

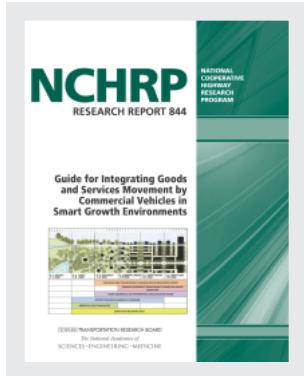
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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP RESEARCH REPORT 844

**Guide for Integrating Goods
and Services Movement by
Commercial Vehicles in
Smart Growth Environments**

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2017

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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Recognizing this need, the leadership of the American Association of State Highway and Transportation Officials (AASHTO) in 1962 initiated an objective national highway research program using modern scientific techniques—the National Cooperative Highway Research Program (NCHRP). NCHRP is supported on a continuing basis by funds from participating member states of AASHTO and receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board (TRB) of the National Academies of Sciences, Engineering, and Medicine was requested by AASHTO to administer the research program because of TRB's recognized objectivity and understanding of modern research practices. TRB is uniquely suited for this purpose for many reasons: TRB maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; TRB possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; TRB's relationship to the Academies is an insurance of objectivity; and TRB maintains a full-time staff of specialists in highway transportation matters to bring the findings of research directly to those in a position to use them.

The program is developed on the basis of research needs identified by chief administrators and other staff of the highway and transportation departments and by committees of AASHTO. Topics of the highest merit are selected by the AASHTO Standing Committee on Research (SCOR), and each year SCOR's recommendations are proposed to the AASHTO Board of Directors and the Academies. Research projects to address these topics are defined by NCHRP, and qualified research agencies are selected from submitted proposals. Administration and surveillance of research contracts are the responsibilities of the Academies and TRB.

The needs for highway research are many, and NCHRP can make significant contributions to solving highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement, rather than to substitute for or duplicate, other highway research programs.

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Project 08-96

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FOR E W O R D

By William C. Rogers

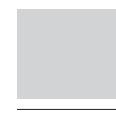
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NCHRP Research Report 844 provides policymakers with tangible proactive and reactive practices—policy, planning, design, and operations—to integrate goods and services movement by commercial vehicles in smart growth environments. The Guide describes practices (1) that effectively and efficiently consider the coexistence of goods and services movement in smart growth environments at both the design and implementation stages and (2) to retroactively improve existing conditions. It will be particularly helpful to stakeholders as they work together to create environments that achieve the multiple benefits of smart growth while accommodating freight movement to support critical economic activity.

Smart growth and its compact, transit-oriented, and walkable land uses and streetscapes have been proposed as an alternative to urban sprawl. Transportation planning organizations are looking to influence future land-use patterns to create livable, sustainable communities by reducing such factors as vehicle miles traveled and congestion, and, therefore, greenhouse gas emissions and air pollution. As more communities are being designed for mixed use, higher density land uses, and other common tenets of smart growth, delivery of goods and services are often inadequately addressed or completely overlooked. Going beyond zoning and addressing the needs of shippers, receivers, and trucking companies in the design, development, and implementation of infrastructure projects is critical for both commerce and sustainability principles to coexist.

In NCHRP Project 08-96, Cambridge Systematics was asked to (1) review smart growth principles and applications; (2) describe how goods and services movement by commercial vehicles is considered; (3) describe and analyze the constraints on and opportunities for such movement in smart growth environments; (4) discuss the potential for improved coordination among stakeholders in smart growth environments; (5) develop a typology of smart growth environments and illustrate how each relates to goods and services movement by commercial vehicles; and (6) identify the various stakeholders and develop and implement a stakeholder outreach plan to obtain their perspectives on the integration of smart growth environments with goods and services movement by commercial vehicles.



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CHAPTER 1

Introduction

1.1 Background

Communities across the United States are increasingly adopting “smart growth” planning principles to guide new development and redevelopment of existing neighborhoods. The core principle of smart growth is to locate residents and transportation choices near jobs, shopping, and schools, regardless of whether the community is urban, suburban, or rural. In addition to supporting local economies and protecting the environment, smart growth seeks to foster safe and affordable areas with ample transportation options. Smart growth encompasses various planning concepts, but typically includes

- Compact and walkable neighborhoods,
- Mixed-use development,
- “Complete Streets” to improve safety and accessibility for all modes and users,
- Urban infill and redevelopment, and
- New communities that integrate a mix of housing styles and commercial development in a walkable environment.

Smart growth is intended to create more livable communities while reducing the effects of development on the environment. The environmental benefits of successful smart growth planning include various outcomes to improve overall quality of life in a community. Examples include improved air and water quality, reduced greenhouse gas emissions, preservation of natural lands, and the redevelopment of brownfields, all of which can improve a community’s economy and overall quality of life. Although smart growth encourages economic activity, the necessary movement of freight and service vehicles can put pressure on smart growth communities that lack supporting infrastructure or policies. Examples—based on real-world situations in the United States—where smart growth principles and freight activity can come into conflict are presented below:

- Legacy light industrial uses remain in a warehouse district which is redeveloping with new mixed-use residential buildings and artists’ lofts. As a result, the neighborhood experiences increased truck conflict, more noise generated by idling trucks waiting to access the site, and noise from the remaining industrial and warehousing uses.
- Urban manufacturing plants and warehouse distribution are pushed to the region’s edge by rising property values and redevelopment plans. As a result, employment in skilled and unskilled trades becomes less accessible to the urban residents.
- Pedestrian safety measures, such as curb extensions and pedestrian refuges, implemented in older neighborhoods improve safety for pedestrians and slow traffic, but create turning radii too small to be easily navigated by trucks making deliveries.

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- Loading docks and garbage pickup sites in a mixed-use development are sometimes sited immediately next to residential units. Consequently, truck noise is audible at all hours of the night, which disturbs some neighbors in the residential development.
- A small urban community would like to revitalize its historic main street using traffic-calming techniques to create a more pedestrian-friendly area. However, the main street is also a state highway with heavy truck traffic and is part of the oversize/overweight network for the state and thus must be accessible for larger vehicles.

The potential conflicts between freight traffic and urban development are not new. However, they can be exacerbated by smart growth development if and when it is not “smart” enough, especially given the high expectations residents of these neighborhoods often have for quality of life. These conflicts need to be addressed through planning, design, and operational decisions. Interventions vary in scale, from the dimensions of street and site design to regional-level land use planning across municipal boundaries. Those who move freight also must adapt to the changing environment they seek to access, but can be aided by new technology, smaller vehicles, and adapting operational procedures.

In many cities, municipal governments are working with developers and the freight industry to address these conflicts by integrating freight and truck access into site planning and traffic management. In addition to site design, some smart growth environments are using operations strategies, including curbside management policies, and working with businesses to adjust delivery hours and locations. Locally adopted Complete Streets policies, often a critical component in a city’s smart growth strategy, may recognize the need to prioritize freight access, especially on heavily traveled truck routes or near industrial corridors or intermodal facilities. On roads with limited or irregular freight needs (such as those in residential neighborhoods), truckers should acknowledge that access via a large trailer may be impractical and adapt to fit the needs of the location. However, when accessing low-volume streets, truck drivers tend to have little difficulty using opposing traffic lanes and jockeying trucks where geometry is tight. It is on streets where regular truck access and high pedestrian, bicyclist, and transit use occur that the tradeoffs become less clear, and communication between the groups is essential.

In some smart growth developments, especially greenfield or major site reuse projects, freight has been overlooked in the design and development stages. Although a growing body of practitioners (such as developers, traffic engineers, and planners) are recognizing goods movement and making provisions for its integration into new developments, few resources document these practices. For example, most educational material related to smart growth does little to explain how the freight system fits into smart growth environments. On the other side, many freight plans do not mention smart growth or identify opportunities or logistics strategies to operate safely and efficiently in smart growth environments. These two topics are often separated from one another, even though there is continual interaction in the real world. Although there is a growing body of literature on freight and land use issues, these resources do not focus on the specific issues of goods and services movement in smart growth environments.

1.2 Purpose of the Guide

To close the gaps noted in Section 1.1, this Guide is designed to help government agencies, developers, building and streetscape designers, and freight carriers identify conflicts and issues and approaches to better integrate goods and services movement in the design and management of buildings and streets in smart growth environments, using best practices and case studies. The Guide can help address the gap in the available educational materials and improve the dialog between the freight stakeholders operating in smart growth environments and the professional

community that designs, develops, and maintains the assets of these places. The ultimate objective is to help stakeholders work together to create environments that achieve the multiple benefits of smart growth while accommodating freight movement to support critical economic activity. Strategies for accommodating freight in multiple types of smart growth communities have been identified, detailed, and supported with current examples from the United States and abroad. This Guide is one element in a broad effort to assist communities, states, and metropolitan planning organizations (MPOs) in integrating freight into smart growth environments.

1.3 Development of the Guide

This Guide was developed under NCHRP Project 08-96, “Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments.” The research was conducted in two phases.

The first phase focused on a state-of-the-practice review of smart growth principles, planning and development of smart growth communities, key goods and services considerations and issues, and best practices. The state-of-the-practice review consisted of a review of literature supported by interviews with transportation, freight, and land use planners at all levels of the government, smart growth advocates, freight operators, and researchers. The first phase concluded with the development of a case study outreach plan and an interim report.

The second phase consisted of the implementation of the case study outreach plan, which included site visits to six case study smart growth environments, focus group meetings with various stakeholders in each case study community, and documentation of findings. The development of the draft guide, a peer review of the draft guide, and development of the final version of the Guide were completed in the second phase. During peer review, the project panel and a group of experts from throughout the country reviewed and commented on the Guide and participated in a 1-day peer exchange workshop aimed at refining the Guide’s contents. Lastly, the NCHRP Project 08-96 project panel reviewed and commented on the final version of the Guide.

1.4 Using the Guide

This Guide will help the reader understand common issues and conflicts, how those issues and conflicts manifest themselves in different smart growth environments, and the types of strategies and actions stakeholders can take to better integrate goods and services movement by commercial vehicles in smart growth environments. This Guide has three additional chapters:

- **Chapter 2: Planning for Smart Growth** describes and defines smart growth and its planning principles and describes six smart growth classifications and common issues and conflicts associated with goods and services movement in each. This chapter also describes the primary stakeholders, working relationships, and opportunities for coordination among municipal, federal, state/regional, and private companies. Chapter 2 concludes with information about best practices, common conflicts, and areas for achieving progress in areas where mutual benefits exist. When reading this chapter, consider the qualities of your existing or planned smart growth community, and use this discussion to affirm existing or anticipate potential issues and conflicts.
- **Chapter 3: Strategies for Supporting Goods Movement in Smart Growth Environments** is the core of this Guide. It walks the reader through a “needs identification” framework to identify appropriate strategies and actions that can better integrate goods and services

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movement in smart growth environments. The description of each strategy group recognizes the obstacles that planners and policymakers may encounter when supporting smart growth and goods movement. The rest of the chapter outlines a series of strategies for each of the four phases of integrating freight into smart growth communities and identifies which strategies support each of the six aforementioned smart growth classifications.

- **Chapter 4: Case Studies** presents the findings of each of the six case studies: the Brady Arts District (Tulsa, OK), the Ballard neighborhood (Seattle, WA), Over-the-Rhine (Cincinnati, OH), Route 9 in Glens Falls (NY), Daybreak (South Jordan, UT), and the Belmar District (Lakewood, CO).

The Guide also contains a list of references and a list of abbreviations, acronyms, and initialisms.



CHAPTER 2

Planning for Smart Growth

2.1 What Is Smart Growth?

2.1.1 Description and Definition

Smart growth goals typically focus on environmental stewardship, public health and safety, and economic sustainability. Objectives such as increasing population density, development intensity, infill of brownfields or other underdeveloped urban areas, access to public and/or non-motorized transportation, and specific combinations of land uses are often cited as ways to achieve the goals of smart growth (see Figure 2-1).

Although it is difficult to pinpoint the origin of the modern smart growth movement, two key initiatives (begun in the mid-1990s) are often credited. The first was an effort by the American Planning Association (APA), the U.S. Department of Housing and Urban Development (HUD), and the Henry M. Jackson Foundation to update local land use controls to create smaller and more compact development patterns. In a separate effort, the National Resources Defense Council (NRDC) and the Surface Transportation Policy Project (STPP) developed a series of measures to assist local and state governments in building walkable development with access to public transportation, called the Smart Growth Toolkit. From there, other public agencies and academic researchers continued to study and promote policy development centered on the benefits of walkable development and social and fiscal costs associated with sprawl (Bengston 2005).

From there, several advocacy and professional groups, such as STPP, the Sierra Club, NRDC, the Environmental Protection Agency (EPA), and APA, began publishing reports and connecting with a wide range of supporters and stakeholders, all uniting under a series of smart growth goals and planning principles. According to the EPA, smart growth is a set of approaches with the goal of creating and maintaining socially, economically, and environmentally sustainable places based on the following 10 basic principles (USEPA 2014):

1. Mix land uses;
2. Take advantage of compact building design;
3. Create a range of housing opportunities and choices;
4. Create walkable neighborhoods;
5. Foster distinctive, attractive communities with a strong sense of place;
6. Preserve open space, farmland, natural beauty, and critical environmental areas;
7. Strengthen and direct development toward existing communities;
8. Provide various transportation choices;
9. Make development decisions predictable, fair, and cost-effective;
10. Encourage community and stakeholder collaboration in development decisions.

These principles broadly address the attributes that many communities want to emulate. Smart Growth America, an advocacy group that helps communities across the country with

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Figure 2-1. Example of a mixed-use infill community in New Jersey with residential above retail development (Source: New Jersey Future).

coalition building, policy development, and smart growth research, identifies eight key areas that smart growth practices can help improve for any community (Smart Growth America 2016):

- **Housing.** Throughout the United States, demand is increasing for homes in walkable neighborhoods. Residents benefit when communities have a range of housing options and choices to accommodate different incomes. This can include single-family homes, duplexes, apartments, condominiums, and lofts of all sizes. Smart growth strategies can help meet market demand, stabilize home prices, create more housing choices for more people, and reduce overall housing and transportation costs for residents.
- **Business.** Local businesses of all sizes can flourish in smart growth environments with a sizeable workforce, access to multiple transportation options, and a vibrant downtown. More Americans want to work and live in communities with these attributes, which, in turn, helps businesses stay competitive and market themselves to a changing customer base. Smart growth strategies can help boost foot traffic, help recruit and retain employees, improve efficiency, raise commercial property values, and create a stronger local economy.
- **Jobs.** Smart growth is great for jobs: it can both create jobs and help workers find those jobs, regardless of the job type or skill level required. By contrast, communities with excessive sprawl and limited public transportation options make it difficult for workers to find and access quality jobs. Smart growth strategies can help workers get to jobs faster and more efficiently and has been shown to create more jobs per dollar invested on smart growth projects like transit, as well as create more medium-wage and green jobs.
- **Economic Prosperity.** Achieving economic prosperity requires success in several aspects of a community, including jobs, business, transportation, and affordable housing options. This is because these are all interdependent parts critical to building and maintaining a strong local economy. Research has found that in many communities, the combined cost of transportation and housing makes up more than half of the average household budget, which is an overwhelming burden on many low-income families. Smart growth strategies benefit both municipal and household budgets through a solid transportation network and increased property values, in addition to adding value for both businesses and jobs.
- **Transportation.** Various transportation options help accommodate more travelers and create better options for accessing homes, jobs, stores, and entertainment. Options can include expanding the network to include buses, subways, trolleys, light rail, street cars, and ferries,

instead of focusing on roads for personal vehicles. Smart growth also allows more trips by bicycle and foot because of shorter trip distances. This approach often helps concentrate development and reduces infrastructure costs. Smart growth transportation strategies create economic opportunity, make roads safer, are more efficient, and reduce congestion.

- **Environment.** Transportation options, land use, and open space decisions have long-term effects on the natural environment. Ensuring that air, water, and natural habitats are protected benefits the entire community. Smart growth strategies can result in cleaner air and water, as well as protected wildlife and valuable environmental areas—all of these benefit local economies.
- **Public Health.** Many of the aforementioned benefits of smart growth planning result in a healthier place to live. Ensuring that streets are safe for bicyclists and pedestrians allows people to stay active as part of their daily routines. Environmental benefits, such as clean water and air, help residents stay healthy and reduce the risk of disease or illness. Smart growth strategies make walking and bicycling easier, reduce congestion and air pollution, protect drinking water, ensure inclusive development to protect low-income and minority communities, and make streets safer for both drivers and pedestrians.
- **Revitalization.** The suburbanization movement in the 1960s and 1970s resulted in development along the fringe of existing downtowns, resulting in the stark decline of America's main streets and central neighborhoods. Smart growth advocates are pushing for communities to reinvest in abandoned storefronts, industrial buildings, and urban waterfronts to take advantage of the economic potential of these structures. Smart growth strategies can help find new uses for developed land parcels (particularly abandoned properties and brownfield sites), repair existing infrastructure, and engage the community.

Smart growth principles can be manifest in various planning, design, and operational strategies and applied in different contexts and communities in all regions of the United States. Proponents of smart growth strategies suggest them as a way to responsibly develop previously undeveloped land, or “greenfields,” and reuse already-developed land (Richards 2014). Infill development consistent with smart growth principles is often credited with revitalizing urban cores where population growth had been stagnant or declining since the middle of the 20th century (Coes No Date).

A form-based code (FBC) is one of many tools that can be used to advance smart growth principles. FBC is a type of zoning system concerned largely with the physical form of development, rather than its use, in contrast to traditional Euclidean zoning practices, which focus primarily on use. The primary differences between these zoning techniques are shown in Table 2-1 (Michigan Association of Planning 2007). FBC can make it easier to develop mixed-use areas, especially in redevelopment of urban areas. FBC prescribes the physical form and circulation, allowing uses to change as the area evolves, so long as the form and/or streetscape specifications are followed.

Table 2-1. Key differences between Euclidean and form-based code (FBC) zoning techniques.

Euclidean (Conventional) Zoning Characteristics	FBC Characteristics
<ul style="list-style-type: none"> • Use-based • Focus on separating land uses and uniformity through regulation • Development of a particular parcel or lot • Emphasis on building and lot aesthetics • Tends to prohibit development deemed inappropriate or unattractive 	<ul style="list-style-type: none"> • Place-based • Focus on creating livable communities through a mixture of compatible uses • Development of a community through individual buildings and streetscapes • Emphasis on streetscape and holistic integration • Tends to articulate desired urban form and encourage interactive design elements

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Figure 2-2. Rendering of a Complete Street in Hoboken, NJ (Source: New Jersey Future).

Another tool that supports smart growth is the movement for Complete Streets (see Figure 2-2), which advocates for design and operations strategies that improve safety and access for all people, including pedestrians, cyclists, motorists, and transit users, regardless of age, abilities, or transportation mode. The goal is to design transportation facilities to a human scale, instead of the turning dimensions of a large “design vehicle,” thereby calming motor vehicle traffic and safely accommodating all users.

Various operations and design techniques are used to achieve Complete Streets goals, including marked or protected bicycle lanes, reduced number and/or width of motor vehicle lanes, crosswalk treatments intended to improve pedestrian visibility and safety, and pavement markings or other treatments to facilitate safe transit operations. Proponents point to data suggesting that Complete Streets policies improve safety by reducing collision rates and the number and severity of injuries, encourage multimodal travel, and support local economies by improving property values and boosting local employment (Millard and Burnell 2014; Roth, Gillette, and Hart 2014; Hardy 2014; Smart Growth America 2015).

2.1.2 Goods and Services Transportation in Urban Environments

In smart growth environments, as in other types of communities, goods movement and service vehicles are necessary to support economic activity and a desirable quality of life. Trucks are an intrinsic part of this reality and support the operating efficiency of brick-and-mortar shops, e-commerce, construction, waste management, and many other necessary industries.

Freight-generating industries (e.g., manufacturing, wholesale trade, warehousing and distribution, and multimodal freight nodes) are often close to residential areas, especially in urban environments. However, growth pressures have displaced some freight-intensive businesses to more remote locations. These sectors are important to the national economy; in 2013, 12.1% of gross domestic product (GDP) in the United States was from manufacturing activity, 6% from wholesale trade, 5.8% from retail trade, and 2.9% from transportation and warehousing activities (BEA 2013). Additionally, at the start of 2015, about 12 million people were employed in manufacturing, 6 million in wholesale trade, nearly 16 million in retail trade, and nearly 5 million in transportation and warehousing (DOL/BLS 2015). Manufacturing, trade, and warehousing activities are not strictly legacy industries; some businesses within these sectors are attracted to smart growth communities. Examples of these businesses include artisanal food and goods production, restaurants and markets, breweries, and makerspaces. These businesses can flourish

in urban areas with a high supply of loft and warehousing space, which can be found in locations such as Brooklyn, NY, and Baltimore, MD.

Eliminating these facilities from the urban environment will redistribute job locations and tax revenue from central cities to suburban or rural fringes and can increase traffic and emissions associated with serving metropolitan customers from facilities farther afield. Moreover, if the freight-generating industries relocate to suburban or rural areas, they will also be further from their customers, as well as their employees. Goods movement can inflict negative environmental effects on neighbors, especially residential areas. Solutions that avoid or mitigate these effects while accommodating the economic and quality-of-life benefits that rely on goods and service vehicles movement will best serve the human, environmental, and economic aspects of sustainability and smart growth.

For this report, trucks are categorized into two groups: commercial vehicles and service vehicles. Commercial vehicles are used to carry goods and fare-paying passengers, including long-haul trucks, local delivery trucks/vans, garbage trucks, postal trucks, UPS trucks, and moving vans (see Figures 2-3 through 2-5). Service vehicles are vehicles used to transport employees, tools, equipment, and supplies to or from a job location, and include vehicles used by contractors, construction vehicles, emergency vehicles, and utility vehicles.



Figure 2-3. US Route 9 and Main Street, Tarrytown, NY (Source: Cambridge Systematics).



Figure 2-4. Warehouse delivery in Baltimore, MD (Source: Cambridge Systematics).



Figure 2-5. Construction services performed in Cincinnati, OH (Source: Cambridge Systematics).

Commercial/service vehicles traveling within, through, and next to communities typically fulfill one of three primary trip purposes:

1. **Traveling to or from a freight-generating facility in the midst of a smart growth community to deliver or pick up goods.** Communities with goals to incorporate smart growth principles in redevelopment plans are often situated near freight-generating or freight-handling facilities (e.g., a manufacturing facility, warehouse or distribution center, rail yard, or marine terminal). Trucks traveling to and from the freight-generating facility may have to travel through or pass the perimeter of smart growth communities and may use streets primarily designed for pedestrian, bicycle, and automobile traffic in the process. Those streets may also be lined with residential, retail, and/or entertainment or other uses that may be sensitive to noise, vibration, emissions, and other external effects of truck movement. Trucks waiting to enter the facility and idling vehicles create additional noise and air pollution, even though they are mostly stationary.
2. **Commercial vehicles delivering goods or services to businesses and residents in the smart growth community.** These commercial vehicles perform many duties (e.g., delivery to restaurants, retail establishments, businesses, and residents) and include waste collection vehicles, utility service vehicles, construction or renovation vehicles, and moving trucks. Many business establishments in smart growth environments are small retailers, restaurants, and other businesses that receive deliveries using small box trucks or delivery vans, and rarely, if ever, need to receive a tractor-trailer. Larger or national chain establishments (e.g., large chain supermarkets, hardware stores, and big-box retailers) are more likely to receive deliveries from a tractor-trailer that is delivering shipments to multiple store locations in a city or region. These vehicles must travel not only on the collector, arterial, and highway roadways, but sometimes on residential streets to get as close as possible to where services are needed. Curbside loading areas may be sufficient for businesses that receive shipments from box trucks or delivery vans, and for occasional deliveries from tractor-trailers. If businesses receive frequent deliveries from tractor-trailers, especially in busy commercial districts where curbside parking is heavily used, an off-street loading area or loading dock may be desired. Street and lane widths, turning radii, and parking and loading areas that can accommodate freight and services uses while supporting other road users are important to consider when planning for freight in smart growth environments.
3. **Commercial vehicles traveling on highways or major roadways that pass through or next to the smart growth community (see Figure 2-6).** Highways or arterial roadways



Figure 2-6. Trucks passing by neighborhoods in Los Angeles, CA (Source: Cambridge Systematics).

are often the primary access routes to or from nearby freight-generating facilities (e.g., clusters of manufacturing or warehousing, marine terminals, or rail yards or terminals). If alternate routes are not available for diverting trucks trips to or from these facilities, planners can use strategies to avoid or mitigate potential effects on the residents and businesses in the smart growth community. State highways pose a particular issue in that, while they are often the “main street” through smaller villages and towns, they may carry a large percentage of truck traffic, including potentially oversize and overweight shipments, because they also are often major freight routes. Design decisions for state highways may be made outside the local government agency responsible for making land use plans and site plan reviews (USEPA 2012).

For each of these three trip purposes, commercial and service vehicles may idle while waiting to complete a pickup or delivery.

2.1.3 Smart Growth Classifications

Smart growth strategies have been applied in communities of varying sizes throughout the United States and beyond. Six smart growth environments have been identified by the research team and affirmed by the literature review and interviews. Table 2-2 presents the current classification scheme, along with a list of key commercial/service vehicle and goods movement issues found in each class and examples of communities that possess the characteristics of the classification. The six smart growth environment classifications are as follows:

-  Industrial areas transitioning to housing and entertainment districts;
-  Working waterfronts transitioning to mixed-use and/or recreation;
-  Older commercial and neighborhood areas being revitalized;
-  Retrofitting aging commercial corridors;

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Greenfield new communities; and



Large-scale reconstruction.

Some classifications are more likely to be found in urban core areas, while others are more likely to be found in suburban or rural areas. A visualization tool commonly used to illustrate the gradient in development intensity from rural areas to urban areas is the rural-to-urban transect. The transect includes zones that range from undeveloped natural areas to urban cores, including rural, suburban, general urban, and urban center zones in between. It can serve as a

Table 2-2. Smart growth classifications.

Classification	Common Commercial/Service Vehicle and Goods Movement Issues to Consider	Examples
 1. Industrial areas transitioning to housing and entertainment districts	<ul style="list-style-type: none"> Continuing function of freight-dependent industry as roads are reconfigured to accommodate more people walking, driving, biking, and using transit. A decrease in industry will lessen its influence in design and function of the area. 	<ul style="list-style-type: none"> Brady Arts District, Tulsa, OK South Downtown, Los Angeles, CA Lower Downtown (LoDo), Denver, CO Inner Eastside, Portland, OR Harbor Point, Baltimore, MD Dogpatch, San Francisco, CA
 2. Working waterfronts transitioning to mixed-use and/or recreation	<ul style="list-style-type: none"> Addressing the competition for access to the waterfront for industrial versus recreational, residential, and entertainment purposes. 	<ul style="list-style-type: none"> MIZOD, Baltimore, MD Port of Seattle, Seattle, WA Ballard Neighborhood, Seattle, WA Port of Bridgeport, Bridgeport, CT Port of Portland/S Portland, Portland, ME Port of Boston/South Boston, Boston, MA
 3. Older commercial and neighborhood areas being revitalized	<ul style="list-style-type: none"> Existing prewar neighborhood could see growth in need for deliveries to new commercial enterprises. Concerns about noise, street design, and safety. 	<ul style="list-style-type: none"> Northeast, Portland, OR NoMa, Washington, DC Canton, Baltimore, MD Northwest, Portland, OR Main Street, Burlington, IA
 4. Retrofitting aging commercial corridors	<ul style="list-style-type: none"> Road diets, access management, conversion of parking lots to buildings may affect freight needs. Planning for continued through-movement while enhancing walkability. Deliveries to new restaurants, retail, and apartments. 	<ul style="list-style-type: none"> MLK Boulevard, Portland, OR Colfax Avenue, Denver, CO Long Beach Boulevard, Long Beach, CA Chicago (various corridors), IL Columbia Pike, Arlington, VA H Street, Washington, DC Raymond Avenue, Poughkeepsie, NY Glen Street (US 9), Glens Falls, NY
 5. Greenfield new communities	<ul style="list-style-type: none"> Planning at the beginning of a project to identify routes and access ways for all modes. Could include separate routes for freight and deliveries. 	<ul style="list-style-type: none"> Orenco Station, Portland, OR Daybreak, South Jordan, UT Celebration, FL Issaquah Highlands, WA
 6. Large-scale Reconstruction	<ul style="list-style-type: none"> Fitting into existing networks, often using aging malls, rail yards, and airports. 	<ul style="list-style-type: none"> "Gateway Mall" TOD, Salt Lake City, UT Stapleton airport redevelopment, Denver, CO Mueller airport, Austin, TX Ville Bois, Portland, OR Belmar, Lakewood, CO

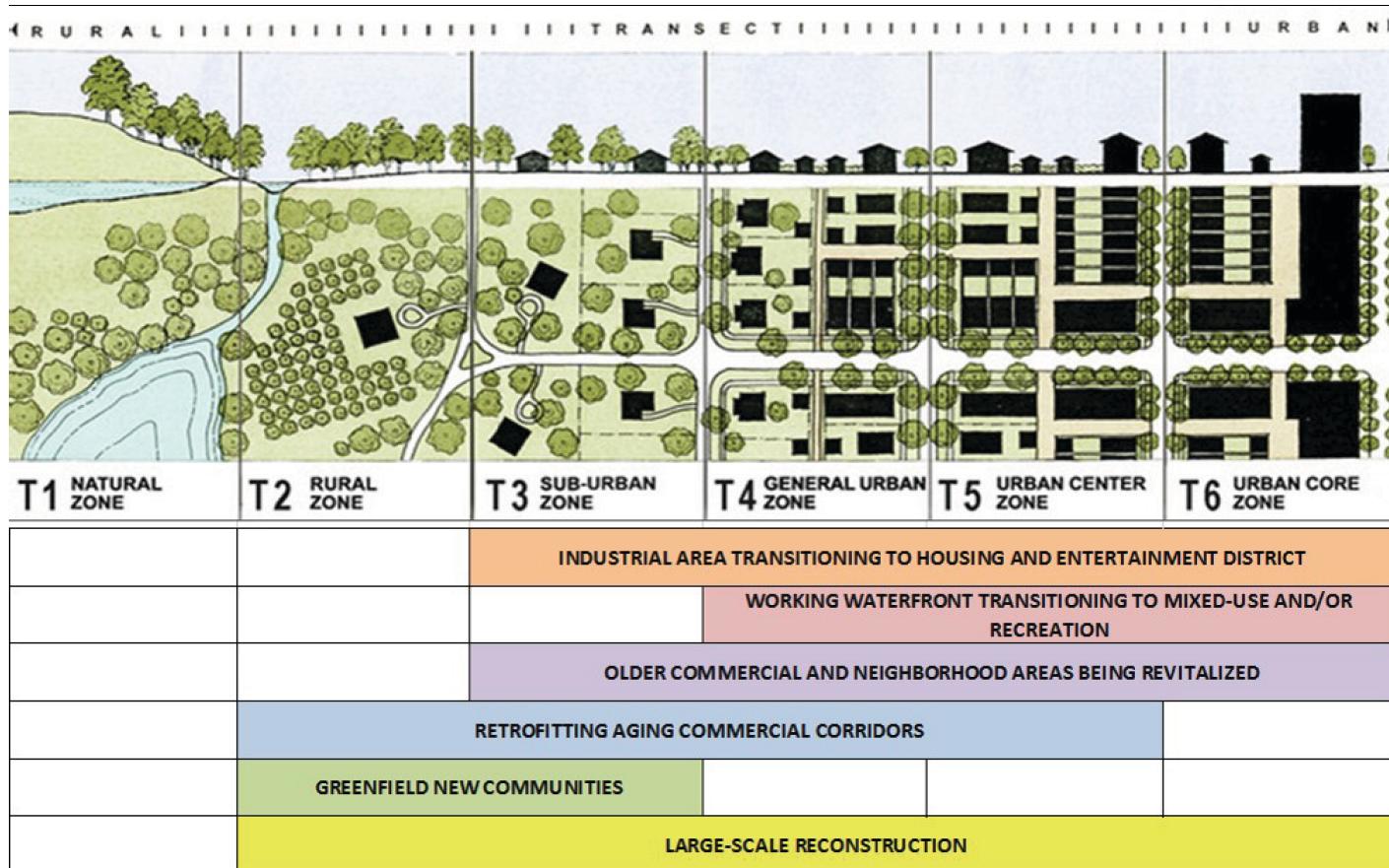


Figure 2-7. Relationship of each smart growth classification to the rural-to-urban transect (Source: Center for Applied Transect Studies, enhanced by Cambridge Systematics).

basis for FBC zoning that emphasizes neighborhood structure, walkable streets, and other smart growth principles (Center for Applied Transect Studies 2014). Figure 2-7 shows where each of the six smart growth environment classifications is in the rural-urban transect.

Industrial areas transitioning to housing and entertainment districts are most likely to be found in urban and suburban environments. Working waterfront areas that are transitioning to mixed-use are rarely found in the urban core zone, but are common in the urban center and general urban zones. Older commercial and neighborhood areas being revitalized are usually in urban center, general urban, and, in some cases, suburban zones. Commercial corridors are typically found outside the urban core and urban center zones, in the general urban, suburban, and occasionally in the rural zones. Greenfield new communities are almost always developed in the rural and suburban zones, because previously undeveloped land is rarely available in urban areas. Large-scale reconstructions typically occur in any of the three urban zones, but may be found in the T3 Suburban Zone as well.

Industrial Areas Transitioning to Housing and Entertainment Districts

Urban populations in the United States are growing as younger individuals, couples, and the older Baby Boomer generation, especially active empty-nesters, seek

Example: Dogpatch Neighborhood



The Dogpatch neighborhood in San Francisco, CA, is an industrial and commercial area with historic residential housing. It is undergoing a transition because waterfront space throughout the city is prime for redevelopment. The San Francisco Planning Department seeks to maintain the historical pattern of development by keeping businesses small, maintaining small-scale residential buildings, and restricting the capacity and ability to increase freight generation in the area. This strategy has helped preserve the off-beat character and working-class roots of Dogpatch, while supporting new types of businesses and maintaining a high quality of life for residents.

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to live in mixed-use, higher density environments. A 2012 study conducted by the American Planning Association (APA) found that 56% of millennials and 46% of active Baby Boomers would prefer to live in a walkable community rather than an area that requires driving to most places (APA 2014). This trend is creating demand for more residential and commercial space in cities, and, as a result, many industrial areas in the urban core are transitioning to residential and commercial uses. Older industrial sites occupy some of the prime locations in cities, especially along waterfronts and/or close to downtown districts that developers of residential and mixed-use communities desire. Smart growth principles (e.g., mixed-use development, pedestrian-scale design, compact buildings, and various transportation choices) are all viable in these locations. Complete Streets strategies that promote roadways designed to accommodate the needs of all users are also desirable.

Several issues are associated with transitioning industrial areas. For example, former industrial sites may contain contamination that requires mitigation prior to redevelopment. These sites, known as brownfields, can add significant delays and costs to the process. This shift of use also creates conflict between industrial and residential/commercial uses. For example, Figure 2-8 illustrates conflict between a residential building and a neighboring freight line. New industry cannot move to an urban area if the land is not zoned and available. Additionally, land with existing uses may experience price increases due to conversion of surrounding parcels. Finally, new development can be incompatible with existing freight uses. If an entire area undergoes this transition, remaining freight uses may be forced to relocate.

Smart growth solutions may also interfere with freight access in these types of neighborhoods. For example, Complete Streets treatments often include bulb outs, curb extensions, or other techniques meant to reduce vehicle travel speed and decrease the amount of space that pedestrians need to cross. If not designed correctly, such treatments can impede commercial/service vehicle turning movements or take away needed curbside unloading zones. The concerns of existing and potential freight generators must be considered when land use changes are proposed. The implementation of smart growth development need not hinder the ability of freight to exist and prosper in urban settings. In some areas, the tradeoff between restricting some freight access and increasing mobility for other modes may be accepted, because the



Figure 2-8. Recently developed residential buildings surround a cement plant in Dogpatch, San Francisco, CA (Source: Dave R. "Illinois Street 12-2015." Online image. Flickr. December 18, 2015. https://c2.staticflickr.com/1/598/23532496449_edeb98a01b_b.jpg).

benefits for other modes may outweigh increased costs to freight. Communities and freight providers must work together to determine how best to resolve this conflict.



Working Waterfronts Transitioning to Mixed-Use and/or Recreation

Waterfront real estate is valuable, not only to developers seeking to create smart growth environments but also to industries that require water access for transportation or manufacturing uses. Historically, industries positioned themselves along waterfronts to gain easy access to transportation. However, the dominant transportation modes have shifted from water to roadways and railways, and manufacturing has sharply declined throughout the United States since the mid-20th century. In many areas, this trend has led to industry leaving the waterfront, resulting in vacant parcels now targeted for redevelopment.

This transition is an opportunity to use adaptive reuse techniques. Rather than demolish old industrial structures to make way for new commercial or residential uses, adaptive reuse focuses on rehabilitating and converting older buildings to serve new purposes. This strategy helps maintain the aesthetics of historic waterfront districts, even if their function has expanded beyond strictly industrial uses. Figure 2-9 depicts the results of efforts to redevelop the waterfront district in Baltimore, MD, to accommodate tourism, entertainment, and other outdoor activities.

Similar to the first smart growth classification, the interaction of historic freight-generating uses with newer mixed-use or recreation activities can lead to conflict in waterfront districts. Repurposing land for its highest and best use is attractive to private developers, because residential and commercial properties typically generate higher land values than industrial uses. When residential, commercial, or recreational uses encroach on a waterfront industrial cluster, several issues can arise. For example, increasing land values and conflicts with new neighbors over noise, traffic, and other issues often create tension among users. This can result in the sale and relocation of industrial uses to locations where pressures are not present. The use of these vacated industrial parcels subsequently changes to residential or commercial, which increases the pressure on the remaining industrial uses. Incompatible uses adjacent to freight, street designs that do not accommodate freight use, and brownfield mitigation concerns are other potential issues that must be addressed.



Older Commercial and Neighborhood Areas Being Revitalized

Smart growth can improve commercial and neighborhood locations in need of development. Small commercial zones near residential neighborhoods stagnated in the 1960s and 1970s as decline brought on mass suburbanization and disinvestment in downtown communities. Many of these pre-war neighborhoods are being revitalized because they were built in a form that lends itself to the principles of smart growth. Indeed, one of the principles listed by the EPA is to “strengthen and direct development toward existing communities.” The compact nature of these areas also makes them attractive for transit expansion due to their dense, mixed-use environment, which also fulfills a smart growth principle.



Example: MIZOD

The City of Baltimore instituted the Maritime Industrial Zone Overlay District (MIZOD) to preserve existing industrial uses near the Inner Harbor in the face of demand for conversion to commercial and residential properties. This zoning protects waterfront land with deep-water drafts from nonindustrial development, while allowing areas outside of MIZOD to transition to residential or commercial use. Domino Sugar is cited as an industrial tenant successfully retained in Baltimore Harbor, partially due to MIZOD. Thought it has been found that the tax base benefit resulting from residential redevelopment may not be substantial enough to make up for the lost industrial and revenue-generating land, the district's expiration date was extended from 2014 to 2024 (APA 2014). Despite MIZOD's shortcomings, it has helped retain the Port's businesses and industrial facilities while allowing for the development of premium housing and waterfront condos.



Example: NoMA

Revitalized due to its excellent transportation options and access to downtown Washington, DC, NoMA (North of Massachusetts Avenue) has seen an explosion of new residences and office buildings congregating near an infill transit stop. It was developed with financial contributions from the Federal and DC governments and with significant input from the private sector. The area is roughly 50% built out with room to grow. Adaptive reuse is a key concern in order to retain the look and function of older industrial buildings. There is also a freight rail corridor in the neighborhood that may create conflict as the area builds out. It is crucial for planners to monitor NoMA's growth potential while preserving its original character and managing freight uses appropriately to foster a high quality of life for residents.

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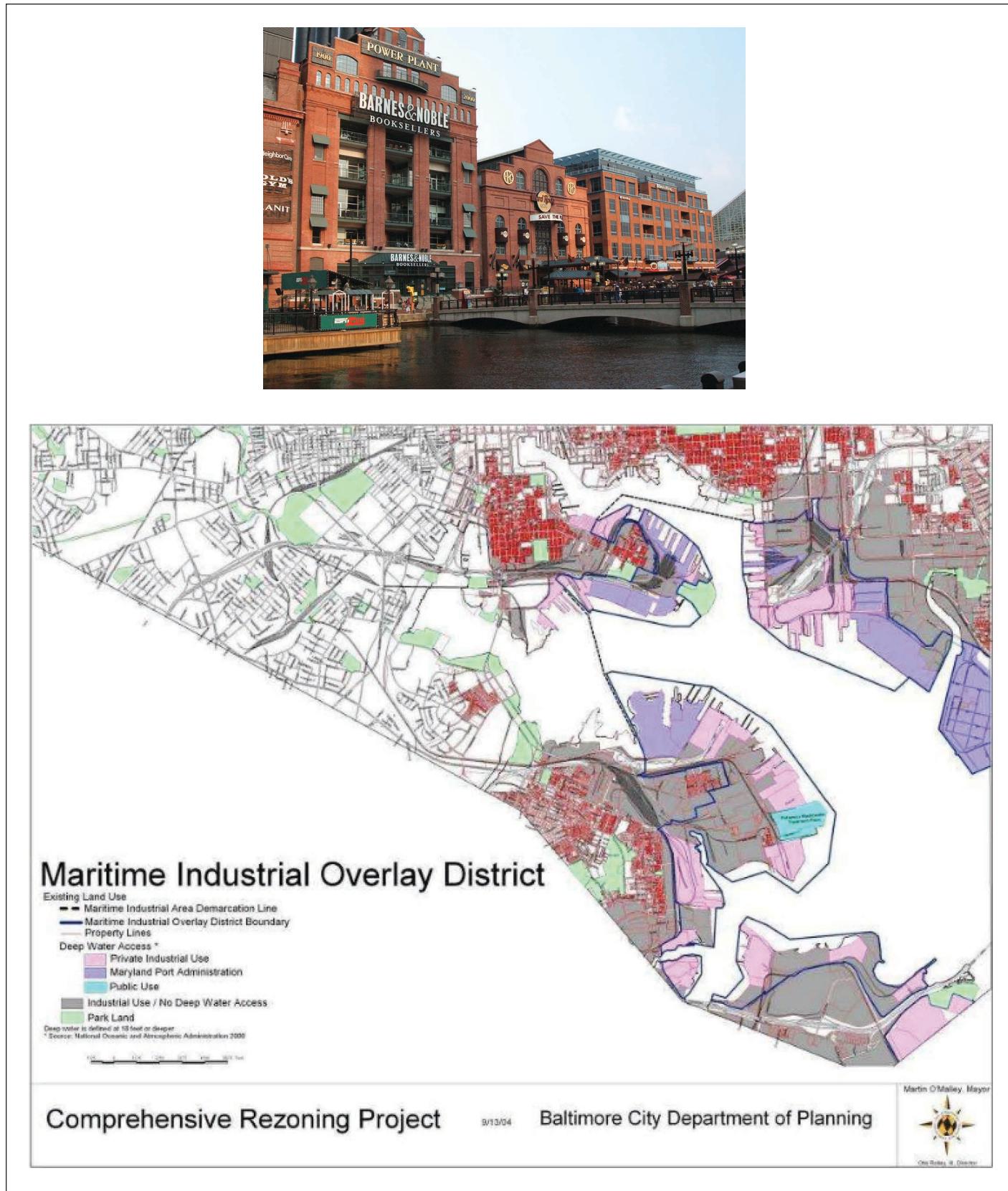


Figure 2-9. Waterfront View and Maritime Industrial Overlay District from Baltimore City Department of Planning (Source: [top] Cameron Rogers. "Baltimore Waterfront." Online image. August 5, 2005. <https://www.flickr.com/photos/dumbyyellowdog/272738592>. [bottom] Baltimore City Planning and the Waterfront Center).



Figure 2-10. *Infill development, REI community space in NoMa, Washington, DC (Source: Ted Eytan. "REI Community Space at Noma." Online image. August 4, 2015. https://c3.staticflickr.com/1/456/20472252106_6577607d6a_b.jpg).*

Much of the development occurring in these communities is considered “infill,” which aims to use land within developed areas for construction or redevelopment, instead of looking for larger undeveloped tracts, helping to fill in the gaps of the dense, vibrant, and distinctive neighborhoods that developed prior to World War II (see Figure 2-10). Infill development is also critical to raising home values, because a single dilapidated structure or vacant property on a dense street can reduce values for all.

As these urban neighborhoods are rejuvenated and repopulated, freight demand rises. Newly reopened storefronts must receive deliveries of goods to sell, restaurants must receive food and beverage deliveries, and new residents receive shipments of goods ordered online. Freight conflicts can exist in older commercial and neighborhood areas as a result of the increased commercial vehicle traffic. If road capacity, parking availability, and pedestrian safety are not evaluated prior to expansion, the additional commercial vehicles can overwhelm smaller communities. Furthermore, e-commerce is continuing to grow in the United States and requires direct delivery to customers, who are typically in residential areas. If these compact neighborhoods attract new residents, the number of delivery trips is likely to rise as businesses continue to expand their online shopping capabilities. Commercial or service vehicles in these areas can generate noise and emissions. Also, the design of many streets in older neighborhoods may predate the automobile and may not safely accommodate trucks, especially large tractor-trailers. This issue can be mitigated by the use of smaller delivery vehicles and non-motorized vehicles, such as cargo cycles, or by delivering shipments to a centralized delivery center.



Retrofitting Aging Commercial Corridors

Two types of aging commercial corridors are candidates for smart growth policies. The first type is a commercial strip (in an urban setting) that failed as population shifted to suburban areas. The development of malls and shopping centers outside of cities contributed to this decline, because people could fulfill all of their shopping needs at a single location instead of relying

Example: Harrisonburg

Harrisonburg, in the Shenandoah Valley of Virginia, has approximately 49,000 residents and is at the crossroads of US 11 and US 33. Downtown revitalization began in 2002 during discussions about creating a pedestrian mall. Ultimately, Main Street remained open to traffic, but investment has bolstered the downtown core. The city has adopted and is implementing new streetscape designs and has adopted a truck route system to move through trucks around the downtown core. As a result of its efforts, the city of Harrisonburg was awarded the Great American Main Street Award in 2014 for its success in boosting downtown housing, redeveloping historic buildings, and creating economic incentives for local businesses (*Envision Freight 2015*). The city has benefited economically while fostering livability for residents.



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on multiple, smaller vendors. The completion of the Interstate Highway System also hurt these areas, because drivers could bypass busy routes entirely, thereby decreasing traffic near local businesses. Denver's Colfax Avenue is an example of this phenomenon. Colfax Avenue was a bustling commercial corridor for years until the completion of I-70, which diverted most road traffic off Colfax and led to lost businesses and abandoned properties.

The second type of aging commercial corridor reflects the opposite situation. In some parts of the country, population has begun to shift from suburban communities back to urban communities, which has prompted businesses to leave suburban strip malls in favor of downtown retail space. Abandoned strip mall structures are on large lots with ample parking, providing a redevelopment opportunity for revitalized shopping and entertainment in suburban smart growth communities.

Both types of commercial corridors present challenges for smart growth:

- The corridors are typically auto-centric, with limited accommodations for pedestrians, bicyclists, or transit users.
- These corridors often have large parking lots facing the street that disrupt compact design and walkability within the vicinity.
- The corridors were designed for a single commercial use without easy connections to other types of development.

Smart growth techniques that could fix these issues include road diets, conversion of commercial spaces into mixed-use development, and infill development of expansive parking areas see Figure 2-11. Technological developments can also help reduce the effects of this type of land use. For example, streetlights can use solar power and reduce light pollution; reflective asphalt and concrete can reduce heat islands and glare from the sun; and concrete blended with other materials can absorb nitrogen oxide from the environment and reduce air pollution.

Similar to previous classifications, redevelopment of a commercial area may lead to increased commercial vehicle traffic as new stores, restaurants, and businesses grow. Designs for street diets and access management plans, which limit the number of access points from roadways to parking areas, can create conflicts for commercial or service vehicles if specific needs such as congestion, geometry issues, and sight restrictions are not considered. This becomes



Figure 2-11. Retrofitted commercial corridor in Cathedral City, CA (Source: Freedman Tung + Sasaki Urban Design).

an even more acute issue if the route is a major freight corridor and/or part of the oversize/overweight network, where access for larger commercial vehicles must be maintained.



Greenfield New Communities

Smart growth construction is not limited to previously occupied areas. Greenfields—areas that have not been previously developed in any way—can be the site of new master-planned communities. Development in greenfield environments, however, represents an expansion of the urbanized area, contributing to sprawl and associated environmental issues. Development of greenfields may not be desired in many regions, but when and where appropriate, the development can and ought to adhere to the tenets of smart growth. These sites can be designed to incorporate smart growth principles in brand new developments with multiple transportation choices, a mix of land uses, a strong sense of place, and a range of living options, while preserving and providing easy access to open space. One advantage that this type of development enjoys compared to redevelopment of already-developed areas is a lack of constraints imposed by existing structures or land uses. There are also no issues with contaminants in the land or soil. Developers can take advantage of this flexibility to design locations to allow easier access for freight than might be possible at other sites. For example, they can include adequate entrance/egress, loading and parking areas, and access management. They can also group freight-reliant uses in a specific area and design access streets in those corridors or zones to accommodate freight while other streets can provide bicycle, pedestrian, or transit access.

Although greenfield new communities typically do not include industrial uses, commercial and residential establishments will still require freight services. Plans at the beginning of the development should include access to and routes for freight deliveries to all types of land-users. Unlike in already developed zones, these planned communities can separate freight traffic from other forms of transportation, either by creating separate streets or alleys, or through distribution centers or other techniques

Example: Orenco Station



Orenco Station (see Figure 2-12) in Hillsboro, OR, is a transit-oriented master-planned neighborhood on the formerly vacant site of the Oregon Nursery Company. The community was able to come to fruition due to the planning and development of the light rail extension to the area. The suburban location has significant levels of transit use and a mix of residential and commercial property on 209 acres of land. Smart growth principles enacted on this site include zoning requirements that foster a pedestrian-friendly environment and maintain many architectural features of the former company town, resulting in a distinct neighborhood with character. There are many successful businesses in the downtown, and ensuring efficient freight deliveries is key to remaining successful with minimal disruptions to health and public safety. In the years following its development, Orenco Station has supported a mix of residential units, high levels of pedestrian safety and walkability, and various small businesses. It is a prime example of a community that balances the needs of business and residents (*National Trust for Historic Preservation 2014*).



Figure 2-12. Streetscaping in Orenco Station, OR, a greenfield new community (Source: Cambridge Systematics).

Example: Stapleton Airport

After flights ceased in 1995, Stapleton Airport transitioned to a mixed use neighborhood that has grown rapidly, with plans to be fully operational in 2016. Integrated into Denver's existing street pattern, this community has residential, commercial, and light industrial uses designed at the human scale with sustainability as a core principle. However, some homes are outside the ideal quarter-mile range of shopping, transit, and schools, resulting in less walkability. There are also several chain retailers in the development. It is critical to reconcile between the freight needs at Big Box retailers and the pedestrian-oriented development goals of the overall community. However, Stapleton planners have been proactive in creating bicycle trails and transportation alternatives, such as bus and light rail service, to establish a strong transportation network. Once fully built out, Stapleton is expected to generate less traffic than the former airport. Even with Big Box retailers, the development will allow for safe and effective foot traffic (Leccese 2005).



that limit large truck access but still allow freight to move via other modes. Connections to the wider freight transportation network must be considered as well. However, communities must not become “islands” separated from other development where freight deliveries could become prohibitively expensive.

**Large-Scale Reconstruction**

Some large-scale sites present the opportunity for a master-planned community adjacent to an already developed area. Examples of this include large shopping malls, old military bases, railyards, and defunct airports. Smart growth principles similar to the new greenfield communities can be incorporated into the design, given the large size of the site, but developers can establish better connectivity with the urban environment in a large-scale reconstruction setting. Most reconstructions of this nature include transit-oriented development (TOD), a mix of uses, design for the pedestrian scale, and a wide range of housing choices. The potential for contamination from previous uses (e.g., fuel leaks at an airport site) are a potential problem in this type of smart growth classification and must be mitigated or resolved prior to the introduction of new communities.

Similar to the greenfield developments discussed above, these planned communities should incorporate freight concerns in their design. Because they are more likely to be near existing development, they may include industrial uses in the community or adjacent areas. This adds a freight-generating dimension that may not be present in the greenfield sites. Site design guidelines, buffering requirements, and extensive contact between potential businesses and other uses such as “good neighbor policies” will help mitigate issues. Good neighbor policies encourage increasing communication to make sure the needs of both freight users and residents are acknowledged, promoting hiring within the community, attending public outreach events, and other communication strategies. Good neighbor policies can also include potential operational changes or mitigation strategies by the freight user to reduce complaints from neighbors and other issues. Operational changes can include drapes to conceal light at loading docks, separate power supplies to provide cooling without running the engine on a truck, or alternative fueled vehicles for trucks that enter/exit a facility frequently (Strauss-Wieder 2003).

2.2 Stakeholders, Relationships, and Opportunities for Coordination

A broad range of public- and private-sector stakeholders are involved in planning, designing, building, and managing day-to-day transportation operations in smart growth environments. Although municipalities retain most of the authority governing land use planning and zoning, other stakeholders can be involved and influence those activities. The balance of this section describes the organizations involved and, in general, the activities in which they can play leading or supporting roles in integrating goods and services movement in smart growth environments. Although conflicts can arise among stakeholders during planning, smart growth advocates and freight stakeholders share goals. Figure 2-13 lists these mutual goals, which can help foster better coordination and conflict resolution. Although both groups ultimately support both goals,



Figure 2-13. Common goals for smart growth advocates and freight stakeholders
(Source: Cambridge Systematics).

some of these goals may have a natural tension with each other (e.g., increasing access and improving safety).

Ultimately, integration gives freight and service vehicles the access and room to operate that they need to do their business. In turn, this ensures that the community receives needed services and goods. When integration is done well, the negative effects of freight can be minimized, if not eliminated entirely.

2.2.1 Municipal Departments or Agencies

The relevant municipal agencies include municipal planning departments and/or planning boards, transportation and/or public works departments, and municipal economic development agencies. Table 2-3 lists activities that these agencies can lead or participate in to foster goods and services movement and smart growth.

Table 2-3. Municipal departments or agencies—activities and roles.

Activity	Role	Role Description
Municipal Land Use Planning	Lead	Conduct comprehensive plans that assess land use, transportation, economic development, environmental, and community issues and needs. The comprehensive plan may establish a smart growth vision for the community and identify transportation needs.
Corridor or Subarea Plans	Lead or support	Lead and/or participate in regional or local corridor or subarea plans, which may advance smart growth principles and address goods movement issues.
Zoning	Lead	Establish and enforce zoning to help determine use and/or form.
Site Plan Review	Lead	Review development proposals for conformity with zoning requirements.
Parking Management	Lead	Manage curbside and off-street parking facilities, especially in urban core or commercial districts. Establish and enforce commercial vehicle parking and loading areas.
Designing and Managing Local Streets	Lead	Design, build, and maintain municipal streets. Implement Complete Streets treatments, traffic-calming treatments, and traffic control devices on these streets. Control speed limits to enhance safety.
Community Issues	Lead	Field complaints from residents, community groups, and/or elected officials regarding environmental and community impacts associated with goods movement and deliveries. Process this feedback to shape changes to zoning, traffic operations, and other municipal functions.
Urban Renewal Agencies	Support	Play a role in urban renewal agencies, which can be funding sources for redevelopment.

2.2.2 Regional and State Transportation and Planning Agencies

The relevant regional and state agencies include state departments of transportation (DOTs), state planning agencies (where they exist), metropolitan planning organizations (MPOs), regional planning organizations (RPOs), councils of governments (COGs), state environmental agencies, state energy agencies, and state and regional economic development agencies. These regional and state agencies bring stakeholders together across a large jurisdiction to develop the economic development and transportation policies and infrastructure. These activities are, on the one hand, building a state or regional strategy from the bottom up by aggregating the activities, needs, and desires of the constituencies within the state or region. On the other hand, the state and regional strategies help to establish a context for smart growth development at the local level and explore the relationships that local land use decisions have with those of neighboring communities and regional priorities. Table 2-4 lists activities that these agencies can lead or participate in to foster goods and services movement and smart growth.

2.2.3 Federal Agencies

Federal agencies such as the U.S. Department of Transportation (US DOT), U.S. Environmental Protection Agency (USEPA), U.S. Department of Energy (US DOE), Federal Motor Carrier Safety Administration (FMCSA), and U.S. Army Corps of Engineers (USACE) have regulatory and/or advisory roles in the state, regional, and municipal planning. Further, these

Table 2-4. State and regional agencies—activities and roles.

Activity	Role	Role Description
State and Regional Freight Plans	Lead	Link regional freight access/mobility issues and local land use strategies. Use planning process as a forum for engaging municipalities and the private sector. Identify statewide and regional commercial motor vehicle needs.
Corridor or Subarea Plans	Lead, support, and/or fund	Lead a corridor plan for a state highway (State DOTs and MPOs). Fund and/or participate in an advisory role in regional or local corridor or subarea plans, which may advance smart growth principles and address goods movement issues. Help determine design criteria and flexibility (State DOTs).
TIP and STIP Project Selection	Lead	Develop selection criteria that may include smart growth, complete streets, freight considerations/accommodation, or other objectives.
Funding Programs	Lead	Develop and manage sustainable development or “livable communities” planning and implementation grants. Programs can emphasize freight through selection criteria or implementation guidance. States also administer Congestion Mitigation and Air Quality (CMAQ) and other similar Federal funding programs, which can help reconcile freight and residential uses.
Transportation Demand Management	Lead	Implement and oversee transportation demand management programs to reduce the demand for roadway travel, particularly for single-occupancy vehicles, which helps support smart growth development (State agencies—either transportation or environmental).
Municipal Planning and Zoning	Support	Provide technical assistance (through workshops or training, data, and model ordinances) to help municipalities implement strategies.
Private Development	Support	Establish partnerships or agreements with private entities to encourage smart growth and address freight access issues.
Private Freight Operations	Support	Establish partnerships or agreements (with private freight companies) to manage travel demand during peak periods and reduce environmental and community impacts.
Education/Outreach	Lead	Provide forums for stakeholder information exchange and collaboration via standing committees, annual conferences or summits, guidelines and education materials, etc.
Energy Consumption	Lead	Plan for and fund alternative fuel and shore power systems.
Information and Technology	Lead	Lead development of Intelligent Transportation Systems (ITS) to improve data collection and distribution to private-sector carriers so as to improve truck operations and limit the negative impacts of trucks (typically, State DOTs). For example, during an emergency road closure, variable message signs that provide truck routing can help keep trucks from using inappropriate roadways. Similarly, improved data collection by DOTs and MPOs can help communities better integrate future freight needs with desired growth patterns.

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agencies offer incentive programs that encourage private-sector carriers and shippers to adopt strategies that reduce emissions and other environmental and community impacts. Table 2-5 lists some of the roles that federal agencies perform that could facilitate integration of goods and services movement in smart growth environments.

2.2.4 Private Developers and Financiers

Private developers are often the stakeholders who design and build buildings or whole communities that employ smart growth principles. Sometimes the developers take cues from local zoning requirements that encourage smart growth. Often, the developers recognize market demand for smart growth development and push the municipality to allow the implementation of elements that run contrary to zoning. Table 2-6 lists the roles of these stakeholders.

2.2.5 Shippers, Carriers, and Logistics Companies

Private shippers, carriers, and logistics companies are involved in moving goods and services among locations where raw materials are extracted, locations where finished goods are manufactured, and the distribution and retail facilities that connect the goods with consumers and users. Carriers include trucking companies, railroads, shipping lines, and airlines that move goods and services. Shippers send and receive shipments and include neighborhood shops and restaurants, national retail chains, and manufacturers. Shippers may be represented by national industry associations or local chambers of commerce. Logistics companies manage the flow

Table 2-5. Federal agencies—activities and roles.

Activity	Role	Role Description
Emissions Standards	Lead	US EPA establishes emissions standards in order to reduce emissions from trucks and other sources over time.
Energy Consumption	Lead	US DOE's Clean Cities program aims to cut petroleum use in transportation. The effort supports reduced dependence on petroleum at all levels of government, using partnerships, publications, tools, and other resources to achieve this goal.
Incentive Programs	Lead	Incentivize reductions of emissions and other environmental and community impacts through grants and loans to the private sector.
State and Regional Freight Plans	Support	Provide guidelines for state and regional freight and transportation plans, data, and technical assistance. US DOT and FHWA also have a role in design criteria on the National Highway System (NHS).
TIP and STIP Project Selection	Support	Provide guidelines, data, and technical assistance to state and regional agencies.
Regulatory	Lead	Federal Motor Carrier Safety Administration (FMCSA) controls motor carrier safety regulations and promulgates and enforces rules that improve truck safety and reduce the effect of trucks on the surrounding community. FMCSA will be involved with developing rules for alternative delivery vehicles (e.g., Uber or Lyft) and the introduction of autonomous or semi-autonomous vehicles.

Table 2-6. Private developers and financiers—activities and roles.

Activity	Role	Role Description
Development Proposals and Design	Lead	Incorporate smart growth principles and anticipate commercial vehicle needs in development proposals and design.
Site Plan Review	Participant	Submit site plans for review to municipal agencies (developers). In many cases, the requirements and standards are uniform throughout a municipality and allow a developer little flexibility. Developers with control over large planned-unit developments and/or long-standing, collaborative relationships with municipal agencies may be able to pilot more innovative design elements, with conditions.
Municipal Zoning	Support	Design and develop buildings and/or whole communities that employ smart growth principles, as required by zoning. Often, however, developers push the municipalities to accept smart growth elements in a proposed design; such elements may run counter to standing (albeit often outdated) zoning codes.

of materials among shippers using combinations of carriers. In many instances, especially with national or multinational retailers, the functions of shippers, carriers, and/or logistics management are integrated. Table 2-7 lists the roles of these companies in integrating goods and services movement in smart growth environments.

2.2.6 Community Groups

Community groups represent the interests of the residents of a neighborhood. These groups include neighborhood associations, community boards, and homeowners associations. These are the stakeholders who often alert government agencies to adverse effects of commercial or service vehicle movements in their communities. Table 2-8 lists the roles such community groups play.

Table 2-7. Shippers, carriers, and logistics companies—activities and roles.

Activity	Role	Role Description
Operational Efficiency & Safety	Lead	Analyze operations and implement strategies to improve safety and operational efficiency while reducing community and environmental effects.
Technology Solutions	Lead	Implement technology solutions to reduce emissions (using federal and state grants or loan assistance) and improve operational efficiency.
State and Regional Freight Plans	Support	Participate in advisory committees, outreach, or draft reviews to offer perspective on industry needs and trends.
Corridor or Subarea Plans	Support	Participate in advisory committees, outreach, or draft reviews to offer perspective on industry needs and trends.
Zoning	Support	Provide input on loading zone and loading dock design and access issues.

Table 2-8. Community groups—activities and roles.

Activity	Role	Role Description
Municipal Plans	Support	Participate in public meetings, community group briefings, and other forums to provide planners with community concerns and priorities and to suggest solutions.
Corridor or Subarea Plans	Support	Participate in public meetings, community group briefings, and other forums to provide planners with community concerns and priorities and to suggest solutions.
Zoning	Support	Provide planners with community concerns and priorities and to suggest solutions.
Freight Operations	Support	Raise concerns regarding noise, emissions, or other external impacts to companies and public agencies.

2.3 Best Practices and Conflicts

The key conflicts identified in the research throughout the classifications tend to occur in one of four major phases: stage setting, creating places and streets, operation with minimal effects, and ongoing monitoring. The primary problems, issues, needs, and potential solutions pertaining to each phase are described below.

1. **Stage Setting.** This phase requires appropriate and coordinated land use planning at the local, regional, and, sometimes, state level. When local comprehensive plans and zoning ordinances result in clusters of incompatible land uses, the prosperity of the area can be harmed. To set the stage for smart growth, planners must identify land uses that are compatible and buffer land uses that are fundamentally incompatible. However, in older communities with established infrastructure and legacy zoning ordinances, revitalization can introduce new uses or intensities and associated conflicts without opportunities to include appropriate buffers. Examples of conflicts follow:

- **Encroachment on existing or planned industrial areas and transportation corridors.** Mixed-use, walkable neighborhoods can result in residential and commercial properties near industrial uses. There are various implications of this particular blend of neighboring uses. Combined with increases in the price of renting or acquiring land, freight-generating users can be pushed to the periphery of these urban areas or be blocked from entering the market entirely. This phenomenon, known as freight sprawl, can result in negative consequences for communities, such as longer trips for trucks delivering to urban customers, increased congestion, and associated environmental and transportation costs. In addition, freight sprawl can make it more difficult for employees to get to work, particularly by public transit, and can also result in the relocation of high-paying jobs away from population centers (Mehaffy 2001, Strauss-Wieder 2003, Rouse 2014, Baker 2014, Coes No Date).
- **Zoning to plan for successful freight activity.** Another source of conflict arises when planners do not explicitly integrate industrial or freight activity in communities. In many cases, planners may not zone sufficient land for industrial and other freight-generating uses and so fail to provide transportation system access, utilities, and other needs for these businesses. Without adequate freight-specific resources, companies may seek to use other land to meet their needs, creating a potentially negative effect on neighboring land uses (Leccese 2005, Rhodes et al. 2012). In areas using form-based codes (FBC), planners should ensure that the code does not accidentally exclude freight uses. For example, restricting the width or

height of doors or other building openings could eliminate some industrial uses that require space to move larger goods into and out of buildings.

2. **Creating Places and Streets.** This phase of smart growth planning is a continuation of designating appropriate land uses. It is typically led by local planners, state DOTs (when a state highway is involved), and private developers creating buildings and private streets. This phase primarily concentrates on the methods for designing streets and public places that help support key smart growth principles. Issues arising during urban design, site planning, and streetscaping can be mitigated through zoning and subdivision or development regulations and during the site plan review. This phase is particularly important because design elements can affect how users interact within a smart growth community, and municipalities can have a strong hand in ensuring the right design elements and zoning ordinances shape the community to safely accommodate freight. Examples of conflicts follow:
 - **Truck noise.** Noise from truck movement, idling, loading, and unloading can be difficult for residents to tolerate, especially during the off hours. Exposure to noise has been shown to cause hypertension, sleep disturbances, and increased aggression. Excessive noise has also been linked to an increase in the use of antacids, hypnotics, and sedatives. Trucks can be disproportionately noisy; one diesel bus or heavy truck can produce the noise equivalent of over 32 automobiles (Edmonton Trolley Coalition 2015). When loading docks and garbage disposal sites in a mixed-use development are immediately next to residential units, residents suffer from truck noise at all hours of the night, affecting their health and well-being within the community. In light of these issues, regulatory and marketplace pressures may cause carriers to use electric bicycles for short-distance deliveries.
 - **Lack of buffering near housing.** Without proper buffering between residential and industrial uses, freight activity is more likely to spill into surrounding areas. Residents may notice frequent and/or fast-moving truck movement and feel more unsafe walking, bicycling, and navigating their neighborhood. If new housing or mixed-use units are developed near existing freight uses or rights-of-way without sufficient buffering from existing uses, residents may complain about excessive truck activity or threats to pedestrian safety.
 - **Street and intersection design and commercial vehicle access.** Providing access for large trucks and other commercial vehicles in communities is a contentious issue. Although it is not appropriate to design every street to accommodate a tractor with a 53-ft-long trailer, smaller box trucks and emergency vehicles need to be able to access areas where retail, restaurant, industrial, and institutional freight customers are located. Realistically, smart growth communities depend on freight deliveries to maintain a high quality of life. Most importantly, pedestrian safety and commercial vehicle access are not mutually exclusive goals. Traffic-calming treatments (e.g., cushioned humps, speed tables, and rumble strips) can reduce vehicle travel speeds and enhance drivers' awareness of pedestrians and cyclists, without "designing out" delivery vans or emergency service vehicles from streets and roads where they are needed (Project for Public Spaces 2016). Some intersections can be designed with traversable aprons, which provide additional width around the perimeter of the central island for larger vehicles. They are often used on roundabouts and occasionally on the corners of traditional four-way intersections to allow trucks, buses, and emergency vehicles to complete tight turns.
 - **On-street loading.** The supply of available curbside space for truck parking and loading/unloading is often not sufficient, although providing it for drivers can help make deliveries more efficient and keep trucks from blocking travel lanes. This lack of supply may be due to insufficient spaces, illegal use of space by non-commercial vehicles, or extended use by commercial vehicles serving a location but not loading or unloading. In addition, the



Figure 2-14. Alley in San Francisco, CA (Source: National Association of City Transportation Officials).

height of the curb can cause issues for commercial vehicles making a curbside delivery. Low curbs are generally preferred for Americans with Disabilities Act (ADA) access, as well as drivers using delivery carts, while high curbs can make access more difficult for all users. Commercial vehicle operators often accept that they will be ticketed for illegal parking, and it is often factored in as part of the cost of doing business, which is typically passed on to consumers (Hardy 2014). However, illegal parking can create hazardous conditions for users, particularly bicyclists and pedestrians, making them more likely to be injured. Strategies to reduce illegal parking include marked loading zones, protected bicycle lanes, and sidewalk barriers to allow trucks to unload while protecting pedestrians (see Figures 2-14 and 2-15). Technology advances may result in more innovative solutions (e.g., allowing trucks to reserve and pay for a curbside loading spot). Truck parking reservations are available for some truck rest stops, but no U.S. municipality uses such a system to control curb parking. Addressing this issue and implementing a solution can help reduce negative effects on both carriers and residents.

3. **Operation with Minimal Impacts.** In addition to planning and designing spaces and streets, it is necessary to ensure that the operation of commercial vehicles in a smart growth environment occurs with minimal negative effects on the environment and quality of life in a community. Operational issues include commercial vehicles' contributions to peak-period congestion, parking and loading in inappropriate locations, and performing delivery or pickup during peak periods (which contributes to traffic congestion) or during late night hours (when many adjacent or nearby residents wish to sleep). Daily operations may be enhanced with additional policies, practices, and investment from both the public and private sectors. How the overall transportation system operates can either create conflict or be used to reduce conflict among goods movement and other priorities. Examples follow:
 - **Time of day.** Traffic flow fluctuates depending on the time of day. Deliveries during peak morning and evening rush-hour periods exacerbate traffic congestion. Truck operators must cope with unreliable pickup and delivery times. This ultimately results in higher costs of delivery to make up for the time lost as a result of congestion. When trucks make curbside deliveries, they move goods across sidewalks when many pedestrians are walking around—this inhibits flow and can reduce pedestrian safety. Deliveries made during nighttime hours may be less disruptive to the performance of the transportation system, but may require businesses to stay open to receive deliveries and can introduce noise



Figure 2-15. Protected bicycle lane in Vancouver vs- non-protected lane in New York City (Source: Paul Krueger via Flickr [top], Gregory H. via Flickr [bottom]).

and vibration nuisances during the hours many residents wish to sleep. New York City pioneered an off-hour pilot delivery program in 2009, which was well-received by both businesses and carriers, enabling more productive staff, faster deliveries, and significant cost savings. Additionally, there were no increases in noise complaints from neighboring residents. However, in other communities, the freight industry may need to be more sensitive to noise impacts.

- **Capacity.** Capacity can be measured both in terms of roadways and the freight rail system. Reaching capacity on the roadway system is often a result of congestion, which arises for several reasons, including the aforementioned time-of-day concerns. Competition for capacity on the rail system leads to conflicts between passenger and freight rail interests. In smart growth environments with passenger and freight rail service, increased passenger rail service can result in pressures to reduce freight operating windows. Although freight railroads own most rail lines in the United States, in shared-use corridors, passenger railroads and freight lines may have different priorities. There also may be different factors and performance targets for their service operations and different opinions over cost-sharing schemes to finance capacity expansion. Delays to passenger trains create delays and ripple

effects in other transit systems, while delays to freight trains can result in lost productivity and noise/air pollution from idling trains.

- **Emissions and air quality.** Diesel engine emissions have been shown to harm the natural environment and human health. Diesel fuel contains more than 40 toxic air contaminants, many of which are suspected cancer-causing substances. Although the prevalence of diesel-powered vehicles makes it nearly impossible to avoid exposure, people living in urban and industrial areas are more likely to be exposed to pollutants regularly (American Lung Association of California 2015). Natural gas is also a fossil fuel, but it creates less particulate matter (PM) and NO_x emissions than does diesel fuel. Even if freight operations are efficient, using outdated technology or fossil fuels in freight vehicles may harm residents in neighboring areas. However, emissions impacts can be minimized by awarding incentives to owners of freight-depending properties for using cleaner trucks and providing accommodations for engine shut-down during pickups and deliveries.
- **Lack of consensus about Complete Streets and freight movement.** Although some recent Complete Streets design guidelines [e.g., the National Association of City Transportation Officials' (NACTO) *Urban Street Design Guide* and the Institute of Transportation Engineers' (ITE) *Designing Walkable Urban Thoroughfares*] include consideration of freight in some contexts, in many of the ancillary or policy documents, freight needs are limited or absent (NACTO 2014, ITE 2014). Complete Streets advocates and freight or trucking interests disagree about various points. In particular, disagreement exists over designing turning radii and other elements of the street network to accommodate trucks hauling 53-ft-long trailers. Such trailers are the national standard for over-the-road trucking and are often used to deliver shipments to retail establishments and restaurants, especially to retail chain establishments. Some trucking companies argue that a shift to smaller urban delivery vehicles will require the use of more than one truck to make a delivery to a customer, resulting in increased freight transportation cost to customers. One 53-ft-long trailer can carry up to 30 standard 40-in-by-48-in pallets, while a 24-ft-long box truck can only carry up to 12 pallets, and a 12-ft-long van can only carry up to four pallets. Replacing one fully-loaded large truck trip with multiple small truck or delivery van trips, therefore, could allow freight to fit more easily into narrower street and intersection design and on-street loading capacity, but could also increase truck vehicle-miles traveled (VMT) and associated contributions to traffic congestion and emissions (Roth, Gillette, and Hart 2014; Rouse 2014; MacCleary 2014; Baker 2014; Holguin-Veras 2012).

This tradeoff is implied, but rarely discussed in detail in the literature presented by either smart growth advocates or freight/goods movement plans. For example, the *Urban Street Design Guide* offers that DL-23 delivery trucks can be a viable design vehicle for urban streets, but does not discuss the positive or negative effects of these vehicles (NACTO 2014).

4. **Ongoing Monitoring.** After foundational and operational elements are in place, active monitoring helps to ensure that freight practices improve, adapt, and align with national or global standards and evolving community needs. Even if the prior phases are completed and conflicts are addressed, issues can arise or reappear if there is no adequate monitoring. Public-sector transportation agencies can monitor the performance of the roadway network and assess the benefits or identify unintended consequences of design or operational features. Local agencies may field comments or complaints from local businesses or residents regarding commercial or service vehicle movement, parking, delivery, or other issues. Both the private and public sectors can have a role ensuring a consistent and positive outcome from accommodating freight in smart growth environments. Although freight activity tends to be driven by profit maximization within individual organizations, monitoring strategies can be used to mitigate or eliminate negative consequences.
 - **Evaluating performance.** Many public agencies and private stakeholders gather and analyze data and qualitative information on the performance of their respective infrastructure and

Table 2-9. Evaluating performance of integrated goods and services movement in smart growth environments.

Key Evaluation Questions	Categories of Data or References
Is the community safer?	<ul style="list-style-type: none"> • Crash type and severity data • Perceptions from police/EMS and residents
Are deliveries being made safely and efficiently?	<ul style="list-style-type: none"> • Traffic operations data (speed, delay, etc.) • Motor carrier and shipper data or qualitative assessment • Relative change in transportation cost relative to comparable markets
Are business establishments thriving?	<ul style="list-style-type: none"> • Lease rates and occupancy data • Employment and sales data
Are the environmental impacts reduced and quality of life enhanced?	<ul style="list-style-type: none"> • Air quality monitoring • Noise monitoring • Relative change in real estate sales or lease rates • Perceptions from stakeholders

operational systems. When places and streets are designed and operated to safely integrate goods and services movement with Complete Streets and other smart growth goals, it is important to understand whether the measures taken are effective. Table 2-9 lists questions to guide such an evaluation and general categories of data or information.

- **Divergent planning goals.** Planning goals can diverge over time—disparities between planners and government agencies can develop, innovation or updates to best practices may be lacking, changes can occur in local or regional priorities, and staff turnover may result in a loss of planning strategies and expertise. Smart growth policies that affect land use decisions generally occur at the local level, while freight transportation is often regional, national, or international in scope. Smart growth policies, when strategically applied, should help shape how freight operates. Local land use and development policies that do not accommodate the needs of freight can have negative repercussions that extend far beyond the area where the land use decision was made.

As conditions change and initial stakeholders move on, the original conditions that encouraged collaboration among freight and smart growth advocates can fade. For the public sector, turnover in staff or changing priorities or political views at the municipal or state level can erode the sense of accomplishment. In the private sector, financial considerations, competition, and staff changes can also create difficulties. Sustaining communication and re-evaluating goals based on changing needs is an ongoing challenge demonstrated in every case study in Chapter 4.

2.4 Goal-Setting and Mutual Benefits

Given the aforementioned freight conflicts, cooperation among public- and private-sector stakeholders is crucial so as to avoid, reduce, or mitigate such conflicts. Building cooperative relationships takes time, effort, and resources and does not always produce consistent progress. Progress can be facilitated by open and honest communication, which helps create trust among stakeholder groups. The four strategies presented below outline how stakeholders can come together, identify common goals, and work together to achieve their goals. This process is most difficult when groups of stakeholders are trying to work together for the first time. By using the four strategies in tandem, stakeholders can build relationships founded in trust, which can be transferred forward and facilitate cooperation in subsequent phases or future projects. Through this process, public- and private-sector stakeholders can work together to develop smart growth

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goals that yield economic, environmental, and social benefits while supporting safe and efficient freight transportation. The strategies identified later in this Guide depend on these types of cooperative relationships, and the case studies in Chapter 4 provide real-world examples.

- **Share knowledge.** Paramount among the strategies to foster cooperative relationships is open and honest communication and sharing of knowledge among stakeholder groups. Stakeholders who are unaccustomed to working together may be suspicious of the motives of others. Facilitating communication and knowledge sharing through events such as open houses, inviting representatives to speak at association meetings, and educational materials (e.g., brochures or online educational videos) can help agency staff, the private sector, and the public at large better understand how (1) commercial vehicle movements support the economy and quality of life and (2) those movements can impose negative effects on residents adjacent to freight facilities. A public agency (e.g., a municipal, regional, or state transportation or planning agency) can facilitate this sharing of information through standing committees, project committees, and special events (e.g., an “industry day” or a “sustainable neighborhoods day”) that are focused on communication and knowledge sharing across stakeholder groups.
- **Establish common objectives.** Although each set of stakeholders has its own set of goals for smart growth and freight management, there may be overlap among stakeholder groups. Recognizing where goals may be similar can help achieve faster outcomes with mutually beneficial results. For goals that do not completely overlap, there may also be commonalities among goals that can be more efficient to address simultaneously. Common interests, such as managing curbside parking and loading areas, or being “good neighbors” may lead to the identification of strategies that support the goals of more than one stakeholder group.
- **Prepare to compromise.** Stakeholders will benefit more in the long run from making compromises among their own goals or interests with those of other stakeholder groups. For example, public agencies can help strike a balance between stakeholders by establishing commercial vehicle loading zones available to commercial vehicles during morning hours, when demand for deliveries is greatest, and return that space to resident or visitor parking in the afternoon and evening hours when demand for those uses is greatest. Such a compromise results in the provision of parking supply for both groups, but that parking is not available to either group at all times.
- **Demonstrate results.** Being able to show that their involvement has contributed to a positive result is perhaps the most critical aspect of establishing and maintaining trust among a wide range of stakeholders. Implementing a solution may take longer than some stakeholders might hope. Compromise is often necessary, and adjustments to policies and procedures may be needed over time. However, by participating in this process, each stakeholder involved should recognize that, by working together, all parties can identify issues and common ground and implement workable solutions. This mindset establishes a trust in the process as well as the other stakeholder groups.



CHAPTER 3

Strategies for Supporting Goods Movement in Smart Growth Environments

This chapter provides a framework for planners and policymakers to assess a community's context, identify obstacles, and determine specific strategies to pursue in order to better support goods movement in smart growth environments. Section 3.1 discusses identifying a community's freight needs and potential hurdles to implementation. Section 3.2 presents a complete list of recommended strategies with links to each of the six smart growth classifications.

3.1 Needs Identification

It is crucial to establish a thorough understanding about the community, its primary problems, where it is in the smart growth development process, and potential obstacles that might arise during this development. It is not advisable to pursue specific strategies for supporting goods movement without full knowledge of the community context. Figure 3-1 can be used to help a community gain a complete understanding of its current situation. This diagram was developed to help planners and policymakers assess their smart growth environment, note the most significant issues, and understand potential obstacles that may arise. The structure of the diagram is as follows:

- **Establish context.** Without a full review of the smart growth community and its assets, it will be difficult to identify problems with freight and goods movement. The first step is to examine each aspect of the community's context and role in the national economy. The top eight elements are as follows:
 - **Smart growth classification.** Review Section 2.1.3 to learn about each of the six smart growth classifications identified in this Guide, all of which have been affirmed by a robust literature review and interviews with national experts on freight movement and smart growth. Each smart growth classification features a list of specific issues that often arise in that specific environment.
 - **Environment.** Consider existing infrastructure in the smart growth community and how humans interact with the built environment. Is there a full network of sidewalks with safe crossings? Are roads wide or narrow, and what are the speed limits? Do people seem to enjoy walking around the community? It is also important to consider the natural environment. Are there parks and open spaces that have been preserved? If yes, are they clean, safe, and well-maintained? If not, is there a need for public open space?
 - **Transportation users.** The existence of multiple transportation options is a key feature of smart growth planning. How do people tend to get around the community? What vehicles are people using?
 - **Freight.** Conduct an assessment of the perceived freight needs of the community. What are the main types of freight? How and where does that freight move? Is there freight rail

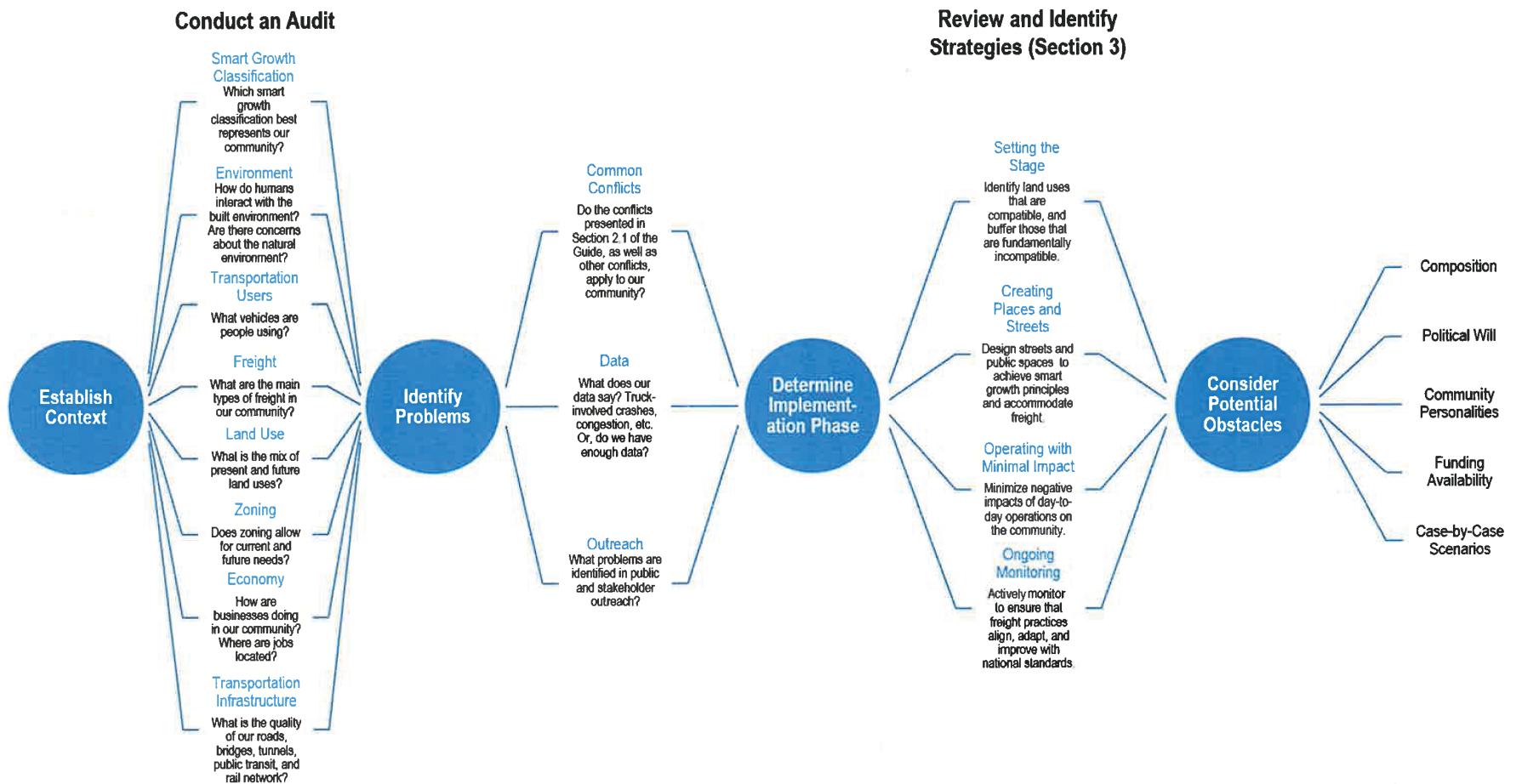


Figure 3-1. *Diagram to identify and assess community context, problems, and potential obstacles (Source: Cambridge Systematics).*

access in the community? Do certain corridors seem to have more truck flow than other corridors? There is also a difference between service vehicles and goods vehicles, as well as between through truck movement versus delivery needs. Most deliveries have short dwell times, whereas service vehicle may remain all day. Through trucks want to move fast while local trucks move more slowly and access flexibility is more important.

- **Land use.** Land use is an important part of successful integration of freight activity into a smart growth community. What is the mixture of present and future land uses in the community? Do any adjacent land uses appear to conflict? If so, what are they?
- **Zoning.** It is beneficial to review the community’s zoning code to see whether desired development is permitted. Does zoning allow for current and future needs? Do there appear to be inconsistencies or gaps in the zoning ordinances?
- **Economy.** Businesses are an important stakeholder in any goods movement plan. How are businesses doing in the community—do they appear to be struggling or thriving in different areas? In addition, determine where jobs are located.
- **Transportation infrastructure.** This evaluation extends beyond roads and sidewalks. What is the quality of the community’s roads, bridges, tunnels, public transportation, and rail network? What improvements are needed?
- **Identify problems.** After establishing the context of the smart growth community, the next step is to assess where problems may arise with freight movement. Types of problems to address follow:
 - **Common conflicts.** Section 2.1.3 details common issues for each of the six smart growth classifications. Review this section and consider whether any of the conflicts presented in this section apply to the community.
 - **Data.** Certain kinds of data can be useful in identifying problems with supporting freight in smart growth communities. What kind of data do planners and policymakers track? What does that data say about truck-involved crashes, congestion, businesses, and so forth? Problems may also arise from lack of data about certain aspects of transportation. Determine whether there is enough data available, or if resources are lacking.
 - **Outreach.** People—in this case, residents, businesses, and the freight industry—can often be the best way to identify problems with freight movement. Public meetings, town halls, and other forms of public and stakeholder outreach are effective ways to ensuring a complete understanding of freight issues throughout the community.
- **Determine implementation phase and identify strategies.** Once the main problems have been identified, determine in which phase of smart growth planning that they occur, and what types of solutions may be applied in the planning, design and construction, and operation of buildings, businesses, and streets in the community. The four phases identified in this research are as follows:
 - **Setting the stage.** The first phase focuses on the foundational elements of smart growth planning. Identify the land uses that are compatible in the community, and buffer those that are fundamentally incompatible.
 - **Creating places and streets.** The next phase focuses on the design features and overall aesthetic of the community, which can affect how freight operates. The goal is to design and construct streets and public places to achieve smart growth principles while accommodating necessary freight needs.
 - **Operating with minimal impact.** The third phase addresses problems that may arise during daily operation of freight movement that go beyond infrastructure design. Examples include time-of-day restrictions, type of delivery vehicle, and technology use. Minimize the negative effects of daily operations on the community as much as possible.
 - **Ongoing monitoring.** The final phase encourages planners and policymakers to monitor freight activity once the foundational and operational elements are in place. Even if prior

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phases are completed, issues can arise or reappear. Active monitoring helps ensure that freight practices align, adapt, and improve with national and global standards.

- **Consider potential obstacles.** Various obstacles can arise during smart growth planning. Each community is different, with different needs, goals, and visions. Regardless of the context, it is helpful to be prepared for any impediment. In planning for goods and services movement, the most common types of obstacles are as follows:
 - **Physical and environmental issues.** Elements of a plan or design may be challenged by physical constraints and/or potential environmental impacts that are insurmountable or difficult to overcome.
 - **Political will or harmony.** Even when all other obstacles appear to be surmountable, lack of political will or lack of harmony among key stakeholder groups can derail a project. As a result, planners need to understand political context without compromising results.
 - **Community personalities.** Stakeholders often disagree with planners on certain construction or land use initiatives. In the context of freight and goods movements, residents may disagree with changing the transportation network, eliminating parking spots in favor of truck loading zones, or other changes. Public meetings can help engage local residents and other stakeholders and allow them to air concerns, but ultimately it is up to the planner to do what is best for the community.
 - **Funding availability.** One of the most difficult obstacles can be funding availability. In recent decades, transportation funding has not been consistent, and it can be difficult to rely on funding sources dedicated to freight transportation initiatives. It may be necessary to seek alternative financing strategies or public-private partnerships (PPPs) if state or federal funds are not immediately available.
 - **Case-by-case scenarios.** Ultimately, every community is different. Not all smart communities look the same, and each one comes with a different history, aesthetic, economy, and vision for the future. There is no one-size-fits-all approach for integrating freight and goods movement in a smart growth community, and planners should consider all options and opportunities to succeed in this planning initiative.

3.2 Identifying Strategies

The key conflicts identified in this research tend to fall into one of four major phases: setting the stage, creating places and streets, operating with minimal effects, and ongoing monitoring. These conflicts can be mitigated by both the public and private sector with the right policies and incentives. Various strategies can be used to address these conflicts while integrating freight into smart growth communities.

Subsections present each phase-related strategy (including the strategy name, an overview of the strategy, how it supports freight and smart growth, information about key considerations and tradeoffs in implementing the strategy, the relevant smart growth classifications to which the strategy applies, the implementing entity and stakeholders, implementation information, and domestic and international examples of the strategy in a real-world situation).

Table 3-1 details the complete list of strategies for each of the four phases and identifies each strategy's applicability to each of the six smart growth classifications. The connection between the strategies and each of the six categories can be understood as degrees of applicability, with some strategies being more applicable to a particular smart growth category and other strategies being less applicable to the same category. However, some strategies, particularly in the final two

phases, are universally applicable to all six smart growth categories. The smart growth classifications are defined as follows:

-  Industrial areas transitioning to housing and entertainment districts;
-  Working waterfronts transitioning to mixed-use and/or recreation;
-  Older commercial and neighborhood areas being revitalized;
-  Retrofitting aging commercial corridors;
-  Greenfield new communities; and
-  Large-scale reconstruction.

Table 3-1. Strategies to integrate goods and services corresponding to smart growth environments.

	Smart Growth Classification					
	 Industrial areas transitioning to housing & entertainment districts	 Working waterfronts transitioning to mixed-use and/or recreation	 Older commercial and neighborhood areas being revitalized	 Retrofitting aging commercial corridors	 Greenfield new communities	 Large-scale reconstruction
Setting the Stage						
1A. Define your community's goals	●	●	●	●	●	●
1B. Employ freight-compatible development	●	●	●	●	●	●
1C. Promote freight villages or urban logistics centers	○	●	●	●	●	●
1D. Consider overlay zoning	●	●	●	●	○	○
1E. Reuse brownfields for freight development	●	●	●	●	○	●
1F. Discourage incompatible land use development	●	●	●	●	●	●
1G. Promote cargo-oriented development around rail hubs	●	○	●	●	○	●
Creating Places and Streets						
2A. Consider off-street loading facilities in new developments where practical	●	●	○	●	●	●
2B. Establish designated curbside loading zones	●	●	●	●	○	○
2C. Adopt design requirements for storing containers and equipment	○	●	○	○	○	●
2D. Enact developer mandates for buildings to accommodate freight activity	●	●	●	○	●	○

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Table 3-1. (Continued).

	Smart Growth Classification					
	 Industrial areas transitioning to housing & entertainment districts	 Working waterfronts transitioning to mixed-use and/or recreation	 Older commercial and neighborhood areas being revitalized	 Retrofitting aging commercial corridors	 Greenfield new communities	 Large-scale reconstruction
2E. Design safe and flexible intersections	●	●	●	●	●	●
2F. Create “buffers” with setback and/or landscaping requirements	●	●	●	○	●	○
2G. Designate truck routes	●	●	●	●	●	○
2H. Implement traffic-calming techniques to reduce conflict	●	●	●	●	●	●
2I. Use innovative financing techniques	●	●	●	●	●	●
2J. Implement rail quiet zones	●	●	●	○	○	●
Operating with Minimal Impacts						
3A. Develop off-peak delivery plans	●	●	●	●	○	●
3B. Use non-motorized vehicles in dense urban centers	○	○	●	●	○	○
3C. Extend hours of operation at terminals	○	●	●	●	○	○
3D. Provide direct transfer of goods from ship to rail	○	●	○	○	○	●
3E. Make deliveries at lockers versus directly to residents	●	○	●	●	●	○
3F. Reduce delivery vehicle emissions	●	●	●	●	●	●
3G. Launch certification/recognition programs for green fleets	●	●	●	●	●	●
3H. Invest in technology to aid freight operators	●	●	●	●	●	●
3I. Identify and support route networks	●	●	●	●	●	●
3J. Add smaller delivery vehicles to fleets	●	●	●	●	●	●
Ongoing Monitoring						
4A. Host community workshops to connect stakeholders	●	●	●	●	●	●
4B. Provide technical assistance to local planners	●	●	●	●	●	●
4C. Participate in national or global discussion on freight best practices	●	●	●	●	●	●
4D. Work with the private sector to pilot-test delivery solutions	●	●	●	●	●	●
4E. Adapt to changing market forces	●	●	●	●	●	●
4F. Determine ways to measure and monitor performance	●	●	●	●	●	●
Strategy Applicability Measure:		Less applicable	○	●	● More applicable	

3.2.1 Phase 1. Setting the Stage

To integrate freight into smart growth communities, land use plans must be appropriately and properly coordinated. One of the issues most often discussed in studies of freight and land use issues is conflicts resulting from comprehensive plans that do not support complementary land uses. In some cases, the adjacent land uses can be naturally opposing and generate conflict among opportunities, goods, services, and livability. Achieving a balance of mixed uses (including housing, education, employment, retail, entertainment, and other opportunities) is essential to achieving a high quality of life in smart growth communities (FHWA 2013).

This problem has two components: (1) identifying land uses that are compatible and (2) buffering land uses that are fundamentally incompatible. Some types of land uses generate the same pattern of vehicular activity, or can support higher levels of noise, traffic, and transport compared to a subdued residential development. It is helpful to understand which land uses have natural similarities to increase the success of all of the land uses. For land uses that are fundamentally incompatible and that have few or no natural similarities, planners can use zoning and design strategies to minimize the negative effects of these types of land uses and keep them in distinct areas of a smart growth community.

Several key strategies can help set the stage for a successful smart growth community with freight activity. State DOTs and MPOs can use state and regional freight plans to identify clusters of freight activity, emerging freight trends, and access and mobility issues in their states or regions. Corridor or subregional plans may take a closer look at land use trends and identify emerging smart growth environments and existing or potential transportation needs to support smart growth and goods movement. In these activities, state and regional agencies can (1) help municipal planners to better understand the context of their smart growth development within the broader land use and transportation scheme of the state or region and (2) supply municipalities with technical assistance to ensure that local comprehensive and land use plans account for smart growth and goods movement needs.

Local agencies with land use controls have an important role to fill when establishing a smart growth community. These agencies can (1) disincentivize incompatible land use development or redevelopment through legislation and zoning ordinances (including overlay zoning) and (2) preserve and strengthen designated freight corridors. Additionally, with the right opportunities, municipalities can help reduce overall freight activity by promoting freight villages and urban logistics centers, cargo-oriented development around new or existing rail hubs, and the reuse of existing brownfields for freight development. Municipalities can transition underused land into development that facilitates safer and more efficient freight activity in smart growth communities. All of this preparation also helps the private sector operate more efficiently within the community. Table 3-2 presents each of the seven recommended strategies for setting the stage for freight.

Table 3-2. Strategies for setting the stage for freight.

Strategy 1A:	Define your community's goals
Strategy Overview	Identify valuable freight assets, and determine those that should be preserved, upgraded, or removed entirely. Update or develop a comprehensive plan with desired zoning regulations and land uses.
How It Supports Freight & Smart Growth	Identifying freight goals helps guide appropriate land use patterns necessary to achieve these goals and preserve valuable freight assets. Some types of land uses generate the same pattern of vehicular activity or can support higher levels of noise, traffic, and transport compared to a subdued residential development. Understanding which land uses have natural similarities can increase the success of all of the land uses. For land uses that are fundamentally incompatible and that have few or no natural similarities, planners can use zoning and design strategies to minimize the negative effects of these types of land uses and keep them in distinct areas of a smart growth community.

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Table 3-2. (Continued).

Key Considerations and Tradeoffs	Freight movement is often an afterthought during planning. Although freight is rarely the highest priority, incorporating freight concerns in the plan can help avoid future conflict. Understanding how a community's freight assets fit into the overall freight network of the region is also important. Critical truck routes, intermodal facilities, distributors, warehouses, and other assets that affect the regional economy beyond the smart growth community should be considered.
Classifications	All 
Implementing Entity	Public sector: municipal planning department
Supporting Stakeholders	Community groups, MPOs, state DOTs and planning agencies, neighborhood organizations, retail and commercial establishments, trucking industry
Implementation	Comprehensive planning involves dictating public policy in terms of transportation, land use, utilities, recreation, and housing. Planners can assess their community's stage by developing a comprehensive plan with information about land use, desired development, and designated truck routes or high-volume corridors.
Example(s)	Communities, cities, and states across the country regularly develop plans to shape the growth and development of their region. <i>One New York</i> , the citywide plan for New York City, features four overarching visions for the city that touch on aspects of housing, jobs, transportation, infrastructure, the environment, natural resources, and city services. <i>One New York</i> helps to identify what the City's priorities are so planners can develop appropriate zoning, land use, and other public policies.

Strategy 1B:**Employ freight-compatible development**

Overview	Freight-compatible development is designed to preserve existing freight facilities and corridors, plan for future freight activity and needs, and reduce the negative effects that occur when incompatible land uses are near freight corridors and facilities.
How It Supports Freight & Smart Growth	Proper zoning is used to accommodate long-standing industrial facilities and allow for the development of boutique manufacturing, such as artisan food production, breweries, apparel or maker spaces, and other business establishments that may exist in smart growth environments with minimal effects on neighbors. This can be achieved through buffering land use zoning or FBCs that accommodate various uses and activities, but govern building form and external effects.
Considerations and Tradeoffs	Integrating freight into development plans can involve scaling back certain land uses to make more room for freight. Although this is an initial tradeoff, it can enhance the overall efficiency and maneuverability of the development plan with seamless freight integration.
Classifications	All 
Implementing Entity	Public sector: municipal planning department, community development department
Supporting Stakeholders	Trucking industry, development community, retail and commercial establishments, neighborhood organizations, community groups, MPOs, state DOTs and planning agencies
Implementation	Tools include effective long-range planning, zoning, and design that incorporate freight needs, environmental impact mitigation strategies, and education and outreach (Christensen Associates et al. 2012).
Example(s)	The Maryland Strategic Goods Movement Plan (2015) from Maryland DOT predicts high levels of freight activity in and through the state and suggests coordinating land use planning and economic development planning with transportation planning and project development. The Plan also encourages transportation improvements and interagency coordination to achieve a more balanced, multimodal system of accommodating freight.

Table 3-2. (Continued).

Strategy 1C:	Promote freight villages or urban logistics centers
Overview	Freight villages and urban logistics centers aim to cluster freight activities in a single area. Activities best suited for this strategy include transloading facilities (for transferring a shipment from one to another), rest areas, U.S. Customs, restaurants, and repair services (Rhodes et al. 2012, Christensen Associates et al. 2012).
How It Supports Freight & Smart Growth	Freight villages and urban logistics centers can improve how freight activities are integrated into an urban environment. One of the primary benefits of such consolidation is that it often reduces urban truck trips and vehicle-miles traveled (VMT) by combining goods from multiple vendors in a single vehicle or by performing multiple activities—product assembly, e-commerce fulfillment, consolidation or deconsolidation of shipments, vehicle and equipment maintenance and repair, etc.—within the freight village. Maintaining a strong freight presence also helps smart growth environments retain jobs and a strong, diverse tax base.
Considerations and Tradeoffs	Freight villages are most successful with an established public-private partnership, but can succeed with exclusively private funding. In many cases, the public entity is the main shareholder, while the private entities own smaller percentages of the venture. However, private companies can benefit from partnering with other companies with similar logistical needs to reduce overall costs.
Classifications	
Implementing Entity	Public and private sectors: municipal planning department, retail and commercial establishments, logistics operators
Supporting Stakeholders	Trucking industry, community groups, MPOs, state DOTs, local and state grant/loan financing agencies
Implementation	Unify freight interests among local retail, commercial, and trucking entities to help consolidate deliveries. Secure funding, either from private stakeholders or through a public-private partnership.
Example(s)	<p>Orlando, FL, illustrates how the freight village concept can develop organically in a metropolitan area. Orlando developed a new zoning designation for warehousing and logistics, which included design standards for freight-related activities. This allows for the building of intermodal connections and attracts businesses looking to lower operating costs by taking advantage of conglomeration effects (Holloway No Date, Smart Growth America No Date, LaCour No Date).</p> <p>Raritan Center in New Jersey is a fully private development executed with the goal of profit maximization. The Center serves over 3,000 private companies and employs over 15,000 people throughout the complex (Center for Advanced Infrastructure and Transportation (CAIT), Freight and Maritime Program, Rutgers, the State University of New Jersey 2008).</p> <p>Vanderbilt Medical Center, a private entity, in Nashville, TN, showcases the advantages of consolidating freight warehousing in a single, off-site location a short distance away. Shippers bring goods to an off-site distribution center operated by a third-party logistics (3PL) firm, who consolidates small shipments into full truckload shipments for delivery to the Center (Rhodes et al. 2012).</p>

Strategy 1D:	Consider overlay zoning
Overview	This strategy establishes a zoning district over one or more previously established zoning districts, so as to establish stricter standards and protect certain features of the land. Overlay zoning can also be used to promote specific forms or uses, which are important to the history and/or character of a community or relevant stakeholder groups.
How It Supports Freight & Smart Growth	Zoning overlays can preserve existing or potential industrial zones in redeveloping areas. They can also specify form-based design and/or operational criteria (e.g., limitations on truck trip generation and maximum allowable noise levels), which would allow low-intensity industrial or commercial uses (e.g., boutique manufacturing or “maker spaces”) in buildings that conform to the criteria.

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Table 3-2. (Continued).

Considerations and Tradeoffs	Although overlay zoning can be an effective regulatory tool, it can create complexity and inequity among properties as a result of additional restrictions applicable to some properties and not others. Furthermore, another layer of complexity in the zoning code can increase the time and cost of reviewing and approving new developments.
Classifications	
Implementing Entity	Public sector: municipal planning departments
Supporting Stakeholders	Private developers, industry firms, community organizations, trucking industry, MPO or state planning agencies (advisory)
Implementation	Existing land use and zoning standards should be reviewed to determine how they facilitate truck movement and whether this can be improved.
Example(s)	The Maryland Maritime Industrial Zone Overlay District (MIZOD) in Baltimore, which protects land in the Baltimore Harbor with water access and deep drafts (18 feet or deeper) suitable for industrial use, illustrates the use of overlay zoning for industrial preservation. MIZOD was established in 2004 and has been extended to 2024 to protect its maritime industries (Strauss-Wieder 2003, Christensen Associates et al. 2012).
Strategy 1E: Reuse brownfields for freight development	
Overview	This strategy involves the transition of brownfields into functioning freight centers to remain within urban environments while limiting the footprint to previously used industrial land.
How It Supports Freight & Smart Growth	Brownfields have limited development opportunities depending on the level of contamination, especially within urban areas. Reusing brownfields to develop urban freight resources is a cost-effective productive use of land and benefits neighboring businesses and commercial districts and helps retain or add jobs in urban areas.
Considerations and Tradeoffs	Some brownfield sites may be attractive to real estate developers, for both residential and commercial uses. Therefore, converting some parcels into freight-related uses may miss opportunities to provide more housing or retail development in urban areas. However, an efficient use of brownfield space for freight uses can benefit local businesses and keep trucks from taking up valuable pedestrian space.
Classifications	
Implementing Entity	Public and private sectors: municipal planning department, real estate developers, retail and commercial establishments
Supporting Stakeholders	Trucking industry, community organizations, local and state grant/loan financing agencies
Implementation	Identify brownfield locations within a city or town and establish distances to freight-intensive districts or businesses. Determine how they can be repurposed to facilitate truck movement.
Example(s)	The North Jersey Transportation Planning Authority conducted a regional brownfields assessment and identified opportunities to accommodate freight facilities in the urban parts of their region (FHWA 2012). The former Bethlehem Steel facility in Lackawanna, NY, is an 11,000 acre site in a designated Empire Zone, making it eligible for special tax incentives and support. The site has close access to Class I rail service, the St. Lawrence Seaway marine freight network, and the Interstate Highway System. The site is being remediated and redeveloped after being declared a Superfund site in 1988 and includes wind energy facilities and a business park that is home to several manufacturing firms (Rhodes et al. 2012).

Table 3-2. (Continued).

Strategy 1F:	Discourage incompatible land use development
Overview	Use various strategies through government agencies to discourage development that will create incompatible land uses near existing and viable industrial sites.
How It Supports Freight & Smart Growth	New development can hasten the departure of existing industrial facilities. Although new development can benefit a town or city, it is important to segregate land uses to minimize conflict while allowing each use to thrive separately. In particular, residents near an industrial site may be frustrated with noise, traffic, and other negative effects on livability. Keeping land uses separate will help mitigate negative effects while allowing industry to thrive. Additionally, there are different kinds of industrial or freight-generating land uses, and, therefore, different combinations of incompatibility. For example, a slaughterhouse produces negative health and environmental consequences, as well as effects associated with commercial vehicle pickups and deliveries. On the other hand, an urban farm can be considered a smart growth-friendly addition to a community, but the commercial or service vehicles required to bring farming materials on site and distribute produce to offsite markets may create unintended conflicts.
Considerations and Tradeoffs	Discouraging incompatible land uses will reduce the productivity of land throughout a town or city by forcing residential or industrial developers to choose other sites that may be sub-optimal. However, the long-term benefits to segregating conflicting land uses far outweigh the short-term obstacles of securing a proper site with minimal effects on neighboring uses.
Classifications	All 
Implementing Entity	Public sector: municipal planning department
Supporting Stakeholders	Trucking industry, community and neighborhood organizations, developers, industry firms, retail and commercial establishments, MPO (advisory), state planning agencies (advisory)
Implementation	Existing land use and zoning standards should be reviewed to identify potential clashes between neighboring land uses. New or developing areas should be reviewed before construction to ensure minimal conflicts. It is also important to ensure that there are no loopholes in existing land use regulations that may result in undesirable or incompatible development.
Example(s)	Logan City, UT, has developed zoning codes to control the development of freight facilities. "M" zoning districts (that is, districts for manufacturing/industrial use) must minimize effects from adjoining uses and districts. "M" districts are only allowed to locate near rail lines and highway interchanges, and most non-industrial uses are not allowed in the "M" districts (FHWA 2012). The City of Toronto blocked a condominium development in 2008 that would have been next to an industrial enclave (Gough 2014). Although there could be a benefit to locating housing near employment, complaints from residents often drive industrial uses out of the area as residents move in.
Strategy 1G:	Promote cargo-oriented development around rail hubs
Overview	Similar to freight villages, cargo-oriented development (COD) around railroad logistics hubs is another strategy to concentrate freight uses in a single area.
How It Supports Freight & Smart Growth	Logistics, warehousing, small-scale manufacturing, and other industries related to the breakdown of rail container shipments can locate in a single area, specifically at existing rail hubs. In addition to concentrating freight uses to enhance efficiency, this has the added benefit of promoting rail transportation, which will help remove long-haul truck trips from the road. In existing communities, CODs help contain sprawl by concentrating activity, reclaiming existing brownfields, and allowing workers to make shorter commutes via public transit, biking, or walking. Furthermore, COD yields environmental benefits as a result of decreased congestion, emissions, and wasted fuel from idling vehicles (Center for Neighborhood Technology 2013).
Considerations and Tradeoffs	Public-private partnerships are critical to meet the funding needs for railroads, but private entities constitute the bulk of customer demand.

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Table 3-2. (Continued).

Classifications	
Implementing Entity	Public sector: municipal planning department
Supporting Stakeholders	Private developers, community development groups, local residents
Implementation	Existing local and state building lot depth and setback standards should be reviewed as to how much they can protect or buffer residents from negative aspects of truck delivery.
Example(s)	The City of Memphis, TN, published a plan called Blueprint for Prosperity, which addressed reducing poverty by connecting more people to job centers at freight, logistics, and manufacturing facilities. The city is home to the central FedEx depot, but also has several Class I railroad routes moving millions of cargo containers each year. One of the strategies outlined in the plan was achieving COD through more robust public transit and infill development around economic hubs (Center for Neighborhood Technology 2015.).

3.2.2 Phase 2. Creating Places and Streets

The next phase in incorporating freight into smart growth communities is designating appropriate land uses. When developing a site plan for a development or building, other issues must be addressed to ensure that the principles of smart growth are incorporated while allowing for goods movement. These issues can be mitigated through zoning, subdivision or development regulations, and during the site plan review. In many cases, design elements can affect how users interact within a smart growth community, and municipalities can help ensure that appropriate design elements and zoning ordinances shape the community to accommodate freight safely.

Streetscape conflicts can arise with freight activity when using traditional planning methods to encourage walkability and multimodal transportation. Complete Streets in smart growth environments are designed to accommodate many users, including pedestrians, bicyclists, transit, and motor vehicles. Often, planners focus on designing facilities that improve pedestrian and bicycle safety using traffic-calming measures, crosswalk treatments, bicycle lanes, and other features. Although these improve mobility within a community, they may hamper truck circulation and loading activities and can result in a change to how goods are delivered to customers in the community. In many instances, truck drivers will use inappropriate locations (e.g., marked bicycle lanes, bus stops, or curbside parking spaces dedicated to non-commercial users) to park and load and unload. Planners and engineers should seek input from the trucking community when designing a streetscape to ensure that features that can restrict truck access will not affect deliveries in the area. Common concerns for the trucking industry include overhanging trees or light features that restrict vehicle height, curb extensions or roundabouts that lack mountable edges, and speed bumps. Properly designed, many of these elements can be included so as to benefit all road users.

To help create successful public places and streets while accommodating freight activity, municipalities can use several strategies. Agencies can consider off-street loading facilities in new developments, enact developer requirements or guidelines for buildings to accommodate freight activity, and create distinct buffer zones with lot depth and setback requirements. Municipalities also can support the integration of necessary freight activity by creating requirements for storing shipping containers, establishing designated curbside loading zones, separating pedestrian and commercial vehicle traffic, using traffic-calming techniques, and implementing rail quiet zones (see Figure 3-2).

State DOTs can establish design standards for state highways that incorporate Complete Streets. State and regional agencies can, through STIP and TIP project selection criteria and funding programs, encourage the creation of places and streets that integrate commercial



**Figure 3-2. Pedestrian- and bicycle-friendly zone
(Source: Cambridge Systematics).**

vehicles in smart growth environments. State and regional agencies can also provide technical help and best practices to local governments.

Without rules and guidelines from the public sector, it is difficult to manage the needs of the entire community. Table 3-3 presents recommended strategies for creating quality places and Complete Streets to accommodate commercial vehicles as needed, and discourage improper driver behaviors in smart growth communities.

Table 3-3. Strategies for creating places and streets.

Strategy 2A:	Consider off-street loading facilities in new developments where practical
Overview	Consider off-street loading docks where practical in new buildings, and encourage them in substantial renovations of existing buildings. Off-street loading facilities can include internal loading bays, designated alleyways, or other flexible spaces designated for freight during certain times of the day.
How It Supports Freight & Smart Growth	Off-street loading facilities eliminate the conflicts that can result with other vehicles and pedestrians when trucks park on the street or make curbside deliveries. Depending on how many deliveries an operator is scheduled to make, a truck can remain parked for several hours, taking up valuable sidewalk and bike lane space in urban/downtown environments. Additionally, removing trucks from the curb increases pedestrian safety and promotes walkability and vibrant streetscapes.
Considerations and Tradeoffs	Off-street loading facilities are not always practical or possible in certain building configurations. One solution to this problem is to consolidate loading docks for multiple businesses on a given block. The design of off-street loading docks must be considered specifically to each location. Insufficient loading dock geometry can lead to unsafe conditions on streets and sidewalks. Not every business in every location can or should design loading docks to accommodate the largest trucks in use. Additionally, dedicating space for freight on the property, instead of on-street, can increase the size and land cost of development, especially in high-value urban center and downtown locations.
Classifications	
Implementing Entity	Public sector: municipal planning and/or buildings department
Supporting Stakeholders	Trucking industry, community and neighborhood organizations, retail and commercial establishments, MPO or state planning agencies (advisory)

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Table 3-3. (Continued).

Implementation	Identify buildings with potential to add or enhance an off-street loading facility. Establish new regulations for buildings of a certain size or anticipated use to ensure the development of off-street facilities and integration of truck deliveries with minimal conflict with the street or sidewalk.
Example(s)	Seattle, WA, requires new developments to provide off-street truck loading areas and reserves some on-street parking for commercial vehicles (FHWA 2012). This gives vehicles a safe and legal place to load and unload while out of the way of other transportation modes. Seattle also allows vehicles holding a city Commercial Vehicle Loading Zone permit to occupy alleys for loading or unloading, up to 30 minutes. Although many alleys cannot accommodate large trucks, smaller trucks can use such alleys to load and unload without disrupting vehicular or pedestrian traffic on the adjacent streets and sidewalks (Center for Neighborhood Technology 2013, Pivo et al. 1997).
Strategy 2B:	Establish designated curbside loading zones
Overview	Typical curbside deliveries take place on pedestrian-oriented sidewalks. Establishing designated curbside loading zones delineates specific areas for deliveries in high activity areas.
How It Supports Freight & Smart Growth	Expanding curbside loading zones and increasing enforcement will help to keep these designated loading areas available when they are needed. This practice also helps limit instances of trucks loading while double-parked or parked in bicycle lanes or other inappropriate locations.
Considerations and Tradeoffs	Curbside loading zones affect street parking, because they claim spaces that would otherwise be used by residents or visitors to the area. Designated curbside loading zones must have proper signage and clear loading times for both pedestrians and drivers to follow. It is important to take necessary safety precautions for pedestrians in these areas, because freight activity will increase in certain pedestrian spaces. In addition, curbside loading zones remove some walking space for pedestrians, which may cause problems in some congested urban areas.
Classifications	
Implementing Entity	Public sector: municipal public works, municipal planning department
Supporting Stakeholders	Trucking industry, community organizations, retail and commercial establishments, MPO or state planning agencies (advisory)
Implementation	Identify high-traffic curb locations that can be designated loading zones and that serve local business' needs. Establish new regulations for curbside delivery space with safe and seamless integration of truck deliveries with minimal conflict with the street or sidewalk.
Example(s)	Given New York City's high density and competition for space, most retailers and grocery stores do not have off-street loading docks, but on-street parking is often unavailable because of passenger vehicle parking. In some areas of the city, NYCDOT has established delivery windows to make curb space available for delivery trucks, resulting in reductions in double-parking and traffic congestion. For example, part of Church Avenue in Brooklyn south of Prospect Park has defined delivery window spaces between 7 AM and 12 PM or between 7 AM and 3 PM, Monday through Friday. Delivery windows help to support the City's economy by improving the efficiency of truck deliveries (NYCDOT 2015). Within urban neighborhoods, Barcelona, Spain, and Cologne, Germany, have allowed lanes that are reserved for buses only during peak commuting hours to be used for curbside commercial vehicle parking during the middle of the business day so as to increase capacity (Goodchild No Date; Center for Advanced Infrastructure and Transportation (CAIT), Freight and Maritime Program, Rutgers, the State University of New Jersey 2008).

Table 3-3. (Continued).

Strategy 2C:	Adopt design requirements for storing containers and equipment
Overview	Shipping containers, chassis, tractors, and other equipment can be stored in virtually any open space, but implementing design requirements keeps them from interfering with other uses and helps mitigate conflicts between industry and neighboring residents and businesses.
How It Supports Freight & Smart Growth	By specifying site design requirements for storing specific types of containers, terminals can increase their efficiency at processing and locating containers and limit effects to neighboring facilities (Christensen Associates, et al. 2012).
Considerations and Tradeoffs	<p>Design requirements should help make the storage facilities less burdensome on neighboring facilities, but not be so cost-prohibitive as to drive up costs for logistics operators and storage facilities.</p> <p>There are many types of dry cargo, refrigerated, and special containers in varying sizes. The most common types of International Standards Organization (ISO) shipping containers, which are used for intermodal freight movements, are the 20-foot and 40-foot standard container (also known as GP) and the 20-foot and 40-foot high cube (HC) shipping container. GP and HC containers are nearly identical, except that HC containers are 12 inches taller. Both are used for all kinds of general dry cargo. There are also different specifications for refrigerated containers, open-top containers, flat rack and collapsible containers, as well as fuel tank containers. For this reason, it is important to have comprehensive design requirements to dictate the storage requirements for different types of containers (ISBU Association International 2012).</p>
Classifications	
Implementing Entity	Public sector: municipal planning department
Supporting Stakeholders	Trucking industry, community and neighborhood organizations, port operators, logistics centers, retail and commercial establishments
Implementation	Existing local and state design standards for container storage should be reviewed to determine how they can be altered to better integrate in non-industrial contexts.
Example(s)	Will County, IL, developed a model container storage zoning ordinance for municipalities in its jurisdiction to use as a guideline. The ordinance took into account the desire of industry and neighbors to locate container storage as close to intermodal transfer facilities as possible (Will County Center for Economic Development 2007).
Strategy 2D:	Enact developer mandates for buildings to accommodate freight activity
Overview	Municipalities can mandate that developers design buildings to minimize potential noise penetration, light pollution, and other potential effects of freight transportation and outdoor activities.
How It Supports Freight & Smart Growth	Designing building elements to reduce the negative aspects of freight transportation helps reduce conflict between residents and logistics operators. Residents can maintain a high quality of life and logistics operators can conduct business as usual in residential areas. These mandates also enable practices such as off-hour delivery to occur with minimal disturbance to local residents.
Considerations and Tradeoffs	Landscaping and other design features should not impede vehicle movement or sight lines. Any surface parking lots should be designed to ensure that freight circulation routes and driveways are segregated from customer automobile traffic to the extent possible (Goodchild No Date).
Classifications	
Implementing Entity	Public sector: municipal planning department
Supporting Stakeholders	Private developers, municipal public works, community development department, local residents, MPO or state planning agencies (advisory)
Implementation	Existing local and state building design standards should be reviewed to determine how they can protect or buffer residents from negative aspects of truck delivery.
Example(s)	Anaheim, CA, included specific planning requirements within the environmental report section of a transit-oriented development (TOD) project. Measures included requiring residential units to have solid-core exterior doors and minimum sound

(continued on next page)

Table 3-3. (Continued).

<p>class ratings on all windows and exterior walls to help alleviate noise issues while windows are shut (Christensen Associates et al. 2012).</p> <p>Anchorage, AK, involves motor carrier representatives in the site plan review, and such input helps to avoid potential hindrances on safe motor vehicle operation once the plans are approved and the facilities are developed (FHWA 2012).</p>	
Strategy 2E:	Design safe and flexible intersections
Overview	Most street problems occur at intersections, rather than on the roadway itself, making it important for city planners and engineers to focus on designing safe and flexible intersections for all road users.
How It Supports Freight & Smart Growth	Safe intersections can accommodate larger commercial and service vehicles while remaining safe for pedestrians, bicyclists, and other motorized vehicles. Right-hook type crashes, which involve a car passing a cyclist on the left and making a right turn in front of a cyclist, are one of the more common types of crashes that result in injuries. This type of crash can also occur with right-turning trucks and bicycle lanes. Some DOTs have considered terminating bicycle lanes in advance of the intersection and having bicycles merge with the right traffic lane to help reduce crashes. Regardless of the solution, considering these safety risks when designing intersections in smart growth communities can help reduce collisions.
Considerations and Tradeoffs	As with many engineering projects, the details of the design are important. One intersection-related issue includes actual vs. effective turning radii. Roadway designers often determine a corner radius based only on intersection geometry and overlook the effective turning radius, which can vary depending on the size of the vehicle. Mountable curbs and truck treatments can help improve safety and mobility at intersections, but flexible infrastructure is key.
Classifications	All 
Implementing Entity	Public sector: municipal engineering department
Supporting Stakeholders	Private developers, trucking industry, municipal public works, municipal transportation planning department, community development department, local residents, MPO or state planning agencies
Implementation	Existing local and state roadway intersection design standards should be reviewed to determine how they can improve mobility and safety at major and minor intersections.
Example(s)	Oregon DOT implemented a mid-block pedestrian island on US 97 in the City of Madras to enable safer crossing for pedestrians. US 97 is a major north-south route of oversize/overweight (OSOW) loads. On one side of the highway is a low-income residential neighborhood, a convenience store is across the highway, and the nearest traffic signal is approximately a half-mile out of the way. Oregon DOT designed a removable pedestrian crossing in the event of an overdimensional load exceeding normal widths. The island was pre-formed in pieces with pegs, and the concrete pad has holes for the pegs, enabling the concrete to be picked up with a loader and moved if needed.
Strategy 2F:	Create buffers with setback and/or landscaping requirements
Overview	Use lot depth and setback requirements to create buffers between residential or commercial uses and adjacent freight activities when possible. These buffers can be combined with landscaping, walls, or other amenities to reduce noise, vibration, air, and light pollution.
How It Supports Freight & Smart Growth	Buffers created through lot depth and setback requirements help reduce the negative aspects of freight transportation. Residents can benefit from limited interaction with truck deliveries for better quality of life.
Considerations and Tradeoffs	Although using lot depth and setbacks to minimize freight effects can reduce overall density in the area or limit the buildings next to a street, reducing conflict between uses in key areas is an important overarching goal. However, the design outcome may not support smart growth goals for density and walkability.

Table 3-3. (Continued).

Classifications	
Implementing Entity	Public sector: municipal planning department
Supporting Stakeholders	Private developers, community development groups, local residents, MPO or state planning agencies (advisory)
Implementation	Existing local and state building lot depth and setback standards should be reviewed to determine how they can protect or buffer residents from negative aspects of truck delivery.
Example(s)	<p>American Canyon, CA, requires a 20% increase in lot depth for any development next to state highways or railroads (Christensen Associates et al. 2012).</p> <p>Slinger, WI, adopted a design standard in 2007 that mandates a minimum 50-foot non-access easement and planting area for any new land division or condominium next to a limited-access highway or railroad right-of-way. Minimum lot depths were increased by 50 feet in the village to accommodate this buffer area (Christensen Associates et al. 2012).</p> <p>Depending on the density of the community, larger buffers may be required.</p>
Strategy 2G: Designate truck routes	
Overview	Designating truck routes is a key strategy in integrating freight in smart growth communities. The goal is to separate pedestrians and bicycles from commercial vehicles, because it is often difficult and unsafe to have them function simultaneously in the same space. Separation can be achieved by implementing barriers, rails, and trees between streets and sidewalks, thus segregating the uses. At crossing points, municipalities can install traffic lights, zebra crossings, or pedestrian bridges (when necessary) to minimize conflict with vehicles. Deterrent paving can also help guide pedestrians to appropriate crossing points.
How It Supports Freight & Smart Growth	The most critical areas to separate pedestrians and bicycles from commercial vehicle traffic are often in busy commercial districts (Pivo et al. 1997). Keeping commercial vehicles away from pedestrian and bicycle activity allows increased travel speeds and improved safety for freight movement and the general public (FHWA 2012).
Considerations and Tradeoffs	<p>Consider the tradeoffs of protected versus unprotected bike lanes, including bicyclist and pedestrian safety, available space in the street section, potential effects on-street cleaning, waste pickup, and other services, as well as placement of street parking and transit stops.</p> <p>Separating pedestrian and bicycle traffic can have negative implications if the separation creates barriers to desired movement for either mode. In this case, pedestrians may find alternative, but less safe, routes to reach their destinations more quickly.</p>
Classifications	
Implementing Entity	Public sector: municipal public works, municipal planning department, state DOT, roadway or highway authorities (e.g., New Jersey Turnpike Authority), private street owners/developers
Supporting Stakeholders	Trucking industry, community organizations, retail and commercial establishments.
Implementation	Existing local and state guidelines should be reviewed to determine how infrastructure can be developed to protect or buffer residents from freight and truck activity.
Example(s)	<p>Mira Loma, CA, realigned commercial vehicle access to a railyard and established designated and signed truck routes (MIG, Inc., ICF International, and UltraSystems 2009).</p> <p>Many examples of truck route networks exist, including Baltimore, New York City, Stockton, and Naperville. New York City is working to develop protected bicycle lanes throughout the City—such lanes help to segregate both bicycle and pedestrian traffic from motor vehicles. Protected bicycle lanes exist along key avenues in Manhattan, Brooklyn, and Queens, as well as along the waterfronts.</p> <p>Caltrans in California has developed dedicated truck lanes on sections of Interstate 5 in order to separate commercial vehicles from general traffic lanes.</p>

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Table 3-3. (Continued).

Strategy 2H:	Implement traffic-calming techniques to reduce conflict
Overview	Many municipalities, as well as state transportation agencies, have developed traffic-calming guidelines that include recommended street designs and geometric standards. These standards facilitate truck movement with different standards based on the truck priority of the route. These standards may specify which types of devices may be implemented on which types of streets, as well as geometric specifications for different devices on different types of streets.
How It Supports Freight & Smart Growth	Appropriate traffic-calming measures can ensure truck access while improving safety for all road users, including truck drivers making curbside deliveries. Truck compatibility should be based on road functional class, and design treatment should be flexible to accommodate truck needs. For example, municipalities can use alternative paving surfaces to reduce noise and vibration while creating visual cues that slow traffic. Mountable curbs can be designed to slow turning traffic while allowing the rear wheels of trucks to track over the curb without causing damage. Achieving an appropriate traffic-calming strategy can improve the safety and livability of an area with active freight uses.
Considerations and Tradeoffs	The purpose of traffic calming is to slow traffic and increase pedestrian safety. This goal may require geometric compromises (e.g., narrowing of land widths and modifications of turning radii). These interests must be balanced with the needs of trucks. Compromises (e.g., pedestrian median refuges set flush with the pavement) provide a visual cue to cars, yet permit trucks to turn over them when necessary. Such a compromise can introduce pedestrian safety concerns, which should be evaluated and addressed through signage and education if such strategies are pursued. Many traffic-calming techniques can cause problems for public works departments during inclement weather, particularly snowstorms, because it can be difficult to maintain and plow snow in roadways with complex street treatments.
Classifications	All 
Implementing Entity	Public sector: municipal public works, state transportation agency
Supporting Stakeholders	Community development department, municipal planning department, public safety, trucking industry, community groups, MPO, state DOT
Implementation	Existing local and state street design standards, including standards or guidelines describing traffic-calming measures, should be reviewed to determine how they facilitate/support truck movement.
Example(s)	The City of South Gate, CA, uses a rubberized asphalt material on some city streets to reduce noise from truck traffic. Use of this material has led to decreases in noise impacts, thus increasing the quality of life for local residents (MIG, Inc., ICF International, and UltraSystems 2009). Gothenburg, Sweden, has reduced its traffic fatalities over the past 25 years by incorporating planning for pedestrians, cyclists, and mass transportation in the design of its streets (World Resources Institute 2015).
Strategy 2I:	Use innovative financing techniques
Overview	Many smart growth communities have limited financial resources for pursuing major development or redevelopment projects. Using non-traditional financing techniques can enable planners to accomplish more with fewer municipal resources.
How It Supports Freight & Smart Growth	Innovative financing exists to help cities accomplish important development and redevelopment projects that they would otherwise be unable to afford. Various techniques can be used. Tax increment financing (TIF) is a value-capture strategy in which municipalities divert future property tax revenue increases from a specific area toward economic development projects in the community. TIF helps spur investment by allowing for the future repayment of loans for projects (e.g., parking structures, water, or roads) by taxing the

Table 3-3. (Continued).

	<p>incremental rise of property values or sales receipts that occur because of the improvement. TIF funds can then be allocated to a design project within the investment area. Sales tax increments, property tax increments, or a combination of both can be used to fund redevelopment projects.</p> <p>Another financing option is New Market Tax Credits (NMTCs), which are primarily used for commercial, industrial, or non-profit development projects or operations costs in low-income census tracts. NMTCs can subsidize around 20% of total project costs in the form of low-interest, forgivable debt. Communities looking to benefit from NMTCs must obtain financing from a certified Community Development Entity (CDE), which is evaluated by the Community Development Financial Institutions (CDFI) Fund, a division of the US Department of Treasury (SB Friedman Development Advisors 2014).</p> <p>Two other financing strategies for smart growth communities are Special Service Areas (SSAs) and Business Districts. An SSA allows local governments to tax and deliver services (e.g., physical improvements or other development projects) to geographic areas within their jurisdiction. Business Districts, which are contiguous areas of a municipality, have certain powers and authorities that differ from other parts of the municipality. These powers and authorities allow for increased tax collection to fund these defined areas (SB Friedman Development Advisors 2015).</p>
Considerations and Tradeoffs	Although innovative financing techniques can help fund a desired development or redevelopment project, not all project costs will be covered.
Classifications	All 
Implementing Entity	Public sector: MPO, municipal planning department
Supporting Stakeholders	State DOT, logistics operators, private street owners/developers, municipal public works, community development organizations.
Implementation	Municipal planners should review the local tax code to determine whether the desired innovative financing strategy is possible and then work with local legislators if the strategy is not. Once a strategy is identified, evaluate the desired development or redevelopment project to determine whether the financing strategy is appropriate and how it will be managed.
Example(s)	In 2006, the Denver Urban Renewal Authority (DURA) approved the creation of an Urban Renewal Area and agreed to use TIF to help finance several projects within the site. After some redevelopment, the assessed value of the property increased from \$900,000 to over \$5 million in 2 years, and the property generated more than \$380,000 in property taxes. TIF enabled DURA to capture the increase in tax revenue to pay for the redevelopment (Denver Urban Renewal Authority 2016).

Strategy 2J:	Implement rail quiet zones
Overview	Through the Federal Railroad Administration (FRA), municipalities can establish rail quiet zones. These special zones permit trains to pass through rail crossings without sounding their horn.
How It Supports Freight & Smart Growth	Train horns can be disruptive in residential communities, particularly during overnight hours when residents expect quiet. Reduction in noise may make a community more accepting of allowing rail operations at night (FHWA 2012). Additionally, increased rail operations during the evening hours can result in a reduction in traffic and congestion during peak hours for commuting and other non-freight activities.
Considerations and Tradeoffs	Proper design and signage should be reviewed to ensure that the crossings designated as rail quiet zones are safe to both motorists and pedestrians. Because the absence of a train horn increases the crash risk at rail crossings, it is important to install warning devices to alert motorists, including flashing lights, gates, and other devices. These devices can cost local authorities between \$30,000 per crossing to over \$1 million, depending on the number of crossings and the warning devices required for each crossing (FRA 2013).

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Table 3-3. (Continued).

Classifications	
Implementing Entity	Public sector: authority with jurisdiction over roadway crossing (with FRA conditions met)
Supporting Stakeholders	MPO, state DOT, logistics operators, railroad industry, municipal planning department, municipal public works, community development organizations
Implementation	Determine key crossings that are near to residential communities. The municipal planning agency should then work with the FRA to establish designated rail quiet zones. Local authorities should be prepared to finance installation of warnings and safety infrastructure surrounding the crossings.
Example(s)	Residents of Boulder, CO, have struggled with train horn noise from BNSF trains at nine railroad crossings for many years. In 2013, the city requested a cost estimate to implement rail quiet zones at these nine locations and identify options for reducing noise. It was determined that it would cost between \$2.4 million and \$4.4 million to install the infrastructure necessary to create rail quiet zones. Proposed strategies included gates, wayside horns, and hybrid options (SEH 2014).

3.2.3 Phase 3. Operating with Minimal Impacts

Once the foundations for incorporating freight in smart growth communities are established, strategies will still be necessary to ensure success. Daily operations may be enhanced with additional policies, practices, and investment from both the public and private sectors. How well the overall transportation system operates has a powerful influence over quality of place, in that it can either create conflict or be used to reduce or eliminate conflict between goods movement and other priorities.

Poor or inefficient transportation systems can harm the air quality and the environment. Diesel engine emissions have been shown to harm the natural environment and human health. Although trucks represent fewer than 5% of vehicles in the United States, they generate 22% of all transportation emissions—more than airplane, marine vessel, and rail modes (Tomer 2015). The disproportionate effect on air quality elevates the importance of managing trucks in all communities, and particularly in smart growth communities.

Both private- and public-sector stakeholders can help maintain transportation operations that minimize negative effects on a smart growth community. Companies can implement various strategies such as extending hours of operation at terminals, providing direct transfer of goods from ship to rail at port facilities, using cargo cycles and freight tricycles to make deliveries (see Figure 3-3), and investing in technology to assist carriers and freight operators. Public-sector



Figure 3-3. Freight bicycle in San Francisco, CA (Source: Peter Martin).



**Figure 3-4. Amazon locker pickup service
(Source: Cambridge Systematics).**

agencies can develop an off-peak delivery plan, offer incentives for clean vehicles, and launch certification or recognition programs for businesses with sustainable freight plans. Collectively, private- and public-sector agencies can use non-motorized vehicles in urban centers, make residential deliveries at lockers rather than directly to residents (see Figure 3-4), and add smaller delivery vehicles to their fleets. For transportation operations to go smoothly, both sectors must manage their fleets and invest in appropriate technology and delivery vehicles. Table 3-4 presents strategies for operating freight with minimal negative effects on smart growth communities.

Table 3-4. Strategies for operations with minimal impacts.

Strategy 3A:	Develop off-peak delivery plans
Overview	Off-peak delivery encourages delivery of goods to retailers and other customers during overnight hours as opposed to typical business hours when the most vehicles are on the roads.
How It Supports Freight & Smart Growth	New York City DOT conducted a voluntary pilot implementation and analyzed the results. The resulting benefits include improved travel time for truck drivers, improved driver productivity, and decreased odds of encountering delays while searching for available parking or loading areas. The strategy also supports smart growth by increasing pedestrian safety, reducing traffic congestion, and supporting parking for non-freight uses during key hours. For private companies, off-peak deliveries can save shippers and transportation companies significant operations costs. This strategy has been found to reduce congestion and enable larger trucks to access the area, because there is less concern about conflict with other road users.
Considerations and Tradeoffs	Successful off-hour delivery arrangements can take considerable cooperation—desired time of delivery may not match with port and business schedules. Often, success comes from finding the right customer to achieve this balance of freight flow. One of the challenges can be incompatibility with customer operating hours. Although stores not open during the nighttime may not be willing to remain open to receive deliveries, such stores could provide a secure area to drop packages if store personnel are not available. Also, nighttime deliveries can generate noise that might not be well-received by those residing next to or near the delivery location(s). Incentivizing this shift in customer demand could lower delivery costs by reducing congestion and allowing larger trucks to access the area because there would be less concern about conflict with other road users.

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Table 3-4. (Continued).

Classifications	
Implementing Entity	Public and private sector: municipal transportation department in concert with shippers/receivers
Supporting Stakeholders	Trucking industry, community groups, MPO, port operators
Implementation	Freight transporters will respond to the demands of their customers—if shippers/receivers can be convinced to change their demands, the transportation providers will adapt to meet these demands (Holguin-Veras et al. 2012, Pivo et al. 1997).
Example(s)	<p>New York City is the first U.S. city to experiment with off-hour delivery programs. This experiment was successful among participants. Barcelona, Spain, and Dublin, Ireland, have experimented with off-hours delivery programs as well (BESTUFS No Date).</p> <p>Following the success of New York City's program, the FHWA and EPA created a program to provide funding to cities interested in off-hour delivery. Funding was awarded to the cities of Orlando, FL, and Washington, DC; Chicago, Boston, and Atlanta have also expressed interest in participating in the program (Supply Chain Media, LLC 2014).</p>
Strategy 3B: Use non-motorized vehicles in dense urban centers	
Overview	Using alternative means of delivery such as cargo bicycles, especially in congested urban areas, can reduce emissions and congestion for trips that do not require a full commercial vehicle (Tomer 2015, Weber 2012). Similar to the consolidation centers, freight providers can use non-motorized vehicles to serve dense urban centers. These vehicles can run on a hub-and-spoke pattern and operate out of a larger vehicle that remains on the periphery while alternative transportation covers the last mile of delivery (Supply Chain Media LLC 2014, Weber 2012).
How It Supports Freight & Smart Growth	Non-motorized vehicles, such as freight tricycles or cargo bicycles, offer several key benefits to smart growth communities and dense urban centers. Such vehicles help reduce congestion along the roadways, emit virtually zero emissions, have greater flexibility in parking and navigating, and are cheaper to own and maintain than traditional diesel-powered trucks. Private companies also benefit from reducing or eliminating other costs such as vehicle maintenance, insurance, and fuel.
Considerations and Tradeoffs	Despite the substantial benefits of using non-motorized vehicles for freight delivery, there are tradeoffs with scalability, speed, and volume. Because non-motorized vehicles tend to be smaller than traditional trucks, more vehicles and drivers are required to carry the same volume of cargo. Additionally, these vehicles are human-powered and do not travel at the same speed as diesel-fueled trucks.
Classifications	
Implementing Entity	Private sector: logistics operators
Supporting Stakeholders	Trucking industry; retail and commercial establishments; community groups; community development department; local, state, or private grant/loan program managers
Implementation	Logistics operators and private retail or commercial establishments can review their logistics models and identify delivery routes in compact or dense areas and smart growth communities.
Example(s)	<p>Revolution Rickshaws in New York City is a non-motorized vehicle service. This private company provides hourly and route cargo delivery services in and between Manhattan and Brooklyn. Past clients have included Quinciple, Murray's Cheese, and City Harvest, as well as other local companies for which Revolution Rickshaws has provided customized local delivery services to customers and between retail locations.</p> <p>B-Line, a delivery company in Portland, OR, also use cargo cycles to make deliveries to customers from companies such as Office Depot, Portland Roasting Coffee, and Guayakí teas.</p>

Table 3-4. (Continued).

Strategy 3C:	Extend hours of operation at terminals
Overview	Many terminals at major ports have typical business hours between 6:00 AM and 6:00 PM, which align with rush hour traffic and congestion.
How It Supports Freight & Smart Growth	Providing extended access at terminals allows truck drivers to access ports during off-peak hours, thereby avoiding midday and rush hour traffic. Terminals can help increase delivery potential by opening early in the morning, before morning commutes, and/or closing late in the evening. This system has the added benefits of reducing (1) emissions from idling and (2) congestion, thus improving both the air quality and mobility of residents and commuters.
Considerations and Tradeoffs	<p>Extending hours of operation at terminals can help truckers avoid peak hours and enable more deliveries. However, without an off-hour delivery facility, truckers may not be able to make a final delivery at a retail or commercial establishment overnight or early in the morning. Depending on the truck operator and the route/customer base, the operator will need to ensure that deliveries can be completed.</p> <p>If extending the hours of operation at terminals is not possible, one solution may be to identify underused parcels near terminals that can be used as storage. These underused areas (e.g., corners of a shopping mall parking lot) are often vacant after business hours and could be used to store containers while truckers are making multiple trips during overnight hours, before the terminals reopen.</p>
Classifications	
Implementing Entity	Public and private sector: logistics operators, port terminals
Supporting Stakeholders	Trucking industry, retail and commercial establishments
Implementation	Terminals in congested urban areas should review their operating hour policies and determine whether it is possible to extend or shift their business hours to benefit customers.
Example(s)	The PierPASS system, in use at the Ports of Los Angeles and Long Beach, is a private-sector-created non-profit that encourages commercial vehicles loading at the terminals to do so during off-peak hours. To pay for the expanded hours the terminal is in operation, cargo owners pay an increased fee for commercial vehicles entering the port during peak hours. Improved efficiency and reduced air pollution are benefits, but increased noise and emissions during the weekend and at night are potential consequences. This private-sector response, prompted by impending legislative action that would have required a similar system under public control, resulted in nearly 40% of container moves occurring during off-peak hours (Smart Growth America No Date).
Strategy 3D:	Provide direct transfer of goods from ship to rail
Overview	Shippers can opt for direct transfer of goods from ship to rail at ports rather than relying exclusively on trucking.
How It Supports Freight & Smart Growth	Short-haul truck moves, also known as drayage, often use older, less efficient vehicles and need to traverse heavily populated and congested areas. Establishing more direct transfers of goods from ship to rail reduces the demand for drayage trucking and consolidates movements to an off-site location. This can result in reduced emissions, congestion, and delivery times.
Considerations and Tradeoffs	<p>Rail projects are expensive, which may make it difficult for some port agencies to bear the full cost of the project. Additionally, rail lines are fixed and not easily moved or modified if truck routes are to change or adapt over time. It is critical to anticipate future volumes and ensure that this project will make sense for decades to come.</p> <p>If building a shortline railroad is feasible, it is also important to ensure grade separation to reduce conflict between rail and road users. Maintaining full grade separation increases the safety and efficiency of moving goods from the ports to an off-site location.</p>
Classifications	

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Table 3-4. (Continued).

Implementing Entity	Private sector: logistics operators, port terminals, railroads
Supporting Stakeholders	Trucking industry, municipal planning department, municipal public works, port authorities, MPO, state DOT
Implementation	A Port Authority or terminal facility can review common drayage routes and determine whether a rail connection makes sense and is feasible. Depending on cost, a public-private partnership can be used to secure funding and streamline construction and implementation.
Example(s)	A proposal for the San Pedro Bay Ports (of Los Angeles and Long Beach) to increase rail access to the port would eliminate 30,000 daily truck trips by 2035. Twenty-one percent of cargo is transferred from ship to rail (Smart Growth America No Date).
Strategy 3E: Make deliveries at lockers rather than directly to residences	
Overview	Similar to an urban consolidation center, which consolidates larger deliveries before dispatching smaller last-mile delivery vehicles, lockers can have the same effect on residential deliveries. Consumers ordering individual items can select the locker facility from which they want to retrieve their item and pick it up at their convenience.
How It Supports Freight & Smart Growth	In dense urban areas, FedEx and UPS vehicles can spend hours circling for parking and claiming spaces, which reduces available parking for non-freight uses and increases the likelihood for parking tickets. The individualized nature of residential deliveries is highly inefficient and, while convenient for the consumer, negatively affects cities and smart growth communities. Lockers can provide a secure central location for consumers to pick up their packages at their convenience, without the need for a car or delivery signature. These services can help reduce truck traffic, congestion, and emissions in urban areas.
Considerations and Tradeoffs	Private-sector participation is important to making locker delivery services a success, given the high cost of implementation and coordination required. In the Bento Box example (described in the Example(s) section below), this type of system requires coordination and cooperation among multiple entities (e.g., logistics departments, 3PLs, and receivers), and some companies may lose face-to-face contact with customers. Despite the high success rate of delivery lockers in some urban areas, this delivery option requires sufficient volume. If there is not enough demand to use the service, there will not be enough packages delivered to these locations to consolidate delivery patterns. It can also be expensive to manage and operate at locker sites, so maintaining regular activity is crucial to making the service cost-effective for businesses.
Classifications	
Implementing Entity	Private sector: private companies
Supporting Stakeholders	Trucking industry, logistics operators, retail and commercial establishments, community groups, municipal planning department, municipal/grant funding agencies
Implementation	Unifying freight interests among local retail, commercial, and trucking entities can help consolidate deliveries. Secure funding either from private stakeholders or through a public-private partnership.
Example(s)	Amazon, a major online retailer, continues to expand its Amazon Locker services in many cities throughout the United States. A customer orders products from Amazon like any e-commerce purchase, but selects a locker location as opposed to their residential address as the delivery location. Locations exist in office buildings, grocery stores, convenience stores, and other retail locations. Upon pickup, customers retrieve their orders by entering a unique code on the locker touch screen. In 2016, supermarket chain Giant launched a grocery pickup service at several Washington, DC, area Metrorail stations. Customers order online and pick up their groceries at a kiosk at the rail station on their evening commute. A similar concept, Bento Box, was piloted in Berlin, Germany. Bento Box used bicycles for the last-mile segment after packages were deposited in a consolidation center (Weber 2012).

Table 3-4. (Continued).**Strategy 3F: Reduce delivery vehicle emissions**

Overview	Diesel engine emissions have been shown to harm the natural environment and human health. Even if freight operations are efficient, using outdated technology or fossil fuels in freight vehicles may harm residents in neighboring areas. Reducing delivery vehicle emissions in smart growth communities can improve air quality and quality of life of residents. There are many low-emission delivery vehicles on the market, including battery electric vehicles, plug-in hybrid-electric vehicles, liquefied petroleum gas (LPG) vehicles, compressed natural gas (CNG) vehicles, and biodiesel vehicles.
How It Supports Freight & Smart Growth	<p>Diesel fuel contains more than 40 toxic air contaminants, many of which are suspected cancer-causing substances. Although the prevalence of diesel-powered vehicles makes it nearly impossible to avoid exposure, people living in urban and industrial areas are more likely to be exposed to pollutants regularly (American Lung Association of California 2015).</p> <p>Clean vehicles emit fewer pollutants and are often quieter and less disruptive to communities. Using these vehicles contributes to cleaner air and a higher quality of life, particularly in dense or urban environments. Investments in emissions reduction strategies such as hybrid, natural gas, electric, and other truck and locomotive technology have reduced per-vehicle emissions over the past two decades (MIG, Inc., ICF International, and UltraSystems 2009).</p> <p>For many consumers, buying from “green” companies is a priority. Freight stakeholders can gain access to this consumer base by reducing diesel emissions through the use of alternative-fuel vehicles or limiting the distance or frequency of vehicle trips.</p>
Considerations and Tradeoffs	<p>For the public sector, the health and environmental benefits of requiring or incentivizing the “greening” of the freight transportation fleet must be weighed against the potential disruptions to supply chains and the effect that might have on local business (if regulations are used) or the cost of incentives (if that approach is preferred). Non-monetary incentives (e.g., priority access to certain locations) may be a particularly effective approach as the cost to the public side is typically lower.</p> <p>The private sector must weigh the cost of implementation versus the potential benefits of being seen as a “green” carrier and gaining access to incentives. Incentives must be examined to ensure that the financial case is sustainable over the long term.</p>
Classifications	All 
Implementing Entity	Public or private sector; local or state environmental agencies, other public or private grant/loan financing organizations
Supporting Stakeholders	Logistics operators; trucking industry; local, regional, or state planning and environmental protection agencies; community development organizations.
Implementation	<p>Government agencies can help private companies incorporate more clean vehicles in their fleets by offering incentives. The incentive can be monetary or it can improve the delivery process for those that adopt clean vehicles, thus benefitting both the community and the carrier.</p> <p>Incentives can be established by local, state, or federal agencies, depending on the level of political support. The public entity would determine the desired emissions reduction outcomes and create incentives to achieve these goals.</p>
Example(s)	<p>FedEx’s EarthSmart initiative aims to improve the fuel efficiency of its fleet by 30% by 2020. Part of the success comes from using low-emission vehicles. By 2012, FedEx Express had increased its global electric vehicle and hybrid-electric vehicle fleet to 482 vehicles, an increase of nearly 18% (URTC 2014).</p> <p>CALSTART and the Northeast Diesel Collaborative (NEDC) are working with public- and private-sector stakeholders in the California and Northeastern United States to identify opportunities to reduce diesel emissions, improve public health, and promote clean diesel technology. NEDC works to educate the public, lawmakers, and fleet operators; create partnerships; demonstrate new technologies; expand existing programs; and improve data on emissions and health effects.</p>

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Table 3-4. (Continued).

Strategy 3G:	Launch certification/recognition programs for green fleets
Overview	Recognition programs or certification programs for green fleets from the state or federal government can incentivize companies to opt for electric or low-emission trucking vehicles.
How It Supports Freight & Smart Growth	These programs can bring positive publicity for companies and encourage them to adopt sustainable and environmentally-friendly delivery practices, which is aligned with smart growth goals and a higher quality of life. Companies can also use membership for marketing purposes in order to grow their customer bases.
Considerations and Tradeoffs	As with incentive programs, certification or recognition programs can motivate private companies to use low-emission vehicles in their logistics models. However, the certification or recognition program must be able to generate publicity or awareness of the company and its eco-friendly practices in order for it to be effective.
Classifications	All 
Implementing Entity	Private and public sector: municipal transportation department, municipal environmental planning department.
Supporting Stakeholders	Logistics operators, state environmental agencies, state DOTs, MPOs or COGs, community organizations.
Implementation	Certification/recognition programs can be established by local, state, or federal agencies, depending on the level of political support. The public entity would determine the desired sustainability and emissions reduction outcomes and create a certification or recognition program to entice companies to achieve these goals.
Example(s)	<p>Idaho-based transportation asset management company Alpine Group, LLC, presents an annual award, the Eco-Friendly award, to clients who recycle over 750,000 pounds of aging and outdated fleet equipment. The award produces positive press for companies and helps encourage the use of safe and fuel-efficient equipment on the road. Past award winners have included Old Dominion Freight Lines, UPS, and FedEx (Alpine Group LLC 2014).</p> <p>The EPA's SmartWay Program exists to encourage greater efficiency and lower greenhouse gases and other emissions from transportation supply chains. The program has enabled collaboration, technical assistance, and funding to participants to help quantify freight emissions and overall costs in the supply chain. The SmartWay brand is used to promote "green" transportation and demonstrates participants' commitment to SmartWay and freight sustainability. Truck operators and other qualifying passenger vehicles can display a SmartWay-designated mark on their vehicles as a symbol of sustainability (EPA SmartWay 2015).</p> <p>The United States Department of Energy (DOE) Clean Cities Program supports local actions to cut petroleum use in transportation. Clean Cities coalitions are public-private partnerships composed of businesses, fuel providers, vehicle fleets, state and local government agencies, and community organizations. The benefits of joining include networking opportunities, technical training, individual consultation and technical assistance, funding opportunities from DOE, assistance with media outreach, and public recognition for progress in reducing petroleum consumption (USDOE No Date).</p>

Strategy 3H: **Invest in technology to aid freight operators**

Overview	There are many ways to communicate delivery and trucking regulations to drivers and operators, one of which is enhanced technology. In addition to proper signage along roads and near delivery zones, technology can be used to guide and monitor drivers from their smartphones or GPS devices. Cities can also develop resources to help freight stakeholders keep up with changing technology in the industry.
How It Supports Freight & Smart Growth	Technology and variable message signs can be used to direct commercial vehicle operators to available loading zones, alley loading areas, and loading docks. Allowing companies to book parking and loading areas on line could also be effective.

Table 3-4. (Continued).

	Autonomous vehicles are in development and expected to be on the road in the coming decades. Cities have only begun to prepare for the effect that these vehicles will have on our transportation system. The public sector can help the autonomous vehicle industry by engaging in pedestrian safety outreach, in-ground charging facilities, side guards, advanced driver systems, and other strategies to help adapt to new vehicle technology.
Considerations and Tradeoffs	Although mobile apps and electric signage can be helpful, directions should be clear and understandable. Loading zones should be as easy to access as possible to reduce circling and erratic driving of truckers attempting to follow directions. In addition, technology development can be costly, so using personal mobile devices to assist with navigation may be the most scalable and cost-effective option.
Classifications	All 
Implementing Entity	Private and public sectors: state DOTs, municipal transportation department, logistics operators
Supporting Stakeholders	MPOs or COGs, municipal public works department, municipal planning department, trucking industry, community organizations, advocacy groups
Implementation	Both governments and private stakeholders can participate in developing effective technology for truck drivers. Governments can identify key locations for electric directional signage in addition to wired parking spaces to notify drivers where parking is available. Private entities can help build mobile apps to help truckers abide by local truck laws and guide drivers to their destinations.
Example(s)	New York City has experimented with a reservation system with some success (LKW 2010, Caruso and Hollaron 2014). In the private sector, Transfix has the goal of providing better technology for both truck drivers and shippers. Drivers can download an iPhone app to help them plan drives, manage loads, and get paid more quickly. With some enhancements, the route planning feature could help drivers find available parking and loading zones to make deliveries more efficiently.

Strategy 3I: Identify and support route networks	
Overview	When planning freight networks and corridors in a local area, it is important to identify route networks throughout the region. Although a particular corridor may pose problems within a city, it may be a crucial part of the overall transportation network and should be properly supported.
How It Supports Freight & Smart Growth	Transportation networks help connect communities, cities, states, and regions across a geographic area. Although municipalities, counties, and states are responsible for maintaining their designated roadways, the roads are often valued beyond a localized area. Similarly, one corridor can create traffic or flow issues that extend beyond the immediate area of that particular corridor. Scope of a corridor is not always the same as the actual area of effect. As a result, transportation planners must identify complete route networks and support those that are vital for freight movement and traffic flow of the regional and national economy. Understanding the broader freight transportation network can help planners make informed decisions about the roles of certain streets. Most streets ought to be Complete Streets. In some cases, such as connectors to marine terminals or intermodal rail terminals, large volumes of trucks present considerable safety concerns, so elements such as bicycle lanes may not be practical unless physical separation and buffers are included in the design.
Considerations and Tradeoffs	Transportation planners should take care to manage both geographic effects and jurisdictional effects of roadways.
Classifications	All 
Implementing Entity	Public sector: municipal planning department, transportation planning department
Supporting Stakeholders	Logistics providers, MPOs or COGs, municipal public works department, trucking industry, community organizations, advocacy groups

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Table 3-4. (Continued).

Implementation	Municipal, county, and state transportation planners should review their transportation plans to ensure that they identify and support freight transportation networks. If not, revise plans to consider both geographic and jurisdictional effects of roadways on the regional network.
Example(s)	The Alameda County Goods Movement Plan (Feb 2016) considered the entire Bay Area—Sonoma, Napa, Marin, Solano, Contra Costa, San Francisco, San Mateo, and Santa Clara Counties—evaluating the goods movement systems for Alameda County. This included major Interstate Highways, US Highways, State roads, Class I railroads, the Port of Oakland, and other freight assets. With that context established, the plan detailed the local goods movement system for the County and identified the most crucial last-mile connectors. This approach helps support the regional economy by defining how Alameda County's freight movement relies on and supports the broader transportation network. Columbia Street in Brooklyn, NY, is next to a marine terminal and a residential neighborhood. To accommodate truck traffic associated with the terminal and bicycle mobility in the neighborhood, the New York City Department of Transportation, with engagement from the Port Authority of New York and New Jersey and Brooklyn Bridge Park, developed a protected bicycle lane.
Strategy 3J:	Add smaller delivery vehicles to fleets
Overview	Opt to use smaller delivery vehicles, electric vehicles, cargo cycles, or freight tricycles in preference to standard-size trucks in dense, urban environments.
How It Supports Freight & Smart Growth	Smaller vehicles take up less space on the road, require smaller parking spaces, and consume less fuel than standard delivery vehicles. They also can better maneuver urban and smart growth environments, which often have limited space to make deliveries (The City College of the City University of New York and The Region 2 University Transportation Research Center 2014).
Considerations and Tradeoffs	Despite the substantial benefits of smaller vehicles for freight delivery, there are tradeoffs with scalability, speed, and volume. Using smaller trucks can result in an increase in the number of trucks needed to carry the same volume of cargo, perhaps resulting in more traffic and higher transportation costs to shippers. The benefits of smaller delivery vehicles are maximized with efficient incorporation into a company's existing logistics network.
Classifications	All 
Implementing Entity	Private sector: logistics operators
Supporting Stakeholders	Trucking industry, retail and commercial establishments, community groups, MPOs or COGs.
Implementation	Logistics operators and private retail or commercial establishments can review their logistics models and identify delivery routes in compact or dense areas and Smart Growth communities.
Example(s)	Small delivery vehicles are already popular in European and Japanese cities and are beginning to emerge in U.S. cities. FedEx uses a 15-ft-long van from the Nissan Cargo series for city deliveries. Nissan determined two target groups of interested customers: small businesses using non-commercial vehicles to make deliveries due to a lack of inexpensive vehicle options, and large cargo fleet owners seeking to swap out larger vehicles that were inefficient in some routes. The demand appears to be increasing for many businesses operating in dense urban areas (Bestfact 2013).

3.2.4 Phase 4. Ongoing Monitoring

The final phase for integrating goods movement into smart growth environments is ongoing monitoring. Once foundational and operational elements are in place, monitoring helps ensure that freight practices improve, adapt, and align with national or global standards. Although freight activity tends to be driven by profit maximization within individual organizations, monitoring can be used to mitigate or eliminate negative consequences.



Figure 3-5. Ballard case study focus group in session
(Source: Cambridge Systematics).

Monitoring can be done on many levels, so it is important to cover all transportation aspects of a smart growth community as well as neighboring communities. Smart growth policies that affect land use decisions generally occur at the local level, while freight transportation is often regional, national, or international in scope. Local land use and development policies that do not accommodate the needs of freight can have negative repercussions that extend far beyond the area where the land use decision was made.

Organizations from both the private and public sector can get involved in monitoring within a smart growth community or region (see Figure 3-5). Some strategies involve connecting the two sectors to achieve a stronger outcome. For example, hosting a community workshop for all stakeholders and participating in national or international discussions on freight best practices can foster active engagement among all parties. State DOTs, statewide planning departments, MPOs, and/or COGs can provide assistance through workshops, model zoning ordinances, and other efforts to municipal governments. Private-sector companies and organizations can provide information and feedback (on operational issues and needs) to MPOs and local planners who do not have the resources to monitor performance over time. Finally, public agencies can take advantage of the resources available in the private sector by working with firms to pilot-test delivery solutions. Table 3-5 presents strategies for ongoing monitoring.

Table 3-5. Strategies for ongoing monitoring.

Strategy 4A:	Host community workshops to connect stakeholders
Overview	Several communities host workshops to bring stakeholders together to discuss their needs and have them incorporated in the development of comprehensive plans, redevelopment plans, and transportation studies. Live demonstrations and visualization software are helpful in communicating designs and issues to stakeholders.
How It Supports Freight & Smart Growth	Smart growth planning is not a result of efforts from one company or one city agency; it is a collective of stakeholders and a mix of communities, businesses, residents, and consumers. Hosting community workshops allows local entities to discuss issues, identify needs, and find compromises among differing goals and uses within a smart growth community.

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Table 3-5. (Continued).

Considerations and Tradeoffs	Although community workshops enable stakeholders to connect and have vibrant discussion, it is important to establish a clear agenda to avoid off-topic discussion and ensure productive conversation. In addition, defining the roles and responsibilities of ongoing working group participants can help discussion and ideas get put into action.
Classifications	All 
Implementing Entity	Private and public sector: state DOTs; statewide planning agencies, MPOs or COGs; chambers of commerce; community development groups; municipal planning department
Supporting Stakeholders	Logistics operators, trucking industry, retail and commercial establishments, advocacy groups, community groups, community development department, local residents
Implementation	A local community group or planning agency can organize the event, secure the meeting location, connect with all relevant stakeholders, and ensure follow-up on issues discussed in the public meeting. The municipal planning agency can then review the comments and suggestions and incorporate themes into regional freight planning efforts.
Example(s)	The Institute of Transportation Engineers, FHWA, and Delaware Valley Regional Planning Commission (DVRPC) conducted the nation's first Downtown Delivery Symposium in 2015 to recognize the importance of balancing the need to get goods to the point of sale with the importance of offering a high quality of life to the citizens of the region's small, medium, and large towns. The 1-day workshop brought experts and stakeholders together to discuss solutions that balance freight operations and community goals. Oregon DOT (ODOT) established an organized engagement process with the freight industry to help vet issues in the transportation network. ODOT also uses demonstrations such as "better block" and roundabout rodeos that temporarily show how a proposed roadway design will work in real time. In one example, ODOT was building a roundabout intersection of US 20 and Barclay Drive in Sisters, OR. The freight industry was concerned about the ability to move its oversized loads through the intersection, so ODOT set up a mock course and tested the vehicles most likely to move through the intersection. A Washington State DOT study interviewed motor carriers in Seattle and King County to collect their suggestions for road and site design considerations (Smart Growth America No Date).

Strategy 4B: Provide technical assistance to local planners

Overview	Developing a technical assistance capacity at regional agencies such as MPOs can help local planners address smart growth and freight integration.
How It Supports Freight & Smart Growth	GIS analysis tools, better visualization techniques, and travel demand and traffic simulation analysis tools can help planners better understand the potential effects of decision making (Strauss-Wieder 2003, Smart Growth America No Date). Some planning agencies may lack expertise or funding to acquire these tools individually, so technical assistance may be required. Implementing assistance or training programs can help these agencies be more effective and realize optimal outcomes in their planning districts.
Considerations and Tradeoffs	Analysis tools can be improved by expanding and standardizing land use classifications that concern freight activities in travel demand forecasting models and traffic simulation models and refining measures of freight trip generation (estimated based on employment) and freight generation (based on economic activity). Better classifications and modeling factors will allow modelers to more accurately estimate truck and automobile trip generation and to prepare more appropriate plans (Caruso and Hollaron 2014).

Table 3-5. (Continued).

Classifications	All 
Implementing Entity	Private and public sector: state DOTs, statewide planning agencies, MPOs or COGs, private consultancies, municipal planning agencies
Supporting Stakeholders	Community development groups, advocacy groups.
Implementation	MPOs and other regional agencies can release a request for proposals (RFP) to qualified private consultancies, who can strategize and develop technical assistance and analysis tools to assist the planning agency.
Example(s)	Metro (the MPO for Portland, OR) coordinated a technical assistant account for cities to use toward routine modeling and analysis needs. Metro also added a transportation engineer to its team to help smaller jurisdictions with urban design solutions appropriate for their needs (Transport for America 2014).
Strategy 4C: Participate in national or global discussion on freight best practices	
Overview	Private companies can participate in industry forums or conferences to exchange ideas and discuss industry problems.
How It Supports Freight & Smart Growth	This type of engagement can help mitigate issues between incompatible land uses and encourage a more seamless, safe, and environmentally-friendly integration of freight into smart growth communities.
Considerations and Tradeoffs	Although industry engagements enable stakeholders to connect and have vibrant discussion, it is important to establish a clear agenda and encourage productive conversation.
Classifications	All 
Implementing Entity	Private and public sector: USDOT, state DOTs, MPOs or COGs, municipal planning agency, education/research institution
Supporting Stakeholders	Logistics operators, municipal public works, trucking industry, research institutions, consultancies
Implementation	In most cases, meetings can be initiated by a research institution or organization with a topic or issue of interest. Stakeholders could meet in person or via conference calls
Example(s)	The Volvo Research and Educational Foundations' Center of Excellence for Sustainable Urban Freight Systems (CoE-SUFS) hosts webinars, conducts research, and establishes best practices in the freight industry. Private companies can contribute to research efforts and participate in organized discussion on key topics. The New York State Energy Research and Development Authority (NYSERDA) provided funding to organize an international conference in New York City to address cleaner mobility vehicles and last-mile freight delivery issues. The conference brought together over 100 public- and private-sector stakeholders from the United States, France, Portugal, Brazil, and the Netherlands (UTRC 2014).
Strategy 4D: Work with the private sector to pilot-test delivery solutions	
Overview	Government agencies can take advantage of resources within private-sector companies to pilot-test delivery solutions.
How It Supports Freight & Smart Growth	Government agencies can remain involved in developing innovative solutions to freight delivery without investing significant time and money into the testing process. Private companies benefit from the collaboration with the public sector, and delivery solutions can be tested in current, real-world situations. This ensures that the solutions are relevant and effective.
Considerations and Tradeoffs	Financing necessary testing periods may be difficult for some municipalities. Findings may be difficult or cost-prohibitive to implement. Additional staff may be required to manage test projects.

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Table 3-5. (Continued).

Classifications	All 
Implementing Entity	Private and public sector: municipal planning agency, education/research institution
Supporting Stakeholders	Logistics operators, state DOTs, MPOs, municipal public works, research institutions, advocacy groups, consultancies, public or private grant/loan financing organizations
Implementation	Municipal agencies can issue requests for proposals (RFPs) for private-sector companies to develop and test solutions to freight problems within a smart growth community. Project deliverables would include a robust testing period to ensure the effectiveness of the solution.
Example(s)	The European Union is pilot-testing delivery solutions in major cities. In Berlin, Germany, an urban freight laboratory has been developed in a central community with residential and mixed-use business and retail activity. The site consists of lockers for parcel storage and electric-assisted bicycles for delivery (Bestfact 2013). Additionally, TRB's second Strategic Highway Research Program (SHRP 2) was developed to promote research in highway safety, congestion reduction, and improved methods for renewing roads and bridges (TRB 2015). DVRPC, the metropolitan planning organization for Greater Philadelphia, is working on developing the Philadelphia Delivery Handbook (expected completion Fall 2016). The book gives greater attention to last-mile freight operations and the further emergence of vibrant city neighborhoods and offers best practices and a complete streets checklist for delivery considerations. The City of Philadelphia and members of DVRPC's freight advisory committee are helping this effort.
Strategy 4E: Adapt to changing market forces	
Overview	Smart growth environments are most successful when governments adapt plans, strategies, and roles to fit the current context.
How It Supports Freight & Smart Growth	Communities, cities, and states are constantly changing in response to the political climate, economy, and overall society. However, city, state, and regional transportation plans are often developed for an extended period. As market conditions change within a particular area, it is important for the government to embrace positive change and mitigate negative developments. Changes can occur in manufacturing industries, retail and restaurant businesses, rental housing markets, buyer housing markets, and transportation mode choice, among other market forces.
Considerations and Tradeoffs	In addition to adapting to changing market forces, governments can also play a role in enforcing and educating the public about the changes. A public education component can improve the success of a program or initiative because sometimes things do not work because people do not understand them. Outreach material can be helpful to demonstrate to stakeholders how the community was created and where it is headed in the future.
Classifications	All 
Implementing Entity	Private and public sector: USDOT, state DOTs, MPOs or COGs, municipal planning agency, education/research institution
Supporting Stakeholders	Logistics operators, municipal public works, trucking industry, research institution, consultancies
Implementation	Municipal governments should monitor the success of comprehensive plans and adjust plans or policies when necessary, acknowledge when markets begin to affect the local economy or transportation network, and educate the public when appropriate.

Table 3-5. (Continued).

Example(s)	South Park, in downtown Los Angeles, has gone through extensive redevelopment over the past 10 to 15 years. The district experienced a significant decline in the post-WWII era of mass suburbanization, which led to a flight of jobs, businesses, and entertainment from the area. In recent years, South Park has transformed into a central business district, with ample restaurants, shopping, and residential development. There is a strong focus on transportation and making South Park more pedestrian friendly. However, at least six different development plans and eight major project masterplans may have overlapping and potentially conflicting land use regulations. With so many development plans, the South Park Business Improvement District (BID) is taking the lead to coordinate these plans, become more involved in planning and development approval, and ensure that South Park's development is livable and sustainable. The South Park BID is also considering tackling underused surface parking lots, which presents an opportunity to incorporate both smart growth principles and freight into redevelopment plans (Urban Land Institute 2013, Jones Lang LaSalle 2013).
Strategy 4F: Determine ways to measure and monitor performance	
Overview	Once a community implements a plan or strategy related to incorporating freight into smart growth environments, put in place a way to monitor and manage progress and results.
How It Supports Freight & Smart Growth	Developing performance measures for smart growth strategies helps planners evaluate how effective the strategy is in their community. Without appropriate data, it can be difficult for planners to prove to the public whether the strategy works. However, either a quantitative (measurable and quantifiable data) or qualitative (descriptive or observational data) approach to collecting data and assessing performance helps to solve this issue.
Considerations and Tradeoffs	Once planners decide how to measure and record performance data, they should ensure the data is accessible to the public. Doing so increases the transparency of program success and enables others to evaluate the data and provide input on the progress of the program.
Classifications	All 
Implementing Entity	Public sector: municipal planning department, transportation planning/engineering department, MPO
Supporting Stakeholders	Logistics operators, state DOTs, municipal public works, advocacy groups, consultancies, public or private grant/loan financing organizations
Implementation	Identify strategies to incorporate freight into smart growth environments and develop methods of collecting quantitative or qualitative data that evaluates its success or failure. Post data or results in a publicly accessible format (such as a PDF or Microsoft Excel worksheet on the agency's website) for further review.
Example(s)	The Port Authority of New York & New Jersey (PANYNJ), New Jersey DOT, and New York State DOT developed the Goods Movement Action Program (G-MAP) to share the responsibility of managing freight mobility throughout the New York–New Jersey metropolitan region. The program establishes an agenda of discrete and tangible measures to address efficient and sustainable goods movement, operational and regulatory reforms, and long-term investment needs. The team has identified specific “early actions” to improve the freight network, in addition to specific action packages to help accomplish what is vital and achievable. Two G-MAP highlights include (1) a network for 53-ft-long trailers to John F. Kennedy International Airport (JFK), which creates a legal highway-only route to carry freight to and from the airport, and (2) an open source data portal to provide transportation data critical to maintaining an efficient freight network (PANYNJ 2016).



CHAPTER 4

Case Studies

Examples of goods and services vehicle movement issues and the success or failure of potential solutions can be seen in communities throughout the country. Six communities were evaluated as detailed case studies, including site visits and stakeholder focus groups convened to discuss issues, solutions, and unresolved needs. Each case study represents one of the smart growth classifications identified in Section 2.1.3. The case study locations and their smart growth classifications are listed in Table 4-1 and mapped in Figure 4-1.

None of the six case studies offers a perfect example of a community integrating freight into smart growth environments. The case studies highlight specific strategies, only some of which were successful. In general, freight was largely discovered as an issue throughout the process and was not typically at the forefront of the planning or development. However, each case study offers important lessons about what happened and what stakeholders can still do to improve the situation. Perhaps the most important or valuable lesson learned from these case studies is that establishing a shared vision and a cooperative relationship among developers, land use and design review agencies, the business community, and residents paves the way for introducing innovative design and operations strategies. In the cases of Belmar and Daybreak, specifically, maintaining close working relationships among these groups allowed for the use of unconventional “non-standard” design features and gave designers the flexibility to adapt such features over time to respond to observed conditions or to changing needs in the community.

Each case study describes

- The **context and history** of the case study community;
- How plans, studies, and community goals guided the **application of smart growth principles** in the case study community;
- **Conditions**, with an emphasis on how goods and services vehicles operate within the community, and **results** of the approaches used; and
- **Strategies** considered and/or implemented to address problems or issues, as well as **critical factors** that contributed to success.

4.1 Brady Arts District: Industrial Areas Transitioning to Housing and Entertainment Districts

Characteristics of the Brady Arts District are presented in Table 4-2.

4.1.1 Context and History

Settled in the 1820s, Tulsa, OK, is the second largest city in the state with a population of just under 400,000. The Brady Arts District, along with the neighboring Greenwood neighborhood,

Table 4-1. Smart growth classifications.

Classification	Case Study
	Industrial areas transitioning to housing and entertainment districts Brady Arts District, Tulsa, OK
	Working waterfronts transitioning to mixed-use and/or recreation Ballard Neighborhood, Seattle, WA
	Older commercial and neighborhood areas being revitalized Over-the-Rhine, Cincinnati, OH
	Retrofitting aging commercial corridors Glen Street (US 9), Glens Falls, NY
	Greenfield new communities Daybreak, South Jordan, UT
	Large-scale reconstruction Belmar District, Lakewood, CO

are just north of Tulsa's Central Business District, with I-244 forming the northern and eastern boundaries, N. Denver Ave. forming the western boundary, and a BNSF rail line along the southern boundary (see Figures 4-2 and 4-3). These two neighborhoods are experiencing rapid growth, with development focusing on entertainment and restaurants. Further retail and commercial growth, along with an increasing residential presence, is expected in the next decade.

The Brady area flourished in the first half of the 1900s as the Frisco Railroad, followed by the KATY railroad (Missouri-Kansas-Texas Railroad), connected the region with the rest of the country. In the 1920s, what is today the Brady neighborhood developed into a rail-served commercial and industrial area. In the 1940s and 1950s, with the national shift toward trucking, the neighborhood became a center for trucking businesses, including depots, warehousing, and

**Figure 4-1. Case study locations (Source: Cambridge Systematics).**

Table 4-2. Characteristics of Brady Arts District.

Characteristic	Description
Community	Brady Arts District in Tulsa, OK
Smart Growth Classification	 Industrial areas transitioning to housing and entertainment districts
Context	Former rail-served commercial and industrial area. Introduction of trucking turned district into a hub for trucking depots, warehousing, and transfer facilities. Over the past 20 years, the district has transitioned into an arts and entertainment district, but seeks to preserve the industrial character of the neighborhood.
Stakeholders	City of Tulsa, Oklahoma State Historic Preservation Office, real estate developers, local businesses, local residents, freight industry
Key Issues	<ul style="list-style-type: none"> • Rehabilitation/construction has generated a substantial amount of truck activity. New businesses have also generated freight traffic from food/product deliveries. • Residents have mixed feelings about retaining freight-generating industries. • Conflict between residential and commercial uses. Land being used for truck parking and loading/unloading is attractive to real estate developers; if developed, this would affect businesses. • Double-parking for loading/unloading may function well now, but as the community grows, it may be necessary to develop formal delivery or loading zone regulations for commercial vehicles.
Key Takeaways	<ul style="list-style-type: none"> • Certain industrial facilities can be used as a buffer against less desirable municipal uses. • Innovative funding strategies (e.g., tax increment financing) can help planners improve streetscaping and improve walkability with limited resources.
Relevant Strategies	<ul style="list-style-type: none"> • 1A: Define your community's goals • 1B: Employ freight-compatible development • 2F: Create "buffers" with setback and/or landscaping requirements • 2H: Implement traffic-calming techniques to reduce conflict • 2I: Use innovative financing techniques • 4E: Adapt to changing market forces

transfer facilities. Most of the rail spurs and sidings in the neighborhood were removed after railroad access from the west was closed in 1964, and the region is no longer served by rail. In the 1970s and 1980s, investors began to acquire old buildings, and theater and music groups began to move in. In 1993, the City of Tulsa approved the Brady Village Tax Increment District to assist further development (City of Tulsa 2012). Today, the Brady Arts District is bordered by I-244 and an active freight rail line. There is a mix of restaurants, entertainment venues, and manufacturing companies such as Borden Dairy, Baird Manufacturing Company, and L. A. King.

4.1.2 Application of Smart Growth Principles

Over the past 20 years, the Brady Arts District has been reinvented as an eclectic arts and entertainment district that is home to a growing number of bars, restaurants, residences, retail, office space, museums, and arts establishments. Many of these new businesses and residences are being developed so as to preserve the character of the neighborhood's historic industrial buildings.

The completion of Guthrie Green in 2012 on the site of an old commercial warehouse and freight yard has also provided greenspace and a cultural activity center for the neighborhood with daily and special events, food trucks, a farmers market, and other offerings (Guthrie Green 2015). Other entertainment destinations in the district include the Jazz Hall of Fame, Cain's Ballroom, Brady Theatre, and the Woody Guthrie Museum. Another major development was the completion of a Fairfield Inn & Suites in 2012, which added hotel accommodations and was

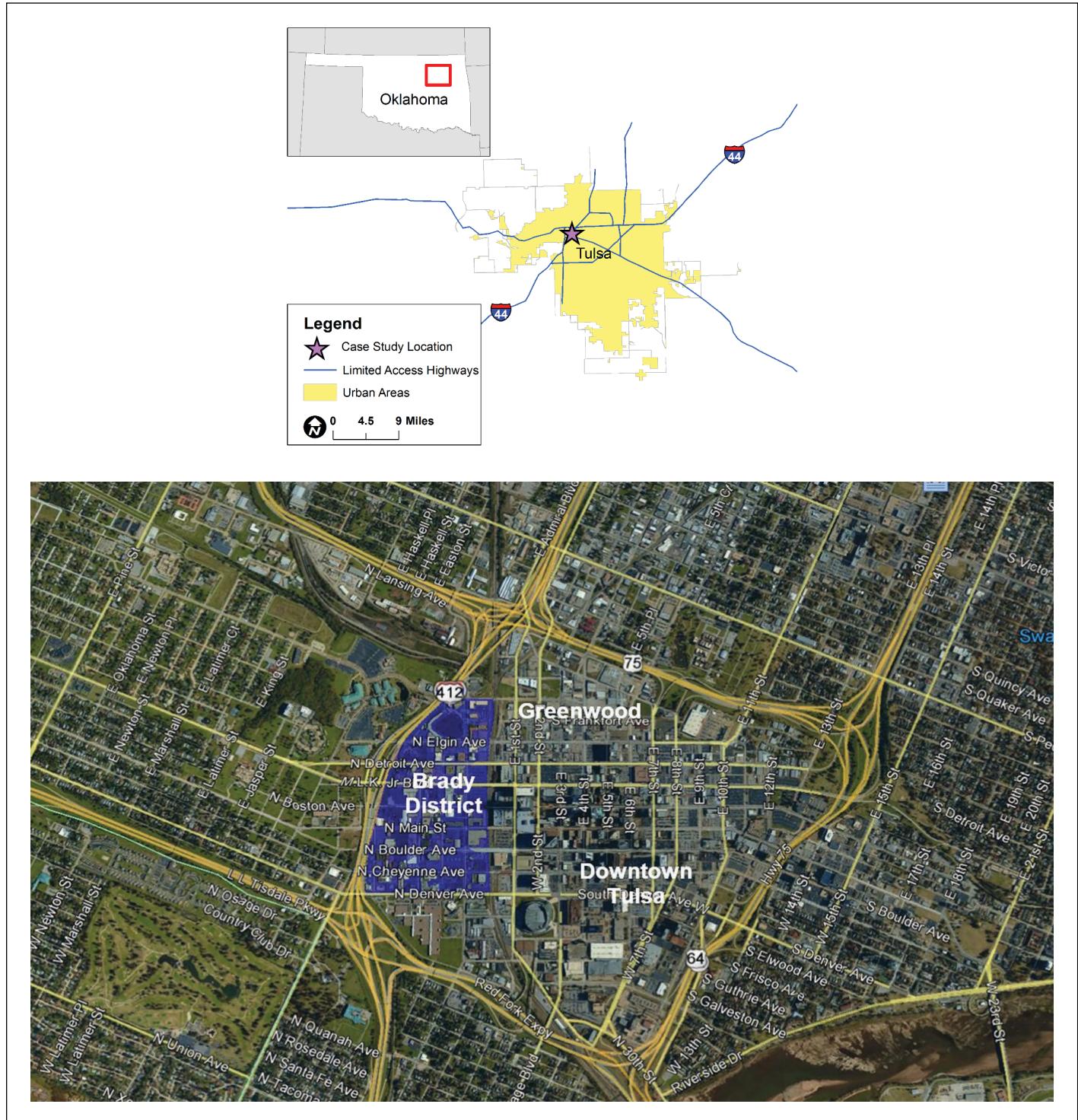


Figure 4-2. Location of Brady Arts District (Source: [top] ESRI; [bottom] Google Earth, 2016).



Figure 4-3. Annotated map of Brady Arts District (Source: Google Earth, 2016).

built with retail and restaurants on the ground floor. Most of the current development is centered on N. Main Street and points east.

The Brady Arts District and the adjacent central business district to the south are gaining population. Over 500 apartment units have come into the downtown in the last few years, with approximately 140 in Brady and neighboring Greenwood. Approximately 1,000 units are either under construction or in planning in Tulsa, with more than 200 of them planned for the Brady/Greenwood areas.

Many of the industrial buildings that have characterized the district since the 1920s still remain, and some of them still house freight-generating businesses. In addition to dining and entertainment and proximity to downtown Tulsa's central business district, the industrial character and history of the Brady Arts District attracts visitors and residents, especially millennials. Housing options available or to be developed in the District include loft-style apartments and condominiums that are unlike the housing stock elsewhere in the region. There is a desire to retain the industrial character of the District.

Availability of both Federal Investment Tax Credit and historic tax credits from the Oklahoma State Historic Preservation Office facilitated rehabilitation of older buildings, instead of building new construction. The two programs allow for a combined 40% reduction in cost for rehabilitation work on non-residential "certified historic structures" (Tulsa Preservation Commission 2015).

The City of Tulsa produced a Small Area Plan for the Brady Arts District and adopted it as part of the City's Comprehensive Plan. The Small Area Plan establishes the long-term vision for the District. It describes the mix of business, residential, and entertainment facilities and activities that



Figure 4-4. City of Tulsa's streetscape guidelines for Brady Arts District (Source: City of Tulsa, OK).

are likely to occur there. The Small Area Plan also establishes design and streetscape guidelines that will advance that vision as they are developed and implemented (see Figures 4-4 and 4-5). These guidelines set safety, aesthetic, and complete streets goals for streetscapes in the district and identify the need to expand the supply of on-street parking and to accommodate loading docks and utilities access as needed (City of Tulsa 2012).

4.1.3 Goods/Services Conditions and Results

Industrial facilities in the district, including Borden Dairy, Baird Manufacturing Company, and L.A. King, produce goods ranging from dairy products to valves and regulators to sheet

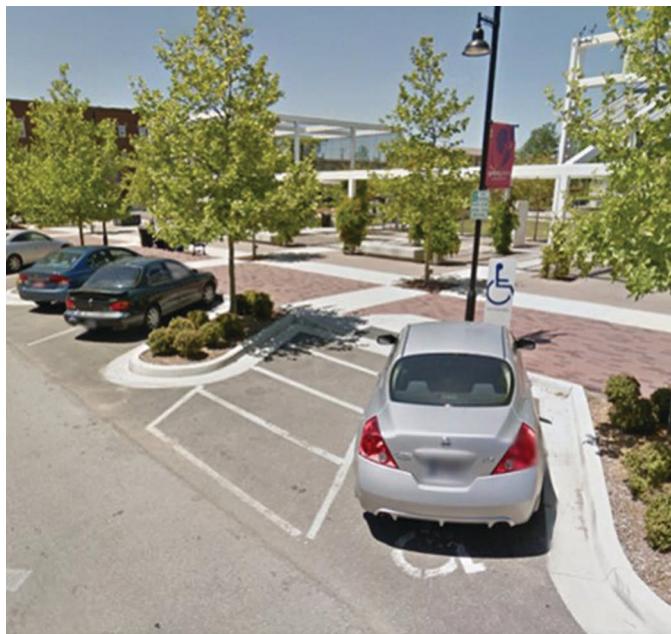


Figure 4-5. Streetscaping at Guthrie Green in downtown Brady (Source: Google Street View, May 2014).

metal, insulation, ventilation products, and other goods used in manufacturing and construction industries. In addition to these legacy businesses, newer businesses in the entertainment and food service industries generate freight in the form of food and product deliveries and waste disposal. The rehabilitation of older buildings and construction of new buildings generate movement of debris, construction materials, and equipment by truck.

The overall view on retaining freight-generating industries was mixed. These industries provide jobs and taxes to the neighborhood and help maintain the authentic industrial atmosphere. Industrial properties on the western edge of the District, including Borden Dairy, serve as a buffer by separating the main entertainment and residential areas from the Tulsa County Jail complex. On the other hand, some of the industrial properties in the District are considered “eyesores,” and, although few residents or other groups have complained about truck traffic or truck parking on or next to industrial properties, such conflicts could become common as the District’s residential population rises.

The continued growth of residential and entertainment uses in the Brady Arts District could create conflict as growth spreads west in the neighborhood. For example, Borden Dairy leases a piece of land across from Brady Theater and uses it as a truck parking area (see Figure 4-6). This piece of land has been identified for conversion to residential or commercial use, with parking for Borden relocated to adjacent areas north or southwest of Brady. Relocating the truck parking could affect (1) Borden’s ability to load and unload shipments efficiently and (2) current or future businesses or residents in the locations to which the parking would be moved.

Deliveries to restaurants and retail establishments are not considered a significant issue. Many of the streets in the Brady Arts District are wide enough to accommodate double-parking during deliveries without traffic flow being affected substantially (see Figure 4-7). Some deliveries can or could use alleys established from former rail spurs or sidings that provided access to many of the industrial buildings when rail was the dominant mode of transportation (Farley 2015). Business representatives in the District stated that double-parking to make deliveries generally works for motor carriers and local businesses and is a generally accepted practice. However, this solution is a work in progress and does not meet the safety, aesthetic, and Complete Streets goals for the District to encourage more walking and bicycling. As the Brady Arts District continues to grow and the numbers of businesses, residents, vehicles, and pedestrians increase, district and



Figure 4-6. Borden Dairy parking area adjacent to Brady Theater (Source: Cambridge Systematics).



Figure 4-7. *Box truck making a delivery in Brady while double-parked (Source: Cambridge Systematics).*

city planners recognize there may be a need to revisit the issue and propose formal delivery or loading zone regulations in the future.

Traffic-calming and streetscaping strategies have been used or are likely to be used in the District in the future, which reflects Strategy 2H to implement traffic-calming techniques to reduce conflict. Developers recognize that such improvements could, unintentionally, affect truck movements and/or loading/unloading, if they are not planned with input from business owners and other freight stakeholders. Coordination with multiple stakeholder groups will have to be undertaken to ensure that safety, beautification, and economic development goals can be accommodated.

The developers, engineers, and business community in the District are generally pleased with the direction the Brady Arts District is heading and want to sustain momentum. Further infill and rehabilitation projects, the creation of a more diversified transportation infrastructure, increasing connections with the Greenwood neighborhood, and increasing the residential population were all mentioned as key next steps. Balancing continued attraction of entertainment and cultural facilities (including the Oklahoma Museum of Popular Culture (OKPOP) which is scheduled to open in the District in 2018) with the needs of existing users will be integral in maintaining the “feel” of the District and promoting growth in the years to come (Tramel 2015).

4.1.4 Strategies and Critical Success Factors

The success of the Brady Arts District has been attributed to the following critical success factors. These can also serve as recommendations to communities facing similar problems.

- **Identifying a champion.** The Brady Arts District owes much of its success to the George Kaiser Family Foundation (GKFF) and the substantial contributions it has made to the neighborhood. Although not every location will have access to the financial resources available through the Foundation, the private-sector “champion” is generally credited with ensuring the success of the District’s revitalization to date. In locations where local government is not

able or eager to drive change, the willingness of a private company or individual to push for adjustments can make the difference. For example, private funding for street trees or public events can produce momentum for larger initiatives. The ongoing development in the District is unfolding organically and is driven primarily by private-sector partners.

- **Planning for all possible growth scenarios.** This aligns with Strategy 1A, which encourages planners to define their community's goals. Developers, engineers, and local officials have all commented that the rate of change in the Brady Arts District was faster than expected. Elements of the Small Area Plan for the Brady Arts District may need to be implemented on a rapid schedule to keep pace with development and growth. Rapid growth could mean that street improvements that require inclusion in the Transportation Improvement Program (TIP), which is a list of priority transportation projects for the region as required by the federal government, may advance simultaneously instead of in a phased approach. In this scenario, the developers and the city will have to work with the MPO to (1) prioritize and phase projects and (2) determine whether all of the needs can be accommodated when other priorities in the region are taken into account in the TIP.
- **Using industry as a buffer.** For the western edge of the District, the Borden Dairy production facility acts as a buffer between the core of the Brady Arts District and less desirable municipal uses. This is related to Strategy 2F to create buffer zones to reduce the negative aspects of freight activity. The ability to see this freight-generating facility as an asset reduces tension between the legacy industrial businesses and newcomers.
- **Recognizing that form and history matter.** The industrial past of the Brady Arts District is generally considered a unique, valuable asset. Retaining the feel, if not always the function, has been critical in the District's success. Good neighbor policies (such as keeping their surroundings clean and coordinating with the community to reduce noise, pollution, or traffic) can help legacy industrial businesses remain vital and desirable members of the community. Although not part of the current Draft Tulsa Zoning Code, the repeated emphasis on form over function may be an argument for using an FBC in other locations.
- **Using innovative funding.** This corresponds with Strategy 2I, which encourages planners to use innovative financing techniques to fund new development. Historic Tax Credits at both the Federal and State level were cited as invaluable resources in allowing the District to keep its historic feel. Brady was also the first Tax Increment Financing (TIF) District in Tulsa, formed in December 1993. TIF is a value-capture strategy in which municipalities divert future property tax revenue increases from a specific area toward economic development projects in the community. This designation allowed the George Kaiser Family Foundation (GKFF) and its engineers to pursue streetscaping activities with limited financial support from the City. These improvements have improved walkability in the neighborhood, further driving economic activity while maintaining an urban, industrial look.
- **Understanding land ownership and industry trends.** This parallels Strategy 4E, which encourages planners to adapt to changing market forces. Knowing the ownership status of properties (leased or owned, length of lease, etc.) helps inform future land use decisions. For example, as an area improves and property values increase, businesses that lease land may face different economic decisions than those that own their land. Rising property values may push leasing industrial uses out of an area as the rent becomes too high. However, businesses that own their land may not face this same issue. Understanding how every property in a neighborhood will react to this type of market condition is necessary in order to predict and guide future development. It is also important to have a sense of whether local industries are growing or declining to better anticipate changing land use needs.
- **Ensuring communication among all stakeholders.** Communication is essential to reducing tension between legacy industrial businesses and new restaurant/entertainment businesses and residents. The relationship between Borden Dairy and the City of Tulsa was strained for

years due to a conflict over the use of eminent domain for the municipal facilities just west of the District—this situation illustrates the consequences of allowing communication to break down.

- **Acknowledging that informal arrangements or work-arounds that suffice for now may have to be changed in the future.** Deliveries to restaurants and retail in the Brady Arts District are often achieved by double-parking the delivery vehicle on the road. The current traffic levels and street designs allow for this with minimum disruptions, and it is accepted practice among businesses in the District. However, most commercial drivers do not prefer this situation because it raises the risk of crashes and receiving a ticket. The ability to double-park may shift as the community grows and delivery and transportation needs change. Anticipating and planning for this will allow for freight movement to continue with minimal disruptions to other users.

4.2 Ballard: Working Waterfronts Transitioning to Mixed-Use and/or Recreation

Characteristics of the Ballard neighborhood are presented in Table 4-3.

Table 4-3. Characteristics of Ballard neighborhood.

Characteristic	Description
Community	Ballard neighborhood in Seattle, WA
Smart Growth Classification	 Working waterfronts transitioning to mixed-use and/or recreation
Context	Originally a destination for lumber and shipping activities in Salmon Bay, northwest of Downtown Seattle, Ballard quickly became a major hub for the maritime industry. The neighborhood was affordable for local working class residents, but population grew dramatically by 2010. Land and housing prices have increased dramatically, putting pressure on the maritime industry and local residents.
Stakeholders	City of Seattle, State of Washington, maritime industry, local businesses, local residents, freight industry
Key Issues	<ul style="list-style-type: none"> • Ballard's increasing residential and mixed-use character is putting pressure on the remaining maritime industry. • Land and housing prices near the waterfront have increased dramatically, affecting both industry and working class residents. • Freight delivery to new business is challenging. Insufficient street geometry and lack of designated commercial loading zones pose a challenge to shippers.
Key Takeaways	<ul style="list-style-type: none"> • The long-term viability of the maritime industry depends on whether the residents want to preserve it. • Most streets should be "Complete Streets," but in the core industrial area there are few options to incorporate elements such as protected bicycle lanes to safely accommodate nonmotorized users on one major truck route. In this rare instance, a "Complete Street" may not be needed or wanted and other routes may be improved to better connect nonmotorized users. • Proper zoning and land use regulations are critical to retaining industry. Planners must be sure to close all zoning loopholes to avoid unwanted development.
Relevant Strategies	<ul style="list-style-type: none"> • 1A: Define your community's goals • 1B: Employ freight-compatible development • 1F: Discourage incompatible land use development • 2I: Use innovative financing techniques • 3I: Identify and support route networks • 4E: Adapt to changing market forces

4.2.1 Context and History

As with the industrial area transitioning environment, many working waterfront communities are experiencing a similar transition, and conflicts among the operational and transportation needs of legacy maritime industrial facilities and the needs of newly arriving residents and entertainment and services businesses can arise. The maritime industry (particularly legacy bulk cargo) has changed over the past several decades. Containerization changed how the waterfront is used and resulted in the consolidation of many maritime support services, leaving vacant waterfront parcels open for redevelopment. However, there is competition for access to the waterfront, and limited options for the maritime industry to relocate.

The Ballard neighborhood in Seattle, WA, is a community seeking to balance the needs of businesses and residential interests and reap economic and quality-of-life benefits by accommodating a robust maritime industry and a residential real estate boom.

The Ballard neighborhood, about 6 miles northwest of downtown Seattle, runs along the north shore of Salmon Bay and the Fremont Cut—both of which allow passage to Lake Union—north to approximately 85th Street and east from Shilshole Bay to approximately 3rd Ave NW (see Figures 4-8 and 4-9). Ballard was founded as an independent city in 1889 and was annexed by Seattle in 1907. Early development was oriented around a commercial center along Ballard Avenue and lumber and shipping activities on Salmon Bay, including shingle manufacturing and ship construction and repair. The 1910s saw an explosion in maritime industry with the creation of the Ballard Locks (1912–1917); the Ship Canal linking Puget Sound to Lake Washington (1911–1934); and Fishermen’s Terminal, which has served as home to most of the North Pacific Fishing Fleet since 1914 (Ballard Historical Society 2015).

Through most of the 20th century, Ballard was an affordable working-class neighborhood where many of the residents worked in local industries. However, rapid growth in housing and population in the neighborhood—from approximately 38,500 in 1990 to approximately 44,000 in 2010—has resulted in surging land and housing values and rising purchase and rental costs for residents (City of Seattle 2011). Since 2008, the average home price in Ballard is more expensive than the City as a whole. The City’s connection to the dot-com industry boom in the late 1990s changed land use patterns and led to a rise in young, higher wage workers entering the housing market, with many choosing to settle in Ballard.

Today, Ballard is a diverse neighborhood that is home to various uses, including residential, commercial, retail, brewing and distilling, and light manufacturing, and a significant waterfront industrial presence that is heavily tied to the North Pacific Fishing Fleet (see Figure 4-10). In 1994, Seattle’s Comprehensive Plan designated most of the neighborhood as a Hub Urban Village (HUV) with mixed-use residential focus, but reserved the shoreline as part of the Ballard-Interbay Manufacturing/Industrial Center (MIC). These designations guide development within each area—the HUV accommodates employment and housing growth and MIC protects current and future industrial uses (Seattle 2005 a and b).

Although the City recognizes the enormous role that the maritime industry has in the local, state, and national economies, Ballard’s increasingly residential and mixed-use character is putting pressure on remaining industries. One of the planning objectives identified in the City of Seattle’s Draft Urban Design Guide for Ballard is “protecting and supporting Ballard’s industries and ensuring a balance between industrial, commercial, and residential growth” (Seattle 2014b). Creating a balance between industry and mixed-use residential that supports the continued viability of the area’s maritime industrial sector is ongoing. The Ballard Merchants Association and Ballard Chamber of Commerce also exist to strengthen the economic vitality of the neighborhood.

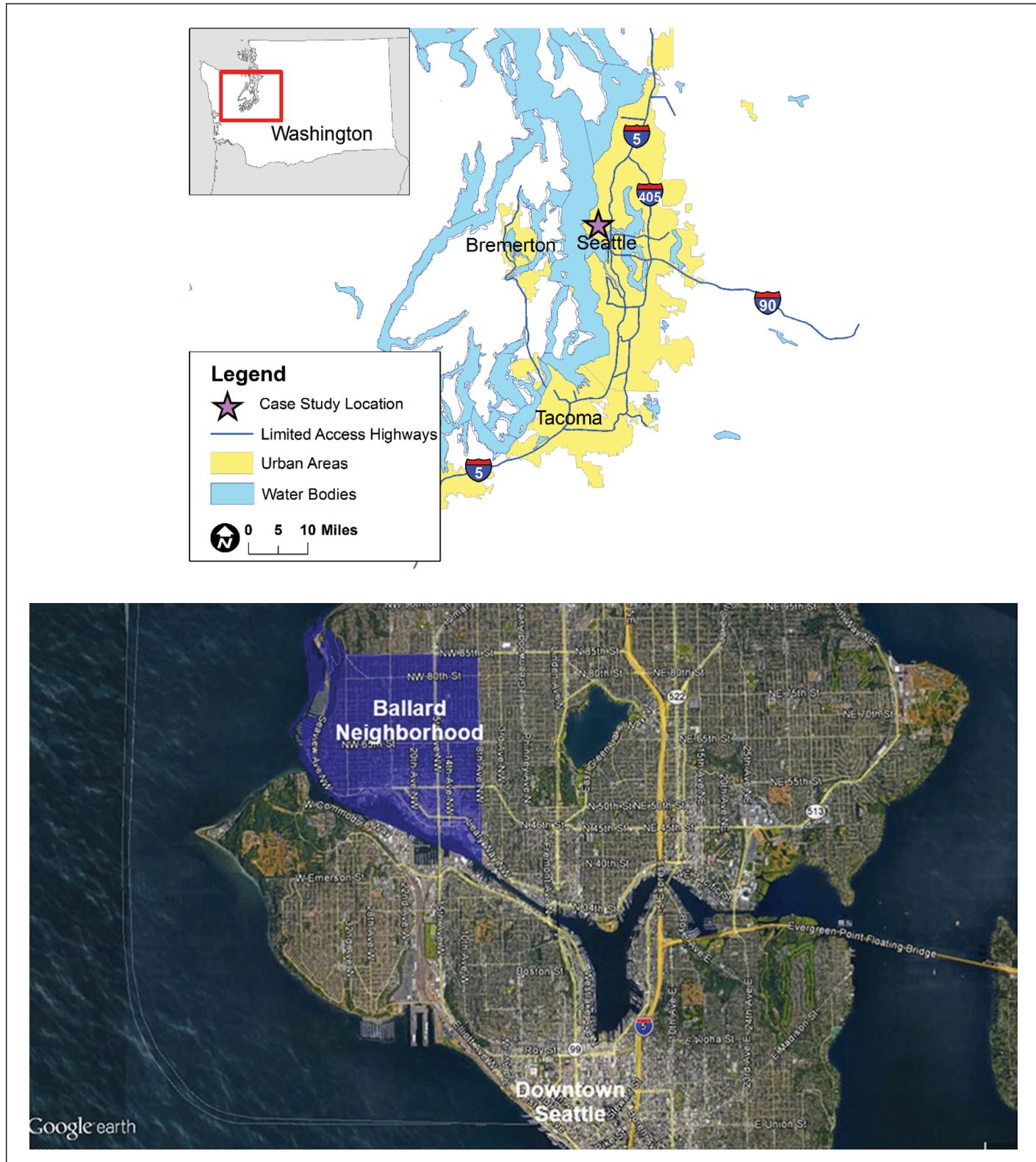


Figure 4-8. Location of Ballard neighborhood (Source: [top] ESRI; [bottom] Google Earth, 2016).

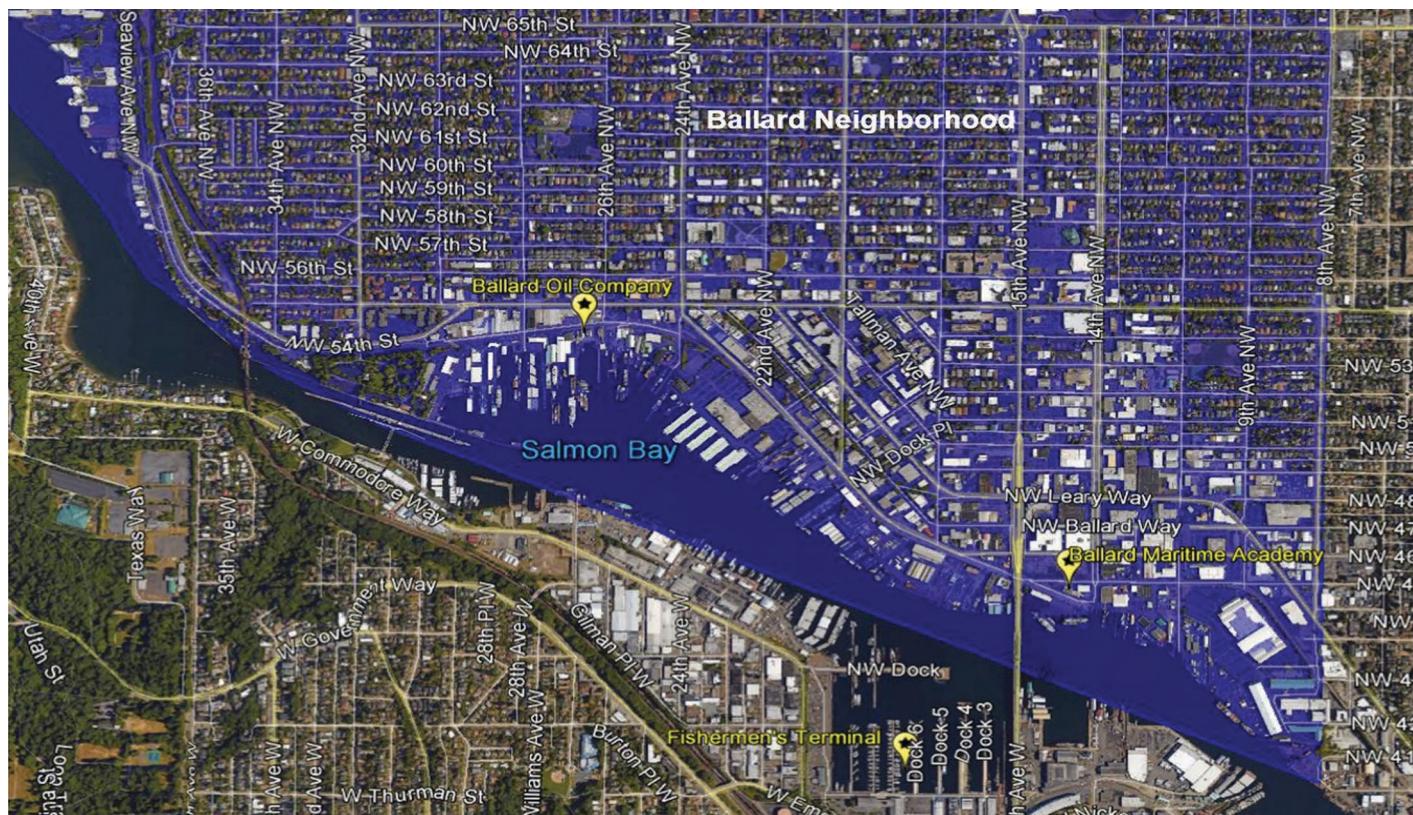


Figure 4-9. Annotated map of Ballard neighborhood (Source: Google Earth, 2016).

4.2.2 Application of Smart Growth Principles

The Washington State Growth Management Act of 1990 resulted in the creation of the Puget Sound Regional Council and the drafting (in 1993) of *Vision 2020*, a regional growth strategy to combat sprawl. *Vision 2020* inspired the Urban Village Strategy outlined in Seattle's Comprehensive Plan, *Toward a Sustainable Seattle* (adopted in 1994) and the first comprehensive plan for the city. The strategy is to accommodate growth and create a sustainable city by targeting increased density in those areas that can best support it. The strategy includes four categories: Urban Centers, Hub Urban Villages (HUVs), Residential Urban Villages, and



Figure 4-10. Waterfront industry in Ballard
(Source: Cambridge Systematics).

Manufacturing/Industrial Centers (MICs). Urban Centers and MICs are regionally designated by the Puget Sound Regional Council (PSRC). Urban villages are locally chosen and based on access to transit, existing development patterns, and capacity for growth. HUVs, like Ballard, are areas that offer goods and services, as well as access to jobs, through a balance of housing and employment. The Crown Hill-Ballard Neighborhood Plan (adopted in 1998) picked up on this strategy to “expand Crown Hill/Ballard’s image from a Scandinavian enclave to a family-friendly neighborhood that offers the best of Seattle living” (Crown Hills/Ballard Neighborhood Planning Organization 1998). The Urban Village Strategy was a key element in the 2005 Comprehensive Plan Update, which maintained Ballard’s HUV and MIC designations. *Seattle 2035*, the current Comprehensive Plan Update, states in the February 2014 Background Report that the plan has “successfully guided three-quarters of the new housing to designated urban centers and urban villages” (Seattle 2014b). However, balancing this type of growth with the need to preserve local industries remains an important part of the ongoing planning efforts. In 2012, the Container Port Element was added to the Comprehensive Plan to specifically protect marine cargo jobs and revenue along with vital freight connections (Seattle 2005b).

In Ballard, the rise in residential uses and associated retail and commercial uses has created challenges for the industries that historically lined the south side of Shilshole Avenue and the waterfront. Rising land prices (resulting from higher assessed value for non-industrial uses of property and the increasing presence of adjacent residential and mixed-use) creates pressure for industrial owners to sell their land. This applies to waterfront industries and industry located further north off the water. However, unlike truck-served manufacturing companies that can relocate to anywhere with reasonable road access to suppliers and customers, few alternative waterfront sites are available to maritime industries. Despite this pressure on industry, the City of Seattle plans to maintain Industrial Buffer Zone (IB), Industrial Commercial Zone (IC), and Industrial General (IG2) zoning designations along the southeast portion of the District, along the waterfront. Depending on whether or not the community decides to preserve this industrial activity, these zoning plans could change.

Industries along the waterfront also face challenges related to the Shoreline Master Program. The Shoreline Master Program governs land use and activities in the waterfront areas of Seattle and is managed by the city, as required by Washington State’s Shoreline Management Act of 1972 (WA GOV No Date). Seattle’s most recent Shoreline Master Program, which took effect in June 2015, includes some goals for the protection of maritime-based industry, such as requiring that no more than 20% of a waterfront urban industrial or urban maritime parcel can be used for non-water-dependent uses (such as machine shops and warehouses). Aspects of the program that protect view corridors and over-water shading present practical limits on the capability of water-dependent industrial businesses to grow or expand in place (Ballard District Council 2011).

Local industrial businesses have raised concerns about additional pieces of city legislation, which make it difficult for industrial uses to maintain regular operations over time. These include

- **City of Seattle’s Noise Code.** Although noise-reducing berms, walls, and other features help address noise issues, owners of water-dependent industrial businesses are concerned that a growing population of residents and non-maritime businesses nearby could expose them to more complaints.
- **Business Occupancy Tax, City of Seattle,** tax on gross revenue over \$100,000 (0.215%), which several business owners have stated is burdensome (City of Seattle 2015). Although this tax applies to all businesses in the City, industrial uses tend to have high gross revenue based on the products they produce, even if their net revenue is much lower due to the high cost of operation. Industrial uses in Ballard cannot easily relocate to avoid this tax because they rely on access to water.

4.2.3 Goods/Services Conditions and Results

Most of the truck movement in the Ballard neighborhood is performing one of two duties—delivering food and goods to businesses, restaurants, and residences; or transporting larger quantities of freight to/from maritime businesses on the shoreline (see Figure 4-11). Three major goods movement issues are

- **Street geometry.** Goods movement in the neighborhood is complicated by awkward road geometry in some areas. Several shippers in the neighborhood are using smaller box trucks to deliver to/from their facilities in the neighborhood. For some shippers, the use of smaller box trucks is safer, but can generate more truck trips and transportation cost due to the reduced carrying capacity. This tradeoff is considered a “business decision” that businesses in the neighborhood must make.
- **Insufficient supply of designated commercial loading zones and insufficient enforcement of parking regulations in the existing designated loading zones.** The City conducts a study of commercial loading zone use and possible adjustments to street parking schemes when streets are repaved, but when the mix of business and residential facilities changes between paving cycles, conflicts can arise.
- **Access roads between the waterfront and Shilshole Avenue are steep in places, with limited sight lines due to trees, buildings, and parked cars.** These obstacles have become worrisome in recent years, because growing numbers of bicyclists, pedestrians, and other traffic in the neighborhood increase the risk of collisions. The proposed extension of the Burke-Gilman bicycle trail near the Ballard waterfront could introduce more conflicts between truck and bicycle/pedestrian traffic.

The City of Seattle’s Department of Transportation’s Freight Master Plan and Freight Access Project together represent efforts that the city is taking to work with regional and state agencies, private stakeholders, and the public to identify freight transportation assets and improvements that will aid economic activity and reduce community and environmental impacts. The Freight Master Plan may provide some aid for the manufacturing industries in Ballard by better defining and recognizing a truck freight network, including crucial first/last-mile connectors that serve businesses or intermodal facilities. The Freight Access Project includes a prioritized list of projects that improve safety, mobility, and connectivity to and from the waterfront industrial area of Ballard, among other industrial areas throughout the City. Sources for the project list include projects identified in previous city plans and studies, the MPO’s RTP, and Washington State DOT’s State Rail Plan (Seattle DOT 2015a and 2015b).



Figure 4-11. Development potential for Ballard neighborhood (Source: Ballard Existing Conditions Report).

Although significant efforts have been made to retain waterfront industrial businesses and preserve the maritime industry in Ballard, long-term viability of the maritime industry will depend on the residents of the community recognizing and voicing their desire to preserve the industry. Changes to the City's zoning code to encourage preservation of the industrial area and avoid conflicts with residential or other encroaching incompatible property types must be supported by the community at large.

4.2.4 Strategies and Critical Success Factors

This case study recognized that much work needs to be done in Ballard to ensure that the needs of the legacy industrial businesses along the waterfront and the needs of the burgeoning residential and entertainment district can be met without harming the character of the neighborhood. Some strategies have been implemented, but several need to be implemented in order to achieve that goal. Such strategies include

- **Raising the profile of the vitality of the maritime industry, its unique characteristics and needs, and its value to the city, state, and nation.** Freight remains a hidden part of the economy; most people do not think about supply chains, freight logistics, and support industries needed to get product to a consumer. That disconnect makes it difficult for the public to have sympathy toward freight-generating industries. In communities with legacy industry, it is important for residents to decide whether the industry still adds value, or if relocation is preferred, which could result in greater distances between local residents and their place of work. The Ballard Maritime Academy program at Ballard High School, for example, focuses on preparing students for careers in maritime industries and raises the community's awareness of career paths in these industries and of the economic benefit these industries bring to the community. The Ballard Maritime Academy is a partnership between private industry, the Seattle Public Schools, and Seattle Central College (public). Other methods to engage the public and foster broader understanding the importance of industry to their lives could include open houses, and an "industry education day" at local restaurants or community festivals, where the source of the food customers are eating and the role local businesses play in delivering that food could be explained. For example, customers could be informed that the fish they are consuming was caught by a vessel powered by fuel delivered by Ballard Oil, which receives its supply via Shilshole Avenue.
- **Acknowledging the need to think creatively about housing and how people decide where to live and work.** Businesses could offer incentives for employees to live closer to work. This has multiple benefits, including reduced commuting, a better socioeconomic mix in the neighborhood, and establishing a residential community that is more closely tied to the industry in the area. Only 6% of the residents in Ballard live and work in the area (Seattle 2014a). The neighborhood is appealing to commuters to downtown Seattle, particularly those in white collar jobs in the tech industry. Housing is generally renter-occupied (71% of all units in 2010) and concentrated in three census tracts in the south-most portion of the District. The City of Seattle classifies this area as an HUV (Seattle 2014a). Figures 4-12 and 4-13 provide additional information about development potential and land uses.
- **Understanding the potential short-, mid-, and long-term issues of businesses served by the waterfront.** This aligns with Strategy 4E, which encourages cities to adapt to changing market forces. A working waterfront is only as valuable as the businesses that rely on it. The needs of the maritime industry reflect whether businesses are consolidating or expanding and plans for the waterfront need to reflect this as well. For example, a railyard may be necessary to support local waterfront businesses in the short term, but may become dormant as those same businesses move, consolidate, or close.
- **Considering implementing a maritime industrial land savings program** similar to agricultural land bank programs to preserve industrial areas with deep water access. This

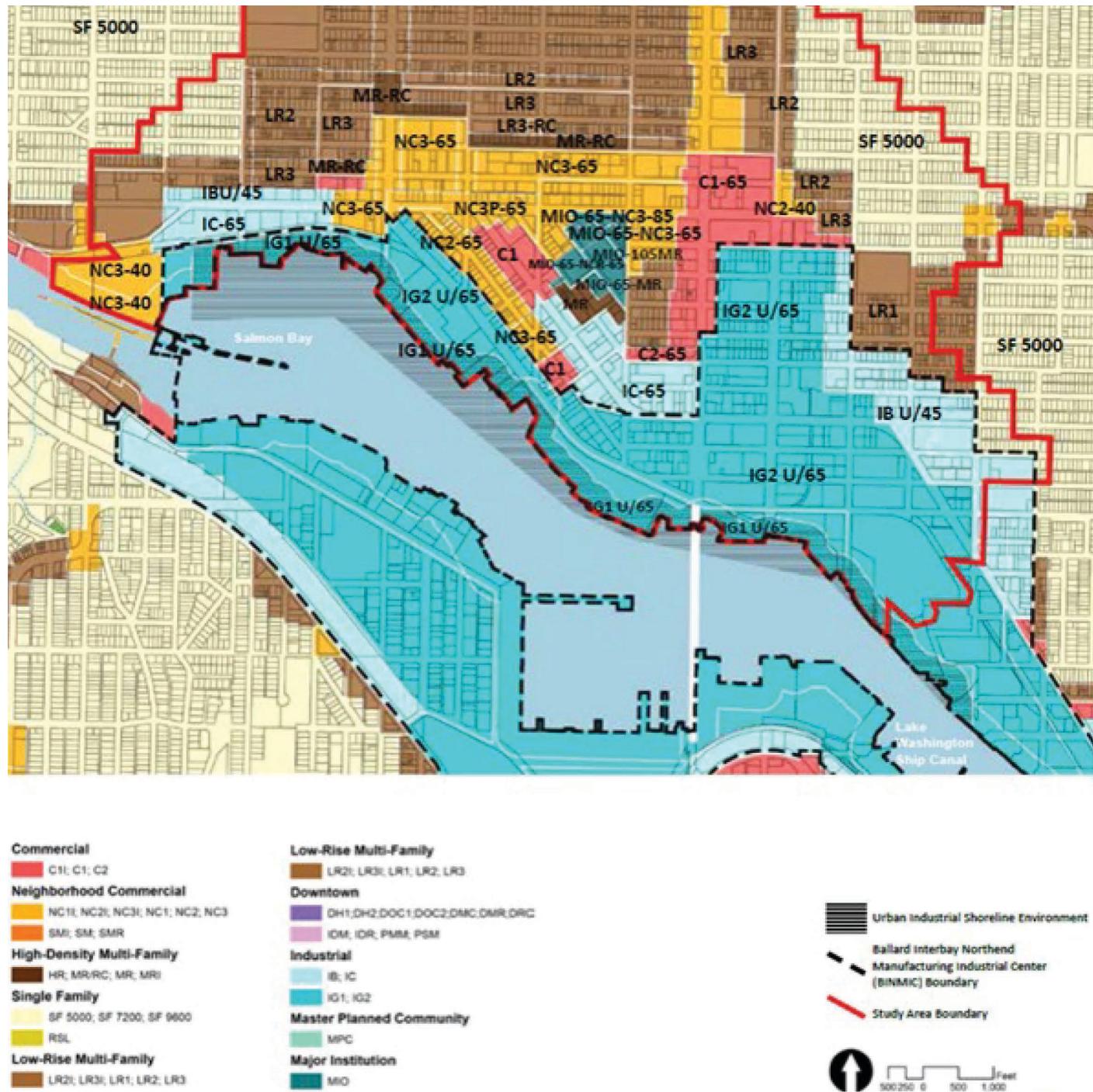


Figure 4-12. Commercial development with curbside on-street delivery (Source: Cambridge Systematics).

would parallel Strategy 2I as an innovative financing technique to help fund development to achieve this goal.

- **Improving wayfinding.** Business representatives have reported the lack of wayfinding in the area, especially compared to what is available for bicycle infrastructure. Lack of wayfinding makes it difficult for trucks to know which streets are supposed to be used to access local businesses or where are safe places to turn around without hampering other road users.

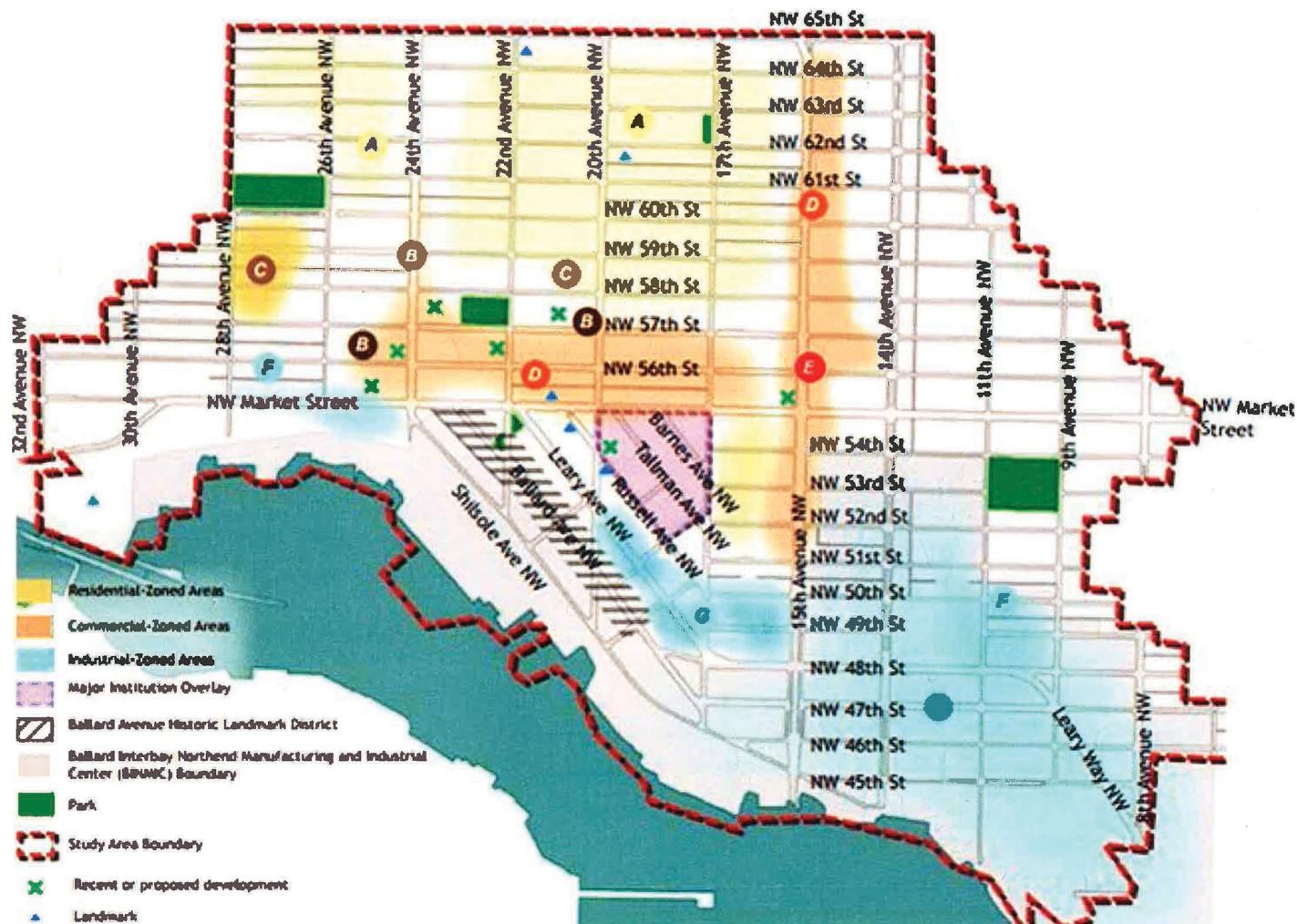


Figure 4-13. Industrial land use (blue) surrounded by commercial (red/orange) and residential (brown/yellow) in Ballard (Source: Ballard existing conditions report).

- **Acknowledging that not every street should be a Complete Street for every user.** This corresponds with Strategy 3I, which suggests planners identify and support route networks. Streets that serve primarily industrial uses (such as Shilshole Avenue) have needs that are difficult to incorporate with Complete Streets. Geometric constraints and sight-line issues were specifically mentioned as freight needs that are sometimes sacrificed in Complete Street designs. Seattle is drafting a Freight Master Plan, which may recognize the need to prioritize truck access on some streets, while others are designed to prefer bicycles and pedestrians. Although Complete Streets are customizable, not every street in a smart growth environment needs to be a Complete Street. For example, a major industrial access route may not be suited to transit use. Similarly, designing a small residential street to accommodate large trucks may be inappropriate.
- **Improving interagency coordination.** The Seattle DOT and the Seattle Department of Planning and Development are working to provide site guidelines and review to better accommodate freight access to new or retrofitted buildings.
- **Understanding that land use zoning is integral to retaining industry.** This lesson would be best supported by Strategy 1A, which involves defining the community's goals. One mistake cited by area businesses was a degradation of buffer zones in Ballard between industry and

commercial/residential areas, allowing for increased encroachment by uses that do not interact well with industry. This was partially an attempt to simplify the zoning code and partially an attempt to attract tech companies to the region. An important lesson from Ballard's experience is for planners to review zoning regulations and close any loopholes that may result in unwanted or incompatible development.

- **Acknowledging that rising land prices create a dilemma for freight-intensive uses.** As land prices rise around industrial uses due to conversion to mixed-use, the industrial users want to be protected from economic pressure to change the character of the neighborhood to a "higher and best use." However, they also want to benefit from the rise in land prices if they decide to sell their property. Increases in land or housing costs can affect the job-housing balance, forcing working-class laborers to travel further to their place of work. In 2010, 40% of households in Ballard paid more than 30% of their total income on rent (Seattle 2014a).

4.3 Over-the-Rhine (OTR): Older Commercial and Neighborhood Areas Being Revitalized

Characteristics of Over-the-Rhine are presented in Table 4-4.

Table 4-4. Characteristics of Over-the-Rhine.

Characteristic	Description
Community	Over-the-Rhine (OTR) neighborhood in Cincinnati, OH
Smart Growth Classification	 Older commercial and neighborhood areas being revitalized
Context	Small neighborhood just north of downtown Cincinnati. By the early 1900s, the neighborhood was inhabited by working-class German-Americans and had a mix of residential and industrial uses (e.g., breweries, barrel making, bottle production, distribution, and shipping). A combination of factors led to urban disinvestment and a deep decline of the OTR neighborhood. Since the early 2000s, the City and local community organizations have tried to revitalize the neighborhood with residential, entertainment, and retail development.
Stakeholders	Cincinnati Center City Development Corporation (3CDC), The City of Cincinnati, local businesses (particularly Rhinegeist and Findlay Market), local residents, freight industry
Key Issues	<ul style="list-style-type: none"> The neighborhood is in transition and rebuilding to become an economically and racially diverse community; however, OTR still has a significant number of abandoned or dilapidated properties. Most deliveries take place using general street parking spaces, despite the availability of some designated curbside loading zones. Many of the loading zones are not located to allow easy access to businesses. As revitalization continues, street parking may not be as easily available in the future. Construction vehicles often block traffic, and larger vehicles have difficulty navigating narrow streets.
Key Takeaways	<ul style="list-style-type: none"> Time-of-day access control allows trucks to make deliveries during early morning hours while allowing the streets to remain open to pedestrians during prime hours. Loading zones are more likely to be used if they are placed strategically near businesses. In addition, metered parking may encourage trucks to use the loading zones instead of parking spaces. Urban development corporations, such as 3CDC, can help spur economic development and revitalization in struggling cities. 3CDC promotes the interests of the neighborhood while using funding from both the private and public sectors.
Relevant Strategies	<ul style="list-style-type: none"> 2B: Establish designated curbside loading zones 2I: Use innovative financing techniques 4B: Provide technical assistance to local planners 4E: Adapt to changing market forces 4F: Determine ways to measure and monitor performance

4.3.1 Context and History

Over-the-Rhine (OTR) is a 360-acre neighborhood in Cincinnati, OH, just north of the downtown business district (see Figures 4-14 and 4-15). The construction of the Miami & Erie Canal in 1828 linked the Ohio River to the Great Lakes and turned Cincinnati into a trading hub, drawing mostly German immigrants to the area just north of the canal or “Over the Rhine” from downtown (Over-the-Rhine Chamber of Commerce No Date). By the turn of the century, the population was mostly working-class German-Americans with a mixture of residential and industrial uses in the neighborhood, focused around a thriving brewery business and off-shoot industries such as barrel making, bottle production, distribution, and shipping.

Anti-German sentiment during and immediately following World War I, combined with Prohibition, led to the closure of many of the breweries and other businesses and a related loss in population. An influx of people during the Depression—primarily from Appalachia—again raised the population and shifted the character of the neighborhood. The construction of Interstates I-71 and I-75 in the 1950s and 1960s displaced a large number of African Americans, many of whom settled in OTR. Suburbanization and urban disinvestment that occurred through most of the latter half of the 20th Century contributed to the decline of the neighborhood. OTR became synonymous with poverty and crime in Cincinnati. Although the efforts of groups and individuals, including the Over-the-Rhine Foundation, helped to slow the decline and stabilize parts of the neighborhood in the 1990s, OTR remained an overlooked section of the City (Over-the-Rhine Chamber of Commerce No Date).

In 2001, the police shooting of an unarmed African American in OTR sparked demonstrations and riots. These riots and acknowledgment of conditions in the neighborhood drew the attention of both private- and public-sector leadership who decided to invest time and resources in restoring OTR.

4.3.2 Application of Smart Growth Principles

The City of Cincinnati’s 2002 Over-the-Rhine Comprehensive Plan and the creation of the Cincinnati Center City Development Corporation (3CDC) in 2003 have been the guiding vision and driving force behind the transformation of the neighborhood. The plan aimed to “rebuild the housing and economic infrastructure of the neighborhood in a way that will create an economically and racially diverse community that can be sustained over the long term.” The 3CDC has provided the guidance and financial tools that have led OTR to becoming one of the most vibrant neighborhoods in the City. While work is ongoing in many parts of the neighborhood, residents are confident that the initial successes will spread.

In 2010, OTR was home to just over 6,000 residents; it is estimated to have risen to around 8,000 since then. The southern end of the neighborhood (below Liberty Street) contains mixed-use development based around entertainment and small retail, especially on Vine Street, Main Street, and the area around Washington Park. This section of the neighborhood has seen the most revitalization, with Washington Park (renovated in 2012) considered one of the major successes. Washington Park provides a central point for the neighborhood, offers a wide variety of programs and activities, provides underground parking, and attracts people to the neighborhood. Most of the major freight-reliant industries (Christian Moerlein and Rhinegeist breweries, Findlay Market, Rookwood Pottery Company) are in the northern part of the neighborhood, an area that still has some abandoned or dilapidated properties—an issue that 3CDC is heavily involved in through its role as a land bank. The entire neighborhood is part of the National Register of Historic Places due to its heavy concentration of Italianate Architecture.

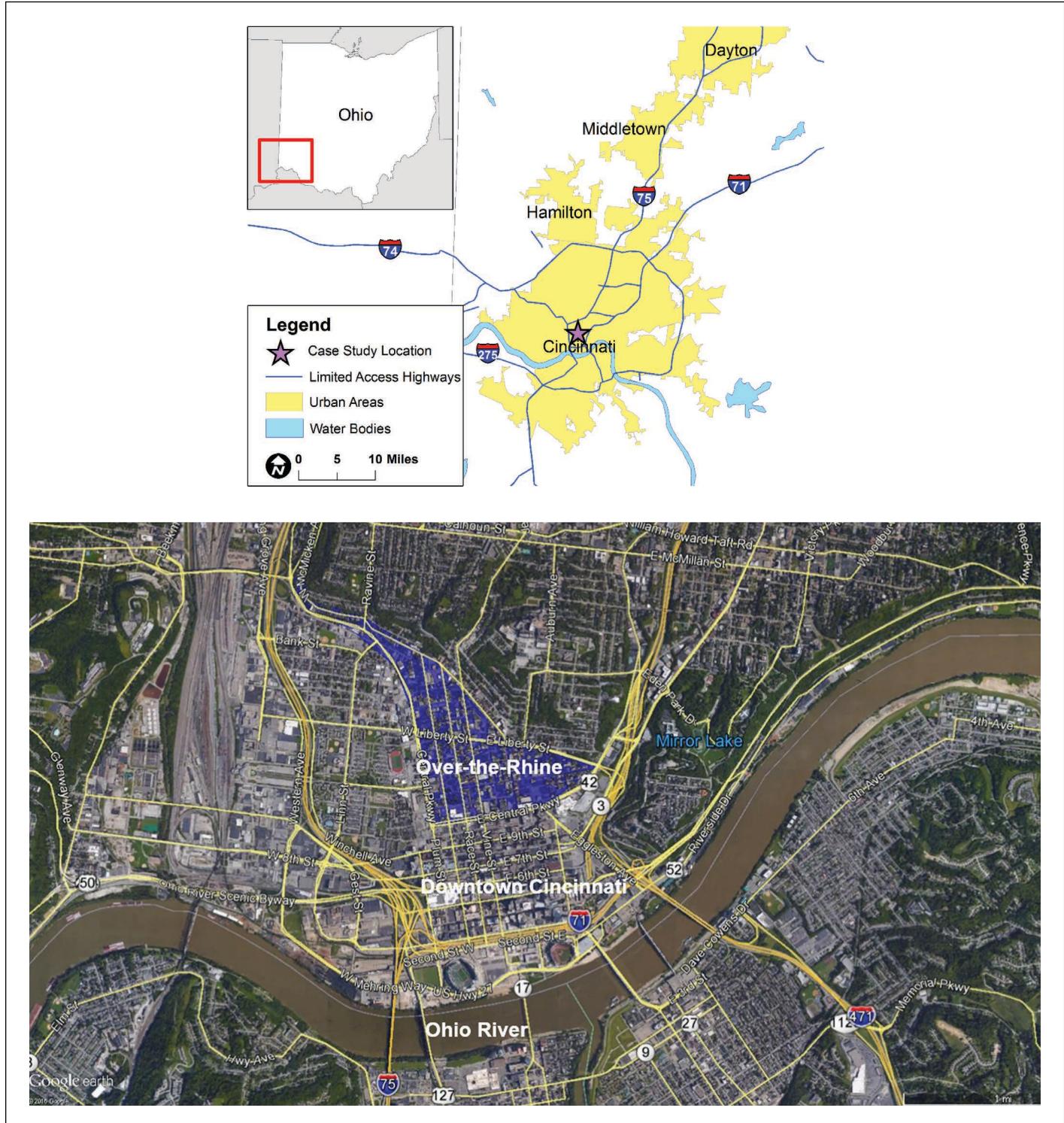


Figure 4-14. Location of Over-the-Rhine (Source: [top] ESRI; [bottom] Google Earth, 2016).

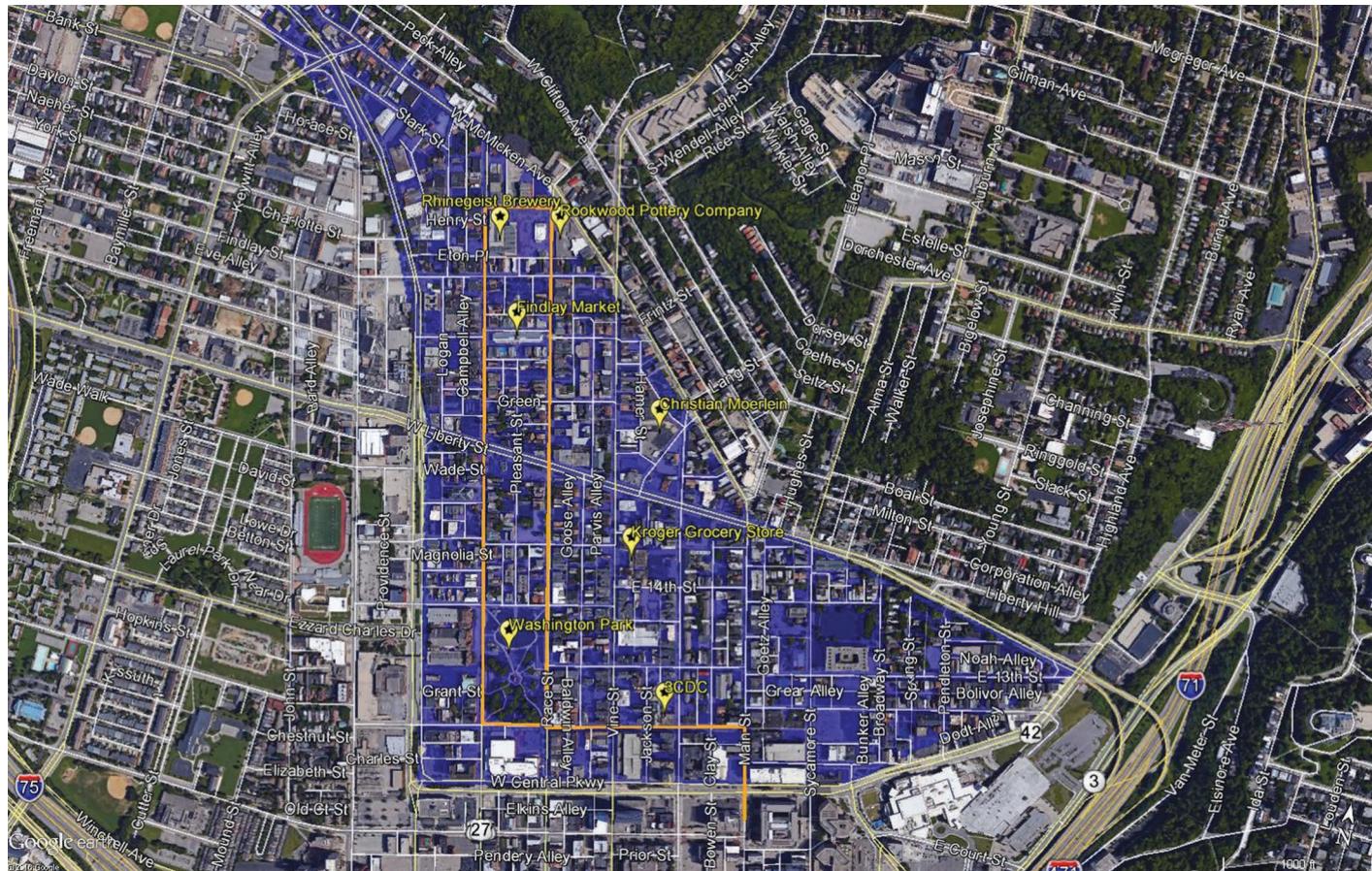


Figure 4-15. Annotated map of Over-the-Rhine (Source: Google Earth, 2016).

4.3.3 Goods/Services Conditions and Results

Most of the goods movement issues in OTR center on deliveries to restaurants, bars, and some of the small businesses. Beyond these, the heaviest producers of freight are the breweries, Kroger Grocery store, and Findlay Market. Adjacent freight generators, including a large Samuel Adams distribution facility on the western edge of the neighborhood, produce some traffic on major roads such as US 27 which borders the western edge of OTR and Liberty Street. Many of the delivery vehicles working in the neighborhood are not full tractor-trailer combinations due to the geometry and relatively narrow streets in OTR, where the typical right-of-way is 65 feet (see Figure 4-16). One exception to this is trucks bringing goods to Kroger. The grocery store has a loading dock that trucks can back up to and be out of the main flow of traffic, but the maneuvering required to dock can block traffic on Vine Street for several minutes as trucks back into and pull out of the loading dock. Both Christian Moerlein Brewing and Rhinegeist have loading docks that allow large vehicles to get out of traffic. Rhinegeist almost exclusively uses Sprinter vans for distribution, which can navigate narrow streets and small parking areas easily.

Most deliveries take place using street parking, which is a problem given the narrow streets and short blocks in central OTR. There are some loading zones throughout the neighborhood, but these are not always conveniently located. As a result, some trucks use regular parking spaces or double-park. Many of the north-south oriented streets are one-way, which provides space for vehicles to pass parked trucks without worrying about oncoming traffic. Many users, including pedestrians, bicyclists, and delivery vehicles, prefer one-way streets, but some one-way streets



Figure 4-16. Narrow streets in central Over-the-Rhine (Source: Cambridge Systematics).

can be problematic for public bus routes and retailers, who tend to favor two-way streets. One-way streets that are properly designed and managed can support smart growth.⁴ Entertainment Group, which runs some restaurants in the neighborhood, mentioned that most of its deliveries occur in off-peak hours, between 9 AM and 3 PM, with trucks using on-street parking. On-street parking or loading zones can be effective as long as they remain available for truck use and are large enough to allow trucks to use them.

In addition to being among the top destinations in the City, Findlay Market is a major attractor for freight activity. Fresh produce must move into the market daily, which draws several trucks to the area. Because of high pedestrian activity throughout the day, the streets immediately next to the market are closed to vehicle traffic after 10 AM. Metal gates swing over the road to block vehicles from entering the area around the market. If trucks want to deliver directly to the vendors, they must arrive before 10 AM. Later deliveries must use the parking spots on nearby streets and move the goods to the Market by hand. Findlay Market is working on building an incubator kitchen across the street that will include a large cold storage area. When opened, this facility could decrease the frequency of truck deliveries to the market by allowing some vendors to store goods and retrieve them as needed using handcarts or other non-motorized methods, instead of relying on daily truck deliveries.

Given that it is a revitalizing area, construction vehicles are also a constant presence in the neighborhood, with many active projects for building stabilization, rehabilitation, and new construction. Construction vehicles block traffic on the streets where they are operating. The narrow roads and tight intersections also make it difficult for construction vehicles to reach projects—some equipment has difficulty navigating turns due to the street corner geometry and presence of parked cars.

The Cincinnati Streetcar is scheduled to begin operating in 2016 on tracks that run past Findlay Market, Rookwood Pottery, and Rhinegeist Brewery. Some view the streetcar as an ongoing project that already has caused limited issues and may cause more problems in the future. One of the maintenance and operation shops for the streetcar will be next to Rhinegeist. Once the streetcar is running, timing conflicts between delivery vehicles and the streetcar will need to be worked out, but the business has been an excellent neighbor and worked well with the City to reduce these conflicts. First, the City worked with Rhinegeist's requests to restrict construction

activity during key pickup and delivery hours for the brewery so as to minimize disruption and delays. In addition, Rhinegeist agreed to contribute \$5,000 a year toward the streetcar in exchange for a tax abatement from the city that is valued at over \$65,000 over a 10-year period (Coolidge and Bowdeya 2014). Once the streetcar is operating, loading zone locations may need to be moved in order to keep delivery vehicles from blocking the streetcar's path when parked. Consolidation of these zones into a single area is also a possibility (Steigerwald 2015).

Waste collection is another commercial vehicle activity that affects the neighborhood (see Figure 4-17). Trash is picked up every week throughout the City of Cincinnati, and recycling and yard waste are collected every other week on the same day as regular trash collection. These vehicles often create traffic issues when blocking the narrow streets that make up most the neighborhood's street types. Some businesses consolidate their waste, thus reducing how many individual stops trucks must make. Because of the historic nature of the district, many businesses do not have locations immediately next to their buildings to dispose of waste. Attendees mentioned this activity will likely need to increase as more businesses and residents enter the neighborhood.

Locals are excited by the future of the neighborhood. They foresee a continued potential for managed and targeted growth in both population and more mixed-use development, with small-scale retail and entertainment as the key target groups. They also hope to spread the new development and success focused in the southern section of the neighborhood toward the north, with the streetcar acting as an economic driver.

4.3.4 Strategies and Critical Success Factors

Several key tools and lessons were identified as part of this project. Although not all are directly related to freight movement, they are all important in the development of the neighborhood,



Figure 4-17. Waste collection in Findlay Market (Source: Cambridge Systematics).

and the resulting growth affects demand for goods and the network on which the movement and delivery of goods takes place.

- **Time-of-day access control.** The Findlay Market allows trucks to access the streets directly next to stalls in the market and make deliveries directly to vendors during the morning, before 10 AM. Most deliveries occur between 7 AM and 10 AM. After this time, trucks must park on adjacent streets and deliver goods by hand (see Figure 4-18). This allows the area to remain a vibrant, pedestrian-focused location during busy lunchtime and afternoon hours, while giving delivery companies and vendors options on the best way to access goods. Once the streetcar begins operations, some of the most convenient on-street parking locations for delivery will be unavailable, thus requiring trucks that deliver after 10 AM to find loading zones farther away.
- **Reliable truck data.** This aligns with Strategy 4F, which suggests planners find methods to measure helpful qualitative or quantitative data. The Kroger store in OTR has a loading dock specifically for off-street truck deliveries, but the maneuvering required to dock can block traffic on Vine Street for several minutes as trucks back into and pull out of the loading dock. Data on truck trip generation would help transportation planners in Cincinnati understand how often trucks need to access the loading dock and what time-of-day it most often occurs, thereby enabling more practical design concepts for local roadways.
- **Strategic placement of loading zones.** This idea complements Strategy 2B, which suggests establishing designated curbside loading zones. Strategically placed loading zones allow trucks access to businesses. Maintaining these parking spaces available for commercial use is a challenge and participants noted that better enforcement may be needed in the future, as businesses and residents continue to locate in the neighborhood. The City is examining the use of floating zones, where commercial loading and unloading is allowed during the day and regular parking is allowed in the evening to allow greater flexibility and shared use of valuable and in-demand on-street parking spaces. The City is also discussing increasing the number of metered parking locations in the neighborhood in order to better control parking issues and encourage the use of nearby parking structures by automobiles.
- **Cooperation to achieve common goals.** Of note was a universal convivial approach among the various stakeholder groups and a shared philosophy and commitment to communicating and working together to solve the inevitable issues of growth. All acknowledged that growth and development are needed, and all acknowledged that growth brings some challenges. Recognizing that everyone shares the goal of wanting the neighborhood to succeed, stakeholder

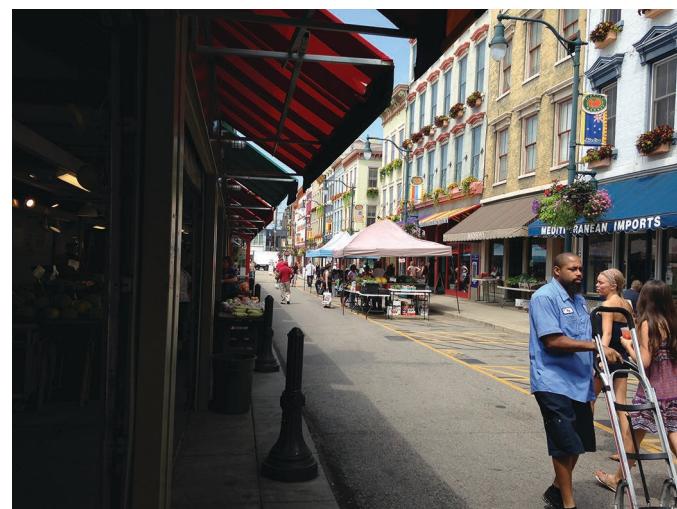


Figure 4-18. Hand-cart delivery in Findlay Market
(Source: Cambridge Systematics).

groups must be willing to discuss issues and work together to find solutions. One example of this cooperation is between Rhinegeist and the City. The new streetcar line runs past the brewery; construction and future operation of the line have affected the ability of trucks to access the brewery. Rhinegeist and the City have worked together to find solutions that allow both parties to accomplish their respective goals and are in constant communication about future operations and needs. Good neighbor policies implemented by businesses are a key component in achieving the balance and communication needed to make a dense, vibrant, and, at times, chaotic urban neighborhoods thrive, especially when it comes to noise concerns from current and future tenants.

- **Waste consolidation.** Some locations in the neighborhood consolidate their waste disposal locations, thereby reducing the number of stops that trucks must make to collect waste. Although it increases the initial distance employees must travel to remove waste, reducing the truck traffic and its effects on traffic in the neighborhood is worth the effort. Neighborhood businesses speak with the waste collection companies and work together to find times and locations that are convenient for all parties and that limit the noise impact to surrounding residents.
- **Flexible and adaptable planning.** Both flexibility and the ability to change direction if things are not working out are needed. Although having an overall direction and plan has proven valuable to the renaissance of Over-The-Rhine (the 2002 Comprehensive Plan is still the guiding document for redevelopment efforts and community planning in the district), both government and private companies must be willing to adapt and discuss and find new solutions if something is not working. Communication with residents is also critical to the district's overall success in that it can help alert other stakeholders to situations that are not working well and are a crucial resource in developing initial plans.
- **Effect of an Urban Development Corporation.** This idea complements both Strategy 4B and Strategy 2I, which suggest providing technical assistance to local planners and using innovative financing techniques, respectively. The recent vibrancy in the neighborhood was largely credited to 3CDC, the City's non-profit development corporation dedicated specifically to this neighborhood. 3CDC promotes the interests of the entire neighborhood and blends funding from both public and private sources to leverage city-owned land-banked properties. Although not directly related to freight movement, the organization takes a "big-picture" approach to development in the neighborhood, advocating for policies and practices, such as waste consolidation, that benefit the neighborhood as a whole. 3CDC wears several hats: developer, land bank, and lender. With the sizeable roll of city-owned properties in OTR, 3CDC has been able to stabilize, manage, and redevelop buildings and properties that otherwise might continue to decline. The singular purpose and geographic scope that 3CDC has been charged with allows the organization to focus resources and act as an "honest broker" for the entire neighborhood and make considerable strides that have resulted in the successful revitalization of one of the largest historic districts in the country. A single organization possessing the resources and responsibilities of the 3CDC is uncommon and could be effective in other communities.

4.4 Glens Falls: Retrofitting Aging Commercial Corridors

Characteristics of Glens Falls are presented in Table 4-5.

4.4.1 Context and History

Glens Falls is in Warren County, NY, approximately 50 miles north of Albany (see Figures 4-19 and 4-20). With an estimated 2013 population of 14,552 and covering just less than 4 square miles, it is a small city surrounded by suburban and rural areas. US Route 9, named

Table 4-5. Characteristics of Glens Falls.

Characteristic	Description
Community	Route 9 (Glen Street) in Glens Falls, NY
Smart Growth Classification	 Retrofitting aging commercial corridors
Context	The only case study bisected by a major highway, Glens Falls has a unique set of freight access issues. The Route 9 corridor is approximately 1 mile and runs through the heart of Glens Falls. It is a State highway, parallel to I-87, and is a major commuting route through the city, as well as a local access route for freight vehicles. The Corridor features a 5-way intersection, which was redeveloped into a roundabout in 2007. The project had a highly positive effect on traffic flow, pedestrian safety, and freight access into downtown Glens Falls.
Stakeholders	City of Glens Falls, Creighton Manning Engineering, MPO, local businesses, local residents, freight industry
Key Issues	<ul style="list-style-type: none"> • Glen Street's 5-way intersection had numerous issues, including long pedestrian crossings, long vehicle queues, and high crash rates. It was perceived as unsafe for pedestrians and avoided by local fire and emergency response. Large trucks and freight vehicles often backed up at this intersection and had difficulty making deliveries. • Pedestrians are exposed to a greater risk of being struck by a motor vehicle when crossing from the median to the sidewalk. Liability exists for drivers who park in the median should an incident occur. • The presence of trucks in the center median may reduce visibility for pedestrians trying to cross mid block. • Anticipate all possible scenarios in planning and design. • The roundabout solution reduced delays, despite increases in traffic volumes. It also addressed safety and congestion issues. The roundabout is credited with spurring revitalization to the area with investment in mixed-use developments, apartments, office space, and retail space.
Key Takeaways	<ul style="list-style-type: none"> • A flush median design between travel lanes serves several purposes. It splits traffic, serves as a safe area for delivery vehicles to load and unload freight, and allows the driver to avoid competing with automobiles in the flow of traffic and so reduces the need for curbside delivery space. • 1A: Define your community's goals • 1B: Employ freight-compatible development • 2E: Design safe and flexible intersections • 2H: Implement traffic-calming techniques to reduce conflict • 4B: Provide technical assistance to local planners • 4E: Adapt to changing market forces
Relevant Strategies	

Glen Street locally, runs through the middle of the downtown core and is a major commuting route through the city (US Census Bureau No Date). US Route 9, a State highway that runs parallel to I-87 (a major corridor throughout New York State) also serves freight users as the local access route to many commercial and retail businesses as well as major freight generators, including Finch Paper LLC, the Glens Falls Hospital, Flomatic Corporation, and SCA Tissue North America. Glens Falls Hospital relies heavily on Route 9 for emergency vehicles to access the site quickly and efficiently.

This case study focuses on the Glen Street corridor through downtown Glens Falls, including Centennial Circle, a roundabout completed in May 2007 that serves as a focal point for the downtown and is considered a key component in the revitalization of the corridor. Running through a smaller urban area with a mix of uses and users as well as regular and diverse freight traffic, Glens Falls' successful revitalization project can provide lessons and tools for similar communities.

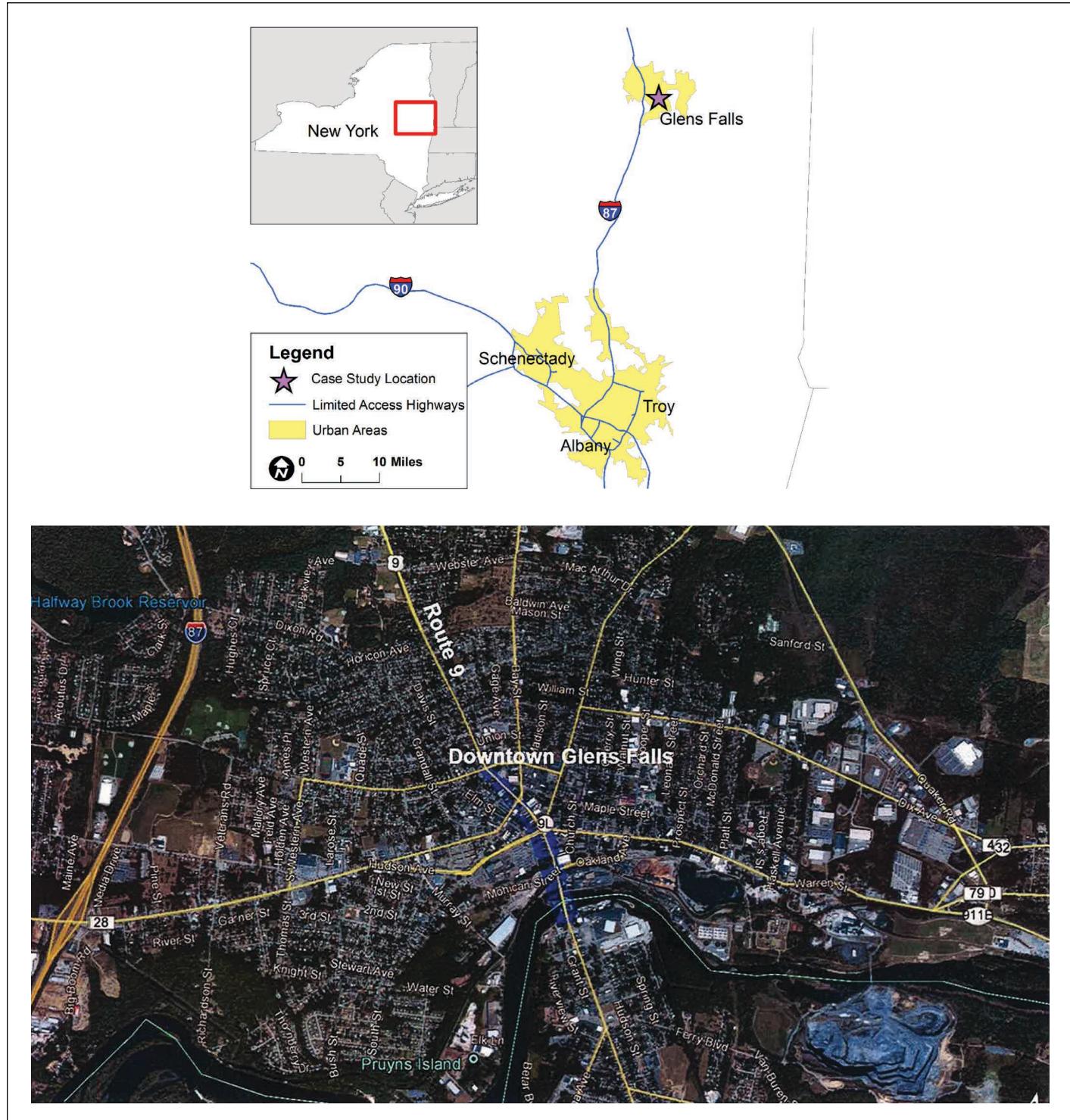


Figure 4-19. Location of Route 9 study area in Glens Falls (Source: [top] ESRI; [bottom] Google Earth, 2016).

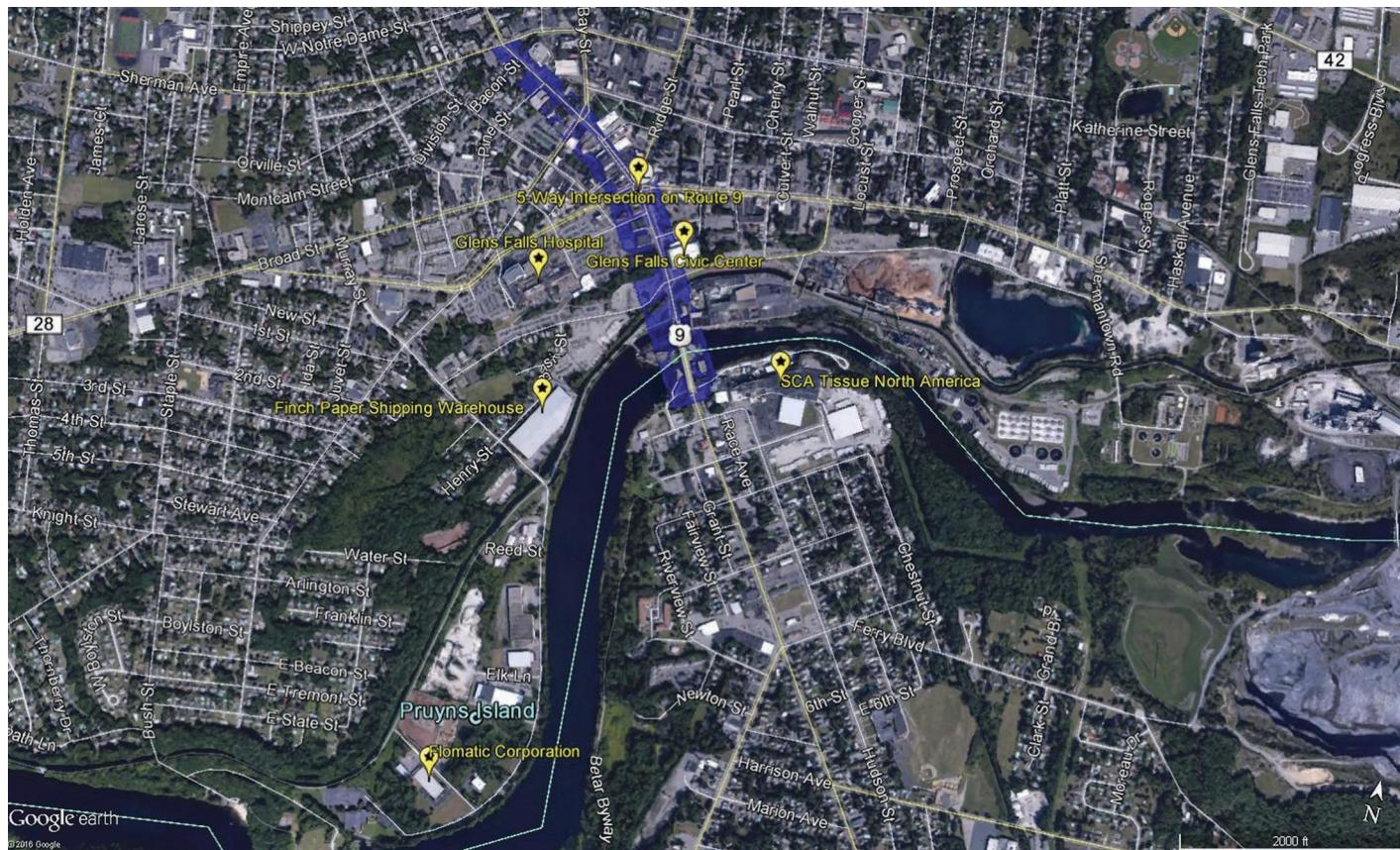


Figure 4-20. Annotated map of Route 9 study area in Glens Falls (Source: Google Earth, 2016).

Route 9 through downtown Glens Falls is over 100 years old and has served as the “main street” for the city for decades. Urban renewal during the 1950s and 60s transformed the route into a one-way thoroughfare to facilitate the movement of automobile traffic. This focus on vehicle throughput created a corridor inhospitable to pedestrians. With the completion of I-87 west of the City, the construction of the Aviation Mall in nearby Queensbury in 1975, and other socioeconomic trends, including a reduction in urban population, businesses in the corridor suffered.

Route 9 was returned to two-way operation in the 1990s, which increased access to the downtown shops but created a five-way intersection with Warren Street, Ridge Street, and Hudson Avenue at the southern end of the downtown business district. Issues with the intersection included

- Long pedestrian crossings, including a 90-foot crossing on the southern leg of Route 9 that created a physical and psychological barrier between different sections of the City;
- Long vehicle queues with 140-second signal phases caused delay for both passenger and freight vehicles; and
- High incident rates due to the multiple movements at the intersection and the long wait times.

Because of these issues, the Glen Street corridor was perceived as unsafe for pedestrians. Traffic performance at the intersection delayed commuters, visitors, and deliveries and created emergency response issues. The local fire department, for example, routed response vehicles differently to avoid the intersection at certain times of the day. These safety and operational

issues convinced local stakeholders and state transportation officials that a different solution was needed.

4.4.2 Application of Smart Growth Principles

The City of Glens Falls led a study of alternatives to improve the safety, congestion, and visual aesthetic of the Glen Street Corridor, with New York State DOT participating in the study. Nine alternatives were initially considered. Options included a return to one-way traffic, modifying the signal timing, various roundabout configurations (including a return to one-way traffic), and the closure of Hudson Avenue at the intersection. Beginning in 2004, 26 outreach meetings were conducted in the community to solicit ideas and feedback on the various options.

New York State DOT's Highway Design Manual encourages that roundabout alternatives be analyzed when reconstructing or constructing new intersections on the state highway system to determine if they are feasible solutions (NYSDOT 2011). For this reason, a roundabout alternative was evaluated, and, ultimately, a roundabout alternative in combination with a two-way traffic pattern on Glen Street emerged as the only alternative that addressed safety and congestion issues (see Figure 4-21).

US Route 9/Glen Street from the roundabout and heading northwest has an 11-ft-wide travel lane in both directions with on-street parallel parking on both sides and a flush median between the travel lanes. The flush median was a conscious design decision based in part on concerns from the business community about access for delivery vehicles. The corridor has many retail and commercial establishments, including banks, a theater, a brewery, a movie theater, restaurants, businesses, and offices. Just south of the roundabout is the Glens Falls Civic Center, which hosts concerts, shows, graduation ceremonies, and sporting events. Bicyclists, pedestrians, transit, service vehicles, and trucks all use the corridor regularly.

The roundabout and accompanying streetscape project is viewed as the catalyst for revitalization in downtown Glens Falls. Streetscape improvements along Glen Street and adjacent and adjoining streets stemmed from the initial Glen Street Corridor Study and have enjoyed general support from area businesses and residents.



Figure 4-21. Five-way intersection converted to roundabout, Route 9 (Glen Street) (Source: Creighton Manning Engineering).

The roundabout and streetscaping has also driven private investment in the business district, including a \$25 million mixed-use development a block west of the corridor that is expected to begin in the Fall of 2015. This project will add 90 market-rate apartments; 40,000 square feet of retail space; 9,000 square feet of office space; and approximately 500 off-street parking spots that will serve the adjacent hospital and the downtown (Pinckney 2015). The infrastructure investment at the roundabout and in the corridor is a key factor in attracting this investment.

4.4.3 Goods/Services Conditions and Results

Traffic volumes increased 20% in the year following construction of the roundabout while delays have decreased (Thompson 2008.). A survey of the “before” (2006 pre-construction) and “after” (2008 post-construction) conditions of the intersection showed that the level of service (LOS)¹ increased substantially, from an overall of LOS F to an overall of LOS C after construction. The overall delay also decreased by approximately 85 seconds. In addition, safety conditions at the intersection improved following construction of the roundabout. A comparison of crash data from before and after the roundabout showed an immediate decrease in crashes (Creighton Manning 2008). Qualitative evidence from business owners and emergency responders indicated that pedestrian traffic has surged and that crashes in the corridor and at the intersection are down. It is estimated that 350 to 400 residential units have been constructed in the downtown in the past 4 years.

The corridor accommodates various commercial vehicles daily. Service vehicles, emergency vehicles, local delivery vehicles, box trucks, and large semi-trailers all use the corridor and roundabout. US Route 9 also serves as an alternate route for oversize/overweight vehicles (such as shipments of wind turbine blades) that must detour from I-87 due to bridge restrictions. The corridor and roundabout can accommodate the large trucks carrying timber that occasionally stray from other routes to manufacturing facilities in the area and end up on Route 9 by mistake.

The initial draft plans called for a raised center median with landscaping along Glen Street. Due to concerns from emergency responders and the local business community regarding the potential for double-parked or disabled vehicles to disrupt the flow of traffic on a single lane in each direction, the plans eliminated the raised center median and selected a flush center median with stamped asphalt and brick color treatment instead. Delivery vehicles often use the space to park while making deliveries (see Figure 4-22), though this was not the intended purpose for the center median, and no signs or pavement markings recommend the practice. Although several businesses in the corridor have access to off-street parking behind the buildings, the geometry of the off-street lots makes access by some commercial vehicles impossible. The center median provides those vehicles with another option. During the site visit, trucks were observed parking in the center median while the drivers used mid-block crosswalks to cross the traffic lane with loaded handcarts (see Figure 4-22).

This practice has both positive and potentially negative implications. By parking in the flush center median, delivery vehicles are out of the flow of traffic and are not competing with automobiles or other users for the limited supply of curbside parking space. By crossing the traffic lane on foot, even in a marked crosswalk, the driver is exposed to a greater risk of being struck

¹Six level of service (LOS) categories reflect the calculated volume-to-capacity ratio on any given corridor. A score of “A” indicates free flow traffic, “B” indicates steady traffic, “C” indicates limited steady traffic, “D” indicates steady traffic at a high density, “E” indicates traffic at saturation (uniform but low speed), and “F” indicates congestion. (Source: Transportation Research Board (1994) *Highway Capacity Manual*, 3rd Edition, p. 3-9.)



Figure 4-22. Truck unloading in the flush center median in downtown Glens Falls (Source: Cambridge Systematics).

by a motor vehicle. Drivers also risk liability for parking in the median if an incident involving a pedestrian or motor vehicle happens. Further, the presence of the truck in the center median could reduce the visibility of those pedestrians using the mid-block crosswalks to passing motorists, decreasing the safety and walkability of downtown Glens Falls.

Further, the design vehicle for the roundabout was the local fire department's largest emergency vehicle, with the expectation that 53-ft-long tractor-trailers and overdimensional vehicles would use an alternate system of designated truck routes that bypass the central area of the city. Although large trucks were not desired or anticipated in the design, the facility has to accommodate those vehicles on occasion. Either by necessity or driver error, large trucks occasionally travel along Glen Street toward the roundabout. Fortunately, the trucks can navigate the circle, but, given acute intersection angles, they must make a loop around the circle to make some turning movements. Signs have been posted to direct truck drivers (see Figure 4-23).

MPO staff and the City's engineers suggested that the "driving culture" of Glens Falls was changed after this project was implemented, and, therefore, the risk to pedestrians is much lower today, thereby making the unique parking/delivery situation effective. Travel speeds in the corridor have been reduced and, qualitatively, a high rate of driver (for trucks, automobiles, and transit) compliance with regulations requiring them to yield to pedestrians has been observed. Targeted enforcement by the local police department and extensive outreach and education are credited with producing this compliance (Lehman 2014).

4.4.4 Strategies and Critical Success Factors

Many residents attributed the success of the Centennial Circle roundabout and Glen Street corridor improvements to the following factors, which can serve as recommendations to communities facing similar problems.

- **Persistence and outreach are key.** The project consultants hired by the City conducted 26 outreach meetings to elicit feedback from stakeholders prior to project construction. Those meetings were crucial to building community support and weathering opposition—including



Figure 4-23. *Truck signage at roundabout, downtown Glens Falls (Source: Cambridge Systematics).*

the election of a mayor opposed to building the roundabout. This approach aligns with Strategy 1A, defining the community's goals.

- **Outside-the-box solutions may appear after planning and design phases are completed.** Median parking for trucks, while not an intentional feature of the design, has solved a problem for this community. This design feature provides delivery vehicles with front-door access to businesses along the corridor, especially for larger delivery vehicles that cannot enter off-street parking behind the buildings. However, although this design solution works now, it may not be suitable for the long term as freight needs in downtown Glens Falls increase. The City should continue to evaluate its effectiveness and monitor any safety or congestion concerns.
- **Education and enforcement must work in combination with environment.** The median parking is effective in this community because the built environment (that is, roundabout, mid-block crossings, traffic calming on approach streets, and parallel parking) is combined with education and enforcement activities. This combination of methods creates a situation where pedestrian movements are anticipated and respected, allowing delivery drivers to use the median parking and mid-block crosswalks safely.
- **Pedestrian focus during planning.** This community recognizes pedestrian activity in the corridor as one of the key drivers of business activity in this corridor. Pedestrian access and safety were therefore key goals of the project. Accommodating goods and services vehicle movements should be considered and planned for appropriately, but not at the expense of pedestrian access and safety. This approach complements Strategy 2H, which suggests implementing traffic-calming techniques to reduce conflict among road users.
- **Anticipate all potential scenarios in planning and design.** The design's intention was not to encourage 53-ft-long tractor-trailer traffic to use the facility as a through route. However, in its early phases, this project failed to anticipate that large trucks would, at least occasionally, find themselves on this corridor. Designing the facility to handle these vehicles when necessary, such as implementing truck aprons and appropriate guidance, helps ensure that the

movement of trucks here does not result in situations where the truck blocks traffic and/or creates a risk to safety or property.

- **Ensure sufficient visibility.** This point complements Strategy 2E, which recommends designing safe and flexible intersections. Truckers are becoming more comfortable with roundabouts and are trained in how to navigate them. However, obstructed views due to objects in the center of the roundabout can cause issues for drivers who may be unfamiliar with the area.
- **Include commercial vehicle operators in the discussion.** One group that was not well represented during the Centennial Circle and Glen Street project outreach was the trucking community. This group is critical to the movement of goods and the provision of services to businesses both in the corridor and in the immediate vicinity. Several other ideas could be considered during similar projects, such as the need for wayfinding signs and navigation applications in multiple language and providing better outreach and education to truckers about appropriate truck routes.
- **Promote mutually beneficial coordination among businesses.** Better coordination among businesses in the downtown could help to limit the number of trucks necessary to serve the area. Consolidating waste collection was specifically mentioned as a topic under review. Further, the possibility of coordinating delivery schedules or using a shared loading or storage facility was raised. Although small independent businesses may be unaccustomed to sharing such services, coordination can help limit the number of trucks needed to serve the downtown business district. The implementation of a new project is a good time to broach this topic.
- **Preserve off-street and alley loading areas when possible.** Although not all trucks can use the available off-street parking (mostly due to geometry restrictions), these areas are assets to several of the local businesses. The center median loading situation accommodates many of the district's delivery needs, but not all communities can use a center median for that purpose, and on-street parking areas are in demand for shopper parking. If a community wishes to transform alleys to pedestrian zones, it must provide some alternative or accommodation for truck loading/unloading.

4.5 Daybreak: Greenfield New Communities

Characteristics of Daybreak are presented in Table 4-6.

4.5.1 Context and History

Daybreak is a master-planned community in the City of South Jordan, approximately 20 miles southwest of Salt Lake City, UT (see Figures 4-24 and 4-25). Daybreak covers 4,000 acres owned by Kennecott Land, a subsidiary of Rio Tinto Group. Kennecott Utah Copper, another subsidiary, operates the Bingham Canyon Mine, one of the world's largest copper mines, on this land. In the early 2000s, when it appeared as though the mine would have to close, Kennecott sought alternative means of generating revenue off of land holdings in the area. Kennecott worked with consultants to draft a development plan and design guidelines for a multiple-use development, including residential, retail, institutional, parkland, and entertainment facilities (see Figure 4-26). The inclusion of these non-residential land uses creates a greater need for commercial vehicle accommodation, particularly in the commercial and entertainment areas such as SoDa Row.

4.5.2 Application of Smart Growth Principles

Daybreak is designed as a traditional neighborhood development (TND), a style that is often associated with smart growth. TND communities include various land uses and housing types (such as single-family and multi-family), where commercial, entertainment, educational, and civic buildings are in walking distance of homes and where walkability, bike-ability, and transit access are defining features of the transportation network. Facilitated by the extensive street grid

Table 4-6. Characteristics of Daybreak.

Characteristic	Description
Community	Daybreak neighborhood in South Jordan, UT
Smart Growth Classification	 Greenfield new communities
Context	Master-planned community approximately 20 miles from Salt Lake City. The site covers 4,000 acres owned by Kennecott Land, a subsidiary of metals and mining corporation Rio Tinto Group. Though not fully developed, the site has various land uses and housing types (all LEED/Energy Star rated), and commercial, entertainment, and educational facilities within walking distance of homes.
Stakeholders	City of South Jordan, Kennecott Land, local residents, local businesses, freight industry
Key Issues	<ul style="list-style-type: none"> Street design and regulations governing traffic operation limit through truck and automobile traffic. Features must not be restrictive enough to prevent trucks from accessing the community. Changing tenancy of commercial rentals has changed the delivery needs of new businesses. This will be an ongoing issue, and proper loading docks should be prioritized in new commercial developments.
Key Takeaways	<ul style="list-style-type: none"> Kennecott Land closely monitors the development in the neighborhood and is sensitive to Daybreak's residents, demographics, and commercial and retail use. Kennecott Land also has a very close working relationship with the City of South Jordan, which gives them the flexibility to try innovative design solutions that wouldn't otherwise be possible. Not all roadway designs have been successful—Daybreak's roadway design has evolved over time via trial and error. This enables the streets to adapt to changing needs and respond to issues in the street network. This flexibility helps ensure that streets are safe for pedestrians, automobiles, and motor vehicles. Establishing multipurpose areas that accommodate freight needs reduces the need for delivery docks while allowing trucks to make safe and efficient deliveries.
Relevant Strategies	<ul style="list-style-type: none"> 1A: Define your community's goals 1B: Employ freight-compatible development 1F: Discourage incompatible land use development 2E: Design safe and flexible intersections 2F: Create "buffers" with setback and/or landscaping requirements 2H: Implement traffic-calming techniques to reduce conflict 4E: Adapt to changing market forces 4F: Determine ways to measure and monitor performance

and multi-use trail network, 88% of school children in Daybreak walk to school, compared to 17% outside the community. Fixed-route and flex bus route services operate within Daybreak. Daybreak is linked to the Salt Lake Valley by the Mountain View Corridor highway and bicycle/walking trail corridor, which traverses the Kennecott Land tract and I-15 several miles to the east, and two Utah Transit Authority TRAX light rail stations.

Today, Daybreak is home to about 3,000 housing units, two elementary schools, and a small cluster of shops, restaurants, and commercial facilities on SoDa Row. Commercial buildings are required to be LEED rated, and homes are Energy Star rated. Most of the commercial development to date is clustered in SoDa Row, a stretch of restaurants, stores, and community facilities along Kestrel Rise Road. When full build-out is achieved, as many as 20,000 housing units and 15 million square feet of commercial space may be developed.

4.5.3 Goods/Services Conditions and Results

Most goods movement in the developed section of Daybreak consists of delivering goods to businesses, homes, and offices in the community. Parcel delivery and small package companies

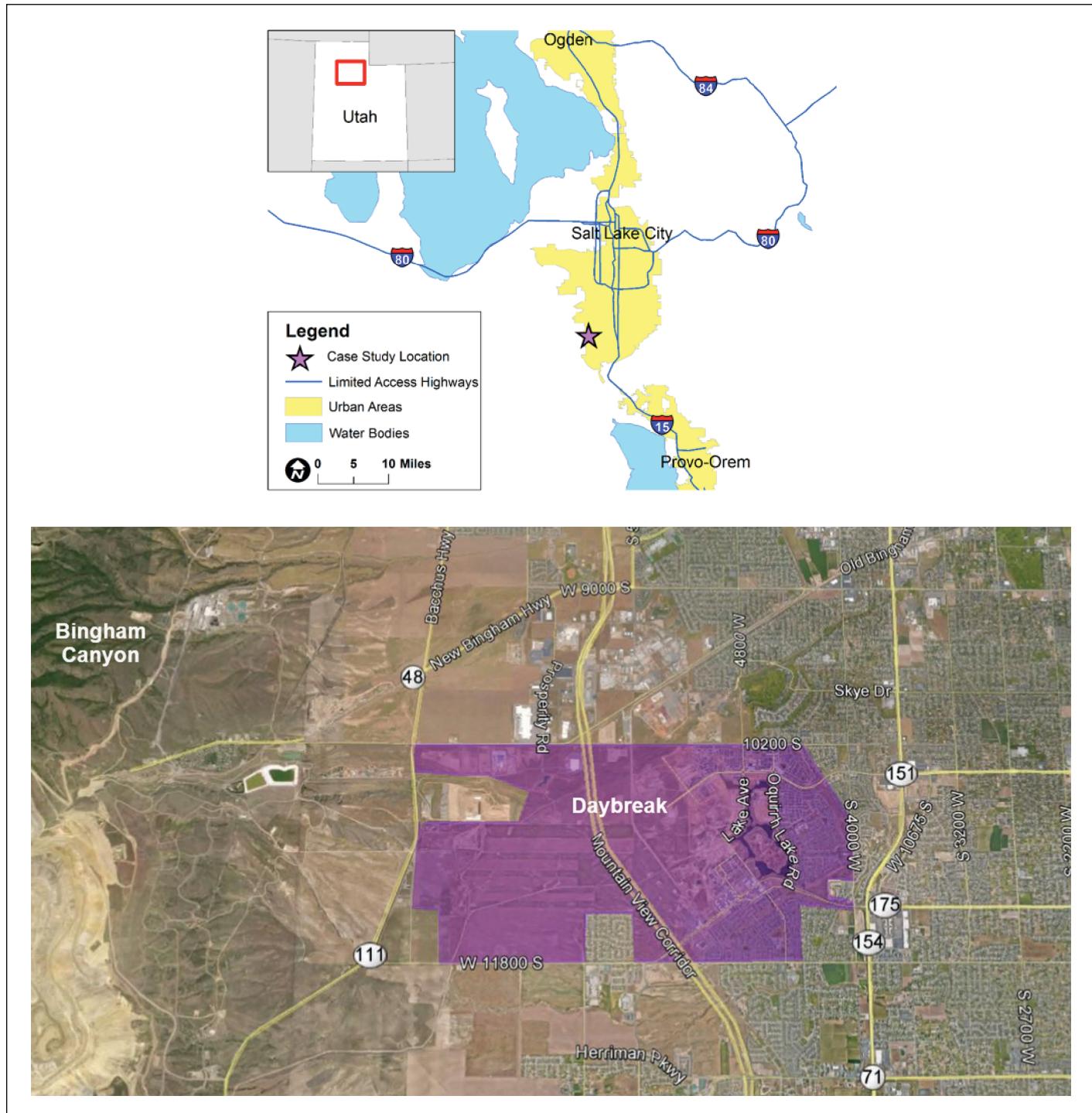


Figure 4-24. Location of Daybreak (Source: [top] ESRI; [bottom] Google Earth, 2016).

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Figure 4-25. Annotated map of Daybreak (Source: Google Earth, 2016).

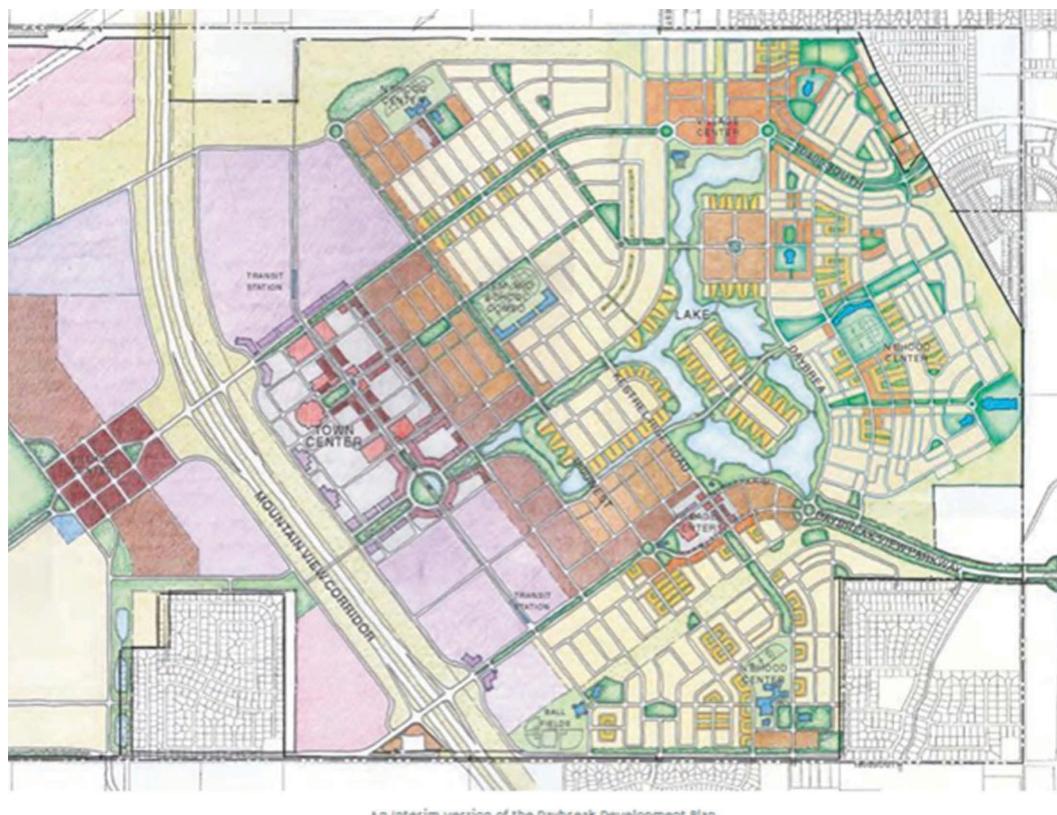


Figure 4-26. Daybreak development plan (Source: Calthorpe Associates).

(such as UPS, FedEx, and USPS) were observed during the site visit. Some service vehicles were observed throughout Daybreak, including those installing cable and internet and collecting waste from homes and businesses. Some of the restaurants along SoDa Row and the University of Utah Medical Center receive deliveries in three-axle single-unit box trucks. Construction vehicles traveling to and from construction sites in the community include dump trucks and haulers of construction materials and equipment.

Trucks traveling into and out of Daybreak use arterial roads, such as Daybreak Parkway, to connect to the regional network. However, vehicles also use the connector streets (such as Kestrel Rise Road) and some of the neighborhood streets to reach their ultimate destinations. Deliveries to commercial and business locations either park curbside to make deliveries or, in some cases, use a multipurpose alley between stores to park close to delivery locations and out of traffic and parking lanes (see Figure 4-27). During the site visit, a delivery driver for a food distribution company mentioned that most of their deliveries are made with 28-ft-long trucks and these have no issues navigating to destinations. However, at times, the company makes deliveries using larger 48-ft-long trucks, which can have problems finding places to park. The problem was described as relatively minor due to the infrequency of deliveries using this type of vehicle. The hierarchical street network is seen as enhancing truck mobility in Daybreak, while keeping significant volumes of truck traffic off of most residential streets.

Off-street loading docks allow many of the facilities that receive frequent deliveries to receive goods and waste pick-ups without interfering with curbside parking and customer access through the front door. The University of Utah Medical Center, for example, has two loading docks in the back of its building which are reached by crossing a mountable curb and backing into a large loading bay. Given that the Medical Center is one of the largest freight generators in the community, this design feature is a key way to keep deliveries away from Medical Center visitors while providing more-than-adequate accessibility for trucks. The Medical Center receives between 40 and 45 truck deliveries a week, with vehicles ranging from Sprinter vans up to 53-ft-long semi-trailers, so having a location to receive deliveries is crucial. One building on SoDa Row has a similar loading dock. The building houses a restaurant and gymnasium, which do not require the use of the dock. However, the property is slated to become a grocery store in the future and will be receiving greater volumes of inbound product and outbound waste. The loading dock will accommodate those delivery needs more efficiently than reliance on curbside deliveries through



Figure 4-27. Delivery from rear parking area at local deli in Daybreak (Source: Cambridge Systematics).

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the front door. This change in tenancy and associated change in delivery needs underscores the importance of considering the range of possible needs that the occupants of a building may have for years to come and to plan accordingly so as to avoid potential conflicts.

The street design and regulations governing traffic operation limit through-truck and automobile traffic. Roundabouts, curb extensions, and narrow lanes, along with a 35 mph speed limit make streets and parkways in Daybreak unattractive “short-cut” routes to through-traffic. Although these design features help increase safety for pedestrians and bicyclists (which is key in smart growth environments), these features must not be so restrictive that trucks cannot enter the community, given that construction and delivery vehicle access is necessary (see Figure 4-28). Kennecott has been heavily involved in ensuring that street design makes sense and has adapted infrastructure to meet changing needs and respond to issues that arise. The flexible and innovative street design has been critical in helping this master-planned community become and remain a success.

Part of the undeveloped land on the western edge of Daybreak is set aside for light industrial uses. Two freight-generating facilities in this area are the distribution center for the Bingham Canyon Mine and a data center for eBay/PayPal. This industrial area is on the opposite side of the Mountain View Corridor from the multiple-use core of the Daybreak community. Significant volumes of truck traffic associated with this industrial cluster are not expected to affect the residential areas of Daybreak for that reason.

As Daybreak grows, a larger mixed-use town center may develop closer to the Mountain View Corridor. With this large cluster of higher intensity development, greater demand for deliveries by truck will exist in this area. The town center’s proximity to the Mountain View Corridor will contain most of the delivery truck traffic to the streets that connect the town center to the corridor, and truck trips will not be dispersed throughout the community.

However, as these new developments are planned and constructed, and as the Utah Department of Transportation advances plans to improve the Mountain View Corridor, coordination between Kennecott Land, local officials in South Jordan, the Wasatch Front Regional Council MPO, and the Utah Department of Transportation will be needed to ensure that



Figure 4-28. *Truck successfully navigating through roundabout in Daybreak (Source: Cambridge Systematics).*

traffic projections remain current. Any changes to land development plans or transportation engineering for the Mountain View Corridor improvements, including ramps and access roads, could change the magnitude and location of associated traffic impacts. Coordination will be necessary to ensure that travel demand can be accommodated and that vehicle and bicycle and pedestrian safety along the corridor and connecting roadways are not adversely affected.

4.5.4 Strategies and Critical Success Factors

Rather than retrofitting an already existing neighborhood, corridor, or building, greenfield development occurs from the ground up. The experience of Daybreak proves that through thoughtful urban design, innovation, and flexible roadway design, and monitoring performance to make adjustments in later phases, freight can operate within a mixed-use, pedestrian environment. Key lessons evident as part of this case study are as follows:

- **Monitor performance.** Kennecott closely measures development in the neighborhood, including the demographics of residents, the rate of purchase for new residences, and commercial and retail use. The operation of the transportation system is similarly monitored over time. Several design features, such as curb extension dimensions, were tested and revised in response to performance. All of these efforts support Strategy 4F, which recommends determining ways to measure and monitor the performance of freight initiatives. The preferred intersection design includes a mountable curb with flexible bollards at intersection corners. This design provides the shorter pedestrian crossing distance achieved by extending the curb, but the mountability allows a truck to complete a turn safely. This practice of evaluating designs and making adjustments to respond to the demands of day-to-day operation informs the design of future phases of the development, allowing each new phase to take a “smarter” form than the phase before it.
- **Share the vision for the community.** This aligns with Strategy 1A to define the community’s goals for all stakeholders. Kennecott Land has a very close working relationship with the City of South Jordan. By including the municipality in every step of the development, the high level of trust allows Daybreak to attempt innovative approaches to road and intersection designs that may not be possible in other areas of the municipality.
- **Establish multipurpose areas that accommodate delivery needs.** In a destination like SoDa Row, which has a limited number of freight movements, each business may not need a dedicated loading dock. Instead, trucks use a multiple-purpose alley as a place to park while making deliveries to adjacent businesses. The deliveries occur during early morning hours, when there are fewer pedestrians in the area. In the afternoons and evenings, the alley can be used as a pedestrian passageway or to accommodate events. This arrangement can save development costs by eliminating loading docks, reduce the need for dedicated on-street curbside loading areas, and provide a public space during most of the day when deliveries are not occurring.
- **Discourage pass-through truck trips.** Traffic-calming features (such as roundabouts, narrow lanes, on-street parking, and low-speed zones) are used to reduce travel speeds and promote safety for vehicles, bicycles, and pedestrians. This approach complements Strategies 2F and 2H, which advocate for safe and flexible intersection design and implementing traffic-calming techniques to reduce conflict, respectively. Traffic-calming measures also discourage the use of streets in Daybreak as “short-cut” routes for pass-through traffic. As Daybreak and the southwestern Salt Lake Valley as a whole grow over time, and as the Mountain View Corridor is further improved and more heavily used in the future, the potential for pass-through traffic may increase. This is not a problem Daybreak can address on its own; therefore, coordination with South Jordan and other local governments, the MPO, and Utah DOT will be needed to

identify appropriate routes for truck traffic to use and measures to appropriately protect safety throughout the region.

- **Learn from Daybreak's example.** Daybreak's experience with roadway design that accommodates both commercial vehicles and pedestrians has evolved over time through careful planning and trial and error. Solutions are not one-size-fits-all, and what works for Daybreak may not work everywhere, but lessons learned over more than a decade of design, implementation, and monitoring could be useful to other communities throughout the region, state, and nation. According to the Wasatch Front Regional Council MPO, Daybreak is presented to other communities in the Wasatch Front region and throughout Utah as a model for smart growth and constructive relationships between private developers and local governments.

4.6 Belmar District: Large-Scale Reconstruction

Characteristics of the Belmar district are presented in Table 4-7.

4.6.1 Context and History

Belmar is a planned, multi-use community built on the site of the former Villa Italia shopping mall in Lakewood, CO, a city of approximately 150,000 located 8 miles west of Denver (see Figures 4-29 through 4-31). The mall was initially developed by Von Frelick Associates in the mid-1960s, housing approximately 140 stores and restaurants at its height and featuring four anchor stores: Foleys, Dillard's, Montgomery Ward, and JC Penny. However, during the 1990s the main tenants left and the mall declined and then closed for good in 2001. The decline of the mall appeared to have a direct effect on property values in surrounding neighborhoods and the perception of Lakewood's desirability to prospective residents and businesses. With the City of

Table 4-7. Characteristics of Belmar district.

Characteristic	Description
Community	Belmar district in Lakewood, CO
Smart Growth Classification	 Large-scale reconstruction
Stakeholders	City of Lakewood, Continuum Partners, local residents, local businesses, freight industry
Key Issues	<ul style="list-style-type: none"> • There are a limited number of commercial loading zones in Belmar. Smaller retail and restaurant establishments mostly use curbside delivery or on-street loading zones, which sometimes results in double parking. • The relationship between Continuum Partners and the City of Lakewood has been excellent, allowing for cooperation and modified rules for the development that would not be permissible in other parts of Lakewood. • Continuum Partners intentionally designed some streets to accommodate larger trucks, while others are narrower and more conducive to pedestrian activity. Major retail tenants have access to loading docks. • Most of the buildings are owned by Continuum, which allows for consolidated trash areas and other conditions for tenants that might not be possible in an area with multiple owners.
Key Takeaways	<ul style="list-style-type: none"> • 1A: Define your community's goals • 1B: Employ freight-compatible development • 2E: Design safe and flexible intersections • 2H: Implement traffic-calming techniques to reduce conflict • 2I: Use innovative financing techniques • 3I: Identify and support route networks • 4F: Determine ways to measure and monitor performance
Relevant Strategies	

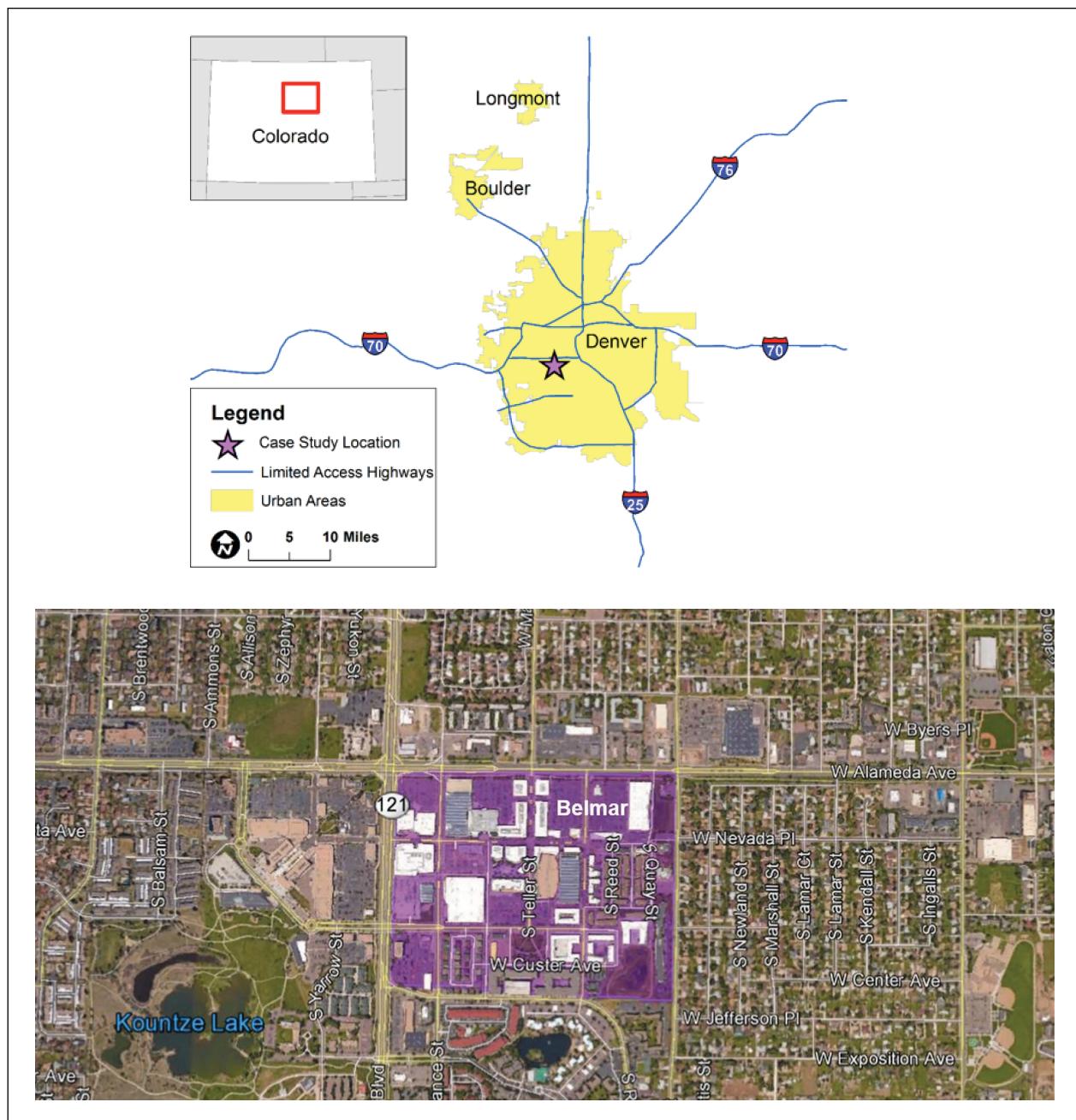


Figure 4-29. Location of Belmar district (Source: [top] ESRI; [bottom] Google Earth, 2016).

Lakewood, Denver-based Continuum Partners led the development of Belmar, beginning in 2002. The site was designed as a multi-use development with residential, commercial, and retail uses in close proximity. Now, instead of anchor stores, the site features several big-box businesses, local shops and restaurants. Although the various uses are within walking distance, they are segregated within Belmar, meaning that there is no residential-above-retail development.

4.6.2 Application of Smart Growth Principles

The redevelopment of the Villa Italia mall site was guided by desires to create a sustainable, mixed-use urban “downtown” environment in a suburban setting, where visitors and residents

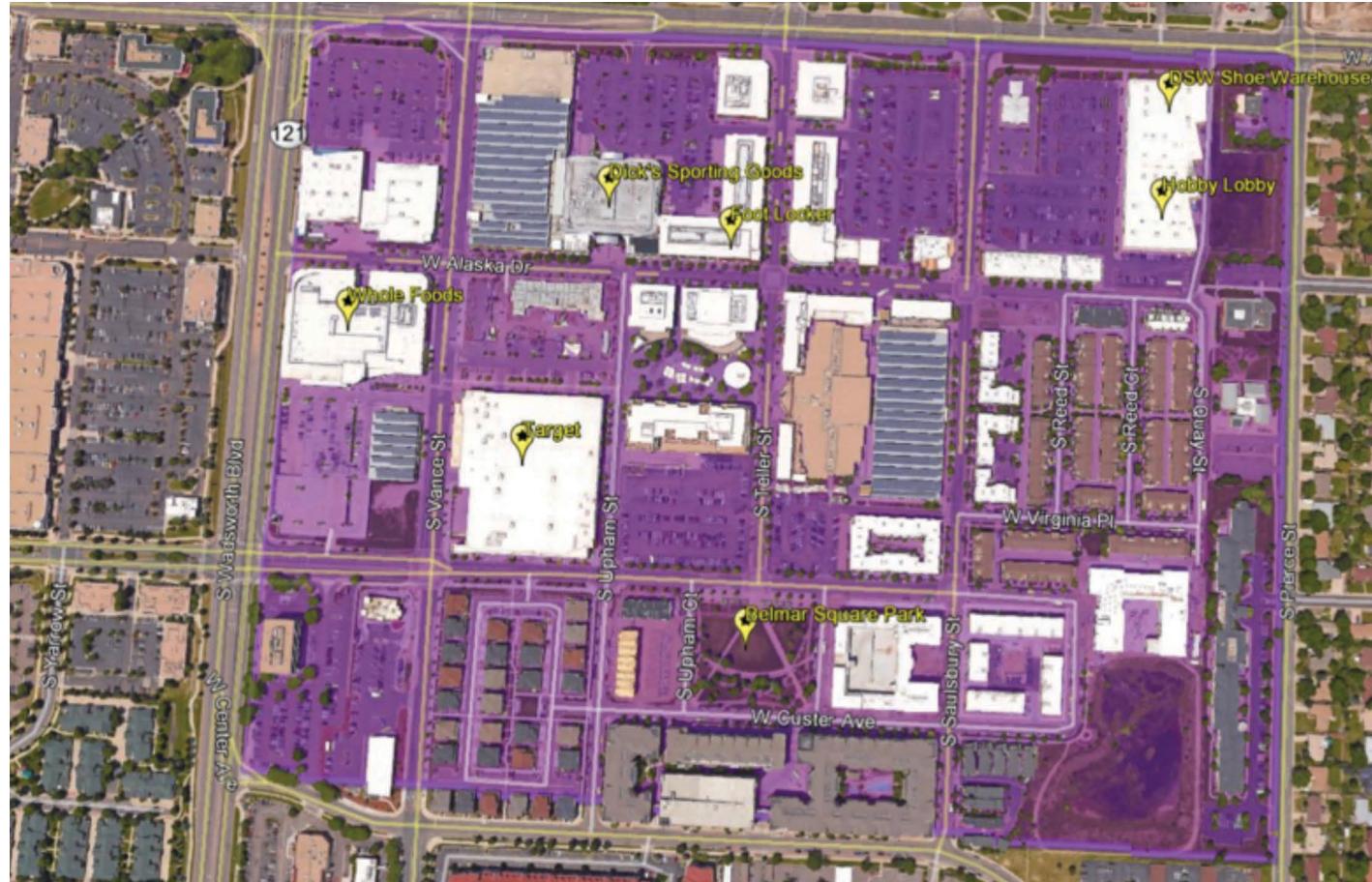
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Figure 4-30. Annotated map of Belmar district (Source: Google Earth, 2016).



Figure 4-31. Villa Italia shopping mall before demolition, 1993 (Source: Google Earth, 1993).

could safely walk between residences, offices, shops, and entertainment facilities in the district. For this reason, the 104-acre site was sliced into an urban street grid consisting of 22 city blocks. The grid is bounded by major arterial roads on the north and west bounds of the site. Within the site, a tiered system of roads includes two-lane collectors which serve as the primary gateways into the community for vehicular traffic and are the routes used by transit buses serving the community. Lesser single-lane streets between the collectors connect residences, businesses, and alleyways. All of the streets in the community include sidewalks, concrete crosswalks at intersections and some mid-block crossings, and attractive street furnishings. Streets in Belmar do not include marked bicycle lanes. Planners say that may change in the future.

The reduction of reliance on fossil fuels is a priority that has guided Belmar's development as well. Colorado's first LEED-certified buildings were constructed here, thereby reducing energy consumption. Continuum used tax incentives to install more than 8,000 solar panels on top of parking decks in the area, which power the lighting inside the parking decks. Parking meters are solar powered, and wind turbines atop street lighting fixtures power street lights.

The City of Lakewood has enjoyed the tax revenues generated by the Belmar development, and residential and commercial property values in adjacent neighborhoods have risen. Further, the success of Belmar has led local officials to support other major investments throughout the municipality (such as light rail and a new medical center) which are credited with further improving Lakewood's quality of life.

Today, Belmar's 22 city blocks contain 900,000 square feet of retail (including big-box retail stores, boutiques, and restaurants); a movie theater; more than 260,000 square feet of office space; and 1,300 residential units consisting of single-family homes, townhouses, and loft-style rental apartments. Belmar is home to more than 2,000 residents within a 22-block area and another 4,000 live within walking distance. Three thousand people are employed by businesses (Briggs 2014). Belmar hosts numerous festivals and events and acts as the downtown core for Belmar as the designers originally intended. The development is almost completely built out, with only a few small areas available for additional construction.

4.6.3 Goods/Services Conditions and Results

Although there are no industrial buildings in Belmar, the site is home to various freight-reliant businesses, including large national retail chains (such as Target and Dick's Sporting Goods), other national chains in small retail stores (such as Foot Locker), and many locally owned retail and restaurant establishments. All of these users require regular freight deliveries. Goods coming into the development move entirely by trucks in a wide variety of types ranging from vans and box trucks to 53-ft-long trailers. Most of the major retail chains rely on larger vehicles and have dedicated loading docks to receive the goods. The smaller retail and restaurant establishments mostly use curbside delivery from box trucks or vans and use handcarts if multiple deliveries are required or a spot cannot be found directly in front of a specific business. There are a few commercial loading zones in the center of Belmar. In addition, at least one of the restaurants picks up goods from an off-site location multiple times a week.

Freight movement in Belmar is aided by a hierarchy of streets arrayed in a grid pattern. It is a conscious effort on the part of the developer to design some streets meant to accommodate large trucks and transit buses while others are narrower and built to a more pedestrian scale. West Virginia Ave., South Salisbury St., and South Vance St. are all built at a larger scale, while West Alaska Drive, South Upham Street, and South Teller Street are built at the smaller scale. The streets in the residential section of the development, specifically South Reed Court, South Quay, and South Reed Street are smaller. Although the smaller streets are designed to

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be “pedestrian-first” streetscapes, trucks making residential and business deliveries and service trucks (such as waste collection trucks) can navigate the streets and get to and from the places they need to go within the community. Intersections incorporate mountable curbs designed to allow trucks extra room to maneuver.

Most of the buildings are owned by a single company—Belmar—which allows the development to impose some conditions on tenants (such as consolidated trash areas) that might not be possible in areas with multiple building owners.

Belmar is nearly built out, and only a few parcels along West Virginia Ave. remain undeveloped. Although few undeveloped parcels remain, the managers of the development intend for Belmar to adapt to future market needs by repurposing or redeveloping buildings or blocks as needed. The hope is that the community in its current form can withstand many decades of changing market and community demands.

4.6.4 Strategies and Critical Success Factors

Some key lessons were discovered as part of this case study. Although not all are directly related to freight movement, these lessons are important in the planning, development, and ongoing operations in Belmar and the demand for goods and services to move into, out of, and through the community.

- **Foster cooperation between developers and local government.** The development team cited the excellent working relation with the City of Lakewood as one of the main drivers of success for the development project over the years. The developers wanted to design roads narrower than the city’s prototypical street dimension, which drew some criticism from utility companies. Intersections were another area where Belmar was given additional flexibility; some intersection dimensions in the development require a truck or fire vehicle to use part of the opposing lane to make a turn. This is not typically permitted in Lakewood, but the cooperative relationship between the developer and the city fostered a “try it and see” flexibility, which led to innovative designs such as mountable curbs and other versatile street designs, which are also ADA-compliant. This relationship has survived through multiple municipal election cycles and has allowed the developers to create a project that meets its guiding principles and continues to draw residents and businesses.
- **Design places for deliveries to happen.** Belmar incorporates multiple design features to allow for loading and unloading of goods, which complements Strategy 1B to employ freight-compatible development. Most of the major retail tenants have their own loading docks to accommodate deliveries and waste pickup. Many of these loading docks, especially those on the periphery of the community, are hidden behind landscaping or behind buildings away from pedestrian streets. On-street loading zones in the core of the development allow for commercial vehicles to deliver goods to the smaller retail locations. Residential areas with low traffic flow are served by curbside (or at times double) parking. For future development, Belmar planners are considering “flexible streets,” which could serve as commercial loading zones during early morning hours and as public spaces or to accommodate food trucks or other vendors during lunchtime, afternoon, and evening hours.
- **Use innovative financing.** Belmar, in conjunction with the Lakewood Reinvestment Authority (LRA), uses tax increment financing (TIF) to help spur investment. TIF allows for the future repayment of loans for projects such as parking structures, water, or roads by taxing the incremental rise of property values or sales receipts that occur due to the improvement. TIF funds can then be allocated to a design project within the investment area. This approach aligns with Strategy 2I, which recommends using innovative financing techniques to accomplish development. Sales tax increments, property tax increments, or a combination of

both can be used to fund redevelopment projects. Belmar is part of the West Alameda Avenue Corridor Redevelopment Area under the LRA (Lakewood Reinvestment Authority 2011).

- **Use of Special Districts.** Special Districts are quasi-governmental corporations authorized by the State of Colorado and formed by municipalities in order to perform specific functions. Governed by a Board of Directors, special districts allow for local control over certain issues in the area governed, while still qualifying for government loans and grants and subject to state oversight. Special Districts have the authority to levy property taxes and condemn property, powers that make them different from a property or home owners association (Special Districts Association of Colorado No Date). This is another example of an innovative financing technique as per Strategy 2I. Belmar incorporates three special districts within the development; one covers most of the residential property, one covers most of the commercial property, and one acts as an oversight/umbrella district for the entire development. These districts also allow for more control and flexibility in street design and geometry than a traditional municipal government might allow.
- **Attention to local road design.** Relatively minor roadway design features including mountable curbs and curb cuts in only one direction of travel help balance the needs of trucks and other road users, including pedestrians.
- **Coordination with State DOT and regional transit agencies.** The Belmar development's western boundary is Wadsworth Boulevard, a state highway under the jurisdiction of Colorado DOT. Although improvements to Wadsworth Boulevard are not planned or foreseen, the City of Lakewood and the Regional Transportation District (RTD) have engaged in Colorado DOT's studies of improvements elsewhere along the Wadsworth Boulevard corridor. This coordination ensures that the DOT can consider alternatives that address the future needs of the community, including goods movement, transit service, passenger vehicles, and pedestrians. Although marked bicycle lanes do not exist on streets within the Belmar development today, the developers have stated that they could be installed in the future. Coordination between the developers, the City, and the State DOT could determine the feasibility of connecting bicycle lanes in Belmar with other parts of the City via a combination of state and local roadways.
- **Establish ways to collect information on performance.** This complements Strategy 4F, which recommends determining ways to measure and monitor the performance of freight initiatives. Better ways are needed to monitor the performance of the transportation network and various design features once the project is completed. Developers acknowledge that once a project is done, they rarely receive feedback on their design decisions—feedback that could help them improve future designs. This issue will require action from all sides—developers, engineers, architects, public officials—in order to discover lessons learned following the completion of a project.



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Abbreviations, Acronyms, and Initialisms

3CDC	Cincinnati Center City Development Corporation
3PL	Third-Party Logistics
ADA	Americans with Disabilities Act
APA	American Planning Association
BID	Business Improvement District
CDE	Community Development Entity
CDFI	Community Development Financial Institutions
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CNG	Compressed Natural Gas
COD	Cargo-Oriented Development
CoE-SUFS	Volvo Research and Educational Foundations' Center of Excellence for Sustainable Urban Freight Systems
COG	Council of Governments
DOT	Department of Transportation
DVRPC	Delaware Valley Regional Planning Commission
EPA	United States Environmental Protection Agency
FBC	Form-Based Code
FRA	Federal Railroad Administration
GDP	Gross Domestic Product
GIS	Geographical Information Systems
GKFF	George Kaiser Family Foundation
G-MAP	Goods Movement Action Program
GPS	Global Positioning Systems
HUD	U.S. Department of Housing and Urban Development
HUV	Hub Urban Village
IDMEC-IST	Research Centre—Instituto de Engenharia Mecânica
ISO	International Standards Organization
ITS	Intelligent Transportation Systems
ITE	Institute of Transportation Engineers
GIS	Geographic Information System
GPS	Global Positioning System
LNG	Liquefied Natural Gas
MIC	Manufacturing/Industrial Center
MIZOD	Maritime Industrial Zone Overlay District
MPO	Metropolitan Planning Organization
NACTO	National Association of City Transportation Officials
NMTC	New Market Tax Credit
NRDC	National Resources Defense Council

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NYSERDA	New York State Energy Research and Development Authority
OKPOP	Oklahoma Museum of Popular Culture
OTR	Over-the-Rhine (Cincinnati, Ohio)
PANYNJ	Port Authority of New York and New Jersey
RFP	Request for Proposal
RPO	Regional Planning Organization
RTD	Regional Transportation District
SHRP	Strategic Highway Research Program
SSA	Special Service Area
STIP	Statewide Transportation Improvement Program
STPP	Surface Transportation Policy Project
TIF	Tax Increment Financing
TIP	Transportation Improvement Program
TND	Traditional Neighborhood Development
TOD	Transit-Oriented Development
UTRC	University Transportation Research Center
USACE	United States Army Corps of Engineers
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
VMT	Vehicle-Miles Traveled

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
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	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
FAST	Fixing America's Surface Transportation Act (2015)
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
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
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
TDC	Transit Development Corporation
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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