

Part IV: Service Monitoring

Part of TriMet's compliance with FTA Circular 4702.1B is ongoing performance monitoring across all modes of service (bus, MAX, and WES). This monitoring is meant to ensure that TriMet is providing service in a way that does not discriminate on the basis of race, color, or national origin. Specifically, TriMet monitors the following service and performance metrics:

1. "Minority" and "Non-minority" lines
2. Service frequency and span
3. On-time performance
4. Vehicle loads
5. Service availability
6. Stop amenities
7. Vehicle assignment

1. MINORITY & NON-MINORITY LINES

"Minority" lines, as defined by the FTA, are lines that provide at least 1/3 of their service (measured by revenue hours) in block groups that are above-average minority population. "Non-minority" lines are all others.

Currently TriMet operates a total of 86 lines, including 78 bus lines, 5 MAX light rail lines, and 1 WES commuter rail line. Of these, 40 bus lines as well as 4 MAX lines are considered minority lines. The remaining 38 bus lines, 1 MAX line, and WES commuter rail are considered non-minority lines. In previous reports WES had been considered a minority line, but updated data from the 2010-2014 American Community Survey indicates a change in demographics around station areas to a lower percentage minority population.

As of spring 2016, Minority lines account for 66% of TriMet system service (measured by revenue hours), and 78% of system boarding rides. TriMet generally aligns service with mobility needs and ridership, thus lines serving areas with above-average minority populations typically have higher ridership and therefore a higher overall level of service than non-minority lines.

2. SERVICE FREQUENCY & SPAN

The analysis of service frequency and span is by mode of service (bus, MAX, WES) and day of service (weekday, Saturday, Sunday). As shown in Tables IV-1 through IV-3

following, the frequency and time span of service is noted for minority and non-minority lines, with comparisons during each time period and for weekday, Saturday, and Sunday.

Findings

1. Weekday service on minority bus lines is more frequent than service on non-minority lines during all time periods.
 2. Saturday service on minority bus lines is more frequent than on non-minority lines during the day, equal in frequency during evenings and slightly less frequent during early AM and night.
 3. Sunday service on minority bus lines is less frequent than on non-minority lines during all time periods.
 4. A higher proportion of minority bus lines operate on Saturday (63 percent) and Sunday (60 percent) than non-minority bus lines on Saturday (39 percent) and Sunday (32 percent).
 5. Service on minority MAX lines is slightly less frequent than service on the one non-minority line (MAX Orange Line) during most time periods on weekdays, Saturdays, and Sundays.
 6. A higher proportion of minority bus lines operate on Saturday (63 percent) and Sunday (60 percent) than non-minority bus lines on Saturday (39 percent) and Sunday (32 percent). All MAX lines operate on Saturday and Sunday.
 7. The average span of service (hours lines are serving riders from start to end of service) on minority lines exceeds the span of service on non-minority lines for bus and MAX on weekdays, Saturdays, and Sundays.
- While non-minority lines on average provide more frequent service during several time periods, especially on Sundays, this is offset by the greater number and proportion of minority lines operating on weekends, as well as the earlier average start of service and later end of service for minority lines for all days and modes. Thus, there are no Disparate Impacts on minority population in regard to frequency or span of service on bus, MAX, or WES.

Table IV-1: Frequency and Span of Service
 Minority and Non-Minority Transit Lines by Mode and Day of Service
 Spring 2016 Service – Weekdays Only

Day of Service	Mode of Service	Line Classification	No. of Lines in Service	% of Weekday Lines in Service	Average Frequency of Service (mins.) ¹						Avg. Time Service Begins	Avg. Time Service Ends	Span of Service (hours) ²
					Early AM	AM Peak	Midday	PM Peak	Evening	Night			
Weekday	Bus	Minority Lines	40	100%	28	28	33	29	28	37	5:14	22:28	16.3
		Non-Minority Lines	38	100%	31	34	44	37	37	42	5:38	20:50	13.2
		All bus lines	78	100%	29	31	38	33	32	39	5:25	21:40	14.8
	MAX Light Rail	Minority Lines	4	100%	17	13	14	13	14	27	3:44	1:12	21.4
		Non-Minority Line	1	100%	15	12	15	11	11	23	4:06	0:20	20.2
		All MAX lines	5	100%	16	12	14	12	13	26	3:49	1:01	21.2
	WES Commuter Rail	Non-Minority Line	1	100%	30	30		30	30		5:21	20:02	9.1
	System	Minority Lines	44	100%	26	27	31	27	27	36	5:06	22:43	16.7
		Non-Minority Lines	40	100%	30	33	43	36	36	40	6:26	20:58	12.7
		All lines	84	100%	28	30	36	31	31	37	5:40	21:40	14.6

Notes:

¹Early AM = Start of service to 6:59 am; AM Peak = 7-8:59 am; Midday = 9 am - 3:59 pm; PM Peak = 4-5:59 pm; Evening = 6-7:59 pm; Night = 8 pm to end of service.

²Span of Service includes only the hours when lines are serving riders. For most lines this is simply the amount of time from the beginning of the first trip to the end of the last trip. However, some lines have gaps during the middle of the day, so their span is adjusted accordingly.

Table IV-2: Frequency and Span of Service
 Minority and Non-Minority Transit Lines by Mode and Day of Service
 Spring 2016 Service – Saturday Only

Day of Service	Mode of Service	Line Classification	No. of Lines in Service	% of Weekday Lines in Service	Average Frequency of Service (mins.) *				Avg. Time Service Begins	Avg. Time Service Ends	Span of Service (hours)
					Early AM	Day	Evening	Night			
Saturday	Bus	Minority Lines	25	63%	41	31	34	41	6:00	0:04	18.1
		Non-Minority Lines	15	39%	40	34	34	39	6:41	22:48	15.9
		All bus lines	40	51%	41	32	34	41	6:15	23:35	17.3
	MAX Light Rail	Minority Lines	4	100%	25	15	14	24	3:54	1:23	21.5
		Non-Minority Line	1	100%	24	15	15	23	5:29	1:16	19.8
		All MAX lines	5	100%	25	15	14	24	4:13	1:22	21.1
	System	Minority Lines	29	66%	38	29	31	38	5:43	0:15	18.5
		Non-Minority Lines	16	40%	39	33	32	37	6:36	22:48	16.2
		All lines	45	54%	38	30	32	38	6:01	23:45	17.7

Notes:

¹Early AM = Start of service to 7:59 am; Day = 8 am-5:59 pm; Evening = 6-7:59 pm; Night = 8 pm to end of service.

²Span of Service includes only the hours when lines are serving riders. For most lines this is simply the amount of time from the beginning of the first trip to the end of the last trip. However, some lines have gaps during the middle of the day, so their span is adjusted accordingly.

Table IV-3: Frequency and Span of Service

Minority and Non-Minority Transit Lines by Mode and Day of Service
Spring 2016 Service – Sunday Only

Day of Service	Mode of Service	Line Classification	No. of Lines in Service	% of Weekday Lines in Service	Average Frequency of Service (mins.)				Avg. Time Service Begins	Avg. Time Service Ends	Span of Service (hours)
					Early AM	Day	Evening	Night			
Sunday	Bus	Minority Lines	24	60%	45	33	37	43	6:15	23:50	17.6
		Non-Minority Lines	12	32%	34	32	29	38	6:54	23:06	16.2
		All bus lines	36	46%	42	33	35	41	6:27	23:36	17.2
	MAX Light Rail	Minority Lines	4	100%	30	17	15	23	3:53	1:20	21.4
		Non-Minority Line	1	100%	29	17	15	26	5:29	1:16	19.8
		All MAX lines	5	100%	30	17	15	24	4:12	1:19	21.1
	System	Minority Lines	28	64%	42	31	34	39	5:55	0:03	18.1
		Non-Minority Lines	13	33%	32	27	24	32	6:47	23:17	16.5
		All lines	41	49%	39	31	32	38	6:10	23:49	17.6

Notes:

¹ Early AM = Start of service to 7:59 am; Day = 8 am-5:59 pm; Evening = 6-7:59 pm; Night = 8 pm to end of service.

²Span of Service includes only the hours when lines are serving riders. For most lines this is simply the amount of time from the beginning of the first trip to the end of the last trip. However, some lines have gaps during the middle of the day, so their span is adjusted accordingly.

3. ON-TIME PERFORMANCE

TriMet continuously monitors on-time performance on bus and MAX through CAD-AVL systems, and by direct observation on WES. TriMet defines “on-time” as no more than five minutes late or one minute early. In this analysis, the on-time performance for bus and MAX lines is compared between minority and non-minority lines on weekdays, Saturday, and Sunday (Table IV-4). WES commuter rail on-time data includes all service, weekdays.

Table IV-4: On-Time Performance
 Minority and Non-Minority Transit Lines by Mode and Day of Service
 Weekday, Saturday, Sunday
 Spring 2016 Service

Mode of Service	Day	Avg. % On-Time (weighted) ¹		Difference; Minority to Non-Minority +/-
		Minority Lines	Non-Minority Lines	
Bus	Weekday	81%	81%	0%
	Saturday	83	83	0
	Sunday	85	86	(1)
MAX Light Rail ²	Weekday	80	82	(2)
	Saturday	82	86	(4)
	Sunday	82	83	(1)
WES Commuter Rail	Weekday	n/a	97	n/a

Notes:

¹For Bus and MAX service, a vehicle is considered “on time” if it departs no more than 1 minute before to 5 minutes after the scheduled time. For WES, trains that arrive at the end-of-line stations (Beaverton Transit Center or Wilsonville) no more than 4 minutes before or after the scheduled time are considered “on time”. Weighted by revenue vehicle hours.
²MAX Orange Line is the only non-minority MAX Light Rail line. Orange Night Bus excluded from average percent on-time calculation.

Findings

1. Minority and non-minority bus lines’ on-time performance is similar for weekdays, Saturdays, and Sundays.
2. MAX on-time performance for the four minority lines is somewhat lower than the performance of the one non-minority line during weekdays (80 percent vs. 82 percent) and Saturdays (82 percent vs. 86 percent), and is similar on Sundays.
3. WES on-time performance is 97 percent.

- While bus on-time performance indicates no Disparate Impact on minority riders, MAX shows slightly lower performance on minority lines because the one non-minority line is the newest in the system (the MAX Orange Line, opened in September 2015). The differences are within the established system-wide Disparate Impact threshold of 20 percent. Nonetheless, TriMet has recently launched a broad initiative to improve on-time performance for the MAX system, which should serve to make all MAX lines more comparable.

4. VEHICLE LOADS

Vehicle loads are examined to determine whether buses or trains are overcrowded. Table IV-5 shows vehicle capacities (including both seating and standing), and Table IV-6 compares average vehicle loads for minority and non-minority lines during the A.M. Peak, Midday, and P.M. Peak times.

Table IV-5: Vehicle Capacities by Mode and Type

Vehicle Type	Passenger Capacities			
	Seated	Standing	Maximum Achievable Capacity	Maximum Load Factor
30-ft. Bus	28	2	30	1.1
40-ft. Bus	39	12	51	1.3
MAX Light Rail 2-Car Train	128	138	266	2.1
WES Commuter Rail - 1 Car Train	70	0	70	1.0
WES Commuter Rail - 2 Car Train	146	0	146	1.0

Notes: All MAX operates as 2-car trains. WES may operate as a single-car or a 2-car train.

Table IV-6: Vehicle Loads
 Minority and Non-Minority Transit Lines
 Weekday by Mode and Time Period
 Spring 2016 Service

	Time Period ¹	Minority Lines		Non-Minority Lines	
		Load/Seat Ratio	Mean Load	Load/Seat Ratio	Mean Load
Bus (28 or 39 seats)	AM Peak	0.45	18.3	0.36	17.3
	Midday	0.44	17.0	0.39	14.2
	PM Peak	0.54	19.9	0.47	17.5
MAX Light Rail (128 seats)	AM Peak	0.80	107.2	1.01	115.0
	Midday	0.69	88.2	0.40	61.5
	PM Peak	1.08	120.2	0.33	88.3
WES Commuter Rail (146 seats)	AM Peak	n/a	n/a	0.55	50.0
	PM Peak	n/a	n/a	0.61	64.0

¹AM Peak = 7:00 - 8:59 am; Midday = 9:00 am - 3:59 pm; PM Peak = 4:00 - 5:59pm

Findings

1. Average load/seat ratios range from a low of 0.36 to a high of 1.08. While the load-to-seat ratio is above 1.0 for the non-minority MAX line during AM Peak and for minority MAX lines during PM Peak, all modes are below the maximum load factor for every time period and across both minority and non-minority lines.
 2. Minority lines have somewhat larger loads than non-minority lines across all time periods, with the exception of AM Peak MAX. Observed loads on both groups of lines are well within the established maximum load factor standards.
- Thus, there is no Disparate Impact on minority population in regard to vehicle loads.

5. SERVICE AVAILABILITY

TriMet considers persons residing within one-half mile of bus stops and/or rail stations as having service available. Service availability is expressed as number and percentage of District-wide population and is determined by mode; for bus, MAX, and WES respectively. Table IV-7 on the next page presents the availability of service by mode for Spring 2016 service.

Findings

1. The percent of minority population with service available exceeds that of the non-minority populations for bus (91 percent vs. 88 percent), MAX (20 percent vs. 15 percent) and WES (>1 percent vs. <1 percent).
- Thus, there are no Disparate Impacts on minority population in regard to availability of service on bus, MAX or WES.

Table IV-7: Availability of Service by Mode
 Minority and Non-Minority Population
 TriMet District
 Spring 2016 Service

			Number and Percentage within 1/2 Mile* of...							
			TriMet District*		Bus		MAX		WES	
			Totals	%	Totals	%	Totals	%	Totals	%
Population (ACS 5 year estimate, 2010-2014)			1,526,154	100.0%	1,348,969	88.4%	245,669	16.1%	11,979	0.8%
Minority	All Minorities		426,154	27.9%	385,900	90.6%	84,483	19.8%	4,754	1.1%
	Black (non-Hispanic)		52,529	3.4%	50,463	96.1%	12,216	23.3%	180	0.3%
	Hispanic		188,244	12.3%	172,742	91.8%	39,850	21.2%	3,631	1.9%
	Asian (non-Hispanic)		112,128	7.3%	97,097	86.6%	20,023	17.9%	433	0.4%
	Native American (non-Hispanic)		8,263	0.5%	7,475	90.5%	1,501	18.2%	65	0.8%
	Hawaiian Native and Pacific Islander (non- Hispanic)		7,490	0.5%	7,131	95.2%	1,306	17.4%	46	0.6%
	Other (Including Mixed Race, non- Hispanic)		57,500	3.8%	50,993	88.7%	9,586	16.7%	398	0.7%
Non-Minority	White (Non- Hispanic)		1,100,000	72.1%	963,069	87.6%	161,187	14.7%	7,225	0.7%

Sources: TriMet GIS, Metro Regional Land Information System, and US Census American Community Survey Tables: 2010 - 2014 (5-Year Estimates), Table B03002. Hispanic or Latino Origin By Race (Block Group Level Data)

To adjust for the fact that some census block groups are only partially within the TriMet Transit District, we estimated the fraction of each block group's population within the transit district by calculating the percentage of residential address points that fell within the district. We then multiplied this address fraction by the Census counts to get the estimated TriMet District population. We used Oregon Metro's Master Address File (with non-residential and vacant addresses removed) as the address points for this analysis.

* Distance calculations based on May 2016 stop and station locations. Similar to the TriMet District level population estimates, we multiplied each block group's counts by the fraction of addresses within it that also fell within a half mile buffer of a transit stop of the specified type.

6. STOP AMENITIES

TriMet analyzes the distribution of stop amenities in the TriMet system (shelters, seating, waste receptacles, etc.) in order to identify any potential disparities. Table IV-8 shows the percentage of stops along minority and non-minority lines containing each amenity.

Table IV-8: Stop Amenities on Minority and Non-Minority Lines
Spring 2016

Category of Amenity	Pct of Stops on Minority Lines	Pct of Stops on Non-Minority Lines
Seating	39%	24%
Lighting	60%	65%
Elevators	<1%	<1%
Digital Displays	3%	1%
Shelters	22%	12%
Signs, Maps and/or Schedules	85%	74%
Waste Receptacles	18%	10%

Findings

1. The percentage of stops containing each amenity on minority lines exceeds the percentage for non-minority lines in all categories examined with the exception of lighting, which is higher for non-minority lines (65 percent compared to 60 percent of stops). However, this is within the system-wide Disparate Impact threshold of 20%.
 - Thus, there is no Disparate Impact on minority population in regard to the distribution of amenities.

7. VEHICLE ASSIGNMENT

In regard to assessing the results of TriMet's vehicle assignment practices in the context of Title VI, the expectation is that the average age of vehicles on minority lines should be no more than the average age of vehicles on non-minority lines. For bus and MAX, average age is calculated by weighting the age of vehicles by the number of hours in service. For WES, the age of primary and spare vehicles are listed separately because vehicle assignment is done differently than for the other modes. Vehicle assignment is shown in Table IV-9.

Table IV-9: Vehicle Assignment
Average Age of Vehicles Assigned by Mode
Spring 2016 Service

Mode of Service	Average Age of Vehicles Assigned (Years)		Difference; Minority to Non-Minority +/-
	Minority Lines	Non-Minority Lines	
Bus	8.3	7.5	1.7
MAX Light Rail	13.8	12.0	1.8
WES Commuter Rail	n/a	Primary: 9.0 Spares: 63.5	n/a

Findings

1. The average age of vehicles on minority bus lines (8.3 years) is about 11% older than the average age of vehicles on non-minority bus lines (7.5 years). This is within the system-wide Disparate Impact threshold of 20%.
 2. The average age of vehicles on minority MAX lines (13.8 years) is 15% older than the average age of vehicles on the non-minority MAX line (12.0 years). This is because the one non-minority MAX line is the newest in the system and involved the procurement of multiple new MAX vehicles. The difference is within the system-wide Disparate Impact threshold of 20%.
 3. For WES, TriMet does not maintain a detailed database of specific vehicles used for specific trips. The four main vehicles used for WES service were all built in 2007; the remaining two were built in 1952 and 1953 and are typically used as spares. WES is a non-minority line.
- Thus, there are no Disparate Impacts on minority population in regard to vehicle assignment on bus, MAX, or WES.

SUMMARY

As summarized in Table IV-10, TriMet finds no disparities in terms of performance standards that would indicate lesser service provision to minority riders or populations. Across nearly every metric minority lines actually performed better than non-minority lines, and minority populations have better access to the TriMet system based on residential proximity to service.

Table IV-10: Evaluation and Findings – Service Standards and Policies
 Comparison of Minority and Non-Minority Lines
 Spring 2016

	Mode of Service			
	Bus	MAX	WES	System
Service Standards				
<i>Vehicle Loads</i>	✓	✓	✓	✓
<i>Service Frequency & Span</i>	✓	✓	✓	✓
<i>On-Time Performance</i>	✓	✓	✓	✓
<i>Service Availability</i>	✓	✓	✓	✓
Distribution of Amenities				
<i>Seating</i>				✓
<i>Lighting</i>				✓
<i>Elevators</i>				✓
<i>Digital Displays</i>				✓
<i>Shelters</i>				✓
<i>Signs, Maps and/or Schedules</i>				✓
<i>Waste Receptacles</i>				✓
Vehicle Assignment	✓	✓	✓	✓
✓ = No disparity in performance or distribution				

TABLE V-1: DEMOGRAPHIC ANALYSIS OF PROXIMITY TO TRIMET SERVICE

Demographic Analysis of Proximity to TriMet Service (Percent)		TM District		Percent within 1/2* Mile of...			Frequent Service	
		Totals (Raw Number)	Totals (Pct.)	Bus	MAX	WES	Bus	Bus & MAX
Population	Total (ACS 5 year estimate, 2010-1014)	1,526,154	100.0%	88.4%	16.1%	0.8%	41.6%	47.5%
Minority	All Minorities	426,154	27.9%	90.6%	19.8%	1.1%	44.3%	52.5%
	Black (non-Hispanic)	52,529	3.4%	96.1%	23.3%	0.3%	59.4%	68.7%
	Hispanic	188,244	12.3%	91.8%	21.2%	1.9%	45.8%	55.0%
	Asian (non-Hispanic)	112,128	7.3%	86.6%	17.9%	0.4%	35.4%	42.4%
	Native American (non-Hispanic)	8,263	0.5%	90.5%	18.2%	0.8%	45.8%	53.0%
	Hawaiian Native and Pacific Islander (non-Hispanic)	7,490	0.5%	95.2%	17.4%	0.6%	40.9%	52.6%
	Other (Including Mixed Race, non-Hispanic)	57,500	3.8%	88.7%	16.7%	0.7%	42.7%	48.8%
Non-Minority	White (Non-Hispanic)	1,100,000	72.1%	87.6%	14.7%	0.7%	40.5%	45.6%
Population	Total population with known income (ACS 5 year estimate, 2010-1014)**	1,503,387	100%	88.3%	16.0%	0.8%	41.3%	47.3%
Income	Below 150% of Poverty Level	354,758	23.6%	93.5%	22.7%	1.3%	51.9%	59.9%

Sources: TriMet GIS, Metro Regional Land Information System, and US Census American Community Survey Tables: 2010 - 2014 (5-Year Estimates)
 Populations of block groups that are only partially within the TriMet district were adjusted using residential address points from the Oregon Metro Master Address File.

* Distance calculations based on May 2016 stop and station locations.

** Population totals for the TriMet district vary between between statistics for race and income/poverty because the ACS total excludes those whom poverty status is not determined.

AMENITIES

Maps of amenities by type and location on minority and on non-minority transit lines that follow illustrate the distribution of amenities overlaid on Census block groups with above-average concentration of minority population:

- Figure V-22 Amenity Distribution: Seating
- Figure V-23 Amenity Distribution: Digital Displays
- Figure V-24 Amenity Distribution: Elevators
- Figure V-25 Amenity Distribution: Shelters
- Figure V-26 Amenity Distribution: Signs, Maps, and/or Schedules
- Figure V-27 Amenity Distribution: Waste Receptacles

Due to the scale of the maps presented below, the large number of amenities, and many items' proximity to each other, these features were aggregated for display. To improve the interpretability of features, groups of like-amenities within 750 feet of each other were aggregated and the center of each cluster of points was used as the spatial location representing that group, and the number of individual points that made up each aggregation was added as an attribute of the new central point. In this process minority amenities were aggregated only with other minority features and likewise with the non-minority group. This technique limited overlap between features while still preserving the majority of their location/spatial relationships to each other. Part IV-Service Monitoring includes a detailed location-based analysis of amenities placement and distribution in relation to minority and non-minority lines.

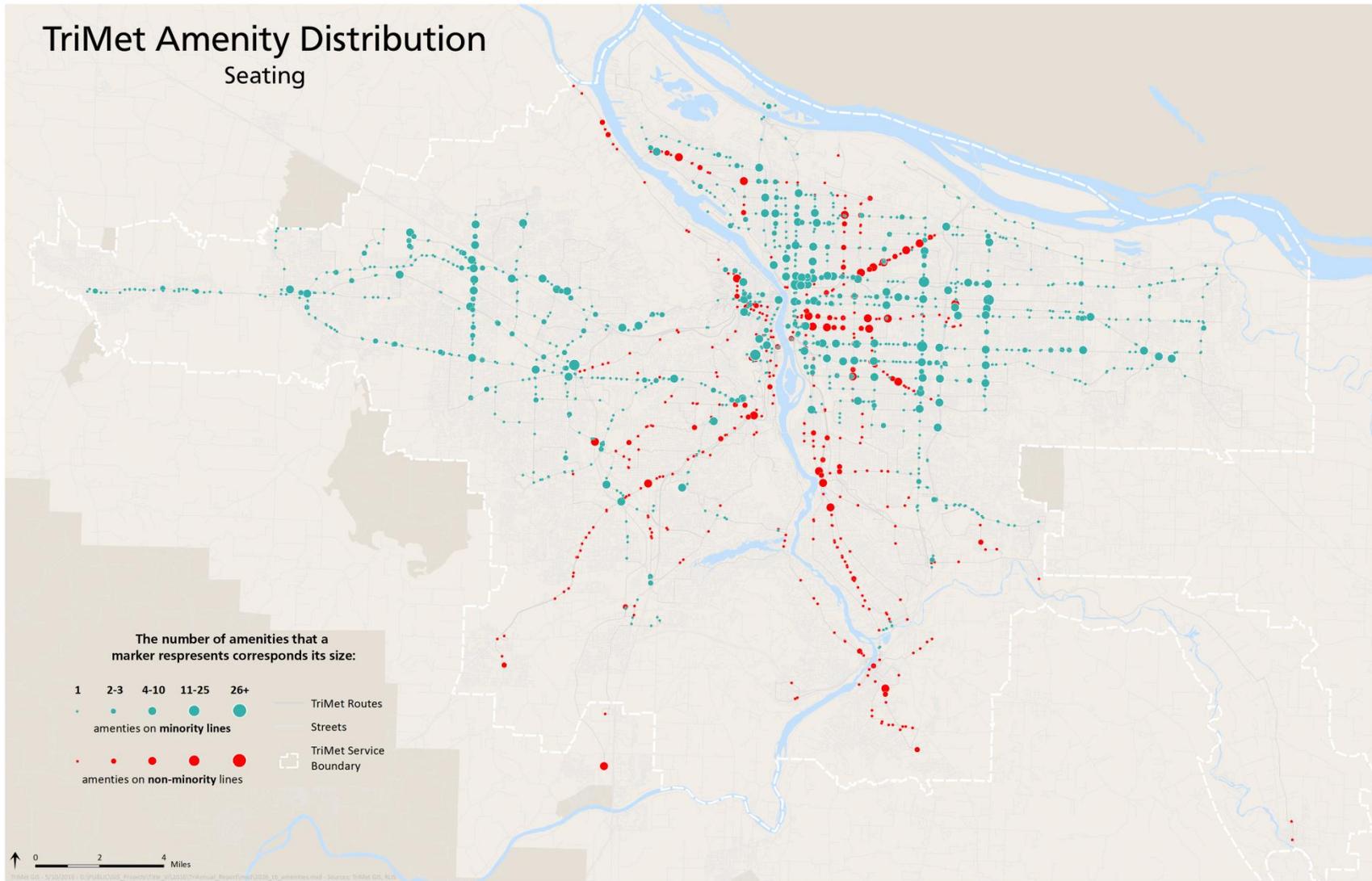


FIGURE V-22 AMENITY DISTRIBUTION: SEATING

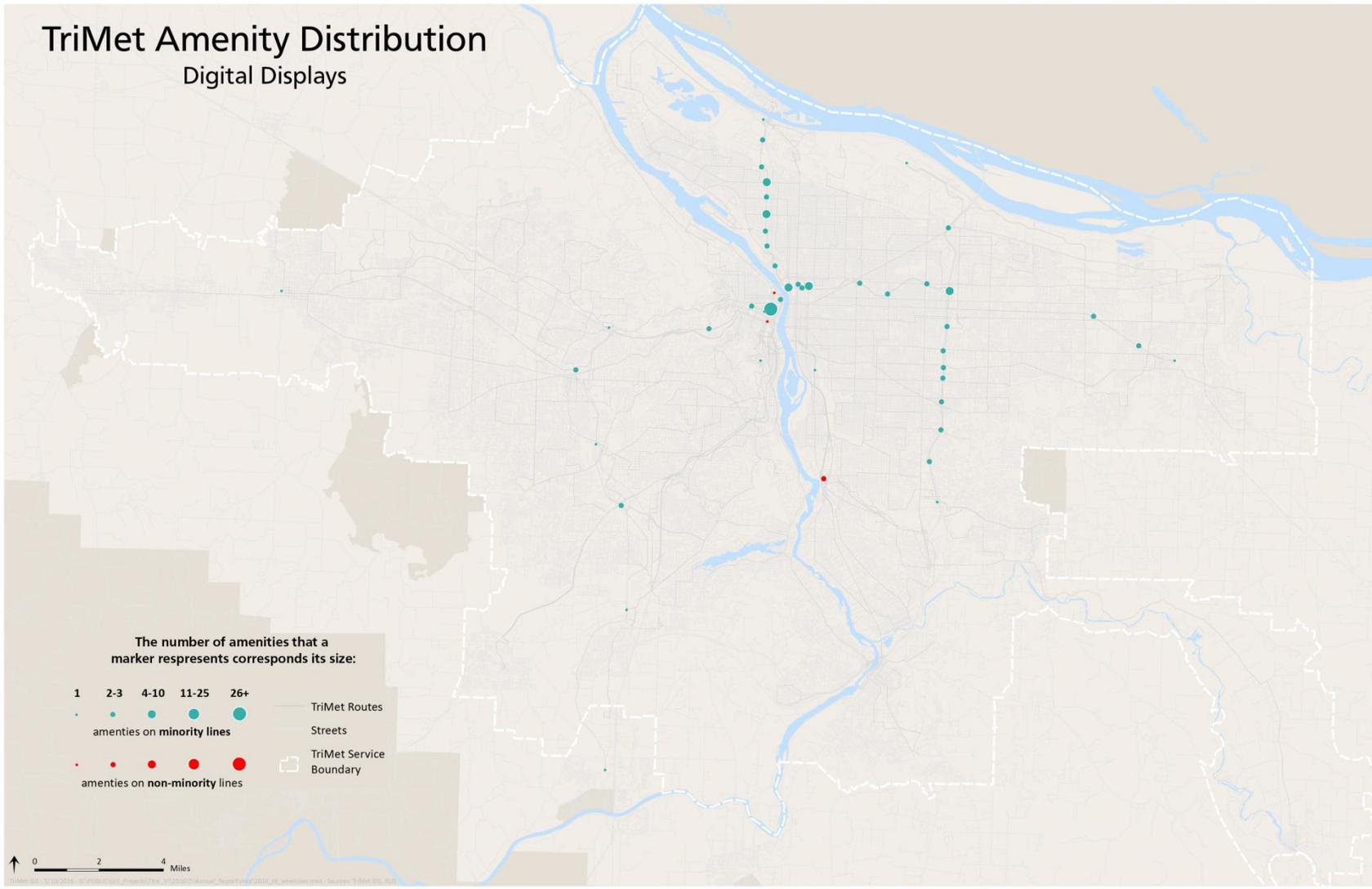


FIGURE V-23 AMENITY DISTRIBUTION: DIGITAL DISPLAYS

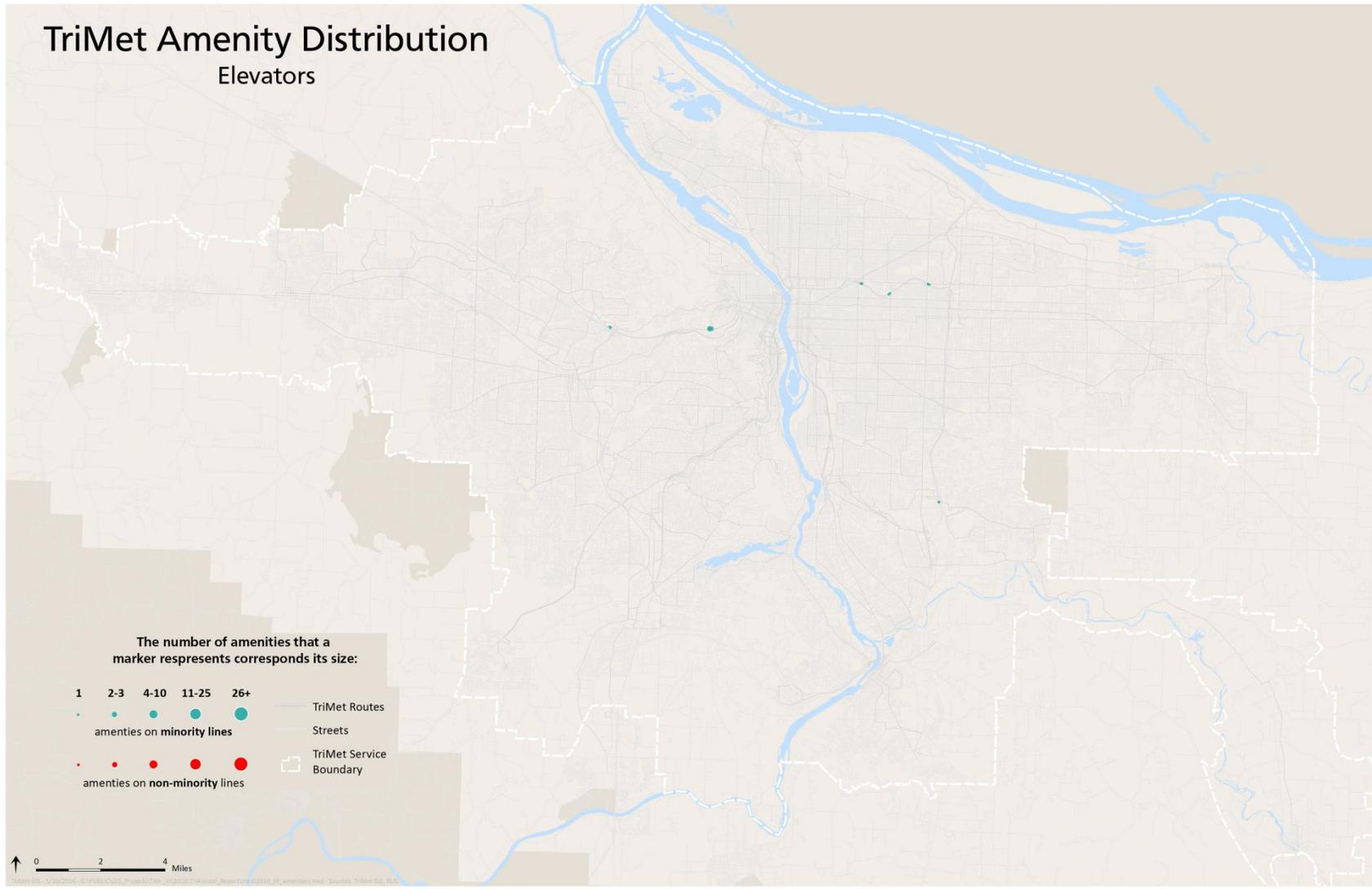


FIGURE V-24 AMENITY DISTRIBUTION: ELEVATORS

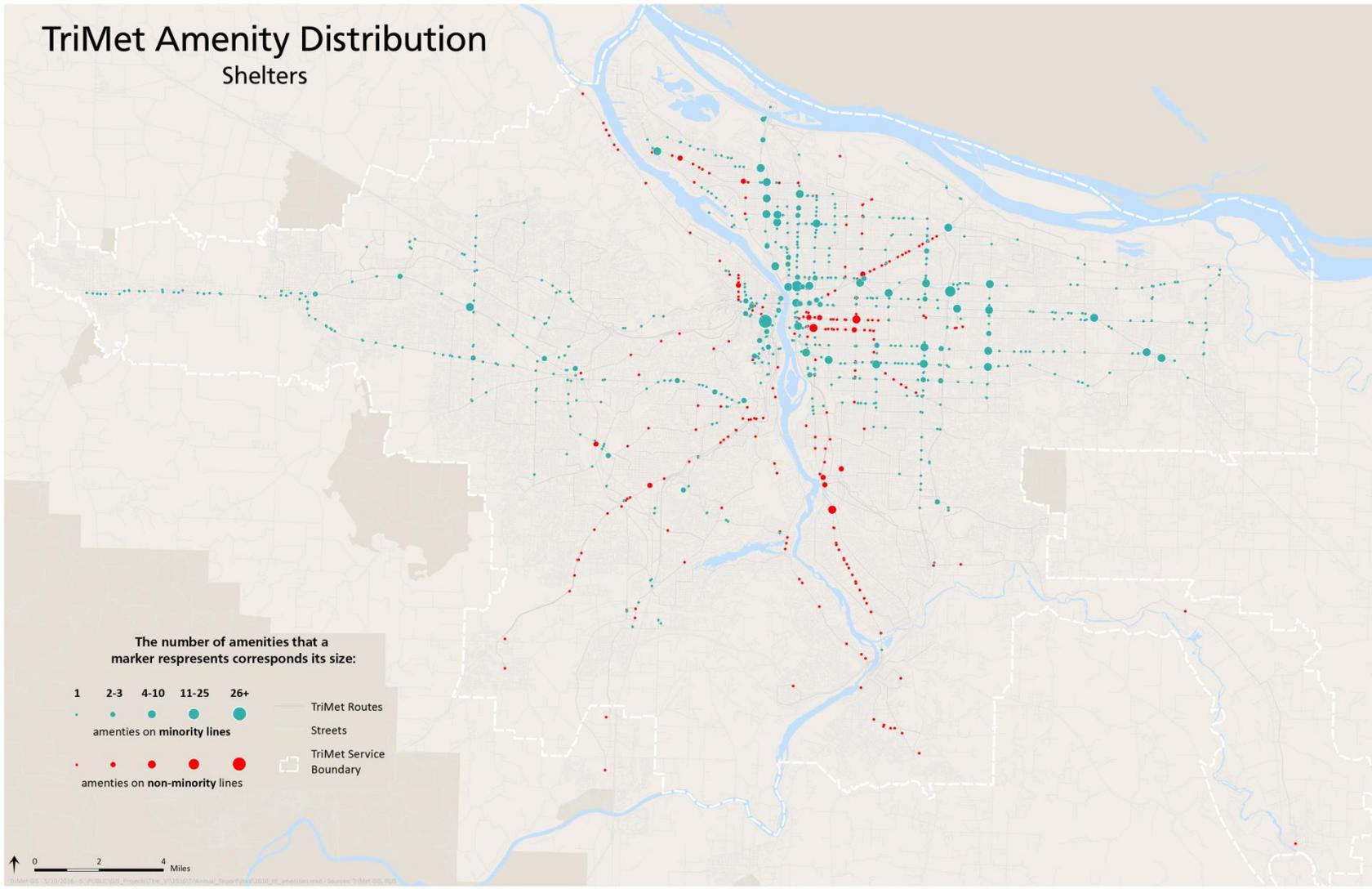


FIGURE V-25 AMENITY DISTRIBUTION: SHELTERS

TriMet Amenity Distribution

Signs, Maps, and/or Schedules

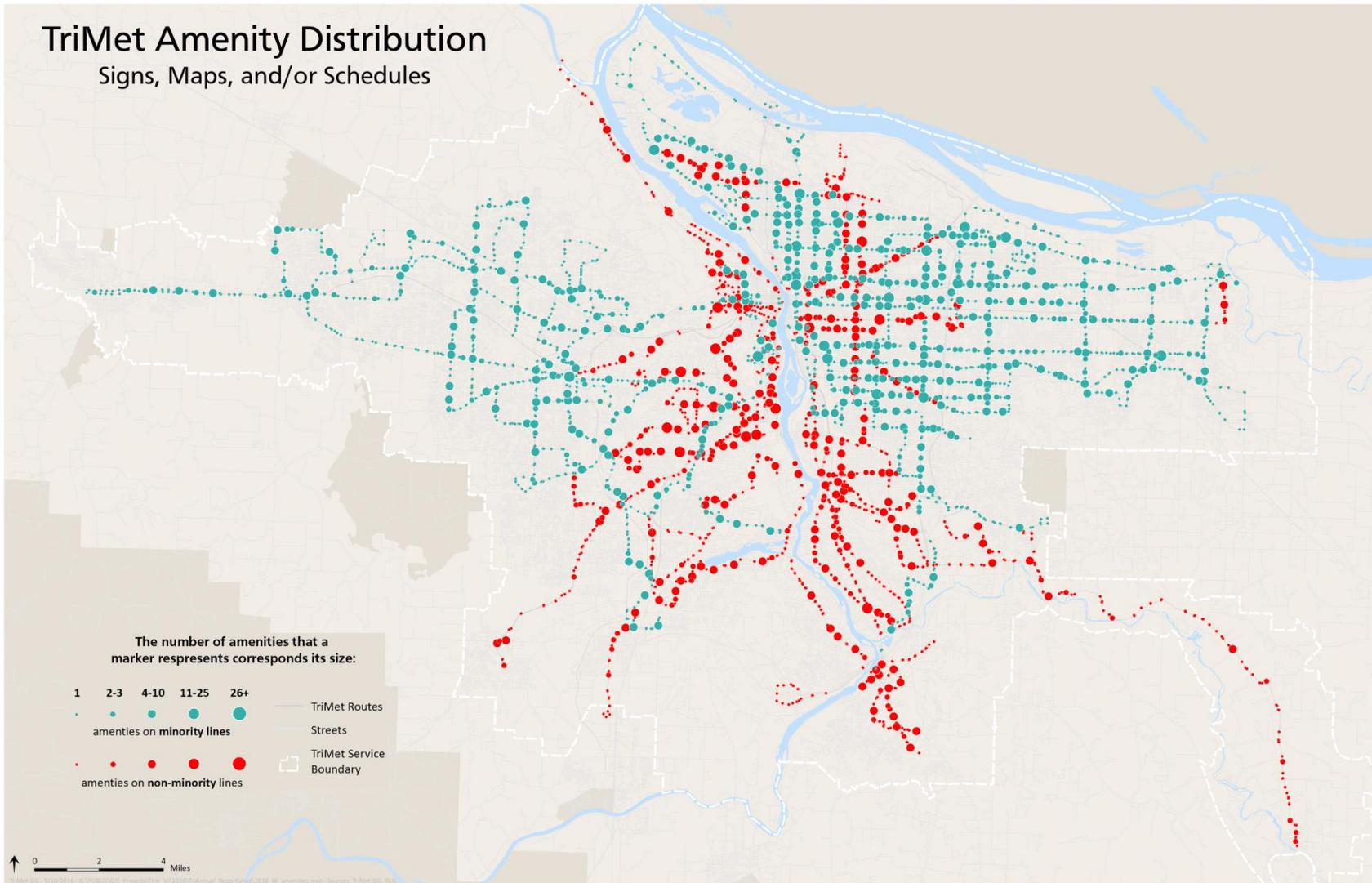


FIGURE V-26 AMENITY DISTRIBUTION: SIGNS, MAPS, AND/OR SCHEDULES

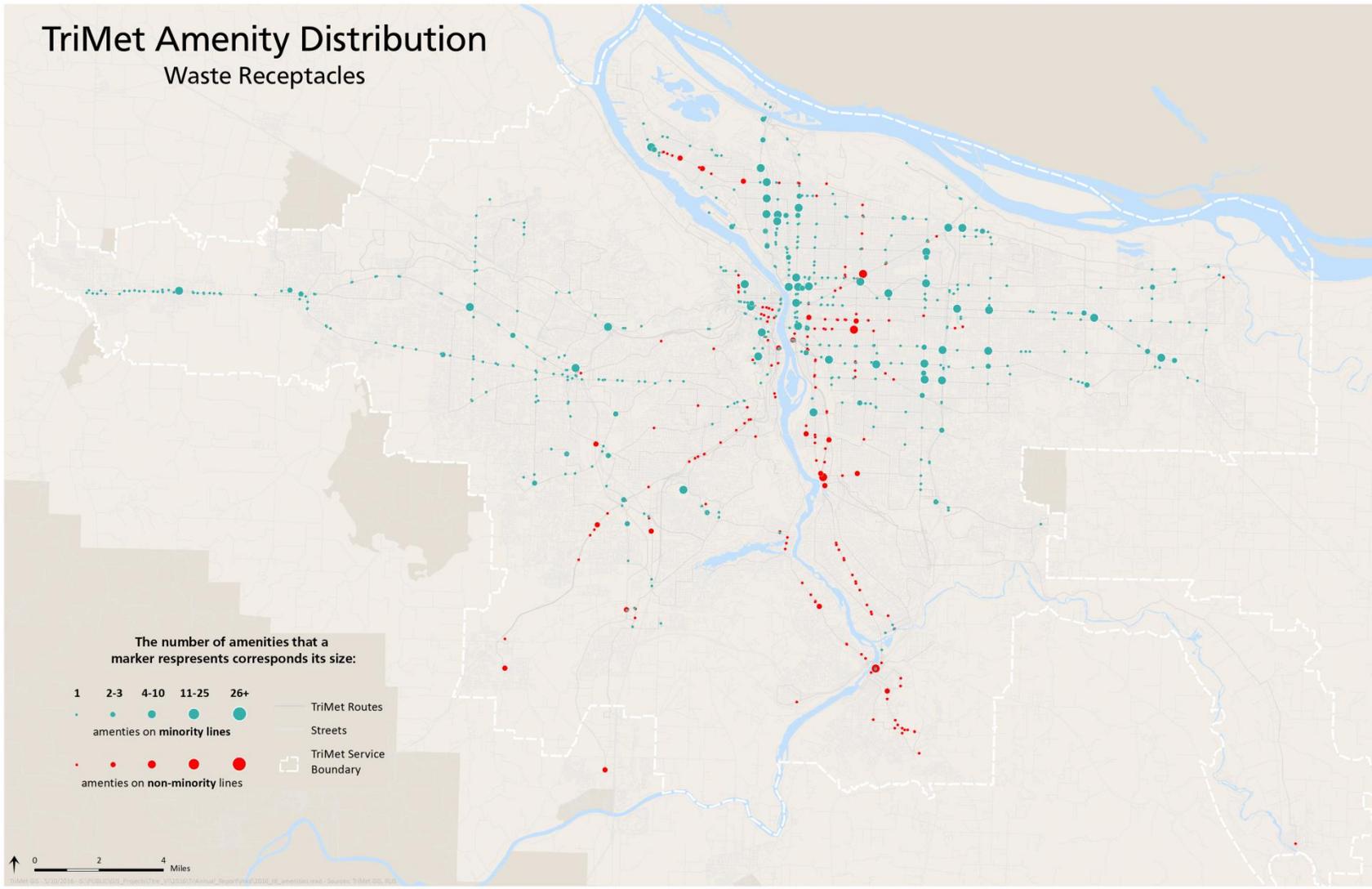


FIGURE V-27 AMENITY DISTRIBUTION: WASTE RECEPTACLES