
Traffic Impact Study Guidelines

Aurora, Colorado



**City of Aurora
Public Works Department
15151 East Alameda Parkway, Suite 3200
Aurora, Colorado 80012
(303) 739-7300**

June 2015

TABLE OF CONTENTS

- 1.0 INTRODUCTION 1**
- 2.0 REQUIREMENTS FOR TRAFFIC IMPACT STUDY 2**
- 3.0 TRAFFIC IMPACT STUDY FORMAT 5**
 - 3.1 INTRODUCTION 7
 - 3.2 EXISTING CONDITIONS..... 7
 - 3.3 PROPOSED CONDITIONS 8
 - 3.3.1 *Site Trip Generation*..... 8
 - 3.3.2 *Trip Distribution*..... 9
 - 3.3.3 *Existing Plus Site Generated Traffic* 9
 - 3.4 FUTURE CONDITIONS 9
 - 3.4.1 *Background Traffic*..... 10
 - 3.4.2 *Total Future Traffic*..... 10
 - 3.5 EVALUATION 10
 - 3.5.1 *Level Of Service*..... 10
 - 3.5.2 *Traffic Control Devices*..... 12
 - 3.5.3 *Queuing* 14
 - 3.5.4 *Safety*..... 14
 - 3.6 CONCLUSIONS 15
- 4.0 TRAFFIC IMPACT STUDY SUBMITTAL 17**
- 5.0 REVISIONS 17**

1.0 INTRODUCTION

These Traffic Impact Study Guidelines were designed to provide development applicants with general direction for the level of detail to present in the study. Following the guidelines when preparing a traffic impact study will present a standard format and facilitate the review process.

Section 2.0 of these guidelines discusses the requirements for a traffic impact study. Section 3.0 presents the recommended traffic impact study format. A discussion of submittal and revision requirements is presented in Sections 4.0 and 5.0, respectively.

The City of Aurora encourages developers to maintain contact with City personnel throughout the development process. Table 1 provides a list of phone numbers for City departments and other agencies that may assist developers during the preparation of a traffic impact study.

Table 1 - Contact Phone Numbers

Department	Phone Number	Area of Assistance
Colorado Department of Transportation (CDOT)	Region 1 - (303) 512-4272	State highway access permit requirements
City of Aurora (COA) - Office of Development Assistance	(303) 739-7345	Pre-application meetings/ overall project contact
COA – Planning	(303) 739-7250	Zoning and parking requirements
COA – Public Works Traffic Engineering	(303) 739-7300	Signal phasing, timing, and cycle length; traffic counts (if available)
Development Review	(303) 739-7300	Traffic study requirements
COA – Transportation Planning	(303) 739-7250	Future traffic volumes and future road requirements

2.0 REQUIREMENTS FOR TRAFFIC IMPACT STUDY

The traffic impact study is used to evaluate the impact of site generated traffic on the existing roadway system and to make recommendations for improvements necessary to maintain a safe and effective roadway system. The traffic impact study will assist City of Aurora staff, Planning Commission, City Council, and the Aurora citizenry in assessing the effects of a proposed development. The Public Works Department reviews the traffic impact study and advises Planning Commission and City Council on traffic-related issues.

The site developer/owner is responsible for the preparation of a traffic impact study. Table 2 provides a general list of traffic impact study requirements by type of development submittal.

Since the need for a traffic impact study depends on site specific characteristics such as location, trip generation, existing road conditions, and type of development submittal, requirements may vary somewhat from site to site. Applicants are strongly urged to attend a pre-application meeting with staff. At the pre-application meeting, site-specific requirements for traffic as well as other areas can be discussed early on in the development process. Pre-application meetings can be arranged through the City of Aurora, Development Assistance Division, (303) 739-7345.

Existing Traffic Impact Studies

A previous traffic impact study which addressed the proposed development will need to be updated if it is more than two years old, if changes to the development proposal have been made which significantly affect trip generation or traffic patterns, or if there have been significant changes to the surrounding area that would affect background traffic conditions. Updates may also be requested at the discretion of the City.

Access to State Highways

Even if the City of Aurora does not require a traffic impact study, a study may still be required by the Colorado Department of Transportation (CDOT) to support a state highway access request. Developers of any site which has or proposes an

access onto a state highway must contact the CDOT region where the site is located for specific access and traffic analysis requirements.

Developers are encouraged to contact CDOT early on in the review process to determine the feasibility of proposed access point(s) to the state highway. The City will require a letter from CDOT indicating they have reviewed the proposed access(es) and have given preliminary concurrence with the access(es). Actual approval and issuance of a CDOT access permit is completed by CDOT at the time of civil plans review. The purpose of the letter is to show Planning Commission and City Council the developer is working with CDOT and has access to the state highway. The letter must be received 10 days prior to the Planning Commission hearing to be reviewed prior to the hearing.

Table 2 - Summary of When to Prepare a Traffic Impact Study

Type of Application	Traffic Study?	Explanation
Rezoning Site > 5 acres	Yes*	Increased intensity will normally require a traffic study if the rezoned parcel is five acres or more. A rezoning analysis includes a comparison of the proposed site generated traffic to the projected traffic from the existing zoning use.
Rezoning Site < 5 acres	Yes*	Parcels less than five acres may require a study or an abbreviated analysis pending the specifics of the rezoning proposal.
Rezoning-downzone	No*	A traffic study normally will not be required if the proposal is a downzoning in use.
General Development Plan (GDP) / Framework Development Plan (FDP)	Yes*	A complete traffic study is usually required.
Preliminary Development Plan (PDP)	Yes*	A complete traffic impact study is required if development proposal is substantially different than the GDP or if a GDP was never approved for the site. A revised study may be required if two or more years have passed since the submittal of the original study.
Site Plan / Contextual Site Plan (CSP)	Yes* if > 75 trips/ hour or unusual conditions	A traffic study or an abbreviated study may be required in conjunction with a site plan where the site is estimated to generate at least 75 trips per hour at any time of the day or where an unusual condition exists which warrants study (such as existing high volumes, high accident incidence, commercial connection to residential area, etc.).
Site Plan Extension	No*	A traffic study will normally not be required unless the surrounding environment has changed since the plan was originally approved.
Use Approval	No*	A traffic study will not typically be required with a Use Approval.
Plat	No*	A traffic study will not typically be required in conjunction with a subdivision plat.

*NOTE: The requirements listed above are only general guidelines: since individual sites differ, actual requirements will be determined on a case by case basis by the City Traffic Engineer.

3.0 TRAFFIC IMPACT STUDY FORMAT

This section describes the format for conducting a thorough traffic impact study for submittal to the City of Aurora. In general, the traffic impact study describes existing conditions, evaluates conditions at full build-out of the site, and evaluates future (20-year projection) conditions. Table 3 presents the traffic impact study outline.

Include applicable traffic data and documentation for the technical analyses in appendices to the study. Review the appropriate City of Aurora comprehensive transportation plan, Southeast Area Transportation Study (SEATS) or Northeast Area Transportation Study (NEATS), to ensure roadway classifications and alignments presented are consistent with the city plans. Exceptions may be appropriate where significant changes in planning have occurred subsequent to the most recent plans. The traffic impact study must be signed and stamped by a professional engineer licensed in the State of Colorado.

The study format presented in these guidelines reflects the requirements for a comprehensive traffic impact study. There may be cases in which this format is not applicable such as updates addressing changes in a previous plan or where the predominant concern addresses only immediate impacts and not long range impacts. In such cases, an abbreviated traffic impact study may provide sufficient information to evaluate the site. The abbreviated study includes some of the elements described below for the traffic impact study, typically the Introduction, Existing Conditions, Proposed Conditions, and Level of Service Evaluation. Also, for changes to a previous plan describe the changes impacting traffic. The City of Aurora will determine individual requirements based on site-specific conditions. The abbreviated study shall also be signed and stamped by a professional engineer licensed in the State of Colorado.

Table 3 - Traffic Impact Study Outline

- I. Introduction
- II. Existing Conditions
- III. Proposed Conditions
 - A. Site Trip Generation
 - B. Trip Distribution
 - C. Existing plus Site Generated Traffic
- IV. Future Conditions
 - A. Background Traffic
 - B. Total Future Traffic
- V. Evaluation
 - A. Level of Service (LOS)
 - B. Traffic Control Devices
 - C. Queuing
 - D. Safety
- VI. Conclusions/Recommendations

TABLES

- Trip Generation Summary
- LOS Summary

FIGURES

- Vicinity Map
- Existing Lane Configuration and Traffic Volumes
- Existing Trip Distribution
- Projected Site Traffic Volumes
- Existing plus Projected Site Traffic Volumes
- Future Background Traffic Volumes
- Total Future Traffic Volumes
- LOS for Existing Traffic Volumes
- LOS for Existing plus Site Generated Traffic Volumes at Buildout
- LOS for Existing plus Future Background Traffic Volumes
- Future Lane Configuration and Traffic Control Devices
- Recommended Improvements

APPENDICES

- Traffic Count Data
- Highway Capacity Software Input/Output Data
- Synchro Analysis
- ARCADY Analysis
- Queue Analysis
- Calculations
- Traffic Signal Warrant Study

3.1 INTRODUCTION

The introduction section of the traffic impact study summarizes the purpose of the study and provides site background information. This section includes a description of the proposed site development, current and proposed land use, site size, and the study area (depicted on a vicinity map). Typically the study area encompasses the roads adjacent to the site up to the next major arterial intersection. Describe any development phasing in this section. Information presented in this section and the remainder of the traffic impact study must be consistent with the site characteristics presented on the plans included with the development application.

3.2 EXISTING CONDITIONS

This section describes the physical environment of the proposed site. Present descriptions of the existing site access points, surrounding land uses and zoning, speed limits and road classifications. Identify the existing lane geometry, traffic control devices, and signal phasing of key intersections and nearby roadways. Also note any unusual terrain features (steep grades, limited sight distance, railroad crossings, etc.) in this section.

Present existing traffic data for the site including AM and PM peak hour volumes by movement and daily traffic volumes on roads in the vicinity of the site. Count data older than two years are not acceptable. The City of Aurora recommends the use of actual traffic count data where feasible since recently collected traffic counts can best represent actual conditions. If data is not available, the owner/developer is responsible for collecting the data. Traffic counting firms and traffic consultants can be contracted to perform data collection. Data collection shall include a 24-hour traffic count, tube count or other similar method for all relevant streets.

Determine the existing levels of service (LOS) for the study area existing intersections using the *Highway Capacity Manual* (HCM) or similar capacity software. Use the current COA signal timing at all signal locations under City control. This information is available from Public Works, Traffic Engineering.

Provide a description and brief justification for the input values used in running the model. Discuss the existing Level of Service (LOS) data in this section, and present the results in a table along with the site generated and future LOS results.

3.3 PROPOSED CONDITIONS

This section of the report describes the traffic impact created by the proposed subject site. Present trip generation and trip distribution for (1) site generated and (2) existing plus site generated traffic conditions. If the site is phased, prepare trip generation estimates for the interim time interval as appropriate, and include the results in this section. Estimate the proposed conditions by determining site-generated trips and then assigning the trips to the road network as described in the following subsections.

3.3.1 Site Trip Generation

This sub-section shows the total number of trips which the site is projected to generate and the methodology for determining the estimate. Use the most current *Trip Generation Manual* (and updates) published by the Institute of Transportation Engineers (ITE) to estimate trip generation rates. In some cases, especially where the *Trip Generation Manual* does not have a classification directly related to the proposed development, trip generation estimates can be based on the operational characteristics of the proposed use or collected data from similar sites in similar settings. If an alternative to the *Trip Generation Manual* is used, discuss the applicability and document the source used.

Clearly identify trip generation estimates in a table, itemized by use or traffic analysis zone (if appropriate). Indicate the ITE trip generation category used, unit trip rate, number of units in the proposed development, and the method for trip estimation (average rate or equation) in the table and/or text. Present the AM peak hour, PM peak hour, and daily site generated trip estimates. If applicable, introduce trip reductions in this section (i.e. pass-by and/or internal trips) and provide supporting references.

3.3.2 Trip Distribution

This sub-section describes the directional orientation of the site-generated traffic. Depict the study area traffic distribution percentages on a figure and describe the basis for selecting the distribution percentages in the text. The distribution percentage should be based on actual traffic. If actual counts are not collected or available for some roads within the study area, distribution may be based on Denver Regional Council of Governments (DRCOG) estimates, City of Aurora Planning estimates, or other appropriate methods as approved by the City of Aurora.

3.3.3 Existing Plus Site Generated Traffic

Using the trip distribution percentage and the estimate of site generated traffic, assign the traffic volumes to the road network. Discuss the site-generated traffic as well as the existing plus site generated traffic as applied to the road network. Present a figure showing the site-generated traffic volumes assigned to the roads within the study area for the AM peak hour, PM peak hour, and daily traffic volumes. Account for any trip reductions discussed earlier in the study in the volumes presented. Also present figure showing the volume of site generated traffic combined with the existing traffic assigned to the road system.

For sites with phased construction, include any additional calculations for site traffic generated during the interim interval periods within this section. Estimate existing or background traffic for the interim interval by adding a 2% growth factor per year, compounded annually, to the existing traffic or by using an estimated future traffic volume provided by City of Aurora Transportation Planning. Include a figure showing the interim site generated traffic volumes plus interim background traffic volumes.

3.4 FUTURE CONDITIONS

This section of the study describes the long-range effect of site generated traffic on the roadway system. The evaluation includes determining future background conditions and adding the influence of site generated traffic. The future conditions

should be evaluated for 20 years from the baseline year. Generally, the baseline year will be the year of the existing traffic conditions.

3.4.1 Background Traffic

Estimates of the background future traffic volumes without the influence of the proposed site are generally available from the City of Aurora Transportation Planning. For some cases developers may instead calculate future background traffic by applying a 2% growth rate factor per year, compounded annually, to existing traffic. In either case the estimates should account for future development adjacent to or near the proposed site based on the current zoning for undeveloped parcels within the study area. If the distribution of future traffic volumes is different than that for existing traffic, provide an explanation of the variance with supporting data. Include a figure illustrating the 20-year projected background traffic volumes.

3.4.2 Total Future Traffic

In this section discuss the total future traffic including future background traffic plus the estimated site generated traffic. Present a figure showing the total future volumes for the AM peak hour, PM peak hour, and daily traffic volumes for all adjacent streets and describe the results in the text. Include adjustments for passer-by effects and internal trips as applicable. Justify the reduction percent.

3.5 EVALUATION

This section of the report identifies the site's impact to the road system. In the evaluation, include a description of the percent change in traffic over existing volumes the proposed site will cause along key roadways and intersections. Discuss the impact on sensitive areas such as residential areas and streets fronting schools. In the site evaluation consider, at a minimum, the level of service, traffic control, queuing, and safety. The existing traffic volume and the percent increase in 24-hour volume and lane geometries for the study area should be placed on the appropriate figures in the study.

3.5.1 Level of Service

The traffic impact study not only addresses the impact of the proposed site, but also identifies needed roadway/intersections improvements to mitigate site

impacts. The LOS, as defined in the latest version of the HCM, will serve as the means for evaluating traffic operations. Explain any deviations from the analysis procedures or default variables presented in the HCM.

Peak hour (AM, PM and site if different than typical rush hour periods) operations will need to operate at LOS D or better. For signalized intersections, individual movements may be allowed to fall to LOS E, but in most cases the overall intersection must operate (or be projected to operate) at a LOS D or better during AM and PM peak periods. If the existing LOS for an intersection is less than LOS D, discuss potential alternatives to improve the intersection to achieve LOS D or maintain the existing critical lane volume with the addition of site generated traffic.

Minor movements at unsignalized intersections, such as left turns onto a major arterial from a side street, may be allowed to fall below LOS D pending the specific conditions. Movements which have a light traffic demand and a viable travel alternative may be allowed to fall below LOS D.

Present LOS estimates for AM and PM peak hour periods for existing traffic, existing plus site generated traffic, future background traffic, future background plus site traffic, and any interim phase discussed in the study. The suggested format is a table summarizing the LOS and delay for the lane groups/turn movements at each intersection within the study area. Discuss changes to the intersection delay resulting from the proposed site and any recommendations for improvements. As applicable, calculate the LOS for the recommended improvements to demonstrate the intersection will be improved and an acceptable LOS will be achieved. Clearly label and include any HCM input/output in an appendix. For Synchro output, include specific information regarding all signal timing assumptions and phasing and operational assumptions such as left turn type, etc.

Roundabout Capacity Analysis

If traffic signal warrant(s) or multiway stop warrant is met, then a roundabout shall also be considered at the intersection. Use HCM methodology for the capacity analysis of a roundabout. The two allowable software packages for such analysis are:

1. Highway Capacity Software (HCS) version 6.3 or later
2. ARCADY version 8 or Arcady Lite

Roundabout operational analysis shall account for possible phasing of capacity expansion, whereby an interim geometry may be established if the analysis reveals that single lane entries are adequate for a period of ten years. If an interim geometry is determined to be allowable, any associated design or planning documents shall also include the ultimate and necessary conditions/information for the conversion from the interim to the ultimate condition.

3.5.2 Traffic Control Devices

The appropriate type and location of required traffic control, such as stop signs, yield signs, traffic signals, or roundabouts should be identified as part of the analysis. FHWA's "Roundabouts: An Informational Guide," as well as other sources identify numerous site-specific conditions that may favor or preclude the use of a roundabout for various situations. Other types of reduced-conflict intersection types, such as Continuous Flow intersections (CFI) and J-turn intersections, may be considered at the City's discretion or request and should be taken into consideration in an alternatives analysis, depending on the site-specific safety and operational concerns that are present.

The need for additional traffic control (signs, signals, roundabouts, lane striping, additional lanes, etc.) should also be considered during the evaluation. Evaluate traffic control warrants as presented in the most recent Manual on Uniform Traffic Control Devices (MUTCD) and provide a roundabout capacity analysis and a signal warrant study using actual traffic counts. Indicate which warrants are met. Traffic signals will only be considered for installation if at least one of the warrants

is met. For warrant purposes the minor street approach traffic shall typically be comprised of all through and left-turn movements and 50 percent of right-turn movements. The Peak Hour warrant is by itself not sufficient for consideration of signalization except under unusual circumstances at the discretion of the City of Aurora Traffic Engineer.

For proposals that include a recommendation for a new traffic signal, the signal must be located one-half mile (plus or minus 200 feet) from a major signalized intersection. An additional signal may also be considered at a location a minimum of 660 feet on one side or the other of a signalized intersection at the mile and half mile points. If a new signal is proposed at a location other than just described, prepare a progression analysis to ensure the new signal can be made to fit within established progression patterns. Cycle lengths between 90 and 150 seconds should be considered in 5 second increments. In emerging areas, the proposed signal must meet a minimum of 35 percent bandwidth while existing areas should meet a minimum of 30 percent bandwidth. If existing conditions are less than 30 percent along a road segment, the analysis must show the new signal will not degrade progression beyond established conditions. Obtain base signal timing assumptions from the City of Aurora, Traffic Engineering, to conduct the analysis. The timing assumptions used in the progression analysis must be consistent with those used in the LOS analysis.

While progression will be an important consideration in the approval of a new signal, another factor considered is position of the signal in relation to accesses on the opposite side of the street(s). The City of Aurora may allow progression to suffer somewhat in exchange for a location which serves the optimum number of users associated with the subject site and adjacent areas. Each proposal will be evaluated on a case-by-case basis.

The feasibility of a roundabout installation, as alternate, shall also be considered when a new traffic signal or multiway stop is proposed. The objective of the

alternate consideration is to document the decision-making process which demonstrates that a roundabout is (or is not) the most appropriate intersection control form. The scope of the feasibility study will vary depending on project conditions and the type and complexity of the proposed roundabout.

3.5.3 Queuing Analysis

A queuing analysis shall be performed for all intersection approach lanes and ramp termini controlled by stop signs, traffic signals or roundabouts within the study area. An estimate should be made of queue lengths that should be accommodated at intersections in close proximity to each other and the results should be discussed. Queue lengths shall be evaluated for left-turn and right-turn lanes to ensure the queues do not overflow into adjacent through lanes. For roundabouts this requires the use of Arcady 8. Through movement queues should be evaluated to confirm they do not obstruct turn lane entrances or extend back into adjacent intersections. Queuing analyses should indicate the available vehicular storage will be adequate 95 percent of the time during peak hours. If additional turn, acceleration, or deceleration lanes are recommended, include calculations for the length of the turn bay lanes as an appendix and discuss the results in the text.

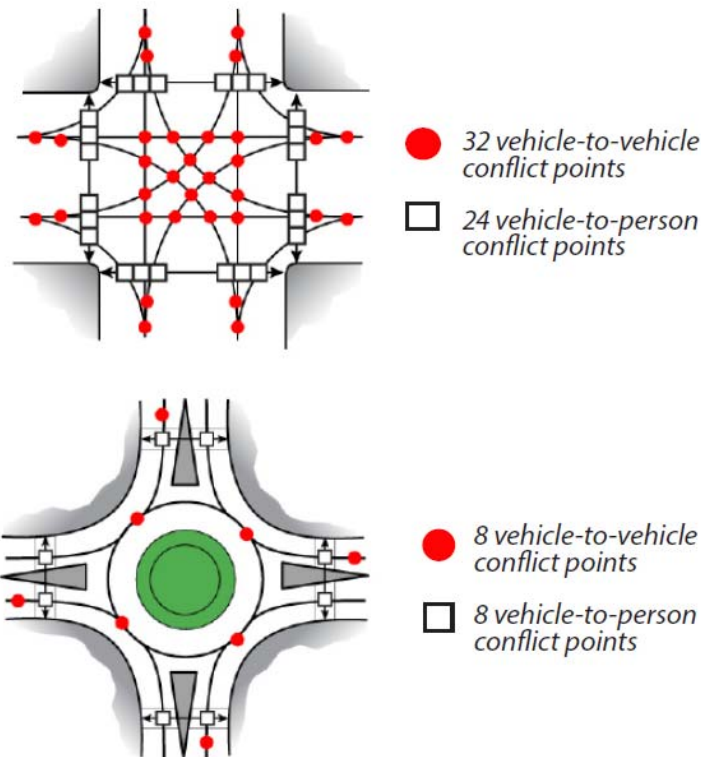
The City of Aurora uses the CDOT access code as a basis for determining when additional lanes are required and for designing the taper and storage lengths. See the Roadway Design & Construction Specifications, latest edition, for minimum, median left-turn storage lengths. For larger projects this information should be placed on a figure within the study.

3.5.4 Safety

This section identifies any traffic safety hazards in the area which may be adversely affected by or created by the layout or traffic volumes of the subject site and presents possible mitigation measures. The evaluation of safety should consider such items as sight distance (based on AASHTO criteria and City standards), driveway approach grades, angles of road intersections, and backing

of vehicles. An example of a potential hazard would include placement of a driveway where driver sight distance would be limited due to vertical and/or horizontal street alignment or the placement of fences/landscaping. Also identify any potential traffic hazards affecting pedestrian movement and present possible mitigation measures.

As shown in the illustrations below, roundabouts have fewer potential conflict points than conventional intersections, making streets safer for all users.



3.6 CONCLUSIONS

The conclusion of the study clearly summarizes all of the findings relative to the site's impact and identifies any short and long range improvements needed to accommodate projected traffic volumes. Recommendations for geometric improvements such as pavement markings, median changes, and additional lanes should be included. Discuss whether the existing right-of-way will accommodate the proposed improvements or whether additional right-of-way will

need to be dedicated. A bullet list format is suggested for presenting the recommendations. A graphic may also be used to present proposed short and long range improvements.

Conceptual Drawings

For all intersections being evaluated for geometric improvements or modifications to existing traffic control, provide conceptual drawings of the intersection alternatives considered. The conceptual drawing shall be to scale, and it is preferred that it be superimposed on an aerial photo or topographic map. Conceptual drawings for a roundabout shall include the lane configuration, the outer diameter of the roundabout and the approximate approach alignment geometry. The roundabout concept plan needs to be well developed to identify approach alignment shifts, corner property requirements, parking impacts and adjacent access impacts. Conceptual drawings for multiway stop, signal control or any type of non-traditional intersection shall include the proposed lane configurations, median width (if any), turn lane storage lengths, and transitions to match the existing roadway. Existing right-of-way limits shall be shown. Except for lane configuration and lane designation, do not include pavement marking, signing, stationing, profiles or turning radii. The intent of the conceptual drawings is to show the approximate impacts of each intersection control alternative to better assist in the determination of the appropriate alternative(s).

In cases where it is advantageous to phase the expansion of a roundabout, building a single lane layout initially for up to ten years of adequate capacity, the concept drawings shall illustrate both the interim and ultimate layouts. The concept design shall be developed to minimize throwaway costs of expanding the layout, e.g. by building a two-lane roundabout footprint but scaling it back to operate with single lanes initially. If an interim geometry is determined to be allowable, any associated design or planning documents shall also include the ultimate and necessary conditions/information for the conversion from the interim to the ultimate condition.

4.0 TRAFFIC IMPACT STUDY SUBMITTAL

Submit an electronic copy of the traffic impact study at the time of the site development application electronic submittal process. Public Works will review the traffic impact study in conjunction with the submitted application, and return any comments with staff comments on the application. Address staff concerns by submitting a revised traffic impact study, electronically, with the subsequent development application submittal.

Submittals shall be set up for 8 ½" x 11" paper.

5.0 REVISIONS

In any revisions prepared for a traffic impact study that has already been accepted by the City of Aurora, reference the date and title of the original document submitted. Provide a summary list indicating what parts of the original document were revised. Clearly present the new conclusions and specify which conclusions from the initial report remain valid.