

16 ENVIRONMENTAL TRAFFIC DATA

16.1 Purpose

Federal regulation requires, in some cases, that an air and noise study be completed to determine what impact, if any, will result from a proposed highway improvement and what measures will be taken to lessen these impacts. Certain projects may also require that greenhouse gas emissions (GHG) be quantified. This chapter presents the general outline for the needs and creation of common traffic data inputs requested for the Air Quality and Noise Analysis sections of the Environmental Impact Statement (EIS) or Environmental Assessment (EA) and for Categorical Exclusion (Class 2) projects as applicable. Traffic data needs for GHG scoping and project-level analyses are also covered.



*The noise, air quality, and GHG methodologies in this chapter are only for the production of environmental **traffic data** needed to support calculation tool inputs. Other ODOT and consultant staff are responsible for using this environmental traffic data in noise, air quality and greenhouse gas tools and models. The actual noise, air quality and GHG analyses are outside the scope of this chapter and the APM.*

16.2 Induced & Latent Demand Project Considerations

An important consideration for projects that address capacity/congestion issues (e.g. adding travel lanes) is that assumptions regarding induced and latent demand need to be assessed (see Chapter 6). As part of the National Environmental Policy Act (NEPA) federal/state/local agency review process and the public hearing and comment periods, comments relating to the analysis and impacts of induced and latent demand are common. NEPA reviews are being added for all roadway expansion projects, so latent and induced demand considerations will be necessary for these types.

Latent demand may cause the build alternative traffic to be higher than the no-build. In addition, if the project is on an edge of an urban/urbanizing area, travel demand model area, or is in an area with building land use and economic pressures (e.g. lack of affordable housing or available employment) the project alternative(s) need to be assessed for the potential of induced demand. Concerns such as these may facilitate development of bedroom communities that might add more demand to the system over time. Ideally, these kinds of expansions would also be accompanied with additional bike and transit networks and infrastructure to maximize mode share, but in cases where they are not increases the potential for latent and induced demand.

The results of the latent and induced demand assessment need to be clearly stated as part of the volume development for the alternatives. Depending on the roadway network and the extent of congestion, there may need to be separate forecasts created for the no-build and build. These separate project forecast assumptions need to be incorporated into the environmental traffic data creation process whether for noise, air quality or greenhouse gases.

Generally, a project should identify the number of new lane miles added including all auxiliary lane types (i.e. weaving, turning, etc.). Use Appendix 10A to isolate any sections of auxiliary lanes that are actually operating as through lanes. The analyst should also discuss with TPAU, ODOT Environmental Section, and their NEPA coordinator/staff any scoping needs or changes to the overall modeling approach to address potential risk from latent and induced demand.

16.3 Noise Analysis Traffic Data

ODOT is responsible for ensuring that state transportation projects are developed within the Federal Highway Administration's noise policies and procedures. To conduct the noise analysis necessary for measuring compliance, the ODOT Environmental and Hydraulic Engineering Section, or noise consultant, requires specific data from the project traffic analyst. This request is typically made through the [Noise Traffic Data Request form](#) in Appendix 16A which is filled out by the noise consultant or Environmental Section staff and delivered to the project traffic analyst. A traffic data request may be for a full or a screening-level noise study. Typically, the full study is requested, and its data requirements are discussed in the following sections. The screening level study uses a subset of the full data, so the same procedures apply. A calculation template workbook meant to streamline the noise traffic data production process in conjunction with the information in this section is available under the Volume Development section on the [Technical Tools](#) web page.

This traffic volume development process should typically only be done on the existing conditions, future no-build and final preferred alternative because of the time required to complete the work. Most times there is only one preferred alternative, but there have been cases of more than one final alternative requiring noise analysis. Any final alternatives need to be "frozen" and not be subject to changing designs, as that will incur excessive rework. Generally, it will take about three weeks for the existing conditions, two weeks for the future no-build, and two weeks for each build alternative for a medium to large-sized project.

The noise analysis needs to identify the times that have the highest impact, which would be the noisiest hour. This could be either the peak hour of all vehicles or the peak truck hour (total volumes could be much less but trucks typically make much more noise than other vehicles). This highest hour is also when the LOS C volumes occur, which is the maximum volume that can pass a point at the maximum (posted or 85th percentile) speed. Higher volumes will have slower speeds and faster speeds require low volumes and both

cases will not have the highest noise levels. For example, at low volumes or densities, (LOS A or B) vehicles are independent and are not affected by others. Speeds will be higher, but volumes will be low thus the noise level will be relatively low. At high volumes or densities (LOS E – F), vehicles directly affect each other and resulting speeds are low which dampens the noise level. At LOS C (at the C/D threshold), vehicles may have to do some space adjusting but can still travel at the posted/85th percentile speed.

The noise analyst will obtain noise measurements in the field to establish the existing conditions. The traffic data supplied by the transportation analyst will be used by the noise analyst to calibrate the traffic levels to the existing noise levels. The noise measurements should be done under similar seasonal conditions (e.g. the PM peak hour used in a MPO area representing the 30th highest hour condition or use of a summer average weekday in a coastal community, etc.) as the traffic to minimize any seasonal pattern impacts that cannot be adjusted for (see Chapter 5). The difference in traffic volumes between the existing conditions and the future no-build will help establish the noise levels for the future no-build. The same goes for translating the future no-build to the future build. In a sense, this is analogous to post-processing with a travel demand model. The noise analysis will be summarized in a report which serves as the basis for recommending any noise mitigations such as soundwalls.

16.3.1 Input Data Needs

The traffic data requested will be the existing and the future design years for the no-build and the design year for the build alternative(s). The data will be provided in a directional segment or link basis. For each of the separate years, the following is required per link:

- Unique link identifier
- Link name
- Link length (mi.)
- Link type
- Posted speed (mph)
- 85th percentile speed (mph); if known
- LOS C volume (vph); Needed if any link volume for any analyzed year has a segment LOS D or higher, so it is highly advisable to include regardless to save time
- Peak hour and peak truck hour volume (vph)
- Percentages (decimal form) of vehicle groups:
 - Automobiles (FHWA Classes 1-3)
 - Medium Trucks (FHWA Classes 4-5)
 - Heavy Trucks (FHWA Classes 6-13)
 - Optional- Motorcycles (FHWA Class 1) and buses (FHWA Class 4)

Other information:

- Percentage of vehicles expected to stop on traffic signal approaches
- Existing and future zoning (or predicted/planned changes in land use from existing)
- Intersection turning movement diagrams (generally just for screening-level requests)

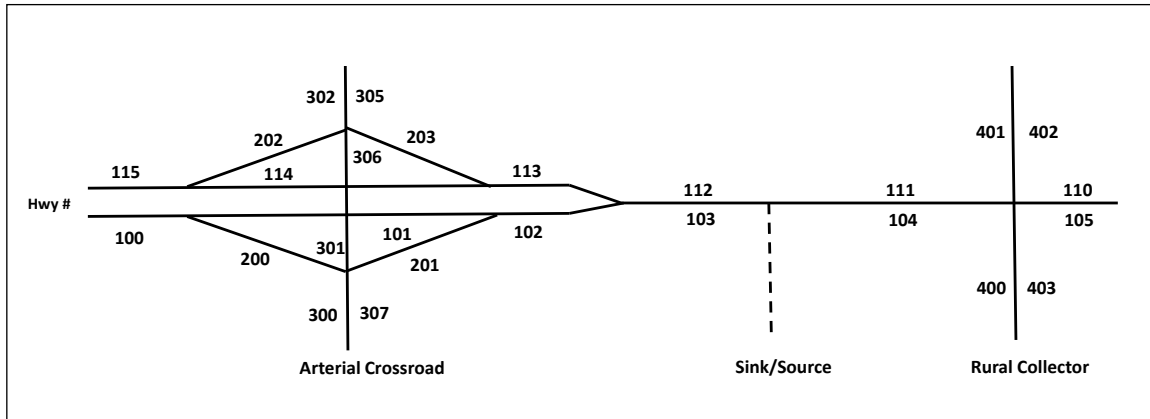
Links & Identifiers

The noise data process requires that the project area roadway network be broken into individual segments as everything will be recorded at the link level. This will be in the form of link diagrams depicting the study area roadway segments that will be included in the analysis for all considered no-build and build scenarios. These diagrams are not only useful for graphically relating the data provided to its location, but help in identifying links created, modified, or removed with each alternative and will facilitate the review and error-checking process. These can either be on paper or in an electronic format (i.e. Excel).

Each link must be given a unique number for identification purposes. Link numbers must be directional. Only roadways with collector and higher functional classifications should be included in a 500' range from the subject facilities in the project area. Local streets and private driveways will have too low of speed and/or volume to make a significant noise impact and can be ignored. All count locations need to be represented as a node. Intersections with local streets and driveway should be noted as a sink/source location and should be a node (link break) if there was a count performed at that location. Creating a break at these locations will make the overall volume balancing process easier. Links representing the local street or driveway at this location should not be added, so the only intersection legs that would be represented would be on the mainline.

As much as possible, keep consistent numbering between the existing, no-build, and build link diagrams. This will mean adding extra links that have zero data into the existing and no-build future network that will accommodate the build alternative(s). It is best not to be completely sequential in the numbering by leaving gaps to accommodate extra links. This will avoid having out-of-order numbering if a new link is needed to be added later. For example, if the eastbound links were numbered 1 to 22, it would be better to start the westbound numbering at 30 instead of 23. The series numbers can also be changed to represent a different facility type for better clarity. For example, the mainline freeway could have the range of numbers being in 1-50, the intersecting arterial could be in the 100's and the ramps connecting the two could be in the 200's. So in this case, Link 101 would be on the crossroad and Link 204 would be a ramp. The more consistent the diagrams are between all the scenarios, the easier it will be for the traffic analyst to create and troubleshoot and the noise analyst to follow. There is nothing wrong with having links with no data in the scenarios if they are labeled as not existing yet (i.e. "Future Link") or not existing anymore (i.e. "Removed"). Exhibit 16-1 shows a sample project area with a wider highway that has access-control and medians transitioning to a two-lane highway section with at-grade intersections. Different numbering was used for the highway, ramp, arterial, and collector links. The link numbering was also non-consecutive to allow for the future alternative to keep numbering between scenarios consistent as possible.

Exhibit 16-1 Sample Link Diagram



Link Characteristics

Each directional link has a series of specific characteristics. This includes link name, length, type, and speed. Link names need to be descriptive with the street name, from-to, and direction. For example, this would be NB Main St (Elm St – Oak St) for a two-way roadway or like SB I5 to WB I105 Off-ramp for a one-way roadway. There should be no ambiguity on location between the description and the numerical identifier.

Link length is defined as the center-to-center intersection spacing. For state highway facilities (mainline, connections, or frontage roads), use of [official roadway inventory data](#) is preferred for existing and the future no-build conditions. Build alternative segment lengths should be determined from available single-line or detailed design drawings. Links on the edge of the network should have a default length of 0.25 mile.

Link type is a general identifier of the roadway environment. This is defined as either rural, urban street, or freeway. Study areas outside of an urban growth boundary should use the “rural” classification unless the facility is a freeway, then the “freeway” classification will override. Freeway ramps and related free-flow interchange connections should also use the “freeway” classification. Urban street interchange crossroads or other urban at-grade facilities should use the “urban street” classification.

Link speeds, at a minimum, are the posted speeds. Dual-posted highways with truck speed limits should weight-average the regular and the truck speed limit together using the heavy truck percentage. If the speed is weight-averaged, it should be rounded to the nearest whole number. If available for existing conditions, the 85th percentile operating speed should be included in addition to the posted speed limit. The 85th percentile operating speed is the highest overall speed at which a driver can travel on a given highway under favorable weather conditions, prevailing traffic conditions, and without at any time exceeding the safe speed as determined by the design speed. This can be estimated by using an analysis of average speeds or could be directly generated from probe speed data packages such as [RITIS](#).

LOS C Volumes

In noise analysis, the LOS C volume is assumed to represent the maximum volume that can be sustained at free-flow speed resulting in the maximum noise condition. This is defined at the LOS C/D threshold as the maximum LOS C value. Because vehicle speeds typically affect noise levels more than vehicle volumes, this condition is often the most critical. In areas where peak period congestion is minimal or only occurs for a short time, allowing for continuously high speeds, the peak hour or peak truck hour may be critical. However, in areas where congestion is present for extended periods, lowering vehicle speeds, the LOS C volume may have a greater impact. It should be noted, however, that many links in a study area will not reach the LOS C level and some may exceed it.

LOS C volumes need to be determined on a link basis to establish a maximum volume threshold. If the peak hour or the peak truck hour volume exceed the LOS C volume on a link, then the link volume is capped at the LOS C value. This way, the shown link volumes (and related vehicle percentages) will not exceed LOS C and will represent the maximum noise condition.



Capped link volumes will no longer balance across adjacent links. Links with capped volumes will need to reduce the number of vehicles such that the vehicle group (e.g. buses) percentages remain constant.

LOS C volumes need to be obtained from the latest version of the Highway Capacity manual for the respective facility type (e.g. freeway, multi-lane, two-lane highway, or urban street). Use the appropriate segment characteristics (number of lanes, widths, and other adjustment factors) to determine an initial value. This should have been done already as part of the project analysis so copies of the same software files can be used to start with. The LOS C volume is calculated using the HCM density-based methodologies, via an iterative process based on the project volumes (i.e. 2x, 1.5x, 0.75x, etc.), to identify the volume where the LOS C threshold occurs (at the top end of LOS C, adjacent to LOS D).

Roadway segments (e.g. merge section, freeway mainline) are relatively straightforward to iterate the initial LOS volume to reach the C/D threshold. Similarly, for signalized intersections, iterate until the overall intersection reaches the LOS C/D threshold. Roundabout and unsignalized intersection approach links for, the LOS C volumes will also need to be iterated using a “best approach” practice using the limiting leg (e.g. the leg with the lowest approach capacity) as it is a balancing activity between the mainline and side-street leg LOS. If mainline volumes were adjusted to LOS C/D, then the side street volumes would likely be LOS F and too high. Likewise, iterating side street volumes to LOS C/D probably will result in mainline volumes being too low. Trying to get the mainline and the side-street to LOS C/D at the same time results in a situation that would not occur unless large changes were made in the overall volume patterns which

would result in inconsistencies with other links not to mention with the volumes used in the rest of the project analysis. Iterate up or down based on the project volumes (i.e. 1.5x, 1.25x, 0.75x etc.) until the limiting leg reaches the LOS C/D threshold.

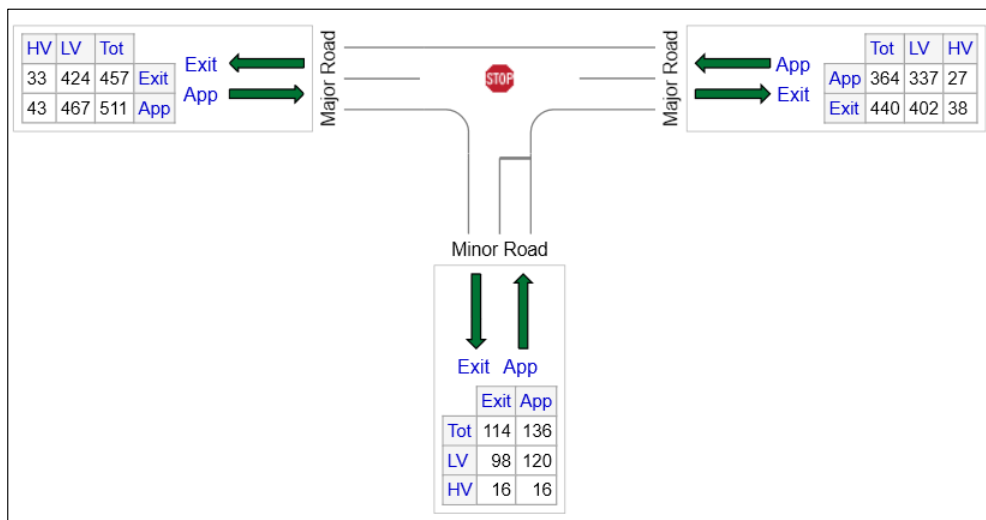
Report out all approach links at that point as LOS C volumes. Report out the departing link LOS C volumes if they would end up being approach volumes for adjacent intersections. This will require that the LOS C volume from the departing link and the approach link to be averaged to create one LOS C volume per link. For documentation purposes, only the final software output with the final LOS C volumes is needed.

Use the following LOS C defaults only for links at the end of the network or for departing intersection links that are not also a calculable approach link at the next downstream intersection.

- For freeway free-flow ramp roadways and on-ramps, assume 1300 pchphl. The analyst should consider effects of ramp metering on freeway ramp LOS C volumes, where applicable.
- For urban arterials, assume 600 pchphl.
- For suburban arterials, assume 1000 pchphl.
- For rural two-lane highways, assume 800 pchphl.
- For rural multilane highways, assume 1200 pchphl

Example 16-2 LOS C Calculations

As part of the noise analysis for a simple urban intersection upgrade project, LOS C volumes are needed for each exiting and entering leg of this two-way stop-controlled “T” intersection. Peak hour light and heavy vehicle volumes and other geometric/control details were entered into a SIDRA analysis (note that any intersection software could be used).



These inputs resulted in the below output. A review of the lane approach capacities indicates that the minor road approach is the limiting leg, so that is the controlling leg on the volume iteration to find the LOS C/D threshold. The starting LOS results show this approach to be LOS C, so initial volumes will need to be raised to have the LOS reach the C/D threshold.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	136	12.0	335	0.405	100	22.9	LOS C
Approach	136	12.0		0.405		22.9	LOS C
East: Major Road							
Lane 1	364	7.5	1679	0.217	100	2.2	LOS A
Approach	364	7.5		0.217		2.2	NA
West: Major Road							
Lane 1	511	8.5	1691	0.302	100	0.1	LOS A
Approach	511	8.5		0.302		0.1	NA
Intersection	1011	8.6		0.405		3.9	NA

The volume iteration is started by assuming a volume multiplier (1.1x since the likely needed change is small) to apply to all entering and exiting volumes. After entering the new volumes the analysis reports that the minor leg is now at LOS D, so the 10% volume increase is a bit too high.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	150	12.3	300	0.501	100	28.5	LOS D
Approach	150	12.3		0.501		28.5	LOS D

For the second iteration the volume multiplier was set at 1.05x which splits the difference between the starting volume and the first iteration. The analysis results still show LOS D, so again the volume multiplier would be cut in half to 1.025x for the third iteration.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	142	11.5	318	0.448	100	25.2	LOS D
Approach	142	11.5		0.448		25.2	LOS D

The third iteration resulted in LOS C, so the 1.025x factor is a bit low, so the volume factor was raised to be halfway at 1.037x for the fourth iteration.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	138	11.8	326	0.423	100	23.9	LOS C
Approach	138	11.8		0.423		23.9	LOS C

The fourth iteration also resulted in LOS C, so it is a bit closer, but a fifth iteration was done with the factor again splitting the difference at 1.043x.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	140	11.6	323	0.434	100	24.4	LOS C
Approach	140	11.6		0.434		24.4	LOS C

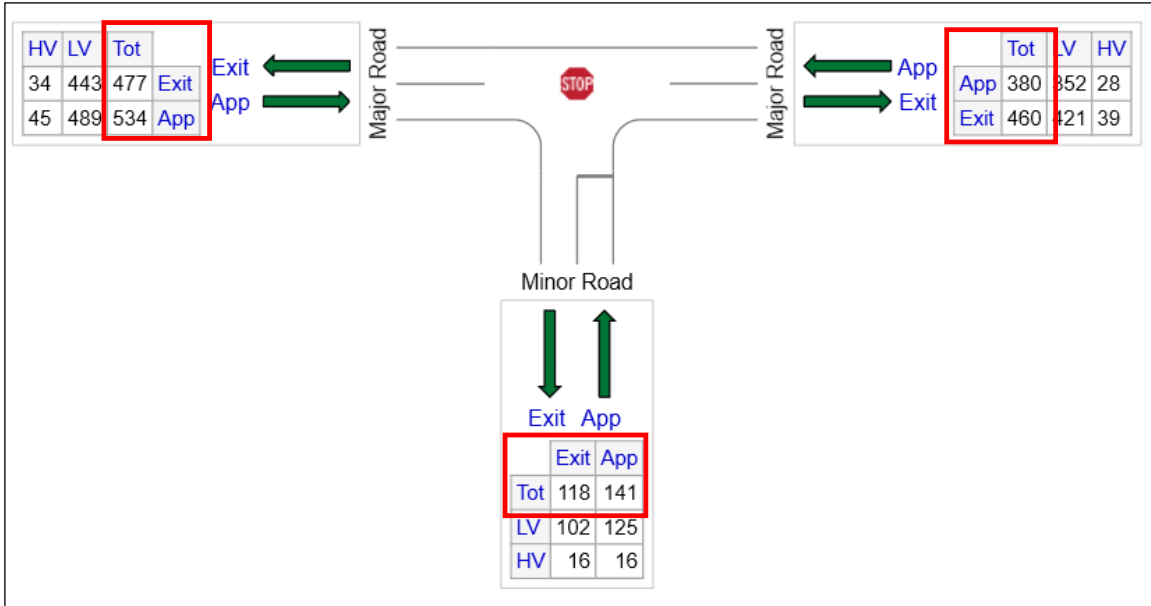
The fifth iteration also resulted in LOS C with slightly lower capacities. One last iteration was performed with a volume factor of 1.047x.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	141	11.5	321	0.440	100	24.7	LOS C
Approach	141	11.5		0.440		24.7	LOS C

The sixth and final iteration resulted in LOS C which was judged to be close enough to the threshold at 141 vph versus the 142 vph from the 3rd iteration which resulted in LOS D. Typically five to seven iterations will be necessary to close in on a final value.

Lane Use and Performance							
	DEMAND FLOWS		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service
	[Total veh/h	HV] %					
South: Minor Road							
Lane 1	141	11.5	320	0.441	100	24.8	LOS C
Approach	141	11.5		0.441		24.8	LOS C

Once the LOS C/D threshold is determined to be reached then the approach volumes for the limiting and other legs are reported out as the LOS C maximum volumes. Departing leg volumes can also be used if they are also approach leg volumes for adjacent intersections.



Peak Hour and Peak Truck Hour Volumes

Each link in the defined project area will need an assigned directional peak hour and peak truck hour volume. This will need to be done for the existing conditions, future no-build, and the future build (design) year scenarios.

Peak hour volumes should be based on the same counts, system peak hour, and factoring assumptions used to develop the project volumes following Chapter 5 and 6 methodologies. Any previously calculated peak hour project volumes for each of the three scenarios (existing, future no-build and future build) need to be converted from a turn movement basis to a link approach basis.

If it is known in the project scoping process that a noise and/or an air quality analysis will be eventually needed, then at least 16 or preferably 24-hour (FHWA 13 vehicle class) classification turn movement counts need to be ordered at all signalized intersections in addition to all intersections with substantial traffic volumes and/or heavy vehicle movements. These counts would also be used for the project volumes and analysis to maintain consistency with the later environmental analyses. Shorter duration counts (i.e. four hours) can still be used for peak hour volumes and be factored to daily volumes using factors from nearby long duration counts but will prove difficult for the calculation of the peak truck hour if they are not in the right period (typically morning). It is generally more efficient and less costly to have a single long duration count than multiple short duration counts.

A separate system peak hour is determined for the peak truck hour similarly as done for the peak hour (see Chapter 5) by noting when the highest amounts of trucks and buses occur (FHWA Classes 4- 13). The easiest way to do this is to add columns to a classification count export summing up the auto (FHWA Classes 1-3), medium truck (FHWA Classes 4 & 5) and heavy trucks (FHWA Classes 6-13) and the total trucks

(medium + heavy). Identify the peak hour when the highest total trucks occur.

Exhibit 16-2 shows part of a 24-hour classification count with the additional summary columns for the auto, medium truck, heavy truck, and total truck summaries. The total truck summary column allows for a quick identification of the truck peak hour when the highest total of medium and heavy trucks occur. The highlighted hourly volume in the exhibit just happens to be the highest number of medium trucks in this count but that cannot be counted on to identify the truck peak hour by itself. In addition, while the identified truck peak hour in this count was from 12-1 PM, the actual truck peak hour could start on any 15-minute interval. This calculation is repeated for each count and then the resulting system peak truck hour is chosen from the count peak truck hours following the same process used in Chapter 5.

Exhibit 16-2 Peak Truck Hour Identification

	Multi Trailer Trucks (5 or less axles)	Multi Trailer Trucks (6 axles)	Multi Trailer Trucks (7 or more axles)	Auto	Med Trks	Hvy Trks	Class 4-13
11:00	0	3	2	929	63	103	166
11:15	0	0	0				0
11:30	0	0	0				0
11:45	0	0	0				0
12:00	0	2	8	1055	83	101	184
12:15	0	0	0				0
12:30	0	0	0				0
12:45	0	0	0				0
13:00	0	1	4	1128	52	99	151
13:15	0	0	0				0
13:30	0	0	0				0
13:45	0	0	0				0
14:00	0	0	0	1110	60	102	162

Truck peak hours typically occur in the mid-morning hours as this is when drivers are trying to minimize delay when going through an urban area or trying to time arrivals into or through a larger adjacent metropolitan area or are making deliveries within an urban area. The number of trucks and buses in the truck peak hour need to exceed the values in the peak hour. However, there likely will be links that will not exceed in the system peak truck hour versus the individual count truck peak hours because of the overall volume patterns in the study area. These exceptions are addressed in the calculation process. The peak truck hour volumes are created as part of the overall calculation process described later rather than independently/directly from the raw count values as done with the peak hour volumes. Note that the truck peak hour volumes are also “all vehicle” volumes which would be the sum of the auto, medium truck, and heavy truck columns in Exhibit 16-2 above. This should not be confused with the vehicle breakouts such as the “peak truck hour medium trucks” which would be the number of medium trucks in the truck peak hour.

Vehicle Classifications and Groups

The noise traffic data process will require percentages and related volumes for certain vehicle groups. All the 13 FHWA vehicle classes will need to be reallocated into these summary groups. This only needs to be done for the system peak hour and peak truck hours on each count to minimize the time and effort needed. Noise sources associated with transportation projects can include passenger vehicles, medium trucks, heavy trucks, and buses. Each of these vehicles produces noise, however, the source and magnitude of the noise can vary greatly depending on vehicle type. For example, while the noise from passenger vehicles occurs mainly from the tire-roadway interface and is, therefore, located at ground level, the noise from heavy trucks is produced by a combination of noise from tires, engine and exhaust resulting in a noise source that is approximately eight feet above the ground.

The 13 FHWA vehicle classes are shown below:

- **Class 1: Motorcycles:** All two- or three-wheeled motorized vehicles. Typical vehicles in this category have saddle type seats and are steered by handlebars rather than steering wheels. This category includes motorcycles, mopeds, and three-wheel motorcycles. This category is not intended to include micro-mobility devices such as e-scooters and e-bikes.
- **Class 2: Passenger Cars:** All sedans, coupes and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.
- **Class 3: Other Two-Axle, Four-Tire Single Unit Vehicles:** All two-axle, four-tire vehicles, other than passenger cars. Included in this classification are pickups, sport utility vehicles, vans, and other vehicles such as campers, motor homes, ambulances, hearses, carry-alls and minibuses. Other two-axle, four-tire single-unit vehicles pulling recreational or other light trailers are included in this classification.
- **Class 4: Buses:** All vehicles manufactured as traditional passenger-carrying buses with two axles and six tires or three or more axles. This category includes only traditional buses (including school buses) functioning as passenger-carrying vehicles. Modified buses should be considered a truck and should be appropriately classified.
- **Class 5: Two-Axle, Six-Tire, Single-Unit Trucks:** All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., with two axles and dual rear wheels.
- **Class 6: Three-Axle Single-Unit Trucks:** All vehicles on a single frame including trucks camping and recreational vehicles, motor homes, etc., with three axles.
- **Class 7: Four or More Axle Single-Unit Trucks:** All trucks on a single frame with four or more axles.
- **Class 8: Four or Fewer Axle Single-Trailer Trucks:** All vehicles with four or fewer axles consisting of two units, one of which is a tractor or straight truck power unit.
- **Class 9: Five-Axle Single-Trailer Trucks:** All five-axle vehicles consisting of

two units, one of which is a tractor or straight truck power unit.

- **Class 10: Six or More Axle Single-Trailer Trucks:** All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power unit.
- **Class 11: Five or Fewer Axle Multi-Trailer Trucks:** All vehicles with five or fewer axles consisting of three or more units, one of which is a tractor or straight truck power unit.
- **Class 12: Six-Axle Multi-Trailer Trucks:** All six-axle vehicles consisting of three or more units, one of which is a tractor or straight truck power unit.
- **Class 13: Seven or More Axle Multi-Trailer Trucks:** All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power unit.



In reporting information on trucks the following criteria should be used:

- *Truck tractor units traveling without a trailer will be considered single-unit trucks.*
- *A truck tractor unit pulling other such units in a “saddle mount” configuration will be considered one single-unit truck and will be defined only by the axles on the pulling unit.*
- *Vehicles are defined by the number of axles in contact with the road. Therefore, “floating” axles are counted only when in the down position.*
- *The term “trailer” includes both semi- and full trailers.*

The summary vehicle groups are as follows:

- (Optional) Motorcycles (Class 1)
- Automobiles (Class 2 & 3): Passenger cars and other two-axle four-tire vehicles
- (Optional) Buses (Class 4)
- Medium trucks (Class 5): Two-axle six-tire trucks
- Heavy Trucks (Classes 6 – 13): Three-axle and greater single-unit trucks and all combination tractor-trailer trucks

The ODOT standard noise request combines the motorcycles into the automobile category and the buses into the medium truck categories, however all the categories may still be requested if there are substantial volumes of these vehicle classes. Separate motorcycle data is rarely needed in Oregon, but specific data related to bus volumes may be appropriate where the link could be experiencing higher than average bus traffic due to influence by a nearby school, bus barn, or tourist attraction. Noise requests from consultants may have the combined or all five categories listed. Generally, it is preferred to have a smaller number of classes to minimize the overall work, which can be very substantial for larger networks considering that the number of motorcycles and buses on a link basis tends to be small and which has limited impact on the results. Check with the

project noise staff on whether all five or just the three main groups are needed before starting.

Other Information

For each approach link at a signalized intersection the percentage of vehicles expected to stop (arriving on the red phase) needs to be estimated. The proportion of vehicles arriving on red for uncoordinated/isolated signals is the inverse of the green time to cycle length (g/c ratio) calculated as:

$$P_{red} = [1 - [(Total\ Split - yellow\ time - all-red\ time)/Cycle\ length]] \times 100$$

If signals are coordinated or closely spaced then the proportion is based on the directional bandwidth available for the coordinated/progressed segment, which will extend across multiple links. Review the time-space diagram from (Synchro, SIDRA, etc.) and determine the arterial bandwidth for the desired direction. The total split, yellow and all-red times come from the upstream signal rather than the subject location as this overall calculation determines how much of the vehicle stream that leaves the upstream signal will stop at the subject location. Use the subject location if it is the first signal in the segment. In this case, the proportion of vehicles arriving on red is calculated for each approach link:

$$P_{red} = [1 - [(Directional\ bandwidth / (Total\ split_{upstream} - yellow\ time_{upstream} - all-red\ time_{upstream})]] \times 100$$

Example 16-2: Proportion of Vehicles Expected to Stop Calculation

A highway signalized intersection has actuated (isolated) operation in the east-west direction and coordinated operation north-south. The cycle length is 100 seconds.

From the Synchro program file for the appropriate alternative and year containing the intersection, the timing window shows the needed total split, yellow and all-red times. The subject intersection times are used for the actuated isolated eastbound and westbound directions and the northbound coordinated time since it is first in this direction. The upstream intersection times are used for the southbound direction.

Subject Intersection												
TIMING SETTINGS	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Split (s)	10.0	55.1	55.1	9.4	54.5	54.5	35.5	35.5	—	35.5	35.5	—
Yellow Time (s)	4.7	4.7	4.7	4.7	4.7	4.7	4.0	4.0	—	3.5	3.5	—
All-Red Time (s)	0.7	0.7	0.7	0.7	0.7	0.7	0.5	0.5	—	0.5	0.5	—
Upstream (Southbound) Intersection												
Total Split (s)	69.0	69.0	—	69.0	69.0	—	31.0	31.0	—	31.0	31.0	—
Yellow Time (s)	4.0	4.0	—	4.0	4.0	—	3.5	3.5	—	3.5	3.5	—
All-Red Time (s)	0.5	0.5	—	0.5	0.5	—	0.5	0.5	—	0.5	0.5	—

$$P_{red} = [1 - [(Total\ Split - yellow\ time - all-red\ time) / Cycle\ length]] \times 100$$

The total split, yellow and all-red times for the eastbound and westbound directions are entered into the equation above for isolated approaches:

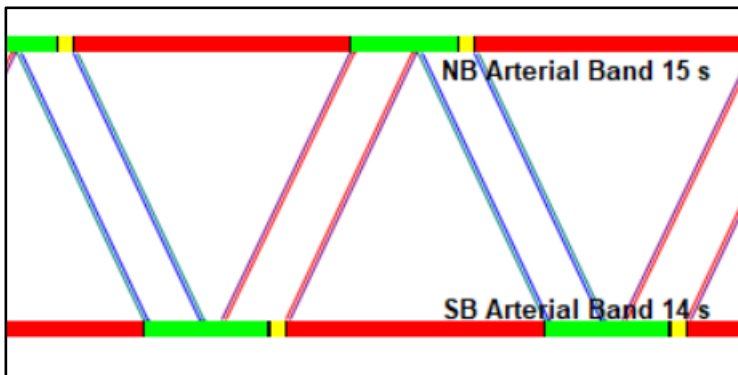
$$P_{red-EB} = [1 - [(55.1 - 4.7 - 0.7) / 100]] \times 100 = \mathbf{50.3\%}$$

$$P_{red-WB} = [1 - [(54.5 - 4.7 - 0.7) / 100]] \times 100 = \mathbf{50.9\%}$$

For the northbound and southbound approaches, the coordinated equation is used:

$$P_{red} = [1 - [(Directional\ bandwidth / (Total\ split_{upstream} - yellow\ time_{upstream} - all-red\ time_{upstream}))] \times 100$$

The time-space diagram from Synchro shows a 14 second bandwidth southbound and 15 seconds northbound. In this case there are only two signalized intersections north-south, so the link bandwidth is the same as the arterial bandwidth (normally this is not the case).



For the northbound direction, since the subject intersection is first, the timing from it is used in the equation:

$$P_{red-NB} = [1 - [(15 / (35.5 - 4.0 - 0.5))] \times 100 = \mathbf{51.6\%}$$

The southbound direction uses the upstream intersection timing since it is first:

$$P_{red-SB} = [1 - [(14 / (31.0 - 3.5 - 0.5))] \times 100 = \mathbf{48.1\%}$$

The overall zoning information is needed for the study area. This is not correlated with the roadway links. This is just a map showing existing zoning. A map showing future comprehensive plan zoning is needed if different from the existing.

Typically just for screening-level noise studies (check with the noise analyst to confirm if this will apply), a turning movement diagram is needed for each intersection in each of the three-year scenarios (existing year, future no-build, and future build alternative). This can be directly from an intersection analysis program, however if there are a larger number of intersections, a consolidated diagram showing multiple locations should be used to lessen the number of pages.

16.3.2 Calculations

The calculations necessary in the noise traffic data production are to generate the proportions of each of the summary vehicle groupings. These proportions will be used in the overall process to generate initial unbalanced volumes for each group, which are then balanced, and the proportions updated to create the final results. This will need to be done for the peak hour and the peak truck hour for all links.

For the peak hour, each of the vehicle groups are calculated by dividing the subject vehicle group volume by the total number of vehicles in the peak hour except for automobiles, which are simply subtracted:

$$\text{Peak Hour Motorcycles Factor} = \frac{\text{Motorcycles in the peak hour}}{\text{Total peak hour vehicles}}$$

$$\text{Peak Hour Buses Factor} = \frac{\text{Buses in the peak hour}}{\text{Total peak hour vehicles}}$$

$$\text{Peak Hour Medium Trucks Factor} = \frac{\text{Medium trucks in the peak hour}}{\text{Total peak hour vehicles}}$$

$$\text{Peak Hour Heavy Trucks Factor} = \frac{\text{Heavy trucks in the peak hour}}{\text{Total peak hour vehicles}}$$

$$\begin{aligned} \text{Peak Hour Automobiles Factor} \\ = 1 - \sum \text{Peak hour factors for all other groups} \end{aligned}$$

The peak truck hour is calculated from the relationship of the truck peak hour to the peak hour. This factor translates the peak hour volumes into peak truck hour volumes. Peak truck hour volumes are less than the peak hour volumes by definition, so the maximum value of the peak truck hour factor is 0.999. If any links have factors 1.000 or greater, they need to be capped at a maximum 0.999. Once the peak truck hour factor is created,

then all the separate vehicle factors are based on it, which is different from the peak hour factors:

$$\text{Peak Truck Hour Factor, max 0.999} = \frac{\text{Total truck peak hour vehicles}}{\text{Total peak hour vehicles}}$$

$$\text{Peak Truck Hour Motorcycles Factor} = \frac{\text{Motorcycles in the peak truck hour}}{\text{Total truck peak hour vehicles}}$$

$$\text{Peak Truck Hour Buses Factor} = \frac{\text{Buses in the peak truck hour}}{\text{Total truck peak hour vehicles}}$$

$$\begin{aligned} &\text{Peak Truck Hour Medium Trucks Factor} \\ &= \frac{\text{Medium trucks in the peak truck hour}}{\text{Total peak truck hour vehicles}} \end{aligned}$$

$$\text{Peak Truck Hour Heavy Trucks Factor} = \frac{\text{Heavy trucks in the peak truck hour}}{\text{Total truck peak hour vehicles}}$$

$$\begin{aligned} &\text{Peak Truck Hour Automobiles Factor} \\ &= 1 - \sum \text{Peak truck hour factors for all other groups} \end{aligned}$$

16.3.3 Process – Existing Conditions

The following procedure is suggested. A spreadsheet should be created with rows for each link and columns for each of the link attributes for the existing conditions (A sample spreadsheet workbook with all of the sub-tables is available in Appendix A):

- Unique link identifier
- Link name
- Link length (mi.)
- Link type
- Posted speed (mph)
- 85th percentile speed (mph); (optional)
- LOS C volume
- Peak hour volume
- Peak truck hour volume
- Automobiles peak hour %
- Medium truck peak hour %
- Heavy truck peak hour %
- Motorcycle peak hour % (optional)
- Bus peak hour % (optional)
- Peak truck hour factor
- Automobile peak truck hour %

- Medium truck peak truck hour %
- Heavy truck peak truck hour %
- Motorcycle peak truck hour % (optional)
- Bus peak truck hour % (optional)

Separate spreadsheets can be used for each of the three volume scenarios as using individual tabs and a single file will result in more than 50 or more which can be hard to follow and review if a good color scheme and formatting is not used. A tab containing the link diagram should also be added but it can be a separate document if desired. The link identifier through the 85th percentile speed columns are the same for all scenarios.

The overall process is as follows:

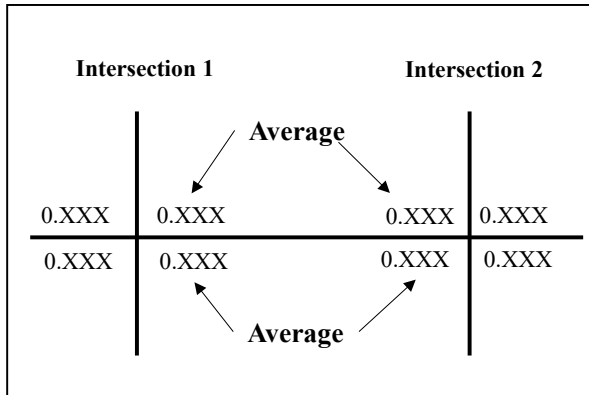
1. Add the unique link numbering scheme, link name/description, length, type and posted/85th speeds.
2. Calculate the LOS C for each link based on its facility type
3. Convert the peak hour existing volumes to a directional link basis
4. On a separate tab, create a linked table with the headers (See Exhibit 16-2):
 - Link identifier
 - Link name
 - Peak hour volume
 - Initial medium truck peak hour volume
 - Initial medium truck peak hour factor
 - Final medium truck peak hour volume
 - Final medium truck peak hour factor

Exhibit 16-2 Example Medium Truck Factor & Volume Calculation Table

Link #	Link Name	Final	Initial	Initial	Final	Final
		2017	Pk Hr Med Trk	Pk Hr Med Trk	Pk Hr Med Trk	Pk Hr Med Trk
		(vph)	(vph)	Factor	(vph)	Factor
101	Beg Proj - 004CQ (SB)	1175	46	0.039	46	0.039
102	004CQ - 004CT (SB)	760	21	0.027	21	0.028
103	004CT - Rdwy 2 meets (SB)	820	26	0.031	26	0.032
104	Rdwy2 meets - N Uturn (SB)	820	26	0.031	26	0.032
105	N Uturn - Vandever Rd (SB)	820	26	0.031	26	0.032
106	Vandever Rd - Rdwy2 meets (SB)	695	20	0.028	20	0.029
107	Rdwy2 meets - S Uturn (SB)	695	20	0.028	20	0.029
108	S Uturn - 4 lanes (SB)	695	20	0.028	20	0.029
109	4 lanes - Sugarpine Butte (SB)	695	20	0.028	20	0.029
110	Sugarpine Butte - 2 lanes (SB)	695	20	0.028	20	0.029
111	2 lanes - USFS Boundary (SB)	695	20	0.028	20	0.029
112	USFS Boundary to end of project (SB)	695	20	0.028	20	0.029
201	Beg Proj - 004CV (NB)	895	62	0.069	62	0.069
202	004CV - 004CU (NB)	560	26	0.047	26	0.046
203	004CT - Rdwy 2 meets (NB)	610	28	0.046	28	0.046
204	Rdwy2 meets - N Uturn (NB)	610	28	0.046	28	0.046
205	N Uturn - Vandever Rd (NB)	610	28	0.046	28	0.046
206	Vandever Rd - Rdwy2 meets (NB)	585	27	0.046	27	0.046
207	Rdwy2 meets - S Uturn (NB)	585	27	0.046	27	0.046
208	S Uturn - 4 lanes (NB)	585	27	0.046	27	0.046
209	4 lanes - Sugarpine Butte (NB)	585	27	0.046	27	0.046
210	Sugarpine Butte - 2 lanes (NB)	585	27	0.046	27	0.046
211	2 lanes - USFS Boundary (NB)	585	27	0.046	27	0.046
212	USFS Boundary to end of project (NB)	585	27	0.046	27	0.046

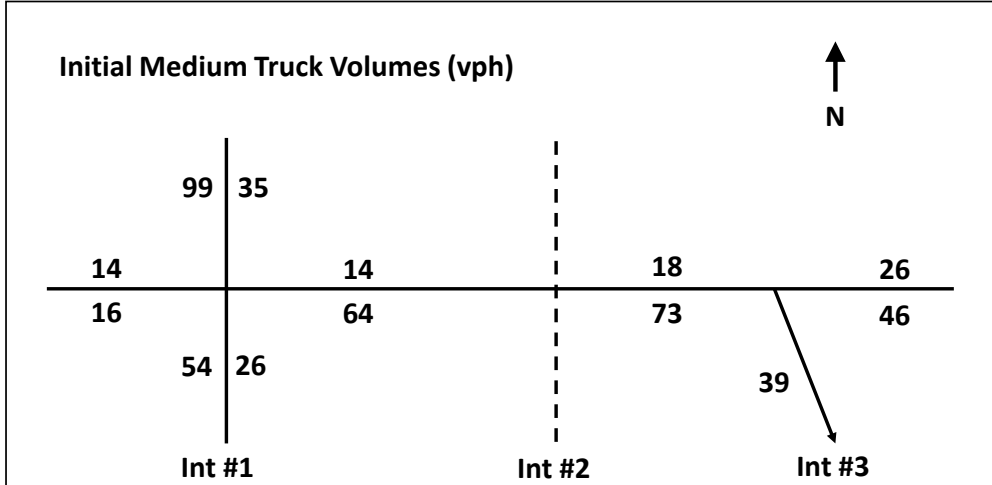
5. The initial medium truck peak hour factor is computed by using the formula shown in Section 16.3.2 by dividing the total number of medium trucks in the peak hour by the total number of vehicles in the peak hour for a particular link from a single count. Values for factors should be to three decimal places. Repeat for all directional entering and leaving links at each count (i.e. intersection) location.
6. Two factor values will be generated on every link from Step 5, one leaving a previous intersection and one entering the next intersection unless it is an external link where there will be only one value. Average these together so there is just one value per link and place in the medium truck factor table.

Exhibit 16-2 Averaging Entering & Leaving Factors



7. Multiply the initial medium truck peak hour factor by the peak hour volume to generate the initial medium truck peak hour volume. For example, from Exhibit 16-2, Link #101; the initial medium truck factor is 0.039 and the peak hour volume is 1175 vph. Multiplying these together gives an initial medium truck volume of 46 vph.
8. The initial medium truck peak hour volumes need to be balanced across all intersections. Balancing can be done via spreadsheet or by paper, but it is somewhat different than the balancing performed for project volumes as it is on a link basis rather than by turn movement. Balancing is done by summing the inbound and outbound volume and computing the difference. The difference in the in or out volumes is then spread around the intersection proportionately. It is generally best to split the difference between the ins and the outs to minimize the change at adjacent locations. Intersections with no minor legs (sink/source) included in the noise analysis scope only needs to reflect the drop or increase across the sink or source. This drop or increase is best reflected when it can be based on a count done at the location. These are also locations that can allow adjusting for differences where just an intersection balance cannot completely adjust for.

Example 16-3: Intersection Balancing



Medium truck peak hour volumes need to be balanced along a local east-west arterial shown above in the figure. This arterial intersects with another north-south arterial (Intersection #1), a local street (Intersection #2), and a ramp terminal (Intersection #3).

The intersecting roadways for Intersections #1 and #3 are also included in the noise analysis, but Intersection #2's are not. Intersection #2 had a count performed at this location, so this will be treated as a sink/source instead.

The first step will be to assess the differences between the in's and out's at Intersection #1:

$$\text{Total In} = 99 + 16 + 26 + 14 = 155 \text{ vph}$$

$$\text{Total Out} = 35 + 14 + 54 + 64 = 167 \text{ vph}$$

$$\text{Difference} = 167 - 155 = 12; \text{ so need to raise in's by 6 and lower out's by 6}$$

The second step will be to determine the proportions of each in and out link as fractions of the total in and out volume checking to make sure that the proportions sum up to 1.000:

$$EB_{in} = 16 / 155 = 0.103$$

$$WB_{in} = 14 / 155 = 0.090$$

$$NB_{in} = 26 / 155 = 0.168$$

$$SB_{in} = 99 / 155 = 0.639$$

$$EB_{out} = 64 / 167 = 0.383$$

$$WB_{out} = 14 / 167 = 0.084$$

$$NB_{out} = 35 / 167 = 0.210$$

$$SB_{out} = 54 / 167 = 0.323$$

The third step will be to calculate the adjustments for the in's and out's, rounding the results to make sure the resulting total adds up to the total change for the in and out:

$$EB_{in} = 0.103 \times 6 = 0.618 = 1$$

$$WB_{in} = 0.090 \times 6 = 0.540 = 0$$

$$EB_{out} = 0.383 \times 6 = 2.298 = 2$$

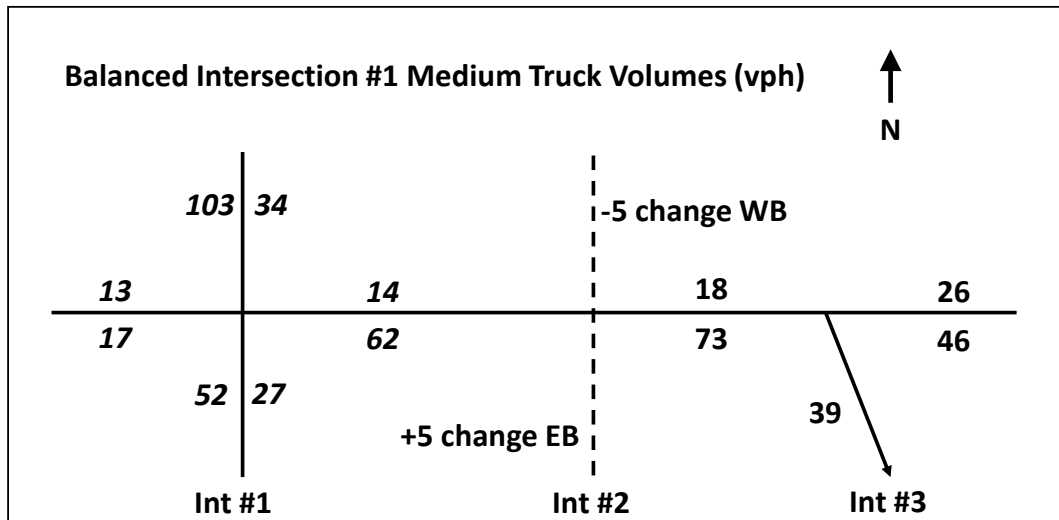
$$WB_{out} = 0.084 \times 6 = 0.504 = 1$$

$$\begin{aligned} \text{NB}_{\text{in}} &= 0.168 \times 6 = 1.008 = 1 \\ \text{SB}_{\text{in}} &= 0.639 \times 6 = 3.834 = 4 \end{aligned}$$

$$\begin{aligned} \text{NB}_{\text{out}} &= 0.210 \times 6 = 1.260 = 1 \\ \text{SB}_{\text{out}} &= 0.323 \times 6 = 1.938 = 2 \end{aligned}$$

The last step will be to calculate the balanced Intersection #1 volumes for each in and out link which are shown as the italicized numbers in the figure below:

$$\begin{aligned} \text{EB}_{\text{in}} &= 16 + 1 = 17 \text{ vph} & \text{EB}_{\text{out}} &= 64 - 2 = 62 \text{ vph} \\ \text{WB}_{\text{in}} &= 14 + 0 = 14 \text{ vph} & \text{WB}_{\text{out}} &= 14 - 1 = 13 \text{ vph} \\ \text{NB}_{\text{in}} &= 26 + 1 = 27 \text{ vph} & \text{NB}_{\text{out}} &= 35 - 1 = 34 \text{ vph} \\ \text{SB}_{\text{in}} &= 99 + 4 = 103 \text{ vph} & \text{SB}_{\text{out}} &= 54 - 2 = 52 \text{ vph} \end{aligned}$$

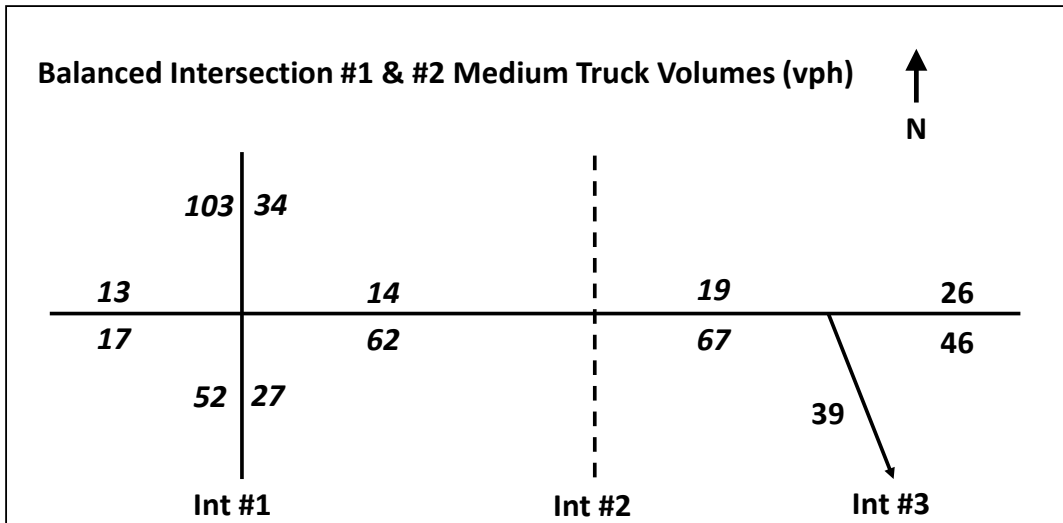


Since Intersection #1 is now balanced, it should be held constant when the adjustments for the Intersection #2 sink/source are done. The balancing at Intersection #1 increased the difference eastbound (i.e. from 9 to 11 vph) but did not affect the westbound difference of 4 vph. It is known from the count at Intersection #2, that the overall change across the intersection adds five vehicles eastbound and subtracts five vehicles westbound. In this case, add the 5 vph difference both to the EB_{out} and the WB_{in} of Intersection #1 to account for the change across Intersection #2:

$$\text{Balanced EB}_{\text{out}} = 62 + 5 = 67 \text{ vph}$$

$$\text{Balanced WB}_{\text{in}} = 14 + 5 = 19 \text{ vph}$$

The resulting Intersection #2 italicized values are shown in the figure below.



The balancing for Intersection #3 is done the same as for Intersection #1, except that the EB_{in} and WB_{out} volumes are held constant.

$$\text{Total In} = 67 + 26 = 93 \text{ vph}$$

$$\text{Total Out} = 46 + 19 + 39 = 104 \text{ vph}$$

$$\text{Difference} = 104 - 93 = 11; \text{ so need to raise in's by 5 and lower out's by 6}$$

Since there are only two inbound legs and one is held constant, all the inbound change is applied to the remaining inbound (WB_{in}), so only outbound proportions are needed. Also, since the WB_{out} is held, its value needs to be subtracted from the total out to determine the split between the remaining outbound links.

Out Proportions:

$$EB_{out} = 46 / 85 = 0.541$$

$$SB_{out} = 39 / 85 = 0.459$$

In/Out Adjustments:

$$EB_{in} = \text{No change}$$

$$WB_{in} = 5$$

$$EB_{out} = 0.541 \times 6 = 3.246 = 3$$

$$WB_{out} = \text{No change}$$

$$SB_{out} = 0.459 \times 6 = 2.754 = 3$$

Resulting balanced volumes shown on figure below in italicized text:

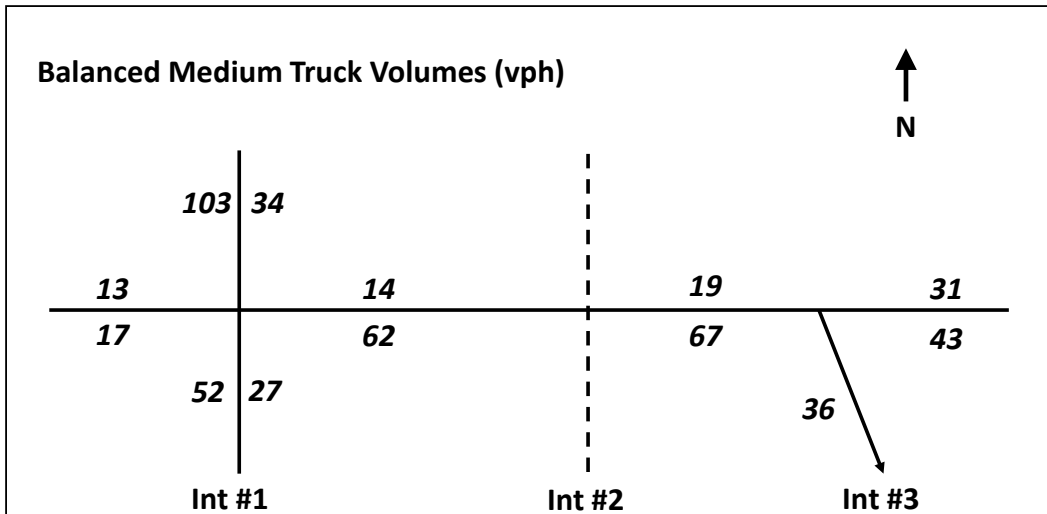
$$EB_{in} = 67 \text{ vph (no change)}$$

$$WB_{in} = 26 + 5 = 31 \text{ vph}$$

$$EB_{out} = 46 - 3 = 43 \text{ vph}$$

$$WB_{out} = 19 \text{ vph (no change)}$$

$$SB_{out} = 39 - 3 = 36 \text{ vph}$$



9. Once the medium peak truck volumes are balanced, enter the values as the final medium truck peak hour volume on the linked vehicle group spreadsheet. These are shown in the second column from the right in Exhibit 16-2 above.
10. Divide the final medium truck peak hour volume by the peak hour volume to obtain the final medium truck peak hour factor. This value should be linked back to the main spreadsheet tab. Following Link 101 in Exhibit 16-2; this would be dividing the final link medium truck volume of 46 vph by the link peak hour total traffic of 1175 vph to come up with the final medium truck peak hour truck factor of 0.039. In this case, the overall volume and factors did not change, as these links were held constant in the balancing process.
11. Repeat Steps 4 through 10 for the other peak hour volume groups: heavy trucks, motorcycles (optional), and buses (optional). Subtract the sum of the volume groups from 100% to obtain the automobile vehicle group percentages.
12. Like Step 4, create a linked table with the headers:
 - Link identifier
 - Link name
 - Peak hour volume
 - Initial peak truck hour volume
 - Initial peak truck hour factor
 - Final peak truck hour volume
 - Final peak truck hour factor

Exhibit 16-3 Example Peak Truck Hour Calculation Table

Link #	Link Name	Final	Initial	Initial	Final	Final
		2011 30HV	2011 Pk Trk Hr	Pk Trk Hr Factor	2011 Pk Trk Hr	Pk Trk Hr Factor
		(vph)	(vph)		(vph)	
1	OB Riley SB - N of OB Redmd	70	70	0.999	70	0.999
2	OB Riley SB - N of Cooley	80	80	0.999	80	0.999
3	OB Riley SB - S of Cooley	90	90	0.999	89	0.989
4	OB Riley SB - N of Empire	145	144	0.990	144	0.993
5	OB Riley SB - S of Empire	170	166	0.979	164	0.965
6	OB Riley NB - S of Empire	170	136	0.799	136	0.800
7	OB Riley NB - N of Empire	165	113	0.682	112	0.679
8	OB Riley NB - S of Cooley	65	61	0.938	63	0.969

13. From each of the counts, obtain the total link volume for the system peak truck hour chosen and enter the initial peak truck hour volume column (4th column from the left in Exhibit 16-3 above). Create a link to the previously calculated peak hour volumes and add those as shown in the 3rd column from left.

14. Create the initial peak hour factor by dividing the initial peak truck hour volumes from Step 13 by the peak hour volumes. If any values equal or exceed 1.000 then cap that link volume factor at 0.999 and readjust the initial peak truck hour volume to match. Note that in Exhibit 16-3 above this calculation would result in an initial factor of 1.000 after dividing the initial peak truck hour volume by the peak hour volume for Links #1 through #3. In this case the peak truck hour volume was the same as the peak hour volume. Links that reflect the actual peak truck hour will likely have volumes that exceed the peak hour volume which will result in overriding the calculation and adjusting volumes. The factor was adjusted from 1.000 to 0.999 but the volumes were small enough that the initial peak truck hour volume did not change.

15. Balance the peak truck hour volumes across the network in a similar fashion to Step 8.

16. Calculate the final peak truck hour factor to check that no values exceed 0.999. Modify the balanced volumes as needed until all factors are 0.999 or less. Note that in Exhibit 16-3 above, Link #1 and #2 needed the final peak truck hour factor calculation overridden back to 0.999, but that Link #3 had a slight balancing change which dropped the final factor to 0.989 which does not require adjusting.

17. Similar to Step 4 and Exhibit 16-2, create a linked table with the headers:

- Link identifier
- Link name
- Peak truck hour volume
- Initial medium truck peak truck hour factor

- Initial medium truck peak truck hour volume
- Final medium truck peak truck hour volume
- Final medium truck peak truck hour factor

This next set of calculations from this step through Step 20 repeats the medium and heavy truck factors (and any optional classifications) and volumes but this time for the truck peak hour.

18. Like what was done in Step 5, compute the initial medium truck peak truck hour factor by dividing the number of medium trucks in the truck peak hour by the peak truck hour volume computed in Step 16.
19. Repeat Steps 6 through 10 but for the medium trucks in the peak truck hour.
20. Repeat Steps 4 through 10 for the other peak truck hour volume groups: heavy trucks, motorcycles (optional), and buses (optional). Subtract the sum of the volume groups from 100% to obtain the automobile vehicle group percentages.
21. Check the final values for any errors by reviewing the number of buses (if used) and medium and heavy trucks in the peak truck hour to see if the values exceed the values in the peak hour. If not, the factors and volumes will need to be adjusted. Many times this may be caused by rounding errors. Typically, this will only be a few vehicle difference. With linked spreadsheets these changes are easily done and should reflect the final corrected values on the main tab.
22. Once all the vehicle group percentages are complete for both the peak hour and peak truck hour, compare the peak hour and the peak truck hour volumes with the LOS C volumes. Any volumes that exceed the LOS C volumes need to be capped at the LOS C volume. This means that any volume (that represents near, at, or over capacity conditions will likely require capping. Note that this capping process will result in volumes that will no longer balance with adjacent links, which is acceptable since the link network was completely balanced before this step.

The highlighted peak hour volumes shown in Exhibit 16-4 below are all higher than the corresponding LOS C volumes. These would all have to be reduced to be equal to the LOS C volumes as these represent the maximum volume that can be accommodated at LOS C. For example, for Link #27, the 2011 30th highest hour volume of 1010 vph would need to be reduced to 1000 vph for the existing conditions and the 2036 DHV of 1560 vph would need also need to be reduced to 1000 vph for the upcoming similar steps for the future no-build.

Exhibit 16-4 Volume Capping

Link #	Link Name	2011	2016	2036	2011 30HV	2016 DHV	2036 DHV
		LOS C Volume (vph)	LOS C Volume (vph)	LOS C Volume (vph)			
25	3rd St (US20) NB - N of Empire	1200	1200	1200	535	590	855
26	US20 NB - One-way Conn	1000	1000	1000	540	595	870
27	US20 NB - One-way Conn	1000	1000	1000	1010	1115	1560
28	US20 NB - S of Robal	1043	1209	1249	1075	1190	1655
29	US20 NB - S of Cooley	1600	1600	830	935	1045	1475
30	US20 NB - S of Mountainview	1600	1600	1600	1035	1165	1625
31	US20 NB - S of OB Red	1600	1600	1600	1015	1145	1605
32	US20 NB - N of OB Red	1600	1600	1600	820	905	1195

23. Any capped peak hour or peak truck hour volumes need to have the vehicle group percentages modified to reflect the reduced volumes. Reduce the individual volumes and factors so that the total volume of the vehicle sub-groups equals the reduced total peak hour or peak truck hour volume and that the percentages still add up to 100%.

The highlighted columns in Exhibit 16-5 show the 2036 DHV that needs to be capped based on the LOS C volume column to the left and the affected medium and heavy truck peak hour volumes. The auto volumes are just the total link DHV minus the sum of the heavy and medium trucks. Exhibit 16-6 shows the result of the capped DHV and its effects on the medium and heavy peak hour truck volumes. Note that the sum of the auto + medium truck + heavy truck equals the capped DHV.

Exhibit 16-5 Volume Adjustments Before LOS C Capping

Link #	Link Name	2036	2036 DHV	Final	2036	Final	2036	2036
		LOS C Volume (vph)		Pk Hr Med Trk Factor	Final Pk Hr Med Trk Volume (vph)	Final Pk Hr Hvy Trk Volume (vph)	Final Pk Hr Auto Volume (vph)	
27	US20 NB - One-way Conn	1000	1560	0.055	86	0.034	53	1421
28	US20 NB - S of Robal	1249	1655	0.056	92	0.033	55	1507
29	US20 NB - S of Cooley	830	1475	0.056	82	0.034	50	1342
30	US20 NB - S of Mountainview	1600	1625	0.054	88	0.050	82	1455
31	US20 NB - S of OB Red	1600	1605	0.052	84	0.054	87	1434
32	US20 NB - N of OB Red	1600	1195	0.049	58	0.068	82	1055
35	US97 SB - N of Bowery	3022	1705	0.048	83	0.054	92	1530
36	US97 SB - S of Bowery	3022	1715	0.048	83	0.054	92	1540

Exhibit 16-6 Volume Adjustments After LOS C Capping

Link #	Link Name	2036	Capped	Final	2036	Final	2036	2036
		LOS C	2036 DHV	Pk Hr	Final	Pk Hr	Final	Final
		Volume		Med Trk	Med Trk	Hvy Trk	Hvy Trk	Auto
		(vph)	(vph)	Factor	Volume	Factor	Volume	Volume
					(vph)		(vph)	(vph)
27	US20 NB - One-way Conn	1000	1000	0.055	55	0.034	34	911
28	US20 NB - S of Robal	1250	1250	0.056	70	0.033	42	1138
29	US20 NB - S of Cooley	830	830	0.056	46	0.034	28	755
30	US20 NB - S of Mountainview	1600	1600	0.054	87	0.050	80	1433
31	US20 NB - S of OB Red	1600	1600	0.052	84	0.054	87	1430
32	US20 NB - N of OB Red	1600	1195	0.049	58	0.068	82	1055
35	US97 SB - N of Bowery	3022	1705	0.048	83	0.054	92	1530
36	US97 SB - S of Bowery	3022	1715	0.048	83	0.054	92	1540

16.3.4 Process – Future No-build

The process to complete the noise traffic data for the future no-build is done in a similar manner to the existing conditions but relies on the data relationships within the existing conditions rather than going back to the actual raw counts. This is why it is important to completely finish and check the existing conditions before starting on the future no-build.

1. Use the same spreadsheet layout as the existing conditions, either in a separate workbook or set of separate tabs.
2. Link ID's, length, type and speeds are the same as the existing conditions
3. A new set of LOS C volumes is needed using the future no-build volumes.
4. Convert the future no-build volumes to a directional link basis.
5. Create the same linked tables for each of the vehicle groups for the peak hour and peak truck hour conditions except automobiles.
6. The initial factors for the peak hour vehicle groups start with the final factors from the existing conditions. These are used to develop the initial volumes for the future no-build which are then balanced by comparing the ins and outs at each intersection and used to modify the factors to reflect the future conditions. Sink/source locations should be consistent with the drop or increase of the existing conditions with the appropriate growth to the future.
7. The initial peak truck hour volumes are created by multiplying the directional link future no-build volumes by the final peak truck hour volume factor from the existing conditions. These volumes are then balanced across the network consistent with how it was done in earlier steps. Once balanced, create an updated peak truck hour factor by dividing the final peak truck hour volumes by the future

- no-build peak hour volumes to make sure that no values exceed 0.999. If so, then readjust the factor and rebalance volumes until the 0.999 criteria is satisfied.
8. Create all the peak truck hour volumes and factors by using the existing year final factors as the initials as done in Step 6.
 9. Check the bus, medium truck, and heavy truck peak truck hour volumes to see if they exceed the values in the peak hour. If not, then adjust factors and volumes until they do. Also, review all the volumes to make sure that the future no-build volumes exceed (or at least equal for no growth areas) the existing condition volumes.
 10. Compare the future no-build peak hours and peak truck hour volumes with the future no-build LOS C volumes and cap off any that exceed. Any capped values need to have the vehicle group percentages/volumes adjusted to match the lower values.

16.3.5 Process – Future Build

The future build data is based off a pivot from the future no-build data. If the build alignment is the same (same link network) with differing number of lanes and/or traffic control, then the build data is done similar to the future no-build. Differences will be mainly in the LOS C volumes, so creation of the future build data will be very quick as the volumes and factors will be the same other than different (likely less) instances of where volumes are capped.

If the build design year volume is different from the no-build because of latent demand issues stemming from pent-up congestion, then the hourly volumes will change, and the process will be same as doing the future no-build. In this case, use the final factors from the no-build future to create the initial future build factors and follow the future no-build process.

The challenge with the future build data is when the build alignment or network layout is different from the no-build alignment as the relationships between links is muddled. The peak hour volumes would have already been re-distributed onto the build network for the project analysis. The analyst will need to figure out separately the routing of the vehicle groups (i.e. heavy trucks) if they do not follow the same patterns as the peak hour.

The process will be generally the same as for the no-build future starting with the no-build volumes factors to create initial volumes to be balanced. The balancing may be more substantial with larger changes in the factors than what was done with the future no-build. LOS C volumes will need to be re-done for the build volumes. The checks such as the 0.999 peak truck hour factor and “Do the peak hour trucks exceed the peak hour trucks” are very important when checking the build conditions.

16.3.6 Final Product Submittal

When all the data for the applicable analysis scenarios has been entered for each link, all errors have been fixed, the data is ready to be submitted to the contractor noise staff and the Environmental Section. Copies of the work should always be submitted to the ODOT noise staff in the Environmental Section for their records as they may be directly reviewing the noise outputs or at least the recommendations from the noise analysis. The entire noise workbook can be sent for documentation or just a copy of the values in the first (front) tab. Exhibit 16-7 shows part of the final link data table (this table is 27 columns wide). Make sure that the corresponding link diagrams are also included on a tab or in a separate document.

Exhibit 16-7: (Partial Table) Example Link Data

Link #	Link Name	BMP	EMP	Posted Speed (mph)	Link Length (mi)	No Build		Build V3		2017 NoBuild		2017 NoBuild		2017 NoBuild		
						2017 DHV	2041 DHV	2041 DHV	2041 DHV	Peak Hr Auto	Peak Hr Med	Peak Hr Hvy	Peak Track Hr Auto	Peak Track Hr Med	Peak Track Hr Hvy	
101	Beg Proj - 004CQ (SB)	152.57	152.82	65	0.25	1175	1850	1850	1030	46	33					463
102	004CQ - 004CT (SB)	152.82	153.40	65	0.58	760	1080	1080	706	21	33					467
103	004CT - Rdwy 2 meets (SB)	153.40	153.67	65	0.27	820	1165	1165	760	26	34					506
104	Rdwy2 meets - N Uturn (SB)	153.67	154.75	65	1.08	820	1165	1165	760	26	34					506
105	N Uturn - Vandevort Rd (SB)	154.75	155.50	65	0.75	820	1165	1205	780	26	34					508
106	Vandevort Rd - Rdwy2 meets (SB)	155.50	155.89	65	0.39	695	960	1040	640	20	35					446
107	Rdwy2 meets - S Uturn (SB)	155.89	156.17	65	0.28	695	960	1040	640	20	35					446
108	S Uturn - 4 lanes (SB)	156.17	157.73	65	1.56	635	960	960	640	20	35					446
109	4 lanes - Sugarpine Butte (SB)	157.73	158.57	65	0.84	635	960	960	640	20	35					446
110	Sugarpine Butte - 2 lanes (SB)	158.57	158.78	65	0.21	635	960	960	640	20	35					446
111	2 lanes - USFS Boundary (SB)	158.78	159.11	65	0.33	635	960	960	640	20	35					446
112	USFS Boundary to end of project (SB)	159.11	159.61	65	0.50	635	960	960	640	20	35					446
201	Beg Proj - 004CV (NB)	152.57	152.82	65	0.25	835	1330	1330	783	62	50					819
202	004CV - 004CU (NB)	152.82	153.33	65	0.51	560	760	760	483	26	45					525
203	004CT - Rdwy 2 meets (NB)	153.33	153.67	65	0.34	610	840	840	537	28	45					543
204	Rdwy2 meets - N Uturn (NB)	153.67	154.75	65	1.08	610	840	840	537	28	45					543
205	N Uturn - Vandevort Rd (NB)	154.75	155.50	65	0.75	610	840	880	537	28	45					543
206	Vandevort Rd - Rdwy2 meets (NB)	155.50	155.89	65	0.39	585	800	880	514	27	44					486
207	Rdwy2 meets - S Uturn (NB)	155.89	156.17	65	0.28	585	800	880	514	27	44					486
208	S Uturn - 4 lanes (NB)	156.17	157.73	65	1.56	585	800	800	514	27	44					486
209	4 lanes - Sugarpine Butte (NB)	157.73	158.57	65	0.84	585	800	800	514	27	44					486
210	Sugarpine Butte - 2 lanes (NB)	158.57	158.78	65	0.21	585	800	800	514	27	44					486
211	2 lanes - USFS Boundary (NB)	158.78	159.11	65	0.33	585	800	800	514	27	44					486
212	USFS Boundary to end of project (NB)	159.11	159.61	65	0.50	585	800	800	514	27	44					486

It generally is more efficient for project flow if the traffic data scenarios are sent off as they are completed so the noise staff can complete their calibration work rather than waiting until everything is completed. Many times the existing conditions and future no-build scenarios can be done relatively early in the project analysis, while the future build needs to wait until the preferred alternative(s) is chosen and all roadway design modifications are frozen a.k.a “pens down.”

APPENDICES

[Appendix 16A – Noise Traffic Data Request Form](#)

[Appendix 16B – Air Quality Traffic Data Request Form](#)