Bicycle Data Collection Plan
Working Paper #3

MAG Bicycles Count Project

Draft Report

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1.0 Purpose of Working Paper #3

Working Paper #3 Bicycle Data Collection Plan describes the process used to select bicycle count stations across Maricopa County and to assign specific count technologies to each of these locations. A key goal of the Maricopa Association of Governments (MAG) Bicycles Count Project is to establish a framework for future non-motorized data collection across the region.

An important part of this framework is to establish a rigorous and justifiable methodology for siting bicycle count stations across the region, which is the subject of this working paper. It is intended that this siting methodology will engender broad support for the proposed bicycle counting locations, and that this support will in turn lead to allocation of funding for annual or bi-annual non-motorized data collection, on-going data maintenance, and the production of an annual report on the status of cycling demand and safety for the region.

As background to this framework, the consultant team conducted a review of counting methods and technologies previously employed in Maricopa County, as well as more broadly across the U.S, to help determine which tools and techniques to employ. The complete review of counting methods and technologies can be found in *Working Paper #2 Bicycle Counting Technology Review*.

Section 2.0 of this working paper describes the siting criteria used for locating bicycle count stations across the region. **Section 3.0** describes the proposed count stations for this project in mapped and tabular formats. Section 3.0 also provides detail on the counting technology to be applied at each site, as well as a general description of the two counting technologies proposed for the overall project. **Section 4.0** summarizes the data collection scheduling.

2.0 Bicycle Count Station Siting Criteria

Four key criteria were used to guide the siting of bicycle count stations across the MAG region: 1) presence of existing bicycle facility, 2) achieving a representative sample of locations in relation to population density, employment density and median household income; 3) a distribution of count sites that generally reflects the distribution of population by local jurisdiction; and 4) review and input from local agency staff. Each of these criteria is discussed below.

2.1 Existing Bicycle Facility

Figure 2-1 displays the existing bicycle facility across the MAG region. **Table 2.1** summarizes the miles of bicycle facility by facility type. As shown in Table 2.1, there are approximately 607 miles of bike path (paved, unpaved and recreational), 1,508 miles of bike lane, 507 miles of bike route, and 272 miles of paved shoulder.

Table 2.2 shows miles of bike facility per 1,000 capita for 24 of 29 jurisdictions in the region with bike facility. Five local jurisdictions have no bicycle facility. As shown in Table 2.2, Cave

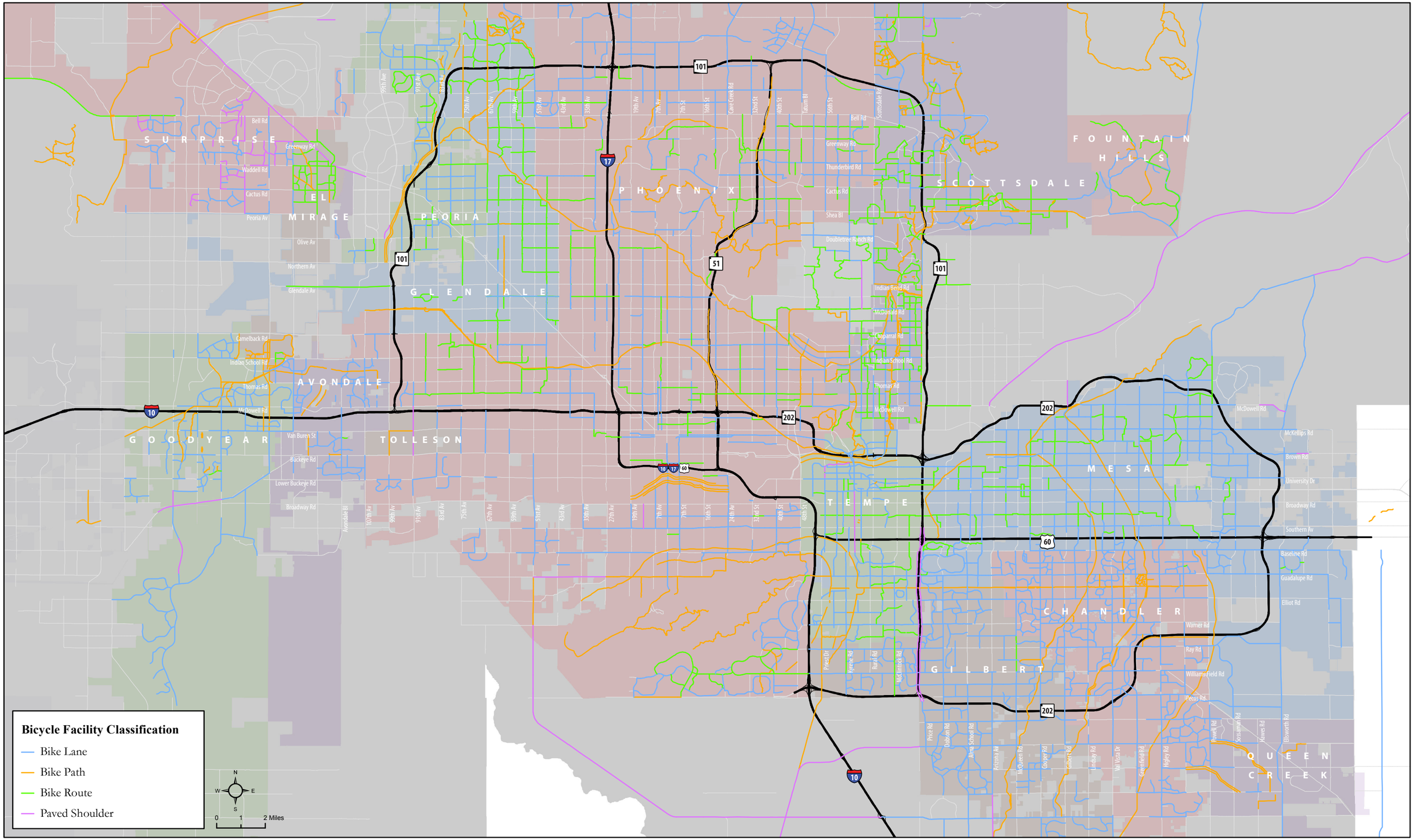

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Figure 2-1
Existing Bicycle Facilities in the MAG Region

TABLE 2.1 Miles of Bicycle Facility by Type in Maricopa County

Facility Type	Miles	Percent of Total
Bike Path - unpaved	289.2	10.0%
Bike Path - paved	260.9	9.0%
Bike Path - recreational	56.9	2.0%
Bike Lane	1,508.1	52.1%
Bike Route	507.1	17.5%
Paved Shoulder	271.6	9.4%
TOTAL	**2,893.7**	**100%**

Source: MAG GIS, 2011; Chen Ryan Associates, September 2013

TABLE 2.2 Bicycle Facility per 1,000 Capita[1]

Jurisdiction	Miles of Bike Facility	2010 Population	Miles of Facility per 1,000 Capita
Carefree	0.3	3,363	0.09
Gila Bend	0.2	1,922	0.10
Apache Junction	3.9	35,840	0.11
Youngtown	1.3	6,156	0.21
Guadalupe	1.3	5,523	0.24
Phoenix	699.5	1,445,632	0.48
Glendale	113.3	226,721	0.50
Buckeye	27.5	50,876	0.54
Avondale	42.7	76,238	0.56
Tolleson	4.0	6,545	0.61
Mesa	298.9	439,041	0.68
Surprise	84.0	117,517	0.71
Queen Creek	21.0	26,361	0.80
Chandler	196.2	236,123	0.83
El Mirage	26.8	31,797	0.84
Tempe	143.8	161,719	0.89
Peoria	139.3	154,065	0.90
Gilbert	236.4	208,453	1.13
Unincorporated	330.3	284,016	1.16
Fountain Hills	32.2	22,489	1.43
Scottsdale	327	217,385	1.50
Goodyear	108.5	65,275	1.66
Litchfield Park	9.9	5,476	1.81
Paradise Valley	30.5	12,820	2.38
Cave Creek	14.3	5,015	2.85

Source: MAG GIS, 2011; Chen Ryan Associates, September 2013

Note:

1) This table is sorted from lowest to highest miles of bike facility per 1,000 capita

Creek and Paradise Valley have the highest per capita rates of bike facility at 2.85 and 2.38 miles of facility per 1,000 people. Carefree and Gila Bend have the lowest level of bike facility per 1,000 people, with 0.09 and 0.10 miles of bike facility per 1,000 people, respectively. Table 2.2 is sorted from lowest to highest in terms of miles of bike facility per 1,000 people.

Although cyclists can legally ride along all roadways in the MAG region, as well as along sidewalks in most locations, this criteria was necessary for narrowing the more than 23,000 miles of roadways in the MAG region (where counting cyclists was possible), to just 2,287 miles of roadway with bicycle facility. This criteria narrowed the potential population of locations across the MAG region to those with a greater likelihood of cycling activity.

2.2 Sampling Strata

A key reason for collecting bicycle count data is to support MAG's ability to estimate and forecast bicycle activity across the region. The sample of bicycle counts collected by this project can potentially be used by local and regional staff to estimate and/or forecast bicycle activity along roadway segments or bike paths in the MAG region. Although estimation and forecasting is not part of the current project's scope of work, the project team understood the added value of producing a bicycle count database that would support this important, ultimate application.

A foundation of good statistical modeling (estimation or forecasting) is to select a reliable sample of cases from the study population under consideration. In this project, the study population is comprised of all segments of the existing bicycle network. A key challenge for this project was to select a reliable or defensible sample of bicycle facility segments for count data collection. The project team employed a sampling method called "stratified sampling" to sample or select bicycle facility segments for count data collection. This approach provides the foundation necessary to enable estimating and/or forecasting bicycle demand across the region.

Stratified sampling entails dividing the total study population into "like" groupings (or strata) and then sampling from these strata. In the current project, we developed the strata using three factors known to influence the demand for travel:

- population density,
- employment density, and
- median household income.

The project team used census data at the census block group level to create the sampling strata.

The three factors used for developing sampling strata were categorized into high, medium and low classes defined by +/- 0.5 standard deviations from the mean census block group value for each factor.

Table 2.3 shows the sampling strata definitions for population density, employment density and median household income.

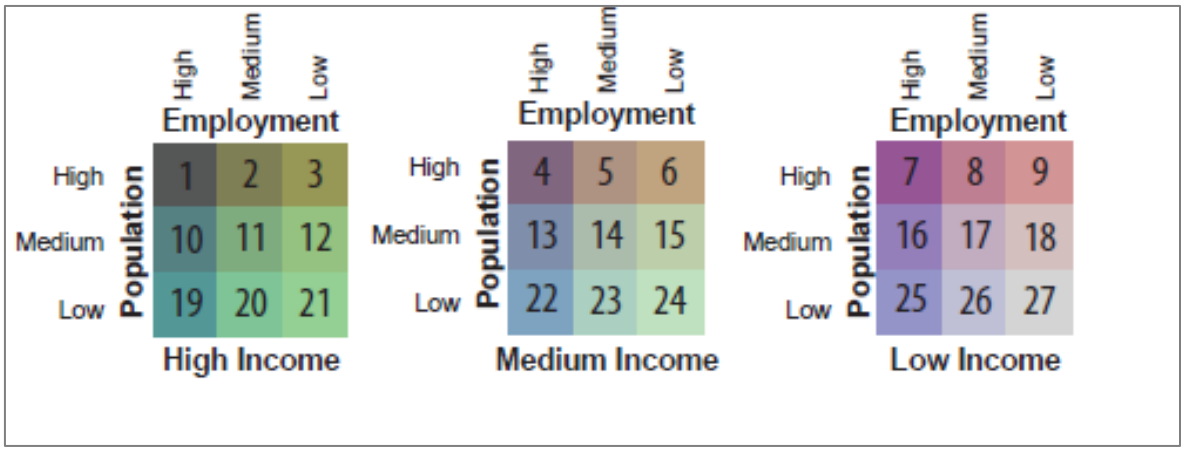
TABLE 2.3 Census Data Inputs to Sampling Strata (by Census Block Group)

Category	Range	Breaks	Standard Deviation Range
Population Density			
High	1	Greater than 11.2 persons per acre	+0.5 and above
Medium	2	5.05 – 11.2 persons per acre	-0.5 and +0.5
Low	3	Less than 5.05 persons per acre	Below -0.5
Employment Density			
High	1	Greater than 5.56 jobs per acre	+0.5 and above
Medium	2	1.59 – 5.56 jobs per acre	0 and +0.5
Low	3	Less than 1.59 jobs per acre	Below 0 (below mean)
Median Income			
High	1	Greater than $59,558	+0.5 and above
Medium	2	$35,863 - $59,558	-0.5 and +0.5
Low	3	Less than $35,863	Below -0.5

Source: US Census Bureau (2010). Data by census block group for year 2010 downloaded at American Fact Finder page: http://factfinder.census.gov/home/saff/main.html?_lang=en; US Census Bureau Longitudinal Employer-Household Dynamics (LEHD), 2009. Data by census block group for year 2009 downloaded at this source http://lehd.did.census.gov/led/, from "On the Map" application: http://lehdmap.did.census.gov/

The combination of these three factors, divided into three categories each, results in a total of 27 sampling strata, as shown below.

H-M-L Population Density **x** *H-M-L Income* **x** *H-M-L Employment Density (or 3 x 3 x 3)*



Source: Chen Ryan Associates, September 2013

Each of the census block groups across the MAG region was assigned to a sampling strata 1 through 27, depending on the population density, employment density and medium household income found there.

As shown in the image above, Strata 1 consists of census block groups with high population density, high employment density and high income; Strata 14 consists of census block groups with medium population density, medium employment density and medium household income levels.

Each segment of the existing bicycle network (or the total study population) was intersected with the census block group layer in GIS and assigned to a sampling strata. The distribution of the total population's strata was examined, and a sample of bicycle count locations was selected in a manner that would match the distribution of the total study population.

Table 2.4 displays how each segment of the existing bicycle network (or the total study population) falls into the twenty-seven strata or groupings. Table 2.4 also shows how the sample of count stations selected (from this total study population of existing bicycle facility segments) falls into the twenty-seven strata or groupings. A statistically rigorous sample of count stations should be characterized by a strong match between the distribution of strata associated with the sample of count stations and with the total study population.

Chart 2-1 compares the distribution of strata associated with the sample of count stations, and the total population of existing bicycle facility segments in the MAG region.

As shown in Chart 2-1, the strata associated with the sample of count stations selected provides a strong match with the distribution of strata associated with the total population of existing bicycle facility segments.

Figure 2-2 displays the proposed bicycle count stations labeled with the associated sampling strata.

This criteria supports the collection of bicycle count data that will allow MAG staff and member agencies to successfully estimate and forecast bicycle travel.

TABLE 2.4 Comparing Percent of Strata for Existing Bicycle Facility and Bicycle Count Stations

Strata ID	Number of Bicycle Facility Segments	Percent of Total Bicycle Facility Segments by Strata	Number of Bicycle Count Stations	Percent of Total Bicycle Count Stations by Strata
1	0	0.0%	0	0.0%
2	2	0.0%	0	0.0%
3	1	0.0%	0	0.0%
4	6	0.0%	1	0.8%
5	53	0.4%	3	2.3%
6	130	1.1%	6	4.7%
7	63	0.5%	2	1.6%
8	137	1.1%	3	2.3%
9	141	1.1%	1	0.8%
10	87	0.7%	1	0.8%
11	459	3.7%	3	2.3%
12	1240	10.1%	6	4.7%
13	258	2.1%	8	6.3%
14	701	5.7%	14	10.9%
15	1132	9.2%	14	10.9%
16	155	1.3%	9	7.0%
17	227	1.8%	5	3.9%
18	266	2.2%	1	0.8%
19	158	1.3%	1	0.8%
20	631	5.1%	3	2.3%
21	3169	25.8%	15	11.7%
22	202	1.6%	1	0.8%
23	203	1.7%	3	2.3%
24	1737	14.1%	10	7.8%
25	184	1.5%	5	3.9%
26	238	1.9%	2	1.6%
27	719	5.8%	11	8.6%
Total	**12,299**	**100.0%**	**128**	**100%**

Source: MAG GIS, 2011; Chen Ryan Associates, September 2013

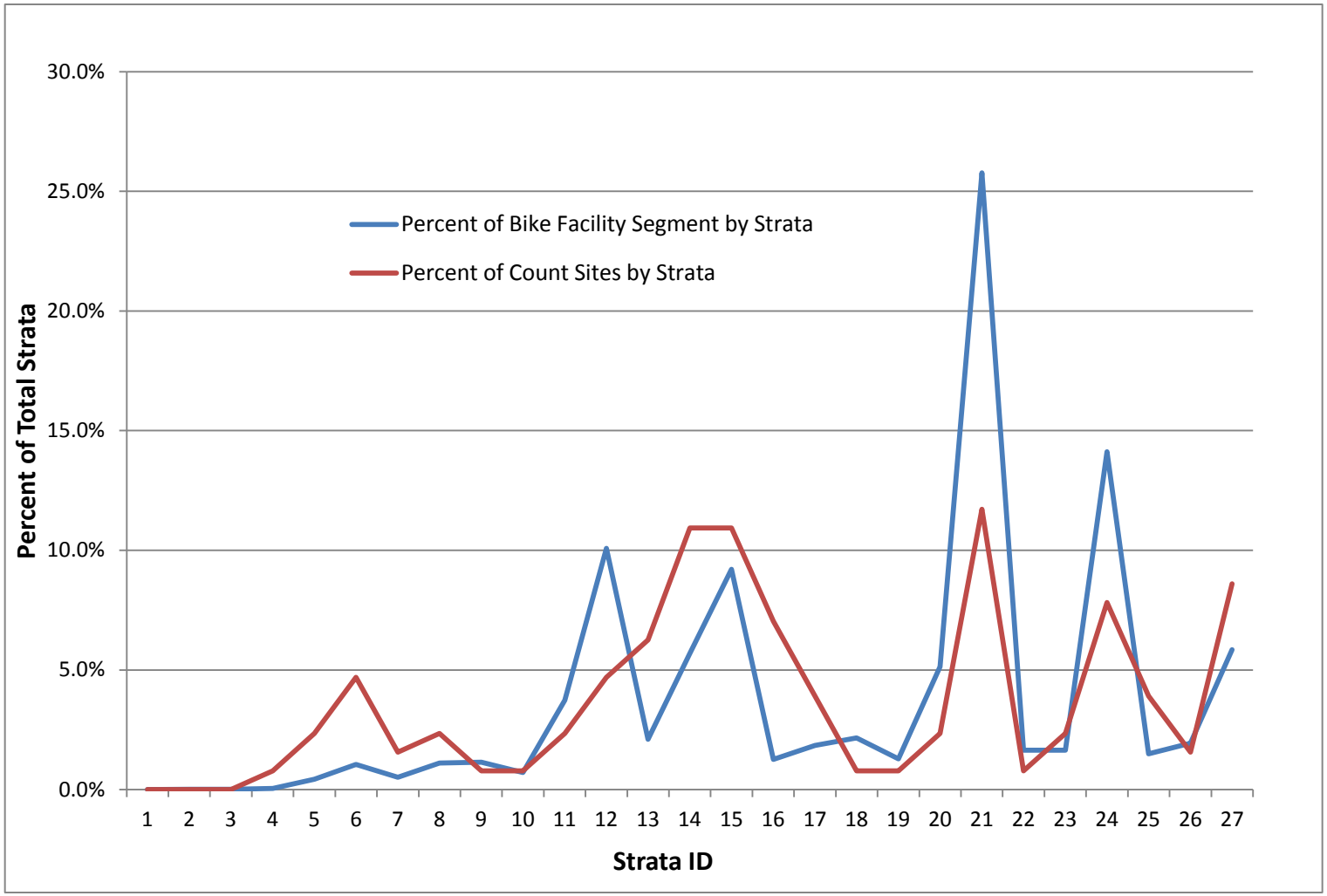


Chart 2-1 Comparing Percent of Total Strata for Existing Bicycle Facility and for Sample of Bicycle Count Stations

Count Stations by Sampling Strata

Count Stations by Strata (#)

Bicycle Facility Classification

- Bike Lane
- Bike Path
- Bike Route
- Paved Shoulder

N W E S

0 1 2 Miles

27 Strata Based on the Combinations of Three Indicators (Population Density, Employment Density, and Median Household Income) and Three Ranges (High, Medium and Low)

Population \ Employment	High	Medium	Low
High	1	2	3
Medium	10	11	12
Low	19	20	21

High Income

Population \ Employment	High	Medium	Low
High	4	5	6
Medium	13	14	15
Low	22	23	24

Medium Income

Population \ Employment	High	Medium	Low
High	7	8	9
Medium	16	17	18
Low	25	26	27

Low Income

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Figure 2-2
Bicycle Count Stations by Sampling Strata

2.3 Population Distribution by Local Agency

The project team also attempted to match the percent of total bicycle count stations in each jurisdiction to its percent of total countywide population. This siting criteria is important for satisfying member agency's understandable concern with the equitable distribution of planning funds from MAG to member agencies.

Table 2.5 and **Chart 2-2** show how the distribution of bicycle count stations relates to the distribution of population across the 29 member agencies.

As shown in Table 2.5 and Chart 2-2, the percent of total bicycle count stations by local agency generally matches the percent of total countywide population by local agency. The cities of Carefree and Tempe, for example, show largest differences between the distribution of population and number of bicycle count stations. Carefree has 0.1% of the total countywide population, while it was allocated 1.6% of the total bicycle count stations; Tempe has 4.2% of the total countywide population, while it was allocated 6.8% of the total bicycle count stations.

2.4 Local Agency Input

The last siting criteria is review and input by local agency staff. MAG utilizes the Bicycle and Pedestrian Commmittee to obtain input on bicycle and pedestrian related projects. This Committee provided valuable input on sensible locations for counting bicycle activity levels within their respective jurisdictions, based on their specific local knowledge of their respective communities.

TABLE 2.5 Comparing Population and Count Station Distribution by Local Jurisdiction

Local Jurisdiction	2010 Population	Percent of Total Population	Number of Bicycle Count Stations	Percent of Total Count Stations
Apache Junction	35,840	0.9%	1	0.8%
Avondale	76,238	2.0%	3	2.3%
Buckeye	50,913	1.3%	1	0.8%
Carefree	3,363	0.1%	2	1.6%
Cave Creek	5,015	0.1%	2	1.6%
Chandler	236,139	6.1%	7	5.5%
El Mirage	31,797	0.8%	1	0.8%
Florence	25,536	0.7%	1	0.8%
Fort McDowell Yavapai Nation	971	0.03%	1	0.8%
Fountain Hills	22,489	0.6%	1	0.8%
Gila Bend	1,922	0.05%	1	0.8%
Gilbert	208,453	5.4%	7	5.5%
Glendale	226,724	5.9%	8	6.3%
Goodyear	65,275	1.7%	3	2.3%
Litchfield Park	5,476	0.1%	1	0.8%
Maricopa	43,482	1.1%	1	0.8%
Mesa	439,193	11.3%	14	10.9%
Paradise Valley	12,820	0.3%	1	0.8%
Peoria	154,067	4.0%	5	3.9%
Phoenix	1,445,656	37.3%	41	32.0%
Queen Creek	26,361	0.7%	2	1.6%
Salt River Pima	6,289	0.2%	1	0.8%
Scottsdale	217,385	5.6%	7	5.5%
Surprise	117,517	3.0%	3	2.3%
Tempe	161,719	4.2%	8	6.3%
Youngtown	6,156	0.2%	1	0.8%
Unincorporated	248,168	6.4%	4	3.1%
Total	**3,874,964**	**100%**	**128**	**100%**

Source: MAG GIS, 2011; Chen Ryan Associates, September 2013

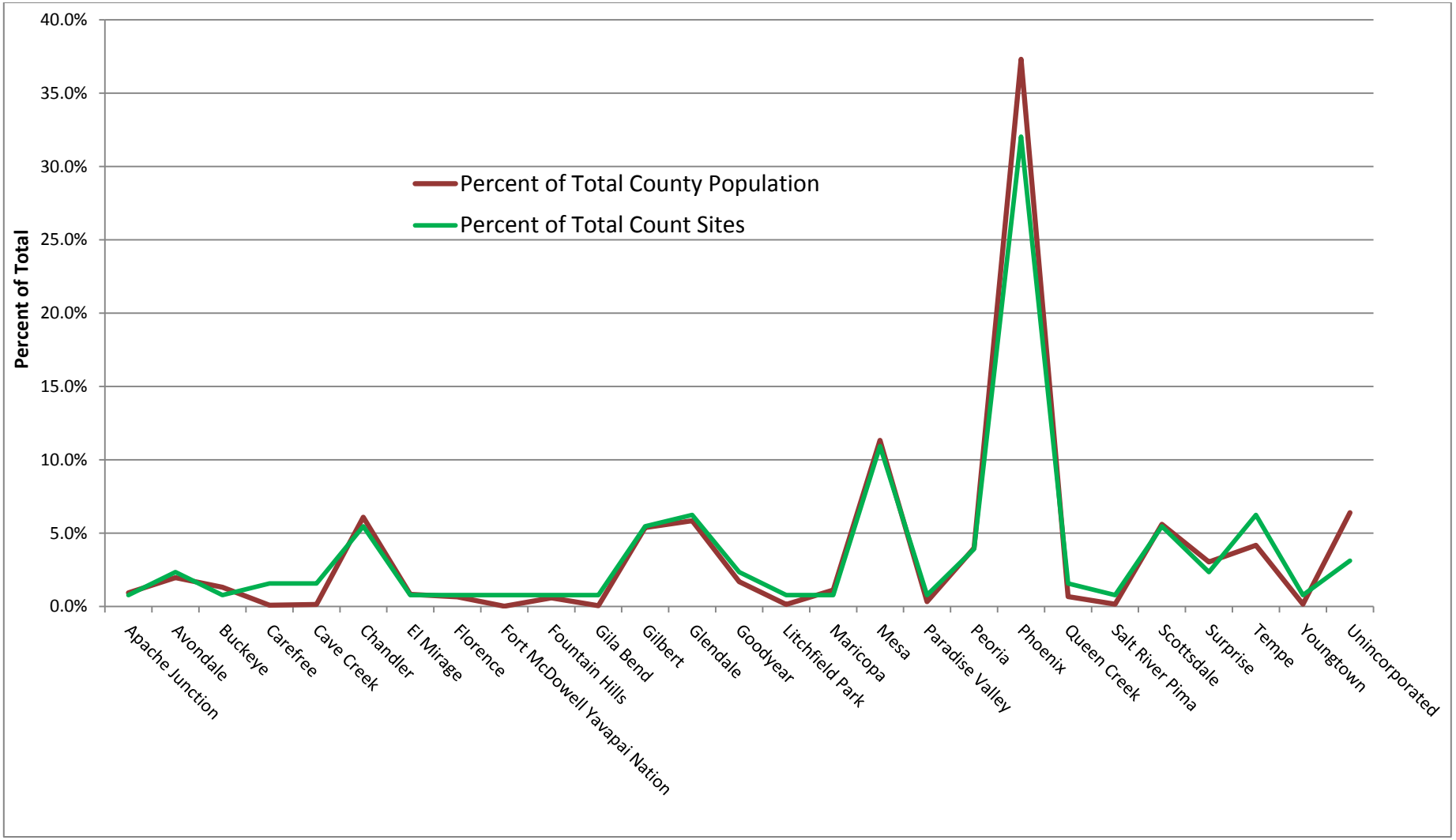
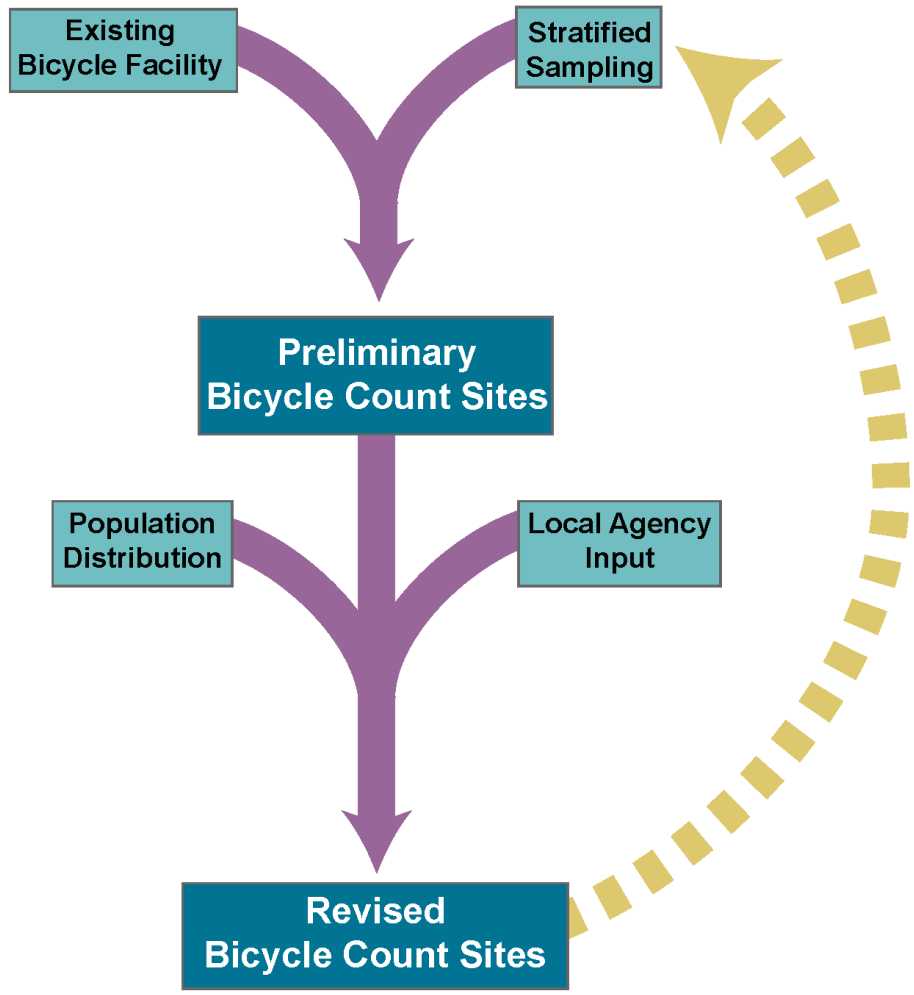


Chart 2-2 Comparing Percent of Total County Population and Total Count Stations by Local Jurisdiction

In summary, the following flow chart illystrates how the four siting criteria were employed in an iterative process to select and refine bicycle count stations across the MAG region.

Bicycle Count Station Selection Process



3.0 Count Station Locations and Technology

Section 3.0 describes the 128 bicycle count locations resulting from the site selection process presented in Section 2.0. This section also describes the two counting technologies to be employed for this effort:

- Continuous automated counting with leased pneumatic tubes, and
- Peak period manual counting.

Figure 3-1 displays all proposed bicycle count stations in the MAG region, distinguishing where automated and manual counting will occur.

3.1 Automated Counting

Forty-four (44) of the 128 count locations were designated as sites for continuous, automated bicycle count data collection, with the remaining 84 sites designated as locations for PM peak period manual bicycle counting. The automated count sites were strategically intermixed with the manual count sites, so that continuous counting in the east-west direction and in the north-south direction would occur within the general vicinity of each of the manual count sites. This approach supports application of the rich temporal patterns collected by the automated counting to data we are collecting via the nearby manual counts. In other words, we can use peak hourly patterns identified through the automated counters to extrapolate peak period counts to daily counts.

Table 3.1 displays the list of locations where continuous, automated bicycle counts will be collected. Each of these locations will be scheduled for approximately two weeks of 24-hour, continuous bicycle count data collection, with data being recorded and reported at 15-minute intervals. The automated counting equipment will be leased from a company called Eco-Counter. The equipment will be installed on a single leg of each intersection location identified in Table 3.1, recording bicycle travel in two directions, either north-south or east-west. Most sites will require two counting machines to be installed, one counting in each direction (either north-south or east-west).

The count sites in Table 3.1 are ordered alphabetically by local jurisdiction.

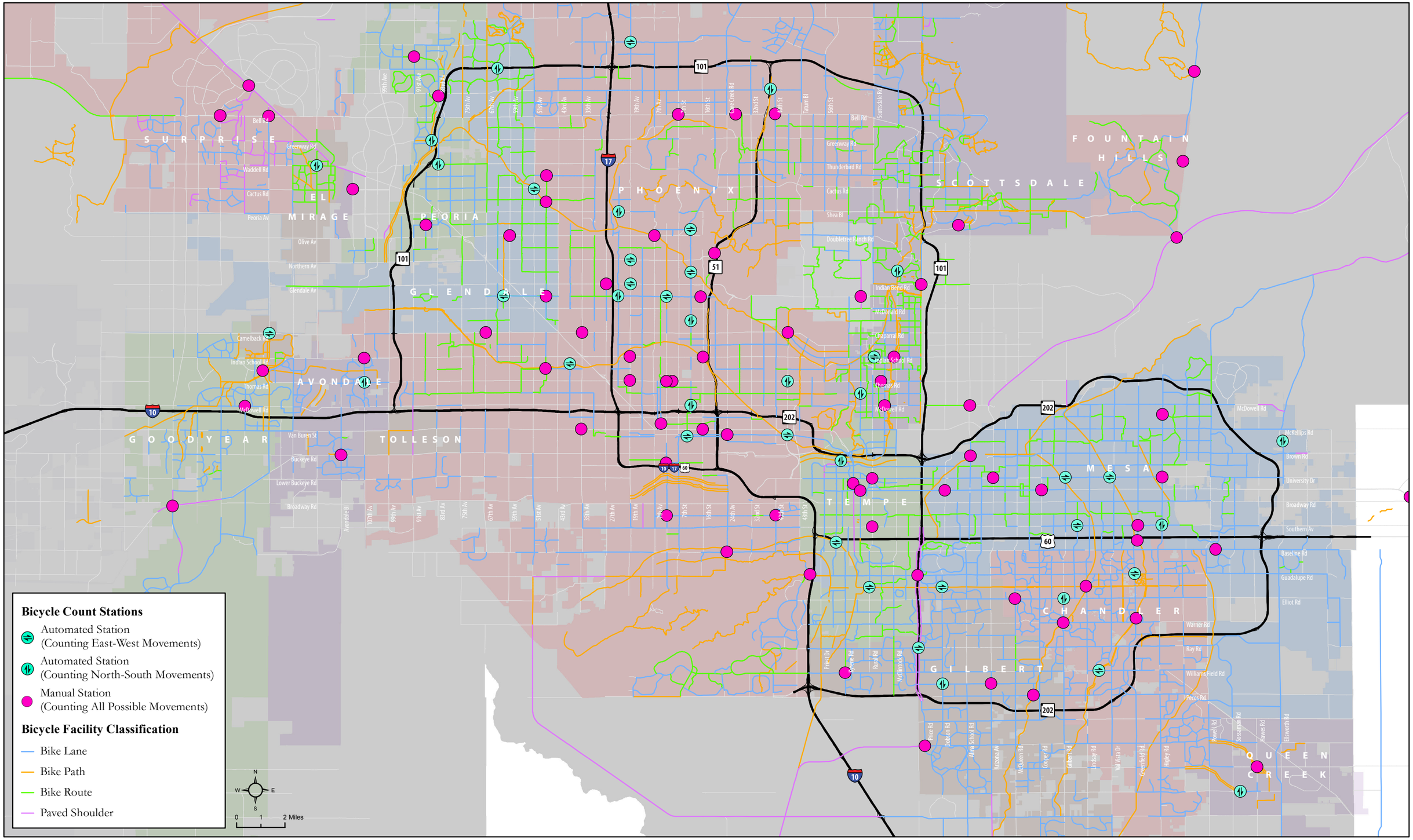


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Figure 3-1

Bicycle Count Stations by Technology (Automated or Manual)

TABLE 3.1 Automated Count Stations by Local Jurisdiction

Count Site ID	Jurisdiction	Count Location	Count Direction	Intersection Leg
1	Avondale	107th Ave & Thomas Rd	NS	South
6	Carefree	Pima Rd & Cave Creek Rd	NS	North
10	Chandler	Dobson Rd & Frye Rd	NS	West
13	Chandler	Dobson Rd & Western Canal Bike Path	EW	West
9	Chandler	Price Rd & W Ray Rd	EW	North
16	El Mirage	El Mirage Rd & Thunderbird Rd	NS	West
23	Gilbert	Eastern Canal Trail & E Wiliams Field Rd	EW	North
17	Gilbert	Gilbert Rd & Elliott Rd	NS	North
18	Gilbert	Greenfield Rd & Guadalupe Rd	EW	East
26	Glendale	51st Ave & Thunderbird Paseo (Canal Path)	EW	South
24	Glendale	61st Ave & Maryland Ave	EW	East
25	Glendale	63rd Ave & Loop 101 Bike/Ped Bridge	NS	North
35	Litchfield Park	Litchfield Rd & Camelback Rd	EW	West
39	Maricopa County	Gavilan Peak Pkwy & Pioneer Rd	NS	West
43	Mesa	24th St & Southern Ave	EW	East
42	Mesa	Eastern Canal Bike Path & University Dr	EW	South
40	Mesa	Ellsworth Rd & McLellan Rd	NS	West
41	Mesa	Gilbert Rd & University Dr	EW	South
46	Mesa	Higley Rd & Southern Ave	NS	East
55	Peoria	115th Ave & Happy Valley Parkway	EW	South
54	Peoria	83rd Ave & Thunderbird Rd	NS	East
58	Peoria	New River Bike Path & Greenway Rd	NS	South
61	Phoenix	11th St & Jefferson St	EW	North
62	Phoenix	12th St & Arizona Canal Bike Path	EW	West
59	Phoenix	12th St & Hatcher Rd	EW	East
98	Phoenix	12th St & Missouri Ave	NS	South
67	Phoenix	12th St & McDowell Rd	NS	West
69	Phoenix	19th Ave & Deer Valley Rd	EW	South
74	Phoenix	19th Ave & Glendale	EW	West
73	Phoenix	19th Ave & Northern Rd	EW	East
66	Phoenix	23rd Ave & Maryland Ave	NS	West
65	Phoenix	23rd Ave & Peoria Rd	NS	South
68	Phoenix	39th Ave & Grand Canal Bike Path	EW	South
60	Phoenix	44th St & Thomas Rd	NS	West
70	Phoenix	44th St & Washington St	EW	West

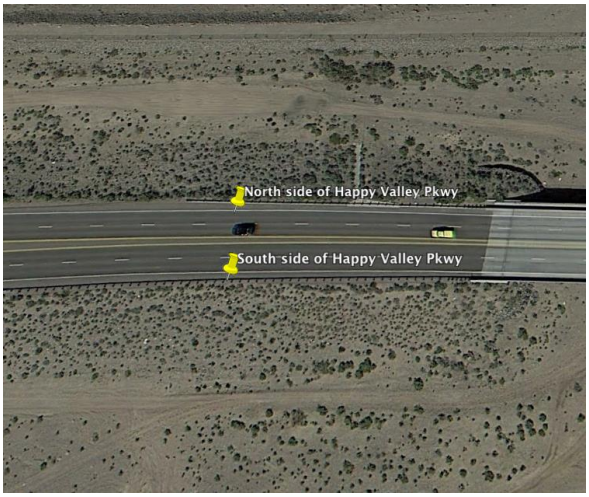
TABLE 3.1 Automated Count Stations by Local Jurisdiction

Count Site ID	Jurisdiction	Count Location	Count Direction	Intersection Leg
64	Phoenix	Bike Path parallel to SR-51 & Union Hills Dr	NS	North
63	Phoenix	Central Ave & Maryland Ave	EW	West
100	Queen Creek	Sonoqui Wash Path & Chandler Heights Rd	NS	West
103	Scottsdale	68th St & Oak St	NS	South
102	Scottsdale	Indian Bend Wash Path north of McCormick Pkwy.	NS	North
104	Scottsdale	Scottsdale Road & Indian School Rd	EW	South
113	Tempe	Hardy Dr & Western Canal Bike Path	EW	North
119	Tempe	Rio Salado Downstream Dam Bridge	NS	East
115	Tempe	Rural Rd & Western Canal Bike Path	EW	West

The images below illustrate the variety of automated count site locations, including along bike paths, bike lanes, bike routes, and in rural locations.

Bike path site at 63rd Ave Bike/Pedestrian Bridge @ the 101

Bike lane site at 107th Ave & Thomas Rd.



Rural site on Happy Valley Pkwy

Bike route site at 61st Ave & Maryland

Eco-Counter's Zelt Pneumatic Tubes (Zelt Tubes) were selected as the most convenient automated counting technology for this project. Key reasons for this choice include:

- Ability to distinguish automobile and cyclists when counting on-street;
- Availability of equipment leasing option and temporary installation since project funds could not be used for purchasing and installing permanent counters;
- Availability of Eco-Counter's Eco-Visio software for performing quick data summaries;
- Relatively affordable price of leasing equipment enabling a reasonable number of locations to be counted for more than one week;
- Strong level of accuracy (+/- 10%) and broad application in other jurisdictions including Portland and San Francisco.

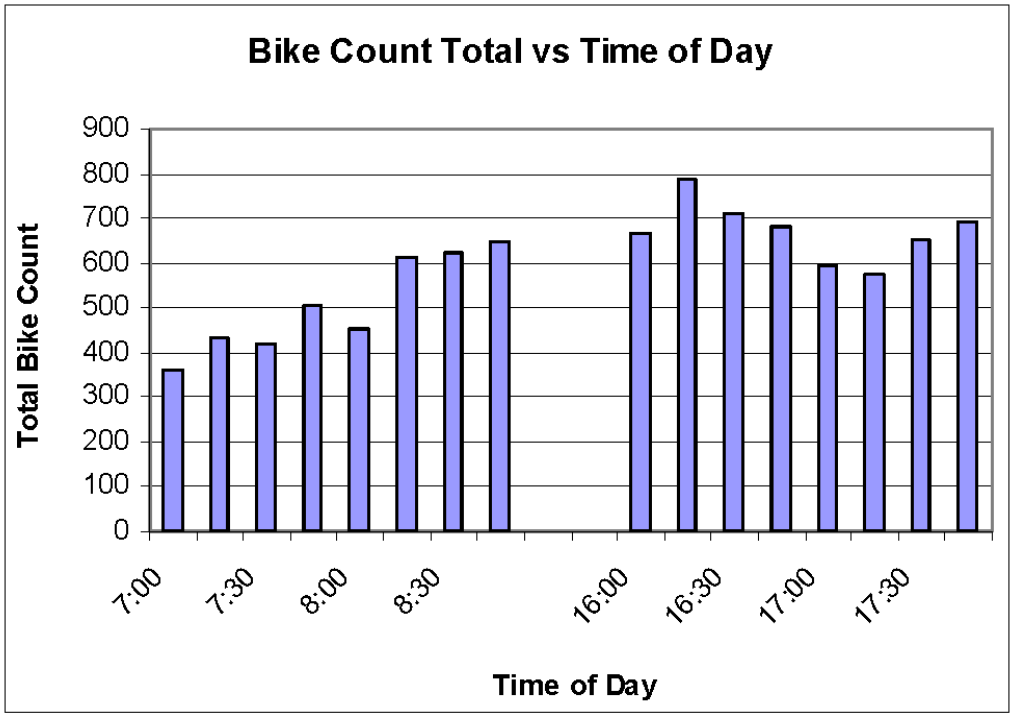

On-street pneumatic tubes Source: *Eco-Counter, 2013*


Mini-tubes on bike path Source: *Eco-Counter, 2013*

In addition to the standard on-street pneumatic tubes, Eco-Counter will also supply "mini-tubes" or "greenway tubes", designed specifically to monitor cyclists riding on bike paths. The mini-tubes are smaller, and more comfortable to ride over than the standard tubes.

3.2 Manual Counting

Manual bicycle counting will occur at 84 of 128 count sites. Manual counting will occur during a 2-hour peak period from 4:00 – 6:00 PM. The PM peak period was selected largely as a result of reviewing peak period count data from the City of Tempe which reflected higher rates of cyclists during the 4:00 – 6PM peak periods as compared with the 7:00 – 9:00AM peak period, as shown in the graph below. Higher PM peak period bicycle travel, relative to the AM peak period, is a common pattern found across many metropolitan regions.



Source: 2011 Tempe Bike Count Report

Count days were established as weekdays, between Tuesday and Friday; and weekends, on Saturdays. Approximately 65% of the manual count sites will be collected during weekdays, and about 35% of the manual count sites will be collected during the weekend. Understanding peak period and 24-hour continuous travel patterns on both weekdays and weekends will be an important consideration for this study, since cycling levels are typically higher on weekends.

Table 3.2 displays the locations of the 84 PM peak period manual count locations scheduled for data collection. Table 3.2 is sorted alphabetically by jurisdiction.

TABLE 3.2 Manual Count Stations by Local Jurisdiction

Count Site ID	Jurisdiction	Count Location
121	Apache Junction	Winchester Rd & Old West Highway
3	Avondale	Avondale Blvd & Buckeye Rd
2	Avondale	107th Ave & Indian School Rd
4	Buckeye	7th St & Monroe Avenue
5	Carefree	N Tom Darlington Dr & E Cave Creek Rd
8	Cave Creek	N Cave Creek Rd & E New River Rd
7	Cave Creek	N Schoolhouse Rd & E Cave Creek Rd
11	Chandler	Arizona Ave & Frye Rd
12	Chandler	Chandler Paseo Trail & Pecos Rd
15	Chandler	Kyrene Rd & West Chandler Blvd
14	Chandler	Price Rd & Queen Creek Rd
126	Florence	Main Street & Butte Ave
125	Fort McDowell Yavapai Nation	El Pueblo Blvd & Grande Blvd
123	Fountain Hills	Beeline Highway & Shea Blvd
127	Gila Bend	SR-85 & Martin Ave
19	Gilbert	Consolidated Canal & Western Powerline
20	Gilbert	Gilbert Rd & Warner Rd
22	Gilbert	Greenfield Rd & Eastern Canal
21	Gilbert	McQueen Rd & Elliott
31	Glendale	47th Ave & Arizona Canal Bike Path
29	Glendale	47th Ave & Maryland Ave
27	Glendale	67th Ave & Camelback Rd
30	Glendale	83rd Ave & New River Bike Path
28	Glendale	59th Ave & Olive Ave
33	Goodyear	Bullard Ave & McDowell Rd
34	Goodyear	Cotton Lane & MC 85
32	Goodyear	Litchfield Road & Indian School Road
128	Maricopa	SR-347 & Union Pacific Railroad (South of W Maricopa-Casa Grande Hwy
37	Maricopa County	243rd Ave & Sun Valley Parkway
36	Maricopa County	7th St & Carefree Highway
38	Maricopa County	McDowell Mountain Rd & McDowell Mountain Park Dr
48	Mesa	Alma School Rd & Tempe Canal Bike Path
44	Mesa	Country Club Dr & University Dr
51	Mesa	Greenfield Rd & Eastern Canal 2
50	Mesa	Greenfield Rd & Southern Ave

TABLE 3.2 Manual Count Stations by Local Jurisdiction

Count Site ID	Jurisdiction	Count Location
53	Mesa	Higley Rd & Hermosa Vista Dr
52	Mesa	Higley Rd & University Dr
49	Mesa	Dobson Rd & Main St
45	Mesa	Stapley Dr & Main St
47	Mesa	Superstition Springs Blvd & Baseline Rd
124	Paradise Valley	Mockingbird Lane & Lincoln Drive
57	Peoria	87th Ave & Mountain View Rd
56	Peoria	91st Ave & Lake Pleasant Pkwy (& adjacent path)
96	Phoenix	15th Ave & Maryland Ave
78	Phoenix	16th St & Indian School Rd
92	Phoenix	16th St & Van Buren St
87	Phoenix	19th Ave & Indian School Rd
89	Phoenix	19th Ave & Thomas Rd
79	Phoenix	24th St & Baseline Rd
99	Phoenix	24th St & Washington St
75	Phoenix	27th Ave & Bell Rd
84	Phoenix	27th Ave & Glendale Ave
77	Phoenix	35th Ave & Camelback Rd
81	Phoenix	35th Ave & Van Buren St
76	Phoenix	3rd Ave & Fillmore St
88	Phoenix	3rd Street &Thomas Rd
93	Phoenix	40th St & Bell Rd
90	Phoenix	40th St & Roeser Rd
82	Phoenix	44th St & Camelback Rd
71	Phoenix	47th Ave & Osborn Rd
94	Phoenix	47th Ave & Sweetwater Ave
97	Phoenix	48th St & Guadalupe Rd (S Pointe Pkwy & Guadalupe)
72	Phoenix	75th Ave & Thomas Rd
85	Phoenix	7th Ave & Dunlap Ave
83	Phoenix	7th St & Bell Rd
86	Phoenix	Central Ave & Mohave St
80	Phoenix	Central Ave & Roeser Rd
91	Phoenix	Central Ave & Thomas Rd
95	Phoenix	Northern Ave & Bike Path south of SR-51
101	Queen Creek	Hawes Rd & Ocotillo Rd

TABLE 3.2 Manual Count Stations by Local Jurisdiction

Count Site ID	Jurisdiction	Count Location
122	Salt River Pima	Alma School Rd & McDowell
108	Scottsdale	Indian Bend Wash Path & Indian School Rd
107	Scottsdale	Miller Rd & McDowell Rd
105	Scottsdale	Pima Rd & Indian Bend Road
106	Scottsdale	Mountain View Rd & Via Linda
109	Surprise	Litchfield Rd & Bell Rd
110	Surprise	Reems Rd & Bell Rd
111	Surprise	Reems Rd & Grand Ave
112	Tempe	College Ave & Apache
114	Tempe	Mill Ave & 10th St
117	Tempe	Rural Rd & Southern
116	Tempe	Rural Rd & University Dr
118	Tempe	SR-101 & Guadalupe Rd
120	Youngtown	111 Ave & Youngtown Ave

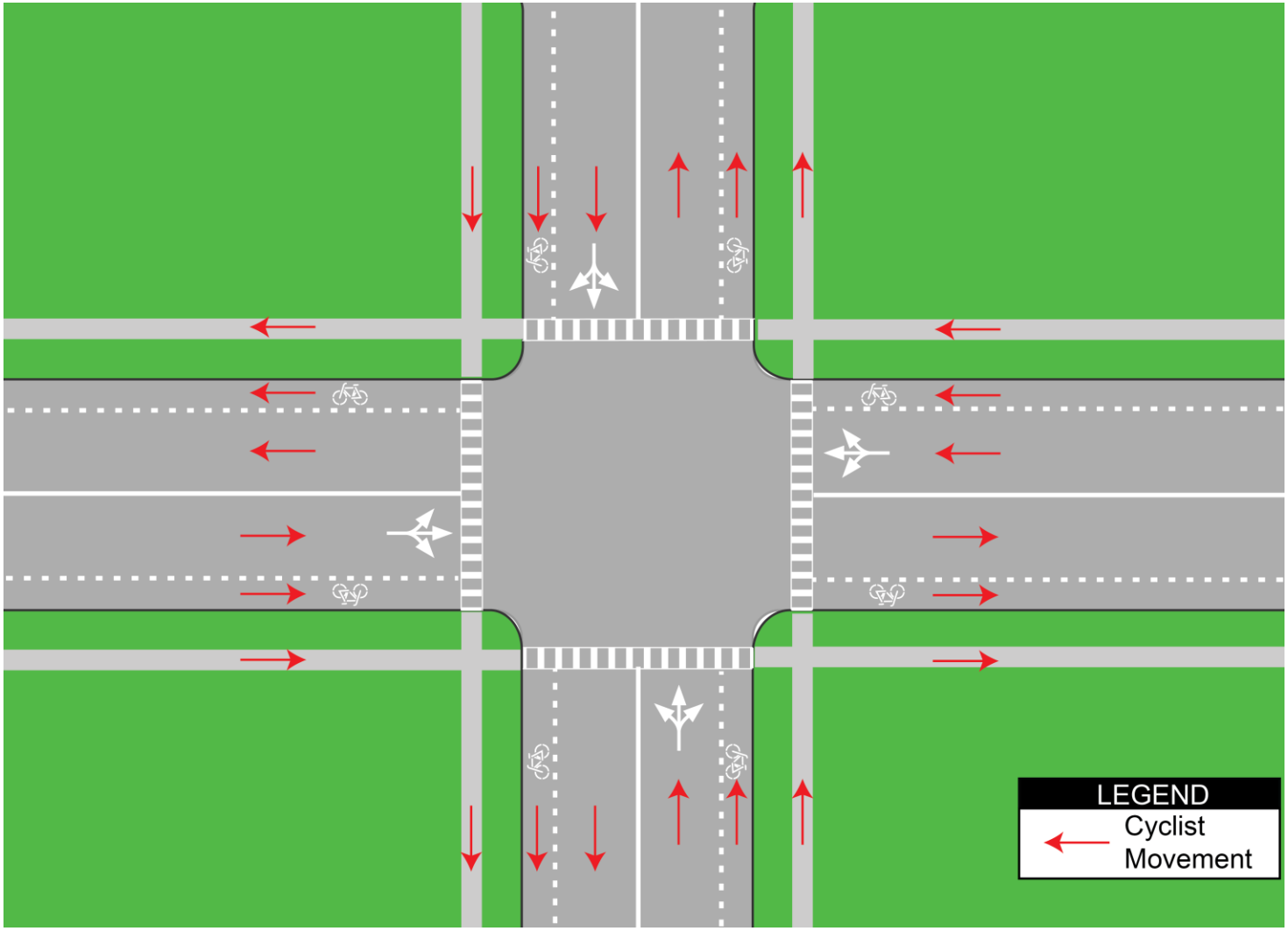
Source: Chen Ryan Associates, September 2013

A local traffic data collection firm, TRA, will conduct the manual counting beginning in October, 2013. TRA staff will be situated at count station intersections and instructed to count screenline movements along each intersection leg, i.e. "ins" and "outs" along each intersection leg, instead of turning movements. In a review of manual counting methods, it was found that in some instances, bicyclists are counted as pedestrians in the crosswalk, in other instances; bicyclists are recorded as "vehicle" turning movements. Both approaches however pose shortcomings. For the purposes of this study, understanding the directional demand on each intersection leg, along with the location of the cyclists in the right-of-way (either in the bike lane/travel lane, or along the sidewalk) is the most valuable type of information for systematic collection.

Figure 3-2 displays the cyclist movements that will be recorded at each of the 84 intersection locations where PM peak period manual bicycle counts will be conducted. A few important notes about the bicycle movements to be recorded:

- No distinction will be made between cyclists in the bike lane or the travel lane; and
- Cyclists traveling the wrong-way along sidewalks, bike lanes, or travel lanes will be recorded as traveling in the same direction as legal traffic flow.

Figure 3-2 Bicycle Movements Recorded at Intersections During Manual Counts



Note: Cyclists in the travel lane and the bike lane will be recorded as the same movement.

4.0 Scheduling

Both automated and manual counting will begin on approximately Monday, September 30, 2013. It is anticipated that manual counting will continue for 2 to 3 weeks. The automated counting will take approximately 8 weeks to complete, ending by approximately November 24, 2013.

As previously mentioned, the automated bicycle counting equipment will be leased from Eco-Counter. A total of 22 units will be leased for 2 months each, at approximately $1,200 per unit (for the entire 2-month period). The cost of leasing includes liability insurance and shipping. Twenty-two units were leased for 2 months, rather than 44 units for 2 weeks because of the Eco-Counter pricing structure, which resulted in the former approach being cheaper.

Project team members will be trained in the installation of the automated counting equipment during a 2-hour webinar provided by Eco-Counter staff on September 17, 2013. A brief version of the webinar will also be delivered to the Bicycle and Pedestrian Committee, so that member agencies will have the opportunity to understand how the pneumatic tube technology functions.

In-street counting stations will require the installation of 2 units in order to capture travel in two directions. Off-street sites will only require one unit to be installed. The automated data collection process will be structured around four, 2-week phases, where the 22 units will be installed in approximately eleven locations during each 2-week phase.

The phase scheduling accounted for school breaks anticipated during the Fall 2013 academic year. In all cases except three sites, automated counting will occur when students are in session at nearby schools.

Table 4.1 lists the four installation and monitoring phases. **Figure 4-1** displays the automated counts stations by phasing.

TABLE 4.1 Automated Count Stations by Data Collection Phase

Count ID	Jurisdiction	Count Location	Count Direction	Installation Instructions	Tube Type	Installation Date	Intersection Leg
6	Carefree	Pima Rd & Cave Creek Rd	NS	On Pima, south of Cave Creek (bolt to ground)	2 X 20'	9/30/2013	South
39	Maricopa County	Gavilan Peak Pkwy & Pioneer Rd	NS	On Gavilan, south of Pioneer (attach to guardrail)	2 X 20'	9/30/2013	South
59	Phoenix	12th St & Hatcher Rd	EW	On Hatcher, west of 12th	2 X 20'	9/30/2013	West
62	Phoenix	12th St & Arizona Canal Bike Path	EW	North side of Canal Bike Path, West of 12th	Mini	9/30/2013	West
63	Phoenix	Central Ave & Maryland Ave	EW	On Maryland, west of Central	2 X 20'	9/30/2013	West
64	Phoenix	Bike Path parallel to SR-51 & Union Hills Dr	NS	Northwest leg of bridge	Mini	9/30/2013	North
66	Phoenix	23rd Ave & Maryland Ave	NS	On 23rd, south of Maryland	2 X 20'	9/30/2013	South
65	Phoenix	23rd Ave & Peoria Rd	NS	On 23rd, north of Peoria	2 X 20'	9/30/2013	North
69	Phoenix	19th Ave & Deer Valley Rd	EW	On Deer Valley, west of 19th	2 X 20'	9/30/2013	West
73	Phoenix	19th Ave & Northern Rd	EW	On Northern, west of 19th (minis on sidewalks, no street)	2 X Mini	9/30/2013	West
74	Phoenix	19th Ave & Glendale	EW	On Glendale, west of 19th (minis on sidewalks, no street)	2 X Mini	9/30/2013	West
98	Phoenix	12th St & Missouri Ave	NS	On 12th, south of Missouri	2 X 20'	9/30/2013	South
9	Chandler	Price Rd & W Ray Rd	EW	On Ray, east of Price	2 X 20'	10/14/2013	East
10	Chandler	Dobson Rd & Frye Rd	NS	On Dobson, north of Frye	2 X 20'	10/14/2013	North
60	Phoenix	44th St & Thomas Rd	NS	On 44th, north of Thomas	2 X 20'	10/14/2013	North
61	Phoenix	11th St & Jefferson St	EW	On Jefferson, west of 11th (one counter in bikelane on north side of Jefferson)	1 X 20'	10/14/2013	West
67	Phoenix	12th St and McDowell Rd	NS	On 12th, north of McDowell	2 X 20'	10/14/2013	North
70	Phoenix	44th St & Washington St	EW	On Washington, east of 44th	2 X 20'	10/14/2013	East
102	Scottsdale	Indian Bend Wash Path north of McCormick Pkwy.	NS	On Indian Bend Wash Path, north of McCormick	Mini	10/14/2013	North
103	Scottsdale	68th St & Oak St	NS	On 68th, north of Oak	2 X 20'	10/14/2013	North

TABLE 4.1 Automated Count Stations by Data Collection Phase

Count ID	Jurisdiction	Count Location	Count Direction	Installation Instructions	Tube Type	Installation Date	Intersection Leg
104	Scottsdale	Scottsdale Road & Indian School Rd	EW	On Indian School Rd, east of Scottsdale Rd	2 X 20'	10/14/2013	East
113	Tempe	Hardy Dr & Western Canal Bike Path	EW	On north side of canal, west of Hardy	Mini	10/14/2013	West
119	Tempe	Rio Salado Downstream Dam Bridge	NS	On south side of bridge	Mini	10/14/2013	South
13	Chandler	Dobson Rd & Western Canal Bike Path	EW	On south side of canal, west of Dobson	Mini	10/28/2013	West
17	Gilbert	Gilbert Rd and Elliott Rd	NS	On Gilbert, south of Elliott	2 X 20'	10/28/2013	South
18	Gilbert	Greenfield Rd & Guadalupe Rd	EW	On Greenfield, north of Guadalupe	2 X 20'	10/28/2013	West
23	Gilbert	Eastern Canal Trail & E Wiliams Field Rd	EW	On E Williams Field Rd, west of Eastern Canal Trail	2 X 20'	10/28/2013	West
40	Mesa	Ellsworth Rd & McLellan Rd	NS	On Ellsworth, south of McLellan	2 X 20'	10/28/2013	South
41	Mesa	Gilbert Rd & University Dr	EW	On University, east of Gilbert	2 X 20'	10/28/2013	East
42	Mesa	Eastern Canal Bike Path and University Dr	EW	On University, west of the Eastern Canal Bike Path	2 X 20'	10/28/2013	West
43	Mesa	24th St & Southern Ave	EW	On Southern Ave, west of 24th	2 X 20'	10/28/2013	West
46	Mesa	Higley Rd & Southern Ave	NS	On Southern, north of Higley	2 X 20'	10/28/2013	North
100	Queen Creek	Sonoqui Wash Path & Chandler Heights Rd	NS	On Sonoqui Wash Path, south of Chandler Heights	Mini	10/28/2013	South
115	Tempe	Rural Rd & Western Canal Bike Path	EW	On south side of canal, west of Rural Rd	Mini	10/28/2013	West
1	Avondale	107th Ave & Thomas Rd	NS	On 107th, south of Thomas	2 X 20'	11/11/2013	South
16	El Mirage	El Mirage Rd & Thunderbird Rd	NS	On El Mirage, south of Thunderbird	2 X 20'	11/11/2013	South
24	Glendale	61st Ave & Maryland Ave	EW	On Maryland, west of 61st	2 X 20'	11/11/2013	West
25	Glendale	63rd Ave & Loop 101 Bike/Ped Bridge	NS	On southern end of bridge	Mini	11/11/2013	South
26	Glendale	51st Ave & Thunderbird Paseo (Canal Path)	EW	On south side of canal bike path, east of 51st	Mini	11/11/2013	East

TABLE 4.1 Automated Count Stations by Data Collection Phase

Count ID	Jurisdiction	Count Location	Count Direction	Installation Instructions	Tube Type	Installation Date	Intersection Leg
35	Litchfield Park	Litchfield Rd & Camelback Rd	EW	On Camelback, east of Litchfield (bolt to ground)	2 X 20'	11/11/2013	East
54	Peoria	83rd Ave & Thunderbird Rd	NS	On 83rd, south of Thunderbird	2 X 20'	11/11/2013	South
55	Peoria	115th Ave & Happy Valley Parkway	EW	Attach to guardrail on Happy Valley Parkway at Agua Fria Recharge Station (between 107th and 115th)	2 X 20'	11/11/2013	East
58	Peoria	New River Bike Path & Greenway Rd	NS	Place on New River Bike Path bridge	Mini	11/11/2013	North
68	Phoenix	39th Ave & Grand Canal Bike Path	EW	On south side of canal, east of 39th	Mini	11/11/2013	East

Source: Chen Ryan Associate, September, 2013

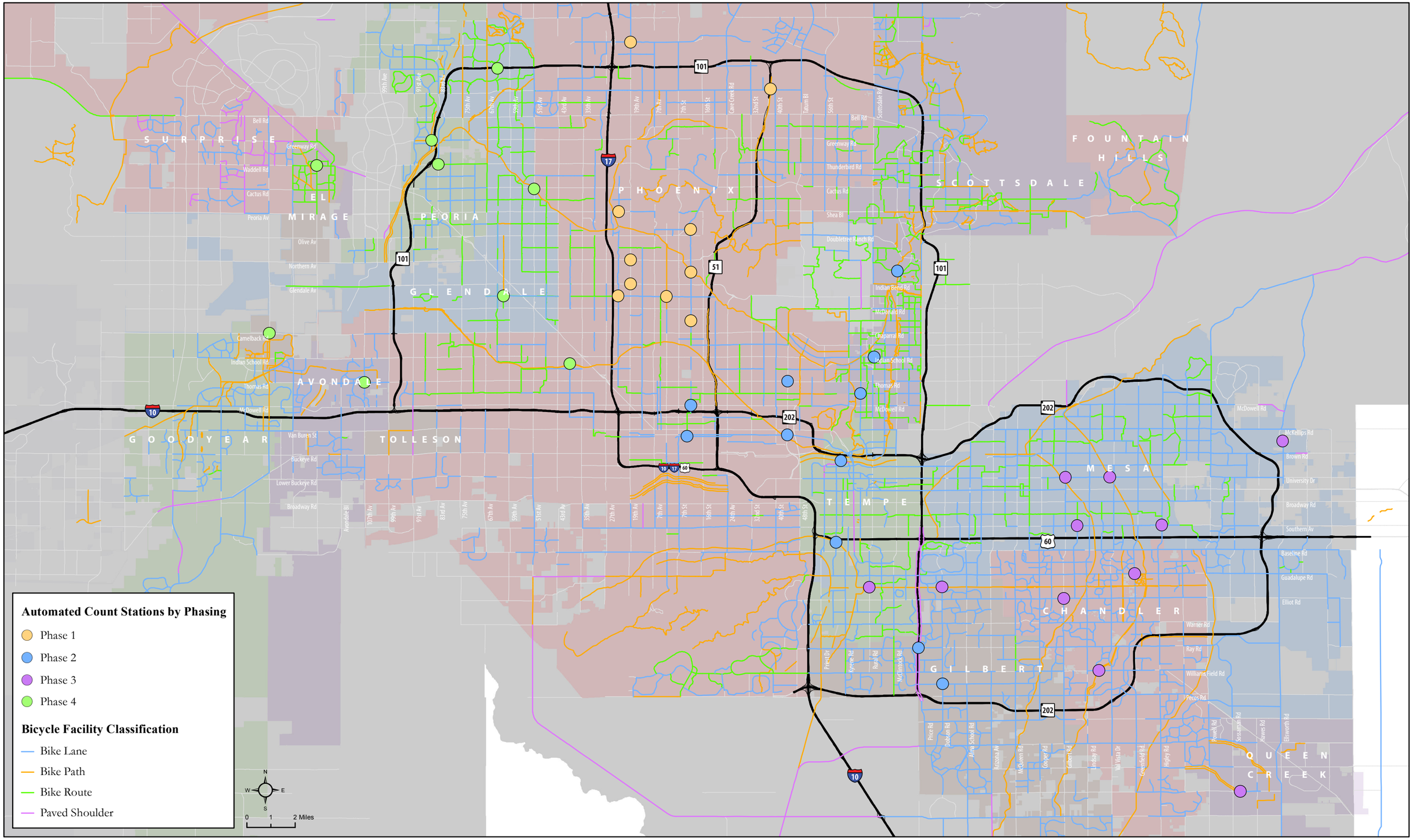


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Figure 4-1
Automated Count Stations by Phasing