



**3 ADDITIONS OR DELETIONS FROM AGENDA / ADDITIONAL DOCUMENTATION TO SUPPORT EXISTING AGENDA ITEMS COMMITTEE**

Hearing none, the meeting continued to the next agenda item.

**4 ORAL AND WRITTEN COMMUNICATIONS TO THE CAPITAL PROJECTS STANDING COMMITTEE**

Hearing none, the meeting continued to the next agenda item.

**5 UPDATE ON PACIFIC STATION RELATED STUDIES**

Barrow Emerson, Planning and Development Director, provided a "FINAL REPORT" submitted by Dan Boyle and Associates entitled, "Santa Cruz Metropolitan Transit District (METRO) Downtown Santa Cruz Operations Analysis" (see attached) and spoke to the staff report.

There is a lot of detail design yet to be finalized to address a few issues that were raised in the staff report. It all hinges on financial viability. Specific staff recommendations are to:

- A. Hold in abeyance decisions about moving forward with detailed planning activities until Summer 2019, pending completion of studies that will identify possible METRO financial responsibilities related to the station; and,
- B. Recommend to the City of Santa Cruz that they preserve the opportunity for a right-turn pocket from Front Street to Laurel Street for UCSC bound buses.

Director Bottorff expressed his disappointment with the delay in receiving the Boyle report as it does not permit adequate review time by the Committee. He had anticipated receiving it in August 2018. As he believes this to be a viable project, Director Bottorff proposed postponing any decision on Item A above, which would allow all three committee members to review and discuss this at a committee meeting to be held before the January 25, 2019 Board Meeting. He would prefer not to wait until summer to proceed. He then asked to hear from the City representatives present.

Bonnie Lipscomb, Director of Economic Development, said the City has no issues with Item B above. They, too, would prefer to make a decision on Item A above before summer.

There was no public comment.

After discussion between Directors, METRO staff and attending City representatives, regarding environmental issues, building assessment, funding options, etc., the following direction was provided to METRO staff:

Postpone this decision to the January 11 committee meeting. At that meeting, METRO staff will provide a structural and environmental assessment update, including any available contamination origination documents and an outline of recent activities and anticipated future steps with timeline. The committee determined Item B above was no longer needed as the City representatives stated it has been communicated to the project sponsor as part of proposed development conditions.

**7 ADJOURNMENT**

Committee Chair Chase adjourned the meeting at 1:43 PM

Respectfully submitted,

Gina Pye, Executive Assistant

Attachment



***Santa Cruz Metropolitan Transit District  
(METRO)  
Downtown Santa Cruz Operations  
Analysis***

***FINAL REPORT***

*Submitted by:* Dan Boyle & Associates, Inc.

*in association with:*

Phillip Boyle & Associates

September 14, 2018

# Attachment

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## **Downtown Santa Cruz Data Operations Analysis Executive Summary**

The purpose of this study is to evaluate the relative accuracy of METRO's assumptions with regard to the number of bus bays needed at Pacific Station, the transit center located in downtown Santa Cruz. The methodology for this study involved:

- Data gathering, reviews of previous studies related to transit operations in downtown Santa Cruz, field observation, and discussions with METRO and City staff members.
- A peer comparison with transit systems of similar size and operating environments (including the presence of a large university) via a six-question survey emailed to peer agencies.
- An assessment of the potential for Automatic Vehicle Location (AVL) technology to reduce the number of required bays.
- An analysis of all bus arrivals, holdover times, and departures at Pacific Station, based on current schedules. The project team measured the holdover time for each trip, assigned buses to the holdover lot or to a lane at Pacific Station, and calculated how many buses were in the holdover lot and in each lane for each minute of a typical weekday.

METRO values the central location for the system's major transit hub with access from and egress to streets on both sides. The holdover lot is also valued for the flexibility it provides, especially given the variation in running times on routes throughout the day and the year. METRO bus operators are well aware of the benefits and shortcomings of Pacific Station. City staff from the Economic Development Department recognize the importance of transit for a healthy downtown and cited Council actions to reduce parking requirements in downtown. The City's major issue regarding Pacific Station is understanding how much space is truly needed.

METRO is unique among its peers in having abundant holdover space immediately adjacent to Pacific Station. Most peers are constrained by available space within the transit center, and all peers noted, either in response to an "ideal world" question or in comments, that more bays or layover locations in or near the transit center would be very helpful for flexibility and future growth.

This analysis was intended to answer four key questions. The questions and their answers are summarized below.

- Do all bus routes that currently serve downtown need to serve downtown? The answer is yes. UCSC students form a compact commuter shed, with over 70 percent living west of San Lorenzo according to UCSC data on residence locations. The number of students living elsewhere is not sufficient to justify a route to UCSC that bypasses downtown. Pacific Station is also a logical terminus for longer routes serving south county locations.

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- Are there efficient and effective ways to serve downtown other than with a single major transit center? There is no workable alternative in Santa Cruz. Typical alternatives are multiple transit centers at the edges of downtown connected by a very frequent shuttle and on-street “super-stops.” Denver is an example of multiple transit centers connected by a free shuttle on a downtown transit mall that operates every five minutes, but its downtown is orders of magnitude larger than downtown Santa Cruz, making the expense of a frequent shuttle difficult to justify. On-street “super-stops” are rare in downtowns because of the impact on parking availability.
- Is an off-street terminal is needed and what is its appropriate size? The answer is yes, an off-street terminal is needed. Off-street terminals are common in downtowns similar to Santa Cruz, as shown by the peer analysis. Based on existing schedules and changes to where certain buses hold over, this analysis recommends 22-24 bays in Pacific Station, including 4-6 bays for holdover buses and 4 bays for future system growth.
- Can Automatic Vehicle Location (AVL) technology facilitate “hot-berthing” and thus reduce the number of required bays? The answer is no. AVL is unlikely to help with hot-berthing for two reasons: (1) METRO already does hot-berthing within Lanes 1 and 4 today; (2) extending this concept to include all lanes would force passengers to cross lanes and create unnecessary safety hazards.

An AVL system would provide a critical benefit of more accurate data on running times and thus allow for the creation of realistic schedules based on this data. To the extent that holdover times are now greater because of uncertainty about running times, an AVL system could also result in less holdover time. Based on comments from METRO operators and staff, a separate summer schedule that would take into account the increased congestion during the summer season is worth considering.

The proposal to allow holdovers in Lane 1 would be easier to implement with sawtooth bays that allow buses to pull out easily even if there is a bus in the bay directly in front. While not part of the scope of this study, a deal between METRO and the City to swap land in exchange for the City building a new Pacific Station with updated design features and passenger amenities can be easily envisioned.

From this analysis, we find that a transit center with 22-24 bays would allow for existing needs and a future service expansion of 4 bays.

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## Chapter One: Data Review

### 1.1 Introduction

The project team gathered data and previous studies related to transit operations in downtown Santa Cruz, observed operation in the field, and discussed issues with Metro and City staff members. What we heard and saw matched information and data from previous studies. This chapter summarizes the results of the data review task. The review begins with previous studies related to Pacific Station, summarizes downtown traffic studies, examines details regarding transit operation at Pacific Station, and offers observations gleaned from transit data and previous studies, including the most recent on-board survey of Metro customers.

### 1.2 Previous Studies Related to Pacific Station

The 2016 *Pacific Station Design: Alternate Tarmac Preliminary Feasibility Study* explored opportunities for a new location for the downtown transit center to consider shared needs of the City of Santa Cruz and METRO. These changes proposed a new entry/exit pattern using perpendicular streets (Front Street and Cathcart Street) to replace the current use of parallel streets (Front Street and Pacific Avenue) that allows two-way bus movements through Pacific Station and the holdover area. An alternate design that moves the proposed Front Street driveway to the intersection of Front and Soquel Streets was also presented; this would be a diagonal driveway entering and exiting the intersection with a separate signal. METRO responded to this study with several concerns, including bus flow issues in the reduced space, loss of holdover space, difficult turns, and the need to stagger bus arrivals. In addition, the future use of articulated buses would create additional complications in bus flow. . It was mutually agreed upon that this potential site would not work for the City or for METRO.

A site at 75 River Street was proposed as a replacement for or supplement to Pacific Station. A METRO review found numerous problems with this proposal and it is no longer under consideration.

### 1.3 Downtown Studies

The City of Santa Cruz revised its downtown plan to generally allow for greater density within the southern portion of downtown, surrounding Pacific Station. Regarding public transportation, the plan states:

*Buses must be able to continue to circulate north and south on Pacific Avenue between Cathcart and Laurel Streets, and along Front Street. No city buses will travel on Pacific Avenue north of Cathcart Street.*

As part of this Plan update, the City conducted an Environmental Impact Report (EIR) that included a traffic analysis. In the FEIR for the downtown plan amendment, the City stated that the amendment would have no impact on policies, plans, or programs regarding public transit. Traffic studies related to the plan amendment forecast improved level-of-service throughout the downtown area, including the streets around Pacific Station.



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## 1.4 Specifics on Pacific Station

Several internal METRO documents were reviewed to understand the design and operation of Pacific Station. Key points include:

- There are currently 14 bays in Pacific Station serving 19 METRO and MST routes plus Greyhound and FLIX, with 11 additional bays for holdover and future system growth in the adjacent holdover lot (former Greyhound station) immediately north of the transit center. METRO estimates that seven holdover bays are currently needed for short-term holdover because there are times when more than one bus per route is at the station at the same time. The long-term assumption is that four additional bays will be needed for system growth, resulting in a total need of 25 bays.
- The number of daily weekday boardings at Pacific Station is approximately 9,000, according to current METRO estimates. Buses operating between downtown Santa Cruz and UCSC account for 48.6 percent of total system ridership. The busiest route (Route 16 – UCSC via Laurel East) accounts for 20.4 percent of system ridership<sup>1</sup>.
- Of the four lanes within Pacific Station, Lanes 1 and 4 are the heaviest in terms of use. All buses serving the University of California Santa Cruz (UCSC) stop in Lane 1. This simplifies boarding for passengers bound for UCSC. Lanes 2 and 3 are lighter in use; better utilization of these lanes would help.
- A pulse in downtown is not mandatory because buses to and from campus are frequent. Leave times for routes to UCSC are:
  - :07-:22-:37-:52 Route 16
  - :15-:45 Route 15
  - :20-:50 Route 10
  - :20 Route 20
  - :25-:55 Route 19

The frequency of service to UCSC enhance the convenience of connecting with a UCSC-bound bus no matter what time the originating bus arrives.

- Only 20% of METRO trips include a transfer. This figure is taken from the most recent on-board survey in 2012. There is no current information regarding transfer patterns.
- There are 291 daily trips with a 10+ minute holdover at Pacific Station. Of these, 117 trips hold over for more than 20 minutes. Holdover times are typically higher when accurate data on trip running times is unavailable and/or when running times are highly variable due to traffic congestion or other factors. In later tasks, the project team will analyze these trips in greater detail. Bus operators make the decision to go to the holdover lot if they have more than 5 minutes to wait before their next trip.

<sup>1</sup> The source for both percentages is “Ridership by Route FY 17 & FY 18 w route names.xlsx” for the first nine months of FY 18

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- It has been suggested by AVL vendors that technological advances such as “hot-berthing” or laying buses over within Pacific Station using an Automatic Vehicle Locator (AVL) system and changeable message signs could possibly result in a maximum savings of a 25% reduction in number of bays. There is tension between two goals: customer legibility (changeable message signs indicating where the next bus on a given route will stop) and operational space efficiency (active holdover with independent pull-in and pull-out could require 100 feet or more space per bay, although well-designed sawtooth bus bays could reduce this spatial requirement).
- Through-routing is another means of reducing holdover time at Pacific Station or bypassing the transit center entirely. The former Route 12 did not stop at Pacific Station, but its low ridership led to its discontinuation. Because UCSC ridership comprises such a high total of overall METRO ridership, efficient through routes could be designed only if new concentrations of student housing were established east of downtown.

## 1.5 Previous Transit Studies and Data

METRO has transmitted to the project team extensive ridership data by route and month, along with pass and fare usage and UCSC student ridership. Together these data sources provide a comprehensive overview of ridership on the METRO system.

The most recent on-board survey in 2012 contained a demographic profile of METRO riders: over 80 percent of riders are without a private vehicle; 70 percent are low income; 60 percent are college-age; seniors account for less than five percent of riders; young people also account for less than five percent of riders. This is a typical profile for a university town. The Comprehensive Operational Analysis (COA) included a graphic showing where transit is most needed, and service is provided to these areas. The COA also provided a typology of the market for transit based on development patterns (heart of the city – other city – suburb – rural).

## 1.6 Summary

This high-level review of previous studies and current data provides the project team with a solid understanding of the current and recent environment for transit in Santa Cruz, especially in downtown. Later tasks analyze and answer four essential questions posed for this study in greater detail:

- Do all bus routes that currently serve downtown need to serve downtown?
- Are there efficient and effective ways to serve downtown other than with a single major transit center?
- Is an off-street terminal needed and what is its appropriate size?
- Can Automatic Vehicle Location (AVL) technology facilitate “hot-berthing” and thus reduce the number of required bays?

The summary section at the end of this report answers these questions.

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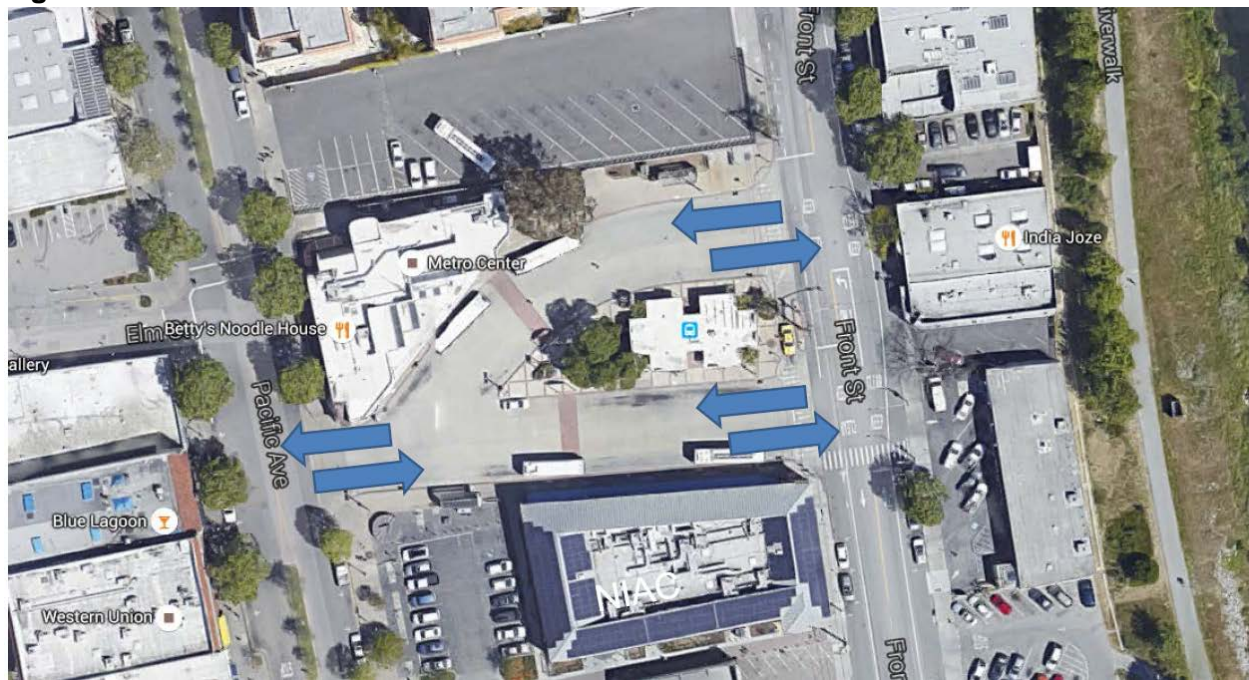
## Chapter Two: Input from METRO and City Staff

### 2.1 Introduction

The City and METRO have spoken in general terms about Pacific Station in the context of ongoing and future developments in downtown. City staff would like to extend development south on Pacific Avenue, which presents an opportunity for a reconfiguration and/or relocation of Pacific Station. Chapter One reviewed studies that evaluated two alternative locations; neither of which was acceptable. METRO is able to continue its current level of operations (with minor improvements in various route frequencies) with its current 14 active bays along with approximately 7 holdover bays. These 21 active bays along with 4 bays held for future system expansion should meet METRO's operational needs in the mid to long term.

Figure 1 below shows the Pacific Station site in downtown, with access from both Pacific Avenue to the west and Front Street to the east. There are four bus lanes. The blue arrows show bus movements. The top left arrow denotes Lane 1 which curves in front of the Metro Center lobby where passengers can wait for their bus and purchase fare media, and also provides Greyhound ticket sales and luggage and freight holding. The right arrow immediately below denotes Lane 2. The lower left arrow denotes Lane 3. Buses in Lanes 2 and 3 stop at an island in the middle of Pacific Station. Lane 3 also serves several Greyhound buses throughout the day boarding and alighting passengers. The lower right arrow denotes Lane 4, with a covered passenger waiting area against the building. The lanes are connected by crosswalks to facilitate passenger transfers. The holdover lot is immediately north of Pacific Station.

**Figure 1 Pacific Station**



Lanes 1 and 4 have the most arrivals and departures in Pacific Station. All routes that serve UCSC stop in Lane 1. Routes serving areas south and east of downtown stop in Lane 4. There

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are no designated stops in Lanes 1 and 4 for specific routes. METRO occasionally receives complaints from passengers that they do not know where to catch the bus on the lane. Field observation indicated that most passengers understand the operation and know how to find their bus.

There is an alighting-only stop along Pacific Avenue in front of the Metro Center Building. University buses and some others drop off passengers at this stop, and then proceed to either the holdover lot or to a bay at Pacific Station for their next trip. This stop also serves ancillary services provided by Apple, Google, and other non-METRO related transportation providers and their services do board and alight at this stop.

This study will help to answer the four major questions cited at the end of the previous chapter. An important first step for the project team was to interview personnel from METRO's Operations, Planning, and Finance Departments and personnel from the City of Santa Cruz. The interviews were intended to provide an in-depth understanding of operating issues, scheduling impacts, previous studies, and operating and capital costs related specifically to Pacific Station. The City interviews explored plans for future development of Santa Cruz' downtown area. Combined with field observation, an informal discussion with bus operators in their break room, these efforts provided us with current knowledge of the various concerns surrounding Pacific Station.

## **2.2 METRO Staff**

METRO staff cited several reasons why Pacific Station works well and should be retained as is. Much of the discussion focused on the value of the holdover lot to METRO:

- The lot is METRO's property and is paid for.
- Without the holdover lot, it is not feasible to stay out of the active bus lane if the holdover is more than 7 minutes. Adjacent streets do not provide enough red curb space for buses to park.
- Without the holdover lot, METRO would have to take apart all interlining, thus decreasing its operating efficiency, and would need to bring buses back to its JKS Operations Base at River St, (1.8 miles away) for operator breaks, thus increasing deadhead time. Travel time between these two locations can take in excess of 10 to 15 minutes due to significant recurring congestion at the intersection of Highways 1 and 9. This situation would contribute to late departures.
- Operation during the "peak of the afternoon peak" is a major concern. Up until 4 p.m. on most days, operation is generally smooth in and around Pacific Station. After 4 p.m., the holdover lot is crucial to successful operation.

Several other issues were discussed:

- A central location for the system's major transit hub with access from and egress to both streets provides operational flexibility for METRO. The design allows buses to pull through Pacific Station without the need to back up or to make a U-turn (difficult in such a constrained location).

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- METRO recently acquired articulated buses for service to and from UCSC on its busiest routes. Staff envisions additional articulated buses (replacing 40-foot buses as a way to meet growing demand in the future without increasing operating costs. Because they are bigger, fewer articulated buses can fit in each lane. This could create operational issues.
- Scheduling is a challenge, because buses are not equipped with automatic vehicle locators (AVL). Running times are established based on limited annual manual on-board surveys and operator input. Staff noted that holdovers have lengthened significantly, as increased regional traffic congestion has resulted in many buses running late. To maintain the schedule throughout the day, METRO schedules longer holdovers, with the recognition that actual holdover time will be less than scheduled in many cases. Summertime is especially challenging due to increased congestion. Schedules add more running time to Route 17 to San Jose in the summer, and this may be a useful strategy for other routes. AVL implementation will provide much more (and more accurate) data on running times for use in building appropriate schedules.
- Lanes 1 and 4 are the busiest lanes. At certain times of the day, these lanes are filled to capacity, with four or five buses loading passengers.
- Staff indicated that certain dedicated stops, such as the stop for Monterey-Salinas Transit Route 78, are “wasted space.” Route 78 has two trips per day at Pacific Station in Lane 3. It should be noted that FLIX buses will be added to Lane 3, joining METRO Route 35, MST Route 78, and Greyhound.
- METRO works very closely with UCSC, and its primary contact at the university also attended the meeting. A fee voted on by the students has funded METRO service to UCSC since 1972. Current enrollment is 18,000, with approximately half of the student body living on campus. UCSC does not provide parking permits for freshmen or sophomore students. UCSC have a legally binding agreement with the City to cap the number of daily vehicle trips at 27,000. METRO accounts for just over 25 percent of all trips to/from campus.
- The students form a compact commuter shed, with over 70 percent living west of San Lorenzo according to UCSC data. Some students are moving out to Live Oak and Capitola. UCSC faculty and staff pay for bus passes. There are eight or nine vanpools from Watsonville to the campus.
- One strategy to reduce the need for holdover time at Pacific Station is to design routes that do not pass through the station. The location of the commuter shed for UCSC, the most important destination in the METRO system, renders this strategy infeasible: there is simply not enough demand to/from UCSC from locations beyond downtown Santa Cruz to justify a direct route. In fact, METRO discontinued a route with this exact design due to poor productivity.
- Another strategy is to interline or through-route buses: a bus arrives at Pacific Station as one route and leaves as a different route. Interlined buses would still dwell in downtown

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to create a transfer window but this approach would reduce or possibly eliminate holdover time at Pacific Station. METRO does interline various routes throughout the day to enhance operational efficiency.

- The university routes operate via a long loop through UCSC with boardings and alightings along the loop. It is impossible to schedule holdover time along an active loop without seriously inconveniencing riders going to or coming from UCSC.
- The use of AVL technology to facilitate “hot-berthing,” where bays are assigned to routes dynamically in real time, could potentially reduce the number of bays needed. In previous projects, the DBA team has not found any agencies using AVL for this purpose. Its possible application to Pacific Station could move buses from the busiest lanes to Lanes 2 and 3 at peak times, but would require an increased use of crosswalks within Pacific Station with the potential for a resulting increase in bus-pedestrian accidents. Hot-berthing is addressed in greater detail in Chapter 4.
- Taking holdover time on-street near Pacific Station is another option. METRO Staff noted that before Pacific Station was open, METRO would park buses at Church Street and along Laurel and Cathcart Streets. These opportunities are no longer available nor would they be feasible given the increased vehicular and pedestrian traffic that now congests these areas. It would only add to the vehicular congestion and create potential safety issues with pedestrians.

## 2.3 METRO Bus Operators

The project team and a member of METRO’s Operations Planning Department met with METRO bus operators outside the supervisor’s office on Wednesday, May 2 between 10:30 a.m. and 2:00 p.m. Operators’ thoughts on Pacific Station are captured by four specific comments:

- Pacific Station is efficient, despite the state of disrepair.
- It would be hard to improve on Pacific Station’s location. Maybe lining up all the buses on the street would be more efficient. But this would compromise the significant number of bicycle riders that would now be pushed further into lanes of traffic since the bicycle lanes would be blocked.
- Pacific Station is not big enough for us anymore, especially with Monterey Salinas Transit and Greyhound. We need more active bays.
- There is nothing you can do to change Pacific Station. Tear it down and start over, with sawtooth angled bays like at Diridon Station.

Operators offered specific ideas for route assignments at Pacific Station:

- Swapping Routes 3 and 20 between Lanes 1 and 2;
- Moving Routes 40, 41, and 42 (nine trips on weekdays) from Lane 1 to Lane 2;
- Turning Route 3 around at the Arena if it could drop inbound passengers at Pacific Station;

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- Assigning each route to a specific bay;
- Adding a fifth bus in Lane 4.

Several disadvantages of current operations were noted:

- The exit from the holdover lot onto Front Street is difficult;
- While the holdover lot works well for buses in Lane 1, an operator in Lane 2 or Lane 4 needs to go around the block with three left turns to access the lot;
- It is difficult to see pedestrians walking within the holdover lot – the procedure is for operators to honk before backing up, but operators would prefer a monitor showing the view from a rear camera. Also, Pacific Station and the holdover lot are too dark at night.
- Parking buses in the holdover lot for break times could be better; it would be nice to have more space, especially with articulated buses, and possibly another spot to hold over since operators with 20-minute holdovers do not want to be in the bus lane at Pacific Station.

Operators expressed strong opinions about traffic. Highway 1 is the only reasonably fast choice, but it is getting more and more crowded. Others noted slow movements through downtown, with gridlock during summer months. The intersections at Pacific & Cathcart and Pacific & Laurel are especially difficult. One operator said that traffic flows reasonably well outside of summer and holidays.

Operators offered several suggestions regarding routes. Two suggestions were especially relevant to downtown:

- A beach circulator in the summer using smaller vehicles and connecting a park-and-ride lot with the beach and boardwalk, similar to the existing service that the Boardwalk provides between the County Building and the beach area, and the trolley service that the City provides between downtown and the beach area, and
- A year-round downtown circulator from Pacific Station up to Soquel Avenue (the heart of downtown) and Water Street and possibly extending east to 7<sup>th</sup> Avenue.

Other operational and schedule-related suggestions included greater use of buses in the midday to reduce the number of split shifts (additional service would require an added funding source), no interlining between UCSC routes and other routes because UCSC routes always run late, and a second yard in Watsonville.

## **2.4 City Staff**

The DBA team met with staff members and consultants from the City of Santa Cruz Economic Development Department and Public Works/Planning Department on the afternoon of May 2. The city is passionate about downtown redevelopment and the opportunities it presents, in particular around increasing the number of housing units in downtown to support vibrant and diverse downtown environment, with opportunities for housing, employment, entertainment, shopping, dining, and culture. The City has \$7 million for affordable housing downtown, including 100 affordable housing units adjacent to the downtown transit center. In addition to the City's affordable housing project, the City is preparing for 500-600 new private and publicly

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funded housing units in the 10-year pipeline and reinvesting additional funding in a new wayfinding system and downtown beautification. More people living downtown translates to more eyes on the street, reduces vehicle miles traveled, promotes walkability, and helps retailers.

Transit and Transportation Demand Management (TDM) actions are integral parts of a successful downtown. The City already has a drive alone rate 20% below the national average, and correspondingly high rates of walking, biking, and transit use. A robust, efficient transit option is an important component of downtown development that helps to address mobility needs while reducing congestion and parking demand. The land use plan for downtown, and the housing goals established by the City Council, are in line with transit oriented development land use patterns and support transit usage. There is no seasonality in transit-oriented land use patterns; they provide everyday demand for goods and services, including transit.

The City's perspective on Pacific Station is one of economic use and increased mobility. Development costs including acquisition and construction are over three times higher in downtown than elsewhere, and the City seeks to maximize the retail, commercial and housing potential for downtown while maintaining a vibrant pedestrian experience, particularly along the Pacific Avenue street frontage. METRO's demands for space when the space is so valuable is a key component of the current project scope. As part of the City's commitment to affordable housing, it would like to develop the Pacific Avenue side of Pacific Station, ideally with a reconfigured transit center entering and exiting on Front Street. In exchange, the City would be willing to negotiate a land swap of city-owned and acquired parcels with METRO owned parcels. Plan B is to develop adjacent to the existing Pacific Station on existing city owned parcels, but Plan A is preferable for its ability to extend development south along Pacific Avenue and continue an active street frontage.

The City's goals for this study are to identify the right size for a downtown transit center, appropriate operational uses for the desirable spaces, and realistic expectations of future service needs.

## **2.5 Summary of Interviews**

METRO staff cite several reasons why Pacific Station works well. METRO values the central location for the system's major transit hub with access from and egress to streets on both sides (Pacific Avenue and Front Street). The holdover lot is also valued for the flexibility it provides, especially given the variation in running times on routes throughout the day and the year and the lack of technology to collect accurate running time data. To maintain schedules throughout the day, METRO schedules longer holdovers, with the recognition that actual holdover time will be less than scheduled in many cases. Summertime is especially challenging due to increased congestion.

METRO bus operators are well aware of the benefits and shortcomings of Pacific Station, as summarized in the comment: Pacific Station is efficient, despite the state of disrepair.

City staff from the Economic Development Department recognize the importance of transit for a healthy downtown and cited Council actions to reduce parking requirements in downtown. Staff



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noted that transit-oriented development provides everyday demand for goods and services, including transit. The City's major goals regarding Pacific Station are to continue positive redevelopment and revitalization of downtown and to understand how much space is truly needed for an efficient and cost-effective transit system. Staff want to ensure that the downtown transit center is right-sized.

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## Chapter Three: Peer Analysis

### 3.1 Introduction

The project team conducted a peer comparison with transit systems of similar size and operating environments (including the presence of a large university). Peer systems were identified by METRO and the City. The peer agencies include:

- Golden Gate Transit, San Rafael
- SLO Transit, San Luis Obispo
- Monterey-Salinas Transit
- Santa Barbara Metropolitan Transit District
- Unitrans, Davis
- Gold Coast Transit, Oxnard
- Santa Clara Valley Transportation Authority, San Jose (specifically for Diridon Transit Center, which is familiar because METRO Route 17 serves this location).

To encourage responses in a relatively short time frame, a streamlined survey of six questions was developed and emailed to a contact at each agency. The request was phrased as follows:

*Please let me know:*

1. *The number of bays in your downtown transit center (for VTA, use Diridon Station, since Metro serves that station and most people in City government are familiar with it).*
2. *The number of routes serving the Transit Center.*
3. *Whether routes are assigned to specific bays or a bus simply pulls up to the first bay.*
4. *Where buses lay over (in the bay or somewhere else in or near the transit center)*
5. *If any bays are reserved for layover or other purposes.*
6. *How many bays you wish you had in an ideal world?*

All agencies responded to the survey. Before presenting the results, the next section includes diagrams or aerial views of each transit center.

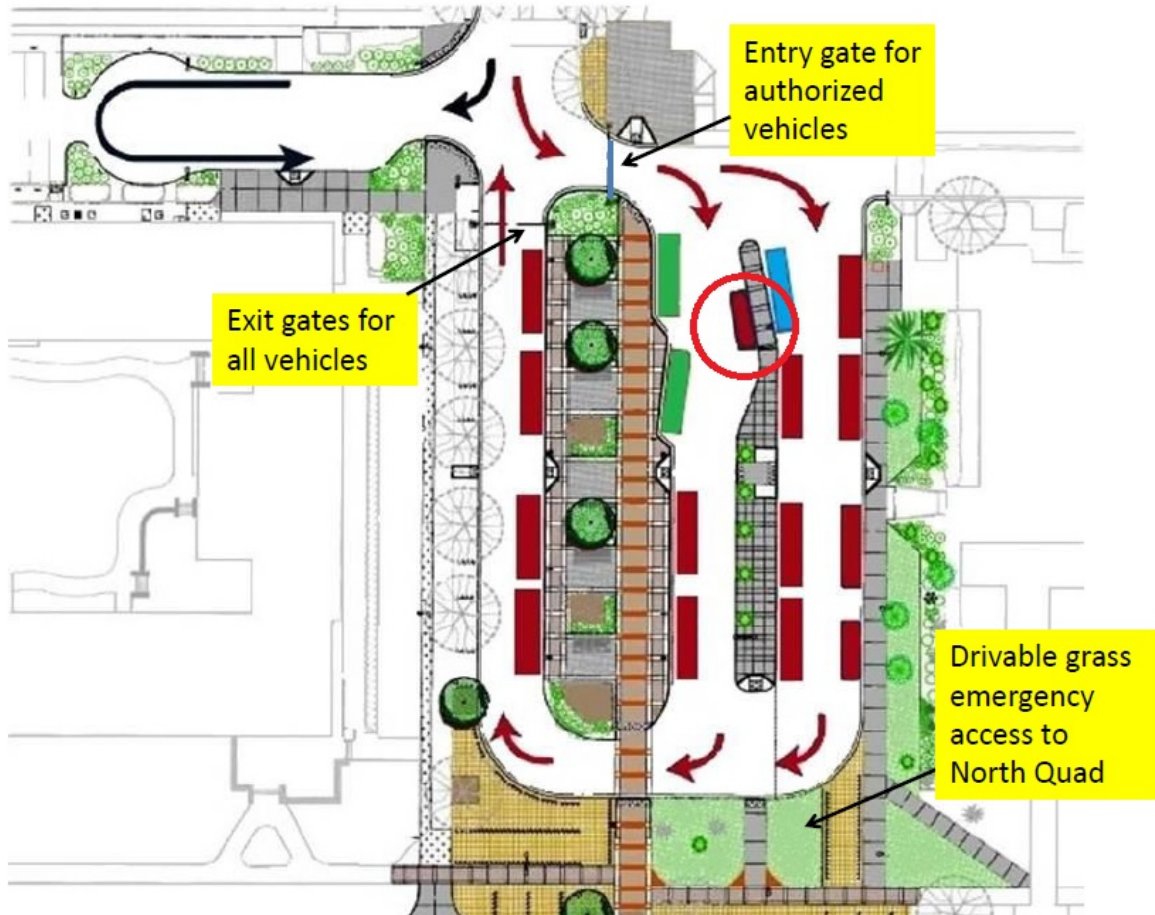
### 3.2 Diagrams of Transit Centers at Peer Agencies

Chapter 2 presented the aerial view of Pacific Station. Diagrams or aerial views of each peer transit center are shown here.

# Attachment

## Davis – Memorial Union Terminal

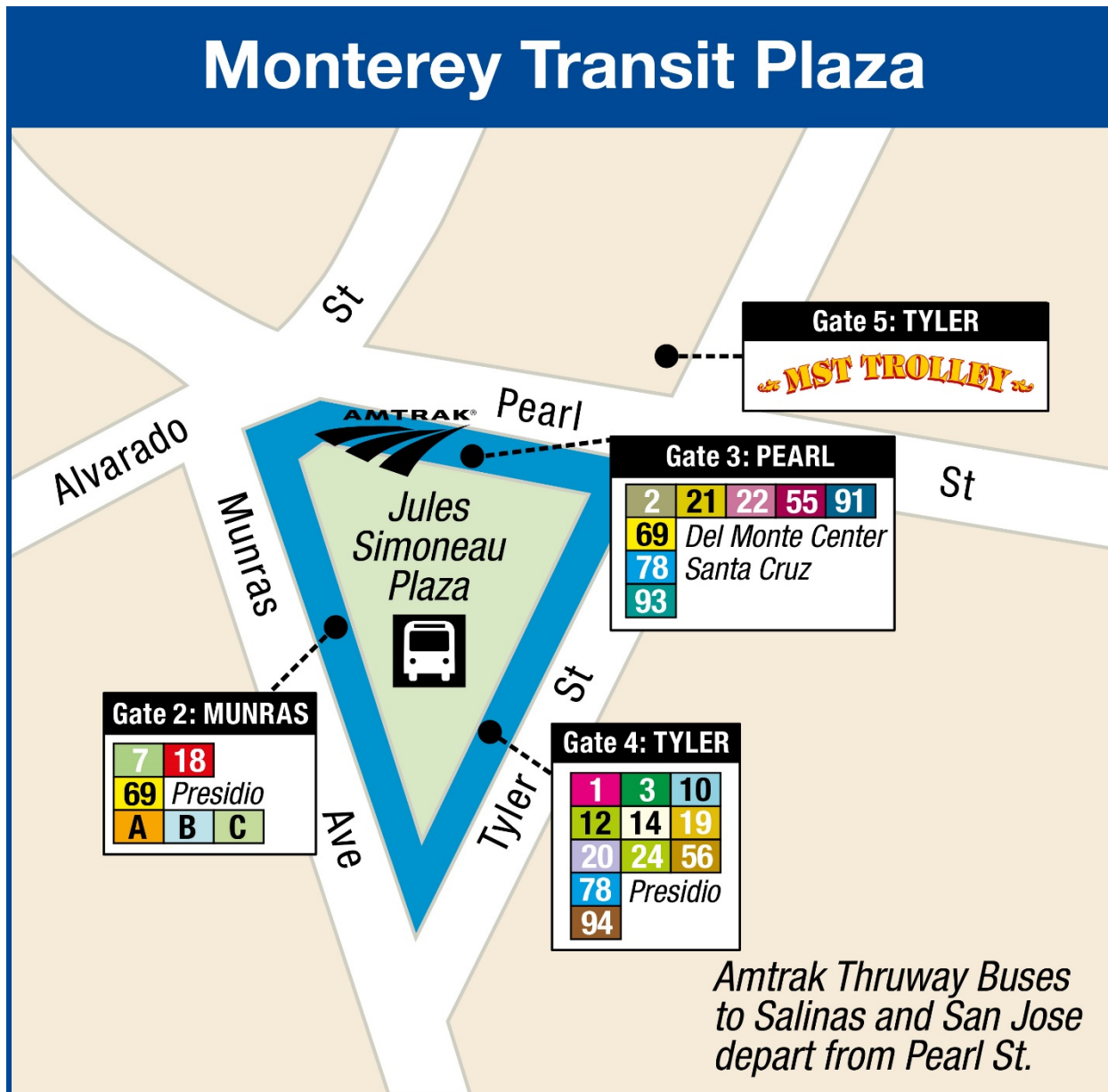
The Memorial Union Terminal is the larger of two transit centers on the University of California Davis campus. The u-shaped transit center has 17 bays for 14 routes, including four bays on the east curb side reserved for layover. Buses enter and exit via Howard Way.



# Attachment

## Monterey

The Monterey Transit Plaza is an on-street transit center with four “gates” along Pearl and Tyler Streets and Mumras Avenue in downtown Monterey, served by 27 routes. Two buses can fit in three of the gates, and one trolley in the fourth gate. Each route is assigned to a specific gate.



# Attachment

## Oxnard

The Oxnard Transit Center in downtown Oxnard has ten sawtooth bays around a central island served by 12 Gold Coast Transit routes. Each route is assigned to a specific bay. VCTC Intercity, Greyhound and Amtrak also serve the OTC but have parking spots on the east side of the transit center. Buses enter and exit via 4<sup>th</sup> Street.



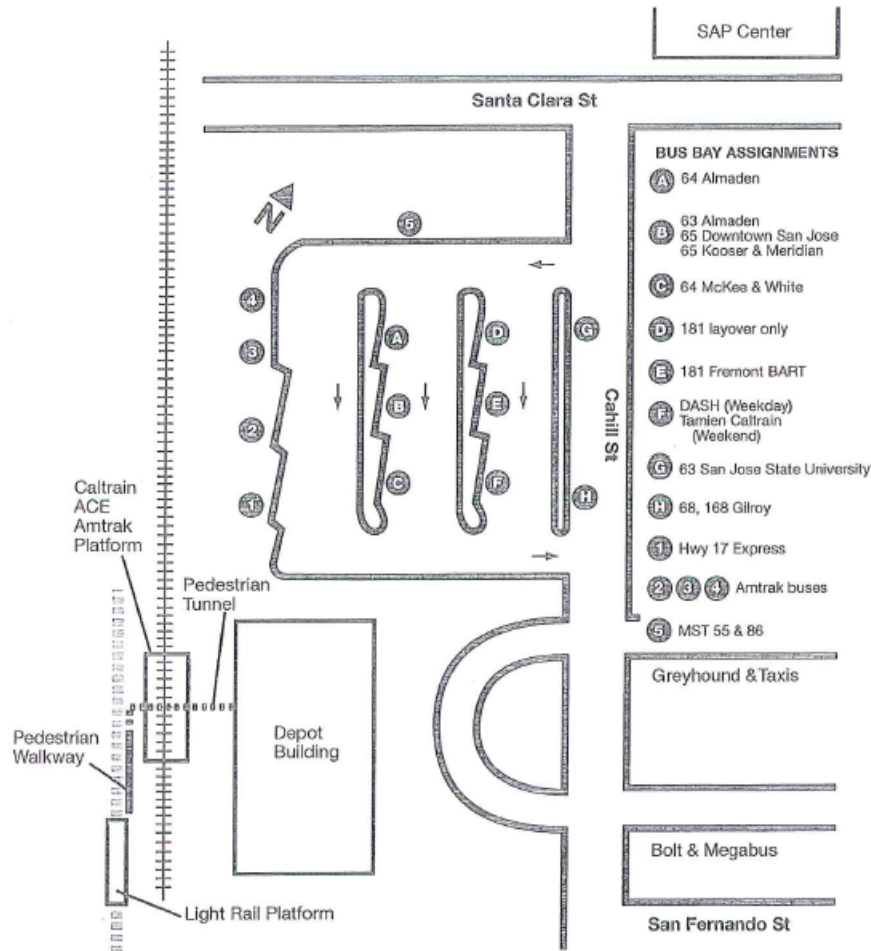


# Attachment

## San Jose – Diridon Transit Center

The Diridon Transit Center, located across the freeway from downtown San Jose, has nine sawtooth bays and room for other buses to stop and/or lay over around the perimeter. Ten bays are used for local buses. There is also room for three buses at the stop on Cahill Street. Twelve bus routes serve Diridon Transit Center. Each route is assigned to a specific bay, with one bay dedicated to layover for Route 181. Buses enter and exit via Cahill Street.

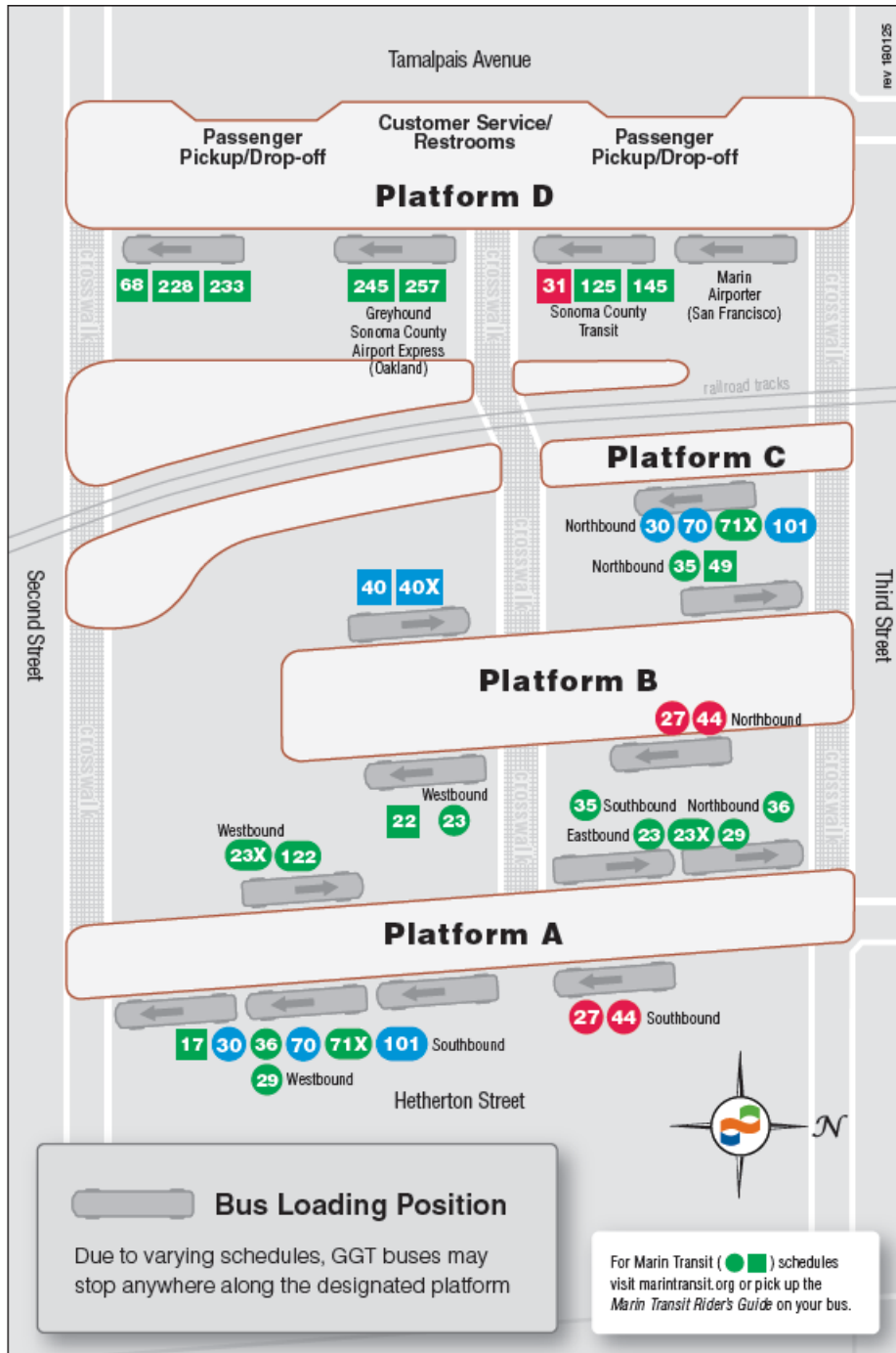
## San Jose Diridon Transit Center APR 9 2018



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## San Rafael

The San Rafael Transit Center in downtown San Rafael has 16 bays on four platforms (two single-sided and two double-sided platforms) served by 27 routes plus Greyhound. Each route is assigned to a specific bay, in some cases by direction, although Golden Gate Transit buses may stop anywhere along the assigned platform. Only one route holds over at this transit center, in a designated bay. Entry and egress are on both sides of the transit center (Third Street to the west and Second Street to the east).

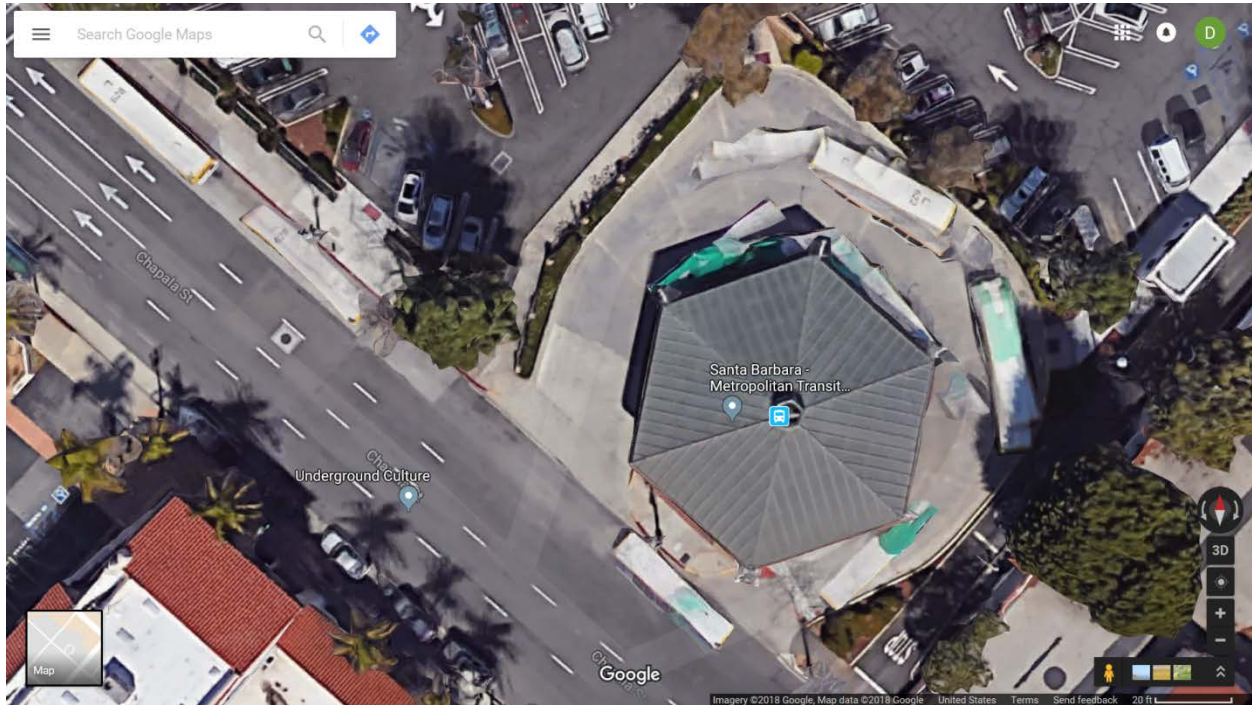




# Attachment

## Santa Barbara

The Santa Barbara Transit Center in downtown Santa Barbara is circular in design, with seven stops (three on the inner circle for Routes 1, 2, and 3 and four on the outer circle for other routes) served by 16 routes. There is also an on-street stop on Chapala Street; not all routes enter the transit center. Layover is taken on-street near the Transit Center. Buses enter and exit via Chapala Street.



# Attachment

## 3.3 Peer Results

Table 1 summarizes the results of the peer review.

**Number of Bays.** Two peers have more bays than Pacific Station (Davis and San Rafael). The average number of bays among peers is 11. The average number of bays in off-street facilities (excluding Monterey and San Luis Obispo) is 12. Pacific Station has 14 bays.

**Number of Routes.** Two peers have more routes serving the transit center than Pacific Station (Monterey and San Rafael). The average number of routes at the transit center is 17. Pacific Station has 19 METRO and MST routes plus Greyhound and the new FLIX service.

**Number of Buses in Peak Hour.** This number ranges from 14 to 42, and was derived from analyzing route schedules. The average is 29 and the median is 27.5. Pacific Station is near the middle of the range with 27.

**Number of Buses with Holdover Time.** Some transit centers are a mid-route stop for some routes. For this measure, buses that pass through a transit center without holdover time are removed from the total number of buses because through buses have much less of an impact on space needs. The average is 24 and the median is 23.5. Pacific Station is above average with 27.

**Assigned Bays.** Six of the seven peers assign routes to specific bays or stops, although at San Rafael Transit Center Golden Gate Bus routes will stop in any available stop in a given lane.

**Layover Location/Bays Reserved for Layover.** Four of the seven peers take layover in the active bay. Davis has four bays reserved for layover and San Rafael has one (most routes here are through routes). Santa Barbara takes layover on the street near the transit center.

**Number of Bays in an Ideal World.** Only one peer reported no need for additional bays. Four peers identified a need for a modest increase in number of bays (between one and three), while Monterey and Santa Barbara indicated a need for a significant increase.

**Peak-hour Buses per Bay.** This is a better measure of usage than the number of routes. This ratio ranges from 1.53 to 6.00, with an average of 3.33 and a median of 2.87. Pacific Station has 1.93.

**Peak-hour Buses with Holdover Time per Bay,** This measure removes through buses without holdover from the calculation. The average is 2.74 and the median is 2.13. Pacific Station has 1.93.

The analysis also examined peak-hour buses with holding time at the busiest bay or lane in each transit center where bay/lane assignments are known. Lane 1 is the busiest lane at Pacific Station, with 2.6 peak hour buses per bay. The overall average (excluding Davis and San Luis Obispo, where bay/lane assignments could not be identified) was 4.81 and the median was 4.5.

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**Table 1  
Results of Peer Review**

Element	Santa Cruz - Pacific Station	Davis - Memorial Union Terminal	Monterey Transit Plaza	Oxnard	San Luis Obispo	San Jose - Diridon TC	San Rafael	Santa Barbara
Number of Bays	14	17	7	10	5	10	15	7
Notes	1 drop-off on street						# bays for local buses	
Number of Routes	19 + FLIX + Greyhound	14	27	12	8	12	27 + Greyhound	16
Number of Buses in Peak Hour	27	26	28	20	14	37	43	42
Number with Holdover Time	27	24	14	20	14	23	32	42
Assigned Bays?	Assigned to specific lanes	Yes	Yes	Yes	Yes	Yes	Yes	Assigned to specific areas
Layover Location	Lot immediately north of Pacific Station	In bays on east curb side	In the bay	In the bay	In the bay	In the bay	Only 1 route has layover, in a bay	On street near the TC
# Bays Reserved for Layover	11	4 available	NA	None	None	NA	1	NA
# Bays in an Ideal World	The purpose of this study	Current layout more than sufficient	Another 3-5 gates.	One or two more bays	6 or 8	2 more	2-3 bays for growth	14
# Peak-hour Buses per Bay	1.93	1.53	4.00	2.00	2.80	3.70	2.87	6.00
# Peak-hour Buses with Holdover per Bay	1.93	1.41	2.00	2.00	2.80	2.30	2.13	6.00

**Comments.** Several peer agencies expanded upon their replies. Specific comments are reported below.

*There are 7 VTA routes inside the transit center and two more that operate close by on Santa Clara St. There are also two MST routes, the Hwy. 17 Express,*

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*Amtrak buses and a weekend Caltrain shuttle. Greyhound, Bolt and Megabus are now adjacent to the transit center as well. (San Jose-Diridon)*

*All Golden Gate Transit and Marin Transit routes have assigned bays (by direction of travel too), the two Airporter companies and Greyhound tend to share bays depending if there are more than one bus for each company there at the same time. (San Rafael)*

*Our Transit Center is rather unique, in that we don't have any bays. There is a circular drive around the TC building with room for several buses to park, and some of our routes (expresses primarily) park on Chapala Street that fronts the TC. (Santa Barbara)*

*Dedicated parking outside of the terminal itself would be helpful between peak periods. Two spaces. That would be ideal. (Davis)*

*VCTC Intercity, Greyhound and Amtrak also serve the OTC but have parking spots in another part of the transit center. (Oxnard)*

*Routes are assigned to bays to provide 1) passengers a consistent pick up location and 2) drivers a clear expectation of how to work around each other. (San Luis Obispo)*

*Because space is so limited and there is no way to circulate back to another bay, we lay over in a bay. For routes with overlaps, we use a second layover bay behind the primary stop. We also do this on Cahill St. since a few buses can wait there at the same time. A couple of our routes are through routes and don't need to lay over here. (San Jose-Diridon)*

*Almost all recovery time scheduled for the transit center. This allows for 1) ideal transfers, 2) driver breaks and 3) on-time performance management. (San Luis Obispo)*

*Most routes run through the San Rafael Transit Center and only have dwell time, not layover time; only one route currently lays over at its designated bay. (San Rafael)*

*No bays are reserved for layover officially, but because routes are interlined/synchronized it becomes very predictable to know what bays are open and which are not and we have some use of a loading zone area around the corner in rare situations. (San Luis Obispo)*

*The challenge with Diridon is that it's hard to serve from buses coming north on Cahill St. (they can't get into the first bus bay island since it's too tight). We also have many other transit centers where there is a layover area, and we have some buses drop off, go to a layover area, then circle back around to the pickup stop. (San Jose-Diridon)*

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*Added bays would help with staging hot buses or a similar situation. (Oxnard)*

*Although buses can share bays with coordinated schedules, there is a need for onsite spare vehicle and supervisor vehicles. Plus as this point we are maxed out with no room to grow our transit system with the continued hub-n-spoke model operating out of the transit center. In the transit world; always, always over build. (San Luis Obispo)*

After discussions with METRO staff, the peer agencies were asked another question: How do your bay limitations impact or constrain your operations? Four peer agencies responded, as shown below.

*Our current situation doesn't limit or constrain us. (Davis)*

*Our transit center is constrained in a couple of areas presently, which will worsen when the construction of the SMART train tracks between Platforms C and D commences shortly. Our Platform D is constrained by the availability of passing space for buses to get around other buses already stopped on that platform. Also, the turning radius for buses entering Platform D from the north side (3rd Street) prevents a bus from loading at the very northern edge of Platform D. These conditions will worsen when construction of the double track rail line and barriers along the trackway commences. We are also constrained with regard to some buses having to make a U-turn around the southern edge of Platform B to get into position. This will become more constrained in the near term future. (San Rafael)*

*The Diridon Transit Center is very tight. We would like to operate Lines 72 & 73 to Diridon (instead of ending at Bassett St.), but there just isn't enough room. We also have notes for some deadheading buses to lay over in other locations prior to coming to Diridon so that we limit the time that buses are at Diridon (due to space limitations). For example, if they are finishing a school tripper, we'll have them hold in Milpitas for 10 minutes before proceeding to Diridon to avoid an overlap with other buses. (San Jose)*

*In MTD's case, we have a dedicated supervisor position at the transit center and that person ensures that everything operates smoothly. (Santa Barbara).*

## **3.4 Summary**

METRO is unique among its peers in having abundant holdover space immediately adjacent to Pacific Station. This was not by design, but resulted from the purchase of the Greyhound property immediately north of Pacific Station. Most peers are constrained by available space within the transit center, and all peers noted that more bays or layover locations in or near the transit center would be very helpful for flexibility and future growth. Several agencies must use adjacent streets to park buses when schedules are disrupted.

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In three of the seven peer transit centers, at least 25 percent of peak-hour buses pass through the center and do not take holdover time. All of the buses at Pacific Station are scheduled for holdover time. The average number of peak-hour buses with holdover time per bay is 2.74 (Santa Barbara is an outlier that raises the average). The median number is 2.13. Pacific Station has 1.93.

METRO has emphasized that the ability to travel through Pacific Station by having access and egress on two streets is a benefit in terms of routing, flexibility, and emergency access. Among peers with an off-street transit center, only the San Rafael Transit Center has a similar structure; most others enter and exit from the same street. Two-way access and egress is preferable but not necessary.

The San Jose-Diridon situation with buses entering northbound from Cahill Street unable to access the first bay island emphasizes the importance of early and ongoing involvement of the Operations Department in any design or re-design of a transit center. The project team has encountered similar issues at other transit centers that could have been avoided if Operations had been involved at an early stage.

Space constraints at transit centers have impacts beyond buses in service. The ideal transit center provides convenient access to and from a holdover location (which may or may not be in the bay), space to park spare buses and supervisor vehicles, and room for system growth. These are all valid operational needs.

The peer results indicate that METRO has more space for bus holdover than its peers, a slightly higher number of bays, and a slightly lower number of peak-hour buses with holdover per bay. Additionally, METRO is unique in that it has the ability to use an adjacent holdover lot, where many peers holdover in the bay. This does not answer the question of how many bus bays are needed. The next chapter explores technological solutions that may reduce bay requirements.

# Attachment

## Chapter Four: Technology

### 4.1 Introduction

In the Request for Proposals for this project, METRO asked if Automatic Vehicle Location (AVL) technology can facilitate “hot-berthing” and thus reduce the number of required bays. The RFP indicated that it has been suggested informally by AVL vendors that hot-berthing can reduce the number of bays required by 25 percent. This chapter explores the potential of AVL-enabled hot-berthing to maximize the available capacity at Pacific Station.

### 4.2 Hot-berthing

The concept of hot-berthing would be applied as follows:

1. As a bus approaches Pacific Station, the AVL system would “see” what bays are open and would recommend a specific bay where the bus will stop.
2. Electronic signage and/or automated announcements at Pacific Station would inform passengers which bay the bus will use, e.g., “Route 19 will be available for passenger boarding in Lane 3.”
3. Customers could then walk to the appropriate bay.

The theory behind hot-berthing is that the overall capacity of Pacific Station could be used more productively, allowing buses to hold over in the active bay assigned and minimizing the number of buses needing to hold over in another location.

The Perth City Busport in Perth, Australia is an example of hot-berthing. Figure 2 shows the main entrance to the facility in downtown Perth. Figure 3 views the main passenger concourse, with a live departures screen immediately visible. Routes are broken into four groups of four, similar to the current design of Pacific Station, so passengers roughly know which sector to be seated in.

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Figure 2 Main Entrance to the Perth Busport



Figure 3 Main Passenger Concourse





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The seating area for passengers is shown in Figure 4. The room is divided into seating areas and kiosks facing live departure screens. These screens are located at regular intervals down the concourse.

**Figure 4 Seating Area**



Figures 5 and 6 on the following page provides views of the stand door at two different times. Each stand door features a monitor. If no services are currently scheduled, it will indicate this to passengers. Once a bus is assigned to a stand but has not yet arrived, it will say “Bus arrival pending,” as in Figure 5. When the bus arrives at the stand, the pending status changes to a live video of the bus at the stand, with the doors now able to be opened (Figure 6).

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Figure 5 Stand Door When Bus is Arriving



Figure 6 Stand Door When Bus Has Arrived



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None of the peer agencies use hot-berthing. The project team has not encountered any transit system in the United States that uses AVL in this fashion. A likely reason is customer confusion. A more serious reason is safety within the transit center. Airports and rail stations can assign gates in real time because the pedestrian space within them is protected. The Perth Busport building is in the center of the site with buses on the sides, so it also has protected pedestrian space. At Pacific Station, real-time assignment of bays would increase the use of crosswalks and thus increase the risk of bus-pedestrian accidents. No transit agency would knowingly take an action that would increase risk in this matter.

Also, METRO uses hot-berthing today *within* the busiest lanes at Pacific Station without AVL. UCSC routes in Lane 1 do not have specific bays for each route. Instead, the first route to arrive stops at the first bay, the next bus at the second bay, and so on (articulated buses are an exception, since they cannot use the first or second bays due to the curvature of the curb, but this does not invalidate the general pattern). South County routes in Lane 4 do not have specific bays for each route, but operate in the same manner. Lanes 2 and 3 are shorter with fewer routes and departures, allowing for assigned bays and buses holding over within the bay. Field observation suggests that it is not unusual for South County routes to hold over in Lane 4.

Passenger confusion, safety issues related to hot-berthing at Pacific Station in its current configuration, and the lack of room for a central building at the current site preclude further consideration of this idea, and use of AVL to facilitate hot-berthing is not recommended. No other technological solutions to reduce the number of bays needed at Pacific Station have been identified.

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## Chapter Five: How Many Bays Are Needed at Pacific Station?

### 5.1 Introduction

METRO has 14 active bays at Pacific Station and 11 holdover bays in the lot immediately north of the transit center, of which 7 are regularly used. The other four bays have been identified as needed for future system expansion. The critical question for this study is: are all these bays needed? If not, how many bays are needed at Pacific Station?

The results in Chapter 3 indicate that peer agencies have many fewer bays dedicated to holdovers. This is useful information, but no two transit agencies are exactly alike. Thus, the answer to this question requires an analysis of current METRO operation.

The next section explains what holdover time (also called layover or recovery time) is and why it is needed in a transit system. Section 5.2 reports on an in-depth analysis of arrivals and departures at Pacific Station throughout the course of a typical weekday. Section 5.3 summarizes findings and suggests future direction.

### 5.2 Holdover Time

*TCRP Report 135* is the scheduling manual for public transportation. It describes layover and recovery time as follows:

*The terms “layover” and “recovery” refer to the time between trips, from the time a bus arrives at a terminal and the time the bus leaves the terminal to begin the next trip. While layover and recovery are often calculated as a single unit of time, in theory they are intended for two different purposes. Recovery time is time allotted by management to ensure that a bus can get back on schedule if it arrives at the terminal, or designated location, slightly behind schedule. A driver could be expected to reduce or eliminate their recovery time if they arrive at the terminal behind schedule and need to leave quickly to begin the next trip. Layover time is time negotiated by union rules and by agency practice to give drivers a break at the end of a trip. Layover time is paid time for operators.*

As with most transit agencies, METRO does not break out holdover time into individual components.

*TCRP Report 135* also notes that the longtime standard in the transit industry has been to calculate recovery time as 10 percent of the trip running time. Given increased levels of congestion that cause unpredictable delays, 15 percent of trip running time is not unusual, and some agencies use 20 percent as the standard.

Holdover time is relatively generous on most METRO routes. The reason is that METRO does not have an accurate way of tracking trip running times other than its limited annual manual on-board surveys and thus is cautious to ensure sufficient holdover time for when trips runs late. While Chapter 4 found that an Automatic Vehicle Locator (AVL) system is typically not used for

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real-time assignment of bays, AVL provides detailed data on running times that would help METRO staff fine-tune its schedules and possibly holdover times on certain routes and trips.

A review of current scheduling practices and operator assignments indicates:

- The METRO scheduler uses many of the advanced features of its scheduling software to optimize efficiency.
- The scheduling software cannot optimize running time because this is an input to the process.
- Long METRO routes are scheduled with holdover at both ends of the route, a standard scheduling practice.
- All UCSC routes travel through the campus on a loop road where holdover time at any point would delay some passengers. All UCSC routes and local routes in Santa Cruz serving Pacific Station take all holdover time at Pacific Station. This is also a standard scheduling practice for loop routes.

To summarize, the purposes of holdover time are to allow a late-arriving trip to leave on its next trip on time and to provide bus operators with time to stretch or use the restroom.

## **5.3 Analysis of Arrivals and Departures at Pacific Station on a Typical Weekday**

To answer the question of how many bays are needed, the project team developed a spreadsheet from current schedules showing all arrivals and departures at Pacific Station. The team then measured the holdover time for each trip, assigned buses to the holdover lot or to a lane at Pacific Station, and calculated how many buses were in the holdover lot and in each lane for each minute of a typical weekday. The calculation was guided by several assumptions:

- All buses with holdover times greater than 7 minutes in Lane 1 were assigned to the holdover lot. This is the general rule for all buses, but fieldwork revealed that buses in Lanes 2, 3, and 4 often take their holdover time in the lane.
- Buses leave the holdover lot 3 minutes before their scheduled departure time and begin loading at their lane. Fieldwork also revealed that this rule is not always followed, but it is assumed for this exercise.
- Buses that pull out from the JKS operations base on River Street to Pacific Station arrive 3 minutes before their scheduled departure time.
- Buses that pull in to the JKS operations base on River Street from Pacific Station depart at the same time that they arrive.
- Buses that are interlined (e.g., arrive as Route 91X and leave as Route 16) are assigned to the lane for their next trip and not for their previous trip. In this example, the bus would arrive and depart at Lane 1.
- There are different schedules for some UCSC trips on Monday-Wednesday-Friday and on Tuesday-Thursday during the school year. The Tuesday-Thursday trips have more holdover time, so the calculation is based on a typical Tuesday or Thursday during the school year.
- Schedules for Spring 2018 (March 8 through June 13) are used.

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Tables 2 and 3 summarize the results of this exercise. Lane 1 is by far the busiest of the four lanes, but never has more than three buses and only has this many buses for ten minutes during the day. For the other lanes where holdover is assumed to be taken in the lane, Lane 2 exceeds capacity by only one minute during the day, and it is likely that this never occurs due to a late arrival on Route 17. Lane 3 never exceeds capacity during the day; METRO may allow an additional inter-city private carrier to use this bay. Lane 4 exceeds capacity twice during the day for a total of 7 minutes. The maximum number of buses in the holdover lot is 7 and the maximum number in Lane 3 is 3. Table A-1 in the appendix shows the number of buses by time of day.

**Table 2**  
**Maximum Number of Scheduled Buses (by Time) in the Holdover Lot and in Each Lane**

Measure	Holdover Lot	Lane 1	Lane 2	Lane 3	Lane 4
Capacity	11	5	3	2	4
Maximum # Buses	7	3	4	2	5
Total Time Over Capacity	--	--	0:01	--	0:07

Note: This analysis excludes the four bays that METRO has identified as needed for future expansion

Table 3 examines the holdover lot and Lane 1 in greater detail. Examining the holdover lot and Lane 1 together, there are seven buses for a total of 13 minutes, at least six buses for a total of one hour and 26 minutes, and at least five buses for a total of three hours and 37 minutes. In the holdover lot alone, there are seven buses for a total of 2 minutes, at least six buses for a total of 30 minutes, and at least five buses for a total of one hour and 48 minutes.

**Table 3**  
**Maximum Number of Scheduled Buses (by Time) in the Holdover Lot and Lane 1**

Measure	Holdover Lot	Holdover Lot + Lane 1
Total Time with 7 Buses	0:02	0:13
# Occurrences in a Day	1	4
Longest Duration	0:02 16:15-16:17	0:07 16:12-16:19
Total Time with 6+ Buses	0:30	1:26
# Occurrences in a Day	8	13
Longest Duration	0:10 16:07-16:17	0:15 15:05-15:20
Total Time with 5+ Buses	1:48	3:37
# Occurrences in a Day	14	24
Longest Duration	0:14 16:05-16:19	0:37 17:37-18:12

These results suggest that if some buses now assigned to the holdover lot used Lane 1 instead, the maximum number of bays in the holdover lot could be reduced below seven. The constraint

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is a maximum of three buses holding over or loading in Lane 1 at any one time. The analysis includes two buses from Lane 4 holding over in the lot for a total of seven minutes.

Table 4 shows that the reassignment of some buses from the holdover lot to Lane 1 could reduce the number of bays required for holdover from 7 to 4. Table A-3 in the appendix identifies which trips are shifted.

**Table 4**  
**Maximum Number of Scheduled Buses (by Time) in the Holdover Lot and in Each Lane If Some Buses Are Assigned to Lane 1 for Holdover**

Measure	Holdover Lot	Lane 1	Lane 2	Lane 3	Lane 4
Capacity	11	5	3	2	4
Maximum # Buses	4	3	4	2	4
Total Time Over Capacity	--	--	0:01	--	--

Note: This analysis excludes the four bays that METRO has identified as needed for future expansion

Note that this analysis is based on scheduled times. Without AVL, there is no way to measure accurate running times across all days. Late arrivals would not adversely affect the results (since the bus would spend less time holding over) unless the departure was also delayed. Early arrivals would create problems at times of capacity constraints. For this reason, while four bays is the maximum number needed in the holdover lot under this analysis, six holdover bays are recommended in the near term to accommodate unexpected deviations from the scheduled times. With no changes in the number of bays by lane, this results in a recommended total of 14 active bays, 4 to 6 holdover bays, and 4 bays reserved for future growth for a total of 22 to 24 bays in Pacific Station.

## 5.4 Summary of Findings

Four questions were posed for this analysis, as noted in Chapter One. The answers to these questions are summarized below.

- Do all bus routes that currently serve downtown need to serve downtown? The answer is yes. UCSC students form a compact commuter shed, with over 70 percent living west of San Lorenzo according to UCSC data on residence locations. The number of students living elsewhere is not sufficient to justify a route to UCSC that bypasses downtown. Pacific Station is also a logical terminus for longer routes serving south county locations.
- Are there efficient and effective ways to serve downtown other than with a single major transit center? There is no workable alternative in Santa Cruz. Typical alternatives are multiple transit centers at the edges of downtown connected by a very frequent shuttle and on-street “super-stops.” Denver is an example of multiple transit centers connected by a free shuttle on a downtown transit mall that operates every five minutes, but its downtown is orders of magnitude larger than downtown Santa Cruz, making the

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expense of a frequent shuttle difficult to justify. On-street “super-stops” are rare in downtowns because of the impact on parking availability.

- Is an off-street terminal is needed and what is its appropriate size? The answer is yes, an off-street terminal is needed. Off-street terminals are common in downtowns similar to Santa Cruz, as shown by the peer analysis. Based on existing schedules and changes to where certain buses hold over, this analysis recommends 22-24 bays in Pacific Station, including 4-6 bays for holdover buses and 4 bays for future system growth.
- Can Automatic Vehicle Location (AVL) technology facilitate “hot-berthing” and thus reduce the number of required bays? The answer is no. AVL is unlikely to help with hot-berthing, since METRO does hot-berthing within Lanes 1 and 4 today and extending this concept to include all lanes would force passengers to cross lanes and create unnecessary safety hazards.

An AVL system would provide a critical benefit of more accurate data on running times and thus allow for the creation of realistic schedules based on this data. To the extent that holdover times are now greater because of uncertainty about running times, an AVL system could also result in less holdover time. Based on comments from METRO operators and staff, a separate summer schedule that would take into account the increased congestion during the summer season is worth considering.

The proposal to allow holdovers in Lane 1 would be easier to implement with sawtooth bays that allow buses to pull out easily even if there is a bus in the bay directly in front. While not part of the scope of this study, a deal between METRO and the City to swap land in exchange for the City building a new Pacific Station with updated design features and passenger amenities can be easily envisioned.

From this analysis, we find that a transit center with 22-24 bays would allow for existing needs and a future service expansion of 4 bays.