Final report

Comparative Case Studies: Trip and Parking Generation at Orenco Station TOD, Portland Region and Station Park TAD, Salt Lake City Region

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Chapter 1. Introduction

This report presents comparative case studies, defined as "the analysis and synthesis of the similarities, differences and patterns across two or more cases that share a common focus or goal in a way that produces knowledge that is easier to generalize about causal questions" (Goodrick, 2014: 1). This follows earlier case studies by the authors at five exemplary transit-oriented developments (TODs) across the U.S.: Redmond TOD in Seattle; Rhode Island Row in Washington D.C.; Fruitvale Village in San Francisco-Oakland; Englewood TOD in Denver; and Wilshire/Vermont in Los Angeles (Ewing et al. 2017).

The subject of this sixth case study is Orenco Station, on the west side of the Portland metropolitan area in the suburban city of Hillsboro, OR. Orenco Station may be the most well-known and lauded freestanding TOD (as opposed to infill TOD) in the nation. The subject of the seventh case study is Station Park, a mixed-use development abutting a commuter rail station on the north size of the Salt Lake City region in the suburban city of Farmington, UT. Station Park labels itself a TOD, but projects as a giant shopping center with a commuter rail station at one corner and a pedestrian pocket in the center.

D Variables

Like the first five case studies, Orenco Station is more or less exemplary of the D variables featured in the built environment-travel literature (Ewing and Cervero, 2010) (see Figure 1.1). It contains a **diverse land use mix**, with residential, commercial, and public uses. It has public spaces, ample sidewalks, street trees, curbside parking, small building setbacks, and other features that make it **well designed** from a pedestrian standpoint. It **minimizes distance to transit**, literally abutting a light rail transit (LRT) station. It is served by one of the best transit systems in the nation, giving it exemplary **destination accessibility via transit**. It provides affordable housing, and thus attracts the **demographics** most likely to use transit and walk. It has **high residential density** relative to the region in which it is located. And some of its buildings have parking management policies that can be considered progressive, these falling under the heading of **demand management**.

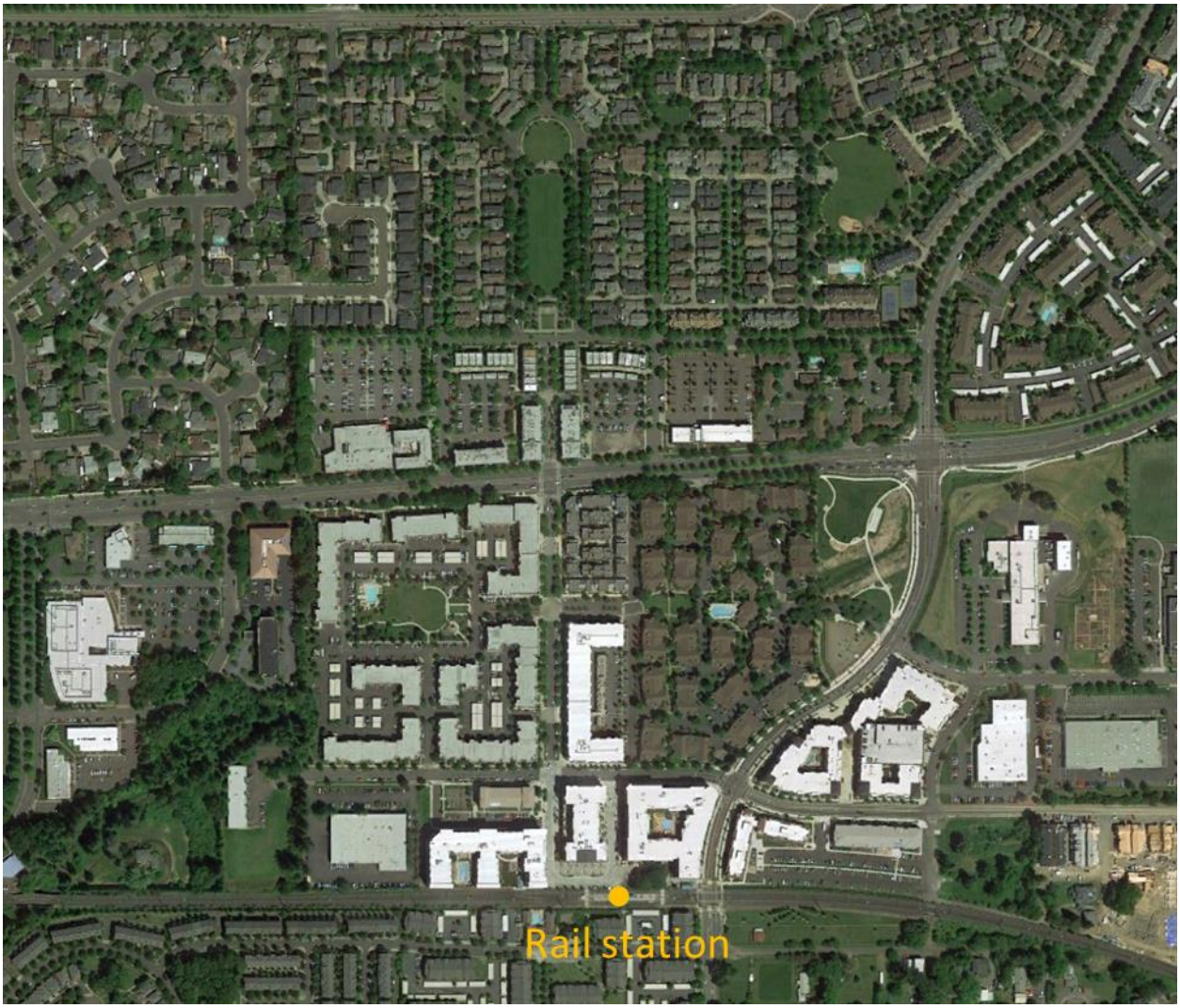


Figure 1.1. Aerial Image of Orenco Station

What distinguishes Orenco Station from the first five TODs is its scale (see Table 1.1). All but one of the first five TODs are less than 10 acres in size. The entirety of Orenco Station is 237 acres, and even the portion featured in this study is about 60 acres. The scale suggests that a much high proportion of trips will be internal to the development, a good thing from a transportation and physical activity standpoint. However, it also suggests that part of the development will be at a considerable distance from the transit station, which means that the average transit mode share may be lower since transit use falls off with distance from a station. It may also suggest a decline in transit use because, unlike the first five TODs studied, not all of the housing will be multifamily on a large site like Orenco Station. A large site ordinarily requires a mix housing types for rapid land absorption and, in fact, our study area includes single-family attached product.

Table 1.1. Net and Gross Residential Densities, and Floor Area Ratios for Commercial Uses, for the First Five TODs Studied and Orenco Station

TOD	Region	Gross Area (acres)	Gross Residential Density (units per gross acre)	Net Residential Area (acres)	Net Residential Density (units per net acre)	Gross Commercial FAR (for retail and office uses)
Redmond TOD	Seattle	2.5	129	2.5	129	0.11
Rhode Island Row	Washington, D.C.	6	46	6	46	0.27
Fruitvale Village	San Francisco	3.4	14	3.4	14	0.94
Englewood	Denver	30	15	10.7	41	0.25
Wilshire/Vermont	Los Angeles	3.2	140	3.2	140	0.27
Orenco Station (study area)	Portland	60	32.4	60	32.4	0.10
Station Park (study area)	Salt Lake City	115	4.1	20	23.3	0.23

Station Park does not perform as well as the other developments with respect to the Ds (see Figure 1.2). It can be classified a couple of ways. In terms of land uses, Station Park is probably most similar to a lifestyle center, defined as a shopping center that combines the traditional retail functions of a shopping mall with leisure amenities oriented towards upscale consumers. However, it does have three other uses that are not common in lifestyle centers, those being a supermarket, a hotel, and a medical facility. And it has a pedestrian-oriented village core.

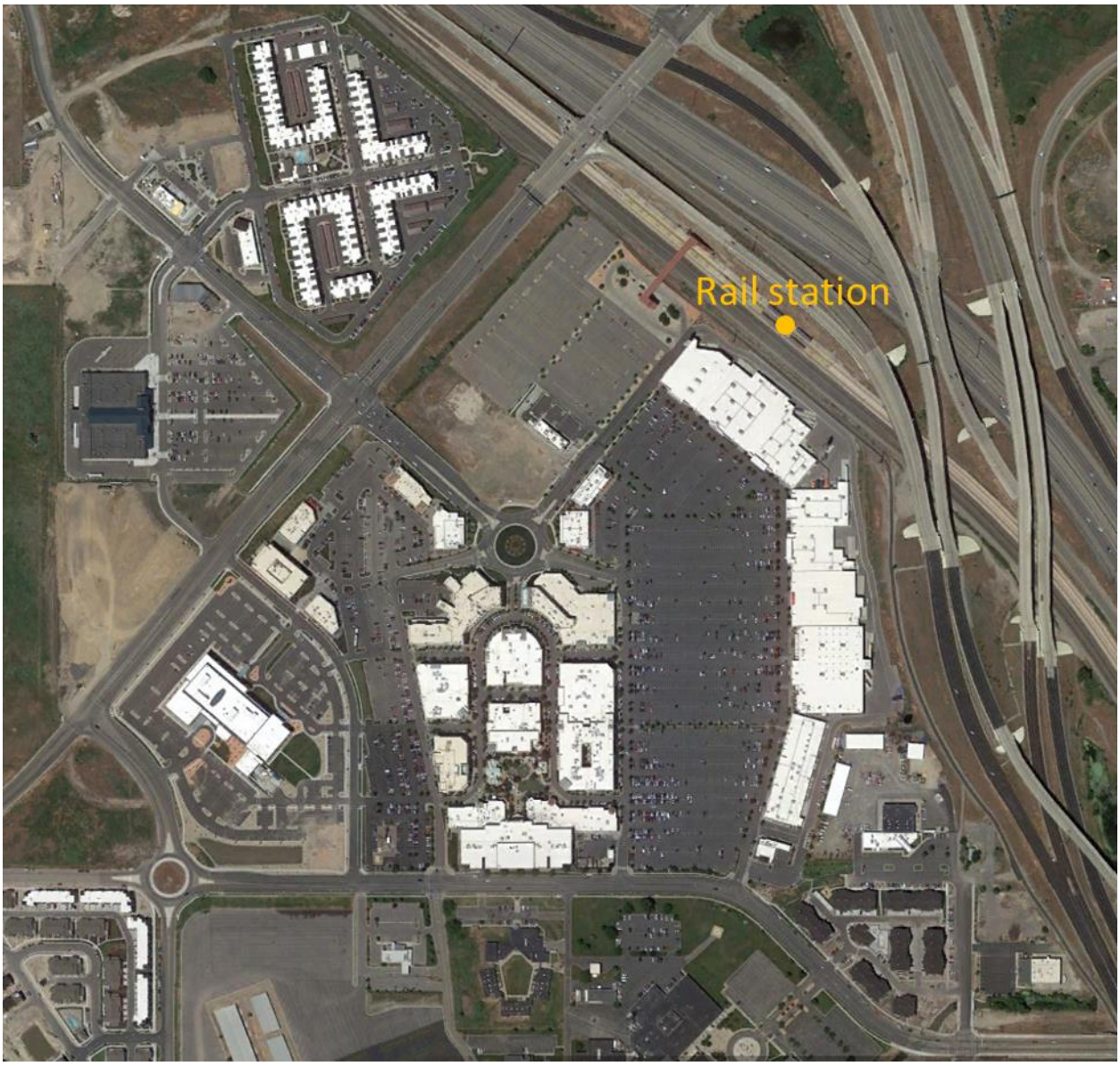


Figure 1.2. Aerial Image of Station Park

Classified by its transit connection, Station Park is more of a TAD (transit adjacent development) than a TOD. Huge parking lots dominate the space between the commuter rail station and other components of the development. The big box component of Station Park turns its back on the commuter rail station. It was not that way in early versions of the site plan, when the most walkable components were oriented toward the commuter rail station. Station Park does not contain residential development within its main development boundaries. Transit accessibility to the rest of the region via commuter rail and bus is limited compared to the transit accessibility of Orenco Station via its light rail line. All parking at Station Park is abundant and free.

Nevertheless, Station Park has succeeded commercially and is contributing to the local economy, mainly thanks to its location near three highway exits at Interstate 15, Highway 89, and the Legacy Parkway. Salt Lake City International Airport is a short 20-minute drive from Station Park. It's a quick in and out for

anyone who visits the area. It supports thousands of jobs on-site. The 500 employees of one corporate office in the village core, Pluralsight, are estimated to pump a million dollars per year into restaurants and other businesses in the shopping center. And the mixed-use nature of the development promises transportation benefits, as the different land uses allow visitors to "park once and walk."

Literature Review

The question of how much vehicle trip and parking demand reduction occurs with TOD is still largely unanswered in the literature. Everyone agrees that there should be some reduction, but is it 10 percent or 20 percent or 30 percent or more?

First we review the literature on vehicle trip generation at TODs. The ITE *Trip Generation Manual* itself states that its "[d]ata were primarily collected at suburban locations having little or no transit service, nearby pedestrian amenities, or travel demand management (TDM) programs" (ITE 2012, pp. 1). It goes on to say: "At specific sites, the user may wish to modify trip-generation rates presented in this document to reflect the presence of public transportation service, ridesharing, or other TDM measures; enhanced pedestrian and bicycle trip-making opportunities; or other special characteristics of the site or surrounding area" (ITE 2012, pp. 1). This kind of modification is seldom done in practice.

Surveying 17 housing projects near transit in five U.S. metropolitan areas, Cervero and Arrington (2008) found that vehicle trips per dwelling unit were substantially below the ITE's estimates. Over a typical weekday period, the surveyed housing projects averaged 44 percent fewer vehicle trips than that estimated by using the ITE manual (3.754 versus 6.715). Another study by the San Francisco Bay Area Metropolitan Transportation Commission found that residents living near transit generated half as many vehicle miles traveled (VMT) as their suburban and rural counterparts (SFBAMTC 2006). Nasri & Zhang (2014) found people living in TOD areas reduced their VMT by around 38% in Washington, D.C. and 21% in Baltimore, compared to their non-TOD counterparts. At the same time, residents living in developments near transit are reported to have higher rates of transit trips than residents living at greater distances (Faghri & Venigalla 2013; Olaru & Curtis 2015; SFBAMTC 2006; Zamir et al. 2014), especially for commuting trips (Arrington & Cervero 2008; Cervero 1994; Faghri & Venigalla 2013; Lund et al. 2004; Lund et al. 2006). However, another study found that new residents in seven TODs in North American adopted more active and transit trips only for amenities and leisure after they relocated to a TOD but that they were less likely to do so for work and shopping (Langlois et al. 2015). These results are specific to multifamily housing developments near transit. To our knowledge, there are only two studies of vehicle trip generation at TODs (defined as mixed-use developments – Handy et al. 2013; Ewing et al. 2016).

Next we review the literature on parking generation at transit-served sites. The ITE *Parking Generation* manual notes that study sites upon which the manual is based are "primarily isolated, suburban sites" (ITE 2010). Studies show that the vehicle ownership is lower in transit-served areas than those that are not transit-served (Faghri & Venigalla 2013; Zamir et al. 2014). By comparing parking-generation rates for housing projects near rail stops with parking supplies and with ITE's parking-generation rates, Cervero et al. (2010) found there is an oversupply of parking near transit, sometimes by as much as 25-30 percent. Oversupply of parking spaces may result in an increase in vehicle ownership (Cervero & Arrington 2008). This is supported by the strong positive correlation between parking supply and vehicle

ownership (Chatman 2013; Guo 2013) and auto use (Chatman 2013; Weinberger 2012; Weinberger et al. 2009). Again, these studies mostly relate to residential developments. Although Loo et al. (2010) studied rail-based TOD and the connection with variables such as parking and car ownership, they did not examine parking demand. To our knowledge, there is only one study of parking demand at TODs (again, defined as mixed-use developments – Ewing et al. 2016), the others being for residential developments near transit.

Simply put, Ewing et al.'s (2016) case study TODs (even the most auto-oriented) were found to create significantly less demand for parking and driving than do conventional suburban developments. With one exception, peak parking demand in these TODs was less than one half the parking supply guideline in the ITE *Parking Generation* manual. Also, with one exception, vehicle trip generation rates were about half or less of what is predicted in the ITE *Trip Generation Manual*. Automobile mode shares were as low as one quarter of all trips, with the remainder being mostly transit and walk trips.

Chapter 2. Orenco Station TOD, Hillsboro, OR

During the past two decades, Portland-area planners have embraced transit-oriented development (TOD) as the dominant land use/transportation planning strategy. Dozens of TODs, including Orenco Station, have been constructed in the Portland region, with several winning national acclaim. Orenco Station has won awards such as "Best New Burb" by Sunset magazine in 2005. Other awards include the Oregon Governor's Livability Award in 1998, the Best Master Planned Community in America Award in 1998, the Ahwahnee Award in 1999, and Transit Communities Livable Design Award in 1999.

History of the Site

One hundred years ago, Orenco Station was the site of one of Oregon's first planned communities — the historic town of Orenco. The name "Orenco" is a nickname for the Oregon Nursery Company, a now-defunct enterprise that was once the largest nursery on the U.S. west coast. Founded in 1867, the company offered fruit and nut trees as well as a wide variety of ornamental shrubs and plants. In 1896 the nursery relocated its 1200-acre (4.9 km^2) operations to the site of Orenco Station.

To accommodate its workers, the company built residential homes, utilities, a school, and a church. It also encouraged small businesses to locate in the area. The town of Orenco was founded in 1908 for the company's 150 employees and their families. Also, in 1908, the Oregon Electric Railway extended a trolley line from Portland to Forest Grove, with a stop at the company town.

The Oregon Nursery Company fell on hard times during the Great Depression, and when one of the partners pulled out, the company filed for bankruptcy and was dissolved in 1927. After the company closed, some families started small nurseries of their own, but most moved away looking for work elsewhere. In 1938, eight Orenco residents, representing the community's remaining families, voted to dissolve the city government (Charles and Barton, 2003; Slater, 1965).

The former town of Orenco and the surrounding unincorporated areas remained relatively rural during the next several decades. In the 1950's, much of the land surrounding Orenco was subdivided and sold without utilities or roads, but the subdivision failed and the area became known primarily as an area for illegal dumping (Apalategui, 1994).

During the early 1980s, the city of Hillsboro created an urban renewal district (URD) in order to consolidate the lots, provide necessary infrastructure and allow large parcels to be sold off to commercial developers. A 300-acre URD was formed in 1989, and the city began buying up lots from willing sellers. By 1994 the city had agreements from about 90 percent of property owners. The city then worked out agreements with Pacific Realty Associates (PacTrust), one of the Pacific Northwest's largest developers, to trade and/or sell lots in order to consolidate ownership and enable planned-unit development to begin (Charles and Barton, 2003).

Early Development

On July 28, 1993 the TriMet board formally approved a 6.2 mile alignment between SW 185th Avenue and downtown Hillsboro that would run through Orenco Station. The U.S. Congress approved the $75M federal funding for the westside light rail extension to Hillsboro, with one catch: regional and local

governments had to commit to higher residential density near the new light rail stations. The area near the old town of Orenco was labeled a “Town Center” by Metro in its 2040 plan for the region (Mehaffy, 1998). The Westside Blue Line, completed in 1998, is 18 miles long, and includes 20 stations, including the Orenco/NW 231st station.

The original Orenco Station neighborhood, north of our study area, was built in the last half of the 1990s. It is the portion of the Orenco Station site more than one quarter mile from the LRT station. The original developer, PacTrust, assumed that, despite the rail station along its southern boundary, the community would remain largely auto-oriented and therefore focused early development on Cornell Road.

PacTrust would have been more comfortable with the kind of high-tech development that was occurring around the Orenco Station site, with Intel to the north and Toshiba to the southeast. PacTrust lacked residential development experience, and therefore partnered with Costa Pacific Homes, a homebuilder. Through visual preference surveys and focus groups, PacTrust and Costa Pacific ultimately became convinced that people, particularly those working in high-tech jobs nearby in what was dubbed Silicon Forest, would pay to live in a relatively dense, amenity-rich community modeled after Portland’s older neighborhoods.

Working with planners at Hillsboro and two other nearby property owners, PacTrust and Costa Pacific developed a master plan for a 195-acre parcel straddling Cornell Road just north of the LRT station. This master planning process was encouraged by government planners as a way to ensure that TOD principles were built into the plan. The costs of the plan were partially paid for by a grant from the Oregon Transportation and Growth Management (TGM) program. In July 1995, PacTrust filed papers with the Hillsboro Planning Department for a planned unit development including apartments, single family homes, and a retail town center.

Public/private partnership was a key to success. The planners and developers sat down together and wrote a new zoning ordinance for the site. The ordinance allowed for a number of significant innovations, including "skinny" (20 foot) streets, close maximum street setbacks (19 feet), side yard easements (allowing high privacy windows for one home while the adjacent home has full use of the side yard), "granny flat" accessory dwellings, live/work homes, and alley-loaded garages. In the Town Center, buildings were required to line the streets, with parking in the rear—a rule-breaking retail formula that has worked in practice surprisingly well. Mixed uses were allowed and in some cases even required. The developers were full participants in writing the new zoning and working out the vision of the community, based on the market research, study of precedents, private-sector expertise and entrepreneurial vision (Mehaffy, 1998).

The neighborhood provides various residential options including single-family homes, apartments, condominiums, townhouses and live/work row houses. It contains a Town Center (a short main street—the retail core) along Orenco Station Parkway just north of Cornell Road and a 50-acre community shopping center on the eastern edge of Orenco Station. The original neighborhood also contains 8 acres of open space, including a large park named Central Park located just north of the retail core, along with smaller parks spread throughout the community like “pearls on a string.” The idea is make the walk to the Town Center (main street) and, ultimately, the LRT station that much more pleasant by providing public spaces along the way.

Figure 2.1. Early Development Plan

(a) Entrance to Main Street Looking North

(b) Small Lot Single-Family Homes

(c) LRT with Hub 9 under Construction

(d) Park-and-Ride Lot before Redevelopment

(e) Affordable Housing under Construction

Figure 2.2. Orenco Station Then (2014-15)

More Recent Development

Development started on the north end of the site and moved south. Most of the land between the original Orenco Station neighborhood and the LRT station remained vacant until relatively recently, which hurt the pedestrian experience and doubtless discouraged transit use.

The first project just south of Cornell Road, called Club 1201, opened in 1999. Just west of Club 1201 are the Q Condominiums, completed in 2006. Across Orenco Station Parkway from Q Condos is the Nexus apartments, opened in 2007.

Across the street and south of that, the Holland Partner Group has developed the multi-phased "Platform District" consisting of five mixed-use buildings. Initially, a text amendment had prohibited residential development just north of the station. From the early site plan (see Figure 2.3), you can see how little development was planned for the area. When Holland purchased the land, they worked with the city of Hillsboro to rezone it to allow mixed-use developments including housing. Currently, the area is zoned SCC/SCR, station community commercial and station community residential.

In 2013, Platform 14 opened. This was followed in 2014 by Tessera. Then in 2015 came Hub 9 and Rowlock and in 2016, the last project, Vector.

Also in the study area, REACH, an affordable housing developer, built affordable apartments on 6 acres, called the Orchards at Orenco (the first opened in 2015 and the second opened in 2016). Alma Gardens was completed by Northwest Housing Alternatives in 2013, providing 45 affordable housing units for seniors.

For these projects, government planners used both carrots and sticks to get the project designs they wanted. TriMet and Hillsboro imposed extensive planning restrictions on the area, mandating high densities near the rail station. On the incentive side, Orenco Station was subsidized with a $500,000 federal Congestion Mitigation Air Quality (CMAQ) grant and Hillsboro provided over $1,000,000 from the county's Traffic Impact Fund (TIF) fees to compensate for infrastructure investments. Other incentives and public-private partnerships are discussed in our final report (Ewing et al. 2017).

(a) Main Street Looking South Toward Cornell

(b) Platform 14 on Orenco Station Parkway

(c) Completed Hub 9 Viewed from Platform

(d) Vector on Former Park-and-Ride Lot

(e) LRT with Rowlock in Background

(f) Public Plaza at Edge of Station Platform

(f) Outdoor Dining at Edge of Plaza

Figure 2.3. Orenco Station Now (2017)

East Village at Orenco Condominiums: Club 1201 (Developer: Simpson Housing)

The first project in this area, called the Club 1201 condominium complex, is an assembly of 21 ten-unit buildings, located on about 7 acres site northeast of the MAX station. Simpson Housing acquired 31.8 acres of land from PacTrust, south of Cornell Road and north of the Orenco light rail station, with a concept plan that included 804 multifamily housing units (FTA, 2014). This 10-acre development includes 210 one-, two-, and three-bedroom condominiums in 21 asymmetrical buildings at 10 units per building. It has a density of about 17 units per acre. The first units were completed in March of 1999, and the project was sold out by 2001. Buildings are inward-looking and on-site amenities include a recreation center and clubhouse with community swimming pool, picnic area, basketball court, and playgrounds.

The project, originally a rental apartment complex, changed to condominiums during construction. Simpson Housing purposefully under-parked the development—each of the 21 buildings includes only 12 spaces for 10 units. Thirty-nine extra visitor/overflow parking spaces are provided throughout the site, resulting in a total of 1.39 spaces per dwelling unit. Additional parking was added at the urging of the residents (FTA, 2014).

The Q Condominiums (Developer: Legend Homes)

Located on the southeast corner of Orenco Station Parkway and Cornell Road, adjacent to the Club 1201 site, are the Q Condominiums. Established in 2006 by Legend Homes, this property includes 62 one- and three-level units (17 condos and 45 townhouses) with private patios and internal courtyards. It consists of 13 three-story townhouse and loft style units. Community amenities include a clubhouse, pool and hot tub, the exercise room, and two parking spaces per unit. It has one commercial space, currently used by a dentist office. In addition to each home's private space, the residents of the Q have full access to the adjacent Club 1201's amenities—basketball courts, spa and pool, meeting rooms, mini-theater, and two playgrounds. There are 118 parking spaces for the Q Condominiums and the parking is handled through underground podium parking (FTA, 2014). The Q Condos was sold to residents at about $260/sq.ft.

The Nexus Apartments (Developer: Simpson Housing)

Located at the southwest corner of Cornell Road and Orenco Station Parkway, across the street from the Q Condos, a luxury apartment complex, called Nexus, is located. The site was developed and is owned by Simpson Housing, which also built Club 1201 condominiums. $50 million project completed in 2007.

On its 10.42-acre site, the Nexus consists of 422-units of three-story apartments, 7,100 square feet of ground floor retail and a 4,500 square foot clubhouse, including a conference center, fitness center, theater and lounge. Nearly half of all units offer large two- and three-bedroom spaces (41 three-bedrooms, 170 two-bedrooms, 168 one-bedrooms, and 43 studios) making the Nexus a family-friendly environment. In the middle, the Nexus has a two-acre park with an outdoor swimming pool. The architecture of Nexus is compatible with the craftsman style and detail of the existing town center buildings built in the late 1990s. Especially, the corner forms and the retail spaces anchor the main town center intersection.

Orchards at Orenco I and II (Reach Community Development)

Washington County has awarded a $750,000 grant to a Portland-based nonprofit, REACH Community Development, to help build the first affordable housing apartment complex in Orenco Station. The county grant, paid out of the federal HOME Investment Partnerships Program Funds. REACH planned a three-phase development project to build about 150 apartments on six acres, called The Orchards at Orenco, just south of Northeast Cherry Drive at Northwest 231st Avenue, adjacent to the light rail station.

The first phase opened on June 29, 2015 with a 57-unit apartment building with rents affordable to residents earning approximately 50 percent of area Median Family Income, or approximately $30,000 for a single-person household. It has 40 one-bedrooms and 17 two-bedrooms. Rents for the one- and two-bedroom units range from $603-$766/month. The 57,750 sq. ft., three-story apartment building is the largest multi-family Passive House building in the United States, reducing heating consumption by 90 percent. Orchards at Orenco Phase II, a 58-unit apartment, began construction in spring of 2015 and was completed in summer 2016. Phase II has 44 one-bedrooms and 14 two-bedrooms. It is also affordable and built using Passive House energy standards. The final phase will consist of two three-story buildings that contain 52 affordable units whose construction is beginning in May 2017. The final phase buildings have 33 two-bedrooms and 19 three-bedrooms.

Phase 1 took $14.6 million and Phase II costed $13.6 million. For the completed two projects, financing sources include 9% tax credit equity (about $9 million for each), Oregon Housing and Community Services grants ($300K for each), Oregon Affordable Housing Tax Credit (OAHTC) ($2.475 million for Phase I and $2.73 million for Phase II), Washington County HOME Loan ($1.5 million for Phase I and $1.17 million for Phase II), and others (e.g. NeighborWorks® America, Energy Trust of Oregon, Meyer Memorial Trust, etc.).

Alma Gardens Senior Apartments (Northwest Housing Alternatives)

The Alma Gardens project is completed by Northwest Housing Alternatives (NHA), a Milwaukie-based nonprofit that has provided housing to 2,500 people in Oregon. After buying a 0.75-acre parcel for $380,000 in 2010, NHA secured the competitive state Low Income Housing Tax Credits. The project finished in September, 2013.

Alma Gardens is the 45-unit, four-story affordable housing complex for seniors, restricted to residents 55 and older. Equipped with 600-square-foot, one-bedroom units, the apartment's monthly rents are capped at $600. The target cap is at 60 percent of the area's median income, roughly $30,000 a year for an individual. One-quarter of the property is dedicated to a community garden, where residents can grow their own food. Each floor has a lounge area for residents to socialize, and a larger community room is on the ground floor. Utility bills are alleviated by onsite solar panels that preheat the complex's water supply (Theen, 2013).

Platform District (Developer: Holland Partner Group)

The developer of the Platform District, **Holland Partner Group**, opened its first new building in the area – the 177-unit **Platform 14** – in November 2013. On 2.3-acres site, the building has 166 traditional apartments (125 one- and 41 two-bedroom units), 11 live-and-work units (with one bedroom/two bath layouts), and 16,328 sq. ft. of commercial space. It also has a recreation center, a swimming pool, and a club house. Platform 14's units come with vinyl faux wood flooring and stainless steel appliances. As the first in the Platform District, the success of Platform 14 made it realize and shaped the following developments, a developer says during an interview.

Holland's next project was **Tessera** apartment complex, located near the intersection of NW 231 1st Avenue and NE Campus Way. It is a 304-unit apartment complex on 4.24 acres. The $57.1 million project was completed in 2014. The four-story apartment buildings are essentially connected, with a ground-floor breezeway. There is 6,900 square feet of ground floor retail. Inside the complex's courtyards, the community features a business center, fitness center, swimming pool, playground, and a hot tub. Among the Holland projects, only Tessera has three-bedroom apartments targeting families, retirees, and some college students.

Following the two Holland individual projects, a multi-phased development consists of three six-story buildings immediately surrounding the light rail station as well as a public plaza surrounding the

platform. These are three buildings with roughly 579 units of housing and more than 20,000-square-feet of retail.

Figure 2.4. Platform District

The $121 million project involves the city, TriMet, and the Federal Transit Administration in addition to Holland, the developer. In an effort to support 2040 Growth Concept and catalyze transit-oriented developments, Metro provided a $700,000 TOD grant to Holland. The developer used the grant to reduce the equity requirement. Other funds include private construction loan ($73 million), private equity investment ($44 million) including $650,000 from TriMet for land, and system development charges (SDC) credits and financing ($4 million). The amounts are estimates.

The city of Hillsboro agreed to a 10-year financing agreement for **system development charges** related to the three new six-story buildings and Tessera. Holland is responsible for a five percent down payment on the impact fees, rather than the customary 15 percent the city employs for other financed projects. Also, the developer is allowed for financing the remaining 95% over 10-year period.

The Hillsboro City Council also approved extending the **vertical housing tax program**. Vertical housing tax program (also known as vertical housing tax exemption or vertical housing tax credit) is Oregon Housing and Community Services (OHCS)' state property tax abatement program. The program encourages mixed-use commercial / residential developments in areas designated by communities through a partial property tax exemption. The exemption varies in accordance with the number of residential floors on a project (12% tax abatement for each level) with a maximum property tax exemption of 80 percent over 10 years. An additional property tax exemption on the land may be given if some or all of the residential housing is for low-income persons. Requirements include specific density level and ground-floor retail proportion. Holland acquires 60% tax exemption for Tessera and 80% for Hub9, Rowlock, and Vector. Through this program, the developer estimates huge increases in property taxes from $600K in 2015 to $2.9 million in 2025.

A 0.8 acre plaza surrounding the MAX station was built by the developer, Holland Partner Group, and the city of Hillsboro. Providing a connection between parking, the buildings, and the light-rail station, the plaza is active with pedestrian access, fronting restaurants, a small kid-friendly fountain, and seasonal events such as community gatherings, festivals, and ice skating. The public plaza is utilized by the city and other organizations to host events such as an ice skating rink in the winter months, an OctoberFest celebration called OrencoFest and a farmer's market in the summer.

The plaza area was previously owned by TriMet and transferred to the city. Holland paid for construction of the plaza ($2.6 million), using system development charges from the three podium buildings. After opening, the city is responsible for the repair, maintenance, capital replacement, and programming of the plaza. For the first 10 years of plaza operation, Holland is paying the city $75,000 per year to help offset the city's cost of programming management.

Hub 9, the first of three buildings, opened in March, 2015, replacing TriMet's 155-space park-and-ride lot. The building is podium-style with four stories of apartments above two stories of parking. The ground floor includes 10,000 square feet of retail space facing the loop road accessing the Orenco Station MAX station. The development includes rooftop courtyards, bicycle facilities for residents and other amenities such as social meeting spaces and fitness centers. The development provides a range of apartment types including 72 one-bedroom units, 16 two-bedroom units and 36 studio units, a total of 124 units.

The 168,204-square-foot mixed-use project was the first in Oregon to be built using a double concrete podium topped by four floors of Type V wood-frame construction. The base of the building includes parking, retail and management offices; the four floors above consist of apartments, community rooms and other amenities.

Rowlock, a six-story development with five ground floor commercial spaces and 255 residential units, opened on August 24, 2015. The residential units include 152 one-bedroom units, 35 two-bedroom units and 68 studio units. Rowlock includes 2-story townhomes with walk-up stoops. The exterior is designed to look like a warehouse, wrapping historic Oregon White Oak trees, preserved during construction and celebrated with a boardwalk and fountain feature.

Finally, **Vector** Apartments opened on the west side of the station on 2016. A 230-units six-story apartment building provides 160 one-bedroom units, 30 two-bedroom units, and 40 studio units. The building has modern, urban-style design with a big outdoor space on the 3rd floor equipped with a deck, a courtyard, and an outdoor game space. Its design and room types attract mostly millennials and young couples. In the Orenco Station area, only Vector provides park-and-ride spaces (125 stalls) on the first floor.

In total, the three developments have 25,000 sq. ft. of commercial space (with 12 retail units) and 609 apartment units. Its appearance and interior are more cutting-edge and modern style. These recent three buildings – Hub 9, Rowlock, and Vector – equip with studio, one, and two bedrooms, mainly targeting millennials and young couples.

Transit Connections

Orenco Station is served by TriMet's light rail and a standard bus route. The station is the 14th stop westbound on the Blue Line from Downtown Portland. The Blue Line generally runs every ten minutes between 5 am and 1 am. The Blue Line is part of an ever expanding network of LRT lines (see Figure 2.5).

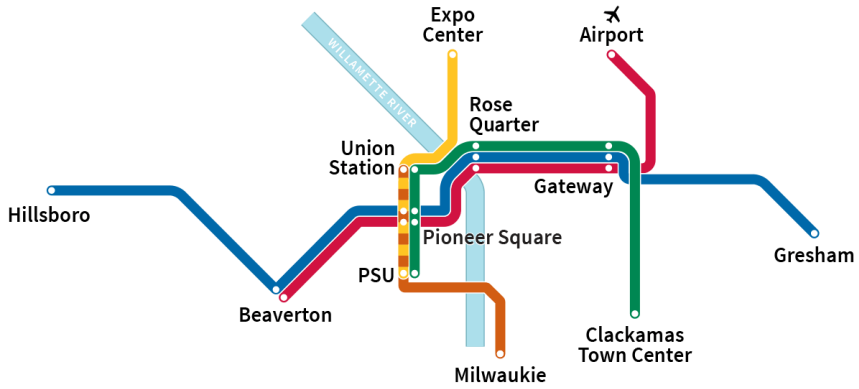


Figure 2.5. Portland's LRT Network

The station is connected to bus line 47-Baseline/Evergreen, connecting Hillsboro and Willow Creek/SW 185th Ave, also run by TriMet. The bus #47 comes every 30-45 minutes. In 2015, a free shuttle called North Hillsboro Link was introduced by Ride Connection (a non-profit), Washington County, the City of Hillsboro and the Hillsboro Chamber of Commerce. It connects the Orenco Station neighborhood to major employers such as Intel, Radisys, FEI and Reser's Fine Foods, among many others. In addition to waiting at one of six stops, shuttle riders can stand anywhere along the two routes, wave at the bus driver, and hitch a ride. The service begins at 5:29 a.m. and lasts until almost 7 p.m. (Ryan 2015).

Our Study Area

For the purposes of this trip and parking generation study, the TOD study area is the approximately 60 acres south of the original Orenco Station neighborhood. This is the portion of the Orenco Station community within about a quarter mile of the LRT station. The rough boundaries are Cornell Road on the north, the LRT station on the south, the Nexus Apartments on the west, and Northwest 67th and Northeast Century Boulevard on the east (see Figure 2.6). Orenco Station Parkway runs north-south down the center of the study site. We did counts and intercepts in the 8-acre Town Center ("main street") just north of Cornell Road, and will be referring to mode shares for visitors to this area. But the rest of the analysis focuses on the section of Orenco Station south of Cornell Road.

Figure 2.6. Orenco Station Study Area Outlined in Red and Looking North (Source: Google Maps)

The TOD study area is made up of the six different development projects described above – Platform district, Club 1201, Q Condos, Nexus, Orchards at Orenco I & II, and Alma Gardens. It consists of 56,730 square feet of commercial space and 1,944 residential units. Right next to and north of the LRT station sits a 0.8-acre public plaza. While we did counts and surveys on the short section of main street (Orenco Station Parkway) north of Cornell Road, the focus of our trip and parking generation study is on these six projects south of Cornell Road.

Table 2.1. Development summary of Orenco Station TOD (60 acres)

Land uses	***Description***	***Unit***	***Occupancy*** [1]
Commercial			
Platform District			
Hub 9	Ground floor	9,118 sq.ft.	97.8%
Rowlock	Ground floor	9,692 sq.ft.	85.1%
Vector	Ground floor	6,505 sq.ft.	100%
Platform 14	Ground floor	17,523 sq.ft.	79.1%
Tessera	Ground floor	6,792 sq. ft.	75.4%
Nexus	Ground floor	7,100 sq. ft.	79%
Residential			
Platform District			
Hub 9	6-story apartments above commercial and 2-story parking structure	124 units	92.7%
Rowlock	6-story apartments above commercial and 2-story parking structure	255 units	93.7%
Vector	6-story apartments above commercial and 2-story parking structure	230 units	83.9%

Platform 14	4-story apartments above commercial	177 units (166 apartments, 11 live/work units)	94.4%
Tessera	4-story apartments above commercial	304 units	93.4%
Club 1201	2-story condominiums	210 units	N/A (no rental unit)
Q Condos	3-story condominiums	62 units	N/A (no rental unit)
Nexus	3-story apartments	422 units	98%
Orchards at Orenco I	3-story affordable apartments	57 units	96.6%
Orchards at Orenco II	3-story affordable apartments	58 units	100%
Alma Gardens	4-story affordable apartments for seniors	45 units	100%
Parking	***Description***	***Unit***	***Peak Occupancy*** [2]
Transit Park-and-Ride			
Vector	2-level parking structure	125 stalls (level 1)	53.5%[3]
Residents-only parking			
Platform District			
Hub 9	2-level parking structure	121 stalls	63.6%
Rowlock	2-level parking structure (105 stalls at level 1 are public)	184 stalls (at level 2)	66.3%
Vector	2-level parking structure	155 stalls (level 2)	49.7%
Platform 14		107 stalls	76.4%
Tessera	6-level parking structure	381 stalls	54.3%
Club 1201	Parking lot and garage	543 stalls [4]	30.4%
Q Condos	Parking garage	118 stalls	Not available
Nexus	Parking garage with shared parking	535 stalls (300 open spots, 125 carports and 110 garages)	Not available
Orchards at Orenco I &II	Surface parking & on-street parking	134 stalls on surface parking lot and 17 on-street parking	50.7%
Alma Gardens	on- and off-street parking	55 stalls	89.1%
Public Parking (on-street or garage)			
Platform District			
Hub 9	on-street parking	22 stalls	81.8%
Rowlock	105 stalls at level 1 of parking structure and 12 stalls on-street parking	117 stalls	91.5%
Vector	2-level parking structure	100 stalls (level 1)	53.5% [3]
Platform 14	on-street parking	48 stalls	89.6%
Tessera	on-street parking	45 stalls	100%
Nexus	on-street parking	45 stalls	71.1%
Orchards at Orenco I & II	on-street parking	28 stalls	40.0% [5]
Orenco Station Pwky	on-street parking	35 stalls	88.6%
NE Cornell Orenco	on-street parking	64 stalls	84.4%

Note: [1] *by May 23, 2017*

[2] *The peak occupancy at May 23, 2017*

[3] *The parking occupancy was measured for the whole first floor in Vector (225 stalls) including public parking lots (100 stalls) and park-and-ride lots (125 stalls).*
[4] *Club 1201 (East Village) has 21 buildings, 10 condos in each of those buildings. Of the 10 condos, 8 have 1 car garages and 2 have 2 car garages. That equals 252 spaces in the garage. In addition to these, there is adequate space for one additional parking space in the driveway in front of each parking garage. Most units utilize the driveway as an additional (or primary) parking space for their unit and use the garage for storage. This equals an additional 252 spaces. Finally, there are 39 extra visitor/overflow spaces, which brings our grand total to 543 parking spaces.*
[5] *The parking occupancy was measured for the whole on-street parking (45 stalls) including some residents-only (17 stalls).*

Table 2.2. Commercial Uses in Orenco Station TOD

Land uses	***Lessee***	***Unit (sq.ft.)***	***Total Unit (sq. ft.)***
Commercial			
Platform District			
Hub 9	Schmizza Public House	1,909	8,918
	Ava Roasteria	3,000	
	Little Big Burger	1,142	
	9 Dang Fine Thai	2,867	
Rowlock	Master Yoo's TKD	2,060	8,250
	iSpark Toys	1,367	
	Aloto Gellato	985	
	La Provence	3,838	
Vector	Orange Theory Fitness	6,495	6,495
Platform 14	Orenco Tap House	1719	13,858
	Cloud Break Yoga	733	
	Salon 14	733	
	American Pacific Mortgage	733	
	Orenco Station Cyclery	1,466	
	The Ridge	1,466	
	Leasing office	1,466	
	Salam Restaurant	2,415	
	Insured by Gallegos	733	
	Paperboy	733	
	Platform Real Estate	733	
	Holland Construction	928	
Tessera	Vivid eye care	2,145	5,124
	Orenco Barber Beauty	834	
	Kumon®	2,145	

The total number of dwelling units within the study area is 1,944 (see Table 2.1). The total square footage of commercial space is 56,730 (see Tables 2.1 and 2.2). The total number of parking spaces in the study area is approximately 2,979 off-street and on-street parking spaces (see Table 2.1).

Excluding the two condominium projects, there are 1,672 apartments and 1,689 parking spaces reserved for residents, for an average parking ratio of approximately 1.0. The peak parking occupancy rates range

from 30-90% for residential-only parking, 40-100% for public parking including park-and-ride and commercial users.

Figure 2.7 shows parking supplies in three buildings (Hub 9, Rowlock, and Vector) of the Platform District. Hub 9 has surface-level parking lots for the public in addition to residents-only parking on the first and second floors. Rowlock (east podium) has residential parking on the first two floors and some shared retail/residential stalls on the first floor. Also, it has a bike-n-ride area. Vector has park-and-ride parking (open to retail customers between 2 pm to 12 am) and public parking (shared retail/residential stalls) on the first floor. Its second floor is residents-only.

In the Platform district, resident parking costs $75/month for a single space and $125 for tandem parking. All parking is unbundled, meaning separate from and in addition to the basic rent payment. Nexus has three parking options. Open parking lots (n=300) are free for renters holding parking permits and their guests. Covered car ports (n=125) are $35/month. And single car garages (n=110) are $135. We would consider this parking bundled. Orchards I and II and Alma Gardens have no parking charges. Free parking is required for the low-income housing tax credit program, which was used to fund both.

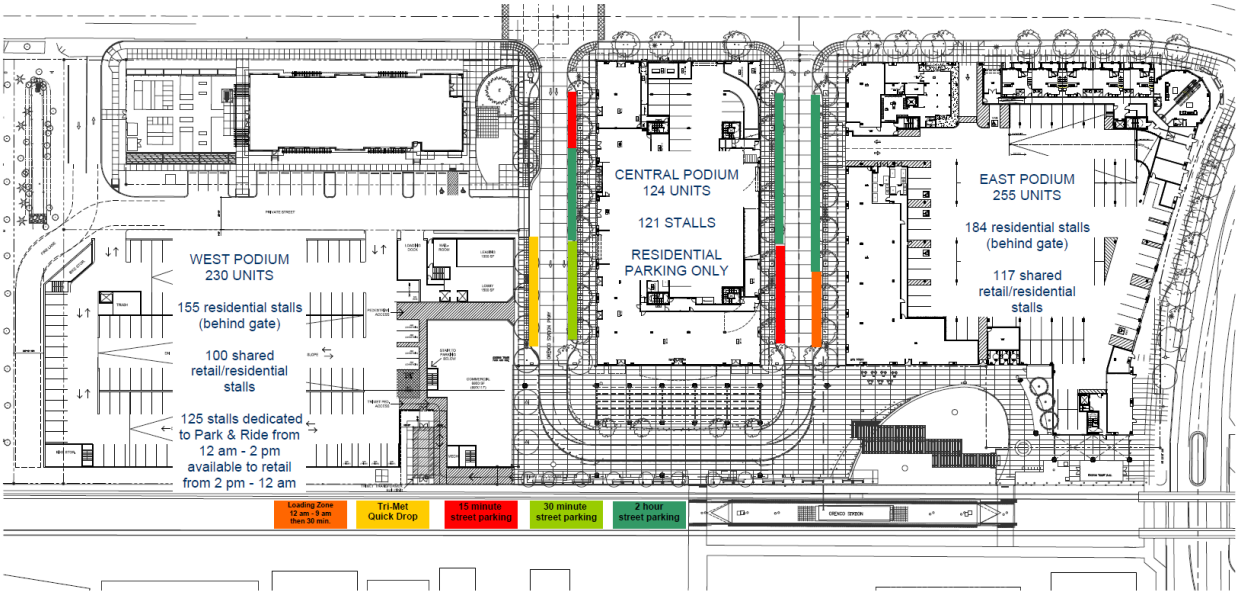


Figure 2.7. Parking Spaces in the Platform District

Data Collection

The data were collected between 7:30 am and 9:00 pm on Tuesday, May 23, 2017. Actually, parking occupancy counts were conducted even later than that to capture peak residential parking demand. Given Portland's reputation for rain, we waited for a month known to have less rain than earlier in the year, and waited for a week and day forecasted a week out to have clear weather. The weather forecasts were right, May 23th was a beautiful day. We also scheduled data collection for a time when Portland State University (PSU) was still in session and before final exams, as we made a decision early on to use urban planning students for the counts and surveys.

That was a wise decision. Not only were students less expensive than random part-time employees hired through a temporary employment agency (which would charge a fee for service on top of hourly wages), but the students were more conscientious in their data collection because, as urban planning students, they understood the importance of the study. Students were recruited through an emailed announcement by Professor Jennifer Dill of PSU. Given the size of the study area, the number of buildings, and the number of entrances, we were prepared to hire all takers. Ultimately, 48 students were employed for up to 14 hours on that one day, at a total one-day cost of almost $12,000.

The multimodal transportation planning firm of Fehr & Peers developed a data collection plan and protocols (see Figure 2.8). The firm also managed data collection in the field and subsequent data entry for three types of travel data: (1) full counts of all persons entering and exiting the buildings that make up the TODs, (2) brief intercept surveys of samples of individuals entering and exiting the buildings that make up the TODs, and (3) parking inventory and occupancy surveys of all off-street parking accessory to the commercial and residential uses of the TODs.

The intent of this approach was to develop an accurate measure of total trip generation associated with the commercial and residential uses at the site, as well as complementary travel survey and parking utilization data that provide a picture of the mode of travel, origin/destination, parking location – if applicable – and purpose for all trips to and from the building throughout the course of the day.

As a first step, surveyors noted whether the subject was observed "coming" or "going" to/from the buildings and the type and location of entrance/exit used, and recorded the time of intercept by checking a box on the data collection form associated with one of four 15-minute periods per hour.

People leaving the building were asked: (1) "How do you plan to get to your next destination?" (e.g., by what mode of travel?), (2) What is the purpose of your trip? (e.g., "Going home," "Going to work," "Shopping," or "other"), and (3) How many destinations are you visiting while in Orenco Station.

People arriving at the building were asked: (1) "How did you get here?" (e.g., by what mode of travel?), (2) What is the purpose of your trip? (e.g., "I live here/coming home," "coming to work," "shopping," or "other"), and (3) How many destinations are you visiting while in Orenco Station.

Individuals who indicated that they had arrived by or would be leaving by automobile were also asked where they parked their vehicle (e.g., "on-street," "in the parking garage," "in the parking lot," or at an "other" location/facility).

Surveyors counted and attempted to intercept only individuals observed walking to or from an entrance to the TOD buildings (or, in observation of the garage entrance, only drivers and passengers in vehicles entering/exiting the garage driveway to/from the public street). Individuals waiting for the bus or train, or walking between the transit stops park-and-ride garages, were not counted or surveyed unless they entered or exited one of the respective TOD buildings.

Figure 2.8. Count Locations (intercept surveyors circulated around these locations)

Mode Shares

In the intercept survey, we had surveyors at building entrances to ask people the three questions. We received 649 valid responses out of 655 respondents. One question in the survey was what transportation mode was used to get to/from this development. The mode shares from the intercept survey are presented in Table 2.3. We then applied these mode shares to the total trip generation counts by entrance to compute the final weighted mode shares.

The final mode shares for Orenco Station TOD are 45.8 percent walk, 2.5 percent bike, 3.9 percent bus, 16.0 percent rail, and 31.4 percent auto (see Table 4). According to the 2011 Oregon Household Activity Survey, the regional mode shares for Portland metropolitan area are 17.6 percent walk, 2.8 percent bike, 5.6 percent transit, and 70.9 percent auto. Compared to the regional mode shares, Orenco Station TOD has a significant mode shift, a shift from auto to walk and transit. Orenco Station TOD has 2.6 times higher percentage of walk trips than the regional average, and 3.6 times higher percentage of transit (bus and rail) trips than the regional average.

As one would expect, the mode shares vary across the study area (see Figure 2.7 for reference). In Zone 1, closest to the LRT station, the transit mode shares are highest (21.1 percent for rail, and 5.3 percent for

bus). In Zone 3, farthest from the LRT station and sitting right on Cornell Road, the auto mode share is highest (61 percent). In Zone 2, in the center of the study area, the walk share is highest (56.7 percent).

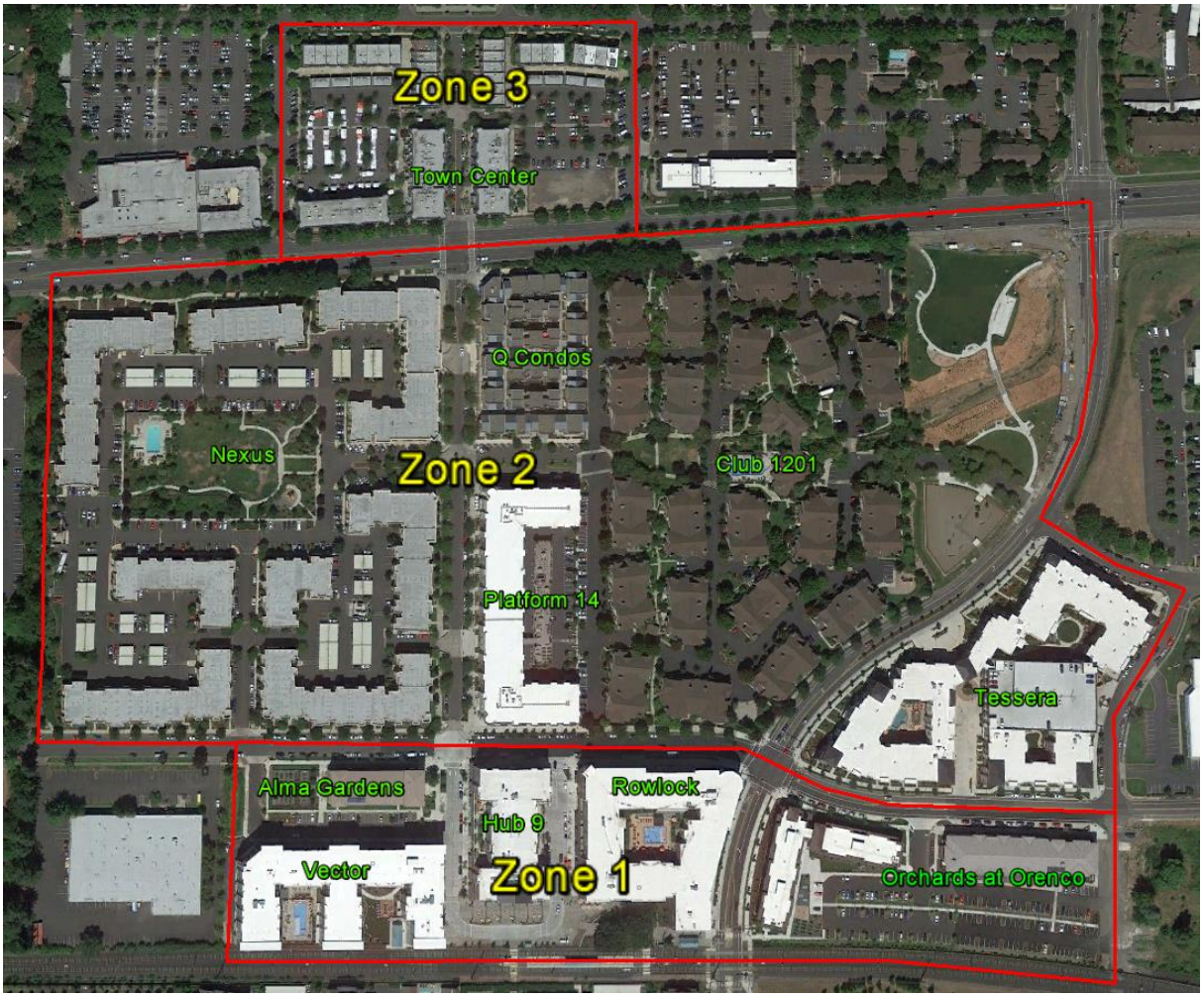


Figure 2.9. Study Area Zones

Interestingly, in Zone 3, the bike mode share is significant at 4.9 percent. This is not too surprising since the neighborhood to the north and east is very bicycle-friendly, and distances are great enough to make bicycling to the Town Center an attractive option. The bike mode share for this portion of Orenco Station is higher than the shares recorded at the original five TODs studied (Ewing et al. 2016).

Table 2.3. Mode Shares in Orenco Station TOD

Intercept survey							
Entrance	***Count***	***Mode share (%)***					
		Walk	***Bike***	***Bus***	***Rail***	***Auto***	***Other***
Zone 1	361	43.5	1.7	5.3	21.1	28.0	0.6
Zone 2	247	56.7	2.4	1.6	14.6	24.3	0.4
Zone 3	41	19.5	4.9	7.3	7.3	61.0	0.0
Trip generation counts							
Entrance	***Count***	***Count for modes***					
		Walk	***Bike***	***Bus***	***Rail***	***Auto***	***Other***

Zone 1	5,998	2,609	100	316	1,263	1,678	33
Zone 2	7,096	4022	172	115	1034	1724	29
Zone 3	2,401	468	117	176	176	1,464	0
Final mode shares	15,495	45.8%	2.5%	3.9%	16.0%	31.4%	0.4%

Trip Generation

Our actual trip generation counts from the survey did not distinguish residential trips and commercial trips. It is not possible to distinguish them when land uses are as mixed, both vertically and horizontally, as they are at Orenco Station. To compare the observed trip generation with ITE's benchmarks, we combined all estimated trips for different uses into a total that could be compared to ITE. We have not yet acquired the development information for the Zone 3 in our study area (see Figure 2.7). Hence, for this trip generation analysis, we focus on developments within Zones 1 and 2.

There were 13,094 person trips and 6,358 vehicle trips observed in Zones 1 and 2 for the day of the survey (7:30 am til 9:00 pm). Those trips were generated by the occupied residential units, 1,841 units (115 units occupied in Hub 9 Apartment, 239 units occupied in Rowlock Apartment, 193 units occupied in Vector Apartment, 167 units occupied in Platform 14 Apartment, 284 units occupied in Tessera Apartment, 210 units occupied in Club 1201 Condominium, 62 units occupied in Q Condos, 413 units occupied in Nexus Apartment, 113 units occupied in Orchards at Orenco I & II Affordable Apartment, 45 units occupied in Alma Gardens Affordable Apartment), and 48,261 sq. ft. leased commercial space. The occupied residential units were computed by multiplying occupancy rates, provided by the property managers, times the total number of units.

The residential buildings at Orenco Station TOD consist of eight three- to six-level apartments, one two-level condominium, and one three-level condominium. For the eight three- to six-level apartments, we used the value for "223 Mid-Rise Apartment" in the *Trip Generation Manual*, which is defined as "apartments (rental dwelling units) in rental buildings that have between three and 10 levels (floors)." The ITE manual reports a trip generation rate for the peak hour but does not report a daily trip generation rate for mid-rise apartments. However, the ITE manual reports both the peak hour and the daily trip generation rate for all apartments ("220 Apartments"). We used this the ratio of daily to peak hour rates for all apartments to compute the daily trip generation rate for mid-rise apartments. Here was the process: (1) the average daily vehicle trip generation rate for "220 Apartments" is 6.65 per dwelling unit on a weekday, 0.55 per dwelling unit at the AM peak hour on a weekday, and 0.67 per dwelling unit at the PM peak hour on a weekday; (2) the average vehicle trip generation rate for "223 Mid-Rise Apartment" is 0.35 per dwelling unit at the AM peak hour on a weekday and 0.44 per dwelling unit at the PM peak hour on a weekday; and (3) the average daily vehicle trip generation rate for "223 Mid-Rise Apartment" therefore equals 6.65*(0.35+0.44)/(0.55+0.67), which is 4.31 per dwelling unit.

For the two-level condominium, we used the value for "231 Low-Rise Residential Condominium/Townhouse" in the *Trip Generation Manual*, which is defined as "residential condominiums/townhouses are units located in buildings that have one or two levels (floors)." The ITE manual reports a trip generation rate for the peak hour but does not report a daily trip generation rate for low-rise condominiums. However, the ITE manual reports the daily trip generation rate for all

condominiums ("230 Residential Condominium/Townhouse"). We used this rate to compute the daily trip generation rate for low-rise condominiums. Here was the process: (1) the average daily vehicle trip generation rate for "220 Residential Condominium/Townhouse" is 5.81 per dwelling unit on a weekday, 0.44 per dwelling unit at the AM peak hour on a weekday, and 0.52 per dwelling unit at the PM peak hour on a weekday; (2) the average vehicle trip generation rate for "231 Low-Rise Residential Condominium/Townhouse" is 0.54 per dwelling unit at the AM peak hour on a weekday and 0.64 per dwelling unit at the PM peak hour on a weekday; and (3) the average daily vehicle trip generation rate for "231 Low-Rise Residential Condominium/Townhouse" therefore equals 5.81*(0.54+0.64)/(0.44+0.52), which is 7.14 per dwelling unit.

For the three-level condominium, we used the ITE *Trip Generation Manual*'s value for "232 High-Rise Residential Condominium/Townhouse," which is defined as "residential condominiums/townhouses are units located in buildings that have three or more levels (floors)". The average daily vehicle trip-generation rate is 4.18 per dwelling units on a weekday.

For trip generation rates of the many commercial uses in our study area, we used the most appropriate ITE land use categories. For example, by reviewing the ITE land use definitions, and perusing restaurant menus on-line, we placed the many restaurants on-site in one of three categories—"931 Quality Restaurant" or "932 High-Turnover (Sit-Down) Restaurant" or "933 Fast-Food Restaurant without Drive-Through Window"—and then assigned them the corresponding daily trip generation rate from ITE's *Trip Generation Manual*.

The matches were not always perfect or even close, so in those cases, we assigned the Orenco Station commercial use the most analogous (in our judgment) ITE land use category. A difficult match, for example, was the Kumon Math and Reading Center at Orenco Station. We assumed its trip generation pattern across the day, hours of operation, and daily trip totals would be very different from the ITE school categories such as "530 High School." The best match we could find in this case, and it is approximate at best, is the trip generation associated with the category "590 Library."

Based on ITE's trip generation rates, the Orenco Station TOD (60-acre study area) would be expected to generate 10,859 daily vehicle trips if it were a typical suburban development without transit (see Table 2.4). The actual vehicle trips we observed on the survey day totaled 6,358, which is 58.5 percent of the ITE expected value.

Table 2.4. The Comparison of Daily Vehicle Trip Generation between ITE Guideline and Orenco Station TOD

		Trip generation rate	***Units (sq. ft.)***	***Total daily trips***
ITE guideline		-	-	**10,859**
Hub 9	223 Mid-Rise Apartment	4.31	115	495
Rowlock	223 Mid-Rise Apartment	4.31	239	1030
Vector	223 Mid-Rise Apartment	4.31	193	832
Platform 14	223 Mid-Rise Apartment	4.31	167	720
Tessera	223 Mid-Rise Apartment	4.31	284	1224
Nexus	223 Mid-Rise Apartment	4.31	414	1782

Orchards at Orenco	223 Mid-Rise Apartment	4.31	113	487
Alma Gardens	223 Mid-Rise Apartment	4.31	45	194
Club 1201	231 Low-Rise Residential Condominium	7.14	62	443
Q Condos	232 High-Rise Residential Condominium	4.18	210	878
Schmizza Public House	931 Quality Restaurant	89.95	1,909	172
Ava Roasteria	932 High-Turnover (Sit-Down) Restaurant	127.15	3,000	381
Little Big Burger	932 High-Turnover (Sit-Down) Restaurant	127.15	1,142	145
9 Dang Fine Thai	931 Quality Restaurant	89.95	2,867	258
Master Yoo's TKD	492 Health/Fitness Club	32.93	2,060	68
iSpark Toys	864 Toy/Children's Superstore	49.9*	1,367	68
Aloto Gellato	933 Fast-Food Restaurant without Drive-Through Window	186	985	183
La Provence	931 Quality Restaurant	89.95	3,838	345
Orange Theory Fitness	492 Health/Fitness Club	32.93	6,495	214
Orenco Tap House	925 Drinking Place	124**	1719	213
Cloud Break Yoga	492 Health/Fitness Club	32.93	733	24
Salon 14	918 Hair Salon	19.3	733	14
American Pacific Mortgage	715 Single Tenant Office Building	11.65	733	9
Orenco Station Cyclery	861 Sporting Goods Superstore	18.4*	1,466	27
The Ridge	630 Clinic	31.45	1,466	46
Leasing office	715 Single Tenant Office Building	11.65	1,466	17
Salam Restaurant	932 High-Turnover (Sit-Down) Restaurant	127.15	2,415	307
Insured by Gallegos	715 Single Tenant Office Building	11.65	733	9
Paperboy	879 Arts and Crafts Store	68.5*	733	50
Platform Real Estate	715 Single Tenant Office Building	11.65	733	9
Holland Construction	715 Single Tenant Office Building	11.65	928	11
Vivid eye care	630 Clinic	31.45	2,145	67
Orenco Barber Beauty	918 Hair Salon	19.3	834	16
Kumon®	590 Library	56.24	2,145	121
Orenco Station TOD		-	-	**6,358**

*Where only peak hour trip generation rates are available from ITE, and no close analogous land use is available, we assumed a default ratio of daily to peak hour trips of 10.
**Absent guidance from ITE, and assuming that drinking establishments have a lower daily to peak hour ratio that restaurants, we assumed a ratio of 8.0.

Parking Generation

Residential Parking Supply and Demand

Residential parking supply and demand recorded for the Orenco Station TOD project were compared to the number of parking stalls as well as occupancy rates from the 2010 ITE *Parking Generation* manual. There are 10 apartment and condominium projects at Orenco Station TOD. Each of them has its own parking garage, parking lot, or designated on-street parking (see Table 2 for details).

For the residential component in the ITE *Parking Generation* manual, "221 Low/Mid-Rise Apartment" (rental dwelling units) are defined as units located in rental buildings that are up to four stories (floors) in height. This is the best match for the five apartment complexes (Platform 14, Tessera, Orchards I & II, Nexus, Alma Gardens) at the Orenco Station TOD. The average parking supply ratio reported by ITE is 1.4 parking spaces per dwelling unit at both urban and suburban sites.

For the ITE land use category 221: Low/Mid-Rise Apartment (urban location), the average peak period parking demand from 40 study sites is 1.20 vehicles per dwelling unit with standard deviation of 0.42, a range of 0.66–2.50, an 85th percentile value of 1.61, and a 33rd percentile value of 0.93. Besides the average rate, the ITE manual also provides the best-fitting regression line for estimating total parked vehicles as a function of the total number of dwelling units:

$$P = 0.92x + 4$$

Where P = parked vehicles and x = dwelling units

For the residential component in the ITE *Parking Generation* manual, "222 High-Rise Apartment" (rental dwelling units) are defined as units located in rental buildings that have five or more levels (floors). This is the best match for three apartments (Hub9, Rowlock, Vector) at the Orenco Station TOD. The average parking supply ratio reported by ITE is 2.0 parking spaces per dwelling unit at central city, not downtown (CND) and urban central business district (CBD) sites.

For the ITE land use category 222: High-Rise Apartment (Central City, Not Downtown), the average peak period parking demand from 7 study sites is 1.37 vehicles per dwelling unit with standard deviation of 0.15, a range of 1.15–1.52, an 85th percentile value of 1.52, and a 33rd percentile value of 0.38. Besides the average rate, the ITE manual also provides the best-fitting regression line for estimating total parked vehicles as a function of the total number of dwelling units:

$$P = 1.04x + 130$$

Where P = parked vehicles and x = dwelling units

For the residential component in the ITE *Parking Generation* manual, "230 Residential Condominium/Townhouse" are defined as ownership units that have at least one other owned unit within the same building structure. This is the best match for two condo complexes (Club 1201 and Q Condos) at the Orenco Station TOD. The average parking supply ratio reported by ITE is 1.4 parking spaces per dwelling unit.

For the ITE land use category 230 Residential Condominium/Townhouse, the average peak period parking demand from 12 study sites is 1.38 vehicles per dwelling unit with standard deviation of 0.24, a range of 1.04–1.96, an 85th percentile value of 1.52, and a 33rd percentile value of 1.28. Besides the average rate, the ITE manual also provides the best-fitting regression line for estimating total parked vehicles as a function of the total number of dwelling units:

$$P = 1.26x + 9$$

Where P = parked vehicles and x = dwelling units

As shown in Table 2.5, the average actual parking supply for all residential units in the apartments and condominiums of the Orenco Station TOD is 2,098 spaces total or 1.08 parking spaces per unit. The average parking supply for the residential uses at Orenco Station TOD is lower than the average by ITE's guideline (1.59 spaces per unit). Note that these numbers exclude shared residential-public parking spaces both on-street and in parking garages. Also note that we have included only spaces in parking garages for Club 1201 condos, even though many residents park in their driveways, often using their garages for storage. If we included driveway space as well as garage space, the parking ratio for the Orenco TOD would increase to 1.21 parking spaces per unit.

The peak occupancy of parking spaces in all the residential parking areas is at 10:00 pm. We were not able to get permission to collect parking occupancy data for Nexus Apartments and Q Condos. These two residential complexes are excluded in the parking demand analysis. For the residential component of the Orenco TOD, the peak parking demand relative to occupied units is 0.63 spaces/occupied unit. The actual demand (860 spaces) is much lower than both the ITE estimate of 1,770 (occupied units only) based on the average parking generation rate and the ITE estimate of 1,537 (occupied units only) based on the ITE regression equation. Based on the latter, residential uses in Orenco generate only 56 percent of the ITE peak residential rate. Note that these numbers exclude shared residential-public parking spaces both on-street and in parking garages.

Table 2.5. Comparison of Residential Parking Supply and Demand between Orenco Station TOD and ITE Guidelines[1]

		Residential			
		Supply		***Peak period demand (occupied unit only)***	
		Parking spaces per unit	***Total parking spaces***	***Vehicles per unit***	***Total parked vehicles***
ITE guideline: 221 Low/Mid-Rise Apartment		1.4	1,488	1.20	731
	Platform 14	0.60	107	0.46	77
	Tessera	1.25	381	0.73	207
	Orchards I & II	1.31	151	0.76	86
	Nexus	1.27	535	-	-
	Alma Gardens	1.22	55	1.09	49
ITE guideline: 222 High-Rise Apartment		2.0	1,218	1.37	749
	Hub 9	0.98	121	0.67	77
	Rowlock[2]	0.72	184	0.51	122
	Vector[3]	0.67	155	0.40	77
ITE guideline: 230 Condominium		1.4	381	1.38	290
	Club 1201	1.39	291	0.79	165
	Q Condos	1.90	118	-	-
ITE guideline		**1.59**	**3,087**	**1.30**	**1,770**
Orenco Station TOD		**1.08**	**2,098**	**0.63**	**860**

[1] These counts do not include on-street parking spaces, which probably are mostly occupied by the public but could be occupied by residents overnight.
[2] These counts for Rowlock do not include 105 shared residential and commercial spaces and any residents occupying then, only the spaces reserved for residents and occupied by residents.
[3] These counts for Vector do not include 100 shared residential and commercial spaces and any residents occupying then, only the spaces reserved for residents and occupied by residents. There may also be residents occupying spaces in the shared park-and-ride and commercial section of Level 1.

Public Parking Supply and Demand (from ITE)

Table 2.6 presents ITE parking supply and peak demand for the public (commercial) uses that make up the Orenco TOD. These are computed by multiplying the parking ratio per 1,000 square feet for each business by the gross floor area in 1,000s of square feet, and then summing over all businesses. If ITE guidelines were followed, the public uses at Orenco Station would be supplied with 419 parking spaces and would occupy 240 spaces at peak times.

A comparison of ITE supply and demand to actual supply and demand for public uses at Orenco Station is not possible, unless we assume that all of the shared parking is occupied by public (commercial) users. That seems to violate the basic idea of shared commercial-residential parking. Therefore, we refrain from making this calculation.

Table 2.6. Parking Supply and Demand for Commercial uses by ITE Guidelines

Commercial (occupied space only[1])						
Land use (Lessee)	***ITE land use category***	***Unit (sq. ft.)***	***Supply***		***Peak period demand***	
			Parking spaces per 1,000 sq. ft. GFA	***Total parking spaces***	***Vehicles per 1,000 sq. ft. GFA***	***Total parked vehicles***
Schmizza Public House	931 Quality Restaurant	1,909	20.2	39	10.60	20
Ava Roasteria	932 High-Turnover (Sit-Dwon) Restaurant	3,000	14.3	43	5.55	17
Little Big Burger	932 High-Turnover (Sit-Dwon) Restaurant	1,142	14.3	16	5.55	6
9 Dang Fine Thai	931 Quality Restaurant	2,867	14.3	41	5.55	16
Master Yoo's TKD	492 Health/Fitness Club	2,060	5.7	12	5.27	11
iSpark Toys	864 Toy/Children's Superstore	1,367	4.8	7	1.94	3
Aloto Gellato	933 Fast-Food Restaurant without Drive-Through Window	985	12.7	13	8.20	8
La Provence	931 Quality Restaurant	3,838	20.2	78	10.60	41
Orange Theory Fitness	492 Health/Fitness Club	6,495	5.7	37	5.27	34
Orenco Tap House	932 High-Turnover (Sit-Dwon) Restaurant with a bar	1719	17.3	30	13.50	23
Cloud Break Yoga	492 Health/Fitness Club	733	5.7	4	5.27	4

Salon 14	918 Hair Salon	733	5.2	4	3.18	2
American Pacific Mortgage	701: Office Building	733	4.0	3	2.47	2
Orenco Station Cyclery	861 Sporting Goods Superstore	1,466	4.4	6	1.78	3
The Ridge	630 Clinic	1,466	6.4	9	4.94	7
Leasing office	701: Office Building	1,466	4.0	6	2.47	4
Salam Restaurant	932 High-Turnover (Sit-Dwon) Restaurant	2,415	14.3	35	5.55	13
Insured by Gallegos	701: Office Building	733	4.0	3	2.47	2
Paperboy	861 Sporting Goods Superstore	733	4.4	3	1.78	1
Platform Real Estate	701: Office Building	733	4.0	3	2.47	2
Holland Construction	701: Office Building	928	4.0	4	2.47	2
Vivid eye care	630 Clinic	2,145	6.4	14	4.94	11
Orenco Barber Beauty	918 Hair Salon	834	5.2	4	3.18	3
Kumon®	590 Library	2,145	3.5	8	2.61	6
ITE guideline			**-**	**419**	**-**	**240**

[1] The commercial uses at Nexus are not included.

Total Parking Supply and Demand

While we cannot estimate public parking supply and demand due to shared parking arrangements, we can get very accurate values for total parking supply and demand, including shared parking (Table 2.7). Meeting ITE supply guidelines, the TOD, excluding Nexus and Q Condos for which we do not have parking demand data, would have a total of 2,849 (3,087-422*1.4-62*1.4+440) parking spaces. The actual number of parking spaces, again excluding these two projects, is 2,326 spaces. Therefore, parking at Orenco Station TOD is supplied at 81.6 percent of the ITE guideline.

We cannot compute a meaningful peak period demand value for Orenco Station TOD from ITE data because residential and public (commercial) uses peak at different times of day. We can, however, determine the total demand for parking at the single hour when parking occupancy is highest, which turns out to be at 10 pm at night. At that time, 1,190 spaces were occupied in the portions of the Orenco Station TOD for which we have demand data, excluding Nexus and Q Condos. Therefore, at that particular hour, about half (51.2 percent) of all parking spaces at Orenco Station were occupied. Orenco Station is actually oversupplied with parking relative to its theoretical shared parking potential. The actual peak demand is only 41.8 percent of the ITE supply guideline. If Orenco had been built to ITE guidelines, parking would have been oversupplied by more than 100 percent.

Table 2.7. Comparison of Total Parking Supply and Demand between Orenco Station TOD and ITE Guidelines

Total

	Supply	*Peak period demand*
ITE guideline	**2,849[1]**	**NA[2]**
Orenco Station TOD	**2,326[3]**	**1,190**

[1] These values do not include the parking supply for Nexus (591) and Q Condos (87).

[2] Demand for residential and commercial parking peak during different periods. Therefore, we cannot simply sum them to get total peak parking demand.

[3] These values do not include the parking supply for Nexus (535) and Q Condos (118).

Parking Demands for Different Land Uses

At the Orenco Station TOD, there are parking lots, parking structures, and on-street parking. We categorize parking as either residential or public, including park-and-ride and commercial users. The public parking consists of: Hub 9 – on-street parking; Rowlock – on-street parking and first-floor shared parking bsetween retail customers and residents; Vector – first-floor park-and-ride parking open to retail customers between 2 pm to 12 am, and first-floor shared parking between retail customers and residents; and on-street parking at Platform 14, Orchards, Nexus, Tessera, and Orenco Station Parkway.

The parking demands for the residential and public during the survey day are shown in Figure 2.8. The residential parking demands are low at midday and peak at night. Around 25 percent of the parking spaces are occupied from 9 am in the morning to 3 pm in the afternoon. The demand starts to increase after 3 pm in the afternoon until it hits a peak at midnight. The peak occupancy rate is about 50 percent. The public parking demands vary during the day. The demand increases from about 45 percent at 9 am until it hits its morning peak at 12 pm. The morning peak occupancy rate is about 60 percent. The demand drops to about 40 percent at 2 pm and starts to increase again until it hits its afternoon peak at 6 pm. The afternoon peak occupancy rate is about 65 percent. Finally, the demand drops to about 60 percent at 10 pm.

The parking occupancy rate for public parking is higher than residential parking. This clearly shows the benefit of sharing parking among different users at TODs. However, the peak parking occupancy rates are still only 65 percent of the parking supply, meaning that even in this TOD with relatively low parking ratios, parking is oversupplied.

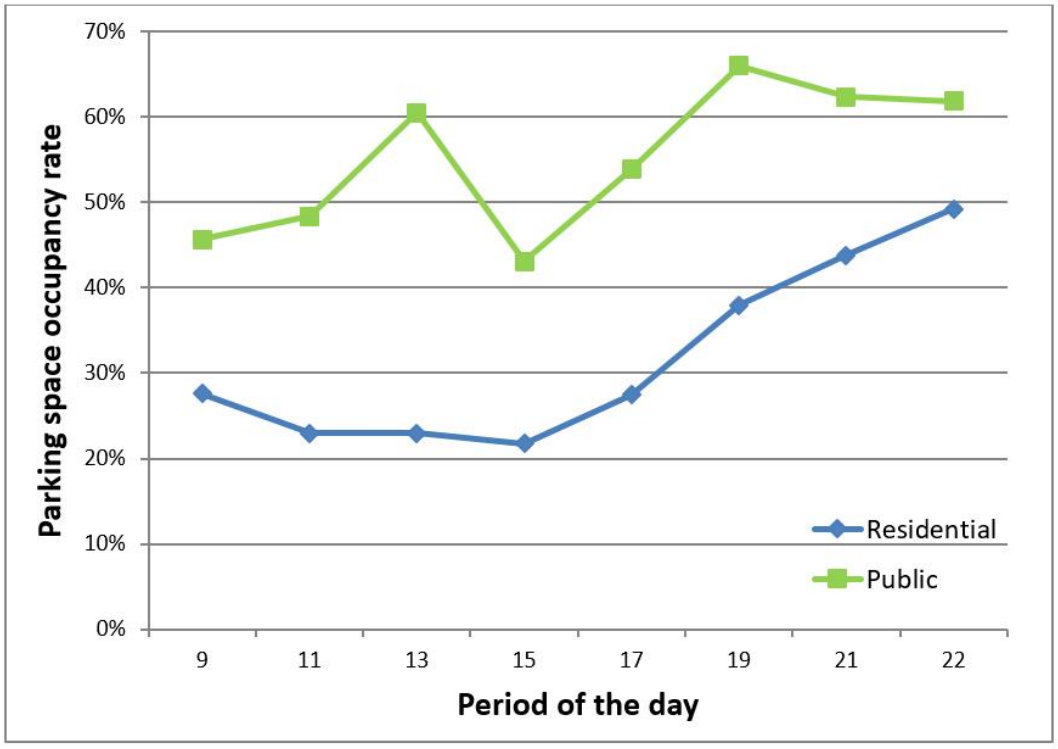


Figure 2.10. Parking Space Occupancy Rate for Different Uses at Orenco Station TOD

Chapter 3. Station Park TAD, Farmington, UT

Station Park is a mixed-use development located at the Farmington commuter rail station in west Farmington, Utah, 15 miles north of Salt Lake City. Our study area consists of multiple projects (see Figure 3.1). The commercial portion, residential projects, and medical project were built by different developers.

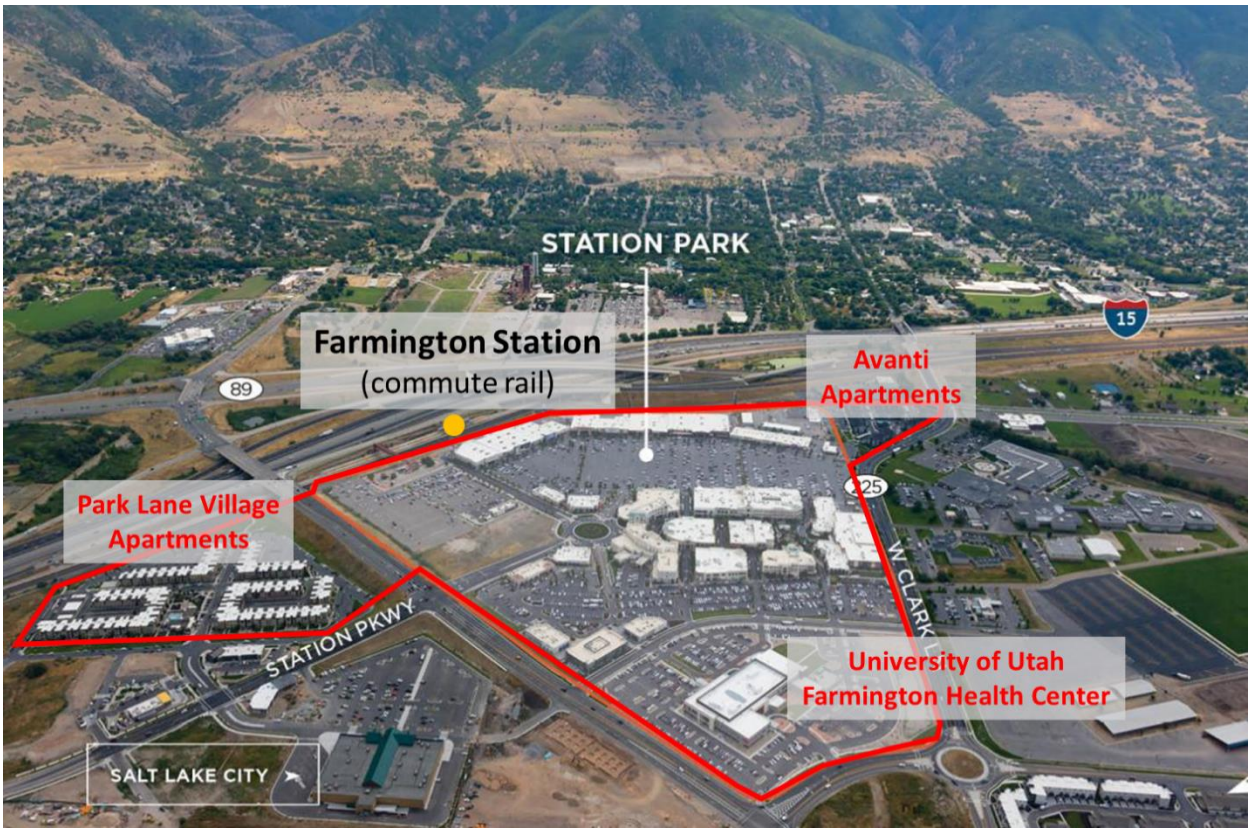


Figure 3.1. Aerial View of Station Park Looking East (adapted from CenterCal Properties website)

Station Park is most appropriately classified as a lifestyle center, defined as a shopping center that combines the traditional retail functions of a shopping mall with leisure amenities oriented towards upscale consumers. It is also most appropriately classified as transit-adjacent development (TAD), rather than a transit-oriented development (TOD). Huge parking lots dominate the space between the commuter rail station (see Figure 3.2) and other components of the development. The big box component of Station Park literally turns its back on the commuter rail station (see Figure 3.2). It was not that way in early versions of the site plan. Consistent with its auto-orientation, it is almost a half-mile (10-min walk) from the station to the movie theater and the water fountain, the core area of the shopping center. Hence the designation as a TAD.

Figure 3.2. Station Park Parking Lots (Source: Deseret News) and Big Box Store Turning its Back on the Commuter Rail Station

What makes Station Park so interesting is its status as the only TAD in our sample. Even relatively auto-oriented Englewood is a TOD, at least in the western portion we studied. Yet, Station Park is prototypically mixed-use, and therefore may provide transportation benefits relative to a stand-alone shopping center, a stand-alone office development, a stand-alone hotel, and a stand-alone medical complex. Station Park allows visitors to "park once, and walk."

People staying at the hotel can walk to a Starbuck's about a minute away across a parking lot. People shopping at the Harmon's grocery store can consecutively shop at dozens of other stores on the strip. People working in the office buildings can walk to restaurants and a gym in a couple minutes. One person interviewed in our intercept survey reported nine sequential destinations within the development. It is not that all shopping centers don't offer such economies, but Station Park has more of them in one place. From the intercept survey, 40 percent of visitors to Station Park have more than one destination within the development; the average number of stops within the development on a single visit is 1.95, or almost two.

Also, unlike most shopping centers (but like many lifestyle centers), Station Park has a pedestrian-oriented village core with public space, high-end shopping, fine dining, offices, and a Cineplex movie theater. Station Park, particularly Fountain Square, has become a gathering place for all of Farmington city (see Figure 3.3).

Figure 3.3. A Free Concert in Fountain Square (CenterCal)

Early History

Farmington is a small community in the Salt Lake region north of Salt Lake City. The town has a population of 22,000 residents. As its name suggests, Farmington was originally an agricultural area, settled by Mormon pioneers in 1847. Soon after it was initially settled, the town was designated the county seat of Davis County. In the late 1800s, the Lagoon Amusement Park was created, and remains a regional attraction to this day. Land uses have changed dramatically since Farmington's early pioneer days, with residential development the dominant land use Farmington is limited its lateral expansion. The town is bounded on the east by the Wasatch Mountains, and on the west by the Great Salt Lake. The town is bisected by Interstate 15 and the Frontrunner commuter rail line, which run north-south along the entire Wasatch Front.

The community's 1994 general plan envisioned limited growth and minimal commercial development. That changed with the economic recession following 9/11. The recession frightened the city council. Without growth and commercial development, and resulting sales tax revenues, how could the city ever afford a fire department and other public services? The city went from anti-commercial development to pro-commercial development.

The land on which Station Park sits was formerly a dairy farm. Developer Rich Haws and his company, The Haws Companies (THC), began to buy land for Station Park in 1996. THC assembled 136 acres for mixed-use commercial and residential development in and near the Station Park area. From 2000-2006,

they worked with Farmington city and other public agencies including Davis County, the Utah Department of Transportation, and Utah Transit Authority to plan for development of the land (Dougherty, 2008). Haws's initial design for the site was loosely based on a TOD template from the Utah Transit Authority, the transit operator for the region. It was a good base template for TOD, and TOD zoning would have been appropriate. However, when developers got involved, the final zoning adopted for the site was a "watered down" version of the template. Good planning principles succumbed to the potential for easy money.

In 2007, Haws sold a 64-acre core area to CenterCal Properties. CenterCal Properties, LLC. is a California-based retail and mixed-use development company founded in 2004, as a joint venture with the California State Teachers Retirement System (CALSTRS). Two pivotal events occurred early in CenterCal's tenure. First, CenterCal flew the Farmington City Council to Oregon to see good examples of TOD, which made them more supportive of the concept. Second, CenterCal hired the design firm Civitas to develop a series of plans for the site, the earliest of which were examples of TOD. The final development agreement, coupled with design standards, a site plan, and TMU (transit mixed use) zoning, were adopted in 2007. Development of Station Park began in 2008.

It was the beginning of the Great Recession, and under pressure from potential tenants, the site plan subsequently morphed into what it is today, the eastern portion consisting of a big-box power center. In the words of Dave Peterson, Planning Director of Farmington, the tenants "wanted to place the buildings where they wanted to place them." They were able to do so under the then-current zoning. The city agreed to the changes in the site plan because it wanted the pedestrian-oriented village core so much that it was willing to accept the auto-oriented power center. You can see the progression in the series of site plans prepared by Civitas (for an early site plan, see Figure 3.4). What would have qualified as a TOD morphed into a TAD.

Figure 3.4. Early Site Plan of Station Park

More Recent Development

Station Park is anchored by a Harmons grocery store and a Cinemark movie theater. In 2009, Harmons and CenterCal Properties executed an agreement to build a new 68,015 sq. ft. Harmons store in Station Park. However, the project was postponed due to the Great Recession of 2008-09. CenterCal Properties sent its request to Farmington city's Redevelopment Agency in 2009 for an extension of the project, specifically delaying tax increment financing (Roberts, 2009). The tax increment wouldn't typically increase much without an anchor.

After a two-year delay in development, the Harmons grocery store opened in May 2011. Then a 42,000 sq. ft. Ross apparel store and a Cinemark movie theater with 14 screens opened in July 2011, followed by many retail shops in the same year. In the year after Station Park opened, Farmington saw an exceptional 22 percent increase in sales tax revenue, according to Farmington City Manager Dave Millheim (Wood, 2012).

A 324-unit apartment complex, Park Lane Village Apartments, was completed in 2012. It is northwest of Station Park, separated by a six-lane road, but will be treated as part of the study area. The apartment complex has such community facilities as a fitness center, a pool, a playground, and a basketball court. A highway underpass connects Park Lane Village Apartments directly to the commuter rail station.

Recently, in August 2016, a 108-room Hyatt Place hotel opened within the existing shopping center with an additional 35,000 sq. ft. of commercial space. Then, in October 2016, University of Utah Health Care opened Farmington Health Center on the far west side of the development. The 136,000 sq. ft. health care facility accommodates more than 60 providers and 150 staff.

Most recently, an apartment development, Avanti at Farmington Station, went up nearly adjacent to Station Park, only a couple hundred feet from the Chase Bank branch at the southeast corner of the shopping center. A kicker in 2007 development agreement with CenterCal was that (1) $80 million in assessed valuation had to be built up before a penny of the $18.5 million (over 20 years) in tax-increment financing would be provided by the Redevelopment Authority, a condition that is now easily met and (2) that no fewer than 50 to 200 housing units had to the built before the tax-increment financing would begin to flow. Avanti at Farmington Station meets this requirement.

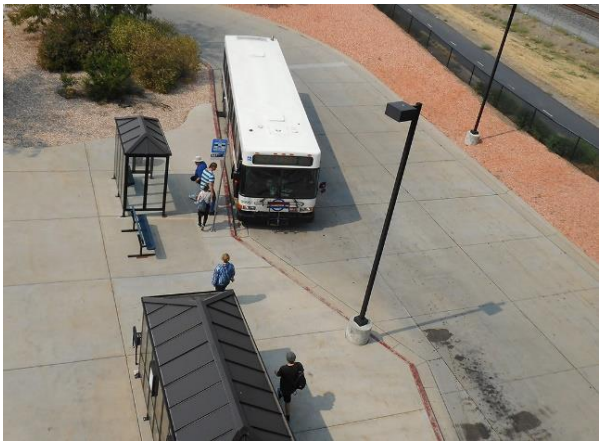
In the center of the pedestrian-oriented village, Fountain Square works as a public space for entertainment and rest, in front of the movie theater. The square has a show fountain, an event lawn, a playground, outdoor fireplace, shaded patios, and sculptures. The fountain becomes an ice-skating link during winter season.

With recent expansion, the Station Park area has come to comprise over 100 acres of retail, office, residential, and service providers. Taken as a whole, our study area does not have much residential development relative to other TODs studied. The city hasn't wanted residential development to "consume the project," again quoting Dave Peterson.

(a) Village Core with Hotel in Background

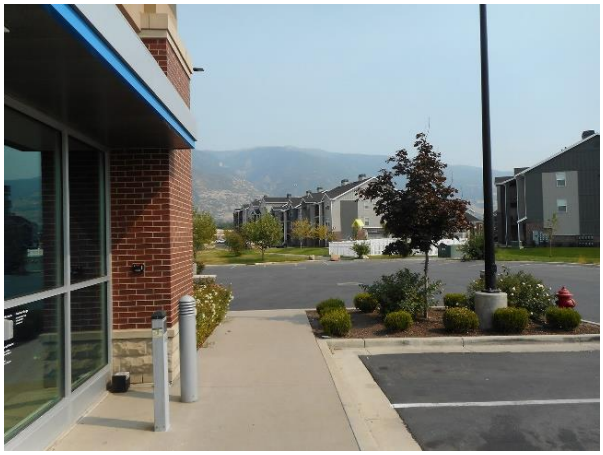
(b) Fountain Square with Theater in Background

(c) Park-and-Ride with Station in Background



(d) Bus Transfer Area from Rail Overpass

(e) Big-Box Supermarket as Anchor



(f) New Avanti Apartments in Background

(g) Access from Park Lane Apts to Station

(h) Underutilized Parking at Midday

(i) Empty Parking at Night

Figure 3.5. Station Park Today (2017)

Future Development

There are several trends that bode well for the future of Station Park. In our interview, Dave Peterson put it this way: "Everyone's paradigm is shifting."

The first positive trend is the addition of residential development in the southeast corner of Station Park. It isn't much residential development, but it is a start. The construction of an office building in the vacant site north of the entry roundabout will also improve the balance of retail to non-retail development.

The second positive trend is UTA's growing interest in residential development on its 11-acre, 900-stall parking lot next to the station. What is being contemplated are mid-rise apartments atop podium parking. The main sticking point is a parking easement held by CenterCal for overflow parking into UTA's park-and-ride lot.

The third positive trend is proposed mixed-use development on vacant land to the northwest of Station Park, which will add to the mass of the development (including new residents who will patronize Station Park retailers and potentially add to UTA's ridership base). Currently, THC and other developers are

proposing a 72-acre, master-planned development, consisting of residential, retail, and office development, called Park Land Commons (Figure 3.6). Back in 2007, the Farmington city adopted a form-based code and regulating plan for Station Park and this additional acreage. Future development will be much finer grained, and subject to a street grid of small blocks under the regulating plan.

Regarding this development, there was a conflict between the city and the original land owner, THC, who still owns the surrounding areas. In 2013, THC filed a lawsuit against Farmington city officials citing discrimination against the company in an effort to benefit the new developer, CenterCal, and failure to follow through on previous agreements (Morgan, 2013). The suit alleged that the city relocated an intersection north of Station Park, to benefit CenterCal, and that the city installed water lines on THC land without permission (Clark, 2014). It also referenced a dispute with the city over the height of a sign for the THC development, alleging CenterCal had been treated with a different standard than THC (Clark, 2014). In 2014, the Haws Companies dropped the suit against Farmington city.

Figure 3.6. More Residential, Retail, and Office Development Proposed Northwest of Station Park (Source: http://www.parklanecommons.com/)

Transit Connection

Station Park is located adjacent to Interstate 15, Highway 89, and Legacy Highway. The site is served by UTA's commuter rail, FrontRunner, and four bus routes. The station has a free park-and-ride lot with about 840 parking spaces available.

The Farmington station is the 11th stop northbound on FrontRunner, three stops from Salt Lake Central station. Commuter rail serves the Wasatch Front region from Provo in Utah County to Salt Lake City, and to Ogden in Weber County and generally runs every hour (or every 30 minutes during peak hours) between 5 am and 12 am. The station is connected to bus lines 455, 456, 473, and 667, also run by UTA, reaching downtown Salt Lake City and Ogden. Bus route 667 is the Lagoon/Station Park Shuttle, delivering the Station Park visitors to an amusement park, Lagoon, across Interstate 15.

A bus rapid transit line is proposed from the suburban community of Bountiful to downtown Farmington and ultimately to Station Park. When completed, Station Park will have unmatched (in this general area) transit and highway accessibility to the rest of the region.

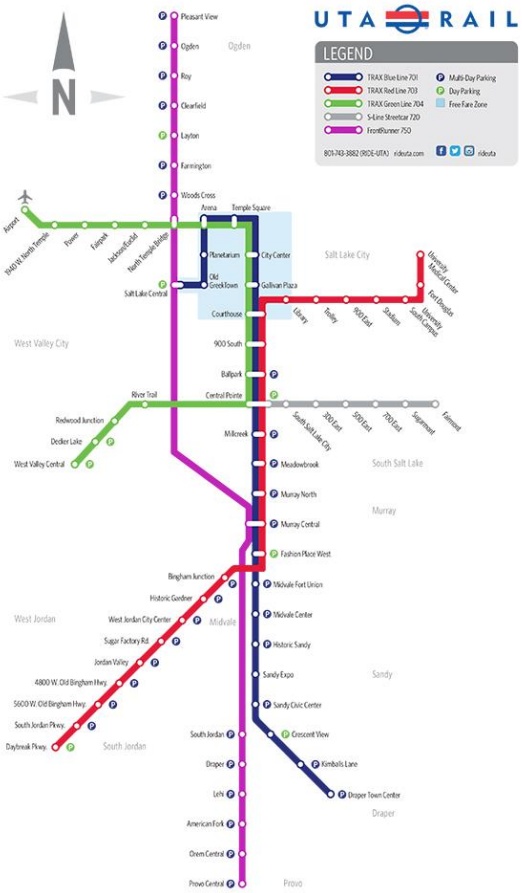


Figure 3.7. UTA rail system map (Source: http://i4.rideuta.com)

Our Study Area

The main part of our study area is the Station Park shopping center, consisting of over one million square feet of retail, entertainment, restaurant, office and hotel space. Across a six-lane road, Park Lane, are the Park Lane Village Apartments. They are not part of Station Park but are linked directly to the commuter

rail station via a trail and highway underpass. A health care center, operated by the University of Utah, is on the west side of the site. A Hyatt Place hotel is integrated into the west side of the shopping center. The newest project, Avanti at Farmington Station, abuts the shopping center at the southeast corner.

Table 3.1. Development summary of Station Park (115 acres)

Land uses	***Description***	***Square feet / Unit***	***Occupancy****
Commercial			
Farmington Health Center	University of Utah Health Farmington; Moran Eye Center – Station Park	136,000 sq. ft.	100%
Vista Outdoor	Building X	35,194 sq. ft.	100%
Hyatt Place	Hotel, 108 rooms	80,000 sq. ft.	100%
Offices	Buildings B, C, E, F, and J	146,944 sq. ft.	100%
Retail	Buildings A, B, C, D, E. F. G, H, J, J upper, K, KA, L, OV, S, U, 1005-1080, 1095-1160, 1180, Q, W	752,002 sq. ft.	85%
Residential			
Avanti	built in 2016, four-story apartments	142 units	100%
Park Lane Village	built in 2012, three-story apartments	324 units	95%
Parking	***Description***	***Unit***	***Occupancy*** **
Avanti	Garage, surface parking and on-street parking	82	90.2%
Park Lane Village	Surface parking and on-street parking	444	81.5%
Shared parking	Surface parking for all users	4,348	42.5
Park-and-ride	Park-and-ride for transit	840	34.9%

** On May 9, 201*

***The peak occupancy on May 9, 2017*

Data Collection

The data were collected between 7:30 am and 9:00 pm on Tuesday, May 9, 2017. Actually, parking occupancy counts were conducted even later than that to capture peak residential parking demand. We scheduled data collection for a time when University of Utah (UU) was still in session and before final exams, as we made a decision early on to use urban planning students for the counts and surveys.

That was a wise decision. Not only were students less expensive than random part-time employees hired through a temporary employment agency (which would charge a fee for service on top of hourly wages), but the students were more conscientious in their data collection because, as urban planning students, they understood the importance of the study. Students were recruited through an emailed announcement by Professor Reid Ewing of UU. Given the size of the study area, the number of buildings, and the number of entrances, we were prepared to hire all takers. Ultimately, 24 students were employed for up to 14 hours on that one day, at a total one-day cost almost $6,000.

The multimodal transportation planning firm of Fehr & Peers developed a data collection plan and protocols (see Figure 3.8). The firm also managed data collection in the field and subsequent data entry for three types of travel data: (1) full counts of all persons entering and exiting the buildings that make up the TODs, (2) brief intercept surveys of samples of individuals entering and exiting the buildings that

make up the TODs, and (3) parking inventory and occupancy surveys of all off-street parking accessory to the commercial and residential uses of the TODs.

The intent of this approach was to develop an accurate measure of total trip generation associated with the commercial and residential uses at the site, as well as complementary travel survey and parking utilization data that provide a picture of the mode of travel, origin/destination, parking location – if applicable – and purpose for all trips to and from the building throughout the course of the day.

As a first step, surveyors noted whether the subject was observed "coming" or "going" to/from the buildings and the type and location of entrance/exit used, and recorded the time of intercept by checking a box on the data collection form associated with one of four 15-minute periods per hour.

People leaving the building were asked: (1) "How do you plan to get to your next destination?" (e.g., by what mode of travel?), (2) What is the purpose of your trip? (e.g., "Going home," "Going to work," "Shopping," or "other"), and (3) How many destinations are you visiting while in Station Park.

People arriving at the building were asked: (1) "How did you get here?" (e.g., by what mode of travel?), (2) What is the purpose of your trip? (e.g., "I live here/coming home," "coming to work," "shopping," or "other"), and (3) How many destinations are you visiting while in Station Park.

Individuals who indicated that they had arrived by or would be leaving by automobile were also asked where they parked their vehicle (e.g., "on-street," "in garage lot" or at an "other" location/facility).

Surveyors counted and attempted to intercept only individuals observed walking to or from an entrance to the TAD buildings. Individuals waiting for the bus or train, or walking between the station and park-and-ride lot, were not counted or surveyed.

Figure 3.8. Station Park Counter and Survey Locations

Mode Shares

In the intercept survey, we had surveyors at building entrances to ask people questions. We received 661 valid responses. One question in the survey was what transportation mode was used to get to/from this development. The mode shares from the intercept survey are presented in Table 3.2. We then applied these mode shares to the total trip generation counts by entrance to compute the final weighted mode shares.

The final mode shares for Station Park TAD are 3.6 percent walk, 1.2 percent bike, 1.4 percent bus, 4.1 percent rail, and 89 percent auto (Table 3.2). According to the Utah 2012 Household Travel Diary survey data, the mode shares in Wasatch Front region are 3.1 percent walk, 1.9 percent bike, 4.5 percent transit, and 90.2 percent auto. Compared to the regional mode shares, Station Park TAD has very similar mode shares.

Table 3.2. Mode Shares in Station Park TAD

Intercept survey							
Entrance	***Count***	***Mode share (%)***					
		Walk	***Bike***	***Bus***	***Rail***	***Auto***	***Other***
Circle	143	2.1%	1.4%	0.0%	2.1%	93.7%	0.7%
East Lot / Harmons	141	5.7%	0.7%	1.4%	3.5%	87.2%	1.4%
NW Retail / U health	157	0.0%	1.3%	1.9%	0.6%	96.2%	0.0%
Train Station	145	16.4%	0.9%	9.5%	39.1%	34.1%	0.0%
Avanti	23	12.6%	4.5%	0.0%	0.0%	82.8%	12.6%
Park Lane Village	52	7.2%	1.9%	0.0%	0.6%	90.3%	7.2%
Trip generation counts							
Entrance	***Count***	***Count for modes***					
		Walk	***Bike***	***Bus***	***Rail***	***Auto***	***Other***
Circle	16,651	349	233	0	349	15,603	116
East Lot / Harmons	10,454	593	74	148	371	9,119	148
NW Retail / U health	10,439	0	133	199	66	10,040	0
Train Station	2,413	395	22	230	943	823	0
Avanti	443	56	20	0	0	367	0
Park Lane Village	1,772	128	34	0	10	1,600	0
Final mode shares	**42,172**	**3.6%**	**1.2%**	**1.4%**	**4.1%**	**89.0%**	**0.6%**

Trip Generation

Our trip generation counts from the survey distinguished residential trips from commercial trips, but not retail trips from office trips. To compare the actual trip generation with ITE's benchmarks, we will separate residential trips and combine all commercial into a total that can be compared to ITE.

There were 42,172 person trips and 30,692 vehicle trips observed for the whole day of the survey. 2,215 person trips and 1,515 vehicle trips were generated by the occupied residential units, 450 total units. 39,957 person trips and 29,177 vehicle trips were generated by the commercial spaces, which occupy 1,037,340 sq. ft.

For the trip generation rate of the two residential complexes at Station Park TAD, we used the value for "223 Mid-Rise Apartment" in the *Trip Generation Manual*, which is defined as "apartments (rental dwelling units) in rental buildings that have between three and 10 levels (floors)." The ITE manual reports a trip generation rate for the peak hour but does not report a daily trip generation rate for mid-rise apartments. However, the ITE manual reports the daily trip generation rate for all apartments ("220 Apartments"). We used this rate to compute the daily trip generation rate for mid-rise apartments. Here was the process: (1) the average daily vehicle trip generation rate for "220 Apartments" is 6.65 per dwelling unit on a weekday, 0.55 per dwelling unit at the AM peak hour on a weekday, and 0.67 per dwelling unit at the PM peak hour on a weekday; (2) the average vehicle trip generation rate for "223 Mid-Rise Apartment" is 0.35 per dwelling unit at the AM peak hour on a weekday and 0.44 per dwelling unit at the PM peak hour on a weekday; and (3) the average daily vehicle trip generation rate for "223 Mid-Rise Apartment" therefore equals 6.65*(0.35+0.44)/(0.55+0.67), which is 4.31 per dwelling unit.

For the trip generation rate of some commercial uses at the Station Park TAD, we used "630 Clinic" for the medical center (Farmington Health Center), "715 Single Tenant Office Building" for the stand-alone

office building (Vista Outdoor), and "310 Hotel" for the hotel (Hyatt Place) from the *Trip Generation Manual*.

We considered all the other commercial uses (including retail and restaurant, smaller offices, theater, and bank) as a whole as a shopping center and used "820 Shopping Center" for its trip generation rate. We treated the other commercial uses as a shopping center because there are so many lessees, some occupying very little space, and many without appropriate ITE land use categories. Station Park meets the basic ITE criteria for a Shopping Center:

> Shopping centers, including neighborhood centers, community centers, regional centers and super regional centers, were surveyed for this land use. Some of those centers contained non-merchandizing facilities, such as office buildings, movie theaters, restaurants, post offices, banks, health clubs and recreational facilities…

It would have made no sense to treat the individual commercial uses separately when they are obviously part of an integrated whole.

Based on ITE's trip generation rates, the residential uses in the Station Park study area would be expected to generate 1,939 daily vehicle trips (Table 3.3). The actual vehicle trips for the residential we observed on the survey day was 1,515, which is 78.1 percent of the ITE expected value. Based on ITE's trip generation rates, the commercial uses at Station Park would be expected to generate 39,138 daily vehicle trips (Table 3.3). The actual vehicle trips for the commercial uses we observed on the survey day was 29,177, which is 74.5 percent of the ITE expected value. This is the highest percentage of the ITE value of any development studied. Station Park is a TAD, not a TOD. The effect of transit on the vehicle trip reduction is limited.

Table 3.3. The Comparison of Daily Vehicle Trip Generation between ITE Guideline and Station Park TAD

	Trip generation rate	***Total units***	***Total daily trips***
Residential			
ITE guideline	-	-	**1,939**
223 Mid-Rise Apartment	4.31	450	1,939
Station Park TAD	-	-	**1,515**
Commercial			
ITE guideline	-	-	**39,138**
630 Clinic	31.45	136,000	4,277
715 Single Tenant Office Building	11.65	35,194	410
310 Hotel	8.17*	108	882
820 Shopping Center	42.70	786,146	33568
Station Park TAD	-	-	**29,177**

* per room

Parking Generation

Parking supply and demand recorded for the Station Park TAD project were compared to the number of parking stalls as well as occupancy rates from the 2010 ITE *Parking Generation* manual.

Residential

Parking at Park Lane Village is essentially bundled, that is, covered by the rent. Designated covered parking spots can be rented for $25/month and there is no limit on how many one unit can rent. Otherwise, residents and guests can park for free in unassigned spaces, either on-street or in parking bays.

Parking at Avanti is also essentially bundled. Some units come with garages, some with covered spots, and some with no parking. For units coming with parking spots, no additional parking charge is levied beyond the basic rent. For units without parking spots, assigned carports can be rented for $50/month and assigned garages can be rented for $150/month. Otherwise, residents and guests can park for free in unassigned spaces, either on-street or in parking bays.

For the residential component in the ITE *Parking Generation* manual, "221 Low/Mid-Rise Apartment" (rental dwelling units) are defined as units located in rental buildings that are up to four stories (floors) in height. This is the best match for the 3-story and 4-story multifamily residential uses in the Station Park study area. The average parking supply ratio reported by ITE is 1.4 parking spaces per dwelling unit at both urban and suburban sites (68 study sites).

For the ITE land use category 221: Low/Mid-Rise Apartment (urban location), the average peak period parking demand from 40 study sites is 1.20 vehicles per dwelling unit with standard deviation of 0.42, a range of 0.66–2.50, an 85th percentile value of 1.61, and a 33rd percentile value of 0.93. Besides the average rate, the ITE manual also provides the best-fitting regression line for estimating total parked vehicles as a function of the total number of dwelling units:

$$P = 0.92x + 4$$

Where P = parked vehicles and x = dwelling units

There are two apartment complexes in the Station Park TAD: Avanti and Park Lane Village. Both of them have their own parking spaces, including garages, parking lots, and on-street parking. As shown in Table 3.4, the actual parking supply for the residential units in the apartment complexes of the Station Park TAD is 526 spaces total or 1.13 parking spaces per unit (82+442)/(142+324). The parking supply for the residential uses at Station Park TAD is lower than ITE's guideline (1.4 spaces per unit).

The peak occupancy of parking spaces in two of the residential parking areas is 11:00 pm (the time of the last count). The numbers of spaces filled at that hour are 74 for the Avanti Apartment Complex parking lot with occupancy rate as 90.2 percent and 362 for the Park Lane Village Apartment Complex parking lot with occupancy rate as 81.5 percent. Thus, for the residential at Station Park, the peak parking demand relative to occupied units is (74+362)/(142+308) or 0.97 spaces/occupied unit. The actual demand (436 spaces) is lower than the ITE estimate of 540 (1.20*450, occupied units only) based on the average parking generation rate and higher than the ITE estimate of 418 (0.92*450+4, occupied units only) based on the regression equation.

Commercial

As with most shopping centers, parking at Station Park is free and unassigned. Different uses share parking at different times of day. For example, office uses occupy most of the parking spaces at the

southwestern lot during the day, while entertainment uses (restaurants and the movie theater) occupy most of the spaces in the evening. Under a parking easement, evening users can overflow into the parking lot directly in front of the health center. Under another parking easement, shoppers can overflow into the park-and-ride lot directly in front of the rail station.

There is a total of 1,150,140 sq. ft. of commercial space at the Station Park TAD, 1,037,340 sq. ft. of which were leased at the time of this study. The total number of parking spaces for the entire Station Park development (including the health center but excluding the park-and-ride lot, which was not being used by shoppers on our visits to the site) is 4,348.

Table 3.4 lists parking supply and peak parking demand for the closest analogs to the Station Park commercial uses in the ITE Parking Generation manual. These uses are "630 Clinic" (Farmington Health Center), "701 Office Building" (Vista Outdoor), "310 Hotel" (Hyatt Place), and "820 Shopping Center" (all the other commercial uses at Station Park).

According to the ITE manual, the parking supply for these commercial uses would be 5,004 spaces (6.4*136+4*35.194+1.3*108+4.9*786.146). The actual parking supply at the Station Park TAD is 4,348 total spaces for all commercial uses. The actual parking supply is 86.9 percent of ITE parking supply guideline less than the ITE parking supply guideline (as shown in Table 3.4).

According to the ITE's guideline, the average total peak period parking demand for the commercial uses would be 2,572 spaces (4.94*136+2.84*35.194+0.89*108+2.55*786.146*0.85), only for leased spaces. The actual peak period parking demand of the commercial uses at the Station Park TAD was 1,848 occupied spaces during the one hour with the highest parking demand on the survey day, which is 71.9 percent of the ITE's peak parking demand estimate.

Table 3.4. Comparison of Parking Supply and Demand between Station Park TAD and ITE Guidelines

Residential					
		Supply		***Peak period demand (occupied space only)***	
		Parking spaces per unit	***Total parking spaces***	***Vehicles per unit***	***Total parked vehicles***
ITE guideline: 221 Low/Mid-Rise Apartment		1.4	652	1.20	540
Station Park TAD		1.13	526	0.97	436
Commercial					
		Supply		***Peak period demand (occupied space only)***	
		Parking spaces per 1,000 sq. ft. GFA	***Total parking spaces***	***Vehicle per unit or 1,000 sq. ft. GFA***	***Total parked vehicles***
ITE guideline		**-**	**5,004**	**-**	**2,572**
	630 Clinic	6.4	870	4.94	672
	701 Office Building	4	141	2.84	100
	310 Hotel	1.3*	140	0.89	96
	820 Shopping Center**	4.9	3,852	2.55	1,704

Station Park TAD	**-**	**4,348**	**-**	**1,848**

* Per room

**Parking supply ratio for community shopping center is used. Average peak period parking demand on a non-Friday weekday (non-December) is used.

Parking Demands for Different Land Uses

At the Station Park TAD, there are several parking lots. We categorized them into three different uses: UTA park-and-ride, residential parking, and commercial (retail and office) parking. The UTA park-and-ride parking lot is shared between transit users and the retail consumers. However, given the observation that the retail parking lot is seldom near to fully parked, we assume none of the retail consumers actually park at the park-and-ride lot. The parking demands for different uses during the survey day are shown in Figure 3.9.

The parking demand for the UTA transit users was around 30 percent of capacity during the day, then dropped quickly after 4:30 pm. The park-and-ride was almost empty at night.

The residential parking demand was low at midday. Around 30 percent of the parking spaces were occupied from 8 am in the morning to 2:30 pm in the afternoon. The demand started to increase after 2:30 pm in the afternoon until it hit a peak at 11 pm. The peak occupancy rate was 83 percent.

The commercial parking demands were at their highest at midday, but we were still far short of capacity. At the peak time of 2:30 pm in the afternoon, about 40 percent of the parking spaces were occupied. Then the demands dropped to near zero at 11 pm. From the standpoint of commercial parking, Station Park is clearly overparked for the typical weekday. It is a policy decision whether shopping centers should have enough parking for the peak hour of the peak day of the year. There is clearly be some benefit to having retail and office uses share parking, and the demand patterns are different. There is also some benefit to having the availability of overflow parking in the park-and-ride lot and the health care center parking lot, so those peak times such as shopping days around Christmas.

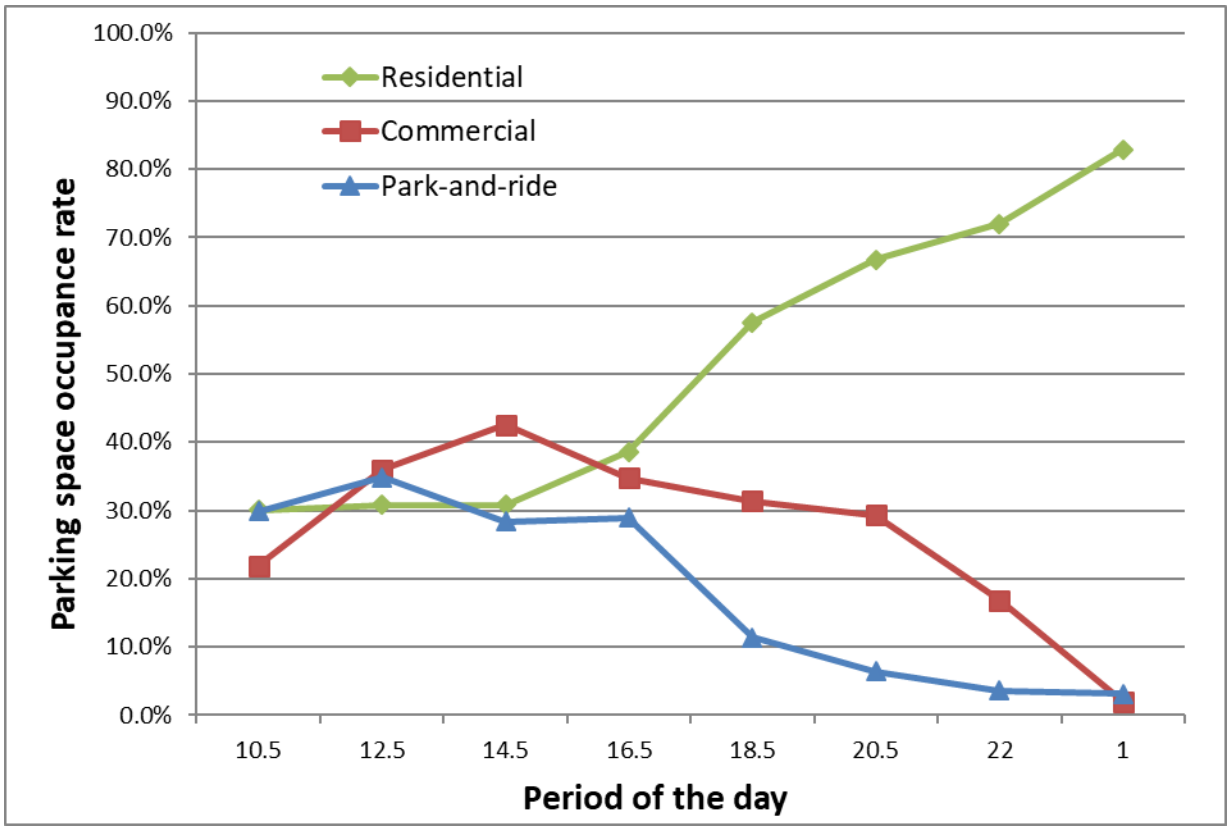


Figure 3.9. Parking Space Occupancy Rate for Different Uses at Station Park TAD

Chapter 4. Conclusion

Case Study Comparisons

Table 4.1 compares the final mode shares for the Orenco Station TOD and Station Park TAD to those of our original five TOD sample (Ewing et al., 2017). Orenco Station TOD has a higher walk mode share than the others, something we anticipated due to the size of the site and exchange of trips within the site. Its transit mode share is at the low end of the sample range, something we also anticipated. Overall, Orenco Station TOD's auto share of trips compares favorably with the others. Station Park TAD has the lowest walk and transit mode shares among the seven sites we studied. This is not surprising for a TAD. The effect of transit on the mode shares is limited by the distance from the rail station to the core of the development and the only passable quality of transit service (with limited available routes and service frequency).

Table 4.2 compares vehicle trip reductions for the Orenco Station TOD and Station Park TAD to those of our original five TOD sample. The actual vehicle trips we observed to/from/within the Orenco Station TOD on the survey day totaled 6,358, which is 57.2 percent of the ITE expected value. This is not as deep a discount as in some of the smaller TODs studied originally, but is deeper than the discount for Englewood, the largest and most auto-oriented TOD in our original study. As posited above, the size of the site and mix of housing types may militate against a very low vehicle trip generation rate. The actual vehicle trips we observed to/from/within the Station Park TAD on the survey day totaled 30,692, which is 74.5 percent of the ITE expected value. This is the lowest vehicle trip reduction among the seven sites we studied. Still, it achieves a 25.5 percent vehicle trip reduction as a mixed-use development. It provides an opportunity to drive and park once, and then walk to multiple destinations within the development.

Table 4.3 compares residential parking supply and demand for the Orenco Station TOD and Station Park TAD to those of our original five TOD sample. The parking generation rate for Orenco Station, on a per dwelling unit basis, is the lowest of all TODs studied except Rhode Island Row. It reflects the character of the residential development right next to the LRT station. It is mid-rise apartments. Parking is shared and unbundled. Note, again, that the calculations for Orenco Station only include reserved spaces for residents. Additional parking is available in shared parking arrangements. The parking generation rate for Station Park, on a per dwelling unit basis, is the lower than the ITE guideline. It reflects the character of the residential development and the mixed-use nature of the setting, more than the presence of the commuter rail station at a considerable distance.

Finally, Table 4.4 compares total parking supply and demand for the Orenco Station TOD and Station Park TAD to those of our original five TOD sample. As with the rest, peak parking demands for both sites are less than half of the ITE supply guideline. However, comparing actual parking supply and demand at Orenco Station and Station Park, peak parking demands are lower (relative to supply) than the original five TODs. Only Englewood even comes close. Put another way, Orenco Station and Station Park are the two most over-parked of the seven sites.

Table 4.1. Average Mode Shares for TODs Studied

TOD	*Count*	*Count for modes*					
		Walk	*Bike*	*Bus*	*Rail*	*Auto*	*Other*

Redmond	1,981	18.9%	1.7%	13.0%	NA	64.9%	1.5%
Rhode Island Row	8,451	16.6%	0.3%	9.3%	27.2%	42.5%	4.0%
Fruitvale	16,558	28.3%	4.3%	15.2%	26.1%	23.0%	3.1%
Englewood	14,073	19.2%	3.8%	3.3%	13.6%	59.7%	0.2%
Wilshire/Vermont	11,043	27.4%	2.2%	21.1%	20.1%	25.9%	3.4%
Orenco Station	15,495	45.8%	2.5%	3.9%	16.0%	31.4%	0.4%
Station Park	42,172	3.6%	1.2%	1.4%	4.1%	89.0%	0.6%

Table 4.2. Average Vehicle Trip Reductions Relative to ITE Rates

TOD	*ITE vehicle trips*	*Actual vehicle trips*	*% of ITE trips*	*% reduction*
Redmond	1,767	661	37.4%	62.6%
Rhode Island Row	5,808	2,017	34.7%	65.3%
Fruitvale	5,899	3,056	51.8%	48.2%
Englewood	13,544	9,460	69.8%	30.2%
Wilshire/Vermont	5,180	2,228	43.0%	57.0%
Orenco Station	11,106	6,358	57.2%	42.8%
Station Park	41,177	30,692	74.5%	25.5%

Table 4.3. Residential Parking Supplies as a Percentage of ITE, and Residential Peak Parking Demand as a Percentage of Actual Supplies

TOD	*ITE supply (spaces per unit)*	*TOD supply (spaces per unit)*	*TOD peak demand (occupied spaces per unit)*	*TOD supply as % of ITE supply*	*TOD peak demand as % of TOD supply*
Redmond	2.0	1.19	0.86	59.5%	72.3%
Rhode Island Row	1.4	0.81	0.44	57.9%	54.3%
Fruitvale	1.4	NA	1.02	NA	NA
Englewood	1.4	1.6	1.29	114.3%	80.6%
Wilshire/Vermont	2.0	1.10	0.81	55.0%	73.6%
Orenco Station	1.6	1.08	0.63	68.0%	51.2%
Station Park	1.4	1.13	0.97	80.7%	82.9%

Table 4.4. Aggregate Parking Supplies as a Percentage of ITE Supplies, and Aggregate Peak Parking Demand as a Percentage of Actual Supplies

TOD	*Aggregate peak parking demand as % of ITE guideline*	*Aggregate peak parking demand as % of actual supply*
Redmond	41.6%	73.5%
Rhode Island Row	32.7%	63.6%
Fruitvale	19.0%	84.0%
Englewood	45.8%	58.3%
Wilshire/Vermont	33.0%	66.8%
Orenco Station	41.8%	51.2%

Station Park	35.5%	41.2%

Study Limitations

The limitations of this study are acknowledged elsewhere but summarized here. The first and most important is the small sample size. These are truly case studies, as opposed to a cross-sectional sample. Due to labor-intensiveness of data collection (two people at each entry point to a TOD, one to count and the other to survey), our sample is limited to six TODs and one TAD.

Related to this is limited external validity. External validity is the extent to which the results of a study can be generalized to other situations, in our case, to other TODs. In particular, TODs we studied including Orenco Station TOD are exemplary in that they meet the definitional criteria we established at the outset. In particular, the fact that they literally abut transit stations suggests that they represent the best case for TOD, except perhaps in a downtown setting. We discuss the application of our results to other TODs in the following section. Let it suffice to say that, unless a planned or proposed TOD shares essential characteristics with a TOD in our sample, generalization will be hazardous.

A third limitation is an inability to account for internal capture of trips within these TODs. Internal trips are trips that begin and end within a mixed-use development. Such trips obviously have much less impact on the environment and are generally subtracted from total trip-generation rates in traffic-impact studies. The majority of our TODs are small and, we argue elsewhere, likely have low internal capture rates. It is hard to imagine, except perhaps at the three larger developments: Englewood, Orenco Station, and Station Park, anyone doing anything but walking within our sample of TODs. Actually, we did ask a third question in our intercept surveys at Orenco Station and Station Park. We asked how many destinations were visited within the development. The results show that 40 percent of visitors to Station Park have more than one destination within the development; the average number of stops within the development on a single visit is 1.95, or almost two. The results show that percent of visitors to Orenco Station have more than one destination within the development; the average number of stops within the development on a single visit is 1.19.

A fourth limitation is related to the phenomenon of residential self-selection. Residential self-selection occurs when people who would use transit anyway elect to live in a TOD. The literature strongly suggests that not everyone living in a TOD does so for the transit connection. But many probably do. If there is ever a case where self-selection is likely to be powerful, it is at developments that offer immediate, high-quality transit options. While the transportation statistics from these case studies can be used to plan individual TODs, which will likewise benefit from self-selection, these statistics probably (due to self-selection) overstate the benefit to the region as a whole in having TODs. Again, these self-selectors would be inclined to use transit anyway, so there is not as much impact on regional mode shares or vehicle trips or perhaps even parking demand as our statistics imply.

There are other limitations, such as the fact that our vehicle counts are typically from 7:00 in the morning until 9:00 at night, rather than the full 24 hours as with ITE. Another is that the seventh D variable, demographics, may be different for these TODs than others because most of the developments in our sample offer some affordable (as opposed to market rate) housing. But we still contend that this study has important practical planning implications, as discussed in the next section.

Applications to TOD Planning

How might the statistics in Tables 4.1 through 4.4 be used to plan for other TODs? Our statistics represent default values, to be used when better estimates are not available. If a TOD already exists and is, for example, being expanded (like Fruitvale's), planners would not use our default values but would want instead to conduct the same types of counts and intercept surveys we did to estimate the performance characteristics of the expanded TOD. The same idea would apply to new developments going in near existing TODs. Planners probably would want to conduct studies at those TODs to get the best possible estimates for new developments nearby. Redmond TOD and Rhode Island Row TOD, and their respective transit stations, have spawned nearby developments that may mirror the statistics of these particular TODs, perhaps with small adjustments since the new developments are not directly adjacent to the stations, as our sampled TODs are.

For planned TODs around other stations, in the same or other regions, our statistics may be used in tandem with regional travel model forecasts for a particular TOD or its respective traffic analysis zone. Regional travel models can capture the effects of transit service at a particular site, but typically do not capture the full effects of the D variables on travel demand. By D variables we mean development density, land use diversity, street design, destination accessibility, and distance to transit for a particular TOD. These are known to affect travel choices (Ewing and Cervero 2010; Ewing et al. 2010; Tian et al. 2015). On the other hand, our mode shares, trip generation rates, and parking generation rates are actual (not modeled) values that reflect all the D variables of particular TODs, but are particular to these developments and their contexts. Whether they apply to TODs with different D variables and different contexts will always be debatable. That is why we say that both modeled regional travel model forecasts and actual trip and parking generation rates for TODs should be considered in the planning of other TODs.

One other source of travel data for mixed-use developments (MXDs) might be used to obtain independent estimates for TODs. For a sample of 412 MXDs in 13 diverse regions of the U.S., Tian et al. (2015) estimated models relating internal capture rates and external walk, bike, and transit mode shares to D variables for the developments and their surroundings. This study built on earlier research by Ewing et al. (2010). It would not be difficult to estimate these outcome variables for any given TOD. This would provide a "third" independent estimate of TOD travel characteristics around which to triangulate.

Perhaps conservatively, one could set a floor on alternative mode shares and percentages trip and parking reductions equal to the minimum values for our six TODs, or could set a cap on these equal to the maximums from these TODs. Also, one could look for the best match to a particular TOD being proposed from among our sample of TODs. As an example, a TOD proposed for a Salt Lake station area might be matched to Englewood TOD in Denver, since the metropolitan regions are most similar and both regions have LRT (light rail transit) rather than HRT (heavy rail transit). This would be particularly appropriate if the planned TOD were large and relatively auto-oriented, like Englewood TOD. Conversely, if the TOD were compact and pedestrian-oriented, largely commercial, and inclusive of affordable housing, one might match to Fruitvale Village, despite differences in rail systems (LRT vs. HRT) and metropolitan regions (Salt Lake City vs. San Francisco). Obviously, any application of these statistics would ideally involve triangulation in light of regional travel demand model forecasts and MXD model estimates.

The preceding discussion leads to a re-acknowledgement of the main limitation of this study, and a partial solution to the problem of finding an appropriate match for any new TOD that might be proposed. The only way to increase the external validity (generalizability) of this effort is to expand the sample of TODs studied, particularly including larger TODs with higher internal capture rates. In theory, at some point, we would have a sample of TODs large enough for statistical analysis. Trip and parking reductions relative to ITE could be modeled in terms of D variables for the TODs themselves, their contexts, and their type of transit service (HRT, LRT, CRT, streetcar, and bus only). However, given the high cost of the associated data collection efforts, we doubt our collective efforts will ever produce a statistical sample. So the best we can hope for is a mix of TODs that represents most of the common variations on the TOD theme. We think it particularly important that more LRT systems be represented in the sample, since these are systems that seem to be generating most of the TOD activity.

In this vein, we call for additional research on trip and parking generation at TODs. TODs, as we have defined them, are an increasingly common development type. In our home region of Salt Lake City alone, there are plans for nine TODs similar to those studied, including adjacency to rail stations. This study is a follow up of the earlier case studies by the authors at five exemplary transit-oriented developments (TODs) across the U.S. As of 2017, we are currently seeking funding to estimate trip and parking generation rates for an additional TOD on an LRT system, City Creek Center in Salt Lake City. But creating a respectable sample of TODs with trip and parking data is too big a task for us to take on alone.

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