OPERATIONS & SAFETY EVALUATION QUESTION GUIDE
UPDATED: FEBRUARY 2025

OPERATIONS EVALUATION QUESTION GUIDE

LEVEL 1

1. Are there identifiable bottlenecks (recurring congestion) in the project area?

Guidance: This question helps identify specific bottlenecks in the area and initiates a discussion about where these bottlenecks originate from and how the project can address them. Field visits should be conducted to observe congestion and verify the data.

FHWA Guidance:
Congestion management Process (CMP): https://ops.fhwa.dot.gov/plan4ops/focus_areas/cmp.htm
Traffic Congestion and Reliability Report 2005-01: https://ops.fhwa.dot.gov/congestion_report/

Process: Review the Operational Level of Service (OLOS) web tool. Navigate to Use Case 1, Recurring Congestion (Bottleneck) tab or Use Case 2, OLOS Query by Time tab. Select the project corridor from the segment list or on the map to view congestion ratings for the selected segment(s). Or filter the selection menu by time period, bottleneck score (0-100), or OLOS category (I-IV) to display a list of TMC segments, sorted from worst to best regarding bottleneck congestion. The Bottleneck impacts are shown in red on the map. Bottleneck score ranges from 0 to 100, and OLOS categories range from I to IV. A score of 0 (OLOS Category I) indicates no bottleneck, while a score of 100 (OLOS Category IV) represents the highest level of bottleneck congestion and the greatest opportunity for improvements. For urban areas, a bottleneck score of 40 or higher is typically considered to experience consistent recurring congestion. CDOT HQ can assist with data analytics and other use cases if a deeper analysis is needed.

Documentation: Provide data output or screenshot of OLOS dashboard, or print out data if available.

SME Contacts: elena.farhadi@state.co.us or dot_tsmoevaluation@state.co.us

2. Are there recurring, daily congestion patterns, including segments with a concerning Bottleneck score or OLOS category?

Guidance: This question helps determine if the bottlenecks are consistent and occur with an expected daily pattern (such as weekday or weekend AM, PM, or mid-day peak periods) along the study corridor and whether the project is a valid candidate to mitigate or alleviate those congestion issues. The goal is to establish when traffic peaks occur on the corridor during a typical day, ensuring that traffic volumes during these periods are accommodated in the project design. It also identifies the time period(s) for which the traffic modeling may need to be conducted in the future. Field visits should be undertaken to observe the congestion and verify the data.

Process: Review the Operational Level of Service (OLOS) web tool. Navigate to Use Case 1, Recurring Congestion (Bottleneck), or Use Case 2, OLOS Query by Time, and filter the selection menu by Peak Period and Day of Week. This will display a list of TMC segments sorted by the worst bottleneck issues for the selected time period, day, or month within the selected year. A bottleneck score of 40 or higher and OLOS categories III or worse in urban areas are typically considered to have consistent and patterned recurring congestion. Alternatively, you can perform big data analysis using StreetLight, query and download peak period traffic volumes during the selected time range for the study area, and review the output data spreadsheets to identify the peak periods and volumes. CDOT HQ can assist with probe data analytics (such as StreetLight Data) and other use cases if a deeper analysis is needed.

Documentation: Provide output file or screenshot of OLOS dashboard, print out data showing the peak periods, or results of peak hour calculations from traffic counts, if applicable. Document all relevant peak hours, including AM, PM, Midday, Weekend, and other peak hours as appropriate.

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3. Are there directional peak-hour traffic volumes that reciprocate one another?

Guidance: This question aims to identify directional traffic flow patterns within the project area. Examples include weekday work trips, which typically flow in opposite directions during the AM and PM peak periods, and weekend recreational trips, where weekend AM and PM trips or Saturday AM and Sunday PM trips often reciprocate. The goal is to identify alternative strategies that improve traffic flow during these directional peak periods and evaluate their feasibility for implementation as part of the project. For projects that need modeling, field visits should be conducted to observe the congestion and verify data.

Process: Review using, Use CDOT OTIS or MS2SOFT to identify count station IDs and obtain the latest AADTs and directional distribution (DD). For continuous count stations, export one or more months of data to Excel and create a heat map to identify peak traffic month, day, and time. Export the available data to Excel or take screenshots for short-duration count stations. The DD (or D%) values between 50-60 indicate directional peak-hour traffic volumes that reciprocate one another. If OTIS or MS2SOFT traffic data is outdated (older than 2 years), consider requesting new traffic counts. Alternatively, you can analyze big data using a CDOT StreetLight Data subscription by querying the traffic volume probe data for the required months, days, and hours, downloading the output spreadsheets, and analyzing the overall data to identify the peak periods and volumes. CDOT HQ can assist with big data analysis.

Documentation: Provide output files or screenshots of OTIS and/or MS2Soft, output and analysis files of StreetLight data listing the directional traffic volumes during peak periods, or results of calculations from field traffic counts.

4. Are there historical trends of peak-period congestion?

Intent: This question aims to identify if the reported peak period congestion follows a recurring and expected pattern from previous years or if it has emerged due to changes, such as new developments or recent infrastructure improvements, that have impacted traffic patterns and contributed to this congestion. Understanding the underlying causes and patterns of the congestion will help determine if this type of congestion can be addressed through design modifications or other mitigation strategies as part of the project.

Process: Review recent and historical traffic counts from OTIS or MS2Soft for peak times. Review the Operational Level of Service (OLOS) web tool, Use Case 1, Historical Trend analysis, and examine the congestion metrics of the project area during the peak periods for the current and past years to determine if peak period congestion has a historical trend.

Documentation: Provide output files or screenshots of OTIS and/or MS2Soft, output and analysis files of StreetLight data, or results of calculations from field traffic counts showing the historical traffic peak periods for the current and previous years. Document all relevant historic peak hours including AM, PM, Midday, Weekend, and other peak hours as applicable.

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5. Are there recurring, seasonal congestion patterns?

Guidance: Similar to Question 2, this question establishes regular and recurring congestion, but only those occurring outside daily peak periods and at varying times of the year within the project area. The goal is to identify if the project can implement strategies or improvements to mitigate these congestion issues.

Process: Review the Operational Level of Service (OLOS) web tool, navigate to Use Case 3, OLOS Query by Time tab, and examine Day of Week and/or Month of Year sub-tabs to plot relevant bottleneck categories and identify recurring seasonal (or periodical) congestions. Alternatively, big data analysis can be performed using StreetLight Data to obtain traffic volumes for selected days of the week and/or months of the year to identify patterns of recurring seasonal (or periodical) congestion. CDOT HQ can assist with big data analysis.

Documentation: Provide an output file or screenshot of OLOS UC 3 and/or OLOS UC 1 or a StreetLight traffic volumes output spreadsheet and analysis summary.

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6. Are there nonrecurring or special event congestion, including areas or segments with concerning PTI to TTI ratios (segments with unreliable travel times)?

Guidance: This question establishes if congestion occurs at relatively infrequent intervals and does not follow a consistent pattern. It initiates a discussion on if such congestion can be anticipated and mitigated as part of the project.

Background Information: The Travel Time Index (TTI) measures the average travel time during peak periods relative to free-flow conditions. A TTI value of 1 or less indicates no peak-hour congestion, while higher values signify greater congestion and increased travel delays during peak periods.

The Planning Time Index (PTI) quantifies the 95th percentile travel time during peak periods, capturing the worst 5% of travel times compared to free-flow conditions. For example, a PTI value of 1 indicates that travelers can expect to arrive without delay. In contrast, a PTI value of 2 suggests they should anticipate delays and plan for twice the free-flow travel time during peak hours.

The PTI-to-TTI ratio serves as an indicator of travel time reliability. The closer the PTI and TTI values, the more reliable the roadway segment. A PTI/TTI ratio of 1 or less signifies a reliable roadway, while higher ratios indicate greater travel time variability and, thus, unreliability of the segment.

Process: Review the Operational Level of Service (OLOS) web tool and navigate to Use Case 1, Nonrecurring Congestion tab. Select the study corridor(s) from the segment list or on the map to view congestion ratings (PTI/TTI ratio) for the selected segment(s). Or filter the selection menu by PTI/TTI ratio to display a list of TMC segments, sorted from worst to best, in terms of nonrecurring congestion.

Documentation: Provide an output file or screenshot of OLOS UC 1 or a brief summary of special event permits.

SME Contacts: elena.farhadi@state.co.us or dot_tsmoevaluation@state.co.us

7. Are there issues with specific turning movements?

Guidance: This question is to identify intersection approaches or turning movements with high traffic volumes that may require specific operational and safety considerations, such as signal re-timing, phase modifications, adjustments to cycle lengths and clearance intervals, and alternative intersection planning. The goal is to determine if the project can address operational issues such as long delays and queues and safety concerns such as inadequate clearance times, insufficient sight distance, high crash risks, high conflict points, low visibility, and inadequate accommodations for vulnerable road users.

Guidelines:

FHWA Proven Safety Countermeasures: Dedicated Left and Right Turn Lanes at Intersections
https://highways.dot.gov/safety/proven-safety-countermeasures/dedicated-left-and-right-turn-lanes-intersections

FHWA Proven Safety Countermeasures: Reduced Left-Turn Conflict Intersections
https://highways.dot.gov/safety/proven-safety-countermeasures/reduced-left-turn-conflict-intersections

CDOT Roadway Design Guideline (2023):
https://www.codot.gov/business/designsupport/bulletins_manuals/2023-cdot-roadway-design-guide

Process: On the Safety side, obtain crash data listing for the past 3 years (or 5 years if available) from the Vision Zero Suite (VZS) web tool, CDOT Statewide Crash Data (2007 - 2024) web page, or CDOT BEDST Crash Database. Review crash patterns at the intersection to see if they indicate significant issues related to a turning movement. If so, review turning movements as part of the Level 1 Safety analysis. Also consider turning movement volumes compared to the number of dedicated turn lanes provided to see if turn lanes provide adequate storage. Heavy truck turning movements may also indicate a need to improve the turning movement. On the operation side, review the Level of Service (LOS), delay, or queue (or any relevant MOE) from big data or project model, if available, to see any indication of poor traffic operation in specific approaches or movements due to TMCs. Alternatively, you can review the OLOS web tool to identify a high Travel Time Index (TTI) as an indicator of long delays. This helps identify intersection improvements that could be incorporated into the project, such as potential improvements to include signal timing, lane assignment etc.

Documentation: If found, describe safety issues related to turning movements and create a map, exhibit, or collision diagram to illustrate the issues. If available, provide MOE results from the model file or big data analysis spreadsheet. CDOT HQ can assist in big data analytics.

SME Contacts: Safety - david.swenka@state.co.us, Signals - david.craft@state.co.us, traffic - elena.farhadi@state.co.us

8. Are there opportunities to provide or improve the following features: Turn Around Points, Staging Areas, Debris Flow Areas, Avalanche Safety Zones, and slopes for vegetation maintenance?

Guidance: Projects should seek to incorporate improvements that would help with maintenance and emergency response when possible. This question pertains to mountainous or rolling terrain roadway segments where roadway geometry or terrain limits vehicle mobility in executing their purpose. Example: Do emergency or maintenance vehicles have turnaround points to allow quick response to a critical task? Example: Are there places outside of avalanche zones for refuge for vehicles.

Process: Review project scope and verify with *Region or Section Maintenance LTC Ops II*.

Documentation: If any of the listed features can be improved, document proposed improvements and create a map exhibit of improvements. Include supporting emails from maintenance (if a concern).

9. Are there lane geometry deficiencies, including shoulders, lanes, sight distance, curves, intersections, and accesses?

Guidance: The project should seek to incorporate safety improvements into the project scope when possible.

Process: Use OTIS/Google Earth maps, survey, or lidar data to check acceleration/deceleration lengths, passing lanes/zones, and sight distance and compare to current regulations. If no information is available, this may require a field visit. Reference CDOT Roadway Design Guide (2023) Chapter 3 and CDOT State Highway Access Code for lane geometry requirements. Projectwise and OnBase should have original plansets for many of CDOT's roadways that have the geometry data.

Documentation: If lane geometry deficiencies are present, create a map exhibit of deficiencies on a Google map, ArcGIS printout, or a white paper.

SME Contacts: Access Requirements (sight distance) - daniel.roussin@state.co.us , Roadway Geometry - Region Roadway Engineers and HQ Design Area Engineer - jerome.estes@state.co.us

10. Will the intersection(s) within the project area require a traffic study for signals, changes to operations, or new configurations?

Guidance: The project should review existing and future intersections to determine the possible need for installing new traffic signals, changes to existing signal operations, or other modifications of intersection control. Signalized intersections adjacent to the project may need to be considered for coordination purposes. Examples of changes to existing signal operations include but are not limited to a full re-timing, a change in sequence or phasing, the addition of a phase, protective-only left-turn phasing, and pedestrian or cyclist-exclusive phasing.

Process: Review intersections within and immediately adjacent to the project limits and consider the operational impacts of the project. Consider the project impact on user movement through each signalized intersection. Review any available tools, such as ATSPM, INRIX Signal Analytics, etc., to determine current signalized operations.

Documentation: A document that summarizes where a signal warrant analysis or ICAT evaluation may need to occur, proposed high-level changes in signal operations, and any performance metrics available for existing signalized intersections.

SME Contacts: Signals - david.craft@state.co.us, ICAT - elena.farhadi@state.co.us or

dot_tsmoevaluation@state.co.us

11. Will there be any significant operational or geometric changes to any intersection in the project limits?

Guidance: Examples of significant operational changes include changing lane assignments for vehicle movements or restricting a previously allowed movement. Examples of significant geometric changes involve adding a turn lane or adding through lanes on any approach.

Process: Discuss the operational deficiencies of intersections in the project area with the project manager and regional traffic operations engineers. If significant changes are made to any intersections, the Intersection Control Analysis Tool should be utilized in the Level 2 analysis to assess alternatives at the intersection.

Documentation: Describe operational deficiencies at the intersection that may require significant operational or geometric changes.

SME Contacts: elena.farhadi@state.co.us or dot_tsmoevaluation@state.co.us

12. Are there opportunities for Variable Speed Limits within the project limits?

Guidance: Variable Speed Limits (VSL) may be implemented on freeways with specific safety concerns to improve safety and increase throughput during weather events or congested periods.

Process: Review Chapter 2 of the Variable Speed Limit Guidelines (publication coming soon; reach out to SME with questions) for decision support for VSL projects.

Documentation: If a project would like to consider VSLs, submit documentation that VSLs are warranted per the decision support flowcharts (Figures 2 and 3 in the Guidelines).

SME Contacts: elena.farhadi@state.co.us or dot_tsmoevaluation@state.co.us

13. Can the current project incorporate signing and striping improvements (See CDOT Signing and Striping Standards)?

Guidance: Projects should seek to incorporate signing and striping improvements such as removing obsolete signs, replacing signs with substandard retroreflectivity, and repainting striping where it is faded into the project scope when possible.

Process: Review with Survey or Maintenance. If no information is available, this may require a field visit. See CDOT Signing and Striping Standards. If roadway improvements are made or proposed, regulatory and warning signs should be reviewed for potential replacement. Coordinate with Region Traffic Representative (TEs) as needed.

Documentation: If signing and striping improvements can be incorporated, document improvements and create map exhibits. Create a list of potential signs to be checked for age/night vision.

SME Contacts: Headquarters: esayas.butta@state.co.us or Region Traffic Maintenance Team.

14. Are there signs that are 7+ years old within the project limits and no region-wide sign project planned within one (1) year?

Guidance: Projects should seek to incorporate signing improvements such as removing obsolete signs or replacing signs with substandard retroreflectivity into the scope of the project when possible.

Review with Survey or Maintenance. If no information is available, this may require a field visit. See CDOT Signing and Striping Standards. If roadway improvements are made or proposed, regulatory and warning signs should be reviewed for potential replacement. Coordinate with Region Traffic Representative (TEs) as needed.

Documentation: If signing and striping improvements can be incorporated, document improvements and create map exhibits. Create a list of potential signs to be checked for age/night vision.

SME Contacts: Headquarters: esayas.butta@state.co.us or Region Traffic Maintenance Teams

15. Are there intersection or roadway geometry and cross-section elements that cause issues for unique users (frequent large trucks, trailers, RVs)?

Guidance: Projects should be aware of unique roadway users and document potential issues so they can be addressed early in the project lifecycle.

Process: Review Freight Corridors Map (requires ArcGIS login) and traffic projections for the percent trucks. Review project plans for any superelevation/roundabout features. Request check of turning movements from the PM. Coordinate with CDOT Freight Program Office Manager as needed.

Documentation: If potential issues for unique users exist document issues and create a map exhibit.

SME Contacts: Roadway Geometry - Region Roadway Engineers and HQ Design Area Engineer - jerome.estes@state.co.us

16. Has appropriate consideration been given to the tie-ins at each end of the project? Consider operations upstream and downstream of the project.

Guidance: Changes within a project area can impact adjacent roadway sections. Considering how a project will tie in early on in the project can avoid re-work in the later stages.

Process: Review for tie-ins for lane configuration, ties into existing roads, signal timing, etc., using OTIS/Google Earth maps. If no information is available, this may require a field visit.

Documentation: Provide brief descriptions of tie-ins' considerations and include map exhibits as needed.

17. Is there an opportunity to incorporate transit improvements (bus pullouts, concrete pads, etc.) with the project?

Guidance: Projects should seek to incorporate improvements that would improve access to transit for all users when possible.

Process: Review the local transit website for infrastructure.

Documentation: If there are opportunities to improve existing transit infrastructure, create a map exhibit to document the location and improvement type.

SME Contacts: Region Mobility Representatives and HQ Transit Representatives

18. Are there railroad crossings or facilities within the project boundaries?

Guidance: Railroad crossings can present unique challenges to a project during construction and traffic operations once constructed. It is important to start planning for those impacts early in the project lifecycle if a railroad is present.

Process: Review for railroad crossings using OTIS/Google Earth maps.

Documentation: If a railroad crossing is present, create a map exhibit to document the location.

SME Contacts: HQ Railroad Liaison - scott.hoftiezer@state.co.us

19. Is there on-street parking at the facility?

Guidance: On-street parking is an essential feature of many downtown areas to promote access but can create additional conflicts for multi-modal transportation system users. If on-street parking is present, the project should consider the impacts on multi-modal users and mitigate them where possible.

Process: Review on-street parking using OTIS/Google Earth maps. If no information is available, this may require a field visit.

Documentation: If there is on-street parking create a map exhibit of on-street parking locations (if a concern).

20. Will a temporary reduction of speed limit be required for work zones within the project limits?

Guidance: Temporary speed limit reductions are governed by Procedural Directive 1502.2, which must be followed for any temporary reductions to speed limits in work zones.

Process: Coordinate with the project designer and construction resident engineer to determine if a temporary speed limit reduction may be needed. Review Procedural Directive 1502.2 for requirements for the reduction of speed limits.

Documentation: If applicable, prepare Form 568: CDOT Temporary Speed Limit Reduction through the electronic 568 system.

SME Contacts: Region Traffic Engineers - Reach out to your region traffic engineer (PE III/PE II)

21. Are there elements of the project that warrant consideration of the CDOT Work Zone Safety and Mobility procedures as part of the scoping efforts?

Guidance: The CDOT Work Zone Safety and Mobility rules and procedures should be considered on all projects that will impact the roadway and require any type of lane closure. Transportation Management Plans are required on all projects with roadway impacts. The CDOT Work Zone Safety and Mobility can help you, the project manager and the designer through what procedures are needed on the project early in the scoping phase.

Process: Check to determine if a Traffic Management Plan (TMP) is anticipated with the PM. Review the Work Zone Safety and Mobility Rule (WZSM) document for more information. The flow chart on page 3 guides to identify significant projects that will require a TMP.

Documentation: If the project qualifies as a "significant" project per the WZSM, note that a TMP is required. Submit TMP documentation. Coordinate with *Regional Traffic Engineers* as needed.

SME Contacts: Headquarters: esayas.butta@state.co.us or benjamin.acimovic@state.co.us or Region Traffic Maintenance Teams

22. Are there opportunities or need for multiple phases or work zones during construction?

Guidance: Multiple phases or concurrent multiple locations on a construction project can be challenging for one traffic control supervisor to manage. There are options if the project manager/designer anticipates needing more than one TCS and wants to incorporate it into the plans and specifications.

Process: Consider the scope of construction work at the scoping meeting or at a separate meeting with the project manager and/or designer. Ask if the construction work will have multiple concurrent work locations or if the project will have multiple phases or lane closures that could require more traffic control maintenance and operation than a typical project. Acquire the appropriate specification and add it to the FIR specification package.

Documentation: Utilize the Revision to 630 Traffic Control Management (Special) specifications. Follow the instructions on the project's special specification that fits the project and recommend them to the project manager as part of the specifications package.

SME Contacts: Headquarters: esayas.butta@state.co.us or benjamin.acimovic@state.co.us

23. Are there opportunities to deploy Smart Work Zone devices during construction?

Guidance: Smart Work Zone (SWZ) implementations are relatively new (Twin Tunnels 2012 and I-25 Gap 2016) to CDOT and have only been deployed on major projects. SWZ device and SWZ system specifications are available for the project to utilize. Most projects will only use the SWZ device specification that can be scaled to any project size. The SWZ system specification should only be used on projects that need numerous devices, subsystems that need software for control and operation, data analytics, traffic control centers, and/or a project need.

Process: If there are opportunities to deploy SWZ devices during construction, the project manager/designer should work with the region traffic engineer and HQ traffic support staff to step through the SWZ Analysis Tool. If the summary indicates that one or both specifications should be utilized, the project team should notify ITS as part of the first SEA document required on every project.

Documentation: A completed SWZ Analysis Excel tool summary printout, specification drafts, and the required SEA project documentation are required and should be filled out as soon as the scoping meeting for project incorporation.

SME Contacts: Headquarters: esayas.butta@state.co.us or benjamin.acimovic@state.co.us

24. Are there bicycle and pedestrian users present that require analysis (known issues, population and/or job centers, disproportionately impacted populations, nearby schools, trails, public lands)?

Guidance: Projects should seek to incorporate improvements that would improve access and safety for multi-modal transportation system users when possible.

Process: Review local land uses, local plans for proposed bicycle/pedestrian improvements, and traffic counts that include bicycle and pedestrian data. Review High Demand Bicycle Corridors of Colorado map, a Tier 1 or Tier 2 corridor indicates significant bicycle usage. Review Access Control Plans (ACP). Coordinate with *CDOT Bicycle and Pedestrian Program* and *Regional Traffic Representatives* as needed.

Documentation: If applicable, create a map exhibit of existing facilities or ACP.

SME Contacts: Primary Contacts: Region Bike/Ped Representatives

25. Does the project intersect with a recognized local, regional, or national bicycle route?

Guidance: Projects with a bicycle route in the project area may need special accommodations during construction to ensure bicyclists are provided with a safe alternative during construction. Project designers should also be aware of bicycle routes and strive to provide safe connections to the bicycle route as part of the project when possible.

Process: Review local and statewide transportation plans for mention of bicycle routes. Coordinate with *CDOT Bicycle and Pedestrian Program* and *Regional Traffic Representatives* as needed.

Documentation: If applicable, create a map exhibit of existing bicycle routes.

SME Contacts: Primary Contacts: Region Bike/Ped Representatives

26. Are there no immediate adjacent options for local bike-ped traffic, or does the project impact established bicycle, pedestrian, and/or ADA traffic and/or existing facilities?

Guidance: Bicycle, pedestrian, and ADA/pedestrian traffic can be highly impacted by CDOT or local agency construction work. CDOT is legally required to maintain bicycle, pedestrian, and ADA access during construction. If the project impacts established bicycle, pedestrian, or ADA traffic, accommodations like pilot cars,

Process: Bicycle, pedestrian, and ADA/pedestrian traffic data should be obtained through CDOT data sources or counted during field visits. The Colorado Bicycle & Byways Map, CDOT Windshield, and OTIS data can also be utilized.

Documentation: Project documentation can include printouts from data sources, field maps, traffic counts, and other information about ADA accessibility.

SME Contacts:HQ: Primary Contacts: Region Bike/Ped Representatives

27. Is the project on an uphill or downhill roadway?

Guidance: Projects on roadways with a significant grade require additional planning to accommodate bicycle and pedestrian detour traffic and should be considered early in the project lifecycle. Anything at or above **4% to 6%** should be regarded as hard to navigate for bicyclists, and planning for where detours begin, or lane closures require stopping should consider these factors.

Process: Review surveys of the project site or grades through OTIS data.

Documentation: Create a map exhibit that identifies steep grades' locations (MM limits).

28. Does the project area include or overlap with any bicycle and/or pedestrian priority areas or corridors in local, regional, or state plans?

Guidance: Projects with planned bicycle routes or pedestrian priority areas within or overlapping with project boundaries should consider the long-term increases in bicycle and pedestrian activities in the project design. Project designers should be aware of planned bicycle and pedestrian routes and strive to provide bicycle and pedestrian accommodations appropriate for the future level of bicycle and pedestrian traffic.

Process: Review local, regional, and statewide transportation plans for mention of planned bicycle routes and pedestrian priority areas. Coordinate with *CDOT Bicycle and Pedestrian Program* and *Regional Traffic Representatives* as needed.

Documentation: If applicable, create a map exhibit of future bicycle and pedestrian routes.

SME Contacts: Primary Contacts: Region Bike/Ped Representatives

29. Are there opportunities for Speed Management infrastructure in the project limits?

Guidance: Speed Management, also known as speed zoning, is changing throughout the United States. In Colorado, Vision Zero is one of the main goals that incorporate speed management infrastructure to calm speeds and protect vulnerable roadway users.

FHWA Guidance:

- https://highways.dot.gov/safety/zero-deaths/vision-zero-cop/vision-zero-action-plans
- https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer
- https://highways.dot.gov/safety/speed-management/speed-management-countermeasures-more-just-speed-humps
- https://safety.fhwa.dot.gov/intersection/ssi/
- https://highways.dot.gov/safety

Process: Speed Management should be considered on every project where there are speed-related crash patterns, vulnerable road users, and where the context could be considered for lower speeds. Reach out to your speed management group at CDOT HQ and see if any recent speed studies recommended speed management infrastructure. Also, consult crash data to see if there have been any pedestrian, bicycle, or speed-related accidents in the past 3-5 years.

Documentation: Speed study memos, strip maps, safety data summaries and graphs, and field visit documentation can be utilized for making speed management or speed calming recommendations for the project.

SME Contacts: Headquarters: elena.farhadi@state.co.us or benjamin.acimovic@state.co.us or brooke.podhajsky@state.co.us

30. Is there any traffic modeling beyond signal timing required for the project?

Guidance: Traffic modeling is typically required when proposed improvements involve significant geometric or operational changes to intersections, arterial corridors, or interchanges that generate or attract substantial trips and/or impact prevailing traffic patterns. For projects where traffic modeling is scoped or deemed necessary for alternative analysis, a Level 2 Operations Evaluation is generally required to assess operational performance, system impacts, and project needs and opportunities. However, it may be waived if the Project Manager provides adequate justification or a valid exemption request.

For projects involving the addition or modification of access points or interchanges on the Interstate, freeway, or state highway system, traffic modeling and operational analysis are typically required as part of the System-Level Study (SLS) document for CDOT 1601 submittals, FHWA Interchange Access Request (IAR) approvals, and National Environmental Policy Act (NEPA) compliance.

FHWA Guidance: Traffic Analysis Tool - Volume III (2019 update)
https://ops.fhwa.dot.gov/publications/fhwahop18036/fhwahop18036.pdf

CDOT Guidance: Traffic Analysis and Forecasting Guidelines (2023 updates)
https://www.codot.gov/safety/traffic-safety/assets/traffic_analysis_forecasting_guidelines/traffic_analysis_forecasting_guidelines

Process: For modeling the existing (base model) and/or future conditions (alternative), review the CDOT Traffic Analysis and Forecasting (TAF) Guidelines and FHWA Traffic Analysis Tool documents. These documents should referenced through all phases of traffic modeling, analysis, and reporting, including the selection of modeling tool, measures of effectiveness (MOEs), project's temporal and spatial limits, as well as data collection, integration of big data, cluster analysis, travel demand modeling (TDM), traffic forecasting, calibration, and alternative analysis.

For traffic modeling, typically, Synchro is used for modeling signal timing intersection improvement and arterial improvements, while Vissim, TransModler, and HCS are used for freeway improvement. Refer to CDOT TAF Guidelines Table 8 for traffic analysis tools based on the facility type and saturation rates.

For traffic big data analysis, typically INRIX/RITIS is used for travel time and speed data and StreetLight Data is typically used for volume and origin-destination data. Refer to CDOT TAF Guidelines Table 4 for a list of available sources of traffic big data.

Documentation: Provide a copy of the final model package, model output or summary tables showing the modeled MOEs, and summary/results of big data analysis showing the recent or historical MOEs.

SME Contacts: Headquarters: elena.farhadi@state.co.us

SAFETY EVALUATION QUESTION GUIDE
LEVEL 1

Typical Level 1 Safety Analysis:

- Projects with minimal traffic impacts (walls, ITS equipment replacement, landscaping) should not require a level 1 safety analysis.
- There are no identified crash patterns for bridge replacement/rehab projects, areas with consistently low LOSS.
- Low frequency of severe crashes (less than 2 crashes/mile/yr for segments, less than 2 crashes/yr at intersections).

Typical Level 2 Safety Analysis Projects:

- 3R projects, full reconstruction projects, corridor improvements projects, intersection improvement projects, signal replacement projects, PEL, EA, EIS, predictive analysis, design exceptions, areas with consistently high LOSS, and multiple identified crash patterns.
- Areas with a high frequency of severe crashes (at least 2 crashes/mile/yr for segments, at least 2 crashes/yr at intersections).

A Safety Evaluation Level 2 is only required when:

- There is a requirement for a deeper analysis of the safety issues.
- Does the project require a Safety Assessment Review (SAR)?
- Does a segment, segments, or intersections within the project area have a Level 3 or 4 LOSS?
- There are one or more correctable patterns (Rear-Ends? Run off the road? Broadside? Bikes? Peds?)
- Is there a pattern of fatalities or severe crashes?

1. Were there any correctable intersection-related or driveway access crash patterns detected?

Guidance: All projects with roadway impacts and not exempt from operations evaluations should run at least a level 1 analysis with the Vision Zero Suite. Overall, detailed summaries should be created along with SPF graphs and direct diagnostic charts should be generated as well. Each intersection should be analyzed if crash patterns are detected.

Process: Process study area with Vision Zero Suite, safety performance function (SPF) and direct diagnostics. Local road ADTs can be sourced here: https://cdot.public.ms2soft.com/tcds/tsearch.asp?loc=Cdot&mod=

Documentation: Detailed Summaries, SPF graphs (total and severe crashes), and direct diagnostic charts.

SME Contact: david.swenka@state.co.us

2. Were there any correctable non-intersection-related crash patterns detected?

Guidance: All projects with roadway impacts and not exempt from operations evaluations should run at least a level 1 analysis with the Vision Zero Suite. Overall, detailed summaries should be created along with SPF graphs and direct diagnostic charts should be generated as well.

Process: Process study area with Vision Zero Suite, pattern recognition. Process study area with Vision Zero Suite, direct diagnostics.

Documentation: Detailed Summaries, SPF graphs (total and severe crashes), and crash pattern recognition graphs.

SME Contact: david.swenka@state.co.us

3. Is there any extensive paving within the project limits?

Guidance: Several automatically generated recommendations may apply if a project is projected to have extensive paving, defined as more than 1,000 tons and requiring paving specifications.

Process: Check with the project manager/designer to determine if the scope of work has more than 1,000 tons and requires paving specifications. Large quantities for patching asphalt bid items do not qualify. Paving may not be the overall main component of the project, but there may still be extensive asphalt paving! If yes is answered to this question, please review and agree to patterns to accept which recommendations are appropriate for the project. Then, add the specifics of each recommendation to the description entry.

Documentation: General recommendations for resurfacing projects will be generated, descriptions added, and then sent to the project manager/designer in PMWeb.

OPERATIONS EVALUATION QUESTION GUIDE
LEVEL 2

An Operations Evaluation Level 2 is only required when:

- There is a need for an intersection control evaluation tool (ICAT)
- There is a need for extensive traffic modeling.
- Major and significant changes to operations that require modeling to determine change impacts.
- The need to evaluate multiple alternatives for intersections, interchanges, alignment changes, or significant geometric changes (System Level Studies, 1601 Interchange Studies, Environmental Impact Statements, and Environmental Assessments)
- You answer yes to Operations Evaluation Level 1 question #30.

1. Have you assessed and documented the overall condition of the corridor or network?

Guidance: Understanding the existing conditions through office work and field visits is key to creating a successful model.

Process: Review site imagery and conditions assessment using OTIS/Google Earth maps and conduct a site visit. This assessment considers existing traffic volumes, roadway classification, and other operational characteristics.

Documentation: Describe existing overall conditions on the project corridor/network.

2. Have you determined and documented the appropriate Measures of Effectiveness (MOEs) to fully understand the existing issues?

Guidance: Picking MOEs that will best represent operational issues and match project goals will help the project highlight its successes in the future.

Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information. MOEs that compare alternatives and communicate how a project meets stated goals and objectives should be chosen for reporting.

Documentation: Provide a list of MOEs that will be used for this project and a brief description of how the MOE relates to the project goals and objectives.

SME Contact: Lead: elena.farhadi@state.co.us

3. Have you determined and documented the modeling requirements and level of detail needed to achieve the desired MOE's for future alternatives analysis?

Guidance: Planning for what the future analysis will look like early in the project lifecycle ensures that important stakeholderscan comment on the methodology before investing significant time and resources into the project.

Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Provide a modeling plan/scope for the project, if applicable.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

4. Have you determined and documented the required spatial limits of the model(s) to be used?

Guidance: Spatial limits should extend past the construction project's limits to encompass all existing and expected future congestion on the project.

Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Describe model spatial limits, including a map exhibit.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

5. Have you determined and documented the required temporal limits of the model(s) to be used?

Guidance: Temporal limits should, at a minimum, include a full peak hour plus any seeding time the model may need (if applicable). Consider modeling the full peak period from the beginning of congestion buildup until the congestion has dissipated to normal operations for complex projects.

Process: Review congestion patterns and traffic count data to determine the peak hours and congestion start/end times as needed. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Provide a list of peak hours/periods that will be analyzed for the project.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

6. Have the analysis years been determined and documented for this project?

Guidance: It is essential to analyze the project over the course of its lifecycle, from open to the expected horizon year. Existing operations are an important benchmark to compare future operations.

Process: Work with the project team to determine years to represent existing traffic conditions (the most recent year from which reliable traffic data is available), open year (the year that the project is expected to open to traffic), and design year (typically open year + 20 years). Interim analysis years may be considered for projects that will be completed in stages or for projects near developments that will be constructed and opened in stages. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Provide the years of each scenario to be analyzed for the project.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

7. Have the assumptions regarding project alternatives to be modeled been determined and documented?

Guidance: All stakeholders should be in agreement about which project alternatives will be considered in the traffic analysis.

Process: For corridor projects, consider reasonable lane configurations that may be constructed. For intersections, use the Intersection Control Analysis Tool (ICAT) to assess which alternatives should be included in the traffic analysis. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Describe alternatives that will be analyzed. If an ICAT was used, provide the printouts of the intersection data, stage 1, costs, and stage 2 sheets for each intersection that will undergo significant operational or geometric changes within the project area.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

8. Has the regional travel demand model informing demand volumes for this project been reviewed and modified as needed to show the appropriate level of detail for the surrounding roadway network, capacities, and existing and future land uses?

Guidance: Applicable when using macroscopic regional travel demand models or mesoscopic modeling. Regional travel demand models are a key component of forecasting future traffic.

Process: Identify the regional travel demand model that covers the project area and review the model for the model years, roadway links, included projects, traffic analysis zones, and other features relevant to the project. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Affirm that the land use has been verified, the model is correctly calibrated, and the network modifications are made for the project. Provide supporting emails, if applicable.

SME Contact: erik.Sabina@state.co.us and scott.ramming@state.co.us

9. Have growth rates been determined and documented for each project alternative to be analyzed?

Guidance: Growth rates applied to existing traffic volumes should be documented for each analyzed scenario.

Process: Growth rates provided in OTIS may be sufficient for small projects that will significantly impact the area's roadway capacity or expected demand. For larger projects, utilize a range of data, including historical traffic, forecasts from regional travel demand models, and other sources as necessary. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Provide growth rates that will be used for the project in the methodology memo, including data sources and calculations to reach the proposed rates.

SME Contact: Regional Travel Demand Models – erik.Sabina@state.co.us, Forecasting Generally – elena.farhadi@state.co.us

10. **Have you determined and documented the temporal limits of the data collection (time periods and duration to capture existing demand)?**

    Guidance: This is similar to question 5 regarding the temporal limits to be modeled. Document the data collection plan if data collection is needed to create the model for the agreed upon temporal limits.

    Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

    Documentation: Provide a list of dates, times, and locations for collecting data.

    SME Contact: Lead :elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

11. **Is local agency data available?**

    Guidance: Local agencies may have recent data from local studies that can supplement other data collected by CDOT or available from third-party data sources.

    Process: Check with your *Region Local Agency Representative* or contact your *Local Agency*.

    Documentation: Provide a summary of data available via local agencies, including the type of data, the date data was collected, the time period of data collection, and how it will be utilized for the traffic analysis.

    SME Contact: Region Local Agency Staff.

12. **Are third-party data sources needed to perform the modeling and analysis?**

    Guidance: Third-party data sources can provide a wealth of information to supplement field-collected data and should be considered an alternative to intense data collection for some projects.

    Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information. Coordinate with Regional and HQ modeling resources as needed.

    Documentation: If third-party resources are needed, describe data needs and proposed sources for the data.

    SME Contact: Lead: david.craft@state.co.us

13. **Is additional data required to meet the modeling and analysis requirements?**

    Guidance: After reviewing available data from the previous questions, is there anything else the project team will need for the traffic analysis?

    Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

    Documentation: Provide a list of additional data needed for analysis, including proposed data sources.

    SME Contact: david.craft@state.co.us

14. Has a data collection plan been prepared?

Guidance: Collecting, compiling, verifying, and validating traffic data can be a huge undertaking for even small projects. A data collection plan can help organize the process from delegating tasks to storing data.

Process: Review CDOT's Traffic Analysis and Forecasting Guidelines for more information about creating a data collection plan.

Documentation: Provide a data collection plan.

SME Contact: Lead: elena.farhadi@state.co.us, Modelers: david.craft@state.co.us

15. Have future open and design year traffic demand volumes for all alternatives to be analyzed been developed, documented, and QC'd for this project?

Guidance: Future traffic forecasts are among the most critical inputs to analyzing a future condition and should be thoroughly reviewed for accuracy and feasibility.

Process: Check calculations and ensure future traffic volumes are balanced across the analysis limits. Demand volumes may not be capacity-constrained but should make sense given the expected geometric design of the alternative being analyzed. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Affirm that traffic forecasts are accurate and feasible per the agreed-upon methodology.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

16. Has the collected data been verified and validated?

Guidance: Almost all collected data is done so without direct human contact. Reviewing raw data being ingested into a traffic analysis for reasonableness and outlier scenarios is important.

Process: Review all collected data for accuracy before utilizing them in the analysis. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Provide a list of data collection locations and include the verification/validation status.

SME Contact: Lead: elena.farhadi@state.co.us , Modelers: david.craft@state.co.us

17. Have microscopic models been calibrated per established thresholds? (Deliverable)

Guidance: Applicable to existing conditions models if using microscopic or mesoscopic modeling.

Process: Ensure existing condition model outputs are within the acceptable calibration thresholds. Review CDOT's Traffic Analysis and Forecasting Guidelines for more information.

Documentation: Provide documentation that the base model meets established calibration targets.

SME Contact:elena.farhadi@state.co.us, Modelers: david.craft@state.co.us

18. Has each new or modified intersection been analyzed using the Intersection Control Analysis Tool to recommend intersection alternatives and document preferred build geometry?

Guidance: ICAT should be completed for all intersections with significant operational or geometric changes as part of the project, per question 5 of the Level 1 Operations Evaluation. Examples of significant operational changes include changing lane assignments for vehicle movements or restricting a previously allowed movement. Examples of significant geometric changes include adding a turn lane or adding through lanes on any approach. This process should be completed early in the project modeling process to assess which alternatives will be analyzed at each intersection.

Process: Complete an Intersection Control Analysis Tool (ICAT) workbook for each intersection that will have significant operational or geometric changes as part of the project.

Documentation: Provide the printouts of the intersection data, stage 1, costs, and stage 2 sheets for each analyzed intersection.

SME Contact: Lead: elena.farhadi@state.co.us **(**ICAT)

SAFETY EVALUATION QUESTION GUIDE
LEVEL 2

1. Was a Safety Assessment Report generated?

Guidance: A Safety Assessment Report provides an in-depth analysis of safety issues and mitigation strategies within a project area over and above the required Level 1 Safety Analysis. The report should thoroughly review crash data to assess crash causality, suggest applicable countermeasures, and recommend improvements based on project budget and scope.

Process: Regions should coordinate with HQ if they believe a Safety Assessment Report is needed on a project. Contact the *HQ Safety Programs, Data, and Analysis Unit* (contact: David Swenka).

Documentation: If yes, upload the report to the web tool.

SME: david.swenka@state.co.us

2. Was Data-Driven Safety Analysis (e.g., Predictive Crash Analysis) generated?

Guidance: A predictive analysis involves calculating the expected number of crashes in the future at a specific location based on geometric and operational characteristics. Predictive analysis is most typical for projects where an Environmental Assessment is required when comparing alternative designs or may be required when applying for a design exception variance.

Process: This task is typically assigned to a consultant, and HQ is available to assist Regions. Contact the *HQ Safety Programs, Data, and Analysis Unit* (contact: David Swenka).

Documentation: If yes, upload the supporting safety analysis to the web tool.

SME: david.swenka@state.co.us

3. Was CDOT Form 464 (Design Variance) generated?

Guidance: In the geometric design of highway projects, there are specific design values that are prescribed in the CDOT Roadway Design Guide and the AASHTO A Policy for Geometric Design of Highways and Streets (Green Book) that have been determined to be paramount to an adequately designed highway. When it is determined that it is not practical for these design values to be met, documented justification must be submitted, and approval must be obtained for inclusion in the design plans. Section 1.4 PERFORMANCE-BASED PRACTICAL DESIGN in the CDOT Roadway Design Guide covers design variances.

Process: Check with the *Region Project Manager* or *Resident Engineer*. Fill out a CDOT Form 464 for each design variance implemented on the project and in the project construction specifications and plan.

Documentation: If yes, upload each form to the web tool.

SME: The CDOT designer should contact their Region Traffic Representative and the Design Area Engineer as early in the project lifecycle to begin PBPD coordination. For any safety analysis for design variables or performance-based practical design, contact your Region Traffic Representative or david.swenka@state.co.us.