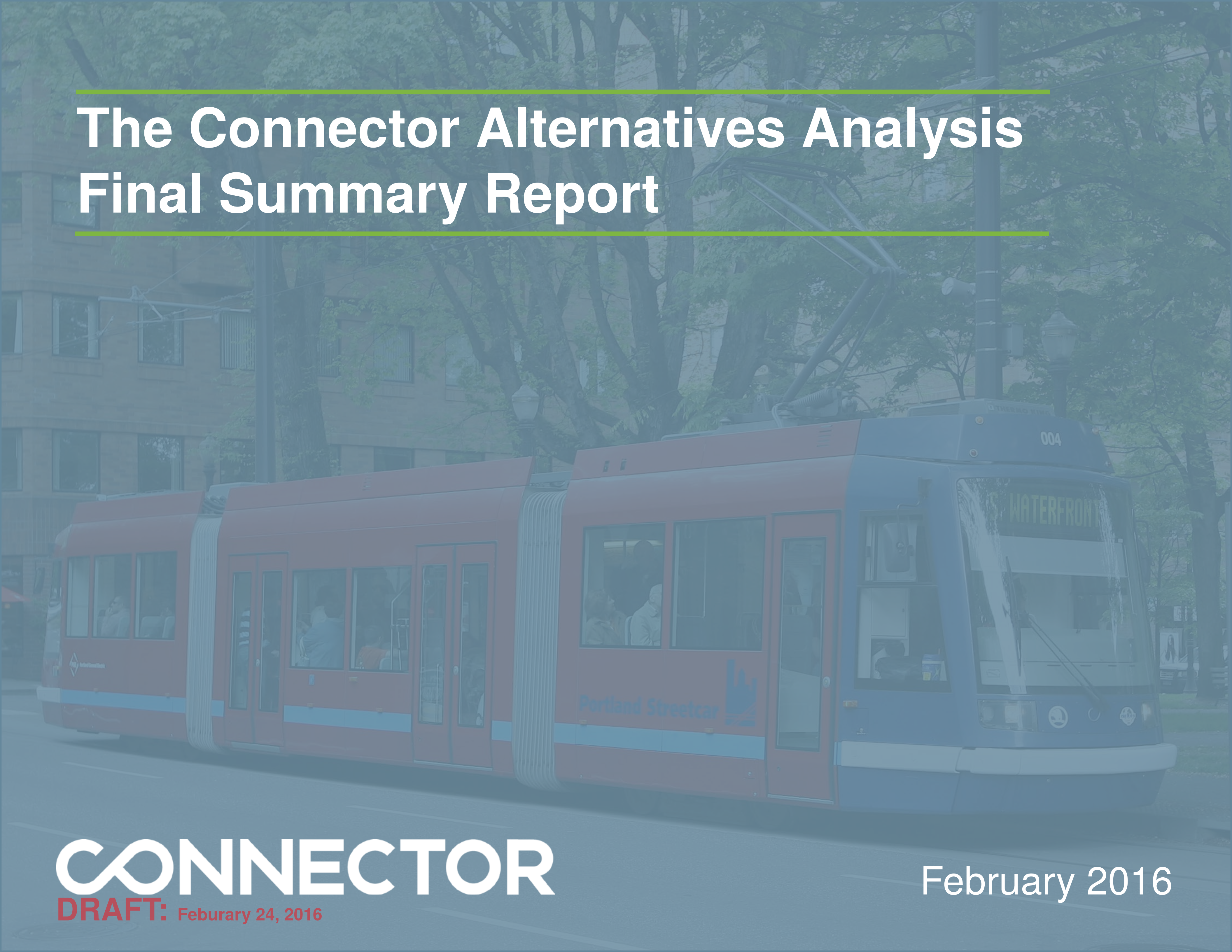
The Connector Alternatives Analysis Final Summary Report



CONNECTOR

DRAFT: Feburary 24, 2016

February 2016

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Acknowledgments

The Connector Alternatives Analysis study was prepared to determine the feasibility of a high capacity transit system linking the North and South ends of the City of Ann Arbor. The Alternatives Analysis was prepared in partnership with the City of Ann Arbor, the University of Michigan, the Ann Arbor Downtown Development Authority, the Ann Arbor Area Transit Authority, the Michigan Department of Transportation, the Regional Transit Authority of Southeast Michigan, the Southeast Michigan Council of Governments, and the Washtenaw Area Transportation Study. The project team would like to thank the following individuals with their assistance in completing the Connector Alternatives Analysis:

City of Ann Arbor

- Eli Cooper

University of Michigan

- Sue Gott
- Lisa Solomon
- Stephen Dolen
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Ann Arbor Downtown Development Authority

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Ann Arbor Area Transportation Authority

- Matt Carpenter
- Chris White
- Michael Benham
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- Alex Bourgeau

Washtenaw Area Transportation Study

- Ryan Buck
- Nick Sapkiewicz

Executive Summary

Executive Summary

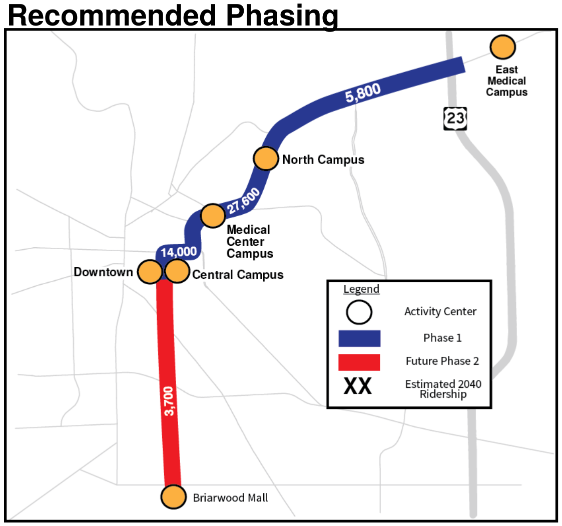
Preferred Alternative Characteristics

- Route Length: 4.78 miles
- Number of Station-stops: 9
- Capital Cost (2025$): $560 - $680 Million
- Incremental Annual Operating Costs (2025$): $3.4 Million
- Annualized Cost Per Passenger (2025$)*: $4.32 - $5.18
- Average Weekday Ridership (2040): 31,600

The range of cost estimates represents a the potential short and long term needs of the system. While 12 single-car LRT vehicles may accommodate opening day demand, ridership growth in the long term may require two-car LRT trains (doubling the number of vehicles needed).

**Sum of the annual operating cost and annualized capital*

Recommended Phasing

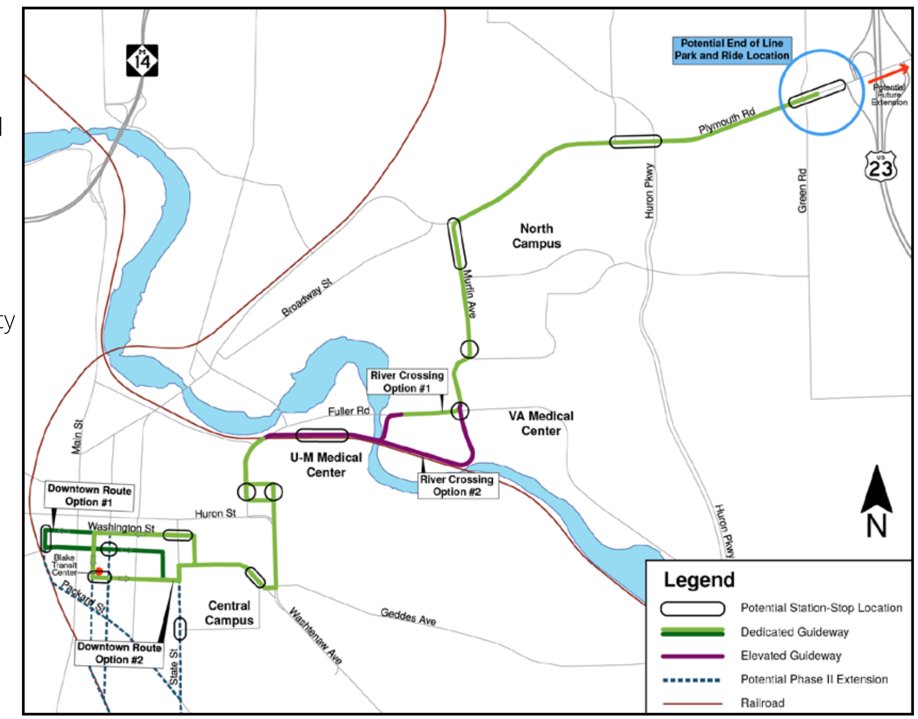


Recommended Route

The purpose of The Connector Alternatives Analysis (AA) is to evaluate high capacity transit options and to select a preferred route and transit mode. The Project Management Committee (PMC), which includes representation from the City of Ann Arbor (City), the University of Michigan (U-M), the Ann Arbor Downtown Development Authority (DDA), the Ann Arbor Area Transit Authority (AAATA, also known as “TheRide”), the Michigan Department of Transportation (MDOT), the Regional Transit Authority of Southeast Michigan (RTA), the Southeast Michigan Council of Governments (SEMCOG), and the Washtenaw Area Transportation Study (WATS) has evaluated the ridership, cost and impacts assessment results and recommends the following be adopted as the Recommended Alternative:

- Phase I - The initial system would extend from Plymouth Road/US 23 into Downtown Ann Arbor providing connections between the major trip generators at the University and Downtown Ann Arbor.
- Phase II of the system would extend the line south from downtown to the vicinity of Briarwood Mall near State Street / I-94. The study evaluated a corridor extending from Plymouth Road and US 23 on the north to State Street and I-94 on the south. From the cost effectiveness assessment (cost per rider) it was concluded that the portion from Downtown to the north is more cost effective than the segment south of Downtown.
- The Huron River is the most significant natural feature along The Connector route. It is recommended that both of the river crossing options be advanced to allow detailed comparisons of wetland, floodplain, parkland and visual impacts prior to providing a recommendation.
- To reduce the impacts along streets with limited widths, the preferred route follows a one-way east-west loop through downtown using a combination of Washington Street, Liberty Street, or William Street and extending west as far as 4th Avenue, Ashley Street, or 1st Street.

More information on the Recommended Alternative is available in Chapter 6, starting on Page 45.



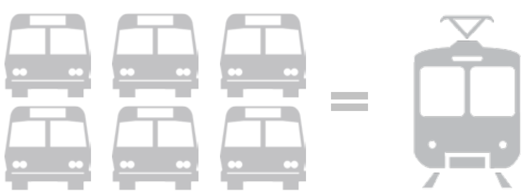
Recommended Alternative

More Information

Additional information and detail of The Connector is available on the study website at: (www.aaconnector.com).

The Bus System is Operating at Capacity

40+ BUSES Per Hour Needed to Meet Rush Hour Demand



A two-car light rail train has the capacity of up to six traditional city buses.

Transit Vehicle

- A rail transit (streetcar or light rail) system is recommended. The study evaluated both rail transit and Bus Rapid Transit (BRT) and concluded that rail transit would provide a better long term, sustainable solution consistent with the project goals. While BRT would have lower initial capital costs, annual operating costs would be substantially higher than a rail based system. The forecast level of passenger demand would exceed the practical capacity of a BRT system. Larger rail transit vehicles, in one- or two-car configurations, can accommodate the forecast level of passenger demand.

- A hybrid light rail/streetcar vehicle is recommended. The size of the vehicle can be tailored to meet demand and fit into the Ann Arbor environment. Advances in 'wireless' technology offer safe, unobtrusive power systems and electric powered vehicles are clean and quiet.

Streetcar: Tacoma, WA

Light Rail: Phoenix, AZ

Tram: Dublin, Ireland

Streetcar: Portland, OR

Project Benefits and Next Steps

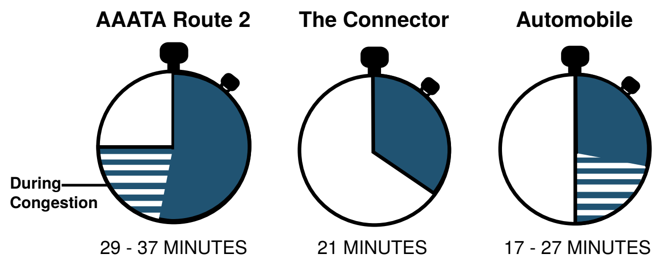
Land Use and Job Growth

In addition to transportation-related benefits, The Connector will also contribute to the City of Ann Arbor's quality of life and sustainability goals. Population and employment densities in The Connector Corridor are already supportive of a high-capacity transit system, and current land use plans and policies indicate the opportunity for additional mixed-use transit oriented development (TOD). This is bolstered by recent development market trends in the downtown and northeast Ann Arbor, as well as the availability of development opportunity sites near proposed Connector station-stops. All of these factors will help enable the Ann Arbor community to leverage this transit investment to support anticipated population and job growth.

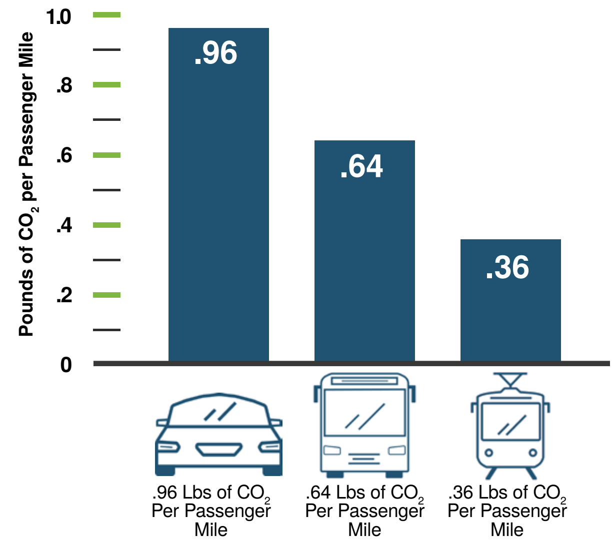
The Corridor is Highly Congested

43% FASTER

And more reliable than current auto and transit trips at rush hour



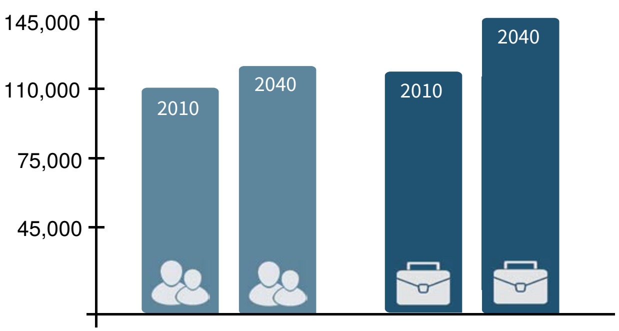
A More Sustainable Form of Transportation



Ann Arbor is Growing

9% POPULATION GROWTH

20% EMPLOYMENT GROWTH



Funding and Next Steps

The Connector study is being conducted in a manner consistent with the Federal Transit Administration (FTA) New Starts program guidance. The New Starts program can provide up to 80% of the capital cost to construct fixed guideway transit systems, although federal funding generally does not exceed 50% of the project cost. If the community decides to proceed with The Connector, a capital funding plan will be developed and the project will be incorporated into the regional transportation funding process. Local funding sources could include support from both public and private entities. With University faculty, students, and staff expected to comprise a large portion passengers traveling to and from campus destinations, the University of Michigan is committed to participating in project funding.

The next step toward implementation of The Connector is conceptual design and environmental review. The use of federal funds mandates compliance with the National Environmental Policy Act (NEPA) which requires a comprehensive review and disclosure of the potential project impacts on the social, cultural and natural environment.

Chapter 1:
Introduction

Study Purpose

Study Partners

The Connector is a planned high capacity transit system extending from the northeast to the south side of Ann Arbor and connecting the campuses of the University of Michigan with Downtown Ann Arbor. The Connector offers the opportunity to build upon a shared vision between the City of Ann Arbor (City), the Downtown Development Authority (DDA), the University of Michigan (U-M) and the Ann Arbor Area Transportation Authority (AAATA, also known as "TheRide") who are seeking to address growing travel demand and existing transportation system deficiencies with a solution that increases the convenience and usability of transit, offers a superior level of connectivity between key activity centers, supports publicly approved plans for future development, and improves sustainability within the City and region. The following goals and objectives have been established to guide the development of the Ann Arbor Connector and to respond to the needs of the study area:

Community Goals	
1	Contribute to community and environmental sustainability and minimize impacts to the natural and built environment.
2	Advance the recommendations of previous City and University plans, including implementation of high capacity, signature transit corridors and transit connections to planned commuter rail service.
3	Support anticipated job growth and sustain economic vitality and a high quality of life in the City of Ann Arbor.
4	Provide a transportation alternative for travel to, from, and within the center city area to minimize the need for additional parking.
5	Engage the public in an open and participatory process to develop a transit strategy that has the support of the community.
Transit Operations Goals	
6	Invest in cost-effective transit solutions.
7	Provide improved transit travel time reliability between activity centers at U-M and in the City of Ann Arbor.
8	Increase transit capacity between North Campus and Central Campus.

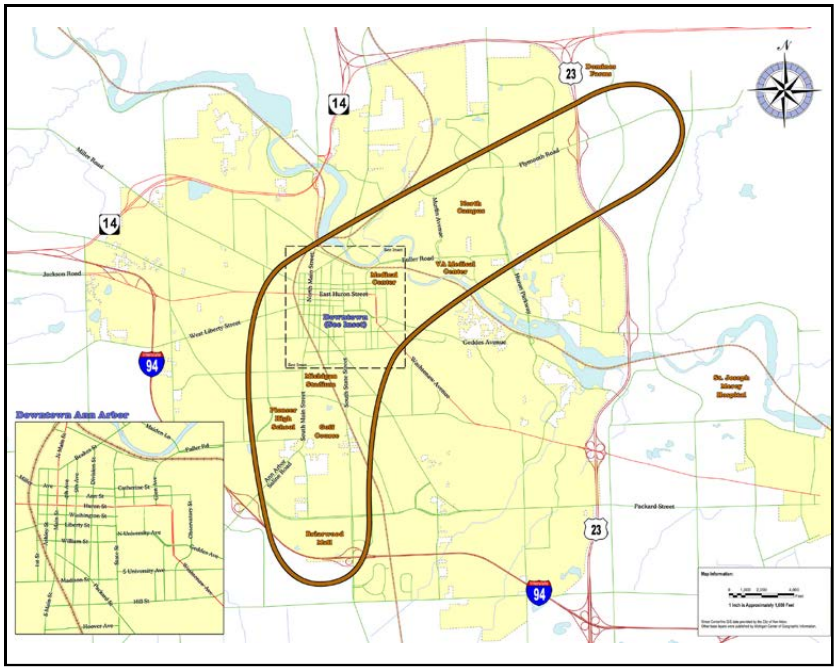
Connector Alternatives Analysis Objectives

In September 2012, the Ann Arbor Area Transportation Authority (AAATA) received approval of a grant from the Federal Transit Administration (FTA) to study Connector concepts. This study is called an Alternatives Analysis (AA) and is intended to:

- Confirm the need for an advanced transit system to serve the Ann Arbor area
- Define specific transit alternatives to meet the defined transportation needs including mode/technology, guideway alignment, operations and station-stop locations
- Evaluate the benefits and costs, environmental impacts, and transportation effectiveness of the transit alternatives
- Engage the community in the study process to select a recommended alternative
- Identify potential sources of funding and help to position the project for phased implementation

Related/Previous Studies

- In February 2011, the City, U-M, DDA, and AAATA completed a feasibility study of advanced transit technologies to serve the transportation needs of the City and the University. The study identified a need for an advanced transit system to connect key destinations in Ann Arbor and support a sustainable system of transportation and land use, and found implementation of such a system to be technically feasible.
- Previous studies by the City, U-M, DDA, the Southeast Michigan Council of Governments (SEMCOG), the Washtenaw Area Transportation Study (WATS), and Washtenaw County have identified common themes including increased use of transit, sustainable transportation, enhancing mobility for all, and support for non-motorized travel.
- The May 2009 City of Ann Arbor Transportation Master Plan Update (TMPU) identified a number of signature transit corridors, including the Plymouth, Fuller and State Street corridors where high capacity transit was recommended.
- The U-M North Campus Master Plan identified a potential high-capacity transit route connecting the North Campus to the East Campus Medical Center and Downtown Ann Arbor.
- Anticipated implementation of the Detroit to Ann Arbor commuter rail line, as well as development of high-speed rail service between Detroit and Chicago, will bring people into the City who will need local public transit service to reach their final destinations.
- The Connector is also being coordinated with the ongoing studies conducted by the Regional Transit Authority of Southeast Michigan (RTA).



The Connector will be a high-capacity transit line in an arc from northeast to south Ann Arbor, connecting major destinations.

Study Methodology

PUBLIC INVOLVEMENT

Define Transit Needs and Community Characteristics ↓	• Existing Transit Service • Socioeconomics/Demographics • Sustainability and Quality of Life • Existing and Future Travel • Activity Centers • Land Use and Economic Development
Develop Preliminary Route and Station-Stop Locations, Service Plan ↓	• Transportation Modes • Conceptual Engineering • Transit Service Operations and Integration
Evaluation Costs, Benefits, and Impacts ↓	• Environmental Constraints • Physical Impacts • Capital Cost • Operating Cost • Ridership / Community Benefits
Determine Recommended Alternative ↓	• Recommended Route • Station-Stop Locations • Transit Vehicle • Land Use and Job Growth • Funding

Public Involvement

The AA was conducted to educate, inform and involve the community in the decision making process. The public involvement process for the AA included social media, a project website, newsletters, a video, handouts, a press conference and public workshops / meetings in:

- December 2012
- June 2013
- November 2013
- March 2016

In addition to the general public process, the AA was coordinated through monthly meetings with a Project Management Committee and periodic meetings with the community through a Leadership Advisory Group composed of community leaders and elected officials. All project materials were posted on the project website (www.aaconnector.com).

Community members discuss The Connector alignment alternatives with project staff.

Members of the Project Management Committee collaborate on The Connector and community needs.

Chapter 2:

Transit Needs and Community Characteristics

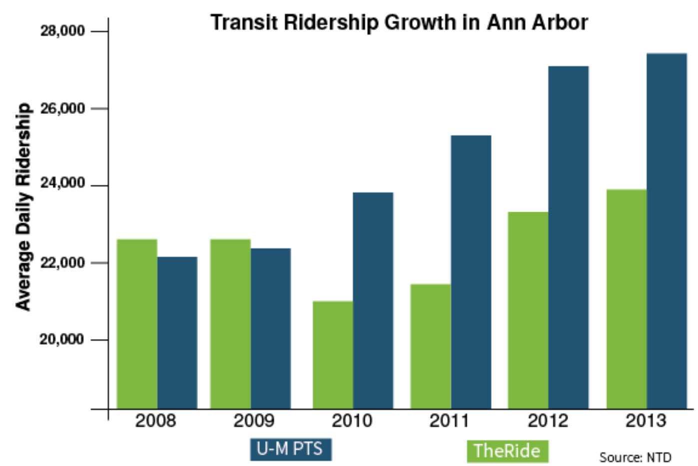
Connector Needs and Related Policies

Planning and Related Policies

- Regional planning efforts from WATS, RTA, and SEMCOG speak to the need for a continued shift toward transit and non-motorized modes of travel, to be accomplished with investments that make these travel options more attractive in the future.
- The City of Ann Arbor is currently completing a project to reorganize and clarify its zoning code, which governs development for much of the Connector study area. The code contains a detailed design overlay district for the downtown area that contains regulations intended to preserve the urban vitality of its many unique districts.
- The parking network is a key asset for the downtown and its businesses, as well as a potential limiting factor for continued growth. The DDA leads the management and planning for the public parking system in the downtown, and has recently embraced a set of strategic objectives related to transportation demand management and pricing.
- Financial incentives do not drive the development activity in the study area, but are in place for projects that help advance key objectives related to design, affordability or transportation, primarily in the downtown.
- The City of Ann Arbor Sustainability Framework encourages the use of alternative transportation modes to reduce congestion and greenhouse gas emissions.

Summary of Needs

- Local Agencies (City/U-M/AAATA) have identified transit as key element of strategic growth planning.
- Regional Agencies (MDOT/RTA/SEMCOG/WATS) plans would increase transit access to the City.
- Travel demand levels are high. There is an estimated travel demand of 50,000 trips per weekday between the North Campus and Central Campus.
- Roadway congestion impacts both personal and transit vehicles and cause unreliable transit travel times.
- Roadway congestion will increase over time The City of Ann Arbor population is forecasted to increase by 8.7% and employment is forecast to increase by 20.2% (24,300 new employees) between 2010 and 2040.
- Constrained parking system - Parking in areas of the City and the University is at or near capacity, particularly in the downtown and Central/Medical Campus areas where continued job growth is anticipated.
- Transit ridership growth - Between 2007 and 2012 ridership on AAATA and U-M buses increased by 20% to 13.6 million passenger trips annually.
- Population and employment densities support advanced transit -The City of Ann Arbor, and particularly the Connector corridor, feature higher residential and employment densities than many communities that have recently implemented rapid transit services.



Transit ridership in Ann Arbor has grown by 16% since 2008.

Existing Transit Service

TheRide consists of a comprehensive network of bus service providing safe, reliable connections throughout the city.

Transit Centers

TheRide's Blake Transit Center is the only transit center in the study area. It is located north of William Street between Fourth and Fifth Avenue, and serves over 5,000 passengers daily. U-M PTS has two large transfer centers, which provide connections between U-M and TheRide routes: Pierpont Commons on the North Campus, located north of Bonisteel Boulevard and east of Murfin Avenue, and the Central Campus Transit Center, which is a joint TheRide/U-M facility located on Geddes Avenue between Church Street and N. University Avenue.

The main transit provider in Ann Arbor is the Ann Arbor Area Transportation Authority (AAATA). The University of Michigan Parking and Transportation Services (U-M PTS) also provides public transit to the university community.

AAATA

AAATA provides a number of transit services including traditional bus service, A-Ride Paratransit, Commuter Express Service between Chelsea & Canton and Ann Arbor, Night Ride/Holiday Ride, senior services, commuter service to park and ride lots, AirRide service connecting to Detroit Metro Airport, and VanRide commuter vanpool service. AAATA bus routes are located throughout The Connector study area, serving destinations including the U-M Medical Campus, Downtown Ann Arbor, U-M Central Campus and others. Routes traveling to/from these destinations frequently see standing loads, and AAATA has already added extra buses to help accommodate peak ridership demands.

U-M PTS Bus Service

U-M PTS provides a number of transit services including traditional bus service, U-M Paratransit, U-M Emergency Ride Home, U-M State Street Ride Free after hours taxi service from U-M campus buildings to the South State Street Commuter (park and ride) lot, U-M Ride Home free shared –ride service when regular U-M bus service is not available, and U-M S.A.F.E. WALK/Night Van service.

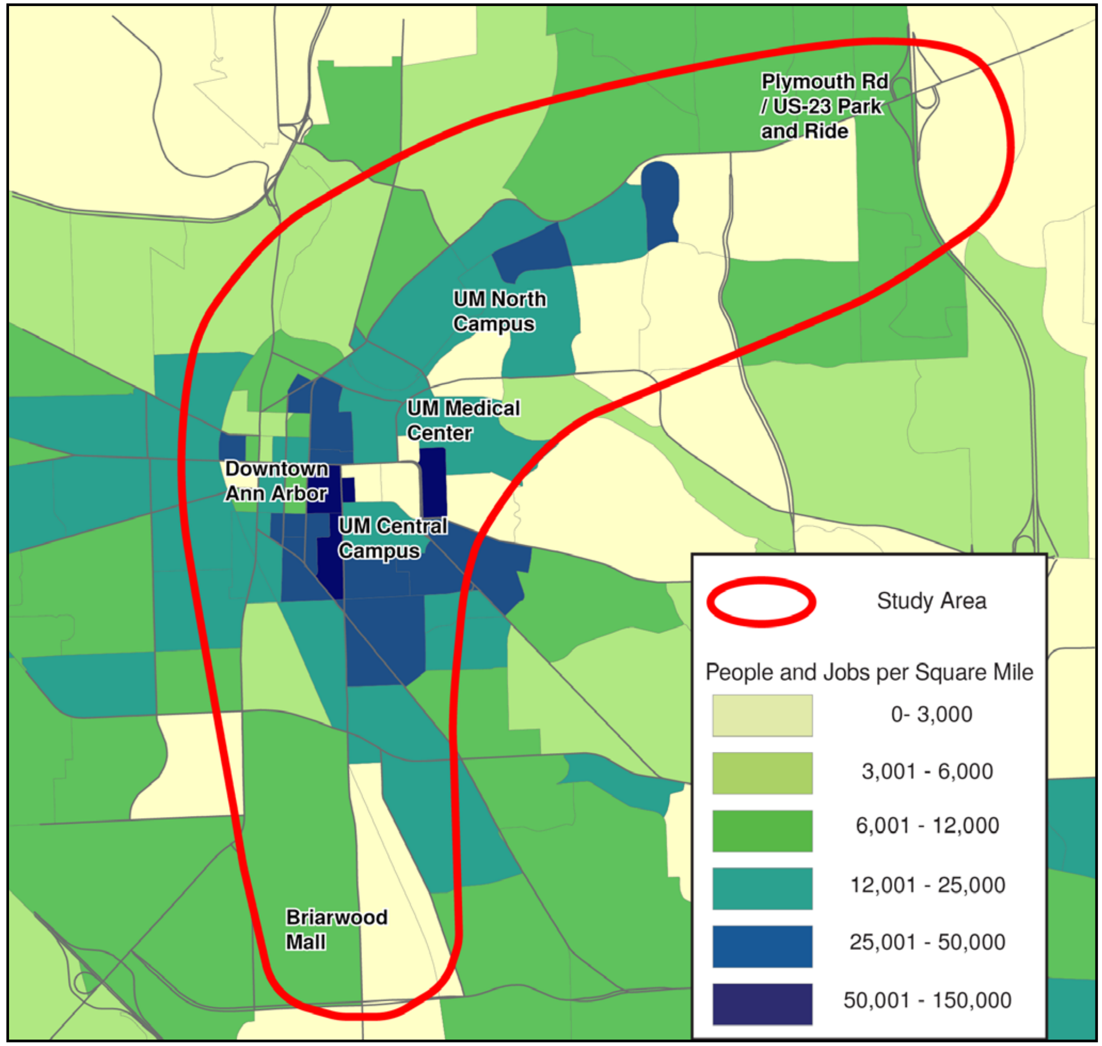
The U-M bus system is already operating at critical capacity with buses running every 2-3 minutes during peak periods, with peak periods lasting from 8:00 am to 4:00 pm. During these times U-M buses also see standing loads, and during the busiest times there are up to 60 buses per hour traveling between North Campus and Central Campus. Approximately 18% of the buses operating between the North and Central Campus are over 75% full (counting both seated and standing capacity) and, during peak periods (class changes), buses are full and people are often left waiting at the busiest stops.

During peak times, the demand for U-M bus service often exceeds available transit capacity.

Socioeconomics

The study area was inventoried for transit target market demographic and lifestyle segmentation to derive a better understanding of opportunities and challenges summarized below:

- The City of Ann Arbor population is forecasted to grow 8.6% between 2010 and 2040.
- The highest-density population areas of the City of Ann Arbor are located within the Study Area.
- The student population accounts for much of the population density, as well as the high concentrations of low-income population present in the study area. While this population may be transient, the overall amount of college student population stays fairly constant.
- The comparison between the 2000 and the 2010 mode to work by Ann Arbor residents reveals an upward trend for public transportation, growing from 6.4% to 8.9%.
- The downtown Ann Arbor and U-M campus areas located in the center of the study area have the highest employment density in the City and the region.
- Ann Arbor differentiates itself from the rest of Southeast Michigan by having a decided cluster of governmental, healthcare, education and professional services employment. In 2010, these sectors accounted for more than 85% of the jobs in the City of Ann Arbor, as compared to 71% for the broader Detroit Metropolitan Area. The concentration of jobs in these sectors is expected to grow in the long-term, with more than 90% clustered in these industries by 2040.



The highest density of jobs and population in Ann Arbor are located within The Connector Study Area

Sustainability and Quality of Life

Sustainability and Quality of Life

A high capacity transit system has the potential to contribute to the quality of life and the attainment of sustainability goals in the Ann Arbor community including:

- Reduce parking demand.
- Contribute to a healthier lifestyle.
- Improve access to jobs, education, medical care.
- Support economic growth and a vibrant downtown.
- Make Ann Arbor more attractive to people entering the workforce.
- Reduce fuel/oil consumption.
- Utilize sustainable energy sources.
- Reduce greenhouse gas emissions.
- Reduce out-of-pocket costs for users.
- Provide reliable and predictable travel times.
- Increase personal time.

Sustainability is one of the primary goals of the Connector project, and all four of the Connector project partners promote accessible green transportation improvements. In 2013 the City of Ann Arbor adopted a Sustainability Framework to guide their efforts, and the University of Michigan's Sustainability Initiative is working to improve campus-wide sustainability on multiple fronts.

The Downtown Development Authority embraces sustainability as a fundamental tenet of downtown development, and has formally adopted the principle of "ensuring Downtown's survival as a vital and viable economic, residential and environmental ecosystem throughout the 21st century."

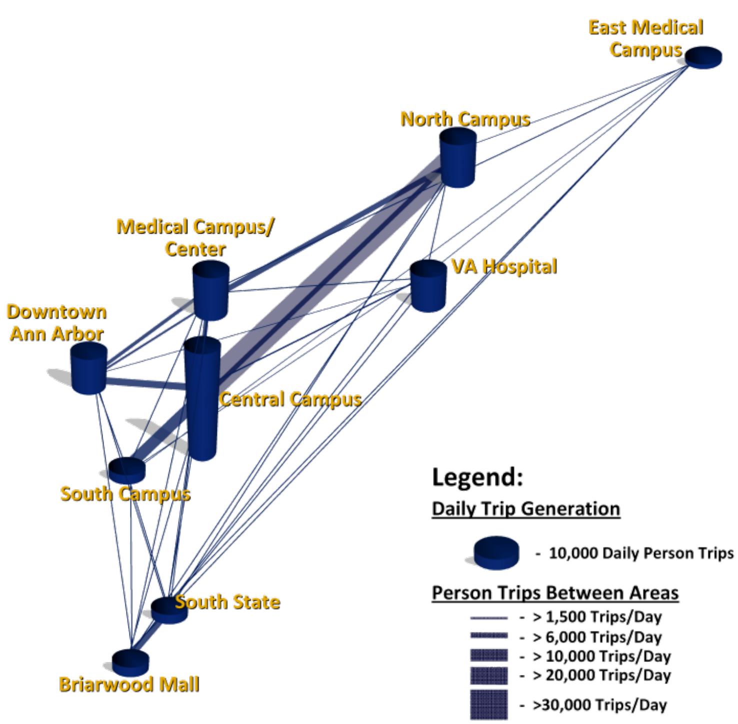
The mission of the AAATA is to provide useful, reliable, safe, environmentally responsible and cost-effective public transportation options for the benefit of the Greater Ann Arbor Community. Sustainability is woven into AAATA's vision, which includes enhancing the quality of life for Washtenaw County stakeholders while promoting the economy, safeguarding the environment, and strengthening communities.

Hydroelectric Power

The City of Ann Arbor owns four dams on the Huron River and hydroelectric power is currently generated at two of the dams (Barton Dam and Superior Dam). The average annual energy produced is about 4.2 million kilowatt hours at Barton Dam and 2.3 million kilowatt hours at Superior Dam, for a total average annual energy production of 6.5 million kilowatt hours. Regarding the potential for a sustainable, locally produced energy source, existing hydroelectric power could be directed to The Connector or additional hydroelectric generating capabilities could be examined.

Existing and Future Travel

This analysis of existing and future travel characteristics was completed for the project Feasibility Study. As documented later in this report, the Alternatives Analysis included a detailed ridership forecasting process supported by an extensive survey of current bus utilization. A description of the travel demand forecasting methodology is included as Appendix B.



The Connector Feasibility study considered the universe of potential travelers (known as candidate trips) in evaluating the magnitude of potential travel, economic and environmental benefits that a high capacity transit system could provide to the community. The universe of candidate trips was established through the combination of information gathered through surveys of services for both AAATA and U-M and from information in the WATS regional travel demand model. The graphic below displays the general orientation of trips between the study area activity centers using 2010 data and 2035 forecast data. Travel patterns for both 2010 and 2035 are relatively similar, though 2035 forecasts include growth in most origin-destination pairs. Key observations for 2010 conditions include:

- 50,000 daily trips travel between Central Campus and North Campus
- 16,000 daily trips travel between Central Campus and the Medical Campus
- 5,000 daily trips travel between North Campus and the Medical Campus
- 10,000 daily trips travel between the Central Campus and South Campus (now known as the Ross Athletic Campus)
- 11,000 daily trips travel between Central Campus and downtown Ann Arbor

The level of travel demand in the corridor is already equal to – or greater than – what has been carried on new advanced transit systems in other communities. As shown in the figure below, the greatest number of total trips and highest trip densities exist in the North Campus, Medical Campus, and Downtown/Central Campus areas. These areas represent the locations that would most benefit from the implementation of higher-capacity transit service.

University of Michigan buses are standing room only during peak period

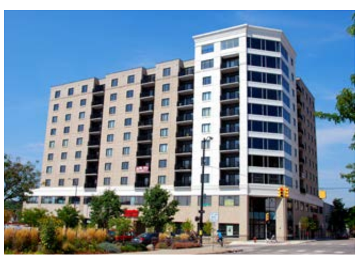
Land Use and Economic Development

Local Plans and Policies

The City of Ann Arbor desired development strategies seek to target anticipated growth into corridors served by multi-modal transportation infrastructure. Recent plans and zoning policies, including the Ann Arbor Downtown Plan (2009), Ann Arbor Master Plan (2009), South State Street Corridor Plan (2013), and the North Main Huron River Corridor Plan (2013), specifically identify redevelopment areas appropriate for consideration of higher-density residential, commercial or mixed-use. In addition, master planning efforts by the University of Michigan, in particular the University of Michigan North Campus Master Plan (2008), commit to continued infill development on the University's existing campus areas.

Federal Transit Administration (FTA) Rating Factors

Transit-supportive land uses and plans are a significant factor analyzed by the FTA when evaluating potential transit projects for federal funding. According to their quantitative rating benchmarks (see table), the Connector corridor would be very likely to score highly.



Rapid transit investments supported by local land use policies and zoning can have a significant positive influence on economic development. Numerous cities have leveraged investment in rapid transit infrastructure into land use and economic development benefits. Recent examples include Cleveland (where a 6.8-mile BRT line has helped to encourage $4.3 billion in corridor development) and Portland, OR (where a 3.9 mile Streetcar line attracted $3.5 billion in development). The Connector Corridor has supportive land use plans and policies, proven market demand and potential development and redevelopment opportunity sites that will enable the community to leverage a transit investment to realize desired future development.

Population & Employment Trends

The City of Ann Arbor had significant residential and employment development over the past five years. Development incorporating transit-supportive densities and design features has already occurred within areas of the corridor, particularly in downtown Ann Arbor and areas adjacent to the North Campus. This activity is an indication of ongoing market demand, and future projections for regional growth indicate that Ann Arbor will continue to see consistent growth in population and employment.

FTA Rating Factor		Connector Estimate	Likely FTA Score
Existing Land Use Factors			
Employees Served by System		80,000	Medium
Station-Area Population Density (avg.)		6,800	Medium
Avg. Daily Downtown Parking Cost		$12	Medium-High
Corridor Planning and Zoning Factors			
Allowable Floor-Area Ratio (FAR)	Downtown	6.0 - 8.0	Medium
	Outside Downtown	1.0 - 2.0	Medium-High
Required Parking Spaces (per 1,000 ft^2)	Downtown	None	High
	Outside Downtown	Varies	Medium

Comparison Communities

The study team developed case studies from communities similar to Ann Arbor that have implemented the types of transit service being considered by The Connector study. This process resulted in the following key observations:

- The City of Ann Arbor is generally smaller in terms of total population or employment than most of the comparison communities. However, Ann Arbor features higher residential and employment densities than many of these same cities.
- The clustering of activity in the Connector corridor compares favorably to that of transit corridors implemented in the comparison communities.
- The level of travel demand between key activity centers in The Connector corridor is already equal to – or greater than – what is carried on new rail and bus corridors when these modes are first implemented.

		Transit Systems Currently in Service									Transit Systems in Planning/Construction			
	Ann Arbor, MI	Cleveland, OH	Eugene, OR	Little Rock, AR	New Orleans, LA	Norfolk, VA	Portland, OR	Salt Lake City, UT	Tacoma, WA	Jacksonville, FL	Lansing, MI	Boulder, CO	Fort Collins, CO	Madison, WI
Land Area (mi^2)	27.8	77.7	43.7	116.2	350.2	53.7	145.4	109.1	49.7	747	36.7	24.7	46.5	76.8
City Population	114,925	393,806	156,929	195,314	360,740	242,628	593,820	189,899	200,678	827,908	114,605	98,889	146,762	236,901
Population Density (mi^2)	4,098	5,068	3,591	1,681	1,030	4,521	4,084	1,741	3,992	1,100	3,123	4,004	3,156	3,085
Employment	105,857	254,178	77,775	164,276	152,251	123,191	360,161	209,521	94,200	461,238	101,336	74,438	63,498	178,540
Employment Density (mi^2)	3,808	3,271	1,780	1,414	435	2,294	2,477	1,920	1,885	617	2,761	3,014	1,366	2,325
University: Enrollment	University of Michigan: 43,426	Cleveland State University: 17,386; Case Western Reserve: 10,026	University of Oregon: 24,591	University of Arkansas, Little Rock: 13,068; University of Arkansas for Medical Sciences: 2,809	Tulane University: 13,486; Loyola University New Orleans: 927; University of New Orleans: 12,000	Norfolk State University: 7,100; Old Dominion University: 24,700	Portland State University: 29,703; Oregon Health and Science University: 2,849: University of Portland: 3,911	University of Utah: 27,164	University of Washington, Tacoma: 4,015; University of Puget Sound: 2,800	University of North Florida: 16,357; Jacksonville University: 3,200	Michigan State University: 48,906	University of Colorado: 29,278	Colorado State University: 29,500	University of Wisconsin, Madison: 42,595
Transit System Stats	BRT	6.8 miles, 14,400 daily riders	11.4 miles							Under Study	8.5 miles, 28 stations	18 miles, 7 stations	5 miles, 14 stations	
	LRT	18 miles, 8,900 daily riders				7.4 miles, 4,900 daily ridership	53 miles, 130,000 daily riders	35 miles, 55,500 daily riders	1.6 miles, ridership unknown					
	Streetcar				13 miles, 13,100 daily riders		3.9 miles, 11,000 daily riders	2 miles, 3,000 daily riders (est)		5 miles, ridership unknown				Hybrid commuter rail-LRT
	AGT									2.5 miles, 5,400 daily riders				

Chapter 3:

Development of Preliminary Alternatives

Transportation Modes Considered: General Characteristics

Standard Bus

- Operates on city streets with frequent stops
- Diesel or dual-fuel rubber tired buses
- Operates at grade, in mixed flow
- Simple stations or stops



Elevated Guideway Transit

- Automated system of electrically powered vehicles operating in an exclusive guideway with single or multiple car trains
- Power is in the guideway
- Grade separated throughout
- Elevated station-stops


Detroit People Mover


Las Vegas Monorail


Clarian Health System, Indianapolis

Bus Rapid Transit (BRT)

- Integrated system of guideway, station-stops, service and amenities that collectively improves the speed, reliability and identity of bus transit
- Diesel or dual-fuel rubber tired buses
- Generally operates at grade
- Either mixed-flow or exclusive guideway


Orange Line, CA


Boston Silver Line


34th Street, Manhattan


Cleveland HealthLine

Streetcar/Light Rail (LRT)

- Electric powered transit vehicles operating on standard railroad tracks with single or multiple car trains
- Generally operates at grade
- Either mixed-flow or exclusive guideway


San Diego Light Rail


Minneapolis Light Rail


Portland Light Rail


Tacoma Streetcar


Portland Streetcar

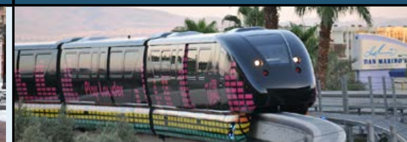

Tuscon Streetcar

Transportation Modes Considered: Design Characteristics

	Standard Bus 	Streetcar/Light Rail (LRT) 	Bus Rapid Transit 	Elevated Guideway Transit 
Vehicle Length	40 Feet	65 - 95 Feet	60 Feet	45 Feet
Vehicle Width	8.5 Feet	8 - 9 Feet	8.5 Feet	9 - 11 Feet
Vehicle Capacity	70 Passengers	150 - 230 Passengers per Car	120 Passengers	85 - 105 Passengers per Car
Average Speed	10 - 15 mph	20 - 35 mph	25 - 40 mph	30 - 40 mph

The Conceptual Engineering Basis of Design is Included as Appendix D

Modal Evaluation

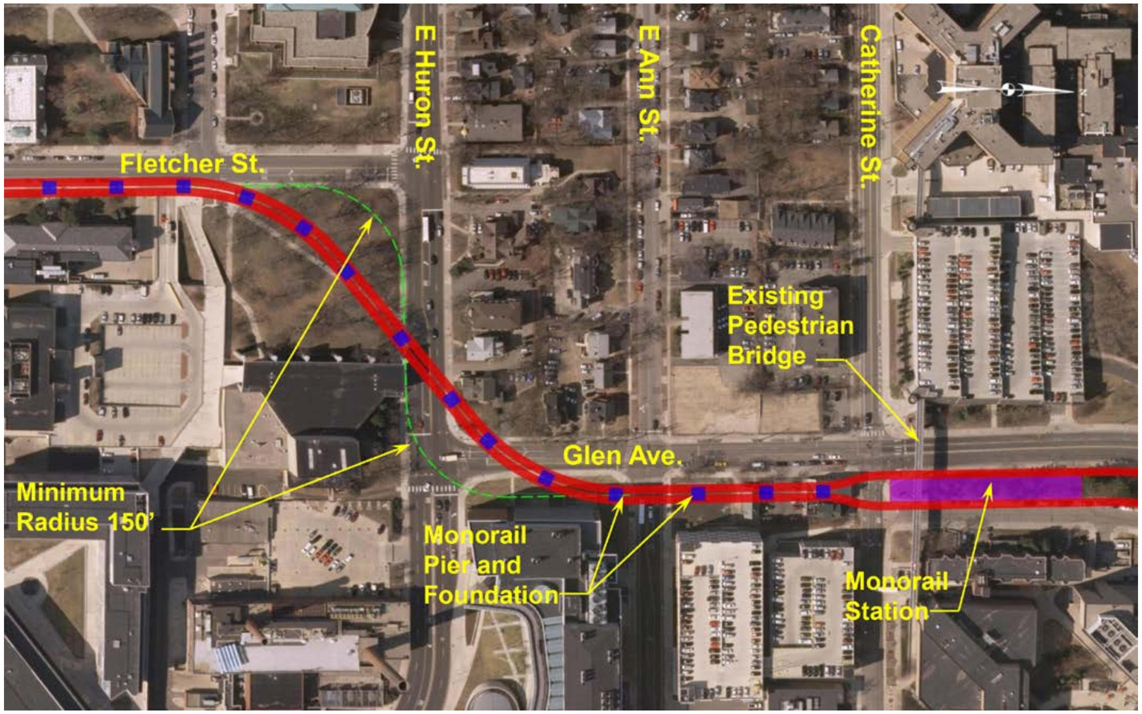
	Light Rail Transit / Streetcar		Bus Rapid Transit	Automated Guideway Transit 4-Car Monorail	Bus
	Single Streetcar	2-Car LRT			
					
Environmental Concerns	Platforms, overhead catenary, signage and shelters at station locations will impact visual entertainment. Noise/vibration will be a concern for noise sensitive locations adjacent to streetcar/ LRT tracks.		Platforms, shelters and signage at station locations impact surrounding visual environment.	Large support columns every 100 ft required to support track above the ground and station locations will require large elevated structures. Impacts to street level and overhead viewshed are likely to be significant through entire corridor. Visual impact of elevated guideway will be of particular concern in Downtown Historic district.	Platforms, shelters, and signage at station locations are likely to have little impact on surrounding visual environment.
Economic Development/ Land Use	Documented positive land use impacts, particularly when serving mixed-use downtown districts (Portland, Seattle). Streetcar project are often built with economic development as a major goal.		Impacts are variable and dependent upon factors such as the level of investment in stations and service and coordination with local planning and development incentives. When the service is perceived as different from local bus service, presence of TOD may increase	Very few new elevated transit corridors make it difficult to gauge impact. Less street-level activity as compared to an at-grade alternative.	Impacts likely to be minimal; proximity to bus service may affect apartment vacancy rates. Little evidence to show that local bus service in a corridor has significant impact on surrounding land uses.
Capital Cost per Mile (2010)	$50 - $60 Million per Mile		$15 - $20 Million per Mile	$150 - $200 Million per Mile	-
Compatibility Between Modes	Yes, can operate with bus and/or streetcar		Yes, can operate with bus and/or streetcar	No	Yes, can operate with bus and/or streetcar
Travel Time	31 minutes (end to end)		32 minutes (end to end)	24 Minutes	36 minutes
Capacity/Frequency	3,600 Peak Hour Passengers at 2 minute Headways	4,800 Peak Hour Passengers at 5 minute Headways	3,600 Peak Hour Passengers at 2 minute Headways	4,272 Peak Hour Passengers at 5 Minute Headways	3,200 Peak Hour Passengers at 1.5 Minute Headways
Peer Community Experience	Several peer communities have recently implemented LRT/Streetcar projects, which typically are short-distance connectors.		Numerous peer communities have imple-mented or are studying BRT, including Grand Rapids and Lansing.	Examples of recent applications limited to larger cities such as Detroit, Jacksonville, and Seattle.	Many peer communities rely on local/ express bus without fixed guideway.
Community Preference	40% of public participants indicated preference for LRT/streetcar		21%	22%	17%
Basis for Recommendation	Proven transit technology that has successfully been implemented in similar communities. Flexible technology that can operate at-grade or with elevated sections to improve travel time reliability.		Proven transit technology that has successfully been implemented in similar communities. Flexible technology that can operate at-grade or with elevated sections to improve travel time reliability.	Need for continuous, elevated guideway results in significant adjacency impacts and capital costs significantly greater than other alternatives.	Minimal positive or negative impacts. Will not provide required capacity to meet travel demand needs
Recommendation	**Retain**		**Retain**	**Not Recommended**	**Retain**

Modal Evaluation: Elevated Guideway Transit

Elevated Guideway Transit was eliminated from further consideration in the study process for the following reasons:

- Elevated guideway transit could include a monorail or a system such as the Detroit People Mover. These types of vehicles receive power through the guideway that they run on. For this reason, pedestrians or other types of vehicles cannot cross over or on the tracks; the guideway needs to be completely separate from the surrounding environment which generally means it must be elevated throughout.
- Creating an elevated guideway is extremely costly. It would cost three to four times as much as a system that can run on the ground.
- An elevated guideway would likely have significant visual impacts particularly in the historic portions of the downtown area.
- Other modes (LRT, BRT) can be configured to have similar benefits with a reduced costs and level of impact

Monorail Concept (Example - Indianapolis)



Potential Monorail Alignment

Conceptual Connector Route Options

The map to the right shows preliminary route alignment alternatives that were reviewed with the public in June 2013.

For purposes of the Alternatives Analysis, both the BRT and LRT/Streetcar options were considered to have essentially the same guideway right-of-way requirements. A two-way guideway would require approximately 30 feet of width to accommodate an 8.5 foot wide vehicle. A one-way guide-way would fit in a 12-foot right-of-way.

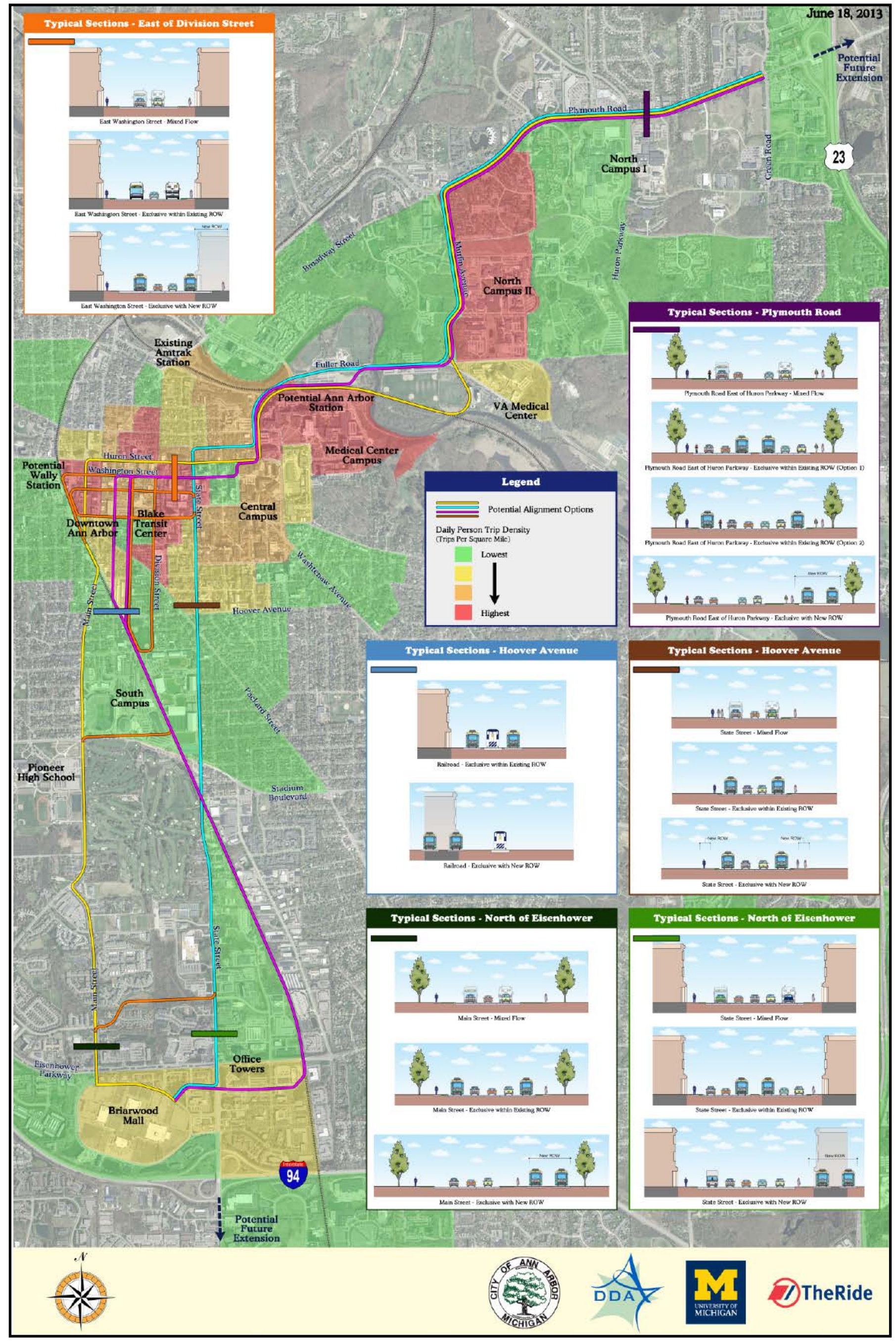
Both BRT and LRT/Streetcar options would be designed to be fully compatible with the Americans with Disabilities Act (ADA). All station-stops and vehicles will be accessible with multiple boarding doors and low-floor vehicles.

For purposes of the Alternatives Analysis, the LRT and streetcar modes were combined. In general, LRT is assumed to have multiple car consists while streetcar would operate in a single car consist. While a vehicle width of 8.5 feet is assumed, the width of a passenger rail vehicle could be as little as 8.0 feet.

The Connector Route

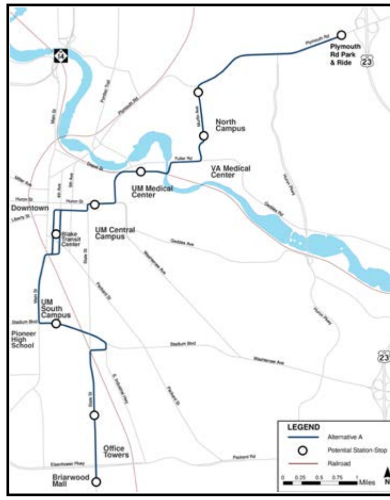
The Graphic to the left illustrates The Connector route. The preferred route is described in more detail on the following pages using the following route segments:

- Northern Segment and Terminus
- Downtown
- Huron River and Railroad Crossing
- Central Campus
- Southern Segment and Terminus

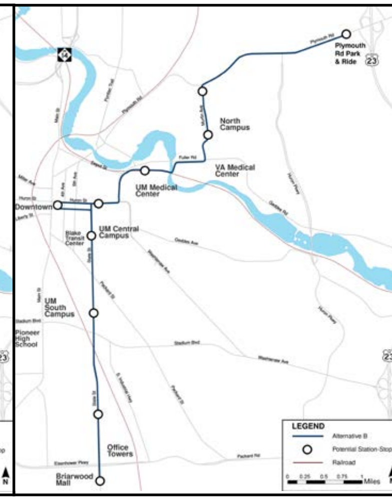


Preliminary Route Alternatives

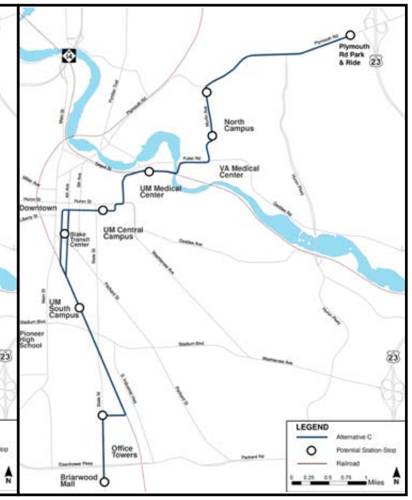
- At the November 2013 public meeting, the public was given the opportunity to comment on a refined set of six route alignment/station alternatives.
- Alternative Connector route alignments and station-stop locations were developed in consideration of previous planning studies, physical constraints, and the location of major trip generators.
- In developing the alternatives, a general priority/hierarchy of transitway design configurations was utilized:
    - Connector in dedicated guideway (new right-of-way)
    - Connector in dedicated guideway (existing right-of-way, maintain all travel lanes/parking)
    - Connector in dedicated guideway (remove parking)
    - Connector in dedicated guideway (remove travel lanes)
    - Connector operating in shared right of way in mixed flow with traffic
- The Connector would be designed to compliment and supplement TheRide and U-M bus service
- In order to provide reliable service and attract the most riders, an exclusive guideway, used only by transit vehicles is highly desirable
- Station-stops will be located approximately ¼ to 1 mile apart to optimize transit travel times while providing convenient service to key destinations



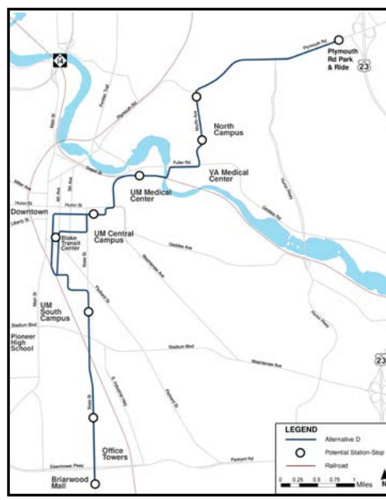
Alternative A



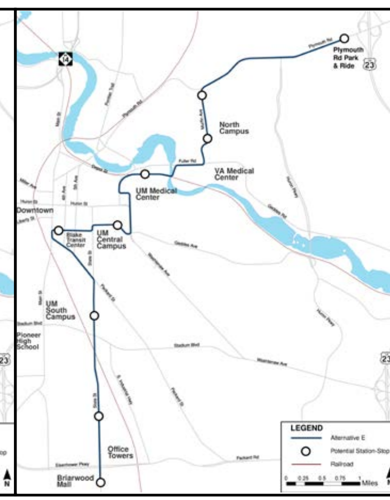
Alternative B



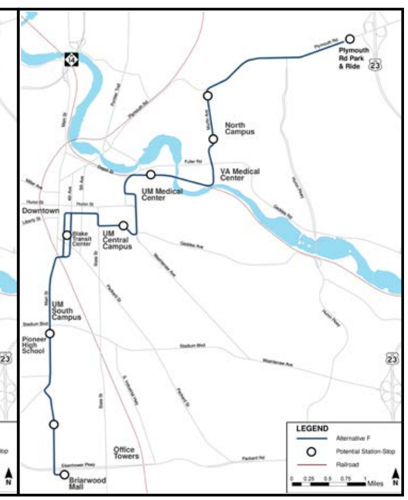
Alternative C



Alternative D



Alternative E



Alternative F

Transit Service Operations and Integration

U-M Routes

For all Connector alternatives, the proposed Northwood Shuttle and Baits Shuttle will replace the following existing routes:

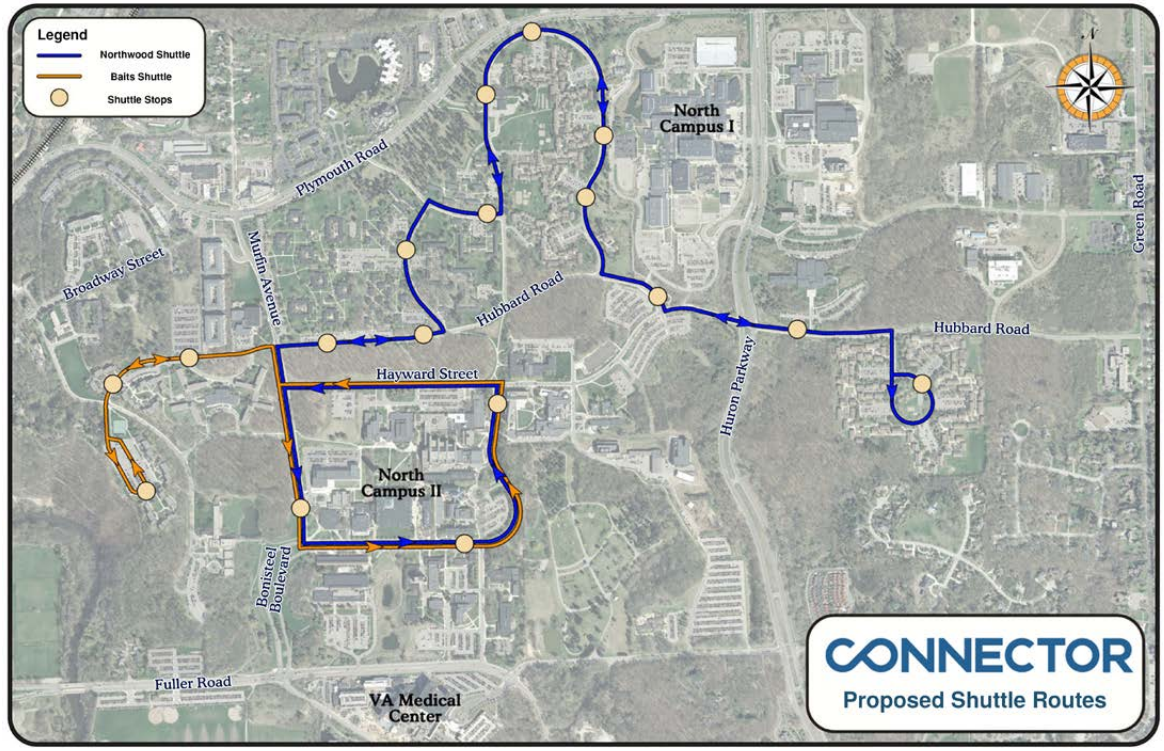
- Commuter North
- Northwood
- Northwood Express
- Bursley-Baits
- Diag to Diag
- North Campus
- Northeast Shuttle

AAATA Routes

Modifications to the following routes:

- #1 (Pontiac Route)
- #2 (Plymouth Route)
- #6 (Ellsworth Route)
- #7 (S. Main – East Route)
- #36 (Wolverine Tower Shuttle)

The Existing Bus Route Modifications Memo is Included as Appendix E



Proposed shuttle routes in the North Campus area.

Proposed Connector Service Plan

Day	Time Period	Hours of Service	Frequency (in Minutes)	Trips Per Day (One Direction)
Weekday	5:45 AM - 10:00 PM	16.25	LRT - 5 BRT - 2	LRT - 195 BRT - 488
	10:00 PM - 2:00 AM	4	LRT - 15 BRT - 10	LRT - 16 BRT - 24

Chapter 4:

Evaluation of Alternatives

Evaluation Methodology - Overview

The following evaluation criteria were examined for each conceptual engineering alternative

- Route and Station-Stops
  - Number of Station-Stops
  - Length of Route
  - Length of Guideway in Mixed Flow
- Operations
  - The Connector End-to-End Travel Time
  - The Connector North Campus to Central Campus Travel Time
  - Vehicle Passenger Capacity
  - Peak Hour Vehicles Required to Accommodate Peak Hour Riders
- Physical Impact Assessment (using City of Ann Arbor GIS data)
  - On-Street Parking Removed/Relocated
  - Alignment in Historic District
  - Alignment in Parkland
  - Alignment in Non-City Open Space
  - Alignment in Floodplain
  - Alignment in Educational Property
  - Turning Movement Right-of-Way Impacts
- Population and Demographics
  - Minority Population
  - Low-Income Households
  - Station Area Population Density*
  - Station Area Employment Density*
  - Station Area Development Potential
- Ridership Model
  - Connector Ridership (Daily)
  - Connector Ridership (Peak Hour)
  - Connector Ridership by Transit Dependents
  - Total Transit Ridership
  - Vehicle Miles of Travel
  - Miles of Congested Roadway
  - Greenhouse Gas Emissions*
  - Transportation Energy Use*
- Cost Evaluation
  - Capital Cost
  - Operating and Maintenance Cost
  - Performance (Cost Per Passenger)*

*Criteria that are included in the FTA *New Starts Evaluation and Rating Process*

The evaluation of alternatives memo is included as Appendix F

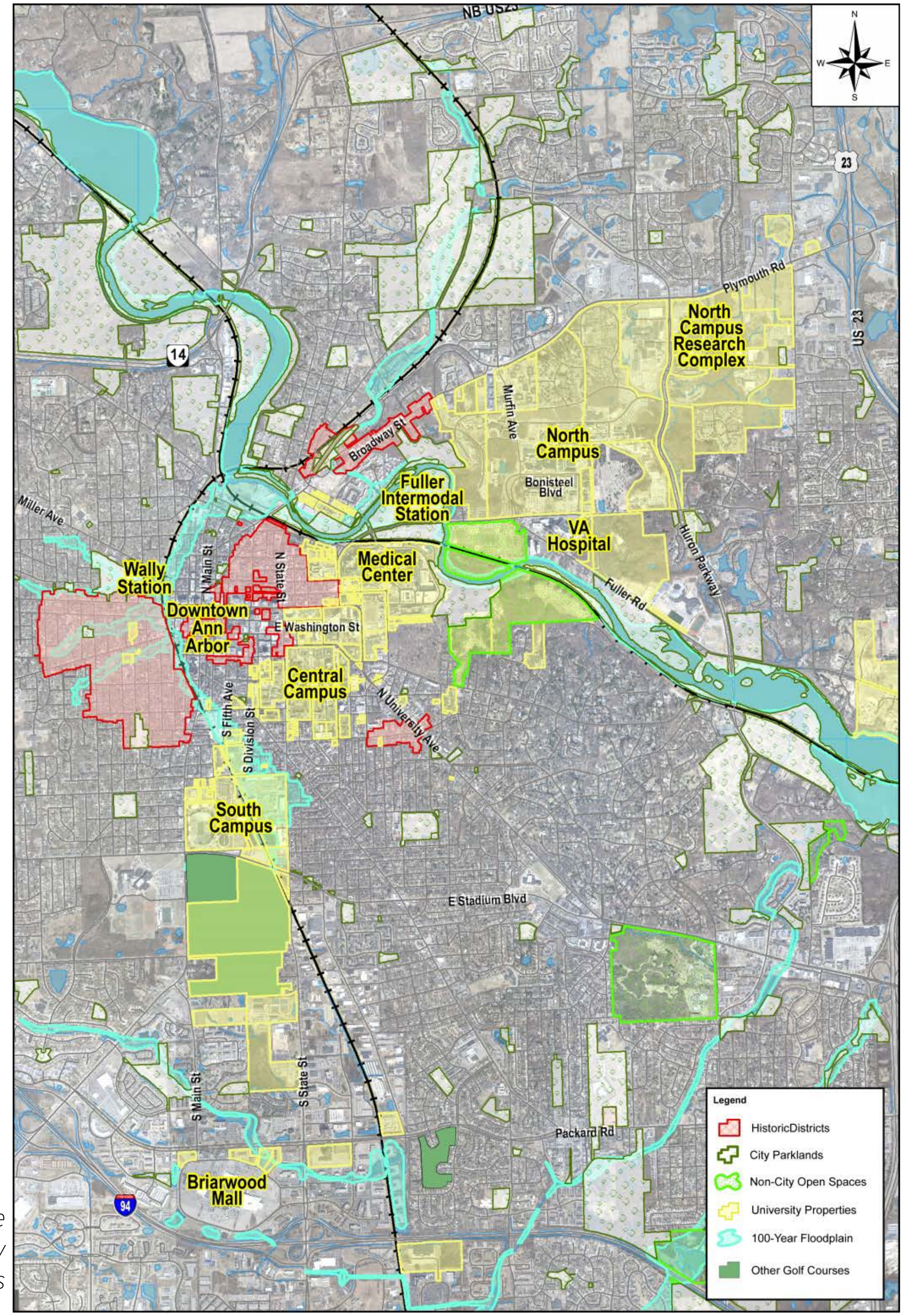
Physical Impacts

The City of Ann Arbor GIS data was used to evaluate and quantify the potential impacts of each alternative. This GIS information was supplemented by aerial photography and other City mapping.

This assessment identifies, at a conceptual level, locations where The Connector alignment could potentially pass through or adjacent to:

- Historic Districts
- Parkland
- Non-City Open Space
- Floodplains
- Educational Property

In some cases along the alignments, on-street parking could be displaced to accommodate The Connector. For each alternative, the number of parking spaces impacted were estimated.

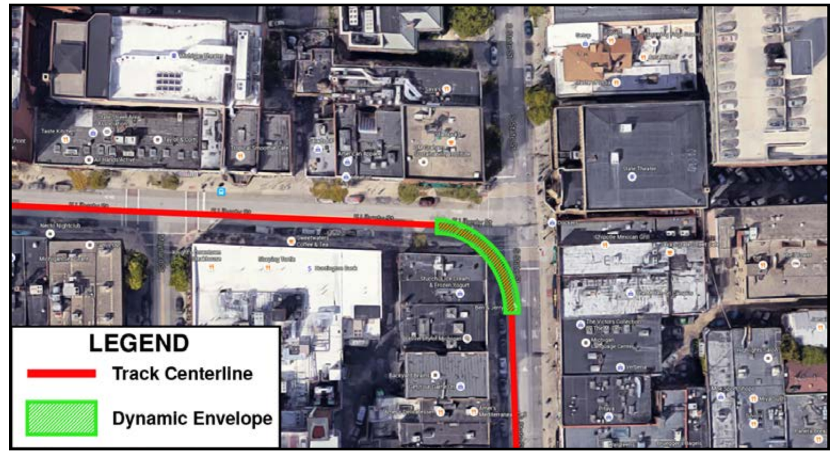


Environmentally sensitive areas within the project study boundaries

CONNECTOR

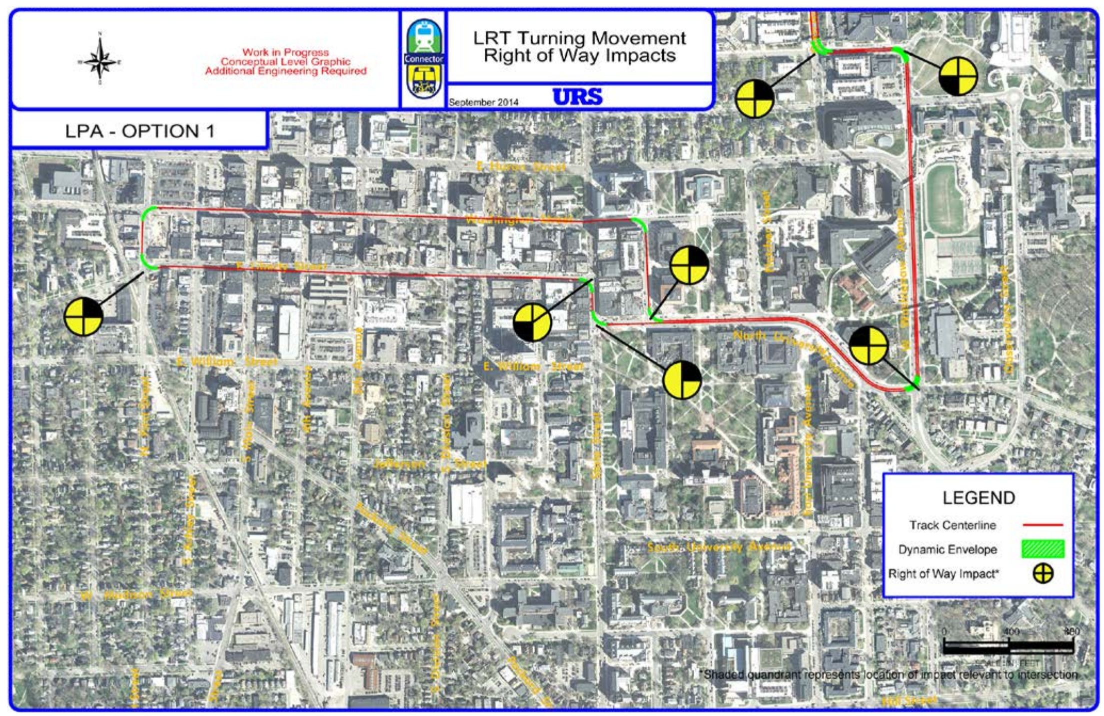
Physical Impacts: Right-of-Way

All of the proposed alignment options would require additional right-of-way along Plymouth Road and Murfin Avenue to maintain existing traffic and provide a new dedicated transit guideway. The existing street network of Downtown Ann Arbor poses challenges for The Connector alignment. In many areas the existing intersection geometry will require modification in order to accommodate the turning movement of The Connector vehicle.



Typical intersection right-of-way concern

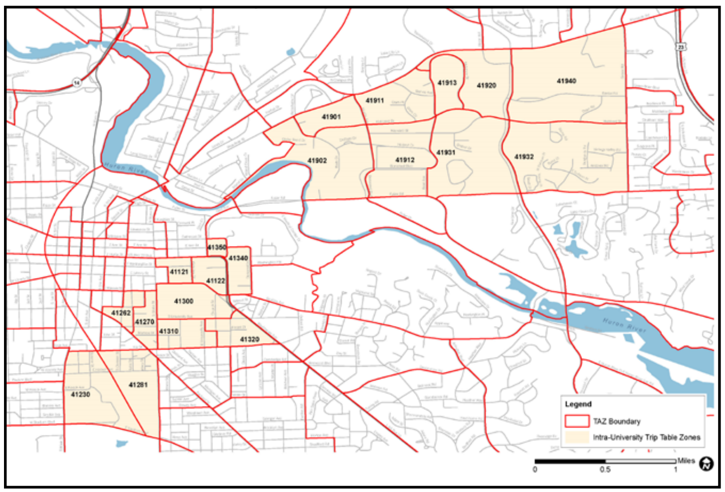
Each alternative was analyzed for impacts associated with the turning movements of both LRT and BRT vehicles. Particular concern was given to the downtown Ann Arbor area, as the existing geometry of intersections in this portion of the study area is restrictive. Dynamic Vehicle Envelopes were derived for each mode (to account for vehicle overhang, etc.) and turning movements were overlaid on aerial photography to determine impacts to existing features outside of the assumed right-of-way. Figures showing the LRT turning movement potential right-of-way impacts for the six concepts (Alternatives A through F) were developed. The LRT figures show the worst-case scenarios in terms of intersection impacts, as BRT is less impactive. More detailed information is available in Appendix F.



Potential LRT turning movement right-of-way impacts

More detailed survey and engineering design is needed to address these potential impacts. Track geometry as well as the physical properties of a vehicle (such as width, length, truck spacing, etc.) determine the turning movement and dynamic envelope respectively. Selection of a vehicle with system-specific properties may be a source of potential mitigation of impacts to existing right-of-way and physical features.

Ridership Model



Traffic Analysis Zones for the Ann Arbor area

As documented in Appendix B, estimates of the number of people who would ride the Connector were developed using the Washtenaw Area Transportation Study (WATS) regional travel model. This model is maintained by WATS and used to analyze proposed transportation improvements in the region. The model is calibrated to existing conditions and contains estimates of future population and employment in the region which are used to forecast future travel. The WATS Model estimates transit ridership based on a number of interacting factors:

- Transit travel time relative to auto travel time. For transit, travel times include the time on the transit vehicle as well as walk time to and from the station-stop and time penalties for transfers.
- Transit fares as compared to out-of-pocket driving costs
- Propensity or relative preference of people to use transit. In general, people have a higher propensity to use a premium form of transit. However, this type of transit mode is not present in the WATS model so no added propensity was included.

The Connector travel time estimates were developed for each alignment alternative and included consideration of the length of the alignment, maximum travel speeds by segment, reduced speed requirements on curves, acceleration and deceleration rates, and station-stop dwell time.

The WATS model estimates trips between campuses of the University using a special Intra-University Trip Table. This study included an extensive survey of existing transit usage between campuses to update the Intra-University Trip Table to reflect actual bus transit usage. This updated trip table was then used to forecast future ridership on the Connector.

The WATS Travel Model was used to estimate the following parameters:

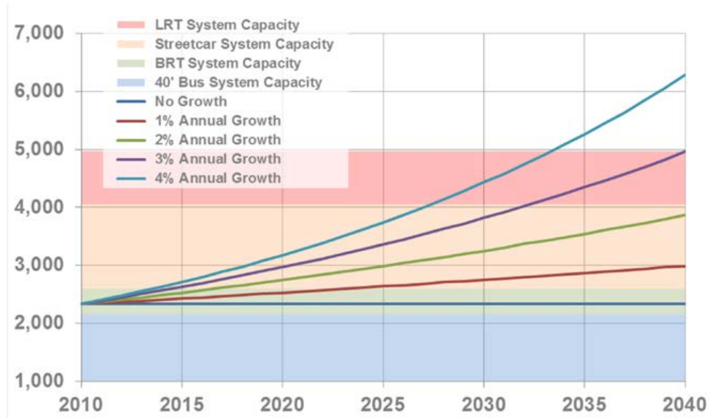
- Number of Connector boardings and alightings at each station-stop
- Total daily boarding on The Connector and total transit ridership
- Auto vehicle miles of travel (VMT) and vehicle hours of travel (VHT)
- Congested miles of roadway
- The VMT estimates were also used as input to the calculation of greenhouse gas emissions and transportation energy use.

University Transit Trips

Recent Trends

U-M transit system ridership has increased on average by nearly 7 percent annually over the last 10 years, and current peak direction ridership (demand) is either at or over the effective capacity of the bus system.

Increases in student enrollment and employment (see table) explain some but not all of the ridership growth. Additional factors, such as land use development, changes in transit service, and the location and supply of parking also contribute to ridership demand.



Projected ridership growth and mode capacity for The Connector

Potential Future Growth

Whether enrollment and employment will continue to increase at historical levels is unknown, but growth planning from both the City and University, combined with a continued limitation in parking supply in the densest portions of the corridor, indicate that transit trip making is likely to continue growing.

Based on recent trends, even a conservative future of low enrollment/employment growth could still result in ridership growth of up to 1 to 3 percent per year.

Findings

As shown in the chart, if ridership demand continues to grow at even a 3 percent annual rate:

- Bus Rapid Transit (BRT) would provide less than five years of reserve capacity in The Connector corridor.
- A single-car streetcar would provide adequate capacity beyond 2030, but leaves little reserve capacity if future conditions exceed historical ridership trends.
- A two-car Light Rail Transit (LRT) system would provide adequate capacity to accommodate future demand through 2040.

If transit demand continues to increase at recent historical rates, the need for a high capacity transit system will become acute in less than 10 years.

Year	U-M Transit Ridership		U-M Enrollment		U-M Employment	
	Daily	Annual Change	Total	Annual Change	Total	Annual Change
2002	15,458	-	35,623	-	-	-
2003	16,766	8.5%	35,888	0.7%	21,553	-
2004	17,762	7.2%	36,554	1.9%	21,673	0.6%
2005	20,062	9.1%	39,993	9.4%	21,849	0.8%
2006	21,460	8.5%	40,025	0.1%	22,096	1.1%
2007	22,138	7.4%	41,042	2.5%	23,176	4.9%
2008	22,060	6.1%	41,029	0.0%	23,740	2.4%
2009	22,260	5.3%	41,674	1.6%	24,469	3.1%
2010	23,930	5.6%	41,924	0.6%	24,732	1.1%
2011	25,236	5.6%	42,716	1.9%	24,674	-0.2
2012	27,003	5.7%	43,426	1.7%	24,960	1.2%
		6.9%		**2.0%**		**1.7%**

Cost Estimates

Operations and Maintenance (O&M) Cost

- Costs were estimated using 2012 prices and escalated to a construction year of 2020.
- LRT O&M costs were calculated from 2012 National Transit Database information (Charlotte, Cleveland, Minneapolis, and Portland)
- BRT O&M costs were calculated from 2012 National Transit Database information (Cleveland and Eugene)
- The unit costs for O&M were applied to The Connector operating parameters to estimate The Connector O&M costs

Annualized Cost

Annualized costs are a function of the capital cost, expected system life cycle, annual O&M cost, cost of capital, and present value annuity factor (based on the life cycle and cost of capital).

Capital Cost

- Costs were estimated using 2009 unit prices and escalated to a construction year of 2020*.
- Cost estimates include a contingency of 30%
- Unit costs were derived from recent light rail transit and bus rapid transit construction projects within the continental United States.
- Station-stops were generally assumed to be standard in cost, except the Medical Center station-stop.
- The Medical Center station-stop was estimated separately and includes a pedestrian connection into the Medical Center, bridging over West Medical Center Drive, and a pedestrian connection to the north, across the railroad tracks to the existing surface parking lot.
- Original cost estimates include the cost of 18 LRT vehicles and 34 BRT vehicles calculated based on assumed cycle time, layover, and headways
- An allowance was included for utility relocation
- Property acquisition costs are not included. Property will likely be required for portions of guideway, end of line parking, transit vehicle storage, and maintenance.
- Cost estimates do not include project development activities prior to preliminary engineering, including preparation of a NEPA document.

**These unit costs were used only to compare the initial alternatives against each other. The Recommended Alternative cost estimate uses 2016 unit costs and costs are escalated to a construction year of 2025.*

Cost Effectiveness (Cost per Passenger)

The cost per passenger was calculated using the following information for each alternative:

- Number of daily riders
- Number of transit dependent riders
- Annualization factor (average weekday equivalents)
- Annualized cost

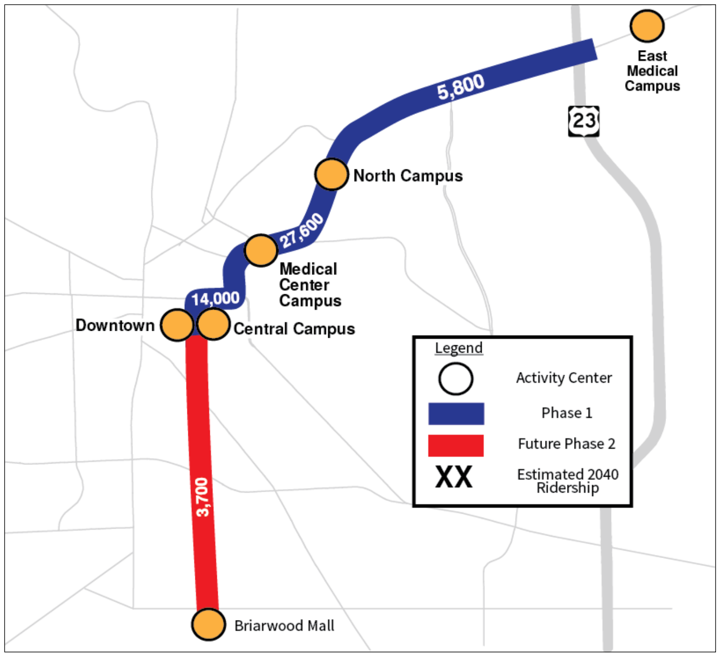
The number of riders does not include special events and represents a standard weekday. Per FTA guidelines, transit dependent riders are weighted to count double. Transit dependents were calculated based on the proportion of zero car households within ½ mile of station-stops.

Evaluation Matrix

** Greenhouse gas emissions calculations based on average power rate for electric power. If using hydro-electric power, it can be assumed that greenhouse gas emissions would decrease.*
***No ROW costs included in evaluation cost estimates*

	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Alternative F	
	LRT	BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT	BRT
Route and Stations												
Number of Stations (#)	12		11		10		10		11		13	
Length of Route (miles)	SB - 7.59 NB - 7.59		SB - 7.19 NB- 7.31		SB - 7.12 NB - 7.20		SB - 7.08 NB - 7.20		SB - 7.45 NB - 7.45		SB - 7.68 NB - 7.68	
Length of Guideway in Mixed Flow (miles)	0.02		0		0.02		0.28		0		0	
Operations												
The Connector End-to-End Travel Time	SB - 31.7 NB - 31.9	SB - 33.5 NB - 33.7	SB - 30.2 NB - 30.5	SB - 31.6 NB - 32.0	SB - 27.0 NB - 27.6	SB - 28.5 NB - 29.1	SB - 29.7 SB - 29.1	SB - 31.3 NB - 30.7	SB - 32.3 NB - 32.3	SB - 33.9 NB - 33.9	SB - 34.0 NB - 34.2	SB - 35.5 NB - 35.9
North Campus to Central Campus Travel Time	12.8	13.5	12.4	13.1	13.7	14.4	13.3	14.0	15.7	16.5	16.0	16.8
Vehicle Passenger Capacity	Single Car Streetcar: 150 2-Car LRT: 460 3-Car LRT: 690 Articulated Bus (BRT): 120											
Peak Hour Vehicles Required to for Demand	Single Car Streetcar: 19 Vehicles; Headway = 3 min. 2-Car LRT: 7 Vehicles; Headway = 8.5 min. 3-Car LRT: 5 Vehicles; Headway = 12 min. Articulated Bus (BRT): 24 Vehicles; Headway 2.5 min.											
Physical Impact Assessment												
On Street Parking Spaces Removed/Relocated	135		252		165		249		132		192	
Alignment in Historic District (miles)	0.21		0.26		0.18		0.40		0.23		0.33	
Alignment in Parkland (miles)	0		0		0		0		0		0	
Alignment in Non-City Open Space (miles)	0.28		0.28		0.28		0.28		0.28		0.17	
Alignment in Floodplain (miles)	0.24		0.31		0.68		1.02		0.31		0.25	
Alignment in Educational Property (miles)	2.64		2.63		2.65		2.62		2.95		2.83	
Turning Movement Right-of-Way Impacts	14	9	12	8	11	8	18	9	18	12	24	17
Population and Demographics												
Minority Population (Within 1/2 Mile of Stations)	28%		29%		29%		29%		29%		29%	
Low Income Households (Within 1/2 Mile of Stations)	35%		38%		38%		38%		38%		38%	
Zero-Car Households (Within 1/2 Mile of Stations)	14%		15%		15%		15%		15%		15%	
Station Area Population Density (People per Mile^2, Percent of Maximum)	5,476, 76%		6,035, 85%		5,510, 77%		5,597, 84%		6,140, 85%		5,627, 78%	
Station Area Employment Density (Jobs per Mile^2, Percent of Maximum)	11,335, 80%		12,286, 87%		11,951, 84%		12,221, 86%		12,250, 86%		10,993, 77%	
Station Area Development Potential	Medium		Medium		Medium		Medium		Medium		Medium	
Ridership Model												
Connector Daily Ridership	33,800	34,700	35,700	36,600	35,200	35,900	35,100	35,900	36,700	37,500	36,900	37,600
Connector Peak Hour Ridership	3,400	3,500	3,600	3,700	3,600	3,700	3,600	3,700	3,700	3,800	3,800	3,800
Connector Ridership by Transit Dependents	6,283	6,516	6,254	6,414	6,431	6,540	6,128	6,257	6,404	6,598	6,629	6,766
Total Transit Ridership	56,900	57,200	57,300	57,600	57,200	57,500	57,100	57,400	57,400	57,800	57,800	58,100
Vehicle Miles of Travel (VMT)	2,583,600	2,583,000	2,591,700	2,591,100	2,586,800	2,586,800	2,585,000	2,585,900	2,583,600	2,582,900	2,570,700	2,571,400
Miles of Congested Roadway	41.1	43.5	41.4	41.5	43.5	43.5	43.5	43.5	43.3	43.4	45.8	45.5
Greenhouse Gas Emissions Decrease /(Increase) (Tons/Year)	32	(504)	(688)	(1,197)	(86)	(656)	37	(542)	125	(389)	1,141	451
Transportation Energy Use Decrease /(Increase) (Tons/Year)	51,717	(4,249)	38,961	(14,455)	46,828	(6,877)	48,433	(5,282)	51,965	(2,791)	68.638	9,910
Cost Evaluation												
Capital Cost (2020 $)	$806.5 M	$500.6 M	$765.5 M	$494.4 M	$755.0 M	$469.4 M	$783.3 M	$502.2 M	$776.2 M	490.3 M	$862.3 M	$560.7 M
Operating and Maintenance Cost (2020 $)	$7.1 M	$20.8 M	$5.0 M	$18.1 M	$4.9 M	$17.8 M	$4.8 M	$17.7 M	$5.4 M	$18.9 M	$7.1 M	$21.0 M
Performance (Cost per Passenger) (2020 $)	$6.05	$5.18	$5.34	$4.68	$4.56	$4.56	$5.53	$4.08	$5.29	$4.61	$5.92	$5.19

Evaluation Results



FTA Rating Factor	Connector Estimate	Likely FTA Score
Mobility Improvements		
Annual Trips	11.5 to 12 Million	Medium
Cost Effectiveness		
Annualized Cost per Passenger	$4.50 to $6.00	Medium to Medium High

General

- The Connector route is approximately 7.5 miles long and the end-to-end travel time would be 30 to 35 minutes with 10 to 13 station-stops.
- Forecast ridership on entire The Connector route is between 34,000 and 37,000 riders per day on typical weekdays. This level of ridership compares favorably to the FTA rating criteria.
- The Connector would effectively serve high density population and employment areas as well as a large proportion of minority, low income, and zero-car households.
- The Connector impacts on the physical environment include potential impacts to historic districts, floodplains, on-street parking, and traffic operations. Mitigation measures will be incorporated into the design of The Connector.
- The cost effectiveness (annualized cost per passenger) of The Connector alternatives compares very favorably to the FTA rating criteria.

BRT Compared to LRT/Streetcar

- The BRT alternatives would have lower capital costs than the LRT/streetcar alternatives, but annual operating costs would be substantially higher than a rail based system.
- To accommodate the forecast level of passenger demand, BRT would need to operate at a frequency of 2 minutes which is functionally not sustainable.
- A rail based system would provide sufficient passenger capacity and could be expanded to support additional ridership growth.

Route Refinement

- The portion of The Connector from Downtown to the north carries substantially more riders than the segment south of Downtown.
- The northerly segment would carry approximately 30,000 to 32,000 riders per day and is the more cost effective portion of the route.
- To reduce impacts along streets with limited widths, the route should follow a one-way loop through the downtown.
- The segment south of downtown should generally follow State Street and should be incorporated into future development plans.

Chapter 5:

Public and Stakeholder Involvement

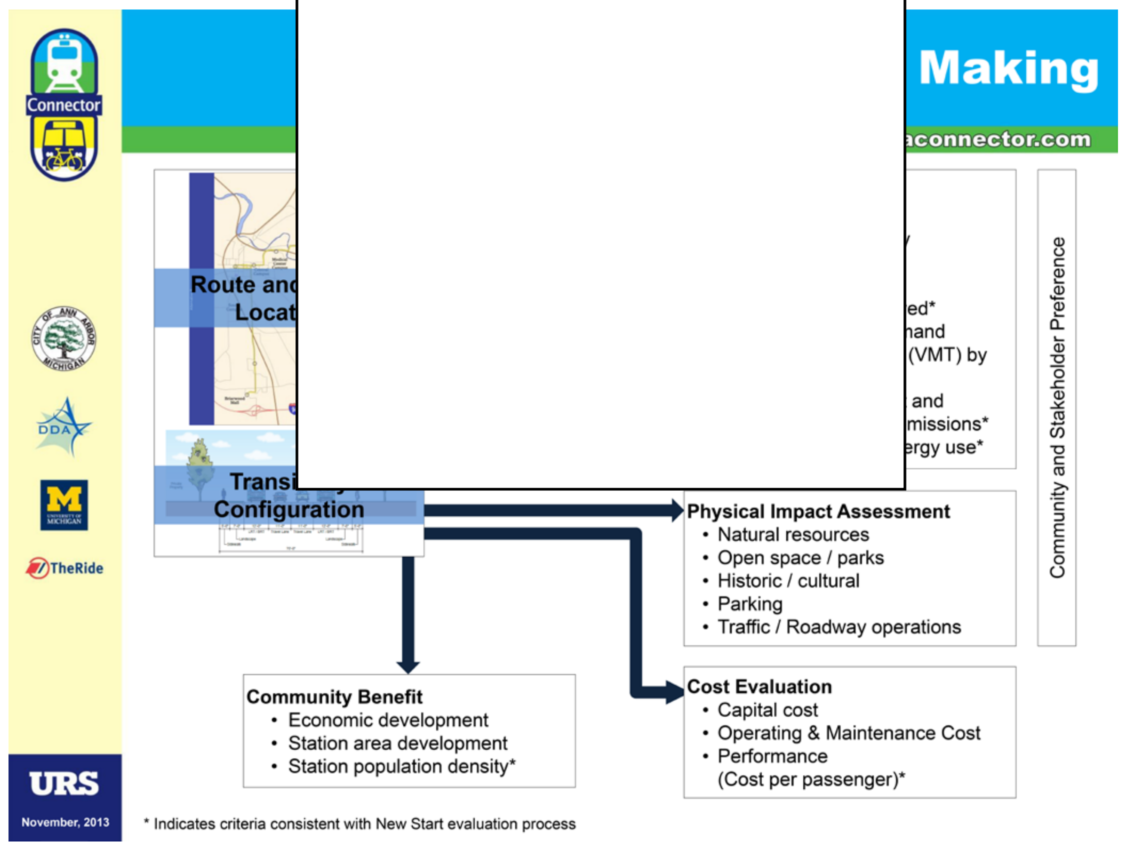
Public Involvement Overview

The AA was conducted to educate, inform and involve the community in the decision making process. The public involvement process for the AA included social media, a project website, newsletters and public workshops / meetings in:

- December 2012
- June 2013
- November 2013
- March 2016

In addition to the general public process, the AA was coordinated through monthly meetings with a Project Management Committee and periodic meetings with the community through a Leadership Advisory Group composed of community leaders and elected officials. All project materials were posted on the project website (www.aaconnector.com).

Placeholder for March 2016 flyer or event material



Public Meeting 1

LRT/Streetcar

40%
Preferred

Elevated Guideway Transit

22%
Preferred

Bus Rapid Transit

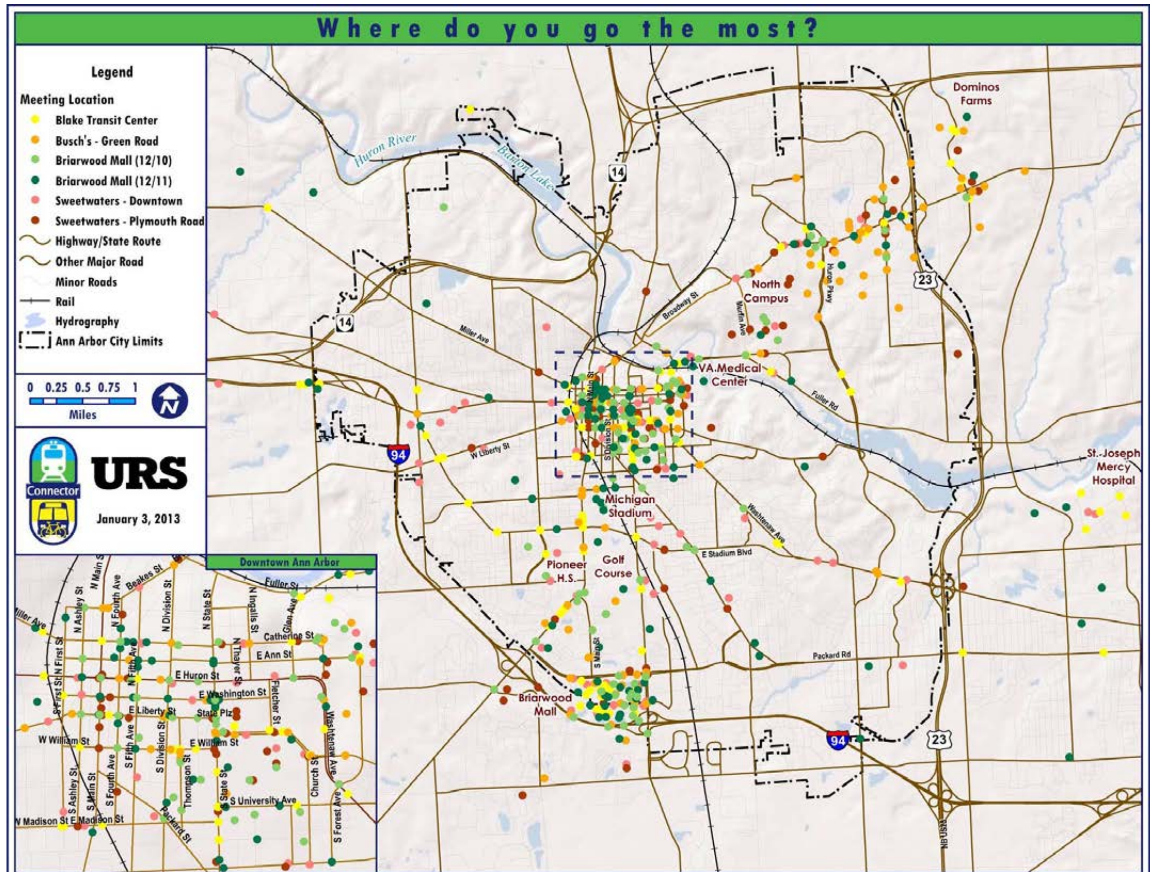
21%
Preferred

Standard Bus

17%
Preferred

Polling results on community member's preferred mode of choice.

At the December 2012 Public Meetings (drop-in events held at Blake Transit Center, Busch's, Sweetwaters, & Briarwood Mall), people were encouraged to stop by and provide their opinions on which mode of proposed Connector travel they prefer and where they travel the most:

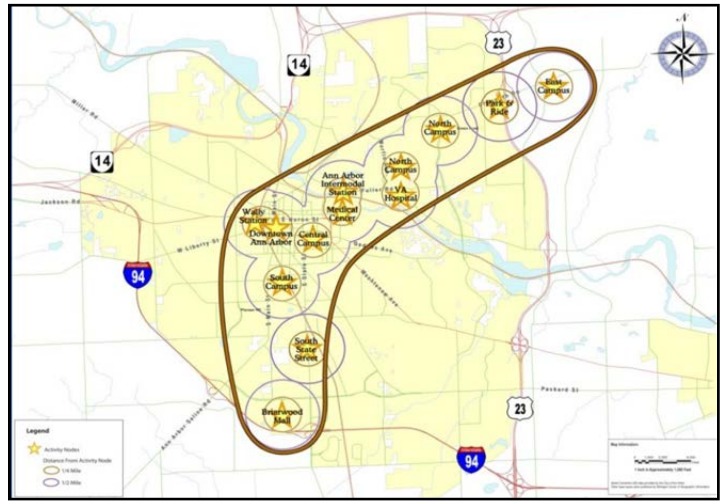


Map of trip locations populated by community members

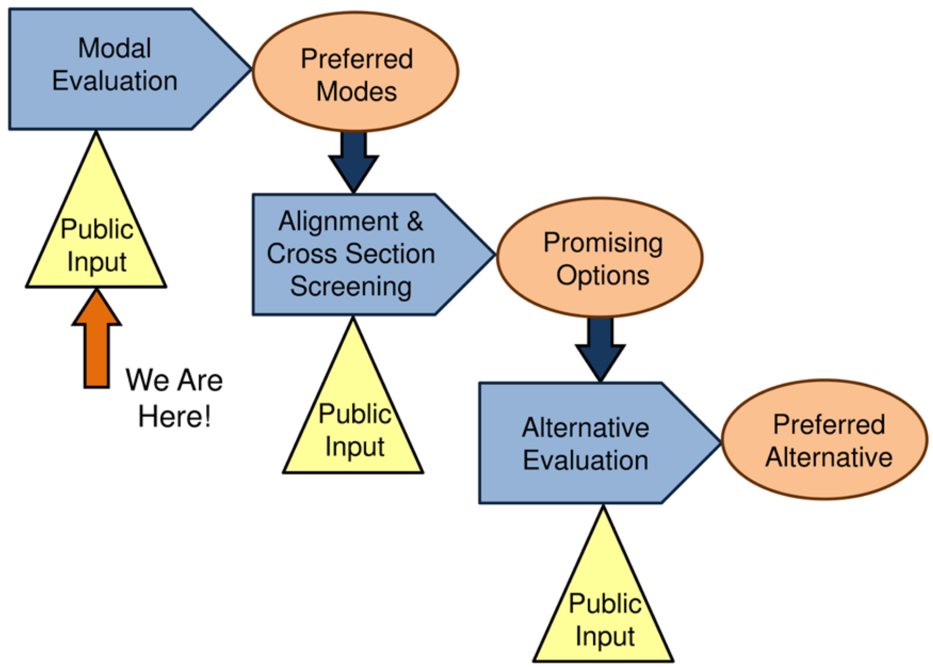
CONNECTOR

Public Meeting 2

On June 18, 2013, a public input event for The Connector was held at the Downtown Ann Arbor District Library. At the meeting, members of the public were invited to comment on various aspects of The Connector project. These areas included the overall project goals, the needs for the project, evaluation of the elevated guideway option, and preliminary route alternatives.



Community members discuss local transportation needs



Public Meeting 3

At the November 2013 Public Meeting, comments from the public were solicited on preliminary route alternatives. Public feedback was considered, along with the relative cost and benefits of each, in determining the preferred route to best meet the needs of the community.

Project staff and community leaders discuss The Connector route alternatives

Community members listen intently to a presentation given by project staff

Illustrated below are The Connector routes that are currently being studied. Based on your comments, and an evaluation of the relative costs and benefits, a preferred route will be developed to best meet the needs of the community

Alternative A

Alternative B

Alternative C

Alternative D

Alternative E

Alternative F

Public Meeting 4

March 2016 Public meeting placeholder

Stakeholder Involvement Groups

Leadership Advisory Group

The Leadership Advisory Group (LAG) was composed of community leaders and elected officials. The LAG met twice during the study on February 6, 2013 and June 18, 2013 to review interim study products and provide feedback and direction for the study process.

Project staff discuss process and direction of The Connector study.

Project Management Committee

The Project Management Committee (PMC) met monthly beginning in September 2012 to manage the study process and provide direction. The PMC included representation from:

- AAATA
- City of Ann Arbor
- Ann Arbor Downtown Development Authority
- University of Michigan
- MDOT
- SEMCOG
- WATS

Community leaders and elected officials discuss The Connector route alternatives.

Chapter 6:

Recommended Alternative

Recommended Transit Mode

Streetcar, Tacoma, WA

Tram, Dublin, Ireland

Light Rail, Phoenix, AZ

Streetcar, Portland, OR

Transit Vehicle

A rail transit (streetcar or light rail) system is recommended. The study evaluated both rail transit and Bus Rapid Transit (BRT) and concluded that rail transit would provide a better long term, sustainable solution consistent with the project goals. While BRT would have lower initial capital costs, annual operating costs would be substantially higher than a rail based system. The forecast level of passenger demand would exceed the practical capacity of a BRT system. Larger rail transit vehicles, in one- or two-car configurations, can accommodate the forecast level of passenger demand.

A hybrid light rail/streetcar vehicle is recommended. The size of the vehicle can be tailored to meet demand and fit into the Ann Arbor environment. Advances in ‘wireless’ technology offer safe, unobtrusive power systems and electric powered vehicles are clean and quiet.

More Information

Additional information and detail of The Connector is available on the Alternatives Analysis website (www.aaconnector.com).

Funding and Next Steps

The Connector study is being conducted in a manner consistent with the Federal Transit Administration (FTA) New Starts program guidance. The New Starts program can provide up to 80% of the capital cost to construct fixed guideway transit systems although federal funding generally does not exceed 50% of the project cost. If the community decides to proceed with The Connector, a capital funding plan will be developed and the project will be incorporated into the regional transportation funding process. Local funding sources could include support from both public and private entities. With University faculty, students, and staff expected to comprise a large portion passengers traveling to and from campus destinations, the University of Michigan is committed to participating in project funding.

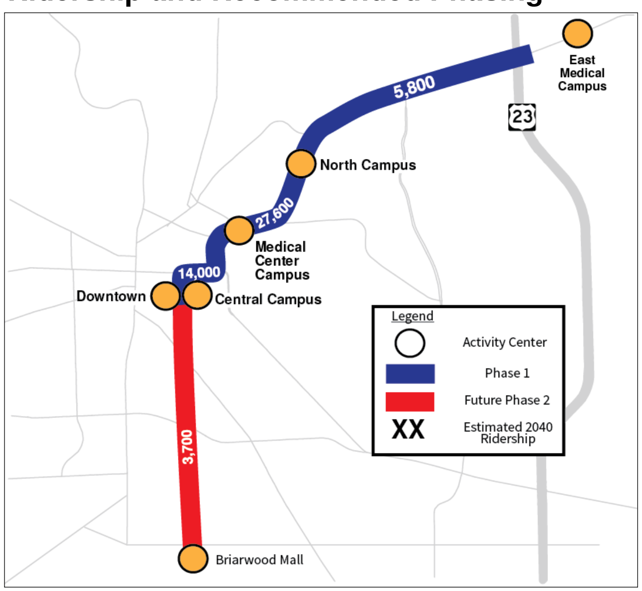
The next step toward implementation of The Connector is conceptual design and environmental review. The use of federal funds mandates compliance with the National Environmental Policy Act (NEPA) which requires a comprehensive review and disclosure of the potential project impacts on the social, cultural and natural environment.

Recommended Route

Land Use and Job Growth

In addition to transportation-related benefits, there are strong indications that The Connector will contribute to the City of Ann Arbor's quality of life and sustainability goals. Population and employment densities in The Connector Corridor are already supportive of a high-capacity transit system, and current land use plans and policies indicate the opportunity for additional mixed-use transit oriented development (TOD). This is bolstered by recent development market trends in the downtown and northeast Ann Arbor, as well as the availability of development opportunity sites near proposed Connector station-stops. All of these factors will help enable the Ann Arbor community to leverage this transit investment to support anticipated population and job growth.

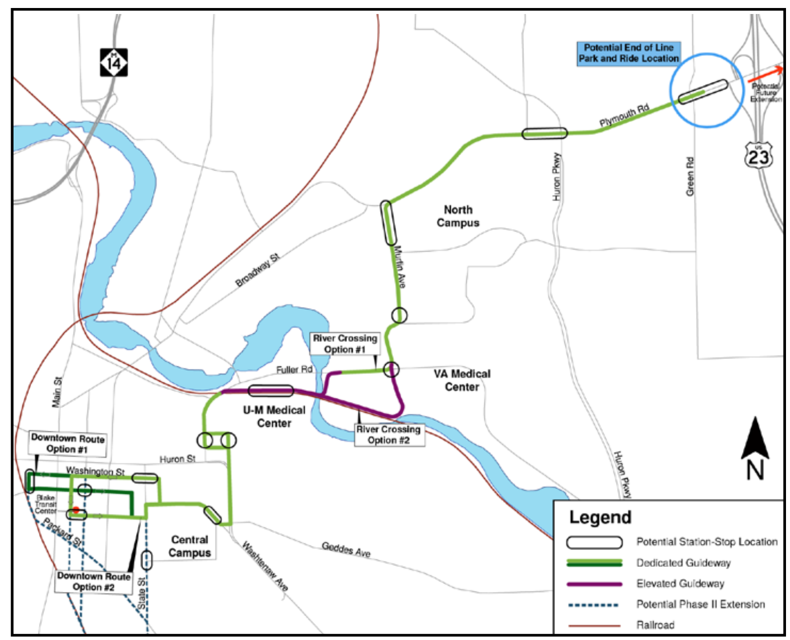
Ridership and Recommended Phasing



Recommended Route

The purpose of The Connector Alternatives Analysis (AA) is to evaluate high capacity transit options and to select a preferred route and transit mode. The Project Management Committee (PMC), which includes representation from the City, DDA, AAATA, U-M, WATS, SEMCOG and MDOT, has evaluated the ridership, cost and impacts assessment results and recommends the following be adopted as the Recommended Alternative:

- Initial system - Extend from Plymouth Road/US 23 into Downtown Ann Arbor providing connections between the major trip generators at the University and Downtown Ann Arbor.
- Phase II of the system would extend the line south from downtown to the vicinity of Briarwood Mall near State Street and I-94. The study evaluated a corridor extending from Plymouth Road and US-23 on the north to State Street and I-94 on the south. From the cost effectiveness assessment (cost per rider) it was concluded that the portion from Downtown to the north is more cost effective than the segment south of Downtown.
- The Huron River is the most significant natural feature along The Connector route. It is recommended that both of the river crossing options be advanced to allow detailed comparisons of wetland, floodplain, parkland and visual impacts prior to providing a recommendation.
- To reduce the impacts along streets with limited widths, the preferred route follows a one-way east-west loop through downtown using a combination of Washington Street, Liberty Street, or William Street and extending west as far as 4th Avenue, Ashley Street, or 1st Street.



Recommended Route

The Connector Route

The Graphic to the left illustrates The Connector route. The preferred route is described in more detail on the following pages using the following route segments:

- Northern Segment and Terminus
- Downtown
- Huron River and Railroad Crossing
- Central Campus
- Southern Segment and Terminus

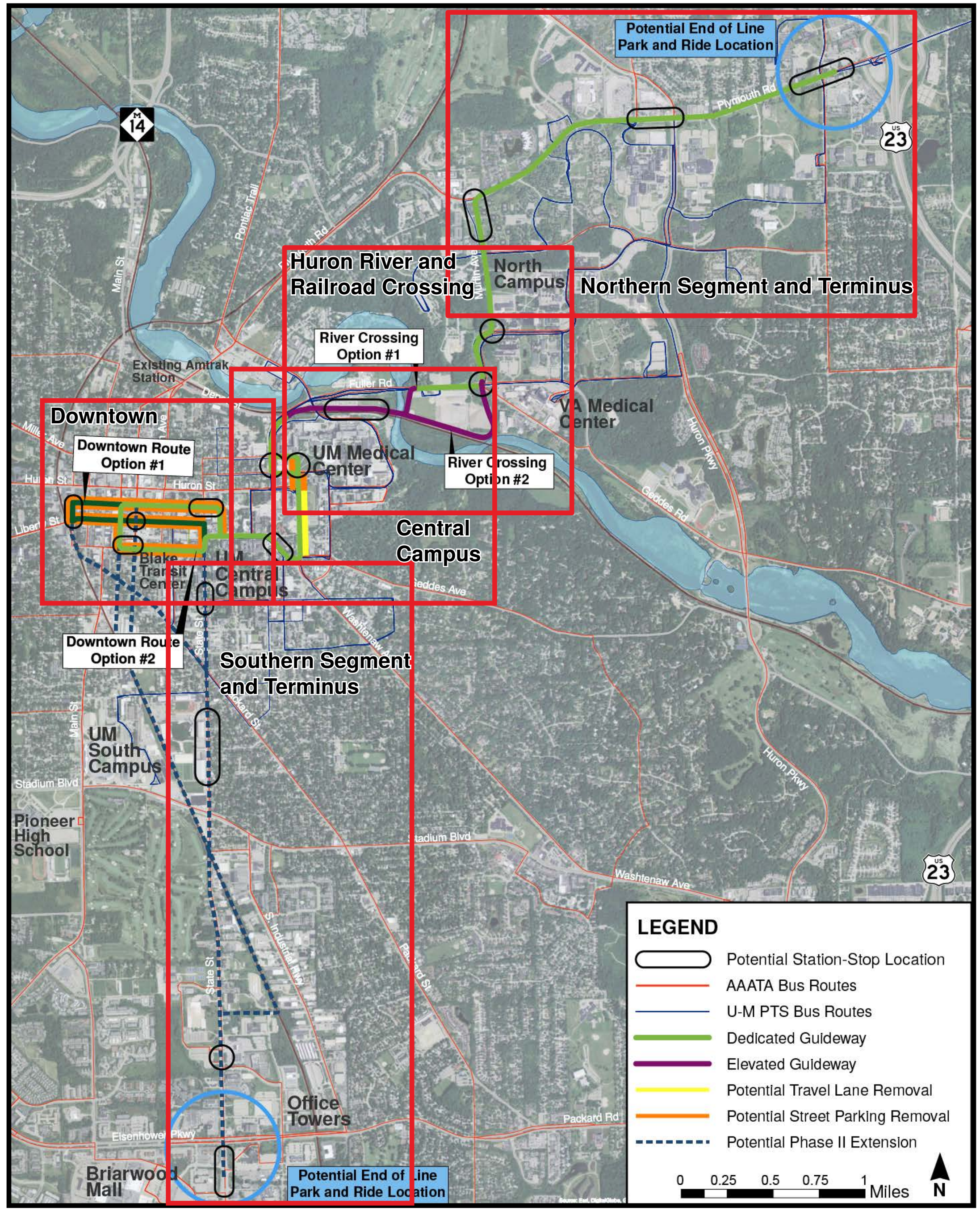
Preferred Alternative Characteristics

- Route Length: 4.78 miles
- Number of Station-stops: 9
- Capital Cost (2025$): $560 - $680 Million
- Incremental Annual Operating Costs (2025$): $3.4 Million
- Annualized Cost Per Passenger (2025$)*: $4.32 - $5.18
- Average Weekday Ridership (2040): 31,600

The range of cost estimates represents the potential short and long term needs of the system. While 12 single-car LRT vehicles may accommodate opening day demand, ridership growth in the long term may require two-car LRT trains (doubling the number of vehicles needed).

Potential right-of-way acquisition costs are included in this cost estimate. Cost estimates were updated to 2025$ at the end of the project process as 2025 was determined to be a more feasible construction start year.

**Sum of the annual operating cost and annualized capital*



Northern Terminus

Northern Terminus

- The project was defined to terminate at a park and ride in the vicinity of the US-23 / Plymouth Road interchange. A specific park and ride location needs to be defined, but a park and ride in along Plymouth Road between the interchange and Green Road is desirable to intercept trips as they exit US-23.
- The project should be designed in consideration of a possible future extension to the east across US-23 to serve either the University of Michigan East Campus or the Domino's Farm area or both.

Recommendation:

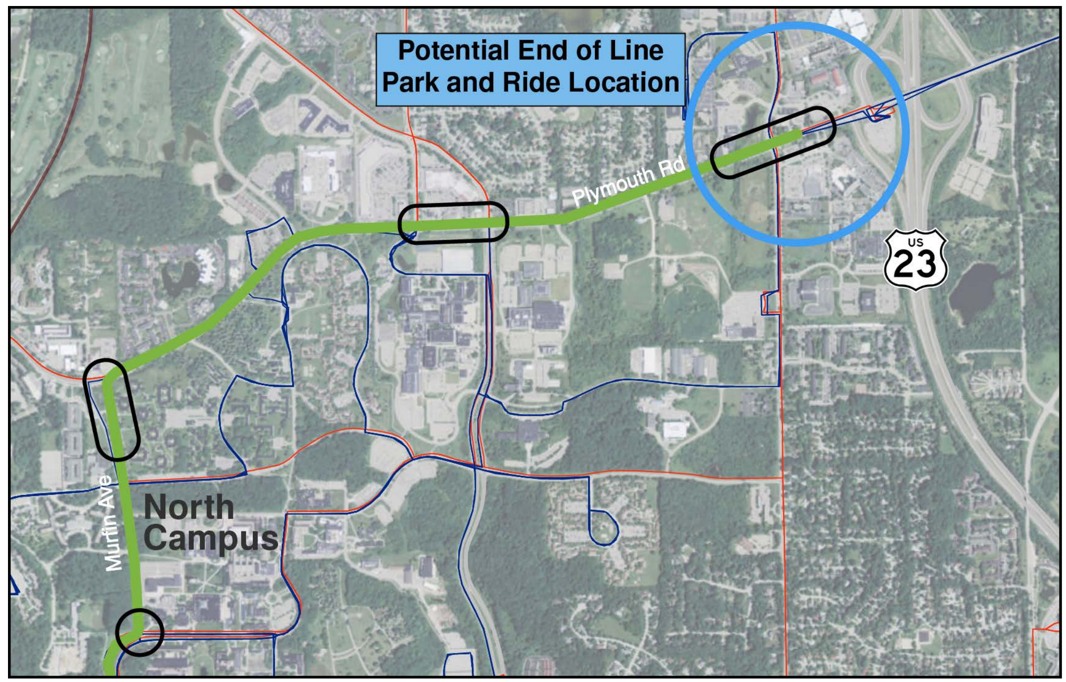
- Park and ride lot in the vicinity of the US-23 /Plymouth Road interchange

North Segment

- Along Plymouth Road, The Connector guideway could be located along the north side, south side or in the center of Plymouth Road. Through this area, it is assumed that there would be no loss of travel lanes on Plymouth Road. Additional right-of-way may be required to accommodate a dedicated LRT guideway or roadway widening. A station-stop would be located in the vicinity of Huron Parkway to serve the North Campus Research Complex.
- Consistent with the U-M North Campus Plan, The Connector would turn from Plymouth Road to Murfin and follow Murfin through the North Campus.
- There would be station-stops located near the intersection of Plymouth and Murfin and adjacent to Pierpont Commons.

Recommendation:

- The alignment through this area will follow Plymouth Road and Murfin. The location of the guideway relative to the roadways will need to be determined.



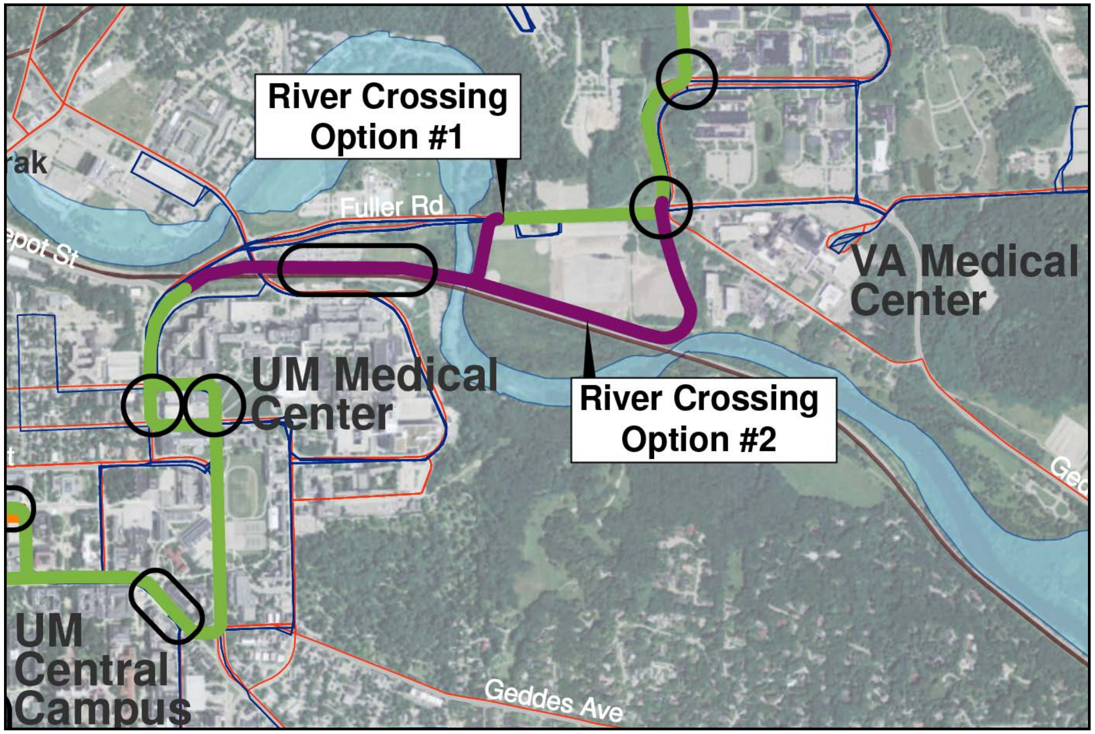
Huron River and Railroad Crossing

From the intersection of Murfin and Fuller proceeding to the south and west, two alignment options were defined to cross the Huron River and the railroad tracks:

- Option 1: At-grade crossing at the Fuller Road intersection, travel west along Fuller Road, and turning south to the railroad on elevated guideway on the west side of Mitchell Field. The guideway would be elevated over the river and the railroad and would then turn to the west on the south side of the railroad tracks.
- Option 2: Elevated crossing at the Fuller Road intersection, potential station-stop at the VA Medical Center, continue south on elevated guideway over the railroad and then west along the south side of the railroad to a new river crossing adjacent to and at approximately the same elevation as the existing railroad bridge.
- Both river / railroad crossing options would proceed along the south side of the railroad tracks between the railroad and East Medical Center Drive with a station-stop serving the Medical Center.

Recommendation:

- The Huron River crossing is the most significant natural feature along The Connector route. It is recommended that both river crossing options be carried forward to allow for detailed comparisons of wetland, floodplain, parkland and visual impacts.



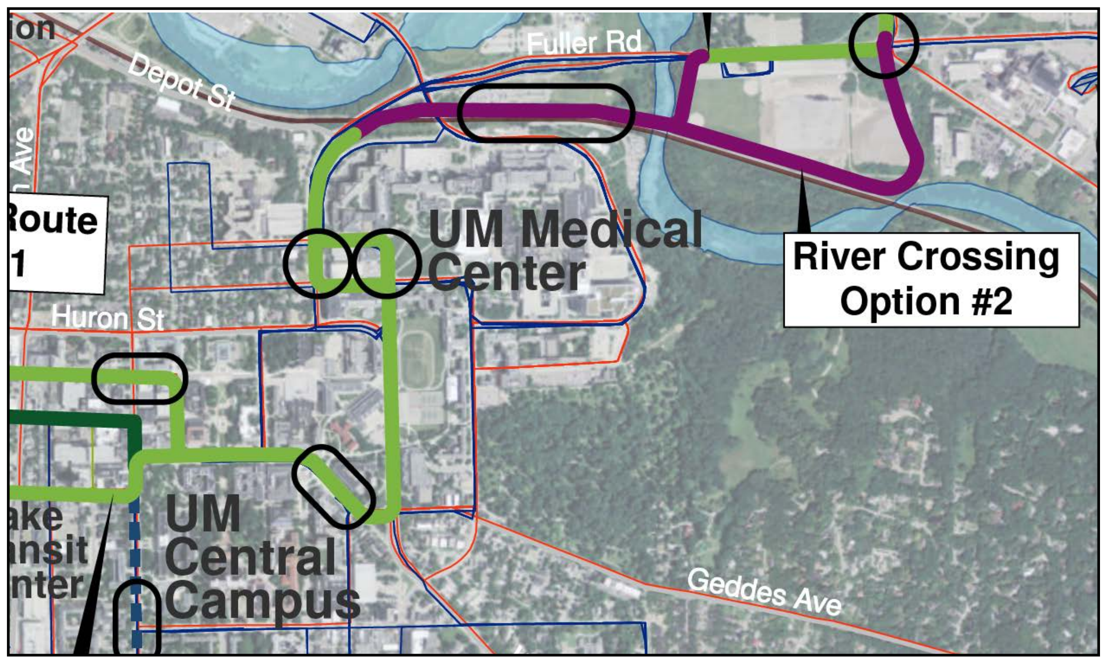
Central Campus

Two route options were considered:

- From the intersection of Catherine Street and Glen Avenue, one option would continue south to either Huron Street or Washington Street where it would turn to the west with a station-stop located in the northwest corner of the Central Campus.
- The second option would be a one-way pair between Ann Street and Catherine Street, justified by existing street grades and the potential for keeping two-way traffic on all streets. In the southbound direction from Glen Avenue, this option would turn east on Ann Street to Zina Pitcher Place and continue south on Zina Pitcher Place to Washtenaw Avenue. The route would then turn to the west on Geddes Avenue to North University Avenue and there would be a station-stop in the vicinity of the Central Campus Transit Center. In the northbound direction, this option would continue on Zina Pitcher Place and turn west on Catherine Street to Glen Avenue. There would be separate station-stops for the southbound and northbound directions on Glen Avenue and Zina Pitcher Place between Catherine Street and Ann Street.

Recommendation:

- The route that best serves the Central Campus travels east on Ann Street, south on Zina Pitcher Place / Washtenaw Avenue, and north on Geddes Avenue/ University Avenue to access the Central Campus Transit Center.

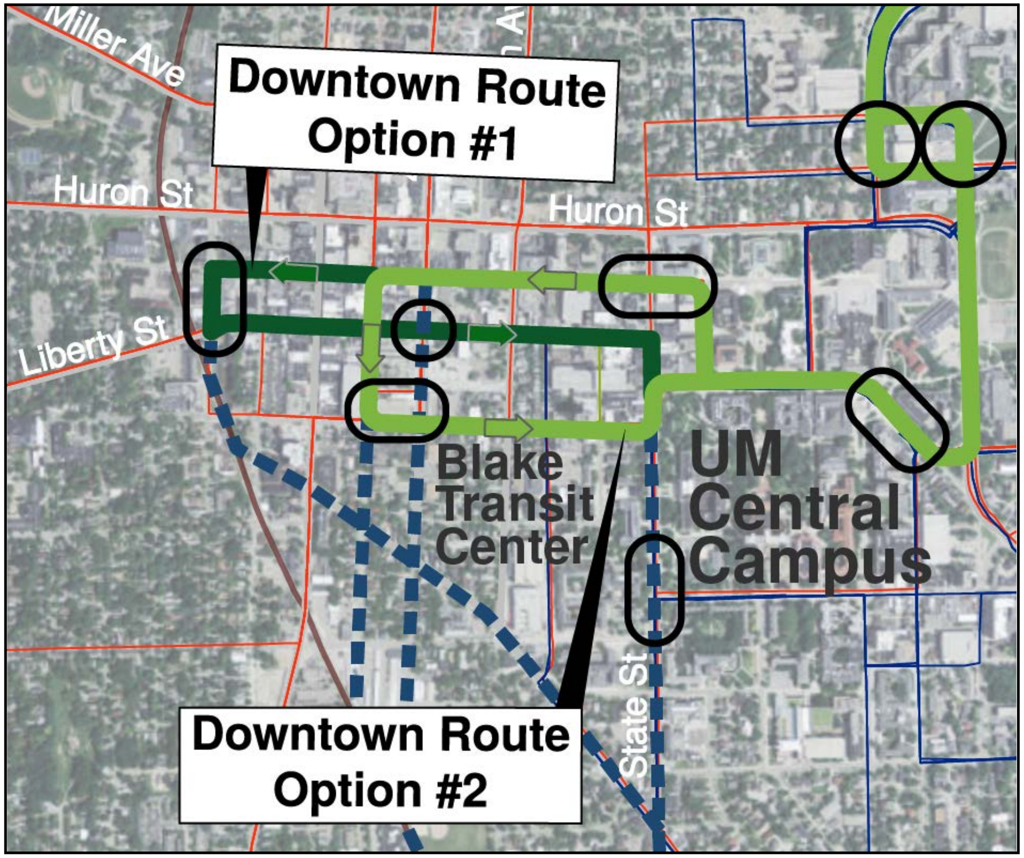


Downtown

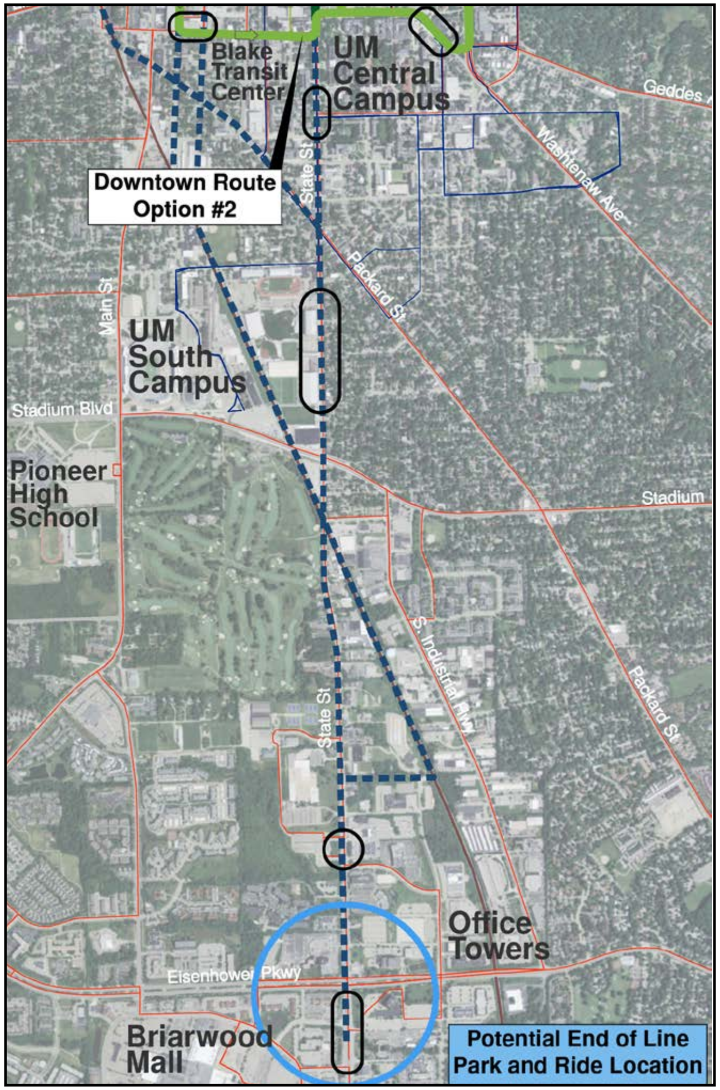
A number of route options were considered including north-south one-way pairs on 4th Avenue/5th Avenue and east-west one-way pairs on Huron Street/Washington Street and Washington Street/William Street.

Recommendation:

- Because of right of way restrictions, the route through the downtown area should be a one-way route to reduce the impact on any one street.
- The route that best serves both the downtown area and Blake Transit Center includes a one-way east-west loop through the downtown area using a combination of Washington Street, Liberty Street, or William Street and could extend west as far as 4th Avenue, Ashley Street, or 1st Street.



Southern Segment and Terminus



Southern Segment

The study considered a number of connections to the south following State Street, 4th/5th, Main Street, and the railroad corridor.

- Forecast Connector ridership south of the Downtown area is lower than north of the downtown area.
- Forecast Connector ridership is lower in the Main Street corridor than it is in the State Street corridor.
- The cost effectiveness (Annualized cost per passenger) of the southerly portion of The Connector is lower than the cost effectiveness of The Connector from Downtown to the north.

Recommendation:

- A route alignment following State Street south of the Stadium Boulevard Bridge is favored over a Main Street alignment primarily because of the City plans for redevelopment along South State Street and the potential for greater ridership.
- The Connector should be developed in two phases. The initial phase would extend from downtown north to the interchange of Plymouth Road and US 23. Phase 2 of the project would extend south from Downtown. During the first phase of the project, existing southbound U-M Commuter Route bus service will be maintained.

Southern Terminus

All considered alternatives ended along State Street in the vicinity of Briarwood Mall.

Recommendation:

- A park and ride should be located at the end of the line station-stop in the vicinity of State Street and Briarwood Mall.
- Land use planning for the South State Street area should consider the need for a Connector corridor through this area as well as a park and ride site.

Costs and Funding: Capital Costs

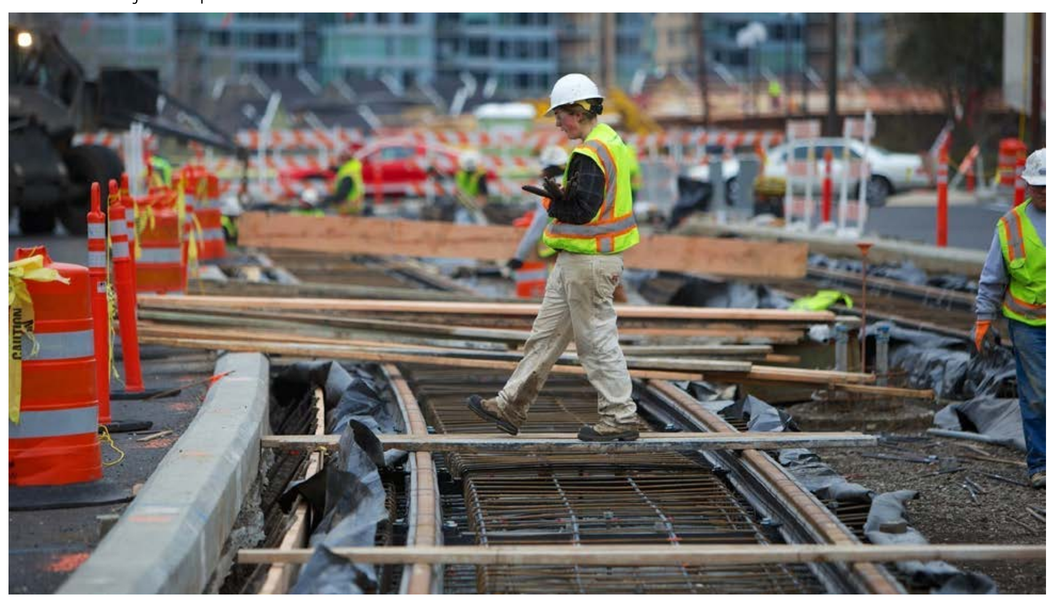
The Connector Capital Cost Estimate

Cost Categories	2025$ (Millions)
Guideway and Track	$78
Station - Stops	$70
Right-of-Way	$14
Support Facilities	$35
Sitework and Special Conditions	$58
Systems	$48
Construction Subtotal	$302
Vehicles	$76 - $152
Professional Services	$110 - $138
Subtotal	$487 - $592
Unallocated Contingency	$73 - $89
Total Project Cost	$560 - $680

The cost to design and build The Connector is estimated to be between $560 - $680 Million in 2025, including the cost of vehicles and a maintenance facility. The range of cost estimates represents the potential short and long term needs of the system. While 12 single-car LRT vehicles may accommodate opening day demand, ridership growth in the long term may require two-car LRT trains. This will double the number of vehicles needed for the system. Potential right-of-way costs are included in the cost estimate. As the project advances, a detailed capital funding plan will be developed. All major transit capital investments are funded from multiple sources including:

State of Michigan Sources

State funding could come from the Comprehensive Transportation Fund (CTF). The CTF is a combination of fuel tax, registration fees, and auto related sales tax dedicated to non-highway transportation. The first priority for the use of the CTF, after debt service and administration, is to match federal transit grants. CTF funds are not yet committed to this project. Funds will not be committed until the Federal funds are committed. However, since the fund began in 1974, the CTF has provided the full 20% non-federal share for all of AAATA's bus purchases, facilities, and other major capital items.



Construction of the Portland Orange Line LRT project in 2014

Costs and Funding: Capital Costs

Funding Sources for Other Michigan Transit Projects

Location	Grand Rapids, MI	Lansing, MI	Detroit, MI
Project	Silver Line	MI/Grand River	M-1 Rail
Year	2010	2013	2013 / 2014
Project Type	BRT	BRT	Streetcar
Length (Miles)	9.6	8.5	3.3
Capital Cost (Millions)	$40	$215	$136
Proposed Funding (Millions)			
New Start/ Small Start	$19	$75	$0
Other Federal	$13	$89	$47
State	$8	$51	-
Local	-	-	-
Private	-	-	$89

Federal Sources

- New Starts – This program is administered by the Federal Transit Administration (FTA) and can provide up to 80% of the capital cost of a transit project although federal funding generally does not exceed 50% of the project cost
- TIGER Grants – Transportation Investments Generating Economic Recovery (TIGER) is a federal program that has been used to help finance transit projects in a number of cities including Cincinnati, Dallas and Detroit.
- CMAQ (Congestion Mitigation Air Quality) Grants – Federal funds are granted to regions to address air quality related to traffic congestion. Funds can be used for projects that reduce air pollutant emissions from transportation sources including transit projects
- Other – A number of other federal grant programs have been used to finance similar projects.

Local Sources

- Value Capture – Incremental increases in property values can be designated to fund transit. This value capture could take the form of a tax increment finance (TIF) district, a Special Assessment or Benefit district
- Parking Revenues – Excess or incremental parking revenues can be designated to fund transit.
- Right-of-way – Value of land provided by municipal or institutional "partners" may count as part of a local match for other funding sources.
- RTA - The Regional Transit Authority may be able to provide some capital cost funds for the project.

Private Sources

As illustrated in the table, over 60% of the M-1 Rail Streetcar project was funded from private sources. These private commitments may be tied to naming rights or other sponsorship opportunities.

Costs and Funding: Operation Costs

Sources of Operating Funds*

Fare Revenues	20%
Local Funds	43%
State Funds	20%
Federal Assistance	14%
Other Funds	4%

**Source: Average of operating funds for 15 transit systems using the 2011 National Transit Database*

The Connector Operating Cost Estimate

	2025$ Operating Costs
Connector Operations	$10,846,000
Eliminated Bus Service	$9,462,000
Added Circulator Service	$1,980,000
Net Change in Operations	$3,364,000

Minneapolis LRT Maintenance Facility

The Connector will provide transit service to many destinations that are currently served by buses. Once The Connector is operating, existing bus routes providing duplicative service will be eliminated. In some cases portions of existing bus routes will be maintained to function as circulators to continue to provide a high level of geographic service coverage. During the first phase of the project, existing southbound U-M Commuter Route bus service will be maintained since there will be no duplicative service. The net additional cost to operate and maintain The Connector is estimated to be $3.4 Million in 2025. This represents an increase of approximately 8% compared to current U-M and AAATA operating costs. The net operating cost is calculated as The Connector operations less the cost of eliminated bus service plus the cost of new bus circulator service.

Funding for Operations

As shown in the table at left, sources of revenue to fund transit operations generally fall into 5 categories;

- Fare revenues comprise an average of 20% of all operating revenues
- Local sources provide the greatest share of operating funds – generally in excess of 40%.
- State funding for transit varies significantly from 0% to over 50% with an average of 20%.
- The Regional Transit Authority may have funds to provide to use toward operations and maintenance costs.
- Federal assistance in the form of formula grants provides an average of 14% of operating funds.
- Other sources can include advertising, parking and casino revenues

Local Funding Sources

In the State of Michigan local funding for transit operations is generally restricted to fare revenues and property tax revenues. In other states, transit funding is provided by payroll taxes, sales taxes and special assessments.

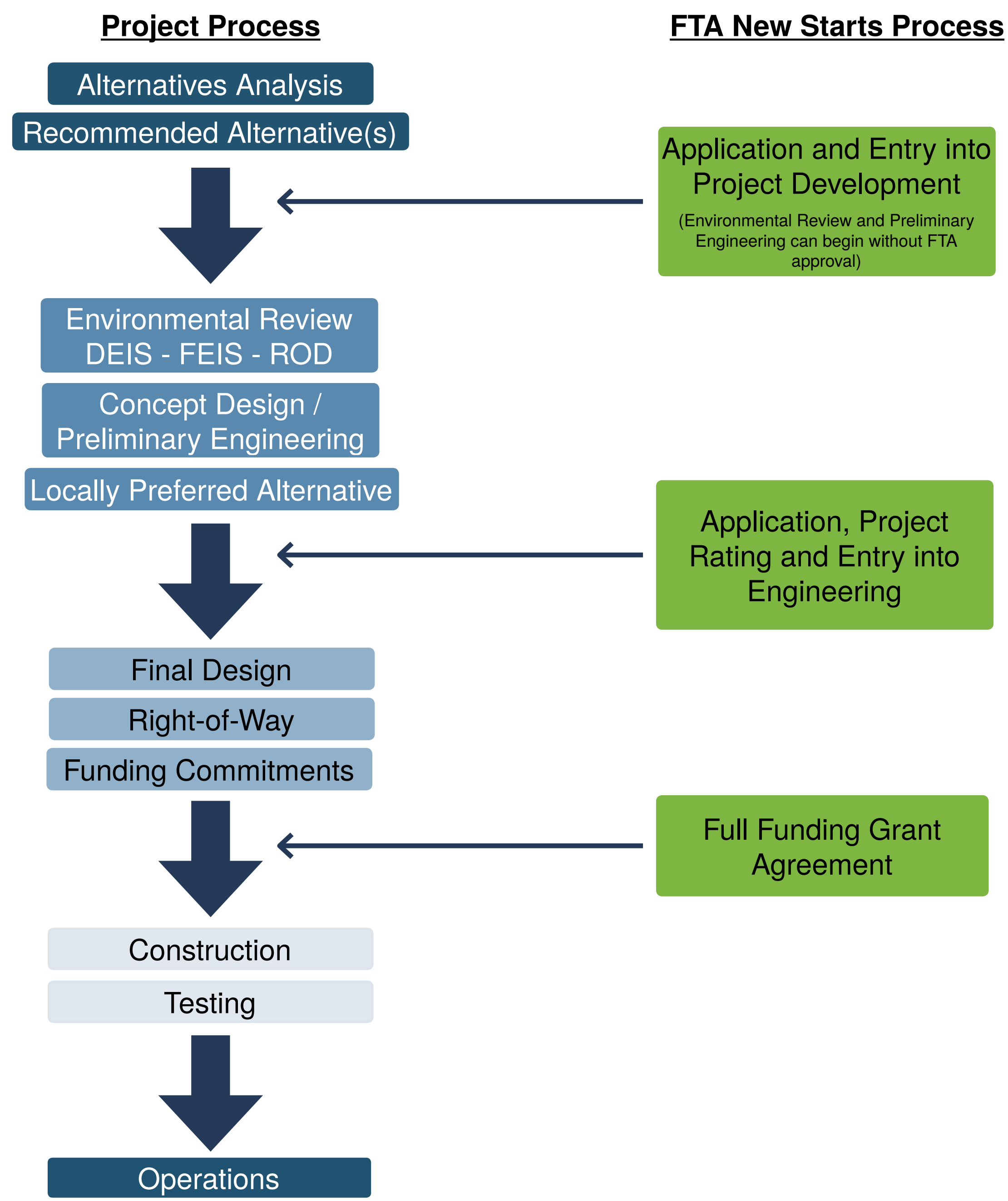
Connector Operations

A funding plan for operation of the Connector will be developed as the project moves forward. The Federal Transit Administration (FTA) requires an operating plan that demonstrates the financial ability of the operator to operate The Connector while continuing to operate and maintain the remainder of the transit system.

The Connector would introduce a new type of transit vehicle to the region. It would require a dedicated operations and maintenance facility along The Connector route. While the cost of a maintenance facility has been included in the project cost estimate, a site for the facility needs to be identified in the next phase of project development.

Next Steps

- The AA process will conclude with selection of a preferred alternative in 2016. The AA will likely result in a small number of alternatives that can be advanced to the next stage.
- If the project proceeds with Federal funding, the next step in the process will be a NEPA review. Given the potential project impacts (historic areas, traffic, river crossing, etc.) the project will likely require an Environmental Impact Statement (EIS). More detailed design to define probable right of way and adjacency impacts will be required. Additional design will be required to refine the selected alternative for the Final EIS and Record of Decision. The NEPA process is likely to take approximately 2 years.
- The Final Design will likely take approximately 12 to 18 months. Right of way procurement can commence during final design. During this time, the implementing agency will need to select a procurement process.
- Depending on the selected project, construction is likely to take about 2 years. A rail option will require time for vehicle procurement which should commence during final design. Vehicle commissioning and system testing generally takes about 6 months.
- This project development process would take approximately 6 years to complete and assumes no gaps or delays in project funding.



Appendices