

Fort Wayne/Citilink COA and TDP Preliminary Recommendations



Draft



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Future Service Change Alternatives

Overview

Previous chapters document work of detailing current service, evaluating current service relative to a range of benchmarks and peers, and characterizing gaps that exist between services provided and what is need and/or can be sustained. The purpose of this chapter is to introduce alternatives with potential to be part of a coordinated plan to address unmet needs, support growth in the region, and provide a transit system that is sustainable within Citilink's budget constraints. Transit alternatives reflect a re-allocation of resources to improve system performance, to reduce redundant service, and to support needs identified by through the following activities:

- Public Information Meetings and Stakeholder Discussions- The first round of public meetings (June 2018) included gathering information from participants about what is needed within the Citilink network to support travel demand associated with work, school, medical, and social trips. In addition, a series of working sessions were conducted with local planners, transit staff and transit board members in which a wide range of service concepts were discussed and reviewed as to how they can address needs and reflect the financial constraints present.
- Surveys – Current Citilink fixed routes and paratransit users were the focus of initial data gathering, including how they use the systems and their perceptions of the systems relative to travel needs, Additionally, an on-line community survey was conducted to gather input from riders and non-riders in the region.
- Interviews – Interviews were conducted with transit agency personnel, members of the Steering Committee, and community leaders to gather input on current service, unmet needs and opportunities in the future.
- Defining Transit Supportive Areas – Technical analyses conducted as part of the existing system assessment included reviewing development density throughout the region and reviewing network performance (route and segment level) relative to the density analysis. Part of the purpose of the development density analysis is to understand the transit operating environment and its impact on system performance.

As there is a finite budget for transit service, as there is for any other public service (police, fire, roads, schools), it is critical to allocate transit funds where the potential customers are located. Thus, providing the greatest potential for benefit. For Citilink services, characteristics incorporated into service area prioritization include:

- Where development density (residential and employment-based developments) will support transit.

- Where populations most in need of public transportation live.
- Where key generators (large employment centers, grocery stores, medical centers) that support transit service are located.
- Path that best connect generators and transit supportive areas and provide the pedestrian infrastructure to connect origins and destinations with transit buses.

Types of proposed service changes include:

- Increased span of service – increasing the span of service means that bus routes operate for more hours. Increasing the hours means that destinations are accessible to transit users for a longer portion of the day and that transit is a transportation option for more trips in the early morning, evening and late night.
- Increased frequency – increasing the frequency, or number of buses per hour, improves convenience and increases capacity along a route. Shortening the time between buses makes the route more attractive and useful by reducing wait times at bus stops. Long waits, especially at night or in inclement weather, can be a barrier to using transit.
- Adding Sunday service – Many current riders getting to/from retail jobs also have work hours on Sundays. Not having service on Sundays hinders travel not only people who desire or need transit to get to/from church, it negatively impacts the ability of transit dependent populations from getting to/from work or other social activities on Sundays.
- Route Extension/New Routes – extending a route or adding new routes are generally targeted to increasing the area served to include new residents and destinations. Route extensions also expand the overall area served by the transit network. This means that residents in other parts of the network can reach more places and people by transit.
- Relocation of routes – In portions of the existing service area multiple route share a similar path or are located in closely spaced parallel corridors. In other areas, routes travel through areas that do not generate ridership needed to defend the service investment. In these areas, current routes/paths were reviewed and where warranted, paths were modified to retain coverage to areas supporting service and relocated unproductive miles to areas likely to generate more use.

Adding to current service through any of the service improvements listed above would add revenue hours or miles of service. Thus, would require budgeting action to address the change. Action could be obtaining new revenue, which is difficult, or action could be make a reduction or reallocation in another area. Enhancements in the category requiring new funding increases are:

- Adding Sunday service.
- Increasing service frequency.

- Extending current routes or creating new routes
- Increasing service hours on weekdays or Saturday

Understanding increasing the operating and capital budget for transit is a difficult task and understanding there is a need to address current service gaps and area productivity issues, two approaches to service modification recommendations were provided:

- **Revenue Neutral:** This approach worked within the current revenue hour budget in allocating service within the community. If in the approach it was warranted to add service in one area, the hours required to support that change needed to be identified through making changes elsewhere that would reduce revenue hours.
- **Revenue Enhancement:** As the TDP is a future planning process, developing a program of where service should be added to best serve the community is central to the effort. With the plan, community-leaders and transit advocates can then understand the budget needs and work to identify means of funding the plan.

Revenue Neutral Alternative

Examination of the cost effectiveness of current service resulted in identification of several potential changes to the current service focused on improving performance without adding substantially to revenue miles and/or hours. This alternative was defined as the Cost Neutral Alternative, which included changes in the following categories:

- **Spacing Between Routes:** General guidelines for spacing within and outside the central business district are:
 - CBD: One-quarter mile
 - Outside CBD: one-half to one mile
- **Direct Routes/Remove Loops:** Routes taking the most direct path between desired areas of the community generally provide the greatest convenience for riders, which generally translates to greater use. The idea of direct, or straight, routes needs to account for turns/deviations from the primary corridor to provide closer access to specific generators, however, deviations need to be evaluated to establish their purpose. The result of creating more direct routes is generally a system that looks more intuitive as to which route to use in traveling from a specific origin to a specific destination.
- **Equity in Access:** Removing service in areas, even if segments of the route are lightly used, should be done sparingly. Thus, in developing the Cost Neutral Alternative the goal was to retain a similar walk access coverage if reasonable and increase the walk distance only in conditions where current productivity is well below average for the system. Most of these low productivity areas/segments are located at the outer reaches of routes where household and/or employment density is lower.

Changes to the current network associated with the proposed Cost Neutral Alternative are outlined in Table 26.

Table 26. Current Network to Cost Neutral Network Changes

Route Designation		Change	Comments
Current	Proposed		
1	1	Eliminate McArthur Drive-Hickory Creek Drive-Lower Huntington Drive Loop	
2	2 and 8	Time Corners: Eliminate Taylor Street segment – Stay on Jefferson Boulevard-Illinois Road between Freeman Street and Admore Avenue. Georgetown: Relocate Central Station access from Washington Boulevard-Wayne Street to Lewis Street.	
3	3	Relocate from Fairfield Avenue to Anthony Boulevard and remove Paulding Road-Wayne Trace-Tilman Road-Hessen Cassel loop.	Pettit Avenue and Paulding Road from Fairfield Avenue to Anthony Boulevard would use New Route 4 or New Route 5.
4	9 and 14	Parkview: Access to Central Station via State Boulevard and Clinton Street and eliminate State Boulevard-Coliseum-Vance Avenue loop. Lugwig: Relocate Central Station route from Wells Street to Sherman Boulevard-Saint Mary's Street. Extend to Cook Road and use Innovation Boulevard to return to Lugwig Road. Remove service to Huguenard Road.	
5	5	Convert from Local (not accessing Central Station) to include hourly access. Relocate from Calhoun Street to Hanna Street and Anthony Street. Replace Lafayette Street-Tillman Road-Calhoun Street-Fairfield Avenue loop with New Route 4 and New Route 2 service.	
6		Eliminate Route 6 and replace coverage with a combination of New Routes 3, 5.	Service area coverage (with exception of east of Anthony Boulevard


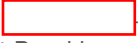
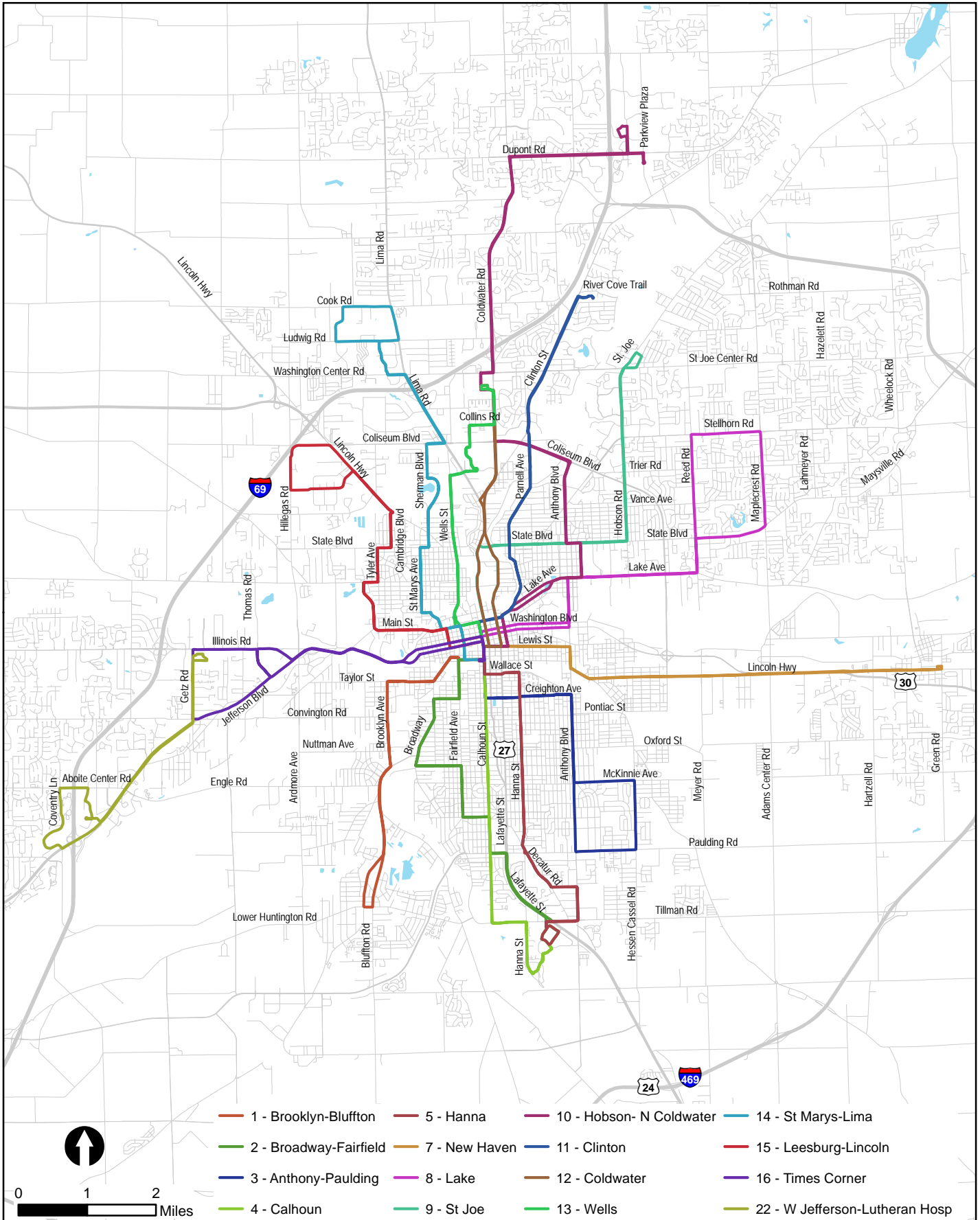
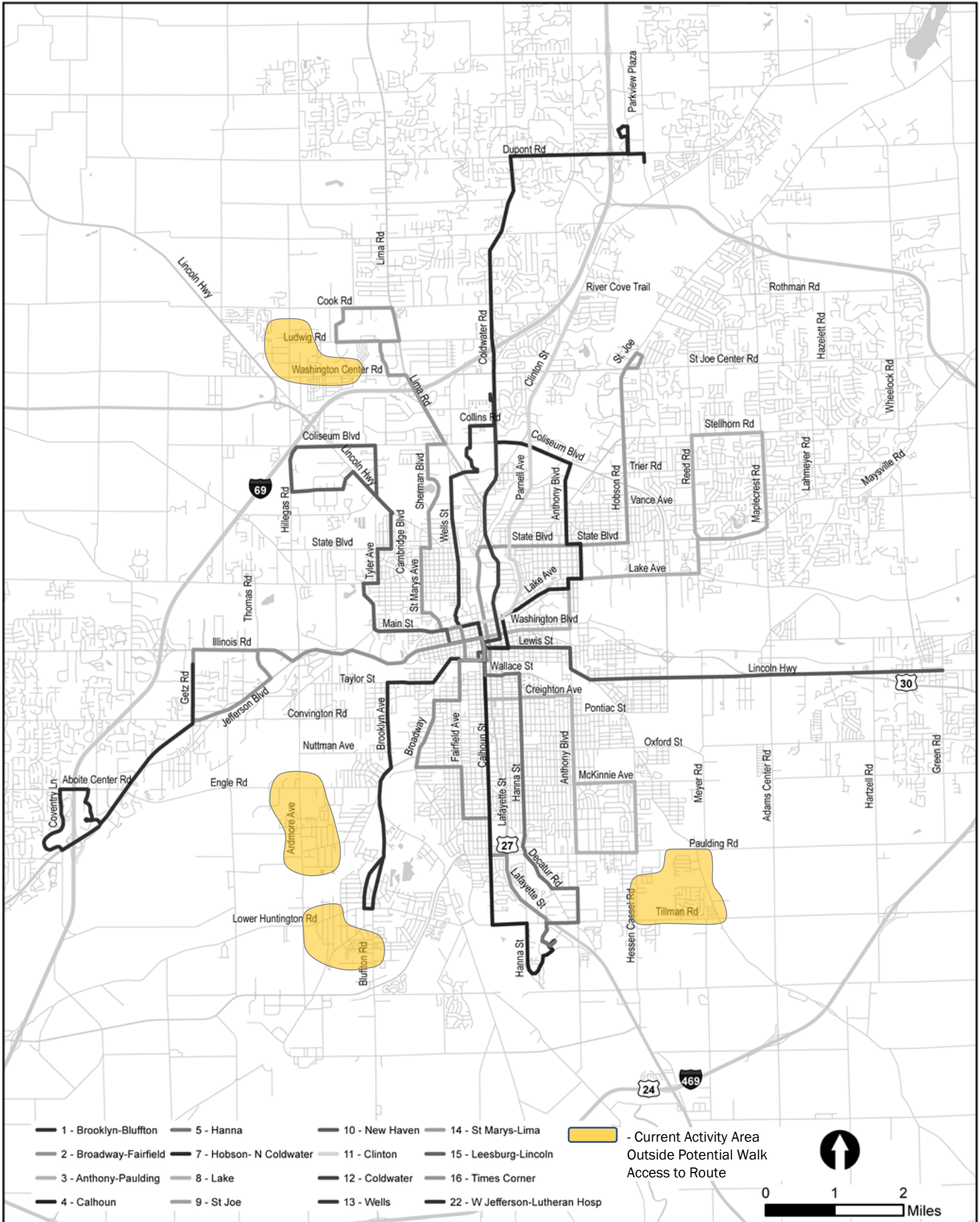
Route Designation		Change	Comments
Current	Proposed		
		Service to McKinnie Avenue-Hessen Cassel Road/Wayne Terrace-Oxford Street loop eliminated.	segments is similar with New Route 3 and New Route 5.
7		Eliminate Route 7 current alignment and replace with combination of New Route 3 and New Route 5.	Service area coverage is similar with New Route 3 and New Route 5.
8	13	Glenbrook/Northrup: Relocate from Spy Run Avenue-Clinton Street to Wells Street. Calhoun/Tillman Road: Replace with New Route 4. Decatur Avenue segment replaced with New Route 5.	Service of Proposed 13 is similar to current Route 8. Serves Turnstone 
9	15	Brooklyn/Taylor: Route removed and replaced with New Route 1.  Ardmore Avenue-Sandpoint Road loop eliminated. St. Francis/Gateway: Little change.	Relocated New Route 1 from Broadway Avenue to Brooklyn Avenue provides access to most active Route 9 stop locations.
10	10	No change.	
15	12	Relocate from Clinton Street to Coldwater Road. Connect with Central Station from both Parkview Hospital (via New Route 8) and Parkview Regional Medical Center (via New Route #). No direct connection between Parkview Hospital and Parkview Regional Medical Center.	Removed direct trip between Parkview medical facilities. Expectation is accessibility of both medical facilities improves with connection to Central Station.
21	12	Replace with New Route 12 providing connections to Central Station and Parkview Regional Medical Center.	Current service area benefits by a direct connection to Central Station and all other routes as well as a one-seat trip to Parkview Regional Medical Center.
22	22	No change.	

Figure 27 displays the proposed Revenue Neutral/Short term route concept. It is important in reviewing the concept to understand where significant changes to current service are located. Figure 28 documents areas that currently have walk access to service that would not if the Revenue Neutral Alternative is implemented. Most of these areas, while presently having reasonable walk access to service, represent low productivity segments of the system.



Proposed Routes (11/26/2018) - Fort Wayne, IN



The low return on the public investment is, in part, reason for eliminating service in these areas and re-allocating service hours/miles to areas with greater utilization potential.

Using boarding and alighting information from counts collected in March 2018 an analysis of the ridership from areas where service would be removed was completed. The results by route for the proposed Revenue Neutral Alternative are documented in Table 27. From this analysis the following were concluded:

- Across the system: Approximately 157 weekday and 68 Saturday boardings per day would no longer be within acceptable walk distance (3/8 mile) of a daily route, which represents approximately 2.7 percent of daily ridership.
- Areas of most significant impact are:
 - Hickory Creek Drive-Lower Huntington Road (Hickory Creek Apartments area): Approximately 41 weekday and 9 Saturday boarding on the current system would be outside the walk distance.
 - Washington Center-Hugenard Road: Approximately 51 weekday and 14 Saturday boardings from location on the current network would be outside the 3/8 mile walk distance.
 - Paulding Road-Wayne Terrace-Tillman Road: Approximately 22 weekday and 17 Saturday boardings on the current route would be outside the walk buffer for the proposed network.
 - Engle Road-Admore Avenue: Approximately 43 weekday and 28 Saturday boarding on the current system would be outside the walk distance for the proposed Revenue Neutral Alternative.
- Relative to the entire affected route, areas outside the walk access area sum to from 4.1 percent to 11.6 percent of the route total daily (weekday or Saturday) boardings.

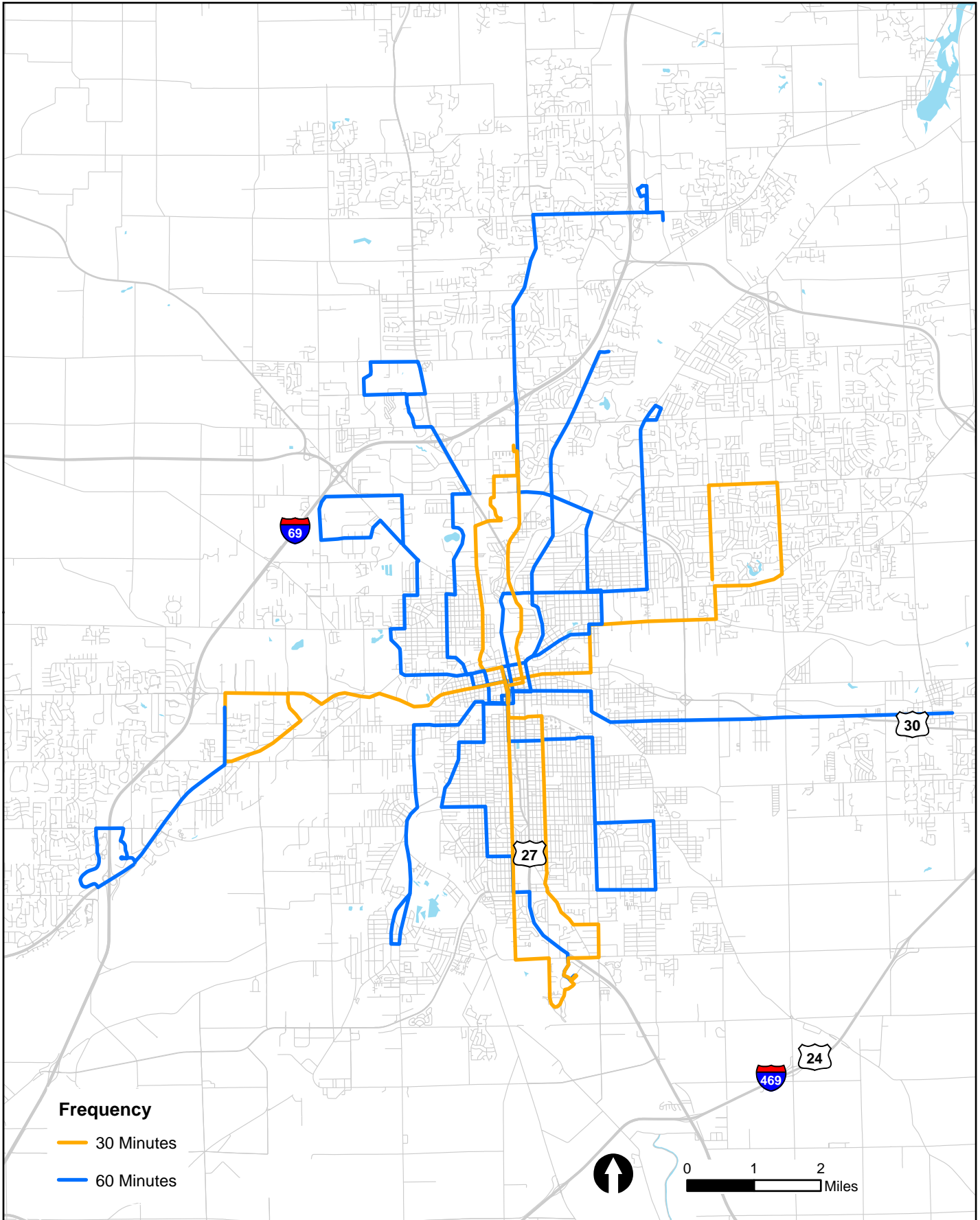
Table 27. Current Daily Ridership of Reduced Walk Access Areas

Current Route Number Area	Impact Area	Number of Daily Trips	
		Weekdays	Saturday
1	Hickory Creek Drive-Lower Huntington Road	43	28
3	Paulding Road-Wayne Terrace-Hessen Cassel Road	22	17
4	Washington Center-Hugenard Road	51	14
9	Engle Road-Admore Avenue	41	9

Figure 29 displays proposed route frequency associated with the proposed Revenue Neutral concept. Thirty-minute frequency through the central spine of Fort Wayne is retained in the alternative along Clinton Street-Spy Run Avenue-Lafayette Street. Through reducing redundant service and reallocating resources from limited productivity areas, an east-west 30-minute service corridor is also established.

Implementation of the route changes associated with the Revenue Neutral Alternative results in an overall savings of approximately 25 daily revenue hours of service. Listed below are a range of options for use of the increment saved:

- Retain the hours as a reserve to address anticipated future cost increases that exceed the anticipated increase in transit funding. Over the last five to six years transit operating funding has stagnated while the cost of each revenue hour and/or revenue mile of service has increased. The budget has been balanced through making smaller incremental adjustments to service and through shifting FTA capital grant funding to operating, however, this practice is not sustainable into the future. By placing the small increment of hours or miles into an operating reserve, Citilink will have bank to draw from as hourly and per mile costs likely continue to escalate on in the future.
- Develop a new route. The increment of revenue hours and miles saved through implementation of the Revenue Neutral Alternative is adequate to allow Citilink to create a 60-minute frequency new route. As part of the analysis, a concept of an Anthony Crosstown was prepared. Figure 30 displays the conceptual Anthony Crosstown route, which would operate from Southtown Centre to Coliseum Boulevard/Coldwater Road primarily along a spine of Anthony Boulevard. The route is characterized as a crosstown as it does not travel through Central Station. A complementary element of this route is proposing a new North Transit Hub along Coldwater Road between Coliseum Boulevard and Washington Center Road.
 - Convert one 60-minute route to 30-minute service. The anticipated cost reduction of the Revenue Neutral Alternative yields the revenue hours and vehicle required to allow one additional route to operate on a 30-minute frequency.
 - Expand daily service hours: The increment of revenue hours saved through the Revenue Neutral concept would support adding three hours of service Monday through Friday to up to six routes. It is recommended that if this option is selected, routes serving retail areas be targeted for the added hours.



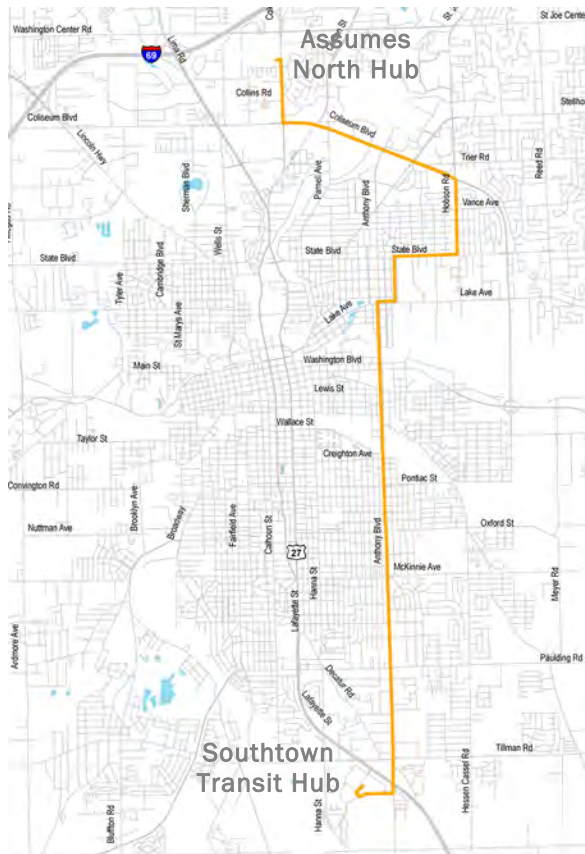
Frequency

— 30 Minutes

— 60 Minutes

Proposed Fixed Route Frequency - Fort Wayne, IN

Figure 30. Conceptual Anthony Crosstown Route



System Improvements with Revenue Enhancement

As the transit development plan is intended to be as much a future planning document as it is a review of current service relative to needs, the recent pattern of revenue stagnation should be a cautionary marker not a given for the future. As such, ideas for service improvements associated with a range of increased budget assumptions were developed. Alternatives were developed using a range of increments of transit revenue for operating and capital expenditures. The range of service assumptions associated with revenue enhancement are:

- **Five percent increase:** This increment reflects a modest increase in the real dollar operating budget and is approximately the minimum amount that would allow Citilink to implement a measurable change in service. Adding an amount to the budget lower than five percent would allow some incremental change in service, however, not enough to be noticeable to the typical everyday user.
- **10 percent increase:** This increment represents an amount needed to add a route to weekday/Saturday service, allow converting a route to 30-minute frequency, or to add Sunday service, which would be moderate improvements to the system.

- 15 percent increase: An incremental change of 15 percent from current service is assumed to be a stretch goal for service enhancement. It adds enough revenue hours/miles to the budget to allow multiple types of improvements to be implemented, while the five and 10 percent increase in the budget supports a single enhancement.

Table 28 displays general service improvements that could be implemented with revenue increases ranging from five percent to 15 percent. Improvements support a range of enhancement opportunities from:

- Providing service to/from currently unserved areas: The five percent increase option would support one additional weekday plus Saturday route operating at a 60-minute frequency, consistent with most current routes. Assessing potential areas for service expansion needs to include information obtained through the on-board surveys, public engagement, as well as the analysis of transit supportive areas as displayed in Figure 11 in the Existing Conditions chapter. The results of the analysis are that expanding service substantially outside the current service area would not likely generate ridership to support the investment. While there are nodes of higher activity outside the current service area, most route segments connecting to these areas travel through low density areas that would not generate much use.
- Strengthening the system core: The level of benefit (utility) derived from transit service is directly related to service convenience, which is measured by:
 - How often one can travel from one point to another (service frequency).
 - How long it takes to get from a traveler’s origin to their destination once on a bus.
 - The days of the week and the span of the day that travel can be made using transit.

Focusing added resources on the core of the system where service exists today and where the greatest development density is found generally provides the best opportunity for a good return on the investment. Adding vehicles to routes serving the core (those routes traveling through Central Station) of the system to increase the frequency from 60-minute service to 30-minute service supports the strengthen the system core concept. Included in the possible focus routes are Routes 1, 2, 3, 7, 9, 11, 13, 14, 15, 16). With an understanding of current route use and locations where density provides the greatest opportunity for transit use, priority routes for adding frequency are:

- Route 9 – St. Joe
- Route 14 – St Mary’s - Lima

Figure 31 displays a possible 30-minute and 60-minute frequency service concept if revenue could be increased. A summary of characteristics, including frequency, are documented in Table 29.

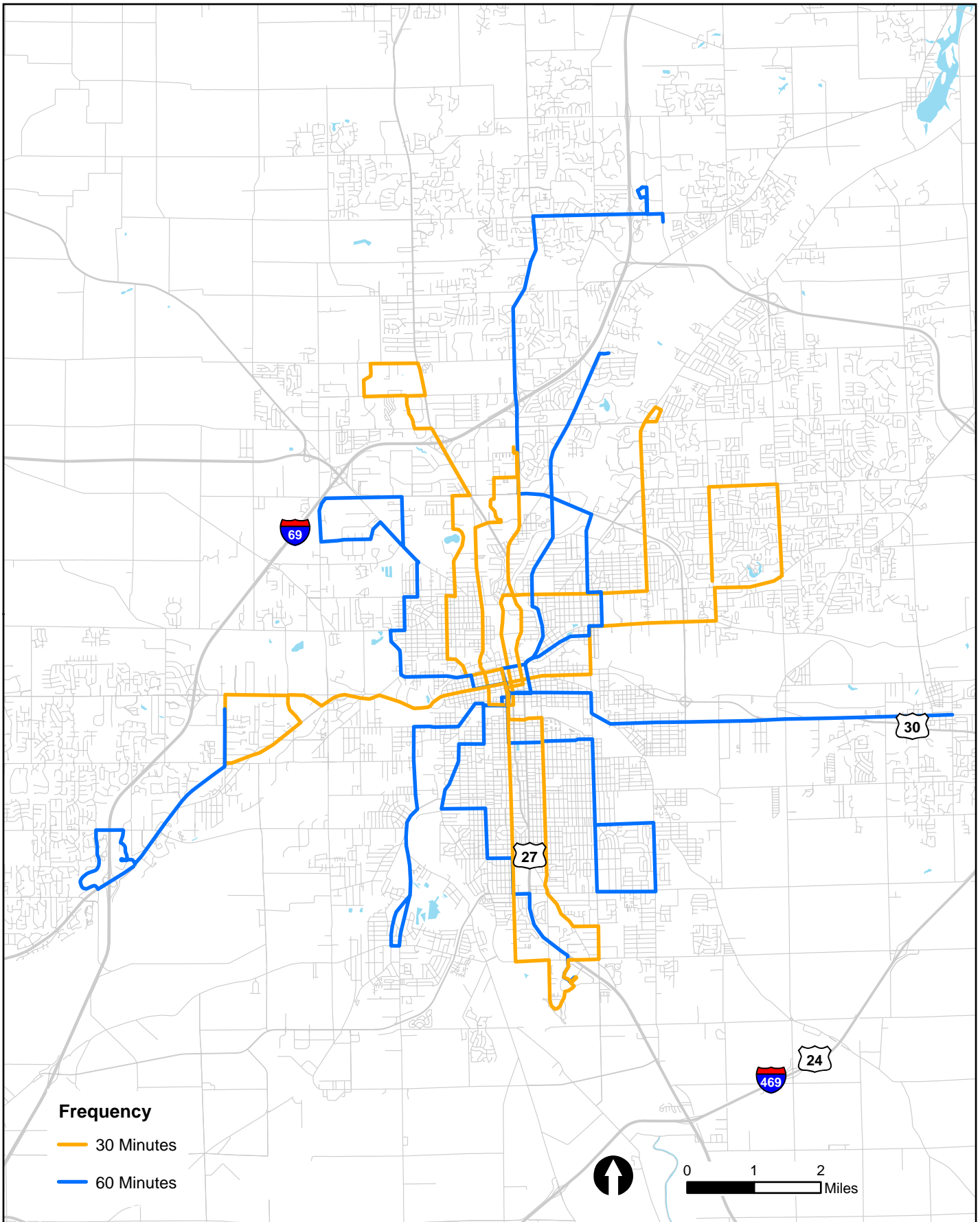
Table 28. Service Enhancement Opportunities by Increment of Revenue Hours

Service Change	Options			
	Add Local Route ¹	Add Hours to Weekday	Upgrade Route Frequency ²	Other
Add 5% to Operating Budget (+\$500,000 – 5,000 Revenue Hours)	Add 1 Route	6 Routes – 3 Added Hours Each	To 1 Route	
Add 10% to Operating Budget (+\$1,000,000 – 10,000 Revenue Hours)	Add 2 Routes	12 Routes – 3 Added Hours Each	To 2 Routes	Add Sunday Service
Add 15% to Operating Budget (+\$1,500,000 – 15,000 Revenue Hours)	Add 3 Route	All Routes – 3 Added Hours Each	To 3 Routes	Add Sunday Service and ONE of Other Options

Notes:

1 - New route assumes 60 minute headway and service 6 days a week

2 - Upgrade frequency assumes route operates every 30 minutes on weekday for 14 hour span



Proposed Fixed Route Frequency (Additional Funding Scenario) - Fort Wayne, IN

Table 29. Frequency and Span Improvements under Additional Funding Scenario

Route Number	Route Name	Frequency Improvement Option				Span Improvement Option				
		Weekday		Saturday		Weekday			Saturday	
		Headway	Span	Headway	Span	Daytime	Night	Span	Headway	Span
1	Brooklyn-Bluffton	60 min	14 hrs	60 min	11 hrs	60 min	-	14 hrs	60 min	11 hrs
2	Broadway-Fairfield	60 min	14 hrs	60 min	11 hrs	60 min	60 min	17 hrs	60 min	11 hrs
3	Fairfield-Rudisill	60 min	14 hrs	60 min	11 hrs	60 min	60 min	17 hrs	60 min	11 hrs
4	Calhoun	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
5	Hannah	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
6	Anthony Crosstown	60 min	14 hrs	60 min	11 hrs	60 min	-	14 hrs	60 min	11 hrs
7	Hobson-North Coldwater	60 min	14 hrs	60 min	11 hrs	60 min	-	14 hrs	60 min	11 hrs
8	Lake	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
9	St Joe	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
10	New Haven	60 min	14 hrs	60 min	11 hrs	60 min	-	14 hrs	60 min	11 hrs
11	Clinton	60 min	14 hrs	60 min	11 hrs	60 min	60 min	17 hrs	60 min	11 hrs
12	Coldwater	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
13	Wells	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
14	St Marys-Lima	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
15	Leesburg-Lincoln	60 min	14 hrs	60 min	11 hrs	60 min	60 min	17 hrs	60 min	11 hrs
16	W Jefferson	30 min	14 hrs	60 min	11 hrs	30 min	60 min	17 hrs	60 min	11 hrs
22	West Jefferson/Luthern Hosp.	60 min	14 hrs			60 min	-	14 hrs		
97	Cougar Express	30 min	10 hrs			30 min	-	10 hrs		

Shaded - Represents routes recommended to be converted to 30-minute service.

- Adding Hours of Service: Currently, the service day begins at approximately 5:30 AM and ends at approximately 9:00 PM on weekdays and approximately 7:30 AM to 6:00 PM on Saturdays. By adding hours at the end of the current service day the system will provide more benefit to persons ending their work day (or school day or just want to make a trip) after 8:00 PM on weekdays and/or after 6:00 PM on Saturdays.
- Adding Sunday Service: Throughout the public engagement process users have stated adding Sunday service would improve their lives by supporting trips to work, church, shopping or any other trip purpose. Generally, transit agencies experience Sunday ridership that is lower than weekday and/or Saturday service. The concept evaluated for Fort Wayne was adding Sunday service consistent with the Saturday level of service (7:30 AM to 6:00 PM), except Route 22-West Jefferson/Lutheran Hospital.

The range of service enhancements were presented at public meetings in November 2018 and people attending the meetings were invited to vote their preference as to which of the alternatives were most important to them. The preference voting exercise provided people the opportunity to rank each of the general expansion proposals from first (most important) to fourth. Please note, placing an alternative fourth on the list does not mean there is not a need for the concept. Figure 32 displays the results of the preference voting completed at each of the public meetings and a range of public and Citilink staff events following the transit plan public meetings.

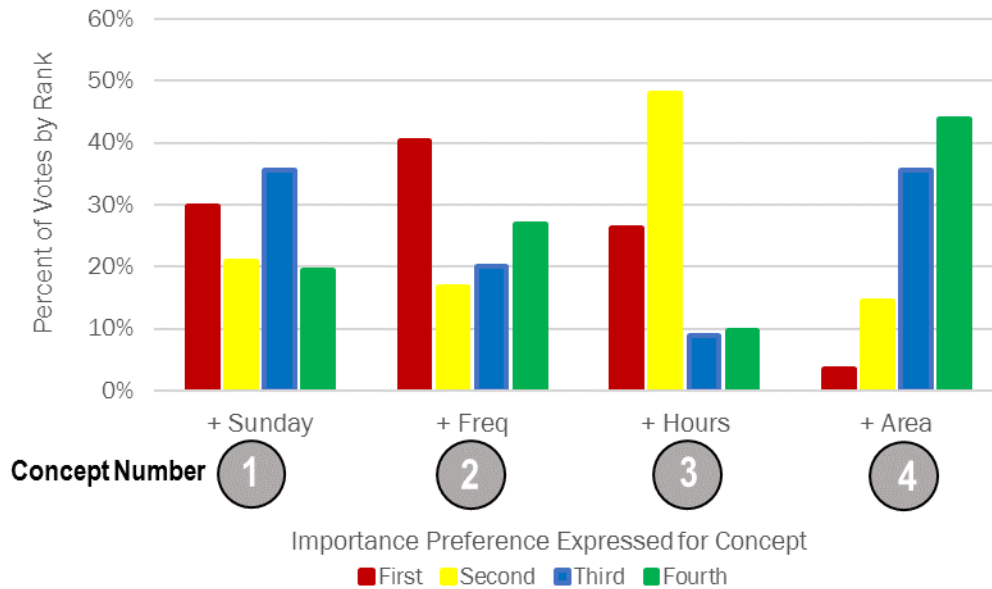
Results of the preference voting were:

- Adding frequency to the core routes (providing 30-minute service to two more routes) was most frequently identified as the highest priority.
- Adding service on Sundays was the second most identified top priority.
- Combining the highest and second highest priorities results in adding hours being the most supported of the alternatives.
- Adding new service areas received the fewest Highest Priority and Second Priority votes.

Potential Impacts of Continued Funding Stagnation

Operating funding for fixed route and paratransit service has stagnated over the last four plus years as the cost per revenue hour for service has continued to increase. If the recent trend continues, it is possible a time will come when making small changes to routes to reduce revenue hours no longer can be used to balance, in the short term, revenue with expenditures. Thus, Citilink through the transit plan has considered, along with potential growth opportunities, a range of actions that could be needed to address reductions in funding.

Figure 32. Results of November 2018 Public Meeting and Community Meetings Expansion Alternatives Preference Voting



Consistent with the process of looking at actions supported by incremental increases in operating funding, through the TDP process a general list of potential service cuts was prepared representing a five, ten, or 15 percent reduction in funding. These scenarios do not require absolute reductions from current funding, but also represent potential conditions if funding increases continue to lag inflationary cost increases to labor, fuel, maintenance, etc.

Table 30 documents potential actions, consistent with the possible funding increase process outlined in Table 28, that could result if more significant service reduction alternatives are needed to address decreases in operating funding. Outlined in the table are more generalized actions reflective of service reductions needed to balance service to budgets between five and 15 percent lower than the current. These conditions are not being identified as likely, however, it is prudent to have an understanding of the significance of not being proactive in advocating for sustained funding for transit at all levels, and seeking out local funding partners and new funding sources.

Table 30. Potential Service Reductions Associated with Funding Cuts

Service Change	Options			
	Route Cuts ¹	Reduce Service Span/Hours	Reduce Route Frequency ²	Other
Reduce Operating Budget by 5% (-\$500,000 / - 5,000 Revenue Hours)	Cut 1 Route	Reduce all Routes by One Hour Weekdays	-2 Route	
Reduce Operating Budget by 10% (-\$1,000,000 / -10,000 Revenue Hours)	Cut 2 Routes	Reduce all Routes by Two Hours Weekdays	- 4 Routes	Cut Saturday Service
Reduce Operating Budget by 15% (-\$1,500,000 / -15,000 Revenue Hours)	Cut 3 Route	Reduce all Routes by Three Hours Weekdays	-6 Routes	Cut Saturday Service and ONE of Other Options

Notes:

1 - Cut route assumes on 60 minute route weekdays and Saturday

2 - Reduce frequency assumes route operates every 60 minutes (from 30) on weekdays for 14 hour span

Service Improvement Implementation

To be Completed Following FINAL Public Meetings/Board Action

Transit Service Technology Enhancements

In the past few years, Citilink has been working with the new-age technologies to make transit riding experience more pleasant and satisfying. An updated Citilink website and technologies like Route Shout and Route Watch make it easier for riders to find out schedule information and real-time bus location to avoid the fear of missing the bus or being at the stop too early. Moreover, Token Transit Mobile Application adds another method of fare payment making it easier for riders to pay for their own or someone else's transit ride.

With the adoption more technology, Citilink is likely to attract more of the younger population. As smart phone and devices get more and more prevalent among all age groups, fare payment using smart devices and real-time bus location applications makes riding Citilink easier for existing riders and is likely to attract potential riders.

In terms of existing fleet, Citilink currently uses some Hybrid buses in addition to conventional fuel buses. In future, as Citilink expands or replaces their fleet, electric and other fuel-efficient vehicles can be considered.

With recent research on Autonomous Vehicles (AV) and advances in technology, the following sub-section intends to explain the current state of the AV technology and how it is likely to affect the public transportation industry in the future. The information provided better informs the transit agency about the possible changes that can occur in infrastructure and transit planning to adopt the new technology.

Autonomous Vehicles in Public Transit⁶

Technology Overview

“Autonomous vehicles are vehicles that are capable of intelligent motion and action without requiring either a guide to follow or teleporter control.”⁷ Although AVs can be used for undersea, space, air, water and land transportation, this section⁷ is focused on land-based autonomous vehicles specifically used for public transportation purposes.

In recent times, autonomous vehicles (AVs) are considered one of the major technological advancement in the transportation sector. Advanced safety features in automobiles

⁶ Majority of the content of this section is created using various online sources and the detailed literature review included in the Autonomous Vehicle Policy Guide for Public Transportation in Florida MPO's, Fall 2017 Studio Team, Florida State University. Available through APA, Florida Chapter.

⁷ Lozano-Perez, T. (2012). *Autonomous robot vehicles*. Springer Science & Business Media.

significantly evolved between 2000 and 2010. These safety features include electronic stability control, blind spot detection, forward collision warning and lane departure warning. Since 2010, auto manufacturers have added several advanced driver assistance features to automobiles like rearview video systems, automatic emergency braking, rear cross traffic alert and lane centering assist.

Driverless vehicle technology awareness and public interest has increased since 2016 but there are some shifts in consumer sentiments based on crashes involving autonomous vehicles⁸. However, the partial automation safety features like lane keeping assist, adaptive cruise control, traffic jam assist and self-park have been popular among the consumers with the consideration that such features help create better drivers. By a combination of software and hardware (sensors, cameras and radar) support, auto manufacturers are able to help drivers identify safety risks and provide warnings to avoid potential crashes. Hence, these smart technologies are helping to save lives and prevent injuries⁹.

There are six levels of autonomous driving¹⁰ as defined by the Society of Automotive Engineers (as shown in Figure 33)

Benefits¹¹

Potential benefits associated with AV technology include:

- Safety: Since 94 percent of all crashes are due to human error, the safety benefits of AVs are paramount.
- Economic and societal benefits: Eliminating human error crashes will get rid of the lost workplace productivity, loss of life and decreased quality of life due to injury.
- Efficiency and Convenience: Smooth traffic flow and reduced traffic congestion
- Mobility: for people who cannot drive due to disability or age-related factors, AVs can significantly improve their mobility allowing people to age-in-place and improving livability of communities.

⁸https://www.researchgate.net/publication/299745930_Societal_and_Individual_Acceptance_of_Autonomous_Driving & <https://electronics360.globalspec.com/article/12572/consumer-acceptance-of-self-driving-cars-declining-report>

⁹ <https://www.ucsusa.org/clean-vehicles/how-self-driving-cars-work#.XCos6TBKipo>

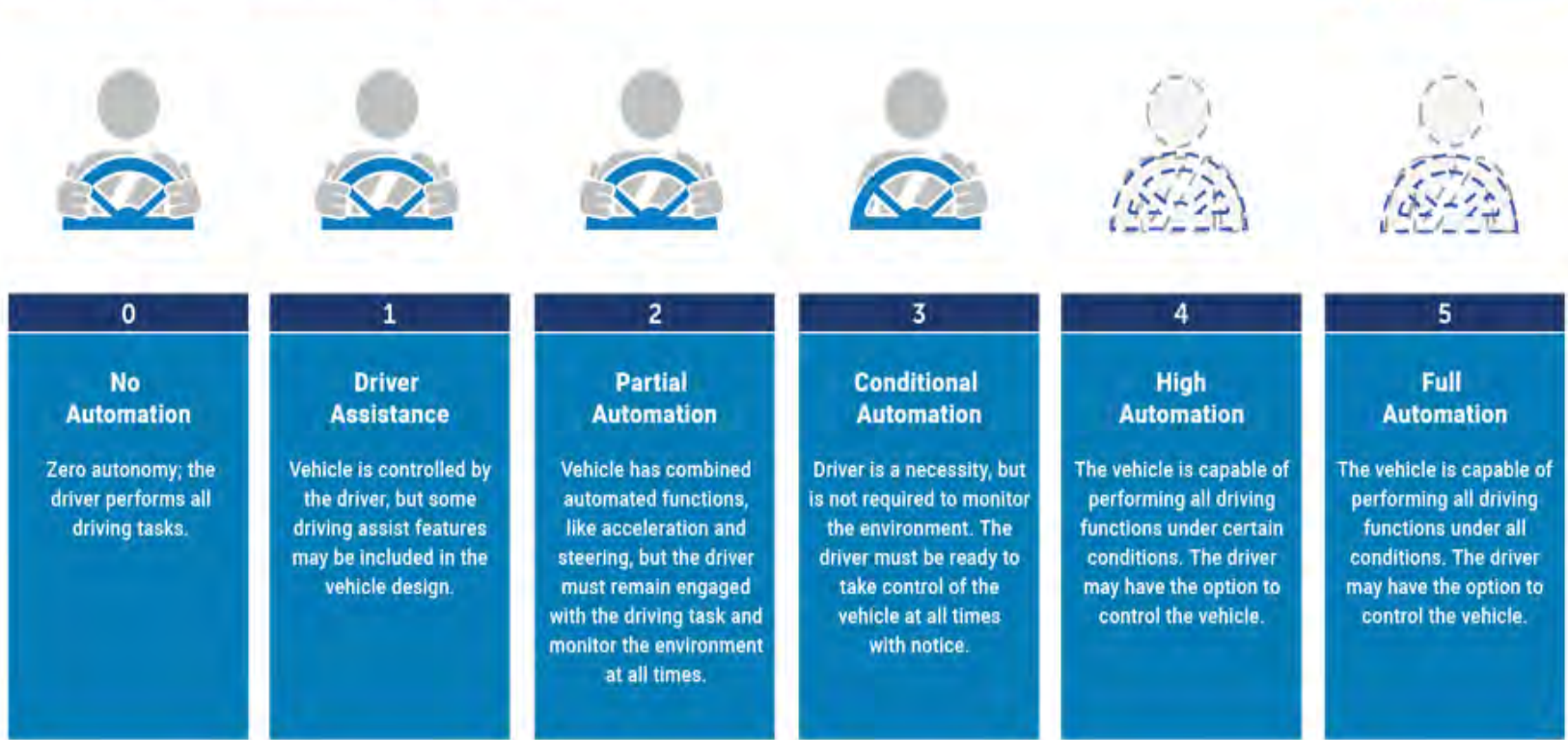
¹⁰ <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety#issue-road-self-driving>

¹¹ <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety#issue-road-self-driving>

Figure 33. AV Automation Levels

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

Full Automation



Challenges¹²

Other than the most common challenge of societal acceptance and perception associated with any new technology, challenges associated with AVs include costs, safety (AV and human driver), system failures, ethics, liability and legal considerations, security, data privacy and travel and infrastructure issues. Moreover, the regulatory and policy challenges need to account for fully autonomous, partially autonomous and human driven cars co-existing on the highways for at least the next 30 years. Since the AVs use machine learning and artificial intelligence as their learning methods while functioning, they are continuously collecting data from their surroundings. There are challenges associated with algorithm robustness, data privacy and security.

AVs in Public Transit

The previous section covered the general benefits and challenges of AVs, however it is also important to assess the benefits and challenges associated with AVs in public transit. Wilmot and Greensword (2016)¹² state that public transit, dedicated freeway lanes and parking are ways to introduce the AV technology in a fixed setting. The following sub-sections explain the various factors associated with AVs in public transit.

Mobility

AVs in public transportation is likely to significantly improve the mobility of people who can't drive due to income, age or disability issues.

Workforce Considerations and Labor Agreements

The adoption of AVs in public transportation vehicles at partial, conditional or high automation levels is likely to require the drivers to possess a wide-ranging skill-set than traditional drivers. The driver duties could include supervising passenger transfer; operating the vehicle to and from storage locations or maintenance depot; and the detection and management of emergency situations. However, to make transition to AVs, labor unions will need to be involved for updated roles and reduced hours to account for autonomous technology. To some extent, the public transit employee federal protection laws provide for

¹² Wilmot, C. Greensword, M. (2016) Louisiana Transportation Research Center – Investigation into legislative action needed to accommodate the future safe operation of autonomous vehicles in the state of Louisiana. Louisiana Transportation Research Center. Url: <https://www.ltrc.lsu.edu/pdf/2016/FR%20571.pdf>

the preservation of jobs and will be critically important to review before AV technology adoption (Gettman et al., 2017)¹³.

Land-use

Heinrichs (2016)¹⁴ states that autonomous transit systems may change the urban fabric differently than autonomous private cars. Anderson et al (2016)¹⁵ suggests that the adoption of autonomous vehicles for public transit could lead to urban centers being denser, thus decreasing the amount of space used to park vehicles. Fully autonomous vehicles could potentially drop off passengers into urban cores and then drive to satellite parking areas.

ADA Compliance

ADA compliance is usually taken care of by bus operators, and the current design for AVs is accommodating but cannot guarantee smooth working if the rider is unable to understand the instructions. However, other than fully autonomous vehicles with no likely presence of human, human driver on-board the vehicle can assist with ADA compliance.

Funding Constraints and Liability

Major challenges include funding constraints, liability of transit agencies, and the general acceptance of the new technology by industry professionals, system operator and the public.

Planning and Partnerships

Long range transit planning and regional planning/coordination must consider future AV technology deployment and favorable infrastructure and land-use decisions for the same. Moreover, due to the many challenges facing local transit authorities within their respective MPOs from decreasing ridership to funding, it will be imperative to have P3s, or public-private partnerships for adopting the AV technology. Partnerships can start with addressing

¹³ Gettman, D. Lott, J.S. Goodwin, G. Harrington, T. (2017) Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations. National Cooperative Highway Research Program; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine

¹⁴ Heinrichs, Dirk (2015). Autonomous Driving: Technical, Legal and Social Aspects. Ladenburg, Germany: SpringerOpen. 213-231. Available from <https://link.springer.com/book/10.1007/978-3-662-48847-8>

¹⁵ Anderson, J. Karla, N. Stanley, K.D. Sorenson, P. Samaras, C. Oluwatola, O. (2016) Autonomous Vehicle Technology: A Guide for Policymakers. Rand Corporation. Available from: https://www.rand.org/pubs/research_reports/RR443-2.html

first mile – last mile connectivity and fixed route gap coverage issues. The NCHRP report created the following suggestions for transit agencies (Gettman et al., 2017)¹⁶.

- Develop or revise long range plans to consider changes in definitions and language
- Identify opportunities and threats posed by AV
- Identify potential strategies for managing the changes
- High frequency BRT
- First/last mile applications
- Conventional fixed route system
- Public Input
- Explore partnership options

Safety and Compliance

The National Highway Traffic Safety Administration (NHTSA) has been given the responsibility to address the following concerns regarding the safe and agreeable adoption of AVs¹⁷.

- Setting Federal Motor Vehicle Safety Standards (FMVSSs) for new motor vehicles and motor vehicle equipment (with which manufacturers must certify compliance before they sell their vehicles)
- Enforcing compliance with FMVSSs
- Investigating and managing the recall and remedy of noncompliance and safety- related motor vehicle defects nationwide
- Communicating with and educating the public about motor vehicle safety issues
- State governments are responsible for addressing the following concerns:
- Licensing human drivers and registering motor vehicles in their jurisdictions
- Enacting and enforcing traffic laws and regulations

¹⁶ Gettman, D. Lott, J.S. Goodwin, G. Harrington, T. (2017) Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations. National Cooperative Highway Research Program; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine

¹⁷ NHTSA, Automated Driving Systems 2.0: A Vision for Safety

- Conducting safety inspections, where States choose to do so
- Regulating motor vehicle insurance and liability

Funding and Acquiring AVs

Funding Options through NHSTA include:

- Emerging technology and autonomous vehicle testing and pilot programs.
- Advanced Transportation Congestion Management Technologies development (ATCMTD).
- Fixing America’s Surface Transportation (FAST) Act.

Below are key findings for transit agencies looking to add AVs to their fleet:

- Retrofitting is a financially viable option compared to buying new a new autonomous bus or shuttle.
- An electric bus will be necessary for compatibility and economic efficiency to transition to an autonomous bus.
- Retrofitting is done mainly for freight semi-trucks, but bus manufacturing companies are applying this to buses.
- Fully automated buses are nearing the end of real world testing and will be on the market soon.
- Autonomous buses will be very expensive to buy or lease.
- Shuttles have about a 12 person capacity with an average max speed of 25 MPH and have undergone more extensive testing than buses.
- Shuttles are currently estimated at \$250,000 to lease.

Short term and Long-term Strategies for Adopting AVs

Most leading car manufacturers plan on releasing self-driving car models by 2021¹⁸ and Transportation Network Companies (TNCs) like Uber, Lyft, Via, Chariot and Waymo are already using driverless taxis in their fleet (just with drivers in them). Table 31 shows the short and long-term strategies.

¹⁸ https://www.just-auto.com/analysis/all-those-in-favour-of-avs-say-ai_id182611.aspx

Table 31. Short-Term and Long-Term Strategies for Adoption of AV Technology

Short-term Strategies	Long-term Strategies
<ul style="list-style-type: none"> • Establish an AV testing bed within jurisdiction • Choose the type of transit to be deployed • Decide the level of automation that should be tested • Select a vendor • Decide whether to buy or lease vehicles • Secure funding • Conduct public participation initiative to establish buy-in and educate the public • Set up a system of payment • Ensure that state and federal safety regulations are met • Designate an agency to license vehicles and establish this procedure 	<ul style="list-style-type: none"> • Update infrastructure • Make sure that all vehicles/ stations/ operators/ etc. are ADA compliant • Have a workforce development plan for loss of bus driver jobs • Designate a lead agency/ stakeholder group to handle questions and decisions that arise • Develop an emergency action plan for potential cyber security breach • Incentivize development around AV service area