

# CHAPTER 4 TRAFFIC IMPACT STUDIES

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CHECKLIST 4 - TRAFFIC IMPACT STUDY

## **4.1 PURPOSE**

The purpose of this document is to outline a standard format for preparing a Traffic Impact Study (TIS) in the Town of Breckenridge.

A Traffic Impact Study assesses the effects of a proposed development on the Town's transportation system. The study identifies if the transportation system can operate efficiently with the development, if there are existing conditions that need to be improved, or if improvements are required to mitigate site impacts.

The owner/developer of a project site is responsible for contracting a traffic consultant to assess project traffic impacts and for providing any necessary mitigation measures as part of the development, when required by Section 4.3 of these Standards.

The requirements listed in this document are applicable for all developments in the Town of Breckenridge. In addition to the requirements of this document, owners/developers with sites having access to or within the influence area of a State Highway (for example SH 9) must contact the Colorado Department of Transportation (CDOT) for specific requirements related to access permits, construction permits, or work in the CDOT right-of-way.

Development and installation of pedestrian systems which integrate with existing and future Town pedestrian systems and with the systems of adjacent developments is required. This will include the provision of sidewalks, where required, and the provision of pedestrian walkways pursuant to the Town trails plan.

It is the policy of the Town to require bicycle and pedestrian paths to be dedicated to the Town as a component of the town's alternative transportation network and to provide recreational opportunities. Subdivision proposals shall include, as a component of the required public improvements, a pedestrian and bicycle path system designed to preserve existing paths, integrate with existing improvements, and provide service appropriate to the character and magnitude of the proposed development.

The inclusion of or the contribution to a permanent nonauto transit system, designed to facilitate the movement of persons to and from Breckenridge or within the Town, is strongly encouraged. Nonauto transit system elements in the Town of Breckenridge include, but are not limited to, buses and bus stops, transit shelters, both public and private, gondola lifts, ski lifts, surface lifts, trams, bicycles, electric bicycles, and other alternative transit systems that have the primary purpose of providing access from high density residential areas or major parking lots of the Town to other destinations of the Town. Any development which interferes with the community's ability to provide nonauto oriented transportation elements is discouraged.

## **4.2 REFERENCE DOCUMENTS**

Any new infrastructure or modifications to existing infrastructure and any new development plans shall be in accordance with the most current adopted version of the Town's Related Planning Documents. Traffic references used in the traffic impact study shall be the most current version available, unless otherwise authorized by the Town Engineer.

### **4.2.1 Related Town Planning Documents**

See Chapter 1, Section 1.1 of these Standards.

### **4.2.2 Traffic References**

1. ITE Trip Generation Manual, 10th Edition, Institute of Transportation Engineers, 2017
2. ITE Trip Generation Handbook, 3rd Edition, Institute of Transportation Engineers, 2017

3. Highway Capacity Manual, 6th Edition: A Guide for Multimodal Mobility Analysis, Transportation Research Board, 2016
4. State Highway Access Code, State of Colorado, March 2002
5. Manual on Uniform Traffic Control Devices, 2009 with Revisions 1 and 2, Federal Highway Administration, May 2012

### **4.3 THRESHOLDS REQUIRING A TRAFFIC IMPACT STUDY**

A Traffic Impact Study may be required as part of the submittal documents for annexation, development plan, final development plan, rezoning, plat, reuse/remodel, or other development application. To determine whether a Traffic Impact Study is required, as well as the category of study, the applicant must first estimate the number of peak hour trip ends generated by the development. A vehicle that stops at a gas station, for example, results in two trip ends at the development: one entering trip and one exiting trip.

A Traffic Impact Study is required for any development, redevelopment, reuse, or remodel that increases peak hour traffic by more than 10 trips. Developments increasing commercial gross floor area by 1,000 square feet or the number of residential/lodging units by 10 may exceed this trip threshold. A Traffic Impact Study is also required where any of the following conditions exist:

1. The site increases peak hour traffic volume by more than 20% at a point of State Highway access
2. The site is part of a larger development
3. Site-specific traffic issues require evaluation, as so determined by the Town Engineer
4. Project study area includes an intersection with planned improvements such as:
  - a. South Park Ave/Main Street
  - b. Park Ave/Village Road
  - c. Park Ave/French Street
  - d. Park Ave/Airport Road
  - e. SH 9/CR 450
  - f. SH 9/Ridge Street

#### **4.3.1 Study Not Required**

A site expected to generate 10 or fewer trips per hour. Typical examples include single-family developments with fewer than 10 homes, a 5,000 square foot office, or a 2,000 square foot retail establishment (not including gas stations, restaurants, or the like).

#### **4.3.2 Trip Generation Letter**

A site expected to generate more than 10 and less than 25 trips per hour. Typical examples include single-family developments with fewer than 20 homes, an office of less than 6,000 square feet, or a retail establishment of less than 5,000 square feet (not including gas stations, restaurants, convenience stores, auto washes, or other services expected to generate more than 10 trips per hour).

In areas that have not been recently studied or located in an area with planned road improvements or identified potential lane additions, a Short-Term Traffic Study may be required.

#### **4.3.3 Short-Term Traffic Impact Study**

A site generating between 25 and 50 trips in the peak hour. The site will typically be developed in a single construction phase with anticipated completion in less than three years from the time of development plan approval. Short-term traffic studies shall be required to evaluate traffic conditions at year-of-opening, and 5 years post-development. Typical examples include single-family developments of approximately 30 homes, an office or retail establishment of 10,000 square feet.

#### **4.3.4 Long-Term Traffic Impact Study**

Development sites generating over 50 trips in the peak hour or sites that are developed in more than one phase. For phased development, a master traffic study will be prepared prior to the first phase of development and a build-out period not longer than 20 years should be assumed. All subsequent phases will need to prepare a trip generation letter comparing the proposed development with the development type and density projected for the site in the master study. The letter may need to include additional analysis if there is a significant difference between the original development concept and the newly proposed development.

In addition to meeting all the requirements for a short-term traffic study, a long-term traffic study shall evaluate traffic conditions 20-years post-development.

Typical examples include single-family developments with over 50 homes and an office or a retail establishment greater than 12,000 square feet.

The Town Engineer may require long-term traffic studies for developments smaller than the thresholds listed above, depending on the size, location, and type of development.

### **4.4 TRAFFIC IMPACT STUDY REQUIREMENTS**

When a Traffic Impact Study is required it shall be included with the development application. Studies will not be accepted prior to development application. After the Town's initial review of the draft study, the traffic professional shall address Town comments and submit a final study for Town approval. The final Traffic Impact Study shall include the PE's stamp, date, and signature. The final Traffic Impact Study must be approved by the Town Engineer prior to Issuance of an infrastructure or building permit.

If the development application includes a proposal for an uncontrolled or mid-block pedestrian crossing, the traffic study shall include a pedestrian traffic analysis as described in Section 5.14.

Submit one PDF electronic copy of all final traffic impact studies to the Engineering Division.

For sites with access to or within the influence area of state highways, the applicant is also required to contact CDOT for requirements and to get approval for the project from CDOT.

<https://www.codot.gov/business/permits/accesspermits/regional-offices.html#Region2-3>

#### **4.4.1 Traffic Impact Study Submittals**

A checklist is provided in Chapter 2 of these Standards that delineates the requirements of the Traffic Impact Study. Not all study elements will be required for every traffic impact study. Content must be specific to the situation and determined based on professional engineering judgment. Where content is specific to a traffic impact study type, that is identified in the checklist.

#### **4.4.2 Land Use Scenarios**

Required land use scenarios for the short- and long-term traffic impact studies are summarized in the following:

#### **4.4.2.1 Short-Term Traffic Impact Study**

Year of Opening w/o Development: This scenario represents area land use as it presently exists. The purpose of this scenario is to identify existing deficiencies and to provide a baseline for comparison with the scenario that includes development.

Year-of-Opening w/Development: This scenario represents area land use as it is projected to exist upon year-of-opening of the development, plus the inclusion of the development. The purpose of this scenario is to identify traffic conditions as they are anticipated to exist with the development.

5-Year Horizon w/o Development: This scenario represents area land use as it is projected to exist at the study's horizon year (5 years), without the development. The purpose of this scenario is to identify anticipated transportation deficiencies and to provide a baseline for comparison with the scenario that includes development.

5-Year Horizon w/Development: This scenario represents area land use as it is projected to exist at the study's horizon year (5 years after year of opening) plus the inclusion of the development. The purpose of this scenario is to identify traffic conditions as they are anticipated to exist with the development upon full-build out.

#### **4.4.2.2 Long-Term Traffic Impact Study**

Year of Opening w/o Development: This scenario represents area land use as it presently exists. The purpose of this scenario is to identify existing deficiencies and to provide a baseline for comparison with the scenario that includes development.

Year-of-Opening w/Development: This scenario represents area land use as it is projected to exist upon year-of-opening of the development, plus the inclusion of the development. Only the parts of development expect to be complete upon opening year shall be included in the analysis. The purpose of this scenario is to identify traffic conditions as they are anticipated to exist upon the opening of the development.

5-Year and 20-Year Horizon w/o Development: These scenarios represent area land use as it is projected to exist 5 and 20 years after the opening year of the development if the development were not built. The purpose of these scenarios is to identify anticipated transportation deficiencies expected to occur regardless of the development, and to provide a baseline for comparison with the scenarios that include the development.

5-Year and 20-Year Horizon w/Development: These scenarios represent area land use as it is projected to exist 5 and 20 years after the opening of the development. The 5-year scenario will include the parts of the development expected to be complete 5 years after of year of opening, while the 20-year scenario will include the parts of the development expected to be completed 20 years after year of opening (typically this represents full build-out). These scenarios will be compared to the 5-year and 20-year horizon without development scenarios to assess the effects that the development will have on the traffic conditions.

#### **4.4.3 Analysis Periods**

Conceptually, the design hourly volume for transportation systems is based upon the 30<sup>th</sup> highest hour of the year. In other words, the traffic volumes used in the study should be sufficiently conservative to ensure that most of the time actual traffic conditions are anticipated to be less than those described in the traffic study. For this reason, traffic data taken off-peak must be factored to peak conditions as described in Section 4.5.1.

With respect to times-of-day, the most important time periods to analyze in the Town of Breckenridge are the weekday PM Peak hour, Saturday AM Peak Hour, and Saturday PM Peak Hour.

In addition to the peak hour, an analysis period should be completed for approximately the median hour in Breckenridge (the hour represent the average traffic volume on a non-peak hour). When comparing traffic conditions and proposed improvements, the peak hour and median hour shall be analyzed for LOS, safety, and other factors. One traffic solution may provide benefits at the peak hour, while a different solution provides benefits at the median hour, resulting in an analysis to compare the benefits and which solution is more favorable when considering all traffic conditions.

#### **4.4.4 Study Area**

The study area should include all intersections and access points that may experience a change in traffic operations due to the project. This typically includes all site access points, adjacent local intersections, and the nearest highway intersection(s) used by the generated trips to go to/from the site. If the generated trips are projected to increase a turning movement at a more distant intersection enough to potentially effect overall intersection operations, that intersection shall be analyzed as well.

#### **4.4.5 Multimodal**

The traffic study should consider not only potential impacts for motorized traffic, but also whether there are impacts to existing nonauto modes including pedestrian, bicycle, and transit. This section of the report should identify the potential for the project to generate nonauto traffic and to evaluate whether nonauto traffic can be accommodated by the existing environment.

In the multimodal analysis, the study should describe how the site provides opportunities for pedestrians, bicycles, and transit, and also include demand management strategies when relevant. The extent and type of existing and planned infrastructure required for multimodal connectivity to the site, such as sidewalks, trails, transit stops/routes, and alternative modes of transportation, should also be described. The multimodal Level of Service (LOS) for the site should be calculated as described in Section 4.5.4. Where multimodal LOS is not acceptable, the study should recommend on or off-site improvements that can be made to improve LOS. Off-site mitigation shall be consistent with street standards and planning documents referenced in Section 4.2.1.

#### **4.4.6 Impact Analysis**

This portion of the study evaluates the impacts that the traffic generated by the project will have on the community. In accordance with Town policy, developments which will generate a volume of vehicular trips which exceed or disproportionately consume the capacity of the external circulation system may have conditions imposed which address the need to provide sufficient traffic carrying capacity to meet this excess demand. This may include a requirement to either provide the necessary improvements at time of development or at some later date, including participating in Improvement Districts, if applicable.

Where the LOS falls below acceptable levels, mitigation will be required. Acceptable mitigation measures may include capacity and access improvements, signalization, signal operation improvements, street widening, additional connections, or other physical improvements. Where existing conditions prevent physical improvements (i.e., steep terrain, adjacent buildings, limited right-of-way, etc.), a project may be required to reduce density, implement transportation demand management (TDM) measures to minimize the demand for vehicle trips and encourage alternate mode use, and/or provide cash-in-lieu of the improvement as described in Section 4.5.7. The TDM strategies may include incentives for carpooling, transit ridership, enhanced bicycle or pedestrian facilities, provisions for telecommuting, or addition of use mixes to increase internal trips.

In addition to evaluating transportation facilities external to the development, the Traffic Impact Study shall include a discussion of the adequacy of the site accesses to accommodate projected site traffic. This may include but not be limited to a review of vehicle turning paths, stacking distances, and the design layout's ability to control speeds and provide safe and efficient circulation.

#### **4.4.7 Existing Street and Access Analysis**

This portion of the study shall evaluate the condition and configuration of the existing street providing access to the development. This section shall analyze the street access for all requirements of Chapter 5 of these standards. These requirements shall include, but are not limited to, intersection geometry, sight distance, roadway horizontal and vertical geometry, street widths, street classifications, adjacent access spacing, roadway drainage, vehicle & pedestrian lighting, signage, pedestrian route, transit access, acceleration lanes, deceleration lanes, and clear zone widths.

The Town Engineer may require improvements to existing streets, due to development impacts to the streets, increased demand on existing improvements, or existing streets serving new developments not meeting current standards. Improvements may include, but are not limited to, intersection improvements, sight distance improvements, street widening, adjustments to horizontal and vertical street geometry, drainage improvements, vehicle and pedestrian lighting, signage, pedestrian routes, acceleration lanes, deceleration lanes, clear zone widening, shoulder improvements, and transit improvements.

Existing streets providing access to a new development must be upgraded to current standards if both of the following conditions are met:

1. The existing street does not meet current Town of Breckenridge Engineering Standards.
2. The proposed development will increase the Average Daily Traffic (ADT) of the street by 25% or more.
3. Or as directed by the Town Engineer.

Existing streets must also be upgraded to current standards if a development changes the street classification. An example would be a development increasing the volume of a roadway from a local street to a collector.

#### **4.4.7 Study Findings**

This portion of the study provides an overview of the conclusions reached based upon the data and analysis performed and the professional engineering judgment of the author. It includes a factual restatement of the study's primary findings, including summaries of:

1. Development characteristics, including type and density of land use, hours of operation (if known), means of vehicular access, plan for implementation, and any other relevant data or information
2. Existing traffic conditions at study area intersections for each analysis period, including identified LOS, safety, or other operational deficiencies (auto as well as nonauto)
3. Development traffic generation, for peak hours as well as over an average weekday and weekend day for each development phase
4. Traffic impacts of the development, including identification of locations requiring mitigation to address existing or proposed LOS, safety, or other operational deficiencies
5. Extent to which study recommendations address development traffic impacts and existing or proposed deficiencies

#### **4.4.8 Recommendations**

Include a list of any improvements needed or proposed, noting who will construct and fund the improvements. Identify if right-of-way is available or is needed to construct the improvements.

Clearly identify study recommendations, including:

1. Proposed mitigation to address identified impacts
2. Other mitigation as identified
3. Improvements needed but not proposed by development

**4.4.9 Certification**

A short-term or long-term Traffic Impact Study shall be prepared under the responsible charge of a traffic engineer. A trip generation letter may be prepared under the responsible charge of any engineer familiar with procedures for using the *Trip Generation Manual* published by the Institute of Transportation Engineers. All traffic studies and letters shall be sealed and signed by a professional engineer licensed in the state of Colorado.

**4.5 TECHNICAL GUIDELINES**

**4.5.1 Data Collection**

The Town Engineer shall be notified at least five (5) calendar days in advance of the proposed locations, days of week and times of day that data will be collected. A Town Right-of-Way Permit shall be obtained prior to placing tubes, cameras, or any other equipment or materials in the right-of-way. Town staff will inform the applicant of any activities that may render the counts invalid such as school holidays, road work, local festivals, or other reasons, in order that the applicant may come up with an alternative plan. Tube counts are not permitted between Labor Day and Memorial Day and may otherwise only occur with prior approval of the Town Engineer.

New traffic counts shall be taken in locations where existing traffic counts are missing or over two years old. Intersection turning movement counts (a record of all vehicle movements including U-turns, left-turns, through movements, and right-turns) should capture the time periods expected to have the highest volumes, typically the weekday PM peak (4-6 PM), and the Saturday AM (8-10 AM) and PM (3-5 PM) peaks. If the changes proposed by the traffic study will have the greatest impact on traffic operations during a time period other than the typical peaks, or the highest overall network volume is expected to occur in a different time period, additional turning movement counts shall be collected during those periods. Turning movement counts shall include pedestrians and bicyclists.

Traffic volumes in Breckenridge are highly seasonal, with the winter and summer months traditionally having the highest volumes. Traffic counts shall be factored to reflect conditions typical to the month of January using the Town’s ADT conversion table. This table was developed using CDOT Count Station Data for CO-9. To account for changing traffic patterns throughout the year, a separate factor shall be used for each time period (e.g., traffic counts taken during the AM and PM time periods on a Saturday in May would be multiplied by 2.37 and 2.04, respectively, to reflect volumes typically seen in January). Several types of developments, such as schools or athletic fields, often see peak volumes outside the network peak hours. If, for example, a school is being analyzed, the traffic counts shall be conducted during the school’s arrival and dismissal time. If a traffic count is taken outside of one of the specific time periods shown in the table below, the counts shall be multiplied by the monthly average shown in the chart below. Continuing with the example of a school, a count taken between 2:00 and 3:00 PM on a weekday in April would be multiplied by 1.34 to approximate that same time period during a peak season (January) school day.

**Table 4.1. Monthly ADT Data Conversion Table**

Month	Saturday AM	Saturday PM	Weekday PM	Monthly Average
January	1.00	1.00	1.00	1.00
February	1.00	1.00	1.00	1.01

March	1.13	1.14	0.95	1.02
April	1.64	1.67	1.26	1.34
May	2.10	1.98	1.32	1.45
June	1.61	1.48	1.08	1.14
July	1.32	1.20	0.95	0.96
August	1.37	1.18	0.95	0.99
September	1.53	1.23	1.02	1.07
October	2.04	1.59	1.14	1.30
November	1.57	1.49	1.18	1.28
December	1.27	1.13	1.01	1.06

Per Highway Capacity Manual (HCM) recommendations, a peak hour shall be modeled for each time period analyzed. For studies containing multiple intersections, a system peak hour shall be selected when an intersection affects operations at adjacent intersections (e.g., coordinated signals, travel times runs, microsimulations). Individual peak hours should be used in networks where intersection operations have minimal effects on the operations of nearby intersections (e.g., stop-controlled intersections, non-coordinated signals, roundabouts). The selected peak hour should represent the hour with the worst traffic operations for the study area, typically the hour with the highest total traffic volume. If the primary focus of the traffic study is to analyze side street operations, or a critical movement whose peak may not coincide with the intersection peak (e.g., school, event hall), the selected peak hour should be based on that movement(s) highest volume, rather highest overall volume. A separate peak hour factor (PHF) shall be used for each intersection approach when possible. If the PHF is not available, a default of 0.92 shall be used. Section 4-3 of the HCM 6<sup>th</sup> Edition should be referenced for further clarification of the peak hour factor.

#### 4.5.2 Trip Generation

Trip generation shall be calculated using the most recent version of the Institute of Transportation Engineers (ITE) Trip Generation Manual. Parts of the procedure discussed in this section cannot be completed with a ITE Trip Generation Manual older than the 10<sup>th</sup> Edition. For developments within downtown Breckenridge, the “dense multi-use urban” setting/location should be used, and for developments in more isolated locations, the “urban/suburban” setting/location should be used. If a land use option does not have a setting/location option, the default shall be used. The trip rate equation shall be used when provided, otherwise, the flat rate shall be used. The trip generation summary shall include weekday AM and PM data, as well as data for the Saturday peak period. If the exact land use of a development is not included in the ITE Trip Generation Manual, a comparable land use should be used. If the ITE Trip Generation Manual does not contain a comparable land use, other sources may be used, such as previous traffic studies or traffic counts at a similar development.

Capture trips are trips that visit multiple land uses in the same development during the same outing. In locations where this is a frequent occurrence, the number of capture trips shall be calculated and incorporated into the trip generation calculations to avoid double counting trips. Engineering judgment shall be used to determine whether a development will have capture trips (e.g. hotel & restaurant), or whether each land use will generate its own trips independently (e.g. office building & movie theatre). A spreadsheet tool which performs many of the required capture trip calculations can be downloaded in the Trip and Parking Generation section of the ITE website. Some of the land uses in the ITE Trip Generation Manual already account for capture trips, such as shopping centers or office parks with retail. In the cases where the land use from the Trip Generation Manual is mixed use, it is not necessary to calculate the number of capture trips.

Pass-by trips are defined as vehicles that stop at a development on the way to their destination without changing their originally planned route. Gas stations are an example of land uses with high

percentages of pass-by trips. While pass-by trips are added to the volume entering and exiting a site, they are not to be added to the traffic volume along the adjacent road, as they would have been traveling on that road anyway. If a development is expected to attract a high percentage of pass-by trips, a reduction factor should be applied to the generated trips on the adjacent roads. The reduction can be found in Chapter 10 of the ITE Trip Generation Handbook.

### 4.5.3 Trip Distribution

The distribution of site generated trips shall be based on existing turning movement data or link volumes on the adjacent roadways. In cases where trip distribution is expected to differ from the existing trip distribution through the network (e.g. if a school is located on the edge of the school zone, trips to and from the school will not follow the same directional patterns as network traffic), engineering judgment is to be used. If the trip generation calculations incorporate captured trips or pass-by trips, these assumptions shall be reflected in the trip distribution.

### 4.5.4 Multimodal

When evaluating operations at a signal with pedestrian crossings, the crossing times shall be compliant with the pedestrian clearance interval requirements outlined in the *Manual on Uniform Traffic Control Devices* (MUTCD). In a coordinated signal network, if there are two or more pedestrian crossings on one leg in an hour, the signal timings should be such that a pedestrian crossing will not force the signal out of coordination.

If the location of a development offers multimodal options of transportation (e.g., bus routes, bike paths/sidewalks, etc.), a portion of the trips generated from the site will likely use multimodal forms of transportation, thus reducing the number of vehicle trips generated. Selecting the appropriate setting/location in the ITE Trip Generation Manual (e.g., general urban/suburban, dense multi-use urban, center city core) will account for this. If a development is planned in an area with easy access to multimodal transportation, and the projected number of generated trips came from outside the ITE Trip Generation Manual without a multimodal factor, a multimodal reduction rate shall be used. These rates can be found in ITE Trip Generation Manual and reduce the number of vehicle trips by a factor that is specific to the location and the development, as some types of developments are more likely than others to generate multimodal trips. Prior to using the multimodal reduction rates, engineering judgment should be used to determine whether a development is in a location, and is the type of development, to generate multimodal trips. The use of a vehicle reduction rate shall be documented.

To fully account for the multimodal function of the transportation system, LOS beyond those calculations described in the *Highway Capacity Manual* shall be considered along development sites and for transportation facilities. New development shall have a minimum multimodal LOS C. LOS D – F shall not be acceptable. While LOS C is acceptable for multimodal LOS, site development should target the best LOS achievable. The site pedestrian and transit LOS shall be evaluated using a directness ratio, as follows:

$$D = (W + U)/C \quad (4.1)$$

Where:

D = the site's directness ratio

W = the total walking distance along a trail, public street, or sidewalk from the site's entrance or furthest building to the destination

U = the distance along the walking route not designed for pedestrians. This includes areas where the pedestrian must walk in the street or shoulder, along unpaved or rough paths, paths less than 4 feet wide, and unmarked crossings of vehicular travel ways

C = the straight-line distance from the site's entrance or furthest building to the destination

The directness ratio for residential or lodging sites will be measured to the nearest public school, park, or restaurant. For all other uses, the directness ratio will be measured to the nearest public multi-use trail or sidewalk. The directness ratio for Transit LOS will be measured to the nearest transit stop. The resulting LOS from the site directness ratio calculation is shown below. LOS is F where the walking distance exceeds ½ mile, regardless of the site directness ratio.

**Table 4.2. Site Directness Ratio**

Pedestrian and Transit Level of Service	Site Directness Ratio
A	≤ 1.2
B	>1.2 – 1.4
C	>1.4 – 1.6
D	>1.6 – 1.8
E	>1.8 – 2.0
F	>2.0 or walking distance greater than ½ mile

Bicycle LOS shall be evaluated by evaluating the Level of Traffic Stress (LTS) for each street or trail running along and internal to the site. LTS for each facility is rated from 1 to 5, with 1 meaning that there is low stress for cyclists and 5 meaning that it is a high stress environment. The road characteristics for each LTS is shown in the table below:

**Table 4.3. Bicycle Level of Traffic Stress (LTS)**

Level of Traffic Stress	Shared Lanes	Bike Lanes	Trails
1	2 lanes <2k ADT ≤ 25 mph	2-3 lanes ≤ 25 mph	Greenway
2	2 lanes 2-4k ADT ≤ 30 mph	2-3 lanes ≤ 30 mph	Sidepath (low ped volume)
3	2 lanes 4-6k ADT ≤ 35 mph	3-4 lanes ≤ 35 mph	Sidepath (high ped volume)
4	≥ 3 lanes > 6k ADT > 35 mph	> 4 lanes > 35 mph	
5	≥ 4 lanes > 6k ADT > 40 mph	> 4 lanes > 40 mph Bike lane < 4 ft	

Once LTS has been evaluated, the LOS will be determined by the length weighted average of the facilities along the site. For example, assume a particular site has a roadway bordering it on two sides. One of the roadways fronts 150-ft of the site and is a two-lane local road with 25 MPH speed limit and an Average Daily Traffic (ADT) of 1,500 vehicles per day. The other road fronts 100-ft of the site and is a four-lane collector with bike lanes and a posted speed of 30 MPH. The length weighted average LTS is:

$$[(150\text{-ft} \times 1) + (100\text{-ft} \times 3)] / (150\text{-ft} + 100\text{-ft}) = 1.8.$$

From Table 4.4 the bicycle LOS is C.

**Table 4.4. Bicycle LOS**

Bicycle Level of Service	Site Bicycle Level of Traffic Stress
A	1.0
B	>1.0 – 1.5
C	>1.5 – 2.0
D	>2.0 – 2.5
E	>2.5– 3.0
F	>3.0

#### 4.5.5 Traffic Forecasts

CDOT’s Online Transportation Information System (OTIS) count stations shall be used when forecasting the background growth for state highways.

<https://dtdapps.coloradodot.info/otis>

The ITE Trip Generation Manual shall be used to calculate the number of generated trips, which will be added to the background growth. When projecting background growth on Town roads, if the road is a through street, the OTIS growth rate for SH 9 may be used. If the road is not a through street, background traffic growth should be based on the trip generation potential for any undeveloped land or known planned development along the local road in addition to the OTIS growth rate for SH 9. For the purposes of this section, “through” streets connect to other roadways and therefore may experience traffic volumes that originate from outside the street in question. If no development (or redevelopment) is expected along a local road, the background growth may be assumed to be zero.

#### 4.5.6 Impact Analysis

Traffic analyses shall be conducted in accordance with procedures outlined in the Highway Capacity Manual, with the Level of Service (LOS) being the primary metric for evaluating intersection operations. LOS is a measure of the quality of traffic flow and ranges from LOS A (nearly ideal traffic conditions with very little delay for motorists) to LOS F (poor traffic conditions with long motorist delays). LOS C is typically considered a “good” traffic condition. LOS D or better conditions are typically desirable during peak traffic periods. A LOS of E or F during peak traffic periods is unacceptable for overall intersections; however, LOS E and F conditions are not uncommon for side street traffic movements at full movement, unsignalized intersections with high volume arterial roadways. In situations where a side street movement operates at LOS E or F, the volume to capacity (V/C) ratio shall be reported as well. If the side street is nearing or at capacity, mitigation measures shall be identified. The Town Engineer may require improvements to any street or intersection projected to operate at a LOS E or F, regardless of whether the movement is a side street. Additionally, the Town Engineer may require mitigation to any drop in LOS (e.g, a reduction from LOS A to LOS C).

A minimum of two future scenarios shall be modeled when assessing the impacts that a development or proposed roadway changes will have on traffic operations. A “w/o Development” scenario, analyzing traffic conditions without the changes proposed by the traffic study, will be compared to the “w/Development” scenario for the same year, analyzing traffic conditions with the proposed changes. If an intersection is expected to operate acceptably for the “w/o Development” scenario, but unacceptably for the “w/Development” scenario (e.g., a signalized intersection or roundabout operating at LOS E or F, or a stop-controlled intersection operating at LOS E or F as well as being near or at capacity), it is the responsibility of the developer to implement intersection improvements in order to ensure acceptable traffic operations at the intersections.

Short-term traffic studies shall be required to evaluate traffic conditions at year-of-opening and 5-years post-development. Long-term traffic studies shall evaluate traffic conditions at year-of-opening, 5-years post-development, and 20-years post-development. In addition, long-term traffic studies that include phased development shall evaluate traffic conditions at completion of each interim phase.

If an unsignalized intersection has high side street volumes, resulting in poor operational conditions, a signal warrant study shall be conducted in a manner consistent with procedures outlined in the MUTCD.

The need for auxiliary lanes on state highways shall be assessed in accordance with the State Highway Access Code requirements. Turning movements that meet the State Highway Access Code standards are required to have an auxiliary lane. If a movement does not meet the required volume, an auxiliary lane may still be installed, if deemed helpful to safety or traffic operations. On local roads, auxiliary lanes shall be installed in locations where they will provide a benefit to traffic operations or safety.

#### **4.5.7 Improvement Recommendations**

If the Town Engineer determines that the installation of a needed improvement is not feasible, a cash contribution determined based upon the magnitude of the development's impacts and the capital cost of the needed improvement shall be assessed. Feasibility shall be determined based on physical, schedule, and financial constraints, as well as consideration for other projects and proposed future improvements. The cash contribution shall be in lieu of the improvement and/or land dedications and in proportion to the impacts attributable to the development. A development's proportional share shall be determined by the percent of total trips triggering the need for an improvement that are made up of site generated trips (e.g., if there is a left turning movement of 14 vehicles per hour, warranting a left turn lane, and 7 of those trips are generated from the development, the developments share of the cost will be 50%). The higher percentage between the AM and PM peak hours will be used to determine the developments required contribution. A development's contribution towards a traffic signal will be determined by the percent of the total trips on the higher volume side street made up of development generated trips. If there is a free right turn lane, it may be excluded from the calculations. The higher percentage between the AM and PM peak hours will be used to determine the contribution.

Cash contributions shall be held by the town solely for the acquisition and improvement of transportation mobility (nonauto as well as auto) alternatives within the community. Because of the small size of the community, the provision of transportation mobility improvements anywhere within the Breckenridge Comprehensive Plan boundary shall be deemed to meet the needs of the proposed project.

#### **4.5.8 Intersection Improvement Recommendations**

If an intersection is forecasted to operate unacceptably and intersection improvements are required, the Town has a strong preference for the installation of roundabouts, mini-roundabouts, or other geometric treatments. If intersection improvements are required at an intersection identified in the 2017 Park Ave SH 9 Roundabout Modeling and Construction Feasibility Study, then the Developer will be required to construct improvements per the recommendations of that study.

Studies conducted by the Town and other agencies have identified many benefits of roundabouts, including:

- Roundabouts reduced injury crashes by 75 percent at intersections where stop signs or signals were previously used for traffic control (IIHS Study).
- Typical signalized intersections have 32 vehicle-to-vehicle conflict points and 24 vehicle-to-pedestrian conflict points. Typical roundabouts only have 8 vehicle-to-vehicle conflict points and 8 vehicle-to-pedestrian conflict points.

- Roundabouts are designed with geometric curves which force vehicles to reduce speeds through the intersection. At traffic signals, vehicles may speed up to “beat the light”, resulting in higher speeds and the potential for more serious collisions.
- Roundabouts often operate at a comparable or better level of service when compared to signalized or stop controlled intersections. Even at high traffic volumes, roundabouts permit traffic to continue moving instead of creating long stops and standing queues, as may be seen at signalized intersections.
- Roundabouts result in economic benefits for the Town, resulting in approximately \$10,000 of savings in maintenance and electrical costs when compared to a signalized intersection. Additionally, roundabouts do not suffer issues from power outages or malfunctioning due to weather.
- In many cases, roundabouts provide environmental and sustainability benefits by reducing stop and go conditions when compared to traffic signals and stop signs, resulting in less fuel consumption, vehicle wear, and improved air quality.
- Roundabouts provide aesthetic benefits by providing increased landscaped areas in intersections and providing a more natural aesthetic than traffic signals, helping to preserve and maintain the historic character of Breckenridge.