**$73,971,896**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$2,900,035
Total	$99,567,853
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$2,987,036
Total	$102,554,888
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$3,076,647
Total	$105,631,535
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$3,168,946
Total	$108,800,481
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$3,264,014
Total	$112,064,495
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$3,361,935
Total	$115,426,430
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$1,731,396
Total	**$117,157,827**

*This cost is 0 because it is included in the Burlington to Iron segment at Iron (i.e. it is not work in addition to the Burlington to Iron segment; it would just be at a different location)

Unit Costs

Streetcar Infrastructure	$	27,000,000.00	TM
Watermain	$	500.00	LF
Comm Fiber	$	130.00	LF
Sewer	$	150.00	LF
Unk Uti	$	1,000,000.00	TM
Armour Interchange*	$	20,630,000.00	Ea
Sidewalk	$	5.00	SF
CG	$	15.00	LF
Rem Pavt	$	0.33	SF
BAD	$	0.43	SF
HMA	$	1.40	SF
CP 9-IN	$	4.00	SF
Striping	$	1.00	TF
Transit Sig	$	20,000.00	Ea
New sig	$	120,000.00	Ea
Earthwork	$	0.26	CF
Ped Upgrades	$	250,000.00	Ea

*From Appendix D of 29/35 EIS, estimated cost of 17.1 million in 2005 dollars is converted to 2013 dollars using escalation of 2.37% per year (www.in2013dollars.com)

Detailed Cost Estimates for Final Alternatives

(Burlington)

Detailed: NorthRail Cost Summary

Burlington Alignment			
Terminus	Single/Double Track	Segment Cost (2020)	Total Cost (2020)
12th	Single	$ 21,900,000	$ 21,900,000
18th	Single	$ 32,800,000	$ 54,700,000
18th	Double*	$ 50,500,000	$ 72,400,000
29th	Double*	$ 48,200,000	$ 120,600,000

*Single Track to 12th (Does not affect operations)

BNSF/Burlington Alignment			
Terminus	Single/Double Track	Segment Cost (2020)	Total Cost (2020)
11th	Single	$ 15,500,000	$ 15,500,000
11th	Double	$ 20,300,000	$ 20,300,000
18th	Single	$ 41,100,000	$ 56,600,000
18th	Double	$ 64,700,000	$ 85,000,000
18th	Mixed Traffic		$ 75,700,000
29th	Double	$ 49,000,000	$ 134,000,000

Detailed: Dedicated Lanes BNSF to 18th Avenue (Single Track)

Item		Cost
Base Cost for Track (Bridge to 18th)	$	26,666,667
Streetcar Costs (2 Streetcars)	$	10,000,000
Vehicle Maintenance Facility (Shared Facility)	$	4,000,000
Traction Power Substation (River Crossing)	$	1,500,000
Right-of-Way & Land Acquisition (Commercial Property Price)	$	200,000
Utilities	$	1,042,555
Signals	$	1,500,000
Miscellaneous*	$	1,753,195
Total	$	46,662,416
2020 Total	**$**	**56,600,000**

*Includes Earthwork, Pavement Widening, Street Reconstruction and Pedestrian Upgrades for Stations

Detailed: Dedicated Lanes BNSF to 29th Avenue

Item		Cost
Base Cost for Track (Bridge to 29th)	$	78,662,500
Streetcar Costs (3 Streetcars)	$	15,000,000
Vehicle Maintenance Facility (Shared Facility)	$	8,000,000
Traction Power Substation (River Crossing)	$	1,500,000
Right-of-Way & Land Acquisition (Commercial Property Price)	$	200,000
Utilities	$	1,838,488
Signals	$	2,400,000
Miscellaneous*	$	2,900,000
Total	$	110,500,988
2020 Total	**$**	**134,000,000**

*Includes Earthwork, Pavement Widening, Street Reconstruction and Pedestrian Upgrades for Stations

Detailed: Burlington - North Bridge Abutment to just north of 12th Ave. (Single Track)

Base Cost		**$11,875,000**
Base Cost / Track Mile		$22,000,000
Route Length (ft)		2,850
Route Length (mi)		0.54
Single (1) or Double (2) Track		1
Track feet		2,850
Track miles		0.54
Additional Cost Allowances		**$6,134,337**
Median Reconstruction		$281,856
Streetcars (1/2 Streetcar)		$2,500,000
Vehicle Maintencance Facility (Cost Shared Facility)		$1,000,000
Traction Power Substation		$1,500,000
Right-of-Way & Land Acquisition*		$0
Pedestrian Upgrades for Stations		$250,000
Utilities - Water		$30,000
Utilities - Sewer		$9,000
Utilities - Fiber		$7,800
Utilities - Unknown		$5,682
New signal (2 intersections)		$500,000
Pavement Widening		$50,000
Total Cost		**$18,009,337**
Cost per Route Mile		**$33,400,000**
Escalated Project Costs (Project Dollars)		
Inflation to Mid Year of Construction Allow 3% per year 2014	Escalation	$540,280
	Total	$18,549,617
Inflation to Mid Year of Construction Allow 3% per year 2015	Escalation	$556,489
	Total	$19,106,106
Inflation to Mid Year of Construction Allow 3% per year 2016	Escalation	$573,183
	Total	$19,679,289
Inflation to Mid Year of Construction Allow 3% per year 2017	Escalation	$590,379
	Total	$20,269,668
Inflation to Mid Year of Construction Allow 3% per year 2018	Escalation	$608,090
	Total	$20,877,758
Inflation to Mid Year of Construction Allow 3% per year 2019	Escalation	$626,333
	Total	$21,504,091
Inflation to Mid Year of Construction Allow 3% per year 2020	Escalation	$322,561
	Total	**$21,900,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: Burlington Dedicated Lanes - North Bridge Abutment to just north of 18th Ave. (Single Track)

Base Cost		**$26,041,667**
Base Cost / Track Mile		$22,000,000
Route Length (ft)		6,250
Route Length (mi)		1.18
Single (1) or Double (2) Track		1
Track feet		6,250
Track miles		1.18
Additional Cost Allowances		**$19,028,096**
Median Reconstruction		$735,542
Streetcars (2 Streetcars)		$10,000,000
Vehicle Maintencance Facility (Cost Shared Facility)		$4,000,000
Traction Power Substation		$1,500,000
Right-of-Way & Land Acquisition*		$0
Pedestrian Upgrades for Stations		$250,000
Utilities - Water		$75,000
Utilities - Sewer		$31,500
Utilities - Fiber		$15,600
Utilities - Unknown		$920,455
New signal (5 intersections)		$1,250,000
Pavement Widening		$250,000
Total Cost		**$45,069,763**
Cost per Route Mile		**$38,100,000**
Escalated Project Costs (Project Dollars)		
Inflation to Mid Year of Construction Allow 3% per year 2014	Escalation	$1,352,093
	Total	$46,421,856
Inflation to Mid Year of Construction Allow 3% per year 2015	Escalation	$1,392,656
	Total	$47,814,511
Inflation to Mid Year of Construction Allow 3% per year 2016	Escalation	$1,434,435
	Total	$49,248,947
Inflation to Mid Year of Construction Allow 3% per year 2017	Escalation	$1,477,468
	Total	$50,726,415
Inflation to Mid Year of Construction Allow 3% per year 2018	Escalation	$1,521,792
	Total	$52,248,208
Inflation to Mid Year of Construction Allow 3% per year 2019	Escalation	$1,567,446
	Total	$53,815,654
Inflation to Mid Year of Construction Allow 3% per year 2020	Escalation	$807,235
	Total	**$54,700,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: Burlington Dedicated Lanes - North Bridge Abutment to just north of 18th Ave.

Base Cost			**$40,708,333**
Base Cost / Track Mile			$22,000,000
Route Length (ft)			6,250
Route Length (mi)			1.18
Single (1) or Double (2) Track			1
Track feet			9,770
Track miles			1.85
Additional Cost Allowances			**$19,028,096**
Median Reconstruction			$735,542
Streetcars (2 Streetcars)			$10,000,000
Vehicle Maintencance Facility (Cost Shared Facility)			$4,000,000
Traction Power Substation			$1,500,000
Right-of-Way & Land Acquisition*			$0
Pedestrian Upgrades for Stations			$250,000
Utilities - Water			$75,000
Utilities - Sewer			$31,500
Utilities - Fiber			$15,600
Utilities - Unknown			$920,455
New signal (5 intersections)			$1,250,000
Pavement Widening			$250,000
Total Cost			**$59,736,430**
Cost per Route Mile			**$50,500,000**
Escalated Project Costs (Project Dollars)			
Inflation to Mid Year of Construction Allow 3% per year	2014	Escalation	$1,792,093
		Total	$61,528,522
Inflation to Mid Year of Construction Allow 3% per year	2015	Escalation	$1,845,856
		Total	$63,374,378
Inflation to Mid Year of Construction Allow 3% per year	2016	Escalation	$1,901,231
		Total	$65,275,609
Inflation to Mid Year of Construction Allow 3% per year	2017	Escalation	$1,958,268
		Total	$67,233,878
Inflation to Mid Year of Construction Allow 3% per year	2018	Escalation	$2,017,016
		Total	$69,250,894
Inflation to Mid Year of Construction Allow 3% per year	2019	Escalation	$2,077,527
		Total	$71,328,421
Inflation to Mid Year of Construction Allow 3% per year	2020	Escalation	$1,069,926
		Total	**$72,400,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: Burlington Dedicated Lanes - North Bridge Abutment to just north of 29th Ave.

Base Cost		**$68,541,667**
Base Cost / Track Mile		$22,000,000
Route Length (ft)		9,700
Route Length (mi)		1.84
Single (1) or Double (2) Track		2
Track feet		16,450
Track miles		3.12
Additional Cost Allowances		**$30,888,488**
Median Reconstruction		$1,150,000
Streetcars (3 Streetcars)		$15,000,000
Vehicle Maintencance Facility (Stand Alone Facility)		$8,000,000
Traction Power Substation		$1,500,000
Right-of-Way & Land Acquisition*		$0
Pedestrian Upgrades for Stations		$750,000
Utilities - Water		$120,000
Utilities - Sewer		$58,500
Utilities - Fiber		$31,200
Utilities - Unknown		$1,628,788
New signal (8 intersections)		$2,150,000
Pavement Widening		$500,000
Total Cost		**$99,430,154**
Cost per Route Mile		**$54,200,000**
Escalated Project Costs (Project Dollars)		
Inflation to Mid Year of Construction Allow 3% per year 2014	Escalation	$2,982,905
	Total	$102,413,059
Inflation to Mid Year of Construction Allow 3% per year 2015	Escalation	$3,072,392
	Total	$105,485,451
Inflation to Mid Year of Construction Allow 3% per year 2016	Escalation	$3,164,564
	Total	$108,650,014
Inflation to Mid Year of Construction Allow 3% per year 2017	Escalation	$3,259,500
	Total	$111,909,515
Inflation to Mid Year of Construction Allow 3% per year 2018	Escalation	$3,357,285
	Total	$115,266,800
Inflation to Mid Year of Construction Allow 3% per year 2019	Escalation	$3,458,004
	Total	$118,724,804
Inflation to Mid Year of Construction Allow 3% per year 2020	Escalation	$1,780,872
	Total	**$120,600,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: BNSF ROW - North Bridge Abutment to South of 11th Ave. (Single Track)

Base Cost			**$6,333,333**
Base Cost / Track Mile			$22,000,000
Route Length (ft)			1,520
Route Length (mi)			0.29
Single (1) or Double (2) Track			1
Track feet			1,520
Track miles			0.29
Additional Cost Allowances			**$6,427,805**
Median Reconstruction			$150,323
Streetcars (1/2 Streetcar)			$2,500,000
Vehicle Maintencance Facility (Cost Shared Facility)			$1,000,000
Traction Power Substation			$1,500,000
Right-of-Way & Land Acquisition* (Commercial Property Price)			$100,000
Earthwork			$500,000
Pedestrian Upgrades for Stations			$250,000
Utilities - Water			$30,000
Utilities - Sewer			$9,000
Utilities - Fiber			$7,800
Utilities - Unknown			$5,682
New signal (1 intersections+1 crossing)			$375,000
Pavement Widening			$0
Total Cost			**$12,761,138**
Cost per Route Mile			**$44,400,000**
Escalated Project Costs (Project Dollars)			
Inflation to Mid Year of Construction Allow 3% per year	2014	Escalation	$382,834
		Total	$13,143,972
Inflation to Mid Year of Construction Allow 3% per year	2015	Escalation	$394,319
		Total	$13,538,291
Inflation to Mid Year of Construction Allow 3% per year	2016	Escalation	$406,149
		Total	$13,944,440
Inflation to Mid Year of Construction Allow 3% per year	2017	Escalation	$418,333
		Total	$14,362,773
Inflation to Mid Year of Construction Allow 3% per year	2018	Escalation	$430,883
		Total	$14,793,657
Inflation to Mid Year of Construction Allow 3% per year	2019	Escalation	$443,810
		Total	$15,237,466
Inflation to Mid Year of Construction Allow 3% per year	2020	Escalation	$228,562
		Total	**$15,500,000**

*MoDOT Right-of-Way is not included in this estimate

Detatiled: BNSF ROW - North Bridge Abutment to South of 11th Ave. (Double Track)

Base Cost		**$10,250,000**
Base Cost / Track Mile		$22,000,000
Route Length (ft)		1,520
Route Length (mi)		0.29
Single (1) or Double (2) Track		2
Track feet		2,460
Track miles		0.47
Additional Cost Allowances		**$6,427,805**
Median Reconstruction		$150,323
Streetcars (1/2 Streetcar)		$2,500,000
Vehicle Maintencance Facility (Cost Shared Facility)		$1,000,000
Traction Power Substation		$1,500,000
Right-of-Way & Land Acquisition* (Commercial Property Price)		$100,000
Earthwork		$500,000
Pedestrian Upgrades for Stations		$250,000
Utilities - Water		$30,000
Utilities - Sewer		$9,000
Utilities - Fiber		$7,800
Utilities - Unknown		$5,682
New signal (1 intersections+1 crossing)		$375,000
Pavement Widening		$0
Total Cost		**$16,677,805**
Cost per Route Mile		**$58,000,000**
Escalated Project Costs (Project Dollars)		
Inflation to Mid Year of Construction Allow 3% per year 2014	Escalation	$500,334
	Total	$17,178,139
Inflation to Mid Year of Construction Allow 3% per year 2015	Escalation	$515,344
	Total	$17,693,483
Inflation to Mid Year of Construction Allow 3% per year 2016	Escalation	$530,804
	Total	$18,224,288
Inflation to Mid Year of Construction Allow 3% per year 2017	Escalation	$546,729
	Total	$18,771,016
Inflation to Mid Year of Construction Allow 3% per year 2018	Escalation	$563,130
	Total	$19,334,147
Inflation to Mid Year of Construction Allow 3% per year 2019	Escalation	$580,024
	Total	$19,914,171
Inflation to Mid Year of Construction Allow 3% per year 2020	Escalation	$298,713
	Total	**$20,300,000**

*MoDOT Right-of-Way is not included in this estimate

Detailted: Burlington Dedicated Lanes Via BNSF ROW - North Bridge Abutment to just North of 18th Ave.

Base Cost	**$50,079,167**
Base Cost / Track Mile	$22,000,000
Route Length (ft)	6,400
Route Length (mi)	1.21
Single (1) or Double (2) Track	2
Track feet	12,019
Track miles	2.28
Additional Cost Allowances	**$19,995,749**
Median Reconstruction	$753,195
Streetcars (2 Streetcars)	$10,000,000
Vehicle Maintencance Facility (Cost Shared Facility)	$4,000,000
Traction Power Substation	$1,500,000
Right-of-Way & Land Acquisition* (Commercial Property Price)	$200,000
Earthwork	$500,000
Pedestrian Upgrades for Stations	$250,000
Utilities - Water	$75,000
Utilities - Sewer	$31,500
Utilities - Fiber	$15,600
Utilities - Unknown	$920,455
New signal (5 intersections)	$1,500,000
Pavement Widening	$250,000
Total Cost	**$70,074,916**
Cost per Route Mile	**$57,900,000**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$2,102,247
Total	$72,177,163
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$2,165,315
Total	$74,342,478
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$2,230,274
Total	$76,572,753
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$2,297,183
Total	$78,869,935
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$2,366,098
Total	$81,236,033
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$2,437,081
Total	$83,673,114
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$1,255,097
Total	**$85,000,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: Burlington Dedicated Lanes Via BNSF ROW - North Bridge Abutment to just North of 18th Ave. (Single Track)

Base Cost				**$26,666,667**
Base Cost / Track Mile				$22,000,000
Route Length (ft)				6,400
Route Length (mi)				1.21
Single (1) or Double (2) Track				1
Track feet				6,400
Track miles				1.21
Additional Cost Allowances				**$19,995,749**
Median Reconstruction				$753,195
Streetcars (2 Streetcars)				$10,000,000
Vehicle Maintencance Facility (Cost Shared Facility)				$4,000,000
Traction Power Substation				$1,500,000
Right-of-Way & Land Acquisition* (Commercial Property Price)				$200,000
Earthwork				$500,000
Pedestrian Upgrades for Stations				$250,000
Utilities - Water				$75,000
Utilities - Sewer				$31,500
Utilities - Fiber				$15,600
Utilities - Unknown				$920,455
New signal (5 intersections)				$1,500,000
Pavement Widening				$250,000
Total Cost				**$46,662,416**
Cost per Route Mile				**$38,500,000**
Escalated Project Costs (Project Dollars)				
Inflation to Mid Year of Construction	Allow 3% per year	2014	Escalation	$1,399,872
			Total	$48,062,288
Inflation to Mid Year of Construction	Allow 3% per year	2015	Escalation	$1,441,869
			Total	$49,504,157
Inflation to Mid Year of Construction	Allow 3% per year	2016	Escalation	$1,485,125
			Total	$50,989,282
Inflation to Mid Year of Construction	Allow 3% per year	2017	Escalation	$1,529,678
			Total	$52,518,960
Inflation to Mid Year of Construction	Allow 3% per year	2018	Escalation	$1,575,569
			Total	$54,094,529
Inflation to Mid Year of Construction	Allow 3% per year	2019	Escalation	$1,622,836
			Total	$55,717,365
Inflation to Mid Year of Construction	Allow 3% per year	2020	Escalation	$835,760
			Total	**$56,600,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: Burlington Mixed Traffic Via BNSF ROW - North Bridge Abutment to just North of 18th Ave. (Curb Running)

Base Cost	**$43,895,833**
Base Cost / Track Mile	$22,000,000
Route Length (ft)	6,400
Route Length (mi)	1.21
Single (1) or Double (2) Track	1
Track feet	10,535
Track miles	2.00
Additional Cost Allowances	**$18,492,555**
Median Reconstruction	$0
Streetcars (2 Streetcars)	$10,000,000
Vehicle Maintencance Facility (Cost Shared Facility)	$4,000,000
Traction Power Substation	$1,500,000
Right-of-Way & Land Acquisition* (Commercial Property Price)	$200,000
Earthwork	$500,000
Pedestrian Upgrades for Stations	$250,000
Utilities - Water	$75,000
Utilities - Sewer	$31,500
Utilities - Fiber	$15,600
Utilities - Unknown	$920,455
New signal (5 intersections)	$1,000,000
Pavement Widening	$0
Total Cost	**$62,388,388**
Cost per Route Mile	**$51,500,000**
Escalated Project Costs (Project Dollars)	
Inflation to Mid Year of Construction Allow 3% per year 2014 Escalation	$1,871,652
Total	$64,260,040
Inflation to Mid Year of Construction Allow 3% per year 2015 Escalation	$1,927,801
Total	$66,187,841
Inflation to Mid Year of Construction Allow 3% per year 2016 Escalation	$1,985,635
Total	$68,173,476
Inflation to Mid Year of Construction Allow 3% per year 2017 Escalation	$2,045,204
Total	$70,218,680
Inflation to Mid Year of Construction Allow 3% per year 2018 Escalation	$2,106,560
Total	$72,325,241
Inflation to Mid Year of Construction Allow 3% per year 2019 Escalation	$2,169,757
Total	$74,494,998
Inflation to Mid Year of Construction Allow 3% per year 2020 Escalation	$1,117,425
Total	**$75,700,000**

*MoDOT Right-of-Way is not included in this estimate

Detailed: Burlington Dedicated Lanes Via BNSF ROW - North Bridge Abutment to just North of 29th Ave.

Base Cost			**$78,662,500**
Base Cost / Track Mile			$22,000,000
Route Length (ft)			9,830
Route Length (mi)			1.86
Single (1) or Double (2) Track			2
Track feet			18,879
Track miles			3.58
Additional Cost Allowances			**$31,838,488**
Median Reconstruction			$1,150,000
Streetcars (3 Streetcars)			$15,000,000
Vehicle Maintencance Facility (Stand Alone Facility)			$8,000,000
Traction Power Substation			$1,500,000
Right-of-Way & Land Acquisition* (Commercial Property Price)			$200,000
Earthwork			$500,000
Pedestrian Upgrades for Stations			$750,000
Utilities - Water			$120,000
Utilities - Sewer			$58,500
Utilities - Fiber			$31,200
Utilities - Unknown			$1,628,788
New signal (8 intersections)			$2,400,000
Pavement Widening			$500,000
Total Cost			**$110,500,988**
Cost per Route Mile			**$59,400,000**
Escalated Project Costs (Project Dollars)			
Inflation to Mid Year of Construction Allow 3% per year	2014	Escalation	$3,315,030
		Total	$113,816,017
Inflation to Mid Year of Construction Allow 3% per year	2015	Escalation	$3,414,481
		Total	$117,230,498
Inflation to Mid Year of Construction Allow 3% per year	2016	Escalation	$3,516,915
		Total	$120,747,413
Inflation to Mid Year of Construction Allow 3% per year	2017	Escalation	$3,622,422
		Total	$124,369,835
Inflation to Mid Year of Construction Allow 3% per year	2018	Escalation	$3,731,095
		Total	$128,100,930
Inflation to Mid Year of Construction Allow 3% per year	2019	Escalation	$3,843,028
		Total	$131,943,958
Inflation to Mid Year of Construction Allow 3% per year	2020	Escalation	$1,979,159
		Total	**$134,000,000**

*MoDOT Right-of-Way is not included in this estimate

Unit Costs

Streetcar Infrastructure	$	22,000,000.00	TM
Watermain	$	500.00	LF
Comm Fiber	$	130.00	LF
Sewer	$	150.00	LF
Unk Uti	$	1,000,000.00	TM
Armour Interchange[1]	$	20,630,000.00	Ea
Sidewalk	$	5.00	SF
CG	$	15.00	LF
Rem Pavt	$	0.33	SF
BAD	$	0.43	SF
HMA	$	1.40	SF
CP 9-IN	$	4.00	SF
Striping	$	1.00	TF
Transit Sig	$	20,000.00	Ea
New sig	$	250,000.00	Ea
Earthwork	$	0.50	CF
Ped Upgrades	$	250,000.00	Ea
Streetcars	$	5,000,000.00	Ea
ROW[2]		$2.91	SF
Maintenance Facility[3]	$	8,000,000.00	Ea

[1]From Appendix D of 29/35 EIS, estimated cost of 17.1 million in 2005 dollars is converted to 2013 dollars using escalation of 2.37% per year (www.in2013dollars.com)

[2]Average Price of commercial property adjoining BNSF ROW

[3]Cost of 10000 SF Maintenance Facility, could handle 3 to 4 cars

NorthRail Streetcar Study

Burlington Corridor Dedicated Lane Traffic Analysis

Travel Time 1 - NB Rte 9, HOA Bridge to N. of Split (Segments 5+6)

Travel Time 2 - NB Burlingtion, HOA Bridge to N. of 32nd (Segments 5+7)

Travel Time 3 - SB Rte 9, N. of Split to HOA Bridge (Segments 8+10)

Travel Time 4 - SB Burlington, N. of 32nd to HOA Bridge (Segments 9+10)

Travel Time Segments
Burlington Dedicated Lane
HOA Bridge to 29th Avenue

Burlington Dedicated Lanes Traffic Appendix

Network Performance:

2040 AM Build – Network Performance Parameter	Simulation 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5	Sim. 6	Sim. 7	Sim. 8	Sim. 9	Sim. 10	Avg.
Average delay time per vehicle [s], All Vehicle Types	135	131	128	125	129	126	140	132	137	128	**131**
Average speed [mph], All Vehicle Types	22	23	23	23	23	23	22	22	22	23	**23**
Number of vehicles that have left the network, All Vehicle Types	6712	6744	6736	6763	6715	6662	6660	6680	6604	6787	**6706**
Average number of stops per vehicles, All Vehicle Types	3	3	3	3	3	3	3	3	3	3	**3**
Average stopped delay per vehicle [s], All Vehicle Types	73	67	67	66	69	68	73	71	72	65	**69**
Total delay time [h], All Vehicle Types	271	266	257	254	260	250	284	264	274	261	**264**
Total Distance Traveled [mi], All Vehicle Types	12940	13101	12877	12969	12968	12760	12762	12793	12699	13019	**12889**
Number of Stops, All Vehicle Types	20687	20657	20684	20354	20562	20169	22336	20609	21248	20067	**20737**
Number of vehicles in the network, All Vehicle Types	508	567	510	576	525	518	642	538	564	537	**549**
Total stopped delay [h], All Vehicle Types	146	137	135	135	138	135	149	141	144	133	**139**
Total travel time [h], All Vehicle Types	579	578	565	563	568	555	589	570	576	571	**571**

2040 PM Build – Network Performance Parameter	Simulation 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5	Sim. 6	Sim. 7	Sim. 8	Sim. 9	Sim. 10	Avg.
Average delay time per vehicle [s], All Vehicle Types	107	109	115	105	109	106	118	121	110	130	**111**
Average speed [mph], All Vehicle Types	25	24	24	25	24	25	24	23	24	23	**24**
Number of vehicles that have left the network, All Vehicle Types	8094	8065	8060	8092	7982	8142	8038	8112	8103	8000	**8076**
Average number of stops per vehicles, All Vehicle Types	2	2	3	2	2	2	3	3	2	3	**2**
Average stopped delay per vehicle [s], All Vehicle Types	55	57	62	54	57	55	61	63	57	69	**58**
Total delay time [h], All Vehicle Types	258	265	279	254	263	260	285	293	267	314	**269**
Total Distance Traveled [mi], All Vehicle Types	15506	15596	15654	15633	15527	15690	15657	15627	15617	15533	**15612**
Number of Stops, All Vehicle Types	20210	20215	21889	19742	20535	20156	22201	22342	20698	25147	**20888**
Number of vehicles in the network, All Vehicle Types	620	653	662	608	710	663	683	610	665	691	**653**
Total stopped delay [h], All Vehicle Types	133	137	149	131	137	135	148	152	138	167	**140**
Total travel time [h], All Vehicle Types	629	638	654	628	634	635	660	668	641	685	**643**

2040 AM No-Build – Network Performance Parameter	Simulation 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5	Sim. 6	Sim. 7	Sim. 8	Sim. 9	Sim. 10	Avg.
Average delay time per vehicle [s], All Vehicle Types	95	99	96	98	91	95	98	101	95	93	**96**
Average speed [mph], All Vehicle Types	26	26	26	26	27	26	26	25	26	26	**26**
Number of vehicles that have left the network, All Vehicle Types	6806	6747	6778	6737	6720	6788	6713	6642	6736	6735	**6740**
Average number of stops per vehicles, All Vehicle Types	2	2	2	2	2	2	2	2	2	2	**2**
Average stopped delay per vehicle [s], All Vehicle Types	51	51	52	51	47	50	54	53	50	50	**51**
Total delay time [h], All Vehicle Types	191	197	192	197	182	190	197	199	188	187	**192**
Total Distance Traveled [mi], All Vehicle Types	13031	13130	12962	12936	13031	12958	12889	12701	12967	12979	**12958**
Number of Stops, All Vehicle Types	15018	15735	15630	15613	15038	15266	15864	16074	15181	14954	**15437**
Number of vehicles in the network, All Vehicle Types	405	434	415	451	447	386	478	429	420	461	**433**
Total stopped delay [h], All Vehicle Types	103	103	103	101	94	101	108	104	99	100	**102**
Total travel time [h], All Vehicle Types	500	507	500	503	490	497	502	500	495	494	**499**

2040 PM No-Build – Network Performance Parameter	Simulation 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5	Sim. 6	Sim. 7	Sim. 8	Sim. 9	Sim. 10	Avg.
Average delay time per vehicle [s], All Vehicle Types	107	114	112	105	111	102	103	108	119	106	**109**
Average speed [mph], All Vehicle Types	24	24	24	25	24	25	25	24	23	25	**24**
Number of vehicles that have left the network, All Vehicle Types	7845	7852	7697	7996	7705	7830	7851	7879	7767	7770	**7819**
Average number of stops per vehicles, All Vehicle Types	2	2	2	2	2	2	2	2	2	2	**2**
Average stopped delay per vehicle [s], All Vehicle Types	57	64	63	55	60	54	56	59	65	57	**59**
Total delay time [h], All Vehicle Types	254	266	259	250	260	241	241	255	279	248	**255**
Total Distance Traveled [mi], All Vehicle Types	14654	14618	14532	14873	14644	14710	14717	14667	14587	14669	**14667**
Number of Stops, All Vehicle Types	19005	19602	18865	18989	19222	17850	17431	18467	20105	19140	**18868**
Number of vehicles in the network, All Vehicle Types	665	586	659	584	706	637	588	568	646	702	**634**
Total stopped delay [h], All Vehicle Types	135	150	147	131	140	128	132	138	152	135	**139**
Total travel time [h], All Vehicle Types	604	614	606	605	608	591	591	604	626	597	**605**

2014 Existing AM – Network Performance Parameter	Simulation 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5	Sim. 6	Sim. 7	Sim. 8	Sim. 9	Sim. 10	Avg.
Average delay time per vehicle [s], All Vehicle Types	72	75	76	75	76	72	72	75	75	74	**74**
Average speed [mph], All Vehicle Types	30	30	30	30	30	30	30	30	30	30	**30**
Number of vehicles that have left the network, All Vehicle Types	5713	5781	5667	5742	5656	5716	5615	5691	5728	5805	**5711**
Average number of stops per vehicles, All Vehicle Types	2	2	2	2	2	2	2	2	2	2	**2**
Average stopped delay per vehicle [s], All Vehicle Types	38	41	41	40	42	40	40	42	42	41	**41**
Total delay time [h], All Vehicle Types	122	129	128	127	127	123	121	126	127	128	**126**
Total Distance Traveled [mi], All Vehicle Types	11105	11298	10962	11208	11071	11046	10897	10932	11180	11273	**11097**
Number of Stops, All Vehicle Types	10627	10816	10865	10739	10911	10660	10124	10494	10580	11084	**10690**
Number of vehicles in the network, All Vehicle Types	360	377	376	367	364	399	399	319	382	386	**373**
Total stopped delay [h], All Vehicle Types	65	70	69	67	70	68	68	70	71	70	**69**
Total travel time [h], All Vehicle Types	367	378	369	374	371	366	361	367	373	376	**370**

2014 Existing PM – Network Performance Parameter	Simulation 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5	Sim. 6	Sim. 7	Sim. 8	Sim. 9	Sim. 10	Avg.
Average delay time per vehicle [s], All Vehicle Types	81	85	81	81	83	78	80	87	83	83	**82**
Average speed [mph], All Vehicle Types	29	28	29	29	29	29	29	28	29	29	**29**
Number of vehicles that have left the network, All Vehicle Types	6869	6798	6775	6840	6820	6822	6662	6831	6812	6835	**6806**
Average number of stops per vehicles, All Vehicle Types	2	2	2	2	2	2	2	2	2	2	**2**
Average stopped delay per vehicle [s], All Vehicle Types	42	44	43	44	43	39	41	46	43	44	**43**
Total delay time [h], All Vehicle Types	164	172	163	163	167	158	160	178	168	170	**166**
Total Distance Traveled [mi], All Vehicle Types	13082	13075	13111	13064	13223	13176	12949	13327	13168	13180	**13135**
Number of Stops, All Vehicle Types	13665	14372	13445	13750	13892	13445	13239	14779	14142	14137	**13887**
Number of vehicles in the network, All Vehicle Types	430	452	491	426	436	479	529	502	492	494	**473**
Total stopped delay [h], All Vehicle Types	85	89	87	88	88	80	82	94	87	89	**87**
Total travel time [h], All Vehicle Types	452	460	453	452	459	448	446	471	458	461	**456**

Travel Times:

Travel Time Segments:

No. 1 - NB Rte 9 (HOA Bridge to N. of Split), Distance 12672.5 ft
No. 2 - NB Burlington (HOA Bridge to N. Oak Trfwy, N. of 32nd St), Distance 13658.1 ft
No. 3 - SB Rte 9 (N. of Split to HOA Bridge), Distance 13169.5 ft
No. 4 - SB Burlington (N. Oak Trfwy, N. of 32nd St to HOA Bridge), Distance 14439.1 ft
No. 5 - NB Rte 9 (HOA Bridge to Armour), Distance 9090.5 ft
No. 6 - NB Rte 9 (Armour to N. of Split), Distance 3570.6 ft
No. 7 - NB Burlington (Armour to N. Oak Trfwy, N. of 32nd), Distance 4551.6 ft
No. 8 - SB Rte 9 (N. of Split to 18th St.), Distance 4868.0 ft
No. 9 - SB Burlington (N. Oak Trfwy, N. of 32nd St to 18th St.), Distance 6136.8 ft
No. 10 - SB Rte 9 (18th St. to HOA Bridge), Distance 8281.7 ft

"Trav" = Travel Time, in seconds

2040 AM Build Travel Times:

Sim. Run	Trav 1	#Veh 1	Trav 2	#Veh 2	Trav 3	#Veh 3	Trav 4	#Veh 4	Trav 5	#Veh 5	Trav 6	#Veh 6	Trav 7	#Veh 7	Trav 8	#Veh 8	Trav 9	#Veh 9	Trav 10	#Veh 10
1	276.7	175	318.8	31	394.8	1144	454.1	395	199.9	372	84	440	116	160	195.2	1745	250.7	532	197.9	2245
2	275.6	163	312.9	33	404	1186	444.7	386	188.3	397	87.1	483	109.3	160	213.1	1740	260.4	533	188	2263
3	287.9	166	300.6	48	389.2	1153	452.3	341	200.8	397	85.4	472	104.2	172	202.3	1732	265.7	526	184.2	2157
4	285.1	185	314.7	42	381.7	1136	434.7	398	193.8	395	87.8	482	110	151	196.4	1674	249.4	544	187.1	2245
5	282.3	188	296.1	49	376.6	1172	432.4	407	198.8	382	85.7	490	109	158	187.7	1699	247.7	555	185.3	2259
6	276.8	156	300.2	27	384.8	1141	451.1	356	191.4	371	85.7	464	111.3	140	202	1734	263.5	500	180.8	2172
7	278.2	157	308.7	42	409.9	1150	469.7	359	194.7	418	84.1	406	115.6	156	216.5	1675	276	504	194.6	2176
8	278.1	174	317.6	40	388.6	1129	440.4	338	197.8	389	82.1	466	110.4	154	191.1	1700	251.1	484	192.3	2152
9	283.8	139	302.9	54	393.4	1099	481.6	381	199	384	85.9	450	107	177	211.9	1686	298.5	556	183.2	2146
10	290.6	158	299.5	27	393.8	1174	453.5	395	195.3	408	89.1	474	109.4	150	211.4	1720	265.4	523	183.6	2284
Avg.	**281.51**	**166.1**	**307.2**	**39.3**	**391.68**	**1148.4**	**451.45**	**375.6**	**195.98**	**391.3**	**85.69**	**462.7**	**110.22**	**157.8**	**202.76**	**1710.5**	**262.84**	**525.7**	**187.7**	**2209.9**

2040 PM Build Travel Times:

Sim. Run	Trav 1	#Veh 1	Trav 2	#Veh 2	Trav 3	#Veh 3	Trav 5	#Veh 5	Trav 6	#Veh 6	Trav 7	#Veh 7	Trav 8	#Veh 8	Trav 9	#Veh 9	Trav 10	#Veh 10
1	363.4	1210	378	382	289.1	95	255.7	2043	108.6	1859	126	709	110	320	167.7	127	175	708
2	365.8	1240	385.6	411	297	105	250.7	2119	114	1885	136.1	776	111.1	311	166.4	122	178	692
3	379.5	1236	408.5	427	284.1	112	267.4	2145	110.6	1882	138.5	761	111.1	318	169.7	124	175.2	720
4	360.2	1187	381.5	441	299.8	102	251.2	2017	110.6	1834	132.8	776	113.6	329	168.7	139	177.2	732
5	365.9	1216	386.6	410	292.2	99	251.7	2084	114.9	1862	137.6	735	118.2	289	171.9	137	172.9	700
6	361.8	1256	387.4	429	291.9	102	247.9	2156	114.9	1980	140.1	777	112.6	325	173.8	110	173.1	704
7	383.4	1214	411.8	404	282.8	109	273	2131	112.5	1865	138	737	108.2	339	164.3	121	175.9	711
8	387.3	1233	408.1	459	284.8	96	271.4	2086	119	1877	140.1	819	117.5	315	174.1	105	175.7	686
9	369.7	1286	390.4	429	291.6	88	248	2130	121.7	1968	142.6	759	117	323	169.1	118	170.9	709
10	351.2	1203	373.3	410	403.3	96	236.5	2116	116.6	1868	138.8	720	248.5	340	262.8	142	171.8	694
Avg.	**370.78**	**1231**	**393.1**	**421**	**290.37**	**100.89**	**257.44**	**2101**	**114.1**	**1890**	**136.87**	**761**	**113.26**	**318.78**	**169.52**	**122.6**	**174.9**	**706.89**

2040 AM No-Build Travel Times:

Sim. Run	Trav 1	#Veh 1	Trav 2	#Veh 2	Trav 3	#Veh 3	Trav 4	#Veh 4	Trav 5	#Veh 5	Trav 6	#Veh 6	Trav 7	#Veh 7	Trav 8	#Veh 8	Trav 9	#Veh 9	Trav 10	#Veh 10
1	272.2	170	302.8	31	331	1176	377.4	396	182.4	370	92.5	445	124.1	158	152.4	1848	201.4	566	174.9	2306
2	289.7	164	302.7	31	342.6	1204	393.8	391	185.3	402	102	475	119.4	149	163	1869	213.1	565	180.1	2312
3	288.5	162	309	48	332.9	1226	404.4	366	196.7	402	94.6	458	109.1	175	148.8	1850	215.7	559	182.9	2286
4	286.8	182	301.4	40	333.8	1132	389.8	401	185.3	394	98	470	127.5	162	156	1834	214.5	584	177.6	2273
5	280.7	195	300	48	334.2	1173	371.7	416	187.5	390	95.6	510	107.3	164	153.3	1827	196.8	594	178.6	2285
6	286.3	154	324.5	26	330.4	1212	374.5	373	187.3	374	94.9	466	117.2	146	152.7	1900	208.9	551	172.9	2283
7	293.4	165	312	43	331.4	1183	386	391	188.1	410	102	439	120.6	153	159.1	1767	210.2	556	170.9	2288
8	277.2	178	307.9	39	344	1115	395.8	347	189.9	402	90.6	461	107.6	161	168.9	1769	216.6	531	174.2	2172
9	292	145	313.6	54	332.7	1162	399.3	388	185.8	393	97.7	454	116.2	193	152.7	1885	217.7	586	178.8	2253
10	277.5	159	294.4	30	328.3	1208	373.9	394	185.7	407	93.6	470	120.7	152	153.1	1855	206.1	546	172.5	2326
Avg.	**284.4**	**167**	**306.8**	**39**	**334.1**	**1179**	**386.7**	**386**	**187.4**	**394**	**96.2**	**465**	**117**	**161**	**156**	**1840**	**210.1**	**564**	**176.3**	**2278**

2040 PM No-Build Travel Times:

Sim. Run	Trav 1	#Veh 1	Trav 2	#Veh 2	Trav 5	#Veh 5	Trav 6	#Veh 6	Trav 7	#Veh 7	Trav 8	#Veh 8	Trav 9	#Veh 9	Trav 10	#Veh 10
1	372.3	1168	391.3	380	246.5	2061	125.7	1801	147.3	702	108.1	363	166.5	141	156.6	473
2	377.5	1241	395.2	418	239.1	2066	140.8	1885	160	783	122.4	350	174.8	138	151.1	410
3	374.2	1151	393.2	393	260.3	2050	115.3	1788	135.7	701	109.4	360	167.4	140	152	410
4	367.7	1207	382.4	445	230.4	1991	138.4	1840	155	781	108.1	367	171.5	160	158.1	556
5	376.7	1189	400.2	406	249.4	2116	130.7	1811	151.5	726	114.3	346	164	159	156.2	463
6	354.1	1195	370.1	409	234.2	2043	120.4	1870	136.6	771	112.1	364	168.6	130	154.2	464
7	355.4	1211	373.8	402	234	2087	123	1834	135.9	759	109.1	366	160.5	136	153.2	460
8	367.3	1212	385.1	444	242.3	2044	127.1	1847	143.8	792	104.2	349	157.8	122	155.9	431
9	386.1	1224	403.8	405	250.8	2075	137.2	1886	156.4	739	114.1	378	171	131	159.9	412
10	364.1	1192	383.5	405	240.3	2082	124.5	1847	146.1	733	113.1	355	167.7	144	154.4	499
Avg.	**369.5**	**1199**	**387.9**	**411**	**242.7**	**2062**	**128.3**	**1841**	**146.8**	**749**	**111.5**	**360**	**167**	**140**	**155.2**	**458**

2014 Existing AM Travel Times:

Sim. Run	Trav 1	#Veh 1	Trav 2	#Veh 2	Trav 3	#Veh 3	Trav 4	#Veh 4
1	278.2	132	301.7	31	289.2	1026	340.9	352
2	272.5	116	292.1	42	296.7	1048	342.7	351
3	278.4	114	315	48	294.1	969	347.2	304
4	273.7	138	291.5	38	290.1	993	342	380
5	269.3	142	289.5	39	297.3	988	353	374
6	281.2	127	291.1	31	294.3	987	341.8	311
7	273.6	130	281.2	43	296.4	984	348.2	335
8	283.4	146	304	38	296.6	942	338.4	302
9	276.5	114	290.5	52	293.4	947	355.5	367
10	278.6	117	273.7	33	294.5	1024	335.5	333
Avg.	**276.5**	**128**	**293**	**40**	**294.3**	**991**	**344.5**	**341**

2014 Existing PM Travel Times:

Sim. Run	Trav 1	#Veh 1	Trav 2	#Veh 2	Trav 5	#Veh 5	Trav 6	#Veh 6	Trav 7	#Veh 7	Trav 8	#Veh 8	Trav 9	#Veh 9	Trav 10	#Veh 10
1	320.6	1070	336.9	334	219.3	1807	102.9	1628	114.1	636	110.1	330	159.8	129	152.7	502
2	329.5	1075	337.5	362	215.1	1843	115.1	1640	121.4	682	108	318	164.5	135	152	498
3	312.1	1031	332.9	361	214	1840	101.4	1592	121.7	646	105.9	339	163.7	116	157.3	512
4	320.5	1066	336.8	373	217.8	1833	102.6	1627	121.4	668	102.9	321	159.5	157	146.9	498
5	318.2	1092	327.5	369	216.6	1891	100.7	1661	112.6	658	107.5	294	164.4	138	155.9	554
6	309.2	1079	324.7	362	210.5	1871	99.4	1674	114.9	690	105.4	315	164.3	114	154.5	531
7	316.6	1011	327.6	356	213	1786	104.4	1557	118.4	684	105	313	164.2	121	160.2	483
8	333.1	1068	347.9	369	227.2	1890	107.6	1636	121.5	695	109.1	292	163.4	100	157.4	521
9	323.3	1102	338.1	354	223.6	1882	99.5	1670	112.7	644	105.1	302	158.6	122	156.7	534
10	323.3	1102	338.1	354	223.6	1882	99.5	1670	112.7	644	105.1	302	158.6	122	156.7	534
Avg.	**320.64**	**1070**	**334.8**	**359**	**218.07**	**1852.5**	**103.31**	**1636**	**117.14**	**664.7**	**106.4**	**312.6**	**162.1**	**125.4**	**155.03**	**516.7**

Node (Intersection) Evaluation:

2040 AM Build Node Eval:

Intersection:	10^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**16.1**	**27.2**	**970.3**	**3739.5**	**B**
E-N	54.4	0.8	72.6	21.9	E
E-S	55.3	0.8	72.6	161.3	
E-W	63.9	0.8	72.6	6.0	
N-E	80.5	21.0	133.6	52.7	B
N-S	14.7	88.3	970.3	2381.5	
N-W	13.1	88.3	970.3	32.7	
S-E	2.9	0.0	0.0	305.4	A
S-N	9.2	20.8	164.7	735.4	
S-W	55.0	23.7	167.8	42.6	

Intersection:	12^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**19.8**	**27.7**	**1028.7**	**3451.5**	**B**
E-N	26.6	0.2	24.0	19.8	E
E-S	82.7	0.2	24.0	22.6	
E-W	78.7	0.2	24.0	5.3	
N-E	85.3	75.3	747.4	133.1	B
N-S	16.3	85.1	1028.7	2389.9	
N-W	17.4	85.1	1028.7	41.3	
S-E	13.6	19.1	222.8	47.7	B
S-N	12.4	19.1	222.8	668.3	
S-W	62.6	13.5	101.7	40.0	
W-E	62.2	17.0	154.7	11.8	D
W-N	63.9	17.0	154.7	20.5	
W-S	19.3	0.0	0.0	51.2	

Intersection:	14^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**14.0**	**29.1**	**923.0**	**3721.2**	**B**
E-N	10.7	16.1	153.0	0.8	D
E-S	0.0	19.2	143.4	0.0	
E-W	42.8	19.2	143.4	79.9	
N-S	12.8	60.4	923.0	2754.3	B
N-W	0.0	60.4	923.0	0.0	
S-E	8.9	9.4	182.6	8.0	A
S-N	7.2	9.4	182.6	701.4	

W-E	47.2	48.5	253.1	160.0	D
W-N	44.7	48.5	253.1	16.8	
W-S	0.0	0.0	0.0	0.0	

Intersection: 16th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**15.0**	**37.8**	**901.0**	**3849.7**	**B**
E-N	30.3	0.0	0.0	48.3	D
E-S	47.4	36.1	216.8	72.2	
E-W	50.9	36.1	216.8	33.1	
N-S	14.8	126.4	901.0	2848.4	B
N-W	14.2	126.4	901.0	55.6	
S-E	8.4	11.8	247.5	53.1	A
S-N	7.4	11.8	247.5	666.1	
W-E	42.4	14.5	108.9	41.5	D
W-N	43.6	14.5	108.9	18.9	
W-S	20.8	0.0	0.0	12.5	

Intersection: 18th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**19.9**	**35.5**	**470.9**	**3881.8**	**B**
E-N	0.0	7.0	73.2	0.0	E
E-S	0.0	7.0	73.2	0.0	
E-W	56.1	7.0	73.2	24.0	
N-E	95.5	94.2	429.9	144.7	B
N-S	16.2	131.1	470.9	2927.2	
N-W	8.2	131.1	470.9	34.7	
S-E	12.9	0.0	0.0	85.6	B
S-N	17.5	28.7	285.3	626.8	
S-W	70.7	5.3	74.7	14.2	
W-E	57.8	7.4	85.1	24.6	E
W-N	0.0	7.4	85.1	0.0	
W-S	0.0	0.0	0.0	0.0	

Intersection: Armour

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**46.2**	**186.1**	**1660.6**	**4211.2**	**D**
E-N	90.4	160.3	1124.9	272.9	F
E-S	160.5	616.9	1660.5	385.6	
N-E	81.4	110.5	996.9	188.7	D
N-S	32.3	219.8	1255.1	2738.2	
S-E	3.5	0.3	96.3	89.8	A

S-N	7.7	8.3	214.8	536.0	

Intersection:	23^{rd} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**32.6**	**65.5**	**963.9**	**4073.0**	**C**
E-N	58.1	61.2	266.2	31.7	E
E-S	66.1	61.2	266.2	137.8	
E-W	56.2	61.2	266.2	11.6	
N-E	85.9	165.9	934.8	152.4	C
N-S	31.4	322.9	963.9	2796.7	
N-W	29.3	32.5	222.6	152.1	
S-E	14.7	23.3	242.7	12.7	B
S-N	14.9	23.3	242.7	673.7	
S-W	59.5	27.5	170.3	84.2	
W-E	46.0	3.5	56.5	4.1	D
W-N	69.7	3.5	56.5	6.2	
W-S	9.4	0.0	0.0	9.8	

Intersection:	26^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**27.4**	**41.7**	**1143.8**	**4061.2**	**C**
E-N	34.6	0.0	31.1	67.6	D
E-S	55.8	55.3	257.1	117.2	
E-W	57.6	55.3	257.1	12.3	
N-S	30.3	253.3	1143.8	3060.9	C
N-W	24.1	11.8	281.4	17.9	
S-E	6.6	0.1	27.7	4.8	A
S-N	7.9	12.2	263.2	708.1	
W-E	41.6	14.4	126.7	8.0	D
W-N	53.1	14.4	126.7	44.4	
W-S	13.1	0.0	0.0	20.0	

Intersection:	Rte. 9 Split

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**23.2**	**75.2**	**1168.4**	**4632.9**	**C**
S-N	3.8	4.1	95.8	516.1	A
NE-S	57.8	132.0	520.9	721.6	E
NW-S	25.3	231.7	1168.4	2362.9	C

2040 PM Build Node Eval:

Intersection:	10th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**25.9**	**50.8**	**1226.8**	**4777.1**	**C**
E-N	55.2	4.2	155.1	73.4	E
E-S	59.8	4.2	155.1	302.4	
E-W	50.4	4.2	155.1	1.7	
N-E	68.2	23.1	153.5	63.0	C
N-S	17.7	49.9	451.5	1094.7	
N-W	17.4	49.9	451.5	14.7	
S-E	8.8	2.7	187.2	261.9	C
S-N	25.1	158.6	1224.2	2940.4	
S-W	58.5	160.0	1226.6	24.9	

Intersection:	12th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**17.0**	**29.7**	**964.1**	**4244.3**	**B**
E-N	49.8	5.6	130.9	85.4	E
E-S	83.0	5.6	130.9	40.1	
E-W	0.0	5.6	130.9	0.0	
N-E	79.9	20.8	151.7	48.7	B
N-S	11.3	22.1	326.1	1019.3	
N-W	13.6	22.1	326.1	6.0	
S-E	16.4	88.1	964.1	16.7	B
S-N	13.8	88.1	964.1	2809.9	
S-W	90.1	17.5	114.9	37.9	
W-E	60.0	40.4	257.7	13.3	D
W-N	57.8	40.4	257.7	49.4	
W-S	27.2	0.0	3.0	117.6	

Intersection:	14th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**14.6**	**47.6**	**977.3**	**4486.1**	**B**
E-N	39.2	60.2	331.3	105.0	D
E-S	57.0	58.6	321.7	81.0	
E-W	52.5	58.6	321.7	28.9	
N-S	9.9	26.1	419.5	1231.6	A
N-W	10.6	26.1	419.5	18.4	
S-E	11.7	74.8	977.3	30.3	B
S-N	12.1	74.8	977.3	2815.0	
W-E	49.5	48.5	264.5	34.0	D
W-N	55.7	48.5	264.5	89.4	

W-S	33.8	0.0	0.0	52.6	

Intersection:	16th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**20.6**	**50.2**	**1067.8**	**4477.4**	**C**
E-N	34.5	0.0	0.0	79.7	D
E-S	51.7	44.1	273.5	62.3	
E-W	51.7	44.1	273.5	37.0	
N-S	8.3	19.3	339.6	1171.0	A
N-W	10.8	19.3	339.6	13.0	
S-E	22.5	155.3	1067.8	56.6	C
S-N	23.1	155.3	1067.8	2921.0	
W-E	45.9	32.2	202.8	50.4	D
W-N	51.9	32.2	202.8	47.4	
W-S	26.8	0.0	0.0	39.0	

Intersection:	18th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**33.8**	**60.2**	**1070.8**	**4323.7**	**C**
E-N	0.0	7.4	83.6	0.0	E
E-S	0.0	7.4	83.6	0.0	
E-W	58.3	7.4	83.6	24.0	
N-E	107.4	31.7	123.4	52.3	B
N-S	13.5	26.2	303.6	855.6	
N-W	0.0	26.2	303.6	0.0	
S-E	0.0	46.5	372.5	0.0	D
S-N	36.4	354.7	1070.8	3034.1	
S-W	0.0	0.0	0.0	0.0	
W-E	86.3	106.1	495.8	26.3	D
W-N	0.0	106.1	495.8	0.0	
W-S	45.0	2.4	84.5	331.4	

Intersection:	Armour

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**25.1**	**105.8**	**1024.8**	**4843.3**	**C**
E-N	35.2	109.6	688.9	478.1	D
E-S	84.5	55.4	524.7	171.9	
N-E	113.6	353.8	1024.8	431.9	D
N-S	8.0	8.4	186.4	736.3	
S-E	7.7	10.8	437.5	401.6	B
S-N	12.2	97.0	467.3	2623.6	

Intersection:	23rd Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**31.7**	**69.8**	**1318.6**	**4432.7**	**C**
E-N	66.1	48.0	219.4	107.6	E
E-S	61.8	48.0	219.4	67.0	
E-W	0.0	48.0	219.4	0.0	
N-E	78.4	106.7	672.2	191.6	C
N-S	15.1	38.8	553.3	1086.9	
N-W	8.3	1.3	69.6	5.0	
S-E	26.3	255.1	1318.6	44.6	C
S-N	32.0	255.1	1318.6	2847.6	
S-W	92.8	25.9	514.1	46.7	
W-E	66.3	5.6	83.5	6.0	C
W-N	77.0	5.6	83.5	5.7	
W-S	9.6	0.0	0.0	24.1	

Intersection:	26th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**11.0**	**21.2**	**872.3**	**4483.1**	**B**
E-N	29.1	0.0	32.6	126.1	D
E-S	52.6	45.2	255.0	73.0	
E-W	51.6	45.2	255.0	9.1	
N-S	9.3	31.0	399.0	1203.0	A
N-W	2.5	0.0	0.0	6.1	
S-E	8.5	0.4	27.0	21.7	A
S-N	9.2	63.3	872.3	2931.6	
W-E	41.9	13.3	125.1	13.7	C
W-N	46.3	13.3	125.1	37.7	
W-S	7.4	0.0	0.0	61.0	

Intersection:	Rte. 9 Split

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	9.0	52.4	1109.9	7124.0	A
S-N	6.8	67.6	793.5	1972.0	A
NE-S	37.5	38.3	157.7	309.3	A
NW-S	8.7	20.9	222.1	898.6	A

2040 AM No-Build Node Eval:

Intersection:	10th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**15.3**	**36.0**	**1055.4**	**3777.3**	**B**
E-N	46.7	35.2	143.7	22.1	D
E-S	52.0	35.2	143.7	162.3	
E-W	57.1	35.2	143.7	6.0	
N-E	77.8	21.3	133.2	54.2	B
N-S	13.6	74.9	1055.4	2415.2	
N-W	12.9	74.9	1055.4	34.2	
S-E	2.4	0.0	0.0	305.3	A
S-N	9.8	22.3	152.1	735.7	
S-W	58.3	25.0	154.6	42.3	

Intersection:	12th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**15.6**	**21.6**	**950.3**	**3385.1**	**B**
E-N	14.1	0.0	0.0	19.9	D
E-S	56.1	9.9	100.3	22.3	
E-W	44.4	9.9	100.3	5.2	
N-E	76.5	15.0	126.0	40.5	B
N-S	15.6	86.7	950.3	2429.6	
N-W	16.6	86.7	950.3	40.0	
S-E	7.0	9.9	162.4	48.1	B
S-N	7.3	9.9	162.4	668.3	
S-W	49.8	9.8	91.9	39.0	
W-E	51.4	10.7	114.0	10.4	C
W-N	51.9	10.7	114.0	17.0	
W-S	15.7	0.0	0.0	44.8	

Intersection:	14th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**12.4**	**23.1**	**895.1**	**3725.3**	**B**
E-N	9.3	12.0	127.1	0.8	D
E-S	0.0	15.6	121.1	0.0	
E-W	44.7	15.6	121.1	63.5	
N-E	70.1	1.3	31.9	4.2	B
N-S	11.1	63.9	895.1	2795.8	
N-W	0.0	63.9	895.1	0.0	
S-E	6.5	8.2	196.3	8.8	A

S-N	6.4	8.2	196.3	699.8	
S-W	44.4	0.4	21.4	0.8	
W-E	49.6	44.2	238.4	134.8	D
W-N	48.7	44.2	238.4	16.8	
W-S	0.0	0.0	0.0	0.0	

Intersection: 16th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**14.2**	**29.6**	**847.0**	**4006.6**	**B**
E-N	38.5	0.0	0.0	45.9	D
E-S	63.2	40.8	224.3	70.4	
E-W	65.5	40.8	224.3	10.2	
N-E	62.7	48.0	261.6	141.7	B
N-S	9.9	76.3	847.0	2925.3	
N-W	9.1	76.3	847.0	50.9	
S-E	13.2	21.9	262.4	52.5	B
S-N	12.9	21.9	262.4	658.0	
S-W	72.9	1.5	28.0	4.4	
W-E	56.4	13.5	121.2	16.5	E
W-N	60.9	13.5	121.2	18.1	
W-S	24.8	0.0	0.0	12.7	

Intersection: 18th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**2.0**	**2.7**	**89.1**	**3933.6**	**A**
E-N	0.0	0.0	0.0	0.0	D
E-S	0.0	7.6	76.3	0.0	
E-W	69.3	9.1	76.6	23.7	
N-E	4.5	0.1	24.3	10.0	A
N-S	1.1	0.0	8.0	3116.6	
N-W	0.6	0.0	8.0	35.4	
S-E	1.6	0.0	0.0	87.0	A
S-N	1.2	0.0	0.0	627.4	
S-W	28.2	1.2	39.9	9.9	
W-E	66.9	8.7	82.5	23.6	D
W-N	0.0	5.2	82.0	0.0	
W-S	0.0	0.0	0.0	0.0	

Intersection:	Armour

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**22.4**	**73.9**	**1316.7**	**4258.1**	**C**
E-N	38.3	16.4	408.9	280.7	E
E-S	100.6	291.2	1290.0	398.9	
N-E	63.3	68.1	456.4	188.1	B
N-S	8.8	48.3	790.6	2765.4	
S-E	6.0	1.0	109.5	90.9	B
S-N	14.2	18.2	212.8	534.1	

Intersection:	23rd Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**19.0**	**25.8**	**898.2**	**3894.0**	**B**
E-N	34.2	34.1	190.9	32.9	D
E-S	38.6	34.1	190.9	141.5	
E-W	41.5	34.1	190.9	11.4	
N-E	37.9	13.8	139.0	93.0	B
N-S	17.7	128.6	898.2	2813.1	
N-W	15.5	3.1	152.2	9.0	
S-E	16.3	26.1	259.2	12.9	B
S-N	16.2	26.1	259.2	738.2	
S-W	45.6	4.7	60.5	21.9	
W-E	41.1	2.4	49.9	4.0	C
W-N	41.0	2.4	49.9	6.3	
W-S	11.1	0.0	0.0	9.8	

Intersection:	26th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**30.4**	**38.3**	**1119.3**	**4143.2**	**C**
E-N	23.9	0.0	36.3	67.7	C
E-S	41.6	38.8	261.7	116.9	
E-W	39.3	38.8	261.7	12.5	
N-E	45.9	36.5	390.9	206.1	C
N-S	31.1	268.8	1119.3	2873.0	
N-W	26.7	8.5	262.4	17.9	
S-E	19.0	0.5	28.5	5.8	C
S-N	20.1	32.6	269.5	708.7	
S-W	48.4	16.0	152.5	63.0	
W-E	26.4	9.8	86.8	8.1	C
W-N	37.1	9.8	86.8	44.0	
W-S	8.1	0.0	0.0	19.5	

Intersection:	Rte. 9 Split

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**28.8**	**123.8**	**1173.0**	**3673.3**	**C**
S-N	8.3	11.4	269.5	566.8	A
NE-S	55.9	128.2	476.2	724.3	D
NW-S	25.4	231.9	1173.0	2382.2	B

2040 PM No-Build Node Eval:

Intersection:	10th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**21.9**	**53.5**	**942.1**	**4348.8**	**C**
E-N	48.0	60.1	336.7	72.0	D
E-S	52.3	60.1	336.7	302.4	
E-W	36.6	60.1	336.7	1.4	
N-E	63.4	22.4	167.6	63.9	B
N-S	9.5	15.9	219.7	840.5	
N-W	9.9	15.9	219.7	13.8	
S-E	5.7	0.0	0.0	252.0	C
S-N	21.9	122.4	939.1	2777.8	
S-W	66.2	124.8	942.1	25.0	

Intersection:	12th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**11.8**	**20.1**	**803.5**	**3775.6**	**B**
E-N	18.1	0.0	0.0	85.0	C
E-S	46.6	16.6	173.1	41.0	
E-W	0.0	16.6	173.1	0.0	
N-E	63.0	2.4	44.7	7.5	A
N-S	8.2	11.8	185.4	759.9	
N-W	10.9	11.8	185.4	5.5	
S-E	10.2	56.2	803.5	16.1	B
S-N	10.4	56.2	803.5	2664.2	
S-W	50.8	3.1	66.7	14.0	
W-E	48.0	33.0	251.8	12.7	C
W-N	49.6	33.0	251.8	50.6	
W-S	22.9	0.1	8.7	119.1	

Intersection:	14^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**14.9**	**41.6**	**837.6**	**4241.1**	**B**
E-N	36.8	54.6	299.6	105.5	D
E-S	61.8	52.8	289.9	84.0	
E-W	55.7	52.8	289.9	4.8	
N-E	61.1	7.5	83.5	22.2	B
N-S	9.5	23.2	314.6	1059.2	
N-W	11.9	23.2	314.6	17.9	
S-E	11.3	95.1	837.6	30.7	B
S-N	12.0	95.1	837.6	2742.1	
S-W	72.8	7.2	66.1	20.2	
W-E	56.8	43.6	243.0	9.8	D
W-N	56.6	43.6	243.0	92.4	
W-S	34.0	0.0	0.0	52.3	

Intersection:	16^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**19.4**	**47.4**	**1093.3**	**4299.8**	**B**
E-N	31.5	0.0	0.0	74.9	D
E-S	58.4	38.0	241.6	61.0	
E-W	58.9	38.0	241.6	9.8	
N-E	58.7	16.0	122.4	48.7	A
N-S	5.0	9.4	185.3	1025.8	
N-W	3.9	9.4	185.3	13.2	
S-E	22.4	199.9	1093.3	56.1	C
S-N	21.5	199.9	1093.3	2904.1	
S-W	0.0	0.0	0.0	0.0	
W-E	55.5	29.2	179.5	25.5	D
W-N	56.9	29.2	179.5	45.3	
W-S	30.8	0.0	0.0	35.4	

Intersection:	18^{th} Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**32.2**	**89.6**	**576.3**	**4113.4**	**C**
E-N	0.0	0.0	0.0	0.0	F
E-S	0.0	28.4	122.8	0.0	
E-W	212.9	30.0	123.1	22.0	
N-E	0.0	0.0	0.0	0.0	A
N-S	0.3	0.0	0.0	902.3	
N-W	0.0	0.0	0.0	0.0	
S-E	0.0	11.6	293.3	0.0	C
S-N	23.9	11.6	293.3	2992.8	

S-W	0.0	0.0	0.0	0.0	
W-E	416.2	461.4	576.3	13.9	F
W-N	0.0	460.9	575.8	0.0	
W-S	300.6	71.1	143.4	182.4	

Intersection: Armour

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**26.0**	**147.9**	**1198.1**	**4785.3**	**C**
E-N	32.8	102.3	774.7	475.9	D
E-S	87.8	48.9	276.9	162.6	
N-E	84.3	240.4	748.1	440.1	C
N-S	5.4	5.2	163.4	737.9	
S-E	13.4	85.4	1113.9	385.4	B
S-N	18.7	405.2	1161.2	2583.4	

Intersection: 23rd Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**25.4**	**49.9**	**1211.4**	**4217.7**	**C**
E-N	58.8	43.9	192.6	108.0	E
E-S	55.7	43.9	192.6	68.7	
E-W	0.0	43.9	192.6	0.0	
N-E	56.1	20.9	142.6	71.9	B
N-S	10.9	27.5	371.2	1077.5	
N-W	4.5	0.0	8.1	4.7	
S-E	23.0	203.1	1211.4	42.0	C
S-N	28.0	203.1	1211.4	2788.1	
S-W	57.3	4.4	81.8	21.0	
W-E	53.4	3.9	62.1	6.0	C
W-N	48.2	3.9	62.1	5.8	
W-S	7.9	0.0	0.0	24.0	

Intersection: 26th Street

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**25.4**	**35.3**	**951.9**	**4425.8**	**C**
E-N	35.8	0.0	24.3	126.0	D
E-S	55.0	49.6	247.6	70.8	
E-W	53.4	49.6	247.6	10.1	
N-E	61.6	41.9	237.3	120.4	B
N-S	13.1	29.2	280.7	1081.4	
N-W	9.5	0.0	0.0	6.5	
S-E	18.8	0.8	45.7	21.3	C
S-N	26.9	216.6	951.9	2855.9	

S-W	57.5	4.7	76.4	21.5	
W-E	52.5	15.7	113.8	14.0	C
W-N	53.6	15.7	113.8	36.2	
W-S	9.9	0.0	0.0	61.7	

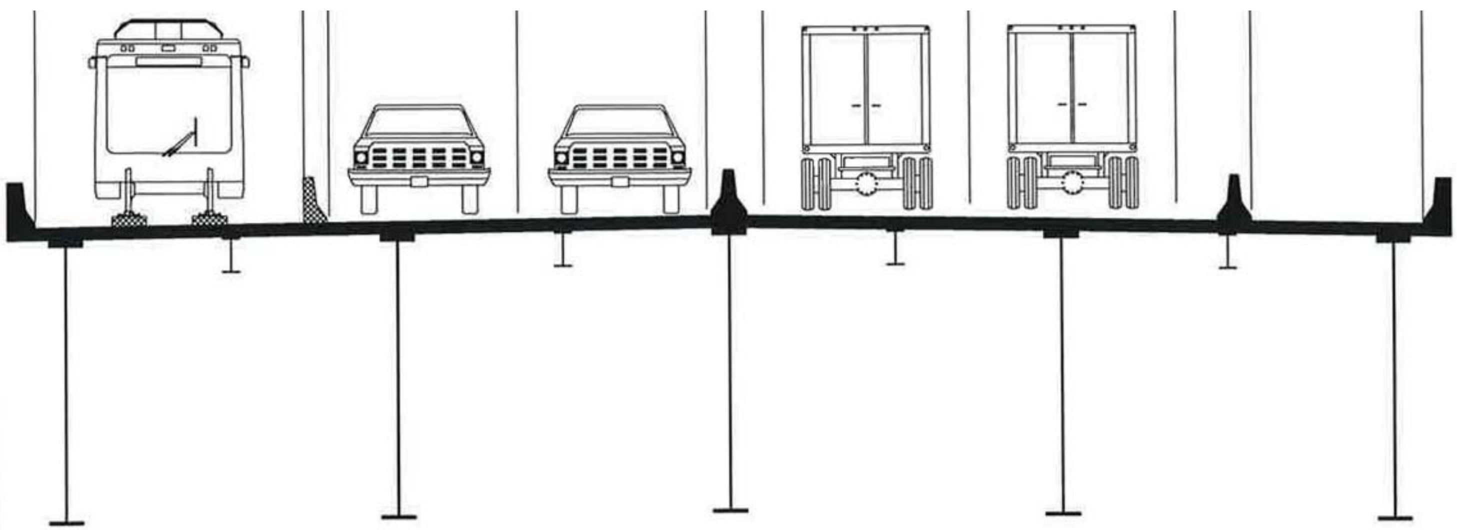
Intersection: Rte. 9 Split

Movement	Average Delay (Sec)	Average Queue	Max Queue	# of Vehicles	LOS
All	**18.2**	**64.7**	**1167.8**	**3209.3**	**B**
S-N	19.6	137.8	1167.8	2000.7	B
NE-S	37.8	38.2	153.1	311.6	D
NW-S	8.2	18.1	203.7	897.0	A

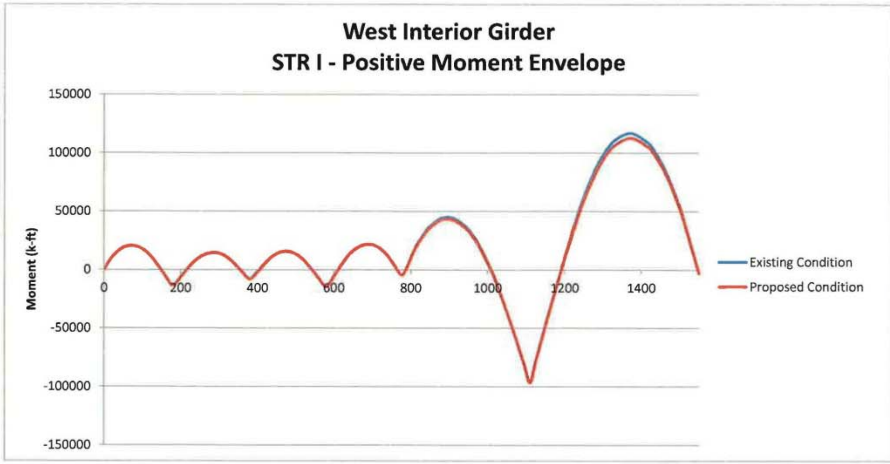
NorthRail Streetcar Study

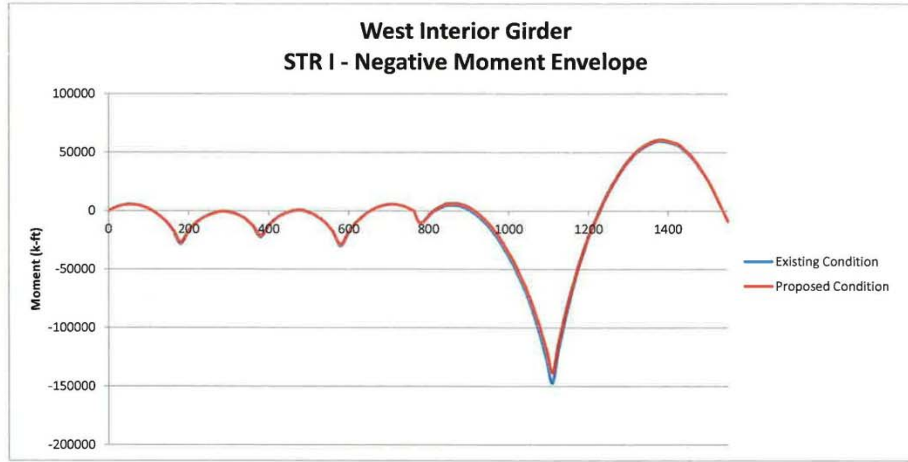
Heart of America Bridge Structural Review Summary

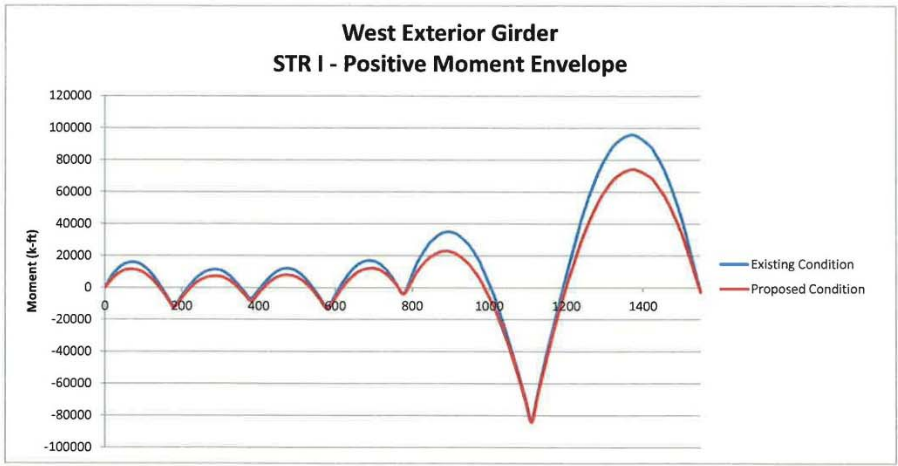
Bridge Analysis – Dedicated R/W



Bridge Analysis – Dedicated R/W







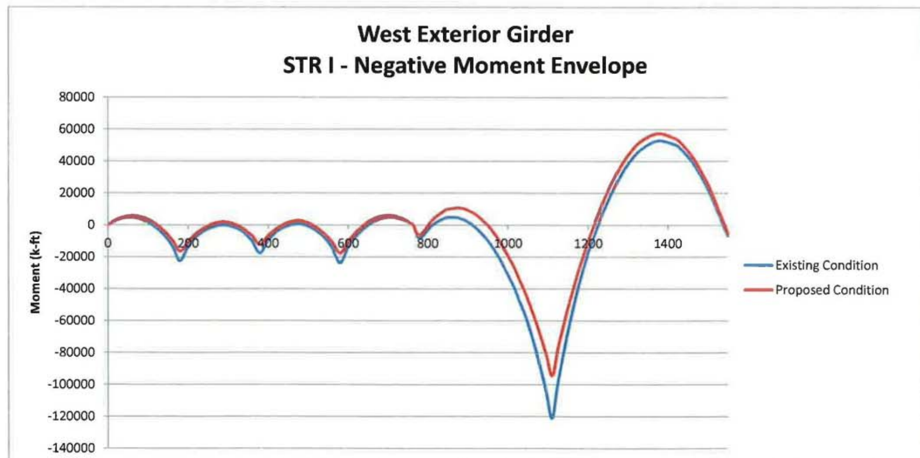
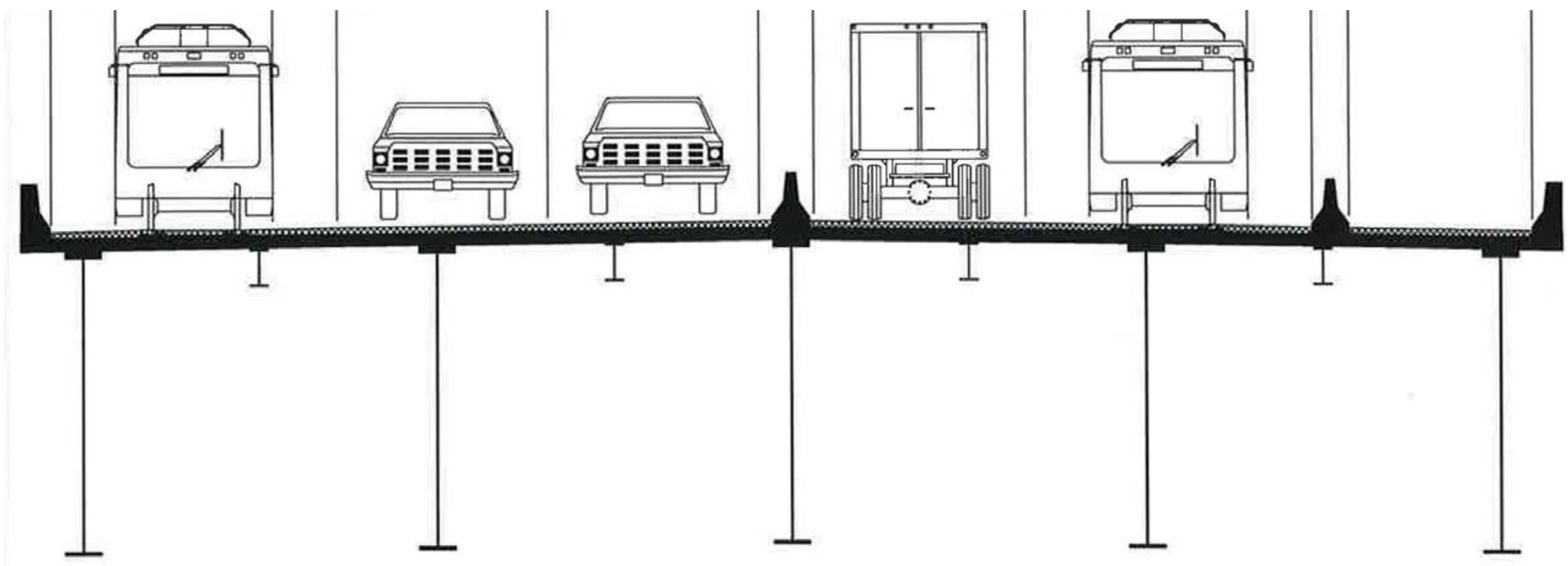
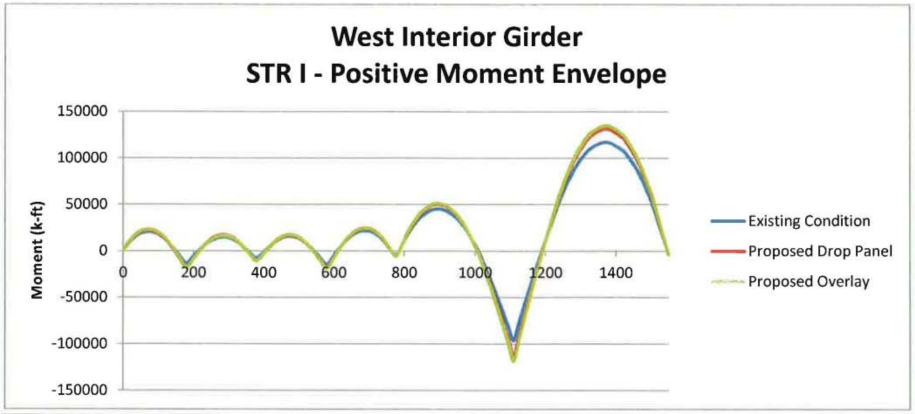


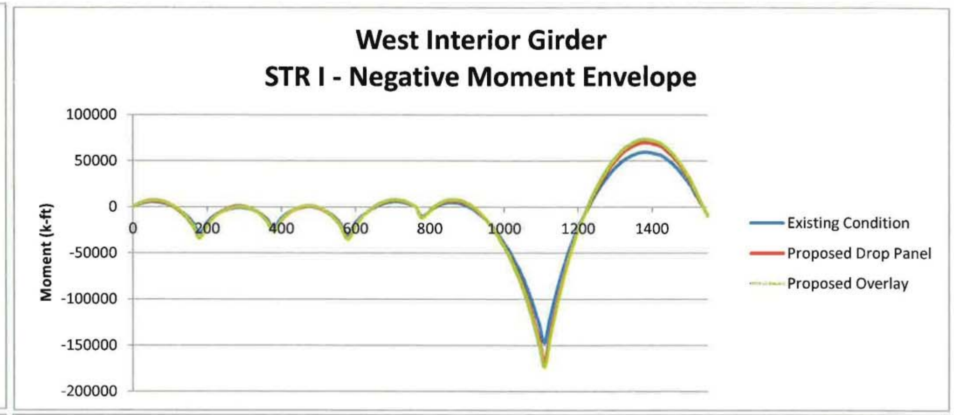
TABLE OF MAXIMUM PERFORMANCE RATIOS		
	West Interior Girder	West Exterior Girder
Existing Condition	1.24	1.02
Proposed Condition	1.16	0.87
% Difference	**-6%**	**-15%**

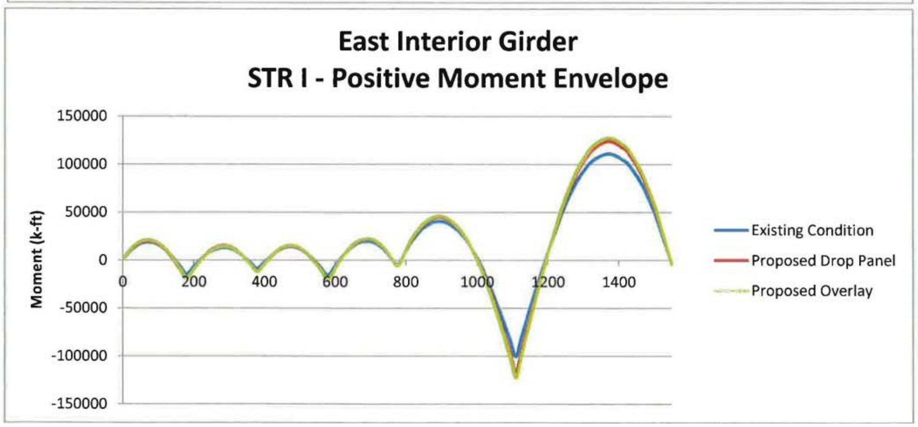
Bridge Analysis – Mixed Use



Bridge Analysis – Mixed Use







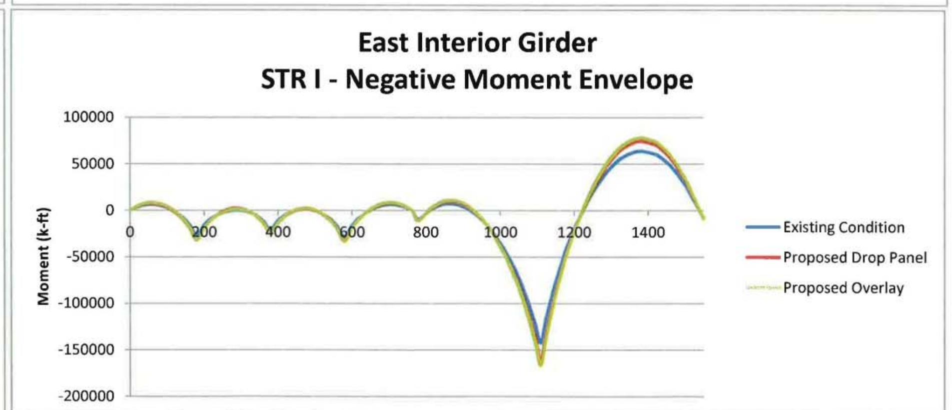


TABLE OF MAXIMUM PERFORMANCE RATIOS				
	West Exterior Girder	West Interior Girder	East Interior Girder	East Exterior Girder
Existing Condition	1.02	1.24	1.20	0.97
Proposed Drop Panel	1.07	1.42	1.36	1.02
% Difference	**5%**	**15%**	**13%**	**5%**

NORTH RAIL
YOUR PLAN TO MOVE US FORWARD

NorthRail Streetcar Study

Public Meeting Informational Boards

Public Meeting #1

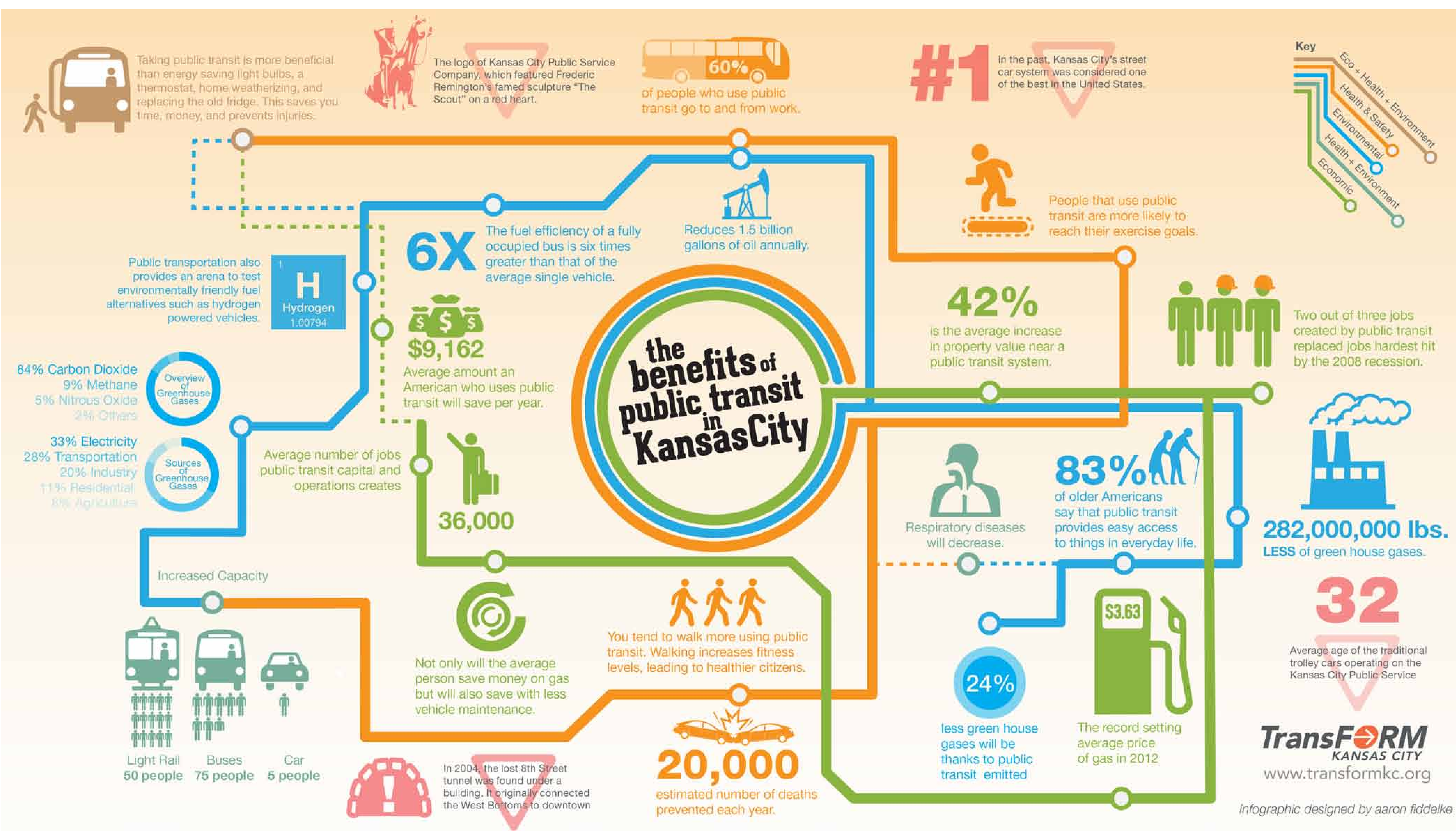
November 21, 2013

WHAT ARE THE BENEFITS OF TRANSIT?

1 83% of older American say that public transit provides easy access to things in everyday life

2 42% is the average in crease in property value near a public transit system

3 60% of people who use public transit are using it to go to and from work



4 $9,162 is the average annual savings of an American who uses public transit

5 20,000 estimated automobile-related deaths prevented per year in America by public transit ridership

6 282 million pounds of greenhouse gases prevented through public transit use in America each year

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COMPARING MODES OF TRANSIT

WHAT ARE OUR HIGH-CAPACITY OPTIONS FOR TRANSIT?	WHAT IS IT, WHERE DOES IT GO, AND WHEN DO I USE IT?	HOW MANY PEOPLE CAN IT CARRY PER HOUR DURING RUSH HOUR?	HOW FAST DOES IT GO ON AVERAGE?	HOW OFTEN DOES IT STOP?	WHEN CAN I GET ON?	REAL WORLD EXAMPLE	
Light Rail	Light Rail is an electrified service that typically operates in its own lane, or in separate rights-of-way. *Typically used to travel from suburbs to central cities.*	400 – 1,400 passengers	15 – 30 mph	¼ to 5 miles apart	RUSH HOUR Every 5 min during rush hour and every 10 to 15 min all other times		The rail system in Houston, Texas and Phoenix, Arizona are light rail. These systems connect residential and employment centers along corridors with proven travel demand.
Street Car	Street Car is an electrified or rubber tire service that can operate in mixed traffic, in its own lane, or in separate rights-of-way. *Typically used to travel in urban locations and can be used to link transit systems.*	700 – 2,000 passengers	10 – 30 mph	2 to 4 blocks up to ½ mile apart	RUSH HOUR Every 10 min during rush hour and every 15 min all other times		Streetcar acts as an urban circulator and a pedestrian accelerator to help shape walkable neighborhoods.
Bus Rapid Transit	Bus Rapid Transit (BRT) operates in mixed traffic or its own lane. It usually consists of longer buses with more technology in them to speed up your trip. For example, many BRT buses communicate with traffic lights to keep lights green longer. *Typically used to travel within a city and between close-in suburbs and the city.*	700 – 1,300 passengers	15 – 30 mph	½ to 1 mile apart	RUSH HOUR Every 10 min during rush hour and every 15 min all other times		The Metropolitan Area Express, or MAX, in Las Vegas, Nevada, is an example of BRT.
Express Bus	Express preferably operates, where available, in highway lanes or designated highway lanes that are free to registered van pools and transit vehicles, and tolled for all other vehicles. The toll rate changes throughout the day based on how much traffic is on the managed lanes in order to keep the lanes fully used without being too busy. *Typically used to travel within a city and between close-in suburbs and the city.*	400 – 900 passengers	40 - 60 mph	Multiple stops within close proximity near termini with 5-25 miles of non-stop service in between	RUSH HOUR Every 10 min during rush hour and every 30 min all other times		Katy managed lanes are operated by the Harris County Toll Road Authority in Houston, TX.
Local Bus	Local bus service uses vehicles sized to meet the demand for service. *Typically used to travel within a city and between centers of population and employment.*	200 – 600 passengers	15 – 30 mph	¾ to 2 miles apart	RUSH HOUR Every 15 to 30 min during rush hour and every 30 to 60 min all other times		Local buses operate at a medium to high level of service to connect activity centers along major roads or access roads, but not highways.

*The passenger ranges show the number of passengers in the early years (low end) and in 2035 (high end). This calculation is based on average vehicle capacity multiplied by the frequency of service during rush hour and by the number of transit vehicles for a one hour period in one direction only. The passenger graphics represent the average of the low end and high end numbers.

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WHAT IS A STREETCAR?

A STREETCAR IS...

Urban Circulator
Downtown Neighborhoods

Usually Mixed Traffic
Shorter Trips

Frequent Service
Quick On And Off

A STREETCAR IS NOT...

Light Rail
Often Exclusive Right-of-way

Commuter Rail
Longer Distances Served

Metro-Rail System
Higher Speeds

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THE POTENTIAL OF A STREETCAR SYSTEM

Streetcar can form the backbone of a fully-integrated regional transit system

1 Streetcar expansion is an opportunity to **reconnect** our City and reintroduce an amenity that improves everyone's **quality of life.**

2 Streetcar expansion is a **strategic investment** in the future of North Kansas City, supporting **unique and thriving neighborhoods** and strengthening the urban core.

3 Streetcar can encourage **new development**, improve access to **jobs and services**, attract **residents and businesses**, increase **transportation options** and more.

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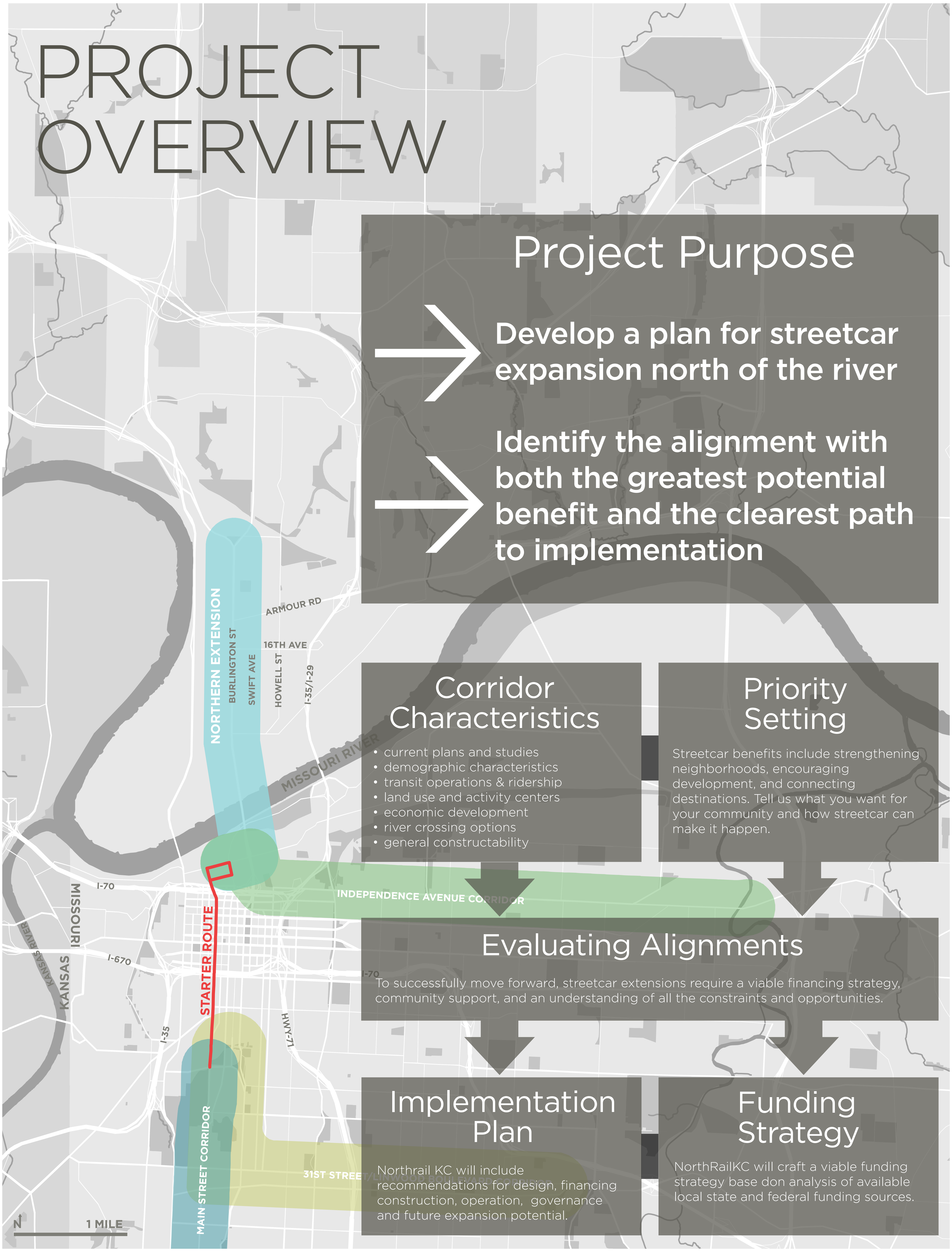
PROJECT OVERVIEW



Project Purpose

→ **Develop a plan for streetcar expansion north of the river**

→ **Identify the alignment with both the greatest potential benefit and the clearest path to implementation**

Corridor Characteristics

- current plans and studies
- demographic characteristics
- transit operations & ridership
- land use and activity centers
- economic development
- river crossing options
- general constructability

Priority Setting

Streetcar benefits include strengthening neighborhoods, encouraging development, and connecting destinations. Tell us what you want for your community and how streetcar can make it happen.

Evaluating Alignments

To successfully move forward, streetcar extensions require a viable financing strategy, community support, and an understanding of all the constraints and opportunities.

Implementation Plan

Northrail KC will include recommendations for design, financing construction, operation, governance and future expansion potential.

Funding Strategy

NorthRailKC will craft a viable funding strategy base don analysis of available local state and federal funding sources.

PROJECT PARTNERS

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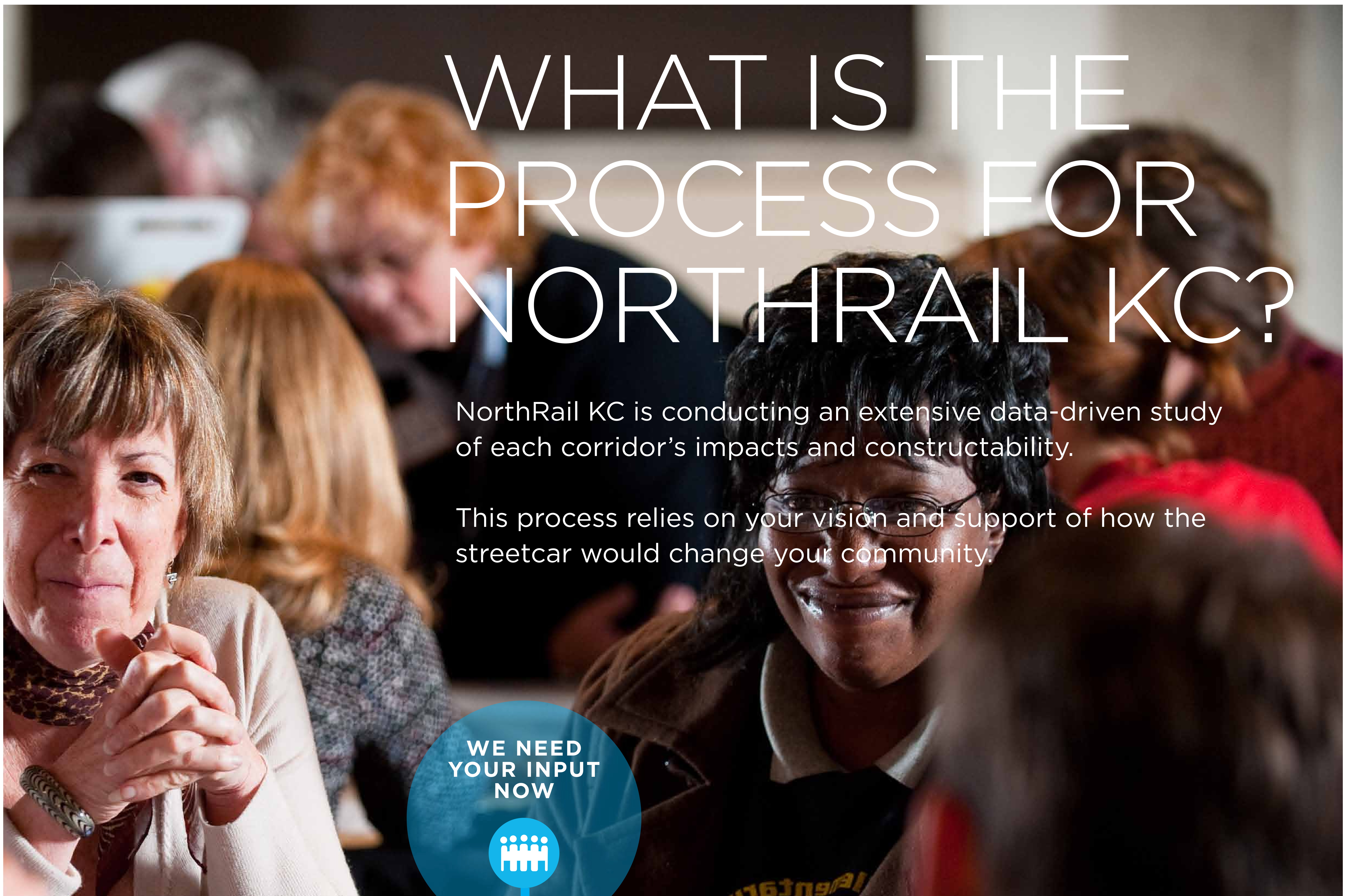
WHAT IS THE PROCESS FOR NORTHRAIL KC?

NorthRail KC is conducting an extensive data-driven study of each corridor's impacts and constructability.

This process relies on your vision and support of how the streetcar would change your community.



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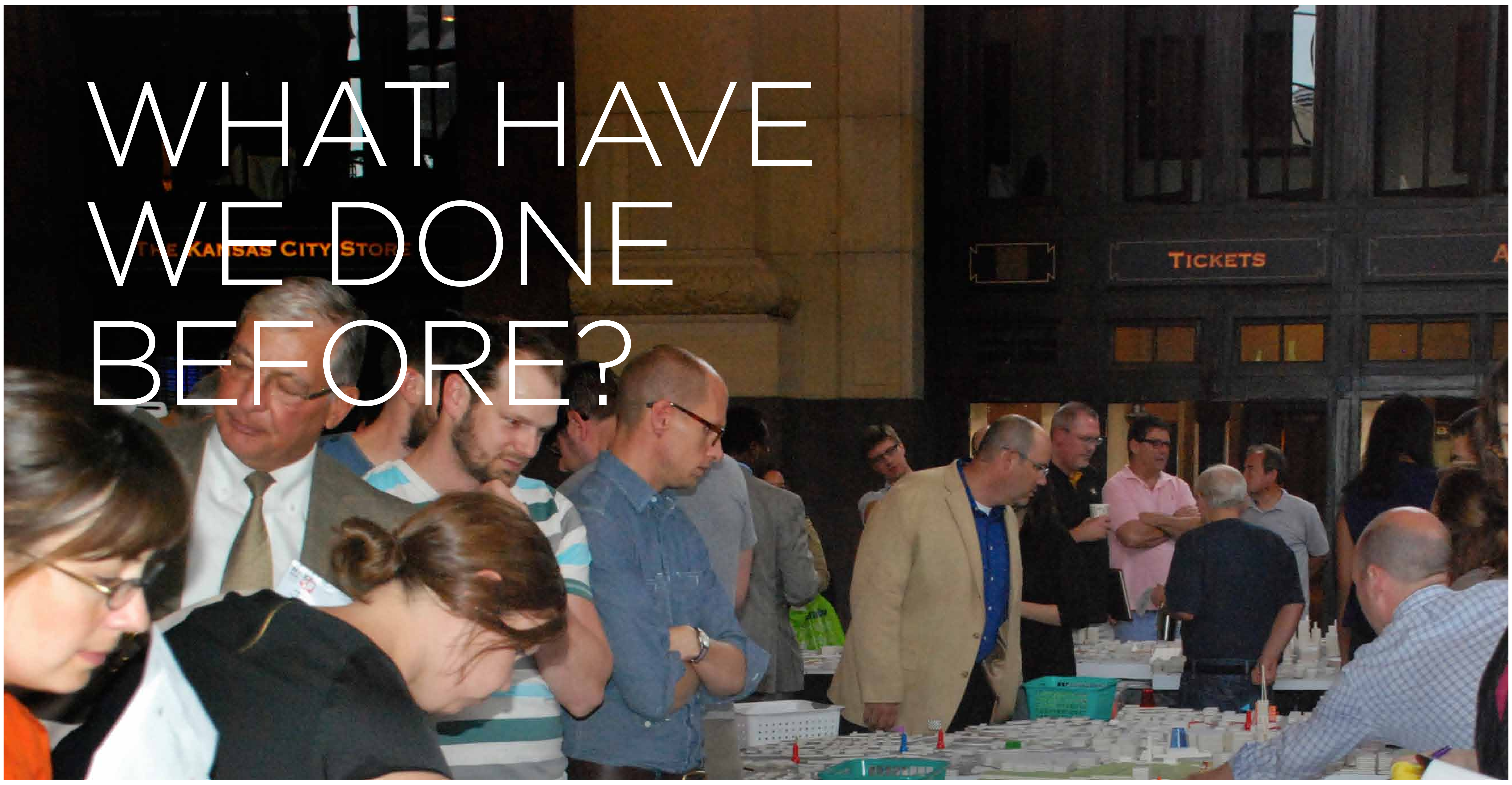


WHAT HAVE WE DONE BEFORE?

BUILDING ON PREVIOUS PLANS

1 NORTH-SOUTH ALTERNATIVES ANALYSIS

- Evaluated north-south corridor from the Northland to south of the Plaza in 2008
- Focused on light rail
- Burlington selected as preferred alignment
- Identified a new transit-exclusive river crossing
- North Kansas City approved funding for their portion but regional ballot measures failed

2 BURLINGTON CORRIDOR STUDY

- 2009 planning process to define future of Burlington corridor.
- Vision for community gateway and urban, mixed-use destination
- Strategies to make Burlington more walkable, attractive, and transit-oriented, including rail

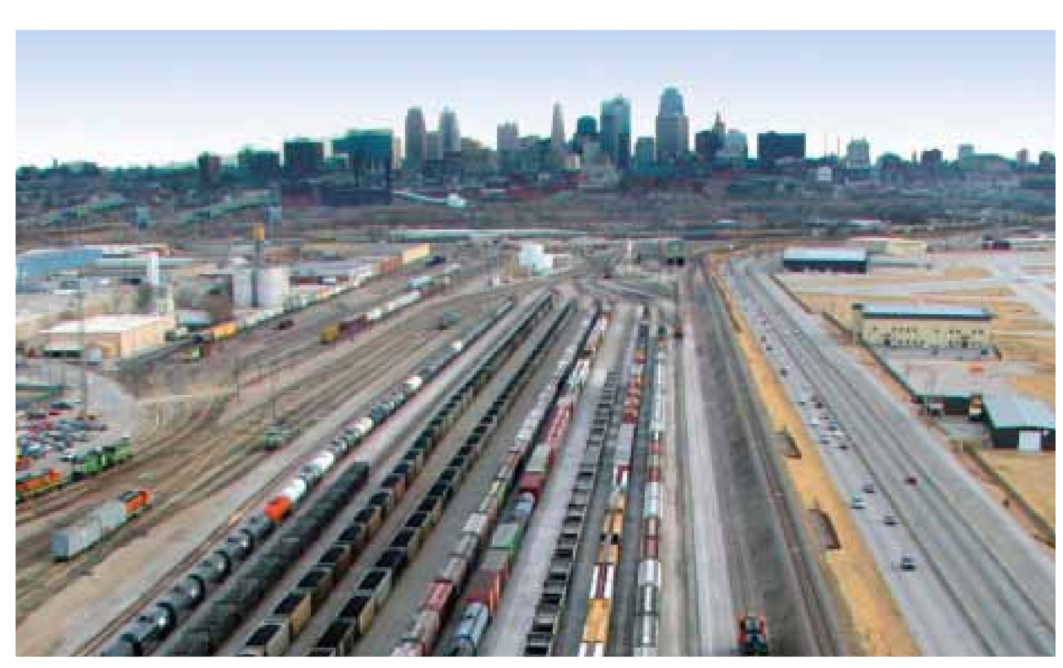
3 NORTH KANSAS CITY STRATEGIC PLAN

- 2012 Action Plan for North Kansas City Council
- Prioritizes redevelopment, active re-use, and improvement of Burlington corridor, all of which could benefit from streetcar expansion

4 NORTH OAK CORRIDOR STUDY

- Examined how transit can be a catalyst for sustainable development and how land use changes can support future transit service
- Options to enhance transit service along the North Oak corridor

5 TRANSPORTATION OUTLOOK 2040



- This MARC plan identifies the North Oak corridor, including connections through North Kansas City, as one of the six highest priority corridors for transit in the region

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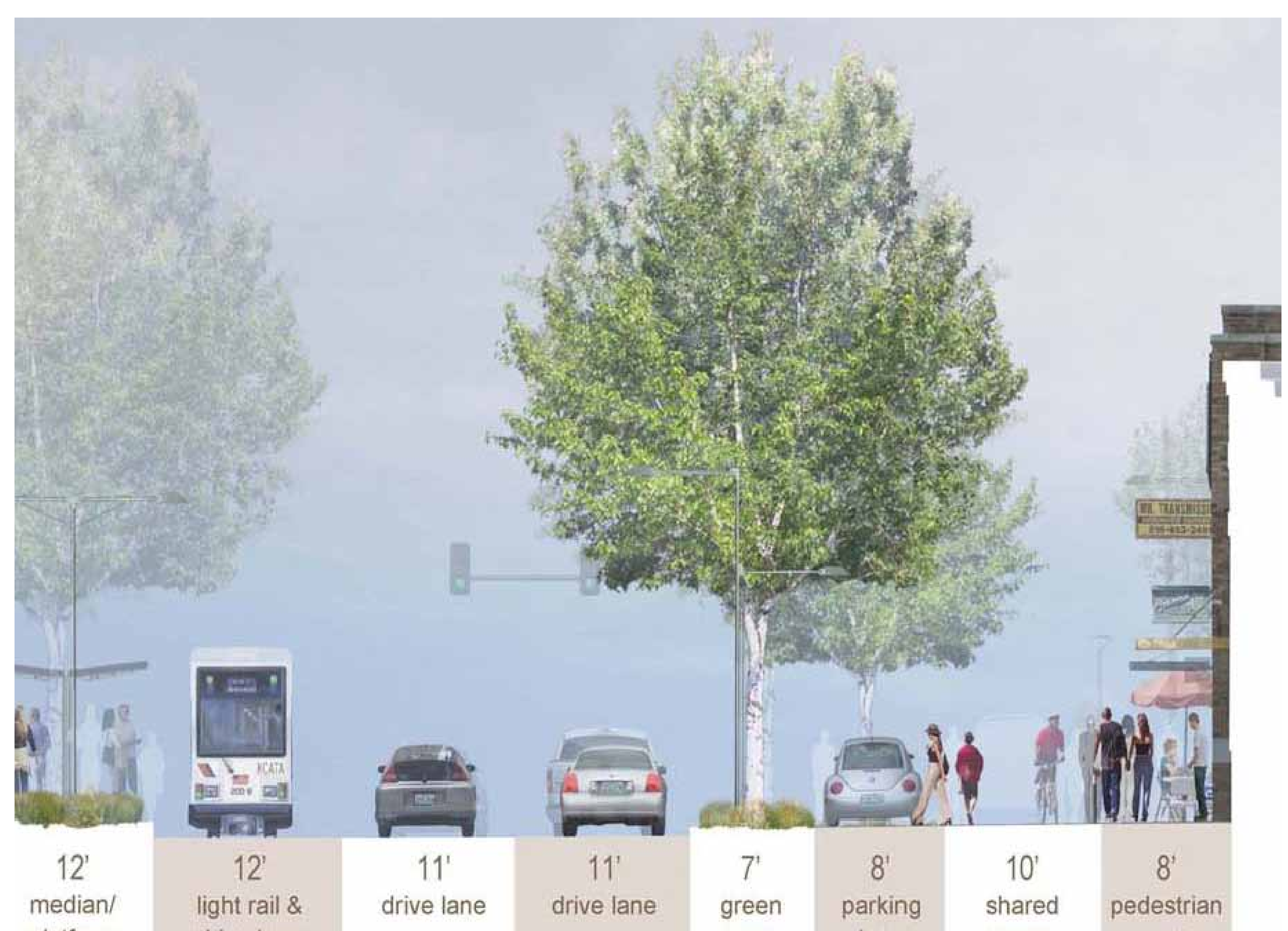
WHAT MAKES THIS PLAN DIFFERENT?

1 PREVIOUS STUDIES FOCUSED ON LIGHT RAIL

- Previous study recommendations were based on light rail as the mode of transit
- Light rail typically requires a dedicated right-of-way, whereas streetcars run in existing traffic
- Different systems have different impacts and considerations



2 THE STREETCAR STARTER ROUTE IS COMING

- This plan will explore how to connect to a system that is already under construction, with plans for expansion to multiple corridors

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WHAT CAN A STREETCAR DO FOR NORTH KANSAS CITY?

1 Streetcar expansion can support efforts to build a more active and vital urban communtiy in North Kansas City.

2 A streetcar can better connect North Kansas City to Downtown, bringing people on both sides of the River close to the jobs, services, and amenties both communites have to offer.

3 A streetcar extension north of the river can unlock the potential for fixed rail transit in the rest of the Northland by overcoming the major barrier of the Missouri River.

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CORRIDOR CHARACTERISTICS

1 EMPLOYMENT DENSITY

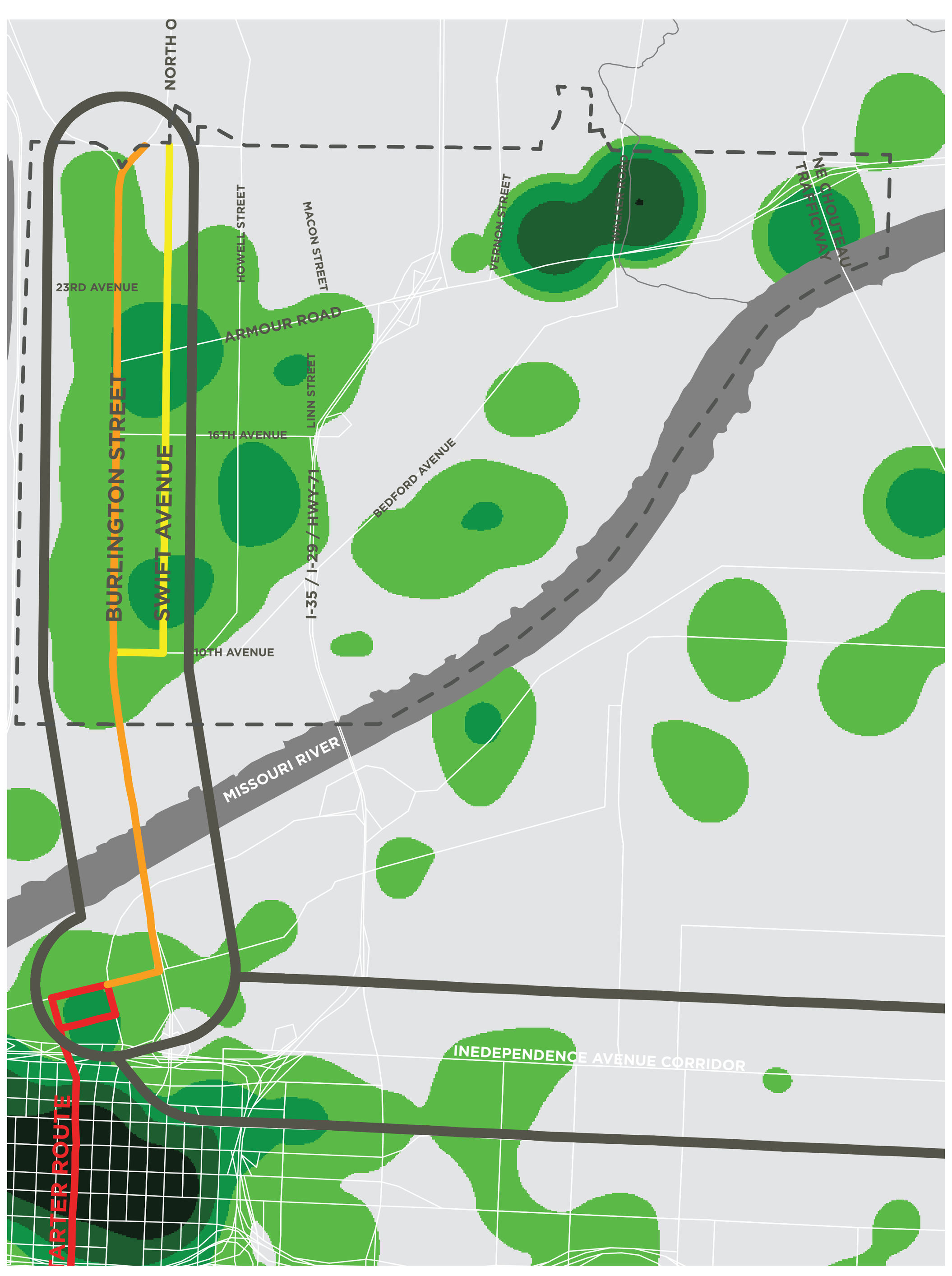
The majority of employment in the corridor is located south of Armour Road. Large portions of the corridor are industrial today and would need to evolve with a greater mix of uses to take fullest advantage of streetcar investments.

2 POPULATION DENSITY

Most people live north of Armour Road, including significant recent development in Northgate village. Swift Avenue travels through the heart of residential neighborhoods while Burlington is located in more commercial areas at the periphery.

3 TRANSIT-DEPENDENT POPUIATION

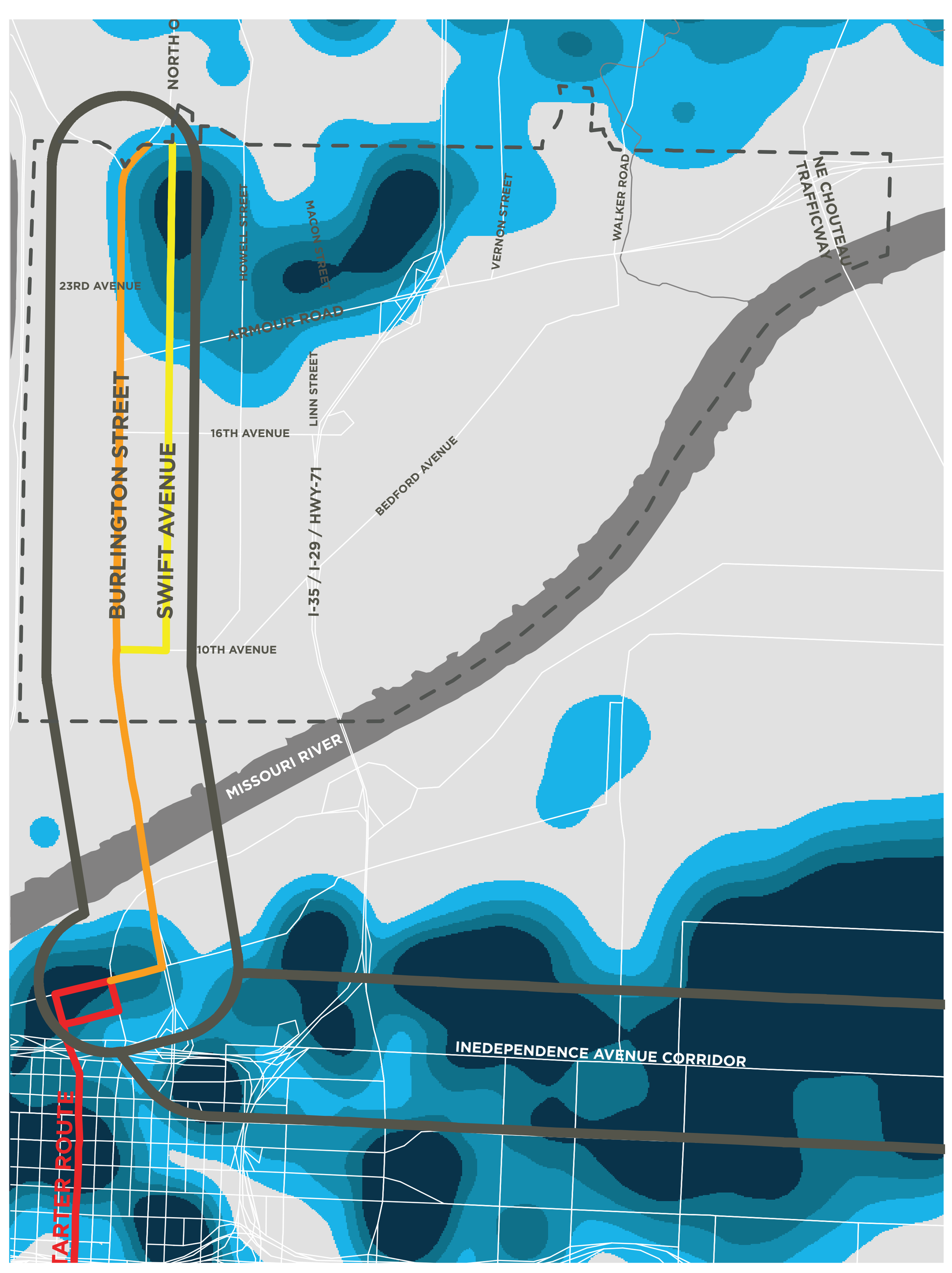
Approximately 12% of the corridor is transit-dependent, with higher concentrations located between Armour Road and 32nd Street. Transit dependency is an important criteria for federal funding.



EMPLOYMENT DENSITY
EMPLOYEES PER SQUARE MILE

- LESS THAN 2,500
- 2,500 to 10,000
- 10,000 to 30,000
- 30,000 to 75000
- GREATER THAN 75,000

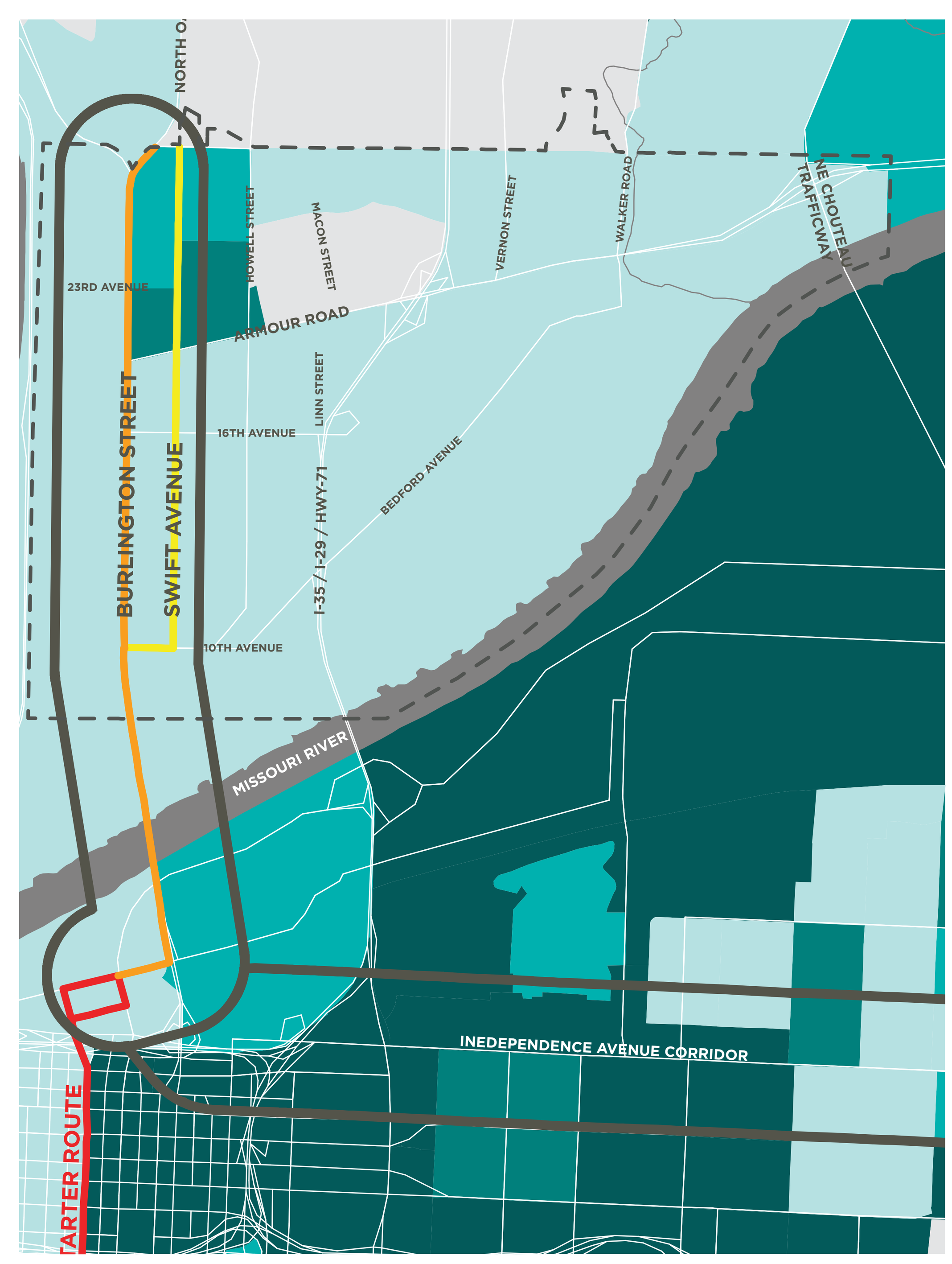
1 MILE



POPULATION DENSITY
POPULATION PER SQUARE MILE

- LESS THAN 1,000
- 1,000 TO 3,000
- 3,000 TO 5,000
- 5,000 TO 7,000
- GREATER THAN 7,000

1 MILE



TRANSIT DEPENDENCE
ZERO CAR HOUSEHOLDS

- 0% TO 5%
- 5% TO 10%
- 10% TO 15%
- 15% TO 20%
- GREATER THAN 20%

1 MILE

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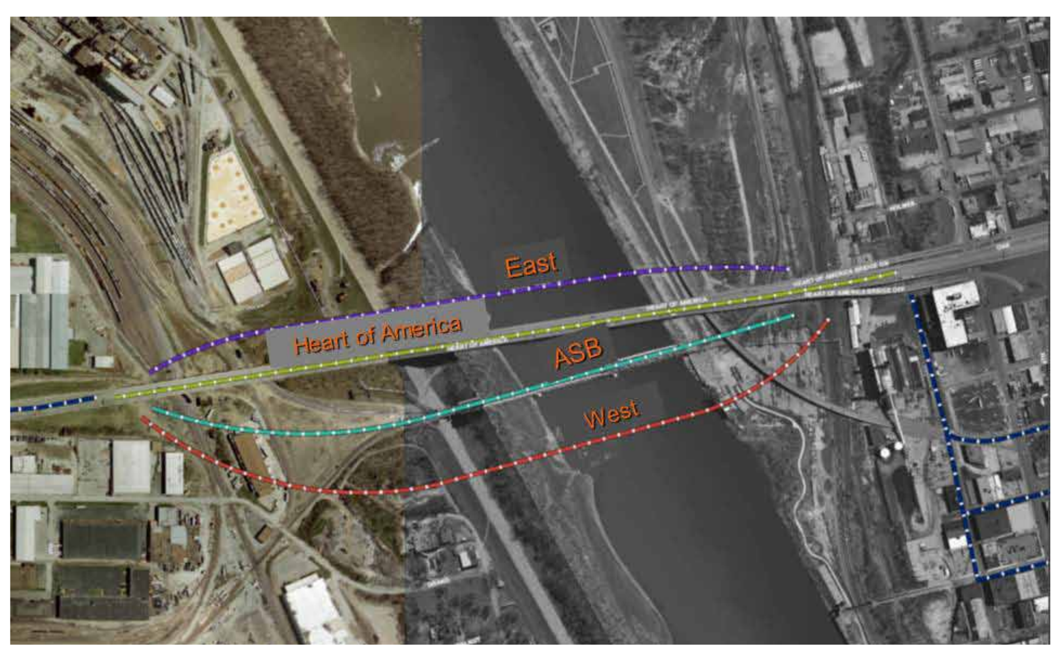
KEY DECISIONS AND CONSIDERATIONS

1 How does the streetcar fit in to future land use and development plans?

- Streetcar can encourage development and help to transform neighborhoods
- Alignment of the streetcar will be a key factor in the location and character of future development

2 How do we cross the river?



Study considerations:
- How do we maintain bike/pedestrian access?
- Will streetcar use dedicated lane on bridge?
- Where will streetcar land after crossing?
- What are the structural limitations of a new or existing structure?

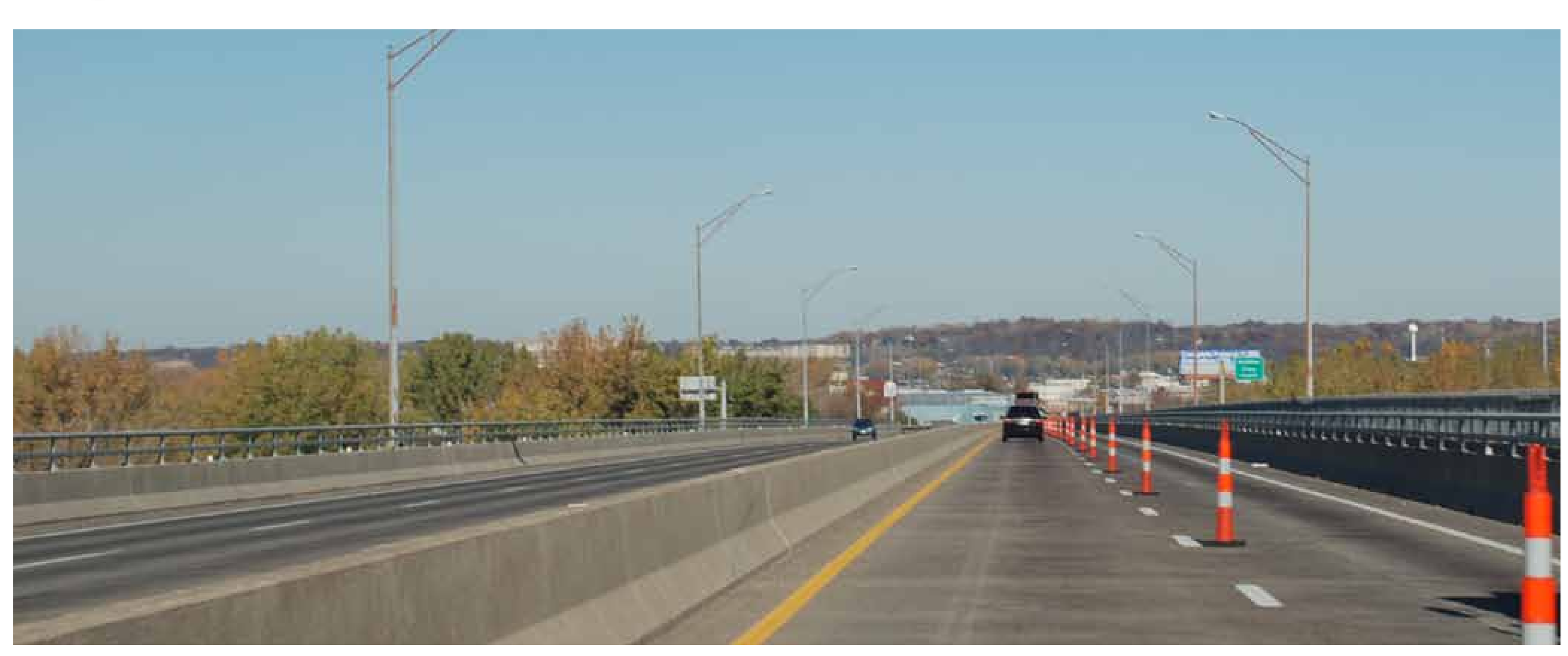
3 Should the streetcar travel on Burlington Street or Swift Avenue?

- Burlington is a major transportation link
- Burlington is not an active mixed-use corridor today, but streetcar could support a community vision for a true urban boulevard
- Swift is a neighborhood scale, neighborhood-oriented street
- Streetcar on Swift could strengthen already active street and directly serve adjacent residents and businesses

4 How will the vehicle function?

- Streetcar can function as a local circulator within North Kansas City
- Streetcar can also connect North Kansas City to other destinations
- Community priorities for how to use the system will impact where it goes and how it operates

5 How can this extension support future expansion into the Northland?



- Consideration of future expansions will inform the evaluation of alignments for the initial extension north of the River

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Public Meeting #2

February 13, 2014

THE POTENTIAL OF A STREETCAR SYSTEM

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2 Streetcar expansion is a **strategic investment** in the future of North Kansas City, supporting **unique and thriving neighborhoods** and strengthening the urban core.

3 Streetcar can encourage **new development**, improve access to **jobs and services**, attract **residents and businesses**, increase **transportation options** and more.

WHAT IS A STREETCAR?

A STREETCAR IS...

Urban Circulator
Downtown Neighborhoods

Frequent Service
Quick On And Off

Usually Mixed Traffic
But it can function in a dedicated lane, similar to many light rail systems.

A STREETCAR IS NOT...

Metro-Rail System
Higher Speeds

Commuter Rail
Longer Distances Served

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PROJECT OVERVIEW

Project Purpose

→ Develop a plan for streetcar expansion north of the river

→ Identify the alignment with both the greatest potential benefit and the clearest path to implementation

Corridor Characteristics

- current plans and studies
- demographic characteristics
- transit operations & ridership
- land use and activity centers
- economic development
- river crossing options
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Streetcar benefits include strengthening neighborhoods, encouraging development, and connecting destinations. Tell us what you want for your community and how streetcar can make it happen.

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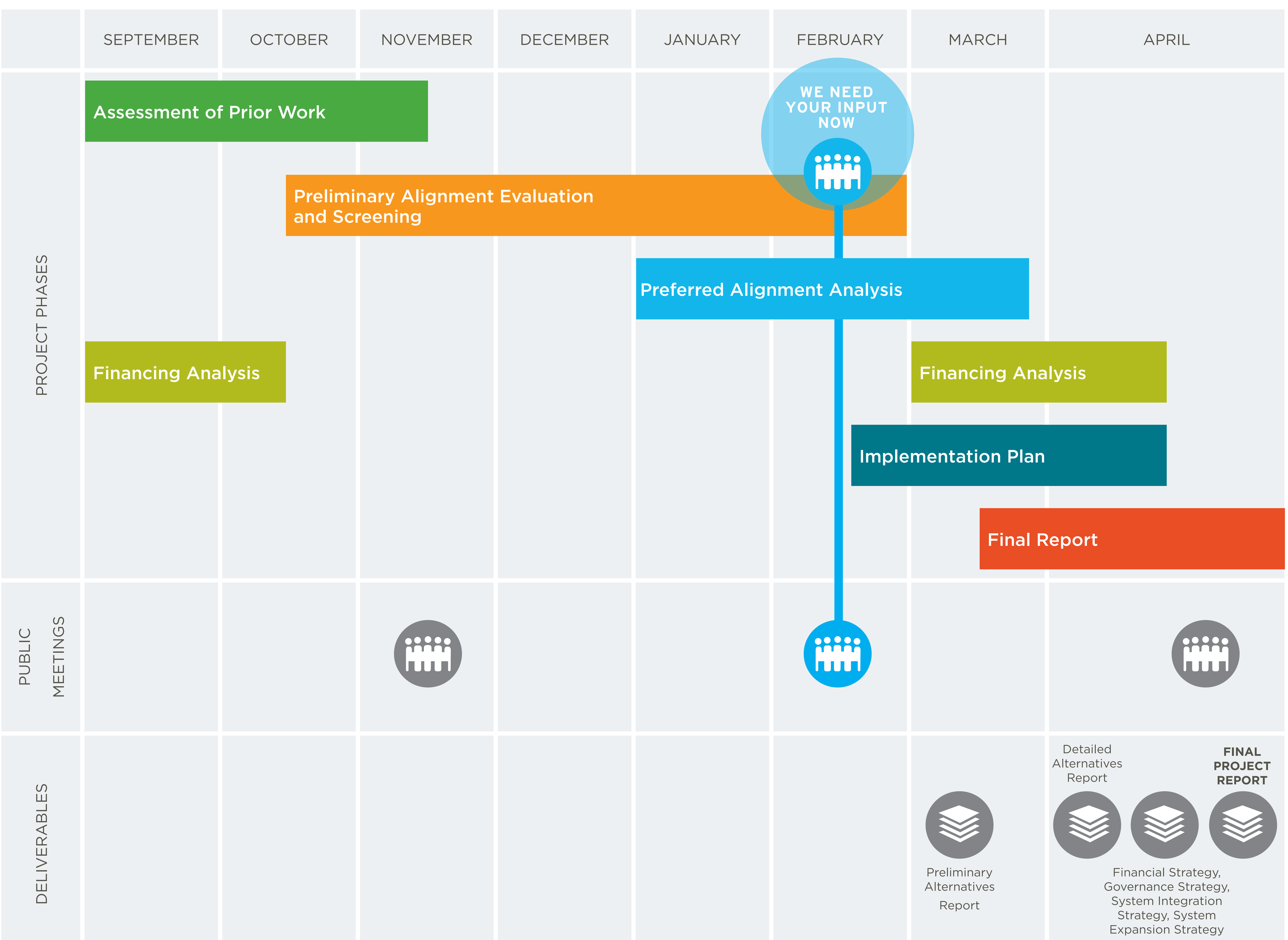
To successfully move forward, streetcar extensions require a viable financing strategy, community support, and an understanding of all the constraints and opportunities.

Implementation Plan

Northrail KC will include recommendations for design, financing construction, operation, governance and future expansion potential.

Funding Strategy

NorthRailKC will craft a viable funding strategy base don analysis of available local state and federal funding sources.



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NEIGHBORHOOD REVITALIZATION AND ECONOMIC DEVELOPMENT

CRITERIA MEASURED

- *Development Capacity* – How much space is available for new development?
- *Development Readiness* – Is there demand and developer interest? Are there walkable, mixed-use conditions in place?
- *Long-Term Opportunity for Revitalization* – Where could streetcar have the greatest impact?
- *Transit-Supportive Planning* – Where can streetcar best support community vision and redevelopment goals?
- *Transit-Supportive Zoning and Policies* – Are policies in place to support streetcar investment, and discourage incompatible development?

Key Findings:

1 DEVELOPMENT CAPACITY

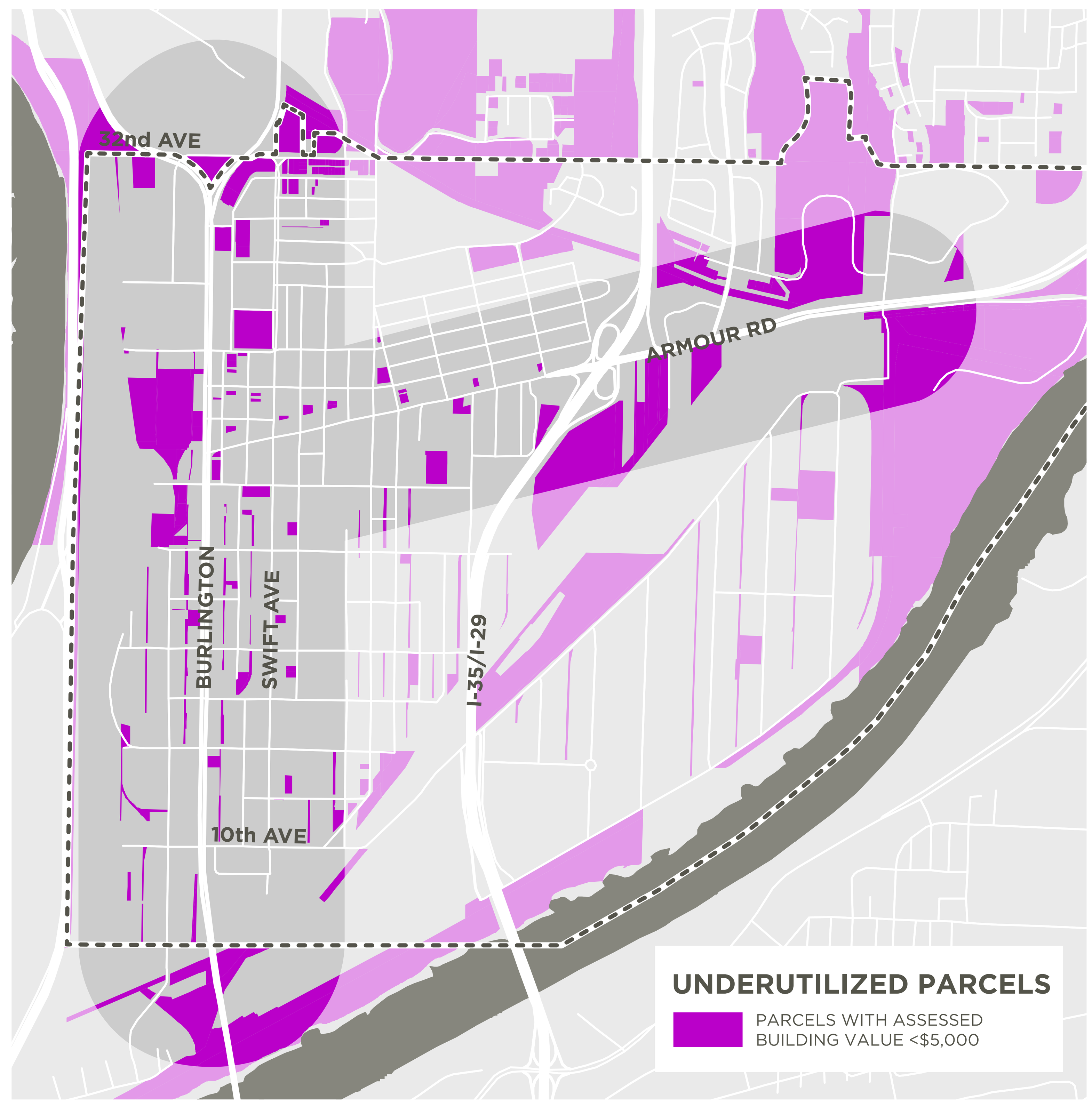
There is significant capacity for new development on Burlington and Armour. There is moderate development capacity on Swift, but Swift generally has smaller lots and fewer vacancies.

2 DEVELOPMENT READINESS

With a walkable mix of uses, Swift is best positioned today to capitalize on the type of economic development that a streetcar can stimulate. To fully realize potential on Burlington, streetcar would need to be coordinated with streetscape improvements, policy and land use changes, and slowing of traffic.

3 LONG-TERM OPPORTUNITY

Because of its role as a highly visible gateway to North Kansas City, extensive community planning efforts, significant development capacity, and large room for improvement, Burlington offers the most long-term potential for impact from a streetcar investment.



Key Tradeoffs:

Pursue long term economic development potential of Burlington, recognizing significant challenges, investment, and time necessary to transform the corridor

OR

Focus on Swift, which is streetcar-ready today, but has more modest opportunities for major redevelopment

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TRANSPORTATION, MOBILITY, AND CONNECTIVITY

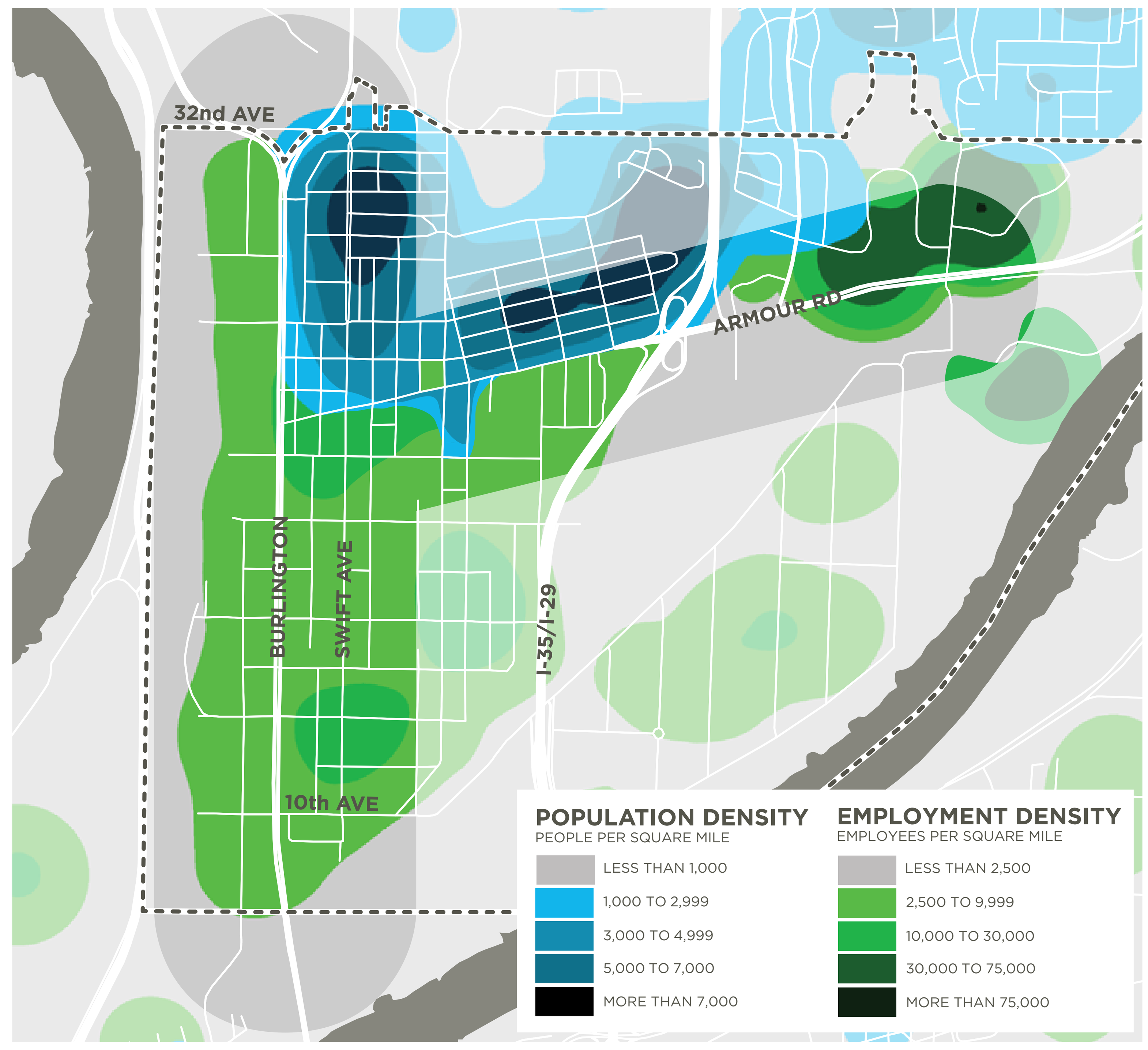
CRITERIA MEASURED

- *Connecting People and Places* – How well do the proposed alignments connect people, jobs, destinations, and activity centers, especially for those dependent on transit?
- *Local Circulation* – Do the proposed alignments have a good network of sidewalks, bike infrastrucutre, and buses to enhance local use of streetcar service?
- *Building a regional system* – How do the proposed alignments support existing transit service and the future expansion of the streetcar system?
- *Ridership* – What is the potential to serve existing transit riders and attract new ridership created by development attracted along the route?

Key Findings:

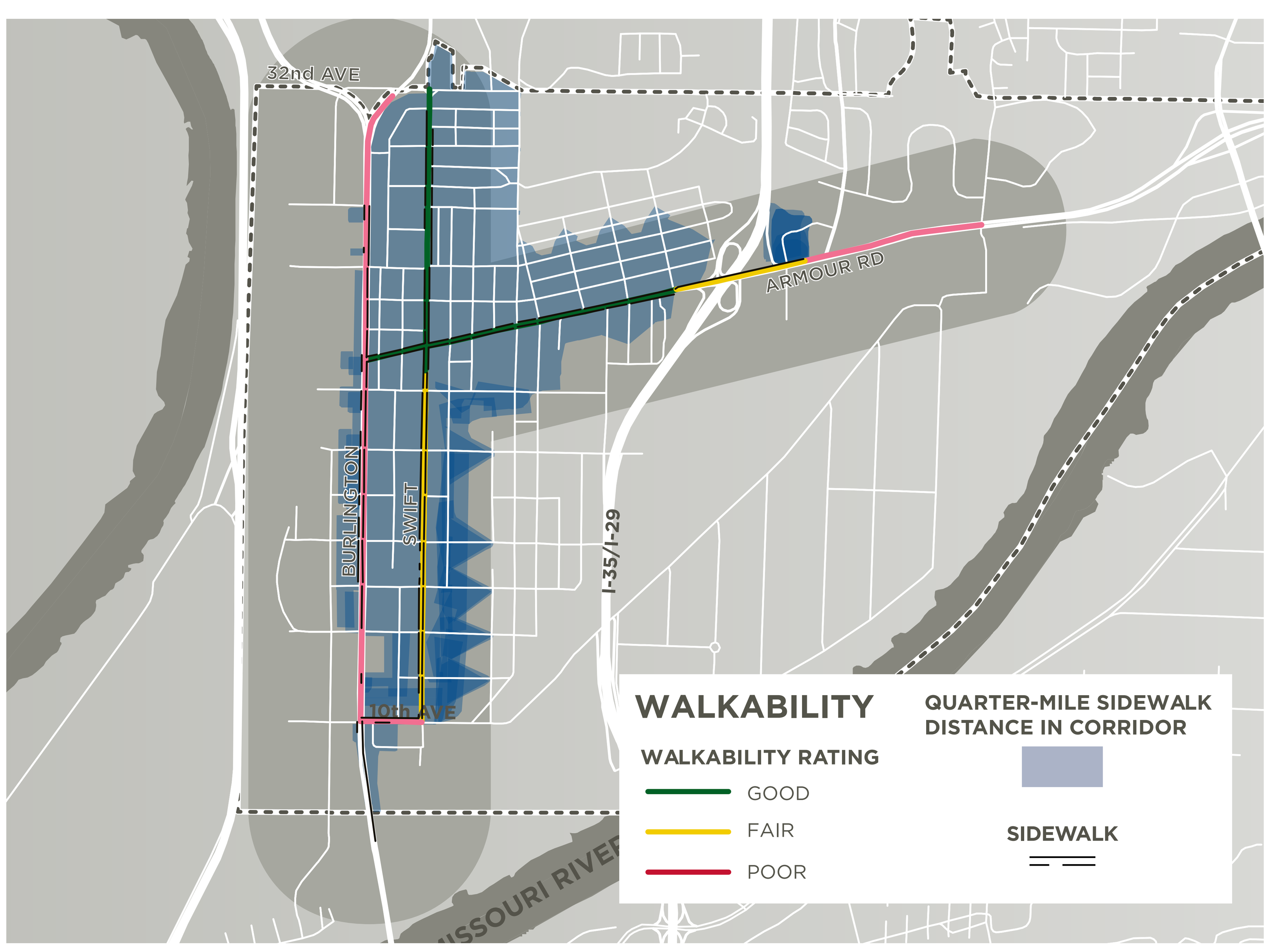
1 POPULATION & EMPLOYMENT

Because it is more centrally located, Swift serves more residents and employees than Burlington. Many residents and employees are located near Armour, but high-density development in Northgate is not well served, and Cerner, NKC Hospital, and the casino are not easily accessible from the roadway.



2 RIDERSHIP POTENTIAL

Current land use and development patterns suggest higher potential ridership on Swift than Burlington or Armour in the short term. Major transit-supportive investments along Burlington would offer the highest long term ridership potential.



3 WALKING/BIKING NETWORK

Traffic and limited sidewalks create walkability challenges on Burlington and eastern sections of Armour. Downtown sections of Swift and Armour have the best network for walking and biking.

4 BUILDING A REGIONAL SYSTEM

Many plans identify Burlington as a preferred regional transit corridor. Swift and Burlington provide opportunities for future expansion to the north. Armour has limited expansion potential because destinations to the north and east are unlikely to connect via Hwy 210.

Key Tradeoffs:

Focus on Burlington, which provides the most efficient connection for enhanced regional transit today, and most potential for future expansion and expanded ridership

OR

Focus on Swift, which serves a greater number of residents and employees in North Kansas City, and has a better pedestrian network to support streetcar ridership in the short term.

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FEASIBILITY

CRITERIA MEASURED

- *Utility Impacts* – Are there public or private utilities along the proposed streetcar alignments that would create significant challenges for construction?
- *Parking and Loading Impacts* – Will the proposed streetcar alignments impact existing parking or truck loading operations, and are there options available to mitigate those impacts?
- *Traffic Impacts* – Will the proposed streetcar alignments increase congestion, reduce traffic speed, increase travel time, or otherwise impact traffic?
- *Bicycle Impacts* – Will the proposed streetcar alignments impact existing bicycle facilities, and are there options available to mitigate those impacts?
- *Cost* – How much will the proposed streetcar alignments cost? Do any of the alignments require specific infrastructure improvements with significant cost?

Key Findings:

1 ON-STREET PARKING

Using a dedicated lane for streetcar on Burlington would result in loss of on-street parking. Mixed-traffic alignments on Burlington, Swift, and Armour could retain most parking spaces with some modification.

2 TRUCK LOADING

Alignments using Swift or a dedicated lane on Burlington could potentially conflicts with industrial truck loading. These conflicts can be resolved but may require changes to street design or business operations.

3 TRAFFIC IMPACTS

A mixed-traffic alignment on Burlington would require a reduction of traffic speed, impacting long term capacity. A streetcar alignment using Swift or dedicated lane on Swift would have minimal traffic impacts.

4 BIKE FACILITIES

Streetcar operations would require reconfiuring bike facilities on Swift. Options include restriping, providing a protected bikeway, or relocating bike facilities to parallel streets or right-of-way

5 MAJOR FEASIBILITY ISSUES

The cost of modifying the I-35/I-29 overpass to accommodate streetcar is a major challenge on Armour. Significant investment in streetscape, road reconfiguration and other infrastructure will be necessary to create a "streetcar-ready" corridor on Burlington.

Key Tradeoffs:

Focus on Burlington, accepting some loss of parking, reduced traffic speed and capacity, and the need for complementary investments, to create a more successful transit corridor.

OR

Focus on Swift, which has fewer construction and traffic impacts than Burlington, but requires addressing bicycle and truck loading accommodations.

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BURLINGTON STREET: OPPORTUNITIES AND CHALLENGES

The Burlington Corridor Study divided Burlington into three different zones each with specific characterstics and recommendations

OPPORTUNITIES

1. Large capacity for new development
2. Greatest long term potential for revitalization, building on extensive community planning
3. Many plans identify as a preferred corridor for regional transit
4. Burlington positions the streetcar system well for future expansion to the north
5. Greatest long-term potential for ridership if coordinated with other transit-supportive investments

CHALLENGES

1. Significant investment, land use changes, and slowing of traffic necessary to create a "streetcar-ready" corridor
2. Serves fewer North Kansas City residents and employees than other alignments
3. Traffic and limited sidewalk infrastructure create walkability challenges
4. Loss of on-street parking if streetcar uses a dedicated lane
5. Reduction in traffic speed and potential regional traffic impacts if streetcar operates in mixed-traffic

POSSIBLE ENDPOINTS

1. **Armour Road**
   With this option, the initial extension of streetcar north of the Missouri River would stop in the key destination of Downtown North Kansas City. The shorter length would result in a lower project cost, and stopping at Armour maintains maximum flexibility for future expansion.

2. **32nd Avenue**
   With this option, the initial extension of streetcar north of the Missouri River would stop at 32nd Ave, where North Kansas City meets Kansas City. Extending to 32nd Avenue more directly serves the dense residential area of Northgate Village, and potential redevelopment sites on Burlington north of Armour. However, the longer route increases the project cost.

Conceptual Cost Estimate:

Dedicated Lane:

- 10th Ave to Armour Rd: **$67-73 Million**
- 10th Ave to 32nd Ave: **$119-132 Million**

Mixed Traffic:

- 10th Ave to Armour Rd: **$63-71 Million**
- 10th Ave to 32nd Ave: **$115-128 Million**

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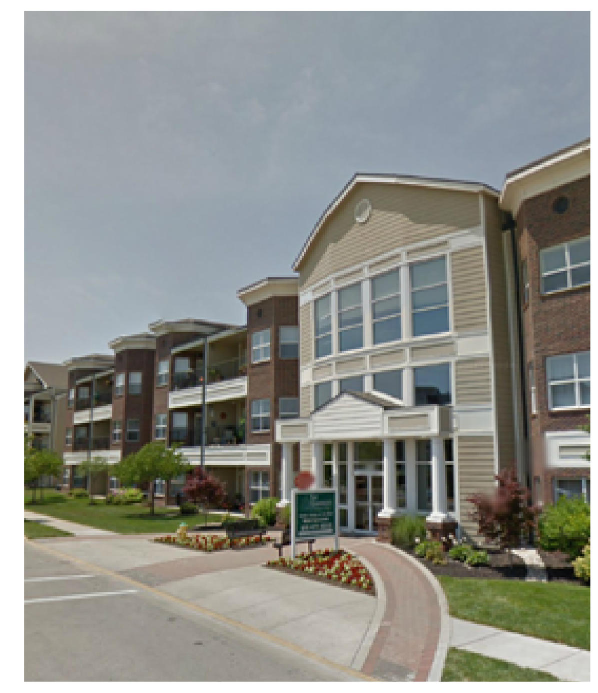
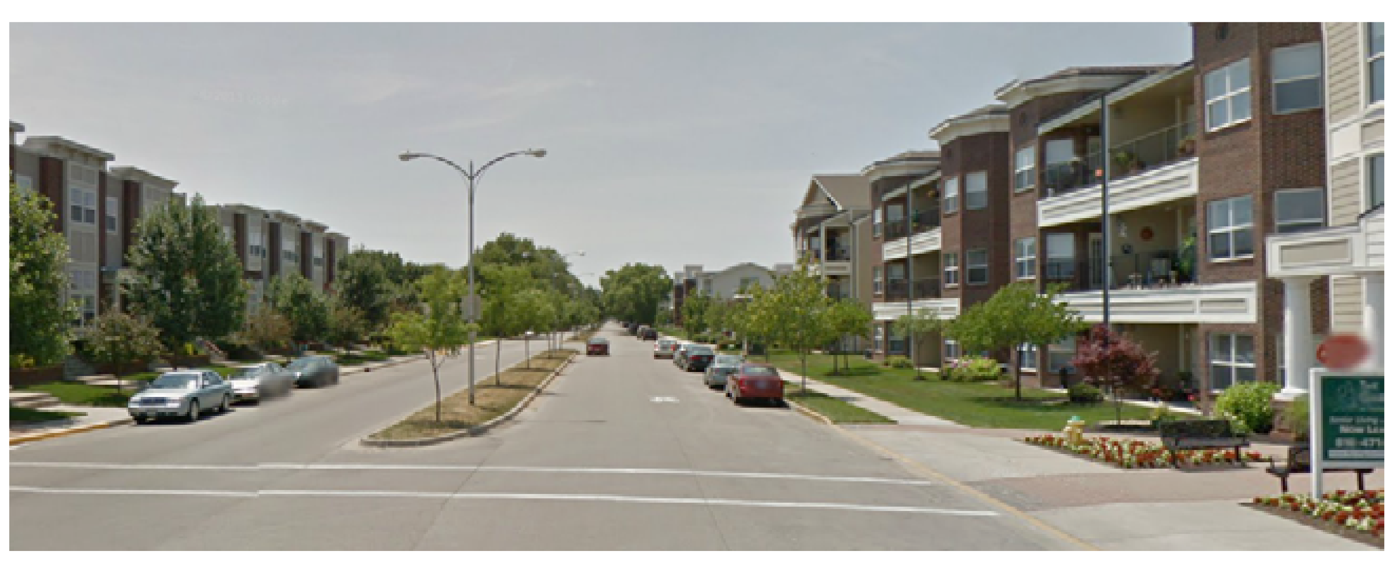
SWIFT AVENUE: OPPORTUNITIES AND CHALLENGES










OPPORTUNITIES

1. Best positioned today to capitalize on the type of economic development and new activity that a streetcar can stimulate
2. With its central location, Swift serves well both residents and employees in North Kansas City
3. Downtown sections of Swift have a good network for walking, biking to support streetcar service
4. Swift positions the streetcar system for future expansion to the north
5. Minimal traffic impacts with Swift alignment
6. Greatest near term potential for ridership due to its existing mix of uses and central location

CHALLENGES

1. Smaller lots,fewer vacancies, and less development capacity than other alignments
2. Requires reconfiguring existing on-street parking but could retain most parking spaces
3. Potentially conflicts with industrial truck loading., but could be resolved through changes to road design or business operations
4. Requires reconfiguring bike facilities. Options include restriping, protected bikeway, or relocating bike facilities to parallel corridors

POSSIBLE ENDPOINTS

1. **Armour Road**
   With this option, the initial extension of streetcar north of the Missouri River would stop in the key destination of Downtown North Kansas City. The shorter length would result in a lower project cost, and stopping at Armour maintains maximum flexibility for future expansion.
2. **32nd Avenue**
   With this option, the initial extension of streetcar north of the Missouri River would stop at 32nd Ave, where North Kansas City meets Kansas City. Extending to 32nd Avenue more directly serves the dense residential area of Northgate Village, and potential redevelopment sites on Burlington north of Armour. However, the longer route increases the project cost.

Conceptual Cost Estimate:

- 10th Ave to Armour Rd: **$76-85 Million**
- 10th Ave to 32nd Ave: **$121-135 Million**

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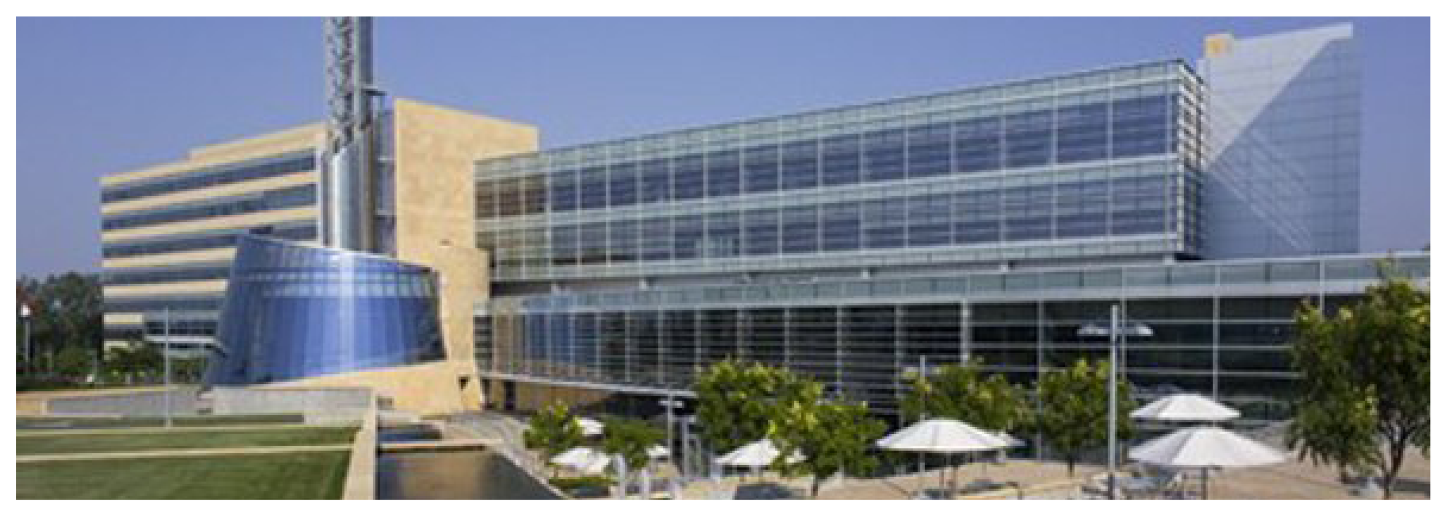
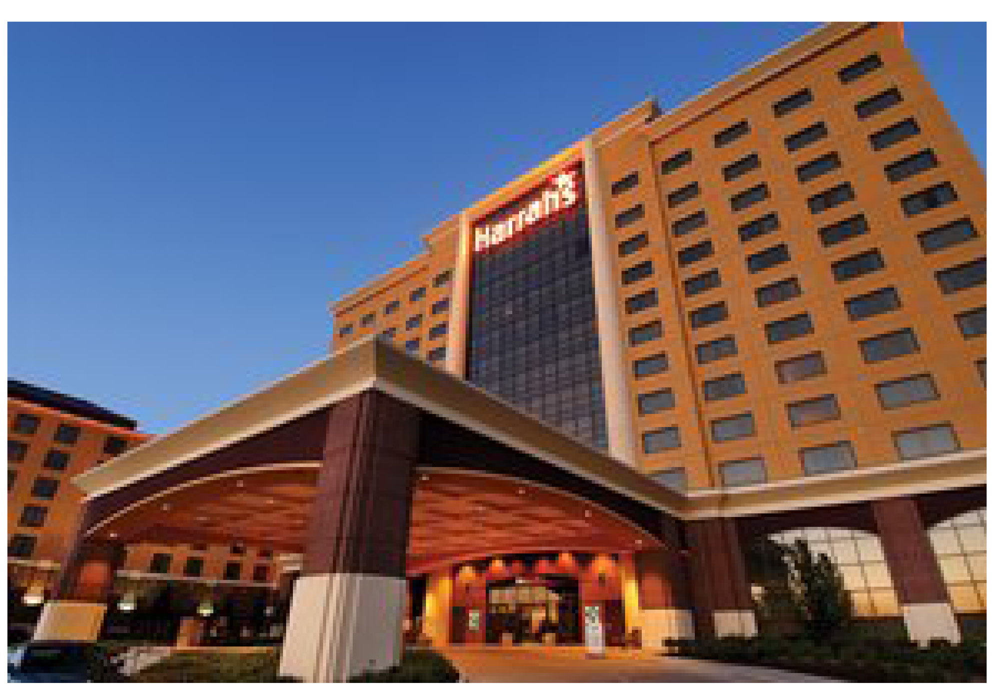
ARMOUR ROAD: OPPORTUNITIES AND CHALLENGES



OPPORTUNITIES

1. Large capacity for new development
2. Serves the greatest number of residents
3. Serves the greatest number of employees if Cerner, NKC Hospital, and Harrah's Casino are included
4. Downtown sections of Armour have a good network for walking and biking to support streetcar service

CHALLENGES

1. Does not serve high-density residential development in Northgate Village as well as other options
2. Key destinations (Cerner, NKC Hospital, Harrah's Casino) are not easily accessible from the roadway and have site challenges that limit potential to capitalize on streetcar investment
3. Traffic and limited sidewalks on eastern sections of Armour create walkability challenges
4. Provides limited expansion opportunities because destinations to the north and east are unlikely to connect via Hwy 210.
5. Require reconfiguration of existing on-street parking but could retain most parking spaces.
6. Cost of reconfiguring the I-35/I-29 overpass to accommodate streetcar is a major challenge
7. Armour is the longest and most expensive alignment

ARMOUR ROAD NOT RECOMMENDED

Based on strong community support at the public Kickoff meeting, the project team added Armour Road as an additional option to be evaluated.. The potential to link the heart of North Kansas City to major destinations like North Kansas City Hospital, Cerner, and Harrah's Casino is significant. However, there are major feasibility challenges that prevent this potential from being realized:

The recently improved I-35/I29 overpass is too low to accommodate streetcar. and would require the significant cost of raising the overpass, lowering the road, or losing a traffic lane. The destinations that an Armour alignment would connect are set back from the road and not easily served.by streetcar. Finally, Hwy 210 offers little opportunity for future expansion compared to alignments headed north. For these reasons, the Project Team and community partners have ruled out an Armour alignment at this time.

Conceptual Cost Estimate:

- 10th Ave to Walker Rd: **$199-219 Million**

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CROSSING THE RIVER

1 EXCLUSIVE STREETCAR LANE ON THE HEART OF AMERICA BRIDGE

COST: $15-35 MILLION

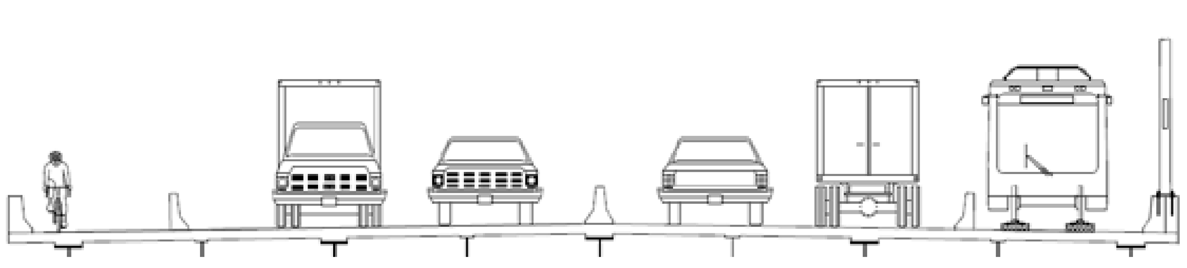
Upper range of cost if bridge deck expanded

ADVANTAGES

- Lower cost than new bridge
- Requires less environmental analysis than new bridge option, resulting in lower cost and faster schedule

DISADVANTAGES

- Reduced streetcar operational flexibility (single track), but well within streetcar needs
- Requires reconfiguring or replacing pedestrian/ bicycle connection across river
- Loss of southbound travel lane would reduce long term traffic capacity (could maintain adequate level of service today)



This option envisions dedicated streetcar lane on the eastern side of the bridge with bike-pedestrian facilities relocated to western side of the bridge, resulting in loss of a southbound traffic lane.

2 NEW FREESTANDING TRANSIT BRIDGE

COST: $40 - 60 MILLION

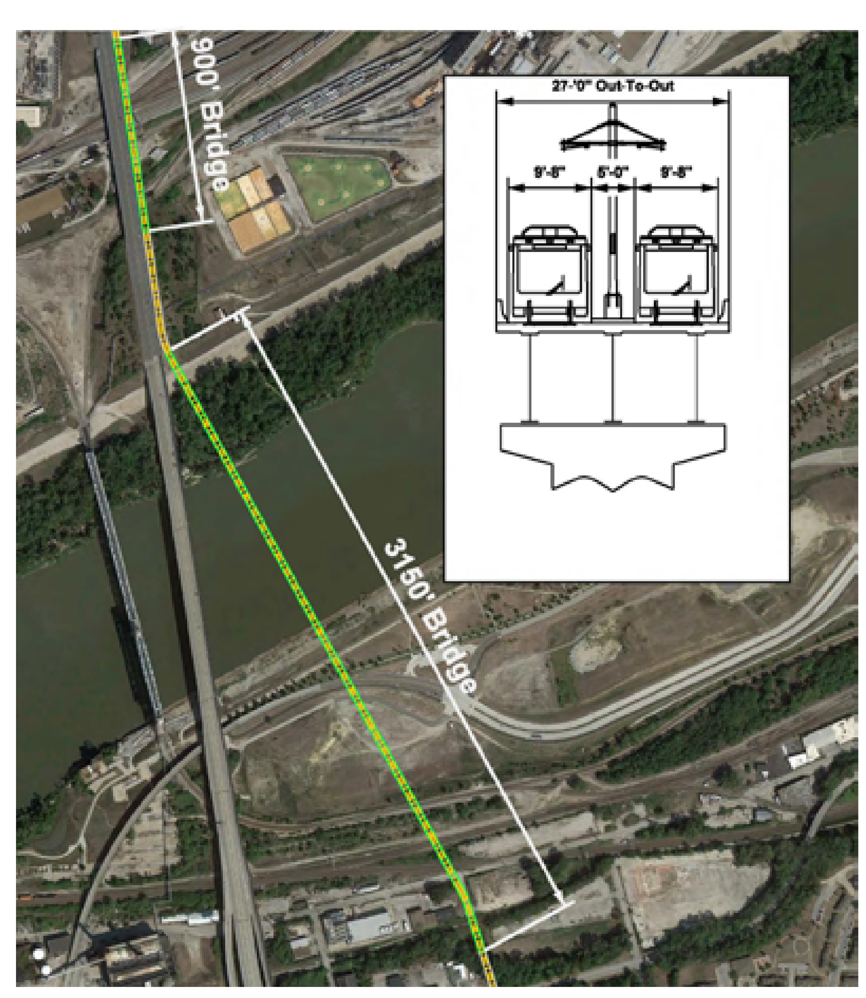
Upper range if bike-ped. facilities included

ADVANTAGES

- Design specifically for Streetcar use
- Long-term flexibility for Streetcar operation (double track)
- Could include bike/pedestrian facilities, which would allow increased traffic capacity on the Heart of America bridge

DISADVANTAGES

- Increased capital cost
- Increased environmental analysis required by new bridge, resulting in higher cost and slower schedule



This option envisions a new transit bridge to accomodate double-tracked streetcar operations. Bike-pedestrian facilities could also be incorporated into a new bridge at increased cost

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SUMMARY

Priorities & Tradeoffs

Neighborhood Revitalization and Economic Development

SHOULD WE

Pursue the long term economic development potential of Burlington, recognizing significant challenges, investment, and time necessary to transform the corridor?

OR

Focus on Swift, which is streetcar-ready today, but has more modest opportunities for major redevelopment?

Transportation, Mobility, and Connectivity

SHOULD WE

Focus streetcar investments on Burlington, which provides the most efficient connection for enhanced regional transit and future expansion of the streetcar system?

OR

Focus streetcar investment on Swift, which serves a greater number of residents and employees in North Kansas City, and has a better pedestrian network to support streetcar?

Feasibility

SHOULD WE

Focus on Burlington, accepting some loss of parking, reduction in auto travel time and capacity, and the need for complementary investments, to create a more successful transit corridor?

OR

Focus on Swift, which has fewer operational challenges and traffic impacts than Burlington, but will require addressing bicycle and truck loading accommodations?

Evaluation of Alignment Options

This evaluation matrix shows the relative strenghts and challenges of each potential streetcar alignment, not including the portion of the streetcar that crossess the river (south of 10th Avenue). Each alignment is rated with "High" being most desirable and "Low" being least desirable conditions for each criteria.

Criteria	Burlington	Burlington	Swift	Armour*	Criteria Description
	Dedicated lane	Mixed Traffic			
Support Neighborhood Revitalization and Economic Development					
Development Capacity	MEDIUM	MEDIUM	LOW	HIGH	How much space is available for new development?
Streetcar Development Readiness	LOW	LOW	MEDIUM	MEDIUM	Is there demand and developer interest? Are there walkable, mixed-use conditions in place?
Long-Term Opportunity for Revitalization	HIGH	HIGH	MEDIUM	MEDIUM	Where could streetcar have the greatest benefit based on capacity today and future plans?
Transit-Supportive Planning	HIGH	HIGH	MEDIUM	LOW	Where can streetcar best support community vision and redevelopment goals?
Transit-Supportive Zoning and Policies	MEDIUM	MEDIUM	MEDIUM	MEDIUM	Are policies in place to support streetcar investment, & discourage incompatible development?
Improve Transportation, Connectivity, and Mobility					
Connecting People, Jobs, & Destinations	MEDIUM	MEDIUM	HIGH	MEDIUM	How well do the proposed alignments connect people, jobs, destinations, & activity centers?
Walkability / Local Circulation	LOW	LOW	HIGH	MEDIUM	Is there a good network of sidewalks, bike facilities, & buses to enhance local use of streetcar?
Building a Regional System	HIGH	HIGH	MEDIUM	LOW	How do the alignments support existing transit & future expansion of the streetcar system?
Ridership Potential	LOW	LOW	MEDIUM	LOW	What is the potential to serve existing transit riders and attract new ridership?
Optimize Route Feasibility					
Estimated Cost to Armour Rd**	$67-73 M	$63-71 M	$76-85 M	To Walker Rd:	How much will each option cost? Do any options require improvements with major costs?
Estimated Cost to 32nd Ave**	$119-132 M	$115-128 M	$121-135 M	$199-219 M	
Major Feasibility Challenges	• Loss of parking • Potential need for R.O.W. acquisition	• Would require reduction of traffic speed	• Would need to reconfigure/ replace bike lane	• Highway overpass would not allow mixed traffic	
Avoidance of Traffic Impacts	MEDIUM	LOW	HIGH	MEDIUM	Will the alignments increase congestion, reduce traffic speed, or otherwise impact traffic?
Avoidance of Parking & Loading Impacts	LOW	HIGH	MEDIUM	HIGH	Will the proposed streetcar alignments impact existing parking or truck loading operations?
Avoidance of Bicycle Impacts	HIGH	MEDIUM	LOW	MEDIUM	Will the proposed streetcar alignments impact existing bicycle facilities?

*Due to major feasibility challenges, an Armour Rd streetcar alignment is not being recommended at this time.
**Costs exclude cost of crossing the Missouri River

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COST AND FINANCING

1 WHAT WILL THIS PROJECT COST?

These costs are presented as orders of magnitude, which are ranges of cost estimates used early on in the planning stages of a project for the purpose ofcomparing options within the same project. Costs are presented in 2019 dollars.

CROSSING THE RIVER

HEART OF AMERICA BRIDGE	**$15 M** (USE 1 EXISTING TRAFFIC LANE)
	$35 M (EXPAND BRIDGE DECK)
NEW TRANSIT BRIDGE	**$40 M**
	$60 M (INCLUDES BIKE/PED LANE)

+

ALIGNMENT OPTIONS

BURLINGTON	TO ARMOUR:	$67M - $73 M
	TO 32ND AVE:	$119M - $123 M
BURLINGTON	TO ARMOUR:	$63M - $71 M
	TO 32ND AVE:	$115M - $128 M
SWIFT	TO ARMOUR:	$76M - $85 M
	TO 32ND AVE:	$121M - $135 M

=

$86M to $195M
IN 2019 DOLLARS

2 HOW IS THE DOWNTOWN STREETCAR BEING PAID FOR?

While there are many possible strategies for paying for this project that are still be explored, a preferred funding option has not been determined. Here's an examplke of how the Downtown Streetcar line was paid for.

HOW IS THE DOWNTOWN STARTER LINE BEING PAID FOR?

FEDERAL GOVERNMENT GRANTS	$37 MILLION
BOND-FINANCED REPAID BY TDD	$63 MILLION
TOTAL CONSTRUCTION BUDGET	$100 MILLION

*NUMBERS ARE ROUNDED

WHAT ARE THE DOWNTOWN TDD REVENUE SOURCES?

ONE PERCENT SALES TAX	$3.9 MILLION
RESIDENTIAL PROPERTY ASSESSMENTS	$0.8 MILLION
COMMERCIAL PROPERTY ASSESSMENTS	$2.7 MILLION
CITY-OWNED PROPERTY ASSESSMENTS	$0.8 MILLION
NONPROFIT-OWNED ASSESSMENTS	$0.16 MILLION
TOTAL ANNUALLY	$8.4 MILLION

*NUMBERS ARE ROUNDED
**ACTUAL AMOUNT WILL VARY BASED ON MARKET CONDITIONS UPON BOND SALE

ANNUAL STARTER LINE BUDGET PAID FROM TDD REVENUE

ANNUAL OPERATING AND MAINTENANCE COSTS:	$2.8 MILLION
ANNUAL BOND PAYMENT:**	$6.1 MILLION

*NUMBERS ARE ROUNDED
**ACTUAL AMOUNT WILL VARY BASED ON MARKET CONDITIONS UPON BOND SALE

DOWNTOWN ASSESSMENT RATES

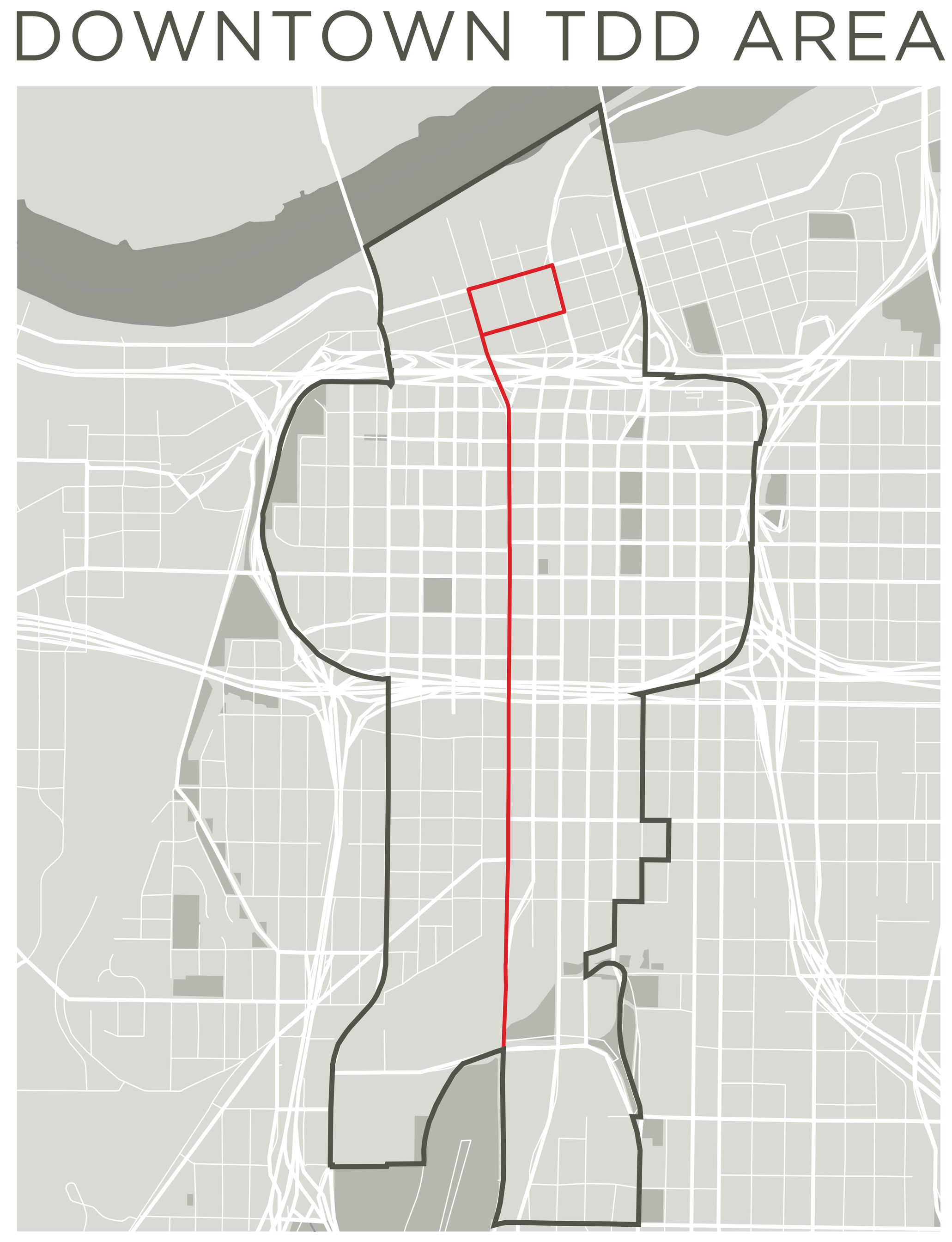
PER $100 ASSESSED VALUE

RESIDENTIAL	$0.70
NON-RESIDENTIAL	$0.48
CITY-OWNED	$1.04
NONPROFIT-OWNED ONLY MARKET VALUE OVER $300,000	$0.40

DOWNTOWN ASSESSMENT EXAMPLES

HOUSE/CONDO WITH $100,000 MARKET VALUE	$133 ANNUAL PAYMENT
COMMERCIAL BUILDING VALUED BY COUNTY AT $500,000	$768 ANNUAL PAYMENT

DOWNTOWN TDD AREA



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Public Meeting #3

April 23, 2014

PROJECT OVERVIEW

Project Purpose

→ Develop a plan for streetcar expansion north of the river

→ Identify the alignment with both the greatest potential benefit and the clearest path to implementation

Corridor Characteristics

- current plans and studies
- demographic characteristics
- transit operations & ridership
- land use and activity centers
- economic development
- river crossing options
- general constructability

Priority Setting

Streetcar benefits include strengthening neighborhoods, encouraging development, and connecting destinations. Tell us what you want for your community and how streetcar can make it happen.

Evaluating Alignments

To successfully move forward, streetcar extensions require a viable financing strategy, community support, and an understanding of all the constraints and opportunities.

Implementation Plan

Northrail KC will include recommendations for design, financing construction, operation, governance and future expansion potential.

Funding Strategy

NorthRailKC will craft a viable funding strategy based on analysis of available local state and federal funding sources.

THE POTENTIAL OF A STREETCAR SYSTEM

1 Streetcar expansion is an opportunity to **reconnect** our City and reintroduce an amenity that improves everyone's **quality of life.**

2 Streetcar expansion is a **strategic investment** in the future of North Kansas City, supporting **unique and thriving neighborhoods** and strengthening the urban core.

3 Streetcar can encourage **new development**, improve access to **jobs and services**, attract **residents and businesses**, increase **transportation options** and more.

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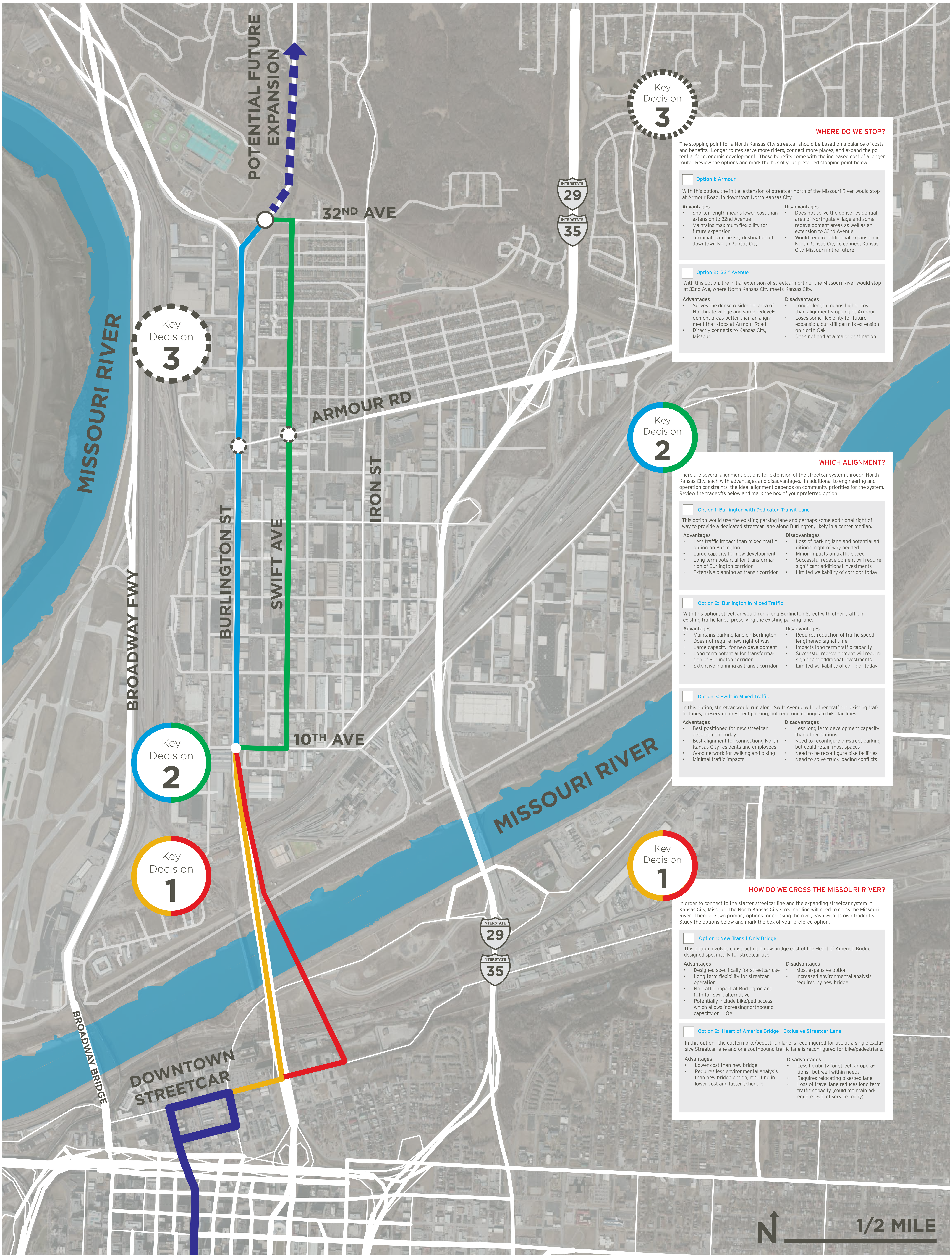

Key Decision 1

HOW DO WE CROSS THE MISSOURI RIVER?

In order to connect to the starter streetcar line and the expanding streetcar system in Kansas City, Missouri, the North Kansas City streetcar line will need to cross the Missouri River. There are two primary options for crossing the river, eash with its own tradeoffs. Study the options below and mark the box of your prefered option.

☐ **Option 1: New Transit Only Bridge**

This option involves constructing a new bridge east of the Heart of America Bridge designed specifically for streetcar use.

Advantages
- Designed specifically for streetcar use
- Long-term flexibility for streetcar operation
- No traffic impact at Burlington and 10th for Swift alternative
- Potentially include bike/ped access which allows increasingnorthbound capacity on HOA

Disadvantages
- Most expensive option
- Increased environmental analysis required by new bridge

☐ **Option 2: Heart of America Bridge - Exclusive Streetcar Lane**

In this option, the eastern bike/pedestrian lane is reconfigured for use as a single exclusive Streetcar lane and one southbound traffic lane is reconfigured for bike/pedestrians.

Advantages
- Lower cost than new bridge
- Requires less environmental analysis than new bridge option, resulting in lower cost and faster schedule

Disadvantages
- Less flexibility for streetcar operations, but well within needs
- Requires relocating bike/ped lane
- Loss of travel lane reduces long term traffic capacity (could maintain adequate level of service today)

Key Decision 2

WHICH ALIGNMENT?

There are several alignment options for extension of the streetcar system through North Kansas City, each with advantages and disadvantages. In additional to engineering and operation constraints, the ideal alignment depends on community priorities for the system. Review the tradeoffs below and mark the box of your preferred option.

☐ **Option 1: Burlington with Dedicated Transit Lane**

This option would use the existing parking lane and perhaps some additional right of way to provide a dedicated streetcar lane along Burlington, likely in a center median.

Advantages
- Less traffic impact than mixed-traffic option on Burlington
- Large capacity for new development
- Long term potential for transformation of Burlington corridor
- Extensive planning as transit corridor

Disadvantages
- Loss of parking lane and potential additional right of way needed
- Minor impacts on traffic speed
- Successful redevelopment will require significant additional investments
- Limited walkability of corridor today

☐ **Option 2: Burlington in Mixed Traffic**

With this option, streetcar would run along Burlington Street with other traffic in existing traffic lanes, preserving the existing parking lane.

Advantages
- Maintains parking lane on Burlington
- Does not require new right of way
- Large capacity for new development
- Long term potential for transformation of Burlington corridor
- Extensive planning as transit corridor

Disadvantages
- Requires reduction of traffic speed, lengthened signal time
- Impacts long term traffic capacity
- Successful redevelopment will require significant additional investments
- Limited walkability of corridor today

☐ **Option 3: Swift in Mixed Traffic**

In this option, streetcar would run along Swift Avenue with other traffic in existing traffic lanes, preserving on-street parking, but requiring changes to bike facilities.

Advantages
- Best positioned for new streetcar development today
- Best alignment for connectiong North Kansas City residents and employees
- Good network for walking and biking
- Minimal traffic impacts

Disadvantages
- Less long term development capacity than other options
- Need to reconfigure on-street parking but could retain most spaces
- Need to be reconfigure bike facilities
- Need to solve truck loading conflicts

Key Decision 3

WHERE DO WE STOP?

The stopping point for a North Kansas City streetcar should be based on a balance of costs and benefits. Longer routes serve more riders, connect more places, and expand the potential for economic development. These benefits come with the increased cost of a longer route. Review the options and mark the box of your preferred stopping point below.

☐ **Option 1: Armour**

With this option, the initial extension of streetcar north of the Missouri River would stop at Armour Road, in downtown North Kansas City

Advantages
- Shorter length means lower cost than extension to 32nd Avenue
- Maintains maximum flexibility for future expansion
- Terminates in the key destination of downtown North Kansas City

Disadvantages
- Does not serve the dense residential area of Northgate village and some redevelopment areas as well as an extension to 32nd Avenue
- Would require additional expansion in North Kansas City to connect Kansas City, Missouri in the future

☐ **Option 2: 32nd Avenue**

With this option, the initial extension of streetcar north of the Missouri River would stop at 32nd Ave, where North Kansas City meets Kansas City.

Advantages
- Serves the dense residential area of Northgate village and some redevelopment areas better than an alignment that stops at Armour Road
- Directly connects to Kansas City, Missouri

Disadvantages
- Longer length means higher cost than alignment stopping at Armour
- Loses some flexibility for future expansion, but still permits extension on North Oak
- Does not end at a major destination

KEY ALIGNMENT DECISIONS

Community Workshop
February 13, 2014

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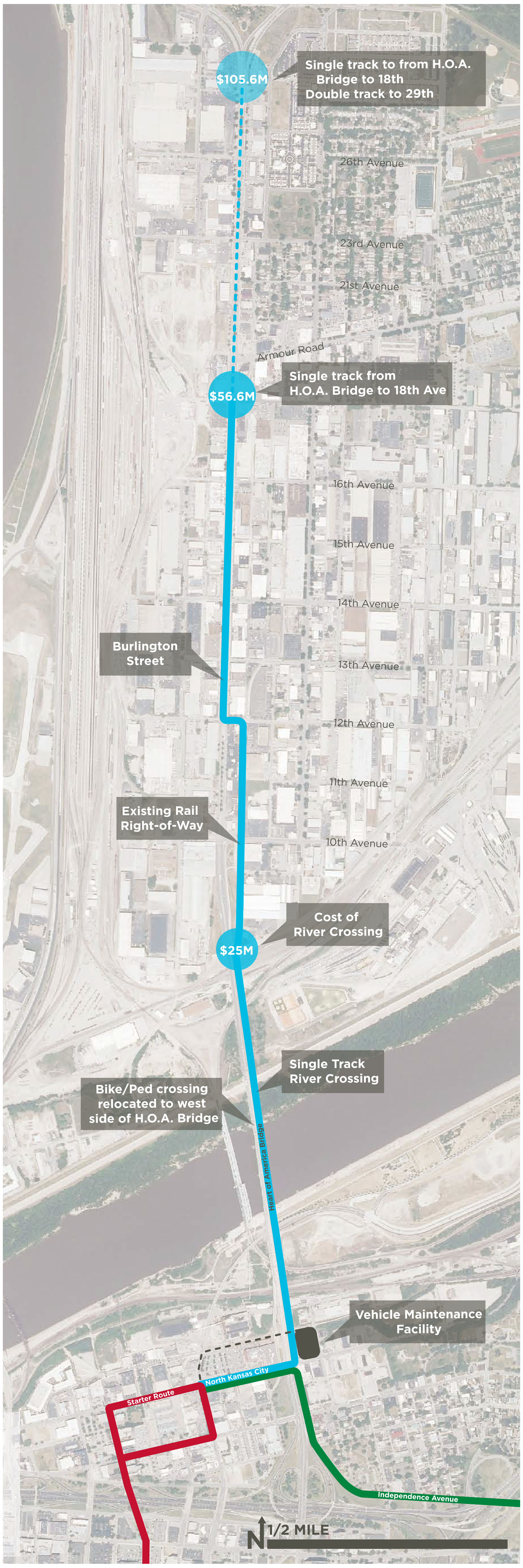
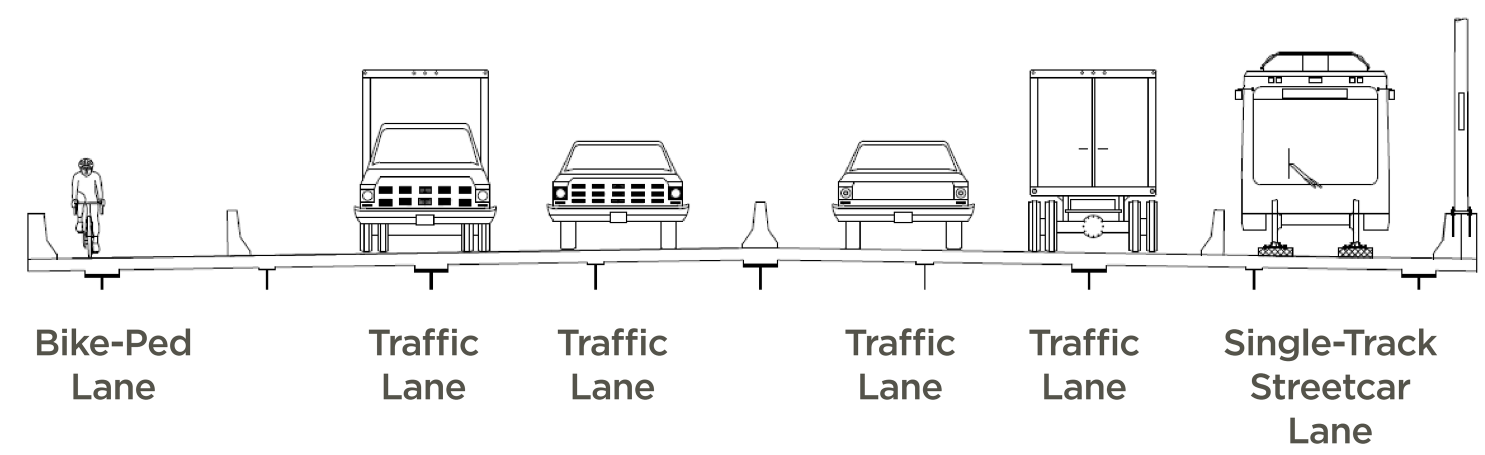
RECOMMENDED ALIGNMENT



1 HEART OF AMERICA BRIDGE TO EXISTING RAIL RIGHT-OF-WAY

- The Heart of America (HOA) Bridge option is a much lower cost than a new bridge.
- The HOA Bridge option can maintain adequate levels of service for auto traffic.
- This option simplifies the streetcar system interface on both sides of the river.
- If this became a much larger project, a transit-only bridge could provide additional capacity and operational flexibility.

HEART OF AMERICA BRIDGE



2 EXISTING RAIL RIGHT-OF-WAY TO 12TH AVE

- Use of existing rail right-of-way allows streetcar to bypass a narrow section of Burlington between 10th and 12th Ave, avoiding traffic, operational, and construction impacts.
- Use of existing rail right-of-way presents an opportunity for new transit-oriented development on vacant site.

3 BURLINGTON STREET ALIGNMENT

- No clear public consensus on a preference between Swift and Burlington.
- Burlington alignment supports an established community vision and planning for a transformed Burlington corridor.
- Financial constraints indicate the need for regional approach in order to extend system beyond North Kansas City, and Burlington is better positioned to serve a regional system.
- Burlington can accommodate a single-track alignment to 18th Ave, which significantly reduces project cost.

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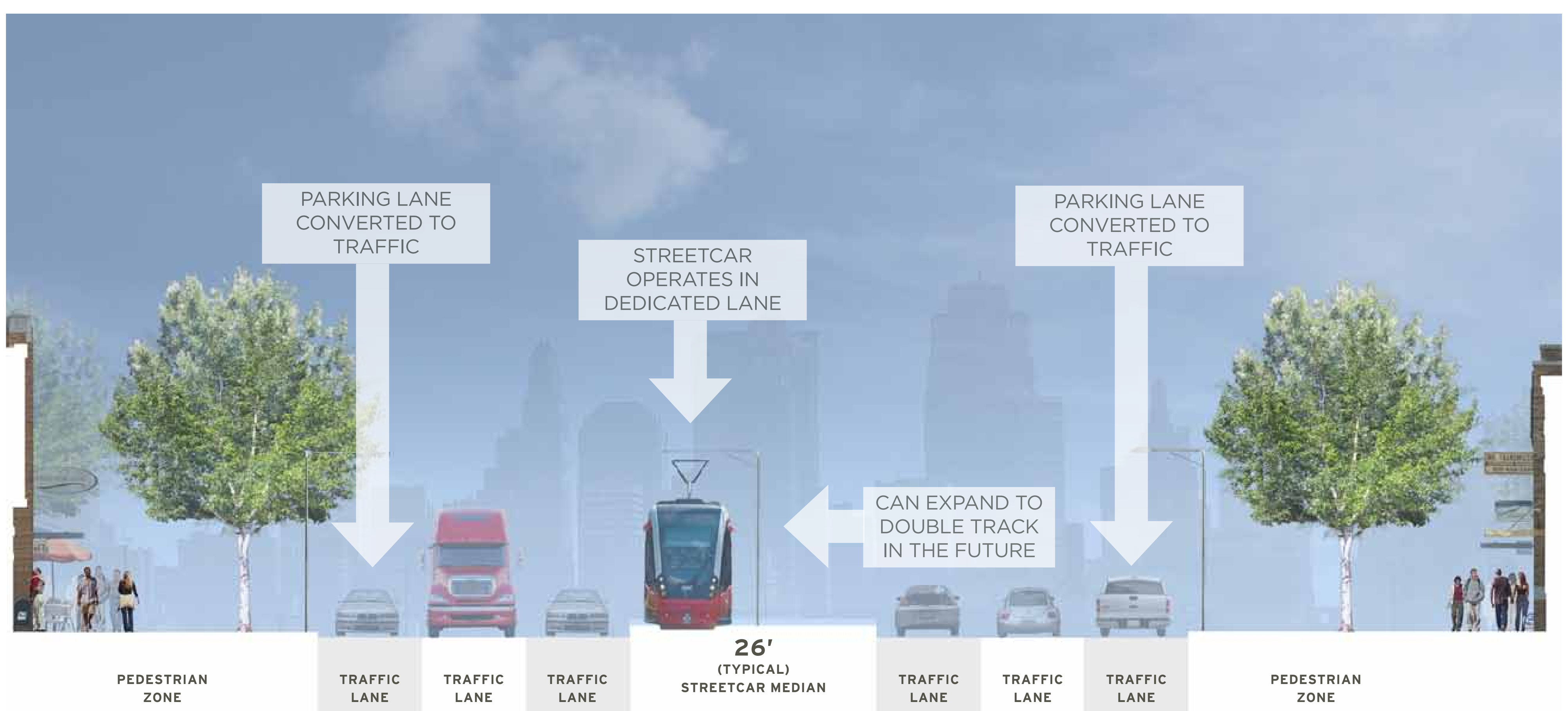
ROADWAY CONFIGURATION OPTIONS

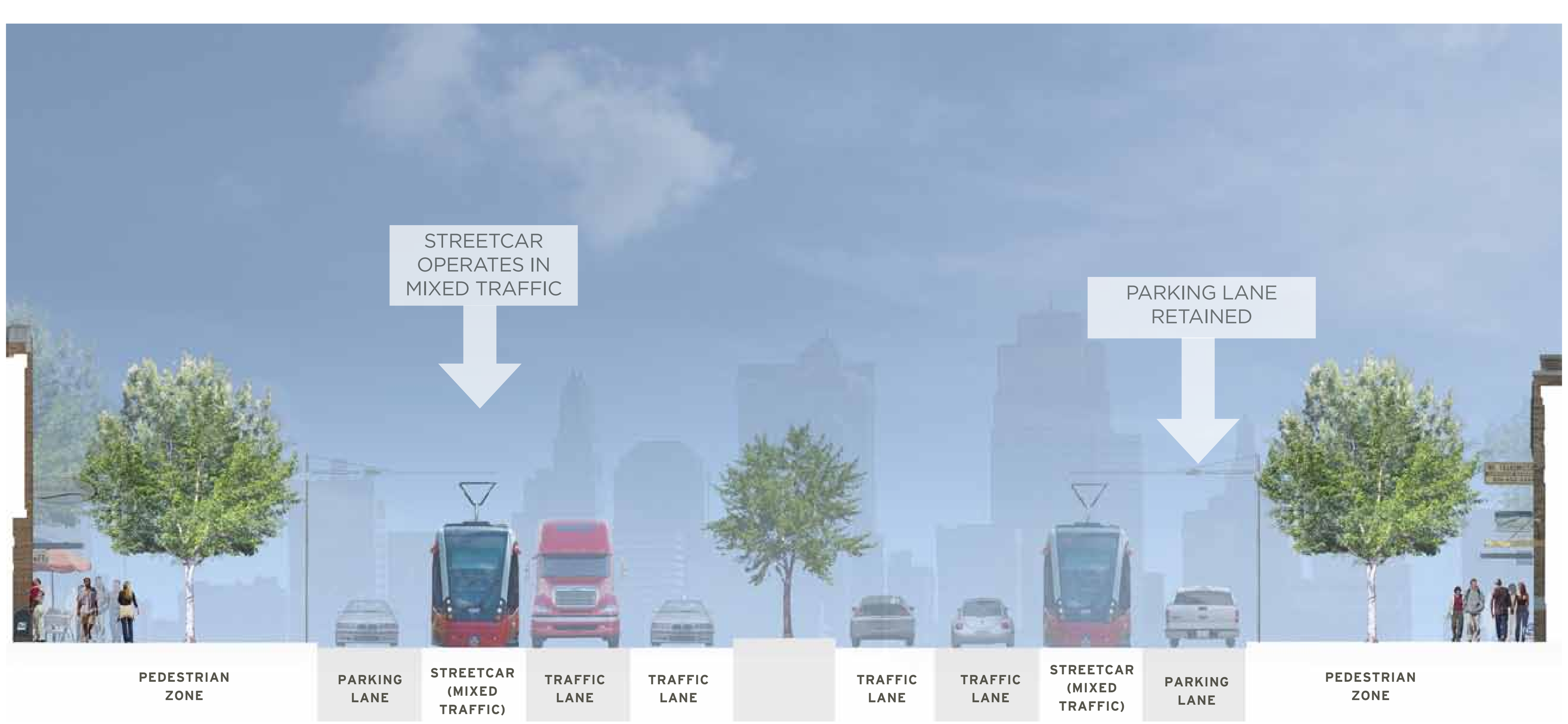
Below are two configuration options for a streetcar on Burlington Street, each of which has a set of trade-offs between various community goals. The final configuration will need to be determined in more detailed engineering phases of the project when the project moves forward.

1 CENTER-RUNNING STREETCAR IN A SEMI EXCLUSIVE MEDIAN



- Center running streetcar avoids impacts to traffic speed and other challenges of running in mixed traffic.
- Traffic study indicates minimal impact to through-traffic with this configuration. but less flexibility in local traffic circulation.
- Requires converting parking lane to traffic lane.
- Auto travel times slightly impacted by required pedestrian signals (also true if walkability improved without streetcar).
- Allows for single track option to 18th Ave, which significantly reduces project cost.
- There are opportunities to improve Burlington streetscape in coordination with streetcar infrastructure and new transit-oriented development projects.

2 STREETCAR OPERATING IN MIXED TRAFFIC



- A streetcar running in mixed traffic would impact the speed of traffic on Burlington, as well as the long-term capacity of the roadway to serve regional auto travellers.
- On-street parking could be retained in a mixed-traffic configuration.
- A streetcar running in mixed traffic would not allow for a single-track configuration, resulting in higher construction costs.
- There are opportunities to improve Burlington streetscape in coordination with streetcar infrastructure and new transit-oriented development projects.

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FINANCIAL CONSTRAINTS

COSTS

- The cost of the streetcar is primarily determined by the length of the route chosen.
- Cost estimates are based upon a single track from the Heart of America Bridge to 18th Avenue
- A curb-running configuration on Burlington would require double the amount of track to operate in mixed traffic.

10TH AVENUE TO 18TH AVENUE (SINGLE TRACK)

ITEM	COST
Base Cost for Streetcar Infrastructure (Track, Catenary, etc.) from Bridge to 18th Ave	$26.7 M
Streetcar Costs (2 vehicles)	$10 M
Vehicle Maintenance Facility (Shared Facility)	$4.0 M
Traction Power Substation (River Crossing)	$1.5 M
Right-of-Way & Land Acquisition	$0.2 M
Utilities	$1.0 M
Signals	$1.5 M
Incidental Construction*	$1.8 M
Total	$46.6 M
2020$ Total	$56.6 M

*Includes earthwork, pavement widening, street reconstruction, and pedestrian upgrades for stations

BRIDGE CROSSING + **NORTH KANSAS CITY PORTION**

BRIDGE CROSSING		NORTH KANSAS CITY PORTION: TO 18TH AVE		TO 29TH AVE
	+	SINGLE TRACK	OR	DOUBLE TRACK FROM 18TH TO 29TH
$25 MILLION		**$56.6 MILLION** ($81.6 M TOTAL)	OR	**$105.6 MILLION** ($130.6 M TOTAL)

FINANCING

- If the Downtown TDD finance model was applied to all of North Kansas City, the annual revenue would be approximately $3.7 Million.
- This funding level could support a streetcar project with a $2 million annual operating cost and capital cost up to approximately $55 million assuming a 50% federal match on the total of both the bridge expansion investment and the local streetcar funding.
- This funding approach could support implementation of an initial streetcar project to 18th Avenue.
- Implementation and operation of the proposed streetcar to 29th Avenue substantially exceeds the funding base available in the City, using a financial model similar to the starter line model being used in Kansas City.
- Expansion of the streetcar serving the length of North Kansas City could be examined under a regional context that expands both the service and funding areas.

TOTAL PROJECT FUNDING

NON-FEDERAL:	$25 M (BRIDGE FUNDING SOURCE)	$15.5 M (LOCAL TDD)
POTENTIAL 50% FEDERAL MATCH:	$40.5 MILLION	

= $81 M

MAXIMUM TDD ASSESSMENT MODEL

ASSESSMENT RATES*

PROPERTY TYPE	PER $100 OF *ASSESSED* VALUE
RESIDENTIAL	$0.70
NON-RESIDENTIAL	$0.48
NON-PROFIT (ALL VALUE UNDER $300,000)	$0.00
NON-PROFIT (ALL VALUE ABOVE $300,000)	$0.40

*No TDD is currently being proposed. These amounts reflect the amounts used in the Downtown Streetcar TDD

EXAMPLES AT MAXIMUM KCMO RATES*

PROPERTY TYPE	ANNUAL PAYMENT
$120,800** HOME	$160.66
$1,000,000 NON-RESIDENTIAL PROPERTY	$1,540
$300,000 NON-PROFIT PROPERTY	$0
$1,000,000 NON-PROFIT PROPERTY	$896

*No TDD is currently being proposed. These amounts reflect the amounts used in the Downtown Streetcar TDD
**Median Housing Value for Owner Occupied Homes in North Kansas City (2012 American Community Survey)

PROJECTED TDD REVENUE (2020$)

1% TDD SALES TAX	$ 2,430,000
RESIDENTIAL ASSESSMENTS	$ 357,976
COMMERCIAL ASSESSMENTS	$ 928,389
TOTAL ANNUAL REVENUE	**$ 3,716,364**
LESS OPERATING COSTS	($ 2,000,000)
NET AFTER OPERATING COSTS	$ 1,716,364
ESTIMATED CAPITAL PROJECT BONDING CAPACITY (FROM TDD)	**$15,500,000**

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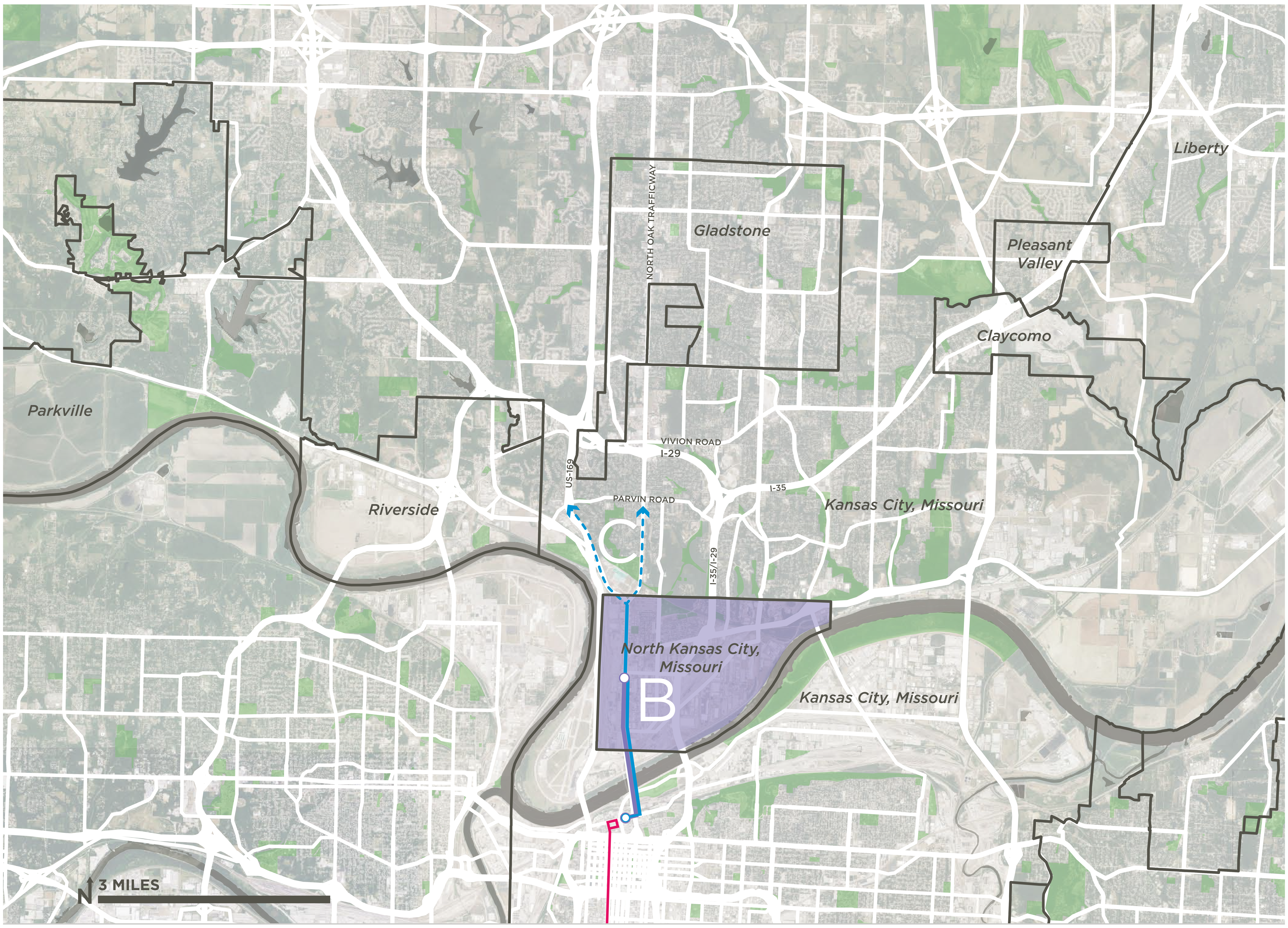
MOVING FORWARD



A — PURSUE INTERIM STRATEGIES FOR ENHANCED TRANSIT

Focus on improving local bus service to important destinations in North Kansas City, and enhancing regional bus service on the Burlington/North Oak corridor. Pursue interim strategies to encourage dense, walkable development that will improve transit-readiness in the future.

B — PURSUE STREETCAR IN NORTH KANSAS CITY WITH LOCAL FUNDING

Build a streetcar system that is viable today by pursuing state and regional funding for a Missouri River crossing and local funding for the portion of the streetcar on Burlington to approximately 18th Avenue.

C — PURSUE A REGIONAL SYSTEM WITH A BROADER FUNDING PLAN

Work to develop a regional partnership with broader participation of the Northland to extend streetcar beyond North Kansas City. Pursue a broader financing plan that may require new types of funding not available today.

PLACE DOTS HERE FOR OPTION A

PLACE DOTS HERE FOR OPTION B

PLACE DOTS HERE FOR OPTION C

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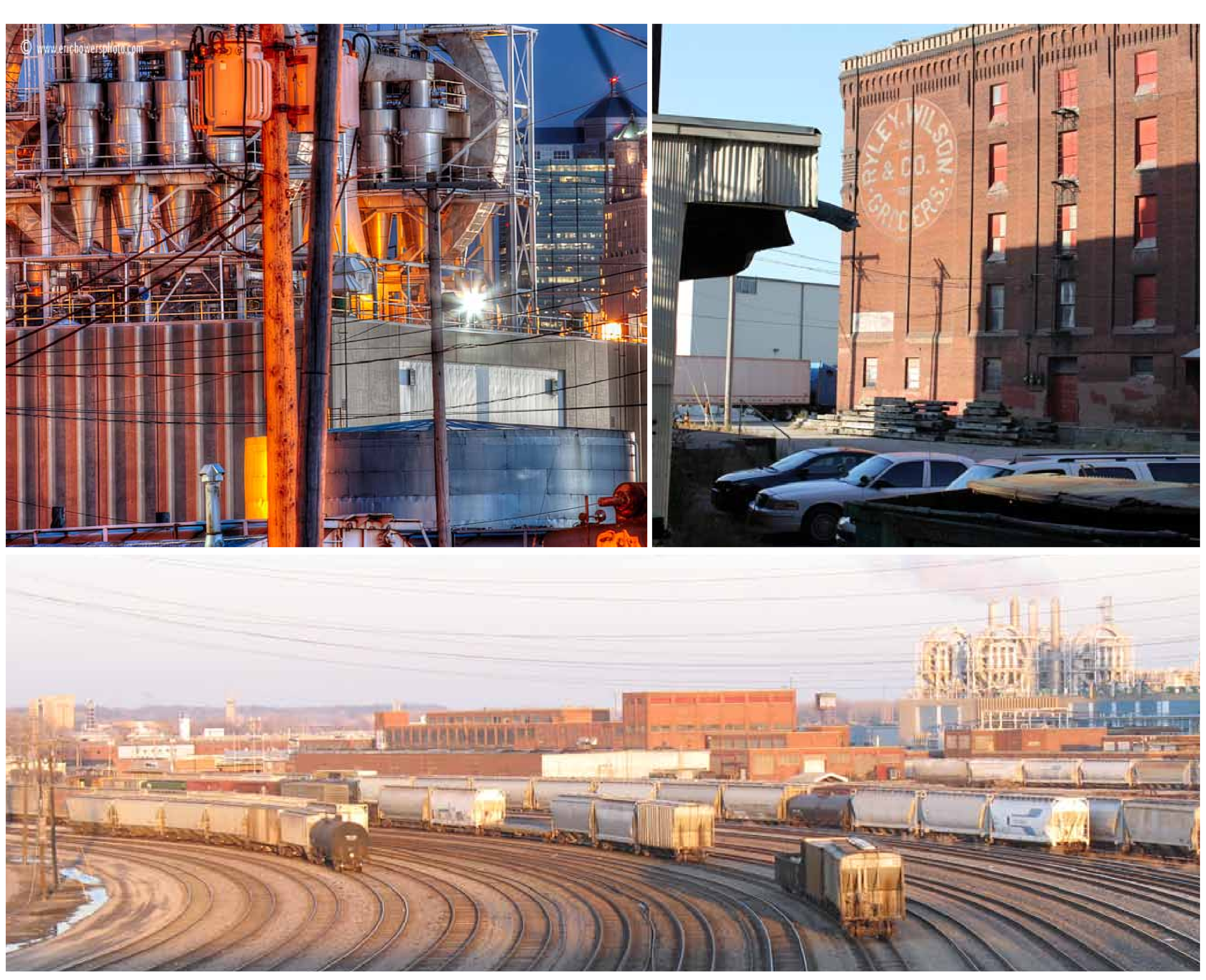
QUESTIONS FOR NORTH KANSAS CITY'S FUTURE

Through this study, several important community questions have come to the forefront. Decisions about future investments depend in large part on community priorities for the future of North Kansas City. Community input on the streetcar expansion suggests several important questions that must be answered by the community to develop a strategic vision for North Kansas City and the need to further engage North Kansas City residents and businesses on these important topics.

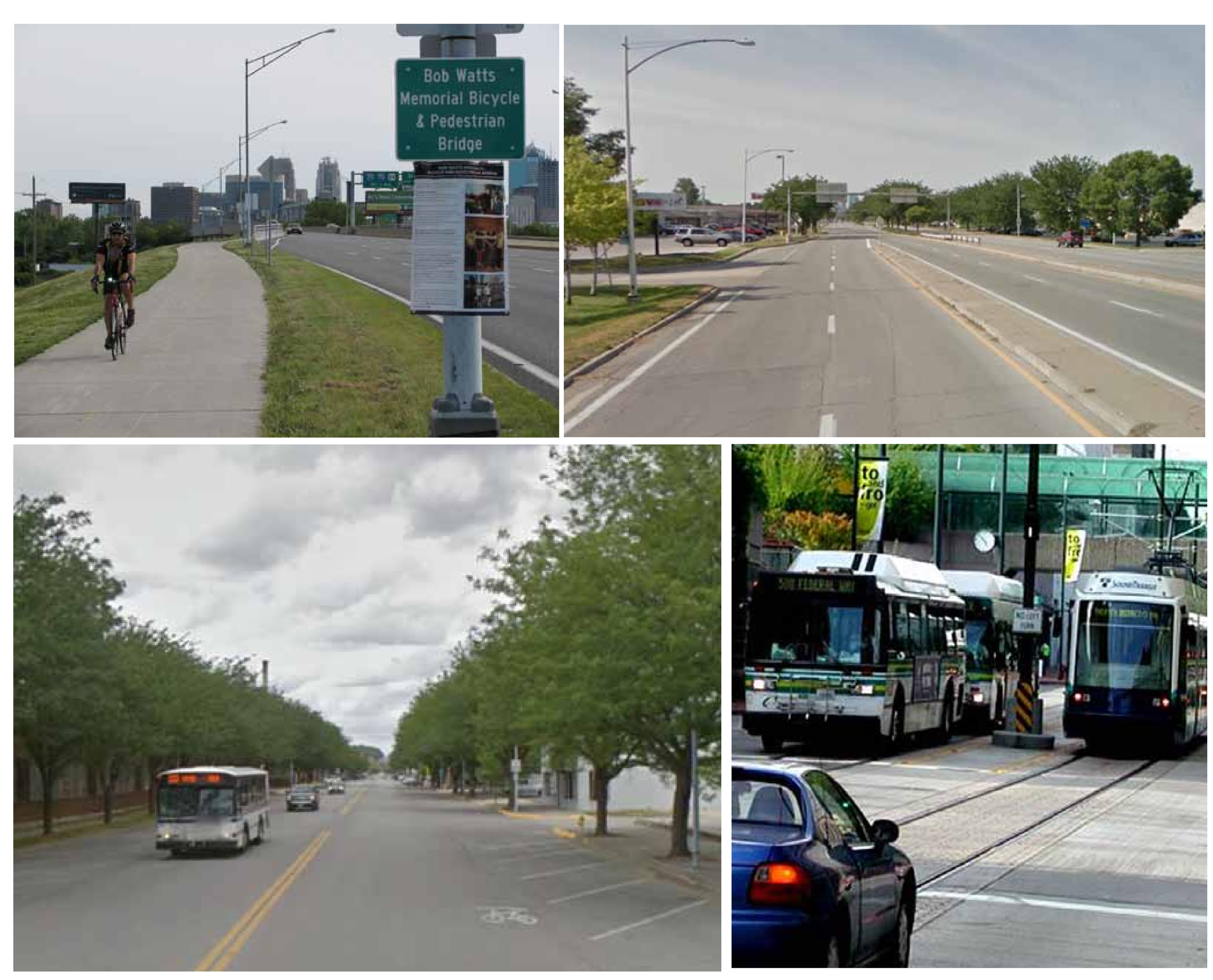
1 WHAT KIND OF COMMUNITY DOES NORTH KANSAS CITY WANT TO BE IN THE FUTURE?

2 HOW DO WE BALANCE THE GOALS OF NORTH KANSAS CITY BUSINESSES AND RESIDENTS?

3 WHAT IS THE FUTURE OF INDUSTRIAL AREAS IN NORTH KANSAS CITY?



4 WHAT WILL OUR PRIORITIES BE FOR FUTURE INFRASTRUCTURE AND TRANSIT INVESTMENT?



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NorthRail Streetcar Study

July 14, 2014

Table of Contents

1. Executive Summary

1.1 Background

The City of Kansas City Missouri (KCMO) has taken the first step towards restoring its substantial streetcar heritage with the groundbreaking for the 2.2-mile Main Street streetcar starter line extending from the River Market through downtown to Union Station. While this construction is underway, a southern extension to Country Club Plaza/University of Missouri Kansas City, and branch lines on Linwood Boulevard and Independence Avenue are progressing through Advanced Conceptual Engineering and environmental analysis. Each of these lines will serve the urban area, south of the Missouri River.

Regional transit planning has historically included a rail component extending north from downtown KCMO to serve North Kansas City, the Northland, and potentially the Kansas City International Airport. The 2008 North/South Alternatives Analysis identified Burlington Street as the preferred northern alignment for Light Rail Transit (LRT). The Burlington Corridor Study, completed in 2009, provided a vision for a mixed-use corridor along this proposed Light Rail route within North Kansas City. The land use changes and infrastructure investment proposed in the Study would enhance the pedestrian environment and reinforce broader and more intensive development patterns, supportive of rail investment. The regional LRT plan was not passed in public referendum, however, and the rail planning activities in the corridor became dormant.

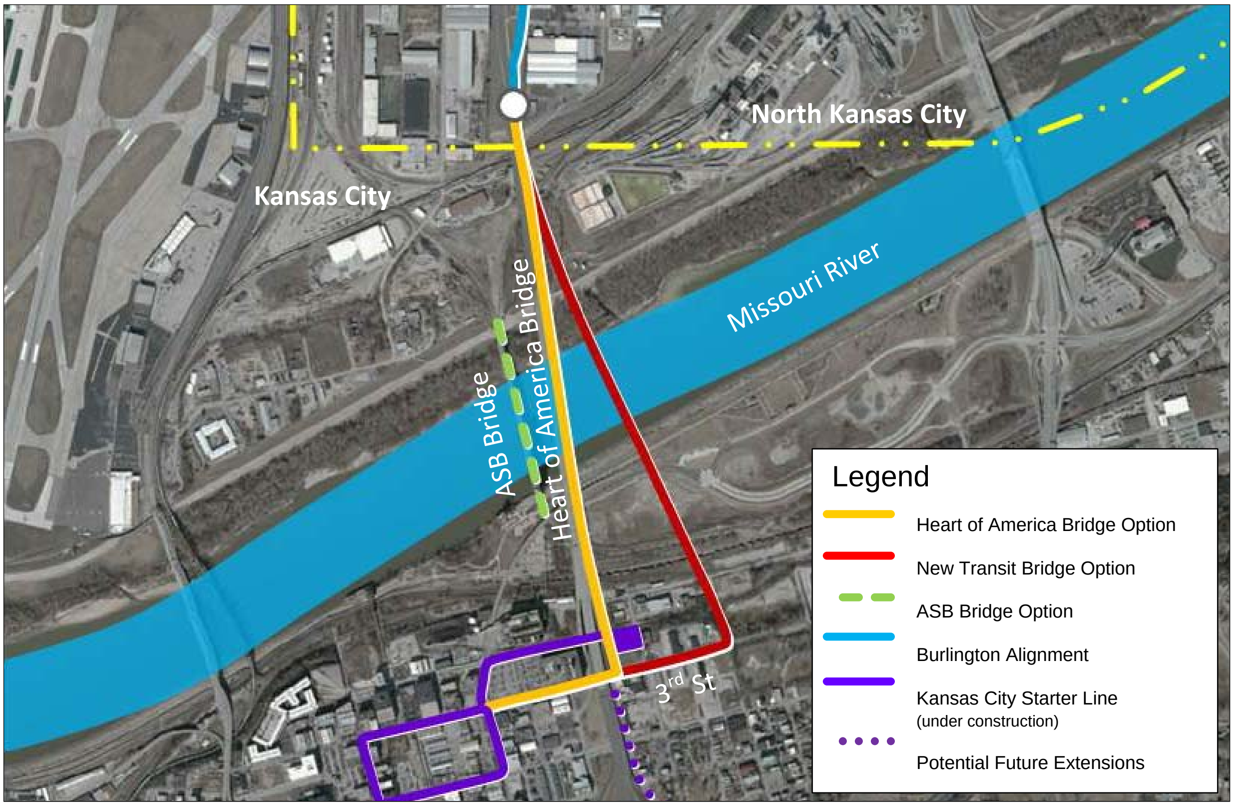
In 2013, a broad group of stakeholders initiated an effort to examine the potential for an extension of the KCMO Main Street streetcar starter line to the north, across the Missouri River. This group included the Mid-America Regional Council (MARC), City of North Kansas City, City of Kansas City, and Missouri Department of Transportation (MoDOT). The streetcar technology shares many physical and operating characteristics with LRT, but provides service that reinforces economic investment in urban areas at a lower implementation cost than LRT.

The goals of this project, the NorthRail Study, were to:

- Assess and detail the general feasibility of a northern streetcar extension,
- Identify the preferable manner and route for extending the KCMO Main Street streetcar line to the north, from downtown KCMO into North Kansas City and the Northland, and
- Develop an implementation strategy to support eventual rail service extension into the Northland.

The overall process was led by a committee consisting of representatives from each of the stakeholder groups. The technical analysis directed by this committee was conducted by a consultant team including HDR, HNTB, BNIM, Hg Consult, and Husch Blackwell. The overall process was conducted within an intensive public involvement framework, soliciting public comment at each major decision point during the study.

Figure 1-1: North Kansas City River Crossing Options



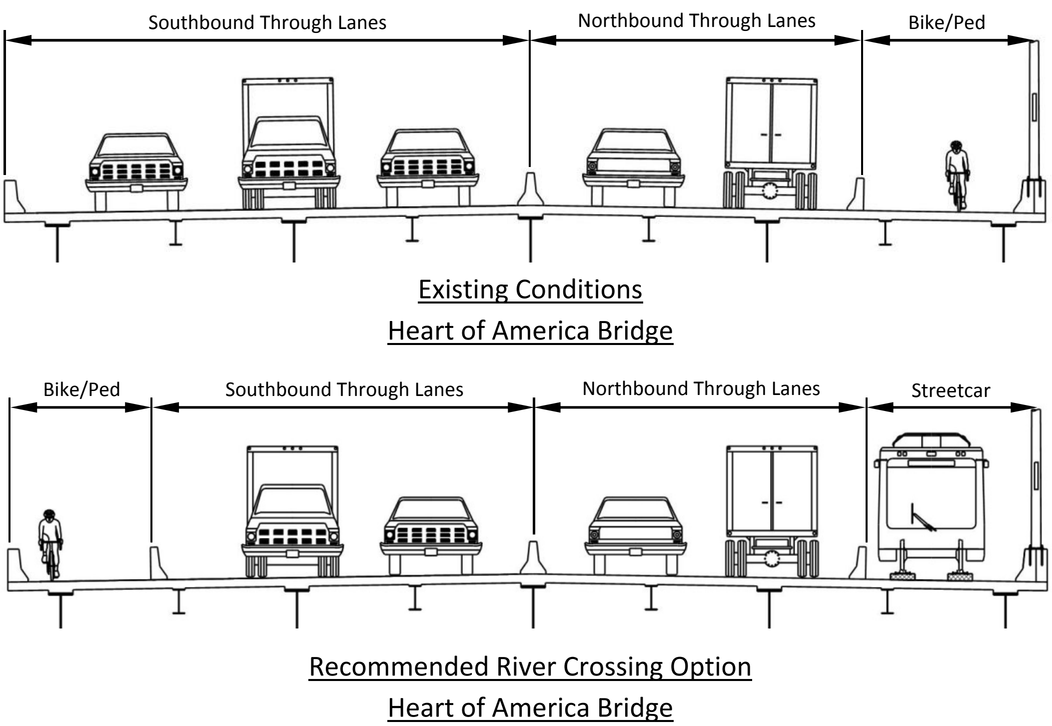
1.2 River Crossing Options

Three distinct approaches shown in **Figure 1-1** were evaluated to carry the streetcar over the Missouri River: reuse of the ASB Railroad Bridge, modification of the Heart of America Bridge (HOA), or construction of a new transit bridge. The ASB Bridge option was eliminated because the private owner would not permit public transit use of the bridge.

The Heart of America Bridge presented a wide range of possible configurations to accommodate a streetcar operation between 3rd Street in Kansas City and 10th Avenue in North Kansas City. Analysis of train capacity revealed that a single-track, operating in both directions, would serve long-term rail needs for the corridor. Therefore, double-track options were eliminated, significantly reducing modifications to the bridge and overall construction costs. Shared lane options (auto and streetcar) were dismissed due to safety issues caused by the high auto speeds.

A variety of exclusive lane, single-track alternatives were developed that would either replace an existing lane or widen the bridge to add the streetcar lane (in addition to the 3 southbound lanes, 2 northbound lanes, and a bike/pedestrian facility). A structural review was conducted to ensure that the options were physically feasible and that the capital cost estimates fully reflected the required bridge modifications. Reducing the number of vehicular through lanes from five to four, moving the bike/pedestrian lane to the west side, and placing the streetcar on the east side was determined to offer the best balance of cost and operating flexibility (**Figure 1-2**). The construction cost for this bridge modification is approximately $24.5 million in 2020 dollars.

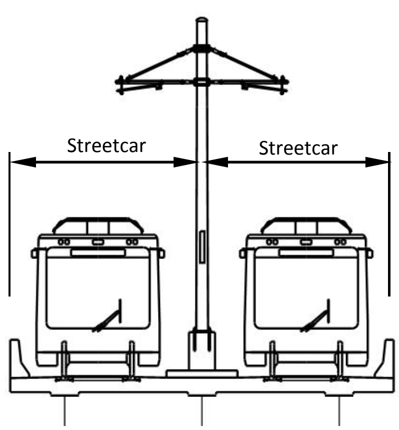
Figure 1-2: Modification of HOA Bridge



The final river crossing approach would use a new transit bridge, constructed east of the existing HOA Bridge (**Figure 1-3**). The new bridge was assumed to be built for double-track operation since the wider track deck would not impinge on adjacent lane uses such as on the HOA Bridge. An alternate transit bridge design would also include a bicycle and pedestrian facility. This would allow the bike and pedestrian lane on the HOA Bridge to be returned to auto use, restoring the northbound auto capacity to be consistent with the southbound capacity. The cost range for the new transit bridge is $41.7 to $60.3 million, with the higher end cost including the bike and pedestrian lane accommodation.

Due to the lower cost associated with the HOA modification, the community preferred this option to carry the streetcar over the river. Since this river crossing would eventually provide rail service to the broader Northland area, the financial plan assumes that this portion of the streetcar cost would be covered by a regional funding source beyond the North Kansas City project.

Figure 1-3: New Double Track Transit Bridge Option



1.3 Analysis of Route Options

The analysis of streetcar route options within North Kansas City was conducted in several iterations. Working with the North Kansas City community, two primary alternatives were identified: Burlington Street (State Highway 9) and Swift Avenue. Both options begin at the end of the HOA river crossing in the vicinity of 10th Avenue. The initial Burlington Street option continued north within street right-of-way while the Swift Avenue alternative turned east along 10th Avenue until reaching Swift, where it continued to the north. Both routes would terminate at a station between Swift and the North Oak Trafficway in the vicinity of 32nd Avenue. The community requested development of additional alternatives with the Burlington and Swift routes turning east along Armour Road (State Highway 210) instead of continuing north. This Armour Road route option would improve streetcar access to Cerner, Harrah's and the NKC Hospital east of the I-29/35 freeway, and would enhance service to downtown North Kansas City. The route options are shown in **Figure 1-4**.

Figure 1-4: Streetcar Alignment Options

The evaluation of the alternatives was conducted using criteria developed with the Partnership Committee and community in public meetings (**Table 1-1**). The evaluation criteria included three different categories:

- Support Neighborhood Revitalization and Economic Development
- Improve Transportation and Mobility
- Optimize Route Feasibility

Table 1-1: Evaluation of Alignment Options

Criteria	Burlington	Burlington	Swift	Armour*	Criteria Description
	Dedicated lane	Mixed Traffic			
Support Neighborhood Revitalization and Economic Development					
Development Capacity	MEDIUM	MEDIUM	LOW	HIGH	How much space is available for new development?
Streetcar Development Readiness	LOW	LOW	MEDIUM	MEDIUM	Is there demand and developer interest? Are there walkable, mixed-use conditions in place?
Long-Term Opportunity for Revitalization	HIGH	HIGH	MEDIUM	MEDIUM	Where could streetcar have the greatest benefit based on capacity today and future plans?
Transit-Supportive Planning	HIGH	HIGH	MEDIUM	LOW	Where can streetcar best support community vision and redevelopment goals?
Transit-Supportive Zoning and Policies	MEDIUM	MEDIUM	MEDIUM	MEDIUM	Are policies in place to support streetcar investment, & discourage incompatible development?
Improve Transportation, Connectivity, and Mobility					
Connecting People, Jobs, & Destinations	MEDIUM	MEDIUM	HIGH	MEDIUM	How well do the proposed alignments connect people, jobs, destinations, & activity centers?
Walkability / Local Circulation	LOW	LOW	HIGH	MEDIUM	Is there a good network of sidewalks, bike facilities, & buses to enhance local use of streetcar?
Building a Regional System	HIGH	HIGH	MEDIUM	LOW	How do the alignments support existing transit & future expansion of the streetcar system?
Ridership Potential	LOW	LOW	MEDIUM	LOW	What is the potential to serve existing transit riders and attract new ridership?
Optimize Route Feasibility					
Major Feasibility Challenges	Loss of Parking; Potential need for ROW acquisition	Would require reduction of traffic speed	Would need to reconfigure/ replace bike lane	Highway overpass would not allow mixed traffic	
Avoidance of Traffic Impacts	MEDIUM	LOW	HIGH	MEDIUM	Will the alignments increase congestion, reduce traffic speed, or otherwise impact traffic?
Avoidance of Parking & Loading Impacts	LOW	HIGH	MEDIUM	HIGH	Will the proposed streetcar alignments impact existing parking or truck loading operations?
Avoidance of Bicycle Impacts	HIGH	MEDIUM	LOW	MEDIUM	Will the proposed streetcar alignments impact existing bicycle facilities?

*Due to major feasibility challenges, an Armour Rd streetcar alignment is not being recommended at this time.

The option of connecting to Armour was eliminated because of the 14’ 9’’ clearance under the I-29/35 Bridge. This low clearance would not allow the streetcar and auto/truck traffic to share the same lane, resulting in the need to eliminate a traffic lane in each direction, lower the roadway, or raise the bridge. None of the options are feasible.

The remaining Burlington and Swift routes have extremely distinctive characteristics. Burlington has high economic development potential because of the extent of existing vacant land adjacent to the street, and the large parcels, which can be easier to develop. At the same time, the current auto emphasis of the corridor is not conducive to streetcar-induced economic development. Implementation of streetcar operations on Burlington may require elimination of curbside parking and restriction of cross-street travel across Burlington at several locations in order to create median streetcar lanes. Reduction of the speed limit from 40 mph to 35 mph may also be necessary if the streetcars share a lane with cars.

Swift could be “streetcar ready” in the short term because of the pedestrian orientation along much of its length. The existing sidewalk network, canopy of trees, and limited impact of the automobile create a pedestrian environment that is attractive for streetcar-induced development. Unlike Burlington, however, most of Swift is already fully developed or projects are already underway. This significantly reduces the potential streetcar development impact for this route. There are also some traffic-related issues with this route. A number of truck loading zones would need to be relocated and the bike route might need to be shifted to another street because of the streetcar tracks.

The characteristics of the Burlington and Swift options were thoroughly discussed in a public meeting. The meeting participants were equally divided, with Burlington supporters emphasizing its superior long-term development potential, and Swift supporters focused upon the lesser, but more immediate economic impact. While they were equally split on which route to pursue, all preferred an initial project that extended to a streetcar stop serving the northern boundary of the city, rather than ending at Armour Road.

The Partnership Team reviewed the equally divided public support for the Burlington and Swift routes. Burlington was selected as the recommended alternative because it would better address local needs of the community and offers more attractive long-term opportunities for service expansion into the Northland. The key factors in the recommendation are summarized below.

The Burlington Avenue option:

- Is consistent with past regional rail plans for service to the Northland,
- Provides more direct, higher speed service for future rail expansion,
- Is consistent with existing North Kansas City development efforts identified in the Burlington Corridor Plan and supported by the Burlington Overlay District,
- Offers more long-term development opportunities, and
- Permits the development of a single track alternative, not feasible on Swift, which increases streetcar implementation options.

1.4 Development of Preferred Route

The Burlington Alternative was further developed with respect to potential right-of-way and traffic impacts (**Figure 1-5**). The Burlington right-of-way is particularly constrained at the south end between 10th Avenue and 12th Avenue. The presence of a former freight railroad spur, behind the parcels on the east side of Burlington, allowed a route modification to be made in this constricted area. The streetcar could continue operating on a single track along that right-of-way east of Burlington, using 12th Avenue to enter Burlington. This alignment adjustment removed the most significant property impact along the entire route. The streetcar entry into the Burlington right-of-way from the east side became a key consideration in selecting the HOA bridge option with the streetcar in the easternmost lane.

The traffic analysis focused upon the potential impact of a Burlington streetcar route on "through" traffic conditions, evaluating two alternatives for placing the streetcar on Burlington. One alternative would place the streetcar in "shared" travel lanes with cars operating adjacent to the parking lanes (**Figure 1-6**). Safety considerations related to the shared traffic lanes would require that the speed limit on all traffic lanes be reduced to 35mph. In addition to reducing the overall speeds, the presence of the streetcars in a shared lane would significantly reduce the speed in those lanes due to the streetcar stops. The City of North Kansas City and MoDOT would need to evaluate approaches to mitigate this impact on through traffic.

Figure 1-5: Preferred Option

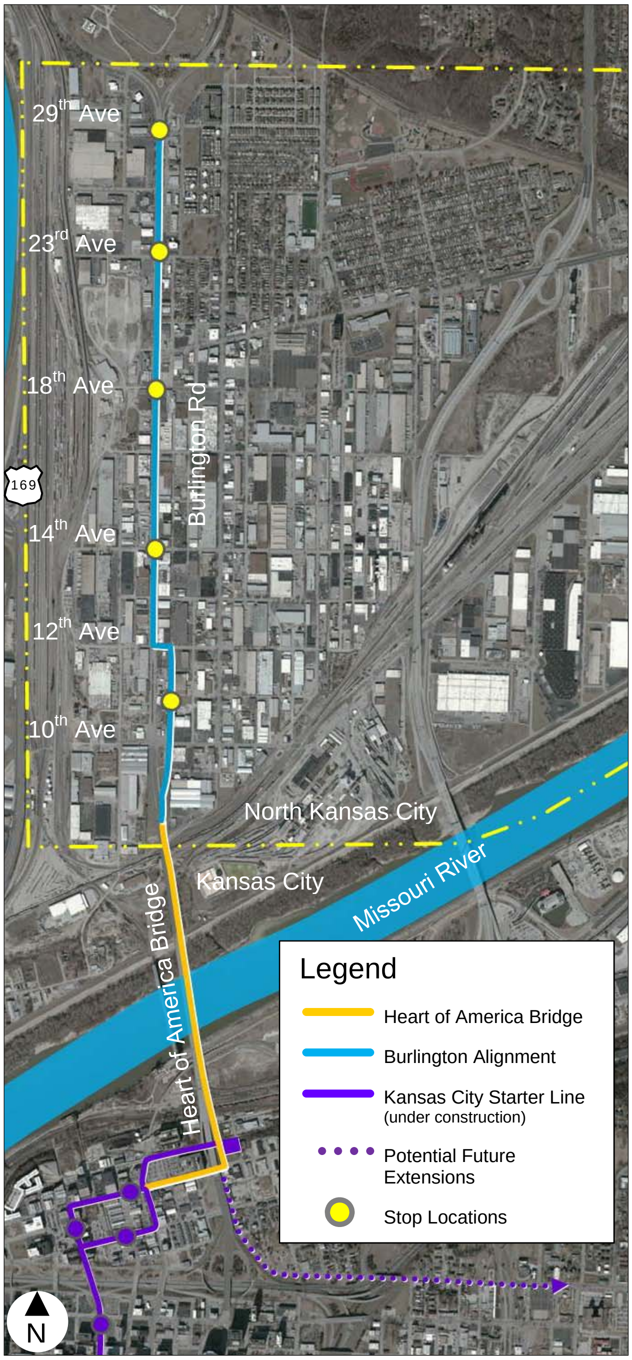
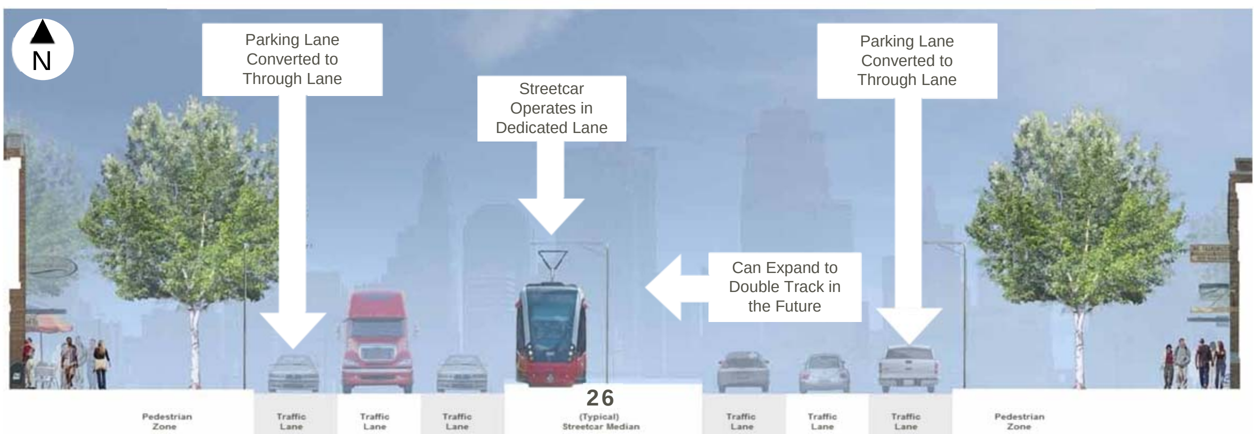


Figure 1-6: Mixed-Traffic Lane on Burlington

A second alternative using two median-running semi-exclusive streetcar tracks was developed in detail to determine if this approach had the potential to largely preserve the existing through capacity along Burlington (**Figure 1-7**). In order to maintain the current number of auto lanes, the curbside parking lanes in both directions would need to be converted to traffic lanes. In addition, the east/west movement across Burlington using local streets would need to be restricted to signalized intersections to reduce the risk of car/train crashes as local traffic attempts to cross Burlington. The reduction in street crossing opportunities could be resolved by placing traffic signals at all of the intersections along Burlington; however, that would likely impede traffic flow along Burlington.

Figure 1-7: Semi-Exclusive Streetcar Lane on Burlington



The traffic analysis for the median streetcar lanes was conducted using sophisticated traffic simulation models. In general, the analysis indicated that using these operating assumptions, the “through” travel speeds along Burlington would not be impacted significantly by streetcar operations. Pedestrian crossing times were the most significant variable influencing the traffic analysis. The key trade-off for this option is the maintenance of “through” travel capacity with the loss of curbside parking and reduction in local travel flexibility.

Implementation of this alternative would require close cooperation between North Kansas City and MoDOT. While initial analysis indicates that it is possible to implement streetcar without a significant impact on through traffic, other considerations may influence the lane configurations and crossing options. This report does not recommend a specific lane configuration. A final decision regarding specific lane configurations should be made in the next phase of project development and advanced conceptual engineering. As the Burlington Corridor redevelops, a greater emphasis will be placed on pedestrian-oriented uses, based on North Kansas City's existing zoning requirements and long-range planning. This land use change may necessitate modifications to Burlington Street operations regardless of future streetcar activities.

1.5 Financial Analysis

The project funding must consider both the initial construction cost and the continuing operating cost. With the exception of the river crossing, the financial analysis followed the same approach used for the KCMO Main Street line. Since the river crossing does not directly serve any adjacent development, and would carry all future streetcar passengers who would travel on extensions beyond North Kansas City, the cost of the bridge was assumed to be funded from a regional source to be later determined.

Key funding assumptions are summarized below:

Capital

- Local investment in the river crossing will be an eligible match for federal capital funding
- A Transportation Development District (TDD) will provide the remaining local match for federal capital funding
- Federal grants will match the local capital funding

Operating

- 100% of the operating cost would be provided through the TDD

For the purposes of this project, the entire City of North Kansas City was assumed to be in the TDD. As with the existing TDD for the Main Street starter line, this analysis assumed a 1% sales tax and a property tax that varied by commercial and residential uses. In general, the commercial property tax rate is up to 0.15% of market value. Residential is approximately 0.13% of market value.

The initial financial analysis revealed that a City of North Kansas City TDD with the same tax rates used on the KCMO Main Street streetcar starter line could not support both the operating and capital costs of a project that extended to the vicinity of 32nd Avenue. Subsequently, a revised project was developed to reduce both the operating and capital costs to determine what streetcar investment could be supported using a North Kansas City TDD. Key characteristics of the reduced project are:

- Initial implementation of the project terminating at the 18th Avenue stop (serves Armour Road).
- Single-track construction, designed for subsequent conversion to double track.

The operating cost for this option is reduced to approximately $2 million per year per year, providing additional resources for capital bonding. This results in a local bonding capacity of about $15.5 million as shown in **Table 1-2**, to be applied towards a reduced construction cost.

Table 1-2: Projected Revenue Using the Kansas City Main Street Starter Line TDD Model

PROJECTED TDD REVENUE (2020$)	
1% TDD Sales Tax	$2,430,000
Residential Assessments	$357,976
Commercial Assessments	$928,389
Total Annual Revenue	**$3,716,364**
Less Operating Costs	($2,000,000)
Net After Operating Costs	$1,716,364
Estimated Bonding Capacity at 6% for 30 Years with 1.30 Coverage	$18,100,000
Estimated Capital Project Fund	**$15,500,000**

The HOA bridge modification would be funded outside of this project, but could be used to match federal funds of approximately $24.5 million towards the streetcar. This approach would potentially fund a reduced project as in **Table 1-3**, shown below (in Year 2020 dollars).

Table 1-3: Capital Funding for Reduced Project

PROPOSED PROJECT FUNDING (2020$)	
Capital Cost (to 18th Ave Stop)	**$56.6 Million**
Capital Resources	
TDD Capital Project Fund	$15.5 Million
Federal Match (TDD Capital Project Fund)	$15.5 Million
Federal Match (HOA bridge modifications)	$24.5 Million
Total Capital Resources	**$55.5 Million**

While this funding scenario reflects a project in which the costs exceed funding by about 2%, the cost estimate includes substantial contingencies which may cover this deficit. In addition, small adjustments could be made in the operating plan if necessary to reduce operating cost and increase the bonding capacity as appropriate. This approach represents the maximum streetcar investment that could be funded using the KCMO Main Street starter line TDD approach throughout North Kansas City. The capital cost for a streetcar project serving the length of the corridor to 32nd Avenue would be approximately $134 million, substantially exceeding local funding capacity.

1.6 Project Opportunities/Recommendations

The NorthRail Streetcar Study provided several conclusions:

- Modification of the Heart of America Bridge offers a viable approach to extend rail transit across the Missouri River to serve the Northland.
- Burlington is the preferred route through North Kansas City because it provides the greatest opportunity to enhance economic development in North Kansas City, and facilitate long-term urban rail expansion into the Northland.
- North Kansas City funding using the KCMO Main Street streetcar starter line TDD model cannot support construction and operation of a project beyond Armour Road.
- The local community prefers that the project reach the northern municipal boundary of North Kansas City (32^{nd} Avenue) in its initial phase.

These conclusions support continued long-term planning for urban rail development along the Burlington Corridor extending to the Northland. The HOA Bridge offers an attractive means to cross the river. The Burlington right-of-way includes several options that could be further developed to support attractive rail service and attract economic development. The initial rail investment through North Kansas City, however, cannot be funded without an expanded funding base.

Although the NorthRail study did not examine streetcar options extending further north beyond North Kansas City, prior studies have considered other fixed-guideway transit options continuing north. As indicated earlier, streetcar and LRT have many similar characteristics that facilitate blending of these modes to meet varying needs along an expanded service area. An urban rail project could easily use the close streetcar stop spacing within North Kansas City, and at major suburban activity nodes in the Northland, and operate with longer LRT style spacing between the activity centers. This would extend the service area of the rail line, and increase the funding base.

The recent Burlington-North Oak Trafficway Corridor study identifies activity nodes along this corridor and recommends land use and infrastructure actions that would support more intensive transit investments. This report would provide a suitable base from which to examine alternative urban rail options along this corridor.

In anticipation of an eventual rail investment, the community should also consider implementation of a low cost Bus Rapid Transit (BRT) project similar to the MAX routes south of the river. This approach would reinforce improvements in the pedestrian network and increase corridor transit ridership, enhancing future rail opportunities along the route. Future rail implementation might result in the removal of some BRT capital investments, although they may be fully depreciated by the time the rail is built. Some local commitment would be required for the BRT planning, design, and construction management, which represents an opportunity cost that could be applied elsewhere in the region.

The development of urban rail options serving the Northland would be tied to development of funding options linked to the service areas. The most recent transit funding approach has followed the Main Street streetcar starter line TDD model. Expanding the service area could facilitate expanding the coverage area of this model. Corridor jurisdictions beyond the NorthRail Partnership would need to be engaged in this effort, which could influence the eventual financing/governance strategy.

Within North Kansas City, several activities would be useful in the short term. The City has aggressively amended its planning and zoning to encourage the increased density, mixed-use development and pedestrian infrastructure planning that would help transform Burlington Street from a light-industrial, auto-oriented area to a pedestrian-friendly commercial/entertainment district. The imminent update of the City's comprehensive plan provides the opportunity to reinforce that direction with local community leaders, investors and business owners. This type of change would enhance the impact of urban rail along the Burlington corridor. A regional commitment to a rail project on Burlington Street would be an incentive to both the private and public sectors to initiate these types of changes.

The implementation of streetcar within the Burlington right-of-way offers its own set of challenges and opportunities that are directly related to the land use and infrastructure changes noted above. Some modifications to the current street operations are necessary for streetcar implementation. These modifications could include adjustments to through and/or local traffic, changes in curbside parking and loading zones, traffic signalization modifications, and pedestrian improvements. Many of these changes would also respond to concerns expressed during the community meetings regarding the need to improve the pedestrian environment along this street. These modifications would require substantial discussion among North Kansas City, MoDOT, MARC, and local property and business owners to determine the extent, cost and funding for the modifications. It is timely to begin these discussions using the results of this study and the awaited City plan update.

A regional commitment to the Burlington corridor will require extension of the streetcar across the Missouri River to 10th Street. This study has identified a viable approach to do so by shifting the bike and pedestrian lane from the east side of the HOA Bridge to the west, and placing the streetcar in the vacated lane. This will require a regional investment up to $25 million. Programming this funding now would demonstrate regional support for the NorthRail project, and encourage the other activities identified above.

The following steps are recommended to advance the conclusions of the NorthRail Study:

1. North Kansas City updates of the city Master Plan supporting Burlington Street as the recommended streetcar route.
2. North Kansas City, MoDOT, and MARC initiate discussions regarding modification of Burlington Street to facilitate pedestrian-oriented development and accommodate future streetcar use along the route.
3. North Kansas City, Kansas City, Gladstone, MARC, and KCATA initiate discussions regarding interim land use and transit strategies to encourage transit-oriented development north of the river in anticipation of future rail service.
4. North Kansas City and Kansas City accept the NorthRail Plan.

5. Appropriate regional jurisdictions develop a long-term plan and financial strategy and supporting rail service to the Northland.
6. MARC incorporates findings into the 2040 LRTP Update.

These activities would overlap in several instances, and would benefit from the participation of Northland jurisdictions and community stakeholders beyond those involved in the NorthRail Partnership.

2. Introduction

Many communities are considering streetcar as a transit solution that acts as an urban circulator and a "pedestrian accelerator," providing convenient and comfortable transit service along a permanent fixed route using modern vehicles, stations, amenities and real time passenger information. The streetcar investment has been proven as a catalyst in shaping compact, walkable neighborhoods by connecting destination with a high quality transit ride. While it is difficult to directly tie development projects to specific transit investments, it is widely recognized that streetcars attract a substantial return on investment with respect to development and redevelopment.

Modern streetcar systems can be implemented at about half the cost of conventional Light Rail Transit (LRT) projects, and provide about 65% of the passenger capacity. The smaller scale of typical streetcar projects typically fits well within the dense urban environment in and around downtown. The speed and simplicity of streetcar construction are also key features.

The City of Kansas City Missouri (KCMO) has taken the first step towards restoring its substantial streetcar heritage with the groundbreaking for the 2.2-mile Main Street streetcar starter line extending from the River Market through downtown to Union Station. While this construction is underway, a southern extension to Country Club Plaza/University of Missouri Kansas City, and branch lines on Linwood Boulevard and Independence Avenue are progressing through Advanced Conceptual Engineering and environmental analysis. Each of these lines will serve the urban area south of the Missouri River.

Regional transit planning has historically included a rail component extending north from downtown KCMO to serve North Kansas City, the Northland, and potentially the Kansas City International Airport. The 2008 North/South Alternatives Analysis identified Burlington Street as the preferred northern alignment for Light Rail Transit (LRT). The Burlington Corridor Study, completed in 2009, provided a vision for a mixed-use corridor along this proposed Light Rail route within North Kansas City. The land use changes and infrastructure investment proposed in the Study would enhance the pedestrian environment and reinforce broader and more intensive development patterns, supportive of rail investment. The regional LRT plan was not passed in public referendum, however, and the rail planning activities in the corridor became dormant.

In 2013, a broad group of stakeholders initiated an effort to examine the potential for an extension of the KCMO Main Street streetcar starter line to the north across the Missouri River. This group included the Mid-America Regional Council (MARC), City of North Kansas City (NKC), City of Kansas City, and Missouri Department of Transportation (MoDOT). The streetcar technology shares many physical and operating characteristics with LRT, but provides service that reinforces economic investment in urban areas at a lower implementation cost than LRT.

The goals of this project, the NorthRail Study, were to:

- Assess and detail the general feasibility of a northern streetcar extension,

- Identify the preferable manner and route for extending the KCMO Main Street streetcar starter line to the north, from downtown KCMO into NKC and the Northland, and
- Develop an implementation strategy to support eventual rail service extension into the Northland.

The remainder of this report outlines the technical approach and analysis of options to accomplish these goals. The final chapter recommends a set of actions to advance rail service serving NKC and extending to the Northland.

3.Project Approach

The NorthRail project includes two distinct, but inter-related elements:

- Missouri River Crossing
- NKC Streetcar

The river crossing segment generally extends from 3rd Street in KCMO 10th Street in NKC. It will carry future rail service to NKC and beyond into the Northland. Since there are no urban land uses within this area, the analysis focused upon structural and cost issues. There are no passenger stops in this segment, and no adjacent land uses that could have substantial impacts. The only potential service impact is related to the quality of service for passengers traveling through this segment. The analysis of bridge options focused upon design and cost issues which are documented in Chapter 6.

The NKC streetcar segment traverses an urban area with significant development along each of the route options. The urban land uses along the route will generate passenger origins and destinations, requiring significant consideration of service issues. The proximity of buildings to the curb lines also presents a key streetcar routing consideration due to the potential for displacement and/or parking and loading zone issues. The streetcar route analysis required a rigorous review of socio-economic data in addition to the physical and cost characteristics included in the river crossing. These considerations are documented extensively in Chapter 7.

While these two segments were developed and analyzed somewhat in parallel, their nexus at 10th and Burlington influenced the selection of a preferred river crossing option. As discussed in Chapter 5, right-of-way implications for the streetcar in NKC reinforced a preferred route east of Burlington. This influenced selection of the preferred river crossing in order to best connect with the preferred streetcar route through North Kansas City.

The operations planning considered the entire extent of the route from the connection to the KCMO Main Street starter line to the northernmost streetcar stop at 29th Avenue. The operating plan, operating costs, and vehicle requirements were developed based upon the travel time and service frequency for the full operating segment.

The technical analysis for the overall study was directed by a Partnership Committee with representatives from the various political and transportation jurisdictions within or serving the corridor. This Committee provided technical direction and advanced the study through key decision points. Committee membership is identified in **Table 3-1**.

Table 3-1: Partnership Committee Members

Name	Organization
Karen Clawson	Mid-America Regional Council
Sara Copeland	North Kansas City, Missouri
Shelie Daniel	Missouri Department of Transportation
Kyle Elliott	Kansas City, Missouri
Tom Gerend	Mid-America Regional Council
Mell Henderson	Mid-America Regional Council
Randy Johnson	Missouri Department of Transportation
Russ Johnson	Kansas City, Missouri
Teresa Martinez	Kansas City, Missouri
Sherri McIntryre	Kansas City, Missouri
Laurel McKean	Missouri Department of Transportation
Luke Miller	Missouri Department of Transportation
Danny O'Connor	Kansas City Area Transit Authority
Michael Smith	North Kansas City, Missouri
Eva Steinman	Missouri Department of Transportation
Matt Tapp	Clay County
Jeffrey Williams	Kansas City, Missouri

The Partnership Committee received public input, primarily from a series of public workshops held in the corridor. This input was a significant consideration in the deliberations of the Partnership Committee. The overall public involvement process and results are discussed in the next chapter.

4. Public Participation

4.1 Purpose of the Public Involvement Program

The NorthRail KC streetcar would potentially impact North Kansas City and its residents in numerous ways. Depending upon location decisions for the route, some local residents would experience enhanced mobility from the initiation of service. In the long term, streetcar projects typically influence development patterns, resulting in more intense, mixed land uses that raise property values, improve tax receipts, and attract more businesses and residents. At the same time, streetcar investment requires local funding support in the form of increased local taxes. All of these aspects impact local residents and business owners in different ways, and their input is essential in determining if, where, and how a streetcar project is implemented. A proactive public participation program was developed and administered in North Kanas City to enhance public understanding of the project options and provide timely input in the decision-making process.

4.2 Public Involvement Approach

The public meeting approach centered around three (3) public meetings held during the project at key milestones.

- Meeting 1: Kick-Off *(November 21, 2013)*
    - Outlined the study purpose and schedule
    - Compared streetcar technology with other modes of transit
    - Described potential streetcar impacts based on experience in other cities
    - Identified the key decisions to be made during the study
- Meeting 2: Community Recommendations *(February 13, 2014)*
    - Reviewed characteristics of River Crossing options for community input
    - Reviewed characteristics of Route options for community input
    - Reviewed Route length options for community input
- Meeting 3: Wrap Up *(April 23, 2014)*
    - Summarized recommendations to date
    - Identified options for accommodating streetcar operations on the preferred route
    - Described a financially feasible streetcar project for North Kansas City
    - Reviewed next step options for community input

Each of the meetings was preceded by an aggressive campaign to encourage attendance, including mailers, emails to participants registered at prior meetings, social media, and canvassing of businesses and neighborhoods along each of the proposed routes and other public destinations. In addition to comments shared at the meetings, public input was collected through questionnaires, comment cards, outreach to neighborhood groups and other organizations, and MindMixer, an online community forum platform used to encourage comments. An information kiosk and open comments board was hosted by both the North Kansas City Library and Community Center to provide information raise awareness and share ideas.

4.3 Public Involvement Results

The kick-off meeting on November 21, 2013 was attended by 94 participants. Residents generally voiced concern that their city was seen as little more than industrial buildings and highways. Some saw the streetcar as an opportunity to help showcase the city's safe, walkable neighborhoods and commercial areas and make the city more of an integral part of the region's central city. There was a desire by many to encourage neighborhood revitalization, enhance economic development and attract new residents and businesses.

Regarding route options, meeting attendees supported both Swift Avenue and Burlington Street options, and requested that Armour Road also be considered. Some preferred Burlington Street because of the strong long-term opportunity for economic development. The need for considerable investment to create a more pedestrian-friendly environment along Burlington was also identified, however. Some meeting participants preferred Swift Avenue because it is already pedestrian-friendly and a streetcar would attract development there more quickly than along Burlington. Some participants thought that adding an Armour Road leg to either the Swift Avenue or Burlington Street alignments would improve access to the Cerner World Headquarters, Harrah's Casino, and the North Kansas City Hospital, which are all east of I-29/35.

There were also a number of attendees who did not support streetcar implementation in North Kansas City. Some expressed concern that the streetcar would not generate sufficient ridership to justify the project. Others did not want any increase in their taxes to fund a streetcar project.

The second meeting, held on February 13, 2014, was attended by 95 stakeholders. The meeting focused upon recommendations in three key areas: the preferred route, the extent of the route, and the preferred river crossing option. The technical analysis of route options revealed that the Armour Road option was not feasible because of the low clearance under the I-29/35 bridge. In order to accommodate the streetcar, the bridge would need to be raised, the street lowered, or cars eliminated from a streetcar lane in each direction. None of these options were reasonable.

Considering the remaining options along Swift Avenue and Burlington Street, half of the attendees favored the Swift option because of the more immediate development impact, and half favored the Burlington option due to its greater long term development potential. There was no majority for either option. There was a general consensus that the initial route should travel all the way through North Kansas City, reaching the northern city limit. There was little support for an intermediate project ending in the vicinity of Armour Road.

Of the options to cross the Missouri River, a small majority preferred using the Heart of America Bridge. The option of converting an existing lane to streetcar use was favored over adding a lane to the bridge, in order to reduce costs.

The Burlington option was advanced in greater detail as the preferred route for the wrap-up meeting held on April 23, 2014, which was attended by 75 stakeholders. The Burlington option was selected over the Swift option because it offered more long term development impacts, provided better service and flexibility for an expanded system, and provided more implementation options than Swift. The financial analysis revealed, however, that the funding that could potentially be generated within North Kansas City could not support implementation of the entire project. A Swift option would have faced the same challenge.

In response to the financial constraints, a reduced project was developed that would end at the 18th Avenue stop, serving downtown North Kansas City. It would be a single-track operation, which further reduces the capital cost, but also limits service frequency.

The meeting attendees were presented with three (3) options to proceed:

- Pursue interim strategies for enhanced transit
- Pursue a streetcar to 18th Avenue with local funding
- Pursue a regional system with a broader funding source

The majority of meeting attendees preferred the first option (66 percent). The reduced project received support from only 13 percent of participants and the regional option was supported by the remaining 21 percent. Those opposing the streetcar primarily cited increased taxes, and disproportionate benefits compared to costs. Streetcar supporters emphasized the need to move the city ahead by improving the quality of life and attracting new residents.

The presentation materials for each of the meetings are included in the supplemental document *NorthRail Streetcar – Public Meeting Informational Boards*.

5. River Crossing Options

5.1 Background

The initial challenge to providing streetcar service to NKC and the Northland is crossing the Missouri River and the freight railroad tracks immediately to the north of the river. There are a variety of potential approaches to accomplish this task, ranging from modification of existing bridges to construction of a new bridge. This decision will influence the long-term urban, commercial, and transportation planning for areas north and south of the river. In order to manage the variables in selecting a route, the following considerations were identified.

- Connect to communities both north and south of the river that represents balanced opportunities for economic redevelopment, measured by proximity to potential development sites;
- Identify a structural means of crossing the river that will balance operational needs with infrastructure cost.
- Assess project partner preferences and incorporate into the recommendations.

5.2 Screening of River Crossing Options

This project examined river crossing options at a scoping screening level, an initial screening level completed during the study, and a more detailed screening level. The candidate bridges considered were those that would provide a connection into, or close to North Kansas City and were relatively close to the KCMO Main Street streetcar starter line (currently under construction). Five options were considered during project screening. Three candidates passed to the study level for initial screening. Two options were identified for detailed screening.

Broadway Bridge

MoDOT has identified the Broadway Bridge as a candidate for replacement. Such a replacement could incorporate accommodations for transit. The south approach to the bridge is approximately 0.25 miles west of the KCMO Main Street starter line. The north end of the bridge connects to the Charles B. Wheeler Downtown Airport. The airport provides services primarily for private and corporate flights. As such, it is anticipated that ridership to the airport would be low. In order to connect to North Kansas City, a streetcar line would need to cross multiple rail lines. This crossing option did not pass the scoping-level screening.

New Bridge East of the Broadway Bridge

A new bridge east of the Broadway Bridge and west of the ASB Bridge would have the advantage of connecting directly to the Main Street starter line on 3rd Street. However, on the north side of the Missouri River, the bridge would need to cross multiple rail lines before reaching destinations in North Kansas City. This crossing option did not pass the scoping-level screening.

The ASB Bridge

The Armour-Swift-Burlington (ASB) Bridge formerly carried a trolley line connection between North Kansas City and Kansas City, Missouri. The trolley line connection was eventually changed to accommodate vehicles. When the Heart of America Bridge opened in 1987, the vehicular deck on the ASB was closed and the approach structures to the upper deck were removed. The bridge is now owned by the BNSF Railway and is used exclusively for freight rail traffic on the lower deck. The ASB Bridge is not available to re-establish a streetcar line on the upper deck and it was eliminated from detailed analysis.

The Heart of America Bridge

The Heart of America (HOA) Bridge carries Missouri Route 9 and connects to I-70 on the south to Route 9 to the north. For the purposes of this report, the HOA Bridge refers to the connection from 3rd Street in Kansas City, Missouri, across the Missouri River, the river levee, and the railroad tracks. This actually refers to two structures: one crossing the river, and a second crossing the railroad tracks.

In 2010, a pedestrian and bicycle facility was added to the bridge (by narrowing shoulders), creating the only designated bicycle/pedestrian crossing of the river from downtown Kansas City. This bridge provides the benefits of being relatively close to the Main Street starter line on the south and providing a continuous connection to the potential alignment on Burlington Street as well as being close to the potential route on Swift Avenue on the north. This bridge was selected for detailed study.

New Bridge East of the Heart of America Bridge

A new bridge east of the HOA Bridge would provide a dedicated streetcar connection from the Main Street starter line to either of the candidate alignments (Burlington or Swift) in North Kansas City. The structure could be designed to accommodate either single- or double-track lines. The structure could also be designed to provide a bike/ped facility across the river. This bike/ped facility could supplement or replace the bike/ped facility on the HOA Bridge. This bridge option was selected for detailed study.

Crossing options that were selected for the detailed screening level were analyzed for detailed operational, structural, traffic, and financial limitations. A table of the screening review is provided below.

Table 5-1: Bridge Crossing Screening

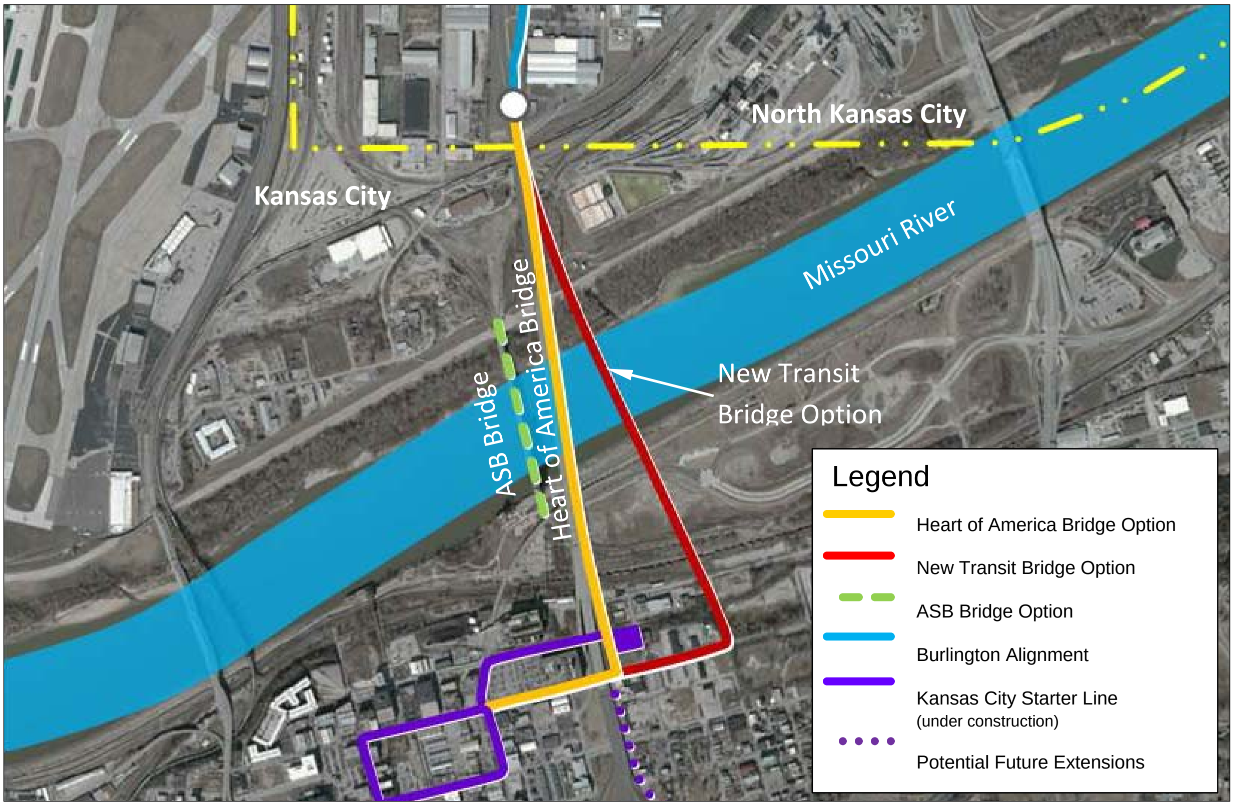
Structure	Screening Level			Comments
	Scoping	Initial	Detailed	
Broadway Bridge	✘	-	-	Bridge is scheduled for replacement. It is not in proximity to destinations in North Kansas City; would result in circuitous path and require grade separation over freight tracks.
New bridge, west of the ASB Bridge	✘	-	-	Bridge is not in proximity to destinations in North Kansas City; would require freight rail fly-overs.
The ASB Bridge	✓	✘	-	Formerly served as trolley crossing (structural elements demolished); owner is not amenable to accommodating a crossing on this structure.
The Heart of America Bridge (HOA)	✓	✓	✓	Acceptable operations, structurally suitable, financially reasonable.
New bridge, east of the HOA Bridge	✓	✓	✘	Improved operations, structurally suitable, financial limitations.

✘ option did not move past this screening | ✓option moved past this screening | - option not considered at this level.

5.3 Initial Screening

The results of initial screening identified two options for detailed screening: the addition of streetcar onto the existing Heart of America Bridge and the construction of a new bridge immediately east of the HOA Bridge. The Figure below shows the relationship of the potential river crossings to the river and the Kansas City Main Street Starter Line.

Figure 5-2: Missouri River Crossing Options

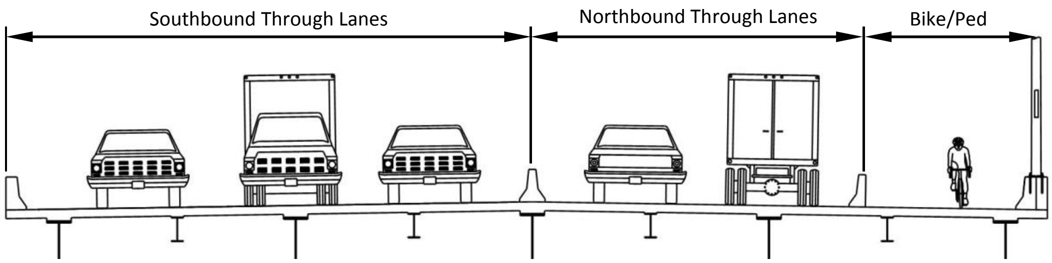


5.4 Detailed Screening

Heart of America Bridge

The Heart of America Bridge has two northbound lanes and three southbound lanes for motorized traffic and a separated pathway (two-way) for bicycle and pedestrian traffic (**Figure 5-2**). This is the only bicycle/pedestrian crossing of the Missouri River. The next nearest bicycle/pedestrian crossing is five-miles away at the Chouteau Bridge. The Partnership Team identified this bicycle/pedestrian crossing as a critical component to maintain, although they agreed that the existing facility could be replaced with a new crossing.

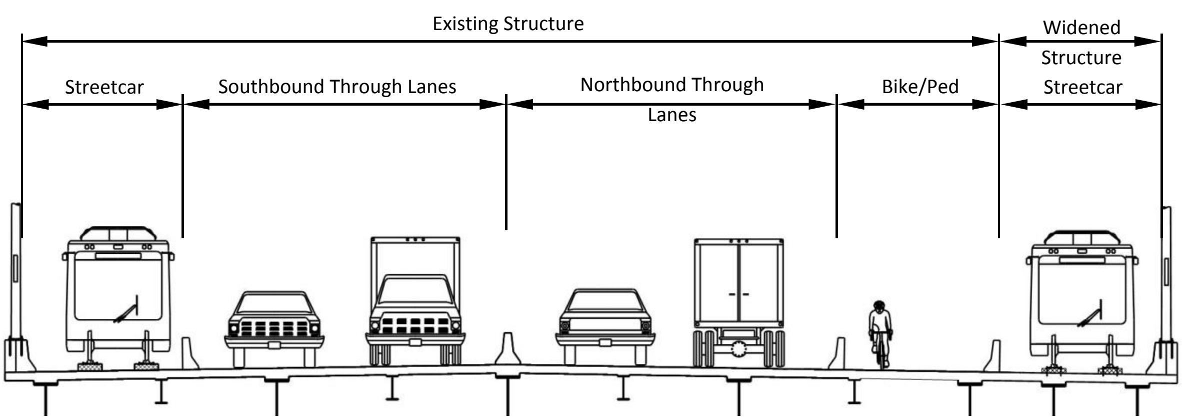
Figure 5-2: Existing Conditions - HOA Bridge



The Heart of America Bridge has a posted speed limit of 45 mph. The generally accepted guideline for safe operation of a streetcar in mixed traffic is 35 mph. Reduction of the speed on the HOA Bridge was deemed as impractical, so streetcar operation in an exclusive lane were identified as a critical design parameter.

A VISSIM traffic analysis of the bridge indicated that there would not be a detrimental motorized-traffic impact if the number of southbound lanes were reduced to two. This would provide two options for the existing bridge – to reconfigure the bridge with two southbound lanes, two northbound lanes, a bicycle/pedestrian lane, and either a single-track on the existing structure, or a double-track if the structure were widened. **Figure 5-3** shows one possible configuration of a widened bridge.

Figure 5-3: HOA Bridge – Widening Option

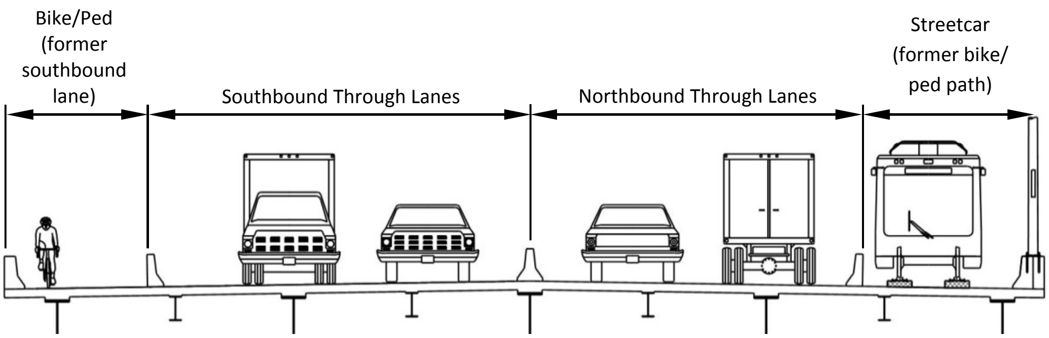


Bridge Widening Option to Accommodate a Double-Track Streetcar – Looking North

The traffic simulation at the intersection of 10th Avenue and Burlington Street indicated that adding a streetcar at that intersection would have a significant impact that would result in propagating impacts to the corridor north of the intersection as well. An alternate streetcar alignment was developed using the former railroad right of way to the east, starting south of 10th Avenue and entering the Burlington median at 12th. This modification mitigated the traffic issue at 10th Avenue, and avoided the right-of-way impacts along the narrow segment of Burlington from 10th to 12th. This opportunity produced a heavily-weighted preference to align the track on the east side of the bridge. An operational analysis of the streetcar indicated that a single track for the river crossing would provide sufficient service for projected operational needs. The single-track option allows a configuration that eliminates the need for structure widening on the HOA option.

The single-track configuration that does not widen the bridge is shown in **Figure 5-4** below. For bridge operations, providing a track alignment on the east or west side of the structure does not present a limiting factor. However, right-of-way limitations north of the bridge, as well as operational limitations at the intersection of Burlington with 10th Avenue, lead to a preferred alignment along the east side of the crossing. Placement of the track in the location of the existing bicycle/pedestrian path precipitates the need to relocate the bicycle/pedestrian crossing along the west side of the bridge.

Figure 5-4: HOA Bridge – Recommended River Crossing Option

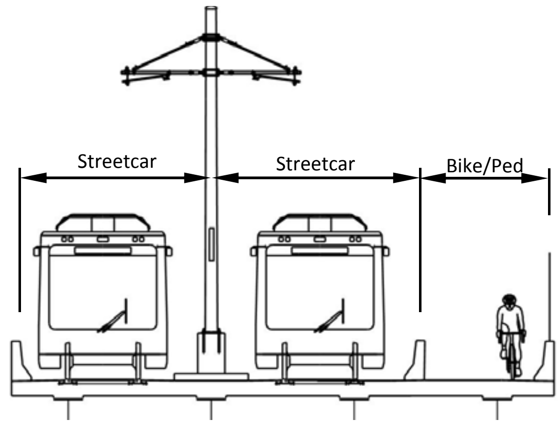


Recommended River Crossing Option – Looking North

The structural capacity of the existing structure, as well as the option of widening the structure, was evaluated. The structural analysis identified that replacing an existing lane with a dedicated lane streetcar was feasible and would be comparable to the existing bridge loadings. Analysis indicated that operating the streetcar in a shared lane would not be a feasible option without a significant retrofit to the structure. The most feasible alternative is to construct a streetcar line on the outer lanes of the structure. A complete structural evaluation is available in the supplemental document, *NorthRail Streetcar – HOA Structural Review Summary*.

A New Transit Bridge

Figure 5-5: New Transit Bridge Option



The option for a new transit bridge presents advantages over the use of the Heart of America Bridge. Construction of a new bridge would eliminate the need to make any modification to the existing bridge. A new bridge could include a new bicycle/pedestrian facility. This facility could either supplement the existing bicycle/pedestrian facility on the Heart of America Bridge, or it could replace it, allowing the existing bicycle/pedestrian facility to be converted to a northbound through lane. The new bridge could also be constructed with a dual track, allowing immediate or long-term expansion of the service crossing the river. **Figure 5-5** shows a possible new transit bridge configuration that includes dual-track and a bicycle/pedestrian crossing.

A new transit bridge would be designed specifically for streetcar use . It should be noted that the placement of new piers in the Missouri River would need special hydraulic analysis. The US Army Corps of Engineers is currently studying the progressing bed degradation in the Missouri River. New piers would need to be founded on bedrock beneath the River, and hydraulic effects on adjacent structures and river banks would need to be analyzed in detail.

A new transit bridge would have little impact to existing auto traffic conditions. It would afford the opportunity to create a new bicycle/pedestrian river crossing, which could supplement the existing bicycle/pedestrian crossing on the Heart of America Bridge, or facilitate removal of that crossing and convert the lane to serve motorized vehicles. The new bridge could be sited such that it avoids interaction with the intersection of 10th Avenue at Burlington Street. Construction of a new bridge would also largely eliminate traffic conflicts during construction.

5.5 Implementation Cost

Costs were developed for an array of options for the Heart of America Bridge as well as for the New Transit Bridge. A summary of these costs is presented in the table below. As would be expected, re-purposing a traffic lane on the Heart of America Bridge would be the least-cost path to implementation.

Table 5-2: Cost Summary

Structure	Option	Cost (millions)	Description
New Transit Bridge	1A	$41.7	27-foot wide bridge; accommodations for a double-track streetcar
New Transit Bridge	1B	$60.3	Option 1A, plus an additional width of 12-feet for a bike/ped lane
Heart of America Bridge	2	$35.2	Bridge widening on east side
Heart of America Bridge	3	$23.3	No bridge widening, streetcar on east side of bridge, new bike/ped facility on west side in existing vehicular lane

5.6 Recommendations

The two options considered in the detailed screening have similar operational parameters with little difference. The recommendation, therefore, is heavily weighted by the cost of the project. It should be noted that an alternative was considered that would site a single-line track along the west side of the HOA Bridge. Because this option would not require the relocation of the existing bicycle/pedestrian facility, it would be a lower cost than those shown. However, at the ends of the river crossing, particularly at the north end, connections to either the Burlington route or the Swift route would create a number of complications at the intersection of 10th Avenue. Because of the geometric layout, it was anticipated that traffic impacts would be significant and negative. Due to these operational concerns, this option was not carried forward. Based on optimization of operations, heavily weighted by cost, Option 3 on the east side of the HOA Bridge was selected as the recommended alternative.

6. Preliminary Alignment Options

The route development process began with a set of general routes identified prior to the study. All route options share a southern terminus at the Main Street Streetcar Starter Line stop near the 3rd & Grand Transportation Hub in the River Market in Kansas City, Missouri.

Within North Kansas City, there were several alignment and termini options identified and evaluated during the process:

- Burlington to 18th Avenue
- Burlington to 32nd Avenue
- Swift Avenue to 18th Avenue
- Swift Avenue to 32nd Avenue
- Armour/210 to Walker Road (extending from Burlington or Swift)

6.1 Burlington Street

Burlington Street is a north-south high-volume 6-lane state highway, Missouri State Highway 9, with three travel lanes in each direction divided by a median. Average daily traffic volumes are approximately 26,000, with posted traffic speeds of 40-miles per hour (MPH). Burlington Street is an important transportation corridor, providing a direct connection to one of three river crossings serving Downtown Kansas City, Missouri.

Existing bus service on the corridor includes KCATA Routes 132, 135 and 142. During the 2008 *North/South Alternatives Analysis*, Burlington was identified as the preferred alignment for Light Rail (LRT). This was followed by the 2009 *Burlington Corridor Study*, which provided a vision for the corridor that would, “Transform Burlington Street to serve as an entry, a destination, and a mixed-use center that represent the safe, amiable, walkable character of greater North Kansas City.”

The Burlington Corridor Overlay District and Design Guidelines were adopted to help implement this vision by providing additional development standards to the underlying zoning districts to ensure a unified appearance, scale, massing and urban design character for future development. The 2002 (updated in 2008) *Smart Moves Plan*, the region’s long-range transit plan, identifies the Burlington/North Oak corridor from the River Market to Highway 152 as a transit spine for the Northland. The 2013 *North Oak Corridor Study* recommended Burlington Road/North Oak as the preferred corridor for a high-level transit investment such as Bus Rapid Transit (BRT) or streetcar.

Two streetcar configurations were developed for Burlington: mixed traffic (shared lanes) in the outside travel lanes, next to the parking lane; and semi-exclusive median lanes that required conversion of the parking lanes to travel lanes in order to maintain number of traffic lanes in each direction. The median lanes are effectively dedicated transit lanes except for at signalized intersections where traffic also uses the lane for left turn access.

6.2 Swift Avenue

Swift Avenue is a north-south corridor serving local traffic with relatively low volumes. The character of Swift Avenue changes dramatically from the north to the south with the dividing point at downtown, identified in the *North Kansas City Master Plan* as the blocks between 16th Street to 21st Street. In the southern portion of the corridor, the ROW is wide with two travel lanes, angled parking and truck loading areas for adjacent industrial and warehouse businesses. In the northern portion of the corridor, the traffic lanes are divided by a median with a boulevard character serving the City's densest residential areas, including the CityView apartments, the Gardens, a retirement community, and Northgate Village, an infill traditional neighborhood development.

Swift Avenue is one of the City's primary transit corridors with bus service from routes 133 and 38. Swift Avenue is also a designated bike route providing an important connection to a barrier-separated bi-directional bicycle/pedestrian path on the northbound span of the HOA Bridge. To-date, the HOA bridge has the only designated bicycle/pedestrian connection across the Missouri River in the metropolitan area. Swift Avenue was evaluated as part of the 2008 *North/South Alternatives Analysis*; however, it was not recommended as a preferred corridor for regional LRT, primarily due to the impacts of a dedicated transit lane to on-street parking. For this study, Swift Avenue was evaluated for mixed-traffic operations minimizing the potential impacts to adjacent businesses and parking. It should be noted that a typical modern streetcar, with a single vehicle, requires a smaller station footprint than a typical multi-car LRT, and is more easily integrated into an urban environment.

The streetcar would operate in mixed traffic along Swift Avenue.

6.3 Armour/210

Armour Road is an east-west state highway, Missouri State Highway 210 (Armour/210). Armour/210 transects downtown, identified in the *North Kansas City Master Plan*, as the blocks between Buchanan and Howell Street, and serving as North Kansas City's "main street." Through this downtown segment, Armour/210 has two travel lanes, angled parking, an enhanced pedestrian character, and an active mix of uses. East of downtown, Armour/210 widens to six travel lanes, three travel lanes in each direction, with a divided median east of the I-29/I-35 interchange.

Armour/210 connects North Kansas City's three largest employers, North Kansas City Hospital, Cerner Corporation Headquarters and Harrah's Casino. Average daily traffic volumes vary from approximately 10,000 to 30,000, with posted traffic speeds of 25 MPH through downtown, 35 MPH on the eastern edge of downtown, and 45 MPH east of the interchange. Existing bus service on the corridor includes Routes 132, 133 and 135. Armour/210 has not been evaluated through past studies as a high-level transit corridor, however, as a result of feedback from Public Workshop #1, mostly related to connections to the City's key activity and employment centers, it was included in the evaluation process.

The streetcar would most likely operate in mixed traffic in the center lanes of Armour Road.

7. Initial Evaluation and Screening

The preliminary alignment evaluation identified a preferred streetcar alignment that best meets the goals of the Community and Partnership Committee, identified at the onset of the process. The preliminary evaluation provided an initial high-level screening of all potential alignment options identified during the process. After selecting a preferred route, the streetcar will be developed and evaluated in greater detail. The evaluation criteria were organized into three major categories:

- Support Neighborhood Revitalization and Economic Development
- Improve Transportation, Connectivity and Mobility
- Optimize Route Feasibility

The preliminary alignment options were evaluated with respect to the evaluation criteria as described in the remainder of this section. For most of the criteria, the screening is the same for both of the Burlington options. The criteria are applied by Burlington alternative (mixed traffic and dedicated lane) when there are differing impacts. This information was presented to the public for comment in Workshop #2, and was reviewed by the Partnership Committee.

7.1 Support Neighborhood Revitalization and Economic Development

A key project goal, articulated by the Partnership Committee and confirmed by Public Workshop participants, was the ability of a streetcar to support neighborhood revitalization and economic development. In other words, the project is as much about community transformation as it is providing enhanced connections. Therefore, the preferred alignment was identified in part by the opportunity to maximize future economic development potential.

7.1.1 Development Capacity

While streetcars have been credited with supporting economic development, there must exist sufficient underutilized and vacant properties along the streetcar alignment to enable development to occur. This “development capacity” is important to understand when considering whether one alignment is more likely than another to be supportive of transit oriented development.

For this study, Burlington Street, Swift Avenue, and Armour Road were evaluated from a development capacity perspective. Properties with a building value of zero in the tax assessor data were treated as vacant. While there is significant open space in North Kansas City, particularly along Burlington, much of this property includes railroad tracks. These parcels were viewed as occupied and not developable for commercial or residential purposes, despite that some portions of these properties may be underutilized.

To better understand the economic development potential, the Team analyzed tax assessor and real estate data for areas within 1/4 mile of the proposed streetcar alignments. Due to the proximity of the Burlington and Swift alternatives, this buffer overlaps both of these routes, obscuring the differences between them. Therefore, the data is presented for a 1/8 mile buffer, which better presents the differences between these route options. The same analysis area was used for Amour for consistency.

Two components of development were estimated. First, vacant and underutilized (e.g., surface parking lot) space located in proximity to Burlington, Swift and Armour was identified. Assumptions related to developable land, building height, and share of parcel dedicated to a physical structure were made to estimate the capacity for new development. Second, redevelopment potential was also estimated based on existing building size and vacancy rates. The combination of these two development components represents the development capacity for each alignment; in other words, it is the upper limit of development likely to occur. To ensure that assumptions and estimates were reasonable, a focus group of real estate and economic development experts was held, and large employers near the alignments were interviewed. Their input helped inform the analysis.

As shown in **Table 7-1** below, Armour and Burlington offer more capacity for development if industrial properties included in the analysis are rezoned to allow commercial or residential development. Specifically, 1.7 million square feet of property is available for redevelopment along Armour Road, between Burlington Street and Iron Street, with an additional 4.8 million square feet between Iron Street and Walker Road. Approximately 1.3 million square-feet of property is available for redevelopment along Burlington Street, between 10th Avenue and Armour Road, with an additional 1.4 million square feet between Armour Road and 32nd Avenue. In contrast, Swift provides 1.1 million square feet between 10th Avenue and Armour Road, and .6 million square feet from Armour Road to and 32nd Avenue.

Table 7-1: Development Capacity Proximate to Alignment (MSF)

Alignment	Residential	Commercial	Industrial	TOTAL
Burlington				
From 10th to Armour	-	0.3	1.0	**1.3**
From Armour to 32nd	-	0.6	0.8	**1.4**
Swift				
From 10th to Armour	-	0.3	0.8	**1.1**
From Armour to 32nd	0.2	0.5	-	**0.6**
Armour				
From Burlington to Iron	0.4	0.5	0.8	**1.7**
From Iron to Walker	0.5	3.1	1.2	**4.8**

Source: Tax Assessor Database and HDR analysis

Development Capacity Evaluation Summary

When evaluated based on development capacity, or the availability of vacant or underutilized space to support development, Armour ranks the highest, followed by Burlington. Swift is relatively more developed and has less available space for new development, and received a

Low rating. Much of Burlington's vacant and underutilized properties are presently zoned industrial in the tax assessor data, and some of the parcels are relatively large making assemblage less of an issue. In addition, most of the industrial property available along Burlington is located close to the proposed alignment. The Burlington corridor received a Medium rating. Armour has significant capacity for development, particularly between Iron and Walker, contributing to its High development potential ranking.

7.1.2 Streetcar Development Readiness

Streetcar readiness is an assessment of each corridor's near-term potential to leverage the economic development opportunities of streetcar service. There are a number of factors that play into determining whether a proposed alignment is streetcar ready. They include:

- Pedestrian friendliness
- Setbacks
- Roadway speeds
- Existing property uses that are consistent with a streetcar
- Systems in place to support long-term operation

All three alignments have significant capacity for development as described above. There remain, however, significant questions surrounding Burlington and Armour if North Kansas City is going to build on the Kansas City streetcar momentum in the relatively near term.

For example, the Burlington corridor, as presently configured, is not pedestrian-friendly. In fact, it is traditionally viewed as a highway in the region. In addition, its wide cross-section, significant building set-backs, and relatively fast roadway speeds make it less than ideal for streetcar service and related development in general. From an operational perspective, it is unclear what entity would be responsible for building and maintaining the roadway if a streetcar was in place. Currently, MoDOT is responsible for the roadway but reconfiguring to accommodate a streetcar could change this arrangement. That uncertainty plays against Burlington's readiness for development.

Armour Road includes some sections that are pedestrian-friendly near Burlington Street, but much of the proposed alignment farther to the east is not. Additionally, many of the larger employers are tucked back away from the street itself, further reducing the perception of easy and efficient access to key destinations by pedestrians.

In contrast, the Swift corridor is more "streetcar ready." It has available capacity for development, and a streetcar could help "fill the gaps" between vacant and utilized properties along the alignment. Also, office, retail and some residential uses are already in place, consistent with the mixed-use development generally desired along streetcar routes. It is also more pedestrian friendly than Burlington Street.

Streetcar Development Readiness Evaluation Summary

Burlington's faster roadway speeds, deeper setbacks, and lack of pedestrian-supportive infrastructure contribute to the alignment's Low ranking from a streetcar-development readiness perspective. In contrast, portions of Swift and Armour are already pedestrian-friendly, and mixed use development, consistent with typical streetcar uses, is already in place. These existing attributes make both alignments relatively better positioned for streetcar development than Burlington and are rated Medium.

7.1.3 Long-Term Opportunity for Revitalization

Long-term opportunity for revitalization is an assessment of each corridor's full potential to leverage the economic development opportunities of streetcar service. Based on current city planning efforts and input gathered throughout the study, the long-term opportunity for revitalization was the deciding factor in determining which alignment should be viewed more favorably. In addition to having more developable space, the larger parcels available on Burlington Street and Armour Road make the corridor easier to develop since significant land assembly is not required. While the Swift corridor offers an advantage from a streetcar-readiness perspective, Burlington and Armour both have more capacity available for development. Additionally, Burlington is better positioned than either Swift or Armour for longer term, more transformative revitalization and development when changes are made to make the corridor more pedestrian friendly. A continuing City emphasis on transforming the Burlington Corridor will further reinforce long-term opportunities along this route.

Long-Term Opportunity for Revitalization Evaluation Summary

The city is committed to redeveloping the Burlington corridor and has implemented plans that are supportive of their efforts. These include planning for more pedestrian-friendly facilities and a move away from Burlington's regional reputation as a predominantly industrial thoroughfare offering few reasons for automobile drivers to stop. Because of the relatively significant development capacity available on Burlington, combined with limited existing mixed use development and the city's desire to transform the corridor, Burlington ranks High while Swift and Armour are rated Medium.

7.1.4 Transit-Supportive Planning

Transit supportive planning activities will facilitate an increase in transit ridership by enhancing the pedestrian environment, increasing residential, retail, and employment intensity, reducing building setbacks, and/or enhancing the ability of transit to offer high-quality service to adjacent land uses. Burlington Street has been the focal point of such an effort in North Kansas City over the last decade. In particular, the Burlington Corridor Plan emphasizes a radical change in the nature of the corridor from a highway, providing commuter access to downtown Kansas City Missouri abutted by industrial and auto-oriented land uses, to a mixed-use, pedestrian oriented urban street. Burlington was rated High due to the City plans to transform the street. Plans for Swift Avenue reinforce its existing pedestrian-friendly atmosphere, and provide for some increase in residential density. Therefore, Swift was rated as Medium with respect to this criterion. The portion of Armour Road with the greatest development opportunity around and east of I-29/35 is generally developing as isolated activity centers such as Harrah's, the hospital complex and the Cerner office center. This development pattern is not conducive to transit, and Armour received a Low rating.

7.1.5 Transit-Supportive Zoning and Policies

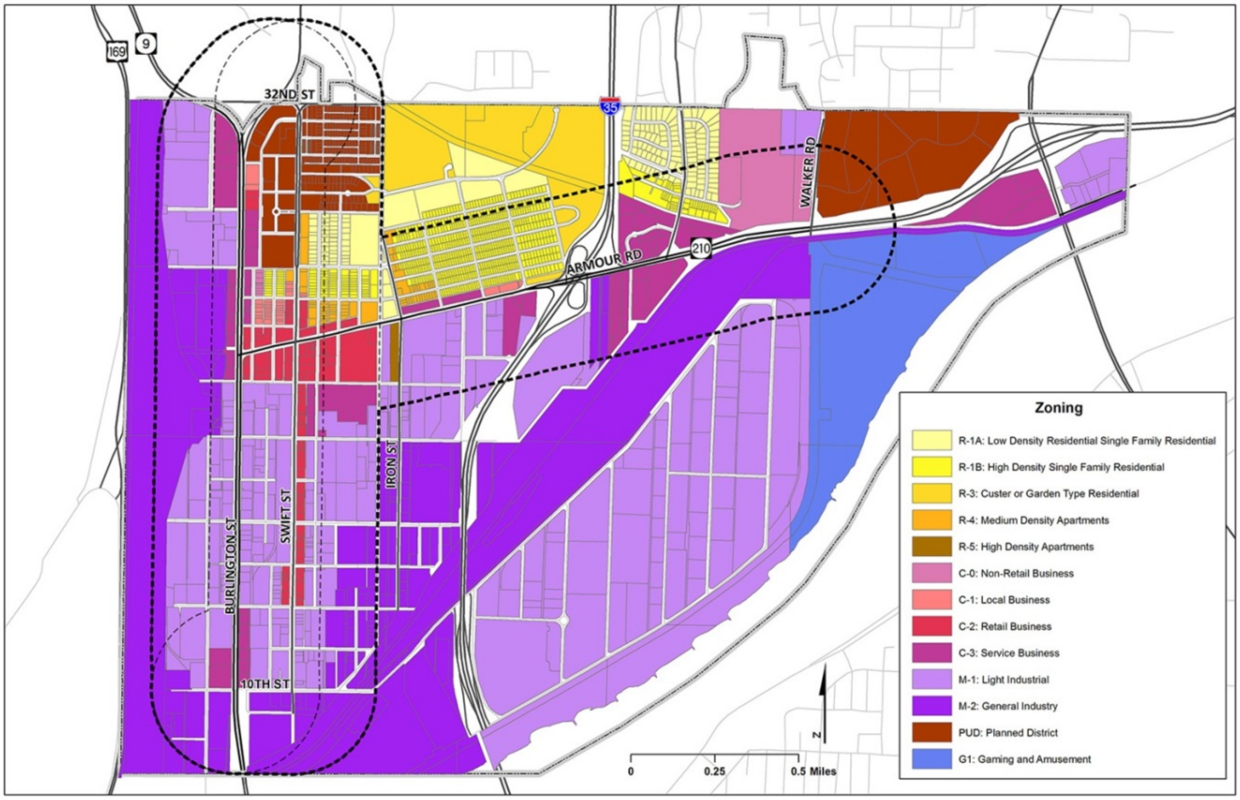
This criterion assesses existing zoning and policies. Zoning and local land use policies are considered transit-supportive if they provide the right mix of uses, densities and design to support frequent or higher-capacity transit service.

Existing zoning and land use (shown in **Figure 7-1** below) were assessed for each of the parcels adjacent to each alignment alternative. To support transit, zoning should include uses that encourage trips via walking or bicycling. Users that have access to daily activities along a single corridor have fewer transfers between transit routes and depend less on transportation by automobile. Ideally, a high-capacity transit corridor connects a wide range of uses within a short walk (less than a quarter mile). Desirable uses include, but are not limited to:

- High-density residential;
- Employment;
- Services;
- Shopping; and,
- Entertainment.

In a transit-oriented community, auto-oriented single-use developments such as drive-through restaurants or banks, gas stations or car sale lots are typically discouraged close to transit stops/stations, because the walkable environment is interrupted. For this analysis, existing generalized land use categories were assigned a rating (low to high) based on their ability to support high-capacity transit service.

Figure 7-1: Existing Zoning in North Kansas City



Burlington Street

Existing land uses along Burlington are currently a mix of light industrial and auto-oriented commercial with some professional office. Current industrial uses, located primarily in the southern portion of the corridor, take up large footprints and tend to have a lower number of employees per square feet than the commercial uses to the north. The nearest residential population is located in the northern portion of the corridor, approximately one to two-blocks to the east. The City has adopted the *Burlington Corridor Overlay District and Design Guidelines* for the corridor. This tool provides the City with the ability to transform the current auto-oriented nature of the corridor to a vibrant mixed-use and pedestrian-friendly district as redevelopment and development occurs.

Swift Avenue

Paralleling Burlington, Swift Avenue, south of downtown, is primarily industrial on the west side of the street with commercial businesses and offices on the east side of the street. The southern area of the corridor has a distinctive industrial character with buildings fronting the street. In recent years, many of these industrial buildings have been converted to a wide variety of commercial business and office uses. North of Armour Road, just north of downtown, the corridor enters the densest residential development in North Kansas City. This includes a number of garden apartments; dense residential neighborhoods on small lots; CityView, with newer loft-style apartments; The Gardens of Northgate, a senior living community; and

Northgate Village, a master planned traditional neighborhood with a mix of residential housing types including row homes that front on Swift, patio homes and single-family homes.

Armour Road/Hwy 210

A significant portion of North Kansas City's residential neighborhoods are north of Armour Road and are within close walking distance to downtown. The few residences directly on the Armour Road corridor include the Northland Lofts Apartments on Iron Street. Employment is well distributed along Armour Road, with a number of active retail commercial businesses, restaurants, and professional office and civic uses including City Hall and the North Kansas City Community Center. On the east end of the corridor there are three significant employment generators: North Kansas City Hospital (approximately 3,000 employees), Cerner Corporation (approximately 4,800 employees) and Harrah's Casino (approximately 1,000 employees). All of these uses generate significant local and regional traffic.

Transit Supportive Zoning and Policies Evaluation Summary

The Burlington corridor provides conflicting characteristics regarding this criterion. The Burlington Overlay District presents strong encouragement for property owners to develop and redevelop in a transit-supportive manner, however, the existing zoning and land uses tend to reinforce a development pattern that is not transit-friendly. These characteristics provided offsetting high and low ratings, resulting in a Medium. The zoning for Armour Road includes a planned district to the far east, but is resulting in insular development that does not have good pedestrian access. Otherwise, both Armour and Swift present a mixed development pattern that supports moderate transit service. Each received a Medium rating.

7.2 Improve Transportation, Connectivity and Mobility

7.2.1 Connecting People, Places, and Key Destinations

This measure evaluates how well the proposed alignments connect people, jobs, designations and activity centers. The Federal Transit Administration (FTA) provides guidance in rating new transit projects that includes the following land use and demographic factors:

- Population density
- Total employment
- Transit-dependent households

Other measures considered under this section include:

- Activity Centers/Neighborhoods
- Ability to Enhance Existing/Planned Transit Service

Population Density and Total Employment

As noted above, population densities and employment within the transit corridor are critical factors in determining the success of transit investments, especially urban rail systems. FTA provides guidance on transit-supportive population density and total employment breakpoints based on the Institute of Transportation Engineers (ITE) *A Toolbox for Alleviating Traffic Congestion.* ITE suggests several minimum density levels for correspondingly intense transit investments:

- ***A minimum level of local bus service*** (20 daily bus trips in each direction or one bus per hour) is often provided in residential areas averaging population densities of 3,000 to 4,000 people per square mile. This level of bus service is suitable for non-residential concentrations of activities in the range of five to eight million square feet or 10,000 to 16,000 employees (assumes 500 square feet per employee), occasionally lower.
- ***An intermediate level of local bus service*** (40 daily bus trips in each direction or one bus every 1/2 hour) is often provided in residential areas averaging seven dwelling units per acre (5,000 to 6,000 people per square mile) and for nonresidential concentrations of activities from eight to 20 million square feet (16,000 to 40,000 employees).
- ***A frequent level of local transit service*** (frequent bus or light rail; 120 daily trips in each direction or a frequency of ten minutes) is often provided in residential areas averaging nine to 15 dwellings per acre (8,000 to 10,000 people per square mile) and for non-residential concentrations of activities from 20 to 50 million square feet (40,000 to 100,000 employees).
- ***Commuter rail service*** with its high speed, relatively infrequent service and greater station spacing is suitable for lower density residential areas, however, the volumes required are only likely in corridors leading to non-residential concentrations of 100 million square feet (200,000 employees) or more, found only in the nation's largest cities.

It should be noted that this initial analysis evaluates population densities and total employment at a corridor level, in this case, a quarter-mile from the potential line. FTA New and Small Starts guidance evaluates population density and total employment within a half-mile of stop locations. This analysis for NorthRail will be refined based on potential stop locations on selected corridors during the detailed analysis.

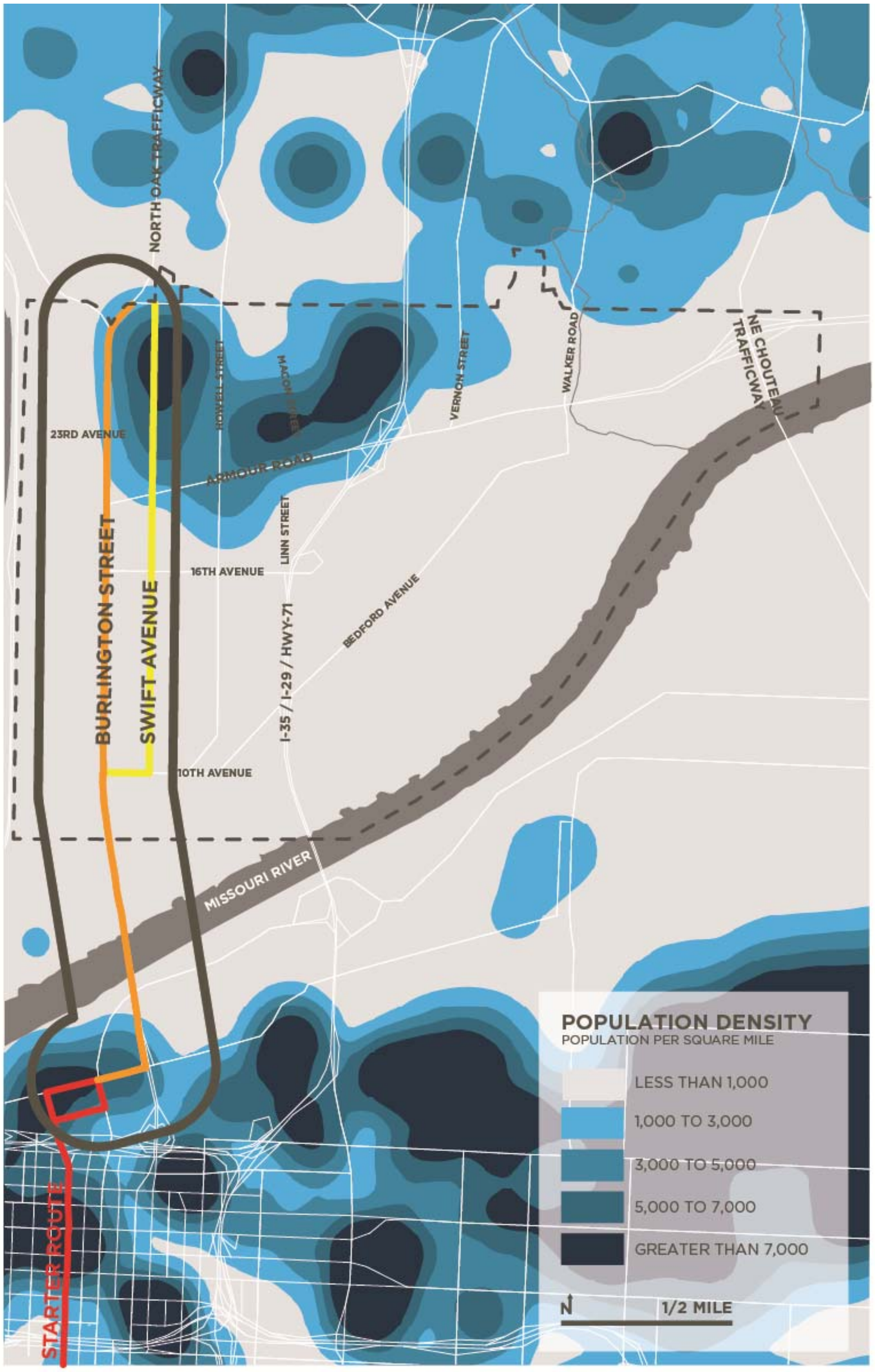
Population densities were assessed for each corridor based on 2010 data from the U.S. Census Bureau. For the purposes of this analysis, population densities are provided per square mile. For the initial analysis, the corridors were ranked relative to one another based on natural breaks. **Table 7-2** provides a summary of population density per corridor. **Figure 7-2** shows population densities by block group.

Table 7-2: Population Density by Square Mile

Corridor	Population Density	Rating
Burlington Street		
10th to Armour	165	Low
Armour to 32nd Street	1,917	
Swift Avenue		
10th to Armour	492	Medium
Armour to 32nd Street	2,995	
Armour/210		
Burlington or Swift to Iron	2,418	High
Iron to Walker Rd	2,131	

Source: U.S. Census

Figure 7-2: Population Density



Source: U.S. Census, block group data smoothed

Employment densities and total overall employment numbers were assessed for each corridor based on 2011 employment data from the Mid-America Regional Council (MARC). For the initial analysis, the corridors were ranked relative to one another based on natural breaks. **Table 7-3** provides a summary of total employment per corridor. **Figure 7-3** shows employment densities by tract.

Table 7-3: Summary of Total Employment per Alternative

Corridor	Total Employment	Rating
Burlington Street		
10th to Armour	3,934	Medium
Armour to 32nd Street	2,041	
Swift Avenue		
10th to Armour	4,651	Medium
Armour to 32nd Street	3,170	
Armour/210		
Burlington or Swift to I-29/I-35	3,551	Medium
Iron to Walker Road (Quarter Mile)	5,208	
Iron to Walker Road (Includes all Cerner, North Kansas City Hospital and Harrah's Casino employees)	10,738	High

Source: Mid-America Regional Council

Figure 7-3: Employment Densities by Tract

Source: Mid-America Regional Council, tracts smoothed

Transit-Dependent Population

For some, the choice of not owning a vehicle is a preference or lifestyle choice. For others, vehicle ownership may be too expensive, inconvenient or not possible due to age or physical constraints. For this reason, transit-dependent population, as measured by the percentage of zero-car households, and also transit trips to work, is an important factor for evaluating potential future transit investments. Due to the importance of this criterion in evaluating potential ridership, FTA gives a weight of two trips for one every trip made by a transit-dependent person. Transit-dependent population was assessed for each corridor based on the percentage of zero-car households, according to 2010 data from the U.S. Census Bureau. **Table 7-4** provides a summary of the percentage of zero-car households per corridor and **Table 7-5** provides the percentage of transit trips to work.

Table 7-4: Percentage of Zero-Car Households per Corridor

Corridor	Percentage of Transit Dependent Population	Rating
Burlington Street		
10th to Armour	14.6%	Medium
Armour to 32nd Street	11.9%	
Swift Avenue		
10th to Armour	14.9%	Medium
Armour to 32nd Street	12.3%	
Armour/210		
Burlington or Swift to Iron	10.8%	Medium
Iron to Walker Rd	6.1%	

Source: US Census, 2011 American Community Survey

Table 7-5: Transit Trips to Work

Corridor	Percentage of Transit Trips to Work	Rating
Burlington Street		
10th to Armour	0%	Medium
Armour to 32nd Street	8%	
Swift Avenue		
10th to Armour	0.5%	Medium
Armour to 32nd Street	7%	
Armour/210		
Burlington or Swift to Iron	2%	Low
Iron to Walker Rd	3%	

Activity Centers/Neighborhoods

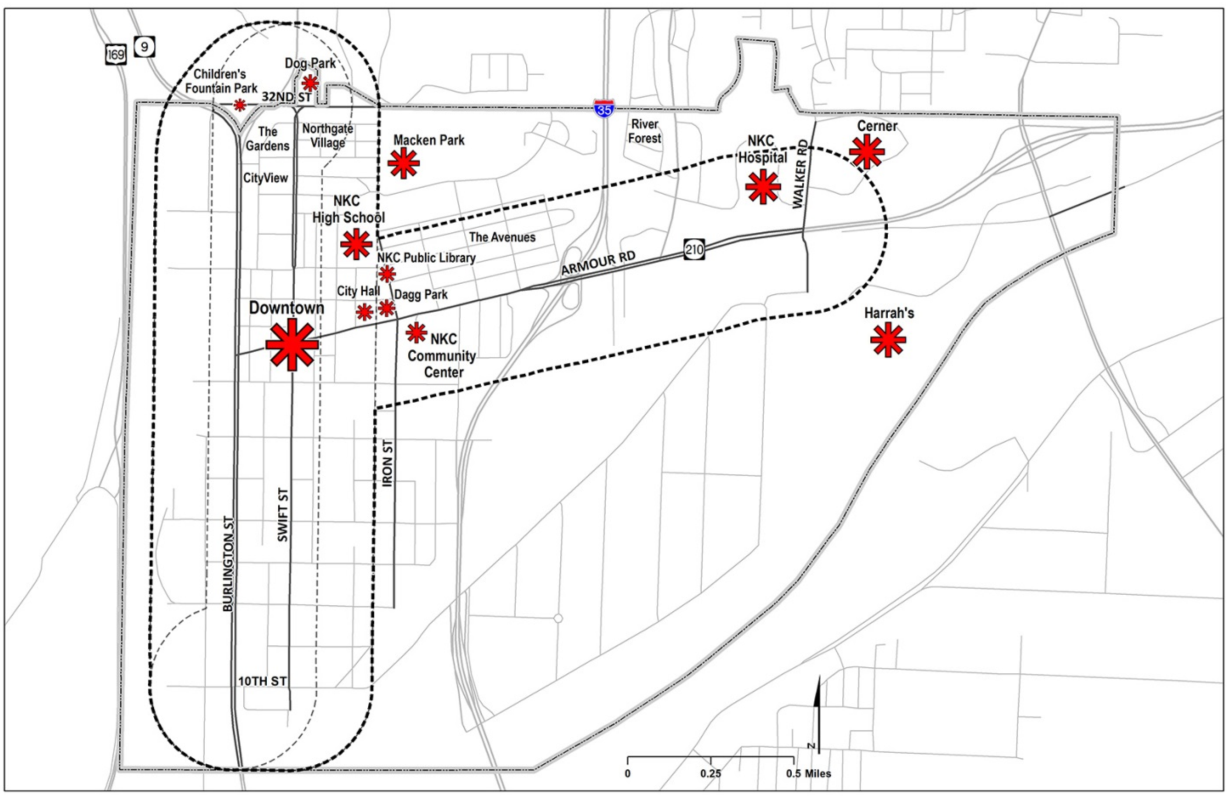
At its heart, transit serves as an extension of pedestrian travel, and this is especially the case with streetcar service. Additionally, an assessment of walkability is important in the FTA's evaluation of a corridor's transit readiness. FTA policy guidance typically also analyzes the demographics, land use, and activity centers within walking distance to the transit line. Therefore, it is critical to assess pedestrian access, comfort, and safety to determine which areas can truly be served.

Activity centers generating consistent all-day trips are a necessary component of a successful urban rail system. For the purposes of this analysis, activity centers were identified within a quarter-mile of each corridor. In general, major activity centers attract higher ridership; however, neighborhood activity centers are important because they have the ability to attract more frequent local trips. Some corridors under evaluation have a higher number of activity centers simply due to their length. Therefore, part of the assessment also considered the number of activity centers per route-mile. **Table 7-6** below provides a summary of the activity centers adjacent to each corridor and activity centers within a quarter-mile of each corridor.

Table 7-6: Existing Activity Centers/Neighborhoods

Corridor	Activity Centers adjacent to the Line	Activity Centers within 1/4 Mile	Rating
Burlington Street			
10th to Armour	Downtown Western Terminus	Downtown Core	Low
Armour to 32nd Street	Children's Fountain Park	CityView, The Gardens, Western Portion of Northgate Village, Dog Park	
Swift Avenue			
10th to Armour	Downtown Core	City Hall, Dagg Park, North Kansas City Public Library	Medium
Armour to 32nd Street	CityView, The Gardens, Northgate Village, Dog Park	North Kansas City High School, Macken Park	
Armour/210			
Burlington or Swift to Iron	Downtown Core, City Hall, Community Center	The Avenues, North Kansas City Public Library, North Kansas High School	High
Iron to Walker Rd	Downtown Eastern Terminus, The Avenues Residential Area	River Forest, North Kansas City Hospital, Cerner, Harrah's Casino	

Figure 7-4: Activity Centers



Connecting People, Places, and Key Destinations Evaluation Summary

This measure considered a broad range of factors, most of which were considered Medium for all of the route options. Because of the proximity of the residences to Swift, this route was given a High rating while the others were rated as Medium.

7.2.2 Walkability/Local Circulation

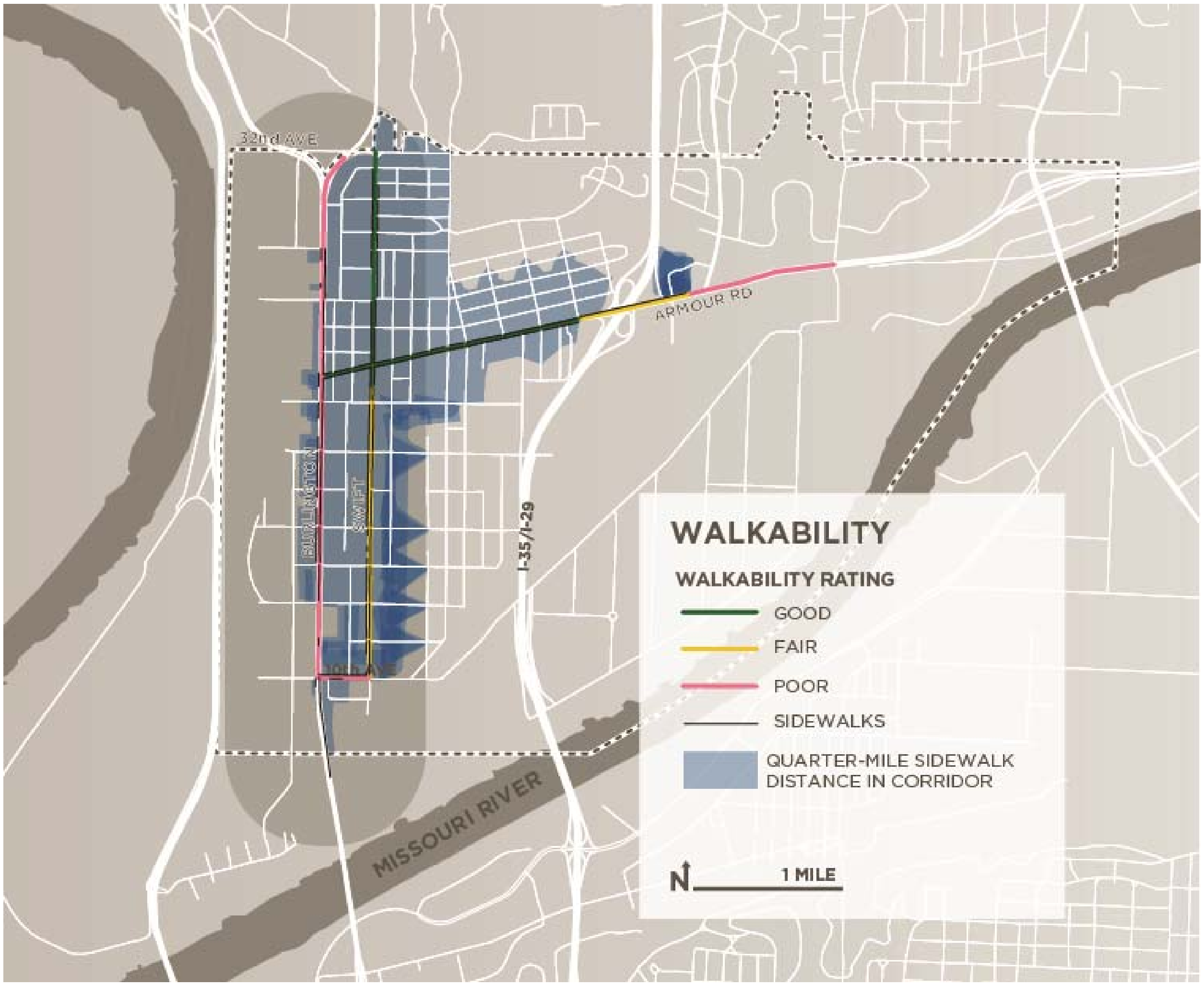
The potential streetcar extension corridors were evaluated based on established walkability criteria. The *Kansas City Walkability Plan* (LSA Associates, Inc, adopted March 2003) set forth five pedestrian levels of service (LOS) criteria that apply at the citywide, community, neighborhood, and project level. The following are the five criteria with a brief description:

- *Directness*: Considers the distance from origin to destination, with the highest scores representing the shortest and most direct route. Priority is given to a complete urban grid.
- *Continuity*: Measures the completeness of a sidewalk network, with preference to corridors with accessible sidewalks on both sides of the street that have a consistent width and are in good condition.
- *Street Crossings*: Considers the number of lanes required to cross by a pedestrian, with highest scores representing the least number of lanes to cross and/or inclusion of pedestrian refuge medians. This criterion also considers accommodations required for safe roadway crossings, such as pedestrian countdown signals, crossing signage, ADA-compliant ramps, lighting, clear sight lines, and pavement crosswalk markings.
- *Visual Interest and Amenities*: Aesthetic considerations of a corridor; scale, attractiveness, design quality, aesthetic lighting, pedestrian-friendly land uses, and maintenance. Highest scores are represented by well-maintained corridors with robust streetscape enhancements, active street-level building frontage, and opportunities for protection from the elements.
- *Security:* Presence of characteristics that convey a sense of safety and security for the pedestrian. Priority is given to corridors with pedestrian lighting, clear visual line of sight, and sidewalk separation from vehicular traffic by on-street parking or a landscape buffer.

Table 7-7: Walkability Assessment Summary

	Directness	Continuity	Street Crossings	Visual Interest & Amenities	Safety and Security	Rating
Burlington Street						
10th to Armour	Low	Low	Low	Low	Low	Low
Armour to 32nd	Low	Low	Low	Medium	Low	
Swift Avenue						
10th to Armour	Medium	Medium	High	Medium	Medium	High
Armour to 32nd	High	High	High	High	High	
Armour/210						
Burlington to Iron	High	High	High	High	High	Medium
Iron to Walker	Low	Low	Low	Low	Medium	

Figure 7-5: Walkability Rating



Burlington Street

- *Directness*: Uses are one to three blocks deep on the west side of the corridor due to active rail lines. *Rating: Low*
- *Continuity*: Sidewalks are not continuous along the corridor. Both sides of the street have significant gaps in the network. *Rating: Low*
- *Street Crossings*: Major street crossings are designated by appropriate crosswalk markings; however, pedestrians have to cross six lanes of traffic. There are small pedestrian refuges at 10th Street and Armour Road intersections. *Rating: Low*
- *Visual Interest and Amenities*: Today, the corridor is dominated by large industrial uses to the south and auto-oriented uses to the north. Large buildings front the street with little room between the sidewalk and the road. Auto-oriented uses typically have large surface parking lots and multiple curb cuts. It should be noted that the Burlington Corridor Overlay District was adopted to encourage an appropriate mix of uses and site design that is

intended to make the corridor more pedestrian- and transit-friendly. *Rating: Low (10th – Armour); Medium (Armour – 32nd)*

- *Security*: The corridor is generally well-lit; however, the sidewalk, with a few exceptions, abuts the street with high traffic volumes and posted vehicular speeds of 40 mph. *Rating: Low*

Swift Avenue

- *Directness*: The pedestrian network is constrained in the southern segment on the west side of the street due to large multi-block industrial buildings. North of Armour, there is an extensive sidewalk network. *Rating: Medium (10th – Armour); High (Armour – 32nd)*
- *Continuity*: Sidewalks are generally continuous on both sides of the street with the exception of a few segments south of Armour. These areas consist of truck docks. *Rating: Medium (10th – Armour); High (Armour – 32nd)*
- *Street Crossings*: Major street crossings are designated by appropriate crosswalk markings. *Rating: High*
- *Visual Interest and Amenities*: The corridor has industrial uses in the south segment with commercial uses on east side of the street. Swift transects the Downtown Core at Armour and the densest residential neighborhoods in the City on the north-end. *Rating: Medium (10th – Armour); High (Armour – 32nd)*
- *Security*: The corridor is well-lit. Pedestrians have a high comfort level crossing the street due to the low traffic volume and posted speeds of 25 mph. *Rating: Medium (10th – Armour); High (Armour – 32nd)*

Armour/210

- *Directness:* The corridor has a significant parallel pedestrian network, especially to the north connecting the City's neighborhoods to Downtown. *Rating: High (Burlington - Iron); Low (Iron - Walker)*
- *Continuity:* Sidewalks are continuous on both sides of the street through Downtown. To the east of Iron Street there is a sidewalk on the north side of the street that ends just east of the I-29/I-35 interchange bridge. *Rating: High (Burlington - Iron); Low (Iron - Walker)*
- *Street Crossings*: All street crossings through Downtown have appropriate crosswalk markings with pedestrian traffic signals. *Rating: High (Burlington - Iron); Low (Iron - Walker)*
- *Visual Interest and Amenities:* Armour is the City's main street and has the highest concentration of pedestrian-scale commercial-retail, professional office, and sit-down restaurants in the City. Buildings are generally at least two-stories fronting the street with active uses on the first floor. The corridor also has a high level of streetscape amenities including street trees, benches, litter receptacles, etc. *Rating: High (Burlington - Iron); Low (Iron - Walker)*
- *Security*: The corridor has ample street and pedestrian lighting. Although the street has high traffic volumes, pedestrians have a high comfort level crossing the street due to the posted

speeds of 25 mph. However, east of the I-29/I-35 interchange, posted speeds increase to 45 mph. *Rating: High (Burlington - Iron); Medium (Iron - Walker)*

Walkability/Local Circulation Evaluation Summary

A summary of the walkability/local circulation evaluation is provided in Table X below. Overall, the Swift alternative rated "High,"Armour/210 rated "Medium," and Burlington rated "Low." It should be acknowledged that Armour/210 through downtown (Burlington to Iron) rated "High," while the segment from Iron to just east of the interchange rated "Medium," and the final segment to Walker Road rated "Low."

7.2.3 Building a Regional System

As part of the evaluation process, the project team assessed each corridor's ability to support long-term rail transit expansion opportunities. As identified in Section 7.4.1 below, the Armour route is virtually cut off at the I-29/35 overpass due to the low clearance under the bridge. The overpass would need to be raised, the roadway lowered, or two traffic lanes converted to exclusive transit use (to protect the overhead streetcar power source that would be attached to the bottom of the bridge). None of these options are considered practical, which would prevent extension of the streetcar beyond the overpass.

For the Burlington and Swift corridors, opportunities north of 32nd Avenue include an extension north along the North Oak Corridor with potential connections to employment and activity centers at Vivion Road in KCMO; the emerging Gladstone Village Center and Heights at Linden Square development, a major mixed-use center; and the employment/retail node and potential park-and-ride at Highway 152. An extension along the Missouri Highway 9 corridor is also possible from either corridor, serving residential, retail and employment nodes including Briarcliff Village in KCMO; the emerging Horizons development, a major planned employment and mixed-use center in Riverside; and potentially to Park University and Downtown Parkville. These corridors could also support the opportunity for longer-term regional connections as far north as the Kansas City International Airport (KCI) as identified in the 2008 *North/South Corridor Alternatives Analysis*.

While both corridors offer similar opportunities to extend north, Burlington offers a more direct route since Swift diverts a block to the east. In addition, Burlington has a travel-time advantage since the speed limit is higher and the signal progression is set to advance through traffic. Finally, one of the Burlington options would operate in a semi-exclusive lane providing higher reliability.

The Regional System evaluation also considered possible expansion of bus operations:

Table 7-8: Ability to Enhance Existing and Planned Transit Service

Corridor	Transit Routes	Ability to Enhance Existing & Planned Transit Service	Rating
Burlington Street	142, 38	The 2013 North Oak Corridor Study has been identified Burlington as a high-capacity transit facility and recommends the corridor for BRT or streetcar in the future. The corridor is designated as a major regional transit corridor in Smart Moves.	High
Swift Avenue	133, 38	Swift is not a major transit corridor. It does provide a direct connection to downtown North Kansas City and adjacent residential areas. The corridor is not identified as a primary corridor in Smart Moves.	Medium
Armour/210	132, 133, 135	Armour is not a major transit corridor. It does provide a direct connection to downtown North Kansas City and adjacent residential areas. The corridor does provide a connection to the major employment centers at Cerner, the North Kansas City Hospital, and Harrah's. The corridor is not identified as a primary corridor in Smart Moves.	Low

Building a Regional System Evaluation Summary

The elimination of Armour option due to the I-29/35 overpass results in two options that could be extended: Burlington and Swift. Burlington has a significant advantage over Swift with respect to travel time and reliability and offers greater opportunity to expand local bus service as an interim step prior to streetcar operation. Therefore, Burlington is rated High, Swift is rated Medium and Armour, Low.

7.2.4 Ridership Potential

The ridership potential is largely driven by the population and employment distribution and walkability that were discussed in Sections 7.3.1 and 7.3.2 above. Burlington has relatively low-density employment and limited access from residential development. The Swift corridor has higher population and employment density than Burlington. Although Armour has the highest employment density, the major employers are not within a convenient walking distance of the potential streetcar route. In addition, those employers are located east of the I-29/35 overpass, and cannot be served by the Armour route.

Ridership Potential Evaluation Summary

The Swift option offers the best access to both population and job concentrations, followed by the Burlington corridor. The high concentration of jobs on Armour Road is not serviceable by the streetcar route. Burlington Street was rated Medium, Swift was High, and Armour was Low, with respect to potential ridership.

7.3 Optimize Route Feasibility

The two operating options (running in a mixed traffic (shared) lane versus a dedicated lane) along the Burlington corridor have had similar impact with respect to the evaluation criteria discussed in the prior sections, and have therefore not been discussed as individual options. Those operating distinctions are significant, however, with respect to each of the criteria in this group, so they will be discussed as separate options in this section.

7.3.1 Major Feasibility Challenges

This analysis evaluates the options from a conceptual cost/engineering perspective. There were two levels of analysis performed for this study: a preliminary analysis to compare the costs for each corridor and a second to determine potential fatal flaws. Either a high cost or a fatal flaw would eliminate an option from consideration. This rating identifies key issues associated with each route, rather than providing a rating. Each alignment was evaluated based on seven categories: grades, street geometry/lane configuration, railroad crossings, bridges/structures, vertical clearances, utility impacts, and lane widths.

For the most part, the streetcar is assumed to operate in mixed-traffic, however, a semi-exclusive lane option in the median was also considered for Burlington Street. Based on the findings in this analysis, an order-of-magnitude capital cost was calculated for each alternative. A baseline cost of $27 million per track mile in 2013 dollars was applied to each alternative. This baseline cost includes vehicle costs and costs associated with maintenance facility expansion. Additional costs were added to the baseline cost based on the findings of the conceptual engineering analysis of each alternative. From this cost, escalation of 3 percent per year was applied to the assumed midpoint of construction. For the purposes of this study, costs were annualized to mid-2020.

A summary of the order-of-magnitude capital costs for each alternative is found in **Table 7-9**.

Table 7-9: Order-of-Magnitude Capital Cost Estimate

Corridor	Route Miles	Cost Per Route Mile	Total Cost In $2020
1 Burlington St (Mixed Traffic)	**1.82**	**$ 59,988,050**	**$ 132,187,822**
10th to Armour	1.00	$ 59,906,204	$ 72,879,123
Armour to 32nd	0.81	$ 60,088,930	$ 59,308,699
1A Burlington St (Dedicated Lanes)	**1.82**	**$ 61,671,050**	**$ 135,896,429**
10th to Armour	1.00	$ 61,671,050	$ 75,026,153
Armour to 32nd	0.81	$ 61,671,050	$ 60,870,275
2 Swift Ave	**1.91**	**$ 59,960,523**	**$ 139,008,787**
10th to Armour	1.21	$ 59,960,523	$ 87,930,627
Armour to 32nd	0.70	$ 59,960,523	$ 51,078,159
5A Armour Rd	**2.80**	**$ 59,568,344**	**$ 225,176,313**
10th to Armour	1.00	$ 59,906,204	$ 72,879,123
Burlington to Iron	0.49	$ 58,879,631	$ 35,139,364
Iron to Walker	1.31	$ 73,971,896	$ 117,157,827

The findings of the initial conceptual engineering analysis, along with the associated allowances applied to the capital cost estimate, are detailed in the subsequent sections of this document. As indicated in the table above, the cost estimate for Armour significantly exceeds that of the other route options.

Burlington Street

Grades

Longitudinal grades along Burlington Street between the southern limit at 10th Avenue and the northern limit at 32nd Avenue are shallow and are well below 7 percent for the length of the corridor. There are no fatal flaws based on grade for this alternative, and no additional capital cost allowances are assumed at this time for grades.

Street Geometry / Lane Configuration

Burlington Street: Mixed Traffic

Burlington Street currently consists of three northbound and three southbound lanes, with a center median with left turn lanes at intersections.

- Between 10th Avenue and 12th Avenue, no parking or bus lanes exist, and sidewalk is mostly nonexistent. The right-of-way width is 110 feet and the existing curb to curb width is approximately 90 feet. Siting streetcar stops on this segment would be very challenging and could include increased costs, should one be located in this area.
- From 12th Avenue to 32nd Avenue, the right-of-way widens out to 130 feet with 10 feet of parking / bus lanes on each side of the road, making the curb-to-curb width 110 feet. Sidewalks are more present in this segment, but there are blocks where they do not exist. Depending on stop locations, sidewalks may need to be constructed to provide continuous access to the stops. An allowance of approximately $60,000 is included in the capital cost for this purpose.
- North of 32nd Avenue, it is assumed that a ”Y”-turnaround would be constructed away from live traffic to allow a northbound vehicle to pull in, the driver to switch ends, and the vehicle to proceed southbound. A transit-only signal phase would be required for this movement to take place. An allowance of $20,000 is included in the capital cost for this purpose. Additionally, if this movement is to take place on the north leg of the intersection, the roadway will likely need to be widened to the west to obtain sufficient room within the median to store a vehicle away from live traffic. An allowance of approximately $85,000 is included in the capital cost for this purpose.

Burlington Street: Dedicated Lanes

For this alternative, it is assumed that the streetcar will run in the center median area of Burlington Street in dedicated streetcar-only lanes.

- To prevent mixed traffic from entering the streetcar lanes, it is assumed that the streetcar lanes would be curb-separated from the adjacent travel lanes, and that the streetcar lanes would be raised to the back-of-curb elevation to obtain a grade separation.

- It is assumed this configuration would consist of two 12-foot streetcar-only lanes adjacent to a 14-foot median to allow sufficient width for stop platforms. Including curb and gutter, a total width of 43 feet of pavement will be removed in the center of the roadway for the length of the corridor, and the grade-separated transit-only median would be constructed. A cost allowance of approximately $2,000,000 is added to the capital cost estimate for this work.
- Between 10th Avenue and 12th Avenue, the existing curb-to-curb width would only allow for two auto lanes in each direction, with no parking lanes or dedicated left-turn lanes at intersections.
- North of 12th Avenue, three auto lanes in each direction could be achievable if parking were to be removed on both sides. Alternatively, parking could be retained on both sides if the number of auto lanes in each direction were to be reduced from three to two, which may not be feasible due to traffic volumes.
- To avoid conflicts between left-turning vehicles and center-running streetcars, it is assumed a transit-only phase would be added to each signalized intersection along the corridor at an estimated cost of $20,000 each.

Railroad Crossings

There are no at-grade railroad crossings on Burlington Street between the southern limit at 10th Avenue and the northern limit at 32nd Avenue. No additional capital cost allowances are assumed at this time for railroad crossings.

Bridges / Structures

There are no bridges or structures on Burlington Street between the southern limit at 10th Avenue and the northern limit at 32nd Avenue. No additional capital cost allowances are assumed at this time for bridges and structures.

Vertical Clearances

There are no overpasses on Burlington Street between the southern limit at 10th Avenue and the northern limit at 32nd Avenue. No additional capital cost allowances are assumed at this time for vertical clearances.

Utility Impacts

Existing utility information is incomplete at this time. At the very least, a water main (unknown size) exists for approximately 8,500 feet, sanitary sewer exists for approximately 5,800 feet, and fiber for approximately 4,700 feet. For these utilities, as well as the unknown utilities in the corridor (assumed cost $1,000,000 per track mile), an allowance of approximately $9.4 million is included in the capital cost estimate.

Lane Width

Existing lane widths are 11 to 12 feet on Burlington Street, providing sufficient width for a streetcar vehicle. It is not anticipated that lanes will need to be reconfigured to accommodate a streetcar vehicle, and no additional capital cost allowance is assumed at this time for lane widths.

Swift Avenue

Grades

Longitudinal grades along Swift Avenue were unavailable at the time of this analysis. Given the relatively flat nature of North Kansas City, and the shallow grades of parallel Burlington Street, it is not anticipated that there will be any fatal flaws based on grade for this alternative, and no additional capital cost allowances are assumed at this time for grades.

Street Geometry / Lane Configuration

Swift Avenue currently consists of one northbound and one southbound lane for the length of the corridor from 10th Avenue to 32nd Avenue, with dedicated turn lanes occurring near intersections.

- Between 10th Avenue and 23rd Avenue, the curb-to-curb width is approximately 68 feet, with a 15-foot angle parking lane on either side of the road (except between 10th Avenue and north of 11th Avenue where parking is parallel), and 19-foot travel lanes. Angle parking lanes pose a safety hazard when adjacent to a streetcar lane, as an approaching streetcar vehicle would not be easily visible to a motorist backing out of a parking spot (although back-in angle parking is considered feasible). An allowance of $40,000 is included in the capital cost estimate to address parking.
- North of 23rd Avenue, the curb-to-curb width remains 68 feet, but the angle parking switches to parallel parking, and a 10-foot grass, tree-lined median exists in the center of the road. No changes to the street geometry appear to be necessary here.
- Just south of 32nd Avenue, it is assumed that a ”Y”-turnaround will be constructed away from live traffic to allow a northbound vehicle to pull in, the driver to switch ends, and the vehicle to proceed southbound. A new signal with a transit-only phase would likely be required to hold traffic entering Swift Avenue from 32nd Avenue for this movement to take place. An allowance of $120,000 is included in the capital cost estimate for this purpose.
- Overall, Swift Avenue is a much more pedestrian-friendly environment than Burlington Street, with sidewalk already in place for the vast majority of the route. No additional allowance to the capital cost estimate is included for sidewalks. It should also be noted that Swift Avenue is a designated bike route and serves as an important bicycle connection to the Heart of America Bridge; therefore, special attention to bicycle coordination and accommodation should be made should this be the selected route. If replacing the bike lanes on an adjacent street is necessary, additional capital costs could be attributed to this alternative.

Railroad Crossings

There are no at-grade railroad crossings on Swift Avenue between the southern limit at 10th Avenue and the northern limit at 32nd Avenue. No additional capital cost allowances are assumed at this time for railroad crossings.

Bridges / Structures

There are no bridges or structures on Swift Avenue between the southern limit at 10th Avenue and the northern limit at 32nd Avenue. No additional capital cost allowances are assumed at this time for railroad crossings.

Vertical Clearances

There are no overpasses on Swift Avenue between the southern limit at 10th Avenue and the northern limit at 32nd Avenue. No additional capital cost allowances are necessary. There are many mature street trees along this route that might conflict with the OCS; for this reason an allowance of $50,000 was added to the capital cost estimate.

Utility Impacts

Existing utility information is incomplete at this time. At the very least, a water main (unknown size) exists for approximately 10,700 feet, sanitary sewer exists for approximately 4,800 feet, and fiber for approximately 9,200 feet. For these utilities, as well as the unknown utilities in the corridor (assumed cost $1,000,000 per track mile), an allowance of approximately $11.5 million is included in the capital cost estimate.

Lane Width

Existing lane widths are typically about 20 feet, providing sufficient width for a streetcar vehicle. It is not anticipated that lanes will need to be reconfigured to accommodate a streetcar vehicle, and no additional capital cost allowance is assumed at this time for lane width.

Armour/210

Grades

This alternative is the same as Alternative 1 between 10th Avenue and Armour Road. Longitudinal grades along Armour Road were unavailable at the time of this analysis. However, no unusually steep grades (greater than 7 percent) appear to exist in photos of the corridor. It is not anticipated that there will be any fatal flaws based on grade for this alternative, and no additional capital cost allowances are assumed at this time for grades.

Street Geometry / Lane Configuration

- The street geometry between Burlington Street and Fayette Street is very similar to that of Swift Avenue in the downtown area, with a curb-to-curb width of 70 feet, and a 15-foot angle parking lane on either side of the road. An allowance of approximately $10,000 is included in the capital cost estimate to address parking.
- From Fayette Street to Iron Street, the angle parking lane is eliminated, and an additional travel lane is added in each direction, along with a two-way left turn lane (TWLTL) in the center of the road.
- The roadway widens to approximately 76 feet east of Iron Street, where there are three lanes in each direction along with a center TWLTL. In this case, the right-of-way is 100 feet wide, leaving approximately 12 feet behind the curb on each side and precluding sidewalk from being routed behind the curb. It is assumed the streetcar would run in the inside through lanes (adjacent to the TWLTL) east of Fayette Street. Because the lane drops (WB) and lane additions (EB) occur on the outside lanes, no transit-only signal additions would be necessary, as the streetcar vehicle would not switch lanes. Stop platforms would need to be located in the TWLTL west of Ozark Street or the existing median east of Ozark Street. The existing configuration of the road here (three lanes in each direction with potentially high speeds) would make pedestrian access to center stops difficult, and the overall pedestrian environment uninviting.

- It is assumed that the streetcar would remain in the inside through lanes through the interchange with I-35/29 until it terminated east of Walker Road. It is assumed that a ”Y”-turnaround would be constructed away from live traffic in the median to allow an eastbound vehicle to pull in, the driver to switch ends, and the vehicle to proceed westbound. A transit-only signal would be required for this movement to take place. An allowance of $20,000 is included in the capital cost estimate for this purpose.

Railroad Crossings
There are no at-grade railroad crossings on Armour Road between Burlington Street and Walker Road. No additional capital cost allowances are assumed at this time for railroad crossings.

Bridges / Structures
There are no bridges or structures on Armour/210 between Burlington Street and Walker Road. No additional capital cost allowances are assumed at this time for bridges/structures.

Vertical Clearances
Interstate 35/29 passes over Armour/210 in the study area. The current structure is posted as having a clearance of 14-feet, 9-inches. Adequate clearance to the overhead contact wire under a mixed-traffic condition would not be feasible in this current condition. The National Electric Safety Code requires a minimum 16-foot clearance for an electrically powered transit vehicle to operate in mixed traffic. As the current street geometry / lane configuration is part of an interstate service interchange, it is unlikely that a center-running dedicated streetcar-only lane would be feasible either. Here, the structure would either have to be raised or the existing Armour/210 would have to be lowered to achieve adequate clearance. Raising the structure or lowering Armour/210 beneath the structure would change the profile of the roadway and would likely affect where the ramps tie in, which could result in a full reconstruction of this interchange. An allowance of $20.6 million is added to the capital cost estimate for this purpose. Alternatively, a fleet of off-wire vehicles could be purchased to eliminate the OCS in this area (rather than reconstructing the interchange), but none of the existing system vehicles would be able to operate on this alignment if they are not already equipped with off-wire technology, rendering this option likely unfeasible. The cost of purchasing a fleet of off-wire vehicles is difficult to estimate because the number of vehicles needed is dependent upon the full route the vehicles would operate on.

Utility Impacts
Existing utility information is incomplete at this time. At the very least, a water main (unknown size) exists for approximately 12,400-feet (including the Burlington segment), sanitary sewer exists for approximately 5,800-feet, and fiber for approximately 4,500-feet. For these utilities, as well as the unknown utilities in the corridor (assumed cost $1,000,000 per track mile), an allowance of approximately $13.2 million is included in the capital cost estimate.

Lane Width
Existing lane widths are a minimum of 11 feet for the length of the corridor, providing sufficient width for a streetcar vehicle. It is not anticipated that lanes will need to be reconfigured to accommodate a streetcar vehicle, and no additional capital cost allowance is assumed at this time for lane width.

Major Feasibility Challenges Evaluation Summary
As indicated at the beginning of this section, key feasibility issues are noted rather than providing an overall rating. The Burlington Dedicated Lane option would create the need to remove curbside parking. It would also cause significant right-of-way acquisition between 10th Avenue and 12th Avenue due to the narrow right-of-way. The Mixed-Traffic option on Burlington would require a reduction of the speed limit for all traffic lanes since the streetcar shares a lane with cars. Streetcar operation on Swift would require relocation of the bike lane to another street. The analysis of Armour revealed the most significant issue, that there is not sufficient clearance under the I-29/35 bridge for cars and streetcars to share a lane. Converting two existing auto lanes to streetcar lanes, raising the bridge, or lowering the road are not practical options. While the issues identified for the other routes create some challenges, the overpass issue effectively eliminated Armour from consideration.

7.3.2 Avoidance of Traffic Impacts

Traffic impacts generally consider capacity, speed, safety and reliability. These impacts vary considerably by alternative.

Burlington Street: Mixed Traffic

The conversion of the outside travel lanes to mixed-use traffic would impact the through capacity of the roadway. Most of the time there would be a Streetcar operating in each direction some place in this segment of Burlington. The average travel speed with stops would be 13 mph, significantly reducing the capacity and speed of that lane. In addition, the speed limit for the entire roadway would need to be lowered from 40 mph to 35 mph, reducing the speed and capacity of the roadway. The use of traffic lanes by both rail vehicles and cars has been safe and effective in many U.S. cities; however, there would be some potential for collisions between these vehicles, although infrequent. The stop-and-go nature of the streetcar would have some impact of the reliability of the lane, and would likely cause some diversion of traffic to other lanes.

Burlington Street: Dedicated Lanes

The capacity lost by conversion of the median traffic lanes to semi-exclusive streetcar lanes would be largely offset by the conversion of the curb parking lanes to traffic lanes. Maintaining this capacity should generally support current speeds, as although some reduction may occur if there are significant streetcar passenger volumes needing sidewalk access. The short walk from median stops would lessen this effect. Detailed traffic simulations would be appropriate before advancing this option beyond the study. Some measures may be required to prevent auto/streetcar crashes caused by cross-street traffic at unsignalized intersections. The streetcar operation in its own lanes should not have a noticeable impact on reliability of traffic flow.

Swift Avenue

The streetcar operation along Swift Avenue would also be in mixed traffic. The lower traffic volumes and speed limit on Swift would significantly reduce the impact of the Streetcar on speeds and capacity. The reduced traffic volumes and speeds would also reduce the likelihood of collisions between vehicles. Service reliability is unlikely to be impacted.

Armour/210

The streetcar operation along Armour Road would also be in mixed traffic. The streetcar impacts on this street would be greater than for the Swift option, but less than the Burlington mixed traffic option. Armour has more capacity than Swift and less traffic volume than Burlington. The interchange at I-29/35 is likely to be the main area of concern, although using the median lanes should help mitigate this impact.

Avoidance of Traffic Impacts Evaluation Summary

The Mixed Traffic option on Burlington would have the greatest impact on traffic and is rated Low with respect to avoiding traffic impacts. While there would be some impacts with dedicated streetcar lanes on Burlington, they would be significantly less that the mixed traffic option, resulting in a Medium rating. Traffic impacts on Swift are likely to be small given the nature of the street and traffic levels. Swift was rated High for avoiding impacts. Armour falls in the middle of the range and received a Medium rating.

7.3.3 Avoidance of Parking and Loading Impacts

Burlington Street: Mixed Traffic

The mixed-use lane would preserve the curb parking and loading zones. An occasional streetcar in the adjacent lane would be unlikely to have a noticeable impact, and might even make parking slightly easier by discouraging auto traffic in the adjacent lane.

Burlington Street: Dedicated Lanes

This option would remove curbside parking and loading zones. Curbside parking would need to move off-street, as would loading zones. The overall effects would be significant. Effects on specific blocks would depend upon available off-street parking and the ability of businesses to accept deliveries from other building faces off Burlington.

Swift Avenue

This option would not directly remove parking or loading zones. Many businesses have loading zones facing the street; however, large trucks or multiple trucks queuing would effectively extend the loading zone into the travel lanes. Cars would be able to maneuver around these trucks; however, streetcars would not have that flexibility. These loading zones would need to be modified or moved in order to facilitate streetcar operations.

Armour/210

There would be no conflicts between streetcar and parking or loading zones on Armour.

Avoidance of Parking and Loading Evaluation Summary

The Burlington Center-Median Dedicated Lane concept eliminates parking and loading zones, and receives a Low rating. Its counterpart, the Mixed Traffic option, has no impact and receives a High rating. The Swift Avenue option receives a Medium rating since it would require some truck loading relocation, although it wouldn't directly displace loading zones or parking. The Armour Road option has a High rating because it would not impact loading or parking.

7.3.4 Avoidance of Bicycle Impacts

Burlington Street: Mixed Traffic

Bicyclists in this area generally avoid Burlington Street because of the high traffic volumes and speeds. The cyclists that do use the facility generally travel in the curb lane because of the slower traffic speeds in that lane. The turbulence created by the streetcar in the outside traffic lane could be somewhat disruptive to bicycle riders.

Burlington Street: Dedicated Lanes

The few bicyclists using the street may benefit marginally with the removal of curbside parking and the risk of parked cars opening doors into the adjacent lane.

Swift Avenue

Swift Avenue is currently marked with Sharrows, and is the primary north/south bike route connecting to the bike/pedestrian lane on the HOA bridge. The presence of the streetcar tracks in the street may create a safety issue for bicyclists, requiring relocation of the bike route.

Armour/210

The streetcar would not have a significant impact on bicycle usage along Armour Road.

Avoidance of Bicycle Impacts Evaluation Summary

The Center-Median Dedicated Lane Burlington option would have no effect on bike travel and is rated High. The Mixed Traffic Burlington option would have some effect, due to the turbulence it would create with auto traffic, and is rated Medium. The Swift Avenue option would experience the greatest effects since the existing bike route might need to be relocated to another street, so it is rated High. The Armour Road option would not have a major effect and is rated Medium.

7.4 Initial Screening Recommendation

The results of the initial screening of alternatives are summarized in **Table 7-10** below. The four alternatives were rated High, Medium, or Low based upon their performance for each individual criterion. The ratings are color coded to highlight the differences between the alternatives.

Table 7-10: Evaluation Results

Criteria	Burlington	Burlington	Swift	Armour*
	Dedicated lane	Mixed Traffic		
Support Neighborhood Revitalization and Economic Development				
Development Capacity	MEDIUM	MEDIUM	LOW	HIGH
Streetcar Development Readiness	LOW	LOW	MEDIUM	MEDIUM
Long-Term Opportunity for Revitalization	HIGH	HIGH	MEDIUM	MEDIUM
Transit-Supportive Planning	HIGH	HIGH	MEDIUM	LOW
Transit-Supportive Zoning and Policies	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Improve Transportation, Connectivity, and Mobility				
Connecting People, Jobs, & Destinations	MEDIUM	MEDIUM	HIGH	MEDIUM
Walkability / Local Circulation	LOW	LOW	HIGH	MEDIUM
Building a Regional System	HIGH	HIGH	MEDIUM	LOW
Ridership Potential	LOW	LOW	MEDIUM	LOW
Optimize Route Feasibility				
Estimated Cost to Armour Rd**	$73 M	$71 M	$85 M	To Walker Rd:
Estimated Cost to 32nd Ave**	$132 M	$128 M	$135 M	$219 M
Major Feasibility Challenges	• Loss of parking • Potential need for R.O.W. acquisition	• Would require reduction of traffic speed	• Would need to reconfigure/ replace bike lane	• Highway overpass would not allow mixed traffic
Avoidance of Traffic Impacts	MEDIUM	LOW	HIGH	MEDIUM
Avoidance of Parking & Loading Impacts	LOW	HIGH	MEDIUM	HIGH
Avoidance of Bicycle Impacts	HIGH	MEDIUM	LOW	MEDIUM

**Due to major feasibility challenges, an Armour Road streetcar alignment is not being recommended at this time.*
***Costs exclude cost of crossing the Missouri River.*

The option of connecting to Armour was eliminated because of the 14' 9'' clearance under the I-29/35 Bridge. This low clearance would not allow the streetcar and auto/truck traffic to share the same lane, resulting in the need to eliminate a traffic lane in each direction, lower the roadway, or raise the bridge. None of the options are feasible.

The remaining Burlington and Swift routes have extremely distinctive characteristics. Burlington has high economic development potential because of the extent of existing vacant land adjacent to the street, and the large parcels, which can be easier to develop. At the same time, the current auto emphasis of the corridor is not conducive to streetcar-induced economic development. Implementation of streetcar operations on Burlington may require elimination of curbside parking and restriction of cross-street travel across Burlington at several locations in order to create median streetcar lanes. Reduction of the speed limit from 40 mph to 35 mph, may also be necessary if the streetcars share a lane with cars.

Swift could be “streetcar ready” in the short term because of the pedestrian orientation along much of its length. The existing sidewalk network, canopy of trees, and limited impact of the automobile create a pedestrian environment that is attractive for streetcar-induced development. Unlike Burlington, however, most of Swift is already fully developed or projects are already underway. This significantly reduces the potential streetcar development impact for this route. There are also some traffic-related issues with this route. A number of truck loading zones would need to be relocated and the bike route might need to be shifted to another street because of the streetcar tracks.

The characteristics of the Burlington and Swift options were thoroughly discussed in a public meeting. The meeting participants were equally divided, with Burlington supporters emphasizing its superior long-term development potential, and Swift supporters focused upon the lesser, but more immediate economic impact. While they were equally split on which route to pursue, all preferred an initial project that extended to a streetcar stop serving the northern boundary of the city, rather than ending at Armour Road.

The Partnership Team reviewed the equally divided public support for the Burlington and Swift routes. Burlington was selected as the recommended alternative because it would better address local needs of the community and offers more attractive long-term opportunities for service expansion into the Northland. The key factors in the recommendation are summarized below.

The Burlington Avenue option:

- Is consistent with past regional rail plans for service to the Northland,
- Provides more direct, higher speed service for future rail expansion,
- Is consistent with existing North Kansas City development efforts identified in the Burlington Corridor Plan and supported by the Burlington Overlay District,
- Offers more long-term development opportunities, and
- Permits the development of a single track alternative, not feasible on Swift, which increases streetcar implementation options.

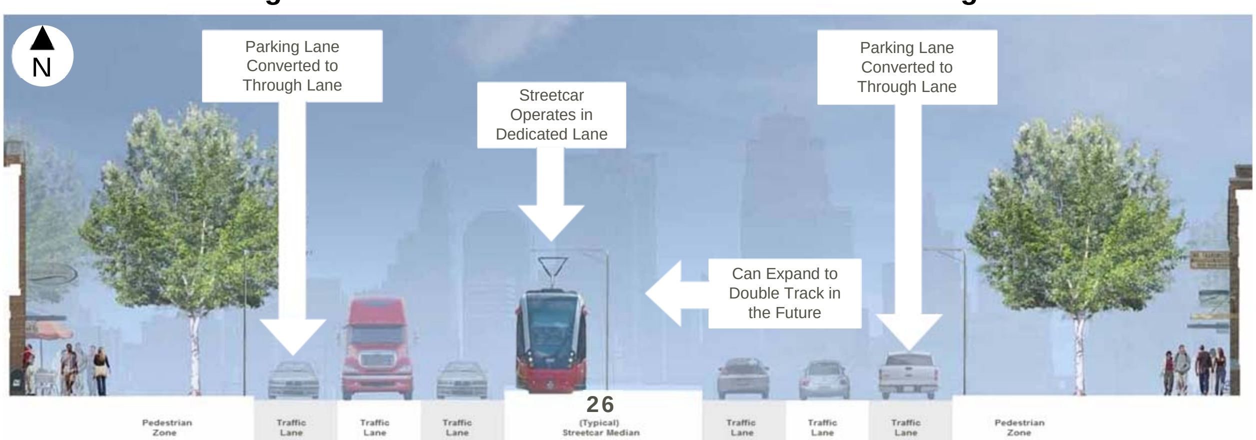
8. Detailed Analysis of Recommended Route

8.1 Conceptual Route and Termini

The two streetcar configurations considered for the recommended Burlington route are shown in **Figures 8-1** and **8-2**. The dedicated lane option would convert the median traffic lane to exclusive streetcar usage and the curb parking lane to a traffic lane to maintain the current number of traffic lanes. The mixed traffic option inserts streetcar operation with auto traffic in the outermost traffic lane adjacent to the parking. A streetcar would be traveling with auto traffic on both sides of the street within North Kansas City for much of the day at an assumed 10-12 minute streetcar frequency.

Figure 8-1: Mixed-traffic Lane on Burlington

Figure 8-2: Semi-Exclusive Streetcar Lane on Burlington



The initial options brought the streetcar onto Burlington Street at the 10th Avenue intersection. The Burlington right-of-way is constricted for the southern two blocks of the corridor, from 10th Avenue to 12th Avenue. The former BNSF right-of-way parallel to Burlington Street provides an opportunity to avoid this narrow section, entering Burlington Street at 12th Avenue. This would occur for either streetcar configuration.

From 12th Avenue, both options would continue in the street to a stop in the vicinity of 29th Avenue that would serve the area to 32nd Avenue. Some track would extend beyond 29th Avenue to provide operational flexibility and temporary vehicle storage.

8.2 Traffic Analysis of Dedicated Lane Option

Both of the potential streetcar options would have some level of effect on traffic operations. The mixed-traffic option would have a noticeable effect on traffic conditions since it would require lowering the speed limit and would lower the capacity of the shared mixed-traffic lane. Since the dedicated lane option maintains the current number of traffic lanes, the potential effect of the streetcar operation on traffic conditions is not immediately obvious. Therefore the dedicated lane option was analyzed using a simulation model to forecast those effects and identify potential solutions.

8.2.1 Existing Conditions

The Burlington Street (State Route 9) Corridor is an important regional connector providing access to the Heart of America Bridge, one of the few North/South Missouri River crossings in the area, and connects North Kansas City to downtown Kansas City, MO. It is a 6-lane divided arterial. The corridor helps serve as an overflow route for I-29/I-35 to the east, and US 169 (Broadway Boulevard) to the west.

The Average Annual Daily Traffic (AADT), from MoDOT's 2012 traffic counts, is over 26,000 vehicles per day. Since part of Burlington Street's function is as a commuter route, the flows are highly directional in the peak hour. The AM peak has heavy southbound inflows into downtown Kansas City, and the PM peak has heavy northbound outflows out of downtown Kansas City. Each of the peak directional approaches experiences volumes up to 2,700 vehicles in the peak hour (SB vehicles in the AM, NB vehicles in the PM). From the south end of the project (the Heart of America Bridge) to the north end of the project (the Route 9/N. Oak Trafficway split); there are 8 signalized intersections in a 2-mile segment (approximately a signal every ¼ mile). Armour Road has higher volumes to the east, as it has access to I-29/I-35 and becomes MO-210. Although the corridor is fairly industrial in nature, truck volumes are less than 5% of total flow in the peak hours. The low side-street volumes (and consequent low green signal time needs) allow most of the green time in the signal cycle to be allocated to Burlington Street. Although the traffic volumes and signal densities are high, there is heavy platooning of vehicles and overall good vehicle progression throughout the corridor. The existing sidewalk system is sparse and unconnected, and signal timings at most intersections don't currently allow time to cross Burlington Street.

8.2.2 Technical Approach

Turning-movement counts were performed at all of the signalized intersections in the corridor. In addition, counts were conducted at N. Oak Trafficway/32nd Street, as well as at the Route 9 ramps to and from 3rd Street in the River Market on the south side of the Heart of America Bridge. The peak hours were determined to be 7:15-8:15 in the AM, and 4:30-5:30 in the PM.

The Design Year of 2040 was used to coincide with MARC's Travel Demand model and allow for several years of design and construction. A growth rate of 0.6% was agreed upon by MoDOT and MARC staff, and this rate was applied to the existing peak-hour turning movement counts. The micro-simulation tool VISSIM was used to analyze the traffic network. The scenarios modeled for comparison were: Existing AM and PM, 2040 No-Build AM and PM, and 2040 Build AM and PM. The 2040 No-Build scenarios applied the 2040 traffic volumes to the existing geometric conditions. These scenarios experience up to 3,100 vehicles in the peak direction of travel. The 2040 Build scenarios used the same traffic volumes as the 2040 No-Build, but included the Streetcar system, and accompanying provisions to the corridor access.

The existing signalized locations are at Burlington Street's intersections with 10th Avenue, 12th Avenue, 14th Avenue, 16th Avenue, Armour Road, 23rd Avenue, 26th Avenue, and N. Oak Trafficway. The intent was to test a Build scenario that would have minimal impacts to traffic operations on Burlington Street. Streetcar median stops were assumed at the 12th Avenue, 18th Avenue, 23rd Avenue, and 29th Avenue (Route 9/N. Oak Trafficway split) intersections. In general, stops were sited at existing signalized intersections, but the Armour Road intersection geometrics were determined to not be suitable for a streetcar stop. A new signal was assumed at 18th Street to facilitate a streetcar stop proximate to Armour Road.

The simulation also reflected the streetcar shift to former railroad right-of-way between 10th Avenue and 12th Avenue.

At the signalized intersections with the Streetcar stops, full access was assumed for this analysis. Left turns were allowed to and from Burlington Street, and side streets were allowed to cross Burlington Street. At the signalized intersections without Streetcar stops, the side streets were allowed to cross, but left turns from Burlington were not allowed – to reduce conflicts with the Streetcar. At unsignalized intersections, left turns from Burlington Street were not allowed, and the side street movements were limited to right in/right out. All of the movements that incurred the restrictions described above were rerouted in the model. For example, the left turns from Burlington Street at 14th Avenue were rerouted to the 12th Avenue intersection.

Very few pedestrians were observed while conducting the peak hour turning-movement counts. As mentioned previously, the existing corridor is not currently "pedestrian-friendly". For the Build scenario, it was assumed that the Streetcar system would attract additional development and spur more pedestrian activity. Exactly how much is impossible to predict. For the signal timing at the Streetcar stop intersections, side street green times were allocated enough green time in every signal cycle to accommodate pedestrian movements between the sidewalk and the median Streetcar stops. Most of the new development, and consequent increased pedestrian activity, is anticipated to occur around the stops.

For signalized intersections without a Streetcar stop, 10 pedestrians per hour were assumed to cross the street. Assuming a 2-minute signal cycle, a little under half the signal cycles would need to have long enough green time for the side street to allow a pedestrian to completely cross Burlington Street. This additional green time would reduce green time on Burlington Street, affecting signal progression.

8.2.3 Analysis Results

For Existing conditions, although the Burlington Street volumes are high, the low side street volumes allow for a high percentage of green time and good progression through the corridor. Queues of several cars are common, but the high throughput and good progression keeps overall delays down.

Results for the 2040 No-Build were similar to those for existing conditions. The volumes were slightly higher, but signal progression was projected to remain intact, and the forecasted intersection levels of service (LOSs) were mostly B's and C's (based on the typical A-F LOS ranking).

is the 2040 Build Scenario exhibited some reduction in level of service with the introduction of the streetcar; however, many of the intersection levels of service are expected to remain unchanged from the No Build scenario. All of the through movements on Burlington are projected at Level of Service D or better.

Table 8-1: Level of Service Analysis

Period	Intersection	Movement	2040 No Build Avg. Queue (ft)	2040 No Build Max Queue (ft)	2040 No Build Delay (sec/veh)	2040 No Build LOS	2040 Build (Streetcar) Avg. Queue (ft)	2040 Build (Streetcar) Max Queue (ft)	2040 Build (Streetcar) Delay (sec/veh)	2040 Build (Streetcar) LOS
A.M. Peak Hour	12th Ave	TOTAL			15	B			20	B
		WB	10	107	35	D	0	24	59	E
		SB	75	919	16	B	85	1029	20	B
		NB	11	170	10	B	19	223	15	B
		EB	12	132	30	C	17	155	36	D
	Armour Blvd	TOTAL			20	C			46	D
		WB	180	929	62	E	617	1661	131	F
		SB	44	715	12	B	220	1255	35	D
		NB	18	196	12	B	8	215	7	A
	23rd Ave	TOTAL			18	B			33	C
		WB	33	206	38	D	61	266	64	E
		SB	122	900	18	B	323	964	34	C
		NB	26	251	16	B	23	243	20	B
		EB	2	50	27	C	3	57	35	D
P.M. Peak Hour	12th Ave	TOTAL			12	B			17	B
		WB	17	173	27	C	6	131	60	E
		SB	12	185	9	A	22	326	14	B
		NB	56	803	11	B	88	964	15	B
		EB	33	252	32	C	40	258	38	D
	Armour Blvd	TOTAL			26	C			25	C
		WB	102	775	47	D	110	689	48	D
		SB	5	163	35	C	354	1025	47	D
		NB	405	1161	18	B	97	467	12	B
	23rd Ave	TOTAL			25	C			32	C
		WB	44	193	58	E	48	219	64	E
		SB	28	371	14	B	39	553	25	C
		NB	203	1211	28	C	255	1319	33	C
		EB	4	62	22	C	6	84	30	C

The analysis of the intersection at 10th Avenue indicated that three southbound lanes are needed to clear the intersection effectively on the HOA Bridge during the morning peak. The preferred river crossing option converts one of the southbound lanes to bike and pedestrian use. Since the third southbound lane is only necessary for a short distance south of 10th Avenue to allow merging, the bike and pedestrian facility could run on the east side of Burlington Street (as it does today) from 10th Avenue south to the north abutment of the freight railroad bridge, then cross under the bridge and run on the west side of both the fright railroad and HOA bridges. This would provide the necessary capacity at 10th Avenue.

The anticipated effects of the dedicated streetcar facility on auto travel times and speeds are summarized for the peak hour, peak direction in **Table 8-2**. As expected, traffic conditions would decline somewhat between the Existing and 2040 No Build scenarios, due to forecasted growth in traffic volumes. The VISSIM simulations indicated that the morning peak travel would experience a more significant change than the afternoon. In the morning peak direction, average travel speeds are projected to decrease from 24 mph to 20 mph,resulting in an increased travel time of about one minute for morning commuters. For the afternoon, the model shows no significant change in average speed, which is reflected by the marginal increase in average travel time (4 seconds). A round-trip commuter would have a daily impact of about 1 minute of travel time on average as a result of the Streetcar implementation in the median lanes. As noted earlier, effects in the off-peak direction would be negligible. Documentation for all of the analysis is included in the supplemental document, *NorthRail Streetcar – Dedicated Lane Traffic Analysis*.

Table 8-2: Travel Time (Min) and Average Speed (MPH) – Dedicated Streetcar Option

		AM Peak Hour			PM Peak Hour		
		Exist.	**2040 No-Build**	**2040 Build**	**Exist.**	**2040 No-Build**	**2040 Build**
NB Burlington *(H.O.A. Bridge to N. Oak Trwy.)*	Travel Time	4.9	5.1	5.1	5.6	6.5	6.6
	Speed	31	30	30	27	24	24
SB Burlington *(N. Oak Trwy. to H.O.A. Bridge)*	Travel Time	5.9	6.5	7.5	5.2	5.4	5.7
	Speed	26	24	20	29	28	27

While the median-running streetcar itself does not substantially impact traffic flow, increased pedestrian activity along the corridor may impact “through” traffic in the future with or without a streetcar.

This VISSIM analysis indicates that the dedicated-lane streetcar option could be implemented without severely affecting “through” auto travel. A number of additional design and operational approaches should be considered during any further analysis of this option. The trade-offs between local traffic and “through” traffic impacts would require careful analysis. Similar analyses should be developed for any other streetcar configurations, such as the mixed-traffic option, as streetcar design continues on Burlington Street in the future.

8.3 Ridership Forecast

A high-level ridership forecast was prepared for the preferred corridor using the FTA's STOPS (Simplified Trips-on-Project Software) model. STOPS is a stand-alone ridership model specifically created by FTA for evaluating new transit networks. The STOPS model is intended to provide project sponsors, and the FTA, with a reliable tool for developing ridership projections through use of standardized data sets and pre-validated ridership based on existing fixed-guideway transit networks.

The STOPS model used the following inputs to create ridership projections:

- 2000 Census Transportation Planning Package (CTPP) Journey-to-Work flows
- 2000, 2010, 2020, and 2040 Mid-America Regional Council (MARC) population and employment data by zone, and zone-to-zone highway time and distance
- General Transit Feed Specification (GTFS) data for existing transit routes and stops from the KCATA. GTFS data is used to support mobile and on-line transit trip-planning applications. The project team edited the GTFS data to include the potential streetcar extensions and Prospect MAX. Preliminary stop/station locations were identified for modeling purposes.
- Conceptual Operating Plan summarized in Section 8.4 below.
    - The ridership forecast reflects service extending from the KCMO Main Street starter streetcar line at 3rd Street and Grand Boulevard to the stop at Burlington Street and 29th Avenue.
- Potential stop locations identified during the process.
    - 11th Avenue (BNSF Development Parcel)
    - 18th Avenue
    - 23rd Avenue
    - 29th Avenue

Even though the earliest a northern streetcar extension would open is 2020, FTA requires project applicants to use current year socio-economic inputs. In this case, the year 2010 was used from MARC's regional model.

Ridership Conclusions

- The ridership forecast for a route extending from 3rd Street and Grand Boulevard to Burlington Street and 18th Avenue is 1,100 average daily riders. If extended to 29th Avenue, the ridership forecast increases to 1,700 average daily riders. This is a significant increase over existing bus service, which is approximately 140 daily riders for existing routes 38, 132, 133, 135 and 142.
- The ridership forecast for NorthRail benefits from the relatively high ridership on the NextRail route which would provide a connection to a larger system.

- The STOPS model assumes riders will walk up to a mile to rail transit service; this would encompass most of North Kansas City.
- The Burlington corridor has significant capacity for future development with higher densities and more transit-supportive uses. However, today there are limited densities to support high-capacity transit service as reflected in the ridership estimates. The ongoing transformation of Burlington Street from auto-oriented low-density uses to a mixed-use walkable corridor will be critical to supporting future high-capacity transit-service in the future.

8.4 Burlington Street Operating Plan and Operating Cost Estimate

The streetcar operating costs were determined primarily using the operating plan and local labor rates. The components of the conceptual operating plan include:

- Frequency of service
- Run times
- Span of service
- Preliminary schedule

These elements were used to determine the vehicle requirement, which was incorporated into the capital cost estimate.

The operating plan for the Burlington Street corridor reflects best practices for similar streetcar systems and input received during the Public Workshops and Partnership Meetings. Thus, it is assumed that peak period headways would be about 12 minutes and off-peak headways will be no greater than 30 minutes. This is compared to 30- to 60-minute headways for bus service on the corridor today. The span of service would be similar to the KCMO starter line (Main Street) streetcar operating plan with service from 5 AM to at least midnight, seven days per week. It is assumed that the underlying local bus routes (38, 132, 133, 135 and 142) and the North Kansas City MetroFlex would remain with coordinated stops and service planning.

The operating plan employs through-routing between the NorthRail line and the Main Street line. Through-routing streetcars between two lines would be both more efficient from a cost perspective, and more effective in generating higher ridership. With through-routing, transit vehicles operate from the end of one line to the end of a second line. If there is a relationship between the areas served by the two lines and demand patterns are consistent with the through route, the alignments will be more effective in generating ridership. This system would allow someone to travel from North Kansas City to Union Station, or ultimately the Country Club Plaza or UMKC, without transferring vehicles at the 3rd Street and Grand Boulevard stop.

Streetcar running times for the preferred alignment were estimated using a model that accounts for variables such as traffic delays and stop spacing. The running times do assume that transit signal priority (TSP) will be employed at key intersections and that there will be no onboard fare collection. At this time, NorthRail does not assume revenue from fares or other operating sources. Whether fares will be charged, and what the final preferred method of fare collection will be, would be decided in future phases. In general, the streetcars are expected to have somewhat shorter running times than the buses operating in the corridor due to the difference in fare collection and the wider station/stop spacing.

Transit operating costs include all costs involved with operating and maintaining vehicles, stations, and other infrastructure, including power distribution systems, management, and administration. Streetcar operating costs were calculated based on the operating plans described previously and an average cost of approximately $150 per revenue-hour in 2013 dollars. This cost is similar to the operation cost assumption used for the KCMO Main Street starter line. Operating costs were escalated to 2020 dollars using a factor of 3 percent per year.

Table 8-3: Burlington Street Corridor Operating Costs

Item	Cost
Daytime Frequency	12 minutes
Length	2.9 miles
Cost per Hour	$150
Annual Hours of Operation	11,807
Total Operating Cost (2013)	$1,771,050
Total Operating Cost (2020)	**$2,114,726**

8.5 Refined Capital Cost Estimate for Recommended Corridor

This section provides a refined estimate of the capital and operating costs for the preferred river crossing option, alignment and conceptual operating plan assumptions.

8.5.1 Refined River Crossing Option Capital Costs

As indicated earlier, the river crossing is assumed to be funded separately from the remainder of the project because of the regional nature of the crossing. The river crossing segment extends from the Kansas City Streetcar at 3rd Street and the HOA bridge ramp to the north bridge abutment over the railroad tracks approximately 1,100 feet south of 10th Avenue. The cost estimate for the preferred option shown in **Figure 8-3** reflects additional analysis of this option and incorporation of construction bid information for the KCMO Main Street starter line. These costs are intended to establish an “order of magnitude” cost, not a detailed estimate. The scope includes all elements required for project development except for the vehicles and a traction power substation that would support operation over the bridge, but would be located off the structure. These costs are included in **Table 8-4** below.

Figure 8-3: HOA Bridge – Recommended River Crossing Option

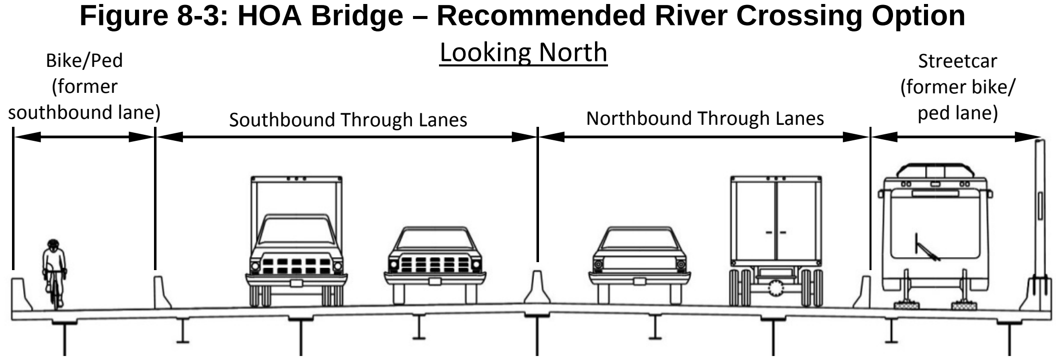


Table 8-4: Recommended River Crossing Option Cost Summary – Modified HOA Bridge

Missouri River Crossing							Current Year	2020	Inflation Rate
							2014 (YR)	*(YR)*	*0 (YR)*
Item Description	**Unit**	**Unit Cost**	**Quantity**	**Item Cost**	**A. Cont.**	**Item Cont.**	**Subtotal**	**YoE**	**Subtotal YoE**
GUIDEWAY & TRACK ELEMENTS (Track Miles)				$2,790,000		$558,000	$3,348,000		$3,997,687
Streetcar Guideway-Single (Embedded)	TM	$3,000,000	0.9	$2,790,000	20%	$558,000	$3,348,000	2020	$3,997,687
SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS				$697,500		$139,500	$837,000		$999,422
Light Maintenance Facility				$697,500		$139,500	$837,000		$999,422
Streetcar MSF Allowance	TM	$750,000	0.9	$697,500	20%	$139,500	$837,000	2020	$999,422
SITEWORK & SPECIAL CONDITIONS				$6,316,975		$1,343,645	$7,660,620		$9,147,181
Site Utilities, Utility Relocation				$465,000		$139,500	$604,500		$721,805
On-Street Drainage Modification Allowance	RM	$500,000	0.9	$465,000	30%	$139,500	$604,500	2020	$721,805
Automobile, bus, van accessways including roads, parking lots				$5,851,975		$1,204,145	$7,056,120		$8,425,376
Bike/Ped Relocation to West Side of Bridge	LF	$400	4910.4	$1,964,160	20%	$392,832	$2,356,992	2020	$2,814,372
Barrier	LF	$80	3923.0	$313,840	20%	$62,768	$376,608	2020	$449,690
Fencing and Railing	LF	$150	7846.0	$1,176,900	20%	$235,380	$1,412,280	2020	$1,686,336
Miscellaneous Strengthening and Repair	SF	$58,845	35.0	$2,059,575	20%	$411,915	$2,471,490	2020	$2,951,088
Expansion Joint Modifications	LF	$2,500	135.0	$337,500	30%	$101,250	$438,750	2020	$523,890
SYSTEMS				$1,953,000		$390,600	$2,343,600		$2,798,381
Streetcar OCS Allowance	TM	$2,100,000	0.9	$1,953,000	20%	$390,600	$2,343,600	2020	$2,798,381
Infrastructure Subtotal				$11,757,475		$2,431,745	$14,189,220		$16,942,671
PROFESSIONAL SERVICES				$4,256,766		$0	$4,256,766		$5,082,801
Preliminary Engineering	LS	3%	$14,189,220	$425,677	0%	$0	$425,677	2020	$508,280
Final Design	LS	8%	$14,189,220	$1,135,138	0%	$0	$1,135,138	2020	$1,355,414
Project Management for Design and Construction	LS	6%	$14,189,220	$851,353	0%	$0	$851,353	2020	$1,016,560
Construction Administration & Management	LS	6%	$14,189,220	$851,353	0%	$0	$851,353	2020	$1,016,560
Professional Liability and other Non-Construction Insurance	LS	1%	$14,189,220	$141,892	0%	$0	$141,892	2020	$169,427
Legal; Permits; Review Fees by other agencies, cities, etc.	LS	2%	$14,189,220	$283,784	0%	$0	$283,784	2020	$338,853
Surveys, Testing, Investigation, Inspection	LS	2%	$14,189,220	$283,784	0%	$0	$283,784	2020	$338,853
Start up	LS	2%	$14,189,220	$283,784	0%	$0	$283,784	2020	$338,853
Professional and Administrative Services						**$2,431,745**	**$18,445,986**		**$22,025,472**
UNALLOCATED CONTINGENCY	**LS**	**10%**					**$1,844,599**		**$2,202,547**
							Current Year Total		***YoE Total***
							$20,290,585		**$24,228,019**

8.5.2 Refined Capital Costs – Burlington Street Portion

The refined capital costs for the non-river-crossing portion of the route reflect more detailed assessment of utility impacts and associated roadway and infrastructure improvements resulting from the project.

Methodology

The capital cost estimates include items related to vehicles, engineering, and construction to establish a base cost. This base cost is structured around engineering experience with similar projects including the KCMO Main Street starter line Streetcar project. These costs are intended to establish an "order of magnitude" cost, not a detailed estimate. The estimate assumes that only improvements absolutely necessary to construct the streetcar will be built; betterments such as streetscape, enhanced street lighting, communication systems, elaborate stations, etc. are not included in the cost. The costs were estimated in both the current year (2014) as well as in the year of expenditure (YoE), and are based on historic cost data for similar streetcar projects.

For the purpose of this study, the YoE is 2020, the year in which the midpoint of construction is anticipated to be. Corridor length is shown in both route-miles (total length of corridor) and track-miles (total length of track in the corridor). Additionally, the level of design is still pre-conceptual; most of the items in the cost estimates are represented as allowances, which in effect act as a "place-holder" until further analysis and design identify quantifiable items needed to develop a more accurate cost estimate.

Assumptions

The assumptions included in each cost component quantified in the FTA's Standard Cost Categories (SCC) 10-70 are detailed in **Table 8-5**.

Table 8-5: Capital Cost Components

Item Description	Item Assumptions
SCC 10: Guideway and Track Elements	
Guideway: Semi-Exclusive	This is a per-track-mile allowance for a semi-exclusive alignment which is generally median-running. It includes all the costs associated with installing the track infrastructure including track excavation, rail, track slab and additional concrete/landscaping for the median.
Guideway: At-Grade in mixed traffic	This is a per-track-mile allowance for a mixed-traffic alignment with the streetcar tracks installed into the existing roadway pavement. It includes all the costs associated with installing the track infrastructure including track excavation, rail, and track slab. Approach and costs are assumed to be similar to the KCMO Main Street streetcar starter line.
SCC 20: Stations, Stops, Terminals, Intermodal	
At-Grade station, stop, shelter, mall, terminal, platform	This item is for a standard streetcar side stop, similar to the KCMO Main Street streetcar starter line. Pedestrian improvements associated with the stops are included in this item.
SCC 30: Supported Facilities: Yards, Shops, Administrative Buildings	
Light Maintenance Facility	This item is an allowance for adjustments to the existing maintenance facility building so it can accommodate additional vehicles, as well as the possibility to build a second maintenance facility at a different location. The current facility could accommodate up to 12 vehicles. In order to distribute the cost for adjustments to the existing facility, as well as provide funds to build an additional one, an allowance was used for NorthRail's portion of the maintenance facility on a per-vehicle basis. The maintenance facility cost allowance for the full NorthRail route to the streetcar stop at 29th Avenue will accommodate service for 3-4 additional streetcar vehicles. The allowance for the option ending at the 18th Avenue stop will service 2 vehicles.
SCC 40: Sitework and Special Conditions	
Demolition, Clearing & Earthwork	This is an allowance for the large area of fill needed to re-grade the former BNSF Right-of-Way from the bridge abutment down to the existing ground elevation, as well as demolition of the existing median and any rails in the BNSF Right-of-Way.
Site Utilities & Utility Relocation	This is an overall allowance for the relocation and adjustment of public utilities. It is purely an allowance that provides a budget to work within for relocation of the public utility infrastructure (mostly water and sewer). It does not include any budget for private utility relocations. The preferred alignment crosses water lines in 5 locations, sewer lines in 7 locations and fiber lines in 4 locations. The preferred alignment is also estimated to impact approximately 4,860 linear feet of storm lines.
Lighting	This cost is per mile, based upon the cost to light the roadway and streetcar tracks.
Roadway Construction	This is a per-mile cost for reconstruction of the median and surrounding affected roadway due to the construction of the streetcar line.
Mobilization, Temporary Facilities and Indirect Costs	This item is to account for the contractor's indirect costs during construction including staff, field offices, vehicles, etc. as well as temporary maintenance of traffic. It is an allowance and based on a percentage of the direct costs in SCC 10-SCC 50.

Item Description	Item Assumptions
SCC 50: Systems	
Traffic Signals and Crossing protection	This SCC category covers all the costs associated with improvements to the permanent traffic control devices, including modifications to existing traffic signals, new traffic signals, and any gates that may be required. An allowance was established for each type of improvement and quantified for each alternative.
Traction Power Supply: Substations	This is an allowance for traction power substations. It was assumed that one substation would be needed per track mile with costs similar to the KCMO Main Street streetcar starter line which also has one substation per track mile.
Traction Power Distribution: Catenary and Third Rail	This is an allowance for the traction power supply system or OCS (overhead contact system). It includes all poles, foundations, contact wires, and support. It is based on the average per-mile cost of the starter line.
Fare Collection System and Equipment	No determination has been made whether a fare will be collected and if so, what type of fare collection will be used. The estimate does not include an allowance for fare collection equipment.
SCC 60: ROW , Land, Existing Improvements	
Purchase or Lease of Real Estate	This item is an allowance to account for any potential ROW acquisition for the preferred alignment. For the BNSF segment, ROW would need to be acquired. ROW acquisition costs for this segment were estimated based on the most recent average valuation of surrounding commercial property plus an additional 10%.
SCC 70: Vehicles	
Vehicles	This item is for the cost of modern streetcar vehicle. The number of vehicles for NextRail was based on a general rule of thumb of one vehicle per track mile (the same as the KCMO starter line) which typically accommodates 10-minute headways. For NorthRail, two streetcars were assumed based on a conceptual operating plan supporting 15- to 20-minute headways. A detailed operating plan, including traffic modeling, layover/dwell time and other inputs (such as spare ratio) will need to be developed in order to determine the actual number of vehicles needed based on more detailed planning and engineering. The cost for vehicles is based on the KCMO Main Street starter line and other similar streetcar projects.

Unit Costs

Unit costs were developed from selected historical data, including final engineering estimates, completed projects, standard estimating manuals, and standard estimating practices. A mix of historical data from various national streetcar projects was used in developing the appropriate unit costs and allowances to be applied to the cost estimate. In most cases, allowances were established based on the KCMO Main Street starter line. These allowances are for planning purposes only and should be considered as “place-holders” until further analysis and design can provide for more accurate and quantifiable units of work in future phases.

Escalation Factor

In order to establish accurate project budgets, an escalation factor must be used. The purpose of an escalation factor is to account for anticipated inflation and increase in the cost of construction, materials, and labor over time. The escalation factor is used to take the current year estimate and project it to a future base year or year of expenditure (YoE). For the purpose of this study, the YoE is the year in which the midpoint of construction is anticipated. The costs assume design starting in 2018 and the mid-year of construction to be 2020.

The factor by which the current year estimate has been escalated to the YoE was 3.0 percent per year. This is considered a reasonable estimate of the possible inflation that could be expected given the constant fluctuation in the economy and cost of material, fuel, and labor. The actual inflation or escalation realized over the next few years could be more or less than the assumed value.

Summary of Costs

The estimates include all project costs including construction, right-of-way, vehicles, professional services (soft costs), allocated and unallocated contingencies, and inflation. Combined, these project costs make up the total project cost as viewed by FTA and are established using the FTA SCC workbook. The Standard Cost Categories are separated into 10 major categories (10-100). The following is a brief summary of the SCC sections and description of what is included.

- Capital costs for the first seven categories (SCC 10-70) described in **Table 8-5** were calculated by using "order of magnitude" unit costs and measured quantities for each component. A per-track-mile unit cost was developed from historical data to apply to the preferred alignment length. The final three categories (SCC 80-100) were calculated as a percentage of construction costs (excluding vehicle procurement).
- Professional Services (SCC 80) – This category includes all professional, technical, and management services related to the design and construction of fixed infrastructure (SCC 10 - 50) during the preliminary engineering, final design, and construction phases of the project.
- Unallocated Contingency (SCC 90) – This category is a contingency; an overall percentage of 10%, applied to the entire project and intended to serve as a project reserve for unanticipated costs incurred during project design and/or construction. This contingency is in addition to the line item (allocated) contingency that is applied individually to each line item in categories 10-70.
- Finance Charges (SCC 100) – This category includes finance charges expected to be incurred to complete the project. Costs would typically be derived from the New/Small Starts financial plan. At this stage, Finance Charges are not assumed or included in the estimate.

Summary of Capital Costs

The Order-of-Magnitude capital costs for SCC Categories 10-70 were calculated for the preferred alternative and are shown in **Table 8-6** below. A more detailed cost sheet for the base costs and other considerations can be found in the supplemental document, *NorthRail Streetcar – Capital Costs*. As noted earlier, these costs reflect more detailed assessment of utility impacts and associated roadway and infrastructure improvements for the detailed alternatives compared to the preliminary alternatives.

Table 8-6: Burlington Street Dedicated-Lane Capital Cost Estimate

Item	Cost
Base Cost for Track (HOA Bridge to 29th Avenue Stop)	$78,662,500
Streetcar Costs (3 Streetcars)	$15,000,000
Vehicle Maintenance Facility (Shared Facility)	$8,000,000
Traction Power Substation (River Crossing)	$1,500,000
Right-of-Way & Land Acquisition (Commercial Property Price)	$200,000
Utilities	$1,838,488
Signals	$2,400,000
Miscellaneous*	$2,900,000
Total (Current Year)	$110,500,988
Total (2020)	**$134,000,000**

*Includes Earthwork, Pavement Widening, Street Reconstruction and Pedestrian Upgrades for Stations

8.6 Financial Plan

The objective of the financial analysis was to identify a funding approach for both the annual operating and maintenance cost and capital cost for the proposed NorthRail project extending from the KCMO Main Street Starter Streetcar line through North Kansas City. As noted earlier in this report, it is assumed that the construction cost of the Missouri River transit crossing would be funded by regional sources since that component would provide a regional transit function as the rail service extends into the Northland.

The projected construction cost for the Burlington segment, and the projected acquisition cost of the vehicles providing service from the KCMO starter line, together total $134 million in 2020 dollars. The year-one annual operating cost is projected to be $2.1 million in 2020 dollars. Again, the river crossing component, at a cost of approximately $24.5 million in 2020 dollars, must be added to reach total projected costs. While this would not be part of the project cost, the bridge investment could potentially be included as local match towards federal funding for the project.

This analysis focuses on a local funding source that satisfies the requirement of a "local match" for purposes of securing federal funding. It is assumed that federal funding would be derived from a transportation-centric direct grant program such as Small Starts/New Starts. Other federal sources such as TIGER grants, Surface Transportation Program (STP), or Congestion Mitigation Air Quality (CMAQ) could also be used for the project.

8.6.1 Methodology

As was the case with the KCMO Main Street starter line, it was recognized at the outset that, due to practical realities related to annual commitments of the local revenue sources, the "local match" funding must be derived from newly created revenue. Missouri law provides a tailored mechanism for creation of new revenue sources to fund public transportation projects through the formation of an entity called a Transportation Development District (TDD). A TDD is being used to fund the operations and maintenance costs, and the local match portion of the capital costs, for the KCMO Main Street starter line, and is presently proposed to serve the same role with respect to an expanded system in Kansas City, Missouri south of the river. Therefore, a TDD was employed as the model for local funding of the proposed NorthRail project.

For purposes of the financial analysis, it was assumed that a NorthRail TDD would impose the same revenue sources, at the same maximum rates, as the KCMO Main Street starter line TDD. The city limits of North Kansas City were assumed to form the boundary for this TDD. The financial analysis identified the revenue that could be derived from the NorthRail TDD revenue sources within the entirety of North Kansas City over a thirty (30) year period from the commencement of collection. For purposes of projecting the future revenue stream, it was assumed that the TDD's revenue would be applied first to pay the NorthRail project's annual operations and maintenance costs and then to repay the annual bond debt service. The remaining projected future revenue stream was then used to model a potential bond financing, with assumptions as to interest rate (6% for a tax-exempt revenue bond financing), length of term (30 years) and debt service coverage (1.30). It was also assumed that the NorthRail sales tax would expire after 30 years from first collection, and that all special assessments would be payable for no more than 25 years from first collection.

The analysis employed certain other assumptions and parameters consistent with the finance model employed for the KCMO Main Street starter line TDD. One noteworthy example is that in projecting special assessment revenue, only the current built environment was considered, and in projecting sales tax revenue, only existing taxable sales levels were considered (rather than projecting revenue from potential future new development or redevelopment). In addition, the financial model does not include any revenue from a fare system, from advertising revenue or naming rights, or from a supplemental City contribution above the special assessments payable on City-owned property.

8.6.2 Funding Analysis for Burlington Dedicated-Lane Alternative

Applying the methodology and assumptions described above, it was determined that the combination of special assessments and sales tax from the TDD with a boundary coextensive with the entirety of North Kansas City should support a revenue bond type financing (i.e., financing supported solely by the revenue stream without any city annual appropriation pledge or other secondary source of repayment) that could yield a project fund available to pay (in 2020 dollars) approximately $6,500,000 of capital costs of the total estimated $134,000,000 in projected capital costs for the NorthRail project. Combined with the $24,500,000 contributed from regional sources for the river crossing, a total of $31,000,000 could be available to match federal funds. Assuming a 50% federal contribution toward the total projected capital cost from direct FTA grant funding through a program such as New Starts/Small Starts, an additional $31,000,000 could be available to fund the capital costs for the NorthRail project. The projected $6,500,000 in TDD bonding plus $31,000,000 in federal funds would support a NorthRail capital project of $37,500,000, leaving a capital deficit of about $96,500,000.

There are other approaches that could improve this financial analysis, such as applying a growth rate to 2020 projected revenue levels (which would also require applying a growth rate to operations and maintenance costs on the expense side), or assuming annual revenue from fares or advertising, or taking steps to reduce the bond interest rate (thereby increasing the bonding capacity), however, none are close to sufficient to reduce this capital deficit to a gap that could be considered reasonable for proceeding further. The TDD model will simply not support implementation of the proposed NorthRail Project extending from the river crossing to the northernmost stop at 29th Avenue.

8.6.3 Analysis for Reduced Project

The proposed project must be reduced in scope in order to fit within the TDD/Federal funding assumptions. Reducing the scope of the project impacts the funding in two ways. First, the total capital budget that must be financed decreases generally in proportion to the length of the project. The operating cost also decreases somewhat proportionally, but this change has a more significant positive impact on the overall financial analysis because lower operations and maintenance costs means more net TDD revenue available to pay annual bond debt service. Using these assumptions, each additional dollar of TDD revenue available to pay annual bond debt service generates approximately $10.50 in bond proceeds to pay capital costs.

The reduced project would terminate at a stop at 18th Avenue rather than 29th Avenue. This would reduce the capital cost (again, without including the river crossing) to $56,600,000. More importantly, an operating cost savings would be created that could leverage additional bonding. Applying the same bond finance assumptions, this increased net revenue stream could yield a capital project fund of approximately $15,500,000 in 2020 dollars. Combined with the $24,500,000 invested regionally in the river crossing, local funds would then attract $40,000,000 in federal funds if a 50% match were realized. This results in total capital resources of about $55,500,000 for the NorthRail project. This leaves a capital deficit of about $1,100,000, compared to the deficit of almost $100,000,000 for the non-reduced project. The revenue and funding approach for this option are summarized in **Table 8-7** and **8-8**.

Table 8-7: Projected Revenue Using the Kansas City Main Street Starter Line TDD Model

PROJECTED TDD REVENUE (2020$)	
1% TDD Sales Tax	$2,430,000
Residential Assessments	$357,976
Commercial Assessments	$928,389
Total Annual Revenue	**$3,716,364**
Less Operating Costs	($2,000,000)
Net After Operating Costs	$1,716,364
Estimated Bonding Capacity at 6% for 30 Years with 1.30 Coverage	$18,100,000
Estimated Capital Project Fund	**$15,500,000**

Table 8-8: Capital Funding for Reduced Project

PROPOSED PROJECT FUNDING (2020$)	
Capital Cost (to 18th Ave Stop)	**$56.6 Million**
Capital Resources	
TDD Capital Project Fund	$15.5 Million
Federal Match (TDD Capital Project Fund)	$15.5 Million
Federal Match (HOA bridge modifications)	$24.5 Million
Total Capital Resources	**$55.5 Million**

At this stage in planning, the deficit for the reduced project is not significant, and would likely be eradicated if the revenue stream and the operations and maintenance costs were grown from 2020 dollars. It could also be covered in the significant contingencies carried through the planning phase, or through small adjustments to the operating plan. Therefore, the TDD model appears to support a conclusion that this reduced alternate project is, theoretically, financially feasible.

The main consideration, therefore, is whether a project that only reaches 18th Avenue is a reasonable and desired investment for the community. Another approach would be to engage Kansas City, Missouri and other Northland municipalities in discussions toward developing a broader, more regional project.

9. Next Steps

The NorthRail Streetcar Study provides a thorough analysis of streetcar options extending from the KCMO streetcar starter line to the northern boundary of North Kansas City. This project would provide streetcar service within North Kansas City, connect North Kansas City with the streetcar system serving Kansas City, Missouri, and provide an opportunity for subsequent streetcar extension into the Northland. The analysis also identified and evaluated several options to carry the streetcar over the Missouri River and freight railroad tracks immediately to the north. Crossing the River is essential for any future rail service to the Northland.

The NorthRail Streetcar Study reached several conclusions:

- Modification of the Heart of America Bridge offers a viable approach to extend rail transit across the Missouri River to serve the Northland.
- Burlington Street is the preferred route through North Kansas City because it provides the greatest opportunity to enhance economic development in North Kansas City, and facilitate long-term urban rail expansion into the Northland.
- North Kansas City funding, using the KCMO Main Street streetcar starter line TDD model, cannot support construction and operation of a project beyond Armour Road.
- The local community prefers that the project reach the northern municipal boundary of North Kansas City (32nd Avenue) in its initial phase.

These conclusions support continued long-term planning for urban rail development along the Burlington Street Corridor extending to the Northland. The HOA Bridge offers an attractive means to cross the river. The Burlington Street right-of-way includes several options that could be further developed to support attractive rail service and attract economic development. The initial rail investment through North Kansas City, however, cannot be funded without an expanded funding base.

Although the NorthRail study did not examine streetcar options extending beyond North Kansas City, prior studies have considered other fixed-guideway transit options continuing north. As indicated earlier, streetcar and LRT have many similar characteristics that facilitate blending of these modes to meet varying needs along an expanded service area. An urban rail project could easily use the close streetcar stop spacing within North Kansas City, and at major suburban activity nodes in the Northland, and operate with longer LRT-style spacing between the activity centers. This would extend the service area of the rail line, and increase the funding base.

The recent Burlington-North Oak Trafficway Corridor study identifies activity nodes along this corridor and recommends land use and infrastructure actions that would support more intensive transit investments. This report would provide a suitable base from which to examine alternative urban rail options along this corridor.

In anticipation of an eventual rail investment, the community should also consider implementation of a low cost Bus Rapid Transit (BRT) project similar to the MAX routes south of the river. This approach would reinforce improvements in the pedestrian network and increase corridor transit ridership, enhancing future rail opportunities along the route. Future rail implementation might result in the removal of some BRT capital investments, although they may be fully depreciated when the rail is built. Some local commitment would be required for the BRT planning, design, and construction management, which represents an opportunity cost that could be applied elsewhere in the region.

The development of urban rail options serving the Northland would be tied to development of funding options linked to the service areas. The most recent transit funding approach has followed the KCMO Main Street streetcar starter line TDD model. Expanding the service area could facilitate expanding the coverage area of this model. Corridor jurisdictions beyond the NorthRail Partnership would need to be engaged in this effort, which could influence the eventual financing/governance strategy.

Within North Kansas City, several activities would be useful in the short term. The City has aggressively amended its planning and zoning to encourage the increased density, mixed-use development, and pedestrian infrastructure planning that would help transform Burlington Street from a light-industrial, auto-oriented area to a pedestrian-friendly commercial/entertainment district. The imminent update of the City's comprehensive plan provides the opportunity to reinforce that direction with local community leaders, investors, and business owners. This type of change would enhance the impact of urban rail along the Burlington Street corridor. A regional commitment to a rail project on Burlington Street would be an incentive to both the private and public sectors to initiate these types of changes.

The implementation of streetcar within the Burlington Street right-of-way offers its own set of challenges and opportunities that are directly related to the land-use and infrastructure changes noted above. Some modifications to the current street operations would be necessary for streetcar implementation. These modifications could include adjustments to through and/or local traffic, changes in curbside parking and loading zones, traffic signalization modifications, and pedestrian improvements. Many of these changes would also respond to concerns expressed during the community meetings regarding the need to improve the pedestrian environment along this street. These modifications would require substantial discussion among North Kansas City, MoDOT, MARC, and local property and business owners to determine the extent, cost and funding for the modifications. It is timely to begin these discussions using the results of this study and the awaited City plan update.

A regional commitment to the Burlington Street corridor will require extension of the streetcar across the Missouri River to 10th Avenue. The NorthRail study has identified a viable approach to do so by shifting the bike and pedestrian facility from the east side of the HOA Bridge to the west, and placing the streetcar in the vacated lane. This would require a regional investment up to $25 million dollars. Programming this funding now would demonstrate regional support for the NorthRail project, and encourage the other activities identified above.

The following steps are recommended to advance the conclusions of the NorthRail Study:

1. North Kansas City updates the city Master Plan supporting Burlington Street as the recommended streetcar route.

2. North Kansas City, MoDOT, and MARC initiate discussions regarding modification of Burlington Street to facilitate pedestrian-oriented development and accommodate future streetcar use along the route.
3. North Kansas City, Kansas City, Gladstone, MARC, and KCATA initiate discussions regarding interim land use and transit strategies to encourage transit-oriented development north of the river in anticipation of future rail service.
4. North Kansas City and Kansas City accept the NorthRail Plan.
5. Appropriate regional jurisdictions develop a long-term plan and financial strategy and supporting rail service to the Northland.
6. MARC incorporates findings into the 2040 LRTP Update.

These activities would overlap in several instances, and would benefit from the participation of Northland jurisdictions and community stakeholders beyond those involved in the NorthRail Partnership.