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GREEN LAKE TRAFFIC ANALYSIS REPORT

Project: SDOT AAC PROTECTED BIKE LANES CONCEPTUAL DESIGN

Date: December 15, 2017

Author: Concord Engineering

The City of Seattle Department of Transportation (SDOT) has a plan to install protected bike lanes (PBL) along E Green Lake Drive N and E Green Lake Way N in the Green Lake area. In order to accommodate the addition of the PBL within the existing right-of-way (ROW), the existing roadway channelization will need to be changed. Concord performed traffic operational analysis to evaluate the traffic impact of the proposed channelization changes and recommend signal timing adjustments to the signalized intersections in order to accommodate the addition of the PBL for the study intersections.

1. Study Area

Exhibit 1 shows the study intersections. The segment of E Green Lake Drive/E Green Lake Way N within the study area has one lane in each direction. It includes six (6) signalized intersections and five (5) unsignalized intersections. Curbside parking is provided on the street side from Green Lake. King County Metro Route 45 currently runs through the study area. The E Green Lake Drive N/E Green Lake Way N corridor is mainly used as a local connector around Green Lake and connects State Route 99 and I-5. According to the SDOT 2015 Traffic Volume Map, the Average Annual Weekday Traffic (AAWDT) is 9,000 vehicles on E Green Lake Drive N and 13,000 – 19,000 vehicles on E Green Lake Way N within the study area.

2. Analysis Method and Assumptions

Analysis Method

Synchro was used to model the traffic operations of the existing conditions and the alternative that includes the proposed channelization changes and the signal timing adjustments. Under special intersection configurations when Synchro was incapable of generating meaningful outputs, SimTraffic was used as a supplemental simulation tool.

Analysis Period

The analysis year is 2017 and the analysis period is the weekday PM peak hour (4:30 PM – 5:30 PM). The PM peak volume is higher than that of the AM or the Midday peak period. Existing condition intersection traffic turning movement counts (collected in 2017) were used for both existing condition and proposed alternative models.

Exhibit 1. Study Area

Measures of Effectiveness (MOE)

Intersection and intersection movement delay and level of service (LOS) in the existing condition and alternative models were used to evaluate the benefits and impacts of the alternative. Exhibit 2 includes the criteria used to determine LOS for signalized and unsignalized intersections.

LOS	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10–20 sec	10–15 sec
C	20–35 sec	15–25 sec
D	35–55 sec	25–35 sec
E	55–80 sec	35–50 sec
F	>80 sec	>50 sec

Exhibit 2. LOS criteria for signalized and unsignalized intersections (Source: HCM 2010)

3. Results and Recommendations

Existing Conditions

The existing PM peak period turning movement counts (Appendix A) show that the peak direction of travel is eastbound on Green Lake Dr N and southbound on E Green Lake Way N (clockwise around Green Lake). Exhibit 3 shows modeled intersection delays and LOS for existing condition (see Appendix C for the delay and LOS summary of each movement). The modeled results indicate the following intersections operate at LOS E or F during the PM peak period:

- E Green Lake Dr N & NE 71st St & NE Ravenna Blvd: SimTraffic results show this intersection operates at LOS F. This long delay is primarily caused by inefficient traffic operations with all-way stop traffic control for five approaches and high pedestrian volumes crossing the streets.
- W Green Lake Way N & E Green Lake Way N (Near Golf Course): SimTraffic results show this intersection operates at LOS F with a delay of 184 seconds per vehicle during PM peak period. For a two-way stop controlled (TWSC) intersection, the intersection LOS reflects the operations of the movement that experiences the longest delay. At this intersection, eastbound left turn traffic experiences the longest delay while waiting behind the stop sign for an adequate gap in the conflicting heavy northbound and southbound traffic before completing the left turn maneuver.
- Green Lake Way N & N 50th St & Stone Way N: The Synchro results show that this five-legged intersection operates at LOS F. In the PM peak period, heavy traffic from each approach exceeds the intersection capacity resulting in long delays.

Intersection	Delay (s)	LOS	Signalized?
GREEN LAKE DR N & N 80TH ST & INTERLAKE AVE N	26	C	Yes
GREEN LAKE DR N & E GREEN LAKE DR N & W GREEN LAKE DR N (Near Densmore)	25	D	No
E GREEN LAKE DR N & WALLINGFORD AVE N	35	D	Yes
E GREEN LAKE DR N & STROUD AVE N	23	C	No
GREEN LAKE PARK/ LATONA AVE NE & E GREEN LAKE DR N	8	A	Yes
E GREEN LAKE DR N & NE 71ST ST & NE RAVENNA BLVD*	83	F	No
E GREEN LAKE DR N & NE 64TH ST	15	B	Yes
E GREEN LAKE DR N & MERIDIAN AVE N	16	C	No
W GREEN LAKE WAY N & E GREEN LAKE WAY N (Near Golf Course)*	184	F	No
GREEN LAKE WAY N & N CLOGSTON WAY	10	A	Yes
GREEN LAKE WAY N & N 50TH ST & STONE WAY N	101	F	No

* Results from SimTraffic.

Exhibit 3. Existing conditions Synchro delay and LOS results

Proposed Alternative

The proposed Alternative (Appendix B) includes installing a two-way PBL on the south side of E Green Lake Dr N and on the west side of E Green Lake Way N in the study area. The existing signal timings will need to be adjusted accordingly to accommodate the channelization changes, mitigate potential impact and improve traffic safety and operations. Two new signals are proposed at the intersections of W Green Lake Dr N & E Green Lake Dr N (Near Densmore Ave N) and W Green Lake Way N & E Green Lake Way N (Near Green Lake Golf Course) to control the multimodal traffic and improve safety and operations. Exhibit 4 summarizes the proposed signal timing changes at each study intersection.

Intersection	Proposed Signal Timing Changes
GREEN LAKE DR N & N 80TH ST & INTERLAKE AVE N	No change
GREEN LAKE DR N & E GREEN LAKE DR N & W GREEN LAKE DR N (Near Densmore)	New signal
E GREEN LAKE DR N & WALLINGFORD AVE N	Optimized signal timing
GREEN LAKE PARK/ LATONA AVE NE & E GREEN LAKE DR N	Dedicated bike signal
E GREEN LAKE DR N & NE 64TH ST	No change
W GREEN LAKE WAY N & E GREEN LAKE WAY N (Near Golf Course)*	New signal
GREEN LAKE WAY N & N CLOGSTON WAY	Optimized signal timing
GREEN LAKE WAY N & N 50TH ST & STONE WAY N	No change

Exhibit 4. Proposed signal timing changes

Exhibit 4 summarizes the intersection delay and LOS for the study intersections for the proposed alternative (see Appendix A for the delay and LOS for each movement). The study intersections would operate similarly to or better than the existing condition for the proposed alternative, except for the following intersections where delay would increase slightly:

- Green Lake Dr N & E Green Lake Dr N & W Green Lake Dr N: the intersection delay would decrease by 5 seconds per vehicle during PM peak period with the new signal. Without signalization, the southbound delay would be substantially increased (819 seconds per vehicle) due to the loss of one southbound right turn pocket, one eastbound left turn pocket and the westbound right turn slip lane.
- Latona Ave NE & E Green Lake Dr N: the intersection delay would increase by 9 seconds per vehicle during PM peak period due to the addition of the proposed dedicated bike phase. Nevertheless, this intersection would still operate at LOS C.
- E Green Lake Dr N & NE 71st St & NE Ravenna Blvd: This intersection would continue to operate at LOS F which is similar to the existing condition. The intersection delay would increase by 22 seconds due to the loss of one northbound travel lane and one westbound right turn pocket at the intersection to accommodate the installation of the PBL. The reduction of the northbound and westbound capacity would also result in longer queues for the northbound and westbound directions.
- E Green Lake Dr N & N 64th St: This intersection would continue to operate at LOS C with an increase of 8 seconds in delay. This increase in delay is caused by the removal of the existing northbound right turn pocket to accommodate the installation of the proposed two-way PBL.

Intersection	Existing		Proposed Alternative	
	Delay (s)	LOS	Delay (s)	LOS
GREEN LAKE DR N & N 80TH ST & INTERLAKE AVE N	26	C	26	C
GREEN LAKE DR N & E GREEN LAKE DR N & W GREEN LAKE DR N (Near Densmore)	25	D	20	C
E GREEN LAKE DR N & WALLINGFORD AVE N	35	D	29	D
E GREEN LAKE DR N & STROUD AVE N	23	C	24	C
GREEN LAKE PARK/ LATONA AVE NE & E GREEN LAKE DR N	8	A	17	A
E GREEN LAKE DR N & NE 71ST ST & NE RAVENNA BLVD*	83	F	95	F
E GREEN LAKE DR N & NE 64TH ST	15	B	23	C
E GREEN LAKE DR N & MERIDIAN AVE N	16	C	16	C
W GREEN LAKE WAY N & E GREEN LAKE WAY N (Near Golf Course)*	184	F	26	C
GREEN LAKE WAY N & N CLOGSTON WAY	10	A	6	A
GREEN LAKE WAY N & N 50TH ST & STONE WAY N	101	F	102	F

* Results from SimTraffic.

Exhibit 5. Proposed Alternative Synchro delay and LOS results

4. Summary of Findings

The analysis performed in this study show that the addition of the PBL to the study corridor combined with the proposed channelization changes and signal timing improvements would not substantially worsen the overall traffic operations for the study corridor.

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Appendix A Existing Conditions Turning Movement Counts (PM Peak Hour)


SDOT AAC PBL GREEN LAKE CORRIDOR
EXISTING CONDITION PM PEAK HOUR VOLUME
N 80th St
Green Lake Dr N
Wallingford Ave N
Stroud Ave
East Green Lake Dr N
West Green Lake Dr N
Latona Ave NE
NE 71st St
NE Ravenna Blvd
N 64th St
East Green Lake Way N
Meridian Ave N
West Green Lake Way N
N Clogston Way
N 50th St
STOP
Legend
Signalized Intersection
Unsignalized Intersection
Study Corridors
N

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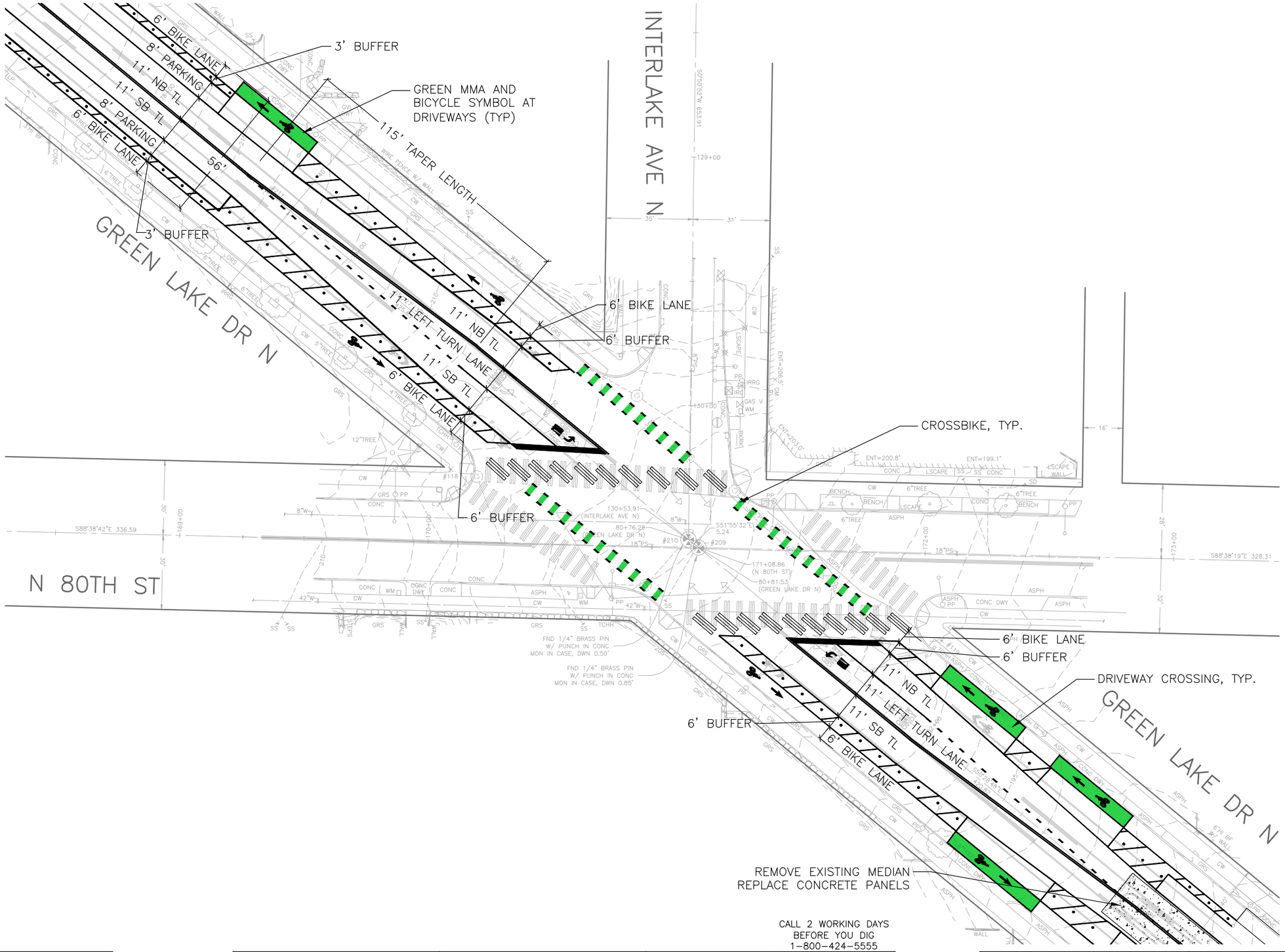
Appendix B Proposed Alternative Channelization



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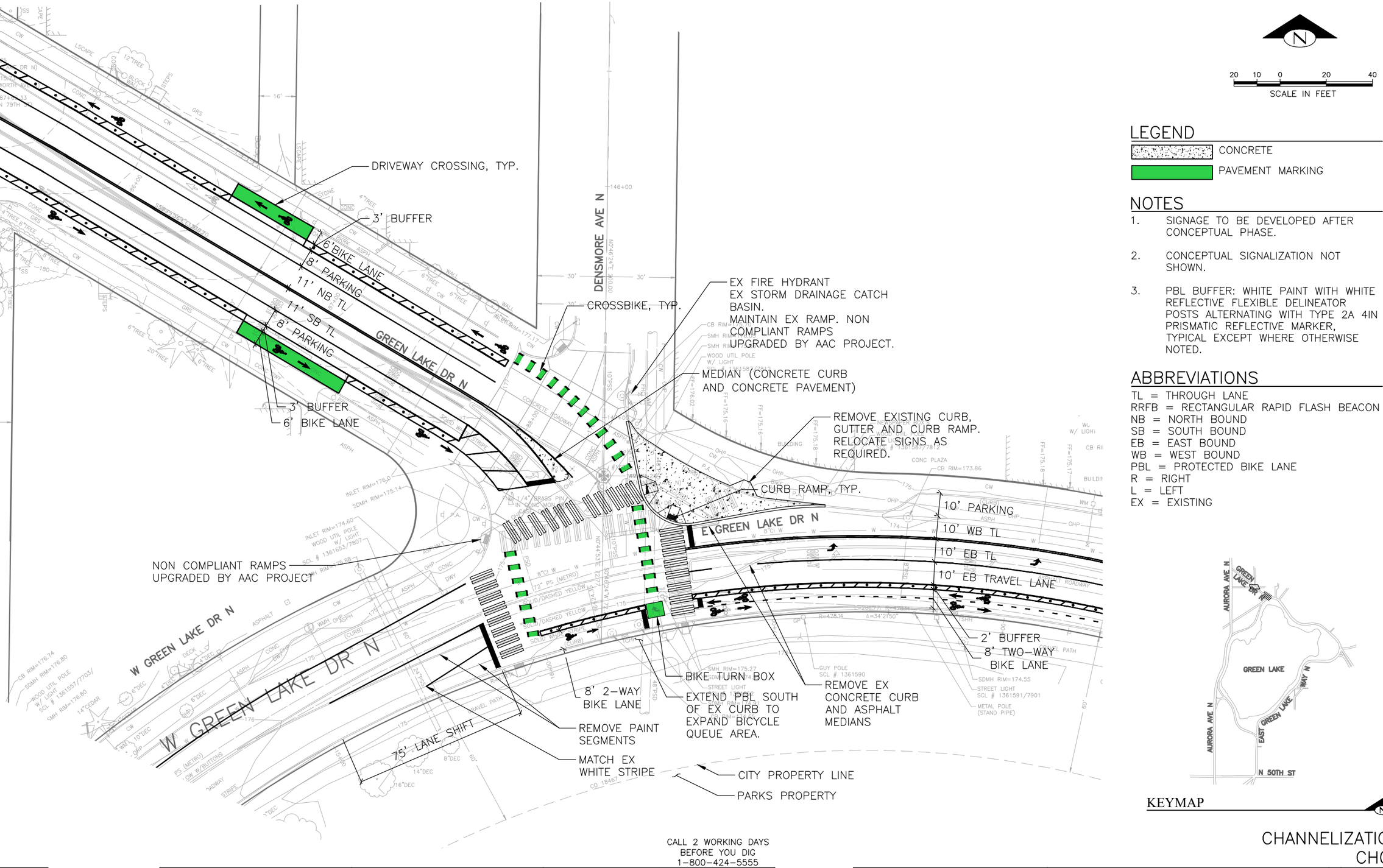

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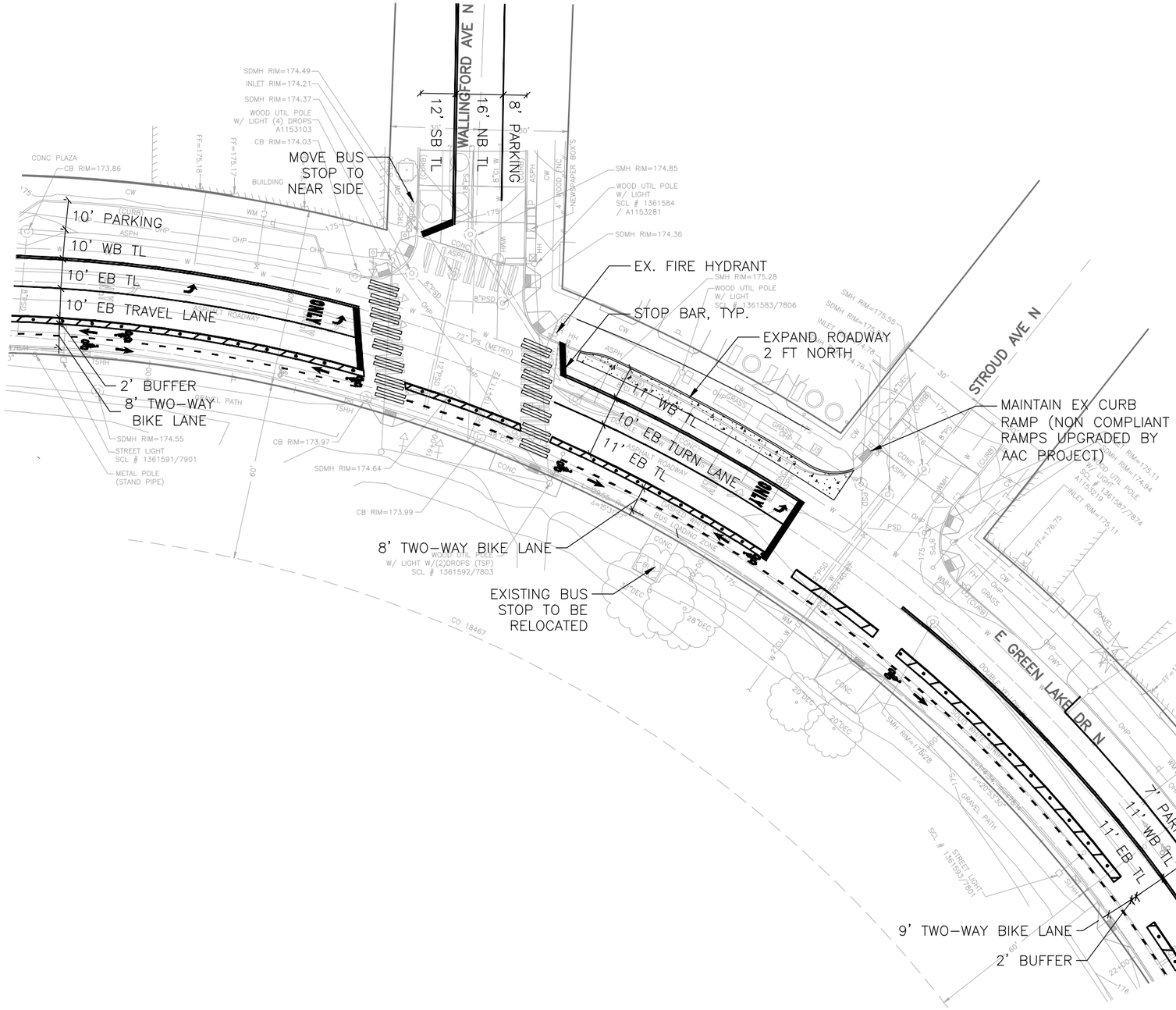

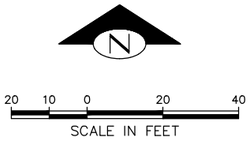

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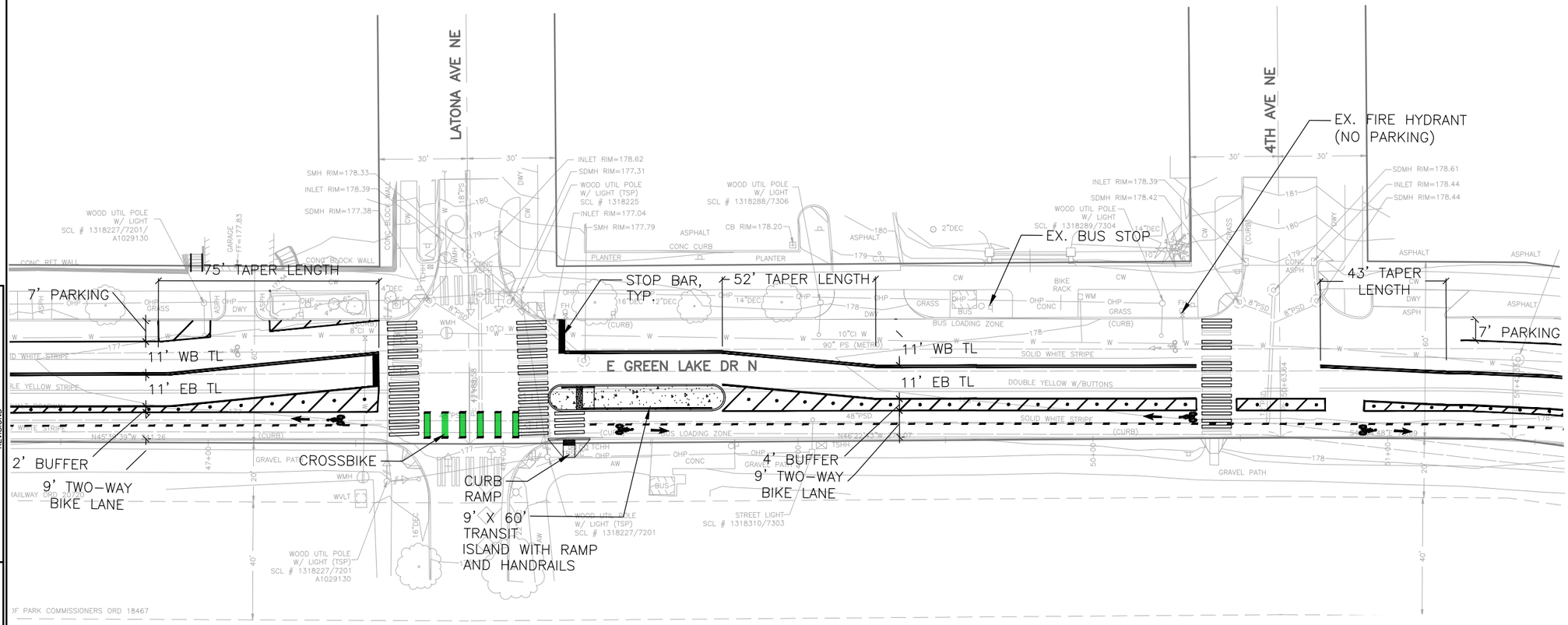

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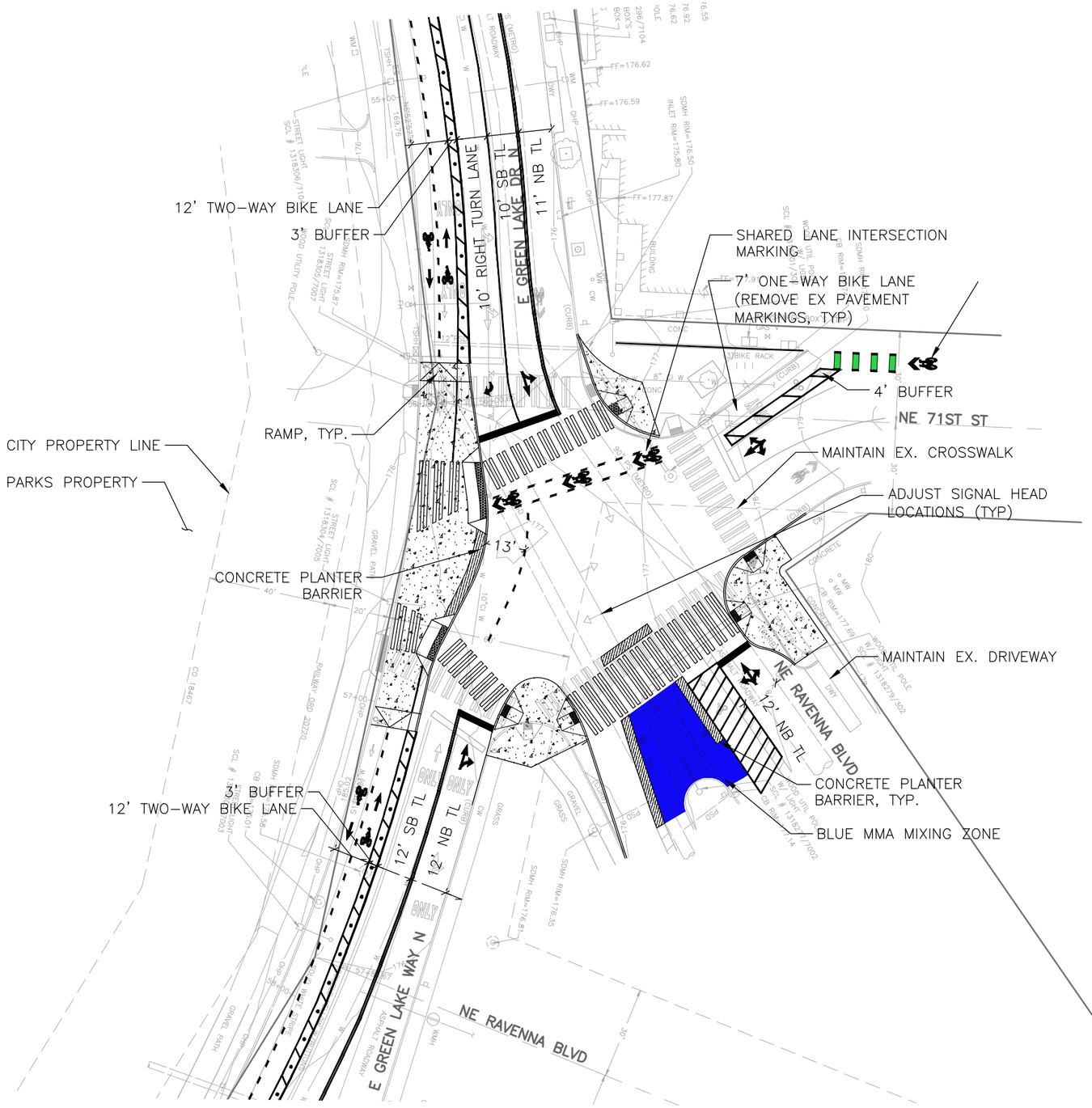

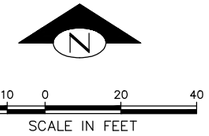

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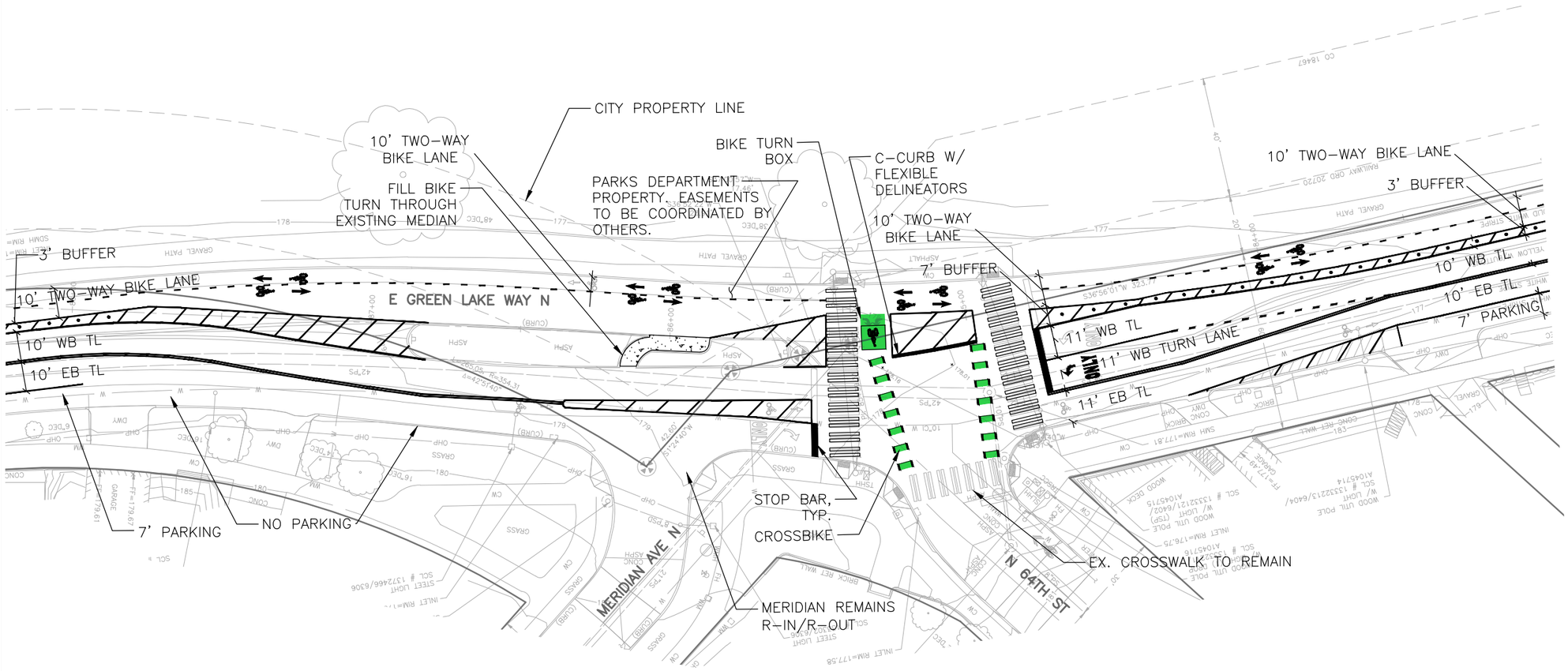

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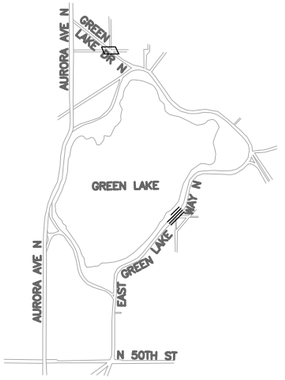

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EAST GREEN LAKE LOOP PROTECTED BIKE LANES

JOB NO.	PC
	R/W
	CO
VAULT PLAN NO.	
SHEET 6 OF 9	

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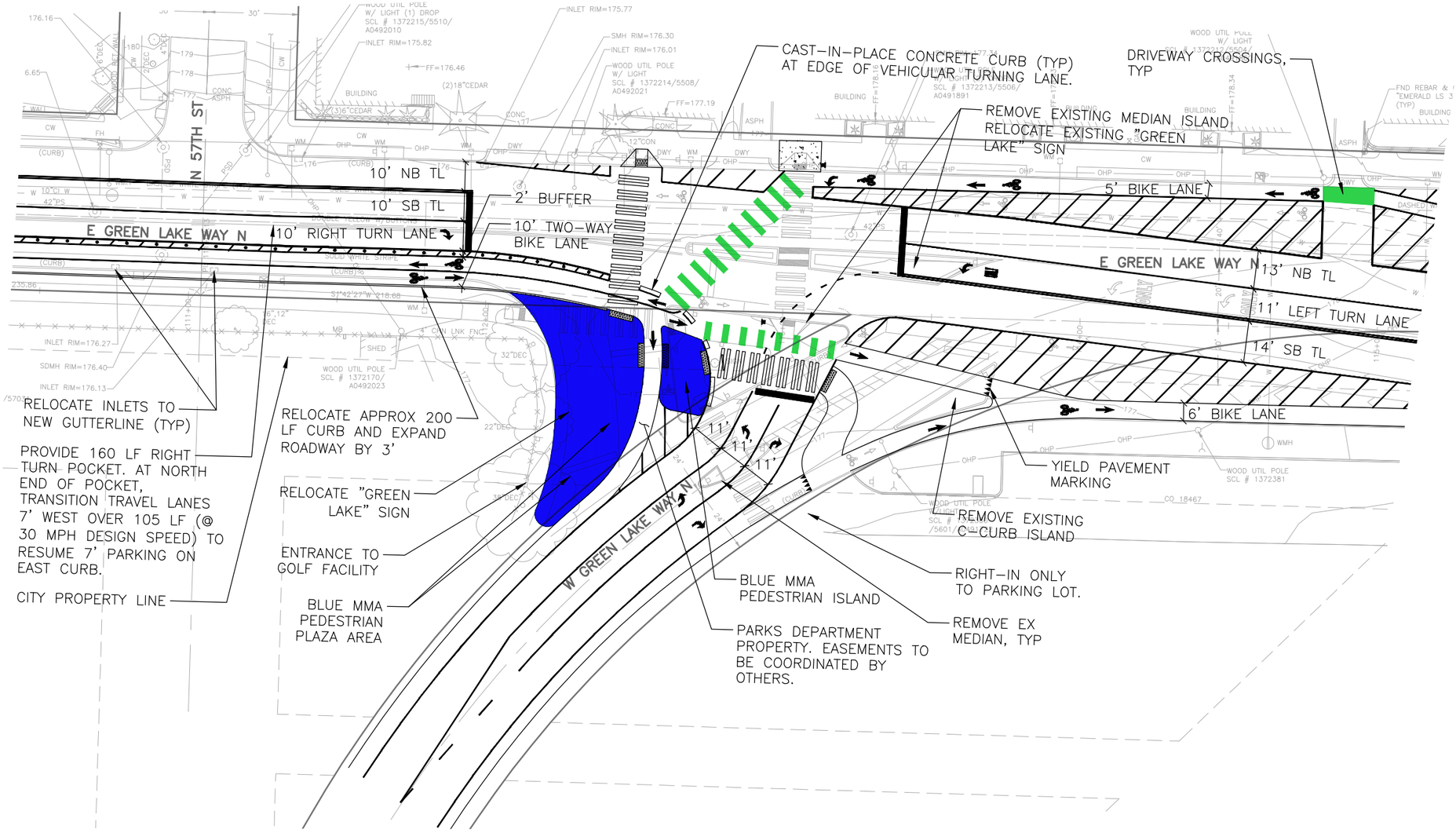

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SCALE IN FEET

LEGEND

CONCRETE

PAVEMENT MARKING

NOTES

1. SIGNAGE TO BE DEVELOPED AFTER CONCEPTUAL PHASE.
2. CONCEPTUAL SIGNALIZATION NOT SHOWN.
3. PBL BUFFER: WHITE PAINT WITH WHITE REFLECTIVE FLEXIBLE DELINEATOR POSTS ALTERNATING WITH TYPE 2A 4IN PRISMATIC REFLECTIVE MARKER, TYPICAL EXCEPT WHERE OTHERWISE NOTED.

ABBREVIATIONS

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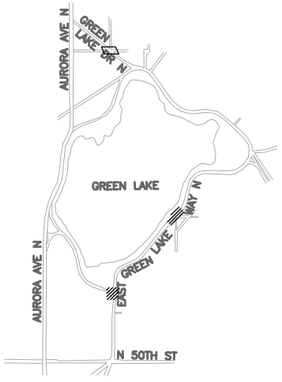

KEYMAP

CONCEPT 12/14/17

CHANNELIZATION
CH07

VAULT SERIAL NO.	DATE	MARK	NATURE REVISIONS	MADE	CHK'D	REV'D

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F 206.329.0525
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EAST GREEN LAKE LOOP PROTECTED BIKE LANES

JOB NO.	PC
	R/W
	CO
VAULT PLAN NO.	
SHEET	7 OF 9

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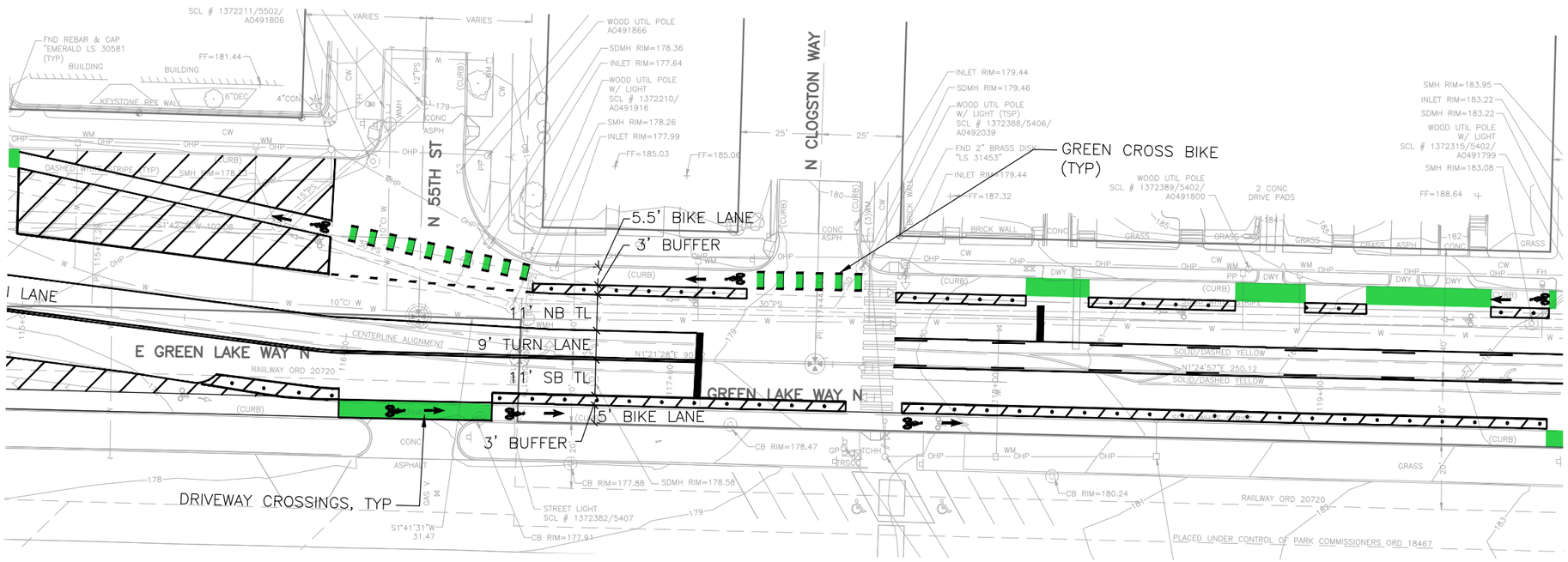

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SCALE IN FEET

LEGEND

CONCRETE

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KEYMAP

CONCEPT 12/14/17

CHANNELIZATION
CH08

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EAST GREEN LAKE LOOP PROTECTED BIKE LANES

JOB NO. | PC / R/W / CO

VAULT PLAN NO.

SHEET 8 OF 9

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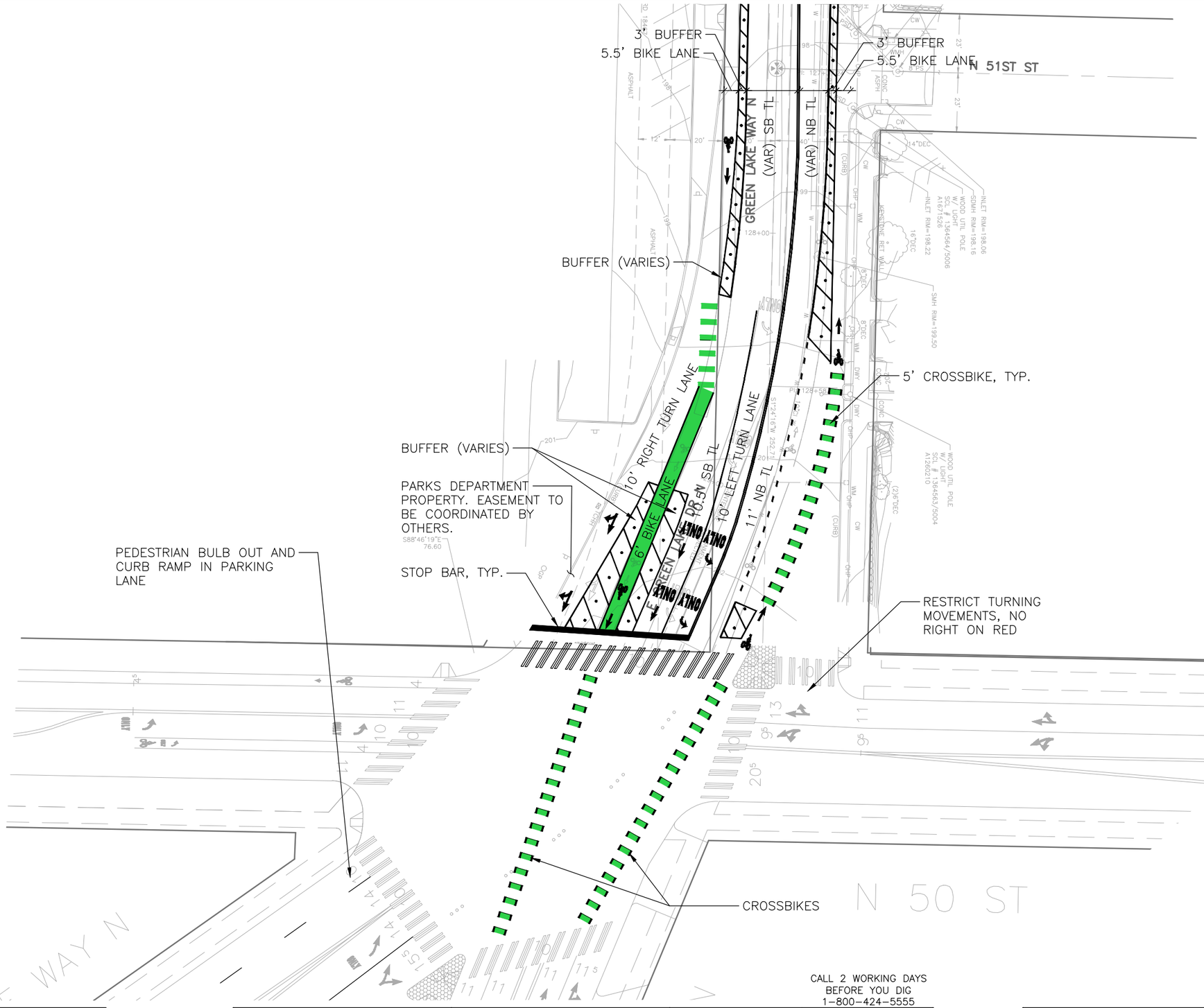

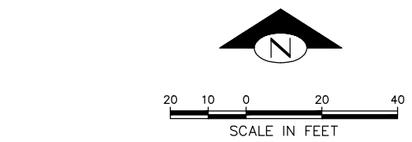

LEGEND

CONCRETE

PAVEMENT MARKING

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KEYMAP

CHANNELIZATION
CH09

CONCEPT 12/14/17

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EAST GREEN LAKE LOOP PROTECTED BIKE LANES

JOB NO.	PC
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VAULT PLAN NO.	
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Appendix C Intersection and Movement Delay and LOS Modeled Results

Intersection	Movement	Existing		Alternative	
		Delay	LOS	Delay	LOS
GREEN LAKE DR N & N 80TH ST & INTERLAKE AVE N	EB	8	A	8	A
	WB	11	B	11	B
	SBR2	0	A	0	A
	SEL	52	D	52	D
	SETR	46	D	46	D
	NWL	55	E	55	E
	NWTR	71	E	71	E
	Intersection	**26**	**C**	**26**	**C**
GREEN LAKE DR N & E GREEN LAKE DR N & W GREEN LAKE DR N (Near Densmore Ave N)	EBL	9	A		-
	EBT(EBLT in ALT)	0	A	28	C
	WBT (WBTR in ALT)	0	A	7	A
	WBR	0	A		-
	SEL (SEB in ALT)	25	D	36	D
	SER	25	D		-
	Intersection	**25**	**D**	**20**	**C**
E GREEN LAKE DR N & WALLINGFORD AVE N	EBL	33	C	48	D
	EBT	11	B	14	B
	WBTR	63	E	34	C
	SBLR	33	C	39	D
	Intersection	**35**	**D**	**29**	**C**
E GREEN LAKE DR N & STROUD AVE N	EBL	11	B	11	B
	EBT	0	A	0	A
	WBT	0	A	0	A
	WBR	0	A	0	A
	SB	23	C	24	C
	Intersection	**23**	**C**	**24**	**C**
GREEN LAKE PARK/ LATONA AVE NE & E GREEN LAKE DR N	SE	8	A	15	B
	NW	8	A	16	B
	NE	10	B	34	C
	SW	10	A	17	B
	Intersection	**8**	**A**	**17**	**B**
E GREEN LAKE DR N & NE 71ST ST & NE RAVENNA BLVD*	WBL2	128	F	139	F
	WBL	121	F	141	F
	WBR	97	F	134	F
	NBT	80	F	162	F
	NBR	25	D	159	F
	NBR2	12	B	134	F
	SBL2	51	F	46	E
	SBL	47	E	48	E
	SBT	22	C	24	C
	NWL	203	F	140	F
	NWR	202	F	140	F
	NWR2	183	F	128	F
	Intersection	**83**	**F**	**106**	**F**
E GREEN LAKE DR N & NE 64TH ST	WBLR	22	C	32	C
	NET (NETR for ALT)	16	B	25	C
	NER	3	A		-
	SWL	8	A	8	A
	SWT	13	B	11	B
	Intersection	**15**	**B**	**23**	**C**
E GREEN LAKE DR N & MERIDIAN AVE N	NBR	16	C	16	C
	NETR	0	A	0	A
	SWT	0	A	0	A
	Intersection	**16**	**C**	**16**	**C**
W GREEN LAKE WAY N & E GREEN LAKE WAY N* (Near Green Lake Golf Course)	EBL	184	F	48	D
	EBR	152	F	27	C
	NBL	22	C	54	D
	NBT	6	A	11	B
	SBT	21	C	23	C
	SBR (SBTR in ALT2)	18	C	17	B
	Intersection	184	F	26	C
GREEN LAKE WAY N & N CLOGSTON WAY	WBR	0	A	0	A
	NBTR	11	B	8	A
	SBL	5	A	1	A
	SBT	8	A	2	A
	Intersection	**10**	**A**	**6**	**A**
GREEN LAKE WAY N & N 50TH ST & STONE WAY N	EBL	92	F	92	F
	EBTR	137	F	137	F
	WBL	86	F	86	F
	WBTR	114	F	118	F
	NBT	150	F	150	F
	NBR	76	E	76	E
	SBL	106	F	106	F
	SBT	66	E	66	E
	SBR	31	C	31	C
	NEL	126	F	126	F
	NER	120	F	120	F
	Intersection	**101**	**F**	**102**	**F**

* Results from SimTraffic

Note: According to HCM 2010, The intersection delay & LOS for two-way stop-controlled (TWSC) intersections is different than all-way stop-controlled (AWSC) intersections and signalized intersections. The TWSC intersection delay and LOS reflects the operations of the movement that experiences the longest delay.