

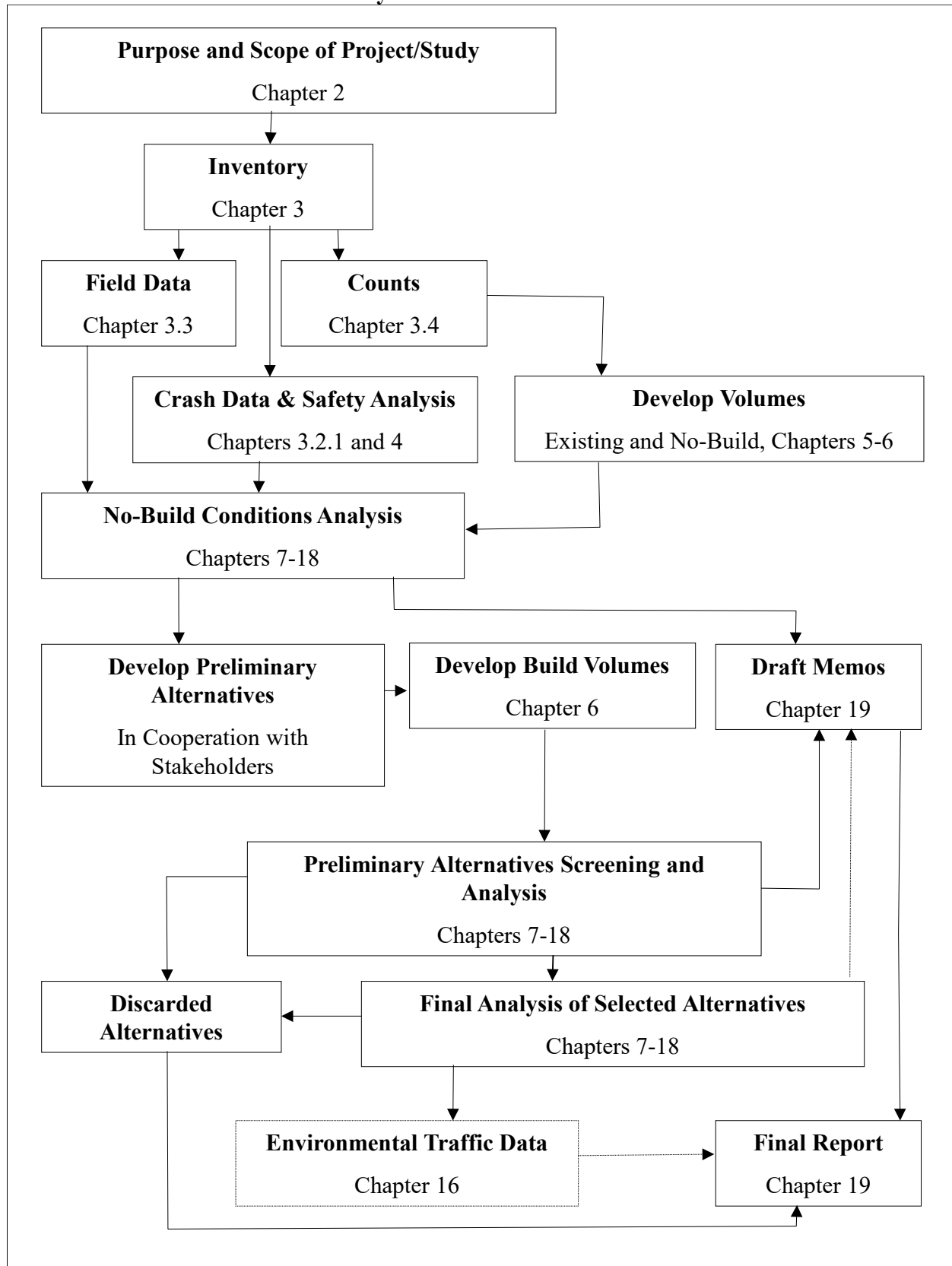
2 SCOPING PROJECTS

2.1 Purpose

The purpose of this chapter is to provide guidance to identify the various steps for scoping the analysis of a transportation study or project. The general flow of traffic analysis steps and the corresponding APM chapters are shown in Exhibit 2-1 below.

The first step is to have a thorough understanding of the work that is identified in a problem statement. The next step is to identify the appropriate level of detail and tools. The last step is to then create a scope of work for the study or project.

Exhibit 2-1: Process of Traffic Analysis



2.2 Problem Statement

2.2.1 Project Understanding

One of the most important steps in conducting analysis work is to clearly define the scope and purpose for the work. Every plan and project is unique with its own set of assumptions and applicable methodologies. There needs to be a clear understanding of what needs to be done by when and at what cost. The understanding should be conveyed through a problem statement that clearly defines the purpose and need for the work. The problem statement is the basis for either creating an analysis work plan for in-house work or for creating a scope of work for contracted work. A detailed scope of work or work plan helps to limit scope creep and lays out expectations for all parties. A problem statement template is available in [Appendix 2A](#).

Information on geometrics, safety, volumes, past studies, prior projects, other analysis performed along with standards, guidelines, and procedures is available and should be used to gain general knowledge of the study area. There may be a project prospectus or initial planning/environmental documents available as well. The analyst should consult or coordinate with the project team to complete the problem statement. There are many useful tools and resources available on the ODOT website. Major sources are explained in Chapter 3.

2.2.2 Project Constraints

Various constraints need to be considered when the work is scoped. If any of these change during the project duration, the problem statement and scope of work should be reassessed and consequences determined. Most constraints fall into two categories. The first is project specific, given the details of what is needed. The second is the project delivery constraints related to delivery /completion date and budget for the work.

The analysis work is controlled by various project factors, issues and concerns. The following questions can focus the problem statement:

- What is the Purpose and Need for the work?
- What questions need to be answered?
- What key issues should be considered?
- What are the Goals and Objectives of the work?
- Who is the audience?
- At what level will the work need to be analyzed and evaluated?
- What types of alternatives need to be evaluated?
- What evaluation measures will be used?
- What is the overall and traffic analysis study area, if different?
- What types of useable information and tools are available and practical?

The purpose and need, goals and objectives and questions and issues typically are determined by a project team, however direction can come from statutes (ORS), rules (OAR), legislation, the Oregon Transportation Commission (OTC), ODOT management, or local jurisdiction. The level of work, types of alternatives and the evaluation measures comes from a process or project/study management team. The study area, tools and information available influence the work. For

example, a study in the Portland Metro area can rely on data from “PORTAL” which has very detailed volume information on the freeways. The rest of the state must rely on physical counts or nearby data recorders to obtain volume information. This difference can be a constraint on the project. Similar to data, the choice of performance /evaluation measures can also be a constraint. Chapter 10 provides more guidance on performance measures and their data needs.

2.2.3 Schedule, Resource, and Budget Constraints

The work is driven by a need to deliver an answer in an identified time frame with an identified resource. Questions to identify these factors include:

- What is the timeframe for the analysis work?
- What are the impacts from changes to Purpose and Need?
- What are the risks from outside sources such as other jurisdictions, stakeholders, and private citizens? For example, local concerns/issues/ politics can easily add time to a projected schedule.
- Are there outside factors or time constraints that may dictate delivery of work items? For example, crash information is needed but cannot be obtained in the specified time frame.
- What resources are available? Are they internal or external?
- Are tasks dependent on resources not within analyst’s control?
- Does the project funding require certain analysis tools and procedures?
- Is the budget adequate to perform the desired analysis and data collection?
- What is the availability and quality of existing data?
- Can the work be divided? Are tasks independent of each other? Are tasks sequential or concurrent?

2.2.4 Additional Details

After the problem, schedule and budget constraints are completed, additional thought needs to be given to what likely performance measures and tools will be used in the project. A project objective will have specific evaluation criteria/measures that will require a particular performance measure which then will require a certain tool to be used. Level of detail (see Section 2.3), and constraints will determine which tools (see Section 2.4) are practical for the effort. This can be somewhat iterative, so the problem statement may need to be modified as the scope of work or internal work plan is constructed.

For example, under a project goal or objective of mobility, the evaluation measure may be travel time. This might be measured by the buffer index which would require either a travel demand model or a micro-simulation depending on the level of detail needed at a particular step in the process.

Once the steps in this section and the previous sections are completed, this will give the analyst the basis to create the scope of work analysis tasks or an internal analysis work plan.

Example 2-2-1 Problem Statement

The below is an example project statement which includes a summary of the field scoping conditions and the defining statement questions and constraints.

OR193 is an older congested regional highway (not a freight route) in an urban arterial corridor within the city of River City. The highway is mostly four lanes undivided (no center turn lane) with a 35 mph posted speed and an average daily traffic load that exceeds 25,000. The corridor has dense retail/service commercial development with limited right-of-way along its length. There are numerous driveways, many closely spaced, because of past uneven growth patterns. Parking and bike lanes are spotty along the length. Sidewalks are curb-tight with many poor slopes in driveway areas and sub-standard curb ramps. In addition, a number of the intersections are high-crash locations. Congestion extends through the peak hour as a significant bottleneck exists in the study area at a bridge over a local small river. The bridge is still structurally acceptable but functionally obsolete with only two lanes, no bike lanes, narrow lanes and sidewalks. The city wants revitalize the corridor with urban renewal and thus wants to improve it for all users, not just vehicles. Efforts to improve access management in the past have met with resistance from property owners. An improvement project has been listed for this location in the City's Transportation System Plan.

The project has been scoped and meets the needs for an Environmental Assessment (EA) because of the potential impacts. A draft project Purpose and Need (P&N) has been developed: "The purpose of this project is to improve multimodal mobility, increase safety, and enhance the economic development potential of the corridor." Some draft Goals and Objectives have been formed aligning with the P&N on mobility, safety, environmental, limiting natural and built-up impacts, and economic development.

The project needs to conform to practical design objectives so that the alternatives can stay within a 25-50 million dollar range. This would keep the project reasonably likely so it could be included in the next available State Transportation Improvement Plan. A travel demand model is available for the area.

Problem Constraints

- What is the Purpose and Need for the work?
 - From the draft P&N: "The purpose of this project is to improve multimodal mobility, increase safety, and enhance the economic development potential of the corridor."
- What questions need to be answered?
 - What are the base conditions to help define the project need? What are the actual congestion and safety problems? What are the future conditions? What is the impact of access management on congestion? What are the pedestrian, bike, and transit needs in the corridor? Are there cost-effective alternatives available that can address most of the issues?
- What key issues should be considered?
 - Whether to widen or to build a new vehicle and/or ped/bike bridge
 - Balancing different modal needs
 - Access management and parking impacts to properties

- What are the Goals and Objectives (G&O) of the work?
 - From draft G&O document: Mobility, safety, environmental, limiting natural and built-up impacts, and economic development.
- Who is the audience?
 - The audience is multilevel with state and local staff and stakeholders (i.e. business groups, bike community, neighborhood associations, freight users) and the general public.
- At what level will the work need to be analyzed and evaluated?
 - Alternative concepts will need to be evaluated on a screening basis.
 - Once concepts are more developed into alternatives, then the alternatives can be analyzed at key locations using deterministic tools.
 - The final set of build alternatives that go into the EA (including the no-build) are analyzed in full detail including simulation, multimodal and predictive safety tools. Air & Noise traffic data will be required for the final alternatives.
- What types of alternatives need to be evaluated?
 - No-build (this is what other alternatives are measured against)
 - Possible future land use alternatives as this drives the future improvement needs (this would need to be settled first before getting into detailed analysis).
 - Couplet (new) alignments
 - Bridge replacement
 - Road diet to better accommodate other modes
 - Wider or better utilized right-of-way to improve multimodal, parking and mobility needs including bridge widening.
 - Transportation System Management (TSM)/Safety improvements including painted/raised medians, center turn lanes, improved crosswalks, and improved access management.
 - Alternative strategies such as a new ped/bike bridge, off-street parking, transportation demand management (TDM), or TSM.
- What evaluation measures will be used?
 - Ones that are applicable to this project area include: These can include: volume-to-capacity ratio (v/c), level of service (LOS), queuing, travel time, delay, emergency response time, multimodal level of service (MMLOS), ped/bike system connectivity, accessibility, duration of congestion, percent crash reduction, expected crashes, access spacing, and conflict points.
- What is the overall and traffic analysis study area, if different?
 - Land use and bridge scenarios will require a city-wide look initially to determine if any significant negative impacts exist on areas potentially outside the project limits. If these occur, and the alternatives will still be pursued, then the project limits and/or the analysis study area may need to be modified.
 - Because this is a congested area and traffic simulation will be necessary, the study area will need to go out two signalized intersections outside of the project limits (area of potential impact). The project will at least need to go a couple of block on each side of the highway to accommodate the couplet alternatives.

- What types of useable information and tools are available and practical?
 - Inventory data, some counts, analysis and modeling work done for TSP
 - A travel demand model and local modeling staff time is available.
 - Mesoscopic methods (i.e. windowing out of a model area)
 - Highway Capacity Manual (HCM) and Highway Safety Manual (HSM) methods
 - Micro-simulation

Schedule, Resource, and Budget Constraints

- What is the timeframe for the analysis work?
 - This project is going to kickoff in July, so counts will need to be obtained immediately to capture the 30th highest hour conditions.
 - The project is one of the Region's top priorities
 - Since this is an EA, the end date is somewhat unknown but is expected to last at least 36 months.
- What are the impacts from changes to Purpose and Need?
 - Likely impacts could be additional alternatives, rework of analysis which will lead to more time required to do the work.
- What are the risks from other sources such as other jurisdictions, stakeholders, and private citizens? For example, local concerns/issues/ politics can easily add time to a projected schedule.
 - Access management and parking concerns will likely cause delay or create issues with the city council/planning commission.
 - Potential issues with internal and/or outside business groups
 - Environmental/Riparian issues along the river
 - Potential additional bridge routes/alignments
- Are there outside factors or time constraints that may dictate delivery of work items? For example, crash information is needed but cannot be obtained in the specified time frame.
 - Counts will need to be obtained between July and September in order to stay on schedule.
 - Staff time to perform analysis is limited because of other legislative high-priority work. Will likely need to have help from consultant to stay on schedule.
- What resources are available? Are they internal or external?
 - Internally, there is the project lead (manager) and at least one analyst available. The EA consultant has additional analysis staff available to help out on contingency.
- Are tasks dependent on resources not within analyst's control?
 - Yes, model applications are dependent on current workload; alternatives are dependent on region designers, alternative development process is dependent on feedback from stakeholders, public open houses and the teams themselves.
- Does the project funding require certain analysis tools and procedures?
 - The project falls under NEPA requirements so full counts and inventory data will be necessary to stay consistent with land use requirements and to support the environmental analysis. In addition, the travel demand model is required to be used.
- Is the budget adequate to perform the desired analysis and data collection?
 - The budget is adequate for the data collection, and up to three detailed alternatives

in the EA document.

- What is the availability and quality of existing data?
 - State inventory data is current. The TSP analysis is still usable but more counts and data will be needed for the project analysis.
- Can the work be divided? Are tasks independent of each other? Are tasks sequential or concurrent?
 - Most work can be divided into concurrent tasks, but simulation work must be done sequentially from a single source to avoid inconsistencies in assumptions. Generally, no-build work must precede alternative work.

Additional Details

- Given the above mentioned evaluation measures and other issues what are the likely performance measures that will be needed?
 - Volume to capacity ratio for the state highway and level of service for the local system will be required to compare with established performance targets and standards. In addition, travel time and queuing will be needed to test the overall efficiency of alternative operations. Multimodal level of service will be used to gauge the impact of mobility alternatives on the pedestrian/bike/transit operations and vice versa.
 - Likely tools to be used?
 - Analysis of the no-build and the alternatives will require the use of the travel demand model to help develop the volumes and to create high-level screening measures to test any model-usable concepts (i.e. road diet, couplet and other network changes), Tools such as Highway Capacity Manual-based software (i.e. HCS and Synchro) and the multimodal tools will be needed to develop the detailed analysis. Micro-simulation will also be needed to create the travel time measures for the detailed analysis and to create the queuing data.
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2.3 Level of Detail

There are many types of analysis work done for transportation related issues. The analysis ranges from high-level policy and procedures, through subject or facility plans to specific issues, locations or improvements projects. For example, a 10-mile long facility plan should have a different level of analysis than a single intersection realignment. The analysis process can have multiple levels such as single-issue or fatal flaw screening through detailed reporting like micro-simulation.

2.3.1 Types of Work

Planning Studies

These studies are generally limited to a specific geographic area or corridor or can cover multiple topics/issues. All of these can be either rural or urban and can overlap into different elements as well as varying level of detail. In some regions, the terms “corridor”, “facility”, “refinement” all

mean the same level of effort. Expressway plans are similar but deal with a certain facility type and condition reports only deal with existing or future no-build needs yet the plans may not look different from a typical refinement plan.

The key difference in plans will be what are the specific questions needing answers and the detail level needed to answer them regardless of what the plan is named. For example the I-205 corridor in a dense urban area would involve use of a regional travel demand model, dynamic traffic assignment (DTA), and micro-simulation while the comparatively rural US395 corridor would only have an urban model in a couple locations and use a higher segment-based analysis.

Examples of each can include:

- **Statewide Policy / Plans** - This work is generally of a statewide nature but can be topic specific; typically guidance or an overriding policy such as:
 - Greenhouse Gases (GHG)
 - Least Cost Planning (LCP)
 - Legislative Studies / ORS / OAR
 - Performance Measures like Alternative Mobility Standards
 - OTP and Modal Plans (OHP, Freight Plan, Rail Plan, Bike/Ped Plan)
- **System Plans** – these focus on:
 - Metropolitan (urbanized) areas –Regional Transportation Plan (RTP)
 - County/multiple jurisdictional – County TSP, Regional Transportation Plan.
 - City – City Transportation System Plans
- **Corridor/Facility Plans** – these focus on:
 - Specific highway corridor
 - Land Use (TPR-type zone change, UGB expansion)
- **Refinement Plans** – these focus on:
 - Topic (Road Diet or Conversion of Two-Way to One-Way)
 - Feature (IAMP),
 - Mode (Safe Routes to Schools)
 - Highway segment
 - Sub-Area

Projects

This operational analysis is limited to specific locations often with specific guidelines or parameters that influence the work. They include

- **Modernization** – this work covers large issues / needs that must be measured against specific data needs or standards. The intent is to bring the facility/project up to standards and/or formalize exceptions.
- **Safety / Operations / Preservation** – this work is specific in nature and may allow deviation from standards. For example on a facility with a high crash rate fitting a minimal left turn lane within the given right-of way may not have standard widths and tapers.
- **Traffic Impact Analysis (TIA)/Traffic Impact Studies (TIS)** – this work is driven by the development itself. The analysis is to determine facility adequacy, significant effects and required mitigation.
 - **Transportation Planning Rule (TPR)/Zone Change** –When a proposed

development requires a change in land use and has a significant effect to the state facility, certain criteria must be met.

- Conforming Use Development- When a proposed development does not fall in the TPR/Zone change, the analysis is dependent on local land use code and approach permitting
- Approach Permitting – These are for developments that do not require a TIA. This driveway type and location considerations such as sight distance, conflict points, influence areas.

Other Procedural / Research Studies

This is analysis work in support of a specific topic or tool, such as but not limited to trip generation studies, determination of analysis factors, procedures or calculators. These studies should conform to appropriate national methods and accepted analytical processes. This work needs to be detailed out with specific deliverables and agreed to by the parties requesting and accepting the work.

2.3.2 Level of Analysis

The questions being asked and the data available can determine the level of analysis needed. This can range from policy and systemic reporting to a very detailed specific need. Resources are limited, so the level of analysis needs to be tailored to the questions.

- Rules of Thumb – Generalization based on common conditions with very little detail. Can be in tabular or checklist format or “canned.” For example, when AADT exceeds 60,000, then six lanes are needed. These need to be taken into context as a general ballpark only. They may be used to help determine a starting point. Actual decisions need to be based on more detailed analysis.
- Broad Brush (a.k.a. “30,000- or 10,000-foot view”) – Big picture generalized planning analysis or a preliminary estimate of a more detailed later task. This could include using daily traffic volumes (AADT’s), assumed roadway geometrics, or default values. This is typically at the system or corridor level (not intersection level). Data is typically at an aggregated level.
- Screening – A mid-level analysis where some plan/project specific data is available but likely not fully developed. This process is used to whittle down large number of scenarios/concepts/alternatives/options to a more reasonable number. This can include both qualitative and quantitative elements. Measures can include items such as policy/standard compliance (a.k.a. fatal flaw analysis), natural and built environmental constraints, segment demand-to-capacity ratios, and key intersection volume to capacity ratios. Context sensitivity / practical design considerations are important at this level and below. Typically in a plan or project, multiple levels of screening are used in increasing detail.
- Detailed – This is a comprehensive look a study area or topic. This uses study-specific data where the use of defaults is limited. This analysis typically furnishes detailed numbers for establishment of standards or policies or details for a specific design (i.e. storage lengths, signal progression). Actual plan or project decisions can be made from information derived from this level.

2.4 Tools

There are many tools used for transportation and planning analysis. They are a mixture of commercially developed and internally created programs serving anything from analyzing the effect of a specific policy to a specific project detail. Often a particular process becomes identified as a tool and is included for discussion purposes.

2.4.1 Individual Tool Descriptions

The following tool descriptions are not exhaustive list and mainly concentrate on the ODOT-used ones. Some of these tools are discussed in more detail in following chapters. Some of these tools could be considered a process, i.e. sub-area modeling or zonal cumulative analysis. Some tools may package together multiple tools (i.e. HCM analysis and simulation) in a suite format. Other tools and methodologies not listed here or later in the APM may be acceptable if explained and documented in a methodology memorandum and approved by ODOT. For more information or availability of these tools, please contact TPAU staff.

Activity Based Models (ABM) - Compared to traditional trip-based models, the activity-based model system has more detailed and accurate representation of space, time, travel patterns, and significantly more person and context-based explanatory variables by individually modeling persons and households. These improve the modeling of non-motorized travel, time-of-day, ride sharing, non-home-based travel, accessibility effects, and provide a flexible household travel survey-like database for custom summaries. This does come at the cost of greater data complexity, data needs, and run time. This modeling system was also developed as the eventual framework for exploring new policy issues: new vehicle types and emissions, parking and different pricing scenarios, connected and automated vehicles, vehicle ownership moving to service, light-weight vehicle infrastructure, telecommuting, and others.

ATR Characteristic Map - The ATR Characteristic Map is web-based mapping tool that displays ATR's based on their characteristic trend. Detailed information can be displayed on the map by clicking on ATR symbols. The ATR Characteristic Table and map are updated on a yearly basis, typically in September.

ATR Characteristic Table – The Automatic Traffic Recorder, or ATR, Characteristic Table can be used to estimate seasonal traffic count adjustments based on common characteristics such as number of lanes, weekly trends, and rural/urban area types.

Crash Decoder Tool – This macro-based spreadsheet tool converts the extensive numerical codes in the typical “long-form” comprehensive PRC crash listing to words. This eliminates the need for the analyst to be familiar with the crash coding manual. The tool will also summarize and graph the crash characteristics.

Crash Graph Tool – This Excel macro-based spreadsheet uses input from the Vehicle Direction report to create a standard set of crash graphs and table by year, severity, collision type, time of day, day of week, surface condition, light condition, on and off-roadway crashes, and milepoint.

DANA – The Database for Air Quality and Noise Analysis (DANA) tool from FHWA provides probe traffic data-based inputs to the Motor Vehicle Emission Simulator (MOVES) vehicle

emissions model and the Traffic Noise Model Aide (TNMAide). This allows for real-world measurements of traffic conditions instead of using transportation model base year traffic data (e.g. vehicle-miles traveled, speed) for environmental studies.

Dynamic Traffic Assignment (DTA) - DTA is an alternative mesoscopic method that assigns traffic across time periods so that adjacent time periods and congestion affect each other. DTA is useful when the typical peak hour traffic spreads across multiple hours. The assignment is more detailed as it incorporates basic signal timing and platoons of vehicles which allow for queuing to be modeled. DTA is a further level of effort and refinement of the model assignment between the typical travel demand model and micro-simulation. Common DTA software tools are Dynus-T and Dynameq but is also included in VISUM and VISSIM.

FIXiT - The Future Improvement Examination Technique (FIXiT) sketch planning tool from the Texas A&M Transportation Institute (TTI) is used to assist in the proper allocation of funds in regard to choosing the right set of congestion mitigation and mobility strategies. The FIXiT tool can be used as an early screening tool in conjunction with a series of factors when allocating funds and prioritizing projects for an area.

Future Volume Tables – These show the future annual average daily traffic volumes for state highway segments based on either 20 years of historical traffic counts or travel demand model-based growth trends depending on the location. These are updated annually.

HCS (HCM) – Highway Capacity Software is a faithful implementation of the Highway Capacity Manual methodology. These methods are point/segment based and are isolated so adjacent sections do not affect each other. This is the only source of deterministic analysis tools for freeway operations (segment, merge, diverge, and weave). HCS/HCM also considers pedestrian, bike and transit multimodal analyses. The HCS/HCM is mostly operational (high detail level) based but there are some planning-level methodologies available using mostly default values and average daily traffic volumes.

HCM Pedestrian Crosswalk LOS & Delay tool – This tool implements the HCM 2010 (and later) MMLOS methodology for analyzing pedestrian crosswalk delay.

HSM Spreadsheets – These implement the Highway Safety Manual Part C predictive safety analysis methods for rural and urban facilities. These include current available Oregon calibration data and factors.

HSM Part B Screening Tools – These characterize observed crash data from a large study area using a minimum of extra data. The results are used to identify a smaller set of locations that can then be analyzed with the HSM Part C predictive methods. These include the Critical Crash Rate and the Excess Proportion of Specific Crash Types explained in Chapter 4.

IHSDM – The IHSDM (Interactive Highway Safety Design Model) implements the HSM Part C predictive method for rural and urban highway segments. The IHSDM evaluates the effects of geometric changes on safety. The IHSDM has a very high input detail level as it requires full geometric design data (curves, grader, stationing, super-elevation, etc). This is best suited for

evaluating final design alternatives.

ISATe –HSM-based Part C predictive analysis spreadsheet-based tool for free-flow facilities, interchanges, ramp terminals and ramp roadways.

Level of Traffic Stress (Bicycle & Pedestrian) – These index-based methodologies quantify the perceived “traffic stress” (i.e. comfort) safety issue of an user being in close proximity to vehicles on a spacing, speed, or and/or volume basis for rural or urban facilities.

MMLOS Intersection – These are index-based analysis tools based on intersection elements (e.g. curb ramp quality, speed) that affect pedestrian and bicyclist safety and comfort using an expert judgment/index basis rating rather than using the high data and time requirements of the full HCM MMLOS method.

MMLOS Segment – These are simplified HCM MMLOS methodologies for pedestrian and bicycle facilities and transit operations along roadway segments.

NCHRP 562 Crossing Treatment tool – This is a spreadsheet tool that can be used as a guide to select or screen potential pedestrian crossing treatments for plans and projects ranging from signing/markings to full mid-block traffic signals.

OTSDE - the Oregon Transportation Safety Data Explorer, is a web based GIS tool, that supports ODOT work in safety and multi modal areas, helping users see connections to leverage efforts across programs. OTSDE has three main areas: identifying corridors, filtering and extracting crash data, and multi modal active transportation work. Users can view and filter crash data, network screening data, and active transportation data to work on crash data analysis, traffic safety investigations, multi-modal analysis, and TSP (Transportation System Plan) review.

Qualitative Multimodal Assessment –This methodology generally follows the principles of the HCM multimodal level of service (MMLOS) but uses general roadway characteristics and applies a context-based subjective “Excellent/Good/Fair/Poor” rating for a relative high-level analysis where the HCM MMLOS does not apply, in small cities, or where data and resources are limited.

RITIS Analytics - The Regional Integrated Transportation Information System (RITIS) is a data integration tool that has an automated data sharing, dissemination, and archiving system that includes many performance measures, dashboards, and visual analytics tools that can be used to gain situational awareness, measure system performance, and communicate information between agencies and the general public. The major sources of data in RITIS are probe speeds, incidents and events, sensors and detectors, dynamic message signs, and weather. In transportation system analysis, RITIS allows users to calibrate models to existing conditions, identify/map existing system performance, and perform before-after analysis.

Seasonal Trend Table - The Seasonal Trend Table can also be used to estimate seasonal traffic count adjustments using seasonal factors organized into different characteristic trend types. The Seasonal Factor Table is updated on a yearly basis, typically in September. Season Trend Table

factors are calculated using the previous full year of ATR data.

SIDRA – SIDRA is a lane-based mesoscopic analysis tool that can analyze urban facilities for the full capacity, delay and queuing impacts in the system without the need for micro-simulation. SIDRA has been typically used for roundabouts, but also is necessary for any intersection/segment configurations that cannot be handled in standard HCM methodologies such as three-way stops, complex interchanges (e.g. single-point and diverging diamonds). SIDRA can also analyze signalized pedestrian crossings, ramp meters, or bus-only, light-rail or truck lanes on segments.

SimTraffic – SimTraffic is a micro-simulation based on the arterial portion of CORSIM and thus is best suited for simulating arterial networks. This allows system-level analysis of a study area network for queuing impacts, travel time, delay of individual vehicles as well as network wide.

Subarea modeling – This is a mesoscopic technique by cutting out a portion of a travel demand model (also called windowing) to be used separately or adding detail to a portion of a model (also called focusing). Both methods involve adding detail to the model (e.g. signal timing, smaller zones, additional centroid connectors, better refined capacities). This additional detail will improve calibration between the model and field counts, possibly to the point that post-processing is very limited. Typical software for the windowing method would be VISUM.

SWIM (StateWide Integrated Model) – is a forecast model designed to represent the Oregon economy with respect to land-use and transportation by simulating the activity and market exchanges made by people and businesses. Household and business location decisions are simulated, as well as the travel generated by activities - such as commuting to work, purchasing commodities for industrial production and transporting final goods to markets within Oregon and outside of the state. It is designed for statewide and regional long range transportation planning and policy analysis. Information from SWIM can be used to inform other modeling tools, answer freight flow questions, determine re-routing impacts (from emergencies, landslides, seismic events, construction projects, etc.), discuss answers to questions from the Oregon Transportation Plan around economics and land use, and to understand traffic impacts in locations where no other modeling tools exist.

Synchro – Synchro is mainly for the operation and system optimization including timing and progression of signalized study area networks. Synchro is mainly focused on the analysis of signalized intersections and arterials following current HCM methodologies.

Trip Generation - This process implements the ITE Trip Generation Manual procedures based on land uses and other site size and type characteristics.

Urban Models (4-Step Travel Demand Models) – Travel Demand Models are generally built as system-level tools so detail is limited at a facility level; including basic characteristics such as number of lanes and speed limits. These models can be used as a screening tool using district travel patterns (origin-destination), demand-to-capacity ratios, percent volume differences, and high level estimates of travel times. Travel Demand Models are also used to develop future volumes for plans and projects through post-processing methods. See the available TPAU and

MPO urban model map on TPAU's website at:

<https://www.oregon.gov/odot/Planning/Pages/Technical-Tools.aspx#travelDemandModel>

VisionEval – This model can be described as a “disaggregate demand/aggregate supply” model. It combines demographic and socioeconomic details from a synthetic population with aggregate treatments of travel (multi-modal vehicle-miles traveled and congestion without explicit trips, or transport networks). The implications of the “aggregate supply” model is that VisionEval cannot be used to evaluate performances of specific projects or corridors. This model is used for large-scale regional emissions planning as part of an area's Greenhouse Gas (GHG) reduction efforts. The model is used to help establish a transportation strategy for meeting greenhouse gas targets, it can also be used for asking a very broad range of “what if” questions about how the transportation system might perform, and how its benefits and costs might be distributed over the community. It can efficiently process hundreds of scenarios looking at many different types of interventions, alternative policies, and hypothetical future conditions and travel behaviors.

Vissim – Vissim is a complex but comprehensive micro-simulation which can be used to model virtually any road network. Vissim also has the capability to handle DTA and multiple modes. The software is extremely customizable but requires significant effort to calibrate and report out useable data. Vissim is a preferred tool for simulating roundabouts, complex intersections, interchanges, and freeway operations.

Vistro- Vistro software analyzes and optimizes traffic operations for intersections, corridors, networks, or transportation impact analyses. Vistro allows use of the multi-resolution modeling process as Visum files can be imported and detailed for a sub-area analysis or eventually passed into Vissim for micro-simulation.

Zonal Cumulative – The Zonal Cumulative volume development process is mainly a manual three-step (generation, distribution and assignment) analysis. This involves creation of zones, uses ITE Trip Generation methodologies, external trip origin-destinations, and gravity-based distribution. Calibration is also required. The Visum modeling software is used to streamline the assignment process in the Enhanced Zonal Cumulative method.

Other Planning Analysis Tools – There are a number of less complex tools that can be used to evaluate a system at a relatively high level. These also can be used as part of a more detailed plan or project analysis as an alternative screening tool. Most of these are based on average daily traffic. Some examples are preliminary signal warrants (PSW) and other tools and methods in the Planning and Preliminary Engineering Application Guide (companion to the HCM)

2.4.2 Tool Evaluation/Selection

The second step for scoping is to determine what tools are available and can be used at particular stages in the analysis effort. Selection of the appropriate analysis procedures from this manual will often be determined by project-specific characteristics such as the type of project, the surrounding environment and land uses, availability of data and the type of traffic controls present in the field. Generally, similar types of projects will use the same analysis procedures to varying degrees. Depending on the study and the project's purpose and need, additional data may be required. For further information on project scoping and selection of traffic analysis

procedures, refer to the Federal Highway Administration's (FHWA) website for the Traffic Analysis Toolbox: <https://ops.fhwa.dot.gov/trafficanalysisitools/>

In this manual, tools are broken into two basic categories: deterministic and stochastic and two sub-categories: systemic and specific. Considering the project needs and constraints, tool selection can greatly impact the resources and time necessary to do the analysis.

- Deterministic – These tools use a set of fixed inputs and result in a single set of outputs. These include, for example, Highway Capacity Manual procedures and the three or four-step travel demand models.
- Stochastic – These tools use a set of inputs and create multiple sets of outputs. These include, for example, micro-simulation and dynamic traffic assignment, activity-based models, and the statewide model. These tools are much more time-intensive for inputs, process, and analysis of outputs.
- Systemic – These tools often cover multiple points, corridors, or networks that interact / influence with each other (e.g. SIDRA Intersection network analysis).
- Specific – These tools analyze a single location (e.g. HCM segment-based analysis).

In the sections that follow, the tools are grouped first by study type and then by analysis type, however, the tables are not exhaustive. Studies likely require more than one type and related tools over their duration. Even within these tools there is a range of uses from high-level planning to project specific. Some tools can be used for widely varying efforts depending on the questions asked. An “X” indicates the tool type in the following exhibits.



The following discussion assumes that these tools have been created, tested, and operational. If a tool is not fully updated and useable, additional time or special considerations may be needed in tool selection.

For each tool, the general data needs, staffing requirements, and time required are shown. Many tools may have a range depending on the task at hand which may be “high” for a simulation model, to “medium” for facility analysis, and to “low” for individual intersection analysis. The following exhibits attempt to reflect a relative difference between the tools and may not capture every specific circumstance.

- “High” (H) generally means obtaining large quantities of data, confidential data, data not readily available, or in the correct format. Long times to collect data or the cost of collection is also considered. These tools require a special separate project effort to collect and clean the data or to customize the tool to the location. Use of default values is very limited. Some tools may require many staff members such as updating a travel demand model or may require many hours from a single person, such as micro-simulation. Processes may take months or years in some cases.
- “Medium” (M) generally means data obtainable in the field or from available information/databases although it might still need conversion or cleaning. Staffing requirements will be a single to a few staff members. Time requirements are generally on the order of weeks.
- “Low” (L) generally means published data or available data in correct formats and can be immediately used. The tool may have a high use of default values. Overall data

requirements are limited in total amount or elements. These tools can be used by a single staff member and time requirements are on the order of days.

Tools Grouped by Study Type

Policy Tools

Used for answering policy level questions such as for the Oregon Transportation Plan or Oregon Highway Plan. Exhibit 2-2 shows this group. These questions can be from the legislature or upper management. Questions can be very complex, to determine the effects of potential policy decisions involving many diverse factors in broad areas including economics, land use and transportation. SWIM is the primary tool used for this purpose. VisionEval has been used to determine strategic direction for greenhouse gas (GHG) emission impacts.

Exhibit 2-2: Policy and Statewide Planning Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
SWIM		X	X		H	H	H
VisionEval		X	X		H	M	M

Statewide Planning Tools

Used for statewide or multiregional analysis studies such as the Bridge Limitation Strategy. These studies usually involve the highway network or elements such as freight movement, congestion, economic impacts of delay/detours, etc. SWIM is used for general flows including freight movements and economic impacts.

System Planning Tools

Used for a wide range of uses in regional, county or city planning studies such as Regional Transportation Plans (RTP) and Transportation System Plans (TSP). Exhibit 2-3 shows the tools for this group. VisionEval is used for establishing regional strategies for greenhouse gas emissions in urbanized areas. For example, SWIM has been used to create growth rates for rural projects, separate truck growth rates, external station growth for models, and distributions for supplementing cumulative analyses. Both activity-based and traditional urbanized and small city travel demand models are used to determine system travel patterns or behavior, to compare multiple land use and network scenarios, or can be used to develop post-processed volumes for more detailed analysis for specific locations.

The DANA tool can be used to quantify emissions (including GHG) across a system or a specific route and create outputs for use in more-detailed tools such as for traffic noise. RITIS Analytics modules can be used to define system-level performance. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Other tools cover specific routes, segments, or locations. Multimodal analysis would be typically done on at least a collector-level and higher facilities across all applicable modes using generally qualitative or low-data requirement quantitative methods. The HSM screening tools are used to flag safety issue areas across an entire area. Highway Capacity Manual operational or planning analysis techniques can be used to determine operational results of roadway segments for all modes. Other planning analysis tools include daily-traffic based intersection tools or service volume tables for determining needs or general traffic control types.

Exhibit 2-3: System Planning Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
SWIM		X	X		H	H	H
VisionEval		X	X		H	H	H
Urban Models (MPO & small urban)	X		X		M	M	M
Activity-Based Models		X	X		H	M	M
DANA	X		X		L	L	L
RITIS Analytics	X		X	X	L	L	L
HCS (HCM)	X			X	M	L	L
HCM Planning Analysis	X			X	L	L	L
HSM Part B Screening Analyses	X		X		L	L	L
Multimodal Analysis (Qualitative & LTS)	X		X	X	L	L	L
Other Planning Analysis	X			X	L	L	L

Corridor & Refinement Planning Tools

Used for specific highway segments, either over an entire highway or a smaller section within or between cities. Exhibit 2-4 shows this group. Corridor plans have more detail than system plans yet may lack the specific details of project or facility refinement plans. Corridor plans may deal with single or multiple parallel facilities or may be dealing with the potential of multiple potential new alignments. Refinement/facility plans are generally limited to the specific roadway in question. The tools used form the full range from the systemic travel demand model-based to intersection operational analysis to micro-simulation. Travel demand model-based tools are used to compare scenarios or help with screening alternatives. Some tools like dynamic traffic assignment (DTA) are used to incorporate shifting demand into the model assignments to better match the field conditions and limit the amount of post-processing needed. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Historic crash analysis is needed at the corridor planning level and crash screening could be done to supplement if there are enough intersections or segments. Predictive crash analysis may be used on the final solutions for urban arterials and rural non-freeways. The NCHRP HSM spreadsheets are used to do the predictive analysis while the Crash Decoder Tool is used to simplify the historic crash analysis.

Analysis would be typically done across all applicable modes at varying levels of detail from HCM-based analysis to micro-simulation. HCM planning analysis can be used for determining operational results of state highway segments along the corridor. RITIS Analytics can be used to help identify bottlenecks, travel times, incident effects and other measures across a corridor. If intersection analysis is needed then any of the HCM-based methods and tools (such as HCS or Synchro) can be used. Typically, micro-simulation will not be needed in corridor plans other than in metropolitan areas. Vissim is typically used for freeway operations, complex configurations, roundabouts, and/or including multimodal issues and SimTraffic is used for signalized arterial corridors.

Exhibit 2-4: Corridor & Refinement Planning Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
Vissim		X	X	X	H	H	H
Urban Models (MPO & small urban)	X		X		M	M	M
Activity-based Models		X	X		H	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X		X	X	M	M	M
SimTraffic		X	X		M	M	M
HSM Part B Screening Analyses	X		X		L	L	L

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
NCHRP HSM Spreadsheets	X			X	M	L	M
ISATe	X			X	M	L	M
RITIS Analytics	X		X	X	L	L	L
Synchro	X		X	X	M	M	L
Vistro	X		X	X	M	L	L
SIDRA Intersection	X		X	X	M	M	L
HCS (HCM)	X			X	M	L	L
Crash Decoder Tool	X			X	L	L	L
HCM Planning Analysis	X			X	L	L	L
Multimodal Analyses (LTS & MMLOS)	X		X	X	M	L	L

Project Tools

Project analysis is the most detailed of all analysis types. Project analysis can involve the full range of tools from the travel demand model to micro-simulation and may involve specialized areas such as environmental analysis. Travel demand model-based tools are used to compare scenarios or help screen alternatives and are used to create post-processed design hour volumes to be used by other tools. Some tools like dynamic traffic assignment (DTA) are used to incorporate shifting demand into the model assignments to better match the field conditions and limit the amount of post-processing needed. The smaller scope of these plans allows sub-area (window) modeling to be done, which will further reduce the post-processing need. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Detailed historic and/or predictive crash analysis is needed at the project level. Tools like IHSDM and the NCHRP HSM spreadsheets, and ISATe are used to do the predictive analysis on urban and rural arterials and freeways while the Crash Decoder Tool is used to simplify the historic crash analysis.

Analysis would be typically done across all applicable modes at varying levels of detail from HCM-based analysis to micro-simulation. HCM/other planning analysis tools are mainly used for alternative scoping or screening. RITIS Analytics can be used to help identify bottlenecks, travel times, incident effects, calibration data, and other measures across a corridor. An intersection-level analysis is usually needed so any of the HCM-based methods and tools (such as HCS or Synchro) can be used. In congested areas or where the HCM methods no longer apply then micro-simulation is required. Vissim is typically used for freeway operations, complex configurations, and/or including multimodal issues, and SimTraffic is used for signalized arterial corridors. Some projects may involve environmental traffic analysis for noise, air quality and energy impacts which normally requires the use of intersection analysis tools and spreadsheets.

Exhibit 2-5: Project Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
Vissim		X		X	H	H	H
IHSDM	X			X	H	M	H
Urban Models (MPO & small urban)	X		X		M	M	M
Activity-Based Models		X	X		H	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
SimTraffic		X	X	X	M	M	M
RITIS Analytics	X			X	L	L	L
Synchro	X		X	X	M	M	L
Vistro	X		X	X	M	L	L
SIDRA Intersection	X		X	X	M	M	L
NCHRP HSM Spreadsheets	X			X	M	L	M
HSM Part B Screening Analyses	X			X	L	L	L
ISATe	X			X	M	L	M
HCS (HCM)	X			X	M	L	L
Crash Decoder Tool	X			X	L	L	L
Trip Generation	X			X	L	L	L
HCM Planning Analysis	X			X	L	L	L
Multimodal Analyses (LTS & MMLOS)	X		X	X	M	L	L
Other Planning Analysis	X			X	L	L	L

Specific Analysis Elements

Volume Development Tools

These tools are used to help develop volumes to be used in the analysis at various levels of detail as warranted by the individual study. Where a travel demand model is available, model assignments can be created to help in creating growth rates for post-processing or modeling specific scenarios. Dynamic traffic assignment and subarea modeling techniques can be used to refine the assignment. Zonal cumulative analyses are used where a travel demand model is not available but may involve use of model assignment software. At the very least, the Future Volume Tables can be used to create forecasts, and the ATR Characteristic and Seasonal Trend Tables are used to adjust for the base conditions. Trip Generation (manual lookup or software-based) is used in cumulative analysis methodologies using rates from the ITE Trip Generation manual.

Exhibit 2-6: Volume Development Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
Zonal Cumulative methods	X			X	H	M	M
SWIM		X	X		H	H	H
Urban Models	X		X		M	M	M
Activity-Based Models		X	X		H	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
Future Volume Tables	X			X	L	L	L
ATR Characteristic & Seasonal Trend Tables	X			X	L	L	L
Trip Generation	X			X	L	L	L

Screening Analysis Tools

Screening analysis is typically a high-level analysis used to reduce the number of scenarios/concepts/alternatives to a manageable level. Most studies will have multiple levels of screening at increasing detail levels. At the top end, travel demand model-based tools are typically used for the system impacts. The Planning & Preliminary Engineering Application Guide, a companion to the HCM, offers numerous levels of screening methods and tools from intersection analysis to service volume table lookups. Middle and lower screening levels are more detailed at the intersection level, which may be using key intersection volume-to-capacity ratios, or multimodal level of services. HCS/HCM methods can use defaults to simplify operational analyses for a quick assessment including reliability. Screening analysis in a project –level analysis will be more complex than in a system plan. Other analysis type tools such as RITIS, FIXiT (TTI), and FHWA’s DANA tool, to name some examples, all use probe data, which can be used to assess different performance metrics at a screening level.

Exhibit 2-7: Screening Analysis Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
Urban Models	X		X		M	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
HCS (HCM)	X			X	M	L	L
HCM PPEAG methods	X			X	L	L	L
Preliminary Signal Warrant Analysis Worksheet	X			X	L	L	L
Other Planning Analysis	X			X	L	L	L

Multimodal Analysis Tools

For a complete analysis of a system or a project area, a multimodal analysis is needed. Urban MPO (Metropolitan Planning Organization) models and the newer subset of activity-based models can be used to determine mode share for the base case as well as alternatives. Bicycle and Pedestrian Level of Traffic Stress methodologies are used to assess network connectivity, quality, and accessibility and can be also used to prioritize improvements based on the size of the resulting low-stress network. Multimodal level of service (MMLOS) is used to create qualitative and quantitative assessments for the pedestrian, bicycle, and transit modes across different facility types for segment and intersection analysis.

Common analysis tools such as Synchro and HCS use HCM methods that ODOT does not use (other than a few specific cases) because of the large amount of data required, so these are not in the tables. In congested areas or in areas where non-auto modes are very common mixing with vehicular traffic such as light rail, streetcar, and buses, SIDRA mesoscopic analysis or Vissim micro-simulation will be needed to judge the impacts of these modes on each other. Vissim is also needed where heavy rail modes cross roadways. Analysis of off-roadway operations (e.g. heavy/light rail, bus rapid transit guideways) requires different resources, such as the Transit Capacity Quality of Service Manual (TCQSM), which will be a future addition to this manual.

Exhibit 2-8: Multimodal Analysis Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
Vissim		X		X	H	H	H
Urban Models	X		X		M	M	M
Activity-Based Models		X	X		H	M	M
SIDRA Intersection	X		X	X	M	M	L
Qualitative Multimodal Assessment	X		X		L	L	L
Bicycle & Pedestrian Level of Traffic Stress	X		X	X	M	L	L
MMLOS methods – Segment	X			X	L	L	L
MMLOS methods - Intersection	X			X	M	L	L
NCHRP 562 Crossing Treatments	X			X	L	L	L
HCM Pedestrian Crosswalk LOS & Delay	X			X	L	L	L

Safety Tools

Most studies will require some sort of safety analysis. At a minimum, a historic crash analysis is needed. The Crash Graphing and Crash Decoder tools simplify the processing and analysis of individual crash records. The Oregon Transportation Safety Data Explorer (OTSDE) GIS tool can expedite safety screenings or capture project-level historic crash data and also allows simultaneous viewing of geographic, safety, and multimodal data. Historic crash data are also needed to support more-detailed predictive analysis. Plans and projects can use Highway Safety Manual (HSM)-based screening methods for establishing critical crash rates within a community or predicting the number of crashes associated with changes to roadway segments or intersections. Tools for screening include the HSM Part B screening method critical rate and excess proportion of crash types calculators. Additional HSM-based spreadsheets tools are available to conduct segment and intersection predictive analyses or ISATe for freeways and interchanges. Interactive Highway Safety Design Manual (IHSDM) software allows for very detailed evaluation of safety effects of geometric design decisions and requires a project-level data collection effort to be used appropriately. See Chapter 4 for more information on safety analysis tools and methods.

Exhibit 2-9: Safety Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
IHSDM	X			X	H	M	H
ISATe	X			X	M	M	M
HSM Spreadsheets	X			X	M	L	M
Excess Proportion of Crash Types Calculator	X		X		L	L	L
Critical Rate Calculator	X		X		M	L	L
OTSDE GIS Tool			X	X	L	L	L
Crash Decoder Tool	X			X	L	L	L
Crash Graphing Tool	X			X	L	L	L

Environmental Traffic Data Tools

Sometimes, plans and projects will require some sort of environmental analysis. This can range from high-level travel demand model-based efforts to very detailed traffic volume development. VisionEval is a strategic-level tool that estimates greenhouse gas emissions (GHG) across a metropolitan region and thus will be mainly used in the development of regional transportation plans (RTP) and related scenario planning/strategic assessments. Development of RTP's requires an air quality conformity determination. Also some metropolitan and smaller urban areas have been (none currently are) non-attainment areas for air quality. The urban models feed data into the air quality model (MOVES) which is the tool for determining air quality conformance. Tools such as FHWA's DANA package allow data for MOVES to be created from probe data automatically, saving time. Project analyses will generally involve at least a noise study with many larger projects needing air quality or GHG emission studies. Traffic data for these studies is typically done using spreadsheets.

Exhibit 2-10: Environmental Traffic Data Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
VisionEval		X	X		H	H	H
DANA	X		X		L	L	L
Urban Models	X		X		M	M	M
Spreadsheet-based analyses	X		X	X	M	M	M

2.5 Creating a Scope of Work (SOW)

The third step for scoping is to determine the specifics for the scope of work (SOW). SOWs can be written for TSPs, Corridor/Facility Plans, Refinement Plans, IAMPs and projects. Traffic Impact Analyses/Statements (TIAs/TISs) also have a SOW, but specific criteria should be consistent with Chapter 3 of ODOT's Development Review Guidelines.

The purpose of establishing a SOW for a transportation study is to define critical parameters such as the study area boundaries, analysis requirements, data needs and the identification of specific concerns to be addressed. An effective SOW should always produce a completed study that satisfies the needs of the corresponding project.

Common elements for most types of transportation studies include:

- Background or Purpose Statement
- Objectives of the Study
- List of Work Tasks
- Identification of Deliverables
- Project Schedule
- Project Budget

It is important that the work tasks and corresponding deliverables be clearly defined and that the party responsible for completing them is identified. The distribution list for deliverables should generally include all the pertinent teams/groups and specific ODOT sections needed for review.

All ODOT analyses must have a discussion on methodologies and assumptions used. For SOWs there must be a requirement for a Methodology Memorandum clearly shown. This memorandum details out the methodologies and assumptions that are to be used in the existing and future volume development and analysis. It should include the range of analysis methodologies from identifying count locations through simulation, including any safety and multimodal analysis. This memorandum should be provided to and approved by ODOT before any analysis work is conducted. This helps to significantly reduce the amount of review by ODOT and potential re-work by the Contractor.

The SOW must require that the methodology memorandum is completed by the Contractor and reviewed by and agreed to by ODOT prior to the Contractor starting any volume development and/or analysis tasks. In the absence of a SOW requirement, the APM requires use of the same methodology memorandum. [Appendix 19A](#) contains an annotated example methodology memorandum. This example does not necessarily include all methodologies that may be applicable in a given context.

2.5.1 Traffic Scoping Considerations

Each SOW likely has specific individual issues; however, there are many common needs such as professional engineer licensing requirements and specific requirements for the state highway system. Some typical SOW traffic analysis statements are shown below.



The following lists are typical of suggested statements used in SOW's for the traffic analysis tasks and are not exhaustive. Not all of these statements will apply to a single study. These tasks may be modified as desired to fit a study's particular needs.

General

- Final versions of the Contractor's transportation analysis must be stamped by an Oregon-registered Professional Engineer (P.E.) with license being current and in good standing, with expertise in civil or traffic engineering.
- Traffic analysis must follow the Highway Capacity Manual (HCM) [named current version] procedures and comply with ODOT's Analysis Procedures Manual available at <https://www.oregon.gov/ODOT/Planning/Pages/APM.aspx>. Signalized intersection v/c's shall be computed manually unless software-calculated.
- Contractor shall coordinate all traffic analysis with ODOT's Transportation Planning Analysis Unit (TPAU) and Region [1-5] Traffic Section. [Coordination with local jurisdictions or groups such as MPO's, may be necessary.]
- Consultant shall obtain approval of existing and future analysis methodology from TPAU and Region [1-5] Traffic via a methodology memorandum prior to beginning analysis.
- All documents will be readable and usable in black and white [Exceptions can be specified for certain deliverables.]
- All documents must be written in plain language and use an easily understood format.
- Contractor shall review all applicable plan/past project documents to the study area
- Contractor shall allow two weeks for review of written and analysis deliverables or as agreed to by the contract administrator.
- Contractor shall furnish written and electronic documentation for all assumptions, data, calculations, and results. This includes paper and computer files (i.e. spreadsheets and analysis software files).

Inventory

- Counts should be broken down by type and duration as suggested in the Analysis Procedure Manual Chapter 3. For clarity, the count locations, types, durations should be

identified on a map as follows:

- Contractor (or ODOT/Agency) will provide 16-hr intersection classification traffic counts with 15-minute intervals at the morning and afternoon peak hours at the following locations:
- Specific locations in list
- [Note: Similar language is needed for any peak period counts or any road tube counts]
- All counts must have at least 15-minute breakdowns from 2 - 6 PM. All counts must include bicycles, pedestrians, and turning movements.
- State highway volumes and classification information is available here: https://highway.odot.state.or.us/cf/highwayreports/traffic_parms.cfm
- Field inventory information – lane configurations, traffic controls, speeds, operational issues (queuing, unique driving behaviors, etc.) will need to be obtained by the Contractor.
- If micro-simulation is desired, then Contractor shall obtain necessary calibration data.
- Note: Five (5) years of crash data shall be obtained from ODOT's Crash Analysis & Reporting Unit for state highways and any local roadways desired in the study area.

Volumes

- All traffic volumes must be adjusted to reflect the 30th highest hour [Note: use the alternative standard (i.e. average volumes) if it applies to the study area].
- Areas that are covered by a travel demand model must use the model to develop future no-build and build alternative volumes.
- Contractor must submit a model request to ODOT's Transportation Planning Analysis Unit (TPAU) at least three weeks before the data are needed. The model request form is available at: <https://www.oregon.gov/odot/Planning/Pages/Technical-Tools.aspx#travelDemandModel> [Note: This is only for travel demand models that TPAU has developed.]
- All raw model numbers must be post-processed or used only in relative (percentage) comparisons.

Analysis

- Analysis locations will include at least the traffic count locations. Exact intersection analysis locations will be determined during negotiations.
- Traffic analysis must follow methods in the Highway Capacity Manual (HCM) [named current version] published by the Transportation Research Board (TRB) or as agreed to by ODOT. All traffic analysis software programs used must follow Highway Capacity Manual [named current version] procedures. Signalized intersection v/c's shall be computed manually unless software-calculated.
- Contractor shall prepare and submit a Methodology Memorandum documenting methodology and assumptions to be used for existing conditions (i.e. seasonal factors used), future conditions (i.e. volume development/post-processing methodology), and alternative analysis (i.e. peak hour factors, analysis parameters, calibration, etc.) to TPAU and Region [1-5] Traffic Section. Consultant shall obtain approval of methodology from TPAU and Region [1-5] Traffic Section prior to beginning analysis. Consultant shall obtain approval of analysis and conclusions from TPAU and Region [1-5] Traffic Section

prior to submitting Draft Tech Memos.

- [Note: for existing conditions] Contractor shall obtain the past five years of crash data from Agency's Crash Data & Reporting Unit for both state and non-state roadways and perform crash analysis. Contractor's data for state highways shall include locations of Safety Priority Index System (SPIS). Contractor shall use the Highway Safety Manual Part B Network Screening Critical Crash Rate and Excess Proportions of Specific Crash Types methods for intersections. Each reference population used in either method must have at least 5 (five) sites. In addition, at least two sites must have at least 2 (two) crashes of the target crash type to be applicable for the excess proportion method. If this is not met, intersection crash rates need to be compared with the published 90th percentile rates (See ODOT Analysis Procedure Manual Chapter 4).
- If the local agency or region has established a critical crash rate for segments or if each segment type within the study area includes a minimum of five study segments, Contractor shall use the Highway Safety Manual Part B Network Screening Critical Crash Rate method for segments to compare segment crash rates to a critical rate. If fewer than five segments exist for a segment type, segment data must be compared with the official published crash rates (ODOT Crash Tables – Table II) for similar facilities [Does not apply to urban areas]. Segments must be homogenous in number of lanes, area type, and volume.
- For intersections that exceed the identified critical crash rate, the excess proportion of specific crash types, and/or the published 90th percentile rate, crash patterns, evaluation of causes and potential countermeasures must be identified for each site. Consultant shall map locations of these safety issue areas and the Safety Priority Index System sites. Consultant shall utilize the Crash Data and MMLOS/LTS to identify potential countermeasures and safety improvement alternatives.
- For segments that exceed the identified critical crash rate or published crash rate and intersections that exceed the identified critical crash rate, analysis of crash patterns, identification of contributing factors, and potential countermeasures need to be completed. Contractor shall map locations of these safety issue areas and the SPIS sites.
- [Add to the above before the last sentence for projects and detailed refinement plans/IAMPs]. Contractor shall perform HSM Part C predictive analysis for all screened locations exceeding segment or critical rates for the existing conditions.
- [Note: Future safety for TSP's, similar detail level plan, and project development screening] For each alternative developed to specifically address a safety concern, Contractor shall summarize safety impacts of each design. Contractor shall use the All-Roads Transportation Safety (ARTS) Crash Reduction Factor Appendix as the initial source of countermeasures. If the ARTS Appendix/List is not sufficient, then Contractor shall use the Crash Modification Factors (CMF) in the HSM Part D and/or the FHWA CMF Clearinghouse to indicate the potential crash reduction for each safety alternative or countermeasure. The ODOT CMF standard is to only use CMF's with a quality rating of three stars or better.
- [Note: Future safety for projects or detailed refinement plans/IAMP's] For each alternative developed to specifically address a safety concern, Contractor shall summarize safety impacts of each design using HSM Part C predictive methods. Full predictive analysis should only be completed on and reported out on the final alternatives (including the future no-build) to be included in the [plan/project].

- Consultant shall conduct a qualitative (“Good, Fair, Poor”) multimodal assessment for the Project Area collectors and above as per APM Chapter 14. The assessment analysis must include bicycle, pedestrian, and transit (if applicable) operations.
- Consultant shall conduct Level of Traffic Stress (LTS) analysis for all roadways in the Project Area as per APM Chapter 14. As much as possible, data should be obtained from current aerial photography and (TSP) roadway inventories before field data collection. Bicycle & Pedestrian LTS will be evaluated and results graphically displayed for the existing conditions.
- Contractor shall conduct a high level MMLOS analysis for [indicate roadways to be studied] in the study area. MMLOS analysis must include vehicle, transit, bicycle, and pedestrian operations. Pedestrian analysis should not include the effective width of sidewalk data and calculations but rather assume a clear sidewalk width for each side of each segment. Bike analysis should use the link-level analysis only. Transit analysis should use as much general or average data from available transit district information as possible.
- Traffic analysis at ODOT intersections must be consistent with ODOT’s Analysis Procedures Manual (APM) available on the internet at <https://www.oregon.gov/odot/Planning/Pages/APM.aspx> . Traffic analysis at non-state intersections needs to be compatible with ODOT procedures and must follow standard engineering procedures and practices.
- ODOT may approve a different or additional intersection analysis method prior to use when the different method can be justified for local and ODOT facilities. Contractor must provide documentation fully explaining the issue and the reasons for the proposed change. Contractor must obtain approval before use.
- Operational targets for state facilities should include the volume to capacity (V/C) ratio. Existing conditions and future no-build must be compared to the Oregon Highway Plan (OHP) v/c targets. Build alternative v/c’s are to be compared with ODOT’s Highway Design Manual v/c’s. Standards for non-state facilities can be v/c and level-of-service (LOS) or a combination of v/c and LOS, depending on the local standards.
- Other performance measures may be required which can include queuing, MMLOS, simulation-based MOE’s, etc. All secondary performance measures shall be included in the methodology memorandum.
- Simulation to determine queues or other measures of effectiveness should be used if v/c’s exceed 0.70 and simulation shall be used if v/c’s are equal to or exceed 0.90. Simulation shall also be used if existing conditions show congested conditions, (i.e. intersection queuing backs into adjacent intersections/connections) or if Agency requires it.
- If simulation is desired to obtain 95th percentile queue lengths or other measures of effectiveness, then the simulation shall be calibrated following procedures in Chapter 15 of the Analysis Procedure Manual.
- Areas with complex freeway geometry/operations, transit operations (bus, light rail, etc), railroad pre-emption, require simulation and shall follow the VISSIM Protocol available at: <https://www.oregon.gov/ODOT/Planning/Pages/APM.aspx>

Traffic Data to Support HB 2017 Benefit Cost Analysis

- Following procedures in the APM, traffic data shall be prepared to support HB 2017 Benefit Cost Analysis (BCA). The analysis shall be coordinated with and prepared using

assumptions and parameters provided by the Region and the economists in the ODOT Program Implementation and Analysis Unit (PIAU). Traffic data shall be provided for the No Build and Build Alternative for both the Base Year and Horizon Year.

Air/Noise/Energy Traffic Data

- Air/Noise/Energy traffic data must be obtained and reported as in the Analysis Procedure Manual Chapter 16 or as agreed upon by Agency.
- Traffic Data for Noise Analysis (Contingency)
 - Consultant shall prepare traffic data needed for noise analysis and noise technical report. This analysis shall include:
 - Existing, future build (design year), and future no-build traffic data for each roadway link in the project area, including collector and higher functionally classified cross streets, for the peak hour and the peak truck hour and in an MS Office-compatible spreadsheet in the form of:
 - Link volumes for each traffic direction
 - Percentages of the following vehicles on each link:
 - Automobiles (FHWA vehicle classes 1-3)
 - Medium trucks (FHWA vehicle classes 4-5)
 - Heavy trucks (FHWA vehicle classes 6-13)
 - Existing and future posted speeds
 - Existing 85th percentile speeds (if available)
 - For each traffic signal in the project area, the percentage of vehicles affected (expected to come to a stop).
 - Land use zoning information for properties within the project area in the form of:
 - Existing zoning
 - Future zoning or predicted changes in land use from existing use
 - Please note that the peak truck hour is typically not in the same period of the day as the peak hour, so longer duration vehicle classification counts (ideally 16+ hour) are necessary. Please refer to ODOT's Analysis Procedures Manual Chapter 16 for details on roadway link creation, vehicle classification, and required factors and their calculation.
 - If peak hour or the peak truck hour link volumes exceed the maximum LOS C volumes (LOS C/D threshold) then the link volumes shall be capped at the maximum LOS C volume. LOS C comparative volumes for can be obtained from current Highway Capacity Manual methods. LOS C volumes for intersection approaches also require an iterative process to obtain the target LOS C value.
 - The methodology for creating the noise traffic data shall be documented in a methods and assumptions memorandum to be reviewed and approved by Agency Transportation Planning Analysis Unit and Region Traffic Engineer before work on creating the noise traffic data starts.
 - The completed draft noise traffic data and related documentation (calculations, notes, etc.) shall be reviewed and reviewed and approved by the Agency Transportation Planning Analysis Unit and Region Traffic Engineer. The noise

traffic data shall be provided as appendix material in the draft and final Noise Technical Report.

Coordination with other Work Areas

- If rail facilities are within the study area, coordination with the ODOT Rail Division is required.
- If the study area is adjacent to an airport or includes any overlay zones then coordination with the Department of Aviation is necessary.
- If studied facilities are formally recognized freight routes, then compliance with ORS 366.215 “Reduction in Capacity” may be needed if alternative concepts could potentially restrict the roadway width (i.e. curb extensions, medians, etc.).

2.5.2 Developing Work Plans

Once a SOW has been determined, a detailed internal workplan that outlines the analysis tasks and timelines should be developed. This will help the analyst determine the analysis process necessary to achieve the SOW deliverables. For internal ODOT-only studies, where SOW’s are not developed, then a detailed workplan is required. This is typically developed by the project manager but also could be developed all or in part by the project analyst. Exhibit 2-1 shows the typical traffic analysis work flow.

The work plan must include the project title, highway name and number, and a purpose statement to identify the project objectives. This work plan must be consistent with the overall project schedule and should be submitted to the project leader for review of timelines. This document will help explain to the project leader/contract administrator analysis and staffing/resource needs and timelines. At the very least, this will start conversation about project expectations. Delays or additional work requests will extend the timelines. The work plan should be updated as the study proceeds especially if major changes occur. A revision date should be on the first page of the work plan. A typical analysis will include most, but not necessarily all, of the following tasks. The tasks are not necessary linear, some may be concurrent or overlap while others provide feedback to other tasks.

The following example tasks assume a typical plan or modernization/safety project. This would need to be modified to fit any specific study.

- **Task 1 – Project Identification and Understanding**
The purpose of this task is for the analyst to have an understanding of purpose and need of the study, the parameters and constraints that influence it, the questions that need to be answered, and to define the level of analysis and tools to be used.

The methodology of this task should include the following which impact the analysis:

- Study purpose and need and goals and objectives
- Identify any prior relevant plans (i.e. TSP’s, refinement plans), analysis (i.e. prior/adjacent projects, traffic impact analyses) that need to be considered in the study area including any usable inventory data
- Identify any concurrent project or planning efforts in or adjacent to study area.
This will require coordination (i.e. data, timelines, project progress etc.) between

these efforts.

- Identify any new data needs (such as need to update a travel demand model)
- Identify any constraints or issues that may affect the project (i.e. funding, natural or built environment, politics).

Task deliverables includes a summary of any prior or current studies in or adjacent to the study area with issues, constraints, and impacts to the analysis discussed. A traffic analysis methodology memorandum may be appropriate if the work needs to be coordinated with multiple staff and or studies.

- **Task 2A – Transportation System Inventory**

The purpose of this task is to review existing data and collect additional inventory data for the study area. Note: Allow 6-8 weeks from date of request for counts requested from ODOT.

The methodology for this task should specify the following:

- Count Request – This should include count locations, types and durations and any other special considerations. Refer to Chapter 3.
- Field inventory data needed including, but not limited to the suggestions in Chapter 3.
- Office inventory data needed including, but not limited to:
 - Five years of crash data for roadways in the study area
 - Available inventory data
 - Pertinent map/aerial photograph of area for figures
 - Roadway functional class, designations and planning information
 - State and local performance measures
- If simulation, or reliability, multimodal, or predictive crash analysis will be needed then more extensive inventory data will be required.
- Other optional inventory data that may be needed, depending on project.

Task deliverables include inventory information, project area map and photo for use in the following tasks.

- **Task 2B – Methodology & Assumptions Memorandum**

The purpose of this task is to create the methodology and assumptions memorandum (see Chapter 19) which needs to be done before any volume development and analysis is performed.

All methodologies and assumptions going into the volume development and analysis for the existing conditions, future no-build and any build alternatives needs to be described. This covers items including, but not limited to:

- Study area coverage
- Count locations/types/durations
- Seasonal/growth factors
- Analysis years
- Peak hours/periods
- Travel demand models/scenarios to be used

- Trip generation/distribution assumptions
- Performance measures to be used
- Analysis tools to be used – both at screening and detailed levels
- Major analysis parameters (e.g. saturation flows, peak hour factors)

All proposed analysis processes for historic/predictive crash analysis, segment/intersection operational analyses, multimodal, reliability, and micro-simulation should be covered in the memorandum. Calibration documentation tasks for micro-simulation or other analyses should be part of this memorandum or as an appendix instead of in a separate process to improve efficiency. The timeline needs to allow two weeks for review by ODOT Region Traffic, other ODOT units, and local jurisdictions as necessary.

Task deliverables include the draft and final versions of the methodology and assumptions memorandum to be used in the following tasks.

- **Task 3 – Develop No-Build (Existing and Future) Design Hour Volumes**

The purpose of this task is to develop base year, build year and future year no-build design hour volumes (30th highest or other alternative standard). Occasionally, other interim years may be needed such as air quality or project phasing (short-term fixes) issues. The base year is the year of the study, or when most of the data was gathered. The build year is the year that has the day of opening of the project. Generally, the build year is one year (for small projects like intersections) to two or more years (for large projects like interchanges) from the let date shown on the project prospectus. The future (design) year is typically 20 years from the build year. For example, a 2015 interchange project with a let date in 2019 could have a base year of 2012, a build/opening year of 2021 and a future/design year of 2041.

The methodology for this task is to use the manual count data to obtain the existing/base 30th highest hour volumes (30HV) using historical and seasonal adjustments in Chapter 5. A single system peak hour must be used with volume balancing as appropriate.

The future volume development methodology should be described, whether by historical trends, cumulative analysis, or with a transportation model (see Chapter 6).

Task deliverables include the figures/worksheets showing the traffic volume development process and the balanced base 30 HV and future no-build volumes on figures in the technical memoranda for the existing and the future no-build conditions.

- **Task 4 – Analysis of No-Build Transportation System**

The purpose of this task is to evaluate no-build system conditions for the base, build and future years. This may help identify any deficiencies related to the study purpose and need.

The methodology for this task should use the base year, build year and future year data developed in Task 2 along with current Highway Capacity Manual (HCM)-based analysis software to evaluate the system by performing the following:

- Use crash data from Task 1 and perform a safety analysis following procedures in Chapter 4. This needs to include a Highway Safety Manual Part B network screening process of locations before doing more detailed safety analysis. This should cover intersections and segments and use historical and predictive methodologies as appropriate.
- Operational analysis including preliminary signal warrants, turn lane criteria, access/street spacing, and signal progression should be covered.
- Evaluate the volume to capacity (v/c) and level of service (LOS) or other performance measures as appropriate by jurisdiction for the study area for intersections, merge/diverge/weaving sections, freeway mainlines and highway segments.
- Perform a multimodal evaluation depending on study type and desired detail level following procedures in Chapter 14.
- Micro-simulation modeling may be needed if there are multiple signals involved or congested conditions exist. All simulations shall be calibrated according to APM methods. Simulation outputs should at least include 95th percentile queues, travel times, speeds, and overall hours of delay. Remember to allow the additional time (least a month) to calibrate the existing condition simulation model.
- Turn bay storage lengths will be compared to the 95th percentile no-build queues. Blocking of turn bays and upstream intersections must be noted if microsimulation is performed.

The task deliverable is a technical memorandum which includes the safety and operational analysis including the various performance measures. If simulation is used, then a calibration report on data gathered, calibration locations and overall calibration results (i.e. methodology memorandum appendix) will be required.

- **Task 5 – Evaluate Preliminary Alternatives (Screening)**

The purpose of this task is to work with the project team to develop and screen the preliminary alternatives.

The methodology for this task is to review goals and objectives with the team considering identified needs, and evaluate each preliminary alternative by comparing operations, safety, multimodal, or other higher-level performance measures at major intersections or other agreed upon key location(s) for the appropriate years. Travel demand models can also be used to screen alternatives effectively if the alternatives have the potential to change traffic patterns beyond the local area. Travel demand model screening can include relative volume comparisons and link demand-to-capacity (d/c) ratios. The future no-build alternative needs to be included in the analysis as the baseline that the preliminary alternatives are compared against.

Any comparisons using HCM-based v/c's need to use the current Highway Design Manual (HDM) v/c's. Travel demand model-based link d/c's have different methodology and cannot be directly compared to the HDM v/c's. Travel demand model-based screening criteria should be based on relative comparisons. Comparisons may also need to be made to local jurisdiction operational standards which could be LOS, v/c or delay based.

The task deliverable is a technical memorandum, with the screening criteria and results shown for each alternative. A summary comparison table that shows how the alternatives and the future no-build alternative perform against the screening-level criteria and each other must be included. Recommendations for keeping or dropping alternatives based on traffic analysis considerations should be included.

Note: Post-memo project team decisions on alternatives should be documented in the next technical memorandum on build alternatives and need to be documented in the alternatives considered but dismissed section of the final memo/narrative.

- **Task 6 – Evaluate Build Alternatives**

The purpose of this task is to work with the project team to develop and completely evaluate the detailed alternatives that satisfy the future transportation needs for this project. All tasks need consider timelines per alternative. Ideally, no more than three detailed alternative analyses are performed. Too many full-detail alternatives will result in excessive time or budget requirements.

The methodology for this task is:

- Develop build and future year Design Hour Volumes (DHVs) for each of the final alternatives. Either distribute the no-build volumes on the build alternatives or create new build volumes for each alternative if currently diverting traffic (i.e. latent demand; see Chapter 6) that would return with the new alternative or new induced demand that could be created is sufficient to invalidate the use of the no-build volumes.
- Operational considerations such as preliminary signal warrants, functional area, and turn lanes will be evaluated.

- Evaluate the v/c and LOS and other performance measures for the study area for intersections, merge/diverge/weaving sections, freeway mainlines, and highway segments.
- Perform a predictive safety analysis if appropriate following procedures in Chapter 4.
- Perform multimodal evaluations across the pedestrian, bicycle and transit modes.
- Microsimulation of build conditions including determining turn bay storage lengths using the 95th percentile build queues and blocking of turn bays and upstream intersections.
- The output build v/c's must be compared with the HDM design v/c's for state facilities. Non-state v/c or LOS need to be compared with the appropriate local operational performance measure standard.
- Work with ODOT Traffic-Roadway Section and Region Traffic if new signals/roundabouts or changes to existing signals are involved. A progression analysis for the study area is needed if more than one signal is included in the alternative.
- Determine if access, intersection and interchange spacing meets or improves over current conditions in the OHP spacing requirements.

The task deliverables include a technical memorandum with volumes, v/c, LOS, queues, safety, multimodal, and other measures of efficiency shown on diagrams for each alternative, a summary comparison of the alternatives (including a table) and how they fared against the evaluation criteria and each other. Also, the design storage lengths and other geometric details need to be forwarded onto the appropriate design staff, either ODOT or consultant.

- **Task 7 – Environmental (Air/Noise/GHG) Traffic Data (If Needed)**

The purpose of this task is to produce environmental traffic data for the no-build and build alternatives. The base year and no-build future year environmental traffic data can be started immediately after the Task 3 volumes are completed. The build alternative environmental traffic data should not be started until the final build alternatives are selected. Note: need to make sure that the data collection efforts properly support this task (i.e. ADT -capable classification counts at most intersections; 12+ hours).

This includes the base year, build year and future volumes. Larger projects may also require the creation of short-term future year (10 year) data. The analyst should contact the air/noise specialist(s) who will be using this information before beginning this task to ensure the correct information is provided. There may be some differences in data requirements from project to project, depending on the needs of the user of the data.

The methodology for this task uses the balanced hourly volumes as the basis to develop the average daily traffic (ADT), LOS C volumes and VMT (vehicle-miles travelled). This volume data, in addition to truck classifications, speeds, and segment lengths, is needed for the base, build and future years to compute the environmental traffic data. The LOS C volumes (representational of the noise hour which is the maximum number of vehicles moving at the maximum speed) are only needed for noise analysis. Work with the noise consultant to confirm years and data results requirements. In congested areas, differing levels of air quality data might be needed depending on the specific pollutant and

environmental study type reporting needs. Energy (burden) data may be needed on large projects of regional significance (environmental impact statements) which involves vehicles miles traveled.

The task deliverables include the environmental traffic data for the base, build and future years delivered to the air/noise/energy consultant(s). Diagrams are also required as the identification/location key for the data.

- **Task 8 –Traffic Analysis Narrative/Final Technical Memorandum**

The purpose of this task is to prepare the written documentation of the project analysis. This will assist the project team in making the preferred alternative selection. For large or complex projects a full narrative report is required. For smaller projects such as single intersection safety or operational projects can be documented with a final technical memorandum.

The narrative/memo should draw from, summarize, and discuss information from all of the previous technical memoranda and any other analyses into a stand-alone document. Draft and final versions will need to be produced. In addition, the final narrative/memo needs to have an engineer's stamp as it is a document of record for the traffic analysis. The narrative/memo will document all of the selected and dismissed alternatives and may or may not make any recommendations.

2.5.3 Typical Task Times

Every project is different so actual task times can be quite different depending on project complexity, actual staff time available or overall project schedule (i.e. fast-tracked) to name some of the factors involved. Timelines should be defined by number of weeks required to complete each task. Target completion dates for each task should be established but should allow for overall analyst workload. For example, the timeline may show three weeks to complete the task if 100% of time was available, but if only 25% of time is available then the target date should be 12 weeks out. The final task timelines are negotiated with the project leader depending on the resources involved. Actual task timeline totals will depend on the overall size of the project, how many different years are analyzed, and number of alternatives/options to be analyzed.

Here are some general guidelines for typical studies:

Project Understanding/Scoping

- Allow at least two weeks to develop work plan, identify issues, constraints and impacts to analysis in review of existing/current plans and projects.

Counts/Inventory

- Allow six to eight weeks for counts to be completed and processed
- Allow at least two weeks if crash data are to be requested from the Crash Analysis and Reporting Unit
- Count timing – can add many months if the data collection window is passed

Volume Development

- Allow a month to create the existing 30th highest hour volumes
- Time to update a travel demand model if needed (6 -12 months or more)
- Allow at least three weeks for model application requests to be completed (activity-based model requests are more complex so these need at least four weeks)
- Allow a month to create the future no-build volumes (including all interim years)
- Allow about two weeks to create volumes for each alternative

Analysis

- Allow at least four weeks to perform and report on alternative screening analysis. This will depend on number of alternatives and how many levels of screening to do (i.e. travel demand model relative comparisons followed by key intersection v/c's).
- Allow two weeks for analysis of each build alternative

Simulation

- Allow one to six weeks for simulation model construction/error checking (depends on software)
- Simulation calibration – SimTraffic (two weeks to a month); Vissim (one month +)?
- Allow one week per alternative for simulation results

Environmental Traffic Data

- Allow one to two weeks to setup link diagrams, spreadsheets, etc.
- For smaller projects allow one to two weeks per existing, no-build future and alternatives (three to six weeks total)
- For larger projects allow four weeks per existing, no-build future and alternatives (12 weeks total).
- Allow one to two weeks for review of data (dependent on reviewer's schedule).

Documentation/Review

- Allow three weeks to write and review tech memos
- Allow a week for a reviewer to review the draft tech memos/ narrative (dependent on reviewer's schedule).
- Allow four to six weeks to write and review draft narrative; two to three weeks for final publication
- Allow one to two weeks for completed deliverable review and comment

Appendix 2A – Problem Statement Worksheet