



# CALL-N-RIDE PERFORMANCE REVIEW



Submitted by:



Transportation  
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# call-n-Ride Performance Review

## 1. Defining RTD's call-n-Ride Services

The RTD call-n-Ride service is currently classified as a non-fixed route service within the RTD Service Standards. These services, which also include Vanpooling, Senior Ride, and Senior Shopper, are designed to compliment the seven fixed route service groups provided by RTD: CBD Local, Urban Local, Suburban Local, Limited, Express, Regional, and skyRide services. Each call-n-Ride is provided within a particular geographic service area.

### 1.1 call-n-Ride Characteristics

Generally, the call-n-Ride service areas are defined by the following characteristics:

- They encompass a geographic area where residents and employees do not have immediate access to one of RTD's fixed route services.
- The service standards specify call-n-Ride areas to be between 4 and 10 square miles with 2 to 4 persons per acre and 1 to 3 employees per acre.
- They connect residents and employees to intersecting RTD fixed route services, as well as with local park-n-Ride facilities and transit stations. They also connect riders to activity centers within the geographic service area, such as shopping malls, schools, and corporate office parks.
- Riders call at least one hour ahead of time to make an appointment by requesting a pick-up time and location and a drop-off destination.
- The vehicles used for the service are typically 15 passenger body-on-chassis.
- They provide service throughout the entire weekday, with few call-n-Ride areas providing weekend service.
- call-n-Rides often utilize point deviation configurations to accommodate more passengers and improve productivity, but requiring customers to access grouping points. Thus call-n-Ride areas may contain one or more zones with checkpoint stops and these can also be at scheduled pickup/drop-off times. Feeder service to a Light Rail station every 30 minutes is a simple example.
- Some call-n-Ride services were implemented in place of eliminated underperforming RTD routes, usually shuttles and circulators.

The following table shows general characteristics of each call-n-Ride within the RTD system:

Table 1.1. General Service Characteristics						
Route	Service Sector	Point Deviation	Bus Route Replacement	Destinations Within Service Area		
				Employment Centers	Shopping Centers	Light Rail Transit Station
Arapahoe	Southeast	●			●	●
Arvada	North				●	
Aurora	Southeast	●				●
Brighton	North		●		●	
Broomfield	North	●			●	
Dry Creek	Southeast	●			●	●
Evergreen	West				●	
Gateway	Southeast	●	●		●	
Highlands Ranch	Southeast				●	
Interlocken	North	●		●	●	
Lone Tree	Southeast	●			●	●
Longmont	North				●	
Louisville	North				●	
Meridian	Southeast	●		●		●
N Inverness	Southeast	●		●		●
N Thornton	North			●		
Orchard	Southeast	●			●	●
Parker	Southeast				●	
S Inverness	Southeast	●		●	●	●
S Thornton	North				●	
Superior	North	●			●	

## 1.2 call-n-Ride Service Types

RTD currently runs three types of call-n-Ride services: simple Demand Response Transit (DRT), point deviation, and route deviation. The three types embody a range of transit options, from basic call-n-Ride to services closely resembling fixed routes. These service types allow for RTD to provide appropriate call-n-Ride service tailored to a service area’s unique characteristics.

### Simple DRT

In its basic form, demand response transit (DRT) service has no established route or scheduled stops and operates as a many-to-many dial-a-ride. Transit service is provided only when specifically requested by customers.

### Point deviation

Point deviation service offers the benefit of scheduled service from at least one common stop (usually local activity centers or transit hubs). The route can deviate between the scheduled stops to serve individual needs; however, the vehicle must

arrive at the checkpoints at the scheduled time. Many of RTD call-n-Rides with scheduled stops at park-n-Rides are included in this service type.

### Route Deviation

Route deviation call-n-Rides take point deviated services a step further, having a fixed route with scheduled stops (usually more stops than point-deviated services). Call-n-Rides of this service type differ from circulators in that they may deviate to serve off-route locations up to a certain distance. These services are often referred to as Flex Routes (such as the current service in Gateway).

## **2. Methodology**

This review aims to identify market characteristics and service design variables related to call-n-Ride route performance. This service review includes analyses of a number of variables which may influence the performance of the call-n-Rides in the RTD system. Factors which demonstrate significant correlation with call-n-Ride services may be used to develop warrants for future call-n-Ride service area proposals, in order to forecast probable service performance prior to implementation.

The two performance metrics evaluated for each call-n-Ride service area are boardings per acre and boardings per in-service hour, as provided by RTD. These metrics reflect both the intensity of passenger activity over a geographic area, and boardings as a measure of transit resources invested.

The population characteristics reviewed for their impacts on call-n-Ride performance include population density, employment density, zero-vehicle household density, median household income, senior density, and youth density. These variables often relate to transit usage, with areas of greater densities and lower household incomes expected to produce strong ridership activity.

Service characteristics are also key indicators of service area performance, as they can provide revealing differences in service level design between the various service areas. The service characteristics evaluated in this analysis include in-service hours, service area size, peak headways (only for service areas with scheduled checkpoints), the mileage of alternative RTD routes within the service area (factored by the size of the area), and the number of connections with other RTD routes.

The connecting route variable is differentiated between timed and non-timed transfers, as each type of connection may have a different type of impact on service performance. Timed connections are perceived as more attractive to customers, since they provide more immediate and convenient service to call-n-Ride passengers who transfer to other RTD routes. In the analysis, therefore, timed transfers are given a greater weight than non-timed transfers.

This analysis assumes that customers have an average wait time of 5 minutes when connecting to another route in a timed transfer environment. Without the timed transfer, a passenger connecting to route running at a 30-minute frequency (the most common frequency in the RTD network) would have an average wait time of 15 minutes. Therefore, the weighted ratio of the convenience of a timed transfer connection is 3:1. This allows the analysis to reflect the significance of having timed connections between call-n-Ride services and RTD fixed routes.

For the purposes of this review, all 20 active call-n-Rides in the Denver metropolitan area have been studied, as well as the Arvada call-n-Ride, which was eliminated in May 2008. These services cover a variety of areas throughout the Denver metropolitan area. A map of call-n-Ride service areas is included as Appendix D.

### 3. Service Area Demographic Characteristics

The following matrix depicts the demographic characteristics of the call-n-Ride service areas. The call-n-Ride services are listed in descending order based upon boardings per in-service hour, and densities are given on a per-acre basis.

Table 3.1. call-n-Ride Service Area Population Characteristics								
Performance Data			Population Characteristics					
Route	Boardings Per Service Hour	Boardings Per Acre	Population Density	Employment Density	Zero Vehicle Household Density	Median Income	Senior Density	Youth Density
Gateway	19.1	0.113	2.67	0.57	0.00	\$54,800	0.04	0.33
Orchard	9.7	0.024	3.61	13.72	0.00	\$98,000	0.35	1.43
N Inverness	9.5	0.034	0.28	5.31	0.00	\$80,000	0.05	0.50
Meridian	8.7	0.278	1.94	11.29	0.00	\$46,000	0.01	0.00
Interlocken	7.7	0.036	2.76	1.35	0.00	\$64,400	0.19	2.14
S Inverness	7.4	0.125	0.75	9.20	0.00	\$23,000	0.01	0.00
Superior	5.7	0.041	2.69	2.92	0.00	\$79,700	0.03	0.60
Brighton	4.5	0.009	2.57	1.04	0.08	\$50,700	0.66	1.42
Broomfield	4.5	0.014	5.45	1.98	0.05	\$67,600	0.54	1.68
Evergreen	4.4	0.020	1.17	0.46	0.00	\$84,200	0.09	0.20
Arapahoe	4.4	0.023	6.09	3.08	0.00	\$103,500	0.33	1.55
Louisville	4.1	0.046	3.58	2.25	0.00	\$76,600	0.26	1.07
Aurora	4.0	0.015	9.58	6.08	0.21	\$50,000	1.09	1.86
Dry Creek	3.8	0.017	6.13	6.64	0.00	\$82,000	0.54	1.80
N Thornton	3.8	0.014	7.85	2.31	0.08	\$62,800	0.45	1.93
S Thornton	3.5	0.010	8.86	2.54	0.03	\$47,800	0.65	2.03
Lone Tree	3.3	0.016	4.79	3.83	0.00	\$88,400	0.15	1.22
Longmont	3.0	0.010	4.50	2.07	0.08	\$56,000	0.70	1.67
Arvada	2.9	0.006	6.42	3.38	0.16	\$45,000	1.17	1.75
Parker	2.9	0.010	3.17	1.68	0.00	\$80,000	0.12	0.60
Highlands Ranch	2.7	0.008	5.52	1.11	0.00	\$96,600	0.23	1.43

Sources: Denver RTD (2008 data), US Census, DRCOG

Table 3.2. call-n-Ride Service Area Characteristics R-squared Values						
	Population Density	Employment Density	Zero Vehicle Household Density	Median Income	Senior Density	Youth Density
Per Service Hour	0.212	0.045	0.096	0.021	0.198	0.209
Per Acre	0.185	0.238	0.079	0.162	0.211	0.402

Each of these service area population characteristics were plotted against both boardings per service hour and boardings per acre, to reveal the levels of correlation between each of the variables and call-n-Ride performance. This data can be found attached as Appendix A. The R squared value represents the amount of variation in the route performance relative to the specific demographic variable against which it is measured. An R squared value of around 0.5 or higher shows significant correlation between the two variables.

None of the demographic variables meet the R squared threshold of 0.5 when plotted against the performance measurements. Very few even surpass a value of 0.3, suggesting that service area population characteristics have little statistically significant influence on the performance of the call-n-Rides.

### 3.1 Low Correlation: Population Density, Employment Density, Senior Density, Youth Density

The population density variable has a low correlation with the boardings per acre performance measure. The relationship between the two variables is a negative correlation, meaning as the population density increases, the boardings per acre decrease. This finding is representative of RTD’s area coverage standards, which require more dense areas to be provided with increased service from its fixed route service classes. Residents of these areas may have increased options to ride alternative RTD services.

As for the effect of employment density on boardings per acre, the results show a low correlation. The correlation is positive, where an increase in employment density appears to coincide with an increase on boardings per acre. This evidence is supported by the presence of numerous corporate office parks and business centers scattered throughout call-n-Ride service areas. This suggests that a number of the employees of these business centers utilize the call-n-Ride service to connect them to other RTD routes or park-n-Rides for their peak hour commute.

The final service area population characteristic that appears to have a slight impact on boardings per acre is the density of the youth population. This variable shows a significantly stronger correlation with the performance measure, suggesting that the presence of a youth population has a higher impact on the performance measurements than the other service area population characteristics. The relationship is a negative

correlation; as youth density increases, boardings per acre tend to decrease. These results suggest that the youth population does not rely on the call-n-Ride service, despite the fact that nearly all of the call-n-Ride service areas contain schools.

As mentioned before, none of these results meet the 0.5 R squared value threshold, meaning that there is no *statistically significant* correlation between the variables. However, it is still worth describing whatever correlations exist for the purposes of revealing any impacts that the service area characteristics may have on call-n-Ride performance.

### **3.2 Insignificant Correlation: Zero-Vehicle Household Density, Median Income, Senior Density**

The demographic variables that have an even weaker correlation with performance measurements are zero vehicle household density and median income (although median income had a slightly higher correlation with boardings per acre).

## **4. Service Characteristics**

The following matrix depicts the service characteristics of the call-n-Ride services. The call-n-Ride services are listed in descending order based upon boardings per service hour.

Table 4.1. call-n-Ride Service Characteristics									
Performance Data					Service Information				
Route	Boardings Per Service Hour	Boardings Per Acre	In-Service Hours	Area Coverage (acres)	Peak Headway	Miles of Existing RTD Route*	Number of Connections		Number of Connections (weighted)
							Timed Transfer	Non-Timed Transfer	
Gateway	19.1	0.113	29.0	4,914	30	2.9	7	-	7
Orchard	9.7	0.024	20.5	1,715	-	1.1	2	-	2
N Inverness	9.5	0.034	26.5	1,414	10	1.2	2	-	2
Meridian	8.7	0.278	21.0	713	15	0.7	2	-	2
Interlocken	7.7	0.036	16.5	3,593	30	3.1	7	-	7
S Inverness	7.4	0.125	20.5	742	10	0.7	2	-	2
Superior	5.7	0.041	14.5	3,699	30	4.7	8	-	8
Brighton	4.5	0.009	14.5	7,340	-	1.4	-	4	1.3
Broomfield	4.5	0.014	14.5	4,752	30	4.4	11	-	11
Evergreen	4.4	0.020	29.0	6,268	-	1.1	-	3	1
Arapahoe	4.4	0.023	14.5	2,766	-	0.7	3	-	11
Louisville	4.1	0.046	16.5	5,469	30	3.9	8	-	8
Aurora	4.0	0.015	14.5	3,962	60	5.5	11 (partial)	-	3
Dry Creek	3.8	0.017	14.5	3,157	-	1.2	3	-	3
N Thornton	3.8	0.014	14.5	6,044	-	1.8	-	6	2
S Thornton	3.5	0.010	14.5	5,567	-	3.7	-	7	2.3
Lone Tree	3.3	0.016	14.5	4,235	-	2.4	5	-	5
Longmont	3.0	0.010	32.5	17,599	-	2.5	-	6	2
Arvada	2.9	0.006	14.5	6,716	-	3.9	-	-	0
Parker	2.9	0.010	14.5	5,126	-	1.4	-	3	1
Highlands Ranch	2.7	0.008	14.5	4,861	-	1.5	-	9	3

\*Miles of route per square mile of service area.

Table 4.2. call-n-Ride Service Characteristics R-squared Values					
	In-Service Hours	Area Coverage	Peak Headway	Miles of Existing RTD Routes	# of Connections (weighted)
Per Service Hour	0.259	0.11	0.06	0.072	0.026
Per Acre	0.074	0.157	0.035	0.113	0

As with the service area population characteristics, each of the service characteristics were plotted against both boardings per service hour and boardings per acre, to reveal the levels of correlation between each of the variables and call-n-Ride performance. The data can be found attached as Appendix B.

The service characteristics appear to show even less correlation with the performance measures than the demographic characteristics. None of the variables come anywhere near the R-squared threshold of 0.5.



#### **4.1 Insignificant Correlation: In-Service Hours, Area Coverage, Peak Headway, Miles of Other RTD Routes, Number of Connecting Routes**

The amount of daily in-service hours was found to be an insignificant variable when plotted against the performance measures. The size of the service area covered and the presence of alternative RTD routes also demonstrated little correlation with the performance measures. Additionally, the number of connections for a service area was found to be statistically insignificant, despite the weighted measurements.

#### **4.2 Point Deviation Service and High Performance**

In general, the call-n-Ride services which offer point-deviated service have higher performance results than those which do not. Four of the top five higher-performing service areas (based on boardings per in-service hour) offer scheduled stops. It is likely that these call-n-Rides perform at a higher level due to the amount of activity during their point-deviation hours. Many of these particular services act as feeder/distributors during the peak commute hours, providing direct connecting routes between employment centers and RTD's main fixed route services (especially the light rail transit stations in the southeast Denver metropolitan area). The presence of scheduled checkpoints typically reflects higher demand within a particular call-n-Ride service area, and results in higher performance for a service area.

### **5. Correlation with Multiple Variables**

On the whole, the demographic characteristics proved to be more predictive of service performance than the service characteristics. The five variables with the highest overall correlation to performance (population density, employment density, senior density, youth density, and median income) were entered into a multiple regression equation against each of the performance indicators, boardings per in-service hour and boardings per acre. The results are shown in the data set provided as Appendix C.

The variables proved highly predictive of boardings per acre. With an R squared value of 0.72, the model shows that roughly 70% of the variation in boardings per acre values can be explained by the five factors included in the equation. This finding makes sense due to the fact that four of the five variables are density measures, and boardings per acre is a measure of the density of call-n-Ride ridership. These variables, therefore, may be appropriate to consider when planning for new call-n-Ride service implementation.

The model was less successful in predicting boardings per in-service hour, only accounting for roughly 30% of variation.

## 6. Additional call-n-Ride Service Area Attributes

There are a number of qualitative service area characteristics which play a significant role in the success of the call-n-Rides, including the presence of employment centers, local activity destinations such as retail complexes, and major transit hubs.

Employment centers provide a consistent market of employees who rely on call-n-Ride services for their daily commute. Four out of the five top-performing call-n-Ride routes include major office complexes. Areas such as the Denver Tech Center (which forms part of several call-n-Ride service areas), which combine employment centers with readily accessible transit stations, are representative of successful call-n-Rides in employment center areas.

Call-n-Rides also benefit from the presence of rail stations and transit (transfer) hubs, where riders are able to transfer from the call-n-Ride vans to a connecting RTD service. Shopping and medical centers and schools are also major traffic generators for call-n-Ride.

## 7. Key Findings

- **Neither demographic nor service characteristics appear to have a strong impact on call-n-Ride performance.**

The results of the statistical analysis show that while demographic characteristics are more highly correlated with performance than service design characteristics, neither have a strong performance of call-n-Ride services. This suggests that the success of a call-n-Ride service varies from community to community, as each target service area has widely varying attributes. The variables analyzed, on their own, are not shown to be appropriate in developing warrants for new call-n-Ride services.

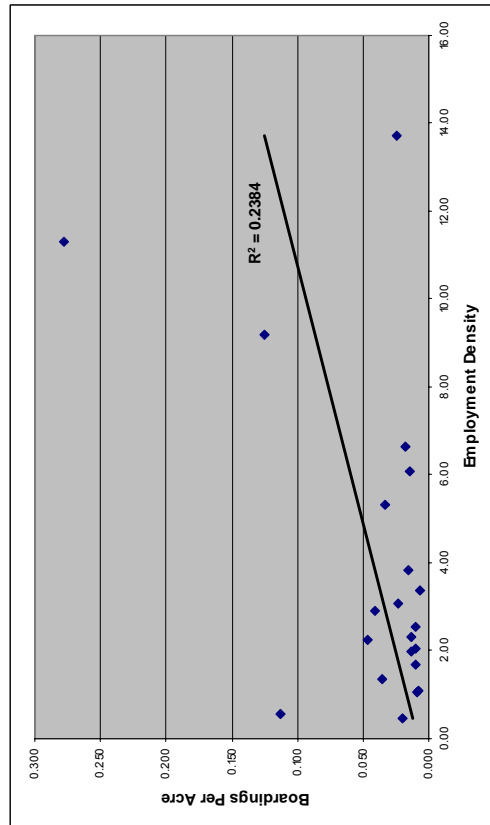
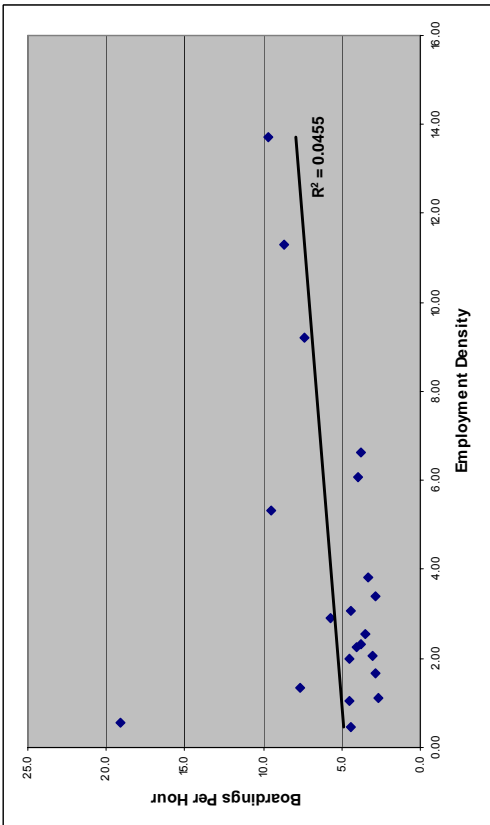
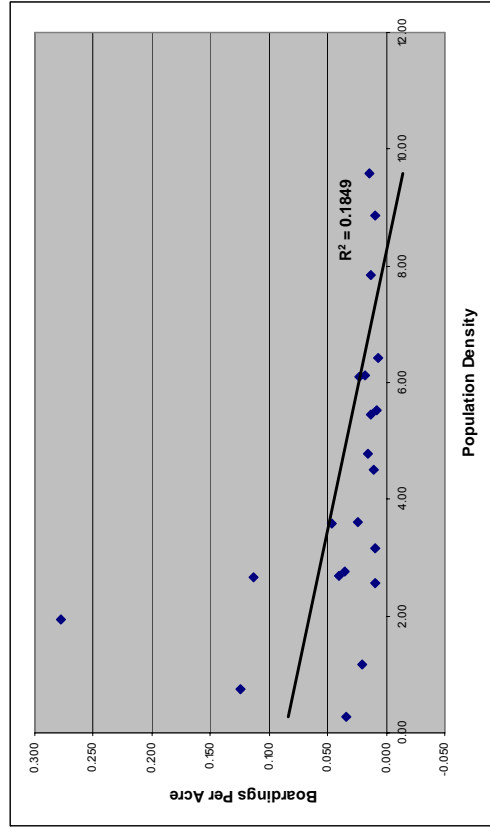
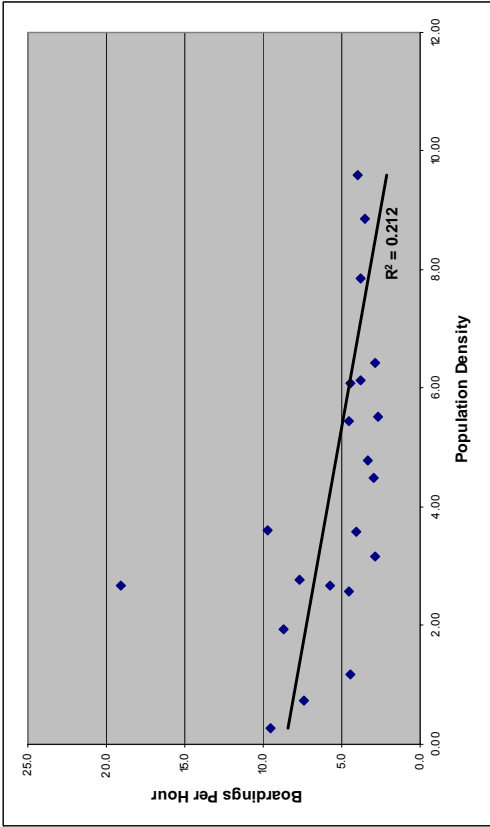
- **Routes with scheduled stops are the most productive call-n-Ride services.**

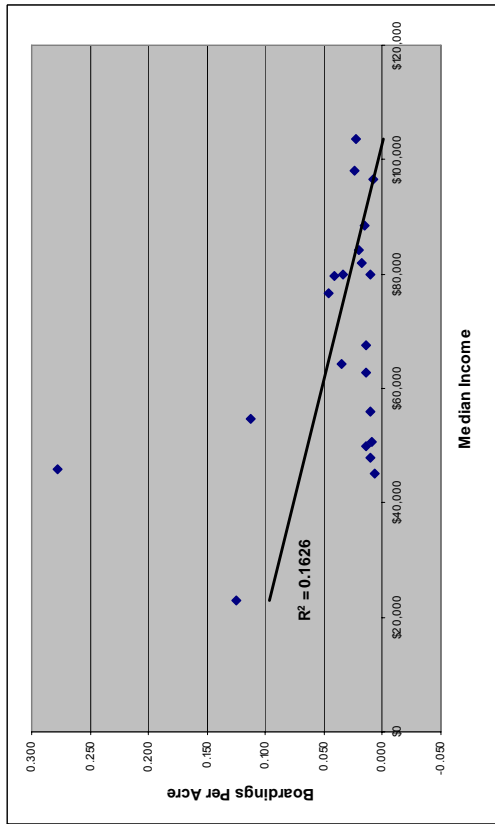
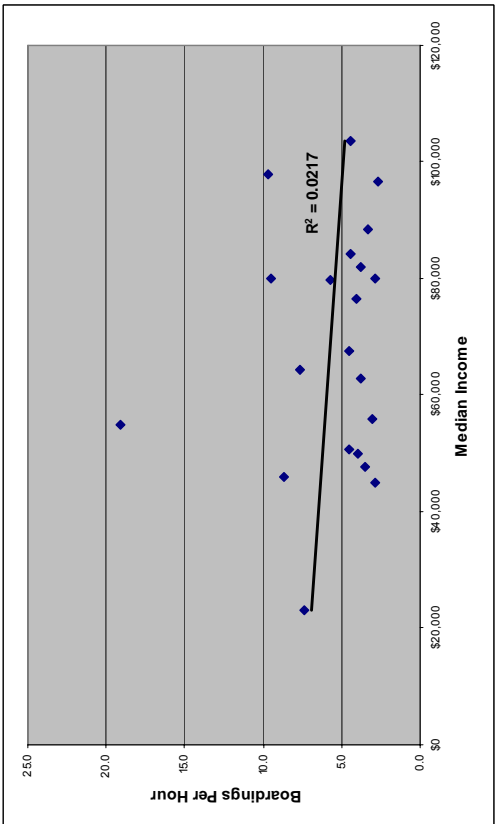
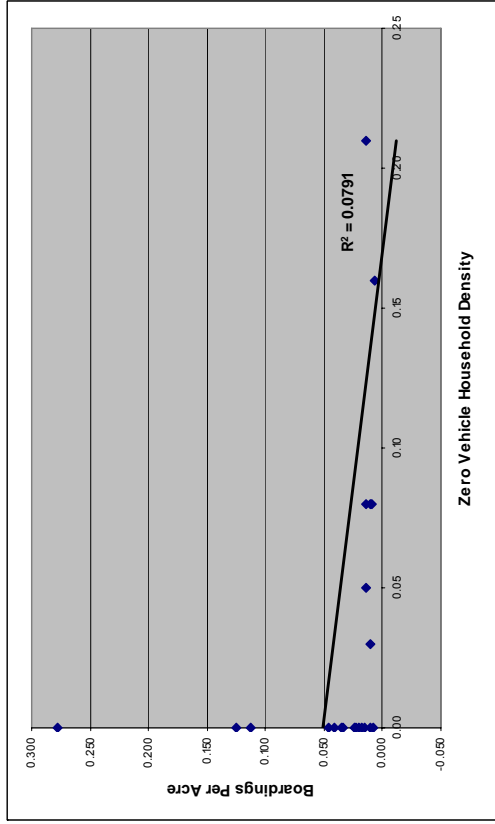
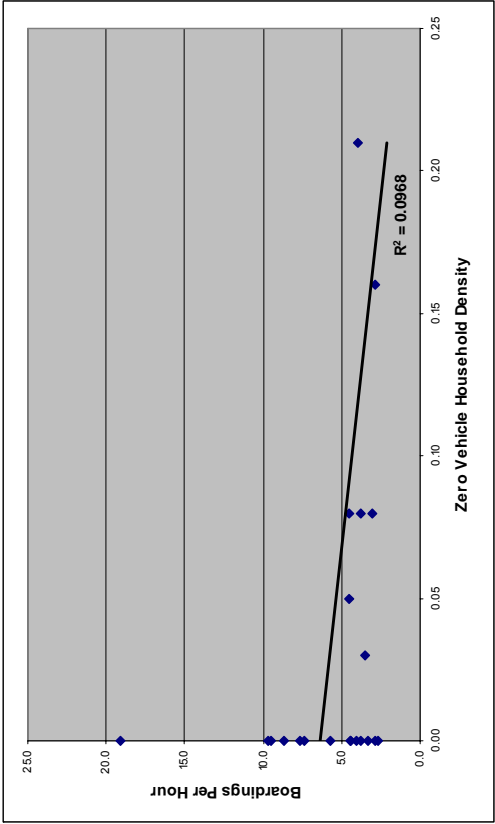
The call-n-Ride services offering point deviation and scheduled checkpoints perform significantly better than those that do not. These particular services seem to work well for regular commuters who routinely ride the call-n-Ride services. The consistency of service helps to increase its attractiveness to riders who require the same service on a repeated basis. Although the implementation of point deviation is partially brought about by high ridership demand, designing other call-n-Ride service areas to provide checkpoint service, if applicable, may help to increase the performance, as it helps to create a base market with consistent ridership. Utilizing scheduled stop service eliminates the need for customers to call ahead to plan trips, allowing for more spontaneous ridership.

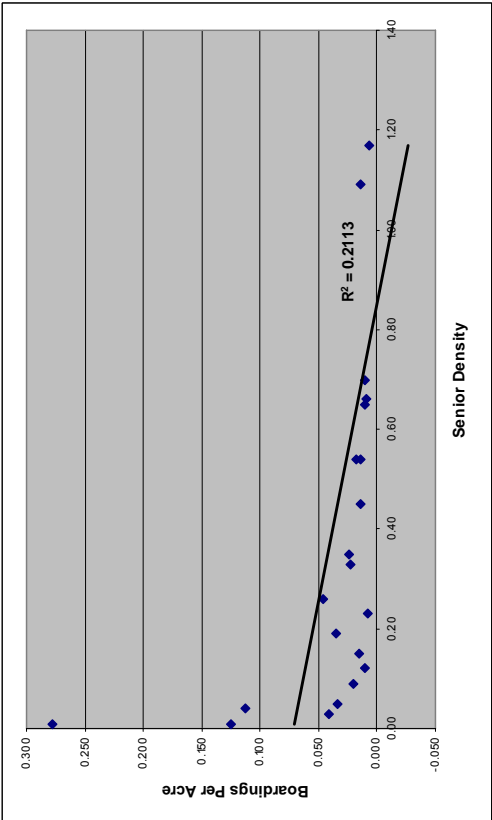
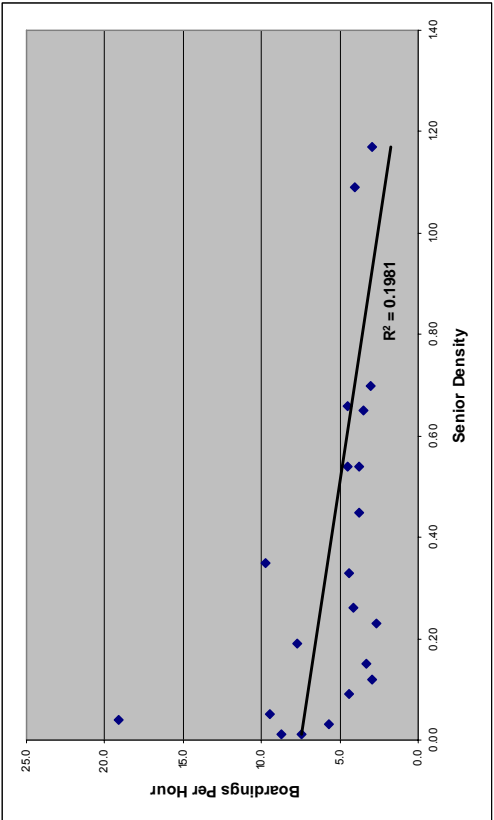
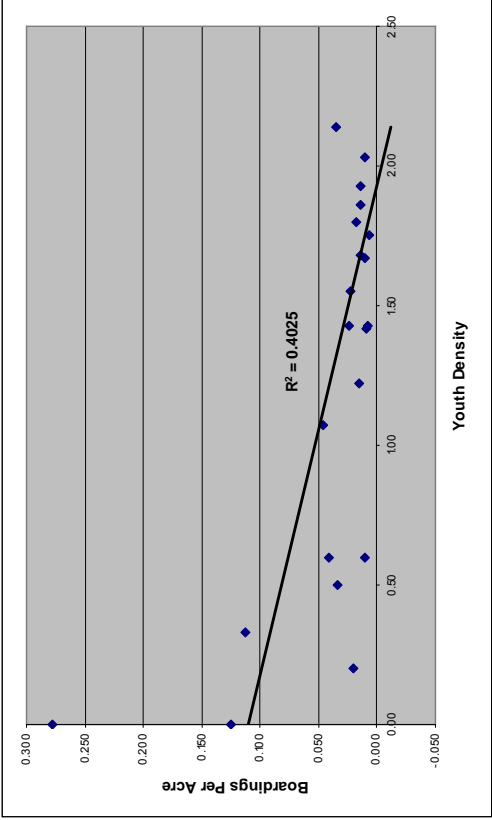
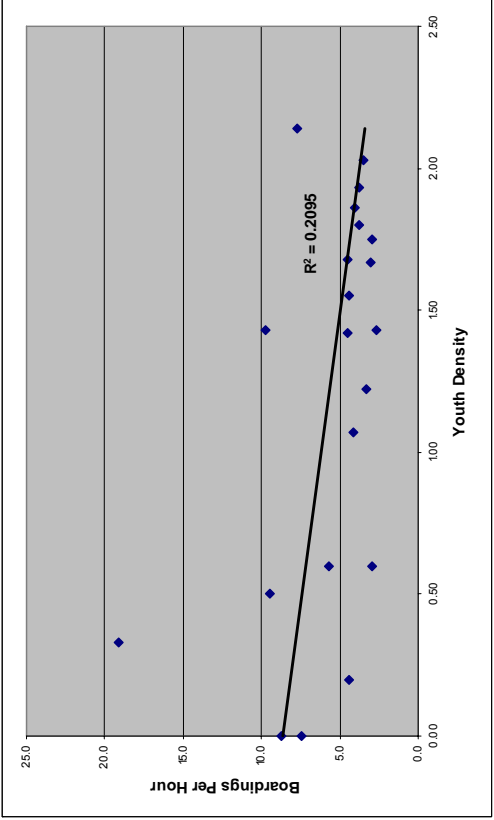
- **Taken together, certain demographic characteristics show some correlation with performance.**

A multiple regression equation including population density, employment density, youth density, senior density, and median income proved to be statistically significant predictors of boardings per acre. These five variables could provide insights into the probable performance of future call-n-Ride services.

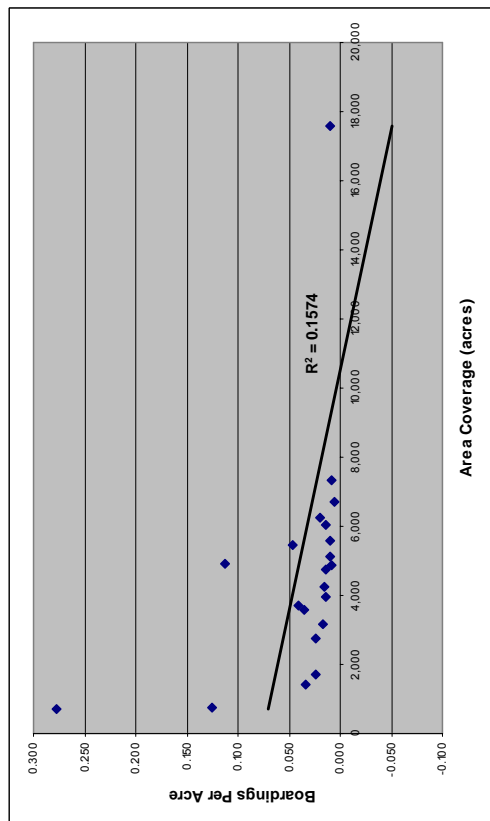
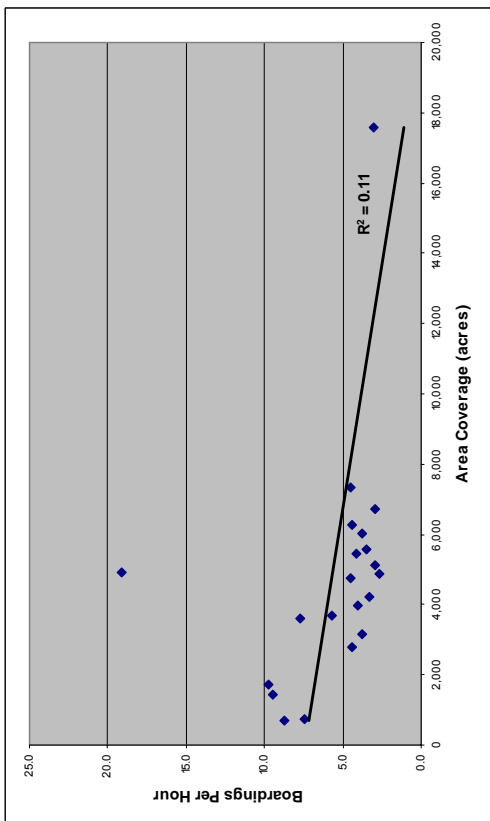
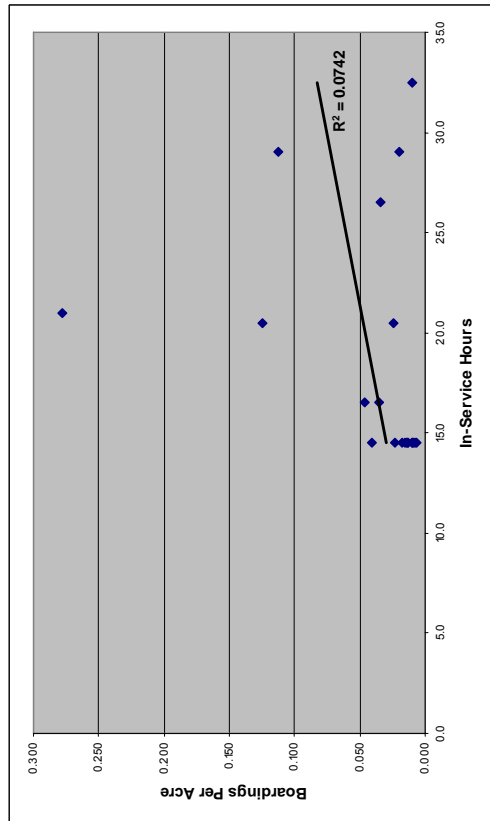
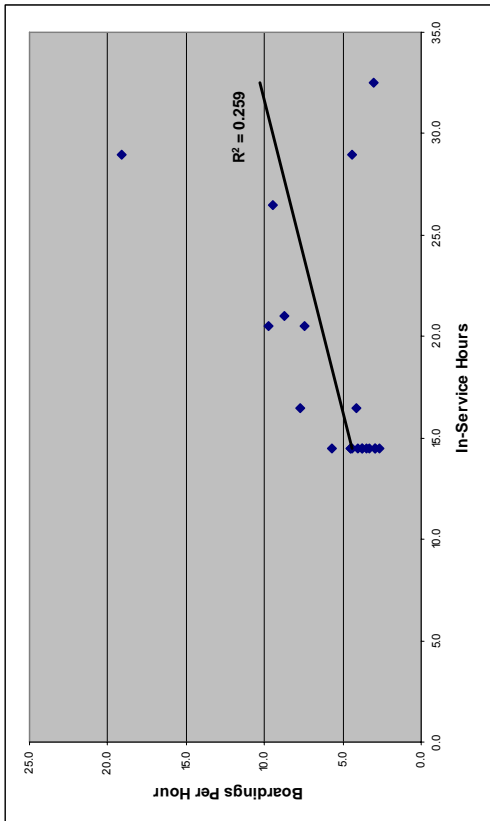
# Appendix A: Service Area Demographic Characteristics

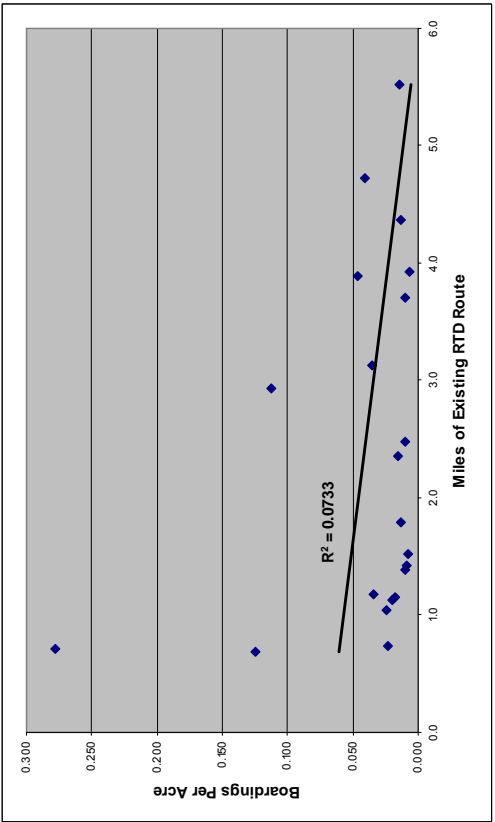
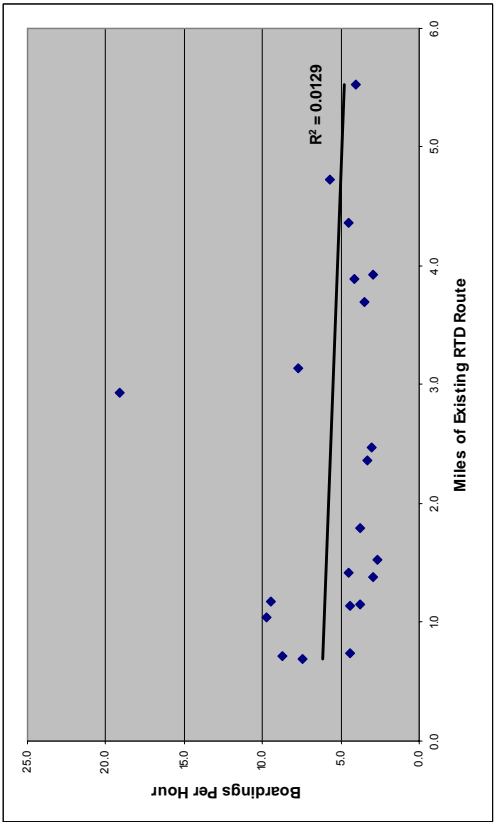
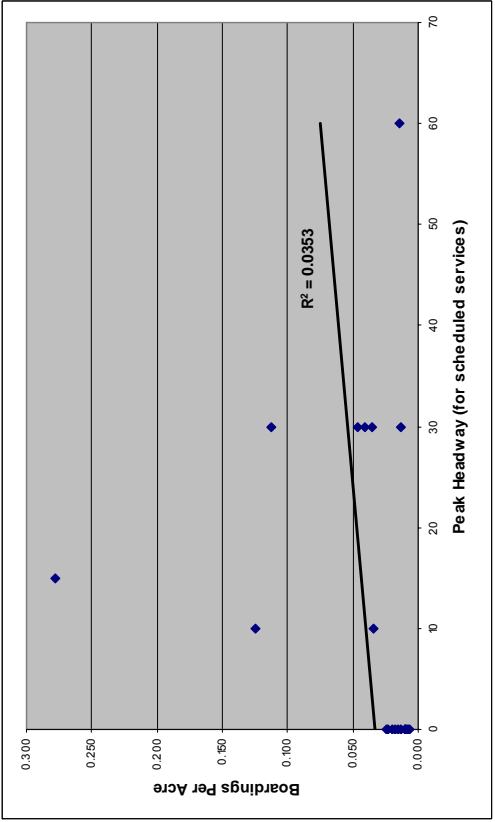
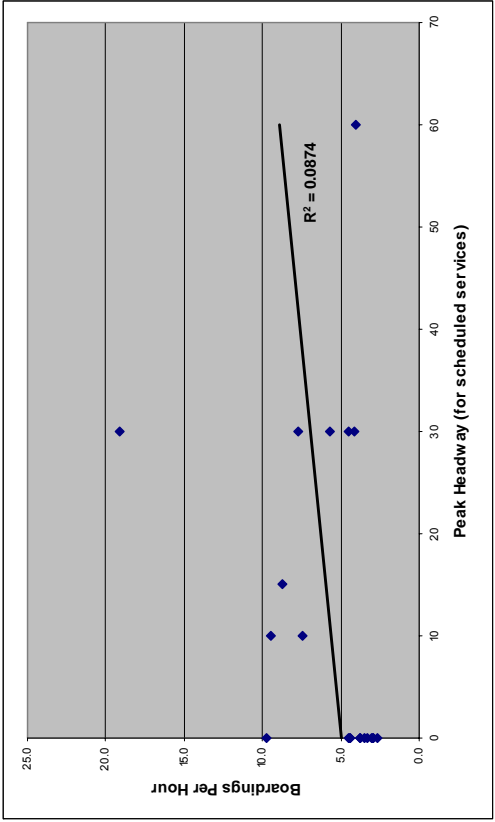




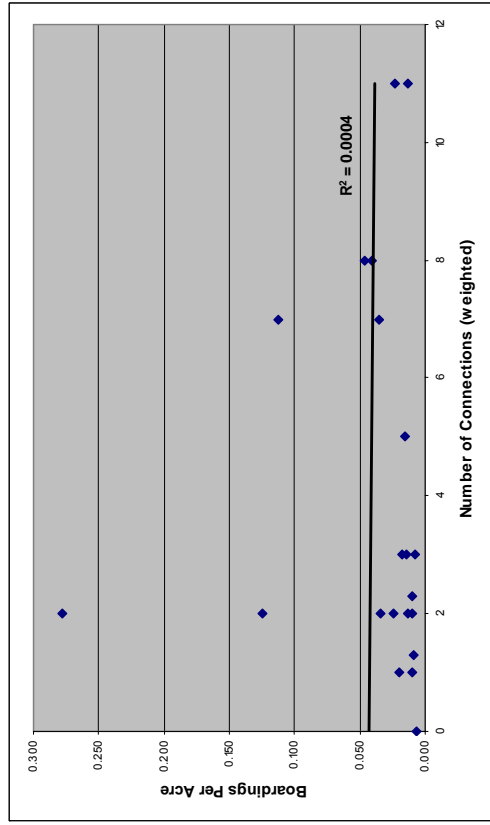
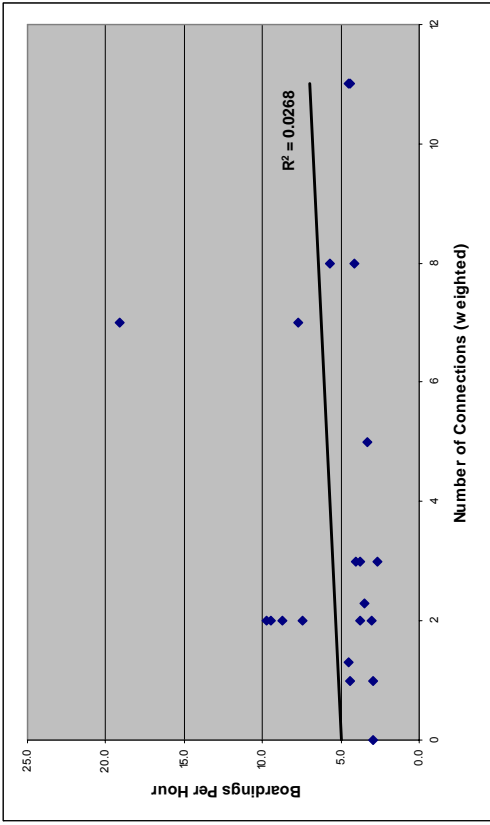


## Appendix B: Service Area Demographic Characteristics







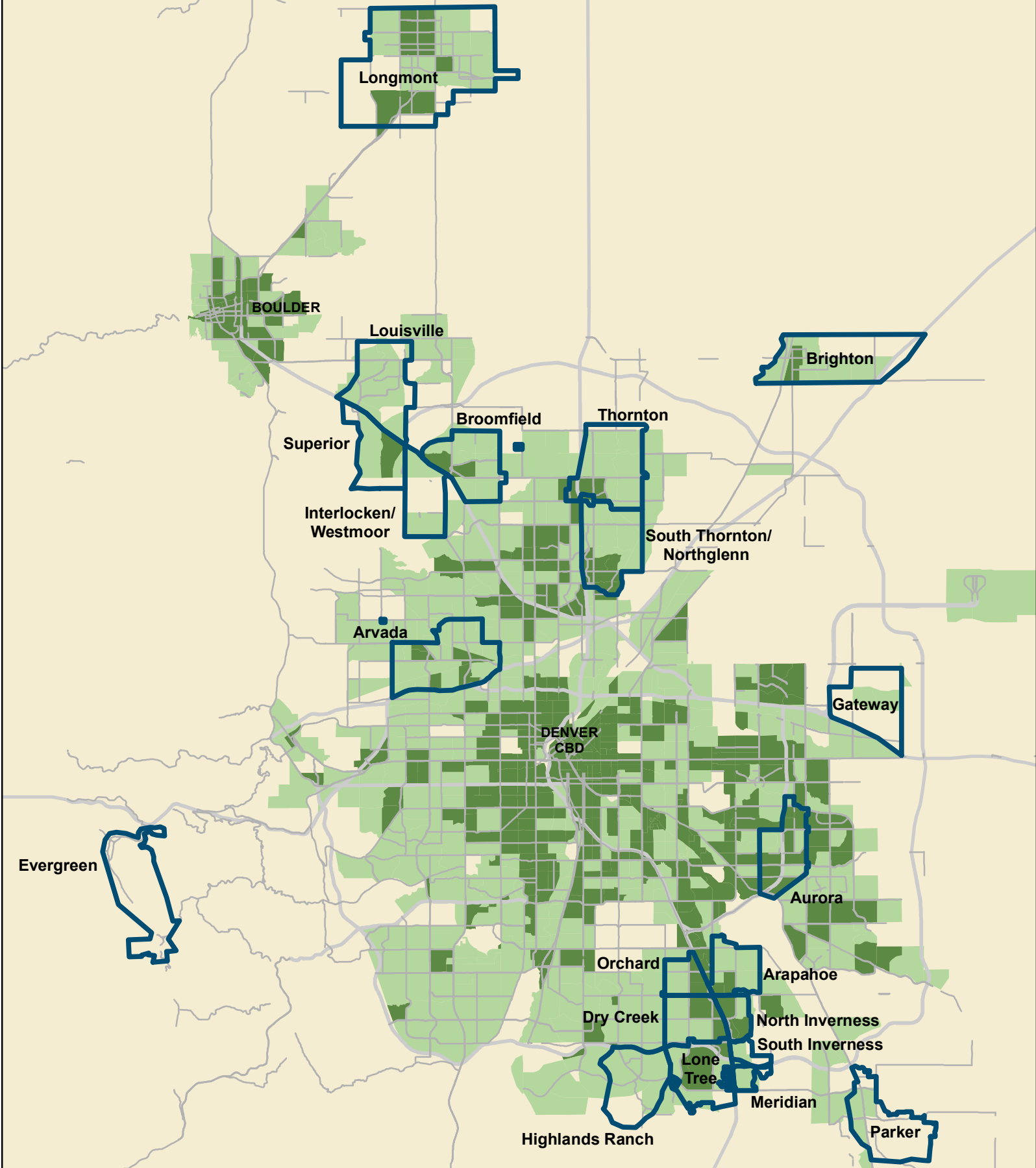


## Appendix C: Correlation With Multiple Variables

<b>SUMMARY OUTPUT – Boardings Per Acre</b>						
<b>Regression Statistics</b>						
Multiple R	0.8460					
R Square	<b>0.7157</b>					
Adjusted R Square	0.6210					
Standard Error	0.0387					
Observations	21.0000					
<b>ANOVA</b>						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	5	0.0565	0.0113	7.5532	0.0010	
Residual	15	0.0225	0.0015			
Total	20	0.0790				
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.1607	0.0376	4.2785	0.0007	0.0806	0.2408
Median Income	0.0000	0.0000	-2.9920	0.0091	0.0000	0.0000
Senior Density	-0.0943	0.0458	-2.0588	0.0573	-0.1919	0.0033
Youth Density	-0.0292	0.0227	-1.2867	0.2177	-0.0777	0.0192
Population Density	0.0057	0.0058	0.9818	0.3418	-0.0067	0.0181
Employment Density	0.0064	0.0025	2.5765	0.0211	0.0011	0.0116

<b>SUMMARY OUTPUT – Boardings Per Hour</b>						
<b>Regression Statistics</b>						
Multiple R	0.5614					
R Square	<b>0.3151</b>					
Adjusted R Square	0.0868					
Standard Error	3.6224					
Observations	21.0000					
<b>ANOVA</b>						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	5	90.5652	18.1130	1.3804	0.2865	
Residual	15	196.8243	13.1216			
Total	20	287.3895				
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	10.8018	3.5169	3.0714	0.0078	3.3058	18.2978
Median Income	0.0000	0.0000	-0.9912	0.3373	-0.0001	0.0001
Senior Density	-4.3066	4.2866	-1.0047	0.3310	-13.4433	4.8301
Youth Density	-0.0011	2.1276	-0.0005	0.9996	-4.5359	4.5337
Population Density	-0.2404	0.5448	-0.4413	0.6653	-1.4015	0.9207
Employment Density	0.1498	0.2316	0.6466	0.5276	-0.3439	0.6435

## **Appendix D: call-n-Ride Service Areas**



# RTD Call-n-Ride Service Areas

**Population/Employment Density (by TAZ)**  
Per Acre

- 0-3
- 3-12
- 12+

Call-n-Ride Service Area

Data Source: Denver RTD, US Census DRCOG

