



October 5, 2023

Danny Kelly  
National Acquisition Company, LLC

Re: QTS Aurora Phase 2  
Traffic Compliance and Gated Queue Analysis Letter  
Aurora, Colorado

Dear Mr. Kelly,

This traffic study letter documents a trip generation comparison to identify conformance with the original master traffic impact study for the proposed QTS Aurora Phase 2 to be located to the northeast of the future 10<sup>th</sup> Avenue & Gun Club Road intersection in Aurora, Colorado. This letter also includes a gated entry vehicle queuing analysis, internal circulation plan, and offsite improvement changes. The project is located within the overall Aurora Crossroads development to the southeast of Interstate 70 (I-70) and E-470. Regional access to QTS Aurora Phase 2 will be provided by I-70 and E-470 while primary access will be provided by Gun Club Road. A conceptual site plan for the project is attached.

#### **SITE INFORMATION AND TRIP GENERATION COMPARISON**

The “Aurora Crossroads Master Traffic Impact Study” that included this overall project area was completed in November 2020. Applicable documents from this study are attached. The trip generation of the proposed QTS Aurora Phase 2 site was compared with the trip generation for the data center land use evaluated as part of the original master traffic study within the same development area. The development area of “Aurora Crossroads Master Traffic Impact Study” was originally considered to include a data center as Development Option #2. The current proposal for the QTS Aurora Phase 2 development contains two (2) two-story buildings. Between the eastern building currently under construction—termed “Gun Club Road Data Center” for purposes of this study—and the two buildings currently proposed on the western side of the site.

The current proposal for this area proposes one full movement access along the south side of Gun Club Road at the eastern roundabout (Intersection #11 in the original master study) that is currently under construction, and one emergency-vehicle-only access along the north side of future 10<sup>th</sup> Avenue on the western side of the site. Of note, the original master study proposed three accesses along the south side of Gun Club Road, including what was referred to as “Main Street” (Intersection #13 in the master study), in addition to a right-in/right-out access (Intersection #12 in the master study) in between “Main Street” and the Eastern Roundabout.

Site-generated traffic estimates are determined through a process known as trip generation. Trip generation data for this site from the original traffic study was received from a potential data center user. This portion of the Aurora Crossroads development within the original study was anticipated to generate 350 daily weekday trips with 102 trips occurring during the morning and afternoon peak hours based on the information provided in the original study.

The three total buildings (Phase 1 & Phase 2) data center is anticipated to incorporate two (2) shifts of 12 hours with 45 employees per shift. It is anticipated that employee shifts will occur at 7:00 AM and 7:00 PM with operations occurring 24 hours per day while customers trips will occur from 7:00 AM to 5:00 PM. This equates to 180 employee trips per day (45 employees x 2 shifts x 2 trips per employee). In addition to the 180 employee trips, approximately 300 daily visitor and deliveries trips (150 customers) are expected to occur uniformly from approximately 7:00 AM to 5:00 PM each weekday. It is believed that all employees that the first shift employees will arrive during the morning peak hour and the second shift employees will depart the site during the same morning peak hour. It should be noted 7:00 PM employee trips will occur outside of the peak hour of the adjacent street traffic (4:00 PM to 6:00 PM). Customer trips are expected to occur uniformly over a 10-hour period throughout the day. However, to provide a conservative analysis it was assumed that 18 customers (15 customers would be uniform throughout the 10-hour period) would arrive and depart the Phase 1 and Phase 2 project site (three buildings) during both the morning and afternoon peak hours.

Based on this information, the proposed data center is expected to generate 480 daily trips, with 126 of these trips occurring during the morning peak hour and 36 trips occurring during the afternoon peak hour. The following **Table 1** summarizes the anticipated trip generation for the proposed QTS Aurora Phase 1 & 2 development compared to the expected trip generation from the previously proposed Aurora Crossroads Master Traffic Impact Study data center development. The change in development of the proposed data centers on this parcel is anticipated to account for a increase of 130 daily trips, an increase of 24 trips during the morning peak hour, and a decrease of 66 trips during the afternoon peak hour.

**Table 1 – QTS Aurora Phase 1 & 2 Traffic Generation Comparison**

Land Use and Size	Weekday Vehicles Trips						
	Daily	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Original Study – Aurora Crossroads Master Traffic Impact Study: Development Option #2							
Data Centers (user-specific) – 51 Employees	350	51	51	102	51	51	102
Current Proposal – QTS Aurora Phase 1 & 2 and Gun Club Road Data Center							
Data Centers (user-specific) – 45 Employees (15 per building)	180	45	45	90	0	0	0
Data Centers (user-specific) – 150 Customers (50 per building)	300	18	18	36	18	18	36
Phase 1 & 2 Total Trips	480	63	63	126	18	18	36
Net Difference in Trips	+130	+12	+12	+24	-33	-33	-66

The overall development area considered in the Aurora Crossroad traffic study anticipated a total traffic generation for the area of 17,845 daily weekday trips, with 1,352 of those trips occurring during the morning peak hour and 1,585 trips occurring during the afternoon peak hour. Based on the differences with this current proposal, the overall development area would generate 17,975 weekday daily trips, with 1,375 of those trips occurring during the morning peak hour and 1,519 trips occurring during the afternoon peak hour. As an overall development area, this would result in a 0.7 percent increase in daily weekday trips, a 1.8

percent increase in morning peak hour trips, and a 4.2 percent decrease in afternoon peak hour trips. The typical governing peak hour of traffic during a given weekday is the afternoon peak hour between 4:00 PM to 6:00 PM which is the time period that triggers the need for intersection improvements. Because the current proposal is anticipated to generate 66 fewer afternoon peak hour trips than the original traffic study for this parcel, it is believed the project is in traffic compliance with that study and that the recommendations from the original study will accommodate expected traffic from this development.

### **GATED ENTRY VEHICLE QUEUING ANALYSIS**

This project proposes one gate station for vehicles entering the Phase 2 project site located to the southeast of the eastern roundabout to access the two buildings on the western side of the site. Therefore, a gated entry vehicle queuing analysis was performed to ensure vehicles will not spillback into the public streets. There will be a separate entry lane for employee and visitors at this proposed gate station. The inside lane at the gate station will be designated for visitors while the outside lane will be designated for employees. Visitors will stop at the guard shack and be processed by a security guard. Employees will have a badge scanned at an automated device which will open an arm gate for entrance.

These two western buildings account for approximately 30 entering employee vehicles and 12 visitor vehicles entering the facility during the highest hour of the off-peak hour. Customer trips are expected to occur uniformly over a 10-hour period throughout the day. However, to provide a conservative analysis, it was assumed that 12 customers (uniform would be 10 customers) would arrive and depart the QTS Aurora Phase 2 development during both the morning and afternoon peak hours.

The traffic volumes expected to enter the gate station were used to analyze the queuing storage requirements. Since it is unreasonable to assume that vehicles will arrive at a constant rate throughout the peak hours, a Poisson distribution storage equation was used to account for the variations in arrival rates. Service rates of 45 seconds per employee vehicles and 180 seconds per visitor vehicles were utilized within the queuing analysis as the time identified at the window.

Based on these volumes and service rate, it was calculated that a storage length of up to four (4) vehicles (100 feet) is needed on site prior to the gate station during the morning and afternoon peak hours and the highest hour of visitor traffic, while approximately 250 feet is available before queued vehicles would spill into the roundabout. Therefore, it is anticipated that the vehicle queueing will be sufficiently accommodated onsite. The gated entry vehicle queuing worksheets are attached.

### **SITE PLAN CHANGES AND ROADWAY IMPROVEMENT IMPACTS WITH DATA CENTER USE**

The Aurora Crossroads Master Traffic Study provided a Development Option #2 evaluation with a data center with the same expected trip generation as the current proposal. In this alternative evaluation within the original traffic study, only three accesses were utilized along Gun Club Road (Main Street #13, RIRO Access #12, and East Roundabout #11 as referenced in the original traffic study).

As the proposed site is a lower trip generator with larger building footprints than the possible commercial development that was studied, all the previously assumed access locations for the uses prior to the data center are not necessary. As such, Intersection Accesses #9 (along Colfax Avenue), #10, and #15 were not included for evaluation for the data center option in the original traffic study. In addition, the access at Main Street (Intersection #13) as well as the originally proposed right-in/right-out access (Intersection #12) are no longer proposed in the current development plan; these are the only major access changes with the current proposal compared to Development Option #2 in the original traffic study. Access at the south leg of “Main Street” (Intersection #13) is not anticipated to be needed based on the relatively low traffic generation anticipated at this site with fewer than one entering and one exiting vehicle per minute during the busiest morning and afternoon peak hours of traffic at full buildout of this project. The right-in/right-out access (Intersection #12) previously provided minimal project traffic volumes entering and exiting this access and it is also closely spaced to the eastern roundabout (Intersection #11), giving minimal benefit to the project. Further, it was determined that the right-in/right-out access (Intersection #12) is not necessary as the internal circulation plan was developed.

This proposed data center now proposes only one access along 10<sup>th</sup> Avenue in the southwestern portion of the project site, but this access is anticipated to be limited to emergency vehicle access only, and as such should have little to no notable impact to traffic conditions. The only access now proposed to the project site is at the East Roundabout (Intersection #11). The original master traffic study assessed this roundabout with the significantly more intense land use assumption with commercial development. The analysis conducted at this intersection with the assumed commercial use showed this intersection would operate acceptably with the addition of project traffic and because this use is less intensive, no additional traffic analysis is anticipated to be needed at this intersection.

As requested from the City of Aurora, the recommendation and result changes based on the Aurora Crossroads Master Traffic Impact with Development Option #2 in place of the more traffic-intensive commercial use is contained below since the current proposal contains the same data center development use and intensity (this contains the same intersection labeling from original traffic study and applicable documents from this study are attached for reference):

- Significant reduction in project trips at intersections and along roadways.
- Improved levels of service and reduced queues throughout study area.
- Gun Club Road at 8th Avenue (Intersection #16)
  - Signalization will be dependent on surrounding development as project traffic does not contribute to this intersection. A site-specific traffic study will evaluate this intersection in more detail as development occurs to the south. A traffic signal will not be needed with development of Gun Club Data Center site.
  - The southbound left-turn volume no longer meets warrants for separate auxiliary lane.
- Gun Club Road at Main Street (#13)
  - Signalization will be dependent on the hospital approach on the north leg of this intersection and not the data center approach. It is anticipated that the signal would be warranted in the PM peak hour, but a full signal warrant analysis has not been conducted at this time.

- Remove eastbound right-turn deceleration lane since volume is less than 50 vph.
- Gun Club Road at Access 9, RIRO (#15)
  - Remove access since it is not anticipated to be needed.
- Colfax Avenue at Access 3, RIRO (#9)
  - Remove access since it is not anticipated to be needed.
- 6th Parkway at Harvest Road
  - The dual left-turn lanes on all approaches may not be needed due to reduced volumes.
- Gun Club Road at 6th Parkway
  - The eastbound dual left-turn lanes may not be needed due to reduced volumes.

The following includes additional results and recommendation changes since the completion of the Aurora Crossroads Master Traffic Impact Study (with the current proposal):

- Gun Club Road at Access 6, RIRO (#12)
  - Remove access since it is not anticipated to be needed.
- Gun Club Road at Main Street (#13)
  - Site specific traffic study for the proposed hospital development to the north will conduct traffic signal warrant evaluation; however, it is believed that this intersection is not an optimal candidate for signalization due to spacing constraints with roundabouts proposed to the east and west along Gun Club Road. A south leg access into this data center is no longer proposed at this intersection with access solely gained along Gun Club Road from the East Roundabout (#11).
- One emergency access into the site proposed along north side of 10<sup>th</sup> Avenue.

### **INTERNAL VEHICULAR AND PEDESTRIAN CIRCULATION PLAN**

As requested by the City of Aurora, a site circulation plan and recommended lane configuration and control of the major internal intersections has been provided and is shown in the attached Figure. It should be noted that due to the proposed emergency access along 10<sup>th</sup> Avenue, an additional emergency access gate is proposed at this location.

While no longer part of the study area considered in the two building being considered in this analysis, a mail sorting facility is proposed east of the East Roundabout intersection and west of Building 1—the building currently under construction today. The purpose of this mail sorting facility is to scan and check all mail and packages for safety. Deliveries will then be sent to the data center buildings once they have gained clearance from security for safety. This sorting facility is expected to have minimal traffic throughout the day and is not expected to impact traffic flows internal to the site. The mail sorting facility is expected to be served by up to WB-40 sized trucks while drop-off and circulation flows have been designed to accommodate such vehicles.

With construction of the project, sidewalk connections are planned for circulation among the parking lots and offices located on the side of each building where parking exists. Pedestrian connections will also be provided at the guard shack and to all public right-of-way along the south side of Gun Club Road. Pedestrian crosswalks should also be designated at the internal intersections with preferred crossing locations adjacent to stop-

controlled approaches. It should be noted that pedestrians are not expected to circulate on the east, west, and south side of the buildings.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the traffic analysis presented in this report, Kimley-Horn and Associates, Inc. believes that QTS Aurora Phase 2 will be successfully incorporated into the existing and future roadway network. The following outlines the conclusions and recommendations from our traffic analysis:

- Development of the proposed data center uses in this area as part of QTS Aurora Phase 2 with two additional buildings in addition to the building on the eastern portion of this area that is currently under construction.
- The proposed project is believed to be in traffic compliance with the original Aurora Crossroads Master Traffic Impact Study completed in November 2020.
- It is anticipated that vehicle queueing at the gated entrance to these proposed two data center buildings will be sufficiently accommodated onsite.

If you have any questions or require anything further, please feel free to call me at (720) 943-9962.

Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

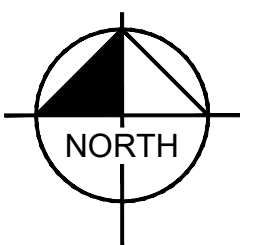
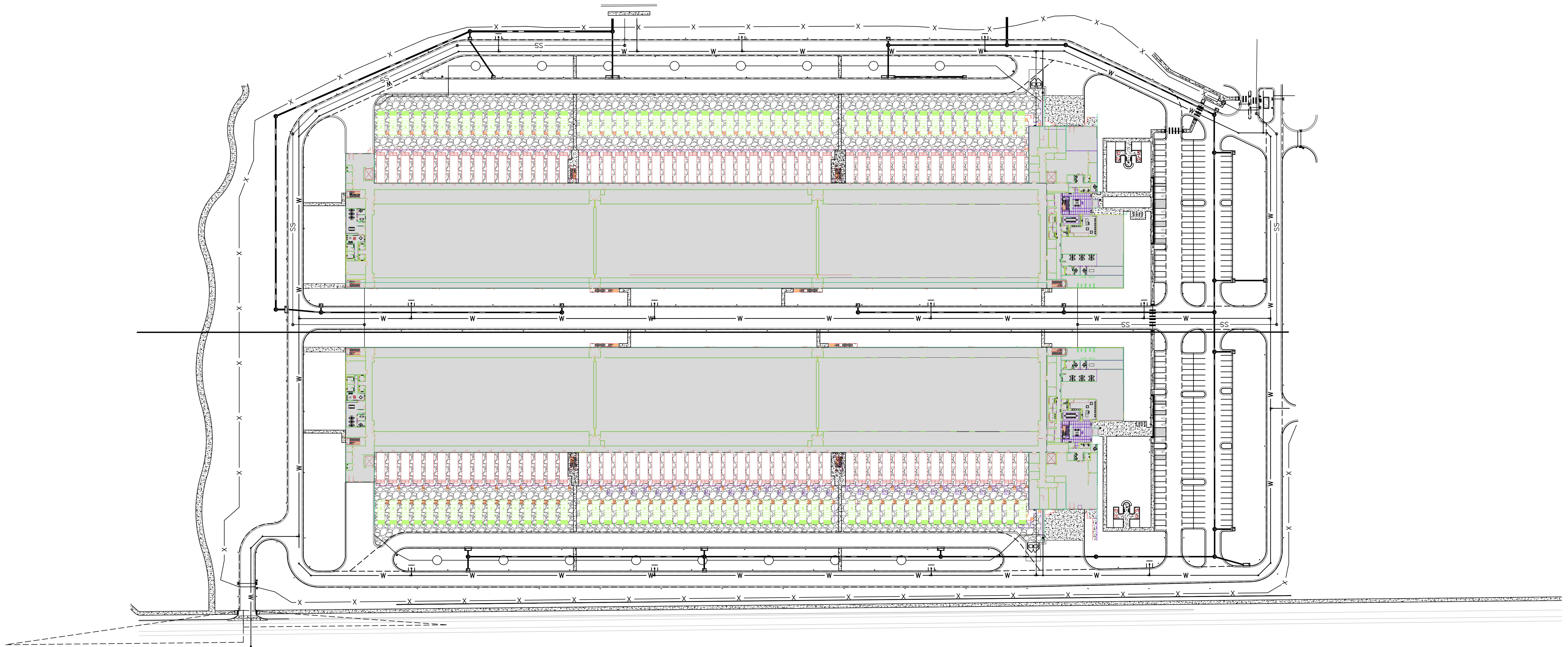


Jeffrey R. Planck, P.E.  
Project Traffic Engineer



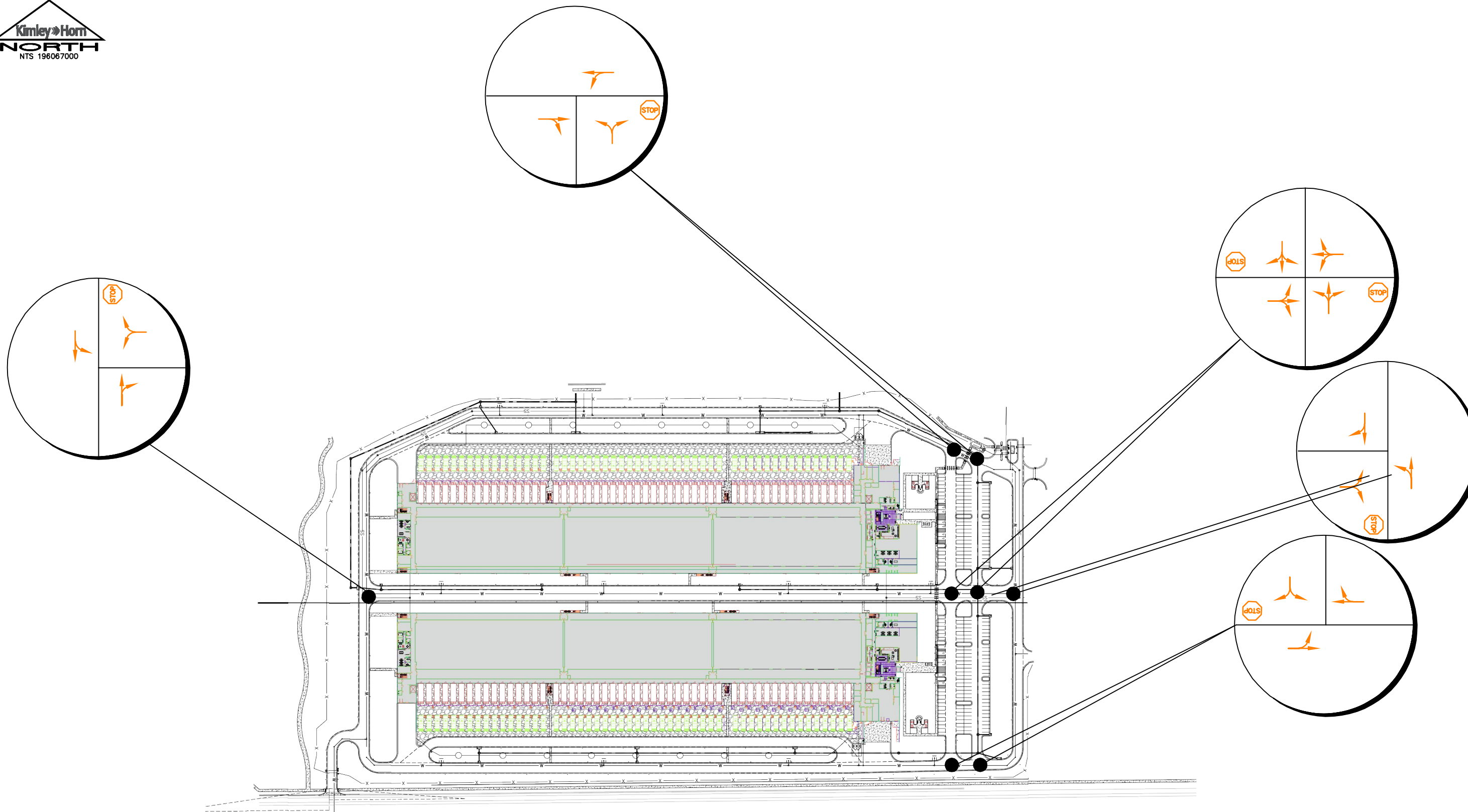
## Internal Intersection Recommendations & Conceptual Site Plan





GRAPHIC SCALE IN FEET  
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GUN CLUB ROAD DATA CENTERS  
AURORA, COLORADO  
INTERNAL INTERSECTION RECOMMENDATIONS

## Original Traffic Study Documents

# Aurora Crossroads Traffic Impact Study



**1<sup>st</sup> Submittal Date:** April 13, 2020

**2<sup>nd</sup> Submittal Date:** July 17, 2020

**3<sup>rd</sup> Submittal Date:** September 29, 2020

**Updated Date:** November 25, 2020

**Submitted To:**

Westside Investment Partners, Inc.  
4100 East Mississippi Avenue, Suite 500  
Denver, CO 80246

**Submitted By:**

Fox Tuttle Transportation Group, LLC  
1624 Market Street, Suite 202  
Denver, CO 80202

### 6.3 Proposed Roadway Network and Access

Access to the Aurora Crossroads site is planned via multiple driveways on Colfax Avenue (future extension) and Gun Club Road (future realignment). The *Manual on Uniform Traffic Control Devices*<sup>6</sup> (MUTCD) signal warrants for the peak hour were utilized, for planning purposes, to determine if a signal should be considered as the traffic control at the proposed intersections.

The following proposed access intersections are recommended to accommodate the proposed trip volume and illustrated on the graphic below:

- **Access #1** – This is the main entrance to the hospital site on Colfax Avenue that is recommended to be signalized and full movement. The following lanes are recommended: one eastbound right-turn lane, one westbound left-turn lane, and two outbound lanes (one right-turn and one left-turn).
- **Access #2** – This access on Colfax Avenue will be restricted to right-in, right-out with side-street stop-control. The access approaches should provide one inbound and one outbound lane.
- **Colfax Avenue at Gun Club Road** (new intersection) – With Aurora Crossroads, this intersection will become four-legged and will need to be signalized. The following lanes are recommended: one left-turn lane and one right-turn lane on all four approaches. The northbound approach will need dual left-turn lanes. The through movement on Gun Club Road (north-south) is recommended to be one lane per direction.
- **Access #3** – This access on Colfax Avenue will be restricted to  $\frac{3}{4}$  movement with side-street stop-control. The following lanes are recommended: one eastbound left-turn lane, one westbound right-turn lane, and one outbound on the access approaches. Note that the eastbound left-turn



<sup>6</sup> Manual on Uniform Traffic Control Devices. Federal Highway Administration. Washington, D.C. 2009.



## 9.0 Development Option #2

There are currently two development options for Planning Area 5 (south of Gun Club Road) in Aurora Crossroads. This traffic study focused on the most conservative land use plan that included commercial uses at an assumed density of 0.18 FAR. The second development option replaces the commercial land uses in Planning Area 5 with a data center up to 1,160,00 square feet at full buildout. Data was received from a potential data center user, who indicated that there is staff 24-hours per day with three (3) shifts of eight (8) hours. Therefore, the peak periods for traffic related to the data center would be at shift changes. Deliveries and visitors are typically within the off-peak hours. Based on similar sites, it is anticipated that this potential data center will have up to 51 employees per shift.

Based on the provided data, it was estimated that there will be up to 350 daily trips, with 102 trips occurring in the AM and PM peak hours. Preliminarily, it is assumed that the data center would utilize three accesses on Gun Club Road (Main Street #13, RIRO Access #12, and East Roundabout #11). There may still be the need for the right-in, right-out access just south of Colfax Avenue, but this analysis did not assume that would be utilized for conservative purposes. Since Main Street and the East Roundabout intersections will be full movement, it was assumed that 45% of the trips would utilize each of these accesses and the remaining 10% would utilize the restricted access.

**This is 2% of the trips generated by the first development option for Planning Area 5 (commercial land uses) for Aurora Crossroads.** The traffic from this option can be accommodated by the proposed roadway network and access intersections. It is anticipated that the reduction in trips will have the following impacts to the recommendations as presented for the higher density option:

- Significant reduction in project trips at intersections and along roadways.
- Improved levels of service and reduced queues throughout study area.
- Gun Club Road at 8<sup>th</sup> Avenue (#16)
  - Reduction in traffic on 8<sup>th</sup> Avenue; however, signal warrants are anticipated to still be warranted with background volumes.
  - The southbound left-turn volume no longer meets warrants for separate auxiliary lane.
- Gun Club Road at Access 6, RIRO (#12)
  - Remove eastbound right-turn deceleration lane since volume is less than 50 vph.
- Gun Club Road at Main Street (#13)
  - Signalization will be dependent on the hospital approach and not the data center approach. It is anticipated that the signal would be warranted in the PM peak hour, but a full signal warrant analysis has not been conducted at this time.



- Remove eastbound right-turn deceleration lane since volume is less than 50 vph.
- Gun Club Road at Access 9, RIRO (#15)
  - Remove access since it is not anticipated to be needed.
- 6<sup>th</sup> Parkway at Harvest Road
  - The dual left-turn lanes on all approaches may not be needed due to reduced volumes.
- Gun Club Road at 6<sup>th</sup> Parkway
  - The eastbound dual left-turn lanes may not be needed due to reduced volumes.

Refer to the **Appendix** for details on the trip generation, trip assignment, and future volumes associated with the Data Center scenario.

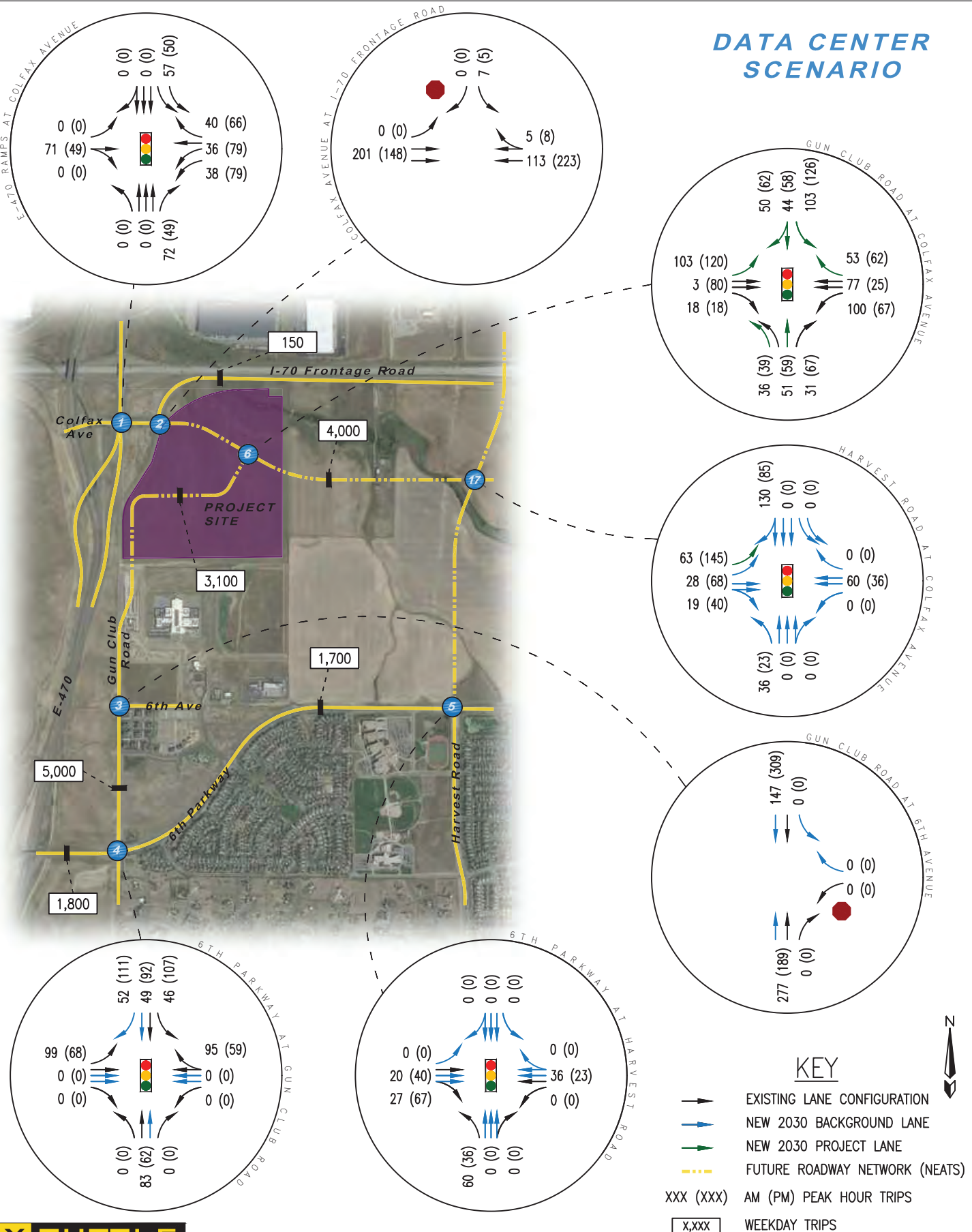
## 10.0 Conclusions

The Aurora Crossroads project proposes to develop up to 495,800 sq. ft. of commercial space, 150,000 sq. ft. medical offices, 355,000 sq. ft. hospital (150 beds), and four hotels. The project property is located in the southeast quadrant of I-70 and E-470. The development will be phased over time and this traffic study assumes the full buildout to occur by Year 2030. The project includes multiple access locations along Colfax Avenue (future extension) and Gun Club Road (realigned road). Internally, local streets will be constructed to provide the most beneficial access into and around the site for people driving, walking, and biking.

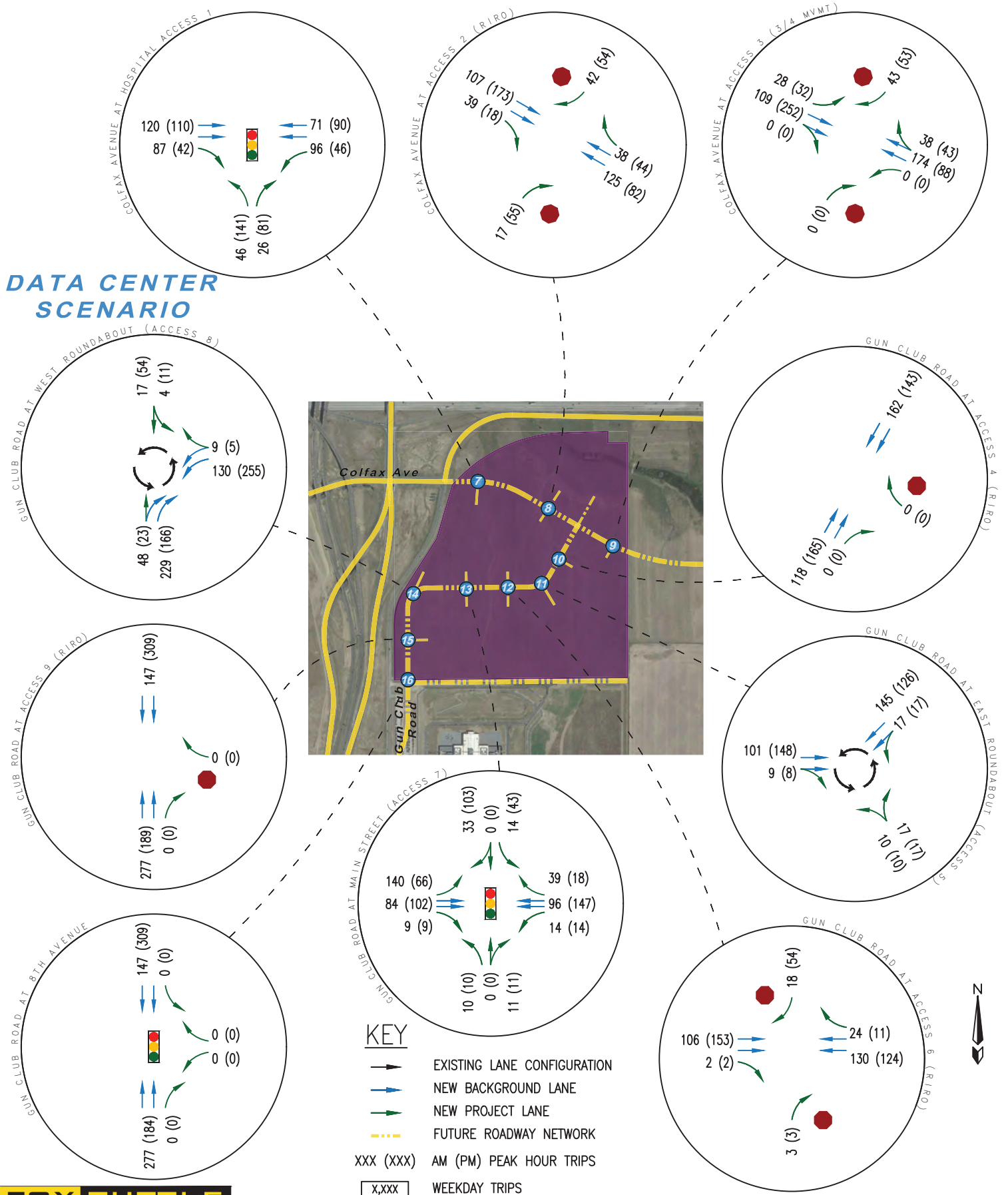
The project is estimated to generate approximately 41,060 daily trips with about 2,250 trips occurring in the AM peak hour and 3,600 trips occurring in the PM peak hour at full build-out. **It was determined that the proposed roadway system can adequately accommodate the projected traffic volumes for buildout conditions.** The proposed background and project-related mitigation measures are shown on **Figure 11A** (existing intersections) and **Figure 11B** (access intersections). The proposed lengths of auxiliary lanes are listed on the figures and in **Table 12**.

Note that the traffic study provides technical information and evaluates the need for transportation mitigation as traffic grows, but it does not address infrastructure commitments or obligations of Aurora Crossroads (refer to the Public Improvement Plan).

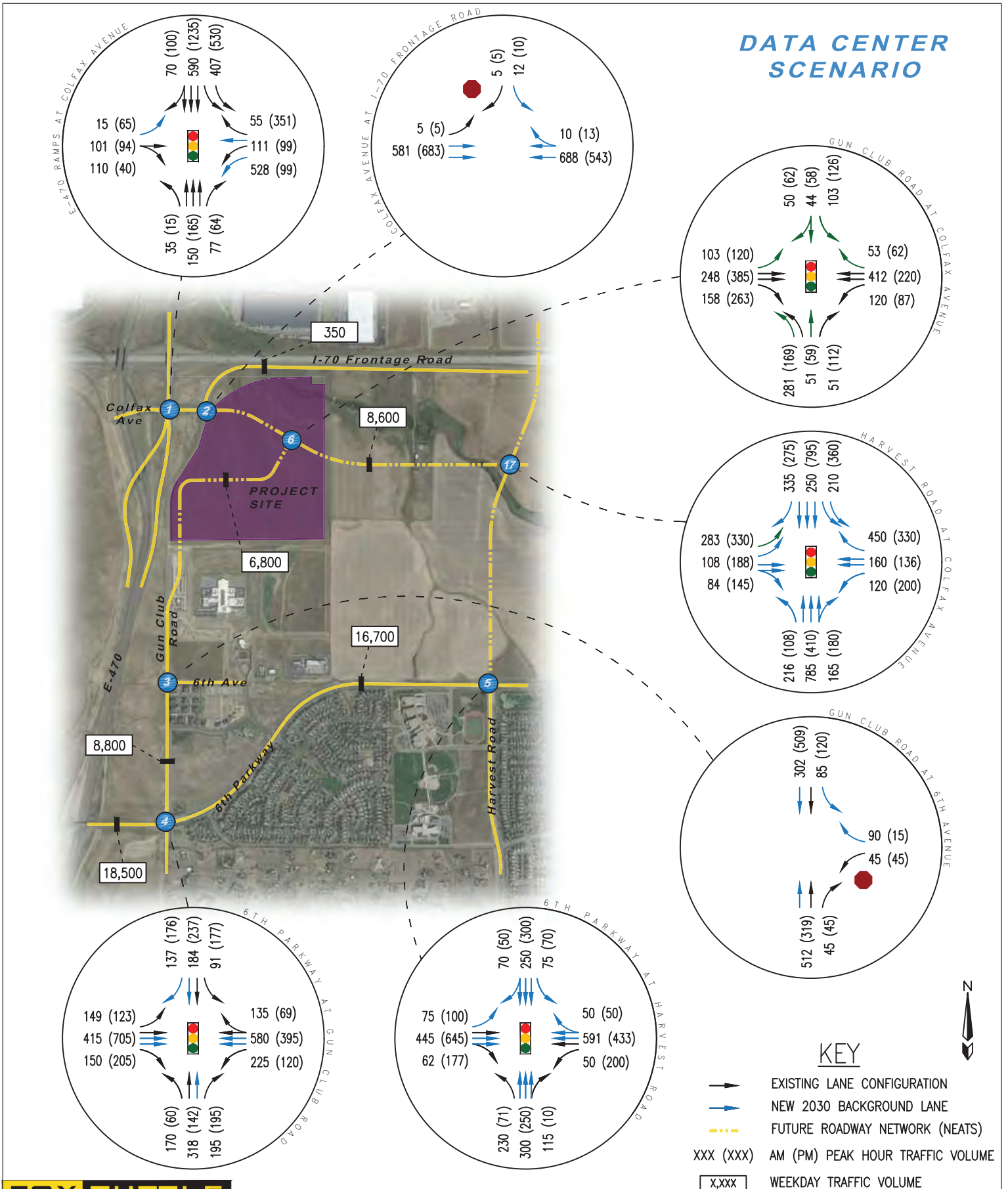
## DATA CENTER SCENARIO



## DATA CENTER SCENARIO

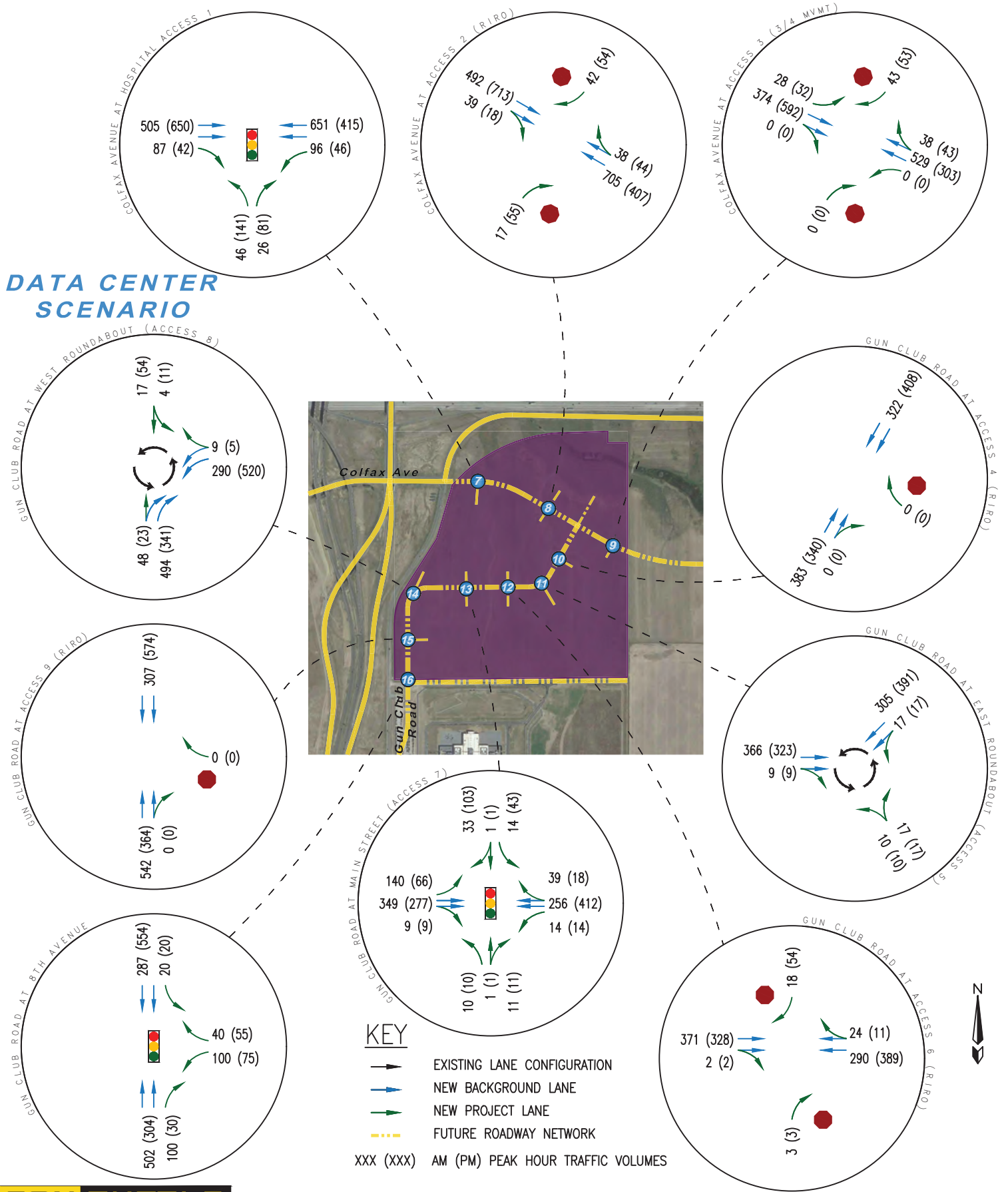


# DATA CENTER SCENARIO



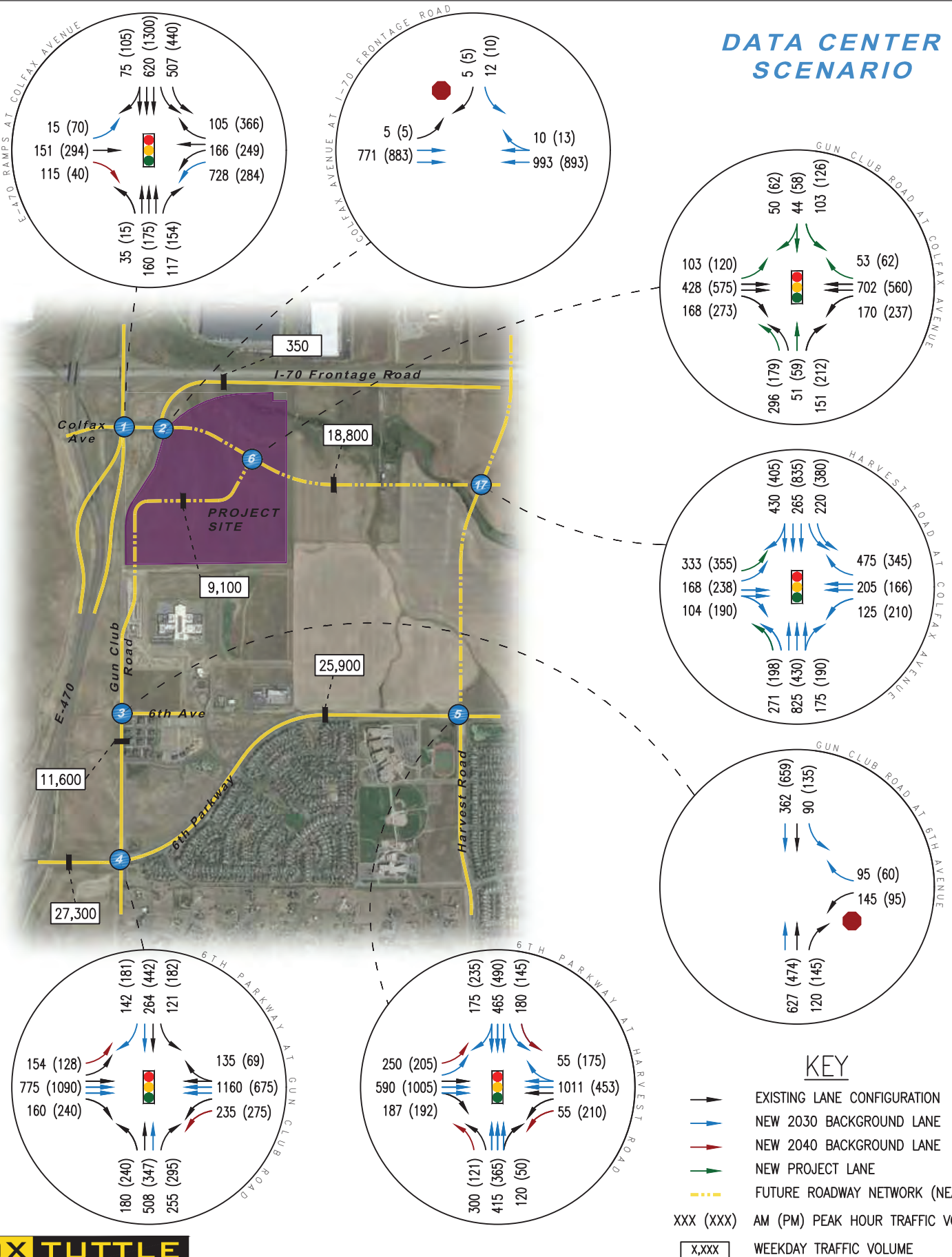


## DATA CENTER SCENARIO

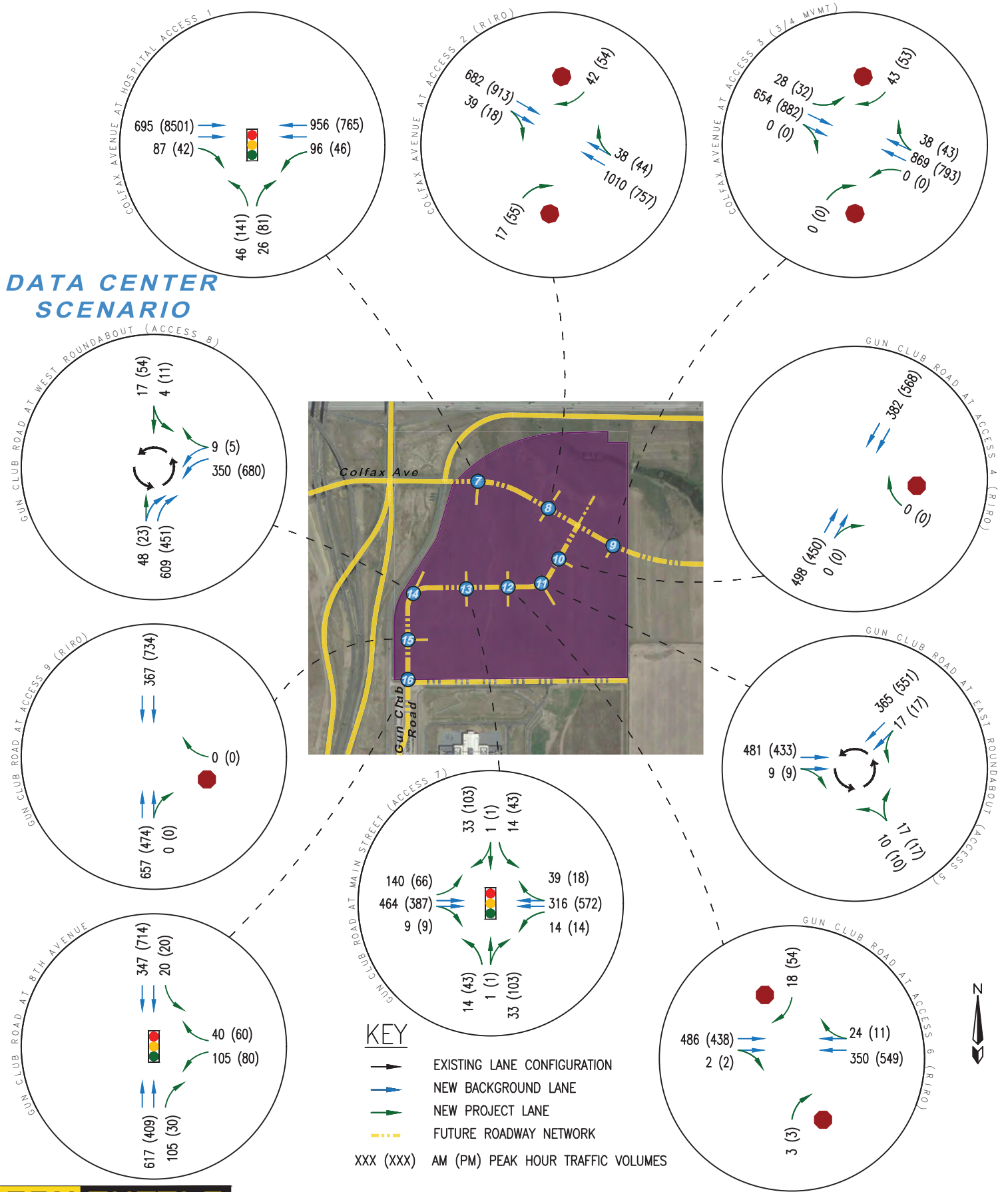




# DATA CENTER SCENARIO



## DATA CENTER SCENARIO





Appendix Table - Trip Generation Summary with DATA CENTER

Land Use	Size	Unit	Internal Capture	Non-Auto Factor	Average Daily Trips				AM Peak Hour Trips				PM Peak Hour Trips			
					Rate	Total	In	Out	Rate	Total	In	Out	Rate	Total	In	Out
PA-1																
ITE 610: Hospital	355	ksf	1.00	0.95	10.72	3,615	1,808	1,807	0.89	300	204	96	0.97	327	105	222
ITE 720: Medical-Dental Office Building	150	ksf	0.90	0.95	34.80	4,463	2,232	2,231	2.78	357	278	79	3.46	444	124	320
Subtotal of New Trips						8,078	4,040	4,038		657	482	175		771	229	542
PA-4																
ITE 310 - Hotel	120	rooms	0.95	0.90	8.36	858	429	429	0.47	48	28	20	0.60	62	32	30
ITE 820: Shopping Center	56.50	ksf	0.95	0.95	37.75	1,925	963	962	0.94	48	30	18	3.81	194	93	101
ITE 934 - Fast-Food Restaurant w/ Drive-Through Window	9	ksf	0.95	0.95	470.95	3,825	1,913	1,912	40.19	326	166	160	32.67	265	138	127
ITE 945 - Gas/Service Station w/ Convenience Market	16	fueling stations	0.90	0.95	205.36	2,809	1,405	1,404	12.47	171	87	84	13.99	191	97	94
Subtotal of Trips						9,417	4,710	4,707		593	311	282		712	360	352
Pass-by Trips: Shopping Center					34%	-655	-327	-328		0	0	0		-66	-32	-34
Pass-by Trips: Fast-Food (AM)					49%	0	0	0		-160	-81	-79		0	0	0
Pass-by Trips: Fast-Food (PM)					50%	-1913	-957	-956		0	0	0		-133	-69	-64
Pass-by Trips: Gas Station (AM)					62%	-1742	-871	-871		-106	-54	-52		0	0	0
Pass-by Trips: Gas Station (PM)					56%	0	0	0		0	0	0		-107	-54	-53
Subtotal of Pass-By Trips						-4310	-2155	-2155		-266	-135	-131		-306	-155	-151
Subtotal of New Trips						5,107	2,555	2,552		327	176	151		406	205	201
PA-5																
DATA CENTER	1160	ksf	n/a	n/a		350	175	175		102	51	51		102	51	51
Subtotal of New Trips						350	175	175		102	51	51		102	51	51
Total New Trips:						13,535	6,770	6,765	AM >	1,086	709	377	PM >	1,279	485	794
Total Pass-By Trips:						4,310	2,155	2,155	AM >	266	135	131	PM >	306	155	151
Total Trips:						17,845	8,925	8,920	AM >	1,352	844	508	PM >	1,585	640	945

Source: ITE Trip Generation 10th Edition, 2017.

## Gated Entry Vehicle Queueing Worksheets

## QUEUE STORAGE WORKSHEET

### Gated Entrance

ITE Transportation and Land Development, Chapter 8 - Drive-In Facilities

Location QTS Aurora Phase 2 - Gated Entrance

Condition Morning and Afternoon Peak Hours (Employees)

Storage =  $((\ln P(x>M) - \ln Q_m) / \ln p) - 1 \times \text{Average Length of Vehicle}$

M = queue length which is exceeded p percent of the time

N = number of service channels (drive in positions)

Q = service rate per channel ( vehicles per hour)

p = demand rate/service rate =  $q/NQ$  = utilization factor

q = demand rate on the system (vehicles per hour)

$Q_m$  = tabled values of the relationship between queue length, number of channels and utilization factor (if  $n = 1$ ,  $Q_m = p$ )

Where:

Q = 80 vehicles/hour assuming a 45 second wait

$P(x > M) = 5$  percent = .05

25 ft/veh = Average Length of Vehicle

q = 30 vehicles per hour

N = Number of Lanes= 1

$p = q/NQ = \underline{0.38}$   $Q_m = \underline{0.38}$

M = Storage =  $\{[(\ln .05 - \ln 0.38) / \ln 0.38] - 1\} \times 25$

M = Storage =  $\{[(\underline{-2.996} - \underline{-0.96758}) / \underline{-0.981}] - 1\} \times 25$

M = Storage = 27 ft

Where:

SL = Desirable Storage Per Lane= 27 Ft

Available Storage = 250 Ft = Adequate Storage



## QUEUE STORAGE WORKSHEET

### Gated Entrance

ITE Transportation and Land Development, Chapter 8 - Drive-In Facilities

Location QTS Aurora Phase 2 - Gated Entrance

Condition Morning and Afternoon Peak Hours (Visitors)

Storage =  $((\ln P(x > M) - \ln Q_m) / \ln p) - 1) \times \text{Average Length of Vehicle}$

M = queue length which is exceeded p percent of the time

N = number of service channels (drive in positions)

Q = service rate per channel ( vehicles per hour)

p = demand rate/service rate =  $q/NQ$  = utilization factor

q = demand rate on the system (vehicles per hour)

$Q_m$  = tabled values of the relationship between queue length, number of channels and utilization factor (if  $n = 1$ ,  $Q_m = p$ )

Where:

Q = 20 vehicles/hour assuming a 180 second wait

$P(x > M) = 5$  percent = .05

25 ft/veh = Average Length of Vehicle

q = 12 vehicles per hour

N = Number of Lanes= 1

$$p = q/NQ = \underline{0.60} \quad Q_m = \underline{0.6}$$

$$M = \text{Storage} = \{[(\ln .05 - \ln 0.60) / \ln 0.60] - 1\} \times 25$$

$$M = \text{Storage} = \{[(\underline{-2.996} - \underline{-0.51083}) / \underline{-0.511}] - 1\} \times 25$$

$$M = \text{Storage} = \underline{97} \text{ ft}$$

Where:

$$SL = \text{Desirable Storage Per Lane} = \underline{97} \text{ Ft}$$

$$\text{Available Storage} = \underline{250} \text{ Ft} = \text{Adequate Storage}$$