bikeshare business plan

Sacramento Metropolitan Air Quality Management District

Technical Working Paper #2:
Demand, Density, Transit and Technology Integration, Tourism, and Equity

Prepared for: SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

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Revised October 2013

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TABLE OF CONTENTS

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OVERVIEW

The Sacramento Metropolitan Air Quality Management District (SMAQMD) has requested a Bike Share Business Plan for a bike share system in the Sacramento area. This report describes the methodology for forecasting ridership demand, and discusses issues of technology integration and equity.

Demand for Bike Share

The demand evaluation process progressed from a broad, regional analysis, to a detailed ridership forecast at the station level. After reviewing the regional screening, the project team selected station locations for a system with a total of 88 stations: 78 stations in Sacramento and West Sacramento and 10 stations in Davis. Fehr & Peers' Bike Share Ridership Regression Model provided a ridership forecast for each station in the system. The model relies on the relationship between density, demographic and built environment variables and the observed ridership levels at bike share stations in three other North American bike share systems.

Transit System Integration Strategies

A combined transit and bike share payment card has not yet been achieved in a North American system, though there are international examples of a unified payment card. Bike share operators still complement traditional transit with station locations and joint discounts, as well as by coordinating marketing and funding efforts at the organizational level. While there is a precedent for reciprocal membership privileges among bike share systems that share a common hardware platform and vendor, the issue of cross-platform compatibility has not been resolved, and will likely be a continuing challenge.

Equity Analysis

Although bike share holds promise as a means of improving transportation options for individuals with low income and people of color, attracting a diverse rider base to bike share has been an ongoing challenge. Operators have used a variety of strategies to reduce financial barriers, provide physical access to bike share stations, and make information about bike share available to a wide range of communities. Providing the combination of financial, physical, and information access to bike share will be essential to attracting a ridership base that reflects the population of the Sacramento region.

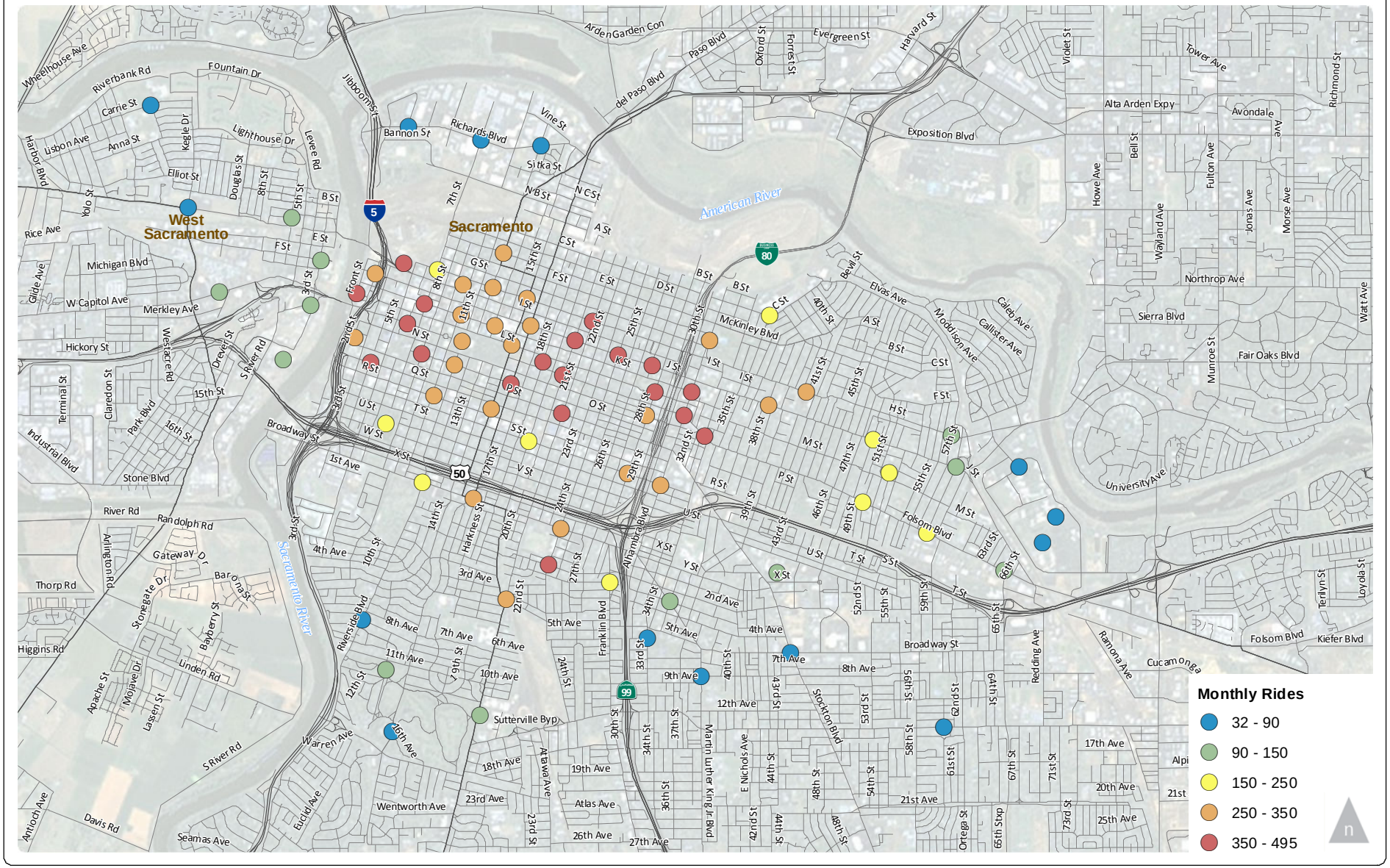
DEMAND FOR BIKE SHARE

The demand evaluation process involved three stages that progressed from a broad, regional analysis, to a detailed ridership forecast at the station level. First, the Regional Demand Screening used broad measures of demographic and built environment characteristics to determine relative bike share suitability across Sacramento and Yolo Counties. Next, Fehr & Peers worked with project stakeholders to examine in more detail the cities of Sacramento, West Sacramento, and Davis, the highest-suitability areas from the regional screening, and to develop draft bike share station locations. The team selected a system of 88 station locations in Sacramento, West Sacramento, and Davis. Finally, the Bike Share Ridership Regression Model was applied to each station location to provide ridership estimates that account for the attributes of each individual station as well as the network of stations as a whole. Based on factors derived from the operating experience of existing bike share systems, these forecasts were adjusted to provide estimates of "opening day", 18-month and 3-year ridership levels, seasonal ridership variations, and weekend vs. weekday ridership. **Table 1** summarizes the ridership forecasts for the 88-station system. **Figures 1 and 2** show the level of "opening day" ridership at each station. Additional detail and methodological description of the forecasting process follows.

TABLE 1 – AVERAGE MONTHLY TOTAL SYSTEM RIDERSHIP

	Low	Most-Likely	High
"Opening Day" (6-month)	10,300	19,890	38,390
18-month	14,300	27,620	53,310
3-year	15,200	29,350	56,640

Source: Fehr & Peers



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STATION RIDERSHIP ESTIMATES
SACRAMENTO AND WEST SACRAMENTO

FIGURE 1

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STATION RIDERSHIP ESTIMATES

DAVIS

FIGURE 2

REGIONAL DEMAND SCREENING

METHODOLOGY

The Regional Demand Screening process combined five variables selected from the Environmental Protection Agency (EPA)'s Smart Location Database (SLD) into a regional bike share Suitability Screening Score that indicates the relative suitability for bike share across Sacramento and Yolo Counties. The variables selected address housing, population, and employment density, land use diversity, and urban design. High population and intersection density (a measure of urban design) are correlated with bike share ridership in the academic literature, and housing density, employment density, and land use diversity intuitively reflect a built environment suitable for shorter trips that could be served by bike share.[1,2] The "D" variables shown in **Table 2** were selected from the EPA's SLD.

[1] Buck, Darren and Ralph Buehler. "Bike Lanes and Other Determinants of Capital Bikeshare Trips." *TRB 2012 Annual Meeting*. 15 November 2011.

[2] Daddio, David William. "Maximizing Bicycle Sharing: An Empirical Analysis of Capital Bikeshare Usage." 2012.

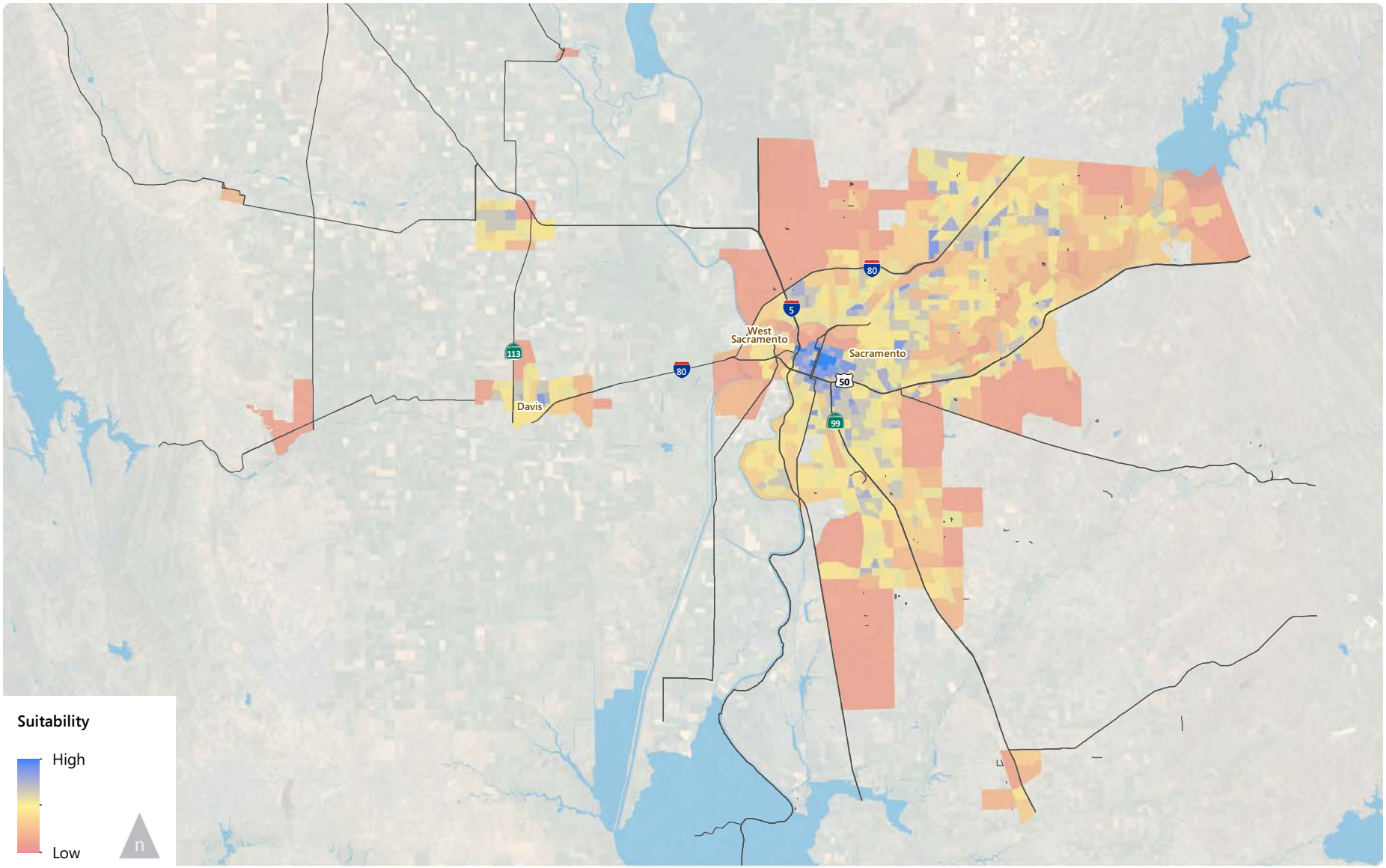
TABLE 2 – EPA SMART LOCATION DATABASE "D" VARIABLES

Factor	Metric	Source Data
Density	$D1_a$: Housing density (units per unprotected acre) in 2010	Housing units: Census 2010
Density	$D1_b$: Population density (people per unprotected acre) in 2010	Population: Census 2010
Density	$D1_c$: Job density (jobs per unprotected acre)	Jobs: Census LED 2008
Land Use Diversity	D2: Entropy index of commercial/industrial/institutional, retail, recreational, and residential within a block group	Jobs and housing units: ESRI Business Demographics 2009
Urban Design	D3: Intersections per sq. mile (weighted by intersection type)	US Census TIGER/Line Shapefile 2009

Source: "EPA's Smart Location Database: A National Dataset for Characterizing Location Sustainability and Urban Form."[3]

These variables were then converted to a 10-meter raster grid, with each variable reclassified on a scale of 1 to 20. The five layers were summed to create a single composite Suitability Screening Score on a theoretical scale of 5 to 100 points and plotted on a map of Sacramento and Yolo Counties to provide a visual indication of relative bike share suitability in the region (see **Figure 3**). **Figures 4 and 5** provide additional detail for the Sacramento area and for Davis, respectively.

[3] Ramsey, Kevin and John Thomas. "EPA's Smart Location Database: A National Dataset for Characterizing Location Sustainability and Urban Form." U.S. Environmental Protection Agency Office of Sustainable Communities. 6 January 2012.



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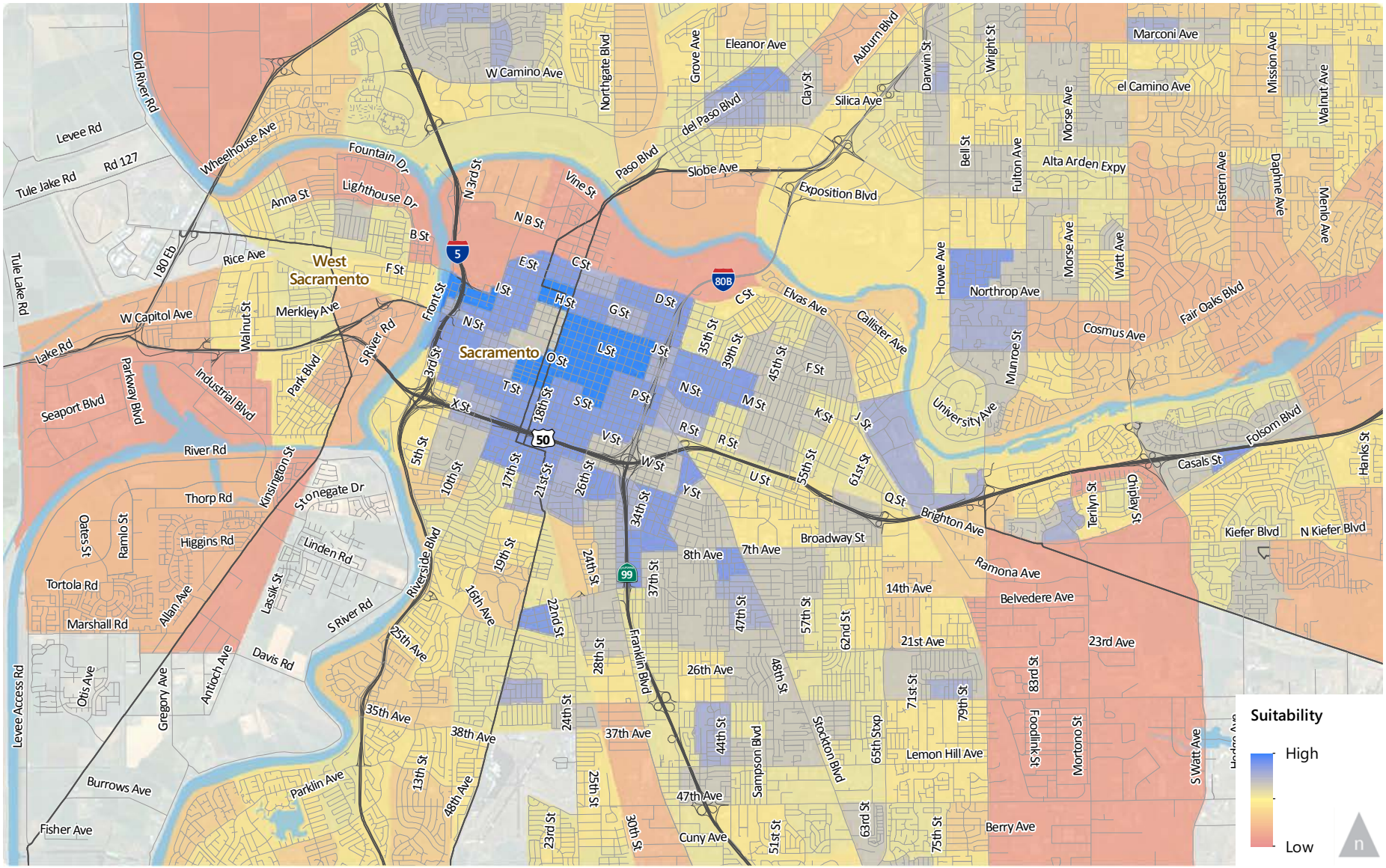
REGIONAL SUITABILITY SCREENING SCORE
SACRAMENTO AND YOLO COUNTIES
FIGURE 3



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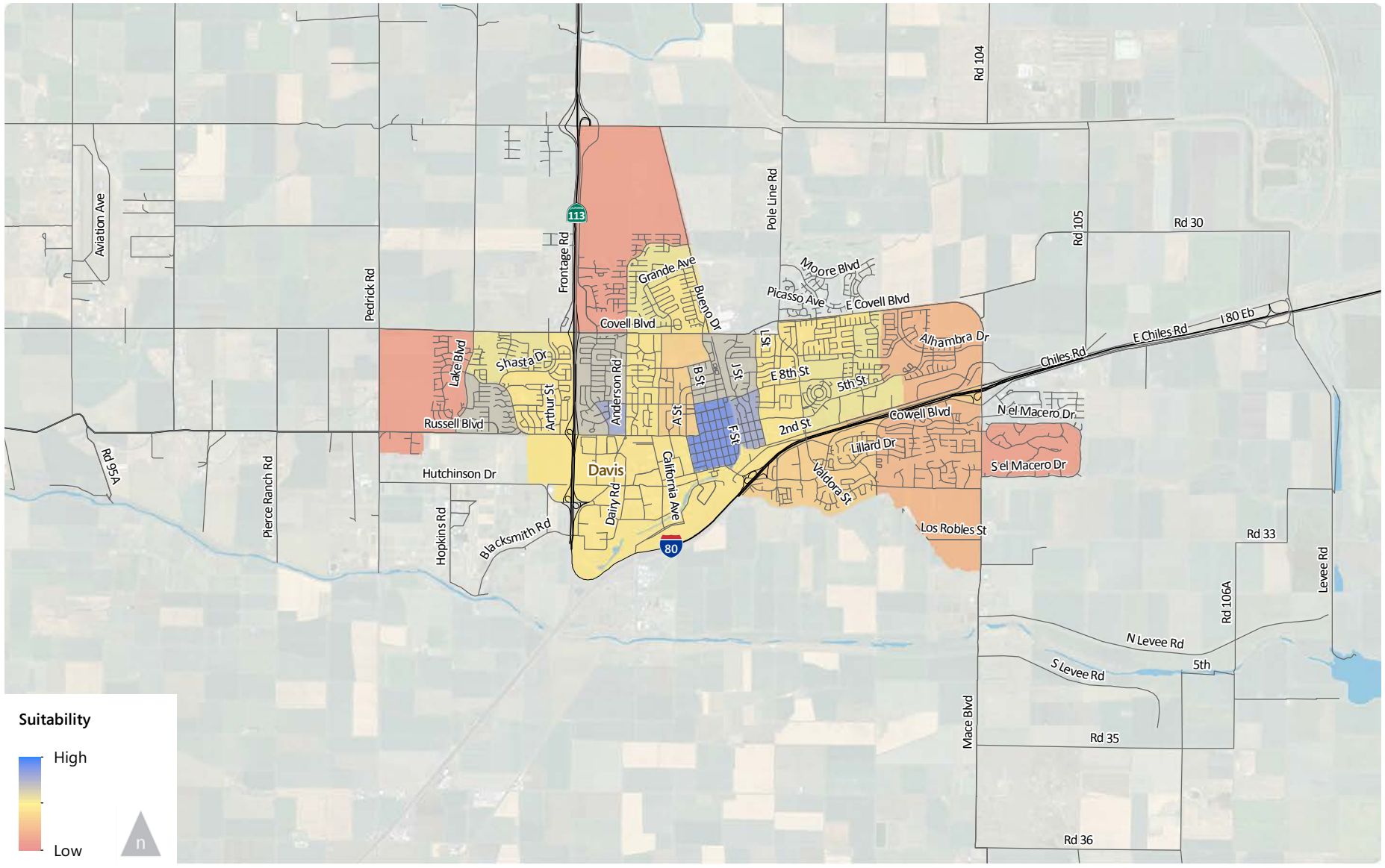
REGIONAL SUITABILITY SCREENING SCORE
SACRAMENTO AND WEST SACRAMENTO
FIGURE 4



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REGIONAL SUITABILITY SCREENING SCORE

DAVIS

FIGURE 5

DISCUSSION

Interpretation

The Suitability Screening Score represents the bike share ridership suitability of a particular grid cell relative to every other grid cell in the analyzed area. A desirable service area for bike share will contain not only areas with the highest Suitability Screening Score, but also a large, relatively contiguous, high-scoring area that can accommodate a network of bike share stations with a variety of attractive destinations. A contiguous service area also reduces the cost of servicing bikes and stations and of redistributing bicycles to ensure the system remains in balance. The area surrounding Downtown and Midtown Sacramento and portions of West Sacramento offers a large cluster of high-suitability areas that could be accessible by bike. Beyond Downtown and Midtown Sacramento, portions of East Sacramento, Oak Park, and Land Park offer high-suitability areas. The central portion of Davis also offers a cluster of moderate- to high-suitability; the presence of UC Davis and a strong local bicycle culture suggests a supportive environment for bike share activity in Davis. These two areas will be the targets for more detailed suitability analysis and ridership forecasting.

Limitations

Despite its usefulness in identifying suitable bike share locations, the Suitability Screening Score is a simple combination of a limited number of factors, and must be interpreted along with additional information and local knowledge. The variables selected are based on ridership data from the Nice Ride system in Minneapolis, MN, the Capital Bikeshare system in Washington, DC, and the Denver B-cycle system, which may have potential riders with different characteristics than those in Sacramento, West Sacramento and Davis.

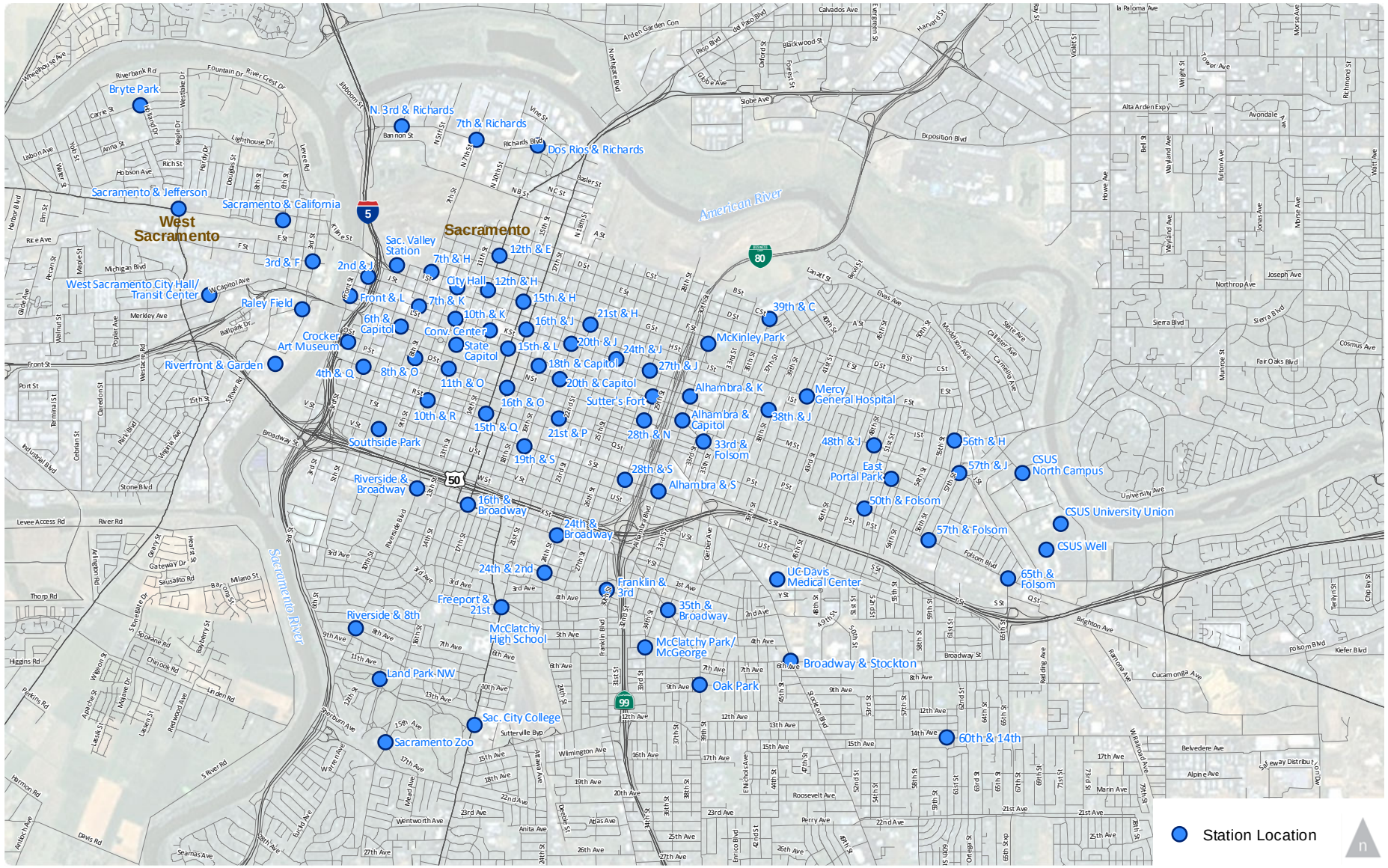
The Suitability Screening Score is focused solely on maximizing the number of check-outs at bike share stations based on empirical relationships in other cities between bike share ridership and the Score's input variables; however, goals other than maximizing ridership are relevant to the selection of a service area and the placement of stations. Stations placed in lower-income areas or areas with a higher non-white population are also desirable to better serve these communities and address economic and racial equity concerns. Placing a station in a lower-ridership suitability area in order to serve a particular attraction or to fill in a gap in the station network might also be desirable. See the Equity Analysis section, below, for further discussion of equity issues and bike share.

STATION LOCATION SELECTION

Informed by the Regional Demand Screening and Detailed Ridership Suitability Analysis, the project team engaged community stakeholders, including the Sacramento Metropolitan Air Quality Management District (SMAQMD), the Yolo-Solano Air Quality Management District, the City of Sacramento, City of West Sacramento, City of Davis, UC Davis, Regional Transit, Capitol Corridor, Yolo County Transportation District, and SACOG, to select planning-level station locations. The following considerations also guided the bike share station selection process:

- **Contiguous network** – ensure that each station has a clear connection to the rest of the station network; avoid isolated stations, even in otherwise suitable areas.
- **Station proximity** – attempt to locate stations within a quarter-mile to half-mile of each other.
- **Bike facilities** – locate stations near designated bike facilities.
- **Institutions** – locate stations to serve large government employers in Downtown Sacramento; educational institutions like Sacramento State, Sacramento City College, and UC Davis; and major medical facilities like Sutter General Hospital and UC Davis Medical Center.
- **Density** – locate stations near dense, mixed commercial and residential areas.
- **Attractions** – provide access to active local and regional attractions, such as Capitol Park, Old Sacramento, Crocker Art Museum, and Sutter's Fort.
- **Transit** – provide connections to existing local and regional transit services, such as Sacramento Regional Transit stations, Sacramento Valley Station, and Davis Amtrak.
- **Equity** – locate stations in a variety of neighborhoods to support geographic and social equity.

The team selected 88 station locations: 78 in Sacramento and West Sacramento and 10 in Davis. The station locations are depicted in **Figure 6** for Sacramento and West Sacramento, and in **Figure 7** for Davis.



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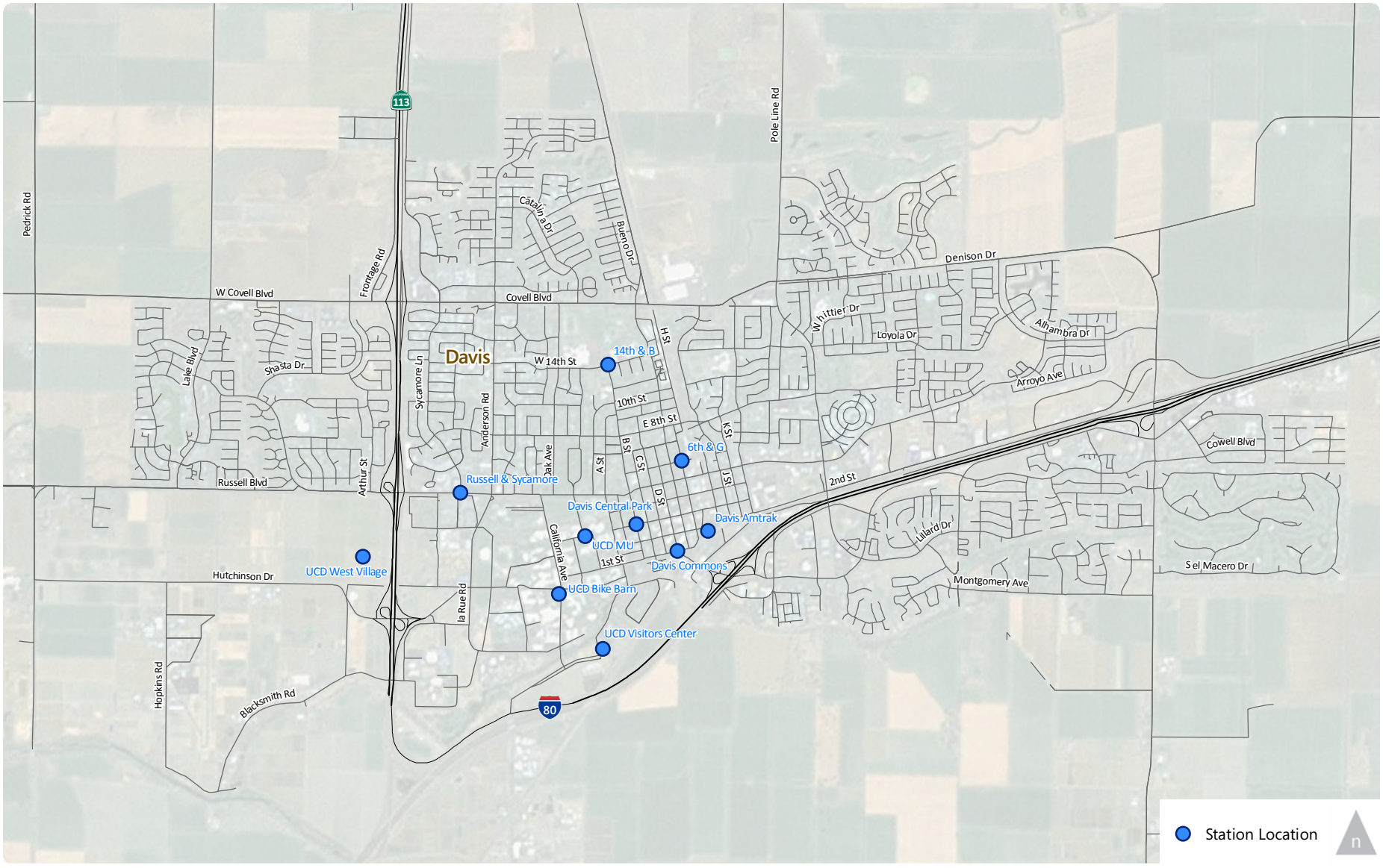
STATION LOCATIONS
SACRAMENTO AND WEST SACRAMENTO
FIGURE 6



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STATION LOCATIONS
DAVIS

FIGURE 7

BIKE SHARE RIDERSHIP DEMAND MODELING

Fehr & Peers analyzed the effects of demographic and built environment characteristics near bike share stations on bike share ridership levels in three operational U.S. systems and applied the resulting regression model to the proposed network of stations in Sacramento, West Sacramento, and Davis. This section describes the development of the regression model and the ridership forecast for the proposed station network.

BIKE SHARE RIDERSHIP REGRESSION MODEL

A regression analysis was performed using stations in the Capital Bikeshare, Denver B-cycle, and Nice Ride MN systems as observations (n=265) and the natural log of average monthly rentals by station in each system's first season of operation as the dependent variable. A consistent dataset of independent variables (see **Table 3**) was collected across all three systems and compiled using a custom GIS toolbox. The variables considered include demographic, built environment, transportation network, and system-specific factors, such as population and employment densities; income, race, commute, and vehicle access variables; proximity to parks and colleges; access to bikeways, bus stops, and other bike share stations; and a city-level precipitation variable and system indicator variables.

Multivariate linear regression models were refined in order to 1) maximize the predictive power of the model as a whole, as measured by the model R-squared, 2) incorporate a variety of independent variables, and 3) maintain statistical significance and intuitive direction of the included variables. The preferred model (see **Table 4**) has a good measure of fit (adjusted R-squared of 0.753) and includes measures of population density, retail job density, share of alternative commuters, median income, share of non-white population, and other bike share stations within 3,200 meters. The stations-within-3,200-meters variable is particularly important to bike share ridership. The variable had a strong positive correlation with ridership in all model specifications tested, and continues to be significant both in isolation and when controlling for the effects of the other regression variables. This variable suggests that bike share systems can support ridership by locating stations in a dense, contiguous network.

TABLE 3 – REGRESSION VARIABLE DEFINITIONS

Variable	Definition	Source
Dependent		
ln(Monthly Rentals)	Natural log of the number of rentals during each system's first operating season, by station; normalized by number of months in first operating season	Bike sharing system operators
Independent		
Demographic Factors		
Population [1]	Total population (in 100s of persons)	U.S. Census Bureau, 2010
Jobs [1]	Total jobs (in 100s), by work area	Longitudinal Employer-Household Dynamics, 2010
High-Income Jobs [1]	Number of jobs (in 100s) paying more than $3,333 per month, by work area	Longitudinal Employer-Household Dynamics, 2010
Retail Jobs [1]	Total retail jobs (in 100s)	Longitudinal Employer-Household Dynamics, 2010
Alternative Commuters [2]	Proportion of workers who commuted by bicycle, walking, or public transportation (100s of workers)	U.S. Census Bureau, 2010
Median Income [2]	Median household income (in 1,000s of dollars)	U.S. Census Bureau, 2010
Non-White Population [2]	Proportion of population that is of a race other than "white alone"	U.S. Census Bureau, 2010
Low-Vehicle Households [2]	Proportion of workers who commuted by bicycle, walking, or public transportation (100s of workers); weighted average by 2010 Census Tract	U.S. Census Bureau, 2010
Built Environment Factors		
College	1 if a college is located within 400 meters, 0 otherwise	U.S. Census Bureau TIGER/Line Shapefile 2009 – Area Landmarks
Park	1 if a park is located within 400 meters, 0 otherwise	DC Office of the Chief Technology Officer; Open Street Map
Transportation Network Factors		
Bikeways	Length of existing bike lanes and paths (in 100s of meters)	District Department of Transportation; Denver GIS; Minnesota Department of Transportation
Bus Stops	Number of bus stops (in 10s of stops)	Washington Metropolitan Area Transit Authority; District Department of Transportation; Denver GIS; Metropolitan Council GIS
Stations Within [X] Meters	Number of bike sharing stations within [X] meters	Bike sharing system operators
System-Specific Factors		
DC Flag	1 if station is in Capital Bikeshare system, 0 otherwise	
DN Flag	1 if station is in Denver B-Cycle system, 0 otherwise	
MN Flag	1 if station is in Nice Ride MN system, 0 otherwise	
Precipitation Days	Average days per system operating month with precipitation 0.01 inches or more	National Climatic Data Center

[1] Summed proportionally by area intersecting 2010 Census Blocks

[2] Weighted average by area of buffer intersecting 2010 Census Tracts

TABLE 4 – PREFERRED REGRESSION MODEL

Variable	Coefficient	Standard Error	p-Value
Population	0.013	0.002	0.000***
Retail Jobs	0.031	0.011	0.008***
Alternative Commuters	1.863	0.268	0.000***
Median Income	0.010	0.002	0.000***
Non-White Population	-2.100	0.184	0.000***
Stations Within 3200 Meters	0.033	0.003	0.000***
Constant	3.536	0.155	0.000***
Independent Variable	ln(Monthly Rentals)		
R^2	0.758		
Adjusted R^2	0.753		

*, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

BIKE SHARE RIDERSHIP FORECAST

Applying the Bike Share Ridership Regression Model to the identified locations results in station-level ridership estimates for each of the 88 proposed bike share stations in the system in Sacramento, West Sacramento and Davis. The Most-Likely "Opening Day" (6-month) model estimates are the actual predicted values based on the model regression coefficients applied to the regression variable values for each station. The Low estimate is one standard error below the Most-Likely estimate, while the High estimate is one standard error above. Because of the model's logarithmic form, the standard error to the upside results in a larger range than the standard error to the downside. This is consistent with experience from the bike share operators interviewed, who noted that ridership grows at a faster-than-linear rate relative to expansions in the system. Maurer (2012) also found a logarithmic bike share ridership relationship.[4] The Most-Likely "Opening Day" (6-month) estimate is equivalent to slightly more than one ride per bike share bike per day, while the High estimate reaches approximately 2.1 rides per bike per day, within the expected range of one to two rides per bike per day based on other operational

[4] Maurer, Lindsay Kathryn. "Feasibility Study for a Bicycle Sharing Program in Sacramento, California." TRB 2012 Annual Meeting. 15 November 2011.

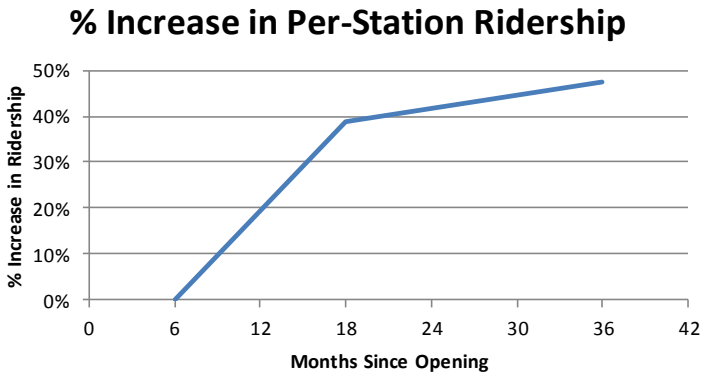
bike share systems and well below Capital Bikeshare's rate of over three rides per bike per day. Figures 1 and 2 display the Most-Likely "Opening Day" (6-month) model estimates for each station.

FUTURE PERIOD, SEASONAL, AND DAY-OF-WEEK FORECASTS

Fehr & Peers analyzed temporal trends in the ridership levels of the Capital Bikeshare and Denver B-cycle systems to develop factors for future period (18-month and 3-year), seasonal, and weekday vs. weekend ridership levels.[5] Factors were developed for each time period and applied to the monthly ridership estimates, resulting in ridership forecasts for each period. In all periods analyzed, ridership levels were normalized for the number of stations by computing rides per operational station on a daily basis.

18-Month and 3-Year Forecasts

To develop 18-month and 3-year forecasts, Fehr & Peers calculated regression equations to relate ridership levels to the number of days since system opening, controlling for seasonality and the number of stations in the system. The regression controlled for seasonality by including flag variables fall (September, October, and November), winter (December, January, and February), and spring (March, April and May). Because the data indicated a "ramp-up" effect, with faster initial growth in per-station ridership, followed by a more moderate growth rate, two different regressions were estimated: one to estimate ridership growth between the "Opening Day" (6-month) level and the 18-month level, and one for growth between the 18-month level and the 3-year level. On average, ridership per station increased by 39 percent between the 6-month point and the 18-month point, and increased 48 percent between the 6-month point and the 3-year point.

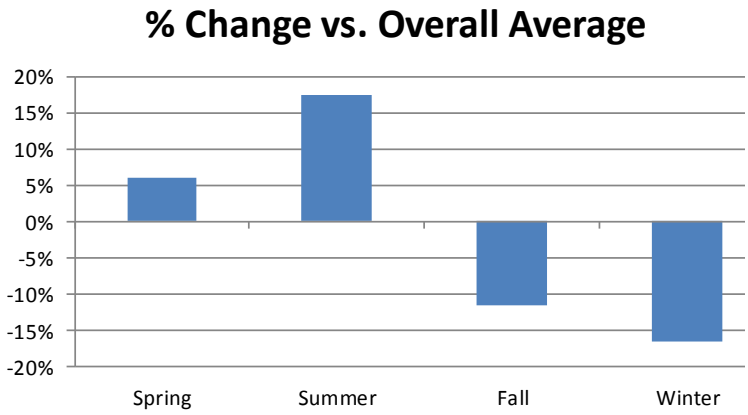


Source: Capital Bikeshare and Denver B-cycle Ridership Data

[5] Nice Ride MN ridership trends were also considered, but ultimately excluded since data were available for the first season only.

Seasonal Forecasts

A similar regression across all available data from the Denver B-cycle and Capital Bikeshare systems was used to investigate the effect of season on ridership levels. Controlling for the underlying increasing ridership trend, spring and summer months experience higher-than-average ridership levels while fall and winter months experience ridership levels that are lower than average. Summer months have 17 percent higher ridership, spring months have 6 percent higher ridership, fall months have 12 percent lower ridership, and winter months have 17 percent lower ridership than average; all differences are significant at the 1 percent level (all p values <0.002).



Source: Capital Bikeshare and Denver B-cycle Ridership Data

This analysis would likely over-represent the negative effect of the winter months on ridership in Sacramento and Davis. Winters in the Sacramento area are milder than those in both Minneapolis, MN and Washington, DC. Winter data from Nice Ride also comprised only a small number of records at the beginning of Decembers before the system closed for each winter, so applying those values against the entire winter season in Sacramento would further exaggerate the negative effect. In order to mitigate these effects and to balance the overall annual ridership forecast so that the net effect of seasonal variation is zero across the entire year, Fehr & Peers has adjusted the seasonal factors to +17 percent for summer, +6 percent for spring, -9 percent for fall and -14 percent for winter.

Weekday versus Weekend Forecasts

Fehr & Peers investigated differences between weekday and weekend ridership levels for the Denver B-cycle system, the Capital Bikeshare system, and for both systems combined. In the Denver system, Weekend ridership levels were eight percent higher than weekday ridership levels (weekend levels were six percent higher than the overall average, while weekday levels were two percent lower). This difference was statistically significant at the five percent level ($p = 0.013$). In the Capital Bikeshare system, however, the difference between weekday and weekend ridership levels was not statistically significant. Similarly,

there was no statistically significant difference in weekday and weekend ridership levels when observations from both systems were considered as a group.

Forecast Summary

Table 5 summarizes the various combinations of future period, seasonal, and sensitivity effects on average monthly total system ridership. Additional detail is broken out for Sacramento/ West Sacramento and Davis in **Appendix A.**

TABLE 5 – AVERAGE MONTHLY TOTAL SYSTEM RIDERSHIP ESTIMATES

	Scenario	Spring	Summer	Fall	Winter	Annual Average
"Opening Day" (6-month)	***Low***	10,920	12,050	9,370	8,860	10,300
	Most-Likely	21,080	23,270	18,100	17,110	19,890
	High	40,690	44,920	34,930	33,020	38,390
18-month	***Low***	15,160	16,740	13,020	12,300	14,300
	Most-Likely	29,280	32,320	25,140	23,760	27,620
	High	56,510	62,380	48,520	45,850	53,310
3-year	***Low***	16,110	17,780	13,830	13,070	15,200
	Most-Likely	31,110	34,340	26,710	25,240	29,350
	High	60,040	66,270	51,540	48,710	56,640

Source: Fehr & Peers; Capital Bikeshare and Denver B-cycle Ridership Data

TRANSIT SYSTEM INTEGRATION STRATEGIES

Integrating bike share with transit systems such as the Capitol Corridor and Sacramento Regional Transit (RT) can provide significant public transportation benefits. In a user survey of three North American bike share systems, over 97 percent agreed that they think of the bike share system as an enhancement to the public transportation system; 41 percent agreed that they had made trips with a combination of public transit and bike share that they had previously made by automobile.[6]

Bike share / Transit Integration Benefits

- Convenient connections when a transfer would be required for a short second leg
- Extended range for transit riders to access destinations beyond a comfortable walking distance from transit ("first-mile/ last-mile")
- Relief for limited bike capacity on board transit vehicles
- A complement to transit for trips that are too long to walk but short enough that waiting for transit is undesirable

STATION CO-LOCATION

The simplest form of integrating bike share with transit is locating bike share stations at or adjacent to transit stops. Denver B-cycle has two stations located directly on Regional Transportation District – Denver (RTD) property and four other stations in rights-of-way directly adjacent to RTD Light Rail stops. Capital Bikeshare has also located many of its stations adjacent to public transportation nodes, such as Metrorail stations and Union Station, the District's commuter rail and Amtrak hub; the bike share stations at the Dupont Circle Metrorail station and at Union Station are the two most active in the entire system.[7] Deutsche Bahn, the German railway company, operates its own bike share service, Call a Bike, at nearly 50 Inter-City Express (ICE) rail stations throughout the country and citywide in eight major cities.

Locating bike share stations near major transit hubs does present challenges with rebalancing. With 31 docks, Capital Bikeshare's Union Station bike share station is among the system's largest, yet it frequently faces the risk of periods when the station is completely full, with no available docking points, or

[6] Shaheen, Susan A., Ph.D., Martin, Elliot W., Ph.D., Cohen, Adam P., Finson, Rachel S. Public Bikesharing Operations in North America, Mineta Transportation Institute, pp.72-74, June 2012.

[7] http://www.capitalbikeshare.com/trip-history-data. 2013Q1. Accessed 27 June 2013.

completely empty, with no bikes available for users to check out. These periods correspond to the peak commute periods when large numbers of commuters arrive at Union Station in the morning peak, looking for bikes, and depart Union Station in the afternoon peak, looking for a place to dock. Because these commute patterns are predictable, operations staff can "pre-balance" the stations by stocking the docks for the morning arrivals or freeing up docks for afternoon departures, but limitations on staff and the time needed to redistribute bikes mean that a rush period with no incidents is not always possible.

TRANSIT DISCOUNT

Offering a discounted bike share membership to users who are also transit pass holders could encourage the use of both the transit and bike share systems. Call a Bike offers a 40 percent discount on day passes and a 25 percent discount on annual memberships. Transit discount programs are not prevalent in the U.S. – Only two of seventeen interviewed North American operators (both in Canada) had a membership discount for transit pass holders.[8]

OTHER COORDINATION

Denver Bike Sharing (DBS) coordinates with Regional Transit District – Denver in a few other ways. RTD's General Manager for Planning has a position on the Denver Bike Sharing Board of Directors, supporting collaboration between the two organizations. Denver Bike Sharing has made the case that the "first-mile" and "last-mile" connectivity provided by Denver B-cycle complements trips made on RTD; RTD will assist DBS by applying for federal capital funding for new bike share stations on their behalf. Marketing is another area for coordination; RTD advertises the bike share service on its buses and light rail in exchange for promotion of RTD services on Denver B-cycle bikes and stations.

[8] Shaheen, Susan A., Ph.D., Martin, Elliot W., Ph.D., Cohen, Adam P., Finson, Rachel S. Public Bikesharing Operations in North America, Mineta Transportation Institute, pp.35-36, June 2012.

FEASIBILITY OF SYNCING WITH CONNECT CARD

CONNECTING WITH TRANSIT OPERATORS

The Connect Card is a partnership of the Sacramento Area Council of Governments and eight local transit agencies, including RT, to allow access to all of the major Sacramento area public transit agencies with a single payment card. Expanding this partnership to include a bike share system could encourage both transit and bike share use, decrease the barriers to using bike share, and expedite the payment process.

There are precedents for the integration of fare media between bike share and other forms of public transit. Stockholm City Bikes accepts the SL Access Card, available from Stockholm's transit agency through ticket agents, SL Centers, and commuter rail stations. The card can be used throughout the SL transit system. Guangzhou Bike Share, which opened in June 2010,[9] also allows members to ride with the Yang Cheng Tong transit card.[10]

The SL Access Card can be used Bike Share and other forms of transit.
Photo: http://swedenstyle.com

However, there are no known examples of shared fare media between transit and bike share being implemented in North America, perhaps due to several implementation barriers. The use of shared fare media has been in place in the San Francisco Bay Area since 1993 in the form of Translink, a magnetic-stripe card[11] and since 1999 in Washington, DC as a contactless smart card,[12] but despite hopes of serving all Bay Area transit agencies by 2001,[13] the Bay Area card (renamed Clipper in 2010) was accepted by only eight agencies by the end of 2011.[14]

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[9] http://www.slideshare.net/rgadgi/guangzhou-bike-share-nitin-warrier

[10] http://en.wikipedia.org/wiki/Yang_Cheng_Tong

[11] http://www.sfgate.com/news/article/Coding-Problems-To-Derail-BART-s-Translink-Program-3019725.php

[12] http://www.wmata.com/about_metro/docs/history.pdf

[13] http://www.sfgate.com/news/article/Multitransit-Card-Proposed-One-ticket-good-for-3016508.php

[14] http://en.wikipedia.org/wiki/Clipper_card

EcoPass, part of RTD's Smart Card system.
Photo: www.rtd-denver.com

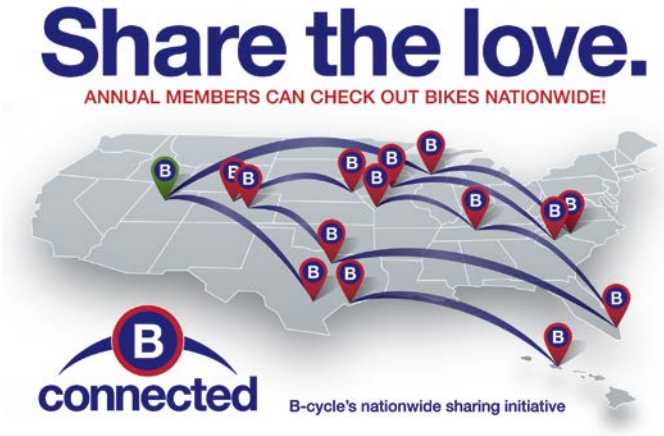
RTD has only recently launched its Smart Card system, which will need to work out reliability issues before potentially including Denver Bike Sharing as a partner. A lack of standards for admitting agencies or organizations to the partnership could also be limiting RTD's willingness to include Denver Bike Sharing. RTD has received numerous requests by prospective partners for inclusion on the Smart Card, and has expressed concern that including Denver Bike Sharing could set a precedent that would be difficult to manage; this concern could be less relevant with a publicly-operated bike share system than it is with non-profit owned and operated Denver B-cycle.

Payment processing presents technical and bureaucratic issues, including linking software systems, separating membership and user fees for each service, as well as managing reciprocity agreements for the distribution of funds from bundled membership fee programs. Bike share typically requires more detailed registration and credit card information than transit passes, in part to help ensure bikes are properly returned; this additional layer of complexity might not be supported by existing transit fare media.

Finally, although it is intuitive that simplifying payment methods for transit and bike share could encourage increased use of both systems, smart cards and bike share are new areas and there is not yet research demonstrating increased ridership from combining payment for both systems onto a single card.

CONNECTING WITH OTHER BIKE SHARE SYSTEMS

Because of the Sacramento Region's relative proximity to the San Francisco Bay Area, reciprocal membership with Bay Area Bike Share, launched in August 2013, could provide additional benefits to bike share users. Annual B-cycle members from nearly any system are able to use B-cycle systems in over a dozen U.S. cities. On their first use in a new system, members swipe their credit card



Cities with B-cycle reciprocal membership privileges.
Image: http://madison.bcycle.com/About/Bconnected.aspx

and accept the system's user agreement; subsequent check-outs can be completed with the B-card as they normally would. Individual B-cycle systems can opt in or out of this reciprocity agreement; currently all systems but one have chosen to participate. Annual membership fees are not shared across systems, but usage fees are collected by the system being used. In Denver, trips by members of other systems constitute less than one percent of total trips.

WE-cycle, a non-profit bike share system in Aspen, CO using Public Bike System Company (PBSC) bikes, has developed a close relationship with Denver Bike Sharing. Upon request, Denver Bike Sharing will provide discounted memberships to WE-cycle members; WE-cycle provides a similar discount to Denver B-cycle members.

Beyond arrangements that can be handled by customer service staff, however, membership, cost, and revenue coordination between systems with different hardware and software platforms (such as B-cycle and PBSC) would be substantially more difficult. DBS staff anticipate that barriers would be too great to overcome at the owner/operator level. Changes to system software to accommodate sharing membership information across platforms would require agreement from the hardware vendors, which vendors would likely resist – beyond the competitive nature of the industry, software and accounting changes to allow revenue and cost sharing would be challenging. B-cycle software cannot currently split membership fees among different B-cycle systems, let alone across hardware and software platforms. Early conversations about the desirability standardizing bike share software systems have begun among bike share operators, but membership integration across platforms does not seem likely at this time.

Cross-platform coordination issues remain challenging.
Image: www.bcycle.com; www.bikewalk.org

EQUITY ANALYSIS

Bicycling in general and bike share in particular have historically struggled to attract lower-income individuals and people of color.[15] African-Americans have significantly lower levels of self-reported bicycle use than the general population, and low-income and non-white households are estimated to have significantly lower rates of bicycle ownership.[16] By providing low-cost access to bicycles, bike share could help reduce barriers to bicycling and encourage bike use in historically underserved communities. In Washington, D.C., bike share users reported significantly lower income than the general cycling population, suggesting that Capital Bikeshare might expand bike access to some lower-income cyclists. Nevertheless, African-Americans make up only 3 percent of Capital Bikeshare users and only 1 percent of Boston Hubway users, while 81 percent of Denver B-cycle users are white and only 21 percent have annual household incomes below $50,000.[17]

Bank on DC expands Capital Bikeshare's membership base. Image: www.bankondc.org

LOWERING BARRIERS – FINANCIAL ACCESS

Bike share programs are making concerted efforts to serve these communities. Capital Bikeshare has partnered with Bank on DC to offer discounted memberships and debit and credit accounts to unbanked individuals who would not otherwise have access to bike share;[18] the program has also reached out to the homeless and unemployed communities, providing discounted memberships to those enrolled in job training sessions.[19] NYC Bike Share, the

[15] Federal Highway Administration. "Bikesharing in the United States: State of the Practice and Guide to Implementation." September 2012. http://www.bicyclinginfo.org/promote/bikeshareintheus.pdf.

[16] Buck, Darren. "Encouraging Equitable Access to Public Bikesharing Systems." 22 December 2012.

[17] http://dc.streetsblog.org/2012/10/03/why-isnt-bike-share-reaching-more-low-income-people/

[18] "Capital Bikeshare Launches Bank on DC Program." 16 December 2011. http://www.capitalbikeshare.com/news/2011/12/16/1140

[19] DePillis, Lydia. "Capital Bikeshare Rolls Out Homeless Pilot." 20 March 2012. http://www.washingtoncitypaper.com/blogs/housingcomplex/2012/03/20/capital-bikeshare-rolls-out-homeless-pilot/

operator of Citi Bike, has also partnered with local housing authorities to increase access to its program. [20] New York City Housing Authority residents and select Community Development Credit Union members are eligible for discounted, $60 annual memberships (a $35 savings). Denver Bike Sharing offers free B-cycle memberships, not tied to a credit card, to Denver Housing Authority residents of buildings adjacent to B-cycle stations. Although DBS has found funding to subsidize these membership and usage fees, significant time and effort go into providing the memberships: Housing Authority staff screen applicants for eligibility and good standing and DBS staff visit sites to recruit members; staff also need to manually adjust records in the software system to exempt these users from fees. Minneapolis' Nice Ride system has eliminated the credit card hold held as a deposit, which presented a barrier to some potential users.[21] Finally, discounts for students, seniors and military are common; Denver offers discounted, $60 annual memberships (a $20 savings) to these groups.

STATION SITING – PHYSICAL ACCESS

Locating bike share stations in communities disproportionately underrepresented in bicycling can improve their mobility by providing affordable access to bicycles; however, low potential ridership levels among these communities might deter systems looking to maximize ridership from locating stations there. In an equity survey of twenty bike share system operators, thirteen reported siting or planning to site stations primarily to serve low-income communities, and the remainder intend to site stations for this purpose in the future.[22] Many systems reported placing stations that serve equity interests, but often incidental to other factors. Nice Ride Minnesota, a non-profit bike share system, placed particular emphasis on station location equity, siting approximately 20 percent of its stations in areas identified by the community as necessary for equity. Beyond providing stations to improve equity in targeted neighborhoods, the program should also ensure that these stations are well-connected to the rest of the system and provide a diverse range of trip-making opportunities for community members.

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[20] Schmitt, Angie. "Why Isn't Bike-Share Reaching More Low-Income People?" 3 October 2012. http://dc.streetsblog.org/2012/10/03/why-isnt-bike-share-reaching-more-low-income-people/

[21] "Frequently Asked Questions: What about low income New Yorkers?" http://citibikenyc.com/faq#_What_about_low_income

[22] Buck, Darren. "Encouraging Equitable Access to Public Bikesharing Systems." 22 December 2012.

MARKETING AND OUTREACH – INFORMATION ACCESS

New bike share systems typically benefit from lots of mainstream press, but reaching broader communities may be more difficult. Only eight of twenty surveyed operators reported current or planned community-specific outreach efforts; of those that did, several indicate targeted outreach through affordable housing authorities, churches, and community-based organizations.[23] While marketing to diverse communities is important, it is also essential to ensure that these populations have physical and financial access to the bike share system, so that marketing efforts can actually result in new members and new trips.

AN ONGOING EFFORT

Reaching historically underserved communities will require continued effort on the part of the bike share operator. Some funding is available specifically for addressing equity issues. Denver Bike Sharing is currently engaged in a two-year project, funded by Kaiser Permanente, to research the operational, economic, and cultural barriers to adoption of bike share by diverse populations. After a first year of research and campaign design, the project will implement a program to increase the diversity of Denver B-cycle membership. The Sacramento Area Bike Share Program should consider employing a broad range of strategies to engage potential bike share users and develop a ridership base that reflects the population of the Sacramento region.

[23] Buck, Darren. "Encouraging Equitable Access to Public Bikesharing Systems." 22 December 2012.

APPENDIX A: RIDERSHIP FORECAST DETAIL

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TABLE A1 – AVERAGE MONTHLY TOTAL SYSTEM RIDERSHIP ESTIMATES

SACRAMENTO/ WEST SACRAMENTO STATIONS ONLY

	Scenario	Spring	Summer	Fall	Winter	Annual Average
"Opening Day" (6-month)	***Low***	10,460	11,540	8,980	8,480	9,870
	Most-Likely	20,190	22,280	17,330	16,380	19,050
	High	38,970	43,010	33,450	31,620	36,760
18-month	***Low***	14,520	16,030	12,470	11,780	13,700
	Most-Likely	28,040	30,950	24,070	22,750	26,450
	High	54,120	59,740	46,460	43,910	51,060
3-year	***Low***	15,430	17,030	13,250	12,520	14,560
	Most-Likely	29,790	32,880	25,570	24,170	28,100
	High	57,500	63,460	49,360	46,650	54,240

TABLE A2 – AVERAGE MONTHLY TOTAL SYSTEM RIDERSHIP ESTIMATES

DAVIS STATIONS ONLY

	Scenario	Spring	Summer	Fall	Winter	Annual Average
"Opening Day" (6-month)	***Low***	460	510	400	380	440
	Most-Likely	890	990	770	720	840
	High	1,720	1,900	1,480	1,400	1,630
18-month	***Low***	640	710	550	520	610
	Most-Likely	1,240	1,370	1,060	1,010	1,170
	High	2,390	2,640	2,050	1,940	2,260
3-year	***Low***	680	750	590	550	640
	Most-Likely	1,320	1,450	1,130	1,070	1,240
	High	2,540	2,810	2,180	2,060	2,400