SacRT Forward Network Plan: Transit Choices Report
APRIL 2018
Existing Conditions in the Sacramento Region

For Sacramento Regional Transit District

JARRETT WALKER + ASSOCIATES
# Table of Contents

**Introduction and Summary** ................................................. 4  
- The Purpose of this Report ................................................. 5  
- What is the Purpose of Transit? ........................................... 5  
- High Ridership is Not the Only Goal ..................................... 5  
- Falling Ridership Despite a Restoration of Service .................... 6  
- Ridership and Coverage Goals Conflict .................................. 8  
- Frequency is Freedom .................................................... 9  
- Frequency and Waiting Time ............................................... 10  
- The Transit Network as an Instrument of Freedom ..................... 11  
- Visualizing Access ....................................................... 11  
- High-Freedom Networks and Ridership .................................. 11  
- Equitable but Low Coverage by Frequent Service ................. 12  
- Why Focus on the Bus Network? .......................................... 13  
- Local Leadership is Critical ............................................... 13  
- Key Choices ........................................................................ 14  
  - How should SacRT balance ridership and coverage goals? .......... 14  
  - Can Connections Be Made More Civilized? ............................ 14  
  - Broadly-useful or specialized? .......................................... 15  
  - Should we focus growth in places where transit works best? ....... 15  
- Get Involved ...................................................................... 16  

**Market and Need Assessments** .......................................... 17  
  - Development Patterns Affect Ridership .................................... 19  
  - Market Assessment: Residents ........................................... 20  
  - Market Assessment: Jobs .................................................. 21  
  - Market Assessment: Jobs .................................................. 22  
  - Market Assessment: Activity and Mix of Uses ......................... 23  

**Existing Commute Flows** ................................................... 24  
  - Market Assessment: Commute Trips .................................... 24  
  - Change from 2002–2015 .................................................. 25  
  - Market Assessment: Vehicle Ownership ................................ 26  
  - Market Assessment: Street Connectivity ............................... 27  
    - Examples: Density and Walkability .................................... 28  
    - Examples: Street Connectivity and Walkability .................... 29  
    - Examples: Linearity ....................................................... 30  
  - Market and Need Assessment: Poverty ................................ 31  
  - Need Assessment: Seniors ................................................ 32  
  - Need Assessment: Youth .................................................. 33  
  - Civil Rights Assessment: Race or Ethnicity .......................... 34  
  - Paratransit ................................................................. 35  
  - Civil Rights Assessment: Race or Ethnicity .......................... 35  

**Land Use Challenges** ......................................................... 36  
  - Recent Changes in Residential Density ................................ 37  
  - Changes in Residential Density around Light Rail Stations ........ 38  
  - Forecasted Future Residential Density ................................ 39  
  - Recent Changes in Job Density .......................................... 40  
  - Changes in Job Density around Light Rail Stations ............... 41  
  - Freeway-Oriented Development .......................................... 42  

**Existing Financial Conditions** ........................................... 43  
  - Planned Operating and Maintenance Expenses ....................... 44  
  - Planned Capital Expenditures .......................................... 44  
  - Anticipated Revenues ..................................................... 45  
  - Project Financing .......................................................... 47
# Table of Contents

## Network and Route Performance
- Freedom and Access .................................................. 49
- Ridership ........................................................................ 53
- System-Wide Productivity ............................................. 54
- Route-by-Route Productivity ........................................... 55
- Daily and Weekly Span of Service ................................ 57
  - “Temporal” Coverage .................................................. 58
- Weekend Productivity .................................................... 59
- Cost per Boarding ........................................................... 60
  - Community Bus Service (CBS) ..................................... 61
- Costs of Peaking ............................................................. 62
- Reliability ......................................................................... 64
  - On-Time Performance .................................................... 64
  - Missed Trips ................................................................ 65

## Network Design Tools
- Network History ............................................................ 67
- Local “Feeder” Networks .................................................. 68
  - “Grid” or “Crosstown” Routes ......................................... 69
- Transfers ........................................................................ 70
- Radial Spacing ................................................................. 71
  - “Trunk-and-branch” frequencies .................................... 72
- Specialization ................................................................... 73
- School-Focused Services ................................................. 73
- Demand-Response Service (“Microtransit” or Dial-a-Ride) .......................................................... 74
- Peak-only Routes ............................................................. 74
- Sac State Parking Lot Shuttle .......................................... 75

## Key Choices
- Should We Focus Growth in Places Where Transit Works Best? ............................................. 79
- How Should SacRT Balance High Ridership with Wide Coverage? ........................................... 80
- Can Connections Be Made More Civilized? ........................................................................ 81
- Broad or Specialized? ....................................................... 82

## Glossary

## Appendix: Methods

## Appendix: Route Atlas
1 Introduction and Summary
The Purpose of this Report

This Choices Report is the first step in the SacRT Forward Network Plan, through which SacRT will:

- Assess the existing transit network and the geometry of today’s city;
- Engage the public, stakeholders and elected officials in a conversation about the goals of transit in the Sacramento region;
- Develop recommendations for changing the transit network in the future.

This Choices Report lays out relevant facts about transit and development in Sacramento, and draws the reader’s attention to difficult choices that these facts force us to consider.

This is called a “Choices Report” to make clear that it contains no recommendations. The Network Plan will require difficult decisions about how to balance competing goals, and these decisions will be made by SacRT based on input from stakeholders and the public.

What is the Purpose of Transit?

Transit can serve many different goals. But different people and communities value these goals differently. It is not usually possible to excel towards all of these goals at the same time.

Understanding which goals matter most in Sacramento is a key step in updating the transit network.

Possible goals for transit include:

- Economic: transit can give businesses access to more workers, and workers access to more jobs, and give students more access to education and training.
- Environmental: increased transit use can reduce air pollution and greenhouse gas emissions. Transit can also support more compact development and help conserve land.
- Social: transit can help meet the needs of people who are in various situations of disadvantage, providing lifeline access to services and jobs.
- Health: transit can be a tool to support physical activity by walking. This is partly because most riders walk to their bus stop, but also because riders will tend to walk more in between their transit trips.
- Personal Liberty: By providing people the ability to reach more places than they otherwise would, a transit system can be a tool for personal liberty, empowering people to make choices and fulfill their individual goals.

Some of these goals are served by high transit ridership. For example, the environmental benefits of transit only arise from many people riding the bus rather than driving. Subsidy per rider is lower when ridership is maximized. We call such goals “ridership goals” because they are achieved through high ridership.

Other goals are served by the mere presence of transit. A bus route through a neighborhood provides residents insurance against isolation, even if the route is infrequent, not very useful, and few people ride it. A route may fulfill political or social obligations, for example by getting service close to every taxpayer or into every political district. We call these types of goals “coverage goals” because they are achieved in part by covering geographic areas with service, regardless of ridership.

High Ridership is Not the Only Goal

If SacRT wanted to maximize transit ridership, it would focus its service only on routes useful to many potential riders. SacRT would be thinking like a business, focusing on places where its service is competitive for a large number of people.

Businesses are under no obligation to operate where they would spend a lot of money to reach few customers.

For example, McDonald’s is under no obligation to provide a restaurant within 1/2 mile of everyone in Sacramento County. If it were, then the company would have to add hundreds of additional locations, some serving just a handful of homes, and most operating at a loss because of the few customers nearby.

People understand that rural areas will naturally have fewer McDonald’s locations than urban areas. We don’t describe this as McDonald’s being unfair to rural or suburban areas; they are just acting like a private business. McDonald’s has no obligation to cover all areas with its restaurants.

Transit agencies are not private businesses, and most transit agencies decide that they do have some obligation to cover their service area. The elected officials who ultimately make public transit decisions hear their constituents say things like “We pay taxes too” and “If you cut this bus line, I will be stranded” and they decide that coverage, even in low-ridership places, is an important transit outcome.

Transit agencies are often accused of failing to maximize ridership, as if that were their only goal. In fact, they are intentionally operating “coverage services” that are not expected to generate high ridership. Agencies must balance the competing goals of high ridership and coverage. The balance they choose depends on the values of the agency and the region.

Figure 1: Is an empty bus failing? That depends entirely on why you are running it in the first place.
Transit investment and transit ridership in many cities have declined since 2009, when the Great Recession caused cuts in public investment of all kinds. One of the basic truths of transit ridership is that you can’t ride a bus that isn’t coming—which means that transit ridership tracks with transit service levels most of the time.

The graph at right shows transit service levels and transit ridership, adjusted to the population each transit agency’s service area.

The major cuts to transit service that SacRT had to make in 2009, 2010 and especially 2011, are visible in the falling black line at top. These cuts meant that, for many then-transit riders, their bus suddenly “wasn’t coming.” In a system so dependent on transfers, to other bus routes or to light rail, lost riders on one route often means lost riders on one or more other routes. The trips those riders made on transit declined, as shown by the falling black line at bottom-right. These two trends are shown more closely in the graph on the following page.

Why has ridership continued falling, even as SacRT has restored some service? Sacramento is not the only city facing falling transit ridership relative to service levels. Only two major U.S. cities (Seattle and Houston) saw gains in transit ridership from 2015 to 2016.¹ It is certain that numerous forces are in play, and that they are not unique to Sacramento.

¹ These cities are too big to be considered Sacramento’s peers, so they are not included in the charts at right.

National research suggests that transit ridership in many cities has been declining due to:

- The very low costs of purchasing and driving cars, from a combination of historically-low interest rates and low gas prices.
- Competition by Uber and Lyft for more affluent riders and for the most time-sensitive trips, especially at night and on weekends when some cities’ transit networks become thin.
- The distances between jobs and housing continue to grow, as many regions (including Sacramento) continue to sprawl outward. Longer distances force transit agencies to offer less-frequent or more expensive services, which are less attractive to potential riders.
- Increasing desirability, property values and rents in pre-war inner city neighborhoods has forced lower income residents to move farther from the center of transit networks. Some of the people with the greatest incentive to try transit therefore live far from the most useful transit.

These trends were all in force in 2013 when the relevance of transit in the Sacramento region began slipping despite increases in transit service. This report will describe some of the ways that transit agencies in any city, and in any situation, can increase the ridership they achieve within their fixed budgets.
The recent history of SacRT investment and relevance is shown more closely in the graph at right. As described on the previous page, very severe service cuts were necessary from 2009–2011, to balance SacRT’s budget. Ridership fell predictably.

SacRT worked hard to restore service as more funding became available, starting in 2012, though service levels in 2016 remained below 2008 levels.

Transit ridership started to recover as SacRT restored service, in 2012 and 2013—then other forces come into play and transit ridership fell again. Meanwhile, the Sacramento region’s population was growing, so relevance (ridership per capita) fell even more steeply than simple ridership.

Why do many people see falling transit ridership, and falling relevance, as a problem? People value transit for many different reasons, but one reason is existential for urban places and that is the efficient use of scarce space. Cities are, by definition, places where people want to congregate near one another. If everyone arrives in their own vehicle or even small carpools, there will not be sufficient space to accommodate them, thus resulting in congestion. No advance in technology will solve this basic geometric challenge of cities.

Most urban areas, including Sacramento, do not have more room on their roads, and will always depend on large shared vehicles to solve this basic problem.

Many factors that govern transit ridership are outside of the control of SacRT, but SacRT does have power over a few factors that govern how much ridership it can attract within its fixed budget:

- How much of its investment is concentrated in services that get the highest ridership relative to their cost?
- How do transit fares compare to the costs of other options (e.g. parking a car, riding Uber or Lyft)?
- How well do transit fares work with the structure of the network?
- How is transit service made clear and appealing to potential riders?

It is not a given that SacRT should take steps to increase transit ridership, because doing so would require impacting other vital outcomes. This trade-off, and others, are described in detail in this report, so that the reader can come to their own conclusion about whether SacRT should make the changes that would be necessary to increase ridership within its fixed budget.
Ridership and Coverage Goals Conflict

Ridership and coverage goals are both laudable, but they lead us in opposite directions. Within a fixed budget, if a transit agency wants to do more of one, it must do less of the other.

Here is an illustration of how ridership and coverage goals conflict with one another, due to geometry and geography.

In the fictional town at right, the little dots indicate dwellings and commercial buildings and other land uses. The lines indicate roads. Most of the activity in the town is concentrated around a few roads, as in most towns.

A transit agency pursuing only a ridership goal would focus service on the streets where there are large numbers of people, where walking to transit stops is easy, and where the straight routes feel direct and fast to customers. Because service is concentrated onto fewer routes, frequency is high and a bus is always coming soon. This would result in a network like the one at bottom-left.

If the town were pursuing only a coverage goal, on the other hand, the transit agency would spread out services so that every street had a bus route, as in the network at bottom-right. As a result, all routes would be infrequent, even those on the main roads.

On a fixed budget, designing transit for both ridership and coverage is a zero-sum game. In the networks at right, each bus that the transit agency runs down a main road, to provide more frequent and competitive service in that market, is not running on the neighborhood streets, providing coverage. While an agency can pursue ridership and provide coverage within the same budget, it cannot do both with the same dollar. The more it does of one, the less it does of the other.

These illustrations also show a relationship between coverage and complexity. Networks offering high levels of coverage are naturally more complex.

In this imaginary town, any person could keep the very simple “high frequency” network in their head, since it consists of just two routes, running in straight lines. They would not even need to consult a schedule to catch a bus. The coverage network would be harder to memorize, requiring people to consult a map (to understand the routing) and a schedule (to catch these infrequent services).

Imagine you are the transit planner for this fictional town.

The dots scattered around the map are people and jobs.

The 18 buses are the resources the town has to run transit.

Before you can plan transit routes, you must first decide: What is the purpose of your transit system?

Figure 6: Ridership and coverage goals, both laudable, are in direct conflict within a fixed budget.
Frequency is Freedom

In transit conversations, there is always a great focus on where transit is provided, but sometimes not enough attention paid to when it is provided.

The “when” of transit service can be described as “frequency” or “headway” (how many minutes between each bus) and “span” (how many hours per day, and days per week, it runs).

Low frequencies and short spans are one of the main ways that transit fails to be useful, because it means service is simply not there when the customer needs to travel.

Frequent service:
- Reduces waiting time (and thus overall travel time).
- Improves reliability for the customer, because if something happens to your bus, another one is always coming soon.
- Makes transit service more legible, by reducing the need to consult a schedule.
- Makes transferring (between two frequent services) fast and reliable.

Existing SacRT Network

The map at right shows SacRT’s existing network, with every route color-coded based on its frequency during midday on a weekday. (An inset map of downtown is shown on the next page.) Only a few SacRT bus routes offer service every 15 minutes, and there are only a few places where a reliably quick connection can be made—where two red lines intersect on this map.

Some large cities have switched from a largely radial transit network (in which most or all routes go to downtown) to a grid network. A grid network allows for anywhere-to-anywhere travel, with a single transfer. But a grid requires, as a prerequisite, a large number of frequent routes, many more than SacRT currently operates. Without high frequencies, the transfers that are an inherent requirement of a grid network will require long waits, and few people will be willing to make them.

The potential for a frequent grid in Sacramento, and the trade-offs it would require, are described starting on page 69, along with other potential network and service design strategies.

Figure 7: On this map of the existing SacRT transit network, lines are color-coded based on their frequency during the midday on weekdays. Only a few routes come every 15 minutes. (A close-up of the downtown transit network is shown on page 72.)
Frequency and Waiting Time

In order to think about whether any frequency is “frequent enough,” imagine waiting one-half of the frequency, on average (since statistically, you will) and ask yourself whether you could tolerate waiting that long as part of an everyday trip.

Many people assume that today, when so many transit systems offer real-time arrival information, nobody needs to wait for a bus anymore, and frequency therefore doesn’t matter. If a bus only comes once an hour, that’s fine, because your phone will tell you when it is a few minutes away and you should walk to the stop.

Despite all these new technologies, frequency still matters enormously, because:

- **Waiting doesn’t just happen at the start of your ride,** it also happens at the end. You may not need to leave the house long before your departure, but if your bus is infrequent, you have to choose between being very early or too late. If you start work at 8:00 am but the hourly bus passes your workplace at 8:10 am, you can be 50 minutes early or 10 minutes late.

- **Many of the places we go don’t let us hang out until our bus’s arrival is imminent.** We can easily do this when leaving home, but it is more awkward when leaving a restaurant or a workplace that is closing.

- **Real-time arrival information doesn’t make the bus more reliable, but frequency does.** Your phone can tell you when your bus is arriving, but it cannot prevent your bus from having a problem and being severely delayed, or not showing up at all. Only frequency—which means that another bus is always coming soon—can offer this kind of reliability.

The mini-maps at right show how frequencies change over the course of a weekday and the weekend in the SacRT network. The highest frequencies are offered during weekday rush-hours (top left). There are a few places where transfers between frequent bus and rail lines are possible, involving only a short wait. By the weekend, no bus route or rail line is running frequently, and only a few come every 30 minutes.

![Mini-maps showing frequency changes](image)

Figure 8: These mini-maps show the frequency of every route and light rail line throughout the weekday, and on Saturdays and Sundays at noon. When frequencies fall so low at night and on weekends, people’s waits for service become long, and using the network as a network requires long waits to transfer.
The Transit Network as an Instrument of Freedom

High transit ridership results when transit is useful to large numbers of people. A helpful way to illustrate the usefulness of a network is to visualize where a person could go using public transit and walking, from a certain location, in a certain amount of time.

Visualizing Access

The map at right shows where someone can go if they start out from the intersection of Arden & Fulton at noon on a weekday. Areas they can reach in less than 60, 45 or 30 minutes are shown in orange, red and purple, respectively. The technical term for this illustration is isochrone.

A more useful transit network is one in which these isochrones are larger, so that each person is likely to find the network useful for more trips.

What goes into the travel time reflected in this isochrone?

- Time spent walking to a bus or light rail stop.
- Time spent waiting for the bus or train, which is one-half of the frequency. (This waiting is unavoidable, and happens at either the start or the end of the trip, as explained on page 10.)
- Time spent riding the bus or train. The faster the vehicle goes, the farther someone can get.
- Time spent walking to the final destination.

Frequency, speed and distance govern people’s travel time on transit. While speed and distance are mostly out of the control of SacRT, the frequency of different transit services is a decision made by SacRT. Long waits for low frequency services can consume a great deal or all of someone’s travel time budget, making for smaller isochrones.

Example: Access to and from Arden-Arcade

The difference in freedom offered by a low-frequency route and a medium-frequency route are visible within the purple part of this isochrone. The isochrone is centered at the intersection of Arden and Fulton, where Routes 26 and 22 cross. A person can get pretty far to the north and south in 45 minutes, thanks to a north-south route coming every 30 minutes. In contrast, they can’t get very far east and west in 45 minutes, because the east-west route comes only every 60 minutes.

Even beyond usefulness, an isochrone shows the level of personal freedom and opportunity afforded by the public transport network. For people living around Arden & Fulton, where can they apply for jobs? While jobs directly on Routes 22 or 26, within Arden-Arcade, are easily reachable, only a few jobs downtown are reachable within an hour’s travel, one-way. Where can they enroll in school? Sac State is reachable within 45 minutes, one-way. If people cannot afford to spend 1.5 or 2 hours of their day traveling to and from school or work, they might not pursue a job downtown or enroll at Sac State. Or they might struggle to succeed because of the length of their commute. Or they might sacrifice some other investment, to come up with the many thousands of dollars a year required to own and maintain a car.

We can think of these shapes as the walls around someone’s life. A transit network can be liberating, giving people access to the opportunities of their city, the freedom to find work, go to school, worship, meet people, and do all of the other things that have drawn humans to cities for thousands of years. The transit network can be an instrument of freedom for the current and future people of the Sacramento area.

High-Freedom Networks and Ridership

Expanding this freedom and opportunity is foundational for ridership growth. While other factors also affect ridership, this measure of freedom and opportunity isolates the transit network’s role in attracting ridership. It reveals ways that a transit network can help more people get to more places sooner, so that they can do more things.

In this Network Plan, SacRT and its stakeholders will have an opportunity to consider changes that would increase access for large numbers of people. Making these changes within the existing service budget would require major trade-offs, but would greatly increase the potential ridership of the network.

The biggest limits on how much access a transit network can offer are the quantity of service provided, the frequency of service, and the span of service throughout each day and week. Frequency and span, as described on page 8, trade-off against geographic coverage, within any fixed budget.

In addition to the example above, similar maps show access to the city from three other places, starting on page 49.

1 Our choice of noon, rather than morning or evening rush hour, is intentional. While travel peaks at rush hours, many different kinds of people need to travel at midday. The retail and restaurant industries tend to change shifts and midday. Office workers need to travel for personal appointments or meetings. College students often finish or start classes at midday. And any parent values being able to get home to pick up a sick kid from school!
**Equitable but Low Coverage by Frequent Service**

The chart at right reports how much coverage is provided by the existing SacRT network, to residents and jobs within SacRT’s very large service area of 367 square miles.

This chart measures coverage by any service as well as to frequent service. The distinction is important because frequent service is most likely to attract high rider relative to its cost.

About 11% of residents are within 1/4 mile of frequent service, but a much larger proportion—55%—are near some kind of service (which may be a peak-only express shuttle, or may be an all-week hourly route). Residents who are non-white are covered, on average, to a nearly identical degree as white residents.

Residents living in poverty are covered at slightly higher proportions by frequent service (13%) and any service (62%).

The Sacramento area is both highly diverse and highly integrated by race and ethnicity. This means that when SacRT provides transit service to an area, it is very likely benefitting people of different races and ethnicities. (The Sacramento region is unusually diverse and integrated, as described and shown in the map on page 34.) SacRT is unusual among transit agencies in managing to cover such similar proportions of low-income residents, minority residents and all residents with any service, and with frequent service.

### Coverage Compared to Peers

Analyzing coverage for peer cities is difficult, but a few data points are available from recent JWA studies:

- In Richmond, Virginia, another state capital, 22% of residents live near frequent service—twice the percentage of Sacramento—and the same percentage of residents live near any service at all. Coverage of jobs by frequent service and any service is almost identical between Richmond and Sacramento.

- In San Jose and Silicon Valley, 26% of residents are near frequent service, and 66% are near any service. 37% of jobs are near frequent service, and 87% of jobs are near any service. These coverage proportions are all higher than what SacRT currently provides, but Silicon Valley is “landlocked” in a way that the Sacramento region is not: between the Bay and the mountains, most new development in Silicon Valley can’t help but be near an existing transit line. In contrast, new development in Sacramento can continue to move away from existing transit service without hitting many natural boundaries.

![Figure 10: While a majority (55%) of the Sacramento area is covered with some transit service, frequent service only covers 11% of residents. Coverage of jobs by frequent service is higher, which is typical in most cities and results from jobs being concentrated downtown.](image-url)
Why Focus on the Bus Network?

The SacRT Forward Network Plan will focus on redesigning the bus network, though it may include some recommendations for changes or improvements to light rail service as well.

Why focus on buses?

- Buses provide more than 2/3 of all transit service in the Sacramento area.
- More than 1/3 of all rail trips include a transfer to or from a bus line.
- About 1/2 of all SacRT boardings are on buses.

Even in cities like New York, where a majority of the population is within a half-mile of a subway station, enormous numbers of people travel by bus. Bus service is much less expensive to operate than rail, bus vehicles are cheaper and easier to procure than rail vehicles, and bus service does not require lengthy and costly construction projects. For moving large numbers of people across a large urban area at a reasonable cost, rail cannot compete with buses.

Finally, the bus network can be changed and improved soon. If SacRT decides to implement part or all of this Network Plan, it can be done relatively quickly.¹

Redesigning the SacRT bus network does not necessarily mean massive change, though it could have that outcome. It does mean, however, that everyone involved in this plan need not be constrained by the existing network. If there are routes and service patterns that are meeting the region’s goals today, they are likely to be retained in the Network Plan. If there are routes and patterns that are artifacts of history and no longer make sense, they can be revised.

Local Leadership is Critical

This process will focus on the design and operation of the bus network, which is largely under SacRT’s control.

However, local authorities like the Cities, the County and the Sacramento Area Council of Governments (SACOG) control the success of the transit system as much as SacRT, because of two enormous powers:

- As land use authorities, they decide whether more people and jobs will locate in places where they can be served by transit that is both cost-effective and useful.
- They control most of the streets and highways on which buses operate. Most speed and reliability problems are related to delays caused by traffic. Other regions are addressing this problem through various kinds of transit priority, including signal improvements and bus lanes.

Many cities in the Sacramento region already have their own adopted transit plans or policies, or are in the process of developing them. Much can be learned from the success of the City of Seattle, which in 2004 became the first city to publish its own Transit Master Plan, even though it did not operate any transit itself. This was the first step of many, as Seattle has taken a leadership position on transit planning, transit-oriented development, and most recently in raising transit funding. The original Transit Master Plan (since updated), and the on-going municipal leadership, are probably the biggest reasons that Seattle is one of only two cities in the U.S. where transit ridership has grown, rather than fallen, in recent years.

Municipal transit plans in the Sacramento region can guide each city’s actions in planning and expediting transit, and help city leaders align their land use, development and street design actions around their own goals for transit.

¹ This is not to say that bus service patterns are temporary. Sometimes, in advocating for the use of rail vehicles, people argue that bus service is temporary, whereas rail is permanent. This is obviously not true, since for a few decades in the late 19th and early 20th centuries U.S. cities were full of trolleys and streetcars running on rails, nearly all of which were ripped out, proving their impermanence. Bus service isn’t permanent either, in that sense.

What is very permanent, however, is a high ridership transit market and the transit service patterns that arise from it. The most frequent and high-ridership bus lines in the center of any U.S. city are likely to have been served by horse-drawn bus in the 1800’s, streetcars in the early 1900’s, and diesel or electric buses since then. For example, one of the most frequent and productive lines in the SacRT network is Route 30, on J Street—once operated by trolleys, and now operated by buses. Transit technologies come and go, but a high-ridership transit market is permanent.

JARRETT WALKER + ASSOCIATES
Key Choices

At the end of this report, we present some key choices that the public, stakeholders and elected officials will need to make about the future of the SacRT transit network and the Sacramento region.

One of these choices is about land use, growth and road design, not about transit service design. This report contains information and maps demonstrating how these non-transit decisions govern transit ridership and transit costs. The future success of the SacRT transit network depends on the land use decisions made by the cities and county.

How should SacRT balance ridership and coverage goals?

In every public transit system, a basic trade-off must be made between concentrating service onto very useful routes that serve large numbers of people, and spreading service out to make sure that people everywhere have access to at least some service. This trade-off is described on page 8.

How should SacRT balance ridership and coverage goals in its network?

Is the current balance (which derives from the historical tweaks and changes to the network over the years) the right one? Should SacRT shift the balance in one direction or the other?

A transit agency needs to choose one extreme or the other—the choice is not binary. However, the two goals trade-off against one another. This means that within a fixed budget, a shift towards one goal is necessarily a shift away from the other. Providing higher frequencies and achieving higher ridership would require reducing geographic coverage, and vice versa.

We estimate that about 40% of the existing bus network is designed as it would be if maximizing ridership were its only goal. The other 60% has predictably low-ridership, suggesting that it is being provided for other purposes. This may be the right balance for SacRT in the future, or the community may value a shift in goals. The direction of that shift—either towards higher ridership or towards wider coverage—is a question for stakeholders to discuss as part of this Network Plan.

One way to manage the perennial conflict between ridership and coverage goals is to determine the percentage of a fixed route budget that should be spent in pursuit of each one. In this Network Plan, the SacRT Board could decide to establish a percentage of its budget that should be spent towards maximizing ridership, and a percentage that can be used for non-ridership purposes.

Nothing we say in this report should be taken to imply that SacRT should strike a different balance than it does today. When we describe potential high-ridership strategies, there is always an implied “if” statement. “IF SacRT wanted to increase ridership, here are some things that could be done, and here are some trade-offs involved in the process.” The choice about how to balance ridership and coverage goals will rest entirely with the public, stakeholders and the SacRT Board.

Can Connections Be Made More Civilized?

The biggest source of complexity in most transit networks is the sheer number of routes. While everyone would like to have a single bus route that takes them to and from their chosen destination, providing such “one-seat-ride” routes for the whole population would generate an overwhelming number of routes, each with extremely poor levels of service.

A network that requires connections can provide much greater access, mobility and choice than a complex network of infrequent “one-seat-rides.” Since the first introduction of light rail in the region, in the 1990s, SacRT has been moving away from providing infrequent routes from everywhere to downtown. Instead, the SacRT network has been designed to move people all over the region, using connections.

Unfortunately, major service cuts during the Great Recession have undermined the quality of those connections. Waits to transfer are often very long. Connections are expensive for riders who pay cash. Poor reliability means that even connections that are scheduled to work well do not work well every day.

If a community can accept connections as part of a transit network—and if the transit agency can make them civilized—it frees up an enormous amount of service that no longer must be spent providing one-seat-rides from everywhere, to everywhere. It also allows for a much simpler network, higher frequencies and, ultimately, shorter transit travel times.

Connections will continue to be an essential part of the SacRT network, whether the network is redesigned for higher ridership and higher frequencies, or for wide geographic coverage. Can those connections be made more civilized?

Some changes that would affect connections are under SacRT’s control: whether frequent routes connect with one another, the scheduling of connections among infrequent routes, and the ways that passengers are asked to pay for transfers. Other changes would need to be led by local cities, the County and the State DOT, because they relate to the walking and waiting environment that supports a connected network.
Broadly-useful or specialized?

Also related to the ridership/coverage trade-off is the balance of broad and specialized services within an agency’s budget.

SacRT currently spends some of its general operating budget on services that specialized around small groups of people or special situations. For example, specialized parking shuttles; peak-only one-way commuter routes; and routes designed to serve schools in certain neighborhoods. Specialized services do not combine with other services to form a network that anyone can use to get around the region.

While as individuals we would like to think that a transit service designed to be perfect for us, and for people like us, will attract high ridership relative to its costs, high ridership transit services are rarely specialized around any particular group of people’s needs. Rather, they are broadly useful to many different people.

Another form of specialization can arise when a transit agency focuses on improvements to “customer experience” that cannot be scaled up to serve large numbers of people.

If improvements to customers’ experiences can be delivered across the entire network, then they can lead to ridership growth. For example, the design of an excellent and affordable bus stop shelter, or the publishing of real-time arrival information, improve the customer experience and can be scaled-up to serve vast numbers of customers.

In contrast, a demand-responsive service, or a specialized shuttle route, or a luxurious type of vehicle, cannot be scaled up to serve vast numbers of customers without a proportionate and therefore vast scaling-up of costs. They may improve the “customer experience,” but their cost per customer means that they cannot be a path to higher ridership.

If SacRT wants to pursue higher ridership relative to costs, one way to do so will be to take a look at its current practices around specialization, and evaluate whether those practices should be maintained or changed in light of long-term ridership goals. It may also be helpful to develop policies that guide specialized services, so that municipal and organizational partners around the region understand what they can expect from SacRT and feel they are treated fairly.

Should we focus growth in places where transit works best?

Parts of this report describe the current development patterns in the Sacramento area, and how those patterns have affected the usefulness of transit service and transit ridership. The immediate concern of this Network Plan is to improve the value of the transit network in the near term.

However, this report can also inform the land use, development and street design policies that are made in the cities and the County, wherever people want transit to be a relevant and useful part of local life.

One of the biggest challenges for transit in the Sacramento area is the lack of proximity between new developments. Spreading transit over longer distances means spreading it thin—lower frequencies, shorter hours of service each day, and shorter spans each week. A thin transit network does not attract high ridership relative to cost.

This means that the design of new developments matters less than their location. The whether or not a development is “transit-oriented” is largely determined by the parcel: its proximity to the existing transit network, and its arrangement along linear corridors down which transit routes can run.

The large-scale growth patterns in the region in the past twenty years have not taken this form. SacRT’s limited transit budget has been spread over longer distances, and will continue to do so unless growth happens in a different way, or the transit budget is substantially increased. If neither takes place, then it will not be fair or productive to measure SacRT’s performance as though high-ridership were its overriding goal.

High ridership is not a reasonable expectation in a sprawling urban area with a fixed budget for transit.
Get Involved

This report is the first step in the SacRT Forward Network Plan.

The planning process will include multiple rounds of public consultation:

• In the spring of 2018, starting with the publication of this Choices Report, the project team will request community input on key trade-offs described in this report.

• In the fall of 2018, the project team will engage the community about potential alternatives that illustrate very different ways SacRT could change its transit network.

• If SacRT decides to move ahead with any of the recommendations of this Plan, then there will be additional community engagement, first when those recommendations are incorporated into SacRT’s updated Short Range Transit Plan, and again before any actual service changes are made.

You have already taken a great first step to understanding and influencing the SacRT Forward Network Plan, by reading this report. A shorter Summary report is also available on the website. We hope you will encourage other people you know to learn about this effort and get involved by:

• Visiting www.sacrt.com/apps/sacrtforward/

• Joining the email list by contacting us at sacrtforward@sacrt.com or (916) 321-2877.

• Providing input via an online survey, which will be available soon at the project website.

• Meeting the project team at a public event—places and times are listed on the project website and will be announced to the project email list as well.
Market and Need Assessments
In this chapter, we present and discuss data that inform two different types of considerations in transit planning:

- Where are the strongest markets for transit, with potential for high ridership and low operating costs?
- Where are there moderate or severe needs for transit, regardless of potential ridership and cost?

**Market Assessment**

A “strong transit market” is mostly defined by WHERE people are, and HOW MANY of them are there, rather than by WHO people are.

On the following pages, these maps and diagrams help us visualize the transit market:

- Residential density map
- Job density map
- Activity density map
- Linearity and proximity in the Sacramento region’s development patterns

None of these data alone tell us that a place has high ridership potential and is therefore a strong transit market. Rather, we must consider them in combination.

If you asked a transit planner to draw you a very high-ridership bus route, that planner would look mostly at densities of all residents and jobs; at the walkability of streets and neighborhoods; and at the cost of running a bus route long enough to reach them. Only secondarily would that planner look into the income or age of those residents or workers.

However, the “who” attribute that has the strongest influence on transit ridership potential is income. This is especially true in suburban areas where driving and parking cars is so easy.

Low income people are, as individuals, more likely to choose transit. That said, the density of all people (including low-income people) around a transit stop will still be the overriding factor in predicting whether that stop gets high ridership. All else being equal, density trumps income (and age) if you are trying to predict where transit will get high ridership.

This is not to say that who people are is not important. It is extremely important, especially when contemplating whether and how to cover areas that do not generate high ridership.

**Need Assessment**

We learn about transit needs by examining WHO people are and what life situation they are in.

On the following pages, these maps help us visualize where transit needs are in the Sacramento region:

- Density of residents in poverty
- Density of seniors
- Density of youth
- Density of zero-vehicle households

If you asked a transit planner to draw you a route that met as many needs as possible, that planner would look at where low income people, seniors, youth and people with disabilities live and where they need to go.

While the densities at which these people live would matter, because at higher densities a single bus stop can be useful to more people in need, the planner might still try to get the route close to small numbers of people. In fact, the more distant and scattered people are, the more isolated they can be and the more badly they might need access to transit.

Most of these measures cannot by themselves tell us that a person has a severe need for transit. For example, many seniors are affluent and able to afford cars or taxis. The same is true of young people. People living in zero-vehicle households may be choosing to rely on transit, walking or cycling when they could theoretically afford a car. We must consider these measures in combination to understand where people’s needs for transit are likely to be severe.

One map included in the Need Assessment pages does not relate directly to people’s need for transit, but does speak to a type of coverage goal, and that is the map of residents’ race or ethnicity. A person’s race or ethnicity does not tell us if they need transit, or if they have a propensity to use transit. However, we know that race and ethnicity are correlated with income.

Understanding the race or ethnicity of Sacramento residents is crucial to understanding whether transit service changes will affect people equitably. Unequal treatment on the basis of race or ethnicity is illegal under the Civil Rights Act of 1964. (Unequal treatment on the basis of other characteristics, including income and age, is also prohibited by law.) Thus an examination of where non-white people live in Sacramento is less part of a “Need Assessment” than part of a civil rights assessment.

The maps in this chapter are based on data from the 2010 full Census and a smaller survey by the Census bureau in 2016. Note that Census data is collected based on residential address, not based on workplace or shopping place or place of worship. This data thus shows us where people live, but not where they wish to go. Information about where people want to go will come from other data sources, from the knowledge of local planners and stakeholders, and from the public.
Development Patterns Affect Ridership

Achieving high ridership requires more than clean, comfortable or even frequent service. Many factors outside the control of SacRT—land use, development, urban design, street networks—strongly affect transit’s usefulness. This is why land use planning by cities and counties is such an essential part of transit’s success.

If SacRT wants to achieve higher ridership, then service must be focused on areas where high ridership is likely and operating costs are low. Land use decisions, in turn, can arrange development in patterns that SacRT can reach with useful, frequent transit, for a reasonable operating cost.

The way that SacRT could attract higher ridership, within a fixed budget, is by targeting places where the “Ridership Recipe” is in effect:

- **Density**: Demand for transit is higher when there are more people, jobs and activities near each transit stop.
- **Walkability**: Service is only useful to people who can safely and comfortably walk to the transit stop.
- **Linearity**: Direct paths among destinations are faster, cheaper for SacRT to operate, easier to understand and more appealing to customers.
- **Proximity**: Shorter distances between destinations attract more riders per hour and are cheaper for SacRT to operate.

These are geometric facts of a city and its design. They are not a matter of opinion or personal values, unlike the Key Choices presented in this report. For example, some people react strongly to the term “density” and infer a value or judgment that must come with it. Yet density is a simple geometric fact: the number of people close to any given transit stop.

All of these factors affect both the costs of providing transit in a particular place and how many people will find the service useful.

- **Density and walkability** tell us about the overall ridership potential: “Are there a lot of people around, and can they get to the transit stop?”
- **Linearity and proximity** tell us about both ridership potential and cost: “Are we going to be able to serve the market with fast, direct lines, or will we have to run indirect or long routes, which cost more to operate (and cost riders time)?”

Though it is not one of the four major factors named in the Ridership Recipe, the mix of uses along a corridor affects how much ridership transit can achieve, relative to cost. This is because a mix of uses tends to generate demand for transit in both directions, at many times of day.

Transit lines serving purely residential neighborhoods tend to be used in mostly one direction and mostly during rush hours—away from the residential neighborhood, towards jobs and services. Transit serving a mix of uses can be full in both directions, all day and all week. Most of SacRT’s high ridership services (including the Blue Line) run through mixes of housing and jobs, and as a result attract riders in both directions throughout the day.
Market Assessment: Residents

Residential density is the simplest measure of public transit’s ridership potential. Nearly everybody makes at least one trip starting or ending at their place of residence every day.

The map to the right shows the estimated residential density for the Sacramento region (including some areas outside of SacRT’s service area). The largest clusters or corridors of dense residential development are in:

- In Midtown.
- In South Natomas, against the interchange of the I-5 and I-80 freeways.
- Along Walerga, in North Highlands.
- Along Fulton and Howe, in Arden-Arcade.
- Along Franklin and Center Roads in the Parkway and Valley Hi neighborhoods.

A key challenge apparent from this map is that most of the high density areas are scattered across the region, far from one another and from jobs and activities.

In addition, most dense developments are not arranged in linear patterns which makes it difficult for SacRT to run bus routes that serve many people while feeling direct to through-riders. A few are, in particular along Walerga Road and Center Parkway.

By comparing this map to the map of the existing network on page 9, we can see that at least some transit service is provided close to the densest pockets of residential development.

However, "close to" is a relative statement. In some developments the local street pattern puts most homes a long walk away from the nearest through-street, making it impossible for SacRT to get close to very many homes. This walkability problem is illustrated on page 29.

Residential density alone is not enough to tell where many people are likely to be going to and from the area around a bus stop. Filling in information about job density will give us a more complete picture, and may reveal more linear corridors along which density is continuously high.

Figure 13: Areas where more people live are shaded more darkly on this map. Dense residential areas are fairly scattered in the Sacramento region.
Market Assessment: Jobs

A map of job density shows us not only the places people travel for work, but also places people go for services, shopping, community, health care, and more. A person’s workplace may be, throughout the day, a destination for dozens or even hundreds of people.

The map to the right shows the existing job density across the Sacramento region. Dense employment areas are more centralized, and more organized along corridors, than are dense residential areas (as shown on the previous page). Some of the largest clusters or corridors are:

- Downtown and Midtown.
- Along Stockton Boulevard from Downtown to Elk Grove.
- Along Auburn Boulevard.
- In Arden-Arcade.
- Along the El Dorado Freeway (US-50) from Downtown, through Rancho Cordova, to Folsom.
- Along I-5 and I-80, north of the river.

Note that the last two corridors on this list are actually along freeways. While these look linear on a map, they are nearly impossible to serve with transit that is both direct and frequent.

The freeway provides a nice direct route, but accessing those jobs requires exiting the freeway and driving in long loops. Providing access to both sides of the freeway requires running two separate bus routes, one to serve each side of the highway. This doubles the cost of serving the area (or halves the frequency of service that can be provided). The effect of “Freeway-Oriented Development” on the transit network is described in greater detail on page 42.

Figure 14: Areas with more jobs (and, in many cases, more visitors and customers) are shaded dark in this map. Job density is more centralized in the region than residential density. However, many jobs are arranged along freeways, where transit cannot stop.
Market Assessment: Jobs

The maps above show the locations of jobs in three different wage categories. The lowest-wage jobs, at left, and mid-wage jobs (at center) tend to be more spread out than higher-wage jobs (at right). This makes sense, given that lower-wage jobs tend to be in the retail, service or industrial sectors, all industries that involve many square feet of space per employee. Higher-wage jobs are more likely to be in offices, where there are fewer square feet of space per employee.

While downtown is dense with jobs at all wage levels, higher-wage jobs are much more concentrated there than lower-wage jobs. A particular challenge for any urban transit network is that the center of the network, where transit access is at its highest, is not an area where low- and medium-wage jobs are concentrated. (The amount of transit access to jobs in downtown is made visible in an “isochrone” on page 49.)
Market Assessment: Activity and Mix of Uses

In the map at right, residential and job densities are combined into Activity Density. This allows us to see how the total density of activities, the mix of uses, their proximity and their linearity.

A few corridors on which moderate or high densities are arranged in a linear pattern, with few gaps between them, are visible on this map:
- J Street/Fair Oaks from downtown to Fulton Ave.
- Freeport/21st Street in Curtis Park and Midtown.
- Many roads in Arden-Arcade.
- Auburn/Greenback from Arden-Arcade to Citrus Heights.
- Walerga Road in North Highlands.
- Folsom Blvd., through Rancho Cordova.
- Stockton Avenue from Broadway to Elk Grove.
- Elsie and Mack Roads and Center Parkway in the Parkway/Valley-Hi neighborhoods.

This map makes clear that density does not drop off steadily from Downtown and Midtown outward. Instead, Downtown and Midtown are encircled by a ring of low-density residential areas and greenspaces. Within this ring, there are a few exceptions, visible in bright yellow and orange: the DMV buildings on 24th south of Broadway, and the UC Davis Medical Center on Stockton.

A great deal of transit service flows into and out of Downtown and Midtown, but on its way through this low-density belt it passes relatively few people.

The mix of residential and commercial land uses is an essential insight into ridership potential. Transit routes serving purely residential neighborhoods tend to be used only in one direction each morning and evening rush hour. In residential areas that are far away from any jobs and services, transit routes tend to be used only for long commutes to and from work, and not at other times of day.

In contrast, on corridors where residential, commercial and other uses are mixed, people are traveling in both directions for work. Travel demand also goes beyond the weekday rush hours, and is high throughout the midday, evening and weekends, as people move in all directions work, socializing, shopping and other activities.

The “one-wayness” of travel demand along a transit route limits how much ridership it can attract relative to its cost, because:

Figure 16: Areas that are dense with a mix of uses are shown in shades of red on this map. A few linear, mixed-use corridors become visible (for example, Jo Street, Folsom Blvd. and Stockton Blvd.), as do clusters of mixed-use density like Midtown and Arden-Arcade.
Market Assessment: Commute Trips

- When ridership is high only during rush hours, agencies often run peak-only service. The costs of buying, maintaining and storing buses are then incurred for only a few hours of service and riders.
- Getting bus drivers to drive rush-hour-only services requires either premium wages, paid time not driving, or complicated and costly work scheduling.
- Ridership in one direction during the peak requires an agency to pay to run mostly-empty buses or trains back in the other direction.

Thus all-day and two-way demand, along an entire route, yields higher ridership relative to cost. A mix of high densities along a transit-accessible corridor suggests that travel demands will be all-day and two-way.

Existing Commute Flows

The circular diagram at right represents the flows of commuters among places within the Sacramento region, by car, transit, or any other mode, as of 2015. Trips originating in each place are color-coded; for example, trips originating in Roseville are shown in pink. Trips that start and end within Roseville appear as a pink “hump,” and trips from Roseville to jobs in Sacramento appear as a pink band going from the top of the diagram to the bottom. The wider the colored band (or hump), the more commute trips it represents.

A very high proportion of commutes by Sacramento residents are to jobs within Sacramento, compared to other places. (Note that “Sacramento” includes areas north of American River, e.g. North and South Natomas.) In suburban places like Folsom and Elk Grove, the majority of commutes are to jobs outside of those places. Very large proportions of the commutes originating in Elk Grove and Arden-Arcade go into Sacramento.

The trips shown in this diagram are a very small minority of the trips that people make in the region! Nationally, only 16% of people’s trips are to and from work. The rest are trips to socialize, shop, access services, and do all of the other things that make for a complete life.

Work trips are, however, well-suited to transit, for a few reasons: they are longer than other types of trips, job sites are more likely to have parking constraints than other destinations, and people make work trips so regularly that they can plan ahead for a regular transit itinerary. Nearly 60% of existing SacRT boardings are for work trips.

On the next page, we summarize the changes in these commute patterns from 2002 to 2015.

Figure 17: This diagram shows the flows of commutes among places in the Sacramento region in 2015. The trip to and from work is very important, but makes up fewer than 1 in 5 trips in the U.S. Most travel, by any mode, happens for other purposes.
Change from 2002–2015

The circular diagram at right shows only the commutes that have increased between 2002 and 2015. The massive residential growth of Elk Grove, and the extent to which those residents commute into Sacramento for work, is clearly visible as the dark green band. Major growth in the number of people commuting from homes in Sacramento to jobs in Sacramento is also visible as the grey hump.

Some commute flows between these places decreased during this time period. Those pairs of places are listed in the table below. Commutes within Arden-Arcade, within Citrus Heights, and from those two places to Rancho Cordova or West Sacramento all decreased. However, from the diagram at right we can see that commutes from Citrus Heights to Roseville increased, and commutes from Arden-Arcade to Sacramento as well as commutes within Arden-Arcade increased.

Unfortunately, no major data source tells us how people’s travel for non-work purposes has changed over the same time period.

<table>
<thead>
<tr>
<th>Residing in</th>
<th>Commuting to</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arden-Arcade</td>
<td>Arden-Arcade</td>
<td>-1,180</td>
</tr>
<tr>
<td>Arden-Arcade</td>
<td>Citrus Heights</td>
<td>-160</td>
</tr>
<tr>
<td>Arden-Arcade</td>
<td>Rancho Cordova</td>
<td>-260</td>
</tr>
<tr>
<td>Arden-Arcade</td>
<td>West Sacramento</td>
<td>-60</td>
</tr>
<tr>
<td>Citrus Heights</td>
<td>Arden-Arcade</td>
<td>-420</td>
</tr>
<tr>
<td>Citrus Heights</td>
<td>Citrus Heights</td>
<td>-190</td>
</tr>
<tr>
<td>Citrus Heights</td>
<td>Rancho Cordova</td>
<td>-260</td>
</tr>
<tr>
<td>Citrus Heights</td>
<td>West Sacramento</td>
<td>-140</td>
</tr>
<tr>
<td>Sacramento</td>
<td>Citrus Heights</td>
<td>-70</td>
</tr>
</tbody>
</table>

Data source: LEHD 2002 and 2015

Commute numbers are shown in thousands.

Figure 18: The increase in commutes (by any mode of travel) among places in the Sacramento region are shown above. A few commute patterns showed a decrease over the same time period, and these are reported in the table at left.
Market Assessment: Vehicle Ownership

The map at right shows the density of households without any vehicles available in the Sacramento area. Darker areas have more households without vehicles.

There is a striking concentration of zero-car households in downtown and Midtown. Interestingly, if we compare this map to a map of Poverty Density (shown on page 31, and repeated in miniature below), downtown and Midtown do not appear dense with low-income residents. Other neighborhoods are dense with low-income residents, but do not have many zero-car households, such as North Highlands and many places south of Florin.

The largest clusters of neighborhoods that appear to be dense with both low-income residents and car-free households are in Arden-Arcade, along El Camino, and along Stockton Blvd.

Low car ownership is a very good predictor of transit ridership potential, but it isn’t necessarily a sign of a severe need for transit, because (especially in recent decades) some middle-income and high-income households have shifted away from owning private cars.

Similarly, people living at low incomes may absolutely require a personal car, if they live and work in places and at times when transit doesn’t operate, or if they can’t afford to wait for infrequent transit. Low income people living south of Florin, or in North Highlands, appear to be more likely to own cars (based on these two maps) than are low-income people living along Stockton Blvd. This may relate to the usefulness of transit in those places: frequent, long-span transit along Stockton Blvd. (Route 51) may have attracted low-income residents, because it allows them to live and work with fewer cars.

Figure 19: Areas with a higher density of car-free households are shown in darker shades of purple on this map. Some are also areas where a high number of people live at low incomes (mapped on page 31, at miniature at left), as along El Camino or Stockton, while others as not, such as Downtown and Midtown.
Market Assessment: Street Connectivity

Density is the first ingredient in the Ridership Recipe because it answers the most fundamental question that governs ridership: How many potential riders are near any given transit stop?

Walkability is the second ingredient because it governs whether the people nearby can actually reach the transit stop. Street connectivity is fundamental to walkability—it governs whether a walking trip is possible at all, and how long it is. It also has influence over how safe and comfortable a walking trip is, because low street connectivity leads to wider arterial roads and longer distances between safe crossings.

The measure of street connectivity shown in the map at right describes how likely streets are to offer people reasonable-length walks to destinations that are within a straight-line “flying” distance.

The part of SacRT’s service area that development before World War II, when most people got around on foot or by transit, is clearly visible as the darkly shaded areas in downtown, Midtown and East Sacramento, and some neighborhoods just south of Broadway.

Old North Sacramento also stands out, a diagonal cloud of dark blue just north of the river.

To a lesser degree, the Meadowview neighborhood, between Florin and Meadowview Roads, also displays decent street connectivity, because of its numerous connections from the neighborhood to major roads, and its relatively linear streets. This is the largest “new” (post-war) development in the area to offer such contiguous street connectivity, and a nice demonstration that street connectivity is possible in modern suburban developments.

One of the most difficult places on the SacRT network to cross a street, walk along a street, or access nearby development from a bus stop is the area around the Watt/I-80 light rail station in the freeway. This area lights up on this map (in white) because of its terrible street connectivity. In effect, there are no “streets” near the light rail station and transit center, by the standards of normal walking distance, because it is so deep inside a freeway interchange.

Figure 20: Street connectivity governs whether it is possible to walk to a bus stop, and how short and direct that walk is likely to be. The parts of Sacramento that were built before cars were prevalent—downtown, Midtown, East Sacramento and Old North Sacramento—show high connectivity, as does Meadowview.
Examples: Density and Walkability

No ingredient of the Ridership Recipe (described on page 19) is sufficient, by itself, to lead to high ridership relative to cost.

For example, there are places in the SacRT service area that are dense with residents and jobs, but the street network and street design make nearby activities (and bus stops) hard to access by walking. There are places where densities are moderate or low, but the street network makes walking easy.

All of the ingredients in the Ridership Recipe can be found, in different combinations, across the region. The highest ridership results where they are all in effect.

- **Moderate density and excellent walkability:** Pre-war neighborhoods typically have both good walkability, and moderate or high densities. The reason is that they developed before cars, so people need to walk, and they needed to locate within walking distance of one another!
  - The Midtown neighborhood of Sacramento, shown at right, has a very well-connected street network, which is not broken up by freeways (though it is bounded on all sides by freeways). Streets also have sidewalks and many safe crossings. The walk to a bus stop on a major road is as short and direct as it could be.
  - Densities are moderate, and there is a mix of uses. This means that a large number of people are likely to be traveling to or from the area around a bus stop, in both directions, at many times of the day and week.

- **Lower density and poor walkability:** Neighborhoods built for car access typically have lower densities and lower street connectivity, with car traffic funneled to a few very large streets or freeways.
  - The area bounded by Howe, Fulton, Marconi and El Camino in Arcade, shown at right, has low densities, with an auto-oriented shopping center at Fulton and mostly single-family residential development. Blocks are long, with few street intersections, so walking distance to a bus stop on a major road is long and indirect. Because main roads are wider, crossing the street to access a bus stop is likely more challenging.
  - Because density is low, far fewer people are likely to be near any given bus stop.

Figure 21: Higher densities, a mix of uses and many direct walking paths support higher ridership.

Figure 22: In places where densities are lower and walks to a bus stop are long and indirect, ridership will naturally be lower.
Examples: Street Connectivity and Walkability

People will walk farther to more useful transit, but everyone has a limit. The fewer streets go through and connect to one another, the longer walking distances become. In addition, without sidewalks or safe crossings of major streets, people may have to walk yet further to preserve their own safety.

For these reasons, walking distances to and from bus stops can far exceed “flying” distances.

- Areas with high street connectivity provide short and direct paths between any two locations.
- Low street connectivity, common in “walled garden” developments, forces long and circuitous paths between locations, discouraging walking.
- Low street connectivity tends to be accompanied by wide, fast arterial streets, because what few streets do go through have to handle all of the neighborhood’s car traffic.

The illustrations at right show the dramatic differences in walking paths between a bus stop and two housing units the same distance away.

No matter how dense each neighborhood is, and how likely the individuals living there are to use transit, it will be hard to get high ridership out of a place with lower street connectivity because it is simply so much harder for people to access a bus stop.

Figure 23: Street connectivity affects how many people can and will walk to transit. Red lines show the best-case walking paths for access to a bus stop. At 65th and Elder Creek Road, where streets are designed to make few connections, the walking distance is many times as long as the “flying distance.” At 59th and Fruitridge Road street connectivity is higher, so for a bus stop the same “flying distance” away, the walking distance is quite short and direct. On the map below, all areas that are within 1/2 mile walking distance of these two bus stops are highlighted in black.
People do not like to be taken out of direction when they are on their way somewhere. (They may, on the other hand, enjoy riding in circles when they are on vacation!) This is part of the reason that linearity is an ingredient in the Ridership Recipe described on page 19. Routes that are circuitous or deviating can only feel direct to the people who are bound for the deviation itself—for most other people, they feel like a waste of time.

The other reason linearity is part of the Ridership Recipe is that circuitous and deviating routes are simply longer, and therefore cost more for SacRT to operate. In the drawing below, imagine stretching out the lines of the Circuitous and Deviating routes. They would be much longer, and therefore take more time to drive a bus down, than the Direct route.

The longer a route is, the less frequent it can be for the same cost. The shorter a route is, the more can be spent on frequency.

Route 54—Center Parkway: Low Linearity
Route 54 is one of the least productive of SacRT’s all-day services, attracting just 12 boardings per hour on weekdays. It serves one of the region’s biggest transit destinations—Cosumnes River College—but offers only very short rides from the College campus to anywhere else, while other routes connect the College to much more of the region. Because it is U-shaped, anyone not starting or ending their trip at the College would be taking a very indirect trip.

Route 28—Fair Oaks/Folsom Boulevard: High Linearity, Low Proximity
Route 28 is another low-productivity route, attracting just over 12 boardings per hour of service. It provides a very linear and direct trip between Citrus Heights and Rancho Cordova, with moderately dense areas near each end of the route. However, it must cover a very long distance between them, with low densities and therefore few potential riders between them. What ridership it attracts is divided over a lot of distance and therefore a lot of operating cost. Its low productivity arises in part from poor proximity between the denser areas it serves.
People who are living on limited incomes can represent a strong market for transit or a need for coverage service (regardless of ridership), depending on the built environment around them.

A common misconception is that transit, especially all-day transit, is only useful to low-income people who cannot afford a car. People at all points on the income spectrum make choices about how to travel, based on their evaluation of cost, time, safety, comfort and other factors.

The more carefully a person must manage their money, the more attractive transit’s value proposition may be. This doesn’t mean that lower-income people will automatically choose transit because it’s the cheapest option. Transit service must be useful and reliable for the kinds of trips they need to make, to compete for their ridership.

The map to the right shows the density of people in poverty in the Sacramento area. Darkly-shaded areas on this map that are not near other dense areas, and are not arranged in linear patterns, will be difficult for SacRT to serve with useful transit, for simple geometric reasons.

Fortunately, many of the dense low-income areas that appear on this map are in fact arranged in proximate and linear patterns:

- On both sides of Stockton Blvd., especially between Broadway and Florin.
- Along Howe and Fulton in Arden-Arcade.
- Along Franklin and Center, as far south as Cosumnes River College.
- To a lesser degree, along Greenback in Citrus Heights, Florin in S. Sacramento and Folsom in Rancho Cordova.

Density alone, as discussed earlier in this report, is not enough to support high transit ridership relative to cost. If a place is dense but is far away from other dense places, and is difficult to walk in, and requires transit routes to deviate or follow circuitous paths, then those factors will reduce its ridership potential.

This makes the “suburbanization of poverty” an enormous challenge for transit agencies. More and more people with severe needs for transit, living at fairly high densities, are nonetheless in a geographic situation that makes it hard to reach them with cost-effective service. Without intervention, if urban growth causes rents to increase along these linear and proximate corridors, low-income people may be pushed to more distant and scattered developments.

Figure 24: Low-income residents live at high and moderate densities along some corridors where SacRT already offers its most useful and direct services: Stockton Blvd., Folsom Blvd., Florin Road and south of Florin on the Blue Line.
Need Assessment: Seniors

The “Need Assessment” maps in this section show where large numbers of people with severe needs are living in the Sacramento area. Note that Census data is collected based on residential address, not based on workplace or shopping place or place of worship. This data thus shows us where elders, and young people, and people living on low incomes reside. To understand where else they want to go, we will rely on the local knowledge of the public, stakeholders and SacRT staff.

A major value of transit coverage is providing service for people who cannot drive, no matter where they live. This need can particularly acute among seniors.

The map at right shows the density of residents over the age of 65 in the Sacramento area. Unlike residents living in poverty (shown on the map on the previous page), seniors do not tend to live at high densities along any particular corridors or in any large areas. There is a low density of seniors living in the Pocket, and some moderate-density Census blocks appear in downtown and Midtown, but otherwise seniors live at low or moderate densities across the residential areas of the entire region.

Seniors’ needs and preferences are, on average, different from those of younger people.

- Seniors are more likely to be discouraged by long walks, because of limits on their physical ability, or concerns for their personal safety.
- Seniors are less likely to be discouraged by long waits for transit, because they are less likely to be employed or in school.
- For the same reason, seniors are, on average, less likely to be discouraged by slow or indirect routes that take them out of their way.

Because of these factors, transit service designed primarily to meet the needs of seniors rarely attracts high overall ridership. Most riders who are employed, in school or caring for kids in school will find service with long waits to be intolerable. Thus, the amount of focus that transit agencies place on meeting the needs of seniors must be thoughtfully balanced with the needs and desires of the rest of the community.

Figure 25: Areas with high numbers of senior residents are scattered around the region. Very few overlap with areas where many residents are living in poverty (shown on the previous page). On average, seniors tend to dislike walking to transit, but tolerate waiting for transit, more than the rest of the population.

Density of Seniors
Sacramento, CA

- under 1,000
- 1,000 - 2,000
- 2,000 - 4,000
- over 4,000

Data Source: 2012 - 2016 American Community Survey 5-Year Summary File.
Need Assessment: Youth

Just as transit coverage can meet the needs of seniors who cannot or choose not to drive, transit coverage can also meet the needs of children and teenagers who are too young to drive.

The map at right in Figure 26 shows the density of residents under the age of 18 in the Sacramento area.

Young people are like seniors in that they often live on a tighter budget than people of working age. For this reason, both are very sensitive to transit fares, and parents are sensitive to paying a fare for each child.

However, young people and seniors are very different in their ability and willingness to walk to transit service. Most young people can and will walk farther to reach service than seniors.

Whatever effect an increase in price has on ridership among working age people, it will have an even stronger effect on ridership among young and old people. (This is why most transit agencies, along with movie theaters and other for-profit businesses, offer a discounted price for seniors and children.)

A few large areas and long corridors have noticeably high or low density of young people:

- Downtown and midtown are home to very few young people.
- Some neighborhoods south of Florin are fairly dense with young people, including places along the Blue Line light rail.
- North Highlands and Antelope are relatively dense with young people, in particular along Walerga Road.
- El Camino, east and west of I-80, runs past many high-youth neighborhoods. Other areas in Arden-Arcade are also dense with young people.
- Stockton Boulevard has moderate densities of young people living on either side, but the densities are continuous and proximate, all the way to Elk Grove. To a lesser degree, the same can be said of Franklin Boulevard.

Figure 26: This map shows areas where many young people live. While young people live all over the Sacramento area, they are concentrated away from Downtown and Midtown. Some of the same areas that appear dark on the map of poverty density (on page 31) also appear on this map.
Civil Rights Assessment: Race or Ethnicity

The map at right shows where people of different races and ethnicities live in the Sacramento area. Each dot represents 50 residents. Where many dots are very close together, the overall density of residents is higher. Where dots of a single color predominate, people of a particular race or ethnicity make up most of that area’s residents.

After the 2010 Census, researchers found that the Sacramento area is both very diverse and very integrated. Not only do many people of different races and ethnicities live here, but they are also highly likely to live within integrated neighborhoods. In fact, of the 100 largest cities in the U.S., Sacramento is the second-most integrated at the neighborhood scale. This would mean that wherever SacRT provides service, it is very likely to be covering people of different races and ethnicities.

While information about people’s income tells us something about their potential interest in or need for transit, information about ethnicity or race do not alone tell us how likely someone is to use transit. However, avoiding placing disproportionate burdens on people of color, through transportation decisions, is essential to the transit planning process.

Transit agency policies that protect non-white people from negative impacts are one type of coverage goal. Such policies might state, for example, that service to high-density and high-minority neighborhoods should be prioritized even if such service would not maximize ridership.

In addition to local policies, federal civil rights law protects people from discrimination in the provision of transit service on the basis of their race or ethnicity. It is important to understand where large numbers of non-white people live, so that service changes can be evaluated in light of impacts to protected people.

1 The research results are summarized at fiveThirtyEight.com/features/the-most-diverse-cities-are-often-the-most-segregated/.
Civil Rights Assessment: Race or Ethnicity

It is encouraging to observe the lack of racial disparity in how the existing network covers Sacramento-area residents. The chart at right shows the percentage of residents near any service, and frequent service.

Non-white residents are just as likely as all residents to be close to some transit service. Low income residents are slightly more likely to live close to some service. This may relate to how well-integrated the SacRT service area is by race and ethnicity.

These conditions are not static and may change in coming years as a result of a changing economy and a changing city. If increasing housing demand near transit and in urban areas is not matched by increases in the supply of housing, then people living on low incomes may move to seek lower rents and property prices. Whether or not this is a consequence of growth and the desirability of urban, walkable areas depends on land use planning, growth permitting and affordable housing policies at local jurisdictions.

Paratransit

While the SacRT Forward Network Plan is focused on the fixed-route bus network, we will be aware of some of the ways that changes to the fixed-route system can impact a transit agency’s paratransit service obligations or practices.

SacRT provides demand-responsive transit for people with disabilities, for trips beginning and ending within 3/4 mile of a SacRT bus route or light rail station. This “complementary paratransit” is required by the FTA for transit agencies to comply with the 1992 Americans with Disabilities Act.

SacRT’s Complementary ADA Paratransit has been provided through a contract with a local non-profit, Paratransit, Inc., since 1992.

Paratransit and Network Redesign Efforts

Major transit network redesigns can effect paratransit by changing the extent and hours of operation of service. Extending routes to new portions of the service area, or running service later into the evenings or during more of the weekends, can increase the period and area over which paratransit service must be provided.

On the other hand, reducing the coverage area of the fixed-route network has the potential to reduce the area an agency is obligated to provide complementary ADA service across. But, sometimes agencies that remove an area from transit coverage where paratransit customers live will provide continued eligibility for those customers for a set period of time. While it is not a central element of the choices for the transit network in the Sacramento area, changes to the fixed route network may affect who is eligible for paratransit service and therefore any changes in that network must also consider the impacts to paratransit service.

It is important to note that in most places, paratransit demand is increasing faster than general population growth or transit ridership growth. This is primarily due to general increases in the average age of the population. In addition, paratransit rides typically cost 4–8 times as much to deliver as do trips on fixed route buses and trains. Thus, one should expect that even if no changes were made to the SacRT fixed route transit network in the next 5–10 years, the paratransit eligible population and ridership would likely rise, and as a result, the costs of providing paratransit would rise.

Figure 28: Coverage by any transit, and frequent transit, does not vary much by residents’ race or ethnicity. People living at lower incomes, however, are slightly more likely to be covered by transit than people living at higher incomes.
3 Land Use Challenges
Recent Changes in Residential Density

Between 1990 and 2016 the population of Sacramento County increased 42% from 1.04 million to 1.48 million. The map at right summarizes changes in residential density that occurred with this growth. Anyone who lives in the Sacramento area is probably aware of the growth that has taken place in North Natomas, in Elk Grove, in Folsom and in North Highlands, which all appear in moderate or dark green on this map, having gained many thousands of residents. Most of these growth areas are not dense (as we can see from the map of existing residential density on page 20, repeated in miniature below) but they have densified the most since 1990.

Other areas closer to the center of the region, and closer to the existing transit network, have also grown slightly, as shown by the patchwork of light green throughout the urbanized parts of the region. (Some additional growth has taken place since 2016, and is not shown in this map.) This map also reveals that some parts of the region have lost residents since 1990, including areas close to the center of the city and the transit network.

While none of this population loss has been severe, it is nonetheless troubling if SacRT wishes to maintain or grow its transit ridership within a fixed budget. Developed places that are close to one another are much less expensive to connect with useful service than are developed places far from one another. Within a fixed budget, if development takes place far from the transit network, the frequency and span of the service SacRT can provide over that lengthening distance will go down.

Figure 29: In-fill development within the core of the urban area and the core of the existing transit network has been sparse (shown in green), and some inner neighborhoods have lost residents (shown in pink).
Changes in Residential Density around Light Rail Stations

In the map at right, 1/2 mile circles around light rail stations are overlaid on the same data shown on the previous page. A few light rail station areas have seen mild increases in residential density, mostly those south of 47th Ave in South Sacramento and Elk Grove. Most other stations, with a few exceptions, have seen little net change. (Any very recent changes, since 2016, will not appear here.)

The first light rail lines in Sacramento opened in 1987, twenty years ago. The change represented on this map, from 1990 to 2016, nearly matches the lifetime of those first lines and stations.

Even within the City of Sacramento, the vast majority of residential growth from 1990 to 2010 occurred in single family homes (as shown in Figure 31, below). If the local jurisdictions in SacRT’s service area continue to add predominantly low-density housing, away from light rail stations and existing bus routes, then the potential for high ridership within SacRT’s existing service budget will not grow.

Some local cities are pursuing in-fill development around light-rail stations, and the City of Sacramento is working to increase multi-family development, especially in downtown and midtown.

Figure 30: Around light rail stations, mild residential growth has happened along the south Blue Line and in outer Rancho Cordova and Folsom. Most other station areas have seen little increase in residents, or even a decrease in residents.

Figure 31: Of the housing added in the City of Sacramento from 1990 to 2010, 81% was in single-family homes (R1 zones).
**Forecasted Future Residential Density**

The map at right shows how the existing planning and zoning for the cities and County may be reflected in residential development by 2036. This forecast is not a given, but is a helpful visualization of the direction in which the region’s growth seems to be headed.

Because this forecast was created in 2009, in the depths of the Great Recession, some of the growth envisioned by 2036 has already taken place. This is particularly true for residential areas in south Sacramento, Elk Grove, North Natomas and North Highlands. (The existing residential density of the area is shown in the map on page 20, and repeated in miniature below using the same color scale.)

The large-scale patterns of residential density forecasted for 2036 are not different from existing patterns. A few corridors do appear to fill in some gaps, such as Folsom Blvd. in Rancho Cordova, and Power Inn Road between the river and 14th Ave. One new corridor appears, which is Jackson/Folsom south Rancho Cordova to Howe Ave.

This forecast was prepared in 2014 and adopted by the Sacramento Area Council of Governments (SACOG) in 2016. While SACOG also forecasted job density for the year 2036, so much job growth has happened since 2009 that the forecast is clearly no longer realistic. Job and residential growth forecasts are currently being updated by SACOG.

---

Figure 32: Residential growth can be forecast based on existing land use plans and regulations. This map shows such a forecast for year 2036, though in the years since the forecast was prepared, some growth projections have already been met or exceeded.
Recent Changes in Job Density

The map at right summarizes changes in job density from 2002 to 2014. It is important to keep in mind that jobs represent not only employment, but also commercial, civic and entertainment destinations for many people who do not work there.

In this time period, there was growth in some outer suburban cities. These areas are not nearly as dense as downtown Sacramento (as shown in the map of job density on page 21, and repeated in miniature below), but they have grown the fastest.

There has been job growth in the very center of downtown Sacramento, as shown in this map, and in addition the Arena and related developments took place after the data reflected in this map was collected. At the same time, parts of Midtown and downtown have lost some jobs, as have neighborhoods close to downtown (along Riverside, Franklin and Stockton).

A few areas of very severe job loss are noticeable. These may be due to the closure of one or a few large employers.

For the same reasons described on the previous page, if developments move farther apart, SacRT will have to sacrifice frequency or span in order to deliver service over longer distances. SacRT does not control the zoning or permitting processes that determine where growth is located, yet the potential for ridership is very strongly influenced by these processes.

Figure 33: A great deal of job growth has occurred at the periphery of the existing SacRT transit network, compared to job growth in locations served by the existing network. Spreading a fixed amount of transit service farther means spreading it thinner.
Changes in Job Density around Light Rail Stations

The map from the previous page is repeated here with light rail station areas circled, to draw attention to the change in job density around SacRT’s biggest capital and operating investment.

Some station areas have seen a mild increase in job density. Others have seen little net change, or even a mild decline in job density.

(This map shows changes in density through 2014. More recent commercial and employment developments, or closures, will not be reflected in this data. The Kings’ Arena is one example.)

The lack of strong residential and job growth around most light rail stations has surely contributed to the decline in light rail productivity over the past 20 years (illustrated by the graph in Figure 35, below).

It is not a given that the Sacramento region should be investing and growing around light rail stations. There are reasons that people might prefer to see growth at the periphery more than at the center. However, if growth does not happen in places where SacRT and others have made a huge investment in transit, then high transit ridership relative to cost is not a reasonable expectation.

Some local cities are actively pursuing in-fill development around light-rail stations, which may affect this trajectory.
Freeway-Oriented Development

Some of the densest development in the Sacramento area is oriented to freeways. This “Freeway-Oriented Development” strategy reduces SacRT’s ability to provide transit service that is both useful and cost-effective.

This pattern is visible in the map of Activity Density on page 23. Dense, developed areas seem to be arranged in a linear and proximate pattern—but the line along which they are arranged is a freeway. One of the ingredients in the Ridership Recipe is linearity, but only if the line being followed is one along which buses can serve stops, and people can access those bus stops. Neither is true of the freeways in Sacramento—buses running down the freeway are walled off from potential riders, and must exit the freeway and loop around to serve stops. For transit, freeways are barriers, not corridors.

There are two major consequence of this “Freeway-Oriented Development” pattern. The most obvious consequence is that development concentrated near freeway exits and entrances requires people to walk in unsafe and unpleasant conditions to access transit service. This will naturally suppress transit ridership at those bus stops below what it could otherwise be.

There is a second-order consequence, which is just as serious. SacRT and other transit agencies in this situation respond quite reasonably by making sure that neighborhoods on both sides of the barrier have access to transit. This means running two routes, instead of one. For example, Routes 86 and 88 both cross the I-5 bridge from South Natomas into downtown. They each come every 30 minutes. They both get fairly high ridership relative to their costs.

With these two routes crossing the same bridge to get to the same general area, SacRT could (in an alternative universe) offer a 15-minute “trunk” service that splits into two 30-minute “branches.” This would give people a short wait for service across the river on the “trunk.” But this cannot happen because Route 88 must cover development west of the freeway, while Route 86 covers development east of the freeway. They cannot serve a shared “corridor” or even a single shared stop on their way to downtown. The transit service is divided by the freeway, even as it serves the development that lines the freeway.

To a lesser degree, the same is true in North Natomas, where the Natomas Flyers (Routes 170-173) cover both sides of the freeway. Development in North Natomas is not as concentrated right next to the freeway as in South Natomas—more is concentrated around roads like Truxel, that are reasonably linear. However, additional development is planned around the freeway in North Natomas for the future.

Dividing a fixed quantity of service into more routes means that routes have worse frequencies (or shorter spans of service) than they otherwise could. Imagine instead that freeway-oriented developments were concentrated to the same degree along arterial roads. Then SacRT could run routes straight down arterials, and provide service that is accessible to people and jobs on both sides of the road. Focusing service onto fewer routes would mean each route can run later at night, and on the weekend, and at higher frequencies.

This is exactly how land use, transportation and transit planning harmonize along Stockton Blvd., where SacRT’s ability to provide long-span frequent service (Route 51), which offers useful, direct service to large numbers of people on both sides of the road. The result is high productivity and, for the residents along Stockton Blvd., greater access and freedom.

1 Nowhere is this clearer than on Watt Ave. north and south of I-80, where getting to bus stops from nearby development requires very long, unpleasant walks and treacherous crossings of free-flowing freeway ramps. This is a general challenge for most freeway-running light rail lines: to get to stations, riders must walk through territory optimized for driving, not walking.
4 Existing Financial Conditions
Existing Financial Conditions

SacRT currently enjoys a relatively strong financial position. The agency has sufficient committed revenues to fully fund its operations and meet the local match needed for its federal capital grants. The agency has recently adopted several financial policies intended to promote financial stability through improved fiscal management. To that end, SacRT implemented a system-wide fare increase in July 2016 to balance the budget and build financial reserves.

RT has been incrementally restoring service levels that had been substantially reduced due to the economic recession in the late 2000s. On the capital side, SacRT opened the South Line Phase 2 light rail extension in 2015, and will soon start construction of the Downtown/Riverfront Streetcar Project (which is funded by a number of agencies, but for which SacRT will lead design, construction and operation).

Like many transit agencies, however, SacRT may face future financial uncertainty due to the possibility of increasing costs, trends of declining ridership, and potential revenue challenges. The agency has implemented numerous successful operating cost management programs in recent years, but future cost growth of unknown magnitude is possible. SacRT is undertaking this route optimization study in an effort to improve ridership in response to the industry-wide declines in ridership. And, while new funding programs have been enacted by the State of California, an effort is underway to repeal the recent gas tax legislation.

RT has significant capital needs on the horizon, including replacement of the original light rail vehicle fleet, bus replacements, and maintenance of the light rail infrastructure. SacRT is well-positioned to evaluate and apply for capital funding opportunities, though the nationwide demand for capital funding results in a highly competitive funding environment. SacRT’s assumptions about future revenues, from fares and from local tax sources, are fairly ambitious and optimistic compared to historical revenues and compared to other sources of forecast assumptions.

Planned Operating and Maintenance Expenses

The adopted Fiscal Year (FY) 2018 operating budget is $161.3 million. Salaries and benefits for staff directly associated with operations make up approximately 68% of SacRT’s operating expenses. This cost category includes wages and benefits for 1,039 SacRT employees, including fixed route vehicle operators, maintenance personnel, management, and administrative staff.

RT uses an outside contractor to provide its paratransit services, which are included in the Professional Services element of the budget, for 15% of the annual expenses. Other Professional Services include some transit security costs, equipment maintenance, facilities maintenance, legal services, and services provided by outside consultants.

Materials and Supplies make up approximately 6% of the budget, and include fuel, bus and light rail parts, small maintenance tools and equipment, cleaning supplies, printed materials, and general office supplies.

Expenditures for utilities, insurance, liability, and other miscellaneous costs comprise the remaining 11% of the annual budget.

A review of the total operating cost per revenue hour (for the combined bus and rail service) based on the data presented in SacRT’s Comprehensive Annual Financial Report (CAFR) shows that SacRT’s operating costs have fluctuated on an annual basis during the last ten years. Overall, the hourly operating cost for all services (bus, rail and Community Bus) has risen from approximately $169 per hour in 2008 to $198 in 2017, an increase of 17% over ten years. This translates to an average annual increase of less than 2%, which is consistent with inflationary growth.

SacRT’s Financial Forecasting Model (FFM) assumes a future growth rate of 2.5% per year for inflation and labor costs. The budget for FY 2018 projects an increase in the hourly operating cost of 1.7%, to approximately $201 per hour.

In the graphs at right in Figure 37, SacRT’s costs to deliver an hour of service on light rail or bus is compared to agencies in peer cities, from 2005 to 2016. All peers have experienced inflation in costs over this period, and Sacramento’s rate of cost growth has been similar to that of the peer group. SacRT’s current unit costs for light rail and bus are firmly in the center of the range established by these peer agencies.

Planned Capital Expenditures

SacRT’s capital budget for FY 2018 is $324.4 million.

SacRT’s capital budget includes several categories of expenses, including: Project Development, Fleet, Infrastructure, Facilities, Equipment, and Transit Security & Safety.

More than 70% of the annual capital budget, or nearly $250 million, is dedicated to project development activities. This includes planning, design and construction of projects that will extend bus and light rail services and capabilities. A large portion of these project development funds ($200 million) represents funding from many other agencies for the Downtown/Riverfront Streetcar, for which SacRT will lead design and

1 As of the fourth amendment in November 2017.

SacRT’s current budget also includes approximately $20 million for the fleet program, which covers vehicle replacements, refurbishments, and overhauls.

Many of the investments and projects in the capital budget will be designed, procured, and/or constructed over several years. The annual budget is a single-year slice of an ongoing program of projects that are planned during the next thirty years, as well as a more detailed near-term five-year plan. The projects are prioritized into five tiers based on construction.

SacRT Forward Network Plan
Transit Choices Report

Figure 37: These two graphs show SacRT’s operating cost to deliver one hour of revenue service on light rail (at top) or full-sized buses (at bottom) from 2005 to 2016, in comparison to peers. SacRT’s total cost to deliver an hour of service per rail car has remained relatively stable, while the total cost of bus service has grown at a similar rate as peer costs. Data source: National Transit Database.

SacRT Forward Network Plan
Transit Choices Report
need and funding availability. The SacRT Board most recently approved the Five-Year CIP in November 2017. As noted previously, the near-term plan includes significant spending to replacing aging light rail cars and buses.

Anticipated Revenues
SacRT’s revenues come from a variety of sources: federal, state, and local taxes and programs, as well as funds SacRT raises through fares, advertising, and miscellaneous other sources.

SacRT’s financial forecasts assume the following, starting in FY 2021:

- The average fare paid per passenger (whether through a pass or a ticket) will grow by 5% every two years.
- Productivity (boardings per revenue hour) will increase by 1% every year.
- Service levels (total revenue hours) will be increased thanks to a new sales tax (as described under “Local Funds” below).

If fares do indeed increase at this rate (5% every two years), and if operating costs increase no more than forecast (2.5% per year), and if ridership stabilizes, then farebox recovery will remain stable.

These assumptions about fares, fare revenues and ridership are under review by SacRT staff, and may be revised in future forecasts and budgets.

Since FY 2011, SacRT’s fare revenues have covered a declining share of operating costs, though the actual fare revenue collections have fluctuated year-to-year. This trend is consistent across many cities as they experience declining ridership, which leads to declining farebox recovery; and continued cost inflation.

Fare revenue is a more stable source of local revenue for transit than is sales tax revenue, which rises and falls cyclically. California transit agencies tend to rely heavily on fare revenue in part to counteract cyclical sales tax revenues.

SacRT uses a significant portion of its FTA 5307 formula funding in its operating budget.

RT’s other sources of Federal operating funds include Congestion Mitigation Air Quality (CMAQ) revenue for South Line Phase 2, and Section 5337 State of Good Repair funding.

On the capital side, SacRT’s CIP summarizes the federal funding sources as follows:

- Section 5309 Bus Discretionary: These funds are for bus purchases and bus support facility projects. (This funding program has been superseded by the Section 5339 program, described below.)
- Section 5337: State of Good Repair: This grant program supports replacement and rehabilitation projects, or capital projects required to maintain public transportation systems in a state of good repair.
- Section 5339 Bus and Bus Facilities: Bus discretionary program is to replace, rehabilitate and purchase buses and related equipment and to construct bus related facilities. A sub-program provides competitive grants for bus and bus facility projects that support low and zero-emission vehicles.
- Highway Discretionary Funds: These funds are distributed for a variety of transportation planning, construction and equipment acquisition needs. Projects are approved for funding by local agencies and forwarded to appropriate state and federal agencies for funding authorization. Funds in this category include Surface Transportation Program (STP) and Congestion Mitigation/Air Quality (CMAQ) Program.

RT has been successful in securing Federal discretionary funds for its major projects, in particular FTA New Starts funds for light rail extensions. The Downtown/Riverfront Streetcar, for which SacRT will lead design and construction on behalf of a consortium of other agencies, is in the FTA Small Starts pipeline.

In recent years, the opportunities for transit agencies to obtain federal capital funding have declined. Federal transportation funding has not kept pace with demand. This trend is most visible in the looming insolvency of the Highway Trust Fund, and the current Administration’s emphasis on reduced federal shares for discretionary funding programs.

There is an expectation that states and local jurisdictions will be financially responsible for maintaining and replacing their capital assets, as well as supporting their transit operations. As a result, there is pressure on transit agencies to reserve more of their FTA 5307 formula funds for

JARRETT WALKER + ASSOCIATES

SacRT Forward Network Plan
Transit Choices Report | 45
ongoing capital costs such as vehicle replacements.

California state funds
The State of California provides several sources of operating and capital funds for transit, both in formula and discretionary programs.

The major sources are the California Transportation Development Act Local Transportation Fund (TDA-LTF), the Transportation Development Act State Transit Assistance Program (TDA-STA), Cap-and-Trade Low Carbon Transit Operations Program (LCTOP), and the Transit Intercity Rail Capital Program (TIRCP).

The formula-based TDA-LTF and TDA-STA funds can be used for both operations and capital expenditures. Under the state’s cap-and-trade greenhouse gas reduction program, the formula-based LCTOP program funds operations and capital projects, and TIRCP is a competitive discretionary program for capital projects.

TRANSPORTATION DEVELOPMENT ACT
California’s transit agencies rely heavily on the TDA-LTF and TDA-STA (described above), which together provide nearly $50 million in revenue for SacRT’s FY 2018 budget.

The TDA-LTF funds are generated through a quarter-cent sales tax in every county in the state, and are returned to their county of origin to be shared among the local transit operators. The TDA-STA funds are generated through taxes on the sale of diesel fuel, and are distributed based on a formula that includes population and transit fare and other revenues.

Both TDA fund sources can be used for operations and capital expenses. However, SacRT’s practice is to use the TDA-LTF and TDA-STA for operations.

Transit agencies can “bank” their TDA revenues for future capital needs. As a result, the TDA funds are typically a relatively stable source of funds from year to year. However, these revenues are subject to market forces, and sales tax revenues in particular are sensitive to economic conditions.

TDA-LTF and TDA-STA funds make up approximately 25% and 6% of SacRT’s annual operating revenue, respectively. Like SacRT, SACOG forecasts future growth in transportation revenues, and it can be informative to compare the two agencies’ forecasting assumptions.

RT’s Financial Forecasting Model (FFM) and the 2016 Metropolitan Transportation Plan (2016 MTP) prepared by the Sacramento Area Council of Governments (SACOG) includes assumptions about future growth rates for both TDA-LTF and TDA-STA revenues. The following table summarizes the previous actual growth rates for these two state funding sources, the growth rates assumed in SacRT’s FFM, and the growth rates assumed in SACOG’s MTP.

<table>
<thead>
<tr>
<th>Actual and Assumed Growth Rates for California (TDA) Revenues</th>
<th>TDA-LTF</th>
<th>TDA-STA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SacRT 10-Year Actual (2009—2018)</td>
<td>2.3%</td>
<td>9.9%</td>
</tr>
<tr>
<td>SacRT FFM Assumption</td>
<td>4.8%</td>
<td>4.2%</td>
</tr>
<tr>
<td>SACOG 2016 MTP Assumption</td>
<td>3.5%</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

Both SacRT’s and SACOG’s forecasts for LTF revenue growth are greater than the actual growth during the last decade. However, the 10-year actuals include the effects of the Great Recession of the late 2000s, which resulted in year-to-year changes in LTF revenues ranging from a drop of 22% in 2009 followed by a similar increase two years later. This year, SacRT’s LTF revenues are projected to reach their pre-recession level for the first time since FY 2007.

SacRT and SACOG’s financial forecasts both assume a lower rate of annual growth in STA revenues than the average for the last ten years, which was 9%. This average covers a decade of volatility in STA funding, with annual changes that include reductions by 60% to increases that more than doubled the year-to-year STA funding available to SacRT. This volatility was due to allocation decisions made by the State of California that transferred the STA diesel tax revenue away from the transit agencies to fund other state needs. Future STA funding is anticipated to stabilize, thanks to legislative changes in 2017 related to the distribution of these funds.

While the 2016 MTP forecast for STA revenue growth is greater than SacRT’s assumption, STA is a smaller revenue source than LTF.

If the actual growth rate of TDA-LTF revenue is lower than SacRT’s assumption, and is closer to either the SACOG assumption or the historic growth rates, SacRT may not meet its planned operating revenue needs.

SENATE BILL 1
California’s legislature recently enacted SB1, the Road Repair and Accountability Act of 2017. This gas tax and transportation fee increase is expected to provide more than $50 billion in new transportation revenue for California in the next ten years.

SB1 includes a substantial increase in transit funding throughout the state. A significant portion of the new revenue flows through the existing LTF-STA funding formula.

RT’s FY 2018 operating budget includes an additional $3 million from SB1 funds. Some of the additional SB1 funding is used for local match to federal capital grants.

SB1 also provides new revenue for other competitive discretionary programs, including the following:

- Transit and Intercity Rail Capital Program (TIRCP)
- Solutions for Congested Corridors
- State and Local Partnership for Self-Help Counties
- Active Transportation Program

RT can apply for funds for eligible projects under these programs. SacRT has been awarded $30 million in TIRCP funds for the Downtown/Riverfront Streetcar project, and has recently applied for more than $300 million in TIRCP for new light rail vehicles, increased light rail frequencies, and infill light rail stations.

Not all Californians are pleased with the new gas taxes, and a repeal effort is underway. An initiative for a constitutional amendment may appear on the November 2018 ballot that would effectively repeal SB1, unless and until it were passed by a majority of California voters. The repeal of SB1 would have a substantial negative impact on SacRT’s ability to fund its planned future services and capital needs.

LOW CARBON TRANSIT OPERATIONS PROGRAM (LCTOP)
California’s cap and trade program for greenhouse gas emissions generates funds for a variety of uses, including transit operations and capital projects under the LCTOP program.

As described by Caltrans, “The LCTOP was created to provide operating and capital assistance for transit agencies to reduce greenhouse gas emission and improve mobility, with a priority on serving disadvantaged communities. Approved projects in LCTOP will support new or improved bus and rail services, expand intermodal transit facilities, and may include equipment acquisition, fueling, maintenance and other costs to operate those services or facilities, with each project reducing greenhouse gas emissions. For agencies whose service area includes...
disadvantaged communities, at least 50 percent of the total moneys received shall be expended on projects that will benefit disadvantaged communities.”

LCTOP funds are generated through cap and trade auction proceeds, and have fluctuated a great deal from year to year. SacRT’s FY 2018 operating budget includes $875,000 in LCTOP funds. In comparison, the FY 2017 operating expenditures totaled nearly $1.9 million. Sacramento includes several disadvantaged communities. As such, at least half of SacRT’s LCTOP funds must be spent on services or projects in those areas.

OTHER STATE CAPITOL FUNDING PROGRAMS

The State of California has developed numerous other capital funding programs, including the cap and trade Affordable Housing and Sustainable Communities Program (AHSC), State Transportation Improvement Program (STIP), Proposition 1A: The Safe, Reliable High-Speed Passenger Train Bond Act Funds, and Proposition 1B (PTMISEA and Transit Security) Funds. SacRT staff evaluate whether their capital projects are eligible and competitive for these funding programs, and apply for funds for specific projects as appropriate.

Local Funds

RT’s primary source of local funding is Measure A, a dedicated transportation sales tax in Sacramento County. Measure A provides approximately 24.7% of SacRT’s annual operating revenue. The current Measure A quarter-cent sales tax was approved in 2004, and expires in 2039.

The 2004 Measure A legislation also authorized the implementation of impact fees. The program directs 20 percent of developer fee revenues to transit capital improvements.

RT’s FY 2018 operating budget includes $29.8 million in Measure A revenue, and this revenue source is also used for several capital projects. Because it is a sales tax, Measure A revenues fluctuate with the economy. Measure A revenue has grown steadily since 2009, when there was a huge one-year drop of 27% during the recession. This and other funding shortfalls triggered severe service cuts from 2009–2011.

RT’s Financial Forecasting Model (FFM) assumes 4.8% growth in Measure A revenues per year. During the last ten years, the average annual growth rate was slightly less, at 4.2%. In comparison, the 2016 Metropolitan Transportation Plan prepared by SACOG assumes a future annual growth rate of 3.5% for Measure A funds.

Historical growth rates in Measure A revenue and SACOG’s assumptions about future growth in Measure A revenue are both lower than SacRT’s budgetary assumption.

If Measure A revenues do not grow as fast as SacRT assumes, the agency may face challenges in balancing its annual operating and capital budgets.

In an effort to raise additional transportation funds for Sacramento County, Measure B was placed on the November 2016 ballot. However, the measure did not receive the two-thirds super-majority of votes required for passage.

Efforts for another sales tax ballot measure continue, and SACOG’s 2016 MTP assumes that there will be a new revenue source equivalent to a half-cent sales tax beginning in 2020. SacRT’s FFM assumes that $10 million in revenue for transit will result from this new sales tax.

Contracted Services

RT has entered into contracts with several jurisdictions to provide transit service, including the Cities of Citrus Heights, Elk Grove, Folsom, Rancho Cordova, as well asMcClellan and the North Natomas TMA.

The revenue that these jurisdictions pay SacRT appears as “Contracted Services” operating revenue in the annual budget.

This funding source is stable, though it can fluctuate with the level of service provided through the contracts.

RT is continually refining its cost allocation model, and has found that not all of its existing contracts with these partners cover the fully-allocated operating costs of the services SacRT provides. Revenue from the North Natomas TMA covers about 51% of the costs of the Natomas Flyers; revenue from Rancho Cordova covers about 65% of the costs of the Cordovans; and the McClellan TMA covers about 24% of the costs of the Route 85 McClellan shuttle. See Figure 68 on page 87 for the full accounting.

Other Funds

About 2% of SacRT’s operating funds come from miscellaneous sources like investment income, commercial real estate leases, advertising income, bus book sales, fare evasion fines, promotional item sales, photo identification activities, and parking revenue.

Project Financing

RT is able to issue debt to fund capital projects as well as to continue to advance projects prior to the receipt of grants. As described in its Five-Year CIP:

“SacRT has expanded its financing capabilities through the passage of AB 1143, legislation which allows SacRT to directly issue Revenue Bonds without the involvement of a third party issuer. SacRT issued $86,865,000 in Farebox Revenue Bonds in November 2012. In addition to having provided advance funding for TCRP funds on the South Line Phase 2 project, the Revenue Bonds will provide funds for a limited number of other time-sensitive capital projects including bus, non-revenue vehicle and equipment replacements.”

In 2017, SacRT received TCRP funds to pay off $36 million of the $87 million in Farebox Revenue Bonds, originally issued in 2012 to fund the South Line Phase 2 project. These funds appear in the FY 2018 capital budget.
5 Network and Route Performance
People ride transit if they find it useful. High transit ridership results when transit is useful to large numbers of people.

A helpful way to illustrate the usefulness of a network is to visualize where a person could go using public transit and walking, from a certain location, in a certain amount of time.

The map at right shows someone’s access to and from downtown, near the Capitol, at noon on a weekday. Areas they can reach in less than 60, 45 or 30 minutes are shown in orange, red and purple, respectively. The technical term for this illustration is isochrone.

A more useful transit network is one in which these isochrones are larger, so that each person is likely to find the network useful for more trips.

In drawing these isochrones, time is allocated for walking to and from bus stops.

Isochrones account for time spent waiting for a bus or train (either at the start of the trip or at the destination), and any time required to make a connection to another line. As described earlier in this report, if someone is transferring to a route that comes every 60 minutes, and the connection is untimed and therefore at random, they will wait on average one-half of the headway: 30 minutes. The average wait for a bus that comes every 20 minutes will be 10 minutes. Thus a great deal of SacRT bus customers’ travel time is used up by waiting for their bus (or waiting at their destination, because the infrequent bus gets them there too early).

The Capitol has the best transit access in the region, because it is at the center of the radial transit network, and in particular because it is at the center of the frequent radial network (which consists of the Blue and Gold light rail lines, and Routes 30 and 51).

The power of light rail’s frequency and speed can be seen in this isochrone. The Blue Line to the south brings many neighborhoods (along Florin, for example) within a 45-minute commute of downtown. The same is true of some areas around Folsom Blvd. in Rancho Cordova, though the poor street network along that road limits how far people can walk from light rail stations.

Similarly, the power of frequent bus lines can be seen in this isochrone. The red “arm” extending down Stockton Blvd. shows how far someone can get on Route 51, because they don’t have to spend much time waiting. The red blob in midtown extends east to Sac State because Route 30 on J Street requires little waiting.

Speed is also visible in the 45-minute area of this isochrone. Routes 86 and 88 cross the I-5 bridge and run on Silver Eagle and El Camino, respectively. Despite requiring, on average, a 15 minute wait (they come every 30 minutes), they can get people far from the Capitol within 45 minutes, because they move so quickly out of downtown and over the bridge.
The isochrone at right shows someone’s access from the intersection of Arden & Fulton.

On page 71, we note that the Arden-Arcade is one of the few close-in areas without a radial route, despite being dense with residents and jobs. This isochrone reveals the absence of a radial route to Arden-Arcade—very little of downtown is reachable within 60 minutes, despite its proximity.

This isochrone also makes visible the combined frequency of Routes 80 and 84 on Watt Ave. SacRT designed and scheduled these two hourly routes to offer a combined 30-minute frequency on Watt Ave. In addition, unlike many other routes, they run through a transit center and a long ways beyond it. For these reasons, they offer substantial access north and south through this part of town. The red “arm” extending north represents how far someone could get by walking 1/2 mile from Fulton east to Morse Ave., and waiting an average of 15 minutes for either Route 82 or 84.

The isochrone also shows the effect of the grid of 30-minute routes in Arden-Arcade. While a grid allows someone to travel from almost anywhere to almost anywhere, at 30-minute frequencies travel times include a lot of waiting. For example, the 30 minute isochrone is mostly the area accessible by walking, and the north-south arms of Route 26. In 45 minutes you can begin to reach destinations further east and west. Transferring to Route 23 allows you to travel just barely farther east on El Camino than walking alone. The advantages of transferring to Route 23 on El Camino don’t really become visible until you’ve traveled longer than 45 minutes (the orange arm to the east that hook north on Manzanita.

Figure 39: Access to and from the intersection of Arden & Fulton within 30, 45 and 60 minutes of travel is made visible on this map. Because Arden-Arcade does not have a radial route to downtown, and does not have a frequent connection to a frequent radial bus route or light rail line, accessing Midtown and downtown takes a long time.
The isochrone at right shows access to and from the intersection of Stockton & Fruitbridge.

The frequent Route 51 on Stockton provides quick access to downtown as well as to Florin Town Centre. While many routes from the south converge at Florin Town Centre, long waits make it impossible to catch one of them without spending more than an hour travelling. Instead, the colored areas south of Florin Town Centre shown in this isochrone would be accessed fastest simply by walking.

This isochrone shows a few examples of trips that involve a transfer, and yet can be made within 45 minutes or an hour:

- From the starting point on Stockton, someone can ride south on Route 51 and then transfer to the (also frequent) Route 81 on Florin Road. This is visible as a red “arm” of 45-minute access west on Florin Road.
- From the starting point, someone can ride Route 81 (in this segment, coming every 30 minutes) north to the 65th Street Gold Line station, and then ride the Gold Line to Rancho Cordova, in an hour.
- From the starting point, someone can ride the frequent Route 51 into downtown, and transfer to the frequent Blue Line, and reach Del Paso within an hour.

These trips illustrate why network design—not just route design—is so important: when connections between routes are fast and reliable, people can go many different places, instead of being limited to the opportunities on “their” bus route.

Figure 40: Access to and from the intersection of Stockton & Fruitbridge is made visible here. Transfers from the frequent Route 51 (on Stockton) to other frequent lines like Route 81 (Florin), the Gold Line (Folsom) and the Blue Line give someone access to The Pocket, Rancho Cordova or Woodlake within an hour. Downtown is also reachable within 45 minutes.
The isochrone at right is centered at Coloma & Cordova, which is served by Route 21 every 30 minutes, and is also a long walk from a Gold Line light rail station.

This isochrone is small, chiefly because it is centered on a single 30-minute frequency line (Route 21), rather than on a frequent route or an intersection where multiple routes come together, as all of the previous isochrones are.

This isochrone illustrates the limits of the “feeder” strategy, which sends Route 21 down Coloma every 30 minutes, and terminates it at the Mather Field light rail station. Waiting for the first bus, and then waiting for the (frequent) train, eats up so much travel time that even Midtown is not reachable within an hour.

In addition, the major street network in Rancho Cordova is chopped up by railroad tracks and the freeway, and few streets go through even on either side of the freeway. Walking paths are less direct than in other parts of the region, so the pedestrian access area from Coloma & Cordova is not as large as it could otherwise be.

The contrast between the large isochrones on the previous page and this smaller isochrone illustrates how much access is provided when multiple transit lines intersect, and when transit lines come frequently. Large isochrones suggest that many people can access a place, though the additional step of counting the residents and jobs within each isochrone is the true measure of that access. We will use such a measure, later in the SacRT Forward Network Plan, to evaluate access provided by future network alternatives.

Figure 41: This isochrone, centered at Coloma & Cordova, is smaller than the previous three because it is not at a point where multiple routes intersect. While north-south travel from this point is relatively easy, the route serving Coloma comes every thirty minutes. Waiting for it consumes enough time that even Midtown isn’t reachable within an hour.
**Ridership**

Access isochrones show the freedom provided by the transit network to and from a certain place. This is a major contributor to transit’s usefulness in that place, and is a very good predictor of ridership.

Ridership is one measure of transit performance. It can be visualized by mapping boardings at transit stops, as shown at right.

From this map, we can observe that the highest boardings occur:

- On the frequent portions of the light rail lines. (Light rail boardings are shown in blue.)
- Along Stockton Blvd., where the frequent Route 51 runs.
- Along Auburn and Greenback, where the frequent Route 1 runs.
- Along Florin, where the frequent Route 81 runs.
- To a lesser degree, along Watt and Howe Avenues.

Some of the largest bus boardings dots on this map are at transit centers, where multiple routes terminate. Some of these transit centers are in high-density areas, and many people are traveling to and from the area. Others are not, and many of the boardings recorded there are likely to be transfers between two bus routes, or between bus and rail. (More than 1/3 of trips on rail involve a bus as well.)

Looking at this map, however, we must keep in mind that not every stop is offering the same level of service. Some of these stops are served just a few times a day. Some are served every 15 minutes.

A small dot on a low-frequency route may simply reflect the low level of service. A small dot on a more frequent route, on the other hand, suggests other problems.

Conversely, a large dot on an infrequent route means that ridership is high despite a low level of service, which suggests that underlying transit demand may be high, along Watt and Howe Avenues for example.

---

**Figure 42:** Average total weekday boardings at every bus and light rail stop, in the fall of 2017. When a stop is served by multiple routes, the boardings for all routes are summed for that stop. The most pronounced strings of dots on this map all represent frequent bus or light rail lines.
Some transit agencies and cities have adopted a goal of “maximizing ridership.” Implicit in this statement, however, is a constraint: there is a limit to how much funding is available to increase ridership. The transit agency cannot spend infinite amounts of money pursuing each additional rider in pursuit of “maximum” ridership.

The more specific way to state this goal, then, is “maximize ridership within a fixed budget.” Even if the budget grows, it is and will always be limited.

People who value the environmental, business or development benefits of transit will talk about ridership as the key to meeting their goals. However, because their transit agency is operating under a fixed budget, the measure they should be tracking is not sheer ridership but ridership relative to cost. They would not be satisfied simply by a large dot on the boardings map on the previous page until they knew what it cost the transit agency to achieve that large dot.

Ridership relative to cost is called “productivity.” In this report, productivity is measured as boardings per vehicle hour.

\[
\text{Productivity} = \frac{\text{Ridership}}{\text{Cost}} = \frac{\text{Boardings}}{\text{Vehicle hour}}
\]

Productivity is strictly a measure of achievement towards a ridership goal. Services that are designed for coverage goals will likely have low productivity. This does not mean that these services are failing or that the transit agency should cut them. It just means that their funding is not being spent to maximize ridership.

System-wide productivity

Bus and rail productivity in Sacramento peaked in 2009, and has fallen since then. Despite steep reductions to service in 2008, 2009 and especially in 2010, productivity fell slowly in those years. (SacRT staff took great care to cut service in ways that would preserve the most productive routes.)

Other factors have likely contributed to the more recent decline in productivity: fare increases; the elimination of discounted transfers; new charges for parking at some SacRT park-and-ride lots; and the addition of some specialized low-ridership services.

1 The costs of transit track more closely with the time that a bus and driver are on the road than with any other single metric. This is why a “vehicle hour” is a decent proxy for operating cost, and is the denominator of the productivity ratio. Vehicle hours include time the bus and driver are on the route, serving customers, as well as time needed to get to and from the start of the route before service, or when the driver is changing shifts or taking a break. The National Transit Database (NTD) does not give us data on “vehicle hours” for all U.S. transit agencies, only “revenue hours.” Therefore productivity comparisons with other agencies are necessarily based on “revenue hours.”
The vehicle hours provided on any particular route, and to any particular stop, will depend on a few factors:

- The length of the route.
- The operating speed of the bus (since a slower operating speed means that covering the same distance takes more time).
- The frequency of service along the route or to the stop (since higher frequency is created by more buses and drivers working the route simultaneously).
- The span of service along the route each day and each week.

Changing any of these factors for a transit route will affect the denominator of the productivity ratio. For example, doubling the frequency of service on a route will double the number of vehicle hours being supplied. This means the denominator of the productivity ratio has been doubled. We might therefore expect that productivity of the route would be cut in half—unless the numerator of the productivity ratio, boardings, were to also increase.

The figure at right shows the individual SacRT bus routes, each plotted according to their frequency (on the horizontal axis) and their productivity (on the vertical axis). Routes that run at rush-hours only are shown on the far right.

The data points form a diagonal cloud, up and to the left. More frequent services tend to have higher productivity (ridership per vehicle hour), even though providing high frequency requires spending more vehicle hours. This is true not only in Sacramento but also all over the world.

However, you can not simply increase the frequency of a route and expect productivity to increase as well. All of the other factors that predict ridership—good density, linearity, walkability and connections among activity centers—must be in place.

Productivity Outliers

While most routes fall roughly in line with the trend, some are outliers.

- Route 1 Greenback connects the Blue Line to American River College and has the lowest productivity among the frequent routes. However, SacRT offers Route 1 every 15-minutes for a very specific reason: if every arrival of the Blue Line train isn’t matched by a trip of the Route 1 bus, buses get extremely overcrowded with college students. The rest of the route isn’t very productive, but its frequency is set high to avoid overcrowding between the Blue Line and ARC.

- Route 87 Howe has the highest productivity of any 30 minute route and the second highest productivity of any bus line. Route 87 connects the Blue Line to the Gold Line via Sac State, along a linear path through areas of good walkability and density.

- Route 11 Truxel has the highest productivity of all 60-minute routes. Route 11 connects fairly dense residential and employment areas in Natomas to downtown, along a reasonably direct path.

- Route 95 Citrus Heights-Antelope takes a winding path through low-density neighborhoods. This means it has few potential customers, and anyone who wants to ride must be willing to tolerate its deviating path and its low frequency.

Figure 44: Weekday productivity plotted against midday frequency. Higher frequency routes tend to be more productive, even though higher frequency increases their costs. Peak-only routes show a range of productivities, but only a few are as productive as all-day 30-minute routes.
Productivity and Frequency

What is true in Sacramento—that higher frequency correlates with higher productivity—is also true everywhere. The plot at right shows the data from hundreds of routes in 23 other U.S. cities. (The individual points are grouped into hexagonal bins, to prevent them obscuring one another; darker-colored hexagons contain more routes).\(^1\)

Sacramento RT bus routes are included, shown as green dots.

Among all of the dots in this chart, there is a clear curve detectable, up and to the left. More frequent services tend to have higher productivity (ridership per revenue hour), even though providing high frequency requires spending more revenue hours. While a higher frequency increases the denominator of the productivity ratio, the higher ridership more than makes up for it.

Because frequent service is the most useful and convenient service for riders, transit agencies typically target this most expensive service towards their strongest markets. Turning up the frequency of just any route won’t necessarily lead to higher productivity, but when frequent service is available to people in a dense, walkable environment, high ridership is a common result.

This illustrates the power of frequency to deliver more ridership than would be expected based on the increase in vehicle hours, when it is available to people in a suitably dense, walkable environment.

---

\(^1\) The productivity measure for routes in this plot is “boardings per revenue hour,” whereas on the previous page the measure was “boardings per vehicle hour.” The only difference is that “vehicle hours” includes deadhead time, when a bus is driven to and from the depot, whereas “revenue hours” do not.
Daily and Weekly Span of Service

The graphic at right summarizes each SacRT route’s current frequency and span of service.

This graphic makes it immediately obvious how much less service is available on Saturdays and Sundays:

- Some bus routes don’t run at all on weekends.
- Most bus routes that do run on weekends come every 60 minutes or worse.
- Even light rail only comes every 30 minutes.
- Spans of service on weekends are short, with only a few routes running past 9 pm.

This chart does not show the peak-express routes and school-oriented services that SacRT provides during rush hours only.

The transportation profession has long been focused on the weekday peaks, because those are the times when our road capacity is most-used and congested. Yet people need to travel at all times of day and week.

Service workers tend to work from very early in the morning to midday, or from midday to late at night. Most people working in retail or restaurants are only offered a job if they can commit to work on both weekend days. A route that doesn’t exist on weekends is particularly useless to low-income service workers.

In addition, anyone taking an evening class, pursuing a hobby, going to worship, or staying late at work to finish a report needs a bus ride home outside of the traditional 8-to-5 workday.

As SacRT has been able to restore service levels from 2012-2016, it has prioritized restoring frequencies on its highest-ridership routes, and lengthening spans of service: earlier mornings, later nights, and longer Saturday and Sunday hours. Despite this partial restoration, spans of service are still fairly short.

<table>
<thead>
<tr>
<th>WEEKDAYS</th>
<th>SATURDAYS</th>
<th>SUNDAYS</th>
</tr>
</thead>
</table>

Sacramento RT Existing Route Frequencies

*Figure 46: The frequencies and spans of service of each SacRT service. Light rail lines—shown at the top—are only frequent on weekdays until 7 pm. No service is frequent on weekends (except the 51X, which is for Arena events).
"Temporal" Coverage

In the graph on page 12, we report the percentage of residents and jobs that are within 1/4 mile of transit service at midday on a weekday. That measure of geographic coverage clearly overstates how many people are able to rely on transit for different kind of trips, since many people need to travel on weekday evenings, very early in the morning, or on weekends, and the transit network is smaller at those times.

There is no way to measure coverage by service that everyone deems "good enough" to meet their needs, but we know that people value service that comes late enough at night to protect them against stranding, or to bring them home from work if their shift ends late.

The map at right shows the coverage provided by the transit network as a weekday evening wanes. The lightest areas are covered until 6 pm, and the darkest until 11 pm.

Someone who works evenings at a restaurant would certainly try to locate within the darkest area of this map, if they wanted to depend on transit, as would anyone who enjoys going out to socialize or recreate at night.

Figure 47: Comparison of areas covered by service as evening turns into night. Very few places are covered by service as late as 11 pm.
Weekend Productivity

On weekends, nearly all SacRT routes run at 1/2 of their weekday frequency, or not at all. Spans of service on Saturdays and Sundays are mostly shorter.

Mini-maps showing the frequencies of bus and light rail lines are shown at right in Figure 48, for noon on weekdays, Saturdays and Sundays. Noon is a time when many different people need to travel, but particularly people working in service industries, and particularly on weekends when restaurants and retail are “all hands on deck.”

The plot in Figure 49 at right compares Saturday frequency to Saturday productivity (for those routes that run on Saturdays). The shape of this graph is very different from the shape of the same type of graph for weekdays: there is a huge range of productivity among routes that come just once per hour on Saturdays.

For example, Route 15, 87 and 67 are nearly as productive as Route 51, even though they offer a much less convenient service.

Nearly all routes reduce frequencies and spans on Saturdays, compared to weekdays. However, some routes are actually more productive on Saturdays: Routes 15, 67, 68 and 93, all visible at or near the top of the 60-minute column of dots in the plot at right.

This is in one sense surprising, since the number of people commuting to the center of the network is so much lower, and since the entire network’s frequency drops so much. The Saturday and Sunday networks are much less useful than the weekday network, yet on many routes ridership relative to cost drops only slightly, and on a few routes it increases.

This suggests that, at least along some routes, service is high relative to demand during the weekday, and low relative to demand on the weekends. Some strategic shifts of service from weekdays to weekends might even result in higher total ridership relative to costs.

Aside from potential ridership increases, there are reasons to provide Saturday and Sunday service even if it does not increase ridership. People need to travel on weekends for many different reasons, including for essential trips to work, medical care and services. Giving people access to their city on the weekend is a valuable outcome for community and personal health. This is an example of a ridership vs. coverage trade-off that is about span of service and “temporal” coverage, rather than geographic coverage.

Figure 48: These maps show how much the frequency of the SacRT network goes down on Saturdays and Sundays (at right) compared to weekdays (at left).

Figure 49: Saturday productivity plotted against Saturday frequency. Unlike weekdays, there is little relationship between frequency and productivity, and a huge range of productivity among routes that come just once per hour.
Cost per Boarding

Productivity measures the amount of ridership attracted relative to service levels. It is a proxy for ridership relative to cost. With information about how much it costs a transit agency to deliver a vehicle hour of service, one can estimate the operating cost per boarding.

\[
\text{Productivity} = \frac{\text{Boardings per Vehicle Hour}}{\text{Operating Cost per Vehicle Hour}}
\]

The plot at right in Figure 50 shows every route as a dot, plotted by its operating cost per boarding (on the vertical axis) and its frequency (on the horizontal axis). The most productive routes (which are at the top of the cloud of dots in the productivity plot on page 55), are at the bottom of this cloud of dots, because their hourly operating costs are divided over a larger number of boardings.

People sometimes assume that targeting transit service at the peak of demand, in particular at rush-hours, will be most “efficient.” In fact, peak-only routes have a very wide range of costs per boarding. In addition, the peak period of service on most routes is less productive than the midday. Of SacRT’s all-day regular weekday routes, five are more productive during the PM peak than the midday, and 38 are more productive during the midday than during the peak.

Six of SacRT’s 11 peak-only routes, shown on the right side of the graph, have two things in common:

- They are provided by SacRT’s “Community Bus Service” division (CBS).
- Their cost is partly covered by contracts with local jurisdictions.
  - About 51% of the average operating cost of the Natomas Flyers (Routes 170–173) is covered by the North Natomas TMA.
  - About 42% of the average operating cost of the Cordovans (Routes 175–177) is covered by Rancho Cordova.
  - About 24% of the average operating cost of the McClellan Shuttle (Route 85) is covered by McClellan.

Routes that are served through the Community Bus Service division (CBS) are shown in blue in Figure 50. This division operates smaller shuttles out of a separate operating base from the “big bus” division.

---

1 The average cost ("fully-allocated," in financial parlance) of an hour of CBS service is currently $168. The average cost of an hour of “big bus” service is currently $149. These operating costs per hour were used to calculate the cost per boarding for each route in the plot on this page.

2 The cost recovery described here is based on direct costs for these services, and does not include CBS overhead costs. See page 87 for the details of these calculations.
Community Bus Service (CBS)

SacRT’s CBS division operates the fixed routes shown in the plot on the previous page in blue (Routes 33, 47, 85, 95, 170–177), as well as the Citrus Heights demand response service.

The CBS division operates small buses only (29 feet or shorter) and was started in the mid-2000s, with a variety of objectives, including:

- Implementing some new services at a lower operating-cost-per-hour.
- Pursuing contracts with local jurisdictions and organizations for neighborhood shuttles and commute expresses.
- Opening up the potential of directly-operating ADA paratransit service.
- Having smaller buses that can navigate smaller streets.

SacRT’s agreement with its operators’ union specifies that CBS service will replace existing full-sized bus service, and not be used for major routes. (CBS drivers are compensated less than drivers of full-sized buses, but are still guaranteed full-time work assignments.)

Using small CBS buses to reduce the costs of existing service is commonly suggested by SacRT’s stakeholders. However, the provisions of the operations contract make this impossible. Only for new or added services can SacRT use CBS to achieve a lower direct operating cost per hour of service. Even so, a number of constraints make this ineffective or unwise.

People understandably guess that the cost of a bus service is proportional to the size of the bus, but the size of the bus is a very minor factor, as the CBS division makes clear. Labor of all kinds—the bus operator, the mechanics, the administrators—makes up the largest component of transit operating cost.

There are many constraints to how CBS buses can be used in transit service:

- CBS buses are small, so a group of students instantly over-fills them, which means that they cannot be assigned to the many routes that run past schools.
- Because they have only a single door and a narrow aisle, they cannot handle multiple boardings at a stop as quickly as a “big bus.”
- CBS buses have long “deadhead” distances to cover, between the starts and ends of routes and the somewhat distant CBS depot in the McClellan Business Park.

CBS’s operating costs per hour have turned out to be higher than those of full-sized buses, for a number of reasons. Some of these reasons relate to administrative and business decisions, such as the location of the bus depot and the lack of maintenance capabilities there. Some of these reasons arise from a lack of “economies of scale”: there isn’t enough CBS service to justify investments that might reduce the cost per hour, and a smaller-than-expected amount of CBS service means that fixed overhead and administration costs are divided over fewer hours of service.

Some of the costs of CBS relate to the type of service it provides: peak-only service on the edges of the urban area. These services will always have geographic and geometric characteristics that simply make them more costly to provide than routes in the core of the network.
Costs of Peaking

During rush hours, the number of people traveling among certain places increases, and it’s normal for service levels to increase in response. Some agencies offer a great deal of extra service during the peak, either in the form of unique rush-hour-only routes, or in the form of higher frequencies. Other agencies offer a largely all-day network, and supplement that network in small ways during rush-hours.

SacRT adds only a modest amount of service during the weekday peaks. This service takes the form of commute express routes (such as the Natomas Flyers), higher frequencies on a few regular routes (such as Route 11 on Truxel Road), and routes designed to meet school bell times. (The pattern of frequencies through the weekday can be seen in the chart on page 57).

Peaking has some high costs that are often invisible to the public, and some transit agencies even struggle to account for these costs in their decision-making:

• Peak hour services have a slightly higher labor cost than service at other hours. This is generally hard to estimate, because it accrues in subtle ways, either to the transit agency or to the operators.
  - SacRT assigns a limited number of split shifts. Split shifts can be awful for operators (which is why their use is typically limited), or they can be expensive for a transit agency (if operators are paid extra for those shifts).
  - Because there cannot be many split shifts, SacRT has to work hard to assemble full-time work schedules out of short pieces of peak-only work. The inefficiencies that result are borne by the agency, but their actual cost is hard to calculate.
  - The agency must maintain a large fleet of buses for the peaks, a fleet that sits idle at all other times. For each extra bus that is run during peak times, the agency had to purchase the bus, find land to store it on, pay people to maintain it.
  - SacRT’s midday fleet requirement is 142, but at peak they need to have 161 on the road. Thus about 13% of the fleet is maintained, stored, and ultimately replaced in order to provide many fewer hours and many fewer riders each week than the rest of the fleet.

SacRT currently stores and maintains its fleet at the edge of Midtown, at 29th and N Streets. The agency will soon have a Campus Master Plan that addresses the possibility of moving or expanding these facilities, which are currently somewhat constrained, though the peak fleet requirement today is 50 buses lower than it was before service cuts in 2009.

In the weekday afternoon, especially in the hour starting at 3 pm, boardings are much higher than service. (This most likely reflects boardings by school kids. Ridership on special routes designed around the needs of schools are included in this graph.) This means that buses get more crowded. Boardings are also slightly higher than service from 4-6 pm.

Service does not appear to get more crowded in the morning rush hour.

In fact, on all-day routes, rush hour is not a very productive time of day. In the morning, when total boardings on the system are highest, only five of SacRT’s all-day routes are at their most productive. In contrast, the other 38 all-day routes are most productive during the midday.

Figure 51 also shows us the shape of demand on Saturday and Sunday. On both days, ridership rises quickly between 6 and 8 am, and then remains fairly constant until about 5 pm.

Of course, ridership patterns throughout the day are not simply a reflection of people’s desires and need for service—they are also a reflection of what service SacRT offers, and when. These graphs can tell us how people are currently responding to SacRT’s weekend network and schedules, but cannot tell us how people would ride in response to different choices about weekend service.

Peaking and “deadhead”

A third type of extra cost that is often associated with peak-only service is “deadheading.” Deadhead is the time that a bus and driver spend getting to the start of a route, or returning from the end of a route. The time a driver spends traveling for a lunch break is also considered deadhead.

While every route requires some deadhead, peak-only routes tend to be provided for longer distances, and in a single direction. (For example, from North Natomas to downtown in the morning, and the reverse in the evening.) This peak-direction-only service can seem efficient to riders, who sit on a reasonably full bus each way. What riders often don’t realize is that the bus and driver have to drive back the other way, empty. This deadhead time still costs the agency, but doesn’t result in any ridership.

Deadhead is one of the factors that has prevented the CBS division from realizing the lower operating costs that were hoped for. CBS bears extra deadhead for three main reasons:

• Many of the routes that CBS operates are peak-direction-only, and so have riderless deadhead time to return to their start.
• The CBS garage (which is in McClellan Business Park) does not have maintenance capabilities, so each CBS bus must be deadheaded to...
and from the central SacRT garage in Midtown whenever they need attention, about once per week.

- CBS-operated routes tend to be far away from one another, and far away from the CBS depot. With CBS services in North Natomas, Citrus Heights, Rancho Cordova and South Sacramento, drivers spend a lot of time deadheading long distances to and from McClellan to start and end service, and to swap out drivers for breaks and shift-changes.

As noted earlier, there are administrative and business decisions that contribute to CBS’s operating costs, but it is essential to notice the geographic and geometric causes of the high costs per passenger of some CBS routes and services.

There is no way for SacRT to avoid the higher costs of providing service over longer distances and during weekday peaks. Shifting service from one division to another will never eliminate these causes, although different business practices may help to mitigate them.
Reliability

On-Time Performance

On-time performance is a measure of how reliably buses depart when customers expect them to depart. SacRT defines “on-time” as 59 sec. before to 5 min. 59 sec. after the scheduled time.

By this standard, a bus that departs from a major stop 6 minutes behind schedule would be counted as late. A bus that departs 5 minutes behind schedule would be considered on-time. This is a relatively lenient standard in the industry.

The graph at right in Figure 52 shows the on-time performance of most SacRT routes. SacRT standards call for buses and trains to achieve 85% on-time performance, and this is fairly typical for urban bus routes that are unprotected from congestion. As the graph shows, only 15 of 53 regular routes are achieving this standard of performance.

Of the five most productive routes the 30, 82 and 87 exceed 85% on-time performance. Routes 51 and 81, both part of the frequent network are on-time only 78% of the time.

When thinking about what reliability is reasonable to expect from a bus route, remember all of SacRT’s buses operate in mixed traffic, just like cars, and have no special traffic-busting powers, just like private cars. But unlike private cars, SacRT is not on-time when its buses depart early. Given the challenges in keeping a bus—without any special traffic avoiding abilities—within a fairly narrow range of departure times, is 85% on-time a reasonable expectation?

When transit is protected from congestion, then even better reliability is possible, and this becomes a reason to ride transit rather than take a private car. Light rail lines have long been protected from congestion, running in exclusive right-of-way and enjoying signal priority. There is no reason—aside from cultural expectation—that the same cannot be provided for bus service. Many cities are starting to protect bus service from congestion, especially high-ridership lines.

The consequences of a late bus can accrue and cascade throughout the day. A small delay to a high-ridership route can mean that more and more passengers are waiting at each subsequent stop. More passengers boarding delays the bus further, and it falls even further behind until it is finally “caught up” by the bus behind it.

To guard against these regular delays, transit schedulers add a cushion to each cycle, called “recovery time.” If the bus is running behind, when it gets to the end of the line it can skip its recovery time and thereby get back on schedule. (Another cushion of time is “layover,” which is meant for driver breaks, and should not be skipped.) Layover and recovery time are essential to maintaining reliable operations for a transit system.

Without sufficient recovery time, a delay at the beginning of the day will cause greater and greater delays throughout the day. At the same time, layover and recovery time costs the agency money, but does not move riders, so balancing these values requires thought and discipline.

Some of SacRT’s current practices and policies may hinder its ability to run service on time:

- There is no policy requiring operators to be seated and boarding customers prior to the scheduled departure time.
- Buses are sometimes held for transferring customers. While this saves a small number of customers at the transfer point the anguish of missing their connection, it affects a large number of customers down the route (and through the day) if it causes the bus to get behind schedule.
- Some routes have uneven frequencies throughout the hour or the day, because of the way SacRT currently provides operators with meal times and breaks. This causes buses to get crowded unevenly (the more minutes since a last bus passed a stop, the more passengers will be waiting at that stop). Uneven crowding leads to unpredictable running times, which leads to reliability problems.
Missed Trips

Another measure of reliability is the number of bus trips that are scheduled that simply do not happen. When a trip is missed, it means that the bus does not show up when passengers are expecting it. If a bus is supposed to come once every 60 minutes, and a trip is missed, then passengers will end up waiting an extra 60 minutes for their bus, during which time they may simply give up.

Because a missed trip on a low-frequency route has such severe negative impacts on each passenger, SacRT intentionally prioritizes getting bus trips out on lower-frequency routes, and pushes any necessary missed trips to higher-frequency routes. This is shown in the plot at right, on which routes are plotted based on their frequency (on the horizontal axis) and the number of missed trips in 2017 on that route. On routes with 15-minute all-day frequency (Routes 1, 30, 51, and 81) there is a much higher occurrence of a bus simply not showing up for passengers.

The trade-off here is that by pushing missed trips to high-frequency routes, SacRT reduces the severity of the impact, but spreads the impact to a higher number of passengers.

The plot at right, below, shows each route plotted according to its total average weekday boardings (on the horizontal axis) and its number of missed trips. The four routes on which missed trips happen the most are also the four routes on which SacRT gets the most weekday ridership. This means that many SacRT passengers have likely had the experience of a scheduled bus not showing up at all.

When a bus trip on a frequent route simply doesn’t happen, the next bus is likely to run behind schedule, because so many extra passengers are now waiting at the bus stops. More passenger loading takes more time, and slows down that following bus. Thus the added wait time for a passenger is likely to be more than 15 minutes, each time there is a missed trip on a frequent route. (The chart on the previous page shows that Routes 1 and 30 have fairly good on-time performance, but Routes 51 and 81 do not.)

Figure 53: SacRT prioritizes making all trips on routes with very low frequencies, because the impacts of a missed trip on a low-frequency route is so severe.

Figure 54: In order to avoid severe negative impacts, SacRT shifts missed trips to higher-frequency routes, but these are also its highest-ridership routes, so the impacts are spread among a large number of riders.

Figure 55: More than 60% of missed trips are caused by insufficient operators.

About SacRT 60% of missed trips occur because there weren’t enough operators to work all of the shifts (labelled “Personnel” in the graph above). This most often causes a missed trip when an operator calls in sick, and there aren’t enough substitute operators to cover the shift.

Using buses to replace or supplement rail service (for example, during light-rail outages) requires more operators than regular train service, and causes 15% of missed trips. Vehicle problems cause another 12% of missed trips, while accidents and other problems combine for the remaining 12% of missed trips.

One of the ways that agencies reduce missed trips is to increase the number of substitute (“extra-board”) operators, who are paid to report for work so that they can cover for a shift at short notice if another operator is absent. This presents an obvious trade-off between keeping operating costs low (since extra-board operators are paid whether or not they drive) and keeping service maximally reliable. Agencies also sometimes work on improving operator retention and reducing sudden absences, as strategies to reduce missed trips.
Network Design Tools
Network History

“Radial” networks have a central point, and nearly all routes go to that point. A radial network design ensures that anyone looking to travel downtown can make their trip without the need to transfer between routes. Anyone wishing to travel to another outlying neighborhood makes a transfer between routes downtown. Radial networks arose naturally in pre-car cities because so much commerce and culture was centralized and dense.

As a city grows larger, radial networks become less practical because the out-of-direction travel required to get between two non-downtown points gets so much longer. In addition, since the invention of the car and freeways, most U.S. cities have developed many more “centers.” A radial system struggles to accommodate multiple centers or sprawling and scattered development.

The Sacramento RT network is somewhat radial, but over recent decades it has been modified with two other network strategies:

- **Small “feeder” bus networks**, which come together at a point where a radial route can take people downtown. The shape of such a network is somewhat like a dandelion gone to seed—some lines extending out from the center, which branch at a single point into many other lines.
- **“Grid” or “cross-town” routes**, that allow people to travel among non-downtown destinations without riding all the way into and out of downtown.

A difficulty arises with either of these strategies, because asking people to transfer between routes essential to the access they provide, yet there are major barriers to transferring on the SacRT network. These two strategies are illustrated on the next pages, and their benefits and drawbacks are described in greater detail.

Figure 56: The SacRT network contains vestiges of history: it is a traditional radial network, with traces of local “feeder” networks that used to make “pulsed” connections at transit centers, and of “grid” or “cross-town” routes that no longer offer the necessary frequency for easy transfers.
Local “Feeder” Networks

About half of the routes in SacRT’s all day network consists of local “feeder” routes. These do not go downtown, and do not go very far, but they go to a point at which people can transfer to a downtown-bound bus route or light rail line.

These networks were designed and first operated under very different conditions than exist today. The feeder routes were infrequent, but they were designed to “pulse,” coming together at regular times in a recurring pattern. A “pulse” makes a transfer between low-frequency routes appealing and fast. The pulsing of these little feeder networks allowed people to make fast transfers to radial routes going downtown, and also allowed people to make fast transfers from one local feeder route to another, for cross-town travel.

In 2005, California law mandated longer breaks for drivers, but did not fund the additional service required to maintain existing schedules. Without additional service, SacRT had to introduce extra time to every bus’s round trip to provide longer breaks. The extra time meant that many routes were no longer synchronized at pulse points.

In addition, when budget cuts during the Great Recession forced SacRT to cut nearly 30% of service by reducing frequencies on many routes, this eliminated the remaining functioning pulses.

Finally, a major difficulty with pulses is that poor on-time performance is devastating for pulsed connections. If buses run every 60 minutes and their connection is pulsed, but one bus is late, then transferring passengers must wait almost the full 60 minutes for the next bus. Being an hour late to work can cost people their jobs. Unpredictable traffic delays, and a failure to protect buses from them, makes it very hard for any transit agency to maintain reliable pulses.

Throughout all of these challenges, some of SacRT’s local feeder route patterns remained in place. This has left the network in a “worst of both worlds” situation:

- Most feeder routes still end at a transit center, rather than continuing through, so routes are short and people can’t go very far without a transfer.
- Yet the frequencies are low, so transfers involve a long wait.
- Getting to downtown requires one transfer, and getting to other places in the region can require two or even three transfers.
- This network design relies on transfers, yet SacRT’s fare structure charges every time someone boards a bus (as described on page 76).

An example of a “legacy” feeder network can be seen in the map above, which shows only routes that serve the Arden/Del Paso station of the Blue Line. Routes 13, 19, 22, 23 and 88 end at the station, Route 15 serves the station and continues on.

None of these local feeder routes are frequent enough to make transfers among them feasible for most people. While transferring from a low-frequency route to the frequent Blue Line requires only a short wait, making the transfer in the reverse direction on the way home requires a very long wait! Recall that transferring to a route that comes every 60 minutes will require, on average, a 30 minute wait.

The connections among the feeder routes at Arden/Del Paso station are not pulsed and would require additional vehicles on most routes to reliably pulse given congestion in the area. Routes 13 and 22 are short because they end at the station, instead of running through and on to more places. Their shortness and the lack of a pulsed connection between them limits the places people on those routes can go without a transfer.
In places where SacRT adapted these local networks, and designed routes to go through transit centers instead of ending there, great access resulted. Routes 80 and 84, for example, go through the Watt I-80 transit center, instead ofterminating there (see the map at right). As a result, people can travel a long ways north and south on Watt Ave., without a transfer. In addition, because the hourly frequencies of these two routes are offset, they effectively work as one 30-minute route. The access they provide is very visible in the isochrone on page 50.

Even if there were enough budget to reintroduce some degree of timing for connection, it is very hard to make connections work well in all directions without having a full pulse, among all routes. If you time a connection only for inbound trips, you leave people making the reverse commute with a very long wait to connect. For routes like the 80 that touch both the Blue and Gold light rail lines, should it be timed for connections to the Blue Line or Gold Line? And for inbound or outbound transfers? Rarely do schedules line-up in a way that allows easy connections among a pair of services, in both directions.

“Grid” or “Crosstown” Routes
The other strategy that was introduced to the radial SacRT network was “grid” or “cross-town” connections, which cross radial bus routes or light rail lines.

In cities with many centers (such as LA, Chicago or Houston) a frequent grid allows people to travel from-anywhere to-anywhere with a single fast transfer. It requires much less out-of-direction travel than a radial network. A frequent grid offers the simplicity and reliability of a street network—you can use it just about anytime, without checking a schedule or making an advanced plan. It is easy to keep the map in your head.

A necessary precursor to a successful frequent grid, however, is high frequency. SacRT does not currently focus enough service into its cross-town routes to offer a frequent grid. In order to do so, SacRT would have to either cut many routes, or greatly increase the supply of transit service.

Examples of infrequent yet “grid”-shaped routes can be seen in the map at right, which shows all routes that serve the Watt/I-80 transit center. While there are some low-frequency feeders, as described in the example on the previous page, Routes 80, 84 and 26 go through the station and far beyond, making connections to the Gold Line to the south.

Someone living on Routes 26, 80 or 84 has the choice of transferring to the Blue Line, or to the Gold Line, and thereby reaching all of the

Figure 58: The SacRT includes some “grid” elements (such as Routes 26, 80 and 84), but without the high-frequencies that allow grids to maximize access over a large and multi-centered region.
places those radial lines go. This is how a transit grid can offer enormous access to large cities—as long as frequencies are high, so that people’s transfers are fast and reliable, in both directions. Grids require people to transfer more than do radial networks, so only with high frequencies (and a transfer-friendly fare structure) are they helpful.

Transfers
Both of these strategies—a radial network with local feeders, and a radial grid—offer people access to their whole city in exchange for asking them to transfer. Transfers on the SacRT network are currently difficult, owing to most services’ low frequencies, the lack of pulses, and a discouraging cash fare structure.

Despite this, a 2010 survey of SacRT riders revealed that transferring was very prevalent on the network. (All of the same conditions that make transfers difficult were in effect in 2010.)

Of people surveyed on light rail, one half of them were making a trip involving a transfer. Of people surveyed on buses, 2/3 of them were making a trip involving a transfer.

This data also revealed how much a service cut on one line would decrease ridership on connecting lines. If a service cut on a particular bus route resulted in the loss of 100 boardings on that route, that would also cause the loss of an additional 44 boardings on another bus route and 37 boardings on a light rail line.

A reduction or increase in boardings does not, by itself, mean that people’s access to their region has been reduced or increased. But this math illustrates how interconnected SacRT services are, and how important it is to make service investments and service cuts with an understanding of their full network effects.
Radial Spacing

The large size of the SacRT service area and the multi-centered development pattern in the region make it impossible for SacRT to give every neighborhood a one-seat-ride to downtown (or to any other particular place, in fact). Asking people to make connections among bus routes and light rail lines will be essential to a network design that provides a large number of people with freedom and access.

Radial routes to the center of the network will always play a very important role in the network. People who are located on a radial route (in particular a radial frequent route) have relatively good access to the rest of the transit network, as well as to the concentration of opportunities in downtown Sacramento.

The spacing and frequency of radial routes in the SacRT network is uneven. This is partly related to the varying levels of density and demand along radial roads, but to some degree it may be a legacy of the past. Some parts of the region have multiple radial routes, such as The Pocket, South Land Park and Greenhaven (served by radial Routes 2, 6 and 62) and South Natomas (served by radial Routes 11, 86 and 88).

In contrast, the Arden-Arcade area is dense with a mix of uses (as shown in the map on page 23, repeated in miniature below), and is proximate to downtown via two different bridges. Yet this “slice” of the city, marked in orange on the map at right, has no radial service.

Figure 59: “One-seat-rides” to the center of the region and the center of the network are extremely valuable, yet they are distributed unevenly and not in proportion to density, proximity, or other measures of ridership potential. Arden-Arcade and Campus Commons, marked in orange, are noticeably lacking in radial service despite many indicators of both high ridership potential and severe needs for transit.

Figure 60: Residential and job densities are combined into Activity Density, the densest areas are in red, orange and purple. See page 23 for more information on activity density. The area of Arden-Arcade and Campus Commons marked in orange has a good mix of dense activities, but no direct route to downtown.
“Trunk-and-branch” frequencies

A “trunk-and-branch” strategy is common in radial networks. It allows people to use higher-frequency service along inner-city, denser corridors, but still provides lower-frequency coverage to more distant outlying areas.

When a more-frequent trunk branches into two less-frequent routes, what is happening is that every-other-bus turns a different way. People who are just traveling along the trunk can take buses destined for either branch, but people traveling to one of the branches need to make sure they get on the correct bus!

SacRT makes limited use of branching in its existing network. One example is the combination of Routes 67 and 68, which travel from Arden Fair to Florin Town Centre (as shown in the map of downtown at right). The branch point is at T Street and Alhambra, so anyone traveling along the line between T Street and Arden Fair has the benefit of frequent service.

People traveling from the trunk segment all the way to Florin Town Centre also have the benefit of the high frequency, since any bus will take them to Florin, by either path (as indicated by the orange arrows in the map at right). In addition, transfers to and from the Gold Line light rail (on R Street) and the frequent Route 30 (on J Street) involve only a short wait.

A trunk-and-branch pattern is particularly useful in a radial network, but can also be used in a frequent grid. In a grid, it is particularly desirable that the trunk intersects with other frequent routes, so that people’s transfers in either direction are fast. Routes 67 and 68 branch before they intersect with the frequent Route 51 on Broadway, preventing people from making a frequent network connection between these routes.
Specialization

SacRT is somewhat unusual in the degree to which it offers narrowly-specialized services to local jurisdictions, institutions, neighborhoods and schools.

While specializing is a generous gesture, and is a way to seem “customer-oriented” and community-minded, most of the time it is not a path to high ridership relative to cost. High ridership transit is typically transit that is workable for a broad range of people, rather than perfect for any particular group of people.

Specialized services do not work together with other services to form a network that anyone can use to get around the city. Instead, they are designed around the needs of one group of people for a particular kind of trip.

School-Focused Services

SacRT provides two types of bus service designed to serve school demands:

- Extra buses sent out to supplement all-day routes to alleviate overcrowding. (When a school lets out, students can overwhelm the next bus that comes along.)
- Special routes designed to run in places and at times when schools start and end. These are the 200-series routes, appearing in the map at right as dashed green lines. These are open to the public, and charge a fare, but they are designed around school bell times and school locations.

Many transit agencies, especially in California, design routes to meet the needs of local school districts. Some do it free of charge, and some have contracts with school districts to provide this service.

SacRT’s supplemental routes designed around schools get fairly high ridership relative to service levels—about 28 boardings per vehicle hour. However, this does not account for additional peak fleet and labor costs. Many of these run at the same time as other peak-only services, so they represent buses owned, stored and maintained only for this specialized purpose.

Supplemental school routes are provided out of SacRT’s general service budget. They are provided unevenly across the SacRT service area for historical reasons.

Figure 62: On this map, all SacRT services are shown, including specialized services like one-direction peak-only expresses, the Sac State parking lot shuttle, and services designed around certain school times and locations.
Demand-Response Service (“Microtransit” or Dial-a-Ride)

SacRT provides a demand-response service in Citrus Heights. This has been operating as a traditional dial-a-ride, in which people call in advance to make a reservation, and are then picked up and dropped off at places of their choosing (within a defined zone).

More recently, SacRT changed the way this service is dispatched and the way customers make reservations and get information about their ride. People can now request a ride anytime they want, and are not required to reserve a ride in advance. The new service is marketed as “SmaRT Ride” but also referred to as “microtransit.”

Demand-response service of any kind—including new “microtransit” services that use an app and take real-time requests—cannot achieve high ridership relative to service levels, simply because driving to and from everyone’s requested places takes a lot of time. This is a physical limitation and is not altered by the size of the vehicle, or the strength of the marketing campaign, or amount of demand.

The record productivity of a traditional dial-a-ride service is 6 boardings per vehicle hour. No app-enabled demand-response service has exceeded 3 boardings per hour. Early results of SacRT’s “microtransit” pilot suggest that it will not exceed 3 boardings per hour.

One of the challenges that is unique to “microtransit” is the promised real-time responsiveness of the service. With traditional dial-a-ride, the transit agency can ask passengers who have some flexibility in when they travel to make their trip at a slightly different time, and that can help to improve productivity. If a “microtransit” service has promised to respond to requests in real-time:

• People’s trips cannot be “nudged” to times that are more efficient to service.

• Extra buses and drivers have to be on the ready (and on the clock) at many more times of the day, so that all requests can be handled.

• If all requests can’t actually be handled in real time, and requests are only fulfilled on a “space-available” basis, that means that people cannot depend on the service, and must have a car in the driveway, a fixed route nearby, or the ability to pay a higher fare for a taxi, Uber or Lyft.

Demand response service, whether it is called “Dial-a-Ride” or “Microtransit,” is generally used as a specialized coverage service. It provides access to transit over a large geographic area, but cannot be

Peak-only Routes

Peak-only routes can be thought of as a “specialization,” because they are relevant only to people to work an 8-to-5 job. The map on the previous page shows SacRT’s peak-only (non-school) routes in dashed green lines.

As described on page 62, peak-only routes and higher peak frequencies have extra costs compared to all-day and all-week routes. In particular, they require additional vehicles that get used for many fewer hours and riders than other routes.

The productivities of SacRT peak-only routes are, on average, middling to low. Their operating costs per boarding are, correspondingly, middling to high, even without accounting for their extra fleet-related costs.

Many of SacRT’s peak-only routes are designed to meet the needs of local partner organizations, who pay SacRT for the service. This is the case for the Natomas Flyers, the CordoVans and the McClellan Shuttle. The agreements SacRT has made with these partners cover only a portion of the costs of these specialized services. This means that the value provided by these services to the general public and the entire SacRT service area should be considered as part of this study, because they are partially funded out of SacRT’s “general” budget.
Network Design Tools

Sac State Parking Lot Shuttle
Sac State is currently building a new parking structure for students, faculty and staff. While it is under construction, SacRT has been running a weekday frequent route (Route 26R, shown in the frequency table on page 57) to shuttle people between an off-site parking lot and campus.

The ridership on this route counts towards SacRT’s performance goals. However, nearly every boarding on this route represents a car trip on a freeway or a local road.

The route is temporary and will be ending soon, which means that it is not an investment in a permanent, frequent network or a transit-oriented city and region. No one has chosen an apartment, or sold a car, or made another similar life choice because they can depend on the 26R. This investment does not contribute to long-term growth in transit ridership and relevance.

The operating and peak fleet costs of this route are covered by SacRT’s general service budget.

Arena Parking Shuttle
SacRT also runs an Arena parking shuttle, only on days and at times when Arena events are taking place. While the route is nominally open to the public, it is designed around the needs of the Arena and is marketed only to Arena employees, so it is almost entirely ridden by Arena employees.

The operating costs of this route are currently covered by SacRT’s general service budget. Discussions about whether to continue this service and how to fund it are taking place among SacRT, the City of Sacramento and the Kings.

Parking shuttles are almost always provided by the employer or institution benefiting from them. It is very rare for them to be funded by the transit agency.
In thinking about transit fares, it is essential to be clear about the three different areas in which decisions and trade-offs must be made:

- The fare level describes the amount of money that people are asked to pay for different fare products. For example, a single ride on SacRT costs, if paid in cash, $2.75.
- The fare structure can be thought of as the set of "products" or "deals" or "incentives" that the agency sells to riders so that they can use the transit system. A very important decision about fare structure, for example, is whether or not a fare product allows for transfers without additional charges.
- The fare media is the actual material that a customer purchases and uses to prove their fare. Fare media can be cash, tickets, "flash-passes" that they show the operator, "tap-cards" that contain an RFID chip, or a smartphone.

Decisions about these matters are often related, but are separable and need to be understood separately. Decisions about fare media do not dictate decisions about fare structure or fare levels. This also means that decisions about fare media do not solve problems with fare structure or fare level—indeed, there is a danger that easier-to-use fare media can conceal problems with fare structures for decision-makers.

### Fare Level

Affluent people, and people who are provided a pass or a card by their employer, can simply wave it at everything and not worry about how much is being deducted. The ease of use of the fare media is what matters most to them. For people who must watch their money more closely, the fare structure and fare level matter a great deal.

The current base fare for a SacRT ride is quite high. At $2.75, it is as high as in San Francisco and New York. It is the highest of any of the peer cities shown in the graphs in this report. The full price for a Monthly Pass is also quite high, second only to New York.

Transit fares have a proven downward effect on ridership. Yet the amount of operating cost recovered through fares is an important performance measure in California, where state transit funds require either 20% of operating cost recovered through fares. However, the amount of farebox recovery that causes total fare revenues to grow. If ridership continues to decline, growing fare revenues by 5% per year may not be possible, even with increases in fare level.\(^1\)

### Fare Structure

The current SacRT fare structure is complex, involving more than 30 different fare products. Some fare products are discounted, at different levels for people in different situations.

Different fare products have different rules and structures. For example:

- A cash fare paid on a bus, for $2.75, can only be used for that single ride and does not allow for transfers to another bus or to a train.
- A cash fare paid at a light rail station, also for $2.75, is essentially a 90-minute pass that allows someone to transfer for free, but only to another train, not to a bus.
- A fare paid with an electronic card or smartphone, also for $2.75, is also a 90-minute pass and allows for unlimited transfers to either bus or rail.
- People with monthly or semi-monthly passes can board an unlimited number of buses or trains to make their trip.

### Passes

SacRT has been very successful at selling monthly transit passes to major employers and other organizations in the region, as well as semi-monthly and daily passes to the general public. As a result, many riders use a pass, and are able to transfer as many times as necessary. In the past, this has been evident in transfer data. In 2010, 2/3 of people who boarded a bus, and nearly 1/2 of people who boarded a train, made at least one additional boarding as part of their trip.

### Charging For Transfers

The fact that SacRT does not include transfers in the price of someone's cash fare is notable, because the network is designed to require a transfer for travel nearly everywhere. To offset the elimination of free transfers SacRT originally offered day passes priced slightly lower than a round-trip with a transfer in each direction.

---

\(^1\) At a certain point, raising fares reduces ridership enough to negate any growth in total revenues. There is no way of knowing where SacRT is today, or will be in 2021, on that demand curve.
perhaps by getting a ride from a friend or family member, or by walking.

**Charging a cash fare for every boarding means that SacRT’s fare structure is in conflict with its network structure.** The value the transit network provides is in helping people make a trip, but the fare structures implies that people gain more value with every boarding.

Another way to say this is that when people transfer they are helping SacRT provide a more effective, less costly network. A network designed for no transfers is complex, duplicative and offers only extremely low-frequencies. Charging for and thereby discouraging this behavior, even among a minority of riders, is counter-productive in the long run.

**“Pay-As-You-Go” Passes**

Aside from the barriers to transferring in fare structures, the high up-front cost of semi-monthly or monthly passes are a barrier to transit access for low-income people and students. The latest “best practice” around this problem is enabled by fare media: electronic cards and smartphone apps can now feature an “accumulator” or a “pay-as-you-go” feature. Essentially, people are charged for single fares until they reach the price of a pass within a certain amount of time.

For example:

- If someone rides enough in the morning that they have effectively paid for a Day Pass, they are automatically granted a Day Pass and no longer charged for boardings.
- If someone rides enough by the 20th day of the month that they could have purchased a Monthly Pass for the same amount, then the system stops charging them.

This brings the enormous benefits of passes within reach of people who need to pay in small increments. It is made possible by new fare media—electronic cards or smartphones—that can keep track of someone’s fare history. SacRT’s Connect Card and Zip Pass (mobile fare app) both have this “pay-as-you-go” feature.
Key Choices
Key Choices

Should We Focus Growth in Places Where Transit Works Best?

Parts of this report describe the current development patterns in the Sacramento area, and how those patterns have affected the usefulness of transit service and transit ridership. The immediate concern of this Network Plan is to improve the value of the transit network in the near term.

However, this report can also inform the land use, development and street design policies that are made in the cities and the County, wherever people want transit to be a relevant and useful part of local life.

Through its land use policies, partners in the Sacramento region could encourage more development that reinforces the “Ridership Recipe”:

- **Density**: Demand for transportation increases as the number of people, jobs and activities around a bus stop increase.
- **Walkability**: Service is only useful to people who can safely and comfortably walk to the bus stop.
- **Linearity**: Direct paths among destinations are faster, cheaper to operate, easier to understand and more appealing to customers.
- **Proximity**: Shorter distances between developed areas attract more riders relative to cost, and are cheaper for SacRT to serve.

All of these factors affect both the costs of providing transit in a particular place and how many people will find the service useful. A key choice for the public and for elected officials, in future land use planning efforts in the region, will be: How much of future development should follow the Ridership Recipe?

---

**The Ridership Recipe: Higher Ridership, Lower Costs**

**Density**  How many people, jobs, and activities are near each transit stop?

- Many people and jobs are within walking distance of transit.
- Fewer people and jobs are within walking distance of transit.

**Walkability**  Can people walk to and from the stop?

- The dot at the center of these circles is a transit stop, while the circle is a 1/4 mile radius.
- The whole area is within 1/4 mile, but only the black-shaded streets are within a 1/4 mile walk.

**Linearity**  Can transit run in reasonably straight lines?

- A direct path between any two destinations makes transit appealing.

**Proximity**  Does transit have to traverse long gaps?

- Short distances between many destinations are faster and cheaper to serve.
- Long distances between destinations means a higher cost per passenger.

Figure 65: Density, walkability, linearity and proximity are four factors that have a major impact on transit’s usefulness and cost, and thereby on its ridership.
How Should SacRT Balance High Ridership with Wide Coverage?

This Network Plan is a unique opportunity for the Sacramento region to rethink the basic purpose of the transit system.

The current transit network is a legacy of past generations, and has accrued years of good intentions, good ideas, stop-gap measures, and special requests. Much of the existing network may be worth keeping as is, perhaps because it suits the region and its values, or perhaps because it is known and familiar to riders, which is a value in and of itself.

It is also possible that since this transit network was last re-designed the region has changed and grown enough to justify a fresh start. Transit networks are intricate, interwoven, living things, and adapting them incrementally over time is very difficult. SacRT staff has done a laudable job of making service cuts that were as un-damaging as possible, and restoring service in strategic ways since then. Despite their best efforts, ridership has continued to fall, and stakeholders have expressed concerns that the transit network is no longer meeting community goals.

The most difficult choices for the Sacramento area will be between providing high frequency, long-span services, in order to attract high ridership; and providing wide geographic coverage.

Recall that high ridership serves several popular goals for transit, including:

- Reducing car costs, emissions and traffic.
- Achieving low public subsidy per rider.
- Allowing continued development, even at higher densities, without apocalyptic traffic congestion.
- Giving people more personal and economic freedom.

On the other hand, many popular transit goals do not require high ridership in order to be achieved, and instead are achieved through transit coverage of many places. These include:

- Ensuring that everyone in the service area has access to some transit service, no matter where they live.
- Providing lifeline access to critical services.
- Providing access for people with severe needs.

A transit agency can pursue high ridership and wide coverage at the same time, but the more it pursues one, the less it can provide of the other. The competing nature of these two goals—high ridership, and wide coverage—is explained on page 8.

No public transit agency focuses solely on either of these goals. Most transit agencies have some direct, frequent, long-span routes on which ridership and productivity are high, and others which run at lower frequencies and more limited times, for specific coverage purposes.

We suggest that people think about this choice not as binary, “yes-or-no” decision, but as a sliding scale (as in the drawing above) that the community can help to set:

How much of the SacRT budget should be spent on the most useful service, in pursuit of high ridership? How much should be spent providing coverage so that people with severe needs have access to some service?

This is not a technical question, but one that relates to the values and needs of a community.

One way to manage the conflict between ridership and coverage goals is to define the percentage of a fixed route budget that should be spent in pursuit of each one. Every agency spends a certain percentage of its budget pursuing these goals, even if the percentage is unstated. This project is an opportunity for SacRT to observe how it currently balances these goals, and think about whether to shift that balance in one direction or the other.

We estimate that about 50% of the existing SacRT network is designed as it would be if maximizing ridership were its only goal. The other 50% has predictably low-ridership, suggesting that it is being provided for other purposes.

Perhaps this is the right balance for SacRT in the future, or perhaps the community will value a shift in emphasis. The direction of that shift—either towards higher ridership or towards wider coverage—is a question for stakeholders to discuss as part of this Network Plan.

SacRT’s desired balance of ridership and coverage goals will determine how much of a role high-frequency routes play in its transit network. A network redesigned for higher ridership would be made of fewer total routes, but with high frequencies. This would make it possible to operate a frequent grid, and provide everywhere-to-everywhere mobility on that grid with a single quick transfer.

A redesigned high-coverage network for SacRT would not concentrate service into fewer, more frequent routes. However, it might include some pulsed connections, so that some transfers between low-frequency routes are possible and reliable.
Can Connections Be Made More Civilized?

The biggest source of complexity in most transit networks is the sheer number of routes. One way to think about this is to ask, “In how many different patterns is my transit agency dividing a fixed amount of service?”

For the past twenty years, SacRT has been moving away from a purely radial network, in which every place has one-seat-rides to downtown. Now that the region has multiple job and housing centers, there is demand for everywhere-to-everywhere travel. A debate should naturally arise about whether there should be single bus routes from everywhere, to everywhere, or whether that access should be provided by a network, through connections.

Making a connection between two bus routes needn’t be an unpleasant or unreliable experience, though the reliability of the waiting time and the quality and safety of the waiting environment both matter enormously.

Connections can happen in a transit center, or they can happen at the intersection of two streets, where routes cross. In either case, they can be comfortable, safe and sheltered from the weather.

If a community can accept connections as part of a transit network—and if the transit agency can make the capital investments necessary to make them pleasant—it frees up an enormous amount of service that no longer must be spent providing one-seat-rides from everywhere to everywhere. It also allows for a much simpler network and the quality and safety of the waiting environment both matter enormously.

Connections can happen in a transit center, or they can happen at the intersection of two streets, where routes cross. In either case, they can be comfortable, safe and sheltered from the weather.

At the top, a network is made of direct routes, one from each of three neighborhoods to each of three major destinations. There are a total of nine routes, but each is only run by two buses, so the frequencies are low. A person traveling from Neighborhood 1 to the University gets a direct ride, but they must wait a long time for their bus, and if they miss it, it’s a long wait until the next one.

At the bottom, a network is made up of fewer routes, operating at much higher frequencies, but people must make a connection to get to one of the major destinations. Now, a person traveling from Neighborhood 1 to the University can step outside their door whenever they are ready, because a bus is always coming soon. And while they must get off and make a connection midway, again, the bus to the University is coming soon. This bottom “Connected” network is more like the one that SacRT operates today, except that SacRT’s network does not offer such high frequencies among connecting routes.

It is essential to observe about these two networks that:

- They cost the same to operate. Both networks are made up of 18 buses and drivers.
- The travel time required by the Connected network is actually less than the Direct Routes network, because so much of the time in the Direct Routes network is spent waiting for infrequent service.
- While the Connected network shown at bottom is radial, the same math is the same for a network using a grid pattern.
- In the Connected network, the connection point is in an arbitrary place. In reality, transit centers are often at universities, malls, or in downtowns. This means that some of the most popular destinations are on high frequency routes.

A Connected network will generate much larger iso-chrones (like those shown starting on page 49) than a Direct Routes network with infrequent service from everywhere, to everywhere. A Connected network is part of a high ridership strategy.

Connections will continue to be an essential part of the SacRT network, especially if the network is redesigned for higher frequencies and higher ridership. Can those connections be made more civilized?

Some changes that are under SacRT’s control would affect connections: the frequencies of connecting routes, the timing of connections, and the ways that passengers are asked to pay for transfers. Other changes would need to be led by local cities, the County and the State DOT, because they relate to the walking and waiting environment that supports a connected network.

Figure 66: People like one-seat-rides, but people also like getting where they are going, soon. Within a fixed budget, offering higher frequencies, but asking people to transfer, results in shorter overall travel times and has a greater potential for high ridership.
**Broad or Specialized?**

High-ridership transit systems are made up of transit routes that a wide variety of people find useful, for many different kinds of trips. Each route makes connections with other routes in the network, and those connections broaden its usefulness even further.

In contrast, specialized services rarely combine with other services to form a network that anyone can use to get around the region. Instead, they are designed around the needs of one group of people for one kind of trip.

SacRT currently provides some specialized services to local partners, funded mostly or entirely of its general budget. Current examples include:

- A high-frequency, temporary Sac State parking lot shuttle.
- A high-frequency parking lot shuttle for Arena employees.
- Routes designed for school times and locations, in certain parts of the region.
- Weekday rush-hour only routes.
- Demand-response service (“dial-a-ride” or “microtransit”).

The diagram at right names some of the types of services that public transit agencies are typically asked to provide. Services that are designed for a large number and a large variety of people and trips are to the left. Services that are useful only at special times, or to small numbers of people, are to the right.

A few of SacRT’s school routes are very productive, but most of its other specialized services have low productivity and high costs per boarding. Specialized services can have hidden costs that are not easily accounted for in the standard measures of “productivity” or “cost per boarding.” For example, they often run at rush-hours and therefore add to the agency’s total vehicle and driver requirements; they may need different vehicles, and therefore different spare parts inventories, different vendor relationships, and different training for drivers and mechanics. Finally, the cost of marketing and communicating each specialized service to the public is no lower than an all-day route, yet the latter adds much more to the system’s usefulness and ridership.

As individuals we can sometimes forget that a service designed to be perfect for us, and for people like us, is not perfect for very many people. High ridership transit services are rarely specialized around any particular group of people’s needs. Rather, they are broadly useful to many different people.

If you ask people on a full bus if the bus route is perfect for their trip, it is unlikely that any of them would say that it is, but most of them would say that it is workable or useful. The trick to getting full buses and full trains is to design service and a network that is broadly useful, safe, and civilized.

Another form of specialization can arise when a transit agency focuses on improvements to “customer experience” that cannot be scaled up to serve large numbers of people. If improvements to customers’ experiences can be delivered across the entire network, then they can lead to ridership growth. For example, the publishing of real-time arrival information has improved the customer experience and can be scaled-up to serve vast numbers of customers. In contrast, a demand-responsive service, or a specialized shuttle route, or a luxurious type of vehicle, cannot be scaled up to serve vast numbers of customers. They may improve the “customer experience,” but for few customers, which means that they cannot be a path to higher ridership.

Specialized services raise a question of precedent. If the taxpayer pays for shuttles at certain employers or schools, why not at others? Where specialized services exist, agencies need an answer to this question. SacRT may wish to define the conditions under which it will provide specialized services, and how much “local match” funding is required. This may help municipal and organizational partners understand what they can expect from SacRT and feel they are treated fairly compared to their neighbors.
Glossary
JARRETT WALKER + ASSOCIATES

An illustration to help visualize where someone can go from a location, in a certain amount of time for driver breaks between trips. Usually included in revenue hours. Unlike recovery time, layover time sometimes cannot be skipped even when a bus is behind schedule.

The time a vehicle spends between the garage and the start or end of revenue service, or some routes have a more frequent inner segment and a less frequent outer segment. The inner segment is called the “shortline,” though technically the longline is the longest path that buses on that route travel, and its length is the inner segment plus the outer segment. The inner segment is called the “shortline.”

Coverage: Coverage can refer to the amount of geographic space, the proportion of people or the proportion of jobs that are within a certain distance of transit service. An assumption about how far people will walk to a given transit service—often ranging from 1/4 to 1/2 mile—must be made in order to estimate coverage.

Deadhead hours: The time a vehicle spends between the garage and the start or end of revenue service, or between the end of a trip on one route and the beginning of a trip on another route. In contrast, paratransit and demand-responsive service may always or often follow different routes for each vehicle trip, as they serve different customers and their trips.

Dial-a-ride: Demand response service, usually requires booking a day in advance, over the phone.

Express: Express can have a range of meanings when applied to transit. It most often describes a route with a long non-stop segment. It can also be used to describe a route with wide stop spacing and overall faster speeds, though that is more commonly called a rapid.

Farebox recovery: Farebox recovery is a measure of how much of a transit system, network or route’s operating cost is recovered through fares. It is often expressed as a ratio, e.g. “The farebox recovery ratio for SacRT’s fixed routes in 2013 was 20%.”

Feeder: A local route that connects or feeds into a radial route. Low-frequency feeders sometimes pulse so that transferring is more convenient.

Fixed route transit: Fixed route transit defines any transit service that is operated on the same predictable route. In contrast, paratransit and demand-responsive service may always or often follow different routes for each vehicle trip, as they serve different customers and their trips.

Frequency: Frequency is often expressed in minutes, i.e. a service that comes every 15 minutes has “15 minute frequency.” A more technical term for frequency is headway.

Grid Network: A network of routes that intersect all over the city. Grid networks are best suited for places with many activity centers, as opposed to radial networks, where most people are traveling to a central location. Grid networks require high-frequency to make transfers short, reliable and convenient.

Headway: Headway is the time between successive trips at a stop, a more technical transit term for frequency. A service that comes every 15 minutes can be said to have a “15 minute headway.”

Investment: Service or revenue hours per capita, a measure of the relative level of transit service.

Isochrone: An illustration to help visualize where someone can go from a location, in a certain amount of time, using transit or by walking.

Land use: Land use describes the way a parcel of land is being used, for example as commercial, industrial or multi-family residential. Land use descriptions can be general or very specific. Land use is distinct from zoning, as land may be rezoned under existing uses and buildings long before changes to its use take place.

Layover: Time for driver breaks between trips. Usually included in revenue hours. Unlike recovery time, layover time sometimes cannot be skipped even when a bus is behind schedule.

Longline: Some routes have a more frequent inner segment and a less frequent outer segment. At the end of the inner segment, some buses turn around and come back, while others continue on to a more distant turnaround point. The outer, less-frequent segment is often called the “longline,” though technically the longline is the longest path that buses travel on that route, and its length is the inner segment plus the outer segment. The inner segment is called the “shortline.”

Microtransit: Demand response service, like dial-a-ride, but usually distinguished by same day or instant booking, often with an app.

Mobility: Mobility is generally used to express the ease with which people can move from place to place. It is distinct from access, which describes the extent to which people can meet their needs nearby. In some places, people have high access (they are able to meet all of their needs without travelling very far or at all) and low mobility (because travelling long distances is difficult or slow). In other places, mobility is high and access is low.

Mode share: Mode share is a technical term for the percentage of a population that uses a particular mode (e.g. transit, walking, driving) for traveling. Mode share information in the U.S. is generally reported for commute trips.

National Transit Database: The National Transit Database is a federal clearinghouse of general information about transit in the U.S. and information specific to each transit agency. Agencies of a certain size are required to submit financial and performance data to the NTD each year. https://www.transit.dot.gov/ntd/

One-seat-ride: A trip that requires boarding only one transit vehicle (no transfers).

Access: The number of jobs or residents reachable from a starting location by transit and walking. Access is often calculated for many starting points in a network, based on some assumed travel-time “budget,” and summarized on a map.
**Glossary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paratransit</td>
<td>A transit service that provides on-demand curb-to-curb travel for people with disabilities, per the American’s with Disabilities Act. It is required by this U.S. law to be provided to people who have a disability that prevents them from using fixed route transit service, within 3/4 mile of fixed route transit, during all times when fixed route transit is operating.</td>
</tr>
<tr>
<td>Peak</td>
<td>In some places, two peaks of travel (and transit) demand take place each day: in the morning and afternoon, as people travel to and from work and school. However, in many places travel demand peaks only once, in the midday or afternoon, as service shifts change and students leave school.</td>
</tr>
<tr>
<td>Peak-only</td>
<td>A transit service that is peak-only operates only during the morning and afternoon travel peaks.</td>
</tr>
<tr>
<td>Productivity</td>
<td>The word productivity is often used in transit to describe the number of people served per unit of cost. Productivity can be expressed for an entire transit system, a subset of the system, individual lines or even for segments of lines.</td>
</tr>
<tr>
<td>Pulse</td>
<td>A pulse takes place when two or more transit services arrive together at the same place at the same time, so that their passengers may transfer among them with minimal waiting.</td>
</tr>
<tr>
<td>Radial</td>
<td>A route or network design where most routes go to and from a central point (typically a downtown). As opposed to a grid network.</td>
</tr>
<tr>
<td>Rapid</td>
<td>Rapid can have a range of meanings when applied to transit. It most often describes a route with wider stop spacing and overall faster speed.</td>
</tr>
<tr>
<td>Recovery time</td>
<td>Extra time between trips to make up for a delay. Unlike layover, which is a driver’s break time, recovery time can be cut short so that the next trip can depart on-time.</td>
</tr>
<tr>
<td>Relevance</td>
<td>Boardings per capita, a measure of how relevant transit is to the population it serves.</td>
</tr>
<tr>
<td>Revenue hours</td>
<td>The time a transit vehicle and its operator spend out in public, available to passengers and (potentially) collecting revenue. Usually includes layover and recovery time, but excludes deadhead.</td>
</tr>
<tr>
<td>Ride check</td>
<td>The National Transit Database requires that transit agencies regularly sample on all of their services to collect ridership and on-time performance information. This is often performed using surveyors on transit vehicles, though increasingly it is performed by automated counters and GPS devices on transit vehicles. It is sometimes called a ride check.</td>
</tr>
<tr>
<td>Ridership</td>
<td>Ridership refers informally to the number of boardings or trips taken on a transit system or a particular transit service.</td>
</tr>
<tr>
<td>Shortline</td>
<td>Some routes have a more frequent inner segment and a less frequent outer segment. At the end of the inner segment some buses turn around and come back, while others continue on to a more distant turnaround point. The outer, less-frequent segment is often called the “longline,” though technically the longline is the longest path that buses on that route travel, and its length is the inner segment plus the outer segment. The inner segment is called the “shortline.”</td>
</tr>
<tr>
<td>Span</td>
<td>The span of a transit service is the number of hours it operates during the day, e.g. a service that runs from 6:00 am to 11:30 pm would have a 17.5 hour span. Span can also describe the number of days per week and per year that a service is operated.</td>
</tr>
<tr>
<td>Street connectivity</td>
<td>The degree to which streets connect to one another, and multiple paths exist between any two points, is describe as that place’s connectivity. Areas with many cul de sacs or loops and few through routes have low connectivity; areas with grid-like street patterns have high connectivity. Low connectivity discourages trips by slower modes (such as walking or bicycling), and presents challenges for transit routing.</td>
</tr>
<tr>
<td>Transfer</td>
<td>When a person uses more than one transit vehicle to make a trip, they transfer in between vehicles. This is also often called a connection.</td>
</tr>
<tr>
<td>Transit dependency</td>
<td>If a person has a severe need for transit, due to a disability or to lack of access to an automobile, they are often referred to as transit dependent. However, transit dependency is in fact a spectrum, not a category. People with disabilities and people without their own cars may have access to rides or taxis, but the extent to which they use those rides may depend on the availability and quality of transit service.</td>
</tr>
<tr>
<td>Transit orientation</td>
<td>As with transit dependency, transit orientation is a spectrum, not a category. People who are living or working around higher activity densities, in places where walking to transit is safe and appealing, or who do not have easy access to an automobile may have some degree of transit orientation. Transit orientation can exist among poor and affluent populations alike.</td>
</tr>
<tr>
<td>Tripper</td>
<td>A tripper is a special type of transit service that makes only a few or a single trip each day. Transit agencies often send one or more trippers to relieve crowding on certain routes, or to provide direct service where none exists at other hours. Trippers often run at the start and end of school days or work shifts.</td>
</tr>
<tr>
<td>Vehicle hours</td>
<td>The time during which a transit vehicle is away from the garage, whether providing revenue service (represented by “revenue hours”), driving between the garage and the start or end of service (represented by “deadhead hours”) or in layover and recovery time.</td>
</tr>
</tbody>
</table>
Appendix: Methods
Appendix: Methods

Cost Recovery for Contracted Services

Cost recovery for any service can be calculated with or without overhead costs included.

In this report, we calculated cost recovery for contracted services as the percent of the direct costs of each contract covered by the contract fee. Overhead costs associated with SacRT general administration are not included in the direct costs used here. Direct costs do include drivers’ labor; fuel, tires, and other wear and tear; and the labor of maintenance personnel and supervisors. Service cannot be provided without these overhead functions, so agencies always include these costs when calculating how much service can be provided, sustainably, for a given level of funding.

The direct cost per revenue hour for each contracted service was assumed to be the same for all CBS services, $127.14 per revenue hour. Annual revenue hours were calculated by multiplying the number of weekdays in the 2017 service calendar (254) by the weekday revenue hours for each service. Total annual costs are simply the annual revenue hours multiplied by the cost per revenue hour.

Figure 68 shows the breakdown of the calculations for each contracted service, and the percentage of the direct costs of providing the service that is covered by each contract. Costs in excess of those covered by each contract are covered by SacRT’s “general” funding.

A “revenue hour” of service represents one hour of a bus and driver’s time, serving customers and accepting fare revenue. Most operating costs track with time rather than distance or vehicle size.

<table>
<thead>
<tr>
<th>Service</th>
<th>Weekday Revenue Hours</th>
<th>Annual Revenue Hours</th>
<th>Direct Costs per Revenue Hour</th>
<th>Annual Direct Cost</th>
<th>Contracted Fee</th>
<th>Cost Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cordovan</td>
<td>21.19</td>
<td>5,382</td>
<td>$127.14</td>
<td>$684,301</td>
<td>$444,055</td>
<td>65%</td>
</tr>
<tr>
<td>McCellan</td>
<td>6.45</td>
<td>1,638</td>
<td>$127.14</td>
<td>$208,293</td>
<td>$50,000</td>
<td>24%</td>
</tr>
<tr>
<td>Natomas Flyer</td>
<td>24.26</td>
<td>6,162</td>
<td>$127.14</td>
<td>$783,442</td>
<td>$397,688</td>
<td>51%</td>
</tr>
</tbody>
</table>

Figure 68: Table of calculations for cost recovery of contracted services. Direct Costs per Revenue Hour from SacRT FY 2018 operating budget.