

We conducted capacity analyses for the 2018 short-term year, as well as the 2037 long-term year, per City of Thornton requirements. The analyses were conducted at the following intersections:

- 144th Avenue and I-25 SB Ramps
- 144th Avenue and I-25 NB Ramps
- 144th Avenue and Lincoln Street
- 144th Avenue and Grant Street
- 144th Avenue and Washington Street
- Proposed 146th Avenue/School Driveway and Washington Street
- Lincoln Street and Lincoln Way
- Proposed 148th Avenue and Washington Street
- Grant Street and Proposed 146th Avenue/Site Driveway 2
- Grant Street and Proposed 148th Avenue/Site Driveway 3
- Grant Street and Site Driveway 4
- Grant Street and Site Driveway 5

This signalized intersection already exists

Ok to reduce taper by 65 feet to allow 285 feet of storage.

As part of this development, we propose the following improvements for the 2018 short-term year as well as the 2037 long-term year:

- The existing eastbound 144th Avenue approach at the intersection with Lincoln Street currently provides two through lanes and a right-turn lane. We propose to widen the eastbound approach to provide three through lanes and an exclusive right-turn lane providing 220' of storage and a 165' taper. There are currently three receiving lanes for the eastbound approach, which would allow for the widening to occur with minimal impact. We also proposed to re-stripe the westbound approach to provide two left-turn lanes, two through lanes, and a shared through/right-turn lane. The through/right turn lane will provide 205' of storage and a 100' taper. The southbound site driveway approach will intersect 144th Avenue directly across from Lincoln Street and provide a left-turn lane, a shared through/right-turn lane, and a right-turn lane.

Right turns from arterials are required to have a right turn deceleration lane

- We will extend Grant Street to the north from its current intersection with 144th Avenue to the proposed 148th Avenue. The extension will be constructed as two lanes in each direction, separated by a median, and will include pedestrian accommodations. The proposed extension will provide four direct-access driveways to the development.

Parks & Open Spaces Master Plan shows bike lanes on Grant St north of 144th Ave. This should be incorporated into plans

With the extension of Grant Street across 144th Avenue, the intersection will become a four-leg intersection under signal control. The eastbound 144th Avenue approach will provide two left-turn lanes, two through lanes and a right-turn lane. The left-turn lanes will provide 185' of storage and a 150' taper. The westbound 144th Avenue approach

Reduce taper to 100 feet and increase storage to 235 feet.

What pedestrian accommodations?

Build-out for Thornton's Transportation Master Plan shows 6 lanes, or 3 through lanes in each direction

Reduce taper to 100' and increase storage to 300'

will provide two left-turn lanes, two through lanes, and a right-turn lane. The northbound Grant Street approach will provide two left-turn lanes, two through lanes, and a right-turn lane. The southbound Grant Street approach will provide two left-turn lanes, two through lanes, and a right-turn lane. The right-turn lane will provide 250' of storage and a 150' taper. The left-turn lanes will provide 150' of storage and a 150' taper.

Reduce taper to 100' and increase storage to 200'

- At the intersection of 144th Avenue and Washington Street we propose to extend the eastbound left-turn lanes to provide 300' of storage and a 165' taper.

285' storage and 100' taper

- 146th Avenue will be constructed directly across from the northern Stargate Charter School signalized driveway, and extend to the west to connect with the proposed Grant Street connection. 146th Avenue will become the fourth leg at the signalized intersection. The eastbound 146th Avenue approach will provide a left-turn lane, a through lane, and a right-turn lane. The eastbound right turn will have an overlap and a green arrow during the northbound and southbound left turn protected phase. The left turn lane will provide 100' of storage and a 135' taper. The right-turn lane will provide 250' of storage and a 135' taper. The westbound School Driveway approach will continue to provide two left-turn lanes and a shared through/right-turn lane. The northbound Washington Street approach will provide two left-turn lanes, two through lanes and a right-turn lane. The left-turn lanes will provide 200' of storage and a 100' taper. The southbound Washington Street approach is proposed to provide a left-turn lane, three through lanes, and a right-turn lane.

Based on results, an exclusive left turn lane is needed at this intersection

Per city's specs the minimum dimensions are 150' storage, 100' taper

- 148th Avenue will be constructed from the extension of Grant Street to Washington Street. 148th Avenue will intersect Washington Street to form a T-shaped stop-controlled intersection. The eastbound proposed 148th Avenue approach will provide a left-turn lane, a shared through/right-turn lane, and will be "stop"-controlled. The left-turn lane is proposed to provide 100' of storage and a 135' taper. The northbound Washington Street approach will provide a shared left-turn/through lane. The southbound Washington Street approach will provide a shared through/right-turn.

Right & Left turn lanes are required at all accesses along arterials

- In the 2037 long-term, we propose to add right-turn overlap signal heads on each approach at both the 144th Avenue & Grant Street and the 144th Avenue & Washington Street intersections. Additionally, we propose to add a right-turn overlap signal head on the eastbound approach at 144th Avenue and Lincoln Street. This will allow the right-turn movement to run during the protected left-turn phases and will allow more vehicles to be processed through the intersection.

There is a development on the SW corner of 144th & Washington proposing a 3/4 access between Washington & Grant on 144th Ave. Their inbound left turn may conflict with extending left turn pockets at 144th & Washington. Please coordinate.

- In the 2037 long-term, along the 144th Avenue corridor, the weekday evening peak hour cycle length should be increased from a 100 second cycle length to a 120 second cycle length. Additional timing improvements are discussed in the Analysis of Future Traffic Operations section.
- To improve capacity along 144th Avenue, from I-25 to Washington Street, the roadway should, in the long term (20 years) be widened to allow an additional lane in each direction (six through lanes total). The future widening is included as a recommendation in the 2009 City of Thornton Transportation Plan

Is this needed in 2018
at opening?

We do not expect the proposed distribution center to significantly impact area traffic operations during peak traffic hours in the short-term (2018). Based on our analyses, we determined the adjacent roadway network has sufficient capacity to accommodate the site-generated traffic associated with the proposed distribution center in the short-term (2018) with the above recommended improvements. More specifically, future traffic conditions at all signalized intersections are expected to operate at acceptable overall levels of service during the 2018 build year.

DESCRIPTION OF EXISTING CONDITIONS

This section describes the major roads and intersections, traffic volumes, and existing operations in the area of the overall development in the City of Thornton, Adams County, Colorado.

Roads

Interstate 25

I-25 is classified as an interstate. The roadway has a general north-south orientation and provides three travel lanes in each direction within the study area with additional auxiliary lanes provided at interchange ramps. The northbound and southbound travel lanes are separated by a concrete median. The posted speed limit is 75 mph.

144th Avenue (Major Road)

144th Avenue is classified as a major arterial. The roadway has a general east-west orientation and generally provides two travel lanes in each direction with additional turn lanes at each intersection. The eastbound and westbound travel lanes are separated by a concrete median. The posted speed limit is 45 mph.

Need to state that Lincoln south of 144th Avenue is a private street.

Lincoln Street

Lincoln Street has a general north-south orientation and provides one travel lane in each direction with a two-way-left-turn median within the study area. The posted speed limit is 30 mph.

Grant is classified as a collector

Grant Street

Grant Street is classified as a minor arterial. The roadway has a general north-south orientation and provides two vehicle travel lanes and one bicycle travel lane in each direction within the study area. The northbound and southbound travel lanes are separated by a concrete median. The posted speed limit is 35 mph.

Washington Street (Major Road)

Washington Street is classified as a major arterial. The roadway has a general north-south orientation and generally provides two travel lanes in each direction with additional turn lanes at each intersection. The northbound and southbound travel lanes are separated by a concrete median. The posted speed limit is 55 mph.

Please specify. Cycle length varies by time of day for all these intersections

Intersections

144th Avenue and I-25 Southbound Ramps

The I-25 southbound ramps intersect 144th Avenue to form a four-leg intersection under signal control. The eastbound 144th Avenue approach provides two through lanes, a through lane that is an extension of the left-turn lane at the I-25 northbound ramps, and a channelized right-turn lane under yield-control. The westbound 144th Avenue approach provides two left-turn lanes and two through lanes. The southbound I-25 ramp approach provides two left-turn lanes and a channelized right-turn lane that free-flows into an auxiliary lane. The signal operates under three phases with a 100-second background cycle length.

144th Avenue and I-25 Northbound Ramps

The I-25 northbound ramps intersect 144th Avenue to form a four-leg intersection under signal control. The eastbound 144th Avenue approach provides two left-turn lanes and two thru lanes. The westbound 144th approach provides two through lanes, two through lanes that are extensions of the left-turn lanes at the I-25 southbound ramps, and a channelized right-turn lane under yield-control. The northbound I-25 ramp approach provides two left-turn lanes and one channelized right-turn lane that free-flows into an auxiliary lane. The signal operates under three phases with a 100-second background cycle length.

144th Avenue and Lincoln Street

Lincoln Street intersects 144th Avenue to form a T-shaped intersection under signal control. The eastbound 144th Avenue approach provides two through lanes and a right-turn lane. The westbound 144th Avenue approach provides two left-turn lanes and three through lanes. The northbound Lincoln Street approach provides two left-turn lanes and a right-turn lane. The signal operates under three phases with a 100-second background cycle length.

144th Avenue and Grant Street

Grant Street intersects 144th Avenue to form a T-shaped intersection under signal control. The eastbound 144th Avenue approach provides two left-turn lanes, two through lanes, and a right-turn lane. The westbound 144th Avenue approach provides two left-turn lanes and two through lanes. The northbound Grant Street approach provides two left-turn lanes, two through that are currently coned and closed, and a right-turn lane. The signal operates under three phases with a 100-second background cycle length.

144th Avenue and Washington Street

Washington Street intersects 144th Avenue to form a four-leg intersection under signal control. The eastbound 144th Avenue approach provides two left-turn lanes, two through lanes and one

The ramps operate with 4 phases

These signals operate with 5 phases

right-turn lane. The westbound 144th Avenue approach provides two left-turn lanes, two through lanes and one right-turn lane. The northbound Washington Street approach provides two left-turn lanes, two through lanes and one right-turn lane. The southbound Washington Street approach provides two left-turn lanes, two through lanes and one right-turn lane. The signal operates under four phases with a 100-second background cycle length.

Washington Street and School Driveway

The School Driveway intersects Washington Street to form a T-shaped intersection under signal control. The westbound School Driveway approach provides two left turn lanes and one shared through/right-turn lane. The northbound Washington Street approach provides one left-turn lane, two through lanes and one right-turn lane. The southbound Washington Street approach provides one left-turn lane, three through lanes, and one right-turn lane. The signal operates under four phases with a 100-second background cycle length.

see comments above

Lincoln Street and Lincoln Way

Lincoln Way intersects Lincoln Street to form a four-leg intersection under stop control. The eastbound Lincoln Way approach provides one shared left-turn, through and right-turn lane and is "stop"-controlled. The westbound Lincoln Way approach provides one shared left-turn, through and right-turn lane and is "stop"-controlled. The northbound Lincoln Street approach provides one through lane, one channelized right-turn lane under yield control, and a two-way-left-turn median. The southbound Lincoln Street approach provides one shared through/right-turn lane and a two-way-left-turn median.

Traffic Volumes

There is overlap with street AM peak hour.

We arranged for traffic counts to be conducted during morning and evening peak periods on a typical weekday at the study intersections to examine traffic conditions near the development. Specifically, we arranged for manual turning movement counts to be conducted on Thursday, 12 January 2017 from 5:00 AM to 9:00 AM and from 4:00 PM to 8:00 PM. Additionally, ATR (Automatic Traffic Recorders) counts were conducted on both 144th Avenue and Washington Street from 12:00 PM on Monday, January 9, 2017, to 12:00 PM on Friday, January 17, 2017.

It is noted that the tenant specific data indicates that peak shift turnover periods and traffic activity associated with the proposed development generally do not coincide with the roadway peak hours. The morning shift turnover for the facility occurs between 6:30 AM to 7:30 AM. During the evening, the shift turnover period occurs between 5:00 PM to 6:00 PM. For the purpose of this study, analyses were conducted during the proposed development's peak hours instead of the street peak hours. Figure 2 illustrates the existing weekday morning and evening peak hour traffic volumes as well as the AADT (Annual Average Daily Traffic) volumes. We obtained the AADT volumes from the ATR counts we performed.

Figure 2 illustrates the existing weekday morning and evening peak hour traffic volumes. Summaries of the manual traffic counts are contained in Appendix C.

The morning peak modeled in Synchro with existing conditions does not use timings from 6:30-7:30

5-6 PM is also street PM peak hour.

Are these shift turnovers subject to change?

What about weekend analysis?
The facility is intended to be 24/7, 7 day a week operation. Need to confirm impact of weekend peak vs. shift turnover.

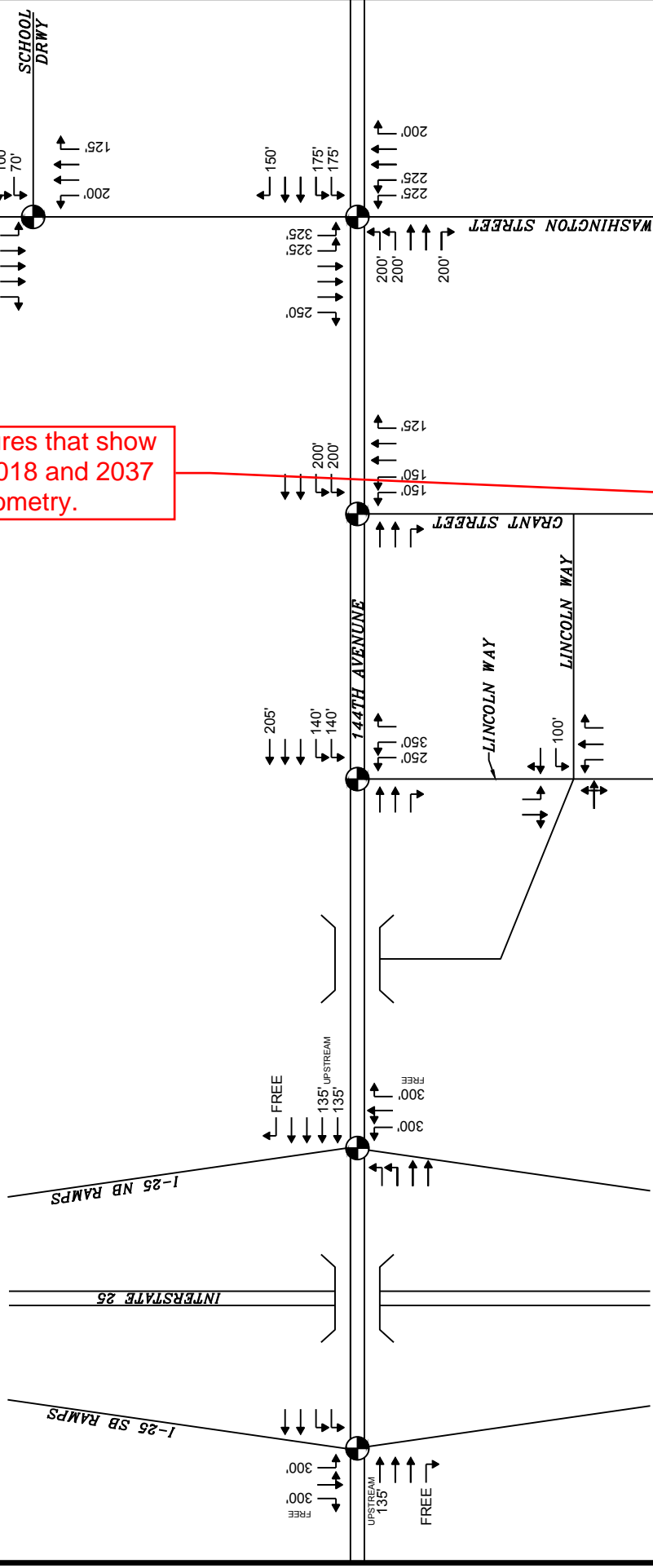
What about truck peak and its impact?

Table 1 Cont'd – Intersection Capacity Analysis Summary (Existing)

Location	Movement	2017 Existing Traffic		
		AM	PM	
Signalized Intersections				
144 ⁺ Avenue and Washington Street	EB	L	E (57.9)	C (32.9)
		T	A (7.0)	C (31.6)
		R	A (1.6)	B (16.9)
	WB	L	D (46.2)	D (45.5)
		T	B (15.4)	B (19.8)
		R	A (0.1)	A (0.1)
	NB	L	D (46.1)	D (48.8)
		T	D (35.7)	D (40.9)
		R	A (0.2)	A (1.2)
	SB	L	D (49.6)	D (50.7)
		T	D (44.9)	D (39.4)
R		A (4.5)	B (10.2)	
Overall		C (21.8)	C (28.9)	
Washington Street and Proposed 146 ⁺ Avenue/ School Driveway	WB	L	D (42.5)	D (43.1)
		T,R	A (0.0)	A (0.1)
	NB	T	A (0.3)	A (0.4)
		R	A (0.0)	A (0.1)
	SB	L	D (45.0)	D (45.8)
		T	A (0.6)	A (2.3)
Overall		A (0.9)	A (6.4)	
Unsignalized Intersections				
Lincoln Street and Lincoln Way	EB	L,T,R	A (8.9)	B (13.0)
	WB	L	A (0.0)	B (12.4)
		T,R	A (8.4)	B (10.0)
	NB	L	A (0.0)	A (7.7)
	SB	L	A (7.2)	A (7.7)
Overall		A (4.2)	A (1.3)	

What about 146th & Grant roundabout level-of-service?

LEGEND
 DIVIDED ROADWAY
 EXISTING ROADWAY
 SITE DRIVEWAY
 STORAGE LENGTH
 TRAFFIC SIGNAL



Add figures that show future 2018 and 2037 lane geometry.

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	Project No. 100612301 Date 02/09/2017 Scale N.T.S. Drawn By EJV Checked By Submission Date FEBRUARY 2017	Sheet 3 of 13	

PROPOSED CONDITIONS

Site-Generated Trips

The overall development was originally approved for approximately 565,000 sf of retail space and a 300-room hotel. The trip generation estimates for the original approval are summarized in Table 2. As per the 2010 traffic studies, the trip generation was determined based on the data published by the Institute of Transportation Engineers (ITE) for Land Use Code 820 (Shopping Center) and Land Use Code 310 (Hotel) as contained in Trip Generation, 7th edition.

Table 2 – Trip Generation Estimates – Original Approval

Use	Daily	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
565,000 sf Retail	2,676	117	84	201	103	107	210
300-room Hotel	24,261	355	227	582	1,017	1,102	2,119
Total	26,937	472	311	783	1,120	1,209	2,329
15% Internal Capture	4,040	71	46	117	168	181	349
Total New Trips	22,897	401	265	666	952	1,028	1,979

Volumes appear to be more in line with a non-peak volume that would be expected. Peak volume would be expected to be much higher.

We prepared trip generation estimates for the proposed distribution center based on tenant-specific projected operations. The trip generation estimates are based on operations during the anticipated peak operating season (November – December). During other times of the year the trip generation would be significantly less (approximately 40 percent), as shown in the table below. Table 3 summarizes the trip generation estimates for the distribution center during the weekday morning and evening peak hours.

Table 3 – Future Trip Generation Estimates – Proposed 856,600 sf Distribution Center

Use	Daily	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
Peak Operating Season (November – December)							
Passenger Cars*	10,586	1,128	12	1,140	1,201	1,201	2,402
10% Carpool Reduction	1,059	113	1	114	120	120	240
Passenger Cars W/ Reduction	9,527	1,015	11	1,026	1,081	1,081	2,162
Trucks*	654	18	14	32	15	13	28
Total	10,181	1,033	25	1,058	1,096	1,094	2,190
Non-Peak Operation Season (January – October)							
Passenger Cars	6,352	677	7	684	721	720	1,441
Trucks	392	11	8	19	9	8	17
Total	6,744	688	15	703	730	728	1,458

*Based on Tenant specific data.

What are truck volumes during "truck peak"?

Need to show how this table relates to ITE trip generation. Land Use 152 High-Cube Warehouse/Distribution Center provides a study on a facility used to "receive, sort and ship overnight or expedited small parcels to local destinations." It shows a trip rate of 1.97/1000sqft (AM) 2.23/1000sqft (PM) and 23.73/sqft (daily). Based on 856,600 sqft, this is 1688 AM trips, 1910 PM trips, and 24,610 weekday trips which varies substantially from the table above

Full changeover would be expected at each shift change. Why is AM "Out" volume not close to or equivalent to AM "In" volume?

Do not assume a 10% carpool reduction.

FIGURE 4

Project No.	100612301
Date	02/09/2017
Scale	N.T.S.
Drawn By	EJV
Checked By	
Submission Date	FEBRUARY 2017

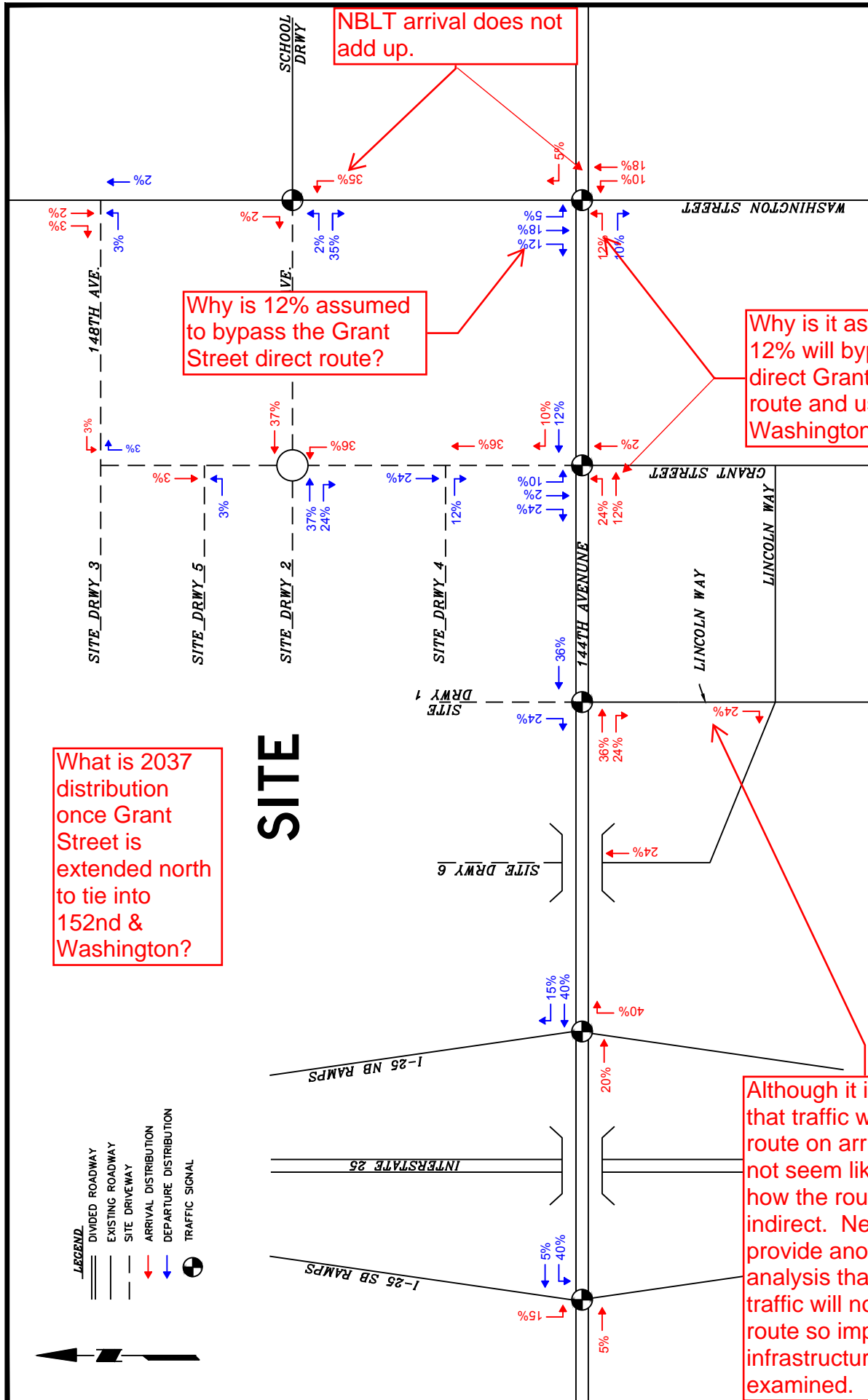
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PASS ARR DEPARTURE DISTRIBUTIONS

PROJECT RIO

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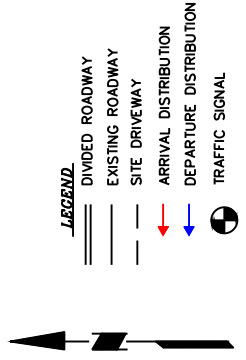
ADAMS COUNTY COLORADO
 CITY OF THORNTON
 NJ CERTIFICATE OF AUTHORIZATION No. 249A27996403



LEGEND

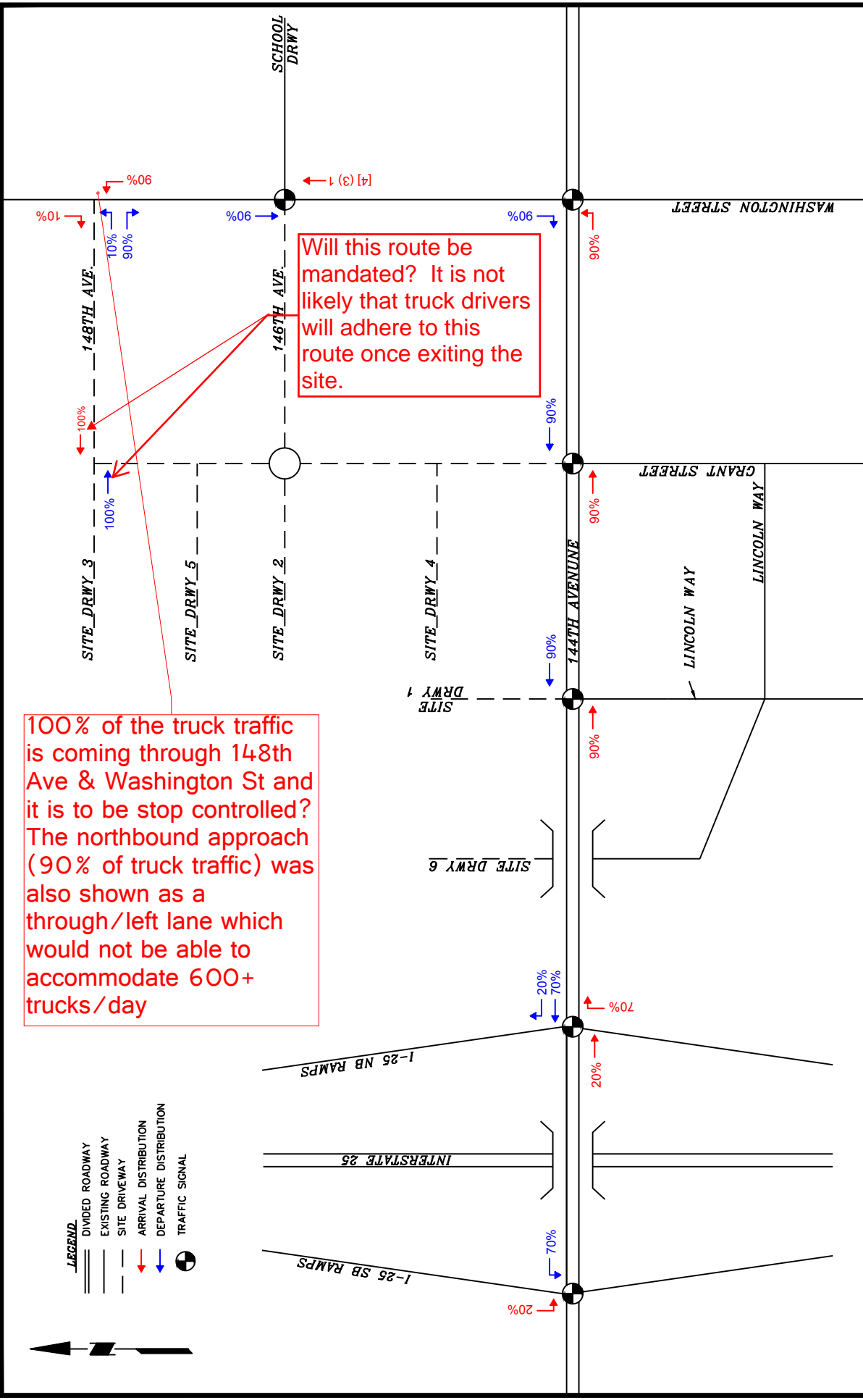
- DIVIDED ROADWAY
- EXISTING ROADWAY
- SITE DRIVEWAY
- ARRIVAL DISTRIBUTION
- DEPARTURE DISTRIBUTION
- TRAFFIC SIGNAL

Although it is hoped that traffic will take this route on arrive, it does not seem likely given how the route is indirect. Need to provide another analysis that assumes traffic will not take this route so impact to infrastructure can be examined.

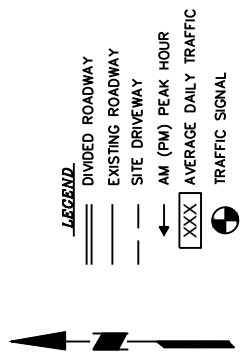


100% of the truck traffic is coming through 148th Ave & Washington St and it is to be stop controlled? The northbound approach (90% of truck traffic) was also shown as a through/left lane which would not be able to accommodate 600+ trucks/day

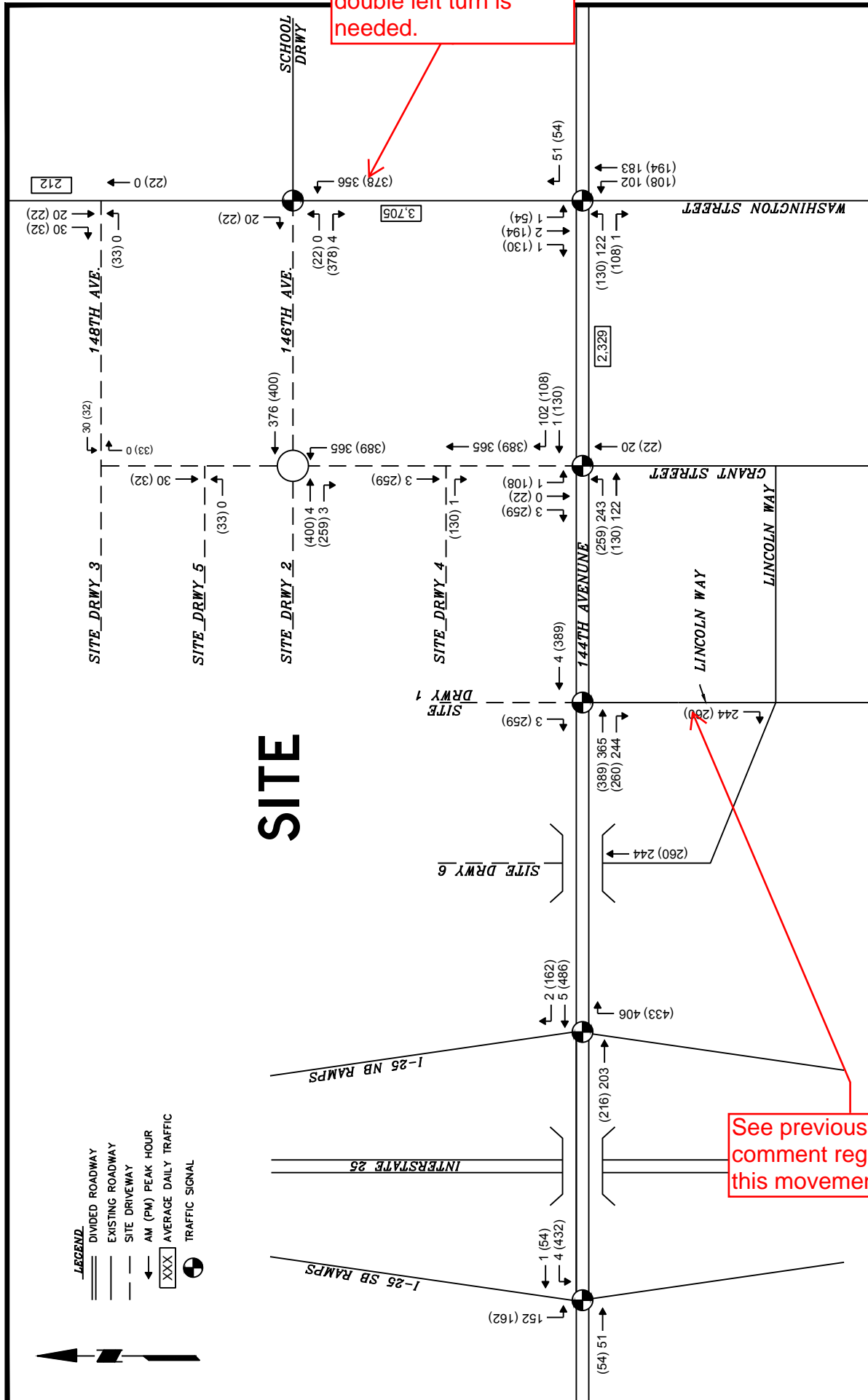
Will this route be mandated? It is not likely that truck drivers will adhere to this route once exiting the site.



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	Project No. 100612301 Date 02/09/2017 Scale N.T.S. Drawn By EJV Checked By N.T.S. Submission Date FEBRUARY 2017	Sheet 5 of 13	© 2017 Langan



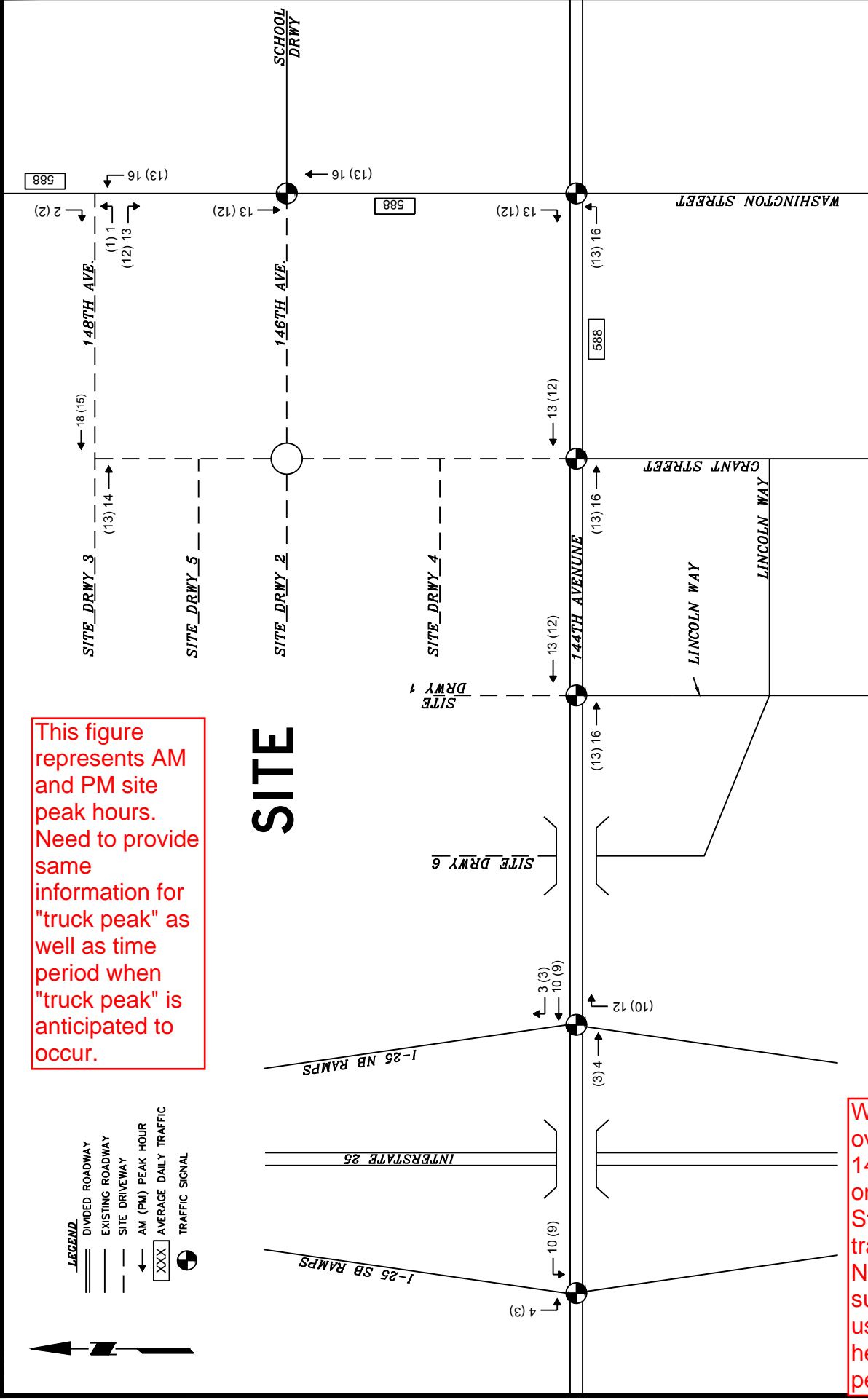
SITE



Volume indicates a double left turn is needed.

See previous comment regarding this movement.

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	Project No. 100612301 Date 02/09/2017 Scale N.T.S. Drawn By EJV Checked By Submission Date FEBRUARY 2017	Sheet 6 of 13	



This figure represents AM and PM site peak hours. Need to provide same information for "truck peak" as well as time period when "truck peak" is anticipated to occur.

What percent of overall traffic on 144th Avenue and on Washington Street does truck traffic make up? Need to make sure Synchro files use appropriate heavy vehicle percentage.

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	Project No. 100612301	Date 02/09/2017	Scale N.T.S.
Checked By N.T.S.		Submission Date FEBRUARY 2017	
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996403		Sheet 7 of 13	

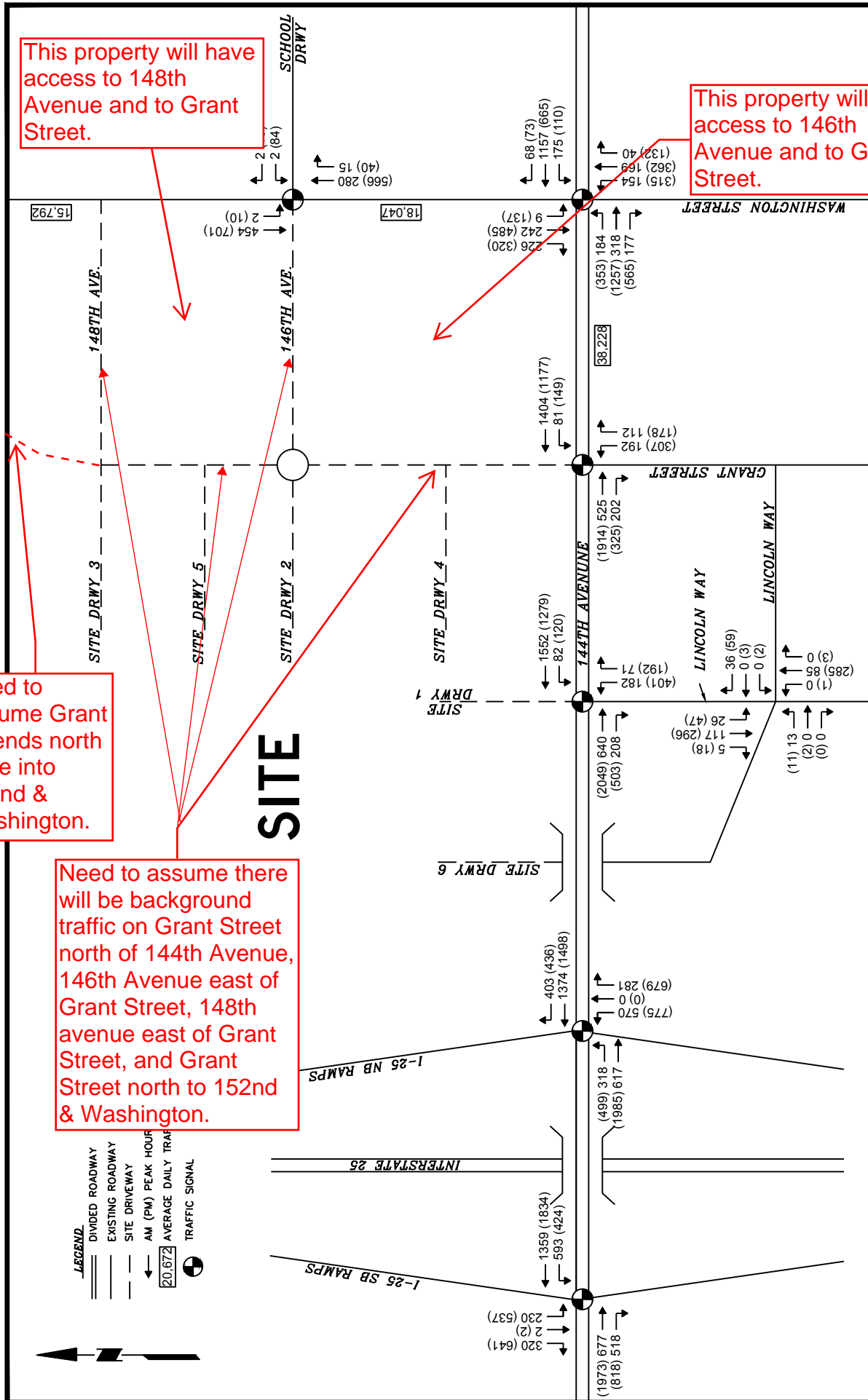
This property will have access to 148th Avenue and to Grant Street.

This property will have access to 146th Avenue and to Grant Street.

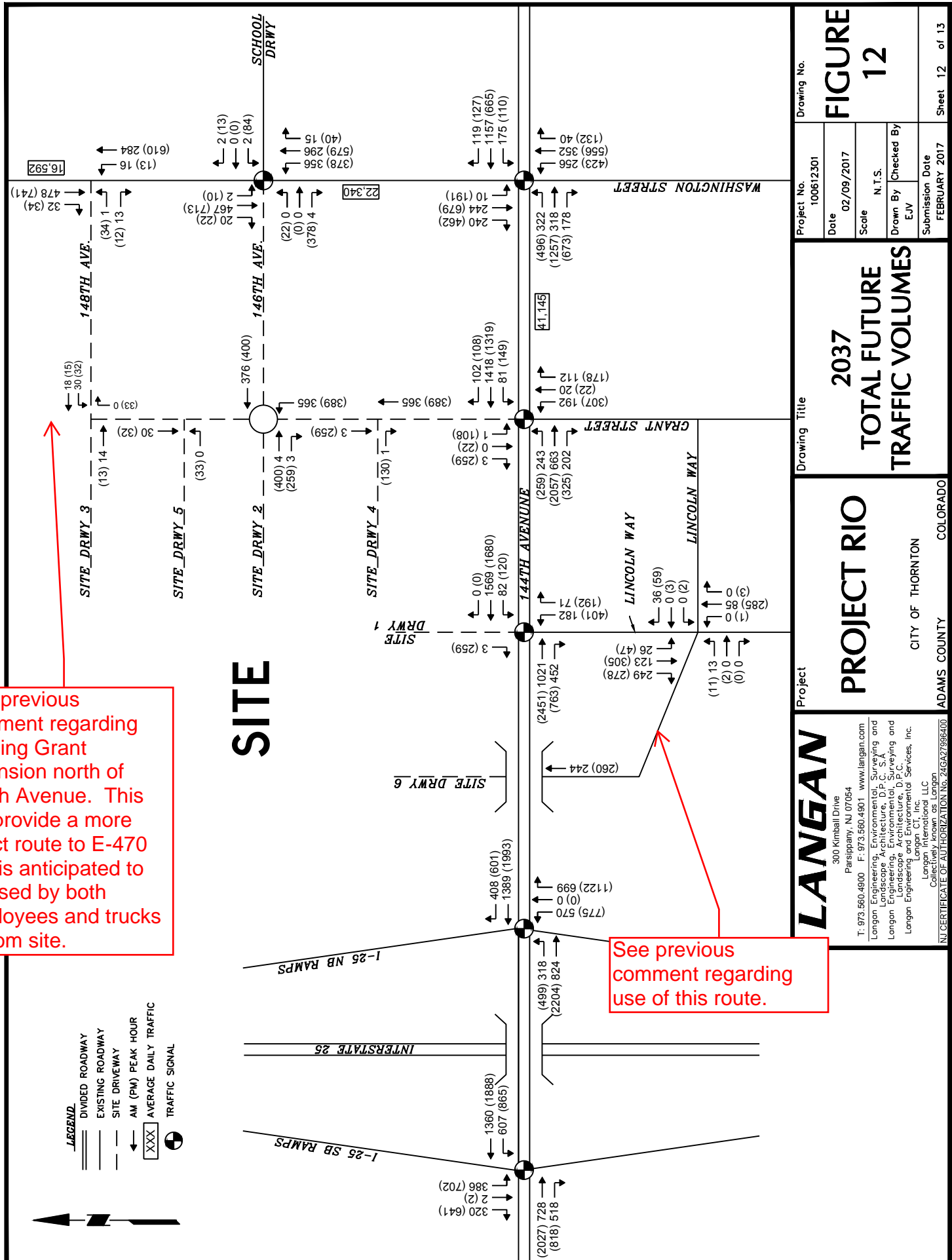
Need to assume Grant extends north to tie into 152nd & Washington.

Need to assume there will be background traffic on Grant Street north of 144th Avenue, 146th Avenue east of Grant Street, 148th Avenue east of Grant Street, and Grant Street north to 152nd & Washington.

- LEGEND
- DIVIDED ROADWAY
- EXISTING ROADWAY
- SITE DRIVEWAY
- AM (PM) PEAK HOUR
- AVERAGE DAILY TRAFFIC
- TRAFFIC SIGNAL



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	Adams County CITY OF THORNTON COLORADO	Project No. 100612 Date 02/09/2017 Scale N.T.S. Drawn By EJV Checked By Submission Date FEBRUARY 2017	Sheet 10 of 13



See previous comment regarding missing Grant extension north of 148th Avenue. This will provide a more direct route to E-470 and is anticipated to be used by both employees and trucks to/from site.

See previous comment regarding use of this route.

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	<p>Submission Date</p> <p>FEBRUARY 2017</p>	<p>Scale</p> <p>N.T.S.</p>	<p>Date</p> <p>02/09/2017</p>	<p>Project No.</p> <p>100612301</p>

ANALYSIS OF FUTURE TRAFFIC OPERATIONS

Capacity analysis provides an indication of the adequacy of road facilities to serve traffic demand. We conducted capacity analyses for the study intersections and found that the proposed distribution center will not detrimentally impact traffic operations during peak hours with the proposed roadway improvements. Tables 6 and 7 summarize the 2018 and 2037 background traffic and future traffic levels of service (LOS) for each of the study intersections. All capacity printouts are contained in Appendix E. The 2010 Highway Capacity Manual (HCM) level of service (LOS) criteria for both unsignalized and signalized intersections is contained in Appendix E.

LOS for this movement does not seem to reflect the volume anticipated.

Table 6 – Intersection Capacity Analysis Summary (2018)

Location	Movement	2018 Background Traffic		2018 Total Future Traffic		
		AM	PM	AM	PM	
Signalized Intersections						
144 th Avenue and I-25 SB Ramps	EB	T	B (12.8)	C (20.2)	B (15.6)	C (31.0)
		R	A (0.3)	A (0.5)	A (0.3)	A (0.5)
	WB	L	D (47.6)	D (38.2)	D (51.0)	E (76.6)
		T	A (6.3)	B (16.5)	A (7.8)	B (12.2)
	SB	L	D (50.4)	D (48.6)	D (49.2)	D (46.6)
		R	A (0.2)	A (0.4)	A (0.2)	A (0.4)
Overall		B (16.5)	B (19.0)	C (20.0)	C (29.8)	
144 th Avenue and I-25 NB Ramps	EB	L	D (45.9)	D (36.6)	D (41.6)	D (37.6)
		T	A (0.9)	A (5.0)	A (1.1)	B (14.8)
	WB	T	C (23.5)	C (26.2)	C (21.9)	C (24.2)
		R	A (0.3)	A (0.3)	A (0.3)	A (0.5)
	NB	L	D (47.4)	D (45.7)	D (47.4)	D (45.7)
		R	A (0.2)	A (0.5)	A (0.9)	A (1.7)
Overall		B (19.7)	B (16.9)	B (15.0)	B (17.9)	
144 th Avenue and Lincoln Street/ Site Driveway 1	EB	T	A (6.0)	B (10.6)	B (10.1)	B (15.4)
		R	A (0.7)	A (1.7)	A (3.4)	A (5.0)
	WB	L	D (46.0)	E (62.0)	D (42.6)	D (42.5)
		T	A (5.5)	A (5.9)	-	-
		R	-	-	A (6.1)	B (11.9)
	NB	L	D (46.5)	D (47.0)	D (46.5)	E (62.5)
		R	B (12.7)	A (8.9)	-	-
		T,R	-	-	B (13.3)	A (8.4)
	SB	L	-	-	D (46.0)	D (46.0)
		T,R	-	-	A (0.0)	A (7.7)
R		-	-	A (0.0)	A (7.6)	
Overall		B (11.0)	B (14.2)	B (11.2)	B (16.9)	
144 th Avenue and Grant Street	EB	L	-	-	E (57.4)	E (71.4)
		T	A (4.5)	A (8.9)	A (1.8)	B (12.5)
		R	A (0.7)	A (2.1)	A (0.4)	A (1.9)
	WB	L	D (40.6)	D (41.1)	D (41.7)	D (54.6)
		T	A (5.0)	A (4.4)	B (17.8)	B (11.0)
		R	-	-	A (6.0)	A (1.8)
	NB	L	D (47.1)	D (51.4)	D (53.4)	E (68.0)
		T	-	-	D (42.2)	D (41.4)
		R	B (12.0)	B (10.9)	A (9.3)	B (13.3)
	SB	L	-	-	D (45.0)	D (46.5)
T		-	-	D (45.0)	D (42.5)	
R		-	-	A (0.0)	D (35.6)	
Overall		B (11.2)	B (13.5)	C (20.5)	C (23.9)	

Westbound right turn lane will be required.

In what year is LOS F anticipated to occur?

Table 7 – Intersection Capacity Analysis Summary (2037)

Location	Movement	2037 Background Traffic		2037 Total Future Traffic		
		AM	PM	AM	PM	
Signalized Intersections						
and I-25 SB Ramps	EB	T	B (15.0)	F (87.2)	B (18.2)	F (131.7)
		R	A (0.6)	A (1.4)	A (0.6)	A (1.4)
	WB	L	E (74.9)	C (29.6)	E (79.1)	F (96.5)
		T	A (7.7)	F (81.7)	A (8.3)	B (18.6)
	SB	L	D (50.3)	D (46.7)	D (48.7)	E (64.9)
		R	A (0.3)	A (0.8)	A (0.3)	A (0.8)
Overall		C (20.8)	E (58.0)	C (23.4)	E (62.4)	
144 th Avenue and I-25 NB Ramps	EB	L	C (31.4)	D (37.7)	C (26.7)	E (62.1)
		T	A (2.7)	E (63.1)	A (5.9)	E (57.6)
	WB	T	C (34.9)	E (68.4)	C (29.3)	D (36.6)
		R	A (0.4)	A (0.4)	A (0.4)	A (0.6)
	NB	L	D (44.2)	F (86.5)	D (44.2)	D (52.2)
		R	A (0.3)	A (1.0)	A (1.1)	A (3.9)
Overall		C (23.9)	D (53.6)	B (19.1)	D (38.4)	
144 th Avenue and Lincoln Street/ Site Driveway 1	EB	T	A (6.5)	E (68.0)	B (11.1)	E (78.6)
		R	A (0.8)	A (5.5)	A (0.6)	A (3.5)
	WB	L	D (53.3)	D (54.5)	D (41.2)	E (68.5)
		T	A (5.5)	A (7.1)	-	-
	NB	L	D (46.5)	D (46.2)	D (45.6)	E (71.5)
		R	B (12.8)	B (13.0)	-	-
		T,R	-	-	B (13.2)	B (19.6)
	SB	L	-	-	D (46.0)	E (56.0)
		T,R	-	-	A (0.0)	B (15.1)
	Overall		A (9.7)	D (39.3)	B (10.2)	D (45.3)
144 th Avenue and Grant Street	EB	L	-	-	E (59.8)	E (60.4)
		T	A (6.6)	D (49.4)	A (2.7)	E (71.7)
		R	A (1.9)	A (1.1)	A (0.4)	A (3.7)
	WB	L	C (33.8)	E (57.3)	D (35.8)	D (52.6)
		T	B (14.4)	A (1.2)	C (32.1)	C (21.3)
	NB	R	-	-	A (4.2)	A (4.2)
		L	D (47.1)	D (51.4)	D (47.7)	E (78.4)
		T	-	-	D (43.9)	D (53.1)
	SB	R	B (12.0)	B (13.1)	B (10.4)	C (32.1)
		L	-	-	D (44.0)	D (54.2)
T		-	-	D (45.0)	E (55.4)	
Overall		B (14.8)	C (30.4)	C (25.2)	D (49.2)	

See previous comment.

See previous comment.

See previous comment about need to assume background volume on Grant, etc.

We used the timing directives provided by the City of Thornton and the City of Westminster and included them in Appendix D. Figure 13 summarizes the 2018 and 2037 future lane geometry at each of the study intersections. In order to create adequate capacity along 144th Avenue, from I-25 to Washington Street, the roadway should, in the long term (20 years) be widened to allow an additional lane in each direction (three through lanes each direction). The results of our 2037 weekday evening peak hour analysis shows that this improvement, which has been recommended previously by other entities, would improve flow along the 144th Avenue corridor. It should be noted that to be conservative, the 2037 analyses contained herein do not include the future widening of 144th Avenue as recommend in the 2009 City of Thornton Transportation Plan.

Need to know if widening to 6 lanes will be adequate by 2037.

144th Avenue and I-25 Southbound Ramps

2018

The signalized intersection is expected to operate at an overall LOS B during both the weekday morning and evening peak hours under the background condition. Under the future condition, the intersection is expected to operate at an overall LOS C during both peak hours. During the evening peak hour it is recommended to shift 7 seconds of green time from the eastbound/westbound R.O.W. phase to the westbound advance phase.

2037

The signalized intersection is expected to operate at an overall LOS C during the weekday morning peak hour and overall LOS E during the weekday evening peak hour under the background condition. Under the future condition, the intersection is expected to operate at an overall LOS C during the weekday morning peak hour and overall LOS E during the weekday evening peak hour.

During the morning peak hour it is recommended to adjust the offset from 32 seconds to 25 seconds. During the evening peak hour it is recommended to increase the cycle length along 144th Avenue to 120 seconds and at this intersection adjust the offset from 0 seconds to 18 seconds.

144th Avenue and I-25 Northbound Ramps

2018

The signalized intersection is expected to operate at an overall LOS B during both the weekday morning and evening peak hours under the background condition. Under the future condition, the intersection is expected to continue to operate at an overall LOS B during both the weekday morning peak hour and evening peak hours.

2037

All movements at this stop-controlled intersection are expected to operate at LOS C or better during the weekday morning peak hour and LOS E or better during the weekday evening peak hour under the future condition.

Grant Street and Proposed 148th Avenue/Site Driveway 3

Geometry

The proposed 148th Avenue and Site Driveway 3 will intersect the proposed Grant Street extension to form a T-shaped stop-controlled intersection. The eastbound site driveway approach will provide a shared through/right-turn lane and will be "stop"-controlled. The westbound proposed 148th Avenue will provide a shared left-turn/through lane and will be "stop"-controlled. The northbound Grant Street approach will provide a left-turn lane and a right-turn lane.

2018

All movements at this stop-controlled intersection are expected to operate at LOS A during both the weekday morning and evening peak hours under the future condition.

2037

All movements at this stop-controlled intersection are expected to operate at LOS A during both the weekday morning and evening peak hours under the future condition.

What about left turns?

Grant Street and Site Driveway 4

Geometry

Site Driveway 4 will intersect the proposed Grant Street extension to form a T-shaped stop-controlled intersection. The eastbound site driveway approach will provide a channelized right-turn lane and will be "stop"-controlled. The northbound Grant Street approach will provide two through lanes. The southbound Grant Street approach will provide two through lanes. It is noted that the northbound and southbound approaches are separated by a concrete median.

What about right turns?

2018

All movements at this stop-controlled intersection are expected to operate at LOS A during both the weekday morning and evening peak hours under the future condition.

2037

All movements at this stop-controlled intersection are expected to operate at LOS A during both the weekday morning and evening peak hours under the future condition.

Grant Street and Site Driveway 5

Geometry

Site Driveway 5 will intersect the proposed Grant Street extension to form a T-shaped stop-controlled intersection. The eastbound site driveway approach will provide a shared left-turn/right-turn lane and will be “stop”-controlled. The northbound Grant Street approach will provide a shared left-turn/through lane and a through lane. The southbound Grant Street approach will provide a through lane and a shared through/right-turn lane.

2018

All movements at this stop-controlled intersection are expected to operate at LOS A during both the weekday morning and evening peak hours under the future condition.

Need separate left
turn lane.

2037

All movements at this stop-controlled intersection are expected to operate at LOS A during both the weekday morning and evening peak hours under the future condition.

Grant Street and Proposed 146th Avenue/Site Driveway 2 (Roundabout)

Geometry

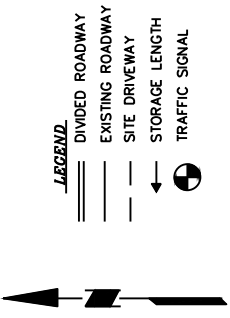
The proposed 146th Avenue and Site Driveway 2 intersect the proposed Grant Street extension to form a yield-controlled roundabout. The inner circle will provide two travel lanes. The eastbound site driveway and westbound proposed 146th Avenue approaches are to provide one entering and one exiting lane and are “yield”-controlled. The northbound and southbound Grant Street approaches will provide two entering and two exiting lanes and are “yield”-controlled.

2018

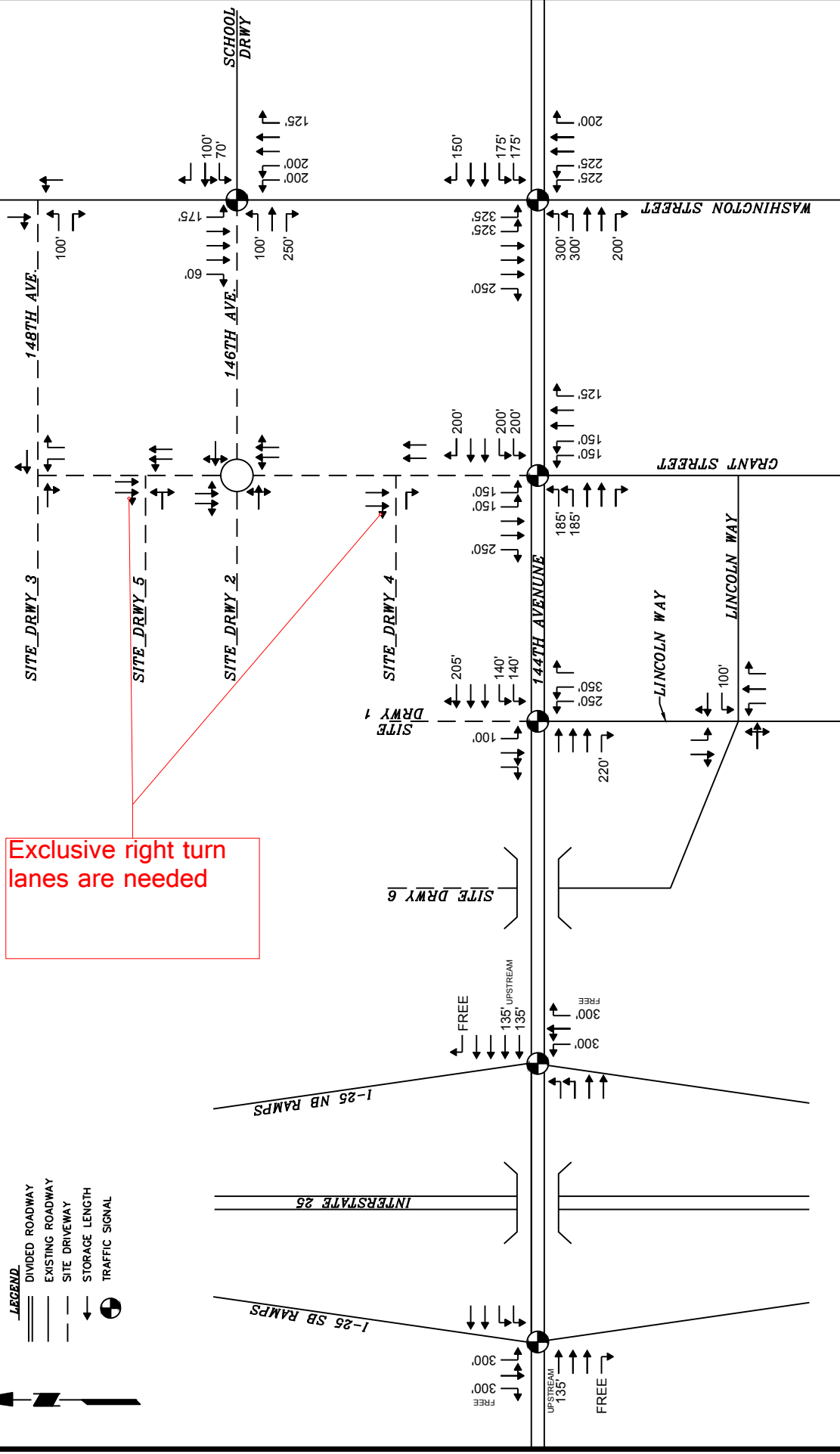
All movements at the roundabout intersection are expected to operate at LOS B or better during both the weekday morning and evening peak hours under the future condition.

2037

All movements at the roundabout intersection are expected to operate at LOS B or better during both the weekday morning and evening peak hours under the future condition.



Exclusive right turn lanes are needed



<p>LANGAN</p> <p>300 Kimball Drive Parsippany, NJ 07054 T: 973-560-4900 F: 973-560-4901 www.langan.com Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C., S.A. Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C. Langan Engineering and Environmental Services, Inc. Langan CT, Inc. Langan International LLC Collectively known as Langan</p>	<p>Project</p> <p>PROJECT RIO</p> <p>CITY OF THORNTON</p> <p>ADAMS COUNTY</p> <p>COLORADO</p>	<p>Drawing Title</p> <p>2018 AND 2037 FUTURE LANE GEOMETRY</p>	<p>Drawing No.</p> <p>FIGURE 13</p>
	<p>Project No.</p> <p>100612301</p>	<p>Date</p> <p>02/09/2017</p>	<p>Scale</p> <p>N.T.S.</p>	Drawn By EJV
<p>Submission Date</p> <p>FEBRUARY 2017</p>		<p>Sheet 13 of 13</p>	

INTERSECTION QUEUING ANALYSIS

We reviewed the 95th percentile queue lengths from the Synchro analyses at the study intersections for the critical turning movements. The table below summarizes the existing turn lane queue lengths, if present, compared to the 95th percentile queue. At the applicable intersections and movements we have also provided a recommended turn lane length as a result of the development project. The queuing analysis results are summarized in Table 8 below for the AM and PM peak hours.

Storage needs to exceed 95th percentile queue (typical).

Existing turn lane length is not this long.

Table 8 – Queuing Analysis Results (2018)

Location	Movement		AM Peak Hour			PM Peak Hour		
			Existing Turn Lane Length (feet)	2018 Queue Length (feet)	Recommended Turn Lane Length (feet)	Existing Turn Lane Length (feet)	2018 Queue Length (feet)	Recommended Turn Lane Length (feet)
144 TH Ave and I-25 SB Ramps	WB	L	685'	199'	-	685'	391'	-
	SB	L	300'	155'	-	300'	234'	-
144 th Ave and I-25 NB Ramps	EB	L	685'	80'	-	685'	106'	-
	NB	L	300'	157'	-	300'	195'	-
144 th Ave and Lincoln St	WB	L	140'	52'	-	140'	55'	-
		L	350'	103'	-	350'	241'	-
	NB	T,R	-	40'	-	-	67'	-
		L	-	6'	100'	-	6'	100'
SB	T,R	-	0'	-	-	17'	-	
	L	-	213'	185'	-	109'	185'	
144 TH Ave and Grant St	EB	L	-	0'	-	600'	26'	-
		R	600'	0'	-	600'	68'	-
	WB	L	200'	51'	-	200'	15'	200'
		R	-	49'	200'	-	188'	-
	NB	L	150'	29'	-	150'	65'	-
		R	125'	3'	150'	-	64'	150'
SB	L	-	0'	250'	-	175'	250'	
	R	-	116'	300'	200'	246'	300'	
144 TH Ave and Washington St	EB	L	200'	0'	-	200'	283'	-
		R	200'	67'	-	175'	52'	-
	WB	L	175'	0'	-	150'	16'	-
		R	150'	104'	-	225'	173'	-
	NB	L	225'	0'	-	200'	9'	-
		R	200'	10'	-	325'	76'	-
SB	L	325'	109'	-	250'	109'	-	
	R	250'	6'	100'	-	41'	100'	
146 th Ave / School Drwy and Washington St	EB	L	-	0'	250'	-	197'	250'
		R	-	4'	-	70'	49'	-
	WB	L	70'	187'	-	200'	196'	-
	NB	L	200'	9'	-	175'	25'	-
SB	L	175'	-	-	-	-	-	

As shown in the table, it is anticipated that the queues will remain within the storage lengths with the exception of the eastbound left and right turn movements at 144th Avenue and Washington Street during the weekday evening peak hour. It is recommended to extend the eastbound double left turn movements to provide a storage length of 300', which would contain the anticipated queue length.

Through movements should also be considered. If through lanes queue pass left turn lanes, extra storage may be required

Why is 148th Ave & Washington St not included in queue analysis?

City of Westminster, CO

509 - 144TH @ I25 SB - Econolite Type - ASC3

Configuration Phase Sequence

Controller Sequence (MM)1-1-1

Hardware Alternate Sequence Enable: Yes

Do not include database printouts for controllers in this report. The preference would be to not have this information in a report.

Phase Ring Sequence.....(Note: Sequences identical to the prior one are not printed)

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
	B	B		B		B		B								
Sequence 1																
Ring 1	| 1	2	| 3	4	| 9	10	| 13	14	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 7	8	| 11	12	| 15	16	| .	.	.	.	.	.	.	.
Sequence 2																
Ring 1	| 2	1	| 3	4	| 10	9	| 13	14	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 7	8	| 11	12	| 15	16	| .	.	.	.	.	.	.	.
Sequence 3																
Ring 1	| 1	2	| 4	3	| 9	10	| 14	13	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 7	8	| 11	12	| 15	16	| .	.	.	.	.	.	.	.
Sequence 4																
Ring 1	| 2	1	| 4	3	| 10	9	| 14	13	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 7	8	| 11	12	| 15	16	| .	.	.	.	.	.	.	.
Sequence 5																
Ring 1	| 1	2	| 3	4	| 9	10	| 13	14	| .	.	.	.	.	.	.	.
Ring 2	| 6	5	| 7	8	| 12	11	| 15	16	| .	.	.	.	.	.	.	.
Sequence 6																
Ring 1	| 2	1	| 3	4	| 10	9	| 13	14	| .	.	.	.	.	.	.	.
Ring 2	| 6	5	| 7	8	| 12	11	| 15	16	| .	.	.	.	.	.	.	.
Sequence 7																
Ring 1	| 1	2	| 4	3	| 9	10	| 14	13	| .	.	.	.	.	.	.	.
Ring 2	| 6	5	| 7	8	| 12	11	| 15	16	| .	.	.	.	.	.	.	.
Sequence 8																
Ring 1	| 2	1	| 4	3	| 10	9	| 14	13	| .	.	.	.	.	.	.	.
Ring 2	| 6	5	| 7	8	| 12	11	| 15	16	| .	.	.	.	.	.	.	.
Sequence 9																
Ring 1	| 1	2	| 3	4	| 9	10	| 13	14	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 8	7	| 11	12	| 16	15	| .	.	.	.	.	.	.	.
Sequence 10																
Ring 1	| 2	1	| 3	4	| 10	9	| 13	14	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 8	7	| 11	12	| 16	15	| .	.	.	.	.	.	.	.
Sequence 11																
Ring 1	| 1	2	| 4	3	| 9	10	| 14	13	| .	.	.	.	.	.	.	.
Ring 2	| 5	6	| 8	7	| 11	12	| 16	15	| .	.	.	.	.	.	.	.

Lanes, Volumes, Timings
12: I-25 NB Ramps & 144th Ave

Existing outside lane
is a shared
through/left.

g Traffic Volumes
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	183	242	0	0	739	183	328	0	138	0	0	0
Future Volume (vph)	183	242	0	0	739	183	328	0	138	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	150		0	0		0	0		0
Storage Lanes	2		0	2		1	2		1	0		0
Taper Length (ft)	25			125			25			25		
Lane Util. Factor	0.97	0.95	1.00	1.00	*0.89	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	3467	3610	0	0	6764	1599	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	3467	3610	0	0	6764	1599	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						208			175			
Link Speed (mph)		45			45			40			40	
Link Distance (ft)		620			720			465			385	
Travel Time (s)		9.4			10.9			7.9			6.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	1%	0%	0%	0%	0%	1%	1%	0%	1%	0%	0%	0%
Adj. Flow (vph)	208	275	0	0	840	208	373	0	157	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	275	0	0	840	208	373	0	157	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	L NA	Left	Right	Left	Left	Right	L NA	L NA	Right	Left	Left	Right
Median Width(ft)		31			30			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2			2	1	1		1			
Detector Template	Left	Thru			Thru	Right	Left		Right			
Leading Detector (ft)	20	100			100	20	20		20			
Trailing Detector (ft)	0	0			0	0	0		0			
Detector 1 Position(ft)	0	0			0	0	0		0			
Detector 1 Size(ft)	20	6			6	20	20		20			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)		94			94							
Detector 2 Size(ft)		6			6							
Detector 2 Type		Cl+Ex			Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Turn Type	Prot	NA			NA	Free	Prot		Free			
Protected Phases	1	6			2		4					

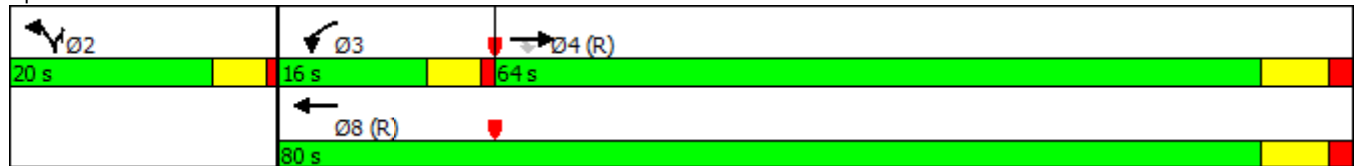
Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 97 (97%), Referenced to phase 4:EBT and 8:WBT, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.36
 Intersection Signal Delay: 8.5
 Intersection Capacity Utilization 33.4%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service A

All of Thornton's controllers are programmed to reference beginning of main street yellow. This may impact some of the existing condition model results.

Splits and Phases: 15: Lincoln St & 144th Ave

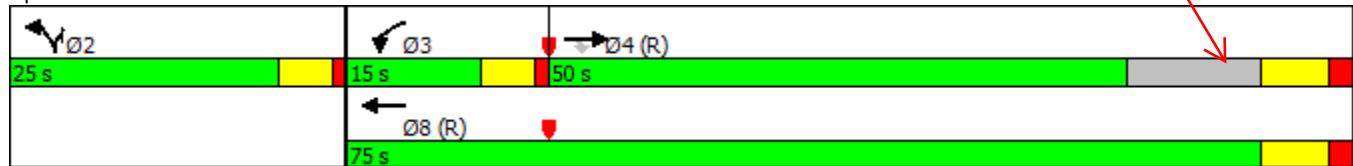


Intersection Summary

Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	100
Offset:	98 (98%), Referenced to phase 4:EBT and 8:WBT, Start of Green
Natural Cycle:	50
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.61
Intersection Signal Delay:	12.0
Intersection Capacity Utilization	48.0%
Analysis Period (min)	15
	Intersection LOS: B
	ICU Level of Service A

Why is full split not coded?

Splits and Phases: 15: Lincoln St & 144th Ave



Lanes, Volumes, Timings
3: Washington St & 144th Ave

2017

mes
Hour

EB through tapers
down to one lane
east of intersection.
This needs to be
reflected in the
model.

Southbound
through tapers
down to two lanes
south of the
intersection. This
needs to be
reflected in the
model.

Lane Group	EBL	EBT	EBR	NBL	NBT	SBR
Lane Configurations	↖↗	↖↗	↖	↖↗	↖↗	↖
Traffic Volume (vph)	95	167	93	87	648	39
Future Volume (vph)	95	167	93	87	648	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	175	150	225
Storage Lanes	2		1	2	1	2
Taper Length (ft)	150			125		100
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850
Flt Protected	0.950			0.950		0.950
Satd. Flow (prot)	3502	3610	1615	3502	3610	1615
Flt Permitted	0.950			0.950		0.950
Satd. Flow (perm)	3502	3610	1615	3502	3610	1615
Right Turn on Red			Yes			Yes
Satd. Flow (RTOR)			153			207
Link Speed (mph)		45			45	
Link Distance (ft)		1010			525	
Travel Time (s)		15.3			8.0	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	107	188	104	98	728	44
Shared Lane Traffic (%)						
Lane Group Flow (vph)	107	188	104	98	728	44
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	L NA	Left	R NA	L NA	Left	R NA
Median Width(ft)		31			24	
Link Offset(ft)		0			0	
Crosswalk Width(ft)		50			40	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9
Number of Detectors	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100	20	20	100	20
Trailing Detector (ft)	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94	
Detector 2 Size(ft)		6			6	
Detector 2 Type		Cl+Ex			Cl+Ex	
Detector 2 Channel						
Detector 2 Extend (s)		0.0			0.0	
Turn Type	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8	

Lanes, Volumes,
12: I-25 NB Ramp

2018 Background Traffic Volumes
PM Peak Hour

To assist with addressing the weave issue for northbound right at 144th & I-25 NB to eastbound left at 144th & Grant, the outside lane will need to be converted to a shared left/through/right lane. The island and traffic signal pole on this corner will need to be modified to accommodate the new lane configuration.



Lane Group	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR			
Lane Configurations		↑↑↑↑	↑	↑↑		↑						
Traffic Volume (vph)	0	987	329	458	0	460	0	0	0			
Future Volume (vph)	0	987	329	458	0	460	0	0	0			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900			
Storage Length (ft)	150		0	0		0	0		0			
Storage Lanes	2		1	2		1	0		0			
Taper Length (ft)	125			25			25					
Lane Util. Factor	1.00	*0.73	1.00	0.97	1.00	1.00	1.00	1.00	1.00			
Frt			0.850			0.850						
Flt Protected				0.950								
Satd. Flow (prot)	3502	3610	0	0	5548	1615	3502	0	1615	0	0	0
Flt Permitted	0.950			0.950								
Satd. Flow (perm)	3502	3610	0	0	5548	1615	3502	0	1615	0	0	0
Right Turn on Red			Yes			Yes		Yes				Yes
Satd. Flow (RTOR)						350		489				
Link Speed (mph)		45			45		40			40		
Link Distance (ft)		620			720		465			385		
Travel Time (s)		9.4			10.9		7.9			6.6		
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	314	1371	0	0	1050	350	487	0	489	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	314	1371	0	0	1050	350	487	0	489	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	L NA	Left	Right	Left	Left	Right	L NA	L NA	Right	Left	Left	Right
Median Width(ft)		31			30		24			24		
Link Offset(ft)		0			0		0			0		
Crosswalk Width(ft)		16			16		16			16		
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2			2	1	1		1			
Detector Template	Left	Thru			Thru	Right	Left		Right			
Leading Detector (ft)	20	100			100	20	20		20			
Trailing Detector (ft)	0	0			0	0	0		0			
Detector 1 Position(ft)	0	0			0	0	0		0			
Detector 1 Size(ft)	20	6			6	20	20		20			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)		94			94							
Detector 2 Size(ft)		6			6							
Detector 2 Type		Cl+Ex			Cl+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Turn Type	Prot	NA			NA	Free	Prot		Free			
Protected Phases	1	6			2		4					
Permitted Phases						Free			Free			

NBLT lane will be required.

SBRT lane will be required.

Intersection							
Int Delay, s/veh	1						
Movement	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	↖	↗		↕	↖		
Traffic Vol, veh/h	34	12	13	398	475	34	
Future Vol, veh/h	34	12	13	398	475	34	
Conflicting Peds, #/hr	0	0	0	0	0	0	
Sign Control	Stop	Stop	Free	Free	Free	Free	
RT Channelized	-	None	-	None	-	None	
Storage Length	100	0	-	-	-	-	
Veh in Median Storage, #	0	-	-	0	0	-	
Grade, %	0	-	-	0	0	-	
Peak Hour Factor	92	92	92	92	92	92	
Heavy Vehicles, %	3	50	50	0	0	6	
Mvmt Flow	37	13	14	433	516	37	

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	996	535	553	0	-	0
Stage 1	535	-	-	-	-	-
Stage 2	461	-	-	-	-	-
Critical Hdwy	6.43	6.7	4.6	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.75	2.65	-	-	-
Pot Cap-1 Maneuver	270	463	816	-	-	-
Stage 1	585	-	-	-	-	-
Stage 2	633	-	-	-	-	-
Platoon blocked, %						
Mov Cap-1 Maneuver	264	463	816	-	-	-
Mov Cap-2 Maneuver	264	-	-	-	-	-
Stage 1	585	-	-	-	-	-
Stage 2	618	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	18.8	0.3	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	816	-	264	463	-	-
HCM Lane V/C Ratio	0.017	-	0.14	0.028	-	-
HCM Control Delay (s)	9.5	0	20.8	13	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.5	0.1	-	-

148th Ave east of
 Grant will be a 3 lane
 road.

Intersection

Int Delay, s/veh 3.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	↻
Traffic Vol, veh/h	14	0	30	18	1	1
Future Vol, veh/h	14	0	30	18	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	15	0	33	20	1	1

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	15	100
Stage 1	-	-	15
Stage 2	-	-	85
Critical Hdwy	-	4.1	6.4
Critical Hdwy Stg 1	-	-	5.4
Critical Hdwy Stg 2	-	-	5.4
Follow-up Hdwy	-	2.2	3.5
Pot Cap-1 Maneuver	-	1616	904
Stage 1	-	-	1013
Stage 2	-	-	943
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	1616	885
Mov Cap-2 Maneuver	-	-	885
Stage 1	-	-	1013
Stage 2	-	-	923

Approach	EB	WB	NB
HCM Control Delay, s	0	4.5	8.8
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	885	1070	-	-	1616	-
HCM Lane V/C Ratio	0.001	0.001	-	-	0.02	-
HCM Control Delay (s)	9.1	8.4	-	-	7.3	0
HCM Lane LOS	A	A	-	-	A	A
HCM 95th %tile Q(veh)	0	0	-	-	0.1	-

Intersection						
Int Delay, s/veh	0					
Movement	EBL	EBR	NE	NT	SBT	SBR
Lane Configurations		↑		↑↑	↑↑	
Traffic Vol, veh/h	0	1	0	365	3	0
Future Vol, veh/h	0	1	0	365	3	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	0	1	0	397	3	0

Is driveway 4 restricted to right out only?

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	-	2	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	6.9	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	3.3	-
Pot Cap-1 Maneuver	0	1088	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	1088	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.3	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 1088	-	-
HCM Lane V/C Ratio	- 0.001	-	-
HCM Control Delay (s)	- 8.3	-	-
HCM Lane LOS	- A	-	-
HCM 95th %tile Q(veh)	- 0	-	-

Intersection							
Int Delay, s/veh	0.3						
Movement	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	W			W	W	W	
Traffic Vol, veh/h	1	0	0	0	0	30	
Future Vol, veh/h	1	0	0	0	0	30	
Conflicting Peds, #/hr	0	0	0	0	0	0	
Sign Control	Stop	Stop	Free	Free	Free	Free	
RT Channelized	-	None	-	None	-	None	
Storage Length	0	-	-	-	-	-	
Veh in Median Storage, #	0	-	-	0	0	-	
Grade, %	0	-	-	0	0	-	
Peak Hour Factor	92	92	92	92	92	92	
Heavy Vehicles, %	0	0	0	0	0	0	
Mvmt Flow	1	0	0	0	0	33	

NBLT lane will be required.

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	16	16	33	0	-	0
Stage 1	16	-	-	-	-	-
Stage 2	0	-	-	-	-	-
Critical Hdwy	6.8	6.9	4.1	-	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	1006	1066	1592	-	-	-
Stage 1	1010	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	1006	1066	1592	-	-	-
Mov Cap-2 Maneuver	1006	-	-	-	-	-
Stage 1	1010	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.6	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1592	-	1006	-	-
HCM Lane V/C Ratio	-	-	0.001	-	-
HCM Control Delay (s)	0	-	8.6	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Lanes, Volumes, Timings
9: I-25 SB Ramps & 144th Ave

2037 Total Future Traffic Volumes
AM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	Free											
Detector Phase	2		1		6				4			
Switch Phase												
Minimum Initial (s)	15.0		6.0		15.0				5.0			
Minimum Split (s)	22.0		11.0		22.0				12.0			
Total Split (s)	41.0		23.0		64.0				36.0			
Total Split (%)	41.0%		23.0%		64.0%				36.0%			
Maximum Green (s)	34.0		18.0		57.0				29.0			
Yellow Time (s)	5.0		3.0		5.0				4.0			
All-Red Time (s)	2.0		2.0		2.0				3.0			
Lost Time Adjust (s)	0.0		0.0		0.0				0.0			
Total Lost Time (s)	7.0		5.0		7.0				7.0			
Lead/Lag	Lead		Lag									
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0		5.0		3.0				1.5			
Recall Mode	C-Max		None		C-Max				None			
Act Effct Green (s)	47.1	100.0	18.0	70.1	15.9	100.0						
Actuated g/C Ratio	0.47	1.00	0.18	0.70	0.16	1.00						
v/c Ratio	0.38	0.34	1.05	0.57	0.75	0.21						
Control Delay	18.2	0.6	79.1	8.3	48.7	0.3						
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0						
Total Delay	18.2	0.6	79.1	8.3	48.7	0.3						
LOS	B		A		E				D		A	
Approach Delay	10.9				30.1						26.8	
Approach LOS	B				C						C	
90th %ile Green (s)	42.6		18.0		65.6				20.4			
90th %ile Term Code	Coord		Max		Coord				Gap			
70th %ile Green (s)	45.3		18.0		68.3				17.7			
70th %ile Term Code	Coord		Max		Coord				Gap			
50th %ile Green (s)	47.1		18.0		70.1				15.9			
50th %ile Term Code	Coord		Max		Coord				Gap			
30th %ile Green (s)	49.0		18.0		72.0				14.0			
30th %ile Term Code	Coord		Max		Coord				Gap			
10th %ile Green (s)	51.7		18.0		74.7				11.3			
10th %ile Term Code	Coord		Max		Coord				Gap			
Stops (vph)	451		0		549		583		357		0	
Fuel Used(gal)	14		4		19		15		11		3	
CO Emissions (g/hr)	984		292		1331		1050		796		236	
NOx Emissions (g/hr)	192		57		259		204		155		46	
VOC Emissions (g/hr)	228		68		308		243		185		55	
Dilemma Vehicles (#)	36		0		0		5		0		0	
Queue Length 50th (ft)	134		0		~240		154		130		0	
Queue Length 95th (ft)	188		0		#355		195		172		0	
Internal Link Dist (ft)	1142				540				294		448	
Turn Bay Length (ft)												
Base Capacity (vph)	2042		1599		617		2532		1005		1615	
Starvation Cap Reductn	0		0		0		0		0		0	
Spillback Cap Reductn	0		0		0		0		0		0	
Storage Cap Reductn	0		0		0		0		0		0	

If LOS E can be improved in model, please do so.

Lanes, Volumes, Timings
9: I-25 SB Ramps & 144th Ave

2037 Total Future Traffic Volumes
PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	Free											Free
Detector Phase	2		1		6				4			
Switch Phase												
Minimum Initial (s)	15.0		6.0		15.0				5.0			
Minimum Split (s)	22.0		11.0		22.0				12.0			
Total Split (s)	50.0		34.0		84.0				36.0			
Total Split (%)	41.7%		28.3%		70.0%				30.0%			
Maximum Green (s)	43.0		29.0		77.0				29.0			
Yellow Time (s)	5.0		3.0		5.0				4.0			
All-Red Time (s)	2.0		2.0		2.0				3.0			
Lost Time Adjust (s)	0.0		0.0		0.0				0.0			
Total Lost Time (s)	7.0		5.0		7.0				7.0			
Lead/Lag	Lead		Lag									
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0		5.0		3.0				1.5			
Recall Mode	C-Max		None		C-Max				None			
Act Effct Green (s)	43.8	120.0	29.0	77.8					28.2	120.0		
Actuated g/C Ratio	0.36	1.00	0.24	0.65					0.24	1.00		
v/c Ratio	1.20	0.55	1.11	0.88					0.94	0.43		
Control Delay	131.3	1.4	96.5	17.7					64.9	0.8		
Queue Delay	0.4	0.0	0.0	1.0					0.0	0.0		
Total Delay	131.7	1.4	96.5	18.6					64.9	0.8		
LOS	F		A		E				E		A	
Approach Delay	94.2				43.1						34.3	
Approach LOS	F				D						C	
90th %ile Green (s)	43.0		29.0		77.0				29.0			
90th %ile Term Code	Coord		Max		Coord				Max			
70th %ile Green (s)	43.0		29.0		77.0				29.0			
70th %ile Term Code	Coord		Max		Coord				Max			
50th %ile Green (s)	43.0		29.0		77.0				29.0			
50th %ile Term Code	Coord		Max		Coord				Max			
30th %ile Green (s)	43.2		29.0		77.2				28.8			
30th %ile Term Code	Coord		Max		Coord				Gap			
10th %ile Green (s)	47.0		29.0		81.0				25.0			
10th %ile Term Code	Coord		Max		Coord				Gap			
Stops (vph)	1672		0		775		947		647		0	
Fuel Used(gal)	91		7		30		26		23		7	
CO Emissions (g/hr)	6366		469		2105		1830		1608		478	
NOx Emissions (g/hr)	1239		91		410		356		313		93	
VOC Emissions (g/hr)	1475		109		488		424		373		111	
Dilemma Vehicles (#)	70		0		0		1		0		0	
Queue Length 50th (ft)	~796		0		~444		254		297		0	
Queue Length 95th (ft)	#893		0		#576		315		#408		0	
Internal Link Dist (ft)	1142				540				294		448	
Turn Bay Length (ft)												
Base Capacity (vph)	1832		1615		846		2341		837		1615	
Starvation Cap Reductn	0		0		0		107		0		0	
Spillback Cap Reductn	212		0		0		0		0		0	
Storage Cap Reductn	0		0		0		0		0		0	

Will six lanes improve the LOS F?

Lanes, Volumes, Timings
12: I-25 NB Ramps & 144th Ave

2037 Total Future Traffic Volumes
PM Peak Hour

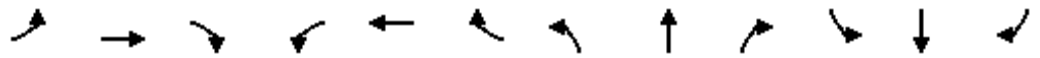


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	Free						Free					
Detector Phase	1	6			2		4					
Switch Phase												
Minimum Initial (s)	5.0	15.0			15.0		5.0					
Minimum Split (s)	10.0	22.0			22.0		12.0					
Total Split (s)	22.0	75.0			53.0		45.0					
Total Split (%)	18.3%	62.5%			44.2%		37.5%					
Maximum Green (s)	17.0	68.0			46.0		38.0					
Yellow Time (s)	3.0	5.0			5.0		4.0					
All-Red Time (s)	2.0	2.0			2.0		3.0					
Lost Time Adjust (s)	0.0	0.0			0.0		0.0					
Total Lost Time (s)	5.0	7.0			7.0		7.0					
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	8.0	3.0			3.0		2.0					
Recall Mode	None	C-Max			C-Max		None					
Act Effct Green (s)	22.5	73.5			46.0	120.0	32.5		120.0			
Actuated g/C Ratio	0.19	0.61			0.38	1.00	0.27		1.00			
v/c Ratio	0.81	1.06			0.84	0.40	0.87		0.75			
Control Delay	62.1	40.4			36.6	0.6	52.2		3.2			
Queue Delay	0.0	17.2			0.0	0.0	0.0		0.6			
Total Delay	62.1	57.6			36.6	0.6	52.2		3.9			
LOS	E	E							A			
Approach Delay		58.4							3.6			
Approach LOS		E							C			
90th %ile Green (s)	17.0	68.0										
90th %ile Term Code	Max	Coord			Coord		Max					
70th %ile Green (s)	19.6	70.6			46.0		35.4					
70th %ile Term Code	Max	Coord			Coord		Gap					
50th %ile Green (s)	22.2	73.2			46.0		32.8					
50th %ile Term Code	Max	Coord			Coord		Gap					
30th %ile Green (s)	24.9	75.9			46.0		30.1					
30th %ile Term Code	Max	Coord			Coord		Gap					
10th %ile Green (s)	29.0	80.0			46.0		26.0					
10th %ile Term Code	Max	Coord			Coord		Gap					
Stops (vph)	432	1509			1706	0	718		1			
Fuel Used(gal)	14	46			45	3	25		15			
CO Emissions (g/hr)	957	3199			3172	202	1763		1057			
NOx Emissions (g/hr)	186	622			617	39	343		206			
VOC Emissions (g/hr)	222	741			735	47	409		245			
Dilemma Vehicles (#)	0	0			22	0	0		0			
Queue Length 50th (ft)	213	~1092			406	0	313		0			
Queue Length 95th (ft)	m192	m#940			442	m0	367		0			
Internal Link Dist (ft)		540			640			385			305	
Turn Bay Length (ft)												
Base Capacity (vph)	657	2212			2538	1599	1108		1599			
Starvation Cap Reductn	0	349			0	0	0		0			
Spillback Cap Reductn	0	311			0	0	0		137			
Storage Cap Reductn	0	0			0	0	0		0			

Over capacity. Will six lanes improve this LOS?

Lanes, Volumes, Timings
15: Lincoln St/Driveway 1 & 144th Ave

2037 Total Future Traffic Volumes
PM Peak Hour

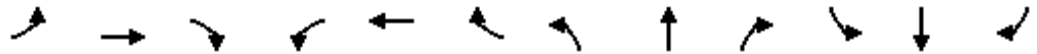


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases			4									6
Detector Phase		4	5	3	8		5	2		1	6	6
Switch Phase												
Minimum Initial (s)		15.0	5.0	5.0	15.0		5.0	5.0		5.0	5.0	5.0
Minimum Split (s)		22.0	10.0	10.0	22.0		10.0	11.0		10.0	11.0	11.0
Total Split (s)		75.0	22.0	10.0	85.0		22.0	25.0		10.0	13.0	13.0
Total Split (%)		62.5%	18.3%	8.3%	70.8%		18.3%	20.8%		8.3%	10.8%	10.8%
Maximum Green (s)		68.0	17.0	5.0	78.0		17.0	19.0		5.0	7.0	7.0
Yellow Time (s)		5.0	4.0	4.0	5.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)		2.0	1.0	1.0	2.0		1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)		7.0	5.0	5.0	7.0		5.0	6.0		5.0	6.0	6.0
Lead/Lag		Lag	Lead	Lead			Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode		C-Max	None	None	C-Max		None	None		None	None	None
Act Effct Green (s)		68.0	92.0	6.1	79.1		17.0	25.9		5.0	5.9	5.9
Actuated g/C Ratio		0.57	0.77	0.05	0.66		0.14	0.22		0.04	0.05	0.05
v/c Ratio		1.09	0.60	0.74	0.55		0.89	0.46		0.01	0.60	0.59
Control Delay		75.2	3.3	68.5	15.5		71.5	19.1		56.0	15.1	14.8
Queue Delay		3.3	0.2	0.0	0.0		0.0	0.4		0.0	0.0	0.0
Total Delay		78.6	3.5	68.5	15.5		71.5	19.6		56.0	15.1	14.8
LOS		E	A	E	B		E	B		E	B	B
Approach Delay		60.7			19.0			54.6			15.1	
Approach LOS		F			B			D			B	
90th %ile Green (s)		68.0					17.0	19.0		5.0	7.0	7.0
90th %ile Term Code		Coord					Max	Max		Max	Max	Max
70th %ile Green (s)		68.0	17.0	6.2	79.2		17.0	27.8		0.0	5.8	5.8
70th %ile Term Code		Coord	Max	Max	Coord		Max	Hold		Skip	Gap	Gap
50th %ile Green (s)		68.0	17.0	6.5	79.5		17.0	27.5		0.0	5.5	5.5
50th %ile Term Code		Coord	Max	Max	Coord		Max	Hold		Skip	Gap	Gap
30th %ile Green (s)		68.0	17.0	6.5	79.5		17.0	27.5		0.0	5.5	5.5
30th %ile Term Code		Coord	Max	Max	Coord		Max	Hold		Skip	Gap	Gap
10th %ile Green (s)		68.0	17.0	6.5	79.5		17.0	27.5		0.0	5.5	5.5
10th %ile Term Code		Coord	Max	Max	Coord		Max	Hold		Skip	Gap	Gap
Stops (vph)		1875	113	108	893		367	66		3	12	12
Fuel Used(gal)		72	5	4	24		11	2		0	1	1
CO Emissions (g/hr)		5055	383	250	1691		745	172		2	60	59
NOx Emissions (g/hr)		984	75	49	329		145	33		0	12	11
VOC Emissions (g/hr)		1172	89	58	392		173	40		1	14	14
Dilemma Vehicles (#)		136	0	0	124		0	0		0	0	0
Queue Length 50th (ft)		~1009	92	55	281		175	46		1	0	0
Queue Length 95th (ft)		m#971	m111	m#88	404		#264	132		7	43	41
Internal Link Dist (ft)		640			635			301			307	
Turn Bay Length (ft)			220	150			350			100		
Base Capacity (vph)		2462	1387	178	3387		496	457		75	252	252
Starvation Cap Reductn		20	118	0	0		0	0		0	0	0
Spillback Cap Reductn		567	0	0	0		0	53		0	0	0
Storage Cap Reductn		0	0	0	0		0	0		0	0	0

Over capacity. Will six lanes improve?

Lanes, Volumes, Timings
20: Grant St & 144th Ave

2037 Total Future Traffic Volumes
AM Peak Hour



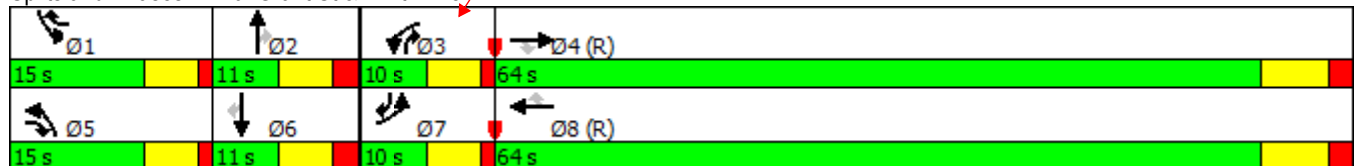
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Reduced v/c Ratio	0.65	0.35	0.17	0.39	0.81	0.10	0.55	0.10	0.41	0.00	0.01	0.01

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 97 (97%), Referenced to phase 4:EBT and 8:WBT, Start of Green
 Natural Cycle: 80
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 25.2
 Intersection Capacity Utilization 73.3%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.

Does 120 need to be assumed for AM?
 EBLT and WBLT split does not look reasonable.

Splits and Phases: 20: Grant St & 144th Ave



Lanes, Volumes, Timings
3: Washington St & 144th Ave

2037 Total Future Traffic Volumes
PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases			4			8			2			6
Detector Phase	7	4	5	3	8	1	5	2	3	1	6	7
Switch Phase												
Minimum Initial (s)	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	17.0	10.0	10.0	12.0	10.0	10.0	12.0	10.0	10.0	12.0	10.0
Total Split (s)	25.0	46.0	23.0	16.0	37.0	23.0	23.0	35.0	16.0	23.0	35.0	25.0
Total Split (%)	20.8%	38.3%	19.2%	13.3%	30.8%	19.2%	19.2%	29.2%	13.3%	19.2%	29.2%	20.8%
Maximum Green (s)	20.0	39.0	18.0	11.0	30.0	18.0	18.0	28.0	11.0	18.0	28.0	20.0
Yellow Time (s)	4.0	5.0	4.0	4.0	5.0	4.0	4.0	5.0	4.0	4.0	5.0	4.0
All-Red Time (s)	1.0	2.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	7.0	5.0	5.0	7.0	5.0	5.0	7.0	5.0	5.0	7.0	5.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag	Lead	Lead	Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	None	None	C-Max	None	None	None	None	None	None	None
Act Effct Green (s)	23.5	44.7	69.7	9.4	30.5	50.4	18.0	29.1	45.5	12.8	23.9	54.5
Actuated g/C Ratio	0.20	0.37	0.58	0.08	0.25	0.42	0.15	0.24	0.38	0.11	0.20	0.45
v/c Ratio	0.86	1.08	0.80	0.46	0.84	0.19	0.93	0.73	0.22	0.59	0.75	0.70
Control Delay	41.2	77.5	34.7	58.1	52.2	5.5	75.2	47.4	6.7	57.3	50.1	27.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.2	77.5	34.7	58.1	52.2	5.5	75.2	47.4	6.7	57.3	50.1	27.7
LOS	D	E	C	E	D	A	E	D	A	E	D	C
Approach Delay		58.2			46.3			53.1			43.4	
Approach LOS		E			D			D			D	
90th %ile Green (s)	20.0	39.0	18.0	11.0	30.0	16.3	18.0	29.7	11.0	16.3	28.0	20.0
90th %ile Term Code	Max	Coord	Max	Max	Coord	Gap	Max	Max	Max	Gap	Max	Max
70th %ile Green (s)	21.4	40.7	18.0	10.7	30.0	14.3	18.0	30.3	10.7	14.3	26.6	21.4
70th %ile Term Code	Max	Coord	Max	Gap	Coord	Gap	Max	Hold	Gap	Gap	Gap	Max
50th %ile Green (s)	24.0	44.3	18.0	9.7	30.0	12.8	18.0	29.2	9.7	12.8	24.0	24.0
50th %ile Term Code	Max	Coord	Max	Gap	Coord	Gap	Max	Hold	Gap	Gap	Gap	Max
30th %ile Green (s)	25.7	47.1	18.0	8.6	30.0	11.4	18.0	28.9	8.6	11.4	22.3	25.7
30th %ile Term Code	Max	Coord	Max	Gap	Coord	Gap	Max	Hold	Gap	Gap	Gap	Max
10th %ile Green (s)	26.5	52.2	18.0	7.0	32.7	9.3	18.0	27.5	7.0	9.3	18.8	26.5
10th %ile Term Code	Gap	Coord	Max	Gap	Coord	Gap	Max	Hold	Gap	Gap	Gap	Gap
Stops (vph)	410	1090	585	101	605	17	383	500	22	179	621	318
Fuel Used(gal)	13	42	16	4	23	2	22	25	3	7	24	12
CO Emissions (g/hr)	875	2911	1150	276	1608	137	1513	1764	217	492	1657	845
NOx Emissions (g/hr)	170	566	224	54	313	27	294	343	42	96	322	164
VOC Emissions (g/hr)	203	675	266	64	373	32	351	409	50	114	384	196
Dilemma Vehicles (#)	0	15	0	0	27	0	0	21	0	0	25	0
Queue Length 50th (ft)	202	~678	587	48	298	9	193	240	12	85	210	273
Queue Length 95th (ft)	m216	m#711	m570	76	358	43	#276	293	50	118	237	384
Internal Link Dist (ft)		930			445			543			1142	
Turn Bay Length (ft)	300		200	175		150	225		200	325		250
Base Capacity (vph)	666	1343	972	321	909	816	525	879	711	525	1210	756
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0

Over capacity. Does six lane improve?