APPENDIX 5

Technical Memorandum, Kittelson and Associates

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TECHNICAL MEMORANDUM

Seward Highway: Midtown Congestion Relief

Concept Evaluation

Forecasted Traffic Operations and Safety Performance

Date: August 6, 2019 Project #: 21302
To: Steve Noble, PE, DOWL
From: Andrew Ooms, PE; Miao Gao, and Wende Wilber, AICP, PTP

This memorandum documents the quantitative Midtown Congestion Relief (MCR) operations and safety evaluation criteria results concepts under consideration. Kittelson extracted speed, travel time, and volume-to-capacity (v/c) results from project's travel demand model, based on the latest available AMATS model. Kittelson also applied crash prediction methodologies to estimate relative crash frequency, severity, and crashes by mode for each concept.

SEWARD HIGHWAY CORRIDOR OPERATIONS

Tables 1 and 2 report the speed, v/c ratio, and travel time for concepts during the weekday a.m. and p.m. peak period. The travel demand models in Tables 1 and 2 are based on concepts shown in Appendix 1. A summary of the output and a discussion of the assumptions and limitations of the results follows.

- Average speed for all concepts is within 4 miles per hour of the 60-mph free flow speed.
- Volume to capacity ratios vary from 0.49 to 0.79.
- Travel times vary up to 20 percent across concepts for each direction and time period.
- Concepts A and E generally have best mainline Seward Highway operational results.
- Mainline travel speed and v/c ratio do not preclude any of these concepts moving forward and the similarity of the results indicates these factors are not key concept differentiators.

Table 1 Seward Highway: Tudor Road to 20th AM Peak Period Operations Summary

Concept	Direction	Average Speed (mph)	V/C ratio	Travel Time (minutes)
Concept A	NB	59	0.50	1.74
	SB	59	0.55	1.71
Concept B, C1 and C2	NB	58	0.49	1.90
	SB	58	0.63	1.95
Concept E	NB	58	0.53	2.00
	SB	59	0.50	1.95
Concept F, G, and J	NB	58	0.54	1.81
	SB	58	0.67	1.64

Table 2 Seward Highway: Tudor Road to 20th PM Peak Period Operations Summary

Concept	Direction	Average Speed (mph)	V/C ratio	Travel Time (minutes)
Concept A	NB	57	0.72	1.78
	SB	58	0.61	1.73
Concept B, C1 and C2	NB	57	0.70	1.93
	SB	57	0.68	1.98
Concept E	NB	57	0.73	2.04
	SB	58	0.58	1.96
Concept F, G, and J	NB	56	0.79	1.88
	SB	57	0.71	1.67

Operations modeling notes and assumptions:

- Concepts C1/C2 are expected to be substantially similar to the Concept B results. Similarly, Concepts F and J are expected to be similar to Concept G.
- Model volumes vary across concepts based on ramp locations and frontage road configurations.
- The beginning and ending points of the study corridor vary by concept by up to 0.3 miles based on the on/off ramps location at 20th Avenue and Tudor Road, making the average speed and v/c ratio more equitable criteria.
- The congested travel time is a direct output from the model delay function, shown below. The values of the Alpha (0.15) and Beta (4) calibration parameters were set by the AMATS modeling team. As a result, the impact of v/c ratio on travel time is limited.

$$TT = FFT(1 + \alpha(v/c)^{\beta})$$

where,

TT: predicted travel time,
FFT: free-flow travel time,
v: traffic volume,
c: capacity, and
α, β : parameters.

- The average congested speed is calculated by dividing corridor length by the congested travel time.
- The reported v/c ratio is the average over all segments within the study corridor.

SAFETY PREDICTION EVALUATION

Kittelson completed the future intersection crash prediction using safety performance functions. FHWA's *Scale and Scope of Safety Assessment Methods in the Project Development Process* affirms that safety can be predicted via AADT-only safety performance functions (SPF) for new facility alternative assessments. In fact, AADT-only SPF's is the preferred analysis method when sufficient detail for crash modification factors (CMFs), such as lane widths, turn lanes, signal phases, etc., is not available at the concept stage.

NCHRP 17-58 *Safety Prediction Models for Six-Lane and One-Way Urban and Suburban Arterials* methods were applied to predict the safety of the concepts' intersections. This is because frontage road and six-lane arterial intersection crash prediction models are not included in the current Highway Safety Manual (HSM) or NCHRP 17-45 *Enhanced Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges* methods. Although NCHRP 17-58 has not yet been publicly released it has been approved by FHWA for inclusion in the Second Edition of the HSM which Kittelson is developing.

The safety prediction process was completed in two stages:

1. Initial 2040 concept screening on Concepts A, B, C, E, F, and G (concepts shown in Appendix 1)
2. Refined concept screening, including
    a. 2028 interim Concepts H-B and H-C2/J (concepts shown in Appendix 2)
    b. 2040 refined Concepts B, C2 and J (concepts shown in Appendix 3)

Safety Prediction Metrics

The crash prediction methodology provides outputs that include the following metrics.

Intersection Crash Frequency

A relative estimated number of total intersection crashes was calculated for each alternative based on the corresponding SPF and generalized CMFs based on default intersection characteristics. To provide as much consistency for comparison across concepts, intersection crashes are reported for the following intersections:

- Seward Highway Frontage Roads at:
    - Fireweed Lane
    - Northern Lights Boulevard
    - Benson Boulevard
    - 36th Avenue (including median u-turn intersections)

  - Tudor Road
- Old Seward Highway/Two-way Frontage Road at:
  - 36th Avenue
  - Tudor Road

The 17-58 SPFs have not been calibrated to Alaska conditions, so a calibration factor of 3.66 was applied to all crashes based on recommended values for Alaska Central Region urban signalized intersections for HSM SPFs.

Non-Motorized Crashes

A generalized estimate of non-motorized crashes is reported. Per 17-58 methods, bicycle crashes are based on a percentage of total estimated intersection crashes and pedestrian crashes are determined by a SPF using general values for factors such as number of lanes crossed.

Crash Severity

Combined fatal and injury crashes were estimated using a 17-58 SPFs and default proportions.

Initial Concept Safety Results

Results for the six initial corridor concepts are shown in Table 3. Concepts B and C and Concepts F and G were grouped together in Tables 1 and 2 as they are based on the same travel demand model network. However, they were analyzed separately in Table 3.

Table 3 MCR Predicted Relative Annual Intersection Crash Summary: Initial Concepts

Concept	Number of Study Intersections	Relative Total Crashes		Relative Fatal and Injury Crashes		Relative Vehicle-Pedestrian Crashes		Relative Vehicle-Bicycle Crashes	
		Total	Per Intersection	Total	Per Intersection	Total	Per Intersection	Total	Per Intersection
A	10	226	22.6	54	5.4	2	0.2	3	0.3
B	12	253	21.1	71	5.9	4	0.3	3	0.3
C	12	254	21.2	71	5.9	4	0.3	3	0.3
E	9	322	35.8	103	11.4	3	0.3	5	0.6
F	9	293	32.6	83	9.2	3	0.3	4	0.4
G	8	286	35.8	95	11.9	3	0.4	4	0.5

In summary:

- The SPFs demonstrate that one-way frontage roads result in fewer intersection crashes than two-way roads, likely due to fewer conflict points. As a result, the one-way frontage road alternatives—Concepts A, B, and C—have an average of 22 percent fewer crashes despite having more intersections than the two-way frontage road concepts—Concepts E, F, and G.
- The results also show that intersections of roads with fewer through lanes are generally predicted to have fewer crashes.

- One-Way Frontage Road Concepts
    - Concept A has the fewest total crashes and fewer intersections than Concepts B and C as it does not include Benson Boulevard intersections. However, the frontage roads are larger than Concepts B and C and Northern Lights is two-way, resulting in more crashes per intersection.
    - Concept B has the lowest crash frequency per intersection due to one-way frontage roads with fewer lanes than Concept A.
    - Concept C is very similar to Concept B with small frontage road volume differences due to ramp locations around 36th Avenue.
- Two-Way Frontage Road Concepts
    - Concept E has the most predicted crashes and the most per intersection, due to two-way, six-lane Old Seward Highway/Frontage Road intersections.
    - Concept F has fewer crashes due to reduced volume on Old Seward Highway compared to Concept E
    - Concept G has reduced crashes from Concept F based on one fewer intersection.

Refined Concept Safety Results

The project team screened and refined the initial concepts down to three 2048 concepts (B, C2, and J) and two interim 2028 concepts (H-B and H-C2/J). The safety prediction results for the 2028 and 2048 concepts are summarized in Tables 4 and 5, respectively. The predicted number of crashes shown in Tables 4 and 5 are based on refined lane configurations, traffic volume projections, and other factors and can be used to assess the relative intersection safety performance among concepts in each table but are not comparable to the results shown in Table 3.

2028 Interim Concepts

The interim 2028 concepts do not include a freeway element and serve all Seward Highway corridor vehicles at surface intersections. Concepts H-C2 and H-J are identical in the 2028 interim period.

Table 4: Predicted Relative Annual Intersection Crash Summary: Refined 2028 Concepts

Concept	Number of Study Intersections	Relative Total Crashes		Relative Fatal and Injury Crashes		Relative Vehicle-Pedestrian Crashes		Relative Vehicle-Bicycle Crashes	
		Total	Per Intersection	Total	Per Intersection	Total	Per Intersection	Total	Per Intersection
H-B	14	310	22.1	82	5.9	4	0.3	4	0.3
H-C2/J	11	258	23.5	73	6.6	4	0.4	4	0.4

Concept H-B includes a pair of median u-turn intersections at 36th Avenue and results in more total crashes and intersections, but fewer crashes per intersection.

Concept H-C2/J replaces the southbound Seward Highway at 36th Avenue intersection with a grade separation, which moves the vehicle conflicts to the Old Seward Highway/36th Avenue intersection and

to where the merge lanes interface with the Seward Highway. This results in fewer total intersections and fewer crashes, but more crashes per intersection than Concept H-B.

2048 Refined Concepts

Table 5 Predicted Relative Annual Intersection Crash Summary: Refined 2048 Concepts

Concept	Number of Study Intersections	Relative Total Crashes		Relative Fatal and Injury Crashes		Relative Vehicle-Pedestrian Crashes		Relative Vehicle-Bicycle Crashes	
		Total	Per Intersection	Total	Per Intersection	Total	Per Intersection	Total	Per Intersection
B	14	312	22.3	85	6.1	4	0.3	4	0.3
C2	11	253	23.0	73	6.6	4	0.4	3	0.3
J	11	329	29.9	88	8.0	4	0.4	4	0.4

In summary:

- Concept B generally has simpler and smaller intersections and the fewest crashes per intersection, but the larger number of intersections results in 23 percent more total predicted crashes than Concept C2.
- Concept C2 reduces the number of vehicle conflicts and intersections through grade separation at 36th Avenue, reducing the total number of total predicted crashes.
- Concept J includes larger intersections and higher north/south traffic volumes at surface intersections than the other 2048 concepts. These factors result in the highest number of total crashes, approximately 30 percent more than Concept C2.

DATA LIMITATIONS AND ASSUMPTIONS

- The reported number of crashes is useful and defensible as relative predictions to differentiate concepts but should not be considered to be accurate estimates due to the lack of CMF detail and poor SPF calibration to Alaska conditions.
- These challenges also mean that a meaningful comparison to existing crash frequency can't be reliably calculated at this stage but could be described with further design refinement via CMFs and general interchange form comparisons. Also, concept crash safety should be compared against a 2048 no build scenario, not 2028 or existing conditions.
- Pedestrian and bicycle crash risk and frequency is heavily dependent on activity level and detailed design factors that are not yet established, such as the presence and radii of free right turns. All concepts currently have the same non-motorized concept and the non-motorized crash totals are based on the same SPF default values.
- Crash severity estimates in the HSM and also in NCHRP 17-58 are based on a combination of separate SPFs as well as some California proportionality data.
- The NCHRP 17-58 methodology does not reflect the turn restrictions at the median u-turn intersections in Concepts H-B and B. To capture the safety benefits of these intersections, the number of predicted crashes was reduced by 9 percent for property damage crashes and 30 percent for fatal/injury crashes per the FHWA Median U-Turn Informational Guide.

Appendix 1 Initial Concepts (October 2018)

KEY FEATURES

- Mainline could be over or under cross streets
- Accommodates future southbound off and northbound on ramps north of Fireweed Lane
- Includes redesign of Benson Blvd/Northern Lights Blvd to be two-way roads east of A Street to accommodate ramp spacing
- Benson Blvd is free-flowing crossing with greater focus on commercial access
- Active transportation free-flow crossing at Benson Blvd

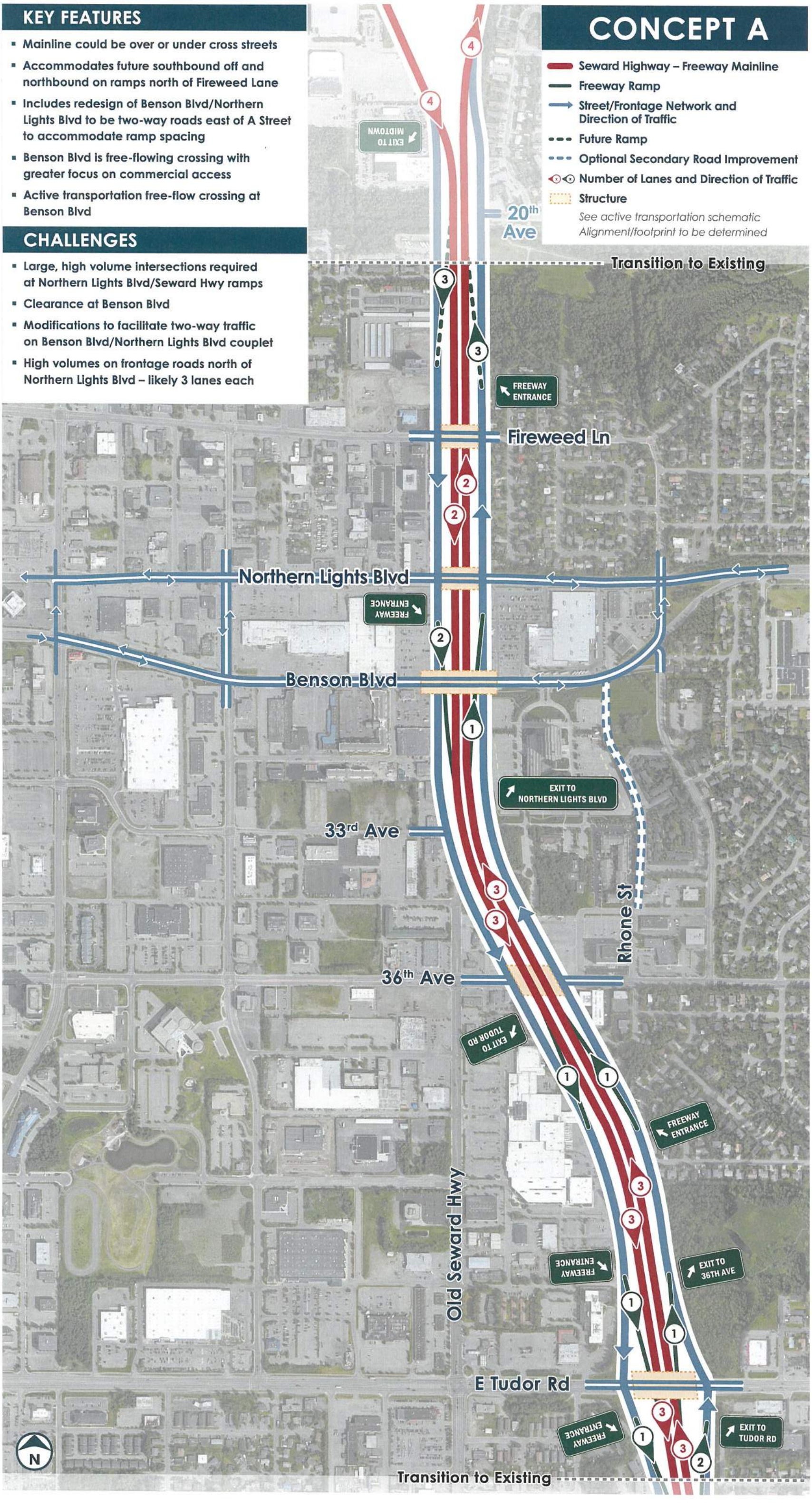
CHALLENGES

- Large, high volume intersections required at Northern Lights Blvd/Seward Hwy ramps
- Clearance at Benson Blvd
- Modifications to facilitate two-way traffic on Benson Blvd/Northern Lights Blvd couplet
- High volumes on frontage roads north of Northern Lights Blvd – likely 3 lanes each

CONCEPT A

- Seward Highway – Freeway Mainline
- Freeway Ramp
- Street/Frontage Network and Direction of Traffic
- Future Ramp
- Optional Secondary Road Improvement
- Number of Lanes and Direction of Traffic
- Structure

See active transportation schematic
Alignment/footprint to be determined



KEY FEATURES

- Ramps north of Northern Lights Blvd avoid signalized intersection at Fireweed Lane and reduce frontage road volumes

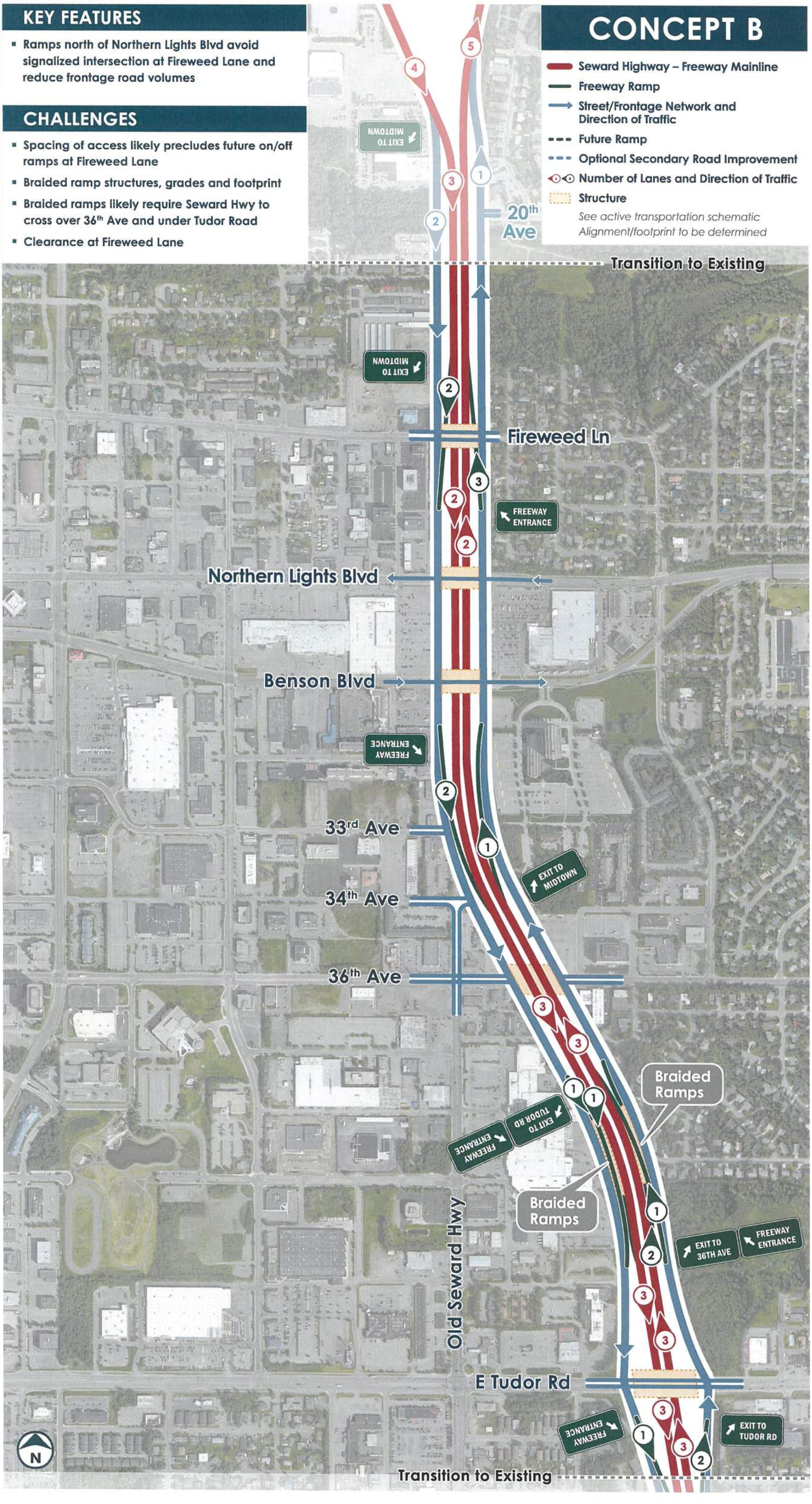
CHALLENGES

- Spacing of access likely precludes future on/off ramps at Fireweed Lane
- Braided ramp structures, grades and footprint
- Braided ramps likely require Seward Hwy to cross over 36th Ave and under Tudor Road
- Clearance at Fireweed Lane

CONCEPT B

- Seward Highway – Freeway Mainline
- Freeway Ramp
- Street/Frontage Network and Direction of Traffic
- Future Ramp
- Optional Secondary Road Improvement
- Number of Lanes and Direction of Traffic
- Structure

See active transportation schematic
Alignment/footprint to be determined



KEY FEATURES

- Benson Blvd, Northern Lights Blvd, and Fireweed Lane operate as a split diamond
- Full access is provided to 36th Ave
- Accommodates future southbound off and northbound on ramps north of Fireweed Lane
- Manages volume on frontage roads north of Northern Lights Blvd

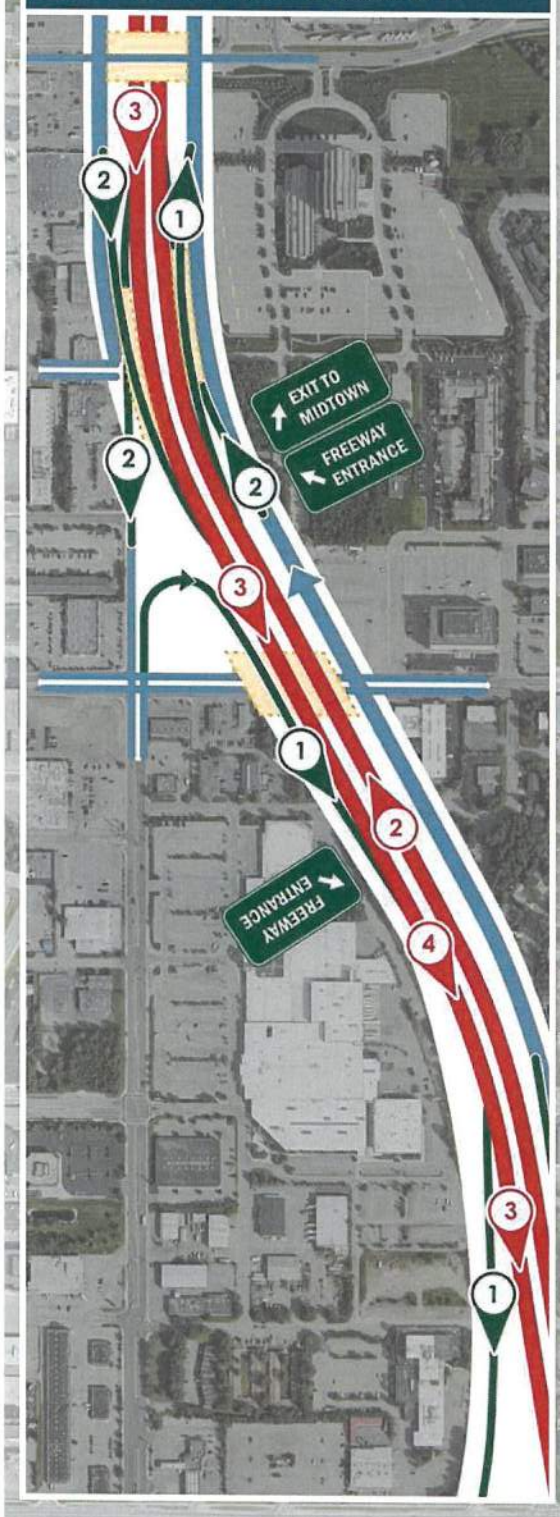
CHALLENGES

- Braided ramp structures, grades and footprint
- Braided ramps likely require Seward Hwy to cross over 36th Ave and under Benson Blvd
- Active transportation connection across Seward Hwy to 33rd Ave would conflict with braided ramps

VARIANT KEY FEATURES

- Reduces the number of intersections along 36th Ave
- Tight weaving and additional lane required along Seward Hwy between 36th Ave and Tudor Rd in southbound direction
- Braided exit ramp ties directly to arterial roadway

BRAIDED RAMP TO OLD SEWARD VARIANT



CONCEPT C

- Seward Highway – Freeway Mainline
- Freeway Ramp
- Street/Frontage Network and Direction of Traffic
- Future Ramp
- Optional Secondary Road Improvement
- Number of Lanes and Direction of Traffic
- Structure

See active transportation schematic
Alignment/footprint to be determined

CONCEPT E

KEY FEATURES

- Mainline could be over or under cross streets
- Traditional two-way road next to the Seward Hwy for Midtown access
- Direct access to businesses may be difficult due to traffic volumes
- Additional structures required crossing mainline to end frontage
- Accommodates future southbound off and northbound on ramps north of Fireweed Lane

CHALLENGES

- High volumes on frontage roads – likely 3 lanes each direction
- Limits ability to add ramps
- Closely spaced intersections along 36th Ave
- Old Seward Hwy to Seward Hwy connection results in high signalized turning movements at Tudor Road and 36th Ave

Seward Highway – Freeway Mainline
Freeway Ramp
Street/Frontage Network and Direction of Traffic
Future Ramp
Optional Secondary Road Improvement
Number of Lanes and Direction of Traffic
Structure
See active transportation schematic
Alignment/footprint to be determined

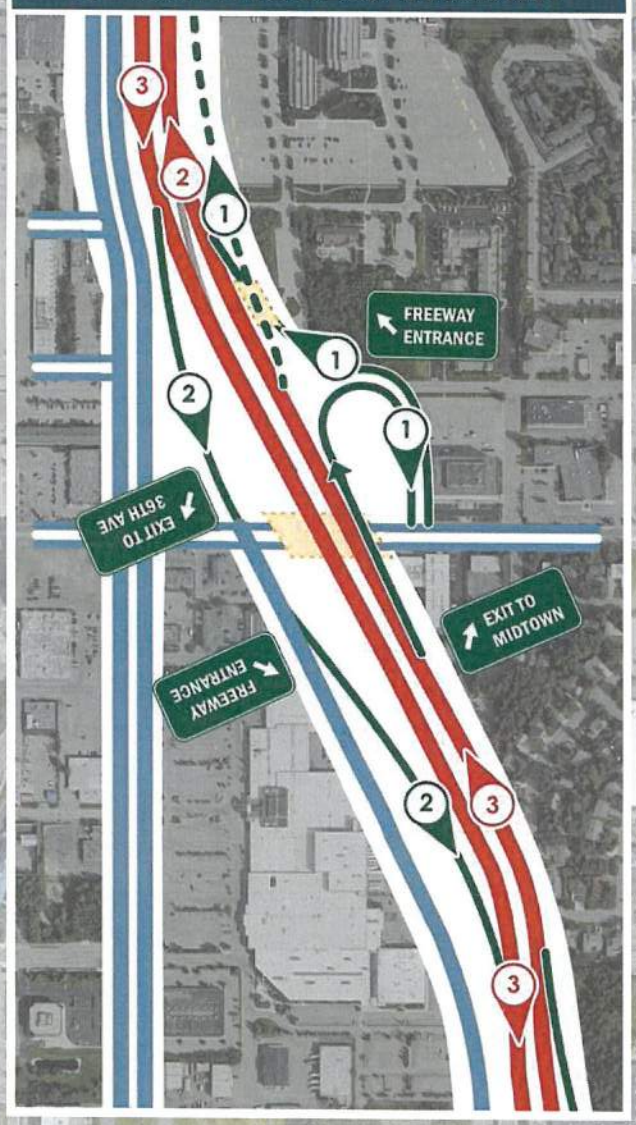
VARIANT KEY FEATURES

- Full access to 36th Ave

VARIANT CHALLENGES

- Braided ramp, structure, grade and footprint

36TH AVE ACCESS VARIANT



KEY FEATURES

- Mainline could be over or under cross streets
- Traditional two-way road next to the Seward Hwy for Midtown access
- Direct access to businesses may be difficult due to traffic volumes
- Additional structures required crossing mainline to begin and end frontage
- Accommodates future southbound off and northbound on ramps north of Fireweed Lane

CHALLENGES

- High volumes on frontage roads – likely 3 lanes each direction
- Limits ability to add ramps
- Long structures required to cross the mainline

CONCEPT F

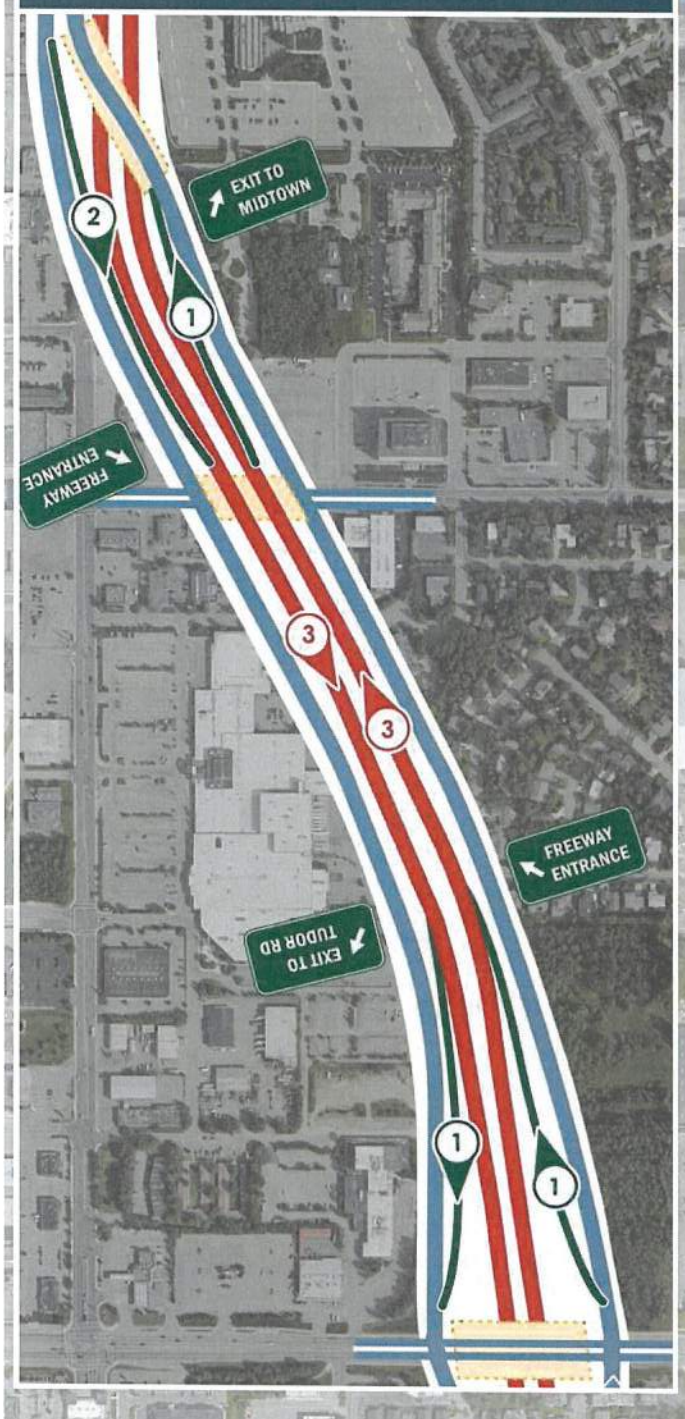
- Seward Highway – Freeway Mainline
- Freeway Ramp
- Street/Frontage Network and Direction of Traffic
- Future Ramp
- Optional Secondary Road Improvement
- Number of Lanes and Direction of Traffic
- Structure

See active transportation schematic
Alignment/footprint to be determined

VARIANT KEY FEATURES

- Access to 36th Ave via frontage road only

FLIPPED RAMP VARIANT



EXIT TO MIDTOWN
20th Ave
Transition to Existing
FREEWAY ENTRANCE
Fireweed Ln
Northern Lights Blvd
Benson Blvd
33rd Ave
34th Ave
EXIT TO 36TH AVE
FREEWAY ENTRANCE
36th Ave
Old Seward Hwy
FREEWAY ENTRANCE
EXIT TO MIDTOWN
E Tudor Rd
FREEWAY ENTRANCE
EXIT TO TUDOR RD
Transition to Existing
N

KEY FEATURES

- Mainline could be over or under cross streets
- Traditional two-way road next to the Seward Hwy for Midtown access
- Direct access to businesses may be difficult due to traffic volumes
- Additional structures required crossing mainline to begin and end frontage
- Accommodates future southbound off and northbound on ramps north of Fireweed Lane

CHALLENGES

- Long structure required to cross mainline
- High volumes on frontage roads – likely 3 lanes each direction
- Limits ability to add ramps
- Braided ramp structures, grades and footprint

CONCEPT G

- Seward Highway – Freeway Mainline
- Freeway Ramp
- Street/Frontage Network and Direction of Traffic
- Future Ramp
- Optional Secondary Road Improvement
- Number of Lanes and Direction of Traffic
- Structure

See active transportation schematic
Alignment/footprint to be determined

Appendix 2 Interim 2028 Concepts (June 2019)

Map - Midtown Congestion Relief PEL

Midtown Congestion Relief PEL
2028 Concept H-B (PM Peak Hr)

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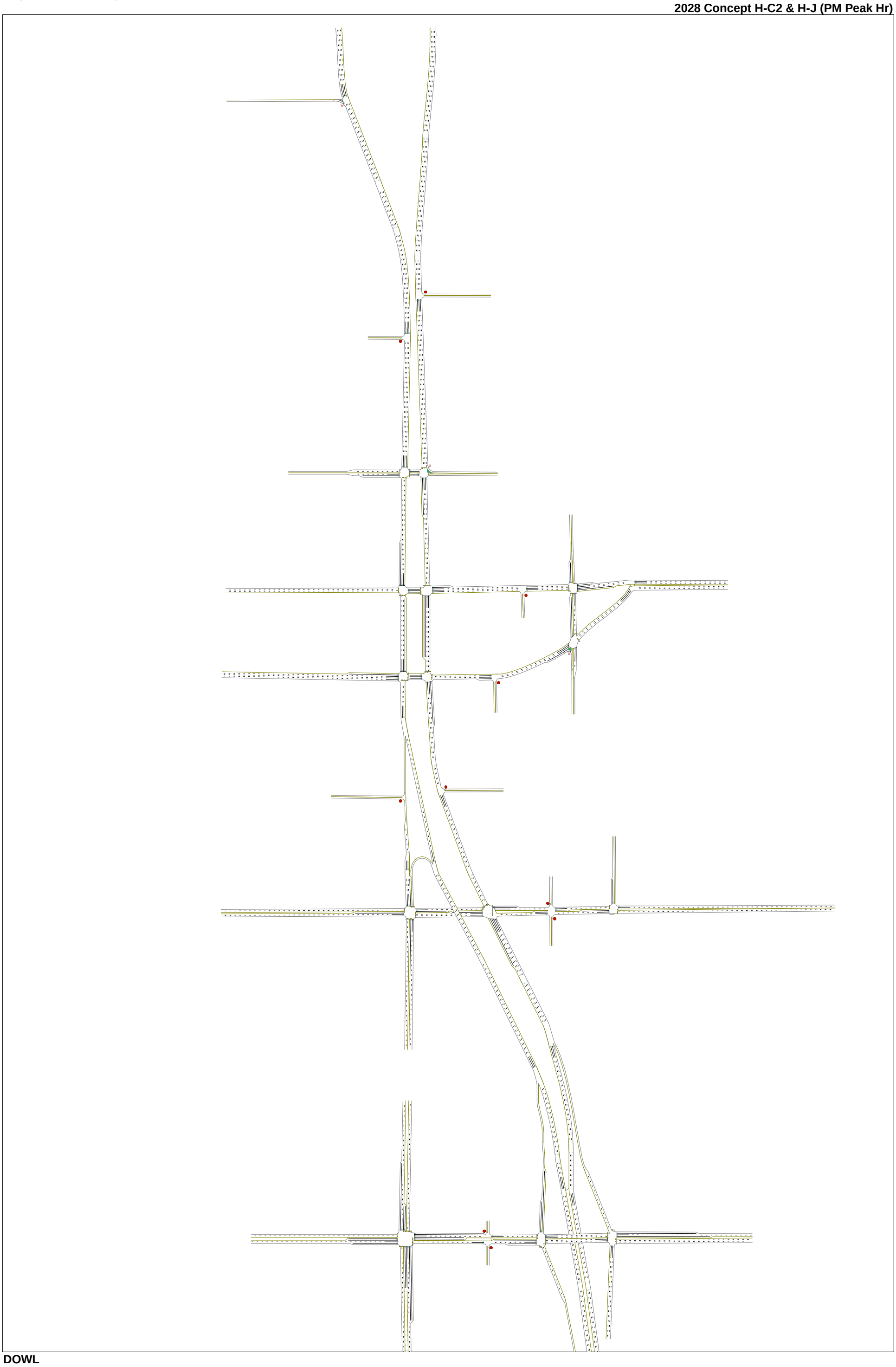
06/15/2019

Map - Midtown Congestion Relief PEL

Midtown Congestion Relief PEL
2028 Concept H-C2 & H-J (PM Peak Hr)



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Appendix 3 2048 Refined Concepts (June 2019)

Map - Midtown Congestion Relief PEL

Midtown Congestion Relief PEL
2048

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05/10/2019

Map - Midtown Congestion Relief PEL

Midtown Congestion Relief PEL
2048 Concept C2 (PM Peak Hr)

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05/10/2019

Map - Midtown Congestion Relief PEL

Midtown Congestion Relief PEL
2048 Concept J (PM Peak Hr)

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05/28/2019