FEHR ✦ PEERS

TECHNICAL MEMORANDUM

Date: November 8, 2017

To: Garrett Gritz, Diablo Engineering Group

From: Robert Rees PE & Diwu Zhou EIT, Fehr & Peers

Subject: Park Boulevard –Traffic Operation Analysis

OK16-0139

This memorandum provides a traffic operation analysis of Park Boulevard in Oakland, California generally between Interstate 580 and State Route 13. The following scenarios are evaluated:

- Existing Conditions
- Existing Conditions with Lane Reductions
- Existing Conditions with Lane Reductions Plus Improvements

Traffic operations analysis uses the Synchro/SimTraffic 9.0 software, based on the procedures outlined in the Transportation Research Board's *2010 Highway Capacity Manual* (2010 HCM). Intersection operation inputs include vehicle and pedestrian volumes, lane geometry, signal phasing and timing, pedestrian crossing times, and peak hour factors. The average of ten SimTraffic model runs determines the intersection operations presented in this memorandum.

A separate roundabout evaluation using SIDRA Intersection 7.0 software was completed for three intersections along the corridor to determine if roundabouts improve intersection operations.

EXISTING TRAFFIC CHARACTERISTICS

Park Boulevard is four-lanes – two in each direction, with turn-pockets at select signalized intersections between Interstate 580 and State Route 13. This assessment includes six signalized intersections and one unsignalized. The intersection of Park Boulevard and Park Boulevard Way/Greenwood Avenue/13th Avenue/East 38th Street are three closely spaced unsignalized intersections considered a single location for this study. **Figure 1** presents the study intersections (all figures attached at the end of memorandum) listed below from west to east:

1. Park Boulevard/Excelsior Avenue/Alma Place/Grosvenor Place;
2. Park Boulevard/Park Boulevard Way/Greenwood Avenue/13th Avenue/East 38th Street;

3. Park Boulevard/Hampel Street/Glen Park Road;

4. Park Boulevard/Glenfield Avenue;

5. Park Boulevard/Wellington Street;

6. Park Boulevard/St James Drive/Leimert Boulevard; and

7. Park Boulevard/Trafalgar Place/Monterey Boulevard.

Fehr & Peers collected multimodal traffic counts at five intersections (3, 4, 5, 6 and 7) on Wednesday, May 31, 2017. We used traffic counts at two intersections (1 and 2) from a separate city-sponsored study. Based on the collected data the observed weekday peak hours along the corridor are from 7:45-8:45 AM in the weekday morning and from 5:00-6:00 PM in the weekday evening. Figure 1 shows the existing peak hour traffic volumes and lane configurations at the study intersections.

PARK BOULEVARD TRAFFIC OPERATIONS

This section discusses Park Boulevard traffic operations under the three study scenarios referenced above. **Figure 2** illustrates the typical street cross section without and with a lane reduction, which generally reduces the corridor to two-lanes, one in each direction, with left-turn pockets at signalized intersection. Each scenario is described below:

- **Existing Conditions** assumes no changes to intersection lane configurations, traffic signal timings, or corridor geometrics.

- **Existing Conditions with Lane Reductions (Scenario 1)** assumes a lane reduction in each direction, protected left-turn lanes at signalized intersections, and optimized traffic signal timings.

- **Existing Conditions with Lane Reductions Plus Improvements (Scenario 2)** assumes a lane reduction in each direction, protected left-turn lanes at signalized intersections, optimized traffic signal timings, and the following intersection geometric change:
  - Reconfigure Glen Park Road at Park Boulevard removing it from the signalized intersection at Hampel Street so Glen Park Road becomes a right-turn in/out only intersection.

Table 1 presents the corridor travel times under each scenario. **Table 2** presents the intersection operation results. **Figures 3** and **Figure 4** show the vehicle queue characteristics for the morning and evening peak hours, respectively.

Table 1: Park Boulevard Road Diet – Corridor Travel Times

Direction of Travel	Peak Hour	Average Travel Time		
		Existing Conditions	Lane Reduction (Scenario 1)	Lane Reduction Plus Improvements (Scenario 2)
Eastbound	AM	5.5 Minutes	6.2 Minutes	5.4 Minutes
	PM	5.3 Minutes	6.1 Minutes	5.5 Minutes
Westbound	AM	6.4 Minutes	11.3 Minutes	6.4 Minutes
	PM	5.7 Minutes	5.4 Minutes	5.1 Minutes

Notes:
Scenario 1 and Scenario 2 incorporate traffic signal optimization. As a result, some travel times may show improvement over the existing conditions where the existing traffic signal timings were used and may not be optimized for current traffic demands.
Source: Fehr & Peers, 2017

Table 2: Park Boulevard Road Diet – Intersection Level of Service

	Intersection	Control	Peak Hour	Existing Conditions		Lane Reduction (Scenario 1)		Lane Reduction + Improvement (Scenario 2)	
				Delay	LOS	Delay	LOS	Delay	LOS
1	Park Boulevard/Excelsior Avenue/Alma Place/Grosvenor Place	Signal	AM	41	D	37	D	43	D
			PM	25	C	26	C	24	C
2	Park Boulevard/Park Boulevard Way/Greenwood Avenue/13th Avenue/East 38th Street	Side Street Stop[1]	AM	--	F	--	E	--	E
			PM	--	C	--	E	--	D
3	Park Boulevard/Glen Park Road-Hampel Street	Signal	AM	26	C	57	E	34	C
			PM	21	C	42	D	25	C
4	Park Boulevard/Glenfield Avenue	Signal	AM	11	B	--	F	7	A
			PM	14	B	9	A	8	A
5	Park Boulevard/Wellington Street	Signal	AM	19	B	--	F	22	C
			PM	18	B	13	B	13	B

PRELIMINARY
FOR DISCUSSION ONLY

	Intersection	Control	Peak Hour	Existing Conditions		Lane Reduction (Scenario 1)		Lane Reduction + Improvement (Scenario 2)	
				Delay	LOS	Delay	LOS	Delay	LOS
6	Park Boulevard/St James Drive-Leimert Boulevard	Signal	AM	19	B	36	D	30	C
			PM	17	B	27	C	29	C
7	Park Boulevard/Trafalgar Place-Monterey Boulevard	Signal	AM	19	B	18	B	19	B
			PM	20	B	22	C	22	C

Notes:
1.   LOS is for the stop-controlled approach with the highest delay.
Source: Fehr & Peers, 2017

Scenario 1 Results

Scenario 1 increases average travel time by 5 minutes on westbound Park Boulevard during the morning peak hour. The Park Boulevard/Hampel Street/Glen Park Road intersection causes the increased travel time. Westbound vehicle queues often extend back from the intersection through the Wellington Street intersection. Maximum queues extend back to about Hollywood Avenue (about 3,100 feet from the Hampel Street intersection). As a result, intersection operations fail for vehicle traffic during the morning peak hour at:

- Park Boulevard/Hampel Street/Glen Park Road
- Park Boulevard/Glenfield Avenue
- Park Boulevard/Wellington Street

Scenario 1 also increases travel time on eastbound Park Boulevard during both the morning and evening peak hours, and is primarily caused by the Park Boulevard/Hampel Street/Glen Park Road intersection. The change in travel time from roughly 5.5 minutes to 6.2 minutes, about 40 seconds, is similar to time lost waiting at a traffic signal because the driver missed the green light.

The Park Boulevard/Hampel Street/Glen Park Road intersection is a five-leg intersection with separate signal phases for the side street approaches, requiring a long signal cycle (about 140 seconds) to serve all approaches. As a result, there is insufficient green time to accommodate westbound Park Boulevard traffic in a single lane during the morning peak hour, and the long cycle length increases delay for eastbound drivers as well. Scenario 2, discussed in the next section, incorporates an intersection reconfiguration to improve the traffic operations at this intersection.

Scenario 2 Results

Scenario 2 includes geometric and traffic signal changes at the Park Boulevard/Hampel Street/Glen Park Road intersection. The Scenario removes Glen Park Road from the traffic signal operations, converting it to an unsignalized intersection with right-turn in/out only. This change removes a signal phase from the intersection's traffic signal increasing green time given to Park Boulevard traffic.

Scenario 2 travel times are similar to the existing scenario and all intersection operate well and shows that lane reductions, whether east of Leimert Boulevard (i.e., Upper Park) or west of Leimert Boulevard (i.e., Middle Park), do not adversely impact overall corridor travel times.

Additional Considerations

Scenario 2 with signal optimization operates similar to existing conditions at the signalized intersections. A lane reduction in each direction changes Park Boulevard's traffic operational character in two fundamental ways. First, driving speeds today are determined by faster drivers because there are two lanes in each direction so drivers can pass slower moving vehicles. Scenario 2, with one lane in each direction, means that the slower vehicles determine the driving speeds because faster drivers cannot pass the slower vehicles. Second, vehicle traffic is spread across two lanes generating gaps in traffic flow for drivers to make left-turns. Scenario 2, with one lane each direction, puts all traffic in a single lane so there are fewer gaps in traffic making left turns more difficult to negotiate.

As a result, Scenario 2 should incorporate additional features to more efficiently serve vehicle traffic to and from the side streets. **Table 3** (next page) identifies the intersections and changes that should be incorporated into future evaluations of lane reductions for the corridor.

ROUNDABOUT EVALUATION

This section presents intersection operations if roundabouts were installed at three intersection on Park Boulevard including:

1. Park Boulevard/Excelsior Avenue/Alma Place/Grosvenor Place
2. Park Boulevard/Park Boulevard Way/Greenwood Avenue/13th Avenue/East 38th Street
6. Park Boulevard/St James Drive/Leimert Boulevard

Roundabout geometric feasibility was not considered in this evaluation, only the operations assuming a single lane roundabout with a 100-foot inscribed circle.

Table 3: Scenario 2 Suggested Additional Intersection Enhancements

Side Street Intersection	Intersection Change	Driver and Pedestrian Change
Kinglsey Street	Right turn in/out only with a raised median. Consider RRFB.	Left turning drivers redirected to traffic signal at Park Boulevard Way.
Park Boulevard Way / 13th Avenue	Signalize intersection with protected left-turn lane.	Vehicle and pedestrian traffic under signal control.
E 38th Street	Right turn in/out only with a raised median and no crosswalks.	Left turning drivers and pedestrians redirected to traffic signal at 13th Avenue.
Greenwood Avenue	Right turn in/out only with a raised median and no crosswalks.	Left turning drivers redirected to traffic signal at Hampel Street, pedestrians redirected to traffic signal at 13th Avenue.
Beaumont Avenue	Signalize intersection with protected left-turn lane.	Vehicle and pedestrian traffic under signal control.
Brighton Avenue	Right turn in/out only with a raised median. Consider RRFB.	Left turning drivers redirected to traffic signal at Beaumont or Hampel Street.
Everett Avenue	Right turn in/out only with a raised median. Consider RRFB.	Left turning drivers redirected to traffic signal at Wellington or El Centro Avenue.
El Centro Avenue	Signalize intersection with protected left-turn lane.	Vehicle and pedestrian traffic under signal control.
Dolores Avenue	Right turn in/out only with a raised median. Consider RRFB.	Left turning drivers redirected to traffic signal at El Centro Avenue.
Hollywood Avenue	Signalize intersection with protected left-turn lane.	Vehicle and pedestrian traffic under signal control.
Trestle Glen Road	Right turn in/out only with a raised median. Consider RRFB.	Left turning drivers redirected to traffic signal at Hampel Street or at Grosvenor.
Estates Drive	Signalize intersection with protected left-turn lane.	Vehicle and pedestrian traffic under signal control.
Mt. Zion Driveway	Provide a left-turn lane and a median left-turn merge lane	Left turning drivers leaving driveway make the movement in two stages

Source: Fehr & Peers, 2017

Table 4 summarizes the roundabout operations for the morning and evening peak hours. Significant vehicle queueing occurs in the westbound direction during the morning peak hour at the three study locations. Vehicles queues at the Park Boulevard/Excelsior Avenue/Alma Place/Grosvenor Place intersection extend back about 1,650 feet east beyond East 38th Street. Queues at the Park Boulevard/Park Boulevard Way/13th Avenue/East 38th Street intersection extend

about 800 feet east about to Brighton Avenue and include right turn restrictions at Greenwood Avenue. Queues at the Park Boulevard/St James Drive/Leimert Boulevard intersection extend back about 1,250 feet

Table 4: Park Boulevard Roundabouts – Intersection Level of Service

Intersection		Roundabout Scenario				
		Peak Hour	Delay	LOS	Degree of Saturation[1]	Queue Distance (ft.)[1]
1	Park Boulevard/Excelsior Avenue/Alma Place/Grosvenor Place	AM	**45.6**	**E**	**1.089**	**1,650 (WB)**
		PM	8.0	A	0.532	100 (WB)
2	Park Boulevard/Park Boulevard Way/13th Avenue/38th Street	AM	25.1	D	**0.961**	**800 (WB)**
		PM	8.8	A	0.583	150 (EB)
6	Park Boulevard/St James Drive/Leimert Boulevard	AM	**37.6**	**E**	**1.040**	**1,250 (WB)**
		PM	18.9	C	0.825	350 (EB)

Notes:
Bold indicates LOS E or F.
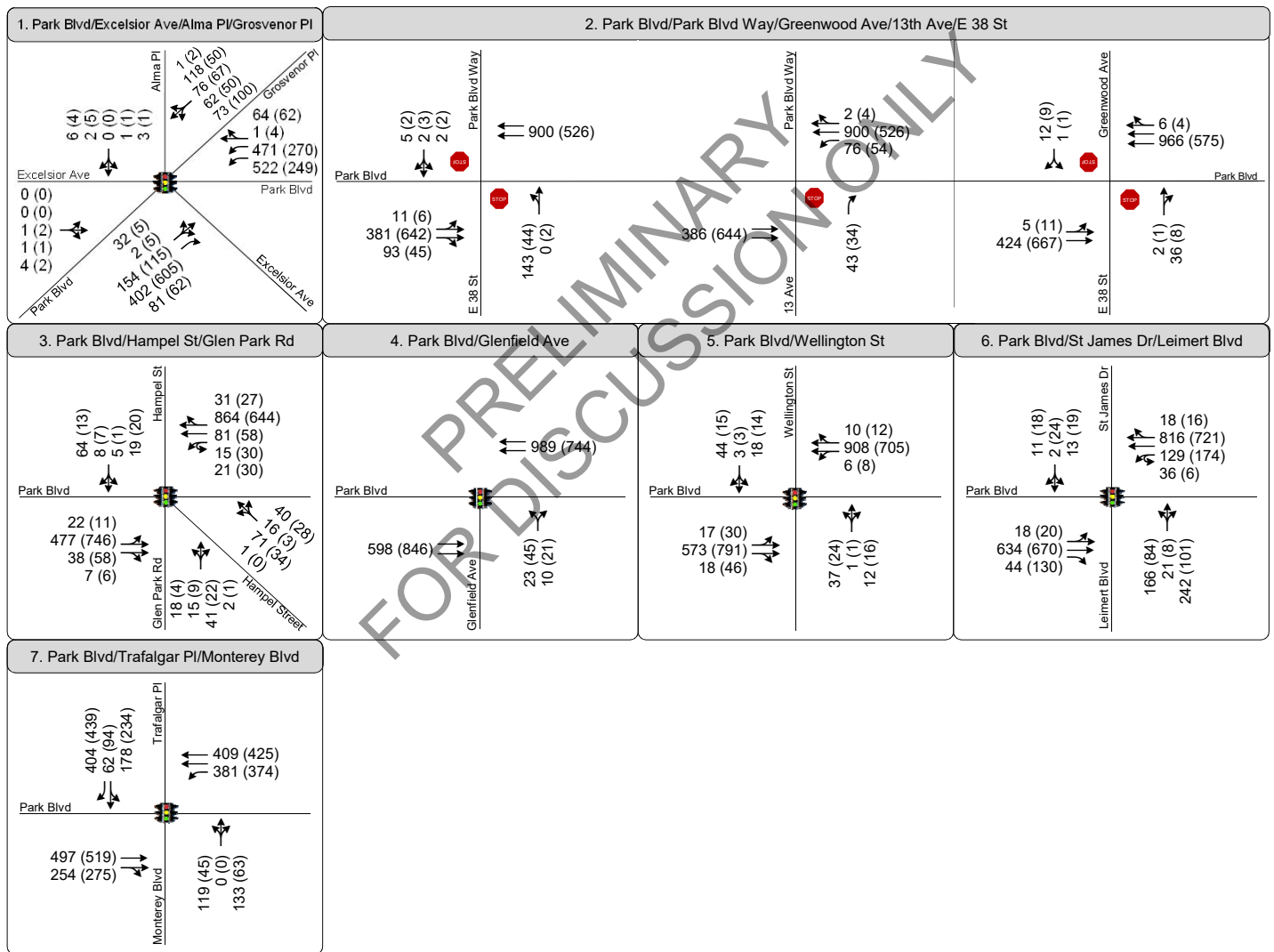   1.   Degree of saturation and approximate queue distance listed for worst movement.
Source: Fehr & Peers, 2017

Attachments:

1. Park Blvd/Excelsior Ave/Alma Pl/Grosvenor Pl

Alma Pl
1 (2)
118 (50)
76 (67)
62 (50)
73 (100)

Grosvenor Pl

64 (62)
1 (4)
471 (270)
522 (249)

6 (4)
2 (5)
0 (0)
1 (1)
3 (1)

Excelsior Ave
Park Blvd

0 (0)
0 (0)
1 (2)
1 (1)
4 (2)

32 (5)
2 (5)
154 (115)
402 (605)
81 (62)

Park Blvd
Excelsior Ave

2. Park Blvd/Park Blvd Way/Greenwood Ave/13th Ave/E 38 St

Park Blvd Way

5 (2)
2 (3)
2 (2)

← 900 (526)

2 (4)
900 (526)
76 (54)

Park Blvd Way

12 (9)
1 (1)

← 6 (4)
966 (575)

Greenwood Ave

Park Blvd

11 (6)
381 (642)
93 (45)

143 (44)
0 (2)

386 (644)

43 (34)

5 (11)
424 (667)

2 (1)
36 (8)

Park Blvd

E 38 St

13 Ave

E 38 St

3. Park Blvd/Hampel St/Glen Park Rd

Hampel St

64 (13)
8 (7)
5 (1)
19 (20)

31 (27)
864 (644)
81 (58)
15 (30)
21 (30)

Park Blvd

22 (11)
477 (746)
38 (58)
7 (6)

40 (28)
16 (3)
71 (34)
1 (0)

18 (4)
15 (9)
41 (22)
2 (1)

Glen Park Rd

Hampel Street

4. Park Blvd/Glenfield Ave

← 989 (744)

Park Blvd

598 (846)

23 (45)
10 (21)

Glenfield Ave

5. Park Blvd/Wellington St

Wellington St

44 (15)
3 (3)
18 (14)

10 (12)
908 (705)
6 (8)

Park Blvd

17 (30)
573 (791)
18 (46)

37 (24)
1 (1)
12 (16)

6. Park Blvd/St James Dr/Leimert Blvd

St James Dr

11 (18)
2 (24)
13 (19)

18 (16)
816 (721)
129 (174)
36 (6)

Park Blvd

18 (20)
634 (670)
44 (130)

166 (84)
21 (8)
242 (101)

Leimert Blvd

7. Park Blvd/Trafalgar Pl/Monterey Blvd

Trafalgar Pl

404 (439)
62 (94)
178 (234)

← 409 (425)
381 (374)

Park Blvd

497 (519)
254 (275)
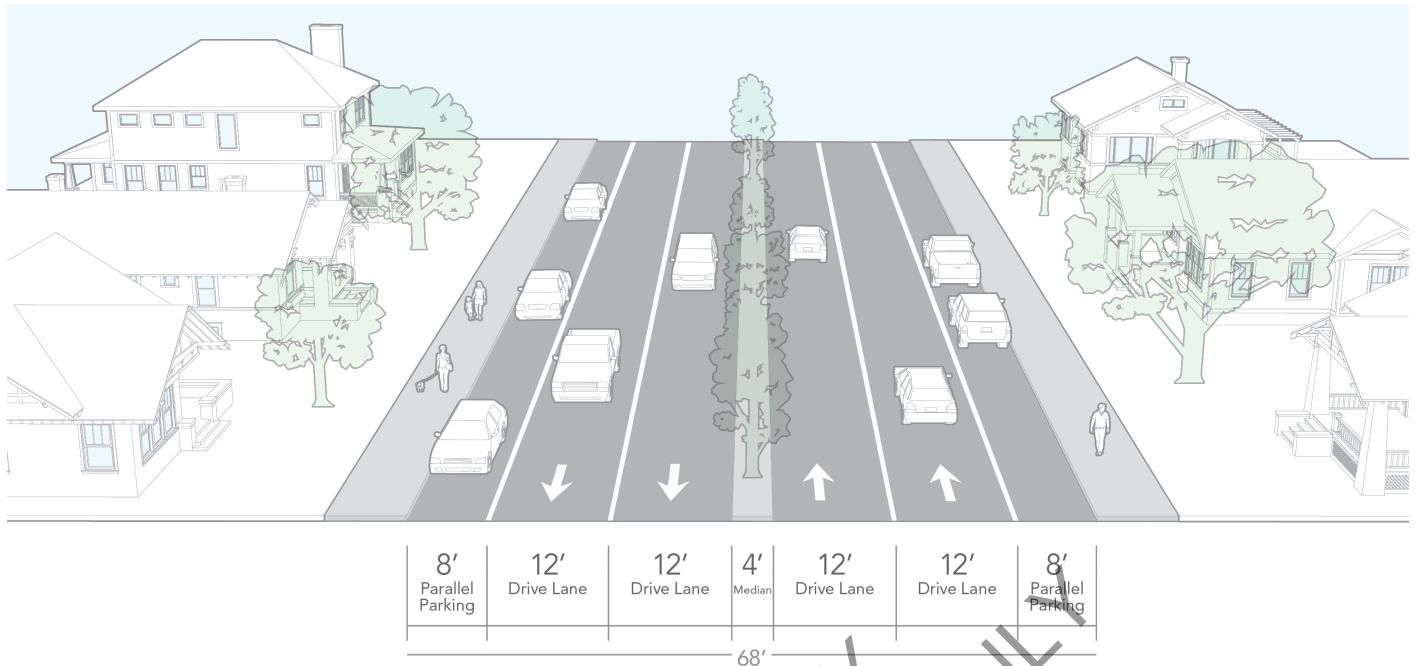
119 (45)
0 (0)
133 (63)

Monterey Blvd

LEGEND   XX (YY) AM (PM) Peak Hour Traffic Volumes   ▦ Signalized Intersection   ● Stop Sign

Figure 1

Existing Conditions
Peak Hour Traffic Volumes and Lane Configurations

Park Boulevard: Existing

8' Parallel Parking	12' Drive Lane	12' Drive Lane	4' Median	12' Drive Lane	12' Drive Lane	8' Parallel Parking

68'

Park Boulevard: Proposed

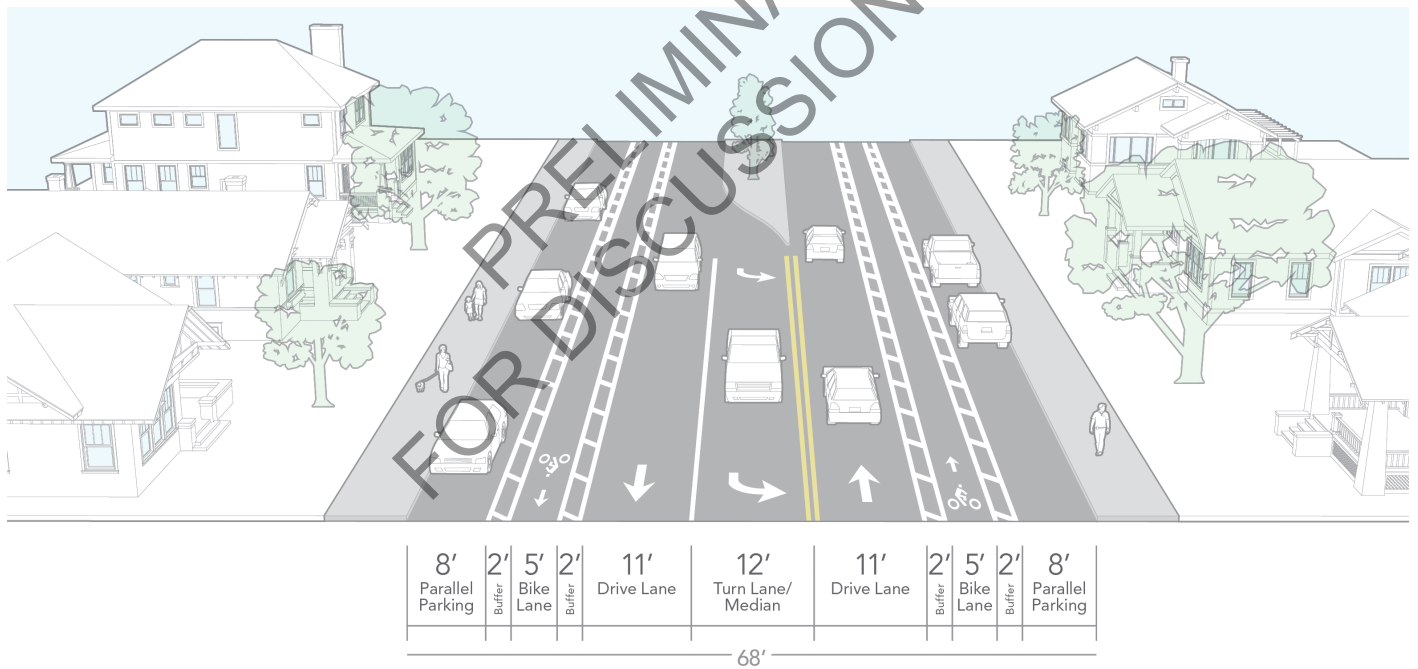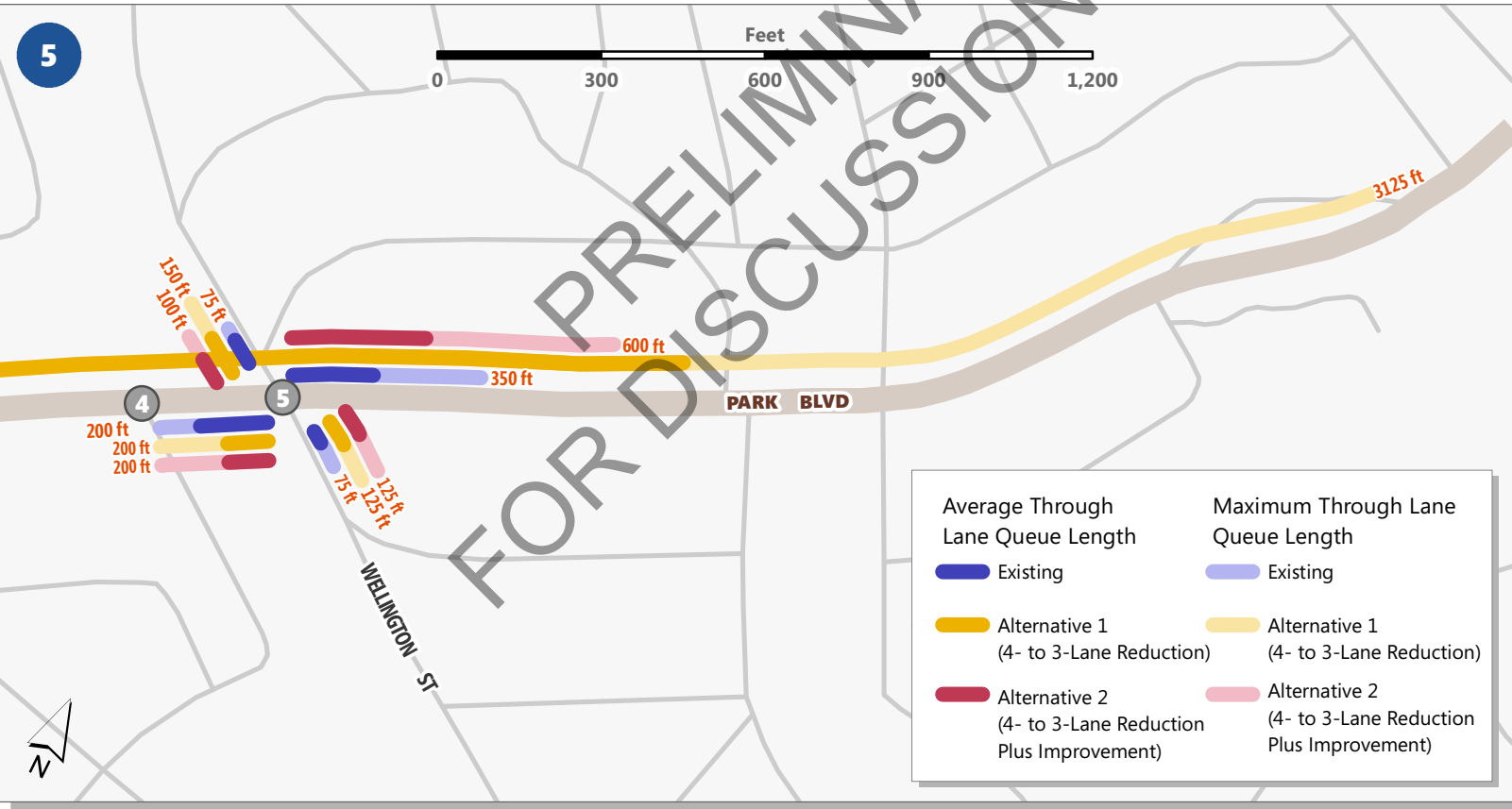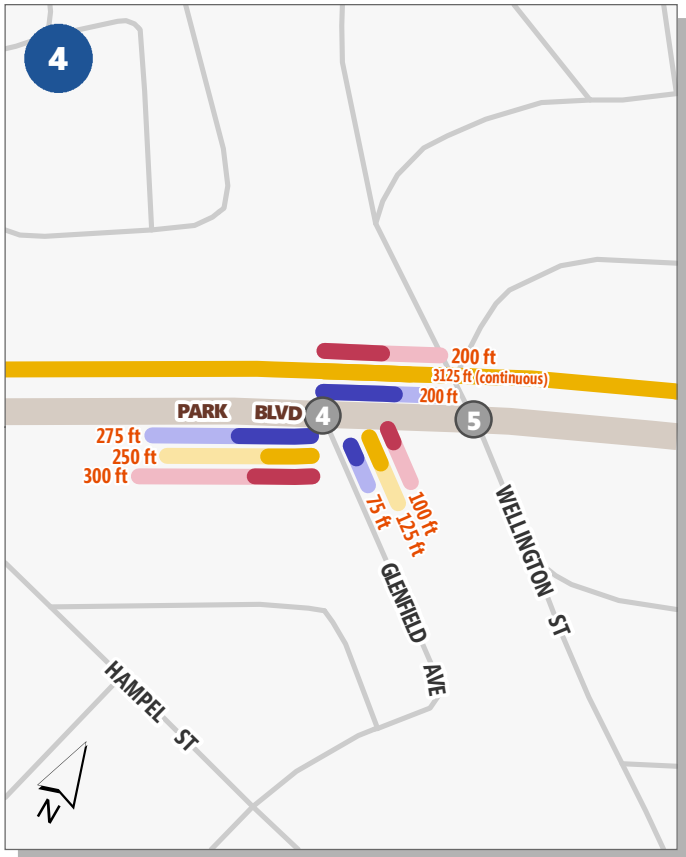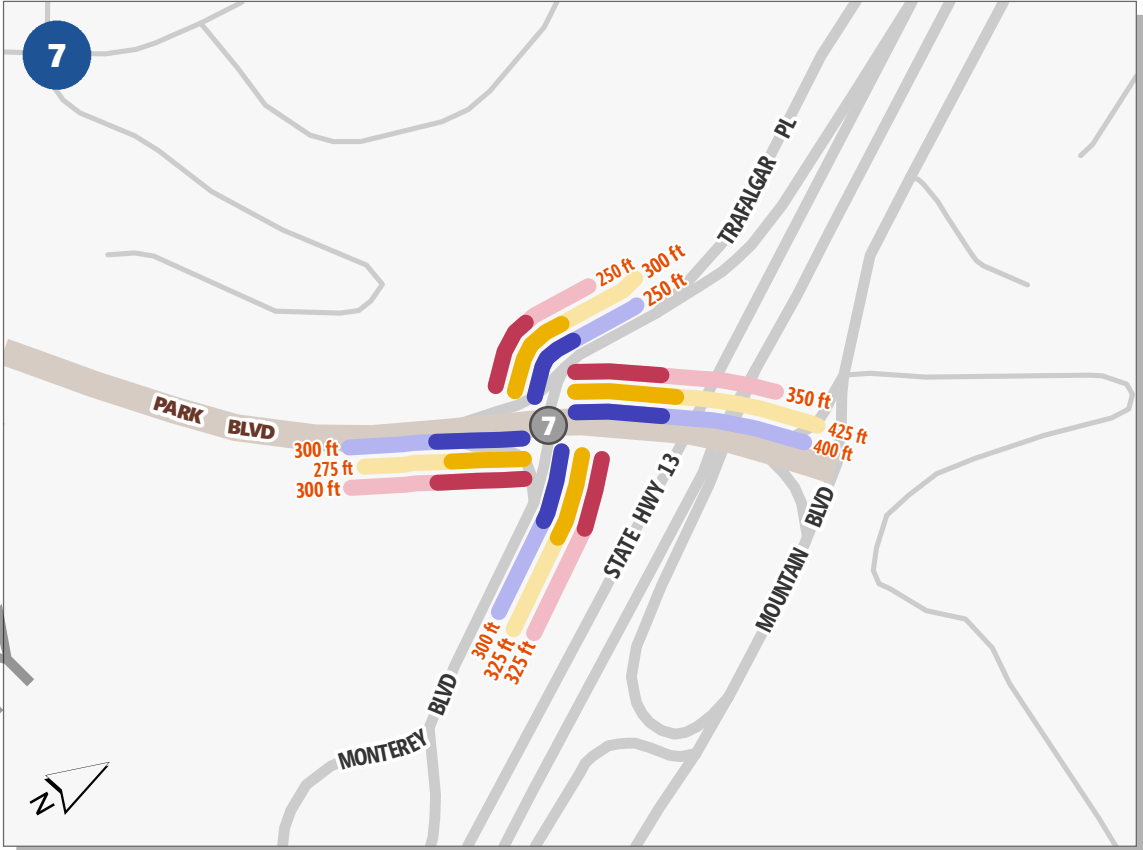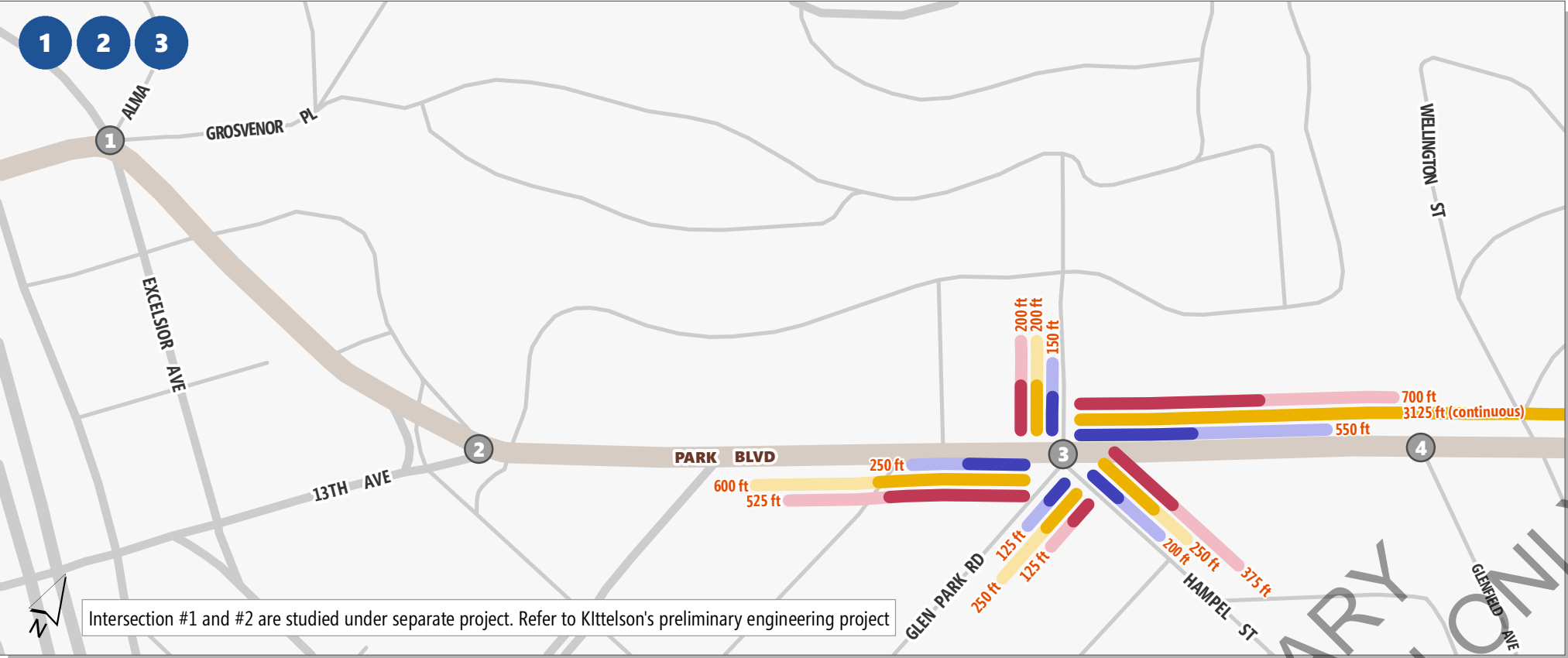| 8' Parallel Parking	2' Buffer	5' Bike Lane	2' Buffer	11' Drive Lane	12' Turn Lane/ Median	11' Drive Lane	2' Buffer	5' Bike Lane	2' Buffer	8' Parallel Parking

68'

Figure 2

Typical Park Boulevard Cross Sections
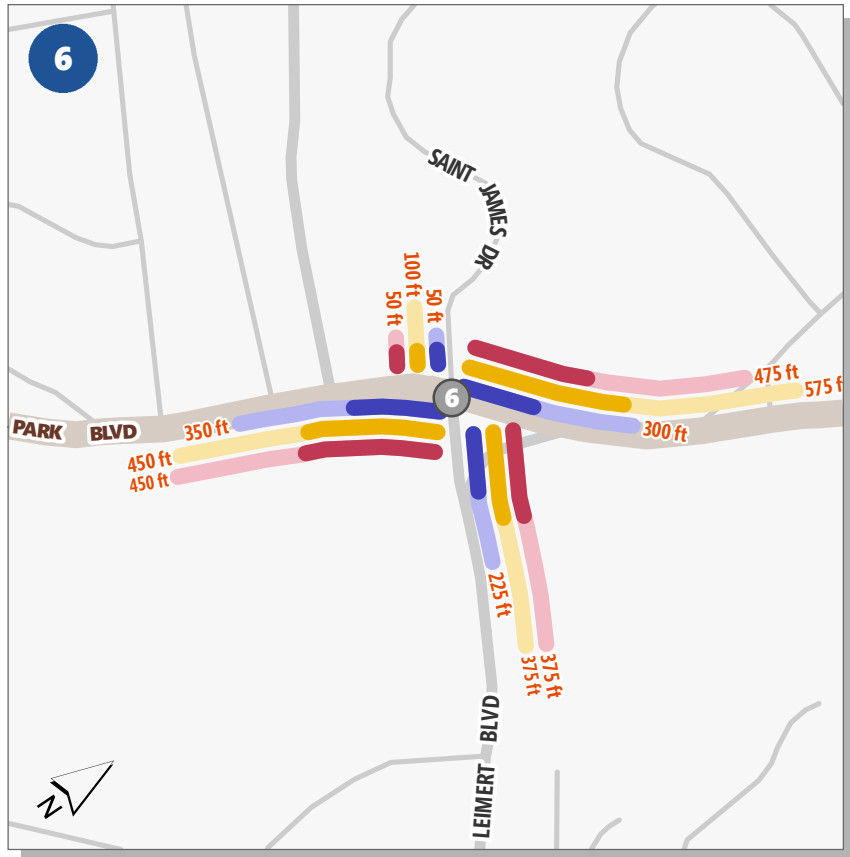
Figure 3

Average and Maximum Queue Lengths: AM Peak

Map Panel 1, 2, 3:
Intersection #1 and #2 are studied under separate project. Refer to KIttelson's preliminary engineering project

GROSVENOR PL
ALMA
EXCELSIOR AVE
13TH AVE
PARK BLVD
GLEN PARK RD
HAMPEL ST
GLENFIELD AVE
WELLINGTON ST

Intersection 3:
- 200 ft
- 200 ft
- 150 ft
- 700 ft
- 3125 ft (continuous)
- 550 ft
- 250 ft
- 600 ft
- 525 ft
- 125 ft
- 125 ft
- 250 ft
- 200 ft
- 250 ft
- 375 ft

Map Panel 7:
PARK BLVD
TRAFALGAR PL
WELLINGTON ST
STATE HWY 13
MOUNTAIN BLVD
MONTEREY BLVD

- 250 ft
- 300 ft
- 250 ft
- 350 ft
- 425 ft
- 400 ft
- 300 ft
- 275 ft
- 300 ft
- 300 ft
- 325 ft
- 325 ft

Map Panel 4:
PARK BLVD
HAMPEL ST
GLENFIELD AVE
WELLINGTON ST

- 200 ft
- 3125 ft (continuous)
- 200 ft
- 275 ft
- 250 ft
- 300 ft
- 75 ft
- 125 ft
- 100 ft

Map Panel 5:
PARK BLVD
WELLINGTON ST

- 3125 ft
- 150 ft
- 75 ft
- 100 ft
- 600 ft
- 350 ft
- 200 ft
- 200 ft
- 200 ft
- 75 ft
- 125 ft
- 125 ft

Feet
0   300   600   900   1,200

Map Panel 6:
SAINT JAMES DR
PARK BLVD
LEIMERT BLVD

- 50 ft
- 100 ft
- 50 ft
- 475 ft
- 575 ft
- 350 ft
- 300 ft
- 450 ft
- 450 ft
- 225 ft
- 375 ft
- 375 ft

Legend:

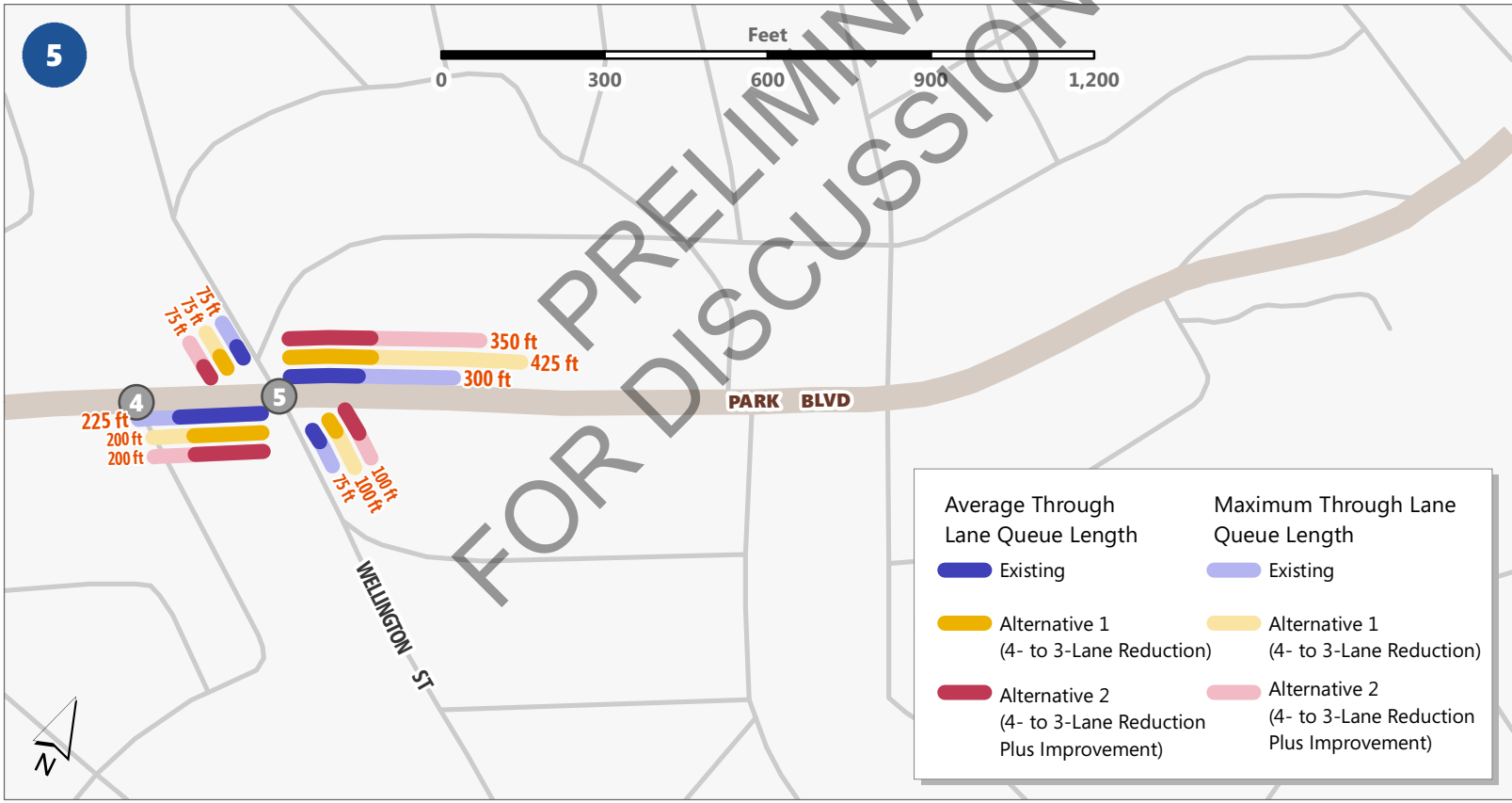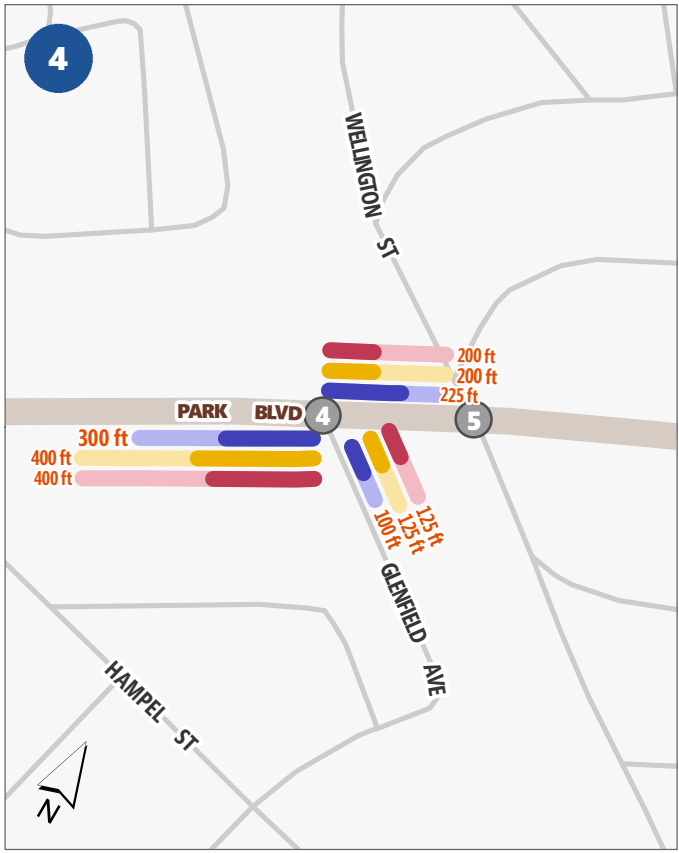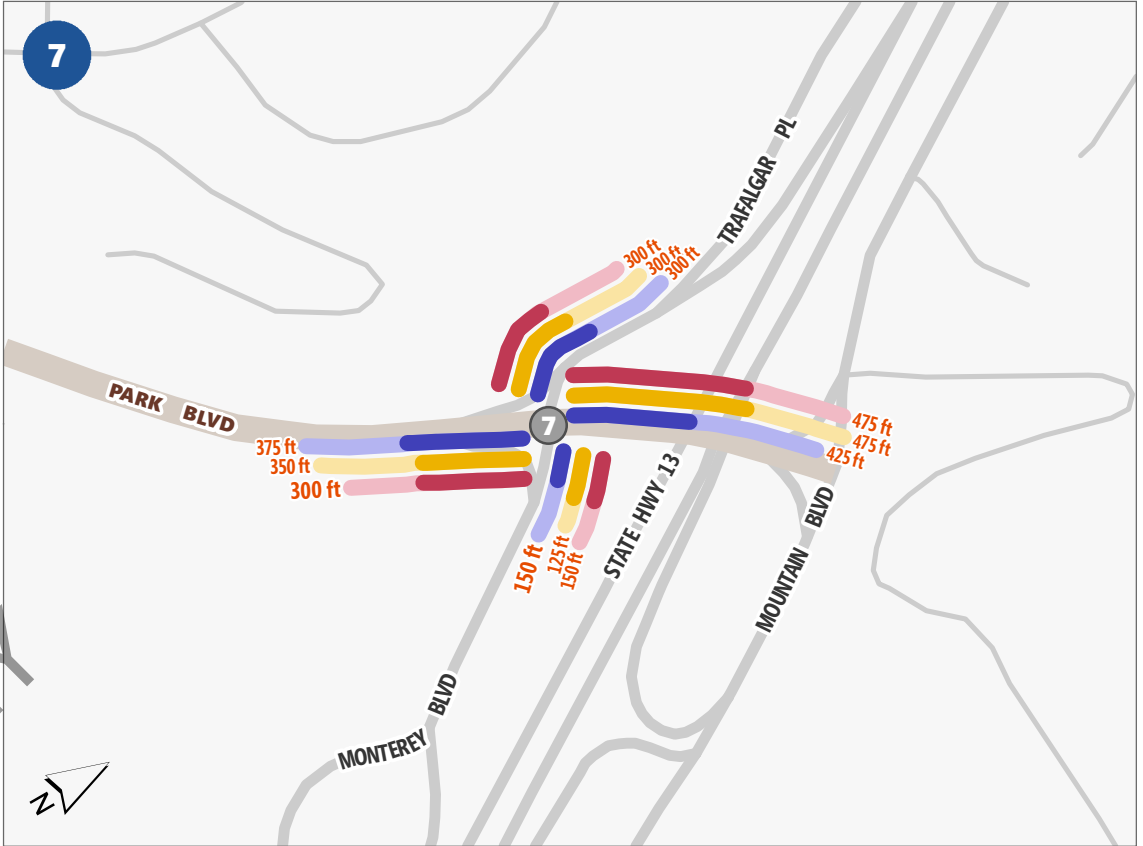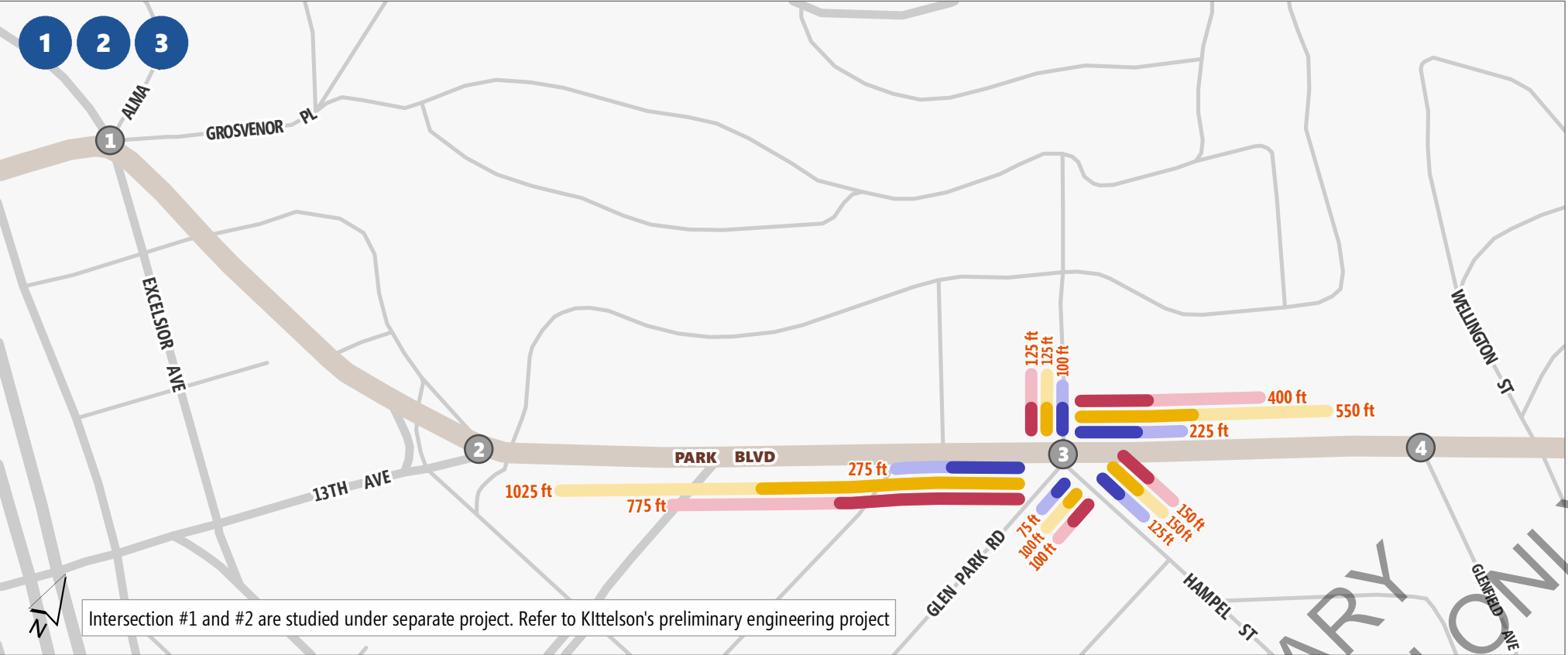| Average Through Lane Queue Length	Maximum Through Lane Queue Length
Existing	Existing
Alternative 1 (4- to 3-Lane Reduction)	Alternative 1 (4- to 3-Lane Reduction)
Alternative 2 (4- to 3-Lane Reduction Plus Improvement)	Alternative 2 (4- to 3-Lane Reduction Plus Improvement)

PRELIMINARY FOR DISCUSSION ONLY

Figure 4

Average and Maximum Queue Lengths: PM Peak