Analysis Procedure Manual

2018 Change Sheets

January 2018

APM Version 2

Chapter 10, Section 10.1

Changed:
This chapter provides guidance on facility level alternative transportation analysis for corridor plans, refinement plans, and project development with or without National Environmental Policy Act (NEPA) involvement. If NEPA is involved or is intended to be involved in the future such as in the creation of an Environmental Impact Statement (EIS) or an Environmental Assessment (EA) then the NEPA guidance for alternative analysis must be followed. Most projects are deemed "CE" for Categorical Exclusion (CE) as there are little to no adverse impacts and typically do not go through the NEPA process. An exception is if the Cat-X project goes through federal lands such as Forest Service or Bureau of Land Management. The NEPA process is usually done by the federal agency, but ODOT can still prepare the environmental document.

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Chapter 10, Subsection 10.2.2

Changed:
Typically, the highway design and traffic operations engineers within ODOT have a key role in assisting the review and confirmation of the selected alternatives. This includes both headquarters staff as well as at the regional technical centers. For example, TRS, specifically the State Traffic Engineer, must approve certain traffic control devices. Design Exceptions are also approved at the headquarters level. It is a good idea to have headquarters staff perform a preliminary review of project alternatives as they may find issues that may be an impediment to approval. This coordination should occur early in the alternatives evaluation process. Planning staff should also be coordinated with to ensure the project does not potentially conflict with past or current planning efforts. The regional technical center staff that would be responsible for the design and implementation of the selected alternative should be included in the concept development, performance assessment and suggested for further refinements.

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Typically, the highway design and traffic operations engineers within ODOT have a key role in assisting the review and confirmation of the selected alternatives. This includes both headquarters staff as well as at the regional technical centers. For example, Traffic Roadway Section (TRS), specifically the State Traffic Engineer, must approve certain traffic control devices. Design Exceptions are also approved at the headquarters level. It is a good idea to have headquarters staff perform a preliminary review of project alternatives as they may find issues that may be an impediment to approval. This coordination should occur early in the alternatives evaluation process. Planning staff should also be coordinated with to ensure the project does not potentially conflict with past or current planning efforts. The regional technical center staff that would be responsible for the design and implementation of the selected alternative should be included in the concept development, performance assessment and suggested for further refinements.

Chapter 10, Subsection 10.2.4

Changed:
The project team(s) control the overall flow of the project. The actual teams and composition of them is dependent on the specific planning or project development effort at hand. For more information see ODOT's Project Delivery Guide. This group may also be known as a Technical Advisory Team (TAC) on a planning project. Typical attendees are ODOT /consultant staff representing different technical areas (i.e. traffic, roadway, environmental, right-of way, mode experts, etc.) and local jurisdiction staff (i.e. planners, public works, etc.). Some other state or federal agencies (i.e. FHWA) may be represented. The PDT reviews the information provided from the analyst, consultants, other staff, other committees, and provides direction, comments, and decisions/recommendations on next steps. The PDT may have voting to screen down alternatives or may have encompassing discussions on an alternative evaluation matrix to help decide what alternatives move into the next step of the alternative development process.

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Chapter 10, Section 10.3

Changed:

Goal - Improve mobility and safety:

Objective:

- Provide improvements that safely accommodate demand for 20 years
- Provide improvements that are consistent with the classification of the highway per the Oregon Highway Plan

To:

Goal - Improve mobility and safety:

Objective:

- Provide improvements that safely accommodate demand for 20 years
- Provide improvements that are consistent with the classification of the highway per the Oregon Highway Plan (OHP)

Changed:

- Objective - Provide improvements that are consistent with the classification of the highway per the Oregon Highway Plan classification
  Evaluation Criteria:
  - Demand-to-capacity (d/c) ratio
- Objective - Identify local street impacts
  Evaluation Criteria:
  - Demand-to-capacity (d/c) ratio
  - Are there parallel local facilities that can capture trips currently on the state highway?
  - Relative extent that local streets are severed by alternative
- Objective - Maintain or improve function of state highway route
  Evaluation Criteria:
  - Compatibility of highway with OHP spacing standards
  - Demand-to-capacity (d/c) ratio

To:

- Objective - Provide improvements that are consistent with the classification of the highway per the OHP classification
  Evaluation Criteria:
  - Volume-to-capacity (v/c) ratio
- Objective - Identify local street impacts
  Evaluation Criteria:
  - Demand-to-capacity (d/c) ratio
  - Are there parallel local facilities that can capture trips currently on the state highway?
  - Relative extent that local streets are severed by alternative
- Objective - Maintain or improve function of state highway route
  Evaluation Criteria:
  - Compatibility of highway with OHP spacing standards
  - Volume-to-capacity (v/c) ratio

Chapter 10, Section 10.5

Changed:

- **Access Management**: Alternatives may impact property access points or access rights which may not be able to be resolved or mitigated. Resolving access issues may be challenging and are governed by statutes and OARs.

To:

- **Access Management**: Alternatives may impact property access points or access rights which may not be able to be resolved or mitigated. Resolving access issues may be challenging and are governed by statutes and Oregon Administrative Rules (OAR).

Changed:

- **Funding Feasibility**: Current funding limitations may preclude many alternatives. It is important to document the reasons why a particular alternative cannot meet funding restrictions. It is important to be realistic and not create a whole set of alternatives that are too expensive to build or have phases that cannot be broken down further into manageable pieces. Phases (or sub-phases) need to have some sort of independent utility that will incrementally work toward the final solution. Alternatives need to be able to be broken into phases either with interim short to medium range solutions or a series of phases for long term implementation. A project may start with larger more expensive alternatives then screen them down to set that is more manageable. The project leader and Region planning generally take the lead on identifying funding availability. The determination of funding availability should be made as early as possible to avoid analysis of alternatives that may not be feasible.

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Chapter 10, Subsection 10.6.3

Changed:

The background traffic signal timing parameters should be modified to be consistent with the proposed improvement. Caution should be applied when changing the background signal cycle assumptions for the purposes of future analysis. Signal timing is continually re-adjusted over time, so future signal timings should be optimized within the typical cycle maximums. The analyst should coordinate with the agency responsible for operating the signals to identify how the signals would likely operate in the field. Typically the cycle length for the analysis should not exceed 60 seconds for a two-phase traffic signal, 90 seconds for a three-phase traffic signal (e.g., protected highway left turns and permissive side streets left turns) or 120 seconds for a four- or more phased traffic signal. In larger or more complex intersections or systems, the cycle length may be longer than 120 seconds. Demand-responsive or adaptive traffic control systems continually vary the cycle length, so the use of optimized timings for base and future conditions is necessary. Coordinate with the Traffic Roadway Section if analysis indicates that cycle lengths in excess of 120 seconds are likely. For more information on signalized intersection analysis see APM version 1 Chapter 7.

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Chapter 10, Section 10.7

Changed:
The end result may be a preferred alternative or a set of final alternatives depending on the type of project or plan. TSPs will end up with multiple projects defined by short (0-5 yr), medium (5-10 yr), or long term (10 yr +) periods. IAMPs or refinement plans can also identify multiple projects. For projects to be considered officially they would need to be adopted into the TSP as part of implementation of the corridor or refinement plan. Projects may also have multiple final alternatives to be analyzed further in a project development process. For more details on TSPs refer to the TSP Guidelines.

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The end result may be a preferred alternative or a set of final alternatives depending on the type of project or plan. TSPs will end up with multiple projects defined by short (0-5 yr), medium (5-10 yr), or long term (10 yr +) periods. Interchange Area Management Plans (IAMP) or refinement plans can also identify multiple projects. For projects to be considered officially they would need to be adopted into the TSP as part of implementation of the corridor or refinement plan. Projects may also have multiple final alternatives to be analyzed further in a project development process. For more details on TSPs refer to the TSP Guidelines.

Chapter 10, Subsection 10.8.1

Changed:
At the beginning of the process, many designs will be drafted up and the basic viability usually compared against “fatal-flaw” criteria. These criteria more than likely will be based on AASHTO or ODOT HDM or local design standards as applicable. This will eliminate transportation concepts that will not work on a geometric, policy, or general nominal safety basis. If a project has a purpose and need (P&N), then concepts are evaluated against it to see if they meet or generally meet the P&N with modifications. Concepts that do not meet the P&N are dropped. The concepts that pass the fatal-flaw and the general P&N screening also need to be evaluated on a transportation operation basis. For simple projects, the transportation screening can be a volume-to-capacity or other performance measure comparison at key locations. Urban areas typically have larger more complex interdependencies that make a simple isolated point-by-point comparison insufficient. Travel demand models are one tool that allow for many concepts

to be evaluated quickly and to arrive at a set of reasonable recommendations for forwarding onto the next step.

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At the beginning of the process, many designs will be drafted up and the basic viability usually compared against "fatal-flaw" criteria. These criteria more than likely will be based on AASHTO or ODOT Highway Design Manual (HDM) or local design standards as applicable. This will eliminate transportation concepts that will not work on a geometric, policy, or general nominal safety basis. If a project has a purpose and need (P&N), then concepts are evaluated against it to see if they meet or generally meet the P&N with modifications. Concepts that do not meet the P&N are dropped. The concepts that pass the fatal-flaw and the general P&N screening also need to be evaluated on a transportation operation basis. For simple projects, the transportation screening can be a volume-to-capacity or other performance measure comparison at key locations. Urban areas typically have larger more complex interdependencies that make a simple isolated point-by-point comparison insufficient. Travel demand models are one tool that allow for many concepts to be evaluated quickly and to arrive at a set of reasonable recommendations for forwarding onto the next step.

Chapter 10, Subsection 10.8.2

Changed:
For example, a model scenario can be constructed for an individual design concept and a demand/capacity ratio plot could be requested to compare links on a relative basis to each other. The d/c ratios cannot be directly compared to the published OHP/HDM targets. Instead, they can be categorized as below (less than 0.70), near (0.70 – to 0.90), at (0.90 to 1.10) or over (greater than 1.10) capacity. Model links that are shown to be over capacity in a d/c plot have proven to be a good predictor of bottlenecks that are difficult to mitigate. Links that are at capacity are generally can be addressed with mitigation, while links that are below likely will not have problems in the detailed analysis. **Error! Reference source not found.** shows an example from the US97 North Corridor Solutions project. It is preferred to show the d/c on a base map that reflects the actual roadway network with major street names shown. Model networks by themselves are simplified and may be difficult to tell locations apart. A simple graphical figure (note the use of colors and patterns so it can be discernable in black and white) such as this can quickly show the overcapacity areas that may or may not be addressable, which might be grounds for dropping an alternative.

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Changed:
If the model is detailed enough, other measures can be screened. Mode split can be evaluated if the model is at a regional level. Models can also be used to evaluate policies other than land-use related where parameters are included in the model such as restricting the overall capacity of arterials or changes to standards. Policies related to monetary issues such as parking, tolling, or VMT taxation require models with economic components. There are other models are not travel demand-based such as land use, greenhouse gas/emission, and economic-based models that can be used in preliminary screening of related concepts.

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Chapter 10, Subsection 10.8.3

Added:
Screening using operational-level measures is typically applied after fatal flaw or first cut screening such as using models. It generally is the third and final level of screening and involves a detailed evaluation of goals and objectives and is applied to a lesser number of alternatives. See Chapter 9 for details on performance measures.

- **Volume-to-Capacity Ratio**: This could apply to individual turning movements, average intersection conditions for all movements, roadway or highway segments, weaving movements and highway merge/diverge operations. This is the primary performance evaluation criterion for ODOT facilities.
- **Level of Service**: Many local jurisdictions use Level of Service ratings in their development code as performance criteria. Most facility evaluation methods provide both a v/c ratio result and a Level of Service result.
- **95% Queue Length**: Safety and operational impacts associated with the likelihood of a vehicle queue frequently blocking circulation or access. Use the 95th percentile queue and compare to storage length.
- **Queue Blocking Percentage**: Generally applied to through travel lanes, this is the portion of the study period (percent of time) where standing queues block the advance of vehicles from the adjoining upstream intersections or block the entrance to turn lanes.
- **Other Operational Indicators**: Travel time (by corridor or by segment), travel time reliability, total delay and total number of vehicle stops. HERS-ST (see Chapter 7) can be used for determining segment or corridor v/c ratio, speed, travel time and delay.
- **Safety:** Screening for safety includes Highway Safety Manual (HSM) Part B methods such as critical crash rate and excess proportion of crash types which are detailed in Chapter 4. Other safety methodologies such as Crash Modification Factors (CMF), functional area, and spacing standards are also included in Chapter 4.
- **Multimodal:** Level of Traffic Stress methodologies can be used for screening pedestrian and bicycle systems. Multimodal Level of Service (MMLOS) methodologies may be used to identify impacts to transit and may be used for pedestrian or bicycle modes. See Chapter 14 for further information.

- **Other Screening Measures:** Other typical screening measures that may be identified in evaluation matrices that may have traffic or design components include right-of-way, environmental (acres of impervious surface, air quality, noise, etc.), socio-economic (displacements, disproportionate impacts), emergency vehicle access, freight travel times, and access points.

Chapter 10, Section 10.10

Changed:
The project team will select a single alternative from the final group of alternatives, or a hybrid of alternatives, which could necessitate additional analysis. If the selected alternative is significantly different from the alternatives described in the Draft EIS then a Supplemental EIS will also be required so the analysis of all alternatives is consistent. For EIS projects, the Preferred Alternative may, or may not, be identified in the Draft EIS, however, a Preferred Alternative should be identified in the Final EIS. The Final EIS and Record of Decision (ROD) identify the "selected" alternative. For Environmental Assessments, frequently only a Build Alternative and No-Build Alternative are evaluated, in which case the Build Alternative is typically considered the Preferred Alternative.

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The project team will select a single alternative from the final group of alternatives, or a hybrid of alternatives, which could necessitate additional analysis. If the selected alternative is significantly different from the alternatives described in the Draft EIS then a Supplemental EIS will also be required so the analysis of all alternatives is consistent. For EIS projects, the Preferred Alternative may, or may not, be identified in the Draft EIS, however, a Preferred Alternative should be identified in the Final EIS. The Final EIS and Record of Decision (ROD) identify the "selected" alternative. For EAs, frequently only a Build Alternative and No-Build Alternative are evaluated, in which case the Build Alternative is typically considered the Preferred Alternative.

Chapter 10, Subsection 10.12.2

Changed:

- Assessment of the potential magnitude of a shift in modes.

To:

- Assessment of the potential magnitude of a shift in modes if possible, such as by using an MPO travel demand model.

Chapter 10, Subsection 10.12.3

Changed:

- Designation of a multimodal mixed-use area (MMA) by a local jurisdiction. This is for areas meeting specific characteristics as defined in TPR OAR 660-012-0060 that, once adopted, allows a local jurisdiction to approve plan amendments without applying motor vehicle congestion related performance standards. Plan amendments within MMAs are still subject to other transportation performance standards or policies that may apply including, but not limited to, safety for all modes, network connectivity for all modes (e.g. sidewalks, bicycle lanes) and accessibility for freight vehicles of a size and frequency required by the development.

To:

- Designation of a multimodal mixed-use area (MMA) by a local jurisdiction. This is for areas meeting specific characteristics as defined in TPR OAR 660-012-0060 that, once adopted, allows a local jurisdiction to approve plan amendments without applying motor vehicle congestion related performance standards. Other performance standards such as safety still apply. Plan amendments within MMAs are still subject to other transportation performance standards or policies that may apply including, but not limited to, safety for all modes, network connectivity for all modes (e.g. sidewalks, bicycle lanes) and accessibility for freight vehicles of a size and frequency required by the development.

Chapter 10, Subsection 10.12.4

Changed:
Access management in state highway facility plans is addressed in ORS 374.331 and OAR 734-051-7010. The location of county roads and city streets within the area described in the facility plan is determined through collaborative discussion and agreement between the department and the affected cities and counties. For state highway facility plans that propose to modify relocate or remove existing public or private connections to a state highway, a methodology is developed which balance the economic development objectives of real properties with safety, access management and mobility and which inform the affected real property owners of the potential for modification, relocation or closure of existing private connections. The department develops a methodology to weigh the benefits of a highway improvement or modernization project to public safety and mobility against local transportation system plans and land uses permitted in local comprehensive plans and the economic development objectives of property owners who require access to the state highway. Affected property owners may request a review through a collaborative discussion process, and/or an Access Management Dispute Review Board Process.

Access management for highway improvement projects in the STIP is addressed in ORS 374.334, OAR 734-051-5120 and PD 03. An access management strategy is developed for the project by the department in collaboration with cities, counties and property owners abutting a state highway. The access management strategy identifies the location and type of public and private approaches and other necessary improvements that are planned to occur primarily in the highway right of way and that are intended to improve current conditions on the section of highway by moving in the direction of the objective standards in ORS 374.311 and OAR 734-051. The strategy establishes the methodology by which private approaches will be considered for modification, relocation or closure and which balances the economic development objectives of properties abutting the state highway with the transportation safety, access management objectives, and mobility. Affected property owners may request a review of the methodology through a collaborative discussion process, and/or an Access Management Dispute Review Board Process.

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Access management in state highway facility plans is addressed in ORS 374.331 and OAR 734-051-7010. The location of county roads and city streets within the area described in the facility plan is determined through collaborative discussion and agreement between the department and the affected cities and counties. For state highway facility plans that propose to modify relocate or remove existing public or private connections to a state highway, a methodology is developed which balance the economic development objectives of real properties with safety, access management and mobility and which inform the affected real property owners of the potential for modification, relocation or closure of existing private connections. The department develops a methodology to weigh the benefits of a highway improvement or modernization project to public safety and mobility against local TSPs and land uses permitted in local comprehensive plans and the economic development objectives of property owners who require access to the state highway. Affected property owners may request a review through a collaborative discussion process, and/or an Access Management Dispute Review Board Process.

Access management for highway improvement projects in the Statewide Transportation Improvement Program (STIP) is addressed in ORS 374.334, OAR 734-051-5120 and PD 03. An access management strategy is developed for the project by the department in collaboration with cities, counties and property owners abutting a state highway. The access management strategy identifies the location and type of public and private approaches and other necessary improvements that are planned to occur primarily in the highway right of way and that are intended to improve current conditions on the section of highway by moving in the direction of the objective standards in ORS 374.311 and OAR 734-051. The strategy establishes the methodology by which private approaches will be considered for modification, relocation or closure and which balances the economic development objectives of properties abutting the state highway with the transportation safety, access management objectives, and mobility. Affected property owners may request a review of the methodology through a collaborative discussion process, and/or an Access Management Dispute Review Board Process.

Chapter 10, Subsection 10.12.5

Changed:

- **Protected/Enhanced Crossings** – NCHRP 562 provides methodologies to evaluate pedestrian crossing enhancements. The road diet mentioned previously can incorporate many of the crossing enhancements below.
  - **RRFB/PHB Beacons** – provide increased motorist awareness of pedestrian crossings, makes a lower stress crossing, particularly where signalized crossings are widely spaced or out of direction travel is excessive. The Traffic Manual provides specific criteria for installation including speed, volume and spacing.
  - **Raised Pedestrian Refuge Medians** – allows for two-stage crossing of wider roadways, providing a lower level of traffic stress and the ability to cross higher volume roadways. May be combined with other techniques such as illumination, bulb-outs and beacons.
  - **Bulbouts** – can reduce pedestrian exposure while crossing the street. Could constrict freight movements, particularly with full-width lane bulbouts. Important to be aware of vehicular composition and heavy vehicle turn movement patterns. Where substantial truck volumes exist, investigation of alternate routes should be evaluated.
  - **Turn Radius Reduction** – provides for slower right turning vehicles, reduced crossing distance, and create improved visibility between drivers and pedestrians. However, the radius needs to be large enough so that large trucks or buses do not overrun the curb, which is a safety concern for pedestrians.

To:

- **Protected/Enhanced Crossings** – NCHRP 562 provides methodologies to evaluate pedestrian crossing enhancements. The road diet mentioned previously can incorporate many of the crossing enhancements below.
  - **Rectangular Rapid Flashing / Pedestrian Hybrid Beacons (RRFB/PHB)** – provide increased motorist awareness of pedestrian crossings, makes a lower stress crossing, particularly where signalized crossings are widely spaced or out of direction travel is excessive. The Traffic Manual provides specific criteria for installation including speed, volume and spacing.
  - **Raised Pedestrian Refuge Medians** – allows for two-stage crossing of wider roadways, providing a lower level of traffic stress and the ability to cross higher volume roadways. May be combined with other techniques such as illumination, bulb-outs and beacons.
  - **Bulbouts** – can reduce pedestrian exposure while crossing the street. Could constrict freight movements, particularly with full-width lane bulbouts. Important to be aware of vehicular composition and heavy vehicle turn movement patterns. Where substantial truck volumes exist, investigation of alternate routes should be evaluated.

    - **Turn Radius Reduction** – provides for slower right turning vehicles, reduced crossing distance, and creates improved visibility between drivers and pedestrians. However, the radius needs to be large enough so that large trucks or buses do not overrun the curb, which is a safety concern for pedestrians.

Changed:

- **Local Truck Routes** – Used to reroute trucks out of a downtown or constricted areas to more suitable roadways. This may require improvements to the designated roadway. Requires coordination with the local jurisdiction as they usually establish the local truck routes by ordinance. If the local government is proposing to take trucks off a state highway they need to go through the Truck Route on Local System (TROLS) Approval Process.
- Chain-Up Areas – Used in areas with defined snow zones for large trucks and other vehicles to install or remove chains.
- **Climbing Lanes (Chapter 11) -** These are used on steep or long grades to maintain the traffic flow and speed by minimizing delay on the overall traffic stream. Unlike a passing lane, a climbing lane is not considered a capacity improvement. The length that extends over the crest needs to be long enough to accelerate the truck to within 10 mph of the posted speed. Driveways and intersections within the climbing lanes are highly discouraged. Evidence of heavy truck driving on the shoulder is a good indication that a climbing lane may be needed.
- **Truck Only Lanes** – These are exclusive lanes typically used to maintain truck speeds up when climbing grades in congested locations (an exclusive climbing lane).
- **Extending Green** – This is an operational improvement at signalized intersections to detect approaching trucks and extend the green time to reduce trucks stopping and re-starting, improving improve safety and efficiency.
- **Truck Aprons** – Paved areas used at roundabouts on approaches and on the center island and other locations to accommodate oversized vehicles. Curbs are of a mountable type that do not limit truck use but are uncomfortable for smaller vehicles. Broken signposts, bent signs, and broken curbs/sidewalks are indications that aprons may be needed.
- **Mountable Curbs** – Can be used on channelization islands, median barriers to allow for overrunning large vehicles or for emergency access. For example, an intersection may be limited to traffic as a right-in-right-out but the mountable curbs allow for a fire truck to quickly access the side street without a lot of out-of-direction travel and a quicker response time.
- **Accommodations for Freight and Oversize/Overweight (OSOW) Vehicles** can include the above apron and curb allowances but should also consider needs for turning radius at intersections, impacts of curb extensions, painted medians in lieu of landscaped medians/ barriers, narrow lanes and other restrictions. Certain highway routes are covered by ORS 366.215 which requires coordination with freight stakeholders when a project proposes to reduce the hole in the air. See the ORS 366.215 Implementation Guidance.
- Note that making freight accommodations (wider radius, limited curb extensions and the like will have an impact on pedestrians and bicyclists, so these kind of improvements need to be discussed in an open project team environment and coordinated with the various stakeholders and local jurisdictions.

To:

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- Note that making freight accommodations (wider radius, limited curb extensions and the like) will have an impact on pedestrians and bicyclists, so these kind of improvements need to be discussed in an open project team environment and coordinated with the various stakeholders and local jurisdictions.

Changed:

- **Signal Pre-Emption** – In order to clear vehicles potentially stopped on the tracks when a train arrives, interconnection is required for traffic signals located within 215 feet of the railroad crossing and should be considered for signals located further away depending on factors including traffic volumes, highway vehicle mix, highway vehicle and train approach speeds, frequency of trains, and queue lengths. For more information refer to MUTCD standards.

To:

- **Signal Pre-Emption** – In order to clear vehicles potentially stopped on the tracks when a train arrives, interconnection is required for traffic signals located within 215 feet of the railroad crossing and should be considered for signals located further away depending on factors including traffic volumes, highway vehicle mix, highway vehicle and train approach speeds, frequency of trains, and queue lengths. For more information refer to Manual of Uniform Traffic Control Devices (MUTCD) standards.

Chapter 10, Subsection 10.12.6

Changed:

Many of the solutions listed in this chapter also have significant safety benefits. The ARTS CRF Appendix is an extensive toolbox that has specific safety solutions and considerations for both spot locations and systemic improvements. The ARTS CRF list should be the primary source for countermeasures on ODOT plans and projects. Systemic improvements really require application over a wider area (city, county, region, statewide) to have the full impact realized. Most APM analyses will be of spot locations as the traffic analysis process will indicate specific needs. The project context and site conditions will determine the overall impact of the safety benefit. Refer to Chapter 4 for safety analysis procedures.

To:
Many of the solutions listed in this chapter also have significant safety benefits. The All Roads Transportation Safety Program - Crash Reduction Factor (ARTS CRF) Appendix is an extensive toolbox that has specific safety solutions and considerations for both spot locations and systemic improvements. The ARTS CRF list should be the primary source for countermeasures on ODOT plans and projects. Systemic improvements really require application over a wider area (city, county, region, statewide) to have the full impact realized. Most APM analyses will be of spot locations as the traffic analysis process will indicate specific needs. The project context and site conditions will determine the overall impact of the safety benefit. Refer to Chapter 4 for safety analysis procedures.

Chapter 10, Subsection 10.12.7

Changed:
When evaluating potential alternatives on a corridor, the effects of potential changes to the facility type or function should be considered, such as whether the facility is interrupted flow or free-flow. For example, for a rural high speed corridor that is currently free-flow, introducing interruption such as a stop sign or roundabout will change the facility type and may not meet driver expectations. Introducing any type of intersection control into a free flow section will reduce the capacity of the mainline dramatically – in some cases capacity can be cut it in half.

To:
When evaluating potential alternatives on a corridor, the effects of potential changes to the facility type or function should be considered, such as whether the facility is interrupted flow or free-flow. For example, for a rural high speed corridor that is currently free-flow, introducing interruption such as a stop sign or roundabout will change the facility type and may not meet driver expectations. Introducing any type of intersection control into a free flow section will reduce the capacity of the mainline dramatically – in some cases capacity can be cut in half.

Chapter 10, Subsection 10.12.9

Changed:
An intersection traffic control study is needed when significant changes to an intersection are under consideration. The analyst should coordinate with Region Traffic and TRS staff in preparing this study. Further guidance is provided in the Traffic Manual. Intersection safety performance should be a primary consideration in evaluating intersection control alternatives. The Highway Safety Manual may be used to evaluate safety performance of intersection control alternatives.

To:
An intersection traffic control study is needed when significant changes to an intersection are under consideration. The analyst should coordinate with Region Traffic and TRS staff in preparing this study. Further guidance is provided in the Traffic Manual. Intersection safety performance should be a primary consideration in evaluating intersection control alternatives. The HSM may be used to evaluate safety performance of intersection control alternatives.

Changed:
Right-turn acceleration lanes are generally not allowed at at-grade intersections. In some situations can be considered where criteria in the HDM and Traffic Manual are satisfied and approval is obtained from the State Traffic-Roadway Engineer through the design exception process. Used for right-turning vehicles joining the traveled way of the highway from a side street for the purpose of enabling drivers to make the necessary change between the speed of operation on the highway and the lower speed of the turning movement. These can also be used to help accelerate heavy vehicles to within least 10 mph of the posted speed so adequate length is needed. These are not for use in urban areas as they are not compatible with nearby downstream intersections or driveways. Special considerations are required for cyclists and pedestrians. For more information and criteria refer to Chapter 8 of the HDM and Section 6 of the ODOT Traffic Manual.

To:
Right-turn acceleration lanes are generally not allowed at at-grade intersections. In some situations can be considered where criteria in the HDM and Traffic Manual are satisfied and approval is obtained from the State Traffic-Roadway Engineer through the design exception process. Used for right-turning vehicles joining the traveled way of the highway from a side street for the purpose of enabling drivers to make the necessary change between the speed of operation on the highway and the lower speed of the turning movement. These can also be used to help accelerate heavy vehicles to within at least 10 mph of the posted speed so adequate length is needed. These are not for use in urban areas as they are not compatible with nearby downstream intersections or driveways. Special considerations are required for cyclists and pedestrians. For more information and criteria refer to Chapter 8 of the HDM and Section 6 of the ODOT Traffic Manual.

Changed:

4. Intersection safety performance should be a primary consideration when pursuing a roundabout for intersection control. Predicted reductions in fatal and serious injury crashes should be compared with other types of intersection control such as traffic signals or other alternatives supported by crash modification factors (CMF) from the AASHTO Highway Safety Manual.

To:

4. Intersection safety performance should be a primary consideration when pursuing a roundabout for intersection control. Predicted reductions in fatal and serious injury crashes should be compared with other types of intersection control such as traffic signals or other alternatives supported by crash modification factors (CMF) from the AASHTO HSM.

Changed:
The ODOT standard intersection traffic control analysis is required to justify new signal installations. It is important that all benefits and disbenefits of traffic signals are fully considered, including safety and multimodal performance. Issues to be considered include safety performance such as using methodologies from the Highway Safety Manual, traffic volumes, freight volumes, pedestrian volumes, and spacing relative to existing signal and the accepted standards for the highway facility. Traffic signals reduce the capacity by approximately half and increase delay of the mainline roadway allowing the side-street approaches to have more capacity and less delay. Traffic signals generally are not compatible in high-speed rural areas as they are not generally expected by drivers and could lead to high speed rear-end or angle crashes. Signals generally convert a lower number of fatal/serious injury high-speed angle and turning crashes into higher numbers of less serious rear-end crashes (still much higher than a roundabout). Queues from traffic signals may block upstream intersections and driveways impeding the flow of traffic

onto or off the roadway. Signalized intersections also create lower stress locations for pedestrians and bicyclists to cross the roadway and ideally should be spaced so out-of-direction travel is minimized. However, complex intersections can make it more difficult for bicyclists to travel through and long crossing distances can be intimidating to pedestrians. Shorter cycle lengths and fewer phases will have lesser delays and shorter queues versus more complex intersections with longer cycle lengths and more phases.

To:
The ODOT standard intersection traffic control analysis is required to justify new signal installations. It is important that all benefits and disbenefits of traffic signals are fully considered, including safety and multimodal performance. Issues to be considered include safety performance such as using methodologies from the HSM, traffic volumes, freight volumes, pedestrian volumes, and spacing relative to existing signal and the accepted standards for the highway facility. Traffic signals reduce the capacity by approximately half and increase delay of the mainline roadway allowing the side-street approaches to have more capacity and less delay. Traffic signals generally are not compatible in high-speed rural areas as they are not generally expected by drivers and could lead to high speed rear-end or angle crashes. Signals generally convert a lower number of fatal/serious injury high-speed angle and turning crashes into higher numbers of less serious rear-end crashes (still much higher than a roundabout). Queues from traffic signals may block upstream intersections and driveways impeding the flow of traffic onto or off the roadway. Signalized intersections also create lower stress locations for pedestrians and bicyclists to cross the roadway and ideally should be spaced so out-of-direction travel is minimized. However, complex intersections can make it more difficult for bicyclists to travel through and long crossing distances can be intimidating to pedestrians. Shorter cycle lengths and fewer phases will have lesser delays and shorter queues versus more complex intersections with longer cycle lengths and more phases.

Changed:
A variation on the indirect left is the right side jug handle. In this case, the major street left turn is replaced by and advance right turn followed by a through movement as shown in **Error! Reference source not found.**.

To:
A variation on the indirect left is the right side jug handle. In this case, the major street left turn is replaced by an advance right turn followed by a through movement as shown in **Error! Reference source not found.**.

Glossary

Changed:
NOTE: This is a work in progress and currently incorporates terms from APM Version 2 Chapters 1-8 and 18.

To:
NOTE: This is a work in progress and currently incorporates terms from APM Version 2 Chapters 1-10 and 18.

Added:
Pedestrian Hybrid Beacon (PHB) – A user actuated traffic control device designed to help pedestrians safely cross busy roadways at midblock crossing and uncontrolled intersections.

Abbreviations

Added:
BRT – Bus Rapid Transit
EJ – Environmental Justice
OSOW – Oversize/Overweight Vehicle
PEL – Planning and Environmental Linkage
R3ST – Rural 3-leg signalized
ROD – Record of Decision
ST – Steering Team
TAC – Technical Advisory Committee
TIGER – Transportation Investment Generating Economic Recovery
TIP – Transportation Improvement Program
TIS – Transportation Impact Study

Changed:
R2 – rural 2 land undivided

To:
R2U – Rural 2-lane undivided

Changed:
U4D – Urban 4 land divided

To:
U4D – Urban 4-lane divided

Changed:
U4U – Urban 4 land undivided

To:
U4U – Urban 4-lane undivided

July 2018

APM Version 1

Chapter 7

Removed:
Chapter 7

Replaced with:
Chapter 7 Intersection Analysis – See APM Version 2 Chapters 12 and 13

APM Version 2

Overall Document

Changed:
Miscellaneous minor updates.

Acknowledgements

Added:
Kristie Gladhill, P.E.

Glossary

Added:
Axle Factor – A factor with a value less than 1.0 that is used to estimate the count of vehicles from a volume only road tube count of axle hits divided by 2. Axle factors are derived from road tube classification counts.

Pedestrian Activated Beacon (PAB) – A user activated warning beacon used at crosswalks with two circular-shaped yellow signal sections that flash in an alternating pattern.

Volume Only Count – A road tube count of the number of axle hits divided by 2. An axle factor from a road tube classification count must be applied to this type of count before use.

Changed:
Pedestrian Hybrid Beacon (PHB) – A user actuated traffic control device designed to help pedestrians safely cross busy roadways at midblock crossing and uncontrolled intersections.

To:
Pedestrian Hybrid Beacon (PHB) – A user activated traffic control device that provides a red signal indication used on busy roadways at midblock crossing and uncontrolled intersections. Vehicles cannot proceed until the red indication turns off. Includes a WALK signal for pedestrians.

Changed:
Rectangular Rapid Flashing Beacons (RRFB) – User-actuated amber LEDs that supplement warning signs at unsignalized intersections or mid-block crosswalks.

To:
Rectangular Rapid Flashing Beacons (RRFB) – A type of PAB available under FHWA Interim Approval IA-21. Includes user-actuated amber LEDs that supplement warning signs at unsignalized intersections or mid-block crosswalks.

Chapter 5

Added:
New Section 5.4 – Axle Factors

Chapter 12

Added:
New Chapter 12 – Unsignalized Intersection Analysis

New Appendix 12C/13B – Software and Settings for Intersection Analysis

Chapter 13

Added:
New Chapter 13 – Signalized Intersection Analysis

New Appendix 12C/13B – Software and Settings for Intersection Analysis

Chapter 14

Added:
New Subsection 14.6.9 – Selecting Pedestrian Crossing Treatments – NCHRP 562

Technical Tools web page

Unsignalized Intersection Tools

Removed:
Single Lane Roundabout Calculator: For each approach, the Roundabout Calculator produces conflict flow, entry flow, capacity, pedestrian impedance factor, v/c ratio, control delay, Level Of Service, and 95th percentile queue data. Chapter 7 of the Analysis Procedures Manual Version 1 provides procedures for roundabout analysis.

Replaced:
Preliminary Traffic Signal Warrant Analysis Form

Volume Development Tools

Added:
Planner Traffic Count Request Template: The TSM unit requires traffic count requests to be submitted using TSM's Planner Traffic Count Request Template. Instructions for completing the request are included in the template. A sample completed request is available in APM Appendix 3B.

November 2018

APM Version 1

Chapter 6

Removed:
Chapter 6 Segment Analysis

Replaced with:
Ch 11 Segment Analysis – See APM Version 2 Chapter 11

APM Version 2

Overall Document

Changed:
Miscellaneous minor updates.

Acknowledgements

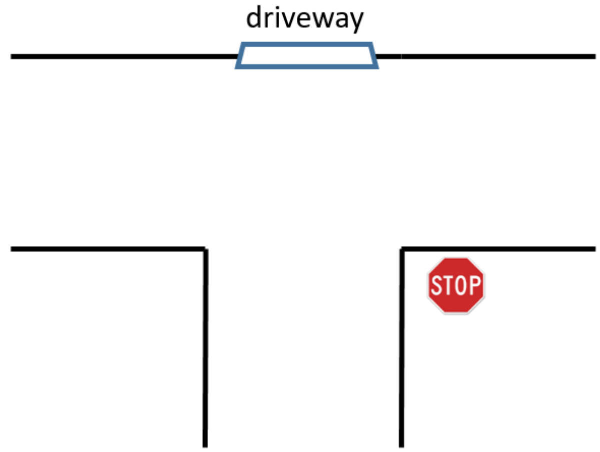
Added:
Kittelson & Associates, Inc.
Paul Ryus, P.E.
Bastian Schroeder, P.E., PhD.
Tyrone Scorsone
Alison Tanaka, P.E.

Chapter 4, Subsection 4.1.1

Added:
For intersections other than the configurations shown in Exhibit 4-1, there are usually too few locations with that intersection configuration to provide statewide statistics.
There are some stop controlled intersection configurations that could be approximated as indicated in Exhibit 4-2 and Exhibit 4-3 below. Any other intersection configurations not in Exhibit 4-1, Exhibit 4-2, or Exhibit 4-3 should by default be flagged for further analysis, since the unusual configuration is likely to warrant a closer look at the crashes.

Exhibit 4-2: 3 legged stop control, with driveway(s) into intersection

<table>
<tr><td colspan="2">3 legged stop control, with driveway(s) into intersection
at what would be a fourth leg location.
Crash rate higher than the reference rate could indicate that the driveway volumes are affecting safe operation of the intersection.</td></tr>
<tr><td>If the driveway volume is low compared to the opposite minor leg, the 3ST reference crash rate could be applied.
Example:
Rogue River, E. Main at Broadway St.

If the driveway volume is high compared to the opposite minor leg, the 4ST reference crash rate could be applied.
Example:
Bend, Cooley Rd at NE Hennell Rd, Bend</td><td>
</td></tr>
<tr><td>Rogue River, E. Main at Broadway St.

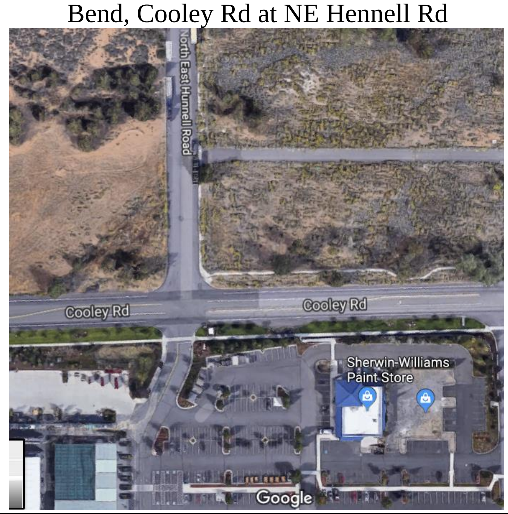
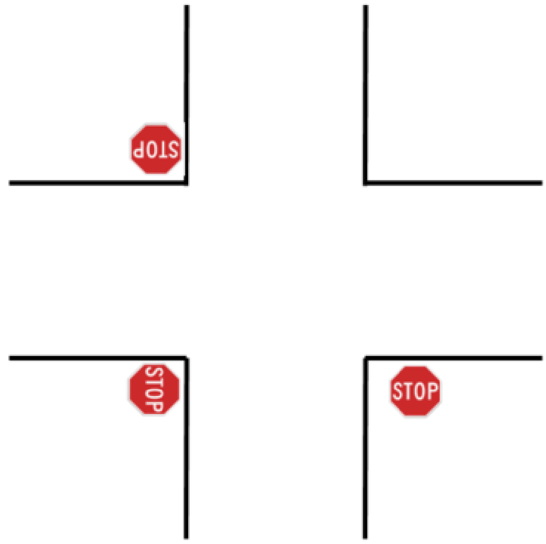
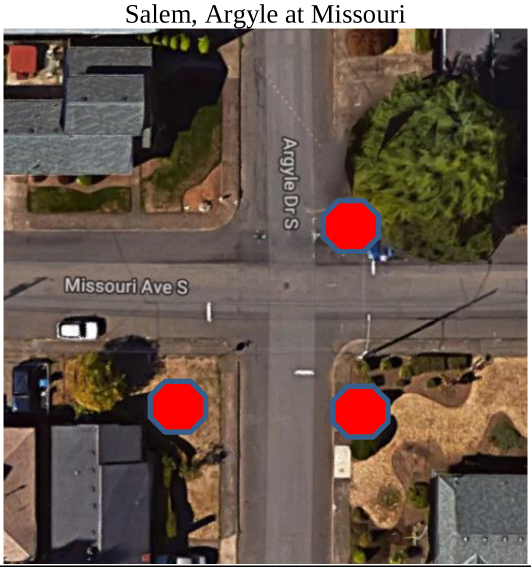
</td><td>Bend, Cooley Rd at NE Hennell Rd

</td></tr>
</table>

Exhibit 4-3: 4 legged intersection, 3 way stop

4 legged intersection 3 way stop This configuration could apply the 4ST reference crash rate, since the minor legs have left turn conflicts similar to the 4ST. Example: Salem, Argyle at Missouri	
Salem, Argyle at Missouri 	Street view, looking west. 

Chapter 4, Subsection 4.8.5

From:
ODOT encourages the development of access management plans and interchange area management plans to maintain and improve highway performance and safety by improving system efficiency and management before adding capacity. Division 51 includes requirements and criteria for Access Management Plans and Interchange Area Management Plans in section 734-051-7010.

To:

ODOT encourages the development of access management plans and interchange area management plans to maintain and improve highway performance and safety by improving system efficiency and management before adding capacity.

Chapter 11

Added:
New Chapter 11 – Segment and Facility Analysis

New Appendix 11A – Determining Free-Flow Speed

New Appendix 11B – Freeway Facility Calibration

New Appendix 11C – Oregon Default Values

New Appendix 11D – Passenger Car Equivalents on Specific Grades

New Appendix 11E – Software Guidance for Oregon-Specific Default Values

Chapter 14, SubSection 14.4.7

Changed:

Application of the LTS methodology to the typical higher-speed rural environment requires considering shoulder widths and volumes. Traffic counts/volumes are necessary for this method. The normal LTS methodology tops out at 40 mph, while most typical state and county rural roadways are posted at 45 - 55 mph.

To:
Application of the LTS methodology to the typical higher-speed rural environment requires considering shoulder widths and volumes. Daily bi-directional (combined) volumes are necessary for this method. The normal LTS methodology tops out at 40 mph, while most typical state and county rural roadways are posted at 45 - 55 mph.

Segment Analysis Tools

Added:
FREEVAL_OR. This is a customized version of FREEVAL incorporating ODOT-specific default values. The file is stored as a .ZIP archive which must be UNZIPPED before running FREEVAL. It includes a generic HCM6 FREEVAL User Guide with specific instructions. For more information refer to Chapter 11 and Appendix 11E of APM version 2.

ODOT Software Capacity Calculator V1.0. This tool is a spreadsheet calculator referenced in Appendix 11E to assist in converting ODOT-default bottleneck capacity values into corresponding capacity adjustment factors (CAF) and speed adjustment factors (SAF). For more information refer to Chapter 11 of APM version 2.