# Analysis Procedure Manual

Change Sheet – May 2015

## *APM Version 1*

## Chapter 7, Subsection 7.3.9

**Changed:**

- Roundabouts – Synchro 7.0 will analyze single-lane roundabouts using the older HCM methodology, which is not the same as ODOT's. Please refer to Section 7.3.6 for roundabout analysis procedures.

**To:**

- Roundabouts – Synchro 8 and later versions will analyze single-lane roundabouts using the current HCM methodology.

**Changed:**

- **Lost Time Adjust** – ODOT default for lost time is 4.0 seconds (unless unusual conditions exist that would warrant a longer time). Synchro 7 redefined the lost time calculation so it is necessary to adjust the lost time up or down to match the default. The lost time adjustment is equal to the difference between the sum of the yellow and all-red times and the lost time default. See Exhibit 7-20 for the default lost time adjustments.

**To:**

- **Lost Time Adjust** – ODOT default for lost time is 4.0 seconds (unless unusual conditions exist that would warrant a longer time). Synchro 7 and later versions redefined the lost time calculation so it is necessary to adjust the lost time up or down to match the default. The lost time adjustment is equal to the difference between the sum of the yellow and all-red times and the lost time default. See Exhibit 7-20 for the default lost time adjustments.

**Changed:**

* These yellow and all-red values are generally applicable where downgrades are less than or equal to 3**.**

**To:**

* These yellow and all-red values are generally applicable where downgrades are less than or equal to 3 percent**.**

**Deleted:**

**Description** – This field can be used to record changes to settings when modifying alternatives, timing, calibrating simulations, or when reviewing other's files.

- **Controller Type:**
  - Actuated-Uncoordinated – This is the primary controller type used by ODOT in isolated situations. When analyzing for a new isolated signal, this is generally the correct controller type to assume;
  - Actuated-Coordinated – This is the primary controller type used by ODOT in progressed network situations;
  - Pretimed – This is used primarily in grid network situations (i.e. downtown networks) or older controllers on city streets;
  - Semi Actuated-Uncoordinated – No longer used by ODOT for permanent controller types, but it may be found on city or county facilities.
  - Unsignalized – Stopped controlled intersections;
  - Roundabouts – Synchro 7.0 will analyze single-lane roundabouts using the older HCM methodology which is not the same as ODOT's. Please refer to Section 7.3.6 for roundabout analysis procedures

**Changed:**

- **Critical Gap(s)** – Leave the Synchro calculated default unless the unsignalized intersection is at an interchange ramp terminal or start of a one-way grid section where there are four legs but only three approaches. Synchro 7 does not use the proper gap times for an unsignalized intersection with a one-way minor street such as at an interchange ramp terminal. Synchro 7 is using the gap times appropriate for a four-legged intersection with four approaches, however, one-way minor street intersections have four legs but only three approaches (see Exhibit 7-21 below).

## To:

- **Critical Gap(s)** – Leave the Synchro calculated default unless the unsignalized intersection is at an interchange ramp terminal or start of a one-way grid section where there are four legs but only three approaches. Synchro does not use the proper gap times for an unsignalized intersection with a one-way minor street such as at an interchange ramp terminal. Synchro is using the gap times appropriate for a four-legged intersection with four approaches, however, one-way minor street intersections have four legs but only three approaches (see Exhibit 7-21 below).

## Changed:

**Phasing Window**

Pedestrian Timing can have a significant impact on an intersection operation. Timing can be obtained from the signal timing sheets or the Region Traffic offices. Otherwise, the walk time is 7 seconds and the curb-to-curb "Flashing Don't Walk" time is generally calculated at 4 ft/sec for the length of the crosswalk. Areas with more pedestrians or older pedestrians may have different timings, so please check with Region Traffic or Traffic-Roadway Section.

## To:

**Phasing Window**

Pedestrian Timing can have a significant impact on an intersection operation. Timing can be obtained from the signal timing sheets or the Region Traffic offices. Otherwise, the walk time is 7 seconds and the curb-to-curb "Flashing Don't Walk" time is generally calculated at 3.5 ft/sec for the length of the crosswalk. Areas with more pedestrians or older pedestrians may have different timings, so please check with Region Traffic or Traffic-Roadway Section.

## Changed:

**Detector Window**

If timing plans that involve actuated signals or a SimTraffic simulation needs to be created, the Detector Window data must be entered. Synchro uses this data to model actuated signal operation. Correct detector settings are critical to a successful simulation in Version 7. If actuated signal operation or simulation is not going to be utilized, the Synchro default detector settings can be used.

- **Number of Detectors** – Enter in number of detectors (1 to 3) for a given lane type.
- **Detector Phases** – Phase that is triggered by detection zone. This value is carried over from the Timing Window.
- **Leading and Trailing Detectors** – <u>Not used in Synchro 7 other than to maintain backwards compatibility with earlier versions.</u> These values are automatically updated as more detailed detector position and size data is entered. The Leading Detector is the first detector that a vehicle encounters on an approach (furthest from the stop bar) while the Trailing Detector is the last detector on an approach and closest to the stop bar.

## To:

**Detector Window**

If timing plans that involve actuated signals or a SimTraffic simulation needs to be created, the Detector Window data must be entered. Synchro uses this data to model actuated signal operation. Correct detector settings are critical to a successful simulation in Synchro. If actuated signal operation or simulation is not going to be utilized, the Synchro default detector settings can be used.

- **Number of Detectors** – Enter in number of detectors (1 to 3) for a given lane type.
- **Detector Phases** – Phase that is triggered by detection zone. This value is carried over from the Timing Window.
- **Leading and Trailing Detectors** – <u>Not used in Synchro other than to maintain backwards compatibility with earlier versions.</u> These values are automatically updated as more detailed detector position and size data is entered. The Leading Detector is the first detector that a vehicle encounters on an approach (furthest from the stop bar) while the Trailing Detector is the last detector on an approach and closest to the stop bar.

## Added:

*ODOT's detector settings are incompatible with the HCM 2010 as the maximum distance from the stop-bar is 20 feet. Signalized intersection analyses need to use HCM 2000 to obtain the intersection v/c ratio. When a HCM 2010-only analysis is desired for local non-state intersections where the intersection v/c ratio is not necessary, the detector placement is limited to the side-street placement style (one 16' detector at two feet from the stop-bar). All analyses that will use simulation ultimately, regardless of jurisdiction, will need to use the full detector settings and an HCM 2000 analysis.*

# *APM Version 1*

## Chapter 8, Subsection 8.3.3

**Changed:**

In addition to setting up the SimTraffic 7 parameter file, there are a number of Synchro settings that must be updated for simulations to work properly in SimTraffic 7.

**To:**

In addition to setting up the SimTraffic parameter file, there are a number of Synchro settings that must be updated for simulations to work properly in SimTraffic.

**Changed:**

- **Taper Length (ft)** – The Taper Length is the remaining length of the turning bay from the end of the storage length to where the outer edge of the turning bay meets the outer edge of the adjacent lane. This value is field-measured or estimated from aerial photographs. For state highways, the taper lengths can be obtained from the Highway Design Manual Figures 9-6 for right turn lanes and 9-7 for left turn lanes. This allows turning bays to store several more vehicles and allows a truer and a more consistent (with design) representation.

**To:**

- **Taper Length (ft)** – The Taper Length is the remaining length of the turning bay from the end of the storage length to where the outer edge of the turning bay meets the outer edge of the adjacent lane. This value is field-measured or estimated from aerial photographs. For state highways, the taper lengths can be obtained from the Highway Design Manual Figures 8-8 for right turn lanes and 8-9 for left turn lanes. This allows turning bays to store several more vehicles and allows a truer and a more consistent (with design) representation.

# *APM Version 2*

## Chapter 6, Subsection 6.12.3

**Changed:**

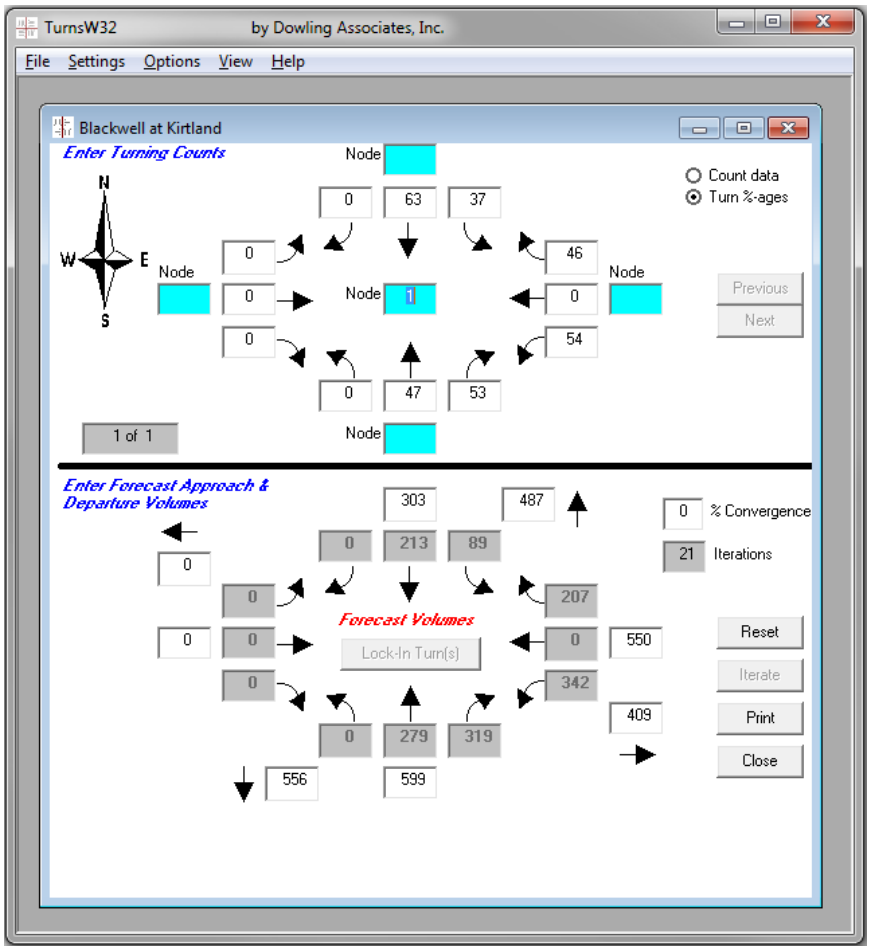
As shown in Exhibit 6-14, turn percentages are input into the upper part of the screen in Turns W32 rather than actual turn movement volumes. Preliminary future link volumes with balanced inflows and outflows are input on the lower part of the screen. The program will not process unbalanced inflows and outflows. The convergence value should be set to 100 percent. After iterating, the lower screen displays the preliminary future year turn movements. These turn movements need to be adjusted in the final step, which is to re-balance the network while holding the model link growth values as much as feasible.

**To:**

As shown in Exhibit 6-14, turn percentages are input into the upper part of the screen in Turns W32 rather than actual turn movement volumes. Preliminary future link volumes with balanced inflows and outflows are input on the lower part of the screen. The program will not process unbalanced inflows and outflows. The convergence value should be set to 0 percent. This value represents the tolerance between successive iterations. A solution is achieved when the results of iteration differs less from the results of the previous iteration by this value. After iterating, the lower screen displays the preliminary future year turn movements. These turn movements need to be adjusted in the final step, which is to re-balance the network while holding the model link growth values as much as feasible.

**Updated:**

**Exhibit 6-1 Turns W32 Screen**




**Changed:**

The final step is to input the balanced directional link volumes and the turn percentages into Turns W32. As shown in Exhibit 6-14, the turn percentages are entered into the upper half of Turns W32, while the balanced directional link volumes are entered into the lower half. The percent Convergence is set to 100%. Upon selecting Iterate, the program computes and displays updated turn movement volumes and directional link volumes. The analyst may need to make further adjustments to turn movements as part of re-balancing of the network.

**To:**

The final step is to input the balanced directional link volumes and the turn percentages into Turns W32. As shown in Exhibit 6-14, the turn percentages are entered into the upper half of Turns W32, while the balanced directional link volumes are entered into the lower half. The percent Convergence is set to **0%**. Upon selecting Iterate, the program computes and displays updated turn movement volumes and directional link volumes. The analyst may need to make further adjustments to turn movements as part of re-balancing of the network.

# *Webpage changes*

## Tools

**Changed:**

- **Synchro/SimTraffic Version 7**

**To:**

- **Synchro/SimTraffic Version 8**

**Updated:**

Synchro/SimTraffic templates.zip file updated to Version 8.

# Analysis Procedure Manual

Change Sheet – June 2015

## *APM Version 2*

## Chapter 5, Subsection 5.8.1

### Changed:

Peak hour factors should be applied in most capacity analyses in accordance with the HCM, which selected 15-minute flow rates as the basis for most of its procedures. It is especially critical to examine the peak 15-minute period when potential queue lengths may become an issue, and at locations with sharp peaking characteristics such as employment sites and locations with low peak hour factors (less than 0.90). Some alternate mobility standards do not use PHF's where the volume-to-capacity standard is equal to or greater than 1. Alternate mobility standards procedures are discussed further in Chapter 10.

### To:

Peak hour factors should be applied in most capacity analyses in accordance with the HCM, which selected 15-minute flow rates as the basis for most of its procedures. It is especially critical to examine the peak 15-minute period when potential queue lengths may become an issue, and at locations with sharp peaking characteristics such as employment sites and locations with low peak hour factors (less than 0.90). Some alternate mobility standards do not use PHFs where the volume-to-capacity ratio is equal to or greater than 1. Alternate mobility standards procedures are discussed further in Chapter 10.

## Chapter 5, Subsection 5.8.2

### Changed:

Typical PHF values range between 0.80 and 0.98. Factors greater than 0.95 are indicative of high traffic volumes, while factors less than 0.80 occur in locations with high peak demand, (i.e. schools, factories with shift changes, venues w/ scheduled events). PHF's calculated from actual traffic count data should always be used for analysis of existing conditions. For all applications other than sketch planning-level analysis, traffic count data should be obtained in 15-minute intervals, and one of the three methods for calculation and application of PHF's described below should be followed. Each of the methods should be reviewed and the method that best represents the conditions should be used. In the following methods the system peak hour is first selected, and PHF's are calculated within that hour. For sketch planning-level analysis where traffic counts are not provided in 15-minute intervals, the HCM 2010 suggests the following defaults:

- 0.95 for urban freeways;
- 0.88 for rural freeways;
- 0.88 for 2-lane highways;
- 0.88 for multilane highways;
- 0.92 for interrupted flow facilities

- **Method 1 - Intersection PHF:** This analysis method uses an intersection PHF to estimate peak 15-minute period equivalent hourly flow rates from the peak 60-minute period volumes. Intersection PHF is the preferred method for signalized intersections in the HCM 2010. The peak 15-minute period with the highest intersection total entering volume (TEV) should be used to determine the PHF for each intersection. The application of global PHF's is generally not appropriate when count data is available. The intersection PHF is calculated as follows.

    - **Step 1:** Determine the peak 15-minute period that has the highest intersection total entering volume (TEV).
    - **Step 2:** Calculate the intersection PHF based on the time period determined in Step 1, by dividing the TEV peak 60-minute volume by four times the TEV occurring during the peak 15 minutes.
    - **Step 3:** In the analysis, apply the intersection PHF from Step 2 to each movement peak 60-minute volume.

- **Method 2 - Approach/Movement PHF:** As an option, in cases where unusual peaking occurs on individual approaches such as from a school or shift change, approach or movement PHF's can be determined from the traffic count volumes. The peak 15-minute period with the highest intersection TEV should be used to determine the PHF's. PHF's are calculated for each approach or movement as follows. If an approach or movement PHF is calculated to exceed 1, entering a value of 1.00 will ensure a slightly conservative analysis.

    - **Step 1:** Determine the peak 15-minute period that has the highest intersection total entering volume (TEV).
    - **Step 2:** Calculate the PHF for each approach or movement based on the time period determined in Step 1 by dividing the approach peak 60-minute volume by four times the approach or movement peak 15-minute volume.
    - **Step 3:** In the analysis, apply the approach or movement PHF's from Step 2 to the approach or movement peak 60-minute volumes (usually calculated by the analysis software).

- **Method 3 – Direct Entry of 15-min Volumes:** As an additional option in cases where unusual peaking occurs on individual approaches, the traffic count volumes for all movements that occur during the single peak 15-minute period can be used directly in software that multiplies the peak 15-minute period volumes by a factor of four. If this method is used both the actual 60-minute period hourly volumes and the equivalent peak 15-minute hourly flow rates should be shown on the Existing Traffic flow diagrams, and clearly labeled to avoid confusion.

    - **Step 1:** Determine the peak 15-minute period that has the highest intersection total entering volume (TEV).
    - **Step 2:** For the time period determined in Step 1, enter the peak 15-minute volumes directly in the software.
    - **Step 3:** Select software analysis procedure based on the peak 15-minute period.
    - **Step 4:** On the flow diagrams show and clearly label both the actual 60-minute period hourly volumes and the equivalent peak 15-minute hourly flow rates to avoid confusion

## To:

Typical PHF values range between 0.80 and 0.98. Factors greater than 0.95 are indicative of high traffic volumes, while factors less than 0.80 occur in locations with high peak demand (i.e. schools, factories with shift changes, or venues with scheduled events). PHFs calculated from actual traffic count data should always be used for analysis of existing conditions. For all applications other than sketch planning-level analysis, traffic count data should be obtained in 15-minute intervals. In calculating PHF, the system peak hour is first selected, and PHFs are calculated within that hour.

For segment analysis at a sketch planning-level, where traffic counts are not provided in 15-minute intervals, the HCM 2010 suggests the following PHF defaults:

- 0.95 for urban freeways;
- 0.92 for interrupted flow facilities;
- 0.88 for rural freeways, multilane highways and two-lane highways

**Intersection PHF**
The analysis method for intersections uses an intersection PHF to estimate peak 15-minute period equivalent hourly flow rates from the peak 60-minute period volumes. The peak 15-minute period with the highest intersection total entering volume (TEV) should be used to determine the PHF for each intersection. The application of global PHFs is generally not appropriate when count data is available. The intersection PHF is calculated as follows.

- **Step 1:** Determine the peak 15-minute period that has the highest intersection total entering volume (TEV).
- **Step 2:** Calculate the intersection PHF based on the time period determined in Step 1, by dividing the peak 60-minute TEV by four times the TEV occurring during the peak 15 minutes.
- **Step 3:** In the analysis software, apply the intersection PHF from Step 2 for all movements at the intersection (flow rates are then usually calculated by the analysis software).

Movement PHF should not be used because using the individual peak 15-minute periods by movement creates a situation that overestimates the volumes and does not exist in reality akin to the reasoning behind using a system peak hour. Conversely, using a single 15-minute period in essence creates a need to force this on all intersections which would create a "false precision" level of detail in the analysis (a

system 15-min is too detailed), not to mention the difficulties in choosing the proper interval which may result in analyzing multiple intervals. In circumstances of unusually pronounced peaking on an intersection approach where an alternative method is desired, a written explanation detailing the analysis area context and proposed alternative methodology must be submitted and approved by TPAU and Region Traffic prior to use.

For intersection analysis at a sketch planning-level, where traffic counts are not provided in 15-minute intervals, the following intersection PHF defaults should be used:

- 0.95 for major arterial-major arterial;
- 0.92 for major arterial-minor arterial;
- 0.90 for minor arterial-minor arterial;
- 0.88 for minor arterial-collector;
- 0.85 for collector-collector or lower classification

# Chapter 5, Subsection 5.8.3

## Changed:

### 5.8.3 Future Conditions PHF

Because traffic flow patterns may change over time and future conditions cannot be directly measured, analysis of future years should incorporate the following default values by approach for the PHF unless better information is available:

- 0.85 for minor street inflows and outflows
- 0.90 for minor arterials
- 0.95 for major streets

Engineering judgment must be used in the selection of PHFs for future years. In cases where the existing PHF is higher than the default value for the future PHF, it may be appropriate to retain the existing value for the future year, as PHFs do not typically decrease as traffic volumes and congestion increase. Likewise for areas that have low existing peak hour factors, using the future PHF default values could produce results that would underestimate the future traffic conditions. For areas with aggressive traffic demand management strategies contained in an adopted plan, a different PHF (to reflect spreading of the demand) may be used for future year analysis if agreed to by ODOT during the scoping process. For areas with pronounced peaking characteristics, such as industrial sites and schools, PHFs lower than the default values listed above should be considered.

**Revising PHF for Future Year**
In areas where alternative mobility standards are in place and the volume to capacity ratios are at or exceed 1.0 (capacity), PHF's may be assumed to be equivalent to 1.0.

## To:

### 5.8.3 Future Conditions PHF

Because traffic flow patterns may change over time and future conditions cannot be directly measured, analysis of future years should incorporate the sketch planning default values for PHF listed previously.

Engineering judgment must be used in the selection of PHFs for future years. In cases where the existing PHF is higher than the default value for the future PHF, it may be appropriate to retain the existing value for the future year, as PHFs do not typically decrease as traffic volumes and congestion increase. Likewise for areas that have low existing peak hour factors, using the future PHF default values could produce results that would underestimate the future traffic conditions. For areas with aggressive traffic demand management strategies contained in an adopted plan, a different PHF (to reflect spreading of the demand) may be used for future year analysis if agreed to by ODOT during the scoping process. For areas with pronounced peaking characteristics, such as industrial sites and schools, PHFs lower than the default values listed above should be considered.

**Revising PHF for Future Year**
In areas where alternative mobility targets are in place and the volume to capacity ratios are at or exceed 1.0 (capacity), PHFs may be assumed to be equivalent to 1.0.

# Analysis Procedure Manual

Change Sheet – August 2015

## *APM Version 1*

## Chapter 7, Subsection 7.3.6

### Changed:

Roundabouts are a safe and efficient intersection design with more free flow and less control than with a stop sign or traffic signal. Roundabouts can be a gateway or transition feature, roadway connection point, or key element of an access management project. Research has shown roundabouts generally reduce crashes and vehicle delay as compared to signals. Roundabouts have fewer conflict points and severe injury crashes in comparison to other intersection designs. The ODOT Traffic Manual and HDM contain roundabout guidelines, standards and siting criteria. Roundabout automobile capacity analysis generally follows the 2010 HCM method. For further information, refer to Roundabouts: An Informational Guide, Second Edition, also known as NCHRP Report 672.

### To:

Roundabouts are a safe and efficient intersection option with more free flow than a stop sign or signal provides. Roundabouts can be a gateway or transition feature, roadway connection point, or key element of an access management project. Research has shown roundabouts generally reduce crashes and vehicle delay as compared to signals. Roundabouts have fewer conflict points and severe injury crashes in comparison to other intersection designs. The ODOT Traffic Manual and HDM contain roundabout guidelines, standards and siting criteria. Roundabout automobile capacity analysis generally follows the 2010 HCM method. For further information, refer to Roundabouts: An Informational Guide, Second Edition, also known as NCHRP Report 672.

### Changed:

Step 4: Entry flow rates by lane, if more than one lane

This step is for a multi-lane roundabout approach with more than one entry lane. For more than one entry lane, it is important to identify current lane utilization ratios and nearby attractions. Future developments should be considered as well. This may be a good opportunity to apply a travel demand model if available. A travel demand model can be used to show origin/destination routes and how they would travel through this intersection which would help inform lane utilization decisions. See HCM 2010 Step 4 including Exhibits 21-13 and 21-14 for procedures.

Step 5: Capacity of entry lanes; uses value from step 3

For single lane roundabouts outside of Bend, Oregon, use HCM 2010 Equation 21-1 to find the capacity for each entry lane using the circulatory flow rate calculated in Step 3.

### To:

Step 4: Entry flow rates by lane, if more than one lane

This step is for a multi-lane roundabout approach with more than one entry lane. For more than one entry lane, it is important to identify current lane utilization ratios and nearby attractions. Future developments should be considered as well. A travel demand model might show origin/destination routes or travel patterns through an intersection. See HCM 2010 Step 4 including Exhibits 21-13 and 21-14 for procedures.

Step 5: Capacity of entry lanes; uses value from step 3

For single lane roundabouts without a capacity and headway study (i.e. Bend, Oregon) one should use HCM 2010 Equation 21-1 to find the capacity for each entry lane using the circulatory flow rate calculated in Step 3.

### Changed:

The City of Bend, Oregon has more roundabouts than any city in Oregon. Therefore, Bend drivers have become accustomed to roundabouts and consequently, they operate at a higher capacity. A study of

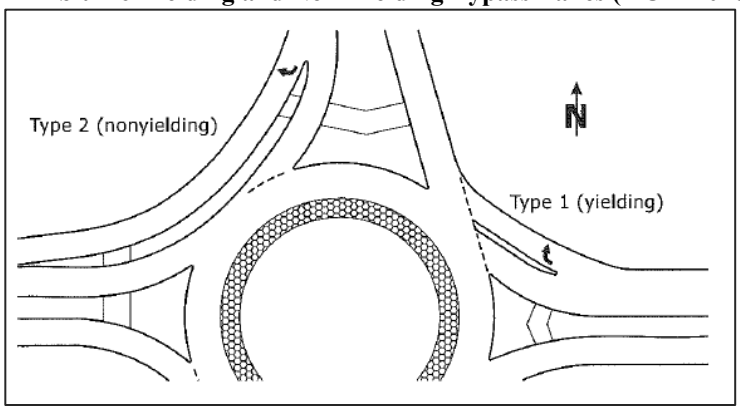
single-lane roundabouts in Bend (City of Bend Roundabout Operational Analysis Guidelines, Kittelson & Associates, Inc., 2009) developed a locally calibrated capacity equation. Rather than the HCM equation, the Bend capacity equation is to be used for all single-lane roundabouts to be built in the Bend area. The local calibration of headways and capacities better match Bend driving habits.

## To:

The City of Bend, Oregon has more roundabouts than any city in Oregon. Therefore, Bend drivers have become accustomed to roundabouts which operate at a higher capacity. A study of single-lane roundabouts in Bend (City of Bend Roundabout Operational Analysis Guidelines, Kittelson & Associates, Inc., 2009) developed a locally calibrated capacity equation. Rather than the HCM equation, the Bend capacity equation is to be used for all single-lane roundabouts to be built in the Bend area. The local calibration of headways and capacities better match Bend driving habits.

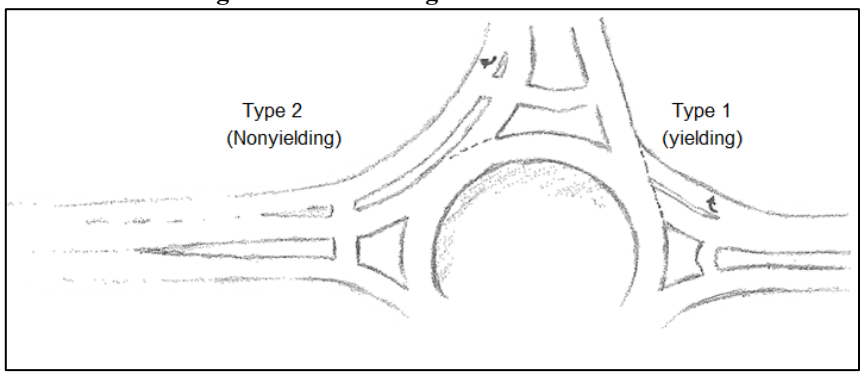
## Changed:

**Exhibit 7-6 Yielding and Non-Yielding Bypass Lanes (HCM 2010 Exhibit 21-8)**




## To:

**Exhibit 7 3 Yielding and Non-Yielding**




## Changed:

An adjustment factor for pedestrians of 1.0 is recommended if there are fewer than 40 pedestrians. Less than 40 pedestrians crossing a leg in an hour do not have a significant effect on single lane roundabout operation.

If the number of passenger car equivalent vehicles circulating in front of an entrance is over 881, then the adjustment factor for pedestrians is a factor of 1.0. If that is not the case and the number of pedestrians crossing at a crosswalk is greater than 40 and less than or equal to 101, then the second equation determines the adjustment factor for pedestrians.

## To:

An adjustment factor for pedestrians of 1.0 is recommended if there are fewer than 40 pedestrians crossing a leg in an hour. Less than 40 pedestrians crossing a leg in an hour do not have a significant effect on single lane roundabout operation.

If the hourly number of passenger car equivalent vehicles circulating in front of an entrance is over 881, then the adjustment factor for pedestrians is a factor of 1.0. If that is not the case and the number of pedestrians crossing at a crosswalk is greater than 40 and less than or equal to 101, then the second equation determines the adjustment factor for pedestrians.

## Changed:

**Logical Design Progression**

Start analysis of a single lane roundabout with existing and future volumes. If an entry lane exceeds the mobility standard, then analyze a bypass lane for that approach. The bypass lane volume is subtracted out of the roundabout entry lane volume. This affects flow rate calculations of Steps 1 through 5. This may also affect capacity, v/c, delay, LOS, or 95th percentile queue length. If a bypass lane merges into an existing lane (Yielding Type 1), then calculate the capacity of the bypass lane (2010 HCM Example Problem 1, page 21-28). If not due to a heavy right turn movement, then a multilane roundabout should be considered (not all of the circulating lanes must have more than one lane). If a multilane roundabout entry lane exceeds the mobility standard, then again consider a bypass lane. A flow chart showing this process is shown in Exhibit 7-8.

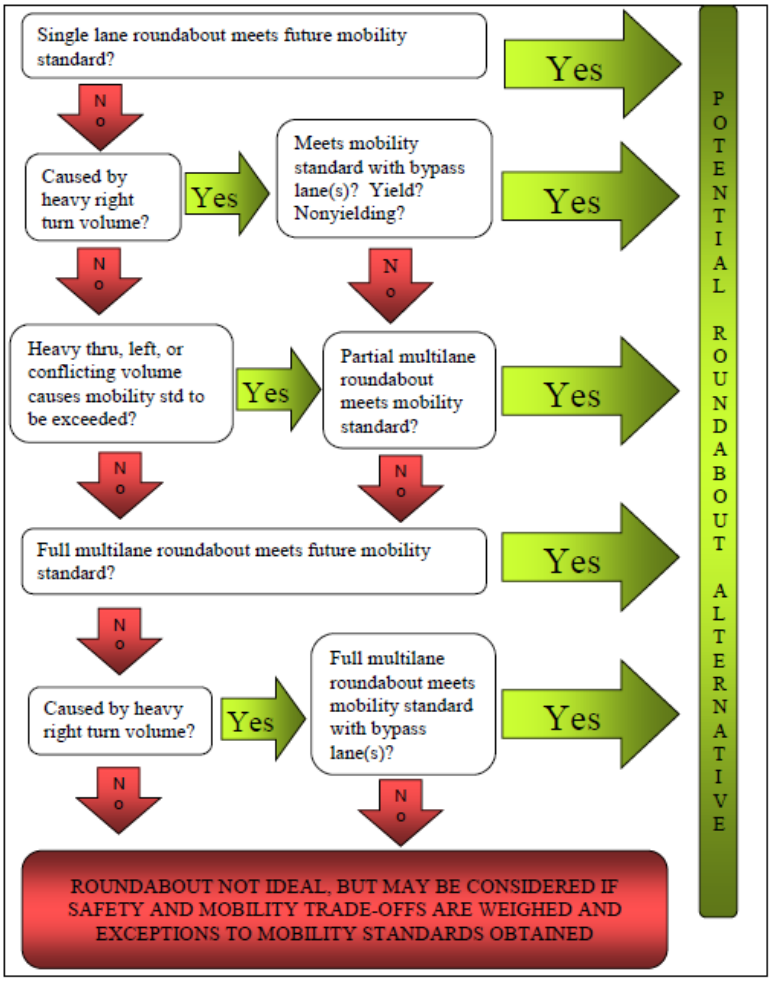
## To:

**Logical Design Progression**

Start analysis of a single lane roundabout with existing and future volumes. If an entry lane exceeds the mobility standard, then analyze a bypass lane for that approach. The bypass lane volume is subtracted out of the roundabout entry lane volume. This affects flow rate calculations of Steps 1 through 5. This may also affect capacity, v/c, delay, LOS, or 95th percentile queue. If a bypass lane merges into an existing lane (Yielding Type 1), then calculate the capacity of the bypass lane (2010 HCM Example Problem 1, page 21-28). If not due to a heavy right turn movement, then a multilane roundabout should be considered (not all of the circulating lanes must have more than one lane). If a multilane roundabout entry lane exceeds the mobility standard, then again consider a bypass lane. A flow chart showing this process is shown in Exhibit 7-5.

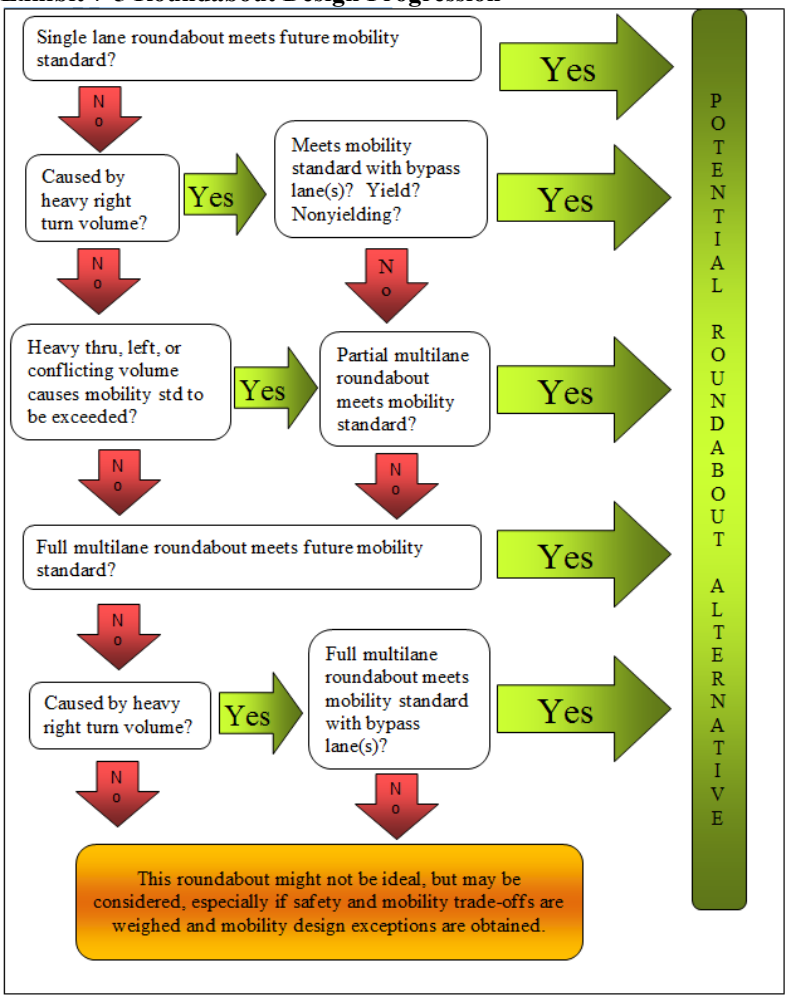
## Changed:

**Exhibit 7-8 Roundabout Design Progression**



**To:**

**Exhibit 7-5 Roundabout Design Progression**




**Added:**

**ODOT Single-Lane Roundabout Calculator**

ODOT Single Lane Roundabout Calculator has been developed to expedite capacity and queuing calculations. The following example illustrates the analysis of a single-lane roundabout. This example uses the ODOT single-lane roundabout calculator to perform the analysis steps.

**Added:**

**Example 7-1 Single Lane Roundabout Calculation**

# *Webpage changes*

## Tools

**Changed:**

- **Roundabout Calculator**
  An update of the roundabout calculator is in progress. Analysis of roundabouts should be consistent with HCM 2010 methodology.

**To:**

- **Single Lane Roundabout Calculator**
  The Single Lane Roundabout Calculator employs HCM 2010 methodology. For each approach, the roundabout calculator produces conflict flow, entry flow, capacity, pedestrian impedance factor, v/c ratio, control delay, Level Of Service (LOS), and 95th percentile queue. Intersection delay and LOS are also calculated. Tabs are in order of use: notes, inputs, single lane, bypass lane, 2nd bypass lane, 3rd bypass lane, and 4th bypass lane. The Analysis Procedures Manual version 1 provides procedures for roundabout analysis in Chapter 7.

# Analysis Procedure Manual

Change Sheet – September 2015

## *APM Version 2*

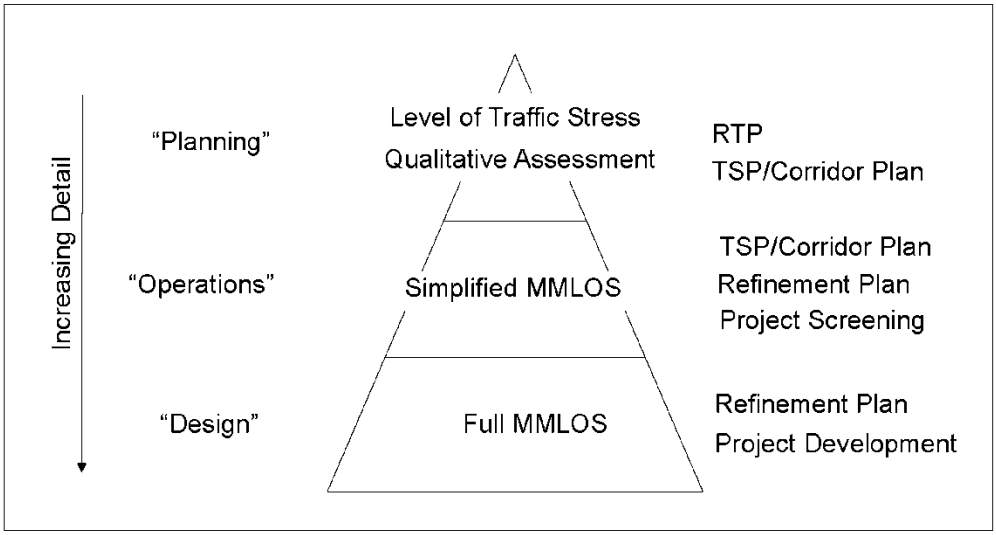
## Chapter 14

### Changed:

**14.2 Multimodal Analysis Methodologies**

The current generation of multimodal analysis methodologies are generally a perception-based rating system of the safety, comfort, and convenience of transportation facilities from the perspective of the user, whether a motorist, bicyclist, pedestrian or transit rider. There are many types of multimodal analysis methodologies available; however, not all are suitable for all applications. Some methods require many specific details which are not typically available, for example in a corridor plan. Some methods are too simple and will not be able to answer the questions posed in the design of a modernization project. The general overall multimodal analysis methodology can be illustrated as a multi-tiered structure (see Exhibit 14-1). As the application increases in level of detail, more specific questions can be addressed, but the analysis will require more data and resources.

**Exhibit 14-1 Multimodal Analysis Context**




A multimodal analysis can be performed at three levels of detail, and can be applied to various applications from planning to operations and design. Any project or plan could use any level or multiple levels of analysis, but many levels of analysis are more suited to a particular application. For example, Level of Traffic Stress (LTS) could be used at a system level to identify key locations, which then can be analyzed further using Multimodal Level of Service (MMLOS). Currently, only the top level has analysis procedures established in this manual with the other levels to be developed.

The top level is meant for system or corridor planning assessments such as Regional Transportation Plans (RTP) and Transportation System Plans (TSP), bike/pedestrian modal plans, and corridor-plans, as well as for screening of preliminary alternatives. Methods like the Qualitative Assessment and the (Bicycle) Level of Traffic Stress require limited data most of which can be obtained from existing inventories, aerial photography, or from "windshield" field surveys. These methods will be able to identify areas of concern whether in system connectivity (Level of Traffic Stress) or in operations

(Qualitative Assessment). These top level methodologies can be applied to a corridor, route, or individual segment. For example, an RTP might include a corridor assessment, a TSP might assess routes to/from community destinations, and a more detailed refinement plan may look at block-by-block segments.

The middle level is more operational-based where it is desired to obtain the "state of the system" with Highway Capacity Manual compliant Multimodal Level of Service (MMLOS) letter grades for pedestrian, bicycle, and transit on a link (segment) basis. This level will work for a more detailed view in a TSP, subarea, or corridor plan or to supplement the Level of Traffic Stress. This is likely to be the primary level for assessing refinement-level facility plans (including Interchange Access Management Plans) but could also be used for screening of concepts and preliminary alternatives in a project development process. There may be additional data needed at this level, but most elements could be obtained without doing a detailed field inventory, provided that unobstructed, high-quality aerials that can be used for the basis of measurements are available. This data level will make comparison easier across concepts and time periods with less subjectivity than with the Qualitative Assessment.

The bottom level can be applied at the design stage where a trade-off analysis (e.g. showing the impacts between wider sidewalks and shared bike lanes versus narrower sidewalks and full bike lanes) is needed between different modes or where multimodal concepts need to be analyzed at a detailed level. Analysis at this level could be done in refinement plans or more typically in an alternative development and evaluation process for a modernization project. Analysis with the full MMLOS segment and intersection methodology even with appropriate ODOT defaults in place will take more effort and have a greater chance of needing field inventory.

Assessing multimodal impacts as part of development review also may involve multiple levels of analysis. The urban context will need to be taken into account as the more urban an area is, even a standard zone change (i.e. residential to commercial) may require more detail. Transportation Planning Rule (TPR) -0060 analysis for a plan amendment is likely to be at the top or middle level. Transportation Impact Analyses (TIA) would be at the middle level for the more typical vehicular-oriented developments (i.e. shopping centers, gas stations, etc.). TIA's that are for mixed-use or transit-oriented developments would likely need to be at the bottom level in order to capture the specific scenario details. Like with other plans, if a TIA has a scenario screening process then top or middle level analysis can be done to pare down scenarios.

While the designation of Multimodal Mixed Use (MMA) areas are based solely on safety concerns, once the designation is in place, multimodal impacts can still be analyzed. Depending on the level of effort desired for a plan/project/TIA that involves a MMA, the multimodal analysis could be at any of the three levels or combinations thereof.

**To:**

### 14.2 Multimodal Analysis Methodologies

The current generation of multimodal analysis methodologies are generally a perception-based rating system of the safety, comfort, and convenience of transportation facilities from the perspective of the user, whether a motorist, bicyclist, pedestrian or transit rider. The range of methodologies presented in this chapter is meant to be complimentary, not competitive, and have been tested for compatibility. There are many types of multimodal analysis methodologies available; however, not all are suitable for all applications. The overall context of the plan or project and the resulting scope of work will control the ultimate methodological choice. Some methods require very specific data which may not typically be collected in a high level study such as a transportation system plan. Some methods are too simple and will not be able to answer the questions posed in the design of a modernization project.

Applicability of multimodal analysis methods by project type is illustrated in Exhibit 14-1. Methods increase in detail from left to right, while plan/project types increase in complexity from top to bottom. As the application increases in level of detail, more specific questions can be addressed, but the analysis will require more data and resources. Regardless of method applied, it is important to include some sort of multimodal analysis on all analysis efforts.

**Exhibit 14-1 Multimodal Analysis Tool Applications[1]**

| | Qualitative Multimodal Assessment | Level of Traffic Stress[2] | Multimodal Level of Service |
|---|---|---|---|
| Regional Transportation Plan (RTP) | ○ | ● | |
| Transportation System Plan (TSP) | ● | ● | |
| Facility Plan/Interchange Area Management Plan (IAMP) | ○ | ○ | ● |
| Project Development | | ○ | ● |
| Development Review | | ○ | ● |

[1]Solid circles represent the preferred methodology. Outlined circles represent where methodology can also be used.
[2]Use of LTS for project development and development review should be limited to a screening-based analysis to quickly identify existing and future needs

Any project or plan could use any single level or multiple levels of multimodal analysis, but many levels of analysis are more suited to a particular application. For example, Level of Traffic Stress (LTS) could be used at a system level to identify key locations, which then can be analyzed further using Multimodal Level of Service (MMLOS).

The primary tool for Regional Transportation Plans (RTP) is LTS as this methodology can be easily adapted to use travel demand model inputs or can be generalized enough to apply to a whole region without too much data and effort. The Qualitative Multimodal Assessment (QMA) can be used to fill in other modes that are not covered by LTS. These methods require limited data, most of which can be obtained from existing inventories, aerial photography, or from "windshield" field surveys. These methods will be able to identify areas of concern whether in system connectivity (LTS) or in operations (Qualitative Multimodal Assessment).

Transportation System Plans (TSP) have enough detail in the inventory and analysis to provide for adequate QMA and/or LTS analyses. Do not duplicate modes between the two methodologies if both are used in a single effort.

More detailed planning efforts such as facility plans and Interchange Area Management Plans (IAMP) typically will use MMLOS-based methods as there is a need for more objective results especially in comparisons of alternatives. This level usually will have a higher amount of detailed data available which is consistent with the smaller analysis segments and more specific detail required. Most elements could be obtained without doing a detailed field inventory, provided that unobstructed, high-quality aerials that can be used for the basis of measurements are available. This data level will make comparison easier across concepts and time periods with less subjectivity than with QMA.LTS and/or QMA can still be used if a plan will be relatively standalone. Plans that need to be consistent with future potential project development efforts especially with environmental assessments or environmental impact statements should use MMLOS-based methods for alternatives and limit LTS/QMA to screening analysis.

Project development requires the highest amount of data as objective design-level decisions need to be supported. The MMLOS methods are the most rigorous and commensurate with the typical available data. LTS can also be used as an initial screening measure to identify areas with existing or future needs. Analysis with the MMLOS segment and intersection methodologies even with appropriate ODOT defaults will take more effort and have a greater chance of needing additional specific field inventory data.

Assessing multimodal impacts in development review will typically involve use of LTS to quickly identify existing/future needs or development impacts and then using MMLOS techniques to identify mitigation scenarios. The urban context will need to be taken into account as the more urban an area is, even a standard zone change (i.e. residential to commercial) may require more detail. Transportation Planning Rule (TPR) -0060 analysis for a plan amendment can likely rely on more use of LTS (however, transit is only available at the MMLOS level) Transportation Impact Analyses (TIA) would likely need

to primarily use MMLOS techniques in order to capture the specific scenario details.

While the designation of Multimodal Mixed Use (MMA) areas are based solely on safety concerns, once the designation is in place, non-automobile multimodal impacts can still be analyzed. Depending on the level of effort desired for a plan/project/TIA that involves a MMA, the multimodal analysis could use any of the methodologies.

## Changed:

The Qualitative Assessment multimodal methodology is based on work done by David Evans and Associates and generally uses the principles of the full version 2010 Highway Capacity Manual (HCM) MMLOS.

## To:

The Qualitative Multimodal Assessment (QMA) methodology is based on work done by David Evans and Associates and generally uses the principles of the full version 2010 Highway Capacity Manual (HCM) MMLOS but was modified to stay consistent as much as possible with the more objective methods presented later in this chapter.

## Changed:

- **Volume and speed of motorized traffic in adjacent travel lane:** Lower vehicle volumes and speeds will rate higher than higher volumes and speeds. The number of lanes and functional class can be used as a surrogate to actual volumes and speeds if they are not readily available at this stage.

## To:

- **Travel lanes and speed of motorized traffic:** Less travel lanes and lower vehicle speeds will rate higher than more lanes and higher speeds.

## Changed:

- **Volume, type, and speed of motorized traffic in adjacent travel lane:** Conditions with lower volumes, fewer trucks, and slower speeds will rate better than higher volumes, more trucks, and higher speeds. The number of lanes and functional class can be used as a surrogate to actual volumes and speeds if they are not readily available at this stage.

## To:

- **Travel lanes and speed of motorized traffic:** Less travel lanes and lower vehicle speeds will rate higher than more lanes and higher speeds.

## Changed:

**Pedestrian & Bicycle Facilities - Future Scenarios**

Both future scenarios would add a sidewalk or path to each side of the highway and would include a buffer on at least one side of the highway and bike lanes on both sides. The segments were rated as good for these conditions. Although less traffic would be in the adjacent travel lane for the five-lane scenario, the bike lane and landscape buffers created were considered sufficient to offset the detrimental effects of the higher adjacent travel lane volumes of the three-lane scenario for pedestrians. However, for bicyclists, the higher adjacent lane volume in the three-lane scenario meant that it rated lower than the five-lane scenario. At intersections, the three-lane scenario was rated better than the five-lane scenario because there would be fewer travel lanes for a pedestrian or a bicyclist to cross.

## To:

**Pedestrian & Bicycle Facilities - Future Scenarios**

Both future scenarios would add a sidewalk or path to each side of the highway and would include a buffer on at least one side of the highway and bike lanes on both sides. The segments were rated as good for these conditions. The less travel lanes in the three-lane scenario rated higher than the five lane scenario as it creates a better environment for bicycles and pedestrians. At intersections, the three-lane scenario was rated better than the five-lane scenario because there would be fewer travel lanes for a pedestrian or a bicyclist to cross.

## Changed:

| **Segment/** | **Mode** | | | |
|---|---|---|---|---|
| ***Intersection*** | **Pedestrian** | **Bicycle** | **Transit** | **Auto** |
| **Existing Conditions – (Four Lanes)** | | | | |
| Rapp Rd to Arnos Rd | Poor | Poor | Fair | Good |
| *OR99 at Arnos Rd* | Poor | Poor | Fair | Good |
| Arnos Rd to Creel Rd | Poor | Poor | Fair | Good |
| *OR 99 at Creel Rd* | Poor | Poor | Fair | Good |

| | | | | |
|---|---|---|---|---|
| Scenario 1 - Five lanes | | | | |
| Rapp Rd to Arnos Rd | Good | Good | Fair | Good |
| *OR99 at Arnos Rd* | Fair | Fair | Fair | Good |
| Arnos Rd to Creel Rd | Good | Good | Fair | Good |
| *OR 99 at Creel Rd* | Fair | Fair | Fair | Good |
| Scenario 2 – Three lanes | | | | |
| Rapp Rd to Arnos Rd | Good | Fair | Fair | Good |
| *OR99 at Arnos Rd* | Good | Good | Fair | Good |
| Arnos Rd to Creel Rd | Good | Fair | Fair | Good |
| *OR 99 at Creel Rd* | Good | Good | Fair | Good |

**To:**

| **Segment/ *Intersection*** | **Mode** | | | |
|---|---|---|---|---|
| | **Pedestrian** | **Bicycle** | **Transit** | **Auto** |
| **Existing Conditions – (Four Lanes)** | | | | |
| Rapp Rd to Arnos Rd | Poor | Poor | Fair | Good |
| *OR99 at Arnos Rd* | Poor | Poor | Fair | Good |
| Arnos Rd to Creel Rd | Poor | Poor | Fair | Good |
| *OR 99 at Creel Rd* | Poor | Poor | Fair | Good |
| Scenario 1 - Five lanes | | | | |
| Rapp Rd to Arnos Rd | Good | Fair | Fair | Good |
| *OR99 at Arnos Rd* | Fair | Fair | Fair | Good |
| Arnos Rd to Creel Rd | Good | Fair | Fair | Good |
| *OR 99 at Creel Rd* | Fair | Fair | Fair | Good |
| Scenario 2 – Three lanes | | | | |
| Rapp Rd to Arnos Rd | Good | Good | Fair | Good |
| *OR99 at Arnos Rd* | Good | Good | Fair | Good |
| Arnos Rd to Creel Rd | Good | Good | Fair | Good |
| *OR 99 at Creel Rd* | Good | Good | Fair | Good |

**Changed:**

**Exhibit 14-1 Rural Segment Criteria with posted speeds 45 mph or greater[1,2,3]**

| **Daily Volume (vpd)** | **Paved Shoulder Width** | | | |
|---|---|---|---|---|
| | **0 – 2 ft** | **2 – 4 ft** | **4 – 6 ft** | **≥ 6 ft** |
| <400 | LTS 2 | LTS 2 | LTS 2 | LTS 2 |
| 400 - 1500 | LTS 2 | LTS 2 | LTS 2 | LTS 2 |
| 1500 - 7000[4] | LTS 3 | LTS 3 | LTS 3 | LTS 2 |
| > 7000 | LTS 4 | LTS 3 | LTS 3 | LTS 3 |

**To:**

**Exhibit 14-2 Rural Segment Criteria with posted speeds 45 mph or greater[1,2,3]**

| **Daily Volume (vpd)** | **Paved Shoulder Width** | | | |
|---|---|---|---|---|
| | **0 – <2 ft** | **2 - <4 ft** | **4 – <6 ft** | **≥ 6 ft** |
| <400 | LTS 2 | LTS 2 | LTS 2 | LTS 2 |
| 400 - 1500 | LTS 3 | LTS 2 | LTS 2 | LTS 2 |
| 1500 - 7000[4] | LTS 4 | LTS 3 | LTS 2 | LTS 2 |

| | | | | |
|---|---|---|---|---|
| > 7000 | LTS 4 | LTS 4 | LTS 3 | LTS 3 |

# Analysis Procedure Manual

Change Sheet – October 2015

## *APM Version 2*

## Chapter 5 Section 5.4

**Changed:**

ATRs provide the percentage of AADT that occurs in the count month and in the peak month. This information can then be used to develop a seasonal adjustment that may be applied to the manual count using one of the following three methods.

**To:**

ATRs provide the percentage of AADT that occurs in the count month and in the peak month. AADT is the annual average value for all days of the year including holidays. This information can then be used to develop a seasonal adjustment that may be applied to the manual count using one of the following three methods.

**Changed:**

When using the ATR Summaries from the TVT's, the analyst should note both the Average Weekday and Average Daily percentages. When there is little variation between the Average Weekday and Average Daily percentages, using Average Weekday supports the notion that the peak is likely on an average weekday. If the Average Daily is much larger than the Average Weekday, then the peak is likely on a weekend day, so use the Average Daily Percentage. Check the Weekly Traffic Trend column from the ATR Characteristic table to aid in this calculation.

**To:**

When using the ATR Summaries from the TVT's, the analyst should note both the average weekday and average daily percentages. Average weekday traffic (AWD) percentages include values for Monday through Thursday while average daily traffic (ADT) includes all days of the week. When there is little variation between the AWD and ADT percentages, using AWD supports the notion that the peak is likely on an average weekday. If the ADT is much larger than the AWD, then the peak is likely on a weekend day, so use the ADT Percentage. Check the Weekly Traffic Trend column from the ATR Characteristic table to aid in this calculation.

**Changed:**

ATRs are also characterized by weekly traffic trends and ADT/AWDT.

**To:**

ATRs are also characterized by weekly traffic trends and ADT/AWD.

## Glossary

**Added:**

**Annual Average Daily Traffic (AADT)** - The total traffic for the year divided by 365 (or 366 in a leap year). Can either be actual values from automatic traffic recorders or estimated with seasonal factors.

**Added:**

**Annual Average Weekday Traffic (AAWDT) –** AADT considering only Monday-Thursday volumes.

## Added:

**Average Weekday Daily Traffic (AWD or AWDT) – ADT** considering only Monday-Thursday volumes.

## Removed:

**Approach –**

**Approach Permitting –** The process of issuing permits for construction or maintenance of highway approaches.

## Changed:

**Arterial –** A thoroughfare, usually with at least two lanes in each direction and regularly spaced traffic signals, designed to serve major travel flows within an urban area.

## To:

**Arterial –** A roadway with primary function being mobility rather than property access

## Changed:

**Benefit Cost Ratio –** The relative monetized (can be tangible or non-tangible) benefits divided by the project cost for an alternative, typically expressed as a decimal. Accepted ratios are 1.0 or greater.

## To:

**Benefit Cost Ratio (B/C or BCR) –** The relative monetized (can be tangible or non-tangible) benefits divided by the cost, typically expressed as a decimal. Accepted ratios are 1.0 or greater.

## Changed:

**Blocking –** The proportion of time expressed as a percentage of the peak hour that a queue obstructs an upstream turn lane or intersection or other significant point (i.e. railroad crossing).

## To:

**Blocking Percentage –** The proportion of time expressed as a percentage of the peak hour that a queue obstructs an upstream turn lane or intersection or other significant point (i.e. railroad crossing).

## Changed:

**Centroids (special nodes) –** They represent the center of an activity zone called a TAZ. This is not necessarily the geometric center of the zone.

## To:

**Centroids –** They represent the center of activity for a transportation analysis zone (TAZ). This is not the geometric center of the zone.

## Added:

**Comprehensive Plan –** A generalized, coordinated land use map and policy document of a local government that interrelates all functional and natural systems and activities relating to the use of lands, including but not limited to sewer and water systems, transportation systems, educational facilities, recreational facilities, natural resources and air and water quality management programs.

## Changed:

**Congestion –** A condition on road networks that occurs with increased traffic volumes, and is characterized by slower speeds, longer trip times and increased queueing. An intersection that may seem very congested in a rural community may not even register as an annoyance in a large metropolitan area.

## To:

**Congestion –** A condition on road networks that occurs with increased traffic volumes, and is characterized by slower speeds, longer trip times and increased queueing.

## Removed:

**Construction Zone Traffic Management –** The system of devices and measures taken by an implementing agency to safely manage traffic flows in and around areas of construction.

## Changed:

**Coordinated –** Signals that are adjusted or connected so that they provide for continuous flow of traffic between intersections at a given speed. Coordinated signals all have the same speed. Coordinated signals can be timed, wired together, or controlled from a central operations center.

## To:

**Coordinated (Signals) –** Signals that are adjusted or connected so that they provide for continuous flow of traffic between intersections at a given speed. Coordinated signals all have the same speed. Coordinated signals can be timed, interconnected, or controlled from a central operations center.

## Changed:

**Crash Coding Manual –** A publication produced by ODOT that compiles data from reported motor vehicle traffic crashes occurring on city streets, county roads, and state highways. The data supports various local, county and state traffic safety programs, engineering and planning projects, legislative concepts, and law enforcement services.

## To:

**Crash Coding Manual –** A publication produced by ODOT that compiles data from reported motor vehicle traffic crashes occurring on city streets, county roads, and state highways.

## Changed:

**Diverge Sections –** A movement in which a single stream of traffic splits into two separate streams without the aid of traffic signals or other right-of-way controls.

## To:

**Diverge –** A movement in which a single stream of traffic splits into two separate streams without the aid of traffic control devices.

## Removed:

**Dynameq –** INRO's mesoscopic travel demand modeling software

**Dynus-T –** Dynamic Urban Systems for Transportation, a simulation-based dynamic traffic assignment software.

## Removed:

**ES202 –** Quarterly Census of Employment and Wages

## Changed:

**Floating Car –** A probe vehicle traveling with the traffic flow for the purpose of recording travel times to be used in micro-simulation models.

## To:

**Floating Car –** A probe vehicle traveling with the traffic flow for the purpose of recording travel times, where the car is driven such that the number of vehicles that pass the "floating car" is equal to the number of vehicles that the "floating car" passes. This is how the floating car approximates the average travel time of the given section.

## Changed:

**Logarithmic (Decelerating) –** Growth tapers off as land approaches built-out status and capacity of roadways. Future growth is mainly contributed by growth in background (through) traffic.

## To:

**Logarithmic –** A decelerating growth curve which tapers off as land approaches built-out status and capacity of roadways. Future growth is mainly contributed by growth in background (through) traffic.

**Changed:**

**LOS C Volume –** The maximum volume at the maximum speed that produces the maximum noise. Used in noise analysis.

**To:**

**LOS C Volume –** Term used in noise analysis. LOS C represents the level of congestion where speeds begin to reduce in a meaningful way. Therefore LOS C represents the maximum volume at the maximum speed that produces the maximum noise.

**Changed:**

**Merge Section –** A movement in which two separate streams of traffic combine to form a single stream without the aid of traffic signals or other right-of-way controls.

**To:**

**Merge–** A movement in which two separate streams of traffic combine to form a single stream without the aid of traffic signals or other right-of-way controls.

**Changed:**

**Mesoscopic –** A hybrid model that includes combinations or approximations of elements from both macroscopic and microscopic models. May include a routable network similar to a macroscopic model, while also incorporation more detailed operation elements of the transportation network to better estimate travel time based on traffic operation similar to a microscopic model.

**To:**

**Mesoscopic Model –** A hybrid model that includes combinations or approximations of elements from both macroscopic and microscopic models. May include a routable network similar to a macroscopic model, while also incorporation more detailed operation elements of the transportation network to better estimate travel time based on traffic operation similar to a microscopic model. Accounts for queuing on each link but not at the individual vehicle level.

**Changed:**

**Microscopic –** A calibrated highly detailed model simulating individual vehicles and driver behaviors on a network.

**To:**

**Microscopic Model –** A calibrated highly detailed model simulating individual vehicles and driver behaviors on a transportation network requiring a high degree of detail.

**Changed:**

**OHP V/C Target –** Targets set by the Oregon Highway Plan for volume to capacity ratios for each specific facility classification.

**To:**

**OHP Mobility (V/C) Target –** Targets set by the Oregon Highway Plan for volume to capacity ratios for each specific facility classification.

**Added:**

**Planning Analysis -** An application of a methodology where most or all of the required inputs are defaulted.

**Changed:**

**Posted Speed –** The posted speed is based on a statistical sampling of existing traffic speeds, safety issues, etc., and is typically lower than design speed.

**To:**

**Posted Speed –** The posted speed is a regulatory sign identifying the legal speed on a roadway. It is based on a statistical sampling of existing traffic speeds, safety issues, etc., and is typically lower than design speed.

**Changed:**

**Project Limits –** the physical boundaries of a project or study area.

**To:**

**Project Limits –** the physical boundaries of a project usually defined by milepoints.

**Added:**

**QCEW (Quarterly Census of Employment and Wages) Data –** A quarterly report on employment and wages by industry, provided by the Oregon Employment Department.

**Changed:**

**Queue Spillback –** When traffic queues at an intersection or bottleneck build up to the point that they block turn lanes, driveways, or even upstream intersections.

**To:**

**Queue Spillback –** When traffic queues at an intersection or bottleneck build up to the point that they block turn lanes, driveways, or even upstream intersections. See Blocking Percentage.

**Changed:**

**Road Diet –** A lane reduction within a "complete street" process that optimizes the available pavement width across all modes. Typically occurs with the conversion of a four-lane street down to two travel lanes and a two-way left turn lane.

**To:**

**Road Diet –** A reduction in through-lanes for a given roadway; occurs within a "complete street" process that optimizes the available pavement width across all modes. Typically occurs with the conversion of a four-lane street down to two travel lanes and a two-way left turn lane.

**Removed:**

**Stack –** Term defining levels of vertically overlapping bridges and ramps at an interchange.

**Changed:**

**Stochastic –** Describes a random-based outcome (repeated attempts result in different results).

**To:**

**Stochastic –** Describes an outcome derived from random probability distribution that may be analyzed statistically but may not be predicted precisely (repeated attempts result in different results).

**Changed:**

**Straight-Line –** Steady growth over time.

**To:**

**Straight-Line Growth –** Steady (linear) growth over time.

**Changed:**

**Transportation Analysis Zone (TAZ) –** A geographic unit used in travel demand models. These contain data population, employment, and household characteristics.

**To:**

**Transportation Analysis Zone (TAZ) –** A geographic unit used in travel demand models. These contain data population, employment, and household characteristics, as well as other land use attributes.

**Changed:**

**Trip Generation –** The first step in the conventional four-step transportation forecasting process used for forecasting travel demands.

**To:**

**Trip Generation –** The number of trips created from a specific type of land use. The ITE Trip Generation Manual provides the accepted source for estimates of vehicular traffic generation for

various land use types. It is also the first step in the transportation forecasting process for travel demand models that estimates person trips based on housing and employment data.

## Removed:

**Trip Generator –** A specific type of land use that will result in an increase in vehicle trips. The ITE Trip Generation Manual provides the accepted source for estimates of traffic generation for various land use types.

## Changed:

**Validation –** Process in which model output is compared to actual field data. The field data used is separate from the data used to develop the model.

## To:

**Validation –**Testing a calibrated model under different conditions for reasonability.

## Changed:

**Vehicle Miles of Travel (VMT) –** A unit to measure travel for private vehicles, such as automobiles, vans, pickup trucks, or motorcycles. Each mile traveled is counted as one vehicle mile regardless of the number of persons in the vehicle.

## To:

**Vehicle Miles of Travel (VMT) –** the sum of the distances traveled by all motor vehicles in a specified system of highways for a given period of time. VMT is calculated by multiplying the AADT value for each section/segment of road by the section/segment length (in miles) and summing all sections to obtain the VMT for the complete route.

## Added:

**Weigh-In-Motion (WIM) –** a permanently installed device for weighing vehicles in the traveled lanes.

# Analysis Procedure Manual

Change Sheet – November 2015

## *APM Version 2*

## Acknowledgements

**Added to Review Group:**

Mark Barrett, P.E.
David Hirsch, P.E., P.T.O.E.

## Chapter 14 Section 14.5, 14.6

**Added:**

Sections 14.5 and 14.6.

## Technical Tools webpage

**Added:**

**Multimodal Analysis Tools**

- **Simplified MMLOS Calculator** – Simplified MMLOS Calculator – This Excel spreadsheet implements streamlined segment-level pedestrian, bicycle and transit analysis methodologies based on the Highway Capacity Manual 2010. For more information on the multimodal methodologies and the inputs into the calculator, see Chapter 14 of the Analysis Procedure Manual (APM) Version 2.