3.0 Alternatives Analysis

3.1 Summary of Transit Technologies

This section reviews the various transit technologies and service alternatives that might have future application in Fresno County. The focus is on local/regional transit opportunities and not long-distance mass transportation services like high speed rail. This is to keep the analysis in line with the scope of the Public Transportation Infrastructure Study (PTIS), Phase 2. Also, although the review presents a long list of technologies found throughout the U.S., it targets the more limited number of technologies that appear most suitable given the development patterns of metropolitan Fresno and, to a lesser extent, of smaller Fresno County communities.

Table 2 summarizes the characteristics of thirteen transit technologies in the US. Of these, twelve are fairly common in major US cities, and one, PRT, is still considered experimental technology in the US and Europe. From left to right in the table, the technologies are listed generally in terms of vehicle and also line capacity, although line (or route) capacity can be highly variable and depends on service frequencies. Certain technologies, which can operate at very high frequencies, will offer greater line capacities than other technologies that actually have higher per vehicle capacities.

Selection of an appropriate transit technology for an urban area is dependent on a range of factors including, most importantly, predicted ridership from serving high-demand destinations in dense areas. The more densely developed or attractive an area is, the greater the justification to invest in a transit technology that carries a large number of people at high frequencies and fairly high speeds that compete with personal car travel times and attractiveness. Large numbers of riders result in higher cost efficiencies of the transit operation, which helps to qualify the project for federal funding in a highly competitive nationwide process.

At one end of the passenger rail spectrum are streetcars, which usually operate on existing city streets, sharing the right-of-way with autos and trucks, and are limited to one- or two-car trains. Individual vehicle capacities can exceed well over 100 passengers, but train frequencies tend to be limited due to the challenges of operating in mixed-flow traffic environments with multiple traffic lights. In the middle ground are light rail and commuter rail systems. Light rail vehicles can carry over 150 passengers on trainsets of typically two to three vehicles, for total capacities of 300 to 500 passengers.

Commuter rail vehicles include passenger cars seating 100 or more (standees on commuter rail trains are assumed to be avoided or kept to a minimum), linked together in trains of five to eight or more cars for a total train capacity similar to heavy rail. Line capacity per hour is usually less due to lower train frequencies. Diesel multiple units (DMUs) are an alternative to conventional commuter rail and even light rail technologies. Each vehicle or married-pair vehicle (essentially two cars permanently hinged in the middle) is self-propelled, but two to four DMU cars can be linked together per train. They are best deployed where large commuter rail trains are not needed due to limited demand and where electrification for propelling light rail trains is not practical and present too high a capital cost.

mmary of Transit Technologies

Definition:	Service Type:	Station Type:	Distance between Stations:	Service Frequency:	Alignment:	Right–Of–Way Width:	Minimum Turning Radius:
-speed, passenger rail cars operating singly vo or more cars on fixed rails in separate which all other vehicular and foot traffic are excluded" (APTA)	Urban/Regional	Raised high-floor level platform. Location: Center or Side	1 to 3 miles apart (except in CBD)	5 to 10 minutes during peak	Separate right of way	25 to 33 feet (Double Track)	330+ feet
long-haul rail passenger service operating olitan and suburban areas, whether within eographical boundaries of a state, usually uced fare for multiple rides, and commutation recurring riders." (APTA) Commuter Rail can sting freight tracks with freight trains if cars ety standards (i.e., are FRA compliant).	Interurban/Regional	Raised high/low floor level or low-level step up platform. Location: Center or Side.	2 to 5 miles apart	20 to 30 minutes	Uses existing tracks (at grade or grade separated crossings)	> 37 feet (Double Track)	140 to 460 feet
vith a 'light volume' traffic capacity compared ail may use shared or exclusive rights-of-way, n loading and multi-car trains or single cars" s an intermediate rail transit between high speed rail and streetcars.	Urban/Regional	Sidewalk sign, raised high/low floor level or low-level step up platform. Location: Center or Side.	1/2 mile to 1 mile	5 to 30 minutes during peak	Either center or side of street in separate or shared right of way with other traffic; exclusive right of way also sometimes provided	25 to 33 feet (Double Track), 11 to 13 feet (Single Track)	50 to 150 feet
le similar to a commuter rail but with lower oviding passenger service on short or medium e self propelled vehicles typically powered by perate as a single unit or multiple units based nited options exist in U.S. for FRA-compliant DMU applications in active freight corridors.	Urban/Regional	Raised high/low floor level or low-level step up platform. Location: Center or Side.	2 to 5 miles apart	Varies. Typically 15 to 30 minutes	Can use existing freight tracks (at grade or grade separated crossings) if meeting FRA requirements; separate guideway is a more expensive alternative.	25 to 37 feet (Double Track)	> 250 feet for single car and > 300 feet for multi cars
il transit vehicles designed for local traffic are powered by electricity from overhead catenary wire.	Urban Circulator	Sidewalk sign, raised low-floor level platform or low level stepup platform	approximately every 1/4 mile	8 to 15 minutes during peak	On street with traffic	19 to 24 feet (Double Track), 11 - 13 feet (Single Track)	40 to 80 feet
Modern Streetcar applies, except replicas of y are used and typically are nonarticulated.	Urban Circulator	Sidewalk sign, low level step-up platform	approximately every 1/4 mile	8 to 15 minutes	On street with traffic	19 to 24 feet (Double Track), 11 - 13 feet (Single Track)	40 to 50 feet
an integrated system of facilities, equipment,		Sidewalk sign, raised low-floor level platform	approximately	10 minute (peak)	On street with traffic	12 feet (single lane), 25	

mmary of Transit Technologies

Definition:	Service Type:	Station Type:	Distance between Stations:	Service Frequency:	Alignment:	Right–Of–Way Width:	Minimum Turning Radius:
is intended to run faster than the local bus. service between the local bus and the bus rapid transit.	Urban and Regional	Sidewalk post sign or shelter, curb-level stop	Approximately every 1/2 mile	10 to 30 minutes	On street with traffic	10 to 12 feet (preferred 12 feet)	40 to 70 feet
ch is intended for passenger pick up and lesignated stops along road corridors.	Urban and Regional	Sidewalk sign post or shelter, curb-level stop	Varies from couple of blocks to every 1/4 mile	5 to 60 minutes	On street with traffic	10 to 12 feet (preferred 12 feet)	40 to 70 feet
transit mode where electrically propelled, es straddle atop or suspend from a single il, or tube. These vehicles ride along grade Typically operates automatically and without le service at tourist attractions and airports.	Urban - Theme parks, Airports	Station, high-level platform for level boarding	Approximately 1/2 mile to 1 mile	Typically 5 to 15 minutes	Grade separated, dedicated right-of-way	Typically 25 ft (over city streets); 6'x8' support pillars	75 to 150 feet
e transit (includes paratransit, dial-a-ride, ised of passenger cars, vans or small buses e to calls from passengers or their agents to vho then dispatches a vehicle to pick up and rs to their destinations. (APTA) While many nd responsive service, most limit the service ilities, their attendants and companions, and ricans (with the exception of taxis).	Urban, Local and Regional	Flexible routes; typically curb stops and no set stations	Varies	Varies	On street with traffic	10 to 12 feet (preferred 12 feet)	Varies, approximately 25 feet
l service operates primarily from rural and as into urban area central business districts loyment centers. Most carpools/vanpools areas, though a few states have statewide programs."" (APTA)	Urban and Regional	Sidewalk sign and/or park-andride lots	Varies, with major destination a major activity center	Varies (on demand)	On street with traffic	10 to 12 feet	Varies, passenger vehicles approximately 21 feet
ffers ondemand, non-stop transportation ndent self-propelled, electric vehicles on a -built guideways. Two different vehicle sizes ectives exist. Smaller vehicles are designed avel party and larger vehicles are sized to er groups, all to the same destination.	Urban / Suburban	Station, platform level with vehicle floor; station is off-line from the main guideway.	Approximately 1/4 to 1 mile	Demand responsive and therefore no regular schedule; vehicle waits in station until passengers board and select destination	Separate right-of-way; typically grade separated	10 to 12 feet for single guideway; 20 to 25 feet for double	Varies, as low as 30 feet

Summary of Transit Technologies

Seating Capacity Per Car:	Route Length:	Capital Cost per Vehicle:	"Capital Cost per Mile: (Excluding Vehicles)"	Power Source:	Vehicle Life Expectancy:	Example Cities:	
60 to 80 seated, 120 to 150 with standees	10 to 30 miles	$2 to $5 million	$50 to $250 million (excluding right of way)	Electric	25 to 30 years	New York (MTA), Chicago (CTA), Washington (Metro), Atlanta (MARTA), San Francisco (BART), Boston (MBTA)	12 … Se
80 to 170 seated	20 to 100 miles	$1 to $3 million	$5 to $25 million (excluding right of way)	Diesel, Diesel-Electric, or electric with overhead catenary	25 to 30 years	Dallas-Fort Worth (TRE), New Jersey (NJT), New York (Long Island RR), San Jose - San Francisco (Caltrain), Chicago (MetraRail), Los Angeles (Metrolink), Nashville (RTA), Albuquerque (NMRR), Northern Virginia (VRE)	1 requ … Se
32 to 100 seated, 150 to 200 with standees	8 to 25 miles	$2 to $5 million	$30 to $70 million (excluding right of way)	Electric with overhead catenary wire	25 to 30 years	Denver, Dallas, Minneapolis, Houston, Salt Lake City. Charlotte, Phoenix, Los Angeles, San Diego	9 dw
Typically 80 seated	10 to 35 miles	$5 (single unit) to $9 million (articulated or A-B units)	$5 to $45 million (excluding right of way)	Diesel, Diesel-electric	NA	New Jersey (River Line), Portland (Westside Express Service), San Diego (NCTD Sprinter Line); Austin Leander Line (2009 revenue opening)	1 - … Se
Typically 30 seated, 115 with standees	1 to 8 miles	$2 to $3.5 million	$20 to $40 million (excluding right of way)	Electric with overhead catenary wire	25 to 30 years	Portland, Seattle, Tacoma	com … Se
Varies, 30 to 45 seated, 70 to 100 with standees	1 to 7 miles	Varies ($100,000 to $1 million)	$5 to $20 million (excluding right of way)	Electric with overhead catenary wire	Varies but typically 25 years or more	San Francisco, New Orleans, Memphis, Little Rock, Kenosha, Galveston	Se
Varies. Typically 45 seated [illegible]	[illegible]	$3 to $25 million [illegible]	$4 to $25 million (excluding [illegible]	Diesel, Alternative Fuel [illegible]	[illegible]	Boston, Pittsburgh, Los Angeles, New York, Cleveland, [illegible]	

mmary of Transit Technologies

Seating Capacity Per Car:	Route Length:	Capital Cost per Vehicle:	"Capital Cost per Mile: (Excluding Vehicles)"	Power Source:	Vehicle Life Expectancy:	Example Cities:	
Varies. Typically 45 seated for regular 40 foot bus, 60 forarticulated buses	Varies, but typically 5 to 20 miles	$350,000 to $500,000	Minimal cost for bus stops and passenger amenities unless in busway ($5 to $10 million per mile)	Diesel, Alternative Fuel (CNG), Diesel-electric Hybrid	12 years	Any city with a bus system	7 c (N it is
Varies. Typically 45 seated for regular 40 foot bus, 60 for articulated buses	Varies, but typically 2-10 miles	$300,000 to $500,000	Minimal cost for bus stops and passenger amenities	Diesel, Alternative Fuel (CNG), Diesel-electric Hybrid	12 years	Any city with a bus system	4 c (N ass
10 to 40 per vehicle (80 with standees; 240-person maximum with 6-car Monorail	Varies (1 to 4 miles)	$2 to $6 million	$50 to $100 million	Electric	10 to 20 years	Lake Buena Vista Florida (Walt Disney World), Downtown Miami (MetroMover), Las Vegas Casino District, Jacksonville (JTA Skyway), and Seattle CBD. Various U.S. and international cites have airport people movers.	S hig w
5 to 18 (paratransit van),	Varies (no fixed routes)	Approximately $60,000	Minimal if operating on city streets	Gasoline, Diesel, CNG	Varies, depends on vehicle type and manufacturer	Any urban area	Sui s
5 (car/small van) to 18 (extended van or minibus)	Varies (5 to 30 miles)	"Carpool-none; vanpool costs are often subsidized"	Minimal if converting existing traffic lane to high occupancy vehicle; $10 to $30 million per mile if new facility	Gasoline, Diesel, Electricgasoline (Hybrids)	Varies, depends on vehicle type and manufacturer	Many areas and employers offer carpool/vanpool services and incentives.	R
3 to 4 for small and 12-15 for large vehicles excluding standees	Varies (2 to 10 miles for first generation systems)	$50,000 to $300,000 for first generation systems (no recent examples in U.S.)	Estimated $10 to $20 million per mile but no recent systems in U.S.	Electric or Cable	10 to 15 years (estimate for first generation systems)	London Heathrow International Airport (in testing), Morgantown, WVA	Po

Passenger Rail Application Thresholds

Passenger rail service includes heavy rail, commuter rail, light rail (LRT), diesel multiple units (DMUs) and modern and heritage streetcars. With the possible exception of streetcars and single vehicle DMUs, passenger rail is best applied where transit demand is very high. This typically means service connects to highly concentrated employment centers with high residential densities also required to generate ridership and improve rail's effectiveness (ridership capture) and efficiency (cost per vehicle mile or hour of service). Heavy rail is very capital intensive and its cost only justified in certain U.S. cities. Commuter rail can be successful where residential densities are low if convenient large-lot park and ride access to train stations is provided. But on the attraction end of the transit service, meaning the employment destination, large central business districts are required to generate large number of users.

Small DMU trains have found applications in lower density commute corridors. If able to use existing freight or similar lines, capital costs are low. The critical issue is usually operating rights and priority over freight rail traffic, which if frequent, can disadvantage passenger train movements. Streetcars are finding new applications in urban activity centers where construction is not overly disruptive to existing uses or very costly. Costs cans be reduced by running track in existing streets, following the street contour, and building stations as sidewalk or sidewalk-extension stops with limited amenities. Streetcars are best justified where residential and commercial activity is mixed and intense. Some systems have been applied in lower density areas (Little Rock, Galveston, and Tacoma) although they would not be considered major transit lines.

Bus Systems

Three types of bus services are profiled in Table 2. The newest application is bus rapid transit (BRT), which attempts to replicate many of the aspects of light rail service at a fraction of the capital costs. BRT has a broad definition. At the high end, it includes dedicated bus lanes (usually in existing public right-of-way); passenger stations with amenities such as real time information, canopies, seating, and safety and security measures, among other features; and high capacity, high frequency service. Vehicles and the service in general are branded to distinguish them from regular buses and conventional fixed-route service. Many BRT lines have articulated buses with a seated capacity of 50 to 60 and total capacity of 90 passengers. Vehicles receive transit signal priority to move more quickly through intersections.

Express bus service can appear similar to BRT services but are now considered an intermediate service between BRT and local service. Limited stops and peak hour service to and from work are the defining characteristics. Express buses may share traffic lanes or operate in the high occupancy vehicle lane on freeways and expressways. Local buses operate in a multitude of environments. They are usually defined by frequent stops and slow average speeds from stopping often and running along arterials in mixed-flow traffic.

BRT and express services are similar to light rail in requiring higher densities or, for freeway express operations, at least the attraction end of transit trips located in a large central business district. Because of their much lower capital costs, they can operate in lower density corridors than light rail operates in. Because buses can operate at very high frequencies, especially if not restricted to mixed-flow lanes, line capacities typically exceed those for streetcars and often approach those for light rail systems. Bus frequencies can be readily tailored to match demand, and range considerably, from five minutes or less on local and BRT lines in central cities to hourly service in low density, low demand suburban and small community applications.

Automated Guideway Transit: People Movers (Monorail) and Personal Rapid Transit (PRT)

Although proposed for conventional transit applications, including moderately high demand corridors, these types of automated systems have failed to gain a foothold. Peoplemovers are becoming more common in airports throughout the U.S. and abroad and as local circulator/excursion services (e.g., Las Vegas, Disneyland/Disneyworld) but not as line haul services to substitute for express bus, BRT or light rail services. PRT systems are still extremely limited, with almost no recent track record of construction and operation, but they are proposed at airports and in unique situations (several locations in the Middle East, such as Masdar City in Abu Dhabi). The current construction cost estimates for PRT hovering around $50million per mile keeps this technology application from serious consideration where less expensive options can meet the same needs for much less money (like BRT at $3.0 million per mile or streetcars at $15 million per mile).

People movers can carry moderate line volumes while PRT is designed more for convenience and local access. PRT vehicle capacities are two to possibly five individuals and applications are limited to constant-demand conditions without peak surges. There is no reliable track record of either technology that would suggest their performance is superior to other more conventional transit modes. Until proven otherwise, it would appear they are best considered for serving special transit needs.

Demand Responsive Transit

Paratransit and demand responsive services are widespread and rely on vans and minibuses. These vehicles operate along existing public roadways and typically do not follow a fixed route. Paratransit is mainly a subsidized service for seniors and the disabled who cannot use fixed-route transit. Demand responsive services work when fixed-route service cannot attract sufficient uses to be cost-effective.

As noted, paratransit vans and minibuses operate in most urban areas as a complementary service to standard transit buses on fixed-route service. Demand responsive vans and minibuses provide service in small urbanized and even rural areas and are probably no longer justified when residential densities average four or more units per acre in larger communities.

Carpool/Vanpool Transit

Although included Table 2, some may view such service as a personalized mode of transit more akin to the auto than to public transit. However, carpools and especially vanpools serve an important function, and fill an important niche, in many large urban transit environments. Carpools and vanpools may operate in HOV lanes or in mixed traffic lanes. Generally, a significant portion of the trip is made in these facilities as that is how they achieve a travel time advantage compared to regular auto trips; carpools and vanpools avoid the congestion of mixed-flow lanes and may be afforded relief from tolls and other transportation system user charges.

Carpools and vanpools usually only become attractive where freeway congestion is high and travel is concentrated in certain corridors proceeding to and from major employment areas. In fact, like commuter rail, large central business districts where parking is limited and/or costly are a precondition to making carpools and vanpools viable.

System Comparisons

The highest volume systems are typically rail systems, with heavy rail, as represented by San Francisco's BART and Los Angeles' Red Line, among the fastest and having the most carrying capacity. Such lines are typically grade-separated in exclusive right-of-way and can carry 10,000 passengers or more per hour each direction.

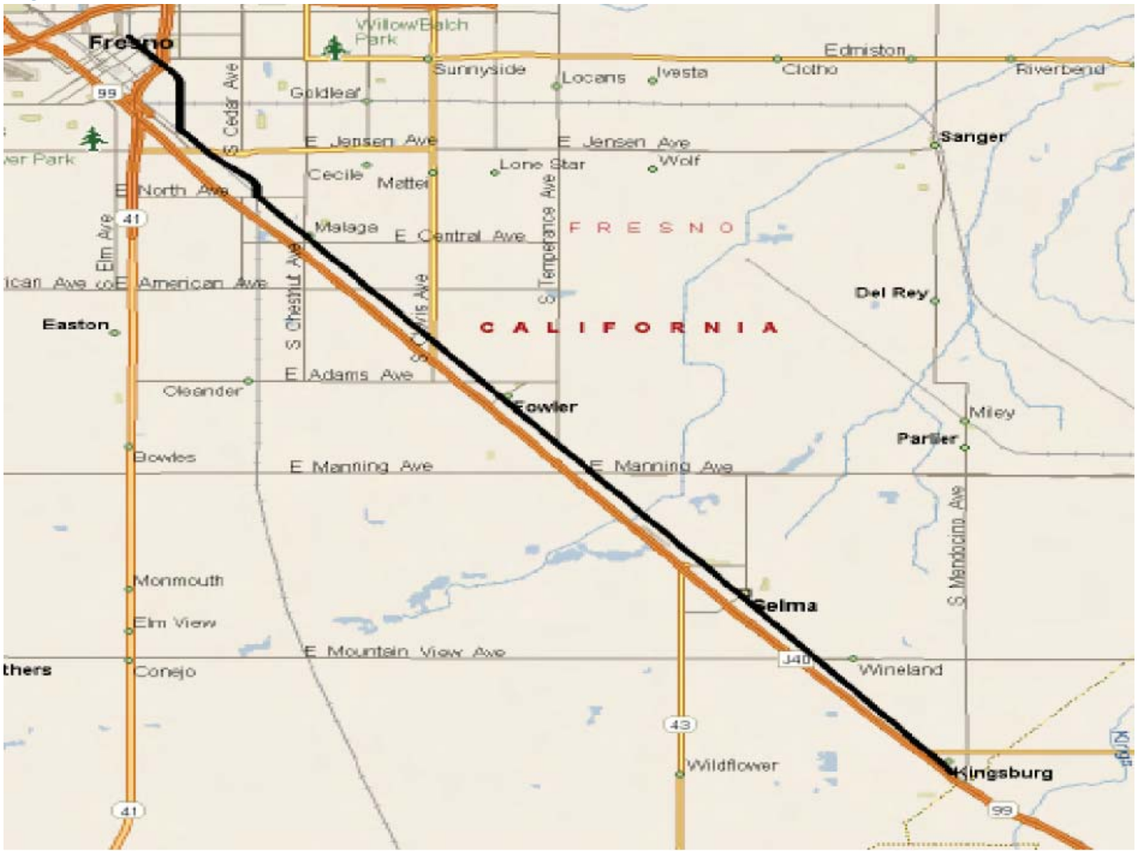
As Fresno County and the state grow and demand for transit increases, other technologies could become attractive for the area. One exciting new opportunity is high speed rail for long-distance intercity travel. Fresno is a candidate for a station served by ultramodern steel-wheel-on-steel-rail trains running at speeds upwards of 250 miles per hour. Planning is underway for this system, with construction several years off, but voters have already approved the first major funding allocation. For local travel, a proposal to implement bus rapid transit (BRT) on Blackstone and Ventura/Kings Canyon, the top two travel corridors in the city, has been approved by the Council of Governments and a Very Small Starts application has been submitted to the Federal Transit Administration (See Chapters 9 and 10 and Appendix A for more detail on the planned BRT project).

The analysis of the levels of urban densities needed to support transit technologies beyond bus and bus rapid transit do not yet exist in Fresno. Applications such as light rail, commuter rail, DMU's and heavy rail require concentrations of residences and employment that do not exist in Fresno and have not been zoned for the future yet. However, work that has begun on the Downtown Specific Plan and the General Plan Update in Fresno is recommending densities that will support the coming high speed rail station, bus rapid transit and a future streetcar system. See the BRT Very Small Starts Application and the Streetcar Feasibility Study in the Appendix of this document for details.

3.2 Feasibility Assessment of Rail Service – Fresno to Kingsburg

An analysis of the Fresno to Kingsburg/Highway 99 corridor was conducted under the PTIS study to determine the feasibility of a light rail or commuter rail system operating along this alignment that parallels Highway 99, also referred to as "the Golden State Corridor".

Figure 8: The Golden State Transportation Corridor



Source: Kimley-Horn and Associates, Inc., 2000 Census database

The population density analysis of the Golden State Corridor was conducted at the COG's request to supplement their Golden State Corridor Economic Development Project, since some form of rail transit was being proposed for that corridor along the existing railroad alignment that parallels Highway 99. Rail transit applications considered and rejected for this corridor include heavy rail, DMU's and commuter rail, due to the need for a large employment hub destination (or series of nodes) that are required to support the investment in these technologies. The Highway 99 corridor has low residential and employment densities, and these communities have not planned or zoned for these kinds of densities in the future. Light rail transit densities were used as a comparison to see if this rail technology would be feasible in this corridor as it can be supported by lower densities. Bus Rapid Transit was not considered for this corridor because BRT operates on surface streets through communities and not on a highway/rail corridor.

An analysis of population densities in comparable cities with light rail systems of similar lengths was conducted to see how this corridor compared with existing systems that had recently been funded (using 2000 Census population data).

Table 4: Existing Light Rail Systems Comparison

City	Transit Authority Monitoring Rail System	System Length (mi)	Total # of Existing Stations	Population Density (per acre)	Household Density (per acre)
Buffalo, NY	NFTA-METRO	6.4	16	11	4.7
Dallas, TX	DART	45.0	48	6.2	2.4
Minneapolis-St. Paul,	Metro Transit	12.0	17	6.9	2.9
Sacramento, CA	Regional Transit	29.7	55	6.3	2.7
Salt Lake City, UT	UTA	19.0	24	5.2	2.3
St. Louis, MO	Metro	17.0	37	4.8	2
Averages		21.5	32.8	6.7	2.8
Fresno, CA	N/A	22.9	N/A	3.5	0.7

Source: 2000 US Census and FTA Transit System Database 2010

The comparative analysis shows the cities with existing light rail service in operation have an average system length of 21.5 miles, similar to the Fresno to Kingsburg corridor at 22.9 miles. Population densities in existing rail corridors range from 4.8 to 11 people per acre. The number of households in the one-mile wide existing rail corridors range from 2.0 to 4.7 per acre. The proposed Fresno to Kingsburg light rail line has a population density of 3.5 persons per acre and a household density of 0.7 households per acre. The proposed rail line has 30% less population density and 65% fewer households than existing light rail lines operating across the U.S.

The conclusion of this comparative analysis is that rail service between Fresno and Kingsburg would not be feasible with current low density residential growth patterns. The existing population density of the Fresno to Kingsburg corridor is compared with rail transit corridors in Buffalo, Dallas, Minneapolis/St. Paul, Sacramento, Salt Lake City and St. Louis. The Fresno to Kingsburg corridor is compared to other cities with an average of 8 persons per acre and 3.25 households per acre. Fresno has 15% of the population density and 12% of the household density of these other existing systems.

Passenger rail service in the Fresno to Kingsburg corridor would not be feasible at this time. However, with changes in planned land use densities in this corridor concentrated around the rail line, transit could capture a large share of the forecast 24,000 daily trips in this corridor, which could make a light rail investment feasible in the longer term. Light rail would be a better fit than commuter rail in this corridor for the foreseeable future, assuming development density patterns are established in the near term to support this future investment.

Interim steps toward that goal would include adoption of a transit-oriented land use policy and new zoning regulations to require significantly higher residential land use densities in identified future transit corridors. In the interim, it is recommended that the Fresno COG consider the construction of Park and Ride lots in each city along the corridor (Malaga, Fowler, Selma and Kingsburg) and provide express bus service into downtown Fresno, with a timed transfer to the Bus Rapid Transit system downtown for destinations north and east of downtown.

3.3 Transit Priority Corridor Recommendations

Based on an evaluation of job centers and commute patterns, the following corridors were recommended by Strategic Economics for transit infrastructure investments. Note that these recommendations are only made based on limited information, and do not factor in investment feasibility, traffic, or other factors that the remainder of the PTIS Phase II study will consider.

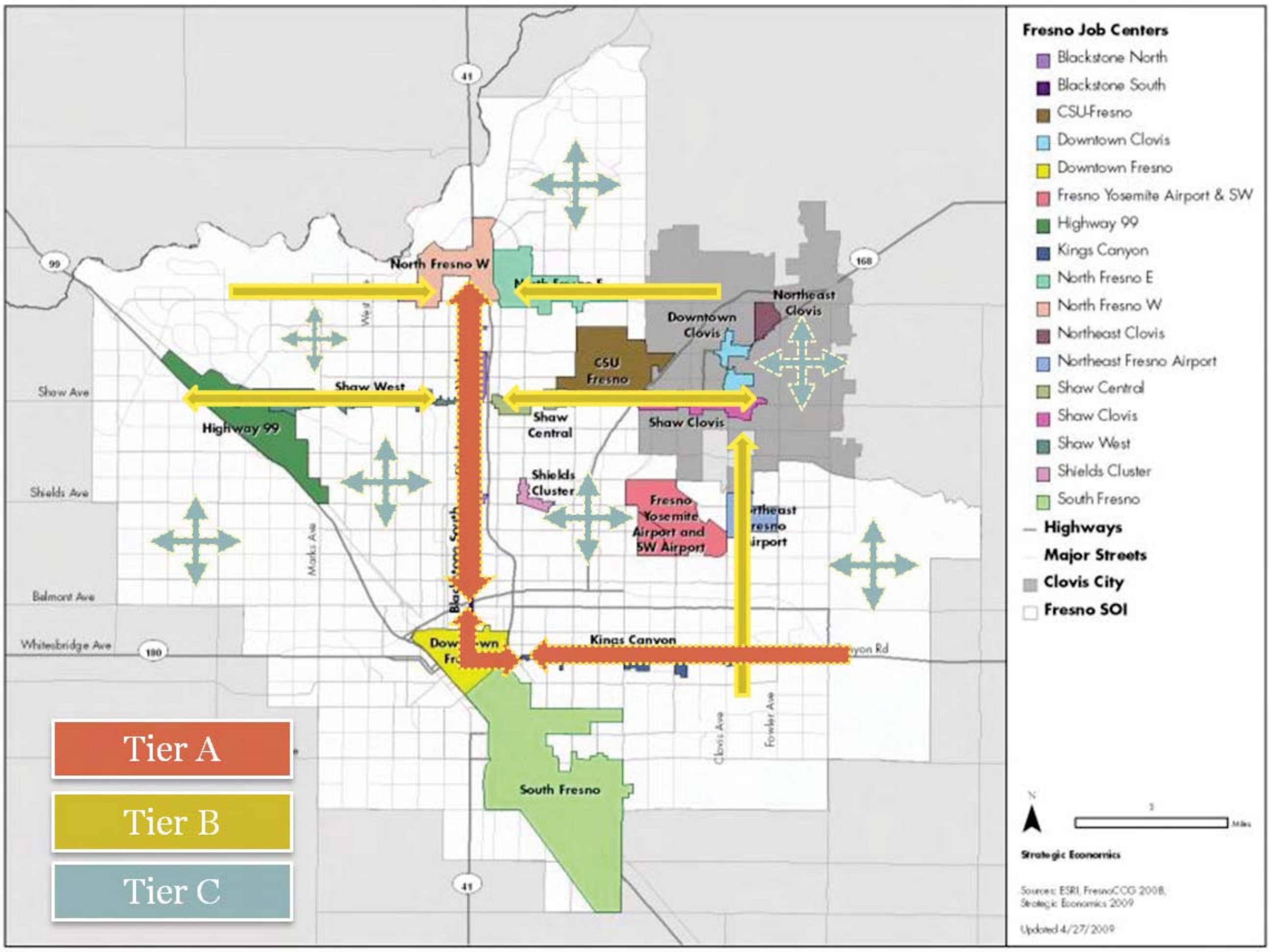
These preliminary corridor recommendations were made in early 2009 to identify potential high capacity transit corridors. This work was further refined in 2010 with the BRT Very Small Starts application which linked the Blackstone and Ventura/Kings Canyon corridors into one operational project which was submitted to the FTA for funding and implementation. This study also identified that Shaw Avenue from Highway 99 to CSU Fresno and downtown Clovis was a strong second corridor for the next phase of BRT implementation in the Tier B corridor identification. The concept of a circulator shuttle system near the CSU Fresno campus as a Tier C project has been explored by FAX for many years, who would like the CSU Fresno campus to partner with them to fund such a project that would shuttle students from nearby neighborhoods to school.

Tier A Transit Connects Top Job Centers, Improves Southern Access to Growing Northern Job Centers
Although new regional job centers have sprouted up in northern Fresno and Clovis, Downtown Fresno is still a job center of regional significance, and continues to draw a significant share of commuters from all of Fresno and Clovis's neighborhoods. The study team recommends extending the planned Kings Canyon BRT line north along Blackstone. Doing so will link the City's two top job centers (North Fresno and Downtown) and create a jobs-rich transit network. To enhance low income residents' access to jobs, the study team recommends a single continued transit corridor from Kings Canyon to Blackstone, eliminating any transfer that might otherwise be needed in Downtown Fresno.

Tier B Transit Links in Secondary Office–Based Job Centers and Improves Northern Resident's Access to Major North Fresno Destinations
Second only to Blackstone, the Shaw corridor maintains a strong economic presence in the City, and accommodates many of Fresno County's office based jobs. Every effort should be made to link to the office nodes aligning Shaw, and to connect the Fresno State campus into the regional transit network. An additional north-south corridor will help link residents to job centers in Clovis and surrounding the airport.

Tier C Transit Offers a Circulator System to Bring Residents to Major Transit Corridors
Fresno maintains a fairly segregated land use pattern. Although jobs are concentrated along major corridors, there is a significant lack of housing along these routes. While there is ample opportunity to accommodate residential and mixed-use development along certain portions of Fresno's corridors, the transit system will be incomplete without a circulator system that can link Fresno's existing residential neighborhoods into the regional transit corridors.

Figure 9: Recommended Transit Priorities



Source: Strategic Economics, 2009.

As shown in Figure 9, forecast travel patterns clearly identify a high volume north-south corridor along Blackstone Avenue into downtown Fresno, and a medium volume corridor along Herndon Avenue in the east-west direction at the north end of the city. The Herndon corridor at the north end of the city between Clovis and Fresno has a high volume of employment trips but no transit service exists across Herndon due to the lack of an inter-local agreement between the two cities to provide transit service across jurisdictional boundaries.* Significant employment trip generators include CSU Fresno State along Shaw Avenue, the IRS complex downtown and North Clovis area.

*However, Fresno and Clovis have an interlocal agreement to operate service on Shaw Avenue. If future demand and funding should materialize, cooperative service could be added on Herndon.

4.0 No Build, TSM and Build Alternatives

Fresno's Existing Travel Patterns

Baseline indicators for the year 2010 from the COG Travel Model are provided in Table 4. Of significance for Fresno is the very small amount of congestion (only 2% of travel) for such a large urban area, which keeps personal automobile use attractive compared with taking transit. The average travel speed of personal autos, at 43.87 miles per hour is significantly better than the average transit travel speed of the local bus service at 16.63 miles per hour. Transit cannot compete with the automobile in terms of travel time attractiveness.

The journey to work in Fresno County is predominantly by the automobile (95.86%) with only 2.17% taking transit to work. Note the high percentage of non-work bicycle and pedestrian trips, suggesting a large number of people prefer to walk or bike over taking transit for discretionary and institutional trips in the neighborhoods.

Table 5: Baseline Performance Indicators

Performance Measure	Mode/Measure	2010 Daily Averages
Vehicle-Miles of Travel	Vehicles	22,925,352
Vehicle-Miles of Travel in Congestion	Vehicles	465,776
Percent VMT in Congestion	Vehicles	2.03%
Person-Miles of Travel	Vehicles	36,000,416
Person-Miles of Travel	Transit	108,340
Vehicle-Hours of Travel	Vehicles	521,092
Person-Hours of Travel	Vehicles	820,572
Person-Hours of Travel	Transit	6,516
Vehicle-Hours of Delay	Vehicles	13,597
Person-Hours of Delay	Vehicles	21,455
Person-Hours of Delay	Transit	81
Average Speed	Vehicles	43.87
Average Speed	Transit	16.63
Total Trips	**Persons Daily**	**4,658,403**
% Work Auto Trips	Percent Daily	95.86%
% Work Transit Trips	Percent Daily	2.17%
% Work Walk/Bike Trips	Percent Daily	1.97%
% Non-Work Auto Trips	Percent Daily	91.05%
% Non-Work Transit Trips	Percent Daily	0.67%
% Non-Work Walk/Bike Trips	Percent Daily	8.28%
% Total Auto Trips	Percent Daily	91.58%
% Total Transit Trips	Percent Daily	0.84%
% Total Walk/Bike Trips	Percent Daily	7.58%

Source: Dowing Assiciates, Inc., Fresno COG Travel Model

These number of transit dependent people in Fresno County indicate an unmet market demand for more formalized carpooling and an expansion of the vanpooling program to match commuters with similar origins and destinations, particularly to outlying areas not well served by fixed route transit. The large number of cyclists and pedestrians points to a need for a formalized bicycle route system with connecting bike lanes and completion of sidewalk networks linking neighborhoods to shopping centers, schools and recreational destinations.

The terms No Build, TSM and Build Alternatives were established by the Federal Transit Administration and are required for any Small Starts or Very Small Starts applications for Federal funding. The terms are used here to be consistent with FTA formats in case Fresno wants to use this study as the basis of a future FTA funding request.

4.1 The No Build Alternative

The No-Build alternative provides the baseline for comparing the environmental impacts of the alternatives, and the cost-effectiveness of the TSM alternative on a largely unimproved transportation system. This alternative is defined to include those transportation facilities and services that are likely to exist in the forecast year. All elements of the No-Build alternative must be part of each of the other alternatives except where an alternative replaces services or facilities inside the corridor.

To provide a basis of comparison the No-Build alternative must include the following features:

- The maintenance of existing facilities and services in the study corridor and region;
- The completion and maintenance of committed projects in the study corridor that have successfully completed their environmental review; and
- The continuation of existing transportation policies.

The No-Build Alternative incorporates "planned" improvements that are included in the fiscally constrained long-range (5-year) Transportation Improvement Plan for projects that are expected to be implemented. The No-Build alternative maintains the current transit operating strategy with a growth in service commensurate with forecast population and employment growth. New bus routes may be added and existing bus routes extended, but the underlying strategy should remain the same.

The Proposed No-Build List of Projects

The following list of projects includes projects found on the 2009 TIP update in the constrained network plus recommended minor improvements in routing and headways consistent with current operating practice. Funding sources, budgeted amounts and programmed year of construction from the 2009 TIP are provided below. The total cost of the No Build transit scenario is estimated at $46.8 million which does not include operating costs associated with driver wages, benefits, gas, and maintenance.

Assumptions:

1) The No-Build Alternative assumes the first two top priority BRT lines (submitted as a single project for Very Small Starts funding) will be built as part of the trend scenario in the forecasted transit system for 2035, based on the current RTP ($35 million budgeted in 2014).

2) It is also assumed that "Owl Service" is introduced to begin offering extended service hours until midnight on 6 or 8 key routes, adding about 5% to total operating hours and cost. The forecasting model will not detect this change, however.

3) A fare increase is assumed to have happened by 2035. Fares on FAX are currently below market and have not been raised for nearly a decade. The model calculates an average of the current adult fare ($1.00) with the ADA fare (75 cents) and the senior fare (no cost per Measure "C") to be about 67 cents. The model will calculate a sensitivity test for a doubling of the average fare (to about $1.34). Dowling will compare the change in ridership against other transit agencies who have undergone a fare change in the past 2 years to test validity of the results from the model.

4) It is assumed that recent discussion about merging the separate transit operations into a single agency serving the region has happened, either through a legislative mandate creating the new agency, or through structured inter-local agreements.

5) Assumes FAX Route 12 and Route 56 have been eliminated.

The following list of approved transit-related projects and a suggested list of improvements to the existing transit service are mapped on "Figure 10: The No-Build Map". In addition to the list of projects in the constrained (4-year) Regional Transportation Plan, The No-Build Alternative also proposes to expand local bus service, consistent with the growth in service over the past three reporting years to the FTA. Fresno's population has averaged 1.5% growth per year over the past four years, while growth in annual vehicle revenue miles on FAX have averaged 1.1% per year over the same timeframe. This trend indicates that the population is growing faster and farther out than the FAX transit system can keep up with. Vehicle Miles Traveled (VMT) is growing faster than the population rate – a reflection that more people have been driving more miles from the urban fringe every year.

Table 6: Fresno Area Express Proposed List of BRT Stations

FRESNO AREA EXPRESS BRT List of Stations September,2010			Bus Classification *(Major, Minor, Basic)*	Distance from Previous Station *(miles)*
1	Friant Road	at Audubon Dr (End of Line)	Minor	-
2	Blackstone Avenue	at N. of El Paso (NB & SB)	Minor	1.16
3		at Herndon Ave (NB & SB)	Minor	0.61
4		at Sierra Ave (NB & SB)	Minor	0.50
5		at Bullard Ave (NB & SB)	Basic	0.50
6		at Barstow Ave (NB & SB)	Minor	0.50
7		at Shaw Avenue (NB & SB)	Major	0.49
8		at Gettysburg Ave (NB & SB)	Basic	0.51
9		at Ashlan Ave (NB & SB)	Minor	0.49
10		at Griffith Way (NB & SB)	Minor	0.25
11		at Manchester Center	Major	0.48
12		at Clinton Avenue (NB & SB)	Minor	0.51
13		at McKinley Avenue (NB & SB)	Minor	0.25
14		at Olive Avenue (NB & SB)	Minor	0.53
15		at Belmont Avenue (SB) at Abby Street (NB)	Minor	0.51
16	Stanislaus St	at P Street (NB & SB)	Minor	0.52
17	M St P St	at Mariposa St (SB) at Fresno St (NB)	Basic Major	0.43
18	Ventura St	at P St (EB & WB)	Minor	0.62
19		at 1st Street (EB & WB)	Minor	0.43
20		at 5th/6th St (EB & WB)	Basic	0.41
21	Kings Canyon Road	at Cedar Avenue (EB & WB)	Major	0.59
22		at Maple Avenue (EB & WB)	Minor	0.50
23		at Chestnut Avenue (EB & WB)	Major	0.51
24		at Helm/Transit Village/Wal-Mart (EB & WB)	Major	0.54
25		at Peach Avenue (EB & WB)	Minor	0.19
26		at Clovis Avenue (EB & WB)	Minor	1.02
			Total Distance to Clovis Ave (mi)	13.79
			Average Spacing (mi)	0.55
			Total project	**41.4 miles**

Source: NTD Database years 2005 to 2007 for Fresno FAX System fixed route service.

The No-Build List of Projects

1) BRT is implemented on Blackstone Avenue and Ventura Boulevard/Kings Canyon The proposed alignment follows N. Blackstone Avenue in the northern portion of the corridor, O and P Streets through Downtown Fresno and Ventura Avenue-Kings Canyon Road in the eastern portion of the corridor. The alignment begins just north of the RiverPark Shopping Center on Friant Road at Audubon Drive and continues south on Blackstone Avenue to Hedges Avenue. Then the alignment follows the one-way couplet through Downtown Fresno (southbound on Blackstone Avenue to O Street, northbound on P Street and Abby Street). The total distance is approximately 41.4 miles. Blackstone Avenue is currently served by FAX Route 30, connecting downtown Fresno with Fresno City College, the Manchester Transit Center, Heald College and the River Park Transit Center.

   The alignment and the BRT service continues east as a single route on Ventura Avenue which turns into Kings Canyon Road east of Cedar Avenue and terminates at Fowler Avenue, a distance of approximately 5.4 miles. The Kings Canyon Road-Ventura Avenue corridor connects a major growth area of southeast Fresno (up to 55,000 new residents provided for in the 2025 General Plan) to downtown Fresno. The route is currently served by FAX Route 28, and connects downtown Fresno with the Social Services offices, Eastgate Shopping Center, Sunnyside High School, and Fresno Pacific University.

   A total of 26 station locations have been approved by the City of Fresno COG for the BRT as identified in Table 6. The total project cost estimate to implement BRT on both corridors is estimated at $48.2 million at 2012 construction costs, or about $3.0 million per mile. The Very Small Starts application for the project was being submitted to the FTA in September of 2010.

2) Prioritize traffic signals for bus routes #9 (Shaw Avenue), to decrease the number of buses needed to maintain existing frequencies, and thereby reduce emissions. CMAQ Program: $1,565,700 for 10/11. This project can be modeled.

3) Commute Green Fresno County: A travel demand management commuter program for Fresno County employees designed to provide subsidies and incentives for program participants. CMAQ: $306,900 for 10/11 and $283,400 for 11/12. (It was determined that this amount of subsidy is too small to be reflected in the model outcomes. It is also not mapped).

4) Continue 15 minute frequencies of service intervals on high demand routes #34 and #38. Fresno Street, 1st Street, and Cedar. Increase frequencies on Route #32 to 15 minutes. CMAQ: $6,736,400 08/09 and $1,036,500 in 09/10.

5) Park & Ride Lot construction to accommodate 58 stalls for long distance commuter vanpools and carpools near SR99. CMAQ: $29,500 10/11 and $618,100 in 11/12. The exact location of this Park & Ride lot is unknown. For modeling purposes, we assume a location to be determined along Highway 99 in Madera, suggest Almond or Pecan Avenue intersections.(outside of mapped area)

6) Construct transit stop facilities along Sierra Street east of Rafer Johnson Street (also known as Greenwood Street) in Kingsburg west of 99. CMAQ: $9,700 in 10/11 and $98,800 in 11/12. (Not modeled or mapped).

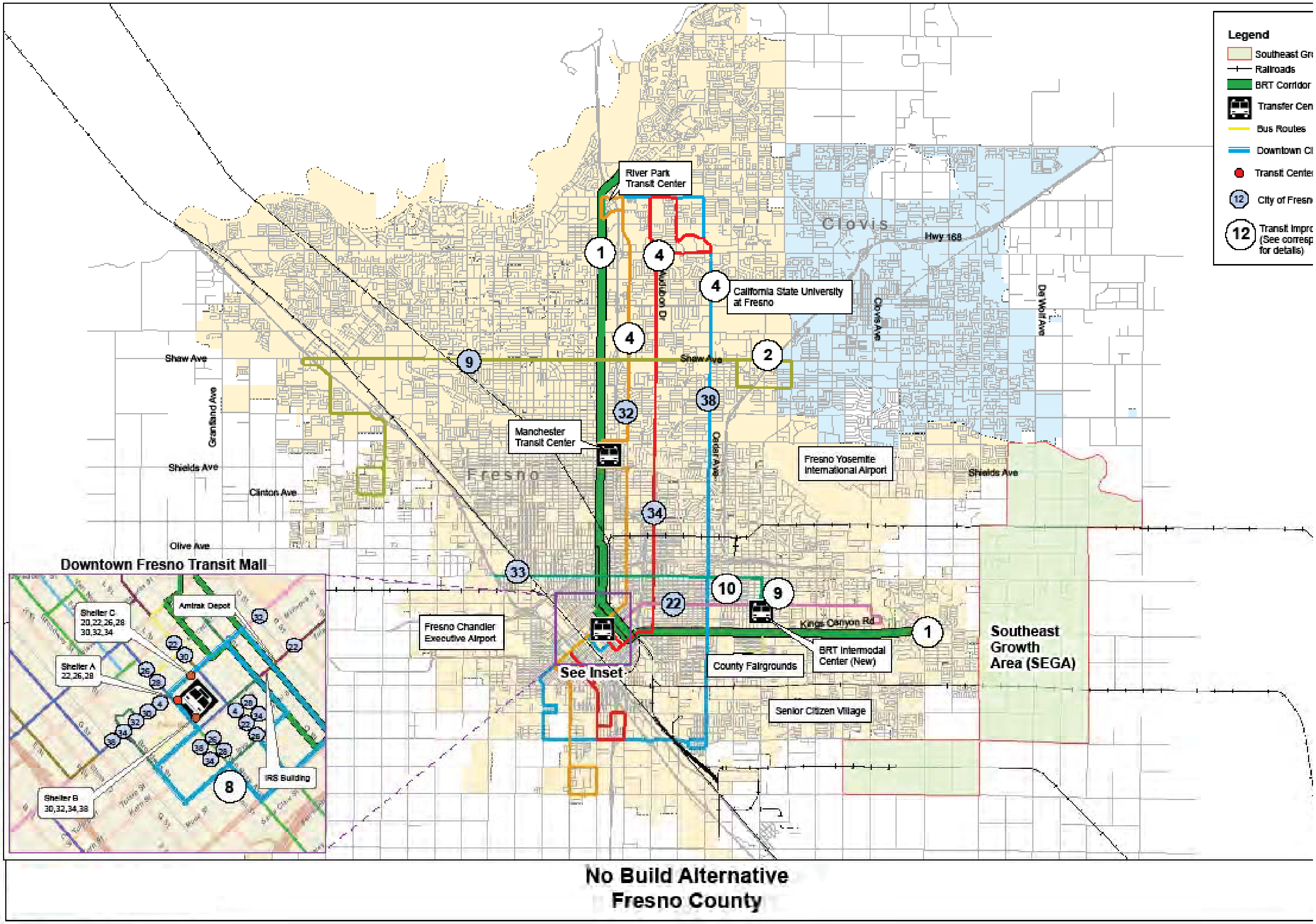
7) Passenger shelters/structures, benches, trash receptacles and lighting; On-street signs; Bus stop repairs, and miscellaneous amenities to benefit transit passengers. FTA Section 5307 Program $600,000 ($200,000 in 2008, $200,000 in 2009 and $200,000 in 2010). (Not modeled or mapped).

8) Downtown circulator program: provide shuttle service throughout downtown Fresno during peak commute hours. Purchase of 4 shuttle vehicles. FTA Reference Projects: $1,200,000 in 08/09. (See the proposed route planned for downtown in the map callout box). Suggest increasing frequency of D/T shuttle to 15 minutes mid-day weekdays and possibly on weekends to support proposed build-out of downtown retail, restaurants and high density housing. Current downtown circulator Route 4 offers two peak hour buses and has an average daily ridership of 412 (replaced by new downtown circulator route)

9) Intermodal facility program: Develop and construct intermodal facility to be located at Kings Canyon and Chestnut in the TOD Village in the Southeast area of Fresno. CMAQ: $1,000,000. Should be in operation in 2012. Will serve as a hub for FAX transit routes 28, 41, 33, and 22 (Route 12 has been eliminated).

Total cost estimate for the No Build Scenario: $46.8 million. Does not include transit operations and maintenance costs per FTA guidelines.

Figure 10: The No Build Map



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4.2 The Proposed TSM Alternative

The TSM Alternative is comprised of low-cost improvements over the No-Build Alternative, as identified in the 25 year Transportation Improvement Plan. The TSM project list is comprised of projects found in the 2007 unconstrained plan (in the 25-year scenario) plus recommendations by the consultant team to add or improve existing transit service. The TSM Alternative projects and service expansion is shown in Figure 9: The TSM Alternative Map.

These projects are not yet budgeted, so they should be viewed as future possible projects. TSM projects typically include:

- Upgrades to current and planned service
- Transit priority measures
- Operations improvements on key transit corridors
- Vehicle upgrades
- HOV Facilities
- Intermodal improvements

The TSM Alternative assumes that all the improvements identified in the “No Build Alternative” have been implemented. All recommended changes or improvements are cumulative and build from one alternative to the next. The total cost of the TSM Alternative is estimated at $258million, including all the improvements listed in the No Build Scenario (again not including operations and maintenance costs). This price tag assumes a built-in cost of replacing the existing fleet of FAX buses estimated at $150 million.

Compared with a fixed guideway investment, transportation system management alternatives are relatively low cost approaches to addressing transportation problems in the corridor. The TSM alternatives provide an appropriate baseline against which all of the major investment alternatives are evaluated. The most cost-effective TSM alternative generally serves as the baseline against which the proposed guideway alternative is compared during the New Starts rating and evaluation process that begins when the project applies to enter preliminary engineering continuing through final design.

The TSM alternative represents the best that can be done for mobility without constructing a new transit guideway. Generally, the TSM alternative emphasizes upgrades in transit service through operational and small physical improvements, plus selected highway upgrades through intersection improvements, minor roadway widening, and other focused traffic engineering actions. A TSM alternative normally includes such features as bus route restructuring, shortened bus headways, expanded use of articulated buses, reserved bus lanes, contra-flow lanes for buses and HOVs on freeways, special bus ramps on freeways, expanded park/ride facilities, express and limited-stop service, signalization improvements, and timed-transfer operations. Outside the study corridor, the TSM should have the same transit network as the no-build alternative. While the scale of these improvements is generally modest, TSM alternatives may cost tens of millions of dollars when guideway alternatives range up to several hundreds of millions or billions of dollars.

TSM Alternative Recommendations

Westside Transit Service Expansion: $2,734,239.

1) Serve growth west of SR99 by extending Route 9 westbound on Shaw Avenue to North Grantland Avenue and east by extending service to De Wolf for a transfer to new service on De Wolf connecting to SEGA (see project #19). Includes a timed transfer at the SavMart transfer center. Increase frequencies from 30 to 15 minutes in TSM. On the east side, tie Route 9 to the Sierra Vista Mall transit center @Shaw and Clovis for a timed transfer. Allow transfers to BRT where it crosses Blackstone.

2) Add a new route on Herndon with transfer points to Clovis bus route 10 that goes west to Grantland and turns south to Shaw. In the middle, connect up to the River Park Transfer Center (up Ingram, right on Nees, then back down to Herndon on Fresno Street). At the east end, go up Highway 168 to Clovis and do a loop, heading left on E. Shepherd Avenue, left on N. Temperance, back to Highway 168.

3) Continue Route 34 to connect to the River Park Transit Center. Eliminate the portion of Route 34 south of D/T transfer center and use time on north extension to River Park. Extends the top end of the route on Nees to connect to the River Park Transfer Center with a timed transfer. The southern end of the route terminates at the downtown transfer center.

4) Separate Routes 30, 32, 34 and 38 at the point where they go south and west of the downtown transit center. Re-route Route 38 to turn west on Ventura Avenue and terminate at the Downtown Transit Mall. Redesign and consolidate these 4 routes into one or two new route(s) that travels between D/T transfer center and the SW area. (See the revised route map for this area) Operate on 15 minute peak/30 minute off peak schedule (transit dependent neighborhood). Routes 30 and 32 remain unchanged.

5) Leave the North/South service on Route 45 from Manchester Transfer Center to Herndon as is. Extend the part of Route 45 that runs east-west on Ashlan all the way westbound to North Grantland Avenue. On the eastbound side, connect all the way to De Wolf Avenue. At Clovis Avenue take a one block detour to connect to the Sierra Vista Mall Transit Center.

6) Route 41 on Shields is realigned to go farther west to Grantland Avenue, then north to connect with expanded route 45 on Ashlan. Destinations north of Shields are now served by other routes. The service meets the Manchester Transit Center on Blackstone and goes east to Chestnut, where it heads south to connect to the new Intermodal BRT Center on Kings Canyon. Route 41 continues to the Senior Citizen Village and Malaga, Fowler and Selma to the south.

7) Extend Route 39 on Clinton Avenue west to Grantland Avenue. This route begins at the downtown transit center, comes up Blackstone, then heads west on Olive Avenue. This route then heads east on Olive to connect to the airport and allows transfers to BRT at the Blackstone crossing. Route 35 on Olive Avenue is extended westbound to Grantland Avenue and goes north to connect with Clinton Avenue to form a loop. This route extends to Clovis Avenue on the east side and loops on Belmont and Peach, then back to Olive. This route forms a continuous loop back into the downtown transfer center on Blackstone.

8) Terminate and separate Route 22 at the downtown transfer center so 22a only goes North/South or and 22b only goes East/West. Increase the frequency from 30 minutes to 15 minutes on the North/South portion. The East-West service on Route 22b on Tulare Street gets combined with route 28b on Ventura Avenue to form a loop that ends at the downtown transfer center. On the east end, route 22b goes south on Clovis to Kings Canyon then extends eastward to De Wolf Avenue ending at the transit center in SEGA.

   (We also separate Route 28 at the downtown transfer center so 28a only goes North/South and 28b only goes East/West).

Eastside Transit Service Expansion: $2,734,239.

1) Create a new route that runs north-south on Clovis Avenue from E. Shepherd Avenue at the northern end in Clovis and south to Kings Canyon Road, then goes west on Kings Canyon about one mile to connect to the Wal-Mart and new TOD intermodal facility/BRT station (5125 Kings Canyon Blvd.) . (May require an inter-local agreement between Fresno and Clovis to run this).

2) Provide new north-south service on the east side connecting employment centers in east Clovis and on Ashland Avenue with the SEGA development running along DeWolf Avenue connecting to a planned future SEGA transit center. The employment centers are served by continuing the route north-south along Temperance Avenue and then east-west along Shepherd terminating near the intersection of De Wolf and Shepherd. This route allows a transfer to other Clovis bus routes at Temperance and Shaw.

Inter-County Transit Service: $3,038,044.

1) Add Express Bus service from remote Park & Ride Lots on SR99 (Madera to the north, Malaga, Fowler, Selma, and Kingsburg to the south) Assumes 20 minute headways during peak AM and PM times only, starting at 6:20am to 9:20am, then returning 3:20pm to 6:20pm

   Express Route#1: Starts in Madera @ Hwy 99, heads south to downtown Fresno transit center with one stop at W. Herndon.

   Express Route #2: Starts in Kingsburg @ Hwy 99 and heads north to downtown transit center with one stop in Selma.

   Express Route #3: Starts in Fowler@ Hwy 99 and heads north to downtown transit center with one stop in Malaga. (this one starts and ends 20 minutes earlier and later because it is so far out)

   Express Route #4: Creates an origin point at the intersection of Hwy 41 and Hwy 145 for a park and ride lot to serve the planned Rio Mesa Development east of Madera. Provides service down to Fresno's transit center downtown, with a stop at the River Park transit center at the north end of Blackstone, where people could transfer to BRT or Clovis destinations.

Transit Transfer Centers (4) $250,000 each

1) Create a timed transfer between FAX routes and Clovis Transit at the Savmart Transfer Center. (The model can reflect shorter transfer times)

2) Enhance the current transfer situation for Clovis to FAX bus routes at the Sierra Vista Mall – corner of Clovis Avenue and Gettysburg Avenue.

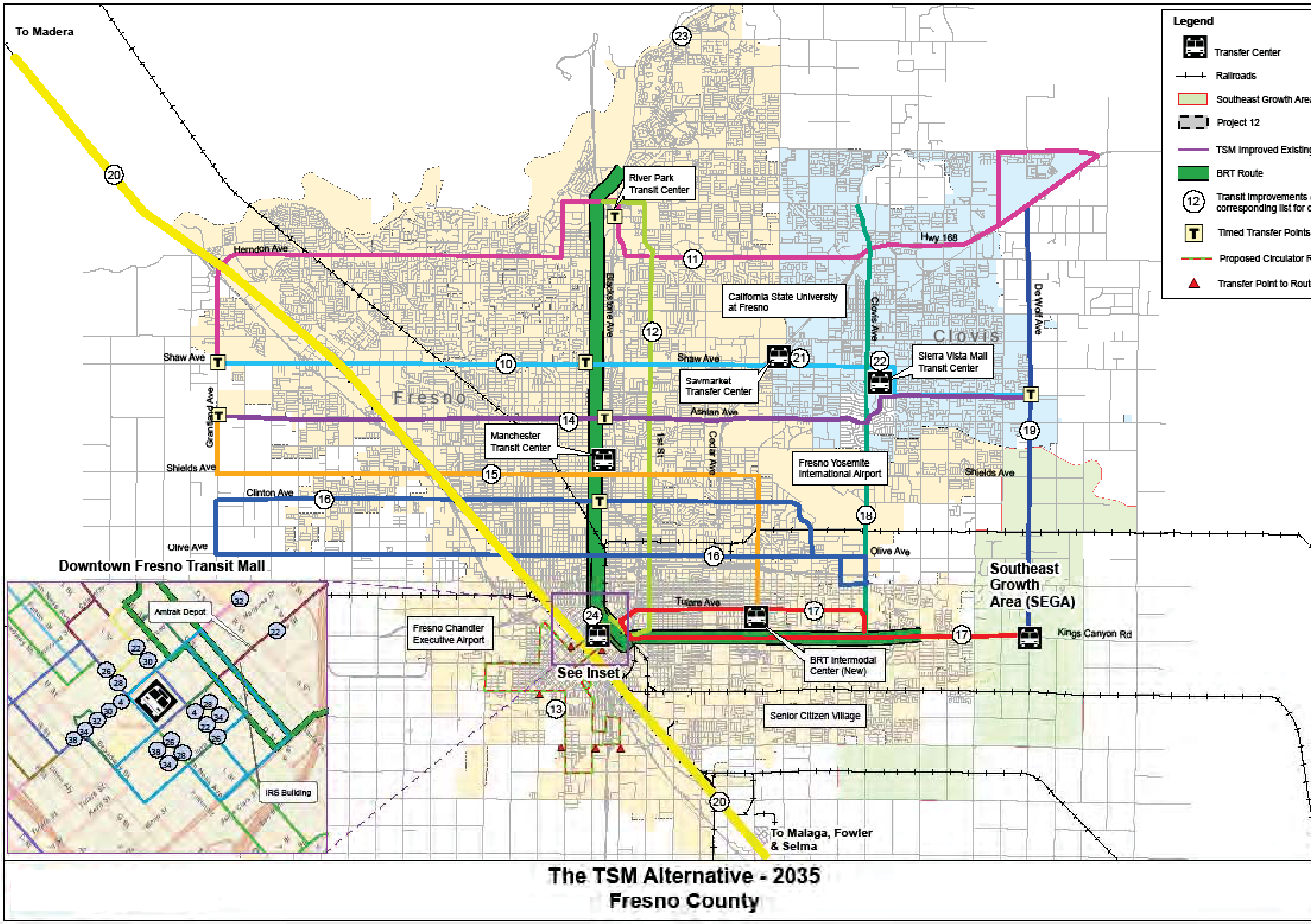
3) A new Park & Ride Facility at Friant Road and East Copper Avenue near Madera County line: $750,000.

4) Transit Mall: Redesign and consolidation of Downtown Fresno transfer facilities to include enhanced amenities including commercial development (references Downtown Circulation Study, not modeled)

- Increased bus fleet (400 to 500 buses) $150,000,000. (see proposed headways for new routes in Table 3). This is modeled.
- Expansion of on-street transit information sign system: $1.5 million. (not modeled or mapped)
- Stop and Station Improvements: (no budget amount) (not modeled or mapped)
- Bus Signal Preemption System: $500,000. Locations unknown. (Not modeled or mapped.)

Total cost estimate for No Build plus TSM: = $440 million does not include transit operations and maintenance costs. It does assume that the $150 million cost for replacing the FAX transit system buses has occurred twice in these 25 years.

Figure 11: The TSM Alternative Map



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4.3 No Build and TSM Modeling Results

The results of the No-Build and TSM scenario forecasts using the FCOG approved travel model identifies key trends to further develop the future transit build packages and to refine the performance indicators.

The following two scenarios were evaluated:

1) The No Build Scenario reflecting FCOG's forecasted transit system based on the current adopted Regional Transportation Plan (RTP). This scenario includes projects found on the 2009 TIP update in the constrained network plus recommended minor improvements in routing and headways consistent with current operating practice.

2) The TSM Scenario comprised of low-cost improvements over the No-Build Alternative, including proposed upgrades to current and planned service, transit priority measures, operations improvements on key transit corridors, vehicle upgrades, HOV facilities, and Intermodal improvements as identified in the Fresno COG Long Range Transportation Plan (LRTP).

Ridership Summary by Route

The model run comparing transit ridership in No Build vs. TSM alternatives by route shows the overall system ridership is projected to grow from approximately 45,000 transit trips in 2010 to 60,000 riders under 2035 No-Build and 80,000 transit trips under 2035 TSM*. Forecasted trip tables by route are included in the appendix of this report.

Upon closer review of the ridership projections for each individual route, the following trends are noted:

2010 to 2035 No Build

- Majority of increased FAX ridership is due to the new Blackstone – Kings Canyon BRT service.
- Of the remaining FAX routes, 1/3 of routes will experience growth in ridership, 1/3 will decrease, and 1/3 will remain stagnant.
- All Clovis transit routes experience ridership increases.
- The FCRTA Coalinga to Fresno line experiences a ten-fold ridership increase (20 to 240 riders).
-

2035 No Build to 2035 TSM

- 7 existing FAX routes experience growth between No Build and TSM with a similar number of routes projected to remain stagnant
- 4 existing FAX routes will see decreased ridership
- The four new FAX routes have ridership ranging between 1,500 and 4,000 riders each
- All Clovis transit routes, except Route 60, will have decreased ridership due to the growing affluence of the area and a non-connecting transit system.
- FCRTA ridership will remain stagnant except for the four new express routes.

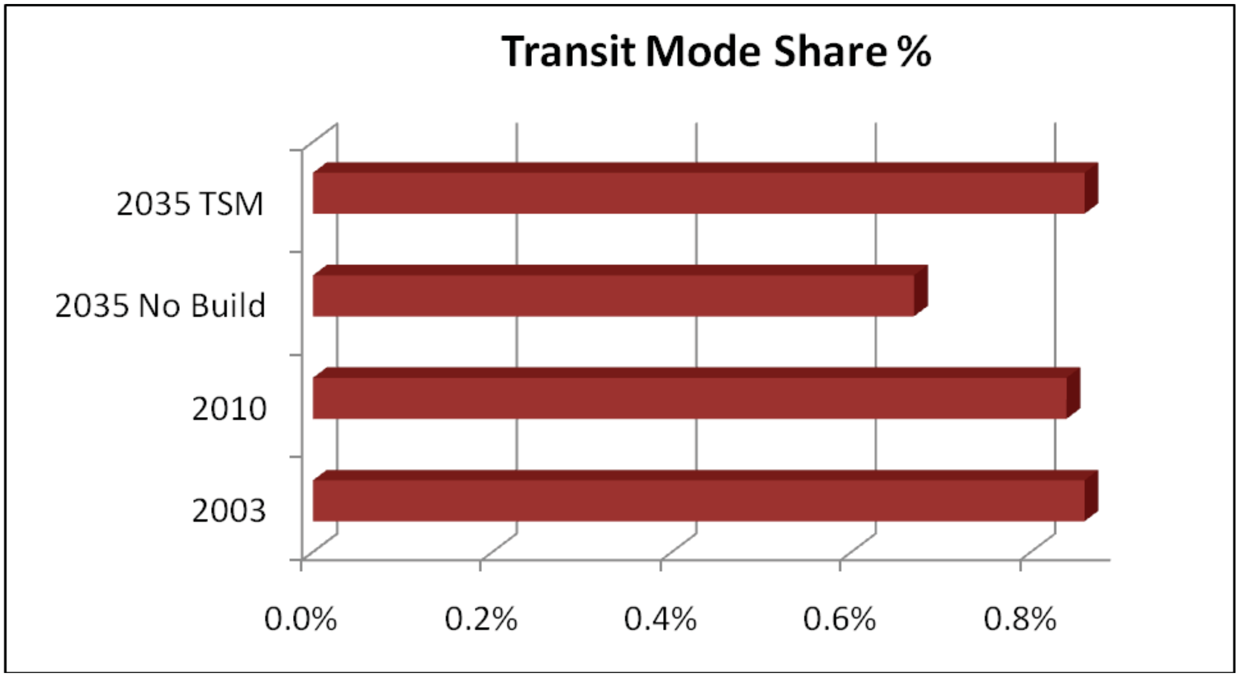
No Build and TSM Performance Indicators

Performance indicators were generated from the COG transportation model for the 2010, 2035 No Build, and 2035 TSM scenarios. The table of performance indicators can be found in the appendix of this report, and are summarized in the graphics below. Upon closer review of the ridership projections for each individual route, the following trends are noted:

2010 to 2035 No Build

- Substantial growth in Vehicle Miles of Travel (VMT), Person Miles of Travel, Vehicle Hours of Travel and Delay.
- Similar substantial increases for Total Auto (work and non-work) trips and Total Walk/Bike Trips.
- Transit mode share continues to decline as a percentage of total trips taken in spite of $440 million dollars of planned investment in transit infrastructure and services, largely as a result of the low-density planned expansion of growth to the urban fringe.

Figure 12: No Build to TSM Change in Transit Mode Share

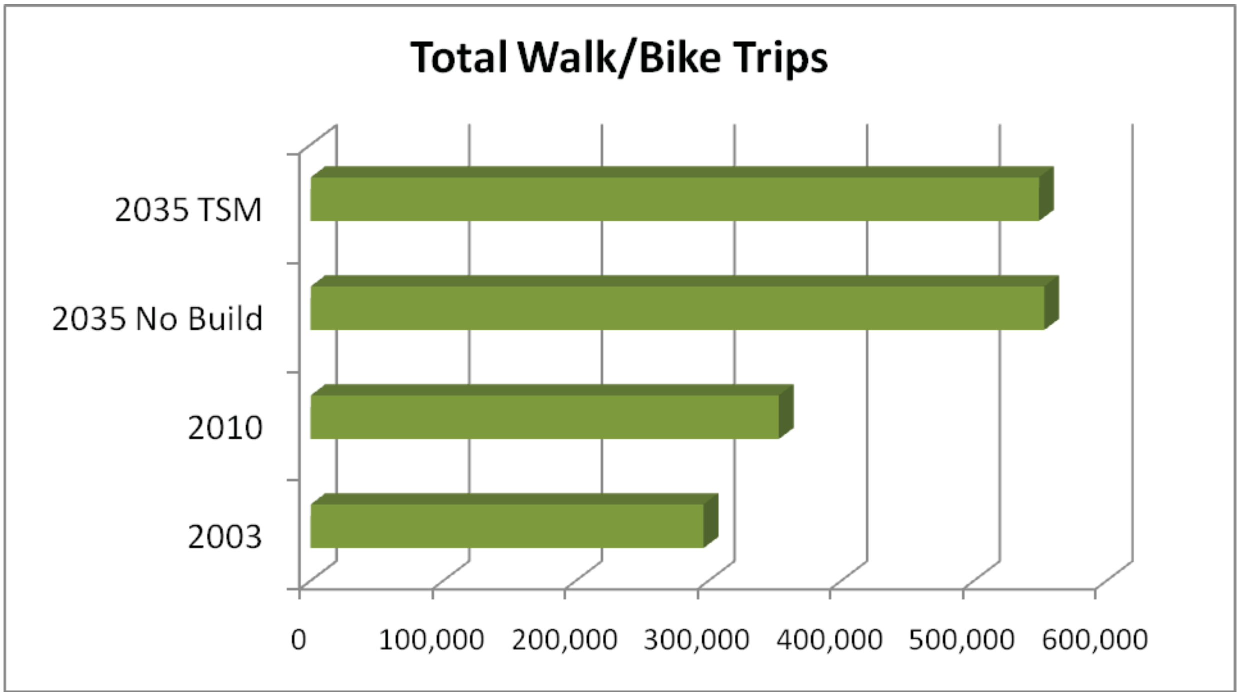


Source: Kimley-Horn and Associates, Inc.
Note: There was a change of less than 1% in total auto trips after investing $440 million in transit improvements.

2035 No Build to 2035 TSM

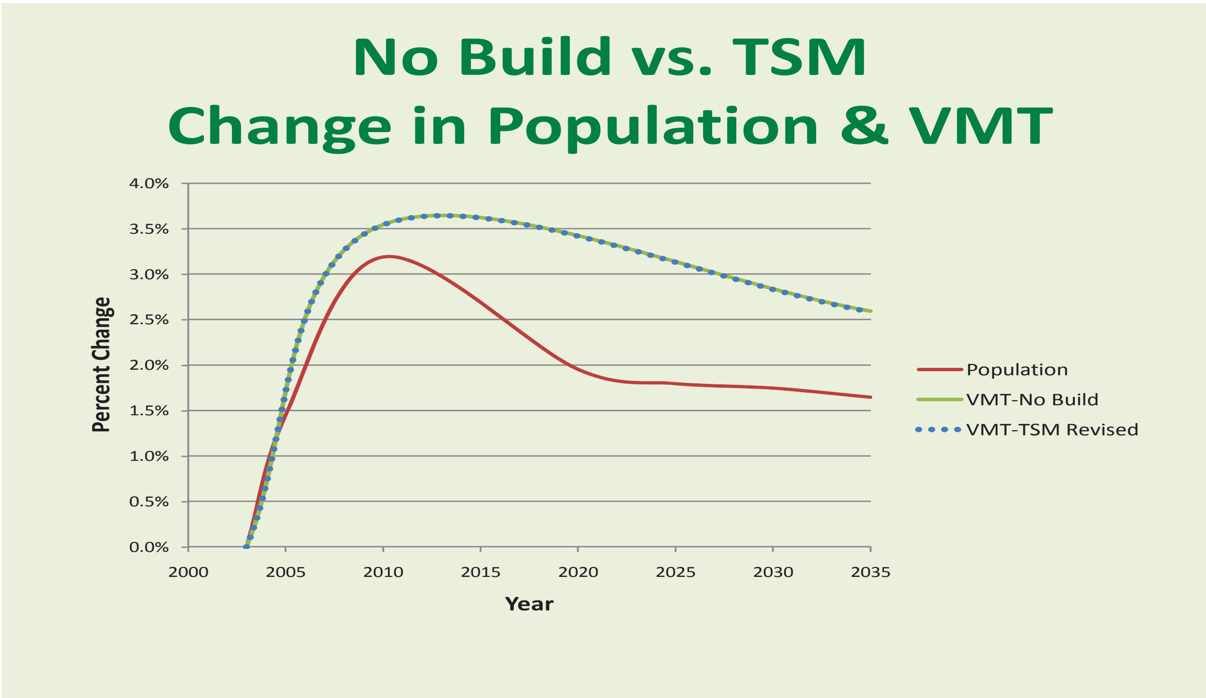
- Slight decreases in non-transit performance indicators and Total Auto Trips.
- Slight decrease in walk/bike trips and the mode share of walk/bike trips also declines.
- Over 25% increase in total transit trips, but transit market share continues to decline due to low density suburban growth in the outlying areas where transit services cannot be effectively expanded.

Figure 13: No Build to TSM Change in Walk and Bike Trips



Source: Kimley-Horn and Associates, Inc.
Note: There is a less than 1% change in total walk and bike trips between he No Build and TSM Alternatives.

Figure 14: No Build vs TSM Change in Population and VMT



Source: Kimley–Horn and Associates, Inc.

Comparing the No Build to the TSM Scenario, we find that VMT doubles from 18 million miles in 2003 to 37 million miles in 2035. VMT Grows at the same rate as the population under the current land use scenario. However, shown as a percent change by year over time, VMT grows at a faster rate than the population.

No Build to TSM Conclusions

The following concluding remarks are drawn from the results of the ridership projections and from the performance indicators:

- A majority of the new ridership growth is attributed to the Blackstone-Kings Canyon BRT service under 2035 No Build scenario
- VMT is not projected to substantially decrease under 2035 TSM suggesting that transit is not an attractive option to driving.
- Additional investments in transit improvement/packages beyond TSM Alternative would likely yield minimal increases in ridership or mode split (assuming no changes in FCOG 2035 land use)
- TSM Alternative improvements are needed to maintain existing 2003 mode split
- Although transit trips are increasing between the study scenarios, this suggests the growth is due to extensions of existing routes or new routes
- The number of transit riders to rural Fresno communities is very small thus resulting in a high cost/rider ratio.
- The increase of just over 500 riders on the FCRTA rural transit service between 2010 and 2035 indicates the growth in demand is linked to overall slow growth in the rural areas and can likely be handled with the existing number of vehicles and service levels.

4.4 The Land Use/Transportation Scenarios

The three landuse scenarios were merged with the COG travel model to estimate how well the transit network would perform under the different landuse densities. Each future land use scenario explores the impacts of higher density assumptions on transit use and bicycle/pedestrian trips. The initial scenario is evaluated under the current COG trend land use scenario, assuming Fresno continues to grow into the future as it did in the past. This growth pattern is characterized by lower density suburban growth that encroaches into the “area of influence” or the urban growth boundary. Subsequently, the build alternatives will be evaluated under higher density, transit-focused alternative land use scenarios identified as “COG Trend” (or the virtual future), “Constrained TOD” and the most aggressive “Full Build-Out TOD”.

Chapter 6 describes the transportation indicators from three landuse/density scenarios in illustrates the high capacity transit network that forms the basis of the high capacity TOD greater detail. The three scenarios are designed to answer the question:

Scenario Building Process

The scenario building process begins with the creation of prototype buildings. The buildings are modeled using existing and projected data for the Fresno area. Inputs include; unit size, land costs, building uses, parking ratio, rent and sales prices and construction costs. The outputs are the return on investments. A collection of buildings are assembled to create a development type or “place”. A “place” is created by a variety of buildings, a percentage of streets and the amenities that make up places people live, work and play. Scenario builder is used to paint the development types on a map to design several possible future land use scenarios to test the implications of different decisions or policies. The outputs of the “painted” map are evaluated in a spreadsheet. Evaluation criteria include: density and mix of uses, transportation mode choice, and housing mix and affordability.

> “What effect does development density and mix of housing and employment have on people’s travel behavior in specific transit corridors and downtown?”

4.5 Transit Network for the Three Alternatives

All three future land use alternatives assume the same future transit network has been built, as described below and illustrated in Figure16 " Future High Capacity Transit Corridors". The initial "Build" transit network builds upon the projects and improvements already identified in the TSM and the No Build Alternatives and contains the following transit improvements:

1) BRT is implemented on Shaw Avenue with a new Transit Center/Park & Ride Lot at the intersection with Highway 99 North at the west end. This system extends up Hwy 168 on the east end terminating near downtown Clovis. A transfer center is located at CSU Fresno.

2) An extension of BRT on Kings Canyon Road to the planned Southeast Growth Area (SEGA) transit center in the Constrained TOD Scenario, but it stops at Clovis Avenue in the Full Build Out Scenario (because SEGA is assumed not to exist).

3) It is assumed that high speed rail is approved and operating by the year 2035. The planned High Speed Rail station is located west of H Street along the Union Pacific Railroad corridor. (See Figure 11 below)

4) BRT on Blackstone and Kings Canyon is extended downtown to interface with the planned High Speed Rail station.

5) A streetcar system comprised of two alignments is added downtown replacing the former circulator trolley downtown. Figure _ below illustrates the preferred streetcar alignments for downtown. Preferred streetcar routes are: 1) Fulton or Van Ness through downtown, connecting to the Tower District and Fresno City College See details of the streetcar analysis in the separate Feasibility Study for the Downtown Fresno Streetcar in the appendix of this document; and 2) Fresno Street from Chinatown to San Joaquin High School, with connections to high speed rail and the regional hospital.

6) By the year 2025 or 2030 it is assumed that sufficient population and job density have been achieved in the high capacity transit corridors to justify upgrading transit service on Ventura/Kinds Canyon and Blackstone Avenue from BRT to LRT.

**The 45,000, 60,000, and 80,000 numbers represent the number of trips using transit each day to get from an origin to a destination. Many of these trips use more than one transit vehicle (due to transfers) so the ridership (total boardings) number is always higher than the person trip number.*

Figure 15: Future High Capacity Transit Corridor Recommendations

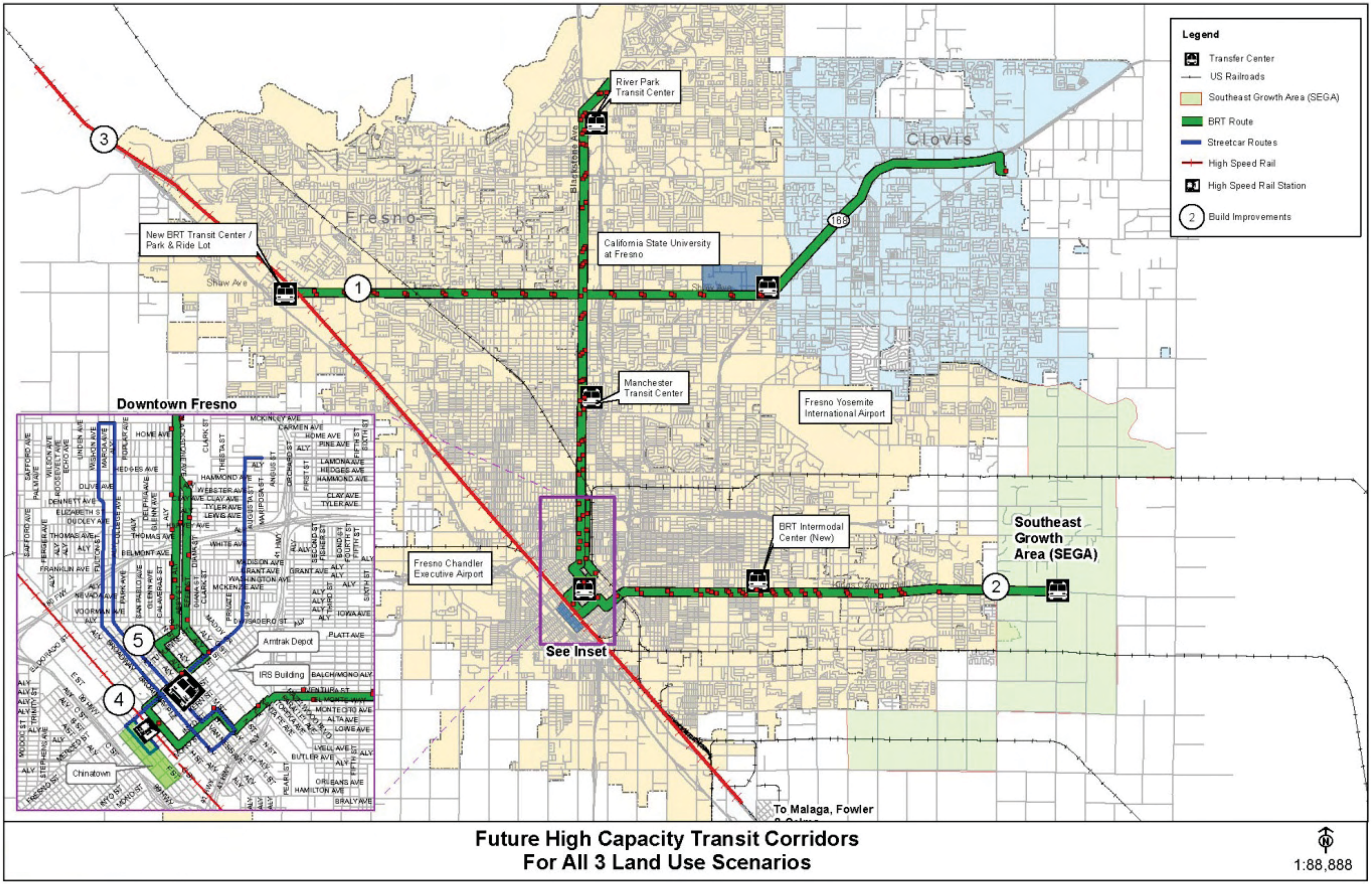


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Figure 16: Proposed Downtown Fresno Streetcar Alignments

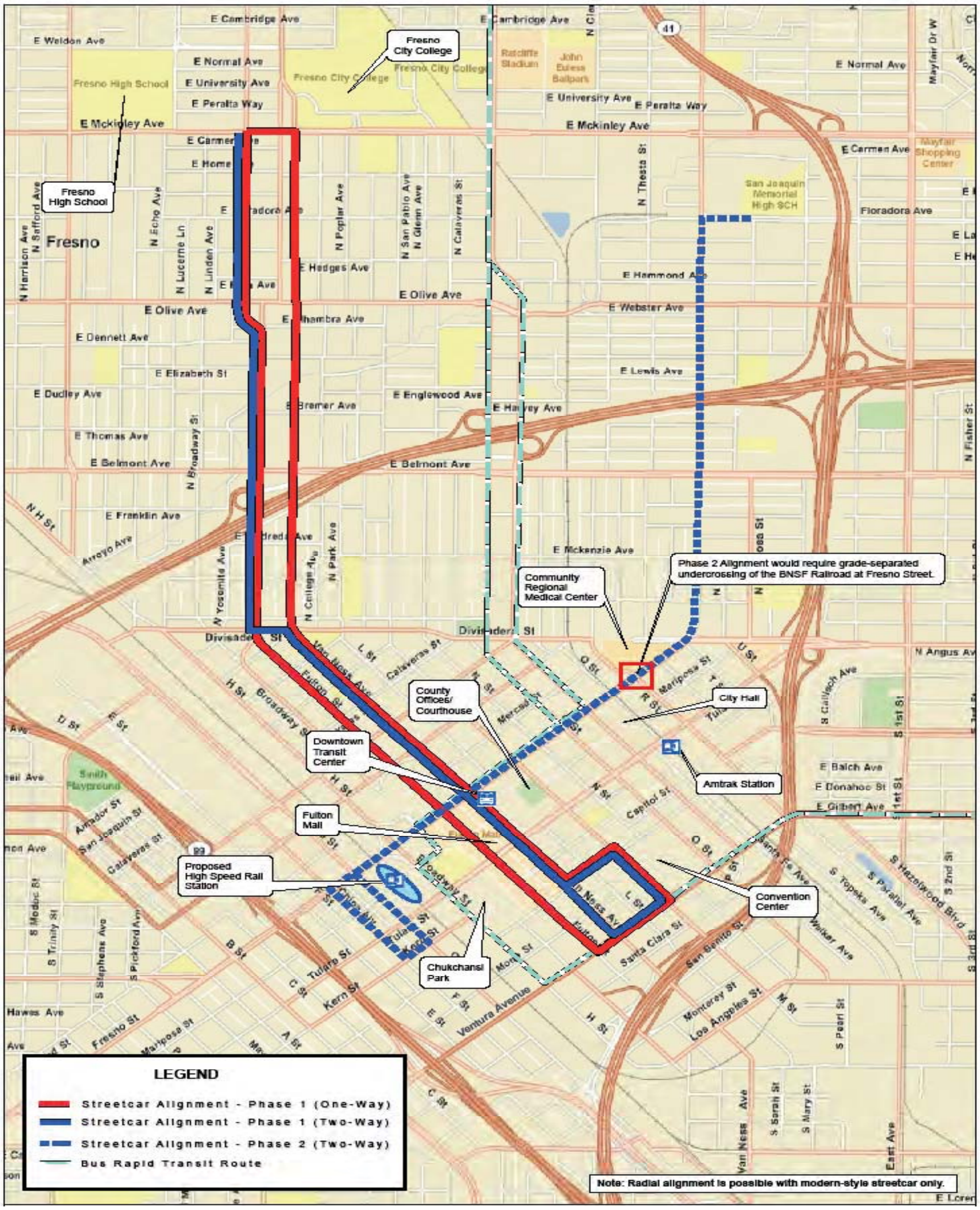

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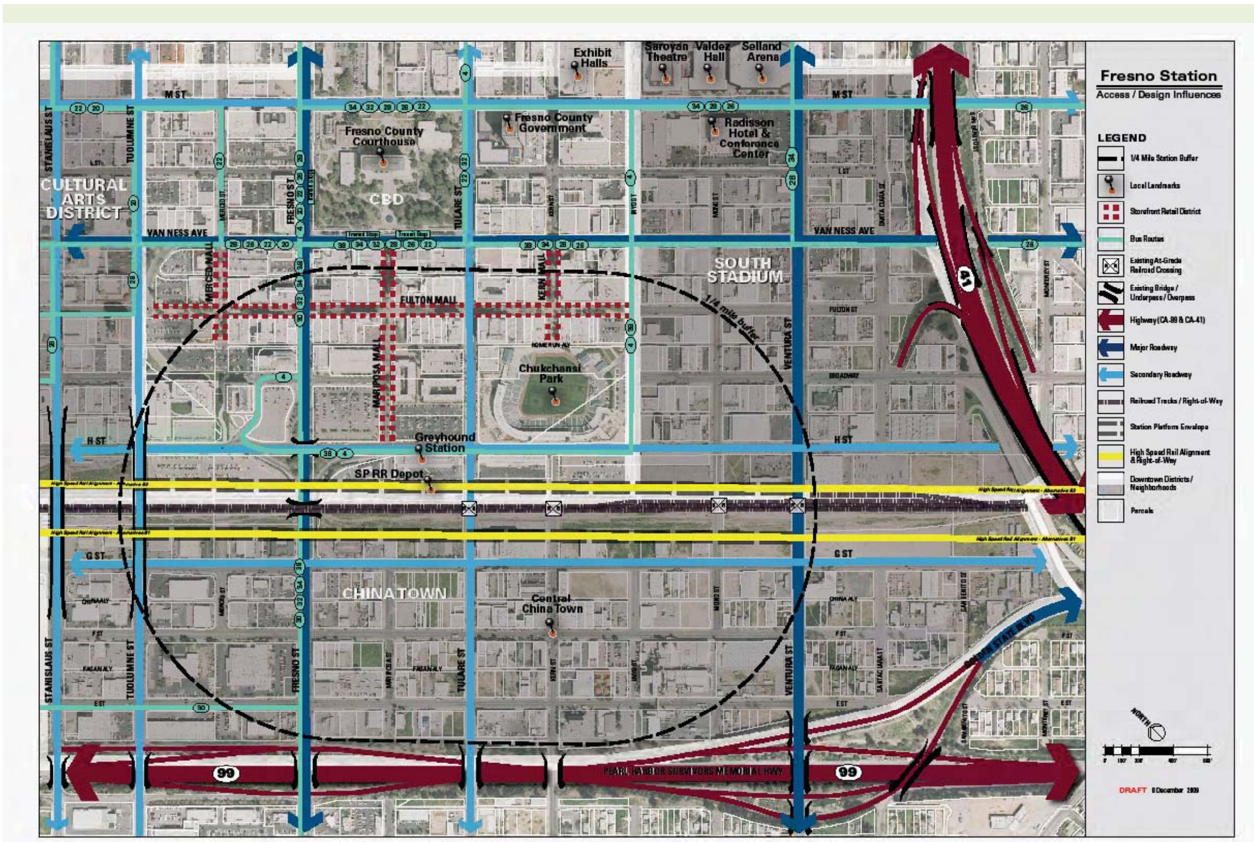
Figure 17: Location of the planned High Speed Rail Station



Map Source: California High Speed Rail Authority

Proposition 1A, approved by California voters in November of 2008 is a bond measure to help fund a 200mph high speed rail line that will connect Los Angeles and San Francisco through the Central Valley with a station in Fresno. Proponents of the project expect new, high density developments will be built adjacent to the stations, which will be a catalyst for development in downtown Fresno. The train system is expected to be completed in 2030.

5.0 Land Use Alternatives Analysis

Developing alternatives for Fresno's Transit Investments begins with an analysis of the land use densities and destinations that shape regional travel patterns. Existing high demand travel corridors are forecast to become very high demand travel corridors in the future. With the right kind of land use planning these future travel corridors could be developed as transit-supportive corridors, supported by well planned environments where walking or riding a bicycle become preferred options for more trips.

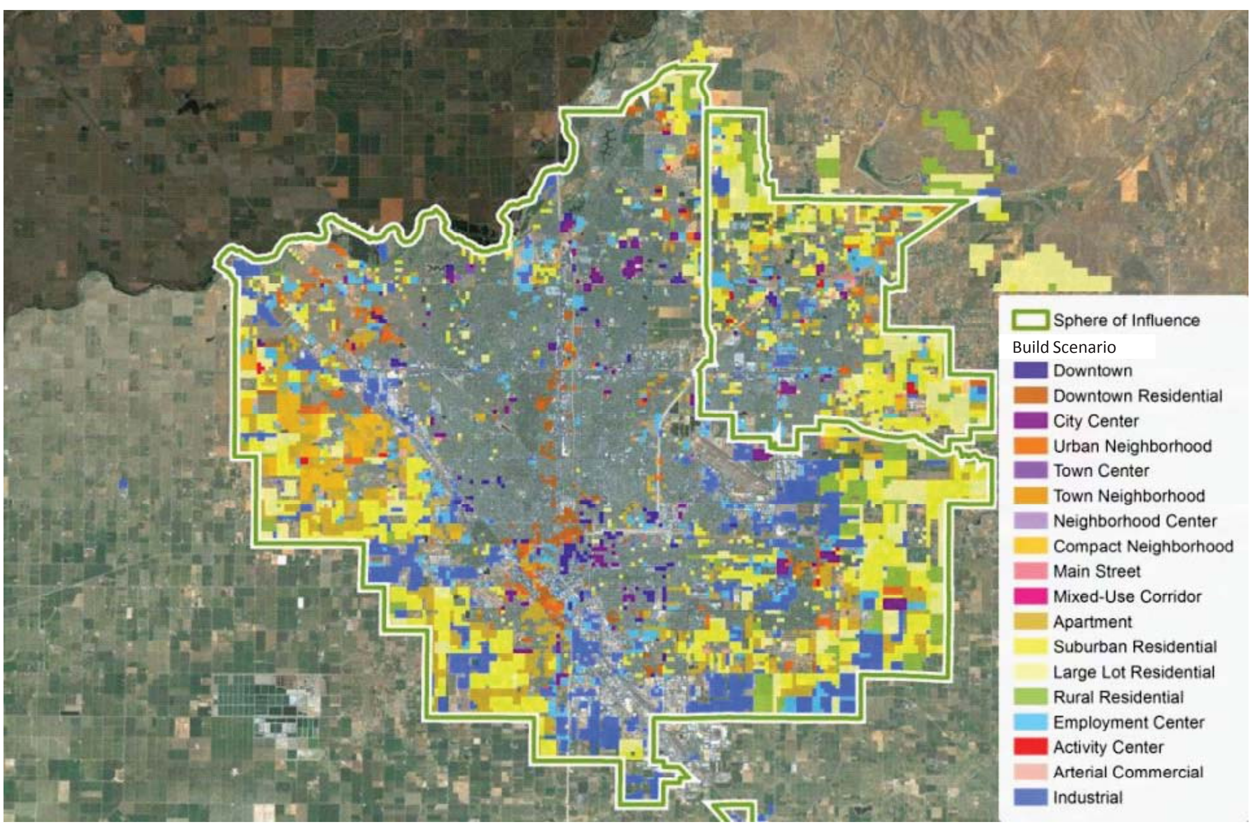
Analysis of existing and forecast land use densities reveals that significant changes in zoning and development densities will need to occur in order to concentrate development in specific corridors to support future high-capacity transit investments. Depending on the amount of development density and mix that can be attracted to the transit corridors, both bus rapid transit and light rail transit may be feasible in twenty years.

The Fresno Council of Governments recently updated their travel model to predict changes in travel patterns and behavior as a function of land use plans in future years. In travel demand modeling, future growth patterns become an extrapolation of current growth patterns. Growth predictions are a useful tool in planning future transportation investments and services. The figure below illustrates the COG's growth forcast for 2030. New residential growth as shown by the yellow coloring is anticipated south and west of Highway 99 in Fresno. Clovis and the north east areas are also expected to continue their strong growth patterns. A cluster of new development in the South East Growth Area (SEGA) also appears in the model by the year 2035. These new growth areas currently have no transit service and the ever-increasing expansion of low-density development on the urban fringes makes providing transit service to these areas increasingly inefficient and unsustainable.

5.1 The Build Land Use Scenario - 2035

The first Build Scenario (also called COG Trend Forecast) assumes that Fresno continues to grow in the future as it has in the past (according to the adopted COG land use plan), out to the year 2035. The Build Scenario assumes 38% of new population growth is absorbed into the three BRT corridors and downtown. Residential, low density single family homes are built out on the urban fringes consuming valuable farmland and requiring the outward expansion of roads, utilities, schools and municipal services to support this growth. There is some mixed use development but no clustering of this kind of growth, and some redevelopment of downtown, but not at significant changes in existing density.

Figure 18: Build Scenario 2035 Land Use



Source: Fregonese and Associates

Growth Assumptions for the Build Scenario

- 38% of new growth is located in the BRT corridors and downtown
- 9% of new housing units are in mixed-use buildings
- 23% of jobs are in mixed-use building
- Mixed-use buildings in the scenario include:
  - 5-story, 4 story and 3 story retail/residential
  - 4 story retail/office
  - 10 story mixed use office
  - Main street commercial

COG Forecast Model Population for the Build Scenario: 236,869 in the ½ mile walk zone around the BRT corridors and 600,974 people in the 1 ½ mile bicycle shed around the BRT corridors. Development density for the is increased to 9.22 du/ac in the 1 mile wide corridor on either side of the transit line. The Growth Scenario absorbs 38% of the new growth coming to Fresno County by the year 2035.

The modeled results for the Build Scenario shows the Countywide automobile mode share for all trips is 91.36%, with a 0.93% transit mode share and a 7.71% combined mode share for bicycle and walk trips. In the approximate one mile wide TOD corridors for the 3 BRT alignments, the mode splits remain virtually unchanged from No Build to the Build Scenario: the automobile mode share is 89.6%, the transit mode share is 1.7%, bicycle trips are 0.82% and walk trips are at 7.89%

5.2 The Constrained TOD Scenario

The population totals are held constant in each of the future growth scenarios to illustrate how changes in population density can influence mode choice and travel behavior in identified high-growth corridors that can be well-served by transit. New growth in housing and jobs is moved to the transit corridors to illustrate the effectiveness of the TOD growth strategy on trip reduction and the shift to transit, walking and bicycling in the ½ mile "walk shed" and the 1 mile "bike shed" around the transit corridor..

The Constrained TOD Scenario was modeled two ways, one showing trips by mode with a shared BRT lane and the other with a dedicated lane for BRT (or future light rail). The shift in transit, bike and ped mode shares in the exclusive BRT lanes scenario made the difference of only +0.05%, and was not statistically significant. The percentages given for this scenario use the figures for BRT in dedicated rights of way.

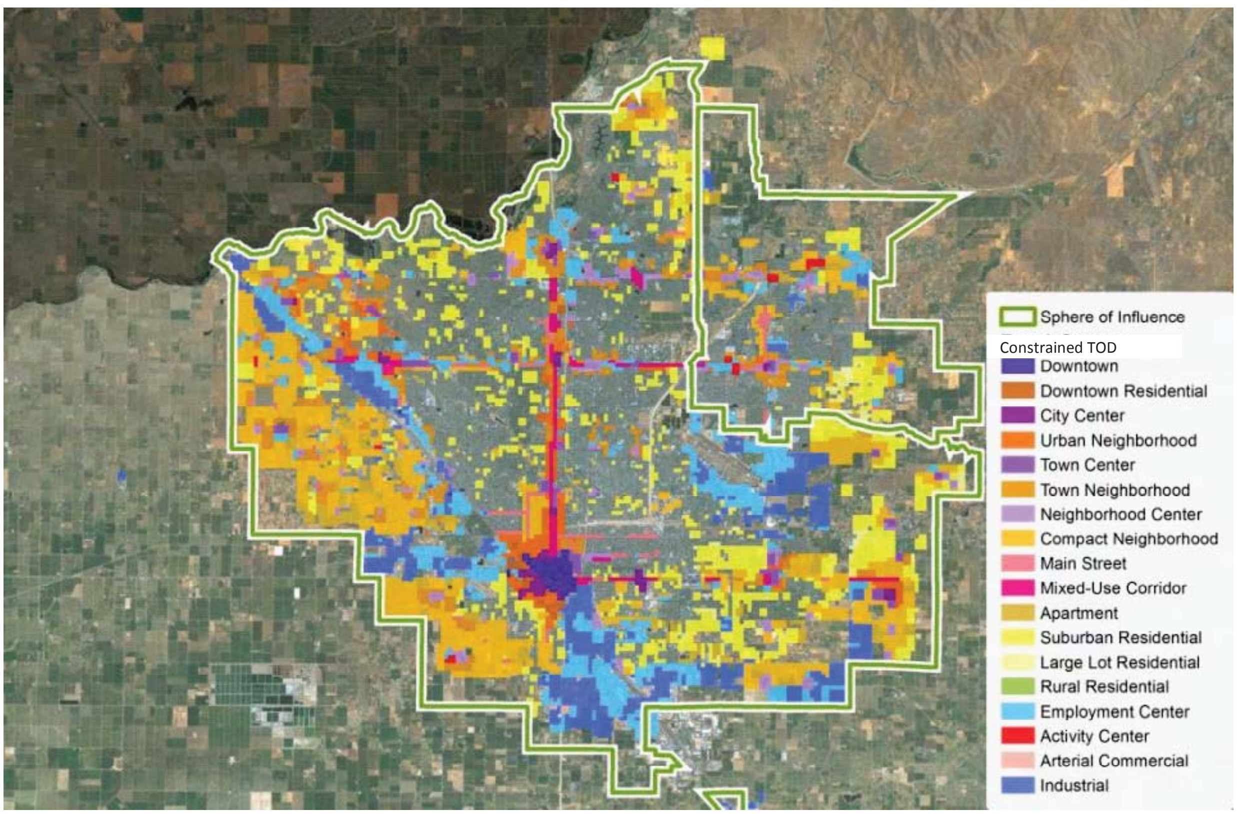
The Constrained TOD Scenario is based on the same transit network developed for the Build Scenario (with BRT on Blackstone, Ventura/Kings Canyon and Shaw Avenue going up Highway 168 to Clovis). The Constrained TOD Scenario assumes 42% of the new population growth is absorbed into the three BRT corridors and downtown. Population densities and employment in mixed use buildings are moved to the BRT corridors in the land use model to illustrate a conservative approach to transit oriented development in Fresno.

Table 7: Comparing Land Use Scenarios

	COG Trends	Constrained TOD	Aggressive TOD
% of new growth	38%	42%	52%
Density in 1 mile	9.2 du/ac	12.32 du/ac	14.85 du/ac
Transit Mode Share of all trips for region	.93%	1.22%	1.45%
Transit Mode Share for all trips 1 mile corridors	1.7%	2.3%	2.5%
Transit Share to work on BRT Corridors	5.65%	7.64%	8.51%
GHG Reductions*	0–2%	6%	8%

Source: Fresno COG staff

Figure 19: The Constrained TOD Land Use Scenario- 2035



Source: Fregonese and Associates

Growth Assumptions for the Constrained TOD Scenario

The constraints assumed by the Constrained TOD Scenario are 1) that the market demand for TOD housing in the future is limited by the same income and household makeup constraints that exist in Fresno now and 2) that the Southeast Growth Initiative (SEGA) is built on the urban fringe.

- 42% of the new population growth will move to the BRT corridors and downtown
- 18% of new housing units are in mixed-use buildings
- 37% of jobs are in mixed-use buildings
- Mixed-use buildings in the scenario include:
  - 5-story, 4 story and 3 story retail/residential
  - 4 story retail/office
  - 10 story mixed use office
  - Main street commercial

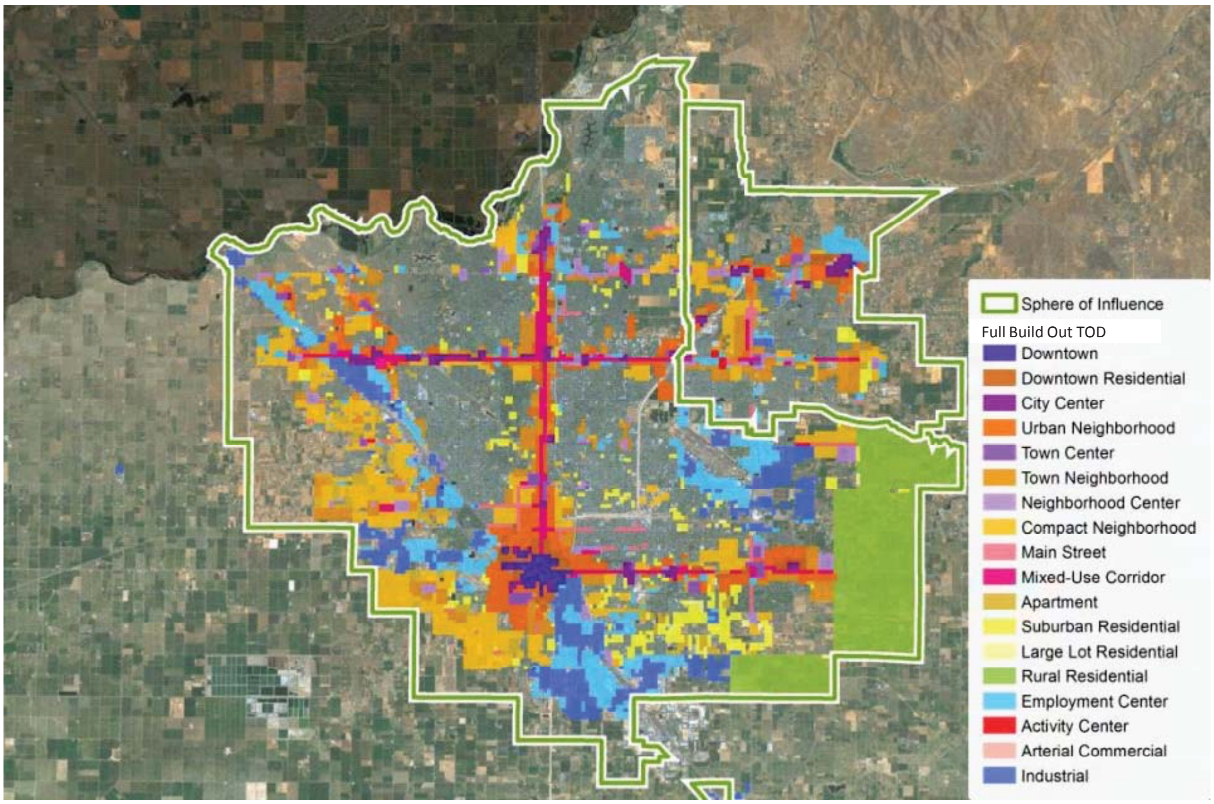
Constrained TOD Population: 317,203 people in the ½ mile walk shed of the BRT corridors and 689,508 people within the 1 ½ mile bicycle shed of the BRT corridors. Constrained TOD density is increased to 10.58 du/ac in the 1 mile wide area either side of the transit corridors. The Constrained TOD Scenario absorbs 43% of the population growth coming to Fresno County by the year 2035.

Comparing the No Build to the Constrained TOD Scenario, the transit mode share for all trips in the BRT corridors increases from 1.21% in to 2.3%. The bike trips decrease slightly from 0.86% to .81% as some bike trips are shifted to transit and the walk trips increase from 8% to 8.88%. The automobile mode split has decreased only 2% - from 89.93% to 88.0%.

5.3 The Full Build-Out TOD Scenario

In the Full Build Out TOD Scenario, the restrictions placed on growth and density in the Constrained TOD Scenario are removed. The BRT Corridors and downtown are built up with as much growth in dwelling units and employment as possible, absorbing 52% of the new population growth into the three BRT corridors and downtown. Our planning experts felt that going beyond this level of development in terms of total growth and density levels could not be supported. In this scenario, SEGA no longer exists and all of SEGA's forecast residential and employment development is moved to the three BRT corridors and a planned employment center in north Clovis at Highway 168. The Bus Rapid Transit line on Kings Canyon now stops at Clovis Avenue, 2.5 miles short of the planned transit terminus in the middle of SEGA at the intersection with North Locan.

Figure 20: The Full Build-Out TOD Land Use Scenario- 2035



Source: Fregonese and Associates

Growth Assumptions for the Full Build-Out TOD Scenario

- 52% of new growth moves to the BRT Corridors and downtown
- 27% of new housing units are in mixed-use buildings
- 43% of jobs are in mixed-use buildings
- Mixed-use buildings in the scenario include:
  - 5-story, 4 story and 3 story retail/residential
  - 4 story retail/office
  - 10 story mixed use office
  - Main street commercial

Full Build-Out TOD Population: 398,414 people within the ½ mile walk shed of the BRT corridors and 782,009 people within the 1 ½ mile walk shed of the transit corridors. Density is 14.85 du/ac in the 1 mile wide corridors.

Comparing the No Build to the Full Build-Out TOD Scenario, the transit mode share for all trips in the BRT corridors increases from 1.21% in to 2.48%. The bike trips decrease slightly from 0.86% to .84% and the walk trips increase from 8% to 9.73%. The automobile mode split has decreased from 89.93% to 86.95%.

5.4 Comparing the Scenarios

Table 8: Comparing Densities in the BRT Corridors

Existing	Density	in BRT	Corridors	Total	Housing	and Jobs
	.25 Mile	.5 Mile	1.5 Mile	.25 Mile	.5 Mile	1.5 Mile
Housing Units per Residential Zoned Acre	9.48	8.20	7.41			
Housing Units per Acre	2.25	2.38	2.15	22,726	47,806	132,161
Employment per Acre	6.25	5.41	2.83	63,138	108,678	174,131
Build Scenario				Total Count		
	.25 Mile	.5 Mile	1.5 Mile	.25 Mile	.5 Mile	1.5 Mile
Housing Units per Residential Zoned Acre	13.81	11.77	10.59			
Housing Units per Acre	3.28	3.42	3.07	33,117	68,654	188,919
Employment per Acre	8.16	7.25	4.20	82,509	145,597	258,262
Constrained TOD Scenario				Total Count		
	.25 Mile	.5 Mile	1.5 Mile	.25 Mile	.5 Mile	1.5 Mile
Housing Units per Residential Zoned Acre	21.60	15.81	12.32			
Housing Units per Acre	5.12	4.59	3.57	51,801	92,190	219,748
Employment per Acre	11.97	9.29	4.70	120,973	186,489	289,528
Full Buildout TOD Scenario				Total Count		
	.25 Mile	.5 Mile	1.5 Mile	.25 Mile	.5 Mile	1.5 Mile
Housing Units per Residential Zoned Acre	36.16	23.52	14.85			
Housing Units per Acre	8.58	6.83	4.30	86,708	137,196	264,908
Employment per Acre	14.97	11.03	5.32	151,336	221,487	327,390

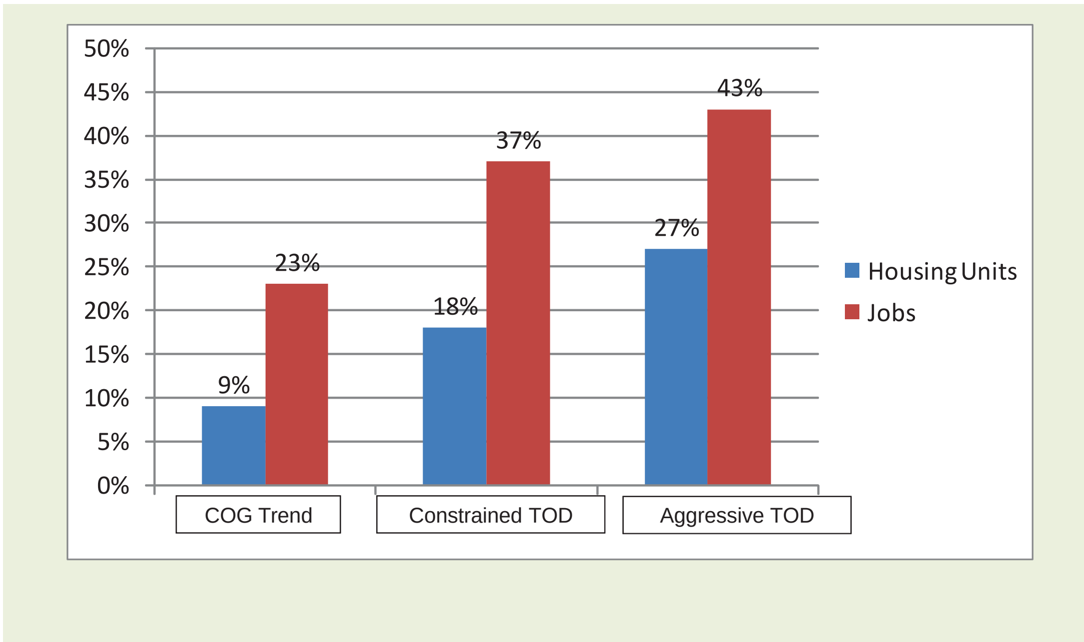
Source: Fregonese and Associates

Population density in the BRT corridors and downtown increases significantly as the scenarios build from the existing growth patterns of the virtual future (or Build Scenario) to the kinds of densities that would support a high-capacity transit investment. The growth scenarios increase housing units per acre from 68,654 units in the Build Scenario to a high of 137,196 in ½ mile walk shed in the Full Build-Out TOD Scenario. To keep things in perspective it is important to note that these population numbers represent only 1.7% to 2.3% of Fresno County's population total expected in the year 2035. Accordingly, it will be important to judge the impact of this small shift in development density relative to the development patterns that exist in most of Fresno County and have existed over the past 100 years.

When we evaluate the BRT corridors as new growth areas with a potential to make a difference in a defined area the differences in population and employment are quite dramatic compared with the baseline population in the corridors of 178,940 people. Of the 527,403 new residents that are expected to come to Fresno County, the Build Scenario would house 38% of them; the Constrained TOD Scenario would house 43%; and the Full Build-Out TOD Scenario would house 52% of the new residents. Residential densities triple from the current 8.2 du/ac to 23.52 du/ac in the ½ mile walk shed zone.

Increasing the Density and Mix of Uses

Figure 21: Percentage of housing units and jobs in mixed-use buildings



Source: Fregonese and Associates

Across the three scenarios, housing is increased from 9% of the mix to 27% of the mix, while jobs are increased from 23% to 43% of the development mix. Increasing the mix of land uses in higher density development has a significant impact on mode choice in a corridor. With origins and destinations in close proximity, many more trips can be made by walking, bicycling, and taking transit. As a result of increasing density and mix of uses in the BRT corridors, comparing the No Build to the Full Build Out TOD Scenario, the transit mode share increases 105%, walk trips increase 21.63% and bicycle trips actually decline by 2.3% as transit attractiveness replaces trips that used to be taken by bicycle in the transit corridors.

6.0 Forecast Demand for TOD-Style Development

A focused market analysis for Transit Oriented Development -style housing in Fresno identified a market demand deficit for TOD projects due to Fresno's unique demographics. Compared to the State of California and the United States as a whole, Fresno has a much higher share of family households with children. Fresno County households tend to earn lower median incomes on average, and are less likely to live alone. These demographic characteristics do not generate a significant share of conventional demand for TOD.

It is estimated the demand for TOD-type housing in Fresno County is only 14% of the total demand for new housing, compared to 25% share reported at the national level. This represents about 73,000 of the total 520,000 households forecast by 2035. Of that total, it is estimated that only 40% of those TOD households (29,200 households in 2035 and

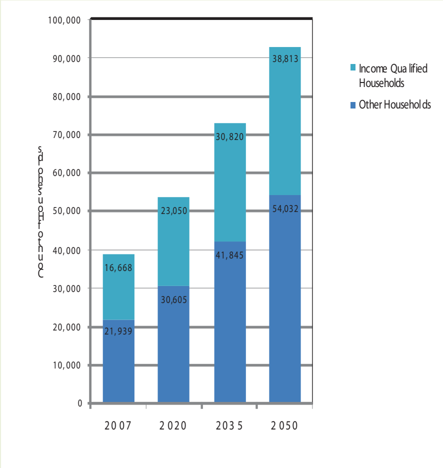
39,000 households in 2050) will be able to afford new built, market-based units. The remaining 54,000 units in 2050 will need to be rehabilitation of existing housing, warehouse conversions and subsidized housing for lower income families.

While the Fresno market has an abundance of affordable single family products but not many choices for mixed use or multifamily housing. As new employers enter the market and wages increase, the new housing products will become more desirable, improving the profitability to developers. Even in regions with a larger concentration of young professionals – such as San Francisco – developers will tend to build only to the highest end of the market when possible.

Figure 22: Market-rate multi-family housing likely to be targeted to higher income households

Only 40% of TOD households (30,000 in 2035) can afford newly built, market-rate higher density units.

Demand for Multifamily Units by Income



Source: US Census ACS 2005-2007; California Department of Finance, 2010; Strategic Economics

Source: Strategic Economics

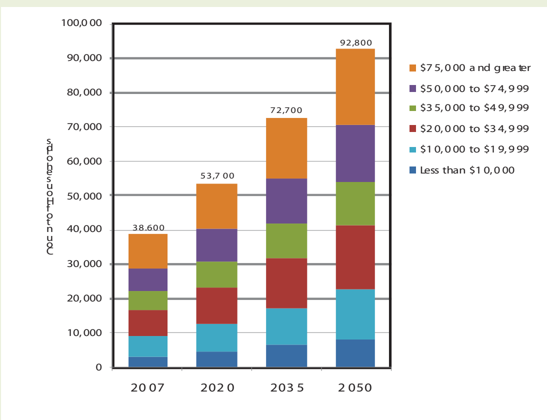
With this very limited demand for TOD-style housing in the Fresno market, the cities of Clovis and Fresno first focus on enhancing their existing job centers, and concentrating any future market momentum for TOD and transit-supportive jobs in these existing areas which are more central to the existing and proposed regional transit network (i.e. in downtown Fresno, Clovis and the planned BRT corridors on Blackstone and Kings Canyon/Ventura, and then on Shaw Avenue to CSU Fresno in the future).

6.1 TOD Building Types to Support Transit

In order to support a robust transit system, new building and development types will be required. Mixed use buildings

Figure 23: TOD Demand by Income

60% of TOD demand (43,000 units in 2035) is from households with low and very low incomes.



Source: US Census ACS 2005-2007; California Department of Finance, 2010; Strategic Economics, 2010

Source: Strategic Economics

become commonplace along transit corridors. Downtown development types are made up of some residential towers, mixed use high rise condos and a number of mixed use four- story buildings. Three and four story mixed use residential and office and retail buildings will characterize the corridors. The development types described in the scenarios are both types that are seen on the ground presently in Fresno and new types that will become more common in a transit supportive future.

Rates of redevelopment range from zero percent for large lot residential types to 50 percent for downtown. Downtown and urban development types are generally higher profit projects and these areas have more demand for change; therefore have a greater chance of redevelopment. Stable large lot residential areas on the other hand are unlikely to redevelop.

Figures 24: Examples of Lower Density Housing and Offices

Adjacent to the transit corridors will be supporting compact neighborhoods. Infill single family homes, townhomes and

Creating inviting places for the pedestrian

New small scale mixed–use development

Townhomes are suitable for Fresno

Densities are in the 15–30 units per acre range

Photos courtesy of Fregonese and Associates

duplexes, cottage homes and some apartments will make up these neighborhoods. The market in Fresno will need to be different in the future to support these building types. For instance, Strategic Economics research shows that multifamily are the most costly per unit. For these transit supportive units to be affordable they will either need to be subsidized or the market will need to shift in large part to support higher paying jobs.

The development types that are familiar to Fresno today but that will not support transit in the future are; suburban

Kimley-Horn and Associates, Inc.

residential, large lot residential, rural residential, activity center, and arterial commercial. The recommended development types that will support transit and introduce some new land uses to Fresno are; **downtown, downtown residential, city center, urban neighborhood, town center, town neighborhood, neighborhood center, compact neighborhood, main street, and mixed use corridor.** The transit supportive scenario uses these new development types, often redeveloping areas that are currently not transit supportive. These development types meet the recognized minimum density of 12 units per acre needed to support bus rapid transit. The average minimum density of 12 du/acre needed to support the BRT investment would be achieved by zoning for a range of densities from 9 du/ac to 21 du/ac or more along the BRT corridors and downtown. The higher densities should be located within ¼ mile of the BRT line and stations. Lower densities could be located farther out – ½ mile to 1 mile walking distance. The development types have a mix of buildings in them that not only encourages transit use but also alternative transportation modes such as walking and biking to reduce the reliance on automobile travel, and as a result greenhouse gas emissions.

Figure 25: Examples of Medium Density Housing and Offices

	
Medium density mixed use.	*Retail on the ground floor, condos above.*

Photos courtesy of Fregonese and Associates

Kimley-Horn and Associates, Inc.

6.2 Fresno's Future Land Use Vision

The land use future vision anticipates that there will be both changes in resident's behavior and changes in land use. A significant portion of projected growth for the county will shift from new undeveloped areas inward to already developed areas. Much of that growth will concentrate in a one mile buffer on either side of transit corridors. The half mile closest to the corridor will consist of denser buildings, including mixed use. In the half mile further from the corridor an increasingly compact neighborhood will evolve. All the neighborhoods in between transit corridors will also experience changes, as vacant and underutilized lots redevelop into higher more intense uses. New buildings will be required to provide less parking, resulting in a drastic reduction of surface parking lots in Fresno. Buildings will front transit corridors and pedestrians will not have to traverse a parking lot between the sidewalk and the building entrance. As inner Fresno City neighborhoods and transit corridors transform they will be increasingly more desirable places to locate. Amenities will be a short walk, bike ride or transit ride away. The transit supportive scenario will accommodate all of the forecasted growth for the region, however, the housing choices will be different and more diverse and the growth will be more concentrated.

Figure 26: Examples of Higher Density Housing and Offices for a Downtown

High-rise office building

High density mixed use.

Photos courtesy of Fregonese and Associates