TCRP
SYNTHESIS 86

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Relationships Between Streetcars and the Built Environment

Sponsored by
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A Synthesis of Transit Practice

TRANSPORTATION RESEARCH BOARD
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TRANSIT COOPERATIVE RESEARCH PROGRAM

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Relationships Between Streetcars and the Built Environment

A Synthesis of Transit Practice

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions*, published in 1987 and based on a study sponsored by the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), *Transportation 2000*, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

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FOREWORD

Transit administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the transit industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire transit community, the Transit Cooperative Research Program Oversight and Project Selection (TOPS) Committee authorized the Transportation Research Board to undertake a continuing study. This study, TCRP Project J-7, "Synthesis of Information Related to Transit Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute a TCRP report series, *Synthesis of Transit Practice*.

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

By Donna L. Vlasak
Senior Program Officer
Transportation
Research Board

This synthesis documents experience with selected streetcar and trolley projects and their relationship with the built environment. There appears to have been a resurgence of such systems in the United States. Their ability to spur growth and revitalization has not been adequately documented, whereas local potential for changes in land use are often used as justification for investment in them. Policymakers and planners seek a better understanding of how this mode of transportation interacts with the built environment. The report examines selected, built streetcar and trolley systems to trace their evolution, define significant factors, and identify commonalities among levels of success in impacting the built environment.

This report presents an initial overview of published literature; a summary of an in-depth telephone survey of 13 of the 14 currently operating U.S. streetcar systems, a 93% response rate; and case studies of five systems with more details on the state of current knowledge and specific relationships of streetcars to their own built environments.

Ron Golem and Janet Smith-Heimer, BAE, Urban Economics, Inc., Emeryville, California, collected and synthesized the information and wrote the paper, under the guidance of a panel of experts in the subject area. The members of the Topic Panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

RELATIONSHIPS BETWEEN STREETCARS AND THE BUILT ENVIRONMENT

SUMMARY

This synthesis summarizes the limited literature and documentation regarding the impacts of modern streetcar systems on the built environment, underscoring the need for further empirical analysis.

Streetcars represent a growing transportation alternative, with more than 45 systems built or in various stages of planning or construction. Their popularity has resulted from a range of factors, including relatively lower cost of construction than other forms of rail transit and their relative ease of integration into the existing urban fabric. Little in-depth work has evaluated this streetcar resurgence, leading to an interest by policymakers and planners to have a better understanding of how this mode of transportation interacts with the built environment, particularly since changes in land use and development patterns are often cited as a justification for investment in streetcar systems.

Great diversity exists among operating and planned systems, and this synthesis begins to identify several stages of streetcar system development. These stages are potentially but not necessarily sequential and include the following:

- *Demonstration:* a volunteer or local agency establishes the feasibility of a modest streetcar line
- *Targeted trips:* expanded service is focused on certain groups, typically tourists and residents but not necessarily commuters
- *Full service:* frequent daily service, including during commute hours with service to downtown or business centers
- *Urban connector:* multiple routes between various districts and full integration into the regional transportation system

These stages have distinctly different implications for the potential impact of streetcars on the built environment, and the types and amount of economic development and changes in the built environment that might occur. Because federal transportation policies, along with most local governments' land use and transportation planning are increasingly emphasizing "green" development, smart growth, reduction in carbon emissions, and increased links between land use and transportation, the need to systematize the study of streetcar impacts is dramatic.

This synthesis presents an overview of published literature on the relationship between streetcars and the built environment, a survey of 13 streetcar systems that have been recently built or expanded, and in-depth case studies of five systems to describe the current state of knowledge and elaborate on the relationship of streetcars to the built environment.

A challenge in considering these questions is the lack of a common and consistent definition of what constitutes a streetcar as opposed to a light rail system. Furthermore, some systems blend characteristics of these two modes. For example, the LINK system in Tacoma, Washington, is termed "light rail" by SoundTransit, its operator, even though its vehicles are the same as those used in the Portland and Seattle streetcar systems. For this

synthesis, a broad definition of streetcar systems was used that builds on rail advocacy organization Reconnecting America's typology of streetcars. Streetcar systems typically run in the street at grade on embedded rails, stop every several blocks, operate at average speeds of less than 12 mph, and have lower construction cost per mile than light or commuter rail.

For this synthesis, "impact on the built environment" was defined as broadly as possible. The definition includes indicators that describe economically vibrant neighborhoods as well as indicators that measure the actual changes in the quantities and types of physical and economic development adjacent to streetcar systems.

A literature review for this synthesis considered the substantial literature on the "value premium" or increase in property values or related economic activity that can be created by fixed guideway transit. This is a key consideration because of policymaker interest in "capturing" some of this value to help finance streetcar construction and operating costs. Because of the broad range in methodologies used and findings from various studies, however, it is difficult to distill conclusions that can be applied broadly. Premiums vary by land use and range from minimal (1% to 2%) to substantial (100% plus). A key challenge in evaluating value premiums is controlling for changes in zoning or other policies permitting greater density in conjunction with new fixed guideway transit, because these alone can increase the value of land and existing properties, separate from any direct transit impacts. Other literature measuring actual changes in economic activity, such as retail sales, visitors, or job growth is nearly nonexistent.

General findings from the streetcar systems surveys and case studies highlight a variety of differences between systems, including that smaller-scale systems typically evolved from community or business initiatives, while larger systems generally were created through more extensive planning efforts, and some have evolved to become an integrated component of overall regional transit systems. A broad range of funding sources and management arrangements are available, encompassing such efforts as repurposing highway funding (Memphis), completing substantial property assessments (Portland and Seattle), and using local nonprofits for development and management of systems. Almost all representatives interviewed believed that streetcars positively affected the built environment, particularly in attracting new development or enhancing revitalization, although the degree of impact varies. Few systems, however, reported the types of ancillary changes in the built environment, such as reduced parking garage construction, increased pedestrian or bike lane investments, or explicit parking reductions that often are associated with light rail systems. Few, if any, streetcar system operators seek information on their impact on economic activity, although most interviewed consider economic-related questions to be vital and desire further research on this topic.

Based on the literature review, case studies, and surveys, a series of suggestions have been developed for future empirical research to augment the limited literature and documentation of impacts of streetcars on the built environment. These are outlined in the Conclusions.

CHAPTER ONE

INTRODUCTION

BACKGROUND

In the past 20 years, numerous cities have planned and implemented new rail transit systems. This movement has coincided with other urban regeneration trends, bringing new life to urban centers and advancing strategies to manage growth that promote more efficient patterns of development. Various forms of heavy rail, light rail, and streetcar systems have been built, many with robust ridership and popularity, owing to a rediscovery of this form of transportation, as well as concerns about growing traffic congestion, volatile fuel prices, and climate change.

One of the types of rail under consideration or built by numerous cities is the streetcar, reviving an older form of urban transportation. At present, more than 45 streetcar systems are either built, under construction, or planned across the United States, ranging from larger cities such as Columbus, Ohio, to smaller cities such as Winston-Salem, North Carolina; Pasadena, California; and Lake Oswego, Oregon. Streetcar systems have gained in popularity because of their relatively lower cost of construction than light or commuter rail, the ease of integrating streetcars into the existing urban fabric, and the convenience of frequent stops (see Figure 1).

FIGURE 1 Portland streetcar (*Source:* Portland Streetcar, Inc.)

The most showcased modern streetcar system in the United States is the Portland streetcar. Opened in 2001, the system has grown to more than 4 mi of track traversing downtown, and currently is in the final design stages of an additional 3.3-mi extension from downtown Portland across the Willamette River. The success of this system, and its relationship to further enhancing the Portland region's extensive network of light rail lines, has made Portland a leader in public rail transit.

The streetcar "renaissance" has brought a strong desire by policymakers and planners to gain a more in-depth understanding of how this form of transportation interacts with the built environment. This report provides a synthesis of published literature on this topic, as well as a summary of a survey of 13 streetcar systems recently built or expanded to identify impacts on the built environment.

PURPOSE OF SYNTHESIS

The purpose of this synthesis is to document experience with selected streetcar and trolley projects and their relationship with the built environment. Local potential for changes in land use are often used to justify investment in streetcar and trolley systems. However, the ability of these systems to spur growth and revitalization has not been documented adequately. Questions remain regarding the direct role of such systems on the built environment versus other factors that also may be important.

In documenting experiences, this synthesis examines selected, built streetcar and trolley systems to trace their evolution, define significant factors, and identify commonalities among levels of success in affecting the built environment.

Definition of Streetcar

Several definitions exist for what constitutes a streetcar system. According to APTA, streetcars are a type of light rail transit, which APTA defines as follows:

> Lightweight passenger rail cars operating singly (or in short, usually two-car, trains) on fixed rails in right-of-way that is not separated from other traffic for much of the way. Light rail vehicles are typically driven electrically with power being drawn from an overhead electric line via a trolley or a pantograph (*1*).

Included within this classification are streetcars, tramways, and trolleys.

To differentiate streetcars from other forms of light rail transit, experts focus on system purpose as well as several physical characteristics of systems and vehicles. According to one widely cited definition, the key difference separating streetcar systems from other light rail transit systems is their intended usage:

> Streetcars are for local transportation. A Light Rail line may operate ten or 20 miles out beyond the downtown, running at high speeds between suburban stations spaced a mile or more apart. Streetcars operate in the downtown and perhaps a bit beyond it, picking people up and letting them off at almost every street corner. Often, people will use Light Rail to come into town, then use a streetcar to get around town (*2*).

In addition to purpose, definitions of streetcars also focus on the following more tangible characteristics:

- Right-of-Way: Streetcars generally operate in mixed traffic rather than in separated exclusive rights-of-way.
- Vehicles: Streetcars generally use smaller, lighter vehicles than other light rail systems, including the use of historic or vintage cars.
- Rails: Streetcar systems often are designed to support lighter weight vehicles than other light rail systems. Hence, it is at times possible to operate a streetcar on a line designed to support other light rail vehicles, but not vice versa.
- Cost: Because of the use of shared rights-of-way and lighter weight materials, streetcar lines generally are substantially less expensive to build than other types of light rail lines.
- Stops/Stations: Streetcars often stop in traffic along streets. As such, infrastructure at streetcar stops is often no more elaborate than a sign or small, covered seating area. Other types of light rail systems often provide more elaborate stations, with parking areas, ticket vending machines, and freestanding structures. Moreover, streetcar stops are often spaced every few blocks along the entire route, in comparison to other light rail systems, which may space stops 1 mi or more apart, outside of downtown areas.

Consistent with these criteria, Reconnecting America has developed a typology that describes modern streetcars as follows: typically running in the street at grade on embedded rails, stopping every two or three blocks, moving at 8 to 12 mph, and providing low cost-per mile construction relative to other light rail and heavy rail (*3*).

Although these definitions work well as a description of many streetcar systems, some systems blur the lines between streetcar and light rail. For example, SoundTransit in Seattle calls its Tacoma, Washington, LINK vehicles "light rail," even though the vehicles are the same as those used in the Portland and Seattle streetcar systems. In San Francisco, several MUNI light rail lines meet many of the streetcar definitional criteria, along a substantial portion of their route, but also operate as subways as they pass through downtown. These and other systems straddle the definition between streetcar and light rail and are at times variously classified as either typology.

Approach to Synthesis

To clearly focus this synthesis on the impacts of streetcars on the built environment, distinct from light rail, and also to draw meaningful findings with respect to the unique qualities of streetcars' impacts, this report focuses on recently built streetcar systems (i.e., developed within the past 20 years).

Hence, systems in Boston, New Orleans, Philadelphia, and San Francisco are not evaluated in this synthesis for their impacts on the built environment. These legacy systems have been in operation for decades and the built environments along the streetcar routes has evolved over the course of decades throughout the 20th century.

The following list of 14 currently operating U.S. streetcar systems are the focus of this synthesis:

1. Astoria, Oregon
2. Charlotte, North Carolina
3. Dallas, Texas (M-Line)
4. Galveston, Texas
5. Kenosha, Wisconsin
6. Little Rock, Arkansas
7. Lowell, Massachusetts
8. Memphis, Tennessee
9. Portland, Oregon
10. San Pedro, California
11. Savannah, Georgia
12. Seattle, Washington
13. Tacoma, Washington
14. Tampa, Florida

The Charlotte streetcar system operates weekends only on a right-of-way shared with the light rail system. Service on the Galveston streetcar system was interrupted because of damage caused by Hurricane Ike, but the system is expected to reopen.

Initial consideration of the diversity of existing streetcar systems highlights a wide spectrum in the level of service that is being offered in terms of routes, hours and days of service, and the types of users being served. This includes "fuller service" systems (Memphis, Portland, Seattle, and Tacoma) that operate 7 days a week year-round, offer service throughout commute hours, and have longer routes enabling them to serve as urban circulators or multiple routes. At the other end of the spectrum, "shorter service" systems (Astoria, Charlotte, Galveston, Kenosha, Lowell, San Pedro, Savannah, and Tampa) operate fewer hours excluding at least one commute period (typically mornings), offer less than daily service, or have a seasonal schedule. Many of these systems are more oriented toward serving tourists than the full range of transit trips, and they include a number of systems that use heritage vehicles or replicas of them. Other systems (Dallas, Little Rock) fall toward the middle of this spectrum.

Streetcar systems that provide a fuller service, and target a broader range of riders, particularly commuters, offer a higher level of transportation amenity and would be expected to generate greater ridership, and potentially a more synergistic effect in stimulating changes in the built environment along their route(s). At the same time, these systems are not static, and as service hours are increased and routes extended, "shorter service" systems can become "fuller service."

Definition of Impacts on the Built Environment

The definition of "impacts on the built environment" can vary quite substantially depending on the policy or research focus. In the most direct sense, streetcar projects affect the built environment through their construction by altering streets, sidewalks, and rights-of-way. In an indirect sense, streetcar systems impact the built environment by activating neighborhoods (e.g., through an increase in foot traffic) or by altering perceptions of an area (e.g., signaling that a district is "up and coming"), affecting a range of public and private investment decisions.

Indicators that a streetcar system is working to activate a neighborhood or enhance its perception could include increased land value or lease rates, increased pedestrian traffic counts, increased sales at existing businesses, increased employment, increased lodging occupancies, or increases in other measures of economic activity near streetcar stops. Such changes tend to improve the climate for investment within an area, ultimately affecting the built environment through increased real estate development activity, which can be measured as the dollar value or quantity of construction.

For this synthesis, the impacts of a streetcar system on the built environment were defined as broadly as possible, so that it considers those factors that are indicative of an economically vibrant neighborhood as well as those measuring actual change in the quantity and types of physical development near streetcar systems.

CHAPTER TWO

LITERATURE REVIEW

For the synthesis, a review of relevant publications on the subject of streetcars and the built environment was conducted using the Transportation Research Information Services (TRIS) database as well as general online searches and references in other synthesis documents.

One of the key challenges of the available literature regarding the impacts of streetcars on the built environment is the definitional challenge cited in the Introduction. The construction of numerous light rail and heavy rail systems across the United States has generated substantial published analysis, especially focused on the "value premium" from land and building rents near transit stations. This literature, however, does not describe these impacts with respect to a contemporary streetcar system.

VALUE PREMIUM IMPACTS

A substantial amount of research and analysis has been undertaken by policy experts over the past decades to track and document the effects of fixed guideway transit systems (e.g., term includes heavy rail, light rail, and streetcar/trolley) on property values. This topic has commanded so much attention because many policymakers believe that fixed guideway transit systems create a "value premium," meaning an increase in property values or related economic factors, as a result of the increased access and desirability of the land served by the fixed guideway transit. If increased value can be linked to the transit investments, a portion of this increase has strong potential to be "captured" upfront in the transit development process and converted to a funding source for the transit system. In other words, to finance the transit system, local and regional governments seek to share in the economic benefits that fixed guideway transit is thought to bring to private property owners.

Numerous studies have used statistical models and other methods to examine whether premiums exist for real estate prices or lease rates near transit stops, particularly for commuter and light rail systems. However, because of the relatively recent emergence of contemporary streetcar systems, almost no analysis of the value premiums associated specifically with streetcars could be found in the literature.

A summary of various fixed guideway transit value premium studies was recently published by the Center for Transit Oriented Development, a nonprofit organization associated with Reconnecting America. Entitled *Capturing the Value of Transit*, the publication reviews the concepts associated with transit and summarizes the findings of more than 20 analyses of the effect of fixed guideway transit on different land uses around the United States (*4*). Many of these studies, in turn, identified a range of value premiums associated with fixed guideway transit and utilized a variety of techniques to come to this conclusion. The range of findings from the wealth of literature indicates that this topic presents challenges in distilling conclusions applicable directly to other locations. *Capturing the Value of Transit* drew the following conclusions from the reviewed studies (see Table 1).

TABLE 1
RANGE OF VALUE PREMIUM ASSOCIATED WITH TRANSIT (*4*)

	Range of Property Value Premium		
Single Family Residential	+2% w/in 200 ft of station (*San Diego Trolley, 1992*)	to	+32% w/in 100 ft of station *(St Louis MetroLink Light Rail, 2004)*
Condominium	+2% to 18% w/in 2,640 ft of station *(San Diego Trolley, 2001)*		
Apartment	+0% to 4% w/in 2,640 ft of station *(San Diego Trolley, 2001)*	to	+45% w/in 1,320 ft of station *(VTA Light Rail, 2004)*
Office	+9% w/in 300 ft of station *(Washington Metrorail, 1981)*	to	+120% w/in 1,320 ft of station *(VTA Light Rail, 2004)*
Retail	+1% w/in 500 ft of station *(BART, 1978)*	to	+167% w/in 200 ft of station *(San Diego Trolley, 2004)*

From: Capturing Value from Transit (Center for Transit Oriented Development, November 2008).
Notes: VTA Light Rail is the Santa Clara, California Valley Transportation Authority.
BART = Bay Area Rapid Transit.

Although this table focuses on those studies that found a premium, the report also describes a study that found negative impacts on value associated with fixed guideway transit. A 1995 study, by Dr. John Landis at the University

of California–Berkeley, found that values for single family homes within 900 ft of light rail stations in Santa Clara County were 10.8% lower than comparable homes located farther away, and no value premium could be identified for commercial properties within 0.50 mi of BART stations in the East Bay of the San Francisco Bay Area (*5*).

One of the most thorough analyses conducted after 2000, when contemporary fixed guideway transit systems had established their resurgence as a modern, desirable form of transportation in urban America, was conducted by Dr. Robert Cervero at the University of California–Berkeley. This study, a survey of other studies covering housing value premiums associated with fixed guideway transit, found that among the seven locations (Philadelphia, Boston, Portland, San Diego, Chicago, Dallas, and Santa Clara County), value premiums ranged from 6.4% to more than 40% (*6*). The authors concluded that value premiums depended on a variety of factors, including traffic congestion, local real estate market conditions, and business cycles.

Transit in Europe also can provide insight to ways of measuring value capture. A study of 15 light rail systems in France, Germany, the United Kingdom, and North America measured housing prices, residential rent, office rent, and property values in each of the cities, concluding that a positive value premium was evident in all but two cities (*7*). These two cities initially experienced negative value impacts from fixed guideway transit because of the noise associated with the light rail system.

One key aspect of this literature is the separation of fixed guideway transit's impacts on existing real estate versus its impacts on new development. In many situations, once a fixed guideway transit system is planned, local governments also increase zoning densities or implement policies that increase the density of allowable development. This makes sense, because fixed guideway transit moves people without creating commensurate automobile traffic impacts. Studies of value premiums, however, often have to control the analysis for changes in zoning (to allow for denser development) and the effects of related development policies. Conversely, increases in allowable development through denser zoning, even in the absence of fixed guideway transit, almost always result in a higher land value, because a developer can build more units on the same site under these increased density conditions.

AMOUNT AND DENSITY OF NEW DEVELOPMENT

One of the only quantitative studies specifically about modern streetcar impacts is the *Portland Streetcar Development Impacts* (*8*). This analysis of the Portland streetcar system measures the amount of new development and its density (measured by amount built compared with amount allowed by zoning), within a fine-grained block-by-block area around Portland's first streetcar segment. The study found that the amount of new development captured near the streetcar line grew after streetcar operations commenced, and that the type of development near the streetcar also became denser, compared with development patterns along the streetcar route before its construction. This often-cited work, described in more detail in chapter four, "Case Studies," for Portland's streetcar, ends with a clear statement that causality needs to be further analyzed, because other factors were in play during the period of the streetcar's construction in downtown Portland.

ECONOMIC DEVELOPMENT IMPACTS

Because streetcar planning is experiencing a resurgence in the United States, the literature contains several published projections of economic development benefits anticipated by future streetcar development in specific cities. However, the methodologies used, and the resulting components of the estimated benefits, generally are not well described beyond the creation of construction jobs. Levine et al. is an exception in its use of an input–output model to estimate economic impacts from a proposed light rail line (*9*).

The literature regarding empirical measurement of actual changes in economic activity, such as changes in retail sales, visitors, or job growth, is almost nonexistent for streetcars. Indeed, this lack of empirical data was cited by many of the streetcar system survey respondents described in this report. One of the few identified published articles, by Crampton, describes in very broad terms the findings of other studies of streetcars (trams) and light rail systems, and contrasts the experience in French and German cities with those in Britain and North America (*10*). He makes a contrast between French systems that explicitly seek to connect city centers and outlying high density residential areas, but have limited potential for new development, versus British or U.S. systems that often seek to use available rail rights-of-way, which tend to be located in industrial or other areas that present a challenge for generating ridership, but offer greater potential for attracting development (although this benefit is likely to only be captured in a strong economy). Crampton shows that trams can attract more shoppers and generate higher growth in property prices and rents. He notes, however, that these factors vary between different towns, for reasons that are not yet fully understood or empirically analyzed (*10*).

SUMMARY OF LITERATURE LIMITATIONS

The literature on impacts on the built environment overwhelmingly focuses on heavy rail and light rail systems. The only study with quantitative analysis of a contemporary streetcar system's impacts can be found in *Portland*

Streetcar Development Impacts (*8*). As described in more detail in this report, the study's findings are not necessarily applicable to other U.S. streetcar systems, owing to the unique presence in Portland of an Urban Growth Boundary (UGB) constraining development at the region's edge (pushing development into the center), the presence of a framework for urban renewal [Urban Renewal Areas (URAs)] with substantial redevelopment incentives, and limits on the study's analysis of causality. Given that federal funding for streetcars emphasizes economic development, along with many local policymakers' objectives to stimulate economic development, the literature is particularly weak on impacts of streetcars on economic development, such as the attraction of jobs, retail sales, and tax revenue.

CHAPTER THREE

SURVEY OF STREETCAR AND TROLLEY SYSTEMS

SURVEY METHODOLOGY

Synthesis reports commissioned by TRB typically include a survey of stakeholders or transit agencies to obtain first-hand knowledge of the current state of the practice.

The number of contemporary streetcar systems completed in the past 20 years, for which the conditions exist to measure changes to the built environment, are limited (a total of 13 systems as described in the Introduction). Thus, this synthesis adjusted the approach to survey each of these systems, using a detailed survey instrument administered by personal telephone interview. The multistep process was as follows:

- **Prepare Draft and Final Survey:** A detailed draft survey instrument was prepared, based on a series of questions and issues raised by the TRB Synthesis Panel. The draft survey instrument was reviewed by the panel and revised to respond to additions or deletions of questions.
- **Identify Interview Subjects:** To comprehensively capture knowledge about the system's planning and development impacts, a transit agency expert with institutional knowledge was identified as well as an economic development expert or land use planner who had managed the related land use and economic development process associated with the streetcar system.
- **Set Appointments for Telephone Survey:** Telephone appointments were made with these two people in each of the 13 communities. Two-person interviews in 12 of the 13 communities were successfully completed, with the exception being the Dallas streetcar, where attempts to arrange the interviews were unsuccessful.
- **Administer the Survey:** The survey was sent in advance to each interview subject, to aid their understanding and enable them to collect background information before the appointed interview. Because the survey instrument consists primarily of open-ended comment questions, the survey administration involved recording all of the comments on the interview form, as well as follow-up requests for information, studies, and images for each system. The survey instrument is provided in Appendix A, respondents are listed in Appendix B, and the survey tabulation is provided in Appendix C.
- **Review Studies, Presentations, and Articles Provided:** All studies provided by the interviewees were reviewed, and follow-up was conducted independently, particularly for the five case study systems profiled in this report. For most systems, beyond anecdotal information elicited during the survey, only limited information regarding streetcar impacts on the built environment was available.

PROFILE OF STREETCAR SYSTEMS

As shown in Table 2, organized in order of annual ridership, the streetcar systems offering fuller commute service show a more intensive use pattern, with routes ranging from 1.3 to 8.0 mi, and ridership ranging from a low of 450,000 in Seattle to a high of 3.7 million in Portland, Oregon. By comparison, the systems with lower ridership range in length from 1.0 to 6.7 mi (with half of them less than 2 mi), with annual ridership ranging from a low of 22,000 in Galveston, Texas (before inoperability resulting from Hurricane Ike), to a high of 100,000 in San Pedro, California. These data exclude the anomalous performance of Tampa, Florida's streetcar with a route of 2.4 miles (expanding an additional 0.3 miles in December, 2010) with annual ridership exceeding 440,000 (this systems connects multiple visitor destinations, including the convention center and a cruise ship terminal).

PLANNING, FINANCING, AND MANAGING THE SYSTEM

It is difficult to generalize about the planning and goals of each surveyed system, because each has a unique individual history. As shown in Appendix C, although each system had general goals for streetcar development, few of the systems had identified measurable objectives that were documented, and almost no objective has been evaluated or benchmarked, other than ridership projections in some cases.

In general, the lower ridership systems evolved from either a community or business initiative to restore streetcars to attract visitors. One exception to this pattern was Kenosha, Wisconsin, which implemented its limited service system after an Urban Land Institute (ULI) advisory panel recommended streetcars as one facet of a strategy to revitalize and stimulate private development on the site of an

TABLE 2
SUMMARY PROFILE OF SURVEYED STREETCAR SYSTEMS

City	Year Started	Type of System	Route Length (miles)	Full Commute Service	Headways (minutes)	Current Annual Ridership (rounded)	Number of Stations
Portland, OR	2001	Modern electric	8.0	Yes	12	3,700,000	46
Memphis, TN	1993	Restored historic cars	7.0	Yes	10	1,000,000	34
Tacoma, WA	2002	Modern electric	1.6	Yes	15	900,000	5
Seattle, WA	2007	Modern electric	1.3	Yes	15	450,000	6
Tampa, FL	2003	Replica of historic cars	2.4	No	15	441,000	10
Little Rock, AK	2004	Replica of historic cars	3.0	Yes	25	155,000	13
San Pedro, CA	2003	Restored & replica cars	1.5	No	20	100,000	4
Lowell, MA	1984	Replica of historic cars	1.0	No	Not regular	80,000	5
Savannah, GA (a)	2009	Restored historic cars	1.0	No	15	75,000	7
Kenosha, WI	2000	Restored historic cars	1.7	No	15 - 20	65,800	19
Astoria, OR	1999	Restored historic cars	3.0	No	Not regular	40,000	18
Galveston, TX (b)	1996	Diesel-electric replicas	6.7	No	NA	22,000	22
Charlotte, NC (c)	1996	Restored historic cars	2.2	No	30	N/A	11

Notes:
a) Service was interrupted due to damage caused by Hurricane Ike, but system is expected to reopen
b) Opened in Feb 2009. Ridership shown is projected.
c) Streetcar shares a right-of-way with the light rail system since 2003 and operates weekends only.
Source: BAE, 2009.

abandoned automobile manufacturing facility located on the shores of Lake Michigan near, but not in, downtown. Another exception was Savannah, Georgia, which considers its recently opened streetcar as a "starter" line to build support for a more extensive streetcar system to resolve bus and auto congestion in its downtown.

The fuller service systems, as might be expected, generally had more extensive planning before construction and many of these systems have evolved over time to become an integrated component of overall regional transit strategies. Most of the fuller service systems seek to transport residents and workers from housing to jobs and back again, along with visitors and patrons of retail and entertainment venues.

Only a few of the system operators reported that alternative modes of transportation were evaluated when the streetcar systems were planned. In contrast, however, most system operators cited the more generalized belief, without analysis, that people are more attracted to streetcars than to buses, and streetcars would better meet the goals of revitalization or visitor attraction. Several systems acknowledged that this opinion needs further empirical research to better understand if this is accurate in their city, and why it may be true.

The Savannah streetcar is notable in terms of explicit identified transportation purposes for its streetcar. In Savannah, the streetcar was implemented in large part to solve congestion on historic streets affected by private automobile traffic as well as an overlapping network of bus and shuttle systems. Based on experience with its initial streetcar line, the current downtown Master Planning process reflects considerable interest in expanding the system.

None of the systems' representatives mentioned explicit environmental goals as being a key driving factor behind development of the systems. Nonetheless, based on growing interest in carbon emissions reductions, it is anticipated that this objective will become more prevalent in the next few years. Consistent with a growing environmental awareness, the city of Seattle has seen a strong trend toward green building along its streetcar line and is currently exploring density bonuses for buildings that achieve a Leadership in Energy and Environmental Design (LEED) Silver certification from the U.S. Green Building Council. (LEED is a green building certification system that provides third-party verification that a building was designed and built using environmentally sound materials and practices.)

Financing for the systems surveyed is varies widely, ranging from the repurposing of Interstate Transfer Funds for a planned (but not constructed) highway project in Memphis, to substantial local property assessments through a Local Improvement District (LID) mechanism in Portland and Seattle. A full comparison of cost per mile, and leveraging of public and private sources of funds, was not conducted for this study.

Management of the systems also varies, including management by several nonprofit organizations. Several of the lower ridership systems rely on volunteers to staff the system, demonstrating an amazing dedication to the concept of transit by streetcar (and the appeal of the heritage aspect of streetcars in their communities).

IMPACTS ON PHYSICAL BUILT ENVIRONMENT

As shown in Appendix B, almost all of the streetcar system representatives believed that the streetcar had positively affected the physical built environment, especially in terms of attracting new development or enhancing revitalization and redevelopment efforts; however, the degree of this impact ranged from mild to strong. At the same time, each

system except Portland noted the critical lack of data and analysis to demonstrate this perception of positive benefit. Moreover, almost all of the systems described the positive benefits as widely varying over time, especially during the current economic downturn.

Some representatives of the systems interviewed also cited perceptions of increased property values and, to a lesser extent, lease rates along streetcar routes. Other than in Memphis, however, for which these increases were analyzed systematically as part of a larger study for the city of Charlotte, none of the cities offered published studies to support the property value opinions.

Changes in related development topics, such as attracting larger developers or stimulating LEED-designed buildings, along the streetcar routes were mixed. Several interviewees noted that developers seemed to be interested in projects along the streetcar route, and cited this as a positive trend. Others, however, noted that while projects may have been discussed or proposed, once the streetcar was in place, other factors created delays in realizing these benefits.

Few systems reported ancillary changes to the built environment, such as reduced parking garage construction, increased pedestrian or bike lane investments, or explicit reductions in parking requirements if located near streetcar. Many of these types of built environment changes have evolved near light rail systems, and perhaps may become more noticeable as contemporary streetcars evolve in the United States.

IMPACTS ON ECONOMIC DEVELOPMENT

One of the most notable aspects of the survey findings is that few, if any, of the systems were seeking information regarding the impacts of the streetcar on economic activity such as job attraction, change in job mix, retail sales, tax revenues, and so on. Although occasionally the literature forecasting economic benefits for proposed streetcar systems posits that streetcars will attract more "creatives" to the area, this idea cannot be substantiated. Few systems surveyed riders as to purpose of trip or demographic composition; of those that have conducted rider surveys, the primary question has been whether the rider is a resident or visitor (likely related to the goal of increasing tourism in several of the systems' communities).

Almost all of the system operators interviewed considered these economic-related questions as vital, and most requested more research around this topic, particularly in cases in which the streetcar system is slated for expansion and significant commitment of public funds.

CHANGES IN FUTURE LAND USE PLANS AND REGULATIONS

Several streetcar systems, having demonstrated their viability, currently are being integrated into local land use planning processes. Notably, this is occurring in Savannah, Portland, Seattle, and San Pedro.

A handful of cities reported having made explicit changes in density or parking requirements either before or as a result of streetcar implementation, including Portland and Seattle. Portland initially constructed the first segment of its streetcar, in part, to explicitly support higher density development in a revitalizing district adjacent to the downtown, and subsequently has utilized the streetcar as a connector to the South Waterfront Aerial Tram, which in turn serves as the key mode of transport to a previously disconnected portion of the waterfront now being developed into major residential, educational, research and development (R&D) uses. In Seattle, the city and a major property developer, Vulcan Properties, see the streetcar as necessary to achieved planned densities and overall goals for pedestrian-oriented development in the South Lake Union neighborhood.

CHAPTER FOUR

CASE STUDIES

KENOSHA, WISCONSIN

The city of Kenosha, with a population of 98,550 (2007), is located on Wisconsin's southeastern border with Illinois along the shores of Lake Michigan. The city lies approximately midway between Milwaukee (40 mi to the north) and Chicago (65 mi to the south). The Metra commuter rail system's Union Pacific North Line connects Kenosha with Chicago, including limited weekday and weekend service.

Streetcar System

Kenosha's original streetcar system operated between 1903 and 1932. Today's streetcar system, the Kenosha Transit Electric Streetcar, commenced service in June 2000 (see Figure 2). As a limited service streetcar system, cars operate primarily during mid-day weekday hours only in the winter, with expanded service throughout the day and on weekends in the summer. The system had an annual ridership of approximately 65,700 in 2008.

FIGURE 2 Kenosha Streetcar, HarborPark. (*Source:* Wikipedia® under the terms of the GNU Free Documentation License.)

Kenosha's streetcar route follows a single-track, one-way loop, normally served by a single car running at about 15 min headways. The 1.9 mi line is routed in a grassy median for about half its length, alongside the street for about a quarter of its length, and in the street for the remaining distance. The system provides daily service with 17 stops, connecting the relatively new 69-acre mixed-use HarborPark neighborhood to the Central Business District. The route provides access to Kenosha's historic civic center, a shopping district, the marina, Lake Michigan lakefront and the adjacent park, museums, and the city's new downtown transit center, where the streetcar system connects with the Metra commuter rail to Chicago.

The current Kenosha streetcar system utilizes five remanufactured Presidents' Conference Committee (PCC) streetcars, built in 1951 by the St. Louis Car Company and formerly used in Toronto. These cars have been refurbished and repainted in a variety of color schemes.

System Development

Kenosha Area Transit (KAT), the city-owned public transportation agency, operates the streetcar system. KAT is part of the Southeast Wisconsin Transit System, which also maintains a fleet of 68 buses, 42 of which operate in Kenosha. Several bus routes intersect the streetcar line.

Planning for Kenosha's streetcar system began in the early 1990s as a part of a master plan for the redevelopment of HarborPark, a 69-acre brownfield site located on the embankment of Lake Michigan. The site was the former location of a large American Motors Corporation manufacturing plant, which closed in the 1980s. In 1996, the city engaged the ULI to create a reuse plan for the brownfield site and for redevelopment of the surrounding area. After one year of studying the area and leading public charrettes, the ULI team recommended reintroducing the streetcar system in conjunction with other aspects of redevelopment to stimulate new development at the HarborPark site and entice developers to rehabilitate existing buildings and invest in the downtown core. In addition to the streetcar, the redevelopment plan included promoting residential and mixed-use development on and surrounding the brownfield site, public investment to enhance the marina, and investment in public activity centers such as museums and public plazas to draw tourism. Furthermore, the streetcar would connect HarborPark to the downtown area and to the Metra station, and enhance what was, at the time, an underutilized Central Business District (see Figure 3). As redevelopment of the area has drawn a larger population to HarborPark and the downtown core, a long-term vision has evolved for the streetcar to eventually serve commuters to and from Chicago by means of the Metra commuter rail as residential density increases in the area.

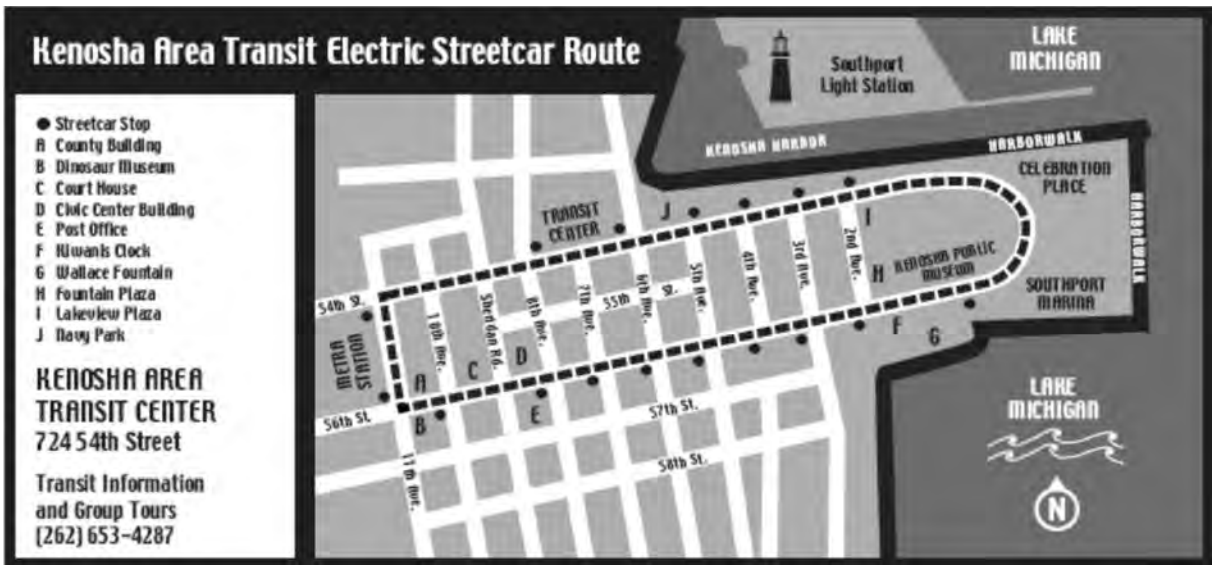

FIGURE 3 Kenosha streetcar map. (*Source:* Kenosha Area Transit.)

System Financing

The initial capital cost of $5.2 million for the Kenosha Streetcar system (see Figure 4) came from the FTA 5309 program, which provides capital assistance for new and replacement vehicles, related equipment, and facilities; and the Congestion Mitigation and Air Quality Improvement Program (CMAQ) with an 80% federal and 20% local funding split. The remaining local funds came from the city's capital improvement program for infrastructure as well as tax increment financing (TIF) for improvements around the streetcar alignment and Metra station.

FIGURE 4 Kenosha streetcar. (*Source:* Kenosha Area Transit.)

System Management

During the summer months, the system operates 7 days a week from 11:05 a.m. to 7:05 p.m. Monday through Friday, and from 10:05 a.m. to 5:35 p.m. on Saturdays and Sundays. During the winter, the system operates Monday through Friday, only, from 10:05 a.m. to 2:05 p.m. Fares are $0.25 per trip or $2.00 for a day pass. The streetcar has 17 designated stops, but also permits flagged stops.

Ridership has substantially increased from 53,662 riders annually in 2006 to 65,759 riders in 2008. Although KAT has not conducted a survey, the KAT director commented that a significant number of riders are tourists visiting the area's four museums.

Impacts of Streetcar on Built Environment

Impacts on Existing Development

Previously an industrial manufacturing zone, the redevelopment plan for HarborPark called for new zoning to allow high-density, residential mixed-use and museums. The plan sought to create a new residential, commercial, and tourism district, with the streetcar, streetscape improvements, and design standards connecting it visually and physically to the historic downtown. Additionally, the city eliminated one-way streets to promote more business traffic around the streetcar alignment in the downtown area. The Business Improvement District provided most of the funding for downtown streetscape improvements around the streetcar alignment.

Private investment in the existing downtown core has focused primarily on rehabilitation. According to the city's community development specialist, the downtown has attracted some local investors who have rehabilitated several buildings, taking advantage of smaller historic structures. However, much of the downtown building stock, in larger historic structures, reportedly is being held off the market because the economics of rents do not yet support substantial investment.

Impacts on New Development

The redevelopment of the HarborPark area has produced new multifamily condominiums and townhouses, a new natural history and art museum, a new Civil War museum, green space, and a two-tiered water-edge pathway around the harbor. The Kenosha Harbor also supports two newly enhanced marinas and 0.25 mi of new public promenade with lighting, small courtyards, and a public seating area. A bicycle and pedestrian trail links the park to the 250-boat slip marina. According to the city's community development specialist, the incentives for high-density residential projects and the development of cultural amenities came from the initial infrastructure laid down for the streetcar. Additionally, the specialist reported that as a result of the zoning changes, only 2 of the 13 blocks that make up HarborPark remain undeveloped. The city is currently offering a reduction in land costs for two city-owned undeveloped sites at HarborPark.

Kenosha's director of transportation, interviewed for this study, commented that the streetcar has supported density and helped the rapid sale of HarborPark's initial 400 condominium units. Several recently completed condominium projects adjacent to the harbor on the streetcar line have experienced slower absorption, however, because of the downturn in the economy. He credited the streetcar, along with new open space and pedestrian and streetscape improvements, with helping the city to attract tens of thousands of people for a variety of summer festivals and a lakefront triathlon each year.

Even with no zoning changes in the downtown core, the once underutilized Central Business District has experienced New Urbanism inspired development with higher densities. Under the redevelopment plan, the city cut parking requirements in half for downtown development. It requires no new parking for rehabilitation projects of existing buildings if the footprint is not altered, and requires only off-street parking for new buildings. The city currently is discussing the option of reducing parking requirements in the HarborPark area and building city-financed parking garages to alleviate the parking cost burden on developers.

Impact on Economic Development

It is difficult to ascertain the impacts of the streetcar on the downtown's economic development. The city's community development specialist commented that traditional, national "main street" anchor tenants have not located downtown, preferring highway locations, but several locally owned restaurants and shops, including a wine bar, have opened downtown in recent years. In addition, a nine-story condominium tower and 60-room hotel have been proposed for development downtown. In general, the mostly locally owned businesses locating downtown have created a niche "hometown downtown." Businesses such as Trolley Dogs have capitalized on the appeal of the streetcar by incorporating streetcar themes into their businesses.

SAVANNAH, GEORGIA

Savannah is a coastal city of approximately 130,000 residents, located along the Savannah River, which separates Georgia and South Carolina. The Port of Savannah is a major seaport, with the fourth-busiest container terminal in the United States. Savannah is the county seat of Chatham County, whose population is approximately 250,000.

Streetcar System

Savannah's River Street Streetcar is the demonstration phase of what is intended to be a larger effort to incorporate extension of a streetcar system with downtown master planning to enhance mobility and the competitive position of downtown for offices, retail, and residential uses (see Figure 5). Future expanded streetcar service is seen as the best means to replace an overlapping and duplicative mix of various types of publicly and privately operated buses and shuttles. Streetcars are seen as being particularly suitable for Savannah, compared with light rail transit options, because of the physical constraints of its historic downtown, with small blocks and its lower cost for this smaller city.

FIGURE 5 Savannah streetcar. (*Source:* John Smatlak.)

The River Street Streetcar commenced operation in February 2009, and runs a single route of approximately 1 mi with seven stops along River Street, the city's primary tourism destination. The Streetcar is part of the downtown department of transportation (DOT) multimodal transportation system that offers free service. From stops along the streetcar route, riders can catch a DOT Express shuttle bus to downtown and between downtown parking structures, as well as the DOT Savannah Belle ferry to the Savannah International Trade and Conference Center across the Savannah River.

The streetcar is a restored W-5 1925 Melbourne streetcar that is self-propelled, using a biodiesel (B50) electric hybrid system. The restoration was completed because use of an overhead catenary is not possible with the extensive tree canopy that is a character-defining feature of the city.

System Development

The River Street route is a demonstration project that establishes the viability of a streetcar. An earlier 2003 study by Chatham Area Transit (CAT), the regional transit operator, had looked at building a longer 4-mi route that would connect the downtown area and River Street. The cost and complexity of that system, however, lead to Chatham County losing interest, and it was never built.

The city went on its own with a smaller demonstration "starter" route along River Street because the rail lines were already in place, and the city was able to buy it from the Norfolk Southern Railroad (see Figure 6). River Street is part of a historic district, a tourist destination, and better suited to rail than buses because of its cobblestone paving. The goal is to start with a system that is a novelty, and then build excitement to support a proposal to extend the streetcar throughout the downtown area.

Other goals for the demonstration project include determining whether the biodiesel–electric hybrid propulsion system would work, as well as the right size of streetcar (47-ft long Melbourne cars or 24-ft long Birney cars). The city now believes that the 47-ft long cars cannot make the tight turns in the city's historic downtown, with its 1733 layout featuring small blocks, and will look to use smaller Birney streetcars in the future.

The city's Department of Mobility Services is responsible for funding the streetcar and contracting with its operators as well as operators for other transportation modes in the downtown and greater downtown areas. The contracted operator is the Savannah Mobility Management Board (MMB), Inc., an independent nonprofit commercial entity that hires the drivers. The Department of Mobility Services hires mechanics. This structure was created to facilitate funding and avoid having city employees operating vehicles. CAT did not want its employees to operate the streetcar because it would have had to create a Rail Division pursuant to FTA rules, and it was not prepared to do so. CAT, however, is willing to take over the route in the future as the streetcar expands and becomes a full system.

System Management

Since opening, ridership has been running slightly above projections, with the current projection for the year (partial-year operation since operations commenced in February) approximately 75,000. The peak season for ridership is springtime. The streetcars do not have air conditioning, and a seasonal drop-off in ridership is expected during Savannah's hot, humid summer. The first ridership survey will be conducted at the 6-month anniversary in August; it is believed that approximately 80% of the ridership is tourists.

The system operates Wednesday through Sunday, from 12 noon through 7 p.m. Headways are generally every 15 min.

System Financing

The financing of the River Street streetcar route was through the city's General Fund, involving an expenditure of approximately $1.5 million. Ongoing operations for the fare-free service are funded through the city's parking system (garages, meters, and tickets).

Impacts of Streetcar on Built Environment

Impacts on Existing and New Physical Development

As a recently opened demonstration route in an established and successful tourist area, the streetcar has not had an identifiable effect on existing development, nor has it led to proposals for new development or other job creation and investment. Because River Street is in an historic district, new development, employment, and investment likely will occur through the reuse of existing structures, rather than extensive development of new buildings.

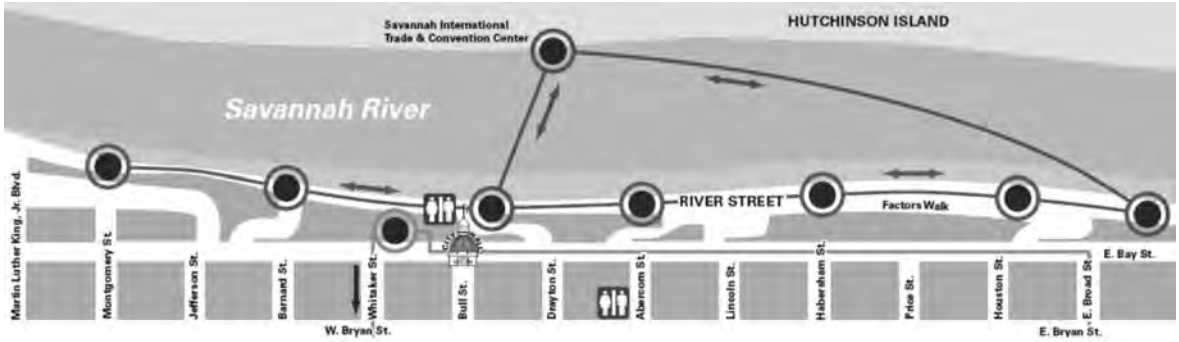

FIGURE 6 Savannah streetcar map.

Changes in Future Land Use Plans and Regulations

The Savannah Development and Renewal Authority (SDRA), in partnership with the city of Savannah and the Metropolitan Planning Commission (MPC), is guiding the development of a new master plan for downtown Savannah. The plan is undergoing administrative review, with public release scheduled for mid-2009.

Expanding the Savannah streetcar system is an integral part of planning process to rationalize downtown Savannah's transit system, improve downtown mobility, and support redevelopment efforts. For example, CAT currently operates 326 daily buses on lines serving the county that congregate in the downtown area. The Savannah College of Art and Design, a 7,000-student downtown campus with 70 properties, operates its own shuttle system with 36 buses, which stop at many of the same locations as CAT buses. These overlapping services—in an historic downtown with small blocks—have contributed to congestion. The city anticipates that an expanded streetcar system integrated into a new multimodal terminal will reduce private automobile and bus transit congestion in the downtown area. Moreover, according to city staff, streetcars are considered a cost-effective solution for downtown mobility, because Savannah is not a large city and cannot support a more expensive light rail system.

Based on the 2003 failed effort to develop a streetcar system, city staff determined that streetcar planning in Savannah needs to be considered as part of a comprehensive mobility system, integrating all modes of travel, including wayfinding for pedestrians, and development of an underground parking structure.

Impacts—Future Planned Economic Development

Expanded streetcar service is seen as an opportunity to promote economic development. Property owners are interested in being on a streetcar stop, and surveys show that residents perceive the experience of riding in streetcars as preferable to buses. The pending downtown master plan identifies the streetcar as a catalyst for economic development, and a means to attract more shoppers, businesses, and investors. In the future, a streetcar system is seen as an opportunity to promote Class A office space by linking buildings with off-site parking structures.

Martin Luther King, Jr. Boulevard, the main north–south route from the core downtown area to the waterfront, historically had streetcar service running down the middle of the street. A study is currently under way, with a September 2009 completion date, on the cost to extend the streetcar along the median. CAT is currently building a transit hub on Martin Luther King, Jr. Boulevard. The hub is also envisioned as a connection point for streetcars that would consolidate public transit downtown, while serving the mix of tourists, downtown workers, students, and local residents drawn to downtown Savannah.

Streetcars are seen as an effective method to extend transit to lower-income areas to the northeast and northwest of downtown, providing access by residents to service jobs downtown. The Savannah River Landing project east of downtown is a major 54-acre mixed-use development that would be linked to downtown by streetcar. Redevelopment of public housing surrounding the downtown into mixed-income developments also would be linked by streetcars.

As with River Street, most of the downtown area is in an historic landmark district. This means that new uses, and associated investment and new employment, primarily would be achieved through adaptive reuse of existing structures rather than development of new buildings. The Downtown Master Plan will encourage streetfront retail and presence, even for larger uses such as hotels, to enhance the pedestrian environment and synergies with an expanded streetcar system.

PORTLAND, OREGON

Oregon's largest city, Portland, is situated at the confluence of the Willamette and Columbia Rivers. Home to 575,000 residents, the city is at the center of a metropolitan area with 2.16 million residents, encompassing portions of northwestern Oregon and southwestern Washington. The streetcar system in Portland has gained national prominence as an example of a modern transportation system using streetcars.

Streetcar System

Portland Streetcar is owned by the city of Portland in partnership with TriMet, the regional transit operator, who contributes a portion of operating funding. Portland Streetcar is managed by the city Office of Transportation, which contracts with Portland Streetcar Inc., a private nonprofit organization, for construction and operation of the system. The streetcar system is not part of the regional MAX light rail system, which links suburban communities more than 30 mi apart to each other as well as offering service to the Portland International Airport and north Portland.

Initially announced in 1997, the system commenced operations in 2001, with the initial segment running from Good Samaritan Hospital to Portland State University. This first segment traversed primarily what was already a rich transit zone offering free bus service through downtown Portland. Following three additional incremental extensions, streetcars follow a 4-mi continuous loop from Legacy Good Samaritan Hospital at NW 23rd Avenue to the South Waterfront District, where the system connects with the Portland Aerial Tram, to a terminus at SW Lowell and Bond.

The current system has a total of 46 stops, located approximately every three to four blocks (see Figure 7). Streetcars run approximately every 12 min during most of the day Monday through Saturday, and less frequently in early mornings, evenings, and Sundays. Currently, it is free to ride the portion of the streetcar route traversing the Fareless Square (see line of squares on map, which is a large area covering most of the downtown area. The Fareless Square predates the streetcar and offers free bus and MAX service as well. Tickets for the streetcar outside of Fareless Square are currently $2.00 for adults and $1.50 for youth. Transfers from other transportation systems are honored. Ridership of the system as of Spring/Summer 2008 averaged 10,000 riders per day and reached up to 12,600 per day during peak summer weekdays.

FIGURE 7 Portland streetcar map. (*Source:* Portland Streetcar, Inc.)

System Financing

Financing of the Portland streetcar system has followed a different path and used a different mixture of funding sources for each segment constructed to date. The first segment, running from the Good Samaritan Hospital to Portland State University, a length of 2.4 mi, had a total capital cost of $56.9 million in 2000/2001. This cost was financed by a mix of local and federal sources. At the local level, the most substantial share of capital costs was financed by a municipal parking revenue bond supported by parking fees in the area of the streetcar. Additional local mechanisms relied on value capture, including an LID and TIF. Major tax-exempt property owners, including Portland State University, pay the LID fee because of the benefits they receive from streetcar service. As summarized in Table 3, funding sources varied as each of the three subsequent, shorter segments was constructed. To date, the streetcar system has been financed by approximately 79% local funds, including 19% contributed by local improvement districts and 21% by tax increment financing (see Table 3).

At present, Portland is preparing for its next stage of streetcar system expansion, which will be a new loop connecting the Pearl District in northwest Portland with areas across the Willamette River east of the downtown core, including the Lloyd District, a major office center. This loop extension will add 3.3 mi of double-tracked lines to the existing streetcar. It will extend from the Pearl District in northwest Portland, crossing the Broadway Bridge, and ending at the Oregon Museum of Science and Industry in southeast Portland. The project is currently in its construction design phase, with service slated to begin by 2011.

Funding sources for this major expansion are shown in Table 4. As anticipated, this extension will rely more extensively on federal funds, with $75 million or just over 51% of the project funded from this source. Local funding, from a Portland Development Commission LID (most likely a mix of TIF and other sources) will contribute 10% and 19%, respectively.

Impacts on the Built Environment

Impacts on Existing Physical Development

The Portland streetcar system has been analyzed extensively, primarily in terms of the amount, density, and timing of development it has stimulated, rather than streetcar impacts on land value. Anecdotally, the initial stage of the system is credited by the operator with stimulating accelerated development of condominiums and specialty retail in the Pearl District, an area that was already undergoing some urban revitalization before the streetcar, as part of Portland's urban renewal process. This area garnered substantial press in the late 1990s, when a major developer who had promoted the streetcar concept agreed to build higher densities when streetcar funding was finalized.

TABLE 3
SUMMARY OF PORTLAND STREETCAR SYSTEM FUNDING SOURCES UTILIZED TO DATE

Segment	Good Sam Hospital to PSU	PSU to RiverPlace	RiverPlace to SW Gibbs St.	SW Moody/Gibbs to SW Lowell	Total	% of Total
Length	2.4 miles	0.6 miles	0.6 miles	0.4 miles	4.0 miles	
Track Type	Double	Double	Single	Double		
Date of Service	July 2001	March 2005	October 2006	August 2007		
Sources of Funds (Million $s)						
Local Funds:						
Local Improvement District (LID)	$9.60	$3.00	$2.00	$4.80	$19.40	18.8%
Tax Increment (TIF)	$7.50	$8.40	$3.80	$1.80	$21.50	20.8%
City Parking Bonds	$28.60	$0.00	$0.00		$28.60	27.7%
City Parking Fund	$2.00	$0.00	$0.00	$0.00	$2.00	1.9%
City General Fund	$1.80	$0.00	$0.00	$0.00	$1.80	1.7%
City Transportation Fund	$1.70	$0.60	$0.00	$0.00	$2.30	2.2%
Transp System Development Charge (SDC)				$2.50	$2.50	2.4%
Miscellaneous Local Funds (a)	$0.20	$0.10	$0.00	$2.60	$2.90	2.8%
Subtotal	*$51.40*	*$12.10*	*$5.80*	*$11.70*	*$81.00*	*78.5%*
Regional and State Funds:						
Regional Transportation Funds	$0.00	$0.00	$10.00	$0.00	$10.00	9.7%
Connect Oregon				$2.10	$2.10	2.0%
Transportation Land Sale	$0.00	$3.10	$0.00	$0.00	$3.10	3.0%
Subtotal	*$0.00*	*$3.10*	*$10.00*	*$2.10*	*$15.20*	*14.7%*
Federal Funds:						
Federal Transportation Funds	$5.00	$0.00	$0.00	$0.00	$5.00	4.8%
U.S. HUD Grant	$0.50	$0.80	$0.00	$0.65	$1.95	1.9%
Subtotal	*$5.50*	*$0.80*	*$0.00*	*$0.65*	*$6.95*	*6.7%*
Total Funding	**$56.90**	**$16.00**	**$15.80**	**$14.45**	**$103.15**	**100.0%**

Notes:
a) Unspecified for 3 segments, includes Gibbs Extension savings and tram transfer for Moody-Lowell segment.
Sources: Portland Streetcar Inc. Capital and Operating Fund Summary, 2-28-08; BAE, 2009.

TABLE 4
SOURCES OF FUNDS FOR PLANNED STREETCAR EXTENSION

Source of Funds	Amount	Percent
Local Improvement District	$15,000,000	10.3%
Portland Development Commission	$27,000,000	18.5%
System Development Charge	$6,000,000	4.1%
Regional Funds	$3,000,000	2.1%
Vehicles from State	$20,000,000	13.7%
Federal Transit Administration	$75,000,000	51.4%
Total Project	**$146,000,000**	**100.0%**

Source: Portland Streetcar Loop Fact Sheet, City of Portland & Tri Met, September, 2007.

The survey conducted for this report included an interview with staff of the Portland Development Commission, the city of Portland's agency devoted to economic development and redevelopment of specific areas of Portland designated as URAs. Staff reported that although the Portland streetcar has been immensely popularized throughout the transit field, those engaged in economic development in Portland view the streetcar as one of many components of a longstanding and ongoing program to revitalize downtown Portland and to reshape the city as increasingly transit-oriented. Major initiatives, including an extensive light rail system (also traversing the downtown), the Fareless Square (free bus, light rail, and streetcar in the downtown), extensive streetscape improvements, substantial allowable density, fine-tuned parking regulations, strong design guidelines and review, and a host of financial incentives offered

by the Portland Development Commission (e.g., land write-downs, subsidies for affordable housing, loans and grants for economic development, and façade improvements), all have contributed to the success of downtown Portland in the areas around the streetcar routes. Staff perspective, shared by many other planners and economic development practitioners in Portland, is that it is difficult to single out the streetcar as a key factor in the downtown's success; rather it is one among a host of urban amenities creating the conditions for success.

Impacts on New Physical Development

More complete documentation is available regarding the actual new development amounts stimulated by the Portland streetcar. A 2005 report prepared by E. D. Hovee & Company for Portland Streetcar, Inc., the operators of the Portland streetcar system, analyzed the new development patterns experienced after the streetcar system was announced in downtown Portland (*8*). The study looked at new development quantities both before and after 1997, the year the streetcar was announced. The geography studied was based on the number of blocks from the streetcar track(s), with the "one block" distance actually representing three blocks in width, as a result of the double streetcar tracks built with a block in between as well as another block on either side of the track.

Hovee's analysis found that between 1997 and 2004, the blocks adjacent to the streetcar attracted more square feet of development, and at denser levels, than had been attracted to the same locations before the streetcar. For the blocks adjacent to the streetcar tracks, new development averaged 90% of allowable Floor Area Ratio (FAR) post-1997, whereas before this time, *existing* buildings constructed over the neighborhood's 100-plus-year life had averaged just 34% of allowable FAR (the study did not look at the density of newer development projects alone, before the streetcar announcement).

In absolute terms, the study notes that the new development averaged 5.9 FAR within the one-block area after 1997, whereas it averaged 6.4 at the three-block distance after 1997. In other words, although the sites adjacent to the streetcar clearly were more densely developed after the streetcar announcement than before, other new development elsewhere in downtown was still denser in absolute terms (owing to the configuration of downtown Portland, many of the most newly and densely developed, well-located downtown sites are not along the streetcar route).

Another way to understand the change is that the addition of more than 4 million square ft in densely developed new projects near the streetcar allowed this specific one-block area to "catch up" with, and thus achieve similar overall density as, more distant downtown blocks that contain Portland's more concentrated downtown districts (see Table 5).

The addition of 4.6 million new square ft of development between and on either side of blocks that separate tracks going in opposite directions ("one block") dramatically increased this zone's capture of total development activity; before 1997, these blocks contained 19% of the neighborhoods' *existing* development, whereas after 1997, the same blocks captured 60% of all new development. This finding suggests that the streetcar attracted a disproportionate share of new development, shifting the attractiveness of sites adjacent or near to its tracks from moderate to high during the period studied.

Local land use policies—such as the UGB surrounding Portland, the construction of other light rail transit systems, and the URA process, as well as the ability to invest TIF to subsidize infrastructure and development projects in these redevelopment areas—have long encouraged downtown development and redevelopment, including but not limited to the streetcar route. Moreover, while the Hovee study measured the amount of zoning capacity used by developers before and after a specific year marking the announcement of the streetcar, other development trends that were present

TABLE 5
SUMMARY OF FINDINGS FROM *PORTLAND STREETCAR IMPACTS,* 2005 (8)

	Buildings Developed Pre-1997				Buildings Developed Post-1997				All Developed Taxlots			
Proximity to Streetcar	Existing SF	Potential SF	% of max SF	% of pre-97 dev.	New SF	Potential SF	% of max SF	% of post-97 dev	Existing SF	Potential SF	% of max SF	% of Total dev.
1 block	9,029,000	26,507,000	34%	19%	4,171,645	4,612,000	90%	60%	13,200,645	31,119,000	42%	25%
2 blocks	5,734,000	16,864,000	34%	12%	793,886	1,074,000	74%	11%	6,527,886	17,938,000	36%	12%
3 blocks	7,465,000	15,399,500	48%	16%	773,015	1,175,000	66%	11%	8,238,015	16,574,500	50%	15%
3+ blocks	24,651,000	56,715,035	43%	53%	1,185,510	4,391,000	27%	17%	25,836,510	61,106,035	42%	48%
Total	46,879,000	115,485,535	41%	100%	6,924,056	11,252,000	62%	100%	53,803,056	126,737,535	42%	100%

Notes:
Condo projects are treated as a single taxlot for this analysis. Redeveloped space – including former warehouses converted to condominiums – is not included in the tally of developed space.
Source: Based on table presented in Hovee, 2005.

in Portland at that time, such as increased developer demand for more densely developable sites, the real estate boom for condominiums offering urban lifestyles with high amenities in downtown Portland, and rising land costs, likely influenced development patterns and resulted in denser development in the past few years, irrespective of the streetcar (as demonstrated by the average new development FAR of 6.4 at the three-block distance). Hovee recommends that a more thorough statistical model be constructed to better verify the causal relationship between the construction of the streetcar and before-after development patterns.

MEMPHIS, TENNESSEE

The city of Memphis, Tennessee, with approximately 650,000 residents, is the central city within a metropolitan region that encompasses 1.27 million residents. With a rich history, and world fame as a center for music (e.g., blues and rock and roll), Memphis has long attracted substantial tourism.

Streetcar System

The Memphis Area Transit Authority (MATA) began operation of the city's trolley system in 1993, approximately 50 years after the city's original trolley system had been dismantled. Today, the system consists of 24 stations along three lines: the Main Street Trolley, the Madison Avenue Loop, and the Riverfront Loop. Together, these lines total 7 mi in length. The system provides daily service, using mostly rehabilitated vintage cars (see Figure 8).

FIGURE 8 Memphis streetcar. (*Source:* John Smatlak.)

The 2.5-mi Main Street line was implemented initially, including a 0.8-mi double track on an exclusive trolley-pedestrian mall, and with the remainder sharing the street with traffic. The Riverfront Loop is a 2-mi-long parallel line that runs primarily on a double-track railroad right-of-way traversing the edge of downtown near the Mississippi River. One of the tracks is dedicated to MATA use, and the other to Amtrak. Riverfront line cars operate in a one-way loop, using the Main Street line as one leg of the circle. MATA opened the 2.5-mi-extension on Madison Avenue in 2004. The Madison Avenue Loop connects the existing downtown system with the Medical Center complex, linking the city's two largest employment centers by rail transit. The Madison line operates in mixed traffic along Madison Avenue, generally on tracks located in the inside travel lanes. This extension also included two major bridge projects: a parallel two-bridge rail-only system at Danny Thomas Boulevard (one rail bridge on each side of the existing street bridge), and a reconstruction of the existing bridge at I-240, with tracks placed on the bridge.

System Development

In initial planning for the trolley system, MATA strategically placed the Main Street line between two intermodal transportation terminals: Central Station to the south, and the proposed new North End Terminal to the north. These two transportation terminals facilitate several types of intermodal connection and house joint development tenants. Central Station, a historic train station renovation and mixed-use project on the south end of the Main Street/Riverside Loop, serves MATA buses, the trolley, Amtrak, and automobile park-and-ride. The new North End Terminal provides a MATA bus, trolley, and an automobile park-and-ride transfer point, as well as a mix of residential and commercial uses (*11*) (see Figures 9 and 10).

According to the manager of planning for MATA, the initial goals for the development of the Main Street and Riverfront lines were to bring life and investment back to Main Street, which had been a deteriorating pedestrian mall. The trolley was meant to connect the north and south transportation terminals, while providing shoppers with convenience to shops and access to some jobs along the pedestrian mall. Other considerations in designing the system included connecting major points of trip generation such as residences, restaurants, parking facilities, hotels, the Cook Convention Center, the Pyramid Arena, the Memphis Civic Center, and riverfront parks. Although MATA evaluated the option of a transit way for a bus system, an electric trolley system was chosen for construction, because it was considered more consistent with the city's goal to minimize downtown air pollution. The primary goal of the third line, along Madison Avenue, was to connect Memphis's two major employment centers: the downtown with about 40,000 jobs and the Memphis Medical Center with approximately 60,000 jobs located east of downtown.

System Management

The Memphis trolley system operates as a full service system, with service provided 7 days a week from 6:00 a.m. to 10:00 p.m., Monday through Thursday; 6:00 a.m. to 1:30 a.m. on Friday; 10:00 a.m. to 1:30 a.m. on Saturday; and from 10:00 a.m. to 6:00 p.m. on Sunday. The trolley oper-

ates on roughly 10-min headways during the week, with less frequent service during off-peak evening weekday hours and on weekends. Ridership has significantly grown since the mid-1990s, when the system had approximately 500,000 riders annually on the Main Street line alone, to more than 900,000 after the opening of the Riverfront Loop in 1997. Since the completion of the Madison line in 2004, ridership has grown to just over 1 million (2008) (see Figure 11).

FIGURE 9 Memphis trolley route. [*Source*: Memphis Area Transit Authority (MATA).]

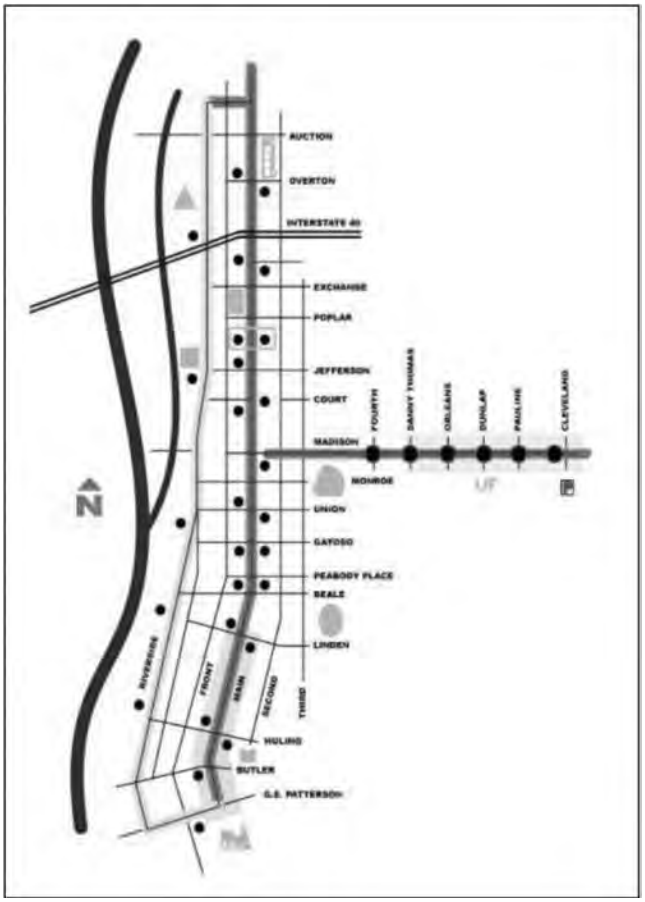

FIGURE 10 Memphis trolley system. [*Source:* Memphis Area Transit Authority (MATA).]

MATA conducted a trolley rider survey in 2001, with results showing that the average ridership over the business week was split about equally between residents (58%) and nonresidents (42%). Over the weekend, the survey showed more nonresidents riders, with 38% local and 62% visitors. Local riders cited using the trolley mostly for home-based trips, followed by work trips and entertainment, whereas nonresidents cited using the system mostly to access their hotel, followed by access to entertainment.

System Financing

The nearly $45 million cost for the Main Street/Riverfront lines was funded by FTA funds from a prior interstate highway project that was never built (I-40), and FTA Formula funds, along with state, local, and private funds. The Memphis Metropolitan Planning Organization allocated 12% of the Interstate Transfer funds for transit capital projects, which in turn funded roughly 70% of the initial Main Street line, and 44% of the Riverfront line (*11*). Funding for the Madison Avenue extension totaled $58.3 million, including $46.7 million from the FTA New Starts program, $5.8 million from the state, and $5.8 million from the city (see Table 6).

Impacts of Streetcar on Built Environment

Impacts on Existing Physical Development

According to the MATA manager of planning, because of the trolley's implementation of its first segment, the Main Street line, the corridor has experienced resurgence in residential uses and population. The trolley system, along with the redevelopment of mixed-use Central Station completed in 1999, has played a major role in reinvigorating downtown. In addition to serving as a major transportation hub, the renovated Central Station project included joint development consisting of 63 one- and two-bedroom apartments, Hudson Hall (a conference room for private functions), 12,000 square ft of commercial space, a public meeting room, an Amtrak ticket office and waiting room, and a police precinct station. This project totaled approximately $23 million in public and private investment in the downtown area (see Figure 12).

Analysis of Value Premiums

As part of a larger study for the city of Charlotte conducted by Bay Area Economics in 2008–2009, original research was conducted to analyze property value changes along the Madison Avenue line, with full data available before and after streetcar service was initiated.

The analysis compared tax appraisal data for residential and commercial uses drawn from the Shelby County Tennessee Assessor's Office for the tax years 2002 and 2008 for properties within 0.25 mi of all stops along the Madison Street line to determine change in property values over

time. The analysis used Geographic Information System (GIS) tools to isolate those parcels within 0.25 mi from stops along the line. Since the Madison Street line opened in 2003, this data analysis compared the before values to after values along the streetcar line, compared with the citywide data for the same time period.

The data analyzed were for appraised values, as determined by the Shelby County Assessor's Office, rather than assessed values. All properties in the city are appraised at their fair market value, but assessed values can vary based on land use type (residential, commercial, industrial, agricultural). In addition, many properties are exempt from tax assessment (i.e., institutional, religious, and government properties). Additionally, the 0.25-mi distance from each Madison Street line streetcar stop limited the scope of the analysis to only those parcels within easy walking distance of the streetcar, excluding most of the nearby waterfront parcels undergoing value increases as well, but not associated with streetcar accessibility at that time.

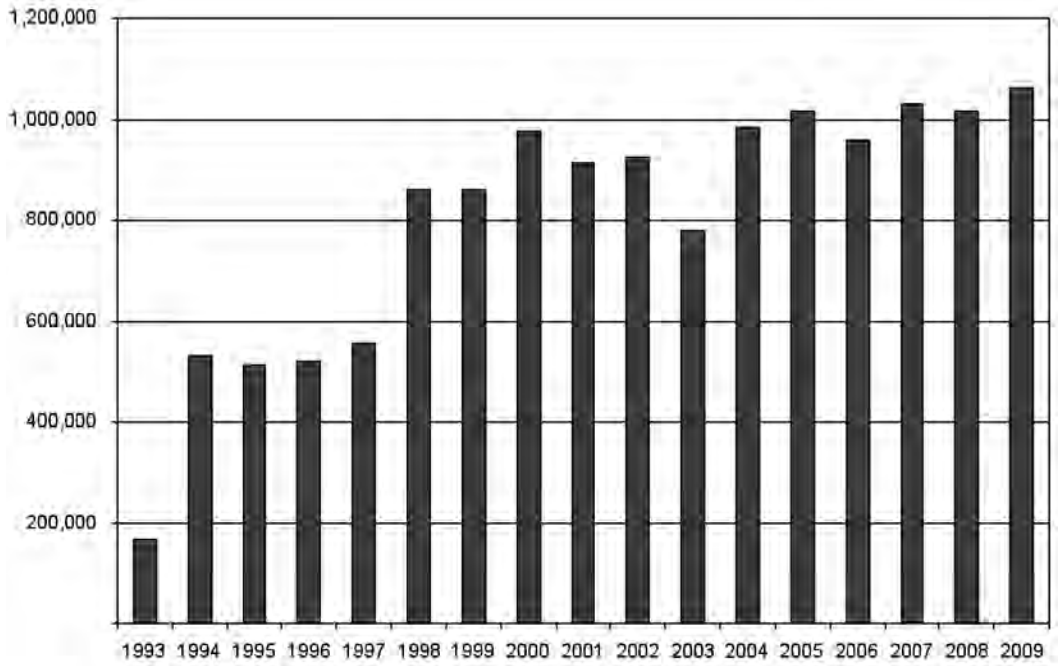

FIGURE 11 MATA rail ridership. (*Source:* Presentation for Birmingham Economic Summit, Nov. 12, 2008, John Lancaster, MATA.)

TABLE 6
FUNDING SOURCES FOR MAIN STREET AND RIVERFRONT LINES

Funding Category	Main Street Trolley	Riverfront Loop
FTA - Interstate Transfer	$23,992,401	$4,127,717
FTA - Formula	$3,023,635	$3,534,718
State - Tennessee Dept. of Transportation	$2,494,931	$806,050
City - City of Memphis	$3,981,251	$945,000
MATA	$1,344,854	$0
Private	$50,000	$15,375
Total	**$34,887,072**	**$9,428,860**
Cost Category		
Construction	$26,571,366	$6,638,877
Trolleys	$2,194,854	$1,550,000
Utility relocation	$2,143,107	$692,161
Architect/Engineer Design	$2,186,214	$547,822
Construction Management	$1,476,211	-$1
MATA Administration	$315,320	$0
Total	**$34,887,072**	**$9,428,859**

Source: Presentation for Birmingham Economic Summit, November 12, 2008. John Lancaster, MATA

FIGURE 12 Economic investment in Memphis. (*Source:* Presentation for Birmingham Economic Summit, Nov. 12, 2008, John Lancaster, MATA.)

As shown in Table 7, residential properties near the Madison Street route increased in aggregate value more than 780% for the period between 2002, before the streetcar opening, and 2008. Over the same period for the city as a whole, taxable residential properties rose just 24%, resulting in a potential premium in value attributable, at least in part, to the location near the streetcar (see Table 7). This dramatic difference between the Madison Street route and the city overall also reflects a substantial urban condominium building boom at that time. Existing commercial structures near the Madison Street stops, in contrast, did not experience dramatic increase in property value per the county's appraisals; these existing structures actually *decreased* in appraised value from 2002 to 2008, whereas similar properties citywide rose 17%. (Notably, the Madison Street route contains 451 tax-exempt parcels out of 1,699 parcels within 0.25 mi of the Madison Street Trolley. These include five hospitals and the University of Tennessee biomedical research campus. Tax-exempt parcels cover 56% of the area's total acreage, compared with 30% of citywide acreage classified as tax exempt.) When vacant, commercially zoned lands alone were analyzed, the Madison Street route experienced substantial value rises on the order of 70% for the period.

Similar to other studies of transit-oriented value premiums, downtown Memphis along the Madison Street route shows varying results; residential properties as well as vacant commercially zoned lands experienced substantial increases in value before and after streetcar service. However, existing commercial structures appear to have declined in value, opposite modest citywide increases during the same period. Because these findings are based on county appraisals, rather than actual land sales, the data may reflect other factors affecting assumptions about commercial structures' values during the period.

Impacts on New Development

The redevelopment of Central Station spurred additional residential development in the downtown core. After 1999, the area emerged as an arts and entertainment district, with a substantial amount of new residential uses, including several adaptive reuse projects that have converted historic buildings

TABLE 7
PROPERTY VALUE INCREASES ALONG MADISON STREET ROUTE (0.25 MI FROM STOPS)

		Aggregate Appraised Value (Millions of $)			
Residential Structures	**# of Parcels**	**2002**	**2008**	**% Change**	**Total Value Premium**
City of Memphis	175,698	$14,963	$18,485	23.5%	
Qtr-Mile from Madison St Rte	458	$9	$83	783.7%	760.2%
Commercial Structures					
City of Memphis	8,555	$4,172	$4,892	17.3%	
Qtr-Mile from Madison St Rte	493	$280	$258	-7.8%	-25.1%
Commercial Land					
City of Memphis	1,763	$155	$178	14.9%	
Qtr-Mile from Madison St Rte	54	$3	$5	70.1%	55.2%

Source: Shelby County Assessor, 2008; BAE, 2009.

into condominiums and apartments. Moreover, in 2000, the National Basketball Association's FedEx Forum was completed, which upgraded and replaced the old Pyramid Arena. Additionally, the area has gained several large hotels, a performing arts center, the National Civil Rights Museum, the renovation of the Cook Convention Center, a retail center, and Beale Street Landing, a $27 million docking facility on the Mississippi River.

Madison Avenue and the city's Medical Center complex also have seen substantial development activity since the implementation of the Madison streetcar line. Examples include the GenX Inn, a 32-room hotel with a construction value of $12 million, two new for-sale residential projects with a total of 45 units ($11 million), and investment by the University of Tennessee at the Medical Center, including $500 million in a research park and College of Pharmacy, and $25 million in a biocontainment lab.

In all, since 1991, more than $3 billion in development projects have been completed, are planned, or are under way on or near the three trolley corridors, leading to a transformation of the physical environment. However, as the manager of planning at MATA noted during an interview for this study, the trolley system was one of several critical factors contributing to the overall urban resurgence in Memphis; he considers the trolley system as a vital component, demonstrating public investment to improve the area.

Impacts on Economic Development

The city incentivizes development through the Center City Commission (CCC), the city's main economic development body. The CCC, through various tools, facilitates downtown development by creating partnerships to implement projects and by administering financial incentives that can help lower the costs of downtown development projects. The CCC's PILOT (Payment in Lieu of Taxes) Program encourages property renovation or new construction by freezing property taxes at predevelopment rates. The CCC's development loan program lends up to $90,000 for building renovation, further leveraging federal historic tax credits in some cases. The city also issues tax-exempt and taxable bonds, provides financial assistance to downtown for façade improvements and signage, and offers forgivable loans to certain retailers.

An interview with the vice president of planning and development for the CCC, conducted for this study, indicated that whereas CCC's incentives have attracted small to mid-size local developers to renovate historic properties, downtown Memphis has not attracted the larger national retailers it seeks. In the past few years, as national interest in transit-oriented development has accelerated, the vice president reported that interest in retailing downtown has increased, attributable in part to Memphis's successful streetcar system.

Changes in Future Land Use Plans and Regulations

The city of Memphis did not change zoning or parking requirements before implementation of the trolley system, as a mixed-use zoning designation was already in place. Currently, the city is in the process of adopting a form-based zoning code that will correspond to the trolley routes. This zoning, which will encourage and create more pedestrian access, wider sidewalks, rear parking, and lower parking requirements, will follow historic building patterns, taking advantage of the trolley system transit.

SEATTLE, WASHINGTON

The Seattle Streetcar has led to a renaissance of interest in developing a citywide streetcar system. It has been an integral factor in the redevelopment of the former light industrial South Lake Union area into Seattle's hottest new area for development, attracting major corporate headquarters campuses such as Amazon.com, as well as a range of biotech and high-tech uses along with extensive residential development. The city council has adopted a concept for expansion of the streetcar route to areas north, south, and east of South Lake Union.

Streetcar System

The Seattle Streetcar is a newer system, consisting of 1.3 mi in a combination of single- and double-track segments through the South Lake Union area, with stops every three blocks or up to 0.25 mi apart (see Figure 13). The route runs between the city's new Lake Union Park at its north end and the Westlake Transit Hub downtown. The streetcar line opened in December 2007, with ridership to date running approximately 30% above original projections.

The South Lake Union area has been the target of extensive public and private investment to create a regenerated urban neighborhood, focusing on biotech R&D, including facilities occupied by the Fred Kettering Cancer Research Center, the University of Washington, and support uses such as urban lofts, retail, office space, and privately occupied R&D space. The streetcar operates the Inekon TRIO 12 streetcar, a double-ended, three-section articulated electric streetcar with a low floor center section (this is the same vehicle as used in the Portland system, with modifications). The cars have capacity to carry up to 140 passengers (29 seated), and feature an on-board passenger information system with audible announcements and digital displays, and Global Positioning System (GPS) system for real-time arrival information at stations and on the web. They also feature regenerative braking. The streetcar stations feature raised platforms for easy boarding and digital displays of real-time arrival information.

FIGURE 13 Seattle streetcar. (*Source:* Seattle Streetcar.)

System Development

South Lake Union is a former light industrial area that was planned and rezoned for redevelopment to accommodate new office and R&D uses. It was designated in 2004 as one of the city's six urban centers, where the city seeks to direct most of its residential and employment growth.

Historically, the area lacked transit. Thus, the streetcar supported the development of jobs and housing in the area and became an implementing action for the urban center. Neither bus nor light rail was considered; a community-based group Build the Streetcar advocated for a streetcar, and cited the experience of Tacoma Link which showed higher ridership on a new streetcar line that replaced bus service. A streetcar also was more attractive to developers, who would not have to worry about its route being changed as they would with bus service, and as city staff noted, streetcars are seen as public transportation with a sense of romance to it. A streetcar was viewed as something that could be gotten up and running more quickly than a light rail system.

System Management

The system runs 7 days a week, Monday through Thursday 6:00 a.m. to 9:00 p.m., Friday 6:00 a.m. to 11:00 p.m., and Sunday 10:00 a.m. to 7:00 p.m. Headways are approximately 15 min throughout the day.

Fares are $2.00 for adults, with reduced fares of $0.50 for seniors, youth, and the disabled; children under 5 years of age ride free. Other transit agency passes, such as PugetPass and Metro, are accepted, along with Metro transfers. Fare box revenues cover approximately 20% of operating costs.

Based on fare checks, approximately 80% of riders have a transit pass, suggesting that they are regular local users of multiple transit modes. Additionally, tourist traffic is significant—the streetcar itself is an attraction. Weekend ridership is getting strong as riders use the streetcar to get to recreational opportunities.

Average annual ridership has been approximately 450,000, and trends for this year suggest that it will reach or exceed 500,000 riders for the full year. In its second year of operation, weekday ridership has become the strongest, as opposed to earlier in its operation when many peak days would be on weekends.

System Financing

The total capital cost of constructing this route segment was approximately $50.5 million, including $25 million from a LID and the balance provided by local, state, and federal sources.

The adoption of the LID worked well in this case, because this area has several major property owners participating with the city of Seattle on revitalization, including Vulcan Properties (a private development company) and the University of Washington. The University, as a tax-exempt entity, still pays the LID fee because of the benefits it receives from the streetcar line.

The city of Seattle made its LID appraisal report available for review, a document that is interesting for several reasons (*12*). Instead of taking a strict engineering-style approach to allocating assessments to properties in a special assessment district on a per square foot of land, distance from station, lineal foot, or some other physical relationship, this LID assessment approach values the before and after values of each property within the predetermined LID zone. However, the methodology cited in the report does not actually spell out how the transit improvements were applied to value each parcel. The report notes that most parcels were valued "vacant, as is" for the before estimate, and to a highest and best-use value based on comparables and income approach for the after series. The Final Special Benefits Study found that in the aggregate, the before value of all properties in the LID zone totaled $5.385 billion, and the after aggregate value was $5.454 billion, for a "special benefit" value difference of $68.4 million. Because the city of Seattle was seeking to assess a total of $25.7 million through the LID assessment process, it would be capturing 38% of the "special benefits" value indicated (e.g., difference in before and after property values).

Impacts of Streetcar on Built Environment

Impacts on Existing Development

The South Lake Union area has seen extensive new development, with more than 3 million square ft of new office space and 6,000 new residential units either built or in various stages of development (including predevelopment). The area is seen as being highly successful in its goal of redeveloping the former light industrial area into denser, more urban mixed use. The city, however, has not closely tracked changes in development, job attraction, or other aspects of the project that would allow more detailed analysis of its impacts.

Approximately 60 acres in the area is owned by a single major property owner, Vulcan, making a large number of sites available so that several buildings could be developed at once, rather than more limited infill development. Vulcan Properties is a long-term developer and the owner has promoted the area as a hub for biotech uses.

Although retail and other businesses are struggling during the current recession, the area continues to experience active leasing of new space, unlike the rest of the city.

A variety of road and streetscape improvements were made in conjunction with the streetcar, including a variety of pedestrian improvements and enhanced signage. Developers have privately funded streetscape improvements as part of their projects, and the city and developers are working together to green sidewalks in the area. More recently, the city has made improvements to promote bicycle access, along with a redevelopment of Lake Union Park that is now under construction.

Impacts on New Development

The city has not been tracking changes in land values or rents, so quantitative information on the streetcar's impact is not available. The city designed the South Lake Union as one of six urban centers to receive a majority of future residential and employment growth, and increased height limits to 90 ft (but not downtown heights) to permit denser development. Previously, height limits were specifically increased to accommodate biotech—that is, to allow a five-story building to go up to 85 ft in height.

All parking requirements were eliminated, with the market allowed to determine what parking would be provided. The city has not yet applied the maximum limits on parking in the downtown area to the other urban centers. Public parking garages are not available in the area, and the nearest garage is at the Seattle Center.

Following Vulcan's lead in obtaining LEED building certification from the U.S. Green Building Council, much of the development along the line is seeking LEED certification as well. The city is assembling data so the South Lake Union area can be designated as LEED-ND Silver or possibly Gold, although currently no city mandate is in place. Future zoning changes that allow for greater downtown heights and densities may lead to a future City requirement for projects to obtain LEED Silver certification to be eligible for bonuses.

Washington State does not allow tax increment financing and is limited on the types of financial incentives it can offer developers or businesses. The primary incentive it controls is zoning. Most new development in the area is being built to the maximum zoning. The city is now working on a zoning plan for its comprehensive plan, with an emphasis at the site level, and is looking to increase height limits to allow high-rise buildings and density. Part of the consideration in the planning process is that the streetcar would support greater height and density. At the same time, certain portions of South Lake Union are seen as being more residential, and height and other incentives will be used to encourage that use.

Impacts on Economic Development

The South Lake Union has become the hottest new area for development in Seattle, with the streetcar seen as an added attraction. Without the streetcar or improved bus service, it would have been much harder to attract firms. The area has attracted company headquarters, including those of Amazon.com, Group Health Coop, and PATH. Part of the attraction for these companies is the campus feel of the area, and how the streetcar provides a convenient connection to the Central Business District, while allowing them to be located just outside it. The streetcar, as part of a broader strategy, is credited with giving the South Lake Union area an advantage over other areas that these firms were considering at the time.

The streetcar has had an impact on the marketing of developments, with projects being sold and promoted as being on the line or within one block of the line. One project put in a mid-block crossing to provide better access to the streetcar line on the next block.

Vulcan, as the major land owner has been careful to bring the types of retail it considers most compatible, avoiding an emphasis on national retailers. The attraction of a Whole Foods store was seen as huge boost to the neighborhood. City staff sees the success of the area as a combination of the urban center zoning, Vulcan's actions, and the development of the streetcar, with all factors reinforcing each other.

Changes in Future Land Use Plans and Regulations

The city has adopted a concept for streetcar expansion to continue the line north across Lake Union toward the University of Washington, as well as to other established urban neighborhoods. Other lines would run through the downtown area to various destinations, and down through to West Seattle.

CHAPTER FIVE

CONCLUSIONS

This synthesis summarizes the literature and documentation regarding the impacts of modern streetcar systems on the built environment, underscoring the need for further empirical analysis.

Streetcars represent a growing transportation alternative, with more than 45 systems built or in various stages of planning or construction. Although the diversity is great among operating and planned systems, based on the work done for this synthesis, it is possible to identify several stages of streetcar system development. These stages are potentially but not necessarily sequential and include the following:

- *Demonstration:* a volunteer or local agency establishes the feasibility of a modest streetcar line
- *Targeted trips:* expanded service is focused on certain groups, typically tourists and residents but not necessarily commuters
- *Full service:* frequent daily service, including during commute hours with service to downtown or business centers
- *Urban connector:* multiple routes between various districts and full integration into the regional transportation system

These stages have distinctly different implications for the potential impact of streetcars on the built environment, and the types and amount of economic development and changes in the built environment that might occur. Because federal transportation policies, along with most local governments' land use and transportation planning increasingly are emphasizing "green" development, smart growth, reduction in carbon emissions, and increased links between land use and transportation, the need to systematize the study of streetcar impacts is dramatic.

Suggested analytical needs include the following:

- Systematic documentation of "before" and "after" streetcar impacts on the amount, type, density, and values of development within specified distances from streetcar routes.
- Use of statistical analyses, similar to existing research on light rail systems, to assess the relationships between streetcars and other factors on outcome such as increased share of citywide development.
- Thorough rider surveys (and related market research such as focus groups as appropriate) to better understand ridership origin, destination, frequency of use, purpose of trip, and rider demographics on streetcars.
- Benchmarking and monitoring of factors such as ridership compared with reduced demand for public parking garage spaces, increased retail sales, and increased public tax revenues.
- Studies to assess the potential for full economic development impacts relating to jobs and employer attraction along streetcar routes, including interviews with businesses to identify site location decisions regarding streetcar access, relationships to certain occupations or industry sectors, and perceptions of employers and employees regarding how streetcars enhance other urban amenities.
- Systematic assessment of streetcars as a feature in carbon reduction strategies, including reductions in vehicle miles traveled by automobile, reduced congestion, and so on.
- Best practices documentation of methods to integrate streetcars into regional transit networks, including streetcar relationships to "complete streets," changes in pedestrian mobility, bicycle lanes, and auto congestion management.

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APPENDIX A
SURVEY INSTRUMENT

STREETCAR SYSTEM BASICS

First we would like some basic information about yourself and the focus of your work:

1. What are your name, title, and focus of your work?

2. How much of your job is associated with the development and/or operation of the city's streetcar system?

3. Please tell us about the streetcar system:

   - Operator name, type of organization, relationship to regional transit operator:
   - Date original operations commenced, or if long-standing operation, when were new additions opened in the last 10 years:
   - Which routes serve the CBD:
   - Nature of financing, federal formula, local tax district, etc.

4. Primary reason(s) for system implementation or additions.

   - What type of vehicles does the system use? Examples: Modern electric vehicles, Historic electric vehicles, Replica electric vehicles, Historic diesel-electric hybrid (e.g., Savannah), Modern diesel-electric vehicles (e.g., Galveston).
   - Do vehicles have rubber or steel wheels? If steel, where are the tracks generally located relative to the street?

5. Please provide us with basic operating information on the system, including noting differences between peak and off-peak periods:

   - Hours of operation by day, and days of operation
   - Headways
   - Average annual ridership (describe significant seasonal variations)
   - Average annual change in ridership over the past three years (or general increase/decrease trend?)
   - Fares
   - Number of stations and average distance (or variations in distances) between stops along the streetcar route

6. If you have collected any data regarding composition of streetcar riders, please summarize for us (or provide study if possible).

   - Time period for data and how was it collected (e.g., on board)
   - Percent commuters, tourists/visitors, students, other local residents, etc.
   - Any demographic data (age, HH income, etc.)

7. Please tell us about the streetcar system's performance relative to original projections for:

   - Actual ridership compared with projections, in terms of trip purpose, time of day, and socio-economic characteristics
   - Actual fare box revenue compared with projections
   - Composition of riders or origin/destinations of riders
   - Other performance measures

Planning the Streetcar System

Next, we are interested in learning about how the streetcar system was originally planned.

8. What were the key factors in selecting the streetcar route (or new segment if system is older than 10 years)? (e.g., promote tourism, tie key sites together, reduce traffic congestion, etc.).

9. Were there explicit goals for the streetcar system? Are these goals being tracked or benchmarked?

10. Was the streetcar promoted as an economic development strategy, or a transportation solution, or both?

11. Were **other types of transit evaluated** compared to streetcar (e.g., bus, electric bus, or light rail)? Please describe the consideration of other types of transit, and reasons why streetcar was selected.

12. How important was the **perception** that more people would ride a streetcar than other transit such as traditional bus, along the same route? If this was important, who (e.g., developers, community residents, others) advanced the idea that this would be the case. Did you do any empirical research on this question?

13. Please describe the **era and general character** of the streetcar route or most recent segment. Does the new streetcar corridor follow any historic streetcar systems (from early 20th century)? Was this important in planning the new system's route?

14. Did the streetcar seek to **serve existing development**, or was there an expectation that the new streetcar would **stimulate new development**? How much was new development a necessity to support the new system?

15. Please rate the importance of the following in selecting the route and planning operations (1 = not important to route planning 5 = very important to route planning):

    - Serving commuters to daily job locations
    - Serving tourists and visitors
    - Serving students
    - Connecting cultural, entertainment, or civic destinations
    - Connecting with other modes of transit (light rail, commuter rail, bus)
    - Stimulating revitalization
    - Generating affordable or workforce housing
    - Organizing new neighborhoods around transit
    - Compatibility with comprehensive/general plans

16. When planning for the most recent segment of the streetcar system, how important was existing/planned **population density**? **Employment density**? Were there goals set forth to encourage more dense development patterns to support the streetcar? How did these goals dovetail with other local initiatives (e.g., smart growth, sustainability, job attraction)?

Incentives and Financing

Next we would like to understand incentives to encourage development, as well as methods used to finance the streetcar, particularly using value capture mechanisms.

17. Did the streetcar alignment coincide with any **existing development incentives** (already existing at the time of streetcar planning?). Please describe the nature of each incentive.

18. Were **new development incentives** put into place as part of streetcar planning or construction? (Examples: tax abatement, density bonuses, reduced parking standards, etc.). Please describe the nature of each incentive.

19. Were any of the following financing tools used to support streetcar construction or related infrastructure investment along the streetcar corridor (please be specific as to each one)? Please provide a summary description for each one that was used:

    - Tax Increment Finance (TIF)
    - Special Assessment Districts
    - Local Improvement Districts
    - Business Improvement Districts
    - Other (please describe):

Impacts of Streetcar on Built Environment

Next we are interested in understanding how the streetcar has changed the amount and type of infill development and new development, and other impacts on the built environment.

20. Are there **notable differences in the built environment** occurring along the streetcar route after its announcement/construction? Please summarize and also provide your thoughts as to whether these changes are related to the streetcar (if addressed in a study, please indicate source and year).

    - Is there a notable **increase in the amount of development** attracted than would otherwise have occurred (e.g., major employment attraction, new development projects, etc.)? Please provide general thoughts or data if available.
    - Are there any notable differences between the **types of new development projects** attracted to the streetcar corridor compared to elsewhere in the community (e.g., more dense, less parking, more pedestrian-oriented?).
    - Are there any notable differences between the **types of developers** attracted to the streetcar route for their projects (e.g., large national companies, small local, no difference compared to elsewhere).
    - Are there any notable differences between the **types of businesses, such as retailers or employers**, attracted to the streetcar route (e.g., large nationals vs. small local)?
    - Are there any notable differences **in business performance or vacancies in the current economic downturn?** (e.g., better or worse than other retail areas or notable differences in vacancies)?
    - We are interested in the interaction between LEED certification, which credits for proximity to transit, and your streetcar system. Do you see **any direct relationship, such as a concentration of proposed/built LEED buildings near the streetcar**?
    - Are there notable differences in **other signs of private investment** along the streetcar corridor (e.g., façade improvements, developer marketing promoting streetcar transit, etc.)?

21. Has the streetcar system **increased the sale value of land and buildings?** If so, please provide opinion (or data) regarding how much.

22. Has the streetcar system **increased the rental/lease rates** charged? If so, please provide opinion (or data) regarding how much.

23. Please describe the **types of public improvements** and approximate value within ¼ mile of the streetcar corridor, completed as either as part of streetcar construction or subsequently:

    - Auto circulation changes (e.g., one-way, re-signalization?)
    - Pedestrian improvements
    - Bicycle improvements
    - New signage (including "next train" signs)
    - Streetscape/street furniture improvements
    - Plazas, parks, or other public space
    - Public parking (surface or structures)
    - Other public improvements

Zoning and Land Use

Next we are interested in how public regulations for land use, zoning, and parking requirements interacted with the streetcar corridor.

24. **Before Streetcar**—Did your city change its zoning, land use designations, or allowable densities along the streetcar route prior to construction of the streetcar or in conjunction with it? If so, please describe the changes.

25. **Before Streetcar**—Did your city change its parking requirements or parking management strategies along the streetcar route prior to construction or in conjunction with it? If so, please describe the changes.

26. **After Streetcar**—Did your city change its zoning, land use designations, or allowable densities after the streetcar was completed? If so, were these changes a result of public policy shifts, the developer community requesting changes, or both?

27. **After Streetcar**—Did your city change its parking requirements or parking management strategies after the streetcar was completed? If so, were these changes a result of public policy shifts, the developer community requesting changes, or both?

28. How would you summarize the **overall impact** of the streetcar on the following (as applicable):

    - Job attraction along its corridor
    - Creating a competitive advantage versus other parts of your city and region
    - Stimulating neighborhood revitalization and reinvestment
    - Downtown and neighborhood retail districts
    - Employment centers
    - Civic or cultural gathering places
    - Tourism venues

Additional Information

29. Have any studies about ridership demographics, impact on built environment, or job attraction been prepared since the streetcar system began operation? Has your city studied the amount of development, changes in density, or other changes to development near the streetcar since it was constructed? Do you have any illustrative images of new projects, list, or map of recently built new projects, or other materials that convey changes along the streetcar corridor?

30. Do you have any other comments or observations regarding the relationship between streetcars and the built environment? Lessons learned? Opportunities realized or missed? Suggestions for new empirical research?

Thank you for your help!

APPENDIX B
LIST OF RESPONDENTS

Astoria, Oregon
Planning Director, City of Astoria
Director of Sunset Empire District, Astoria Riverfront Trolley Association
City Planner, City of Astoria
Ex-Director of Public Works, Astoria Chamber of Commerce

Charlotte, North Carolina
Assistant Director, Strategic Planning Services, City of Charlotte
Manager, Rail Transportation, Charlotte Area Transit System

Galveston, Texas
Vice President, Goodman Corporation (consultant to Galveston Island Transit)
Director of Transportation, Galveston Island Transit

Kenosha, Wisconsin
Director of Transportation, City of Kenosha
Community Development Specialist, City of Kenosha

Little Rock, Arkansas
Executive Director, River Rail System Metro Plan
Planning Manager, Central Arkansas Transit Authority

Lowell, Massachusetts
Community Planner, National Park Service
Planning and Permitting Director, City of Lowell

Memphis, Tennessee
Vice President of Planning and Development, Center City Commission
Manager of Planning, Memphis Area Transit Authority
Memphis Metropolitan Planning Organization

Portland, Oregon
Portland Development Commission
Executive Director, Portland Streetcar, Inc.

Savannah, Georgia
Director of Mobility and Parking Services, City of Savannah
Executive Director, Savannah Development and Renewal Authority

San Pedro (Los Angeles), California
Director of Planning, Port of Los Angeles
Owner, Railway Preservation Resources

Seattle, Washington
Director, Department of Planning and Development, City of Seattle
Streetcar Project Manager, Department of Transportation, City of Seattle

Tacoma, Washington
Project Manager, Tacoma Link, SoundTransit
Division Manager, Community and Economic Development, City of Tacoma

Tampa, Florida
Development Services Manager, Economic and Urban Development, City of Tampa
Vice President, Tampa Historic Streetcar

APPENDIX C
LIST OF RESPONDENTS

Appendix C-1: System Basics

City	Year Started	Type of System	Operator	Route Length (miles)	Route Description	Headways (minutes)	Current Annual Ridership (rounded)	Increasing Ridership	Fare Per Trip	Hours of Operation	No. of Stations/ Avg Distance Btw Stations
Astoria, OR	1999	Restored historic cars	Astoria Riverfront Trolley Association (ARTA), volunteer operator	3.0	Downtown retail, cruise ships, industrial reuse	N/A	40,000	Yes	$1.00	Not regularly scheduled, volunteer operation	18 stops (2 blocks apart)
Charlotte, NC	1996	Restored historic cars	Charlotte Area Transit System (CATS)	2.2	Portion of LYNX light-rail Blue Line between Downtown and South End.	30	N/A	No	$1.50	Sat 10 am - 5 pm, Sun 1030 am - 530 pm, plus group charters.	11, approx. 1/2 mile (4 trolley only stations, others shared with light rail)
Galveston, TX	1996	Diesel-electric replicas	Galveston Island Transit	6.7	Historic downtown, University Texas Medical Branch (UTMB)Campus	N/A	22,000	No	$1.50	Week: 6am-6pm, Weekends:10am-6pm	22 stops. Approximately one block apart.
Kenosha, WI	2000	Restored historic cars	Kenosha Area Transit (city agency)	1.7	New park (Harbor Park), downtown, museums, Merta commuter rail	15 - 20	65,800	Yes	$0.25	Seasonal, varies	19 stops
Little Rock, AK	2004	Replica of historic cars	Central Arkansas Transit Authority (CATA)	3.0	River Market, Clinton Library, convention center, Alltel Arena	25	155,000	Yes	$0.50 - $1.00	8:30 am - 10 pm/midnight except Sundays	13, less than 1/4 mile
Lowell, MA	1984	Replica of historic cars	National Park Service	1.0	National park, interpretive sites, edge of CBD	Not regular	80,000	No	Free	9 am - 7 pm 7 days/week, excluding winter	5 stops
Memphis, TN	1993	Restored historic cars	Memphis Area Transit Authority (MATA)	7.0	Main Street/Central Business District, historic districts, downtown attractions, Amtrak	10	1 million	Yes	$0.50 - $1.00	M-T: 6 am -10 pm; F: 6-2 am; Sa: 6 am - 1 am; Su: 10-6 pm	34 stops
Portland, OR	2001	Modern electric	Portland Streetcar	8.0	Legacy Good Samaritan Hospital, Pearl District, Portland State University, River Place, South Waterfront District, Portland Aerial Tram	12	3.7 million	Yes	50% free to $2.00	M-T: 5:30 am - 11:30 pm; F: 5:30 am - 11:45 pm Sa: 7:15 am - 11:45 pm; Su: 7:15 am - 10:30 pm	46 stops, 500-800 feet apart

City	Year Started	Type of System	Operator	Route Length (miles)	Route Description	Headways (minutes)	Current Annual Ridership (rounded)	Increasing Ridership	Fare Per Trip	Hours of Operation	No. of Stations/ Avg Distance Btw Stations
San Pedro, CA	2003	Restored & replica cars	Port of Los Angeles	1.5	Waterfront destinations, cruise ship terminal, retail area, Downtown	20	100,000	Yes	$1.00 all day pass	Fri, Sat, Sun, Noon - 9 pm	4 stops
Savannah, GA	2009	Restored historic cars	Mobility Management Board (independent non-profit)	1.0	Runs along riverfront tourism area, with connections to ferry, Downtown shuttles	15	Projected 75,000	New - Above Projections	Free	Wed - Sun, 12 noon - 7 pm	7 stops, every 600 - 800 feet
Seattle, WA	2007	Modern electric	King County Metro	1.3	Downtown retail, Westlake Center, South Lake Union (mixed-use neighborhood), biotech campus	15	450,000	Yes	$0.50-$2.00	M-T: 6 am - 9 pm; F-Sa: 6 am - 11 pm; Su: 10 am - 7 pm	6 stops, 1/4 mile apart
Tacoma, WA	2002	Modern electric	Sound Transit	1.6	Union Station, museums, convention center, University of Washington, theater district	15	900,000	Yes	Free	M-F: 520 am - 1010pm; Sa: 8 am - 1010 pm; Su: 1010 am - 6 pm	5 stops, average 1/3 mile apart
Tampa, FL	2003	Replica of historic cars	Hillsborough Area Regional Transit (HART)	2.4	Ybor City, national historic district, Channel District, restaurants, convention center, stadium, aquarium, cruise terminal	15	441,000	Yes	$2.50	M-W: 11 am-10 pm; F: 11 am- 2 am; Sa: 9 am -2 pm; Su: 12 pm - 8 pm	10 stops, 1/4 mile apart

Appendix C-2: System Performance Relative to Original Projections

City	Ridership	Fare Box	Composition/ Destination of Riders	Other Performance Measures
Q: Please tell us about the Streetcar System's Actual Performance relative to original projections for:				
Astoria, OR	No original projections	Achieved projections	N/A	N/A
Charlotte, NC	No original projections	N/A	Primarily group business	N/A
Galveston, TX	Lower than projections	Lower than projections	N/A	N/A
Kenosha, WI	N/A	N/A	N/A	N/A
Little Rock, AK	No original projections	N/A	N/A	N/A
Lowell, MA	N/A	N/A	N/A	N/A
Memphis, TN	N/A	N/A	N/A	N/A
Portland, OR	3.7 million	50% recovery ratio	N/A	Reliability and safety
San Pedro, CA	No original projections	N/A	Patrons of Port visitor facilities	N/A
Savannah, GA	Projected 75,000 first year	Free	Estimated to be 80% tourism	N/A
Seattle, WA	30% higher than projected	As projected, 20% recovery ratio	80% local, regular users	On-time performance approximately 97%
Tacoma, WA	N/A	N/A	N/A	N/A
Tampa, FL	Close to original projections	N/A	N/A	N/A

Appendix C-3: Planning the Streetcar System

Q 8: What were the key factors in selecting the streetcar route (or new segment if system is older than 10 years)?

City	Response
Astoria, OR	Burlington Northern Railroad Line borders Columbia Riverfront. Trolley promoted as economic development tool. Terminates in downtown retail.
Charlotte, NC	Historic streetcar non-profit assembled segments of right-of-way over time to operate historic vehicle; old freight route in former industrial area being redeveloped.
Galveston, TX	Utilized preexisting infrastructure (rail line) to generate economic development. Private developer, Mitchell, reestablished route and sited development projects along line.
Kenosha, WI	To provide a circulator link between former industrial site, downtown, and Metra station.
Little Rock, AK	Economic stimulus to energize Little Rock and North Little Rock downtowns; revitalize old residential neighborhood; connect two entertainment districts; facilitate tourism; initiate the return of light rail system.
Lowell, MA	To connect tourist amenities and to utilize an abandon industrial rail line.
Memphis, TN	1) Main Street Line - to promote use of the pedestrian mall which followed a historic route. Connecting key sites, special event locations. Reducing traffic congestion. 2) Riverfront Line - had existing rail right of way that City ownec that was under
Portland, OR	To create a maximum opportunity for development.
San Pedro, CA	Use existing waterfront freight line to connect waterfront destinations and increase tourist interest
Savannah, GA	Low-cost demonstration line, available freight line City could purchase
Seattle, WA	To connect an area that was zoned and planned for redevelopment to the CBD. To provide local transit service to area transitioning from light industrial to mixed-use residential. To connect Lake Union to other areas.
Tacoma, WA	To connect the spine of downtown from north to south end, enabling alternative transportation, cleaner air, and reducing congestion.
Tampa, FL	Objective was to promote economic development along the line and connect major existing economic engines. Also wanted the streetcar to encourage downtown housing and density.

Q 9: Were there explicit goals for the streetcar system? Are these goals being tracked or benchmarked?

City	Response
Astoria, OR	No goals besides attracting tourism to Astoria.
Charlotte, NC	NA - streetcar was supplanted by new light rail line. Current streetcar operation based on community support, not economics or viability for transit.
Galveston, TX	No explicit goals; however, when Island Transit acquired trolley in 1996 from Mitchell, transit agency attempted to expand ridership.
Kenosha, WI	To stimulate development and tourism.
Little Rock, AK	Long-term goal to grow light rail system for public transit.
Lowell, MA	Didn't want people driving from site to site.
Memphis, TN	Initial goal was for transit to revive obsolete pedestrian mall.
Portland, OR	Catalyst for development, assure safety, provide reliable service.
San Pedro, CA	Goal to connect waterfront destinations, attracting tourists - seen as a demonstration. No tracking
Savannah, GA	None, seen as a low cost "starter line" to prove viability for expansion throughout the Downtown
Seattle, WA	Goal to encourage economic development. Have long term targets for jobs and housing, but no formal system to track development activity yet. Rationale for streetcar was to support the development of jobs and housing.
Tacoma, WA	To enable professional services and employees to move freely in and about downtown to conduct business. Also to connect people to the Dome district, a regional transit hub.
Tampa, FL	See number 9. No benchmarks.

Appendix C-3: Planning the Streetcar System

Q 10: Was the streetcar promoted as an economic development strategy, or a transportation solution, or both?

City	Response
Astoria, OR	Economic development strategy.
Charlotte, NC	Streetcar started by non-profit interested in recreation of historic trolleys. Subsequent City investment based on i serving as an economic development tool for redeveloping South End area.
Galveston, TX	It was reestablished by private individual, George P. Mitchell, as economic development strategy. Island Transit aimed for both economic development and transportation solution.
Kenosha, WI	Economic development strategy.
Little Rock, AK	Economic development strategy, with long-term goal of expanding system for transportation solution
Lowell, MA	N/A
Memphis, TN	Both. It served as a catalyst for development and as a symbol of downtown revitalization.
Portland, OR	Both.
San Pedro, CA	Transportation
Savannah, GA	Transportation
Seattle, WA	Both.
Tacoma, WA	Both. There was an economic development push to revitalize downtown Tacoma, and Link was seen as an essential component.
Tampa, FL	Economic development strategy only.

Q 11: Were other types of transit evaluated compared to streetcar (e.g., bus, electric bus, or light rail)? Please describe, and reason why streetcar was selected.

City	Response
Astoria, OR	No. Sunset Empire Transit District does not compete with ARTA on route.
Charlotte, NC	No. Note that streetcar route was subsequently rebuilt to serve as City first light-rail line; streetcar now operates or light rail right-of-way with limited weekend, group business.
Galveston, TX	No; until 1996, private developer managed trolley system while Island Transit managed all other modes of transit. No overlap.
Kenosha, WI	No.
Little Rock, AK	No, because buses not perceived as having economic development benefits.
Lowell, MA	Streetcar was chosen because it was appropriate to history.
Memphis, TN	Only evaluated rail because we wanted to permanent investment and better air quality. People's perception of buse is that they are noisy.
Portland, OR	Did an initial evaluation. Property owners had a preference for rail because of its permanence. It provided a commitment for investment in property.
San Pedro, CA	Streetcar replaced Port's support of rubber tire trolley jointly operated with the City. Streetcar believed able tc generate more ridership than bus.
Savannah, GA	Buses were not considered viable along the historic cobblestone riverfront street where the streetcar operates; ligh rail would be too expensive.
Seattle, WA	King County Metro did not consider a bus or light rail.
Tacoma, WA	Bus was a precursor to Tacoma Link. The bus was used to get riders ready for using the rail on that corridor. Bus ridership was much lower than the rail.
Tampa, FL	N/A

Appendix C-3: Planning the Streetcar System

Q 12: How important was the perception that more people would ride a streetcar than other transit such as traditional bus, along sc
If this was important, who (e.g., developers, community residents, others) advanced this idea?
Did you do any empirical research on this question?

City	Response
Astoria, OR	Important; Mayor advocated bringing trolley back to Astoria after RR abandoned lines in 1990's. Amenity promoted in marketing materials.
Charlotte, NC	N/A
Galveston, TX	Not very important. Critical that trolley is able to access downtown Galveston, where other transit modes cannot fit.
Kenosha, WI	Streetcars have the appeal needed to enhance development activity. Need a study that looks at sociology of bus versus rail.
Little Rock, AK	A fixed-guide way meant permanent investment that provides security for income producing property and a promised commitment.
Lowell, MA	N/A
Memphis, TN	At public meetings and debates, people spoke up for the streetcar.
Portland, OR	This had enormous importance. It was important to developers since the streetcar serves as a marketing tool.
San Pedro, CA	Perception that ridership would be higher with streetcar. No testing
Savannah, GA	The perception exists, but not considered to be a factor in establishing the streetcar
Seattle, WA	The community-based streetcar advocacy organization, Build the Streetcar, argued for the streetcar. City would find it useful to have more data on this question, but has not gathered any.
Tacoma, WA	N/A
Tampa, FL	People don't like to use public transit in Florida. HART did a study that identified areas of the City where people will not step on a bus but they will get on a trolley-style vehicle.

Q 13: Please describe the era and general character of the streetcar route or most recent segment.
Does the new streetcar corridor follow any historic streetcar systems (from early 20th century)? Was this important in planning new

City	Response
Astoria, OR	Victorian. Rustic red trolley stops complement 1912 car. Follows historic RR route along industrial waterfront.
Charlotte, NC	Followed freight rail lines serving former industrial area. Subsequently extended with City investment to Downtown. Later supplanted by new light rail line on same alignment.
Galveston, TX	19th century Victorian
Kenosha, WI	Historic architecture and new development.
Little Rock, AK	New alignment follows some but not all of old streetcar system. Follows some historic and some modern architecture, mainly low-rise historic buildings, old warehouse district. Loops through working class residential neighborhood.
Lowell, MA	Turn of the century development. Runs through old mill neighborhood.
Memphis, TN	Main Street and Madison follow historic routes, developed in the 1880's/1890's. Streetcar operated from 1903 to 1932.
Portland, OR	Not historic district. The route was a fairly dead corridor and didn't even have buses.
San Pedro, CA	Runs on old freight line through Port land, includes portion of historic Red Car streetcar line, but not important factor. Some need to share with freight line creates complications.
Savannah, GA	Historic waterfront (River Street), operates on abandoned freight line. Historic warehouses, buildings along the River are one of City's primary tourism destinations.
Seattle, WA	There was a streetcar line on much of the route, but this wasn't important to why that route was selected. Goes partially through CDB and goes through two neighborhoods that have been historically underutilized. Some rehabilitated residential and office
Tacoma, WA	Historically Tacoma had a streetcar system. Tacoma Link runs parallel to a historic brewery district
Tampa, FL	Ybor City is a national historic landmark. The Channel District is a redeveloped area that was previously light industrial and heavily blighted.

Appendix C-3: Planning the Streetcar System

Q 14: Did the streetcar seek to serve existing development, or was there an expectation that the new streetcar would stimulate new development? How much was new development a necessity to support the new system?

City	Response
Astoria, OR	Served Existing Development. Hotels and condo projection probably would have occurred without trolley implementation.
Charlotte, NC	City saw opportunity to create a pedestrian spine in revitalizing former industrial area, with trolley running down the middle of it, as precursor to light rail originally anticipated in 15 to 20 years.
Galveston, TX	Both; Originally served preexisting CBD retail district. Attempted to connect largest employer UTMB (Univ. Texas Medical Branch) with downtown. Development- commercial and residential- cropped up around rail line.
Kenosha, WI	Just to stimulate new development and serve the central business district. Also attracted development and rehabilitation of existing buildings.
Little Rock, AK	Sought to stimulate new development and to revitalize working class residential neighborhood. Started with public investment aimed to attract private investment.
Lowell, MA	Existing. It makes downtown walkable and protects a historic district. But it can't take significant credit.
Memphis, TN	Both. Main Street line was serving existing development, but the redevelopment of downtown came simultaneously with expansion of trolley and density was increased. More people starting to live there and it became more of a 24-hour area. As additional de
Portland, OR	The streetcar is not major transportation facility, but more a neighborhood amenity. It didn't stimulate development because of its function but because it's a cool thing to have in your neighborhood. It didn't really enhance density.
San Pedro, CA	Created to allow off-site parking for new cruise ship terminal, also benefit waterfront retail. Preceded Port plans tc redevelop deindustrializing waterfront.
Savannah, GA	Because most of City is in a National Historic Landmark District, limited opportunities for new development - primarily redevelopment of existing structures. Motivation for future expansion is to improve mobility.
Seattle, WA	Primarily to stimulate new development. Property owners voted for assessment as part of financing based on expectation of increased value and development potential.
Tacoma, WA	Both evenly. It serves existing employers and it has brought as much development as was expected.
Tampa, FL	Served both. The line was intended to serve the existing economic engines, e.g. stadium, hotels, museums, Ybor City attractions. All new development is occurring along the streetcar line, resulting in $4 billion in private sector investment.

Q 16: When planning for the most recent segment of the streetcar system, how important was existing/planned population density? Employment density? Were there goals to encourage more dense development to support the streetcar? How did these goals doveta

City	Response
Astoria, OR	Gateway Master Plan, located along the trolley line, allowed higher residential density at Millpond Village. Historic Rehabilitation, parking requirements, and Rails to Trails all tied in.
Charlotte, NC	Area around streetcar was rezoned to Urban District, allowing denser mixed-use development. Extensive development of TOD with subsequent light rail line along same alignment and area to the south.
Galveston, TX	Employment density was very important; I.T. connected largest employer (UTMB campus) with downtown loop.
Kenosha, WI	Was looked at only as the attraction to bring in new residential population.
Little Rock, AK	Initially was not a lot of density along the alignment. Idea was to stimulate more density, which was achieved.
Lowell, MA	N/A
Memphis, TN	Was hoped for and there was some planning but it was more a consequence.
Portland, OR	Both. Were able to create minimum density agreements with developers through development agreements.
San Pedro, CA	Port seeks to redevelop western edge of main channel for commercial uses (residential not allowed), sees streetcar as connector. However, population and employment density not an important factor.
Savannah, GA	N/A
Seattle, WA	Comprehensive plan and supporting development regulations are focused on encouraging more dense development patterns. Streetcar was to support those goals.
Tacoma, WA	Both were important. That's one of the basic ideas behind regional transit, to connect urban centers.
Tampa, FL	There was little residential development when planning the system, except single family homes in Ybor City. Now almost all new investment in the CBD is residential, so the streetcar is playing a role in smart growth. Planners believed the streetcar woul

Appendix C-4: Rating of Importance of Route Selection/Planning for Operations

Q 15: Please rate the importance of the following in selecting the route and planning operation:
1 =NOT Important in Route Planning
5 = VERY Important to Route Planning

Service	Astoria, OR	Charlotte, NC	Galveston, TX	Kenosha, WI	Little Rock, AK	Lowell, MA
Serving commuters to daily job locations	1	N/A	5	4	1	1
Serving tourists and visitors	5	N/A	5	5	5	5
Serving students	1	N/A	2	1	0	1
Connecting cultural, entertainment, or civic destinations	5	N/A	5	5	5	5
Connecting with other modes of transit (light rail, commuter rail, bus)	3	N/A	3	5	1	2
Stimulating revitalization	4	N/A	3	5	5	5
Generating affordable or workforce housing	2	N/A	3	1	3	1
Organizing new neighborhoods around transit	3	N/A	4	5	4	1
Compatibility with comprehensive/general plans	4	N/A	4	5	2	1

Service (cont'd)	Memphis, TN	Portland, OR	San Pedro, CA	Savannah, GA	Seattle, WA	Tacoma, WA	Tampa, FL
Serving commuters to daily job locations	4	1	1	5	5	5	2
Serving tourists and visitors	4	1	5	5	4	5	5
Serving students	3	4	2	3	3	5	3
Connecting cultural, entertainment, or civic destinations	5	5	5	5	5	5	5
Connecting with other modes of transit (light rail, commuter rail, bus)	5	4	3	5	5	5	4
Stimulating revitalization	5	5	5	5	5	5	4
Generating affordable or workforce housing	N/A	4	N/A	5	2	1	2
Organizing new neighborhoods around transit	N/A	5	1	2	5	1	5
Compatibility with comprehensive/general plans	4	5	1	5	5	5	5

Appendix C-5: Financing & Incentives

Q 17: Did the streetcar alignment coincide with any existing development incentives (already existing at the time of streetcar planning?). Please describe the nature of each incentive.

City	Response
Astoria, OR	Yes. Morassi Land Use Plan set the groundwork for trolley and park system. Also had Rails to Trails program.
Charlotte, NC	No.
Galveston, TX	No.
Kenosha, WI	Incentive was City's provision of infrastructure that developers did not have to put in.
Little Rock, AK	No.
Lowell, MA	N/A
Memphis, TN	None.
Portland, OR	Yes, part of streetcar went thru Urban Renewal Area (URA). Incentives included affordable hsg grants, loans, also density bonuses. Density was required by private developers to access subsidies.
San Pedro, CA	No.
Savannah, GA	No.
Seattle, WA	Used design, zoning, and parking incentives.
Tacoma, WA	N/A
Tampa, FL	They were minor during first phase. The Channel District was a clean slate so the City was able to sell the idea of the streetcar and this became an incentive.

Q 18: Were new development incentives put into place as part of streetcar planning or construction?

City	Response
Astoria, OR	Slight parking requirement reduction along rail line. Increased residential density at Millpond Village.
Charlotte, NC	N/A
Galveston, TX	N/A
Kenosha, WI	For the existing buildings the BID has $200K in a revolving loan fund. City also able to discount sites it owns.
Little Rock, AK	On North side, a TIF district was put into place.
Lowell, MA	N/A
Memphis, TN	The City is thinking about doing TIFs.
Portland, OR	There was a development agreement on south end for taller heights, 20-30 story buildings in the south water front. Proposed next segment (Central Eastside) will have employment incentives.
San Pedro, CA	No.
Savannah, GA	No.
Seattle, WA	Incentives in place prior to streetcar, created when area was designated one of City's 6 Urban Centers.
Tacoma, WA	N/A
Tampa, FL	Downtown had zoning incentives such as no FAR limits and height limits only to FAA limits.

Appendix C-6: Sources of Funding

Q 19: Were any of the following financing tools used to support streetcar construction or related infrastructure investment along the streetcar corridor (please be specific as to each one)?
Examples: Tax Increment Financing (TIF), Special Assessment Districts, Local Improvement Districts, BIDs, Other.

		Sources of Financing						
City	Summary of Financing	Federal	City	TIF	Prop Assessments	Private Donations	State DOT	Other Sources
Astoria, OR	Private fundraising, Lewis and Clark Bicentennial Federal Funding, Developer's Agreements, Oregon CDBG, Renewal Fund.					X	X	Lewis and Clark Bicentennial Federal Fund
Charlotte, NC	None.		X			X		
Galveston, TX	Private development (George P. Mitchell), Tax Increment Finance (TIF)	X		X		X		
Kenosha, WI	Tax Increment Finance (TIF)	X		X			X	
Little Rock, AK	None.		X					MPO, Federal appropriation, County
Lowell, MA	N/A							National Park Service
Memphis, TN	None.	X	X				X	Interstate Transfer (unbuilt freeway project)
Portland, OR	TIFs provided for 20% of costs, local improvement district provided for 20%, and there were bonds backed by a parking garage.	X	X	X	X			Local Improvement District assessments
San Pedro, CA	No (self-financed by Port of Los Angeles).							$10M cost self-financed by Port of Los Angeles.
Savannah, GA	No - self-financed using City's General Fund.		X					Parking garage, meter funds cover operating costs
Seattle, WA	Local improvement districts.	X	X		X	X	X	50% from Local Improvement District assessments
Tacoma, WA	N/A							Sound Transit (regional transit operator)
Tampa, FL	TIF districts in Ybor City, Channel District, Downtown. A special assessment district was put into place when the streetcar was built. The Port of Tampa committed a $150,000 annual pledge.	Livable Communi ties	X	X	X	X		State intermodal transit grants, Federal CMAT

Appendix C-7: Impacts on Built Environment

Q 20: Are there notable differences in the built environment occurring along the streetcar route after its

City	Response
Astoria, OR	Yes. However, hotel and condominium projects would have probably occurred without trolley line. Single largest driver was RR abandonment in 1998.
Charlotte, NC	Yes. Area has been transformed, although largest portion of new TOD occurred after planning and development of light rail line along the same corridor and area to south of it.
Galveston, TX	Yes. Along eastern edge of town, speculative out-of-town developers have constructed residential high-rises.
Kenosha, WI	See answers below.
Little Rock, AK	Yes. Streetcar has influenced development.
Lowell, MA	N/A
Memphis, TN	See question 21a. Hard to say is the trolley is the determining factor for development.
Portland, OR	N/A
San Pedro, CA	No - land along route controlled by Port, which is now planning for new development in the area.
Savannah, GA	No - route is in built up historic area, and the system just started in past several months.
Seattle, WA	Yes, has attracted major development and employment, and the area is now the City's hottest property market with strongest leasing.
Tacoma, WA	N/A
Tampa, FL	The streetcar has contributed to new development but is not the sole cause. The Channel District in one of fastest growing areas in Tampa and the CBD is getting a resurge that it hasn't seen in 50-60 years. All of the new housing projects in Tampa are i

Is there a notable increase in the amount of development attracted than would otherwise have occurred?

City	Response
Astoria, OR	No. Brownfields, like Millpond Cannery, were prime for redevelopment. Trolley did not drive development.
Charlotte, NC	Yes. Area has been transformed, although largest portion of new TOD occurred after planning and development of light rail line along the same corridor and area to south of it.
Galveston, TX	Isolated development occurred on the eastern edge of Galveston. Otherwise, unchanged.
Kenosha, WI	Yes, the streetcar supports linear density.
Little Rock, AK	Rehabilitated older hotels; infill development has occurred with three new hotels, several high-rise residential towers, new street-level commercial; minor league ball park relocated to a black way from streetcar.
Lowell, MA	Difficult to measure. The distance of the trolley and ability to expand it was convincing factor that lead to a selecte master developer. It's tough to measure existing downtown improvements. The trolley is a minor piece of the overall National Park d
Memphis, TN	More than $3 billion in development projects recently completed, planned or underway. Central Station was built in 1999 and the Fed Ex Forum in 2000, both located on the route.
Portland, OR	$3.5 billion of investment made within 750 feet from streetcar, 10,300 new residential units with in 750 feet, 3.5 million square feet of new commercial space. Can say the streetcar helped but difficult to quantify this. Other components of recent devel
San Pedro, CA	NA - Port is only now planning for redevelopment of land along streetcar route.
Savannah, GA	NA - historic area limited to redevelopment of existing structure. Major mixed-use waterfront development outside historic district is planned to have connection to streetcar expansion.
Seattle, WA	There has been 3-4 million square feet of new office space and 6,000 new housing units built since the project approval. No difference in height or density, building to maximum density. The streetcar is an added attraction. Without streetcar, would hav
Tacoma, WA	N/A
Tampa, FL	The Channel District was abandoned until six years ago and continues to grow. Through the line, there has been $4 billion in private investment. Master planning of the line recognized opportunities for these projects so it wasn't a coincidence.

Appendix C-7: Impacts on Built Environment

Are there any notable differences between the types of new development projects attracted to streetcar corridor compared to elsewhere in community?

City	Response
Astoria, OR	Higher residential development allowed at Millpond Village, due to large site plan. Business parking requirements lowered due to trolley.
Charlotte, NC	Yes. Area has been transformed, although largest portion of new TOD occurred after planning and development of light rail line along the same corridor and area to south of it.
Galveston, TX	No.
Kenosha, WI	There has been higher density and traditional new urbanism development in the downtown that was in disrepair.
Little Rock, AK	See above.
Lowell, MA	The downtown residential density has increased with 2000 new units. The trolley has been there and makes it appealing. It all works together.
Memphis, TN	The development pattern has followed the historic building patterns.
Portland, OR	Part of development agreements have included not only density but also require affordability for residential projects, so this was governed by development agreements not the streetcar.
San Pedro, CA	NA - no other commercial development on other Port property.
Savannah, GA	NA - much of downtown is in historic districts, with new uses limited to reuse of existing buildings.
Seattle, WA	Several companies located headquarters on the route: Amazon, Group Health Coop, PATH. While it's an urban grid, the area accommodates a sense of campus. Rather than just limited scatted sites in an already developed area, it was a large number of sites
Tacoma, WA	A developers is doing a $35 million remodel of an old parking garage. The streetcar was a leading factor in this project. An R&D land was built but not because of the streetcar. The University of Washington is upgrading a building on the corridor.
Tampa, FL	When the streetcar was being planned no one would have conceived of high density in proximity to the line.

Are there any notable differences between the types of developers attracted to the streetcar route compared to elsewhere?

City	Response
Astoria, OR	Out-of-town Los Angeles developer constructed twin loft projects at eastern edge of town (39th St.) Millpond Village was local developer.
Charlotte, NC	No.
Galveston, TX	Out-of-town developers on eastern edge of Galveston drawn by possibility of trolley line extension (which did not occur).
Kenosha, WI	All local. The smaller buildings are operated by owners. Larger buildings are absentee owners who put little investment into rehabilitating space.
Little Rock, AK	Primary development activity has been local developers, with some national hotel chains and regional developers. Infill doesn't attract national developers.
Lowell, MA	N/A
Memphis, TN	More national, larger developers with interest in developing downtown. They were smaller to medium size developers that initially that took on redevelopment. Have grown into larger developers. Hard to say that trolley is only catalyst.
Portland, OR	Almost no national developers. Development in downtown Portland is hard to break into. In office, there are some national developers, in condos they are local.
San Pedro, CA	N/A
Savannah, GA	No.
Seattle, WA	60 acres in the area was owned by Vulcan before streetcar went in. Vulcan real estate owns large percentage of property and continues to be owner—they don't build to sell. Because of this there is a lot of continuity in the type of development.
Tacoma, WA	N/A
Tampa, FL	Most housing developers were not here until five years ago. Tampa is fortunate to get national and international developers both near and away from the streetcar. So their presence is not because of the streetcar.

Appendix C-7: Impacts on Built Environment

Are there any notable differences between the types of businesses, such as retailers or employers, attracted to the streetcar route?

City	Response
Astoria, OR	Mostly local retailers and businesses. Local boutique hotels, plus three national hotel chains.
Charlotte, NC	South End area TOD, primarily after light rail built along same alignment, has tended to attract creative services firms, as opposed to large financial corporations Downtown. Retail primarily small scale, along big box (Lowe's) has been built next to ligh
Galveston, TX	Some chain restaurants at eastern edge of town (Starbucks, Chile's), though mostly local.
Kenosha, WI	Downtown doesn't have traffic for traditional anchors, so mostly small, locally owned retailers.
Little Rock, AK	Some regional bars have located on streetcar route.
Lowell, MA	N/A
Memphis, TN	Yes. Edgy national retailers look for busier urban neighborhoods so trying to incentive retail development.
Portland, OR	In the Pearl district 90% of businesses are locally owned. The district has always been professional, lots of designers, architects, outdoor wear. How this is tied to the streetcar is hard to say.
San Pedro, CA	N/A
Savannah, GA	No.
Seattle, WA	Streetcar has succeeded in attracting major corporate headquarters uses. Retail leasing by Vulcan deliberate to avoid too many national chain retailers.
Tacoma, WA	Divita, a large biotech employer has grown and Tacoma Link is important to their business. They'd like a stop closer to their building.
Tampa, FL	This is yet to be determined. This hasn't been a good year to attract retail. Much of the retail space is still vacant in new buildings. It will likely be different than what was here before the streetcar.

Are there any notable differences in business performance or vacancies in the current economic downturn?

City	Response
Astoria, OR	Low vacancy rate. Astoria, as a peninsula, has very little room for speculative development.
Charlotte, NC	N/A
Galveston, TX	N/A
Kenosha, WI	Streetcar area will come back quicker because hasn't gone down as much as older retail center away from streetcar
Little Rock, AK	N/A
Lowell, MA	N/A
Memphis, TN	Don't really see it. Haven't been able to determine if vacancy rates have increased. Always had large vacancy on Main Street, maybe due to lack of cars. Larger vacancies on Main Street and Madison.
Portland, OR	N/A
San Pedro, CA	N/A
Savannah, GA	N/A
Seattle, WA	Retailers are struggling in South Lake Union as much as anywhere else. Has been turnover, because lot of development is imminent. Vulcan just announced a lease with PATH and Amazon.com. So there is activity in development and leasing in the area, unlik
Tacoma, WA	N/A
Tampa, FL	No benchmark studies are out there to document this, but most active retail is in Ybor City. Retailers there give a lot of credit to the streetcar. The area around the streetcar performs better than other parts of the City. Residential projects are sti

Appendix C-7: Impacts on Built Environment

We are interested in the interaction between LEED certification, which credits for proximity to transit, and your streetcar system.

City	Response
Astoria, OR	No. Industrial re-use (mostly old canneries like Millpond and Pier 39)
Charlotte, NC	N/A
Galveston, TX	No. Streetcar route located along Silk Socking Historic District, however.
Kenosha, WI	No one has sought that designation in Kenosha.
Little Rock, AK	The Clinton Presidential Library and Heifer International Center and LEED certified. Several other developers shown interest in LEED.
Lowell, MA	N/A
Memphis, TN	Haven't had a whole lot. Have buildings with LEED characteristics but not LEED certified. Had one new residential development condo with LEED features. Selection of site location for farmers market and alternative transportatior was one option determini
Portland, OR	Yes, but not due to streetcar. Portland has a strong design review process and the result is a high level of design.
San Pedro, CA	N/A
Savannah, GA	N/A
Seattle, WA	Vulcan seeks LEED Silver and Gold, this has led other developers to do the same to be competitive. City is looking at LEED-ND Silver or Gold certification. Current zoning review, if upgrades area density to Downtown high-rise standards, would provide bonu
Tacoma, WA	N/A
Tampa, FL	Many offices and a couple of condominiums are proposing LEED, but not because of the streetcar.

Are there notable differences in other signs of private investment along the streetcar corridor (e.g., façade improvements, developer marketing promoting streetcar, etc.?)

City	Response
Astoria, OR	Yes. Backs of businesses, facing streetcar, have been spruced up. Trolley stops. Benches built along Riverwalk.
Charlotte, NC	South End area experienced transformation from former industrial to live/work, loft, offices, other uses. This was occurring around the time of streetcar, and greatly accelerated after construction of light rail along the same alignment.
Galveston, TX	No.
Kenosha, WI	Has been a focus on rehabilitation of older buildings.
Little Rock, AK	N/A
Lowell, MA	It's now changing at current TOD mixed use,15 acre site, a $800 million project. The developer from the beginning has been outspoken that the trolley is amenity going through their site. But streetcar isn't the reason for his investment.
Memphis, TN	All long main street facades are continually upgraded. Over the last ten years we've seen a big improvement. It serves as promotion from condo developers.
Portland, OR	N/A
San Pedro, CA	No.
Savannah, GA	No.
Seattle, WA	New private development has been transformative of the area. One building did renovation.
Tacoma, WA	N/A
Tampa, FL	New condominiums are market the streetcar. Along the line there is a lot of restoration but can't say how much is influenced by the streetcar because it's a hot investment area already.

Appendix C-7: Impacts on Built Environment

Q 21: Has the streetcar increased the sale value of land and buildings? If so, please provide opinion or data regarding how much.

City	Response
Astoria, OR	CBD remains strong; Commercial Street: $40 psf in 2000, $120 psf in 2007, and now price hovers around $100 psf in 2009.
Charlotte, NC	NA for streetcar. Subsequent research on light rail line has established significant increases in value due to the light rail system construction and associated changes in zoning to allow denser/mixed-use development.
Galveston, TX	Possible effect; no research.
Kenosha, WI	Nothing collected. Guess is over last 15-20 year there has been a 50% increase.
Little Rock, AK	N/A
Lowell, MA	N/A
Memphis, TN	Downtown values have gone up a lot. It's safe to say that south Main Street property values sky rocketed. Previously no one could sell. But it's a common of factor and the trolley can't take credit for all of it.
Portland, OR	Typical estimate is 20-25% higher than other blocks with similar zoning.
San Pedro, CA	N/A
Savannah, GA	N/A
Seattle, WA	Not tracking in a formal way, but seeing increases in values.
Tacoma, WA	Land values in downtown have gone up in general in the last 10 years because of condominiums and public investment, but can't say Tacoma Link was causal, but contributed.
Tampa, FL	Definitely land values have gone up significantly, especially in the Channel District. Five years ago land in this area was $25-$30 SF and now it's $125 SF. Some value is driven by the streetcar.

Q 22: Has the streetcar increased the rental/lease rates charged? If so please provide opinion or data regarding how much.

City	Response
Astoria, OR	N/A
Charlotte, NC	N/A
Galveston, TX	N/A
Kenosha, WI	15 years ago rents were $400-$500 for 1000 SF to 1500 SF. Now same space rent is still below $1000.
Little Rock, AK	N/A
Lowell, MA	N/A
Memphis, TN	Parallels pattern for sale values.
Portland, OR	Rentals are similar to land value, 20-25% higher.
San Pedro, CA	N/A
Savannah, GA	N/A
Seattle, WA	N/A
Tacoma, WA	N/A
Tampa, FL	Has been same steady growth. Historically there have not been a lot of rental units in this area.

Appendix C-7: Impacts on Built Environment

Q 23: Please describe the types of public improvements and approximate value within 1/4 mile of the streetcar corridor, completed

City	Response
Astoria, OR	Riverwalk pedestrian walkway, public parks, public benches, transit stops, multimodal transit center, public parking at Maritime Museum.
Charlotte, NC	City built a pedestrian spine, with trails, bike route, also built an overcrossing to Downtown across loop freeway. Some of these improvements had to be redone when light rail was built along the route.
Galveston, TX	Signage, sidewalks, bike racks, transit shelters, park benches, and small public spaces
Kenosha, WI	Streetcar infrastructure; one-ways have been eliminated to promote business traffic; Harbor Park has new bicycle and pedestrian route; streetscape is ongoing; the BID installed bicycle racks and ask trays; plazas were incorporated as a part of Harbor Park
Little Rock, AK	Public library rehabilitated two historic structures and main library; City built new market pavilion on River Market and developed new pedestrian and bicycle trail along streetcar route.
Lowell, MA	Many public improvements were made as a part of the park development.
Memphis, TN	Center City Commission is improving sidewalks, signage, and developing a plaza. They are also providing bicycle rack at park and ride stop and some new garages. "Next Bus" signage is coming.
Portland, OR	N/A
San Pedro, CA	Port has built a large waterfront fountain with water and light show to attract visitors. Streetcar was built in part to allow cruise ship terminal parking to be in another location.
Savannah, GA	None - primary challenge was removing other vehicle traffic from River Street.
Seattle, WA	Most improvements were completed simultaneously with project: Converted a one-way street that was four land to a two way street. The City has made various pedestrian improvements, signage, streetscape. More recently, there have been bicycle improvement
Tacoma, WA	N/A
Tampa, FL	Improved traffic signals. Also the City built the Southern Transportation Center with a public plaza.

Appendix C-8: Changes in Zoning and Land Use

Q 24: Before Streetcar - Did your city change its zoning, land use designations, or allowable densities along the streetcar route prior to construction or in conjunction with it?

City	Response
Astoria, OR	No.
Charlotte, NC	Yes - urban district zoning allowing more density to encourage redevelopment of old industrial buildings into lofts, live/work, other uses.
Galveston, TX	No.
Kenosha, WI	Harbor Park development zoning district allowed for residential museum and mixed use—was new district. The rest of the zoning hasn't changed except when a development has come forward and changed zoning.
Little Rock, AK	No.
Lowell, MA	Not much before. Had same zoning from 1966 to 1988.
Memphis, TN	None. Already had a mixed-use environment.
Portland, OR	Before it was planned there were zoning changes that changed allowable uses.
San Pedro, CA	No.
Savannah, GA	No.
Seattle, WA	South Lake Union zoning changed from manufacturing to commercial mixed-use, designated Urban Center to focus new denser mixed-use employment and residential development in the area.
Tacoma, WA	N/A
Tampa, FL	Downtown had no FAR limits and height limits only to FAA limits.

Q 25: Before Streetcar - Did your city change its parking requirements or parking management strategies along the streetcar route prior to construction or in conjunction with it?

City	Response
Astoria, OR	No.
Charlotte, NC	Parking standards were lowered to urban district standard as part of rezoning.
Galveston, TX	No.
Kenosha, WI	Downtown parking has been reduced (during redevelopment plan). For an existing building rehab, no new parking is required. New buildings have to provide off street parking.
Little Rock, AK	No.
Lowell, MA	No.
Memphis, TN	None.
Portland, OR	Surface parking lots were reduced or banned. Don't think parking ratios were changed.
San Pedro, CA	No.
Savannah, GA	No.
Seattle, WA	Yes - City eliminated all parking requirements as part of Urban Center designation.
Tacoma, WA	N/A
Tampa, FL	No.

Appendix C-8: Changes in Zoning and Land Use

Q 26: After Streetcar – Did your city change its zoning, land use designations, or allowable densities after the streetcar was completed? If so, were these changes a result of public policy shirts, the developer community requesting changes, or both?

City	Response
Astoria, OR	Gateway Master Plan was adopted by Planning Department, when Millpond Village was developed. City currently reviewing land-use designations.
Charlotte, NC	No.
Galveston, TX	No.
Kenosha, WI	N/A
Little Rock, AK	River Market area has design overlay that regulates façade and height frontage. Little Rock simplified entire CBD zoning to be more design oriented and mixed-use.
Lowell, MA	In 1998 the City did an artist overlay district. Also expanded smart growth zoning into neighborhoods and developed contextual zoning to help preserve character.
Memphis, TN	Has been rezoning that occurred that encourages and creates more urban development, more pedestrian movement, wider side walks, less frontage. The overlays have been in correspondence with trolley route. Memphis and Shelby County are adopting a unified
Portland, OR	N/A
San Pedro, CA	No.
Savannah, GA	Downtown master plan underway, with these issues to be addressed.
Seattle, WA	Did amendment to heights when biotech became interested in the areas from 65 feet to 85 feet. Currently working on zoning plan for the Comprehensive Plan to crease heights to high-rise development. Streetcar allows for greater height and density.
Tacoma, WA	N/A
Tampa, FL	City did study for Channel District to upgrade FAR to 7 from 3.5). It would require developers to provide public enhancements like connectivity to transit and pedestrian pathways.

Q 27: After Streetcar - Did your city change its parking requirements or parking management strategies after streetcar was completed? If so, were these changes a result of public policy shifts, developers requesting changes, or both?

City	Response
Astoria, OR	Yes. Businesses along trolley line require slightly less parking than other businesses.
Charlotte, NC	No.
Galveston, TX	N/A
Kenosha, WI	N/A
Little Rock, AK	The River Market district has been such a success That City built parking deck on streetcar route.
Lowell, MA	The City pursued a strategy of structured parking and leased it to development. Helped spurred and commercial development . No on site parking required for commercial at all. For residential one space per unit.
Memphis, TN	Some of the increased density variance applications use criteria for shared and reduced parking. Have one ordinance that allows 10% parking if on trolley line.
Portland, OR	N/A
San Pedro, CA	No.
Savannah, GA	To be addressed in Downtown Master Plan (now in progress).
Seattle, WA	Eliminated all parking requirements to let market determine requirements. To be determined if limits on allowed parking will be established as has been done Downtown.
Tacoma, WA	N/A
Tampa, FL	The City is considering changing parking requirements from one space per bedroom to one per unit, but not ready for that yet. Waiting for the streetcar extension to happen.

Appendix C-8: Changes in Zoning and Land Use

Q 28: How would you summarize the overall impact of the streetcar on the following.
a) Job attraction along its corridor.

City	Response
Astoria, OR	No impact.
Charlotte, NC	Modest impact - most new development residential.
Galveston, TX	No impact.
Kenosha, WI	The streetcar was a tool to support jobs, it didn't create them.
Little Rock, AK	It has not attracted traditional CBD office jobs, but has attracted service jobs.
Lowell, MA	There are two developments: office complex and new office building. Can't say they wouldn't be there without trolley but they like the tracks being there so it may have kept them out of the suburban sprawl.
Memphis, TN	Not rated real high. Employment density remains same.
Portland, OR	N/A
San Pedro, CA	No impact - Port has not yet redeveloped properties it owns.
Savannah, GA	None - system has just started in past several months.
Seattle, WA	Key factor in firms locations decisions.
Tacoma, WA	N/A
Tampa, FL	It has been minimal to date but here are a lot of new institutional and cultural facilities. The streetcar helped the area to be more attractive.

b) Creating a competitive advantage versus other parts of your city and regior

City	Response
Astoria, OR	Has helped Astoria compete and remain attractive to tourists.
Charlotte, NC	No - South End area was historic industrial area, was already well-suited to redevelopment. Area has unique attributes in the region.
Galveston, TX	No impact.
Kenosha, WI	Maybe not a competitive advantage, but it did provide some competitive edge or at least something to compare with given Downtown's lower lease rates.
Little Rock, AK	Has helped the corridors and the historic urban fabric, has given it a unique urban niche unique to other parts of Arkansas.
Lowell, MA	Yes, but the park is the primary attraction that makes Lowell compete, not the trolley.
Memphis, TN	Has given a competitive advantage to downtown because we're able to advertise live work and play.
Portland, OR	N/A
San Pedro, CA	NA - streetcar is intended to serve development of Port-owned property.
Savannah, GA	NA - streetcar is seen mostly as a mobility system for congested, tourism-oriented downtown.
Seattle, WA	We have evidence from firm location decisions that the streetcar as part of broader strategy has helped with competitive advantage to the area and the city. Amazon was looking at other areas in region.
Tacoma, WA	It's more of a sense of pride than competitive advantage. It makes it feel like we're a bigger tier city than we are.
Tampa, FL	It's become more and more obvious that rail transit is very attractive and important. Young people make financial choices to be near transit. For businesses it's less important but they will start to see a growing market place for transit based on a grow

Appendix C-8: Changes in Zoning and Land Use

c) Stimulating neighborhood revitalization and reinvestment

City	Response
Astoria, OR	Community has galvanized around trolley, but has not manifested in neighborhood reinvestment.
Charlotte, NC	Moderate effect.
Galveston, TX	No.
Kenosha, WI	There's been a huge impact but needs more.
Little Rock, AK	See above.
Lowell, MA	The talk of expansion alone generates a lot of interest that some day it will be connected to other parts of the City. It has stimulated benefits to redevelopment and an understating of where it's going to go.
Memphis, TN	Uptown and South Main are prime examples.
Portland, OR	N/A
San Pedro, CA	N/A
Savannah, GA	Future expansion of streetcar seen as key to attracting Class A office, supporting hotels and other service businesses.
Seattle, WA	Streetcar was an implementation action for Urban Center designation to transform the area with dense mixed-use development.
Tacoma, WA	Mostly on adjacent properties.
Tampa, FL	N/A

d) Downtown and neighborhood retail districts

City	Response
Astoria, OR	Insubstantial.
Charlotte, NC	Moderate impact in area already revitalizing. Most retail is restaurants/entertainment uses.
Galveston, TX	Serves existing development; connects visitors and some condo residents with new Safeway downtown.
Kenosha, WI	Have been able to be revitalized while the rest of the city is growing. Has not allowed area to further diminish.
Little Rock, AK	See above.
Lowell, MA	Doesn't get close enough to it. But does connect tourist to get closer to retail.
Memphis, TN	Residential came first. Retail is following residential, especially arts and entertainment and restaurants.
Portland, OR	N/A
San Pedro, CA	N/A
Savannah, GA	NA for existing streetcar segment, but key goal for future expansion.
Seattle, WA	This is lagging a little because new development is still coming on line. There is some new retail but not at a critical mass. It's not retail district yet. But the potential is there.
Tacoma, WA	N/A
Tampa, FL	N/A

Appendix C-8: Changes in Zoning and Land Use

e) Employment centers

City	Response
Astoria, OR	No impact.
Charlotte, NC	Modest impact.
Galveston, TX	Unsuccessful attempt to connect downtown with largest employer, UTMB (Univ. Texas Medical Branch).
Kenosha, WI	Not much impact.
Little Rock, AK	See above.
Lowell, MA	N/A
Memphis, TN	Hasn't changed much.
Portland, OR	N/A
San Pedro, CA	N/A
Savannah, GA	NA for current system segment. Future expansion seen as key to helping get lower paid service workers to jobs Downtown.
Seattle, WA	See Question 29b.
Tacoma, WA	N/A
Tampa, FL	N/A

f) Civic or cultural gathering places

City	Response
Astoria, OR	The pedestrian Riverwalk attracts visitors and residents. Public benches donated by community-members. Pocket Parks.
Charlotte, NC	No.
Galveston, TX	Small public parks.
Kenosha, WI	We have four museums on lake front. Two are brand new and other are a result of expansion and relocation.
Little Rock, AK	The streetcar has stimulated the area as a civic and cultural gathering place.
Lowell, MA	N/A
Memphis, TN	The trolley makes some of the events happen. Ridership goes up in summer.
Portland, OR	N/A
San Pedro, CA	N/A
Savannah, GA	NA for current segment. System has just started in past several months.
Seattle, WA	Streetcar provides access to Lake Union Park and recreational opportunities.
Tacoma, WA	N/A
Tampa, FL	N/A

g) Tourism venues

City	Response
Astoria, OR	Some visitors rent out trolley for the night. Holiday parties. School field trips. Weddings. Limited capacity.
Charlotte, NC	Streetcar was used by some to attend stadium and arena Downtown, but no significant tourism impact.
Galveston, TX	Serves tourist centers, like downtown loop.
Kenosha, WI	This is the biggest thing. It also serves residents to access recreation.
Little Rock, AK	The streetcar has stimulated tourism.
Lowell, MA	Yes, it's a part of the national park.
Memphis, TN	It serves Beale Street—trolley links visitors center, hotel, civil rights museums, etc.
Portland, OR	N/A
San Pedro, CA	Used to move visitors during Port special events, attract visitors to water and light show at fountain installed by the Port.
Savannah, GA	Primary users of streetcar are tourists because of its location in prime tourism destination.
Seattle, WA	In spring in summer a lot tourists ride the streetcar. The streetcar itself is a tourism venue, but this was not the intent.
Tacoma, WA	Le May Auto Museum announced plan to build America's Auto Museum on the corridor.

Appendix C-9: Closing Comments

City	Response
Astoria, OR	New Sheraton Hotel proposed along line. New condo projects. Trial Lewis and Clark train to Portland failed. Streetcar has helped "put Astoria on the map" (movies filmed there).
Charlotte, NC	Streetcars seen as way to stimulate reinvestment, since helped do that in South End. Success built support for building light rail along route earlier than would have otherwise occurred. Planning major new streetcar system in other parts of Charlotte, wil
Galveston, TX	Service suspended in 2008 due to Hurricane Ike. Waiting for FTA funds to rehab cars.
Kenosha, WI	N/A
Little Rock, AK	N/A
Lowell, MA	N/A
Memphis, TN	N/A
Portland, OR	N/A
San Pedro, CA	Originally built as low-cost demonstration, to assist with making the waterfront as a tourism venue, and providing access during special events. Future operation will extend it to Cabrillo Beach, south of Downtown San Pedro.
Savannah, GA	Starter system. Ultimate goal is to use streetcar to improve Downtown mobility, reduce overlapping and independently run buses and shuttles that create congestion in historic Downtown.
Seattle, WA	Difficult to separate streetcar's impacts from actions of Vulcan as major land owner, designation of the area as an Urban Center - but it was an integral part of the area's transformation, and without it the pace of development and attraction of new firm
Tacoma, WA	N/A
Tampa, FL	N/A

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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