BCEO
TRAFFIC IMPACT STUDY GUIDELINES

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TABLE OF CONTENTS

INTRODUCTION

This manual describes the elements required for preparing and reviewing traffic impact studies. The purpose of the manual is to provide guidance and encourage consistency in planning site access, on site circulation, and off-site improvements for new and modified developments through the use of traffic impact studies.

Traffic impact studies (TIS) are invaluable planning tools for communities. The traffic impact study allows a community to foresee the impact a proposed development will have on adjacent road(s), intersection(s), and site access driveways before the community approves the development. This type of planning provides the ability to make modifications to the proposed plans and or plan for the mitigation of the traffic impact long before the development is constructed.

The TIS will provide guidance for site access, on site circulation, parking, and off-site improvements necessary to permit the street system to operate at a satisfactorily level of service by addressing the following questions:

What impact will traffic traveling to and from a proposed development have on the operation of the street system adjacent to the site? Will the development have safe access to the street system? Will the level of service of the adjacent street be lowered significantly because of the proposed development? Will internal site traffic safely interact with external entering traffic?

The Traffic Impact Study guidelines presented in this paper will perform the following functions:

- Establish standards and consistency of study throughout the community.
- Ensure that important traffic issues are addressed.
- Ensure that roadways in Butler County remain safe and efficient.
- Provide staff with checklist for the review process.
- Promote increased understanding of traffic impact issues for those involved in the development process.

TRAFFIC IMPACT STUDY STRUCTURE

A formal process is established to create a standard for all TIS. The formal process establishes consistency of application and provides a forum for the Butler County Engineer's Office (BCEO) and the developer/engineer to discuss the structure of the study and specific issues about the site before the study begins. It is emphasized that the review process should begin when the development's planning is initiated, not after a development has been planned and a traffic study completed.

The first step in the TIS procedure is to determine if a TIS is required. The requirement for impact studies will be based on 'When is a Traffic Impact Study Needed" shown below. If it is determined that a TIS is necessary, the next step is a meeting with the developer/engineer.

The meeting with the BCEO and developer/engineer is intended to discuss issues associated with each development: scope of the study, area of study, methodologies to be used in the study, assumptions, data sources, report contents and any other issues important to the BCEO or the developer. The intent of this formal process is to reduce delays and review time for both the BCEO and the developer.

After the meeting the developer/engineer will prepare a memorandum outlining scope, methodologies, and understandings agreed to in the meeting. The impact study will not begin until the memo has been reviewed and approved by the BCEO.

The structure of the entire Traffic Impact Study procedure is shown beginning on page 10.

WHEN IS A TRAFFIC IMPACT STUDY NEEDED?

A traffic impact study should be requested for any proposed development that meets any of the following criteria:

- When a proposed development will generate 100 or more added new peak hour trips to or from the site during the adjacent roadway's peak hours or the development's peak hour.
- If there is congestion in the vicinity of a proposed development and the development is expected to significantly impact adjacent roadways/intersections.
- Requests for rezoning, zoning variance.

The use of the 100 vehicle threshold is reasonable because in an hour an additional 100 vehicles can:

1. change the level of service at an intersection and
2. require the addition of turn lanes to accommodate site traffic and while not impacting through traffic.

In some cases, a proposed development may generate fewer trips than the threshold indicated above but a safety or capacity issue in the area of the proposed development may require an impact study for the following reasons:

- High accident intersection or section of roadway.
- Proximity of proposed site drives to other site drives or intersections.
- Sensitivity of adjacent neighborhoods
- Existing or projected level of service of street adjacent to proposed development, which is unacceptable.
- High traffic volumes on adjacent roadway that may affect movement into and out of site.

STUDY AREA, SITE PLAN & HORIZON YEARS

STUDY AREA

Minimum study Area

The minimum study area for a complete traffic impact study will include all proposed and existing site access locations and major intersections (signalized and unsignalized) adjacent to the site.

Additional study area

The BCEO will determine any additional area to be included in the study based on, but not limited to, size of the proposed development, local or site-specific issues, local policy, and impacts to residential areas that are likely to occur.

SITE PLAN

To be able to effectively evaluate a submitted plan for access, turn lanes etc. at a new or redeveloped site, the impact study must include a scaled site plan with the adjacent public roadway(s) shown noting the existing lanes and their configuration. All public roads and private access driveways, which exist beyond the proposed site, must be shown to a distance of 500 feet beyond the limits of the site property (This distance may be modified by the BCEO depending upon site characteristics). This distance may be reduced by the BCEO depending upon the site location.

The plans noting the above information shall be at an appropriate scale to allow proper review by the BCEO.

All proposed access points to the public road system must be shown in a preliminary scaled drawing which includes lane lines. Recommendations for roadway improvements must also include existing and proposed public road and private driveways 500 feet beyond the property limits of the site property.

HORIZON YEARS

Horizon years are the year(s) for which study results are to be characterized. The TIS shall address traffic conditions:

- On opening day and/or,
- Anticipated completion year of the proposed development, assuming full build-out and occupancy (minimum 10 years from opening day) and/or,
- If built in phases at the completion of each major phase and/or,
- A time period specified by the BCEO not to exceed twenty (20) years from opening day.

BCEO reserves the right to request revisions/updates to an approved TIS up until the time that all phases of the proposed development are complete.

TIME PERIODS ANALYZED

The objective of the TIS is to analyze the impact a proposed development will have on the public street system. Changes in the peak hours can occur over time, especially in growing areas.

In many cases the street peak traffic hours and the site directional peak traffic hours should both be analyzed to ensure not only adequate roadway operation, but also provision for sufficient driveway, turn lane, and queuing capacity.

The peak hours of the highway system are generally one hour between:

- 7 AM and 9 AM weekdays
- 4 PM and 6 PM weekdays
- 12 noon and 2 PM Saturdays

In most studies only analyses of weekday peak hours will be required; however, land use classifications which experience their highest trip generation during times other than weekday peak hours must be analyzed. Land use categories

which have peak hours different from the weekday peak hours include, but are not limited to schools, theaters, churches, shopping centers, discount stores.

SITE AND NON-SITE ANALYSIS

To provide for accurate evaluation, all transportation infrastructure needs in the study horizon years must be included; however, the impacts and transportation infrastructure needs are to be assessed separately for the horizon year level of service both with and without site development.

All significant developments within the study area that have been approved or are likely to occur by the specified horizon year should be identified and incorporated into the study. The impacts of anticipated off-site development should be assessed separately from those of the proposed development to aid both the BCEO and the developer to determine the origins of transportation infrastructure needs. Also, the study shall determine the transportation improvements required for the approximate proportion of the improvements attributable to the traffic generated by the proposed development.
Traffic having neither an origin from nor destination to the subject site is considered non-site traffic. For each horizon year, non-site traffic volumes are to be estimated to characterize the base conditions for the area of study. Specifically, the traffic volume conditions of the study area in the horizon year, assuming the proposed site is not developed or redeveloped, must be established.

Non-site traffic volumes are to be calculated using the 'build-up' method. This method will typically provide accurate and easily traced results. The concept consists of forecasting peak hour traffic to be generated by approved and anticipated developments in the study area, estimating growth in through traffic generated outside the study area, and adding both to existing traffic in the study area. **Each scenario shall be shown graphically in separate figures**. If the subject site is being redeveloped, existing site traffic is subtracted from this total to provide the estimate of future non-site traffic.

After the non-site volumes have been estimated, an analysis of the future base conditions should begin. This will provide an assessment of the traffic operations and needed improvements in the horizon years without the subject development in place. With the base conditions established, the impact of the subject site can be measured. Improvements necessary to accommodate the non-site traffic in the horizon year at the design level-of-service should be determined. It is the developer's responsibility to identify improvements that have already been committed by other developments.

If pass-by rates are being utilized, as in case of commercial developments, the *Trip Generation Handbook*, latest edition by ITE, shall be used for derivation of rates.

ON SITE PLANNING & PARKING PRINCIPLES

Internal design will have a direct bearing on the adequacy of site access points. The identification of access points between the site and the external roadway system and subsequent recommendations concerning the design of those access points is directly related to both the directional distribution of site traffic and the internal circulation of the facility.

It is clear that driveway traffic volumes of varying sizes need to be accommodated on site, in terms of providing sufficient capacity and queuing space and of distributing automobiles to and from parking space, pick-up/drop-off points, and drive through lanes.

It must be understood that simply providing access to a site by means of curb cuts does not necessarily mean that access to the development has been adequately addressed. The quality of access as it relates to the internal site circulation and design will have a direct relationship on the quality of traffic flow in and around the site development, as well as a direct impact on public safety.
Joint access and cross access by two or more properties may be desirable, depending upon use. Joint access reduces the number of driveway openings, which reduces turning movement conflict. Cross access will permit motorists to travel to adjacent properties without first exiting out of one commercial access onto the public roadway and then reentering adjacent commercial access driveways.

SITE TRAFFIC GENERATION

One of the most critical elements of site impact studies is estimating the amount of traffic to be generated by a proposed development. This is usually accomplished by utilizing trip generation rates or equations from the latest edition of *Trip Generation,* a publication from the Institute of Transportation Engineers. *To determine between the Average Rate and Regression Equations, use Recommended Procedure for Estimating Trip Generation located in the ITE Trip Generation Handbook.* The proposed development should be categorized by specific land use type consistent with classifications contained in *Trip Generation.* If specific trip rates are not available for a particular development, the method of trip rate determination will be discussed with the BCEO at the meeting with developer.

Documentation should be provided to verify the reason for any variation from normally recognized generation rates or equations and for assumptions unique to the development being studied. Trip generation rates must be determined carefully and must be defensible using a combination of available data and professional judgment.
A table should be provided in the study report showing the categories and quantities of land uses, with the corresponding trip generation rates or equations and resulting number of trips. For large developments that will be phased in over time, the table should also provide trip generation expected at each significant phase.

SITE TRAFFIC DISTRIBUTION

After the trip generation for the proposed development has been completed, traffic for the proposed development must be distributed and assigned to the roadway. The traffic is assigned to the roadway in order to analyze the impact of the proposed project on intersections and roadways within the study area.

The directions from which traffic will approach and depart the site can vary depending on several factors including:

- The type and size of the proposed development
- Surrounding and or competing land uses
- Conditions on surrounding street system

An influence area may be designed to help in the distribution of traffic. The influence area should be large enough to include most of the trip ends attracted to the site – this would normally be determined from a market study. If no study exists, the influence area should be determined based on reasonable estimates. Existing trip distribution data from actual sites within the immediate vicinity may be used for making assignments.

Trip assignments should be made considering logical routings, available roadway capacities, left turns at critical intersections, and projected and perceived minimum travel times.

Many land uses such as fast food restaurants, service stations, restaurants, shopping centers not only generate new trips but also attract trips that were already passing by in the traffic stream. These trips are referred to as pass-by trips, and the procedure described in ITE *Trip Generation Handbook* should be used to account for these trips.

ANALYSIS & LEVEL OF SERVICE

Capacity analyses will be performed on each of the major street and site intersections (signalized and unsignalized) in the study area. For each analysis period being studied, projected traffic volumes for site and non-site traffic must be analyzed and used for capacity analysis for future conditions.

The standard used to evaluate traffic operating conditions is referred to as level of service (LOS). Level of service refers to a street's ability to carry traffic in terms of average stopped delay per vehicle. The most commonly used LOS analysis procedure is detailed in the most recent edition of the *Highway Capacity Manual*.

Traffic operational analysis must use the latest version of the Highway Capacity Software (HCS) by McTrans. BCEO prefers SIDRA for roundabout analysis but HCS may be used in some situations. All signal system optimization shall be performed using Synchro unless another simulation software is agreed upon during scoping of the study.

Unsignalized Intersections

The level-of-service for an unsignalized intersection is determined by the computed control delay and is defined for each minor movement. Level-of-service is not defined for the intersection as a whole. The Highway Capacity Manual (HCM) standard LOS values for unsignalized intersections shall be used.

Signalized Intersections

The level-of-service for a signalized intersection is defined by the control delay per vehicle (sec) and the highway capacity analysis computes both the approach delay and the intersection delay. Level of service ranges from 'A' to 'F'. The Highway Capacity Manual (HCM) standard LOS values for unsignalized intersections shall be used.

The goal of the BCEO for the operation of its roadways is an overall level of service 'D' or better during the peak traffic (design) hour of the roadway system. In areas where current levels-of-service is worse than 'D', the base level-of-service must be maintained or improved after development.

The intersection level of service is computed as a weighted average of the vehicle delay; therefore an intersection may have an overall LOS of 'C' or 'D' and have individual movements of LOS 'E' or 'F'. As a result, all movements should be analyzed individually. Recommendations should include modifications to reduce delay and increase capacity on the critical movements.

TECHNICAL REQUIREMENTS

Capacity Analysis

When the level of service analysis is completed for signalized and non signalized intersections, peak hour factors (PHF) are to be calculated based on existing count data**.**

In addition to hard copies of analyses included in the report, all analyses shall be submitted in electronic format with the submission of the written report.

For existing signals that will be analyzed, it will be the responsibility of the developer to obtain and use the existing cycle lengths and signal phasing from the BCEO unless otherwise agreed to by the BCEO in the 'meeting with developer' and outlined in the memo of understanding.

Parameters to use for future conditions analysis:

- PHF = HCS default
- Duration = 0.25
- Balance Delay (within 3 seconds)
- Queue Length Percentile = 95th
- Saturation Flow Rate = Field Calculated or software default
- Phasing – Uncoordinated intersection & Field-Measured Phase Times should be toggled "On"
- No Right Turn on Red
- Clearance intervals - Yellow = 4s and Red=1s. (Actual/calculated values may be used)
- Timing – Minimum green: 10s for thru movement; 7s for turn movement

The following variables will be discussed in the meeting with developer:

- Growth Factor, Grades, Lane widths, Truck percentage, Pedestrians, Lead/Lag Phasing

IMPROVEMENTS

Improvements necessary to maintain capacity, provide signal coordination and improve safety to, from, and within the development are an essential part of impact study recommendations.

Intersection recommendations should include modifications to reduce delay and increase capacity on the critical movements. If the 'Build" condition significantly degrades the intersection compared to the 'No Build' condition, mitigation shall be required to return the level of service to 'No Build' levels. Modifications may include adding lanes, removing curb parking, or changing signal phasing, or timing, or lane use. The preferred goal of the BCEO is to obtain a LOS of 'D' or better on each approach with no individual movements at a LOS of 'F'. Improvements should ensure that non-site traffic is not impacted negatively

If site driveways are proposed to be signalized, the site driveways should be warranted and located to achieve good traffic progression. All access drives shall have adequate ingress and egress capacity. All access drives must achieve adequate intersection sight distance by using 85th percentile speed or 5 MPH over the posted speed limit. Capacity of on-site intersections should be sufficient to prevent traffic entering the site from backing up on the adjacent street. Adequate 'throat' length shall be provided. (See BCEO's Access Management Regulations.)

Turn lane warrants shall be completed for all unsignalized driveways. (See ODOT's Location & Design Manual – Volume 1, Section 400) Some developments may require acceleration and/or deceleration lanes at driveways not because of turn volume requirements but to minimize potential for accidents due to speed reduction at driveways. (See BCEO's Access Management Regulations.)

The following report outline provides a framework for Traffic Impact Study reports to the extent they are relevant to the study issues and needs. Topics not relevant may be omitted; however, additional sections may be warranted because of specific issues to be addressed, local study requirements, and results of the study.

The report must be clearly written and include an Executive Summary. In addition to text material, reports shall contain exhibits necessary to clearly present or describe conditions, conclusions, and recommendation associated with the study. **If a Level-of-Service Analysis Table is necessary, it must contain the delay per movement along with the LOS.**

Each exhibit is to be clearly legible and easily read without magnification. Traffic Impact studies become public record upon initial submittal to the BCEO.

Traffic Impact Study Report Outline

I. Cover

A. Development's name
B. Development's location
C. Applicant's name
D. Preparer's name
E. Report Date

II. Title Page

A. Development's name
B. Development's location
C. Applicant's name, address, telephones and fax numbers
D. Preparer's name, address, telephone, and fax numbers
E. Report date

III. Table of Contents

IV. List of Figures, Tables, and Appendices

V. Executive Summary

One to two page maximum summary including the following:

A. Site location and study area
B. Development description
C. Main findings
D. Conclusions
E. Recommendations

VI. Introduction

A. Site Location and study area
B. Development description

VII. Proposed Site Development

A. Information Sources
B. Existing Zoning
C. Land Use and anticipated quantity
D. Location
E. Site Plan
F. Phasing and timing

VIII. Area Conditions

A. Study Area
    1. Area of influence
    2. Area of significant impact

B. Study Area Land Use
    1. Existing land use
    2. Existing Zoning

3. Anticipated future development

C. Site Accessibility
   1. Area roadway system
      a. existing
      b. future
   2. Traffic volumes and conditions
   3. Transit service
   4. Existing relevant transportation management programs

IX. Projected Traffic

A. Site Traffic (each horizon year)
   1. Trip generation
   2. Trip distribution (**Include Figure showing percentage breakdown.)**
   3. Modal split
   4. Trip assignment

B. Through Traffic (each horizon year)
   1. method of projection
   2. Non site traffic for anticipated development in study area
      a. method of projections
      b. trip generations
      c. modal split
      d. trip assignment
   3. Through Traffic
   4. Estimated volumes.

C. Total Traffic (each horizon year)

X. Traffic Analysis

A. Site Access
   a. Vehicular
   b. Service and emergency (Check with emergency personnel for requirements)
   c. Pedestrian
   d. Transit

B. Capacity and level of service
   Intersections
   Ramps
   Weaving sections

C. Traffic Safety
   Sight distances
   Impact on current high accident locations
   School zones within study area
   Special Circumstances

D. Traffic Control
   Traffic signals
   - Signal warrants
   - Signal coordination

Speed limits
Other

E. Site Circulation and parking
On site parking needs
Ease of internal circulation
On site queuing provisions
Joint Access

XI. Improvement Analysis

A. Improvement to accommodate base traffic
B. Additional improvements to accommodate site traffic
C. Alternative improvements
D. Status of improvements already funded, programmed or planned
E. Evaluation

XII. Findings

A. Site accessibility
B. Traffic impacts
C. Need for any improvements
D. Compliance with applicable codes

XIII. Recommendations

A. Site access/ circulation plan
Site access
On -site circulation and parking
Off- site circulation
B. Roadway improvements (Preliminary drawings showing improvements)
On -site
Off -site
Phasing

APPENDIX 'A'

LOS ANALYSIS SUMMARY TABLE

MAJOR ROAD @ MINOR ROAD

PM Peak

	Existing Year				Horizon Year					
APPROACH LANES	**Background**		**Background w/ Imp.**		**No Build**		**Build**		**Build w/ Imp.**	
	LOS	**DELAY**	**LOS**	**DELAY**	**LOS**	**DELAY**	**LOS**	**DELAY**	**LOS**	**DELAY**
EB LEFT	C	30.4	B	18.6	D	52.6	F	81.4	D	54.6
EB THRU/RIGHT	C	26.6	C	26.6	D	39.0	E	63.0	D	43.9
EB APPROACH	C	28.2	C	23.3	D	44.6	E	69.3	D	47.6
WB LEFT	B	15.7	B	15.7	C	27.2	D	37.3	C	25.3
WB THRU/RIGHT	F	1,313.0								
WB THRU			C	28.9	D	41.7	F	91.4	D	54.5
WB THRU										
WB RIGHT ONLY			D	42.4	E	58.2	C	24.3	C	29.7
WB APPROACH	F	1,166.0	C	33.4	D	47.7	D	50.1	D	38.2
NB LEFT	B	13.4	B	13.4	B	18.9	B	18.3	B	19.5
NB THRU	C	29.6	C	29.6	D	45.2	E	70.2	D	48.2
NB THRU/RIGHT										
NB APPROACH	C	27.7	C	27.7	D	42.1	E	64.2	D	44.9
SB LEFT	D	52.6	D	42.4	D	54.9	F	101.8	E	64.7
SB LEFT										
SB THRU	C	31.0	C	31.0	D	47.0	E	63.6	D	46.1
SB THRU/RIGHT										
SB APPROACH	D	39.6	D	35.5	D	50.1	F	82.7	E	55.4
TOTAL INTERSECTION	F	370.6	C	31.3	D	46.8	E	66.1	D	46.4