# 5 DEVELOPING EXISTING YEAR VOLUMES

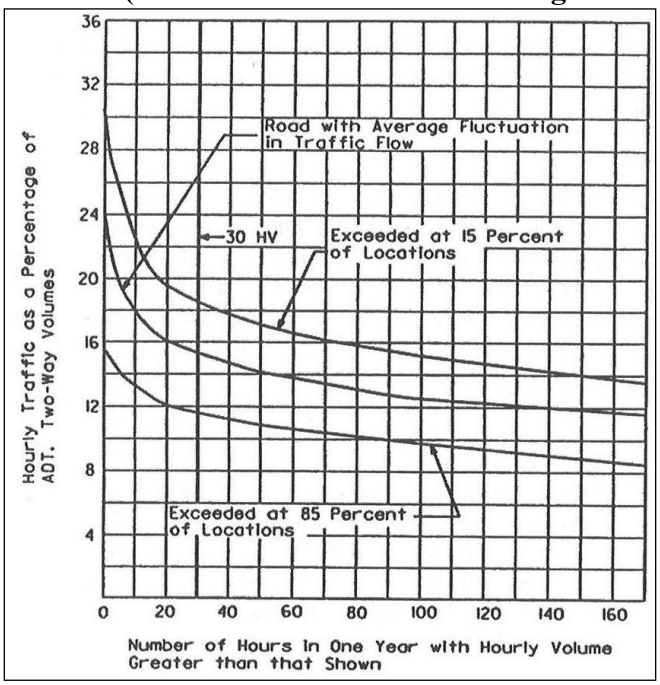
## 5.1 Purpose

Traffic counts alone should not be used for design or operational analysis of projects. This chapter will outline procedures for developing 30th highest hour volumes (30HV) and average daily traffic volumes (ADT) for planning and project level analysis. Existing and count-level data is also needed to support other volume –related analysis inputs such as peak hour factors and truck percentages. This chapter also provides the basis for developing the future volumes shown in Chapter 6.

## 5.2 30th Highest Hour Volumes

For most traffic studies, the 30th highest hour volumes (30HV) should be used to represent existing and future volumes. Future volumes are often referred to as Design Hour Volumes (DHV). The 30HV is the target hour based on the concept that designs are not done to the absolute highest hour of the entire year, but to design to meet most of the needs. Plotting an entire year's hourly volume data ranked from highest to lowest at a specific point will yield a flow curve. The break point between the steep and shallow regions of the curve is typically located at the 30th highest hourly volume as illustrated in the Exhibit 5-1below. Alternatives are generally analyzed at the 30HV to be consistent with accepted analysis methods and comparisons.

**Exhibit 5-1 Relation between Peak-Hour and Average Daily Traffic Volumes on Rural Arterials (2011 AASHTO Green Book Figure 2-28)**




The overall process for developing the 30HV is as follows:

1. Document raw count volumes, types and durations (see Section 5.5.3).
2. Identify a system peak hour (see Section 5.3).
3. Calculate seasonal adjustments; bring counts to a common month (see Section 5.4).
4. Calculate historical adjustments; bring counts to a common year (see Section 5.5).
5. Balance the 30HV across the network (see Section 5.5.1)
6. Round the 30HV (see Section 5.5.2)
7. Document on figures the 30HV process (see Section 5.5.3)

The peak hour from a manual count is converted to the 30HV by applying a seasonal factor. The 30HV is then used for design and analysis purposes. Experience has shown that the 30HV in large urban areas usually occurs on an afternoon on a weekday during the peak month of the year. The Metropolitan Planning Organization's (MPO) of Metro, Salem and Eugene are large enough that the average weekday peak hour approximates the 30HV. Smaller MPO's such as Corvallis and Medford do not have the steady flow throughout the year and the 30HV is concentrated into peak periods of the year. For the Bend MPO, the average weekday peak hour 30HV approximation is limited to commuter-flow dominated high volume arterials such as US97; other areas are subject to normal seasonal fluctuations. The 30HV for an urban area typically ranges from 9- to 12-percent of the Average Annual Daily Traffic (AADT). For a recreational route, the 30HV usually occurs on a summer weekend and ranges from 11- to 25-percent of the AADT.

It is recommended a top 200- to 500-hour count listing of the Automatic Traffic Recorders (ATR) is obtained from the Transportation Systems Monitoring Unit. The 30HV at the ATR(s) will be included in the list so that it will be possible to determine approximately when the 30HV

occurs during the day and in the week. Since the actual 30HV determination is based off of at least the previous year's (ideally at least three years) data, the actual time and day when it occurs for the base year cannot be determined. Manual counts can then be timed for the period when the 30HV will likely occur, minimizing seasonal adjustments.

## 5.3 System Peak Hour Selection

Daily traffic volumes, while useful for planning purposes, cannot alone be used for design or operational analysis purposes. Once all of the traffic counts have been obtained, the intersection counts should be adjusted to a single system peak hour. The peak hour is the single hour of the day that has the highest hourly volume. Use of the 15-minute breakdowns in the traffic counts is necessary in order to determine the true peak hour, resulting in a time period such as 4:00 PM to 5:00 PM or, just as easily, 4:45 PM to 5:45 PM. The final selection of a peak hour may be based on a simple majority of counts that have the same peak hour, using a controlling intersection, or the count(s) that the analyst believes are the most accurate. Counts that have longer durations or that are taken close to the 30HV are generally more accurate. A procedure using TruckSum to determine the system peak hour volumes and other factors when the count peak hour is different from the system peak hour is provided in Chapter 11 of APM Version 1.

Generally PM peak hour volumes are higher than AM peak hour volumes. In areas where there are large industries with shift changes, the hour during the shift change may be as high as or higher than the PM peak hour for the remainder of the transportation network. If this is true, another set of volumes should be developed. Volumes for the non-standard peak hour should be developed along with the PM peak hour volumes so that all of the volumes may be analyzed at a later date. Multiple sets of volumes may be necessary in these circumstances, which may include areas of heavy industrial, retail or recreational uses; coastal routes; or on routes with highly directional commuter flows.

## 5.4 Seasonal Factors

Since manual counts are taken throughout the year, data derived from a count taken in a particular month may need to be converted to the peak month by applying a seasonal factor. The Highway Capacity Manual 2010 Chapter 3 has background information on variations in traffic flow. Seasonal factors can be created using data collected from the ODOT ATR stations.

As of November 2013, there are 177 active ATR stations and 6 proposed ATR sites throughout the State Highway System. Most of these locations have loops in the roadway that count traffic flows for 24 hours a day, 365 days a year, and many have been in operation for many years. In addition, some ATR sites have been replaced with Automatic Vehicle Classifiers (AVC) which classifies vehicles continually in addition to counting. As of the date mentioned, there are 18 AVC sites throughout the system. In the future, it may be possible to create seasonal factors for freight movements using data from the AVCs. ATR information is available from the ODOT Transportation (Traffic) Volume Tables (TVT) located on the TDD Transportation Data Traffic Counting Program web site, as well as the ATR Characteristic Table and the Seasonal Trend

Table located on the Transportation Analysis webpage of the TDD Planning Section website.

Localized seasonal factors could be derived from other sources of data such as the PORTAL system on the Portland area-freeways and from the 170/2070 traffic signal controller downloads for local non-state streets.

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.

- On-Site ATR Method
- ATR Characteristic Table Method
- ATR Seasonal Trend Table Method

The On-Site ATR Method is the best and most accurate method to use, followed by the ATR Characteristic Table Method and then the ATR Trend Table Method. All of the seasonal adjustment tables and ATR information are updated annually.

Seasonal factors greater than 30% should be avoided. Factors such as these indicate that a count was NOT taken at or close to the time that the 30HV occurs. Using a winter count with a high seasonal factor to represent the peak summer period will likely not represent traffic turning movements accurately, as driving patterns change in the winter compared to the summer. If alternate periods are used other than the typical summer like what would be used for an alternate mobility standard, then counts need to be taken in those alternate periods so resulting seasonal factors do not exceed 30%. As an example, suppose a count was taken at a rural intersection in the winter months with one of the minor legs of the intersection serving a campground beyond the intersection. The turning volume in the direction of the campground may be small or non-existent; say 5 vph. Even with a seasonal factor of 50%, this would result in an adjusted volume of only 8 vph, compared to an actual summer 30HV that may be 20 vph. Simply factoring for the season would still leave the turning movements too low.

### 5.4.1 On-Site ATR Method

The On-Site ATR Method is used when an ATR is within or near the project area. If located outside of the project area, there should be no major intersections between the ATR and the project area, and it should be within a minimal distance so that the traffic characteristics such as road class, number of lanes, rural/urban area, etc., are comparable. It is also important to check that the project area's AADT in the Transportation Volume Table is within +/- 10% of the ATRs AADT.

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.

**Example 5-1 Seasonal Factor – On-Site ATR**

On-Site ATR in Project Area

A traffic count was taken June 15th–18th along Kings Valley Highway No. 191 (OR 223) at MP 28.00.

- **Step 1: Transportation Volume Table** - ATR 02-005, located on Kings Valley Highway at MP 26.40, can be used.
- **Step 2: Check ATR Characteristic Table** weekly traffic trend column to identify whether to use the ADT or AWDT for seasonal factor. In this case, the Characteristic Table identifies this as a Weekend ATR; therefore the ADT column is used.
- **Step 3: ATR Trend Summary** - The ATR number corresponds to a table in the last half of the TVT that contains yearly summaries for each ATR. Since the Average Daily percentages are much higher than the average weekday, select a value from the column titled "Average Daily Traffic/Percent of ADT." Both the count month and the peak month percentage of ADT should be recorded. This information should be obtained from the ATR Summaries in the TVT's for the past five years. The peak month is the month with the highest percentage. The highest and lowest percentages should be eliminated to account for construction activity that may have occurred in the vicinity of the ATRs during the five year period. An average percent of ADT is then calculated for the remaining three years. The percentages shown in the TVT represent the 15th day of the month, so interpolation is needed if the count was taken near the beginning or end of a month.

**Seasonal Adjustment Using ATR #02-005**

| | 2012 | 2011 | 2010† | 2009 | 2008 |
|---|---|---|---|---|---|
| Peak Month (September) | 115% | 119% | 124% | 121% | 126% |
| Count Month (June) | 104% | 104% | 103% | 106% | 106% |

† – Sometimes the Peak Month may vary between months, depending on the year. As in this case, 4 of the 5 Peak Months were in September. Therefore, you assume September is the Peak Month for every year of ATR data used.

As shown above, the percentage of ADT values listed during June and September for the past five years are reviewed to calculate the average. The highest and lowest values, shown as shaded, are dropped from this calculation. The average monthly factors are determined as follows:

- The average peak month (September) is: (121%+124%+119%) / 3 = 121%.
- The average count month (June) is: (106%+104%+104%) / 3 = 105%.
- The seasonal adjustment is September/June = 121% / 105% = 1.15.

Therefore, traffic volumes in the month of September are 1.15 times greater than in June. To convert the June traffic data to the 30HV:

30HV = (June PHV) x (Peak Month Percent of ADT/Count Month Percent of ADT).

If one of the peak hour turning movement volumes was 75 vph in June, then the 30HV for September would be 1.15 x 75 vph = 91 vph.

---

When there are two or more ATR's within the project area use the following guidance to determine the appropriate seasonal adjustment:

Scenario # 1: The project area has two ATR's one at each end. The project area ADT, roadway characteristics and roadway functional class are the same as at both ATR's. In order to seasonally factor the peak hour volumes within the project area, an average of the two ATR seasonal factors recommended.

Scenario # 2: The project area has two ATR's on the same highway within the project area but have a major roadway between them. The roadway has different characteristics on each side of the major intersecting roadway. With this scenario, each side should be seasonally factored using the ATR on that side.

Scenario # 3: The project area has two (or more) ATR's located on different roadways. If the roadway has the same characteristics as the ATR then use that one, if not average the ATR's. NOTE: If the ATR's report dramatically different roadways (i.e. freeways and local streets), then they should not be averaged together.

### 5.4.2 ATR Characteristic Table Method

The ATR Characteristic Table provides general characteristics for each ATR in Oregon, and should be used when there is not an ATR on-site. The Characteristic Table is a filterable Excel table that will often provide more than one ATR with similar characteristics. To use the table, filter through the column characteristics from left to right to create a list of ATRs with similar characteristics. See example in Exhibit 5-2 which is an excerpt of the Summer<2500 trend.

Averaging multiple ATRs with similar characteristics will yield a more appropriate factor than if only one ATR is used. Follow the steps described in the on-site ATR Method for averaging count and peak months over 5 years for each ATR with similar characteristics. The factor used to convert the traffic data to 30HV will be an average of these similar characteristic ATR factors. Seasonal Traffic Trend groupings for the table were constructed by plotting the monthly percent of AADT for each ATR. The plots were then grouped into trends with the greatest influence in traffic patterns.

**Exhibit 5-2 ATR Characteristic Table Example**

| 2013 ATR Characteristic Table | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Seasonal Traffic Trend** | **Area Type** | **# of Lanes** | **Weekly Traffic Trend** | **2012AADT** | **OHP Classification** | **ATR** | **County** | **Highway Route, Name, Location** | **MP** | **State Highway Number** |
| Summer < 2500 | Rural | 2 | Weekday | 790 | District Highway | 01-001 | Baker | US 30, La Grand | 37.70 | 66 |
| Summer < 2500 | Rural | 2 | Weekday | 210 | District Highway | 01-007 | Baker | OR 203, Medical | 36.86 | 340 |
| Summer < 2500 | Rural | 2 | Weekend | 390 | District Highway | 13-005 | Harney | OR 205, Frenchglen | 0.01 | 440 |

It is important to note that the trends provided in the table are not the only trends attributed to each ATR, but are the dominant trends. Over time, some ATRs may shift trend categories which are mainly the Summer/Summer<2500 and Recreational Summer/Summer<2500 which are typically small changes. Typically, ATR characteristics stay constant from year to year. After the seasonal traffic trend characteristic is selected, other trend groupings, including area type (e.g., urban, rural), number of lanes and weekly traffic trends are broken down to provide more comparable sub-groupings.

ATRs are characterized by only one of eleven seasonal trends, described below and illustrated in Exhibit 5-3. Project areas should be characterized by these trends in the order listed below.

1. **Interstate Urbanized**: ATRs located on any section of urbanized (areas of population > 50,000).interstate. (Example: I-5, Iowa Street - ATR #26-016.)
2. **Interstate Non-Urbanized**: ATRs located on any non-urbanized interstate section. (Example: I-84, west of Troutdale - ATR #26-001.)
3. **Commuter**: ATRs characterized by small seasonal changes in traffic patterns and commuting between city pairs. (Example: OR 22, West Salem Bridges - ATR #24-014.)
4. **Coastal Destination**: ATRs characterized by summer peaks to/or within larger coastal city destinations as well as favorable routes from the valley. Favorable routes for Coastal Destinations include: Salmon River Highway (OR 18), Corvallis-Newport Highway (US 20/OR 34), Alsea Highway (OR 34), and Florence-Eugene Highway (OR 126). (Example: OR 18, east of Valley Junction - ATR #27-001.) Note: This grouping does not include the Sunset Highway.
5. **Coastal Destination Route**: ATRs characterized by high summer peaks on predominantly rural routes to/or between large coastal cities and coastal destinations. Rural routes include the Sunset Highway (US 26) from the Wilson River Hwy. junction, Umpqua Highway (OR 38), and Redwood Highway (OR 199). (Example: US 101, south of Rockaway - ATR #29-001.)
6. **Agriculture**: ATRs characterized by peaking in the late summer and fall harvest months. (Example: Kings Valley Highway - ATR #02-005.)
7. **Recreational Summer**: ATRs characterized by high summer peaks in recreational areas. (Example: Crater Lake Highway, south of Fort Klamath - ATR #18-021.)
8. **Recreational Summer/Winter**: ATRs characterized by both summer and winter peaks in recreational areas. (Example: Timberline Highway - ATR #03-008.)
9. **Recreational Winter**: ATRs characterized by high winter peaks in recreational areas. (Example:OR35, Mt Hood Highway – ATR #03-007)

If the project area trend does not fall into Trends 1 through 9, either Trend 10 or 11 should be used.

10. **Summer**: ATRs characterized by a smaller summer increase in traffic patterns when compared to Recreational Summer. (Example: US 26, south of Warm Springs - ATR #16-006.)
11. **Summer < 2,500 ADT**: ATRs with less than 2,500 ADT characterized by a smaller summer increase in traffic patterns when compared to Recreational Summer. (Example: OR36, Mapleton-Junction City Highway - ATR #20-004)

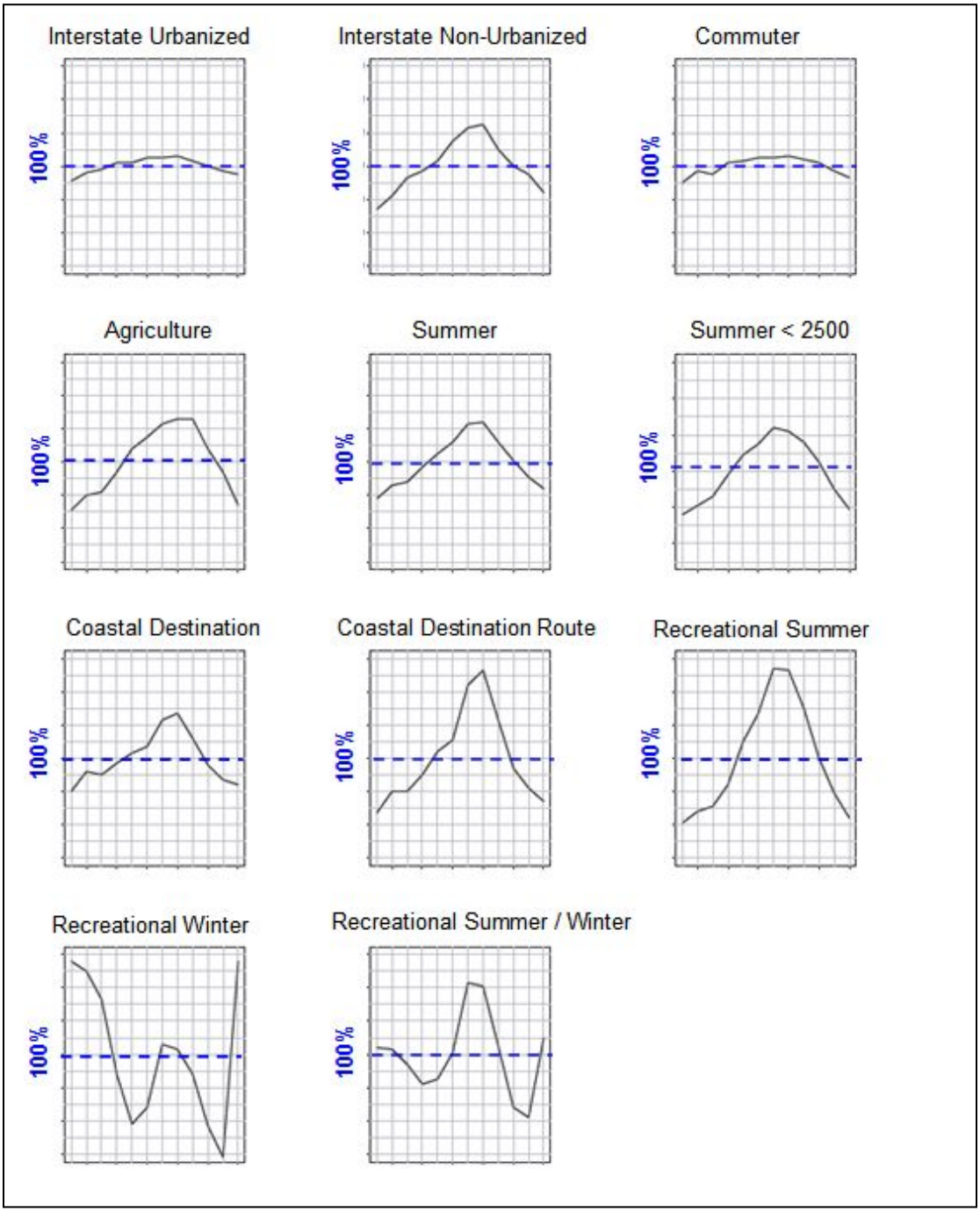
### 5.4.3 Non-State and other Roadway Trends

Many of the state highways mimic characteristics on rural county roads and urban streets. Some of the ATR Characteristic trends can be used to approximate seasonal factors on non-state highway approaches.

- Commuter: Non-state streets in urbanized cities (Example: US20/OR99E, Albany Junction City Highway - ATR # 22-022)
- Summer: Non-state streets in small cities (Example: OR42, Coos Bay Roseburg Highway - ATR #10-006)
- Summer<2,500 ADT: Rural off-system county roads. (Example: OR36, Mapleton-Junction City Highway - ATR #20-004)

Interchange ramps mix characteristics of the mainline freeway and the intersecting cross-roads, so seasonal factors for ramps should be created by averaging mainline and cross-road factors. State frontage roadways should use the applicable seasonal trend other than Interstate, or the bulleted list above.

**Exhibit 5-3 Seasonal Trends**



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

- **Weekday:** Day of the week when the 30HV occurs; typical occurs on weekdays (Monday through Thursday) for commuter trend and urban areas.
- **Weekend:** Day of the week when the 30HV occurs; typical occurs on weekends (Friday through Sunday) for recreational trend and coastal destination trend.

ATRs are also characterized by area type and number of lanes.

- **Urbanized:** ATRs within areas of population > 50,000. (Examples: Portland and Salem) Urban Fringe: ATRs influenced by an urban area, such as an MPO area. (Example: Wilsonville)
- **Small Urban:** ATRs within areas of population between 5,000 and 49,999. (Examples: Albany and Pendleton)
- **Small Urban Fringe:** ATRs influenced by a small urban area. (Examples: US 101 south of Coos Bay and I-5 north of Albany)
- **Rural:** ATRs on routes outside of areas with population <5,000.
- **Rural Populated:** ATRs in cities with a population of less than 5,000. This also includes unincorporated communities. (Examples: Sisters and Tillamook)

To use the table, filter through the column characteristics from left to right to create a list of ATRs with similar characteristics. The table **must** be filtered starting on the far left otherwise, the groupings at the end will not be correct. Starting with the "Seasonal Traffic Trend" column, filter out the traffic trend that best describes the project area. Next, filter the area type, number of lanes, and weekly traffic trend. Make sure that the section of highway where the ATR(s) is located and the project area for which the seasonal adjustments are being made have similar traffic characteristics. To be considered comparable, the AADT of the characteristic ATR should be within +/- 10% of the Transportation Volume Table AADT for the project area.

**Example 5-2 Seasonal Factor – ATR Characteristics Table**

ATR Characteristic Table Method for a Project Area

A count was taken June 15th–18th along Corvallis-Lebanon Highway No. 210 (OR 34), west of I-5 at MP 9.75. The 2012 Transportation Volume Table AADT is 24,900.

- **Step 1: Transportation Volume Table**: There are no ATRs on this section of the highway.
- **Step 2: ATR Characteristic Table**: This section of highway can be categorized as Commuter/Small Urban Fringe/Five-Lanes/Weekday. Filtering through the ATR Characteristic Table from left to right, two ATRs have similar characteristics to the project area. However, ATR 31-003 has an AADT of 11,300; as previously noted, characteristic AADT counts should be within +/- 10% of the Transportation Volume Table AADT in order to be considered comparable to the project area. Alternatively, ATR 09-020 has identical field conditions to the project site and has an AADT of 26,300, which is within 10% of the TVT AADT. The characteristics of these two representative

locations are summarized below.

**Example ATR Characteristic Table (Year 2013)**

| Characteristics | ATR Location 1 | ATR Location 2 |
|---|---|---|
| Seasonal Traffic Trend | Commuter | Commuter |
| Area Type | Small Urban Fringe | Small Urban Fringe |
| Number of Lanes | 5 | 5 |
| Weekly Traffic Trend | Weekday | Weekday |
| 2010 ADT | 11,300 | 26,300 |
| OHP Classification | Statewide Hwy | Statewide Hwy |
| ATR | 31-003 | 09-020 |
| County | Union | Deschutes |
| Highway Route, Name and Location | OR82, Wallowa Lake Hwy | US97, The Dalles-CA Hwy |
| ATR Milepoint | 1.74 | 124.40 |
| State Hwy Number | 10 | 4 |

**Step 3: ATR Trend Summary**: Data from ATR #09-020 is located in the ATR summary in the back of the TVT and under the "ATR Trend Summaries" on ODOT's Traffic Counter Program website TDD Transportation Data Traffic Counting Program. The count was taken on June 15th, which is in the middle of the month, so the ATR percentages from the TVT can be used directly without interpolation. The peak month was found to be August for two of the three years.

**Seasonal Adjustment Using ATR #09-020**

| | 2012 | 2011 | 2010 | 2009 | 2008 |
|---|---|---|---|---|---|
| Peak Month (August) | 113% | 111% | 110% | 108% | 107% |
| Count Month (June) | 109% | 107% | 108% | 108% | 107% |

- The average peak month (August) is: (111%+110%+108%) / 3 = 109%.
- The average count month (June) is: (107%+108%+108%) /3 = 108%.
- The seasonal adjustment is August/June = 109% / 108% = 1.01.

Therefore, traffic volumes in the month of August are 1.01 times greater than in June. To convert the June traffic data to the 30 HV: 30 HV = (June PHV) x (Peak Month Percent of ADT / Count Month Percent of ADT).

If one of the peak hour turning movement volumes were 100 vph in June, then the 30 HV for August would be 1.02 x 100 vph = 101 vph.

### 5.4.4 Seasonal Trend Method

The seasonal trend table is used when there is not an ATR nearby or in a representative area. The Seasonal Trend Table was constructed by averaging seasonal trend groupings from the ATR Characteristic Table and is based on ADT. Essentially, by using a factor from the table, the average for the entire trend grouping is applied to the project area as shown in Exhibit 5-4.

**Exhibit 5-4 Example ATR Seasonal Trend Table (Year 2013)**

| | Jan 1 | Jan 15 | Feb 1 | Feb 15 | Dec 15 | Peak Period Seasonal Factor |
|---|---|---|---|---|---|---|
| Recreation Summer/Winter | 1.0783 | 0.9668 | 0.9719 | 0.9771 | 0.9091 | 0.7038 |
| Recreation Winter | 0.7454 | 0.6408 | 0.6536 | 0.6663 | 0.6398 | 0.6398 |

To determine the appropriate seasonal trend, select from the list the trend that best describes the project area. The seasonal trends have been placed graphically on an ATR Characteristic Trend Map for ease of reference. Trends should be characterized in the same order as previously described in the ATR Characteristic Table Method. The Seasonal Factor Table is updated yearly. It is not necessary to average five years' worth of seasonal factors for this method, or compare AADTs because, as previously stated, this method uses an average of all ATRs in the characteristic trend. In certain areas, averaging seasonal trends may yield a more appropriate factor than just a single trend. These areas include:

- **Coastal Destination and Coastal Destination Route Trends:** It may be necessary to average trends in areas such as Warrenton, Depoe Bay and Yachats. While these cities are destinations along the Oregon Coast, they do not have the summer influx of traffic associated with larger coastal destinations such as Lincoln City and Seaside. A Coastal Destination Trend Factor for these areas may be too high, while a Coastal Destination Route Trend Factor may be too low. When analyzing coastal cities such as these, it is appropriate to average the trends to yield a more reasonable factor.
- **Summer and Commuter Trends**: It may be necessary to average trends when analyzing mid-sized cities such as Philomath, Dallas and Sutherlin. For urbanized areas the commuter trend is appropriate, while for smaller areas the summer trend is appropriate. However, for mid-sized areas such as these, the summer or commuter trends may alone be too high or too low. A more reasonable factor would be obtained by averaging the summer and commuter trends.
- **Interstate and Interstate Urbanized Trends**: It may be necessary to average trends when analyzing interstates in small urban and fringe areas (urban and small urban) such as Albany, Wilsonville and north of Roseburg. For rural areas the interstate trend is appropriate, while for urbanized areas the interstate urbanized trend is appropriate. For small urban and fringe areas such as these, however, these trends may alone be too high or too low. A more reasonable factor would be obtained by averaging the interstate and

interstate urbanized trends.

It is important to note that these are the only trend grouping pairs that would be appropriate to average, Interstate should only be averaged with interstate urbanized, and should never be averaged with Coastal or Recreational. The same is true for the other trends not listed in the above examples. The Seasonal Trend Table is located on the Transportation Analysis webpage of the TDD Planning website.

Factoring count data to the peak month requires dividing the seasonal factor for the count period by the seasonal factor for the peak period. The peak period seasonal factor for a traffic trend is the lowest value in the row, and is highlighted in the last column in the table.

Seasonal factors are given for the 1st and the 15th of each month so if the count date is not at the beginning/end or in the middle of a month interpolation is needed.

**Example 5-3 Seasonal Factor – Seasonal Trend Table**

This example demonstrates the Seasonal Trend Method for a Project Area.

A count of 11,000 was taken July 1st – 5th along Oregon Coast Highway No. 9 (US 101) at MP 63.19 which is just north of Tillamook city limits.

- **Step 1: Transportation Volume Table**: There are no ATRs on this section of the highway.
- **Step 2: ATR Characteristic Table**: This section of highway can be categorized as Coastal Destination/Rural/Two-Lanes. Filtering through the ATR Characteristic Table, from left to right, four ATRs have similar characteristics to the project area. However, none of the characteristic ADT values are within +/- 10% of the Transportation Volume Table ADT for the project area. Refer to the table below for details regarding these four candidate locations.

**Example ATR Characteristic Table (Year 2013)**

| Characteristics | ATR Location 1 | ATR Location 2 | ATR Location 3 | ATR Location 4 |
|---|---|---|---|---|
| Seasonal Traffic Trend | Coastal Destination | Coastal Destination | Coastal Destination | Coastal Destination |
| Area Type | Rural | Rural | Rural | Rural |
| Number of Lanes | 2 | 2 | 2 | 2 |
| Weekly Traffic | Weekday | Weekend | Weekend | Weekend |
| 2012 ADT | 2000 | 5700 | 4700 | 17200 |
| OHP Classification | District Hwy | Statewide Hwy | Statewide Hwy | Statewide Hwy |
| ATR | 02-003 | 20-005 | 21-006 | 27-001 |
| County | Benton | Lane | Lincoln | Polk |
| Highway Route, Name and Location | OR34, Alsea Hwy No. 27, southwest of Corvallis-Newport Hwy No. 33 (US20/OR34) | OR126, Florence-Eugene Hwy No. 62, west of Territorial Hwy No. 200 (OR200) | US20, Corvallis-Newport Hwy No. 33, west of Lincoln-Benton County Line | OR18, Salmon River Hwy No. 39, east of Three Rivers Hwy No. 32 (OR22) |
| ATR MP | 53.89 | 43.86 | 34.24 | 23.23 |
| State Hwy Number | 27 | 62 | 33 | 39 |

- **Step 3: Seasonal Trend Table**: Since there are no ATRs with similar characteristics, the Seasonal Trend Table must be used. The correct values are obtained by following the "Coastal Destination" row to the "Jul_1" count month column, and to the "Peak Period Seasonal Factor" column at the end of the table, as summarized below.

**Seasonal Trend Table (Year 2013)**

| | Jun 15 | Jul 1 | Jul 15 | Aug 1 | Peak Period Seasonal |
|---|---|---|---|---|---|
| Coastal Destination | 0.9345 | 0.8749 | 0.8153 | 0.8005 | 0.7857 |

- The peak period seasonal factor is 0.7857.
- The count date seasonal factor (July 1st) is 0.8749.
- The seasonal adjustment is: Count Date Seasonal Factor/Peak Period Seasonal Factor = 0.8749/0.7857 = 1.11.

Therefore, the peak period volumes for a Coastal Destination are 1.11 times greater than volumes for the 1st – 5th of July.

To convert the July traffic data to the 30HV:

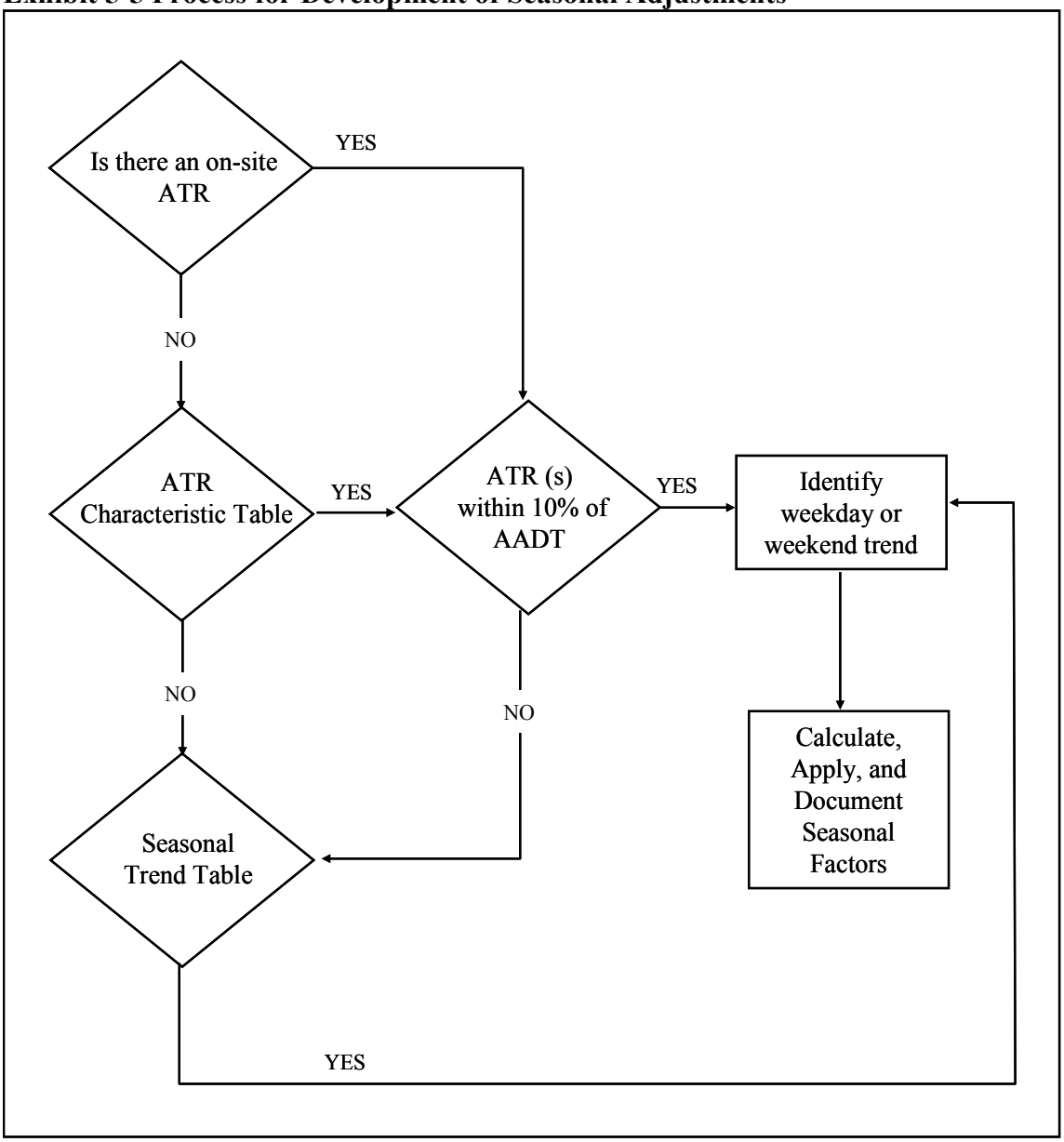
30HV = (July PHV) x (Count Date Seasonal Factor / Peak Period Seasonal Factor).

If one of the peak hour turning movement volumes were 100 vph in July, then the 30HV would be 1.11 x 100 vph = 111 vph.

---

Exhibit 5-5 below is a simplified flow chart of the process for seasonal adjustments.

**Exhibit 5-5 Process for Development of Seasonal Adjustments**



Seasonal Adjustment for Alternate Periods

If it is desired to factor count data to an annual average time of year (Oct or May typically) for determination of an alternate mobility standard, the values in the Seasonal Trend table can still be used. This is same process that the Transportation Data Section uses to create average annual daily traffic (AADT) to create the Transportation Volume Tables.

**Example 5-4 Seasonal Characteristic Table Adjustment for Alternate Period**

This is a continuation of Example 5-2 Seasonal Factor – ATR Characteristics Table (count taken June 15th–18th along OR 34 west of I-5). It is desired to obtain average annual peak hour volumes for this location. It was previously determined using the ATR Characteristic Table method that ATR #09-020 should be used for seasonal adjustments for this site.

**Seasonal Adjustment Using ATR #09-020**

| | 2012 | 2011 | 2010 | 2009 | 2008 |
|---|---|---|---|---|---|
| Count Month (June) | 109% | 107% | 108%% | 108%% | 107% |

For this site location, the ratio of (Count Month ADT)/(AADT) from ATR #09-020 is used. For the five years of this example, dropping the high and low, the average count month % of AADT was found to be 109%.

$$\frac{\text{Count Month ADT}}{\text{AADT}} = 1.09$$

To convert to average annual volumes, count month volumes are divided by this ratio (1.09), i.e., the average annual peak hour volume = (Site June PHV) / (ATR June ADT/ATR AADT)

If one of the site peak hour turning movement volumes were 100 vph in June, then the site average annual peak hour turning movement volume would be 100 vph / 1.09 = 92 vph.

**Example 5-5 Seasonal Trend Table Adjustment for Alternate Period**

This is a continuation of Example 5-3 Seasonal Factor – Seasonal Trend Table (count of 11,000 taken July 1st – 5th along US 101 north of Tillamook). It is desired to obtain the average annual peak hour volumes for this location. The seasonal trend table was used for this location. The applicable seasonal trend was determined to be Coastal Destination.

The factors in the seasonal trend table are ratios of AADT to the month ADT (AADT/Month ADT). The ratio of the AADT/Month ADT is assumed to be the same for the site peak hour volumes. To convert to average annual peak hour, the site month peak hour volume is multiplied by that ratio for that month.

Site Average Annual Peak Hour Volume = Site Month peak hour volume x Trend Table Factor for that month

In this example, the count was taken the week of July 1st. The seasonal factor for July 1st was found to be 0.8749. If one of the site peak hour turning movement volumes were 100 vph in July, then the site average annual peak hour turning movement volume would be 100 vph x 0.8749 = 87 vph.

---

## 5.5 Historical Factors (Factoring to Current Year)

In addition, to adjusting count volumes seasonally, they need to be adjusted to the current or base year of the project. This might mean increasing or decreasing the count peak hour volume. The historical factor process uses the Future Volume Table to adjust the volume regardless of what process is used to create the future volumes (see Chapter 6).

The Future Volumes Table is updated annually. The table is based on long-term 20-year trends of traffic counting sites (for the TVT) on Oregon highways. Each individual record trend has been analyzed to eliminate any unexplained spikes or dips in the data to improve its overall correlation with the 20-year regression curve. The trends are based on linear regression best-fit trends and are extrapolated out 20 years. Over the 20-year period, the linear trends show a steady growth and should not grossly under or over-estimate the future 20-year value outside of travel demand model areas. Use of other curve extrapolation models (i.e. compound growth) shall not be used.

Within the table, the milepoint location for the project highway that most closely resembles the traffic flows for the section being analyzed is selected. Sometimes, another milepoint may be closer to the section being analyzed, but there may be a cross street that affects traffic volumes on the highway so that the growth rate is different.

There are three columns in the table for the most recent three years of traffic count data. Only one of the columns is filled; corresponding to the last year that the location was counted. The far right column contains the R-squared value for the regression equation that was used to estimate the historical trend. The R-squared value measures the degree of correlation between the dependent variable (historical traffic volumes) and the independent variable (time). A value of 1.0 indicates an exact linear relationship between the historical counts and time. Ideally, the R-squared value should exceed 0.75. However, values higher than 0.50 are still acceptable, if there is nothing else available. Conversely, a low R-squared value indicates a weak relationship. In this case, the table should be investigated for a nearby location having similar traffic characteristics and a more acceptable R-squared value.

In areas that have travel demand models, the R-squared value is replaced by the “MODEL” code. This code indicates that the historical trend has been replaced by the model growth rate (future

year divided by the base year). In larger areas, use of the historical growth rate can overestimate volumes, so the use of the model growth rate allows for consideration of capacity constraints. These model growth rates are updated as the models are updated (typically every five years or so).

For non-state roadways, or ramps/frontage roads, historical factors can be averaged from similar roadways with the same characteristics. The seasonal factor sections in this chapter can apply to help locating highway sections with similar characteristics. For example, an interchange ramp is affected by growth on the mainline freeway as well as the intersecting crossroad, so the ramp historical adjustment would be the average of the two.

Local land use changes should also be reviewed if they have occurred between the time that the count was taken and the desired base year of the project. In this case, the Future Volume Table should not be used because it is likely that double-counting would occur. The additional trips from the background and development sections in the traffic impact analysis document need to be added to the count volumes to approximate the existing traffic levels.

**Example 5-6 Adjusting Counts to Current Year**

The project base year is 2013 but the counts available were counted in 2010. The Future Volume Table is used to adjust the counts to the base year.

For the Madras ATR (#16-002) located on US 97 at MP 96.92, The following table shows the 2011 traffic volumes, projected Year 2032 traffic volumes and the R-squared value.

**Example Future Volumes Table**

| Hwy# | DIR | MP | Description | 2011 | 2032 | RSQ |
|---|---|---|---|---|---|---|
| 4 | 1 | 96.46 | 0.02 mile N of Fairgrounds Road | 17700 | 23200 | 0.9150 |
| 4 | 1 | 96.92 | ATR 16-002 - Madras | 12200 | 12500 | 0.7037 |
| 4 | 1 | 97.31 | 0.02 mile S of US 26 | 9300 | 13800 | 0.3994 |
| 4 | 1 | 103.61 | 0.02 mile N of SW Iris Lane | 8200 | 10600 | 0.5093 |
| 4 | 1 | 105.63 | 0.10 mile N of Culver Hwy | 8700 | 13000 | 0.7844 |

RSQ = Root Mean Square

Based on the data above, the 21-year growth factor would be 12500 / 12200 = 1.024.. Assuming linear growth in the future, the annual growth factor would be (1.024 –1.0) / 21 = 0.00114, or 0.114%%. The R-squared value of 0.7037 is acceptable. To convert the 2010 30HV, for example a minor approach left volume of 115 vph, to a 2013 DHV, the 2010 30HV is multiplied by the 3-year growth factor.

2013 DHV = 2010 30HV x [(3 x Annual Growth Rate) + 1] = 115 vph x [(3 x 0.00114) + 1]
= 115 vph x 1.0034
= 115 vph

### 5.5.1 Network Balancing

The 30HV network needs to be balanced. Balancing is somewhat of an "art" that techniques vary from project to project and within areas on a project, so it is hard to list out a specific process. The exhibits and examples below illustrate some different balancing techniques. Balancing is simply, "what goes into an intersection or segment needs to come out." Without balancing, it is possible to have two intersections with nothing between them with the volume that leaves one intersection and enters the next one be 200 vph or more different.

Interstates and expressways with interchanges or roadway segments with no accesses need to balance perfectly from one intersection or interchange to another. Roadways with accesses probably will not balance perfectly, but should be consistent from intersection to intersection. Roadways with many non-counted accesses (especially major ones) should not be forced to balance as this will artificially increases or decreases the adjacent intersection volume beyond the realistic point. If a segment fails to balance because of accesses, it may be best to perform a peak hour count at the point or points to help reduce the balancing needed.

The timing of the traffic counts can help determine how easy a network is to balance. Counts that are spread throughout the allowable three-year span taken at different times of the year will be harder to balance than counts all taken on the same day or within a week of each other. Counts that have similar peak hours will be easier to balance than counts of varying peaks.

Network balancing should be done initially on paper as it is easier to track differences and proportional changes as the process proceeds. An intersection may have to be adjusted more than once in a single balancing process, so a record of the "chronological" adjustments/steps is needed for the analyst to retrace or a reviewer to follow. Trying to follow a spreadsheet-based balancing process is difficult and it becomes more of an effort to identify whether the right formula was used versus the right thought process was used. If a spreadsheet is used, then the thought-process needs to be shown via comments/notes. Once the network is balanced, then the results should be rounded and placed into spreadsheets or figures. The important point is that the balancing thought process be reasonable, logical and be well documented. The balanced network must be reviewed before the values are used in any further analysis or construction of future year volumes.

When balancing, it is important to keep the general proportions of turn splits and leg directional factors relatively constant unless the analyst knows that the counts did not capture the true conditions.

**Identifying High/Low Imbalances**

A good way to start the balancing process is to first identify which intersections/segments are high or low and likely techniques that could be used. Sum up the inflows and outflows on each approach and exit leg and note the differences between them across each intersection. Doing this graphically via sketches on paper with different colors for high and low segments can expedite the process. Note whether the differences seem to be on through movements or turn movements. The count dates, durations, and the analyst's overall confidence in the intersection counts should

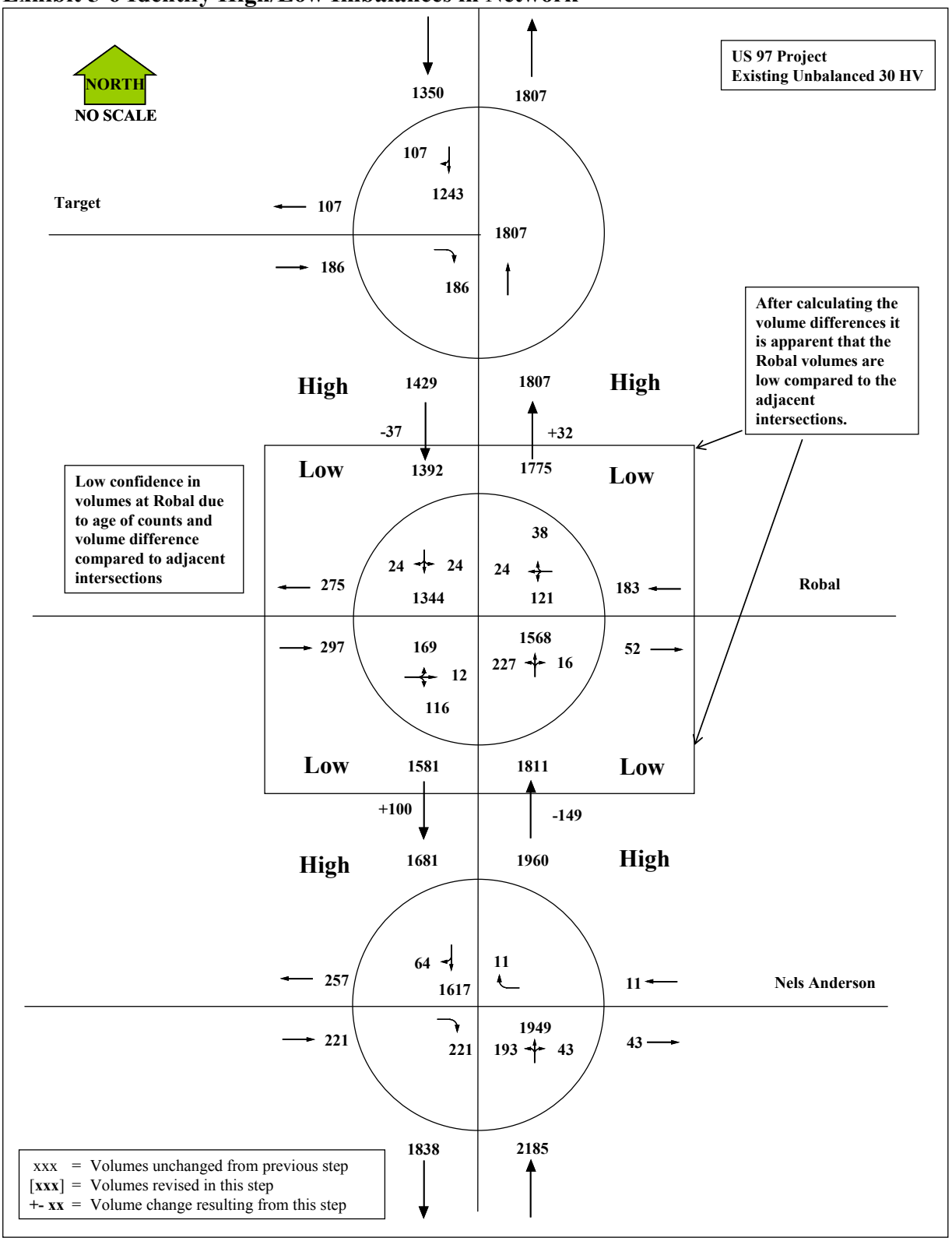
also be documented.

Small differences overall likely mean that a single point could be held and the differences proportionally distributed. Large differences likely mean that differences will need to be split between intersections first. Intersections with whole approaches that are low or high, especially on minor approaches, may mean that the whole approach will need to be adjusted. The average project study area will have many of these conditions so a combination of methods is necessary.

Intersections that are identified to have a high-low-high-low pattern generally have a better success rate in balancing cleanly versus a high-high-high or low-low-low pattern which might create too much of a difference at the network edge.

The following series of exhibits illustrates a small network consisting of three intersections on US 97 and will be used to demonstrate many of these network balancing techniques. Volumes shown in Exhibit 5-6 have been previously developed by factoring counts up to a common year and applying seasonal adjustment factors. The exhibit identifies the high and low imbalances between intersections. There are no driveways between intersections so volumes should balance.

## Exhibit 5-6 Identify High/Low Imbalances in Network



**Holding an Intersection Constant**

If differences are relatively small between intersections, holding an intersection constant and pushing the differences away proportionally may be used. Another use of this method is if the analyst has good confidence in a major intersection count based on count year or duration. For example, long duration counts generally are better to hold than short duration counts. Larger intersections (number of legs and/or volumes) are generally better to hold than smaller intersections. Depending on the situation, it may be best to start with the intersection with the greatest differences.

The selected intersection is held constant and the differences are pushed to the next intersection. The difference is resolved by identifying the splits between the approach turn movements from the next intersection's subject approach and applying those splits to the difference. The difference in the opposing direction is obtained from the proportional splits that make up the movements going onto the exit leg. This is repeated for each segment of the held intersection. Then, the difference is moved away from the held intersection and the difference is proportionally reduced the further away it gets as portions are removed by each turn movement.

It is possible that as the difference is worked downstream, the increases/decreases at an intersection become too great or seem to be going away from convergence (getting worse). In this case, either another intersection could be selected to be held, an entire approach may needed to be adjusted, or better, the differences need to be split instead of held.

This method can also be used to just hold particular approaches constant if desired. This is useful if the analyst believes that the minor street leg growth factors seem to be off and has more confidence in the major approaches.

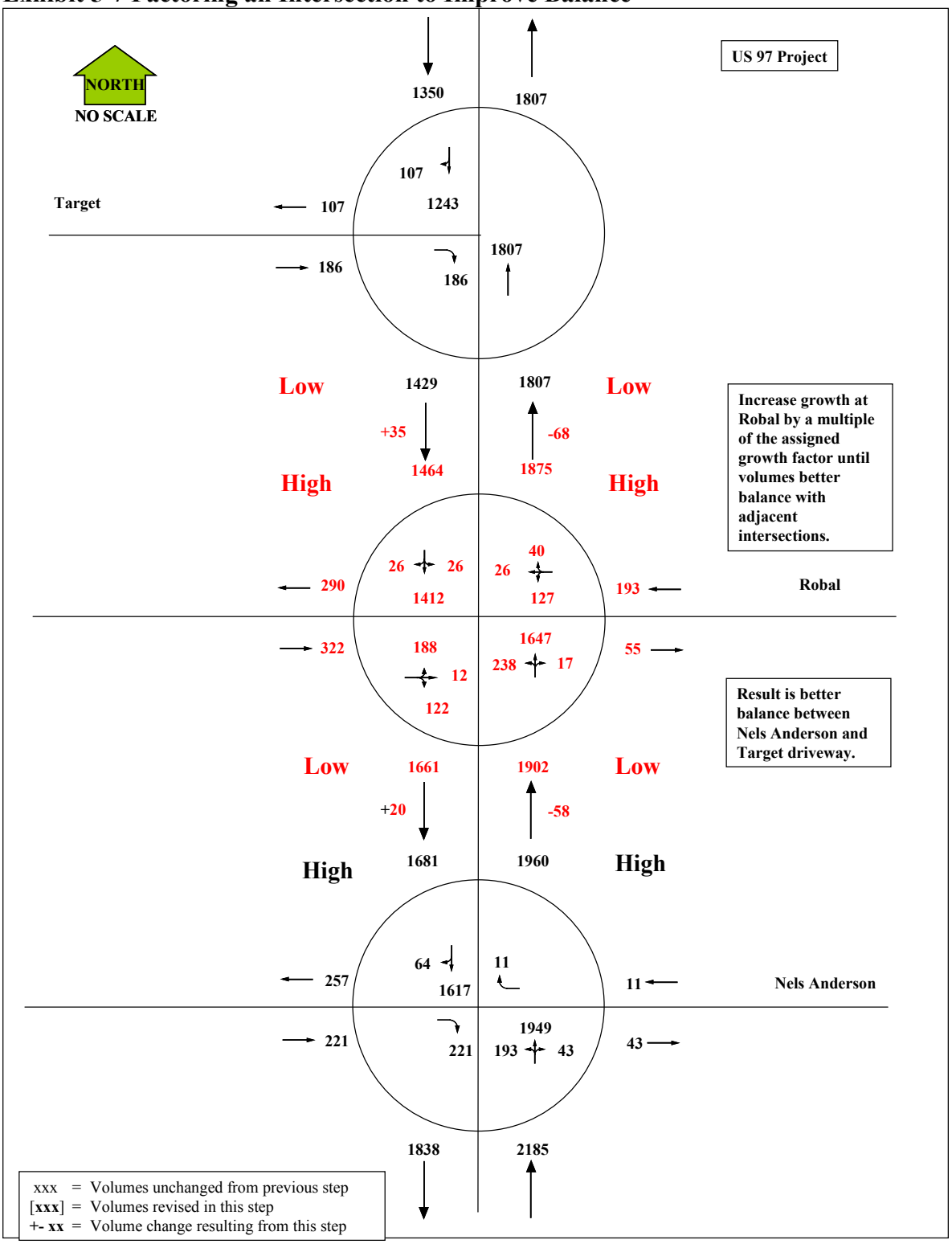
Factoring Approaches/Legs/Intersections

Sometimes, after identifying the high and low imbalances, an approach, or a leg, or an entire intersection appears to be significantly low or high for some reason. These areas may be have been influenced by driveway closures, nearby road construction/diversion, incidents, or special events. Sometimes the count might have an error so this should be checked thoroughly even up to replacing the count with a new one if necessary. If no obvious errors /issues exist then these can be factored up or down to more closely agree with adjacent intersections which the analyst has more confidence in. If these are on state highways, these is most easily done by using the Future Volume Tables to adjust the appropriate leg or intersection further with a growth factor as similarly done in Section 5.5. If a travel demand model exists, then this can be used to create annual growth factors for local roadways.

Exhibit 5-7 illustrates a situation where the volumes on US 97 at Robal are low in comparison to adjacent intersections. In this case there is less confidence in the volumes at Robal because they are based on an older count even though they have been adjusted to a common base year. There is greater confidence in the volumes at Nels Anderson and the Target driveway. In this case volumes at the entire intersection of Robal volumes are increased by a factor of 1.057 based on the Future Volume Table growth along this segment. This factor represents three multiples of the

annual growth factor to bring the intersection to as close as possible without making it too high. The volume imbalance is then recalculated. After this adjustment, Robal is now high compared to the Target driveway to the north, and low compared to Nels Anderson intersection to the south. But the imbalance is now smaller and more realistic.

## Exhibit 5-7 Factoring an Intersection to Improve Balance



**Splitting the Difference**

Large differences between intersection exit leg and the next intersection approach leg need to have the difference split. In this way the difference is moved proportionally in both directions rather than in just one. The proportional adjustments are the same as described above. This is repeated for every intersection until the edge of the network is reached. It may be necessary to re-adjust previously balanced sections of a particular leg does not balance cleanly (does not converge), or if the network circulates the difference back around to the starting spot. Some small differences may be possible to assign to minor streets or non-counted locations.

Exhibit 5-8 illustrates splitting the difference between Robal and Nels Anderson in both the northbound and southbound directions. In order to avoid increasing the imbalance to the north, only turn movement volumes at Robal to and from the south are adjusted. As balanced volumes are created they are rounded to the nearest five vehicles.

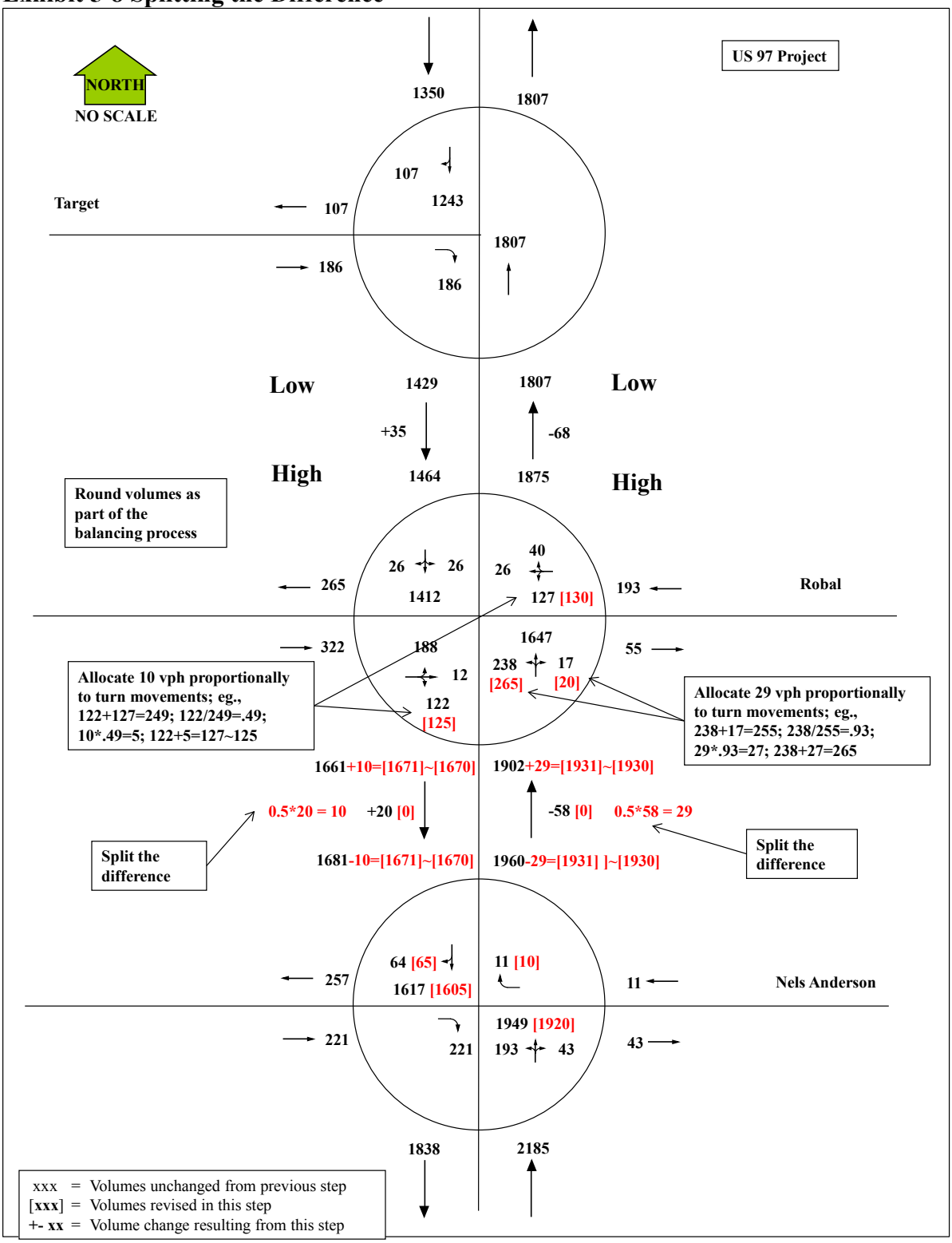
Next, the difference between Robal and the Target driveway to the north is addressed by splitting the difference as shown in Exhibit 5-9. Again, the through movement volumes at Robal are held to avoid re-introducing an imbalance to the south. The difference is proportionately assigned at Robal to the turn movements to from the north only.

In the next step as shown in Exhibit 5-10, the volume adjustments previously made are pushed off the network.

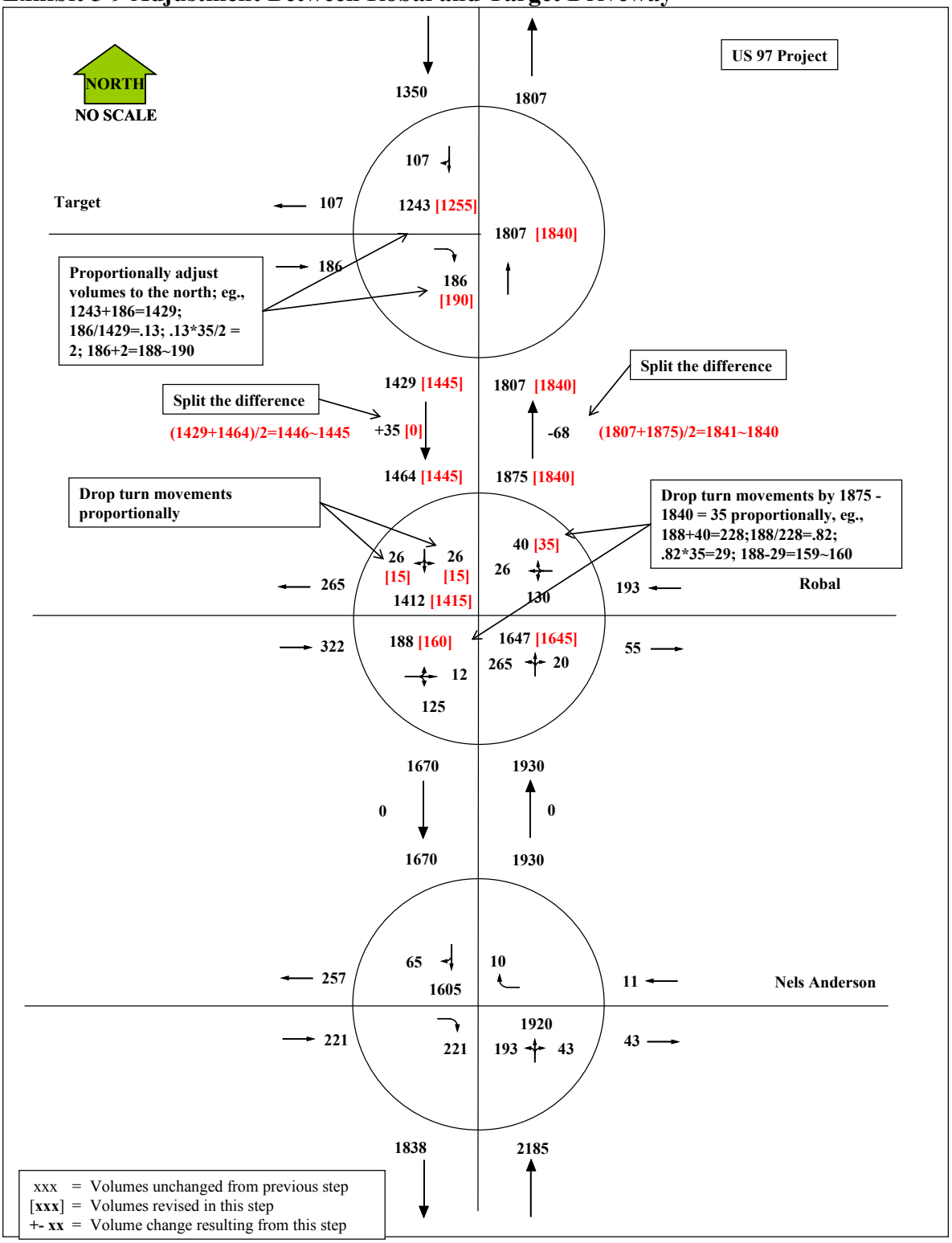
In reviewing the resulting volumes, the drop in turning movement volumes at Robal is determined to be excessive. An iteration is performed by holding the southbound turning movement volumes at Robal and instead applying the difference to the southbound through movement as shown in Exhibit 5-11. That volume adjustment is then pushed off the network. This results in more realistic volumes and illustrates how the balancing process is often iterative, i.e., initial assumptions may need to be changed during the process in order to improve the balance.

Once satisfied that no further improvements in network balance can be made, final balanced volumes are shown as in Exhibit 5-12. Any remaining volumes that were not adjusted and rounded in previous steps were rounded.

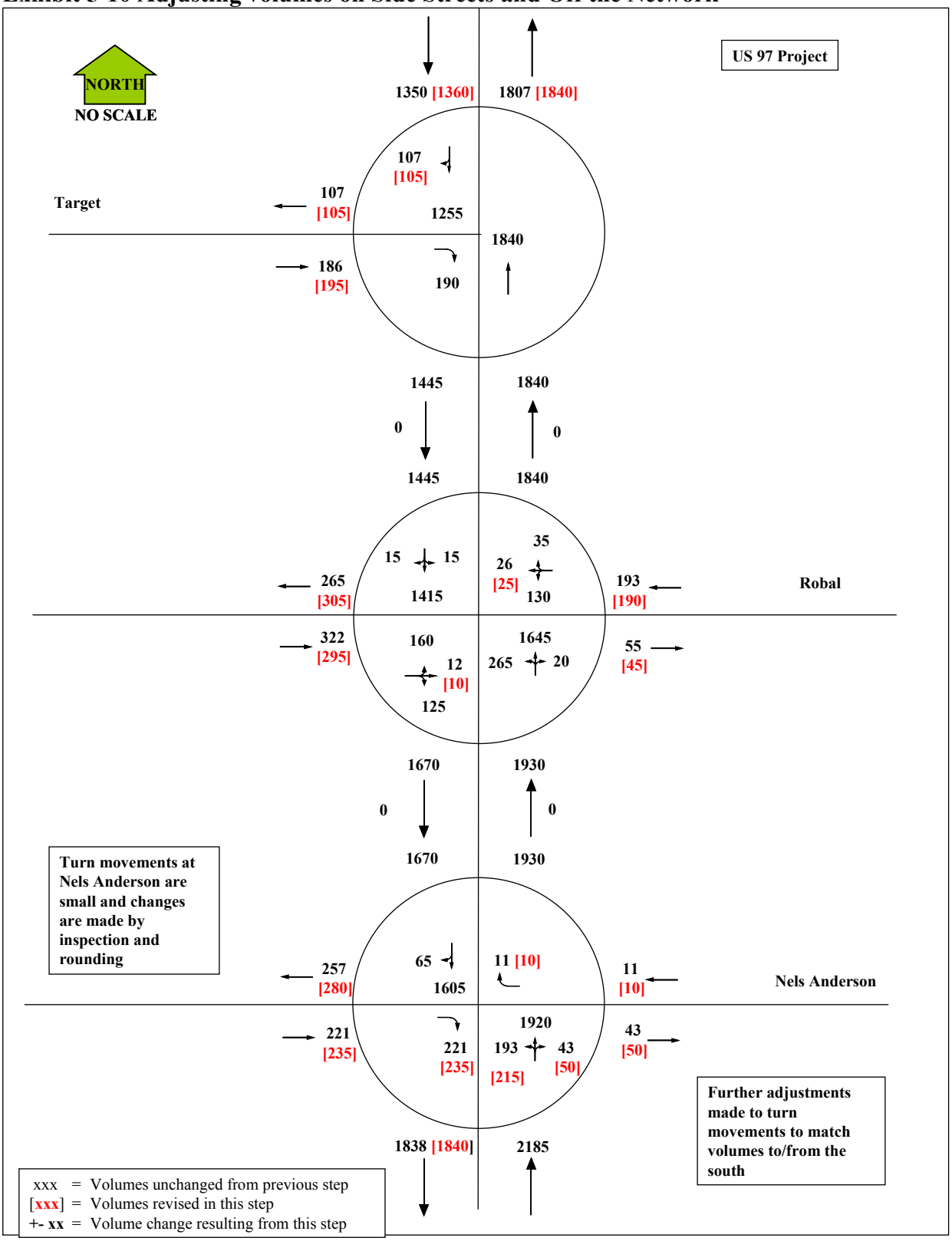
## Exhibit 5-8 Splitting the Difference



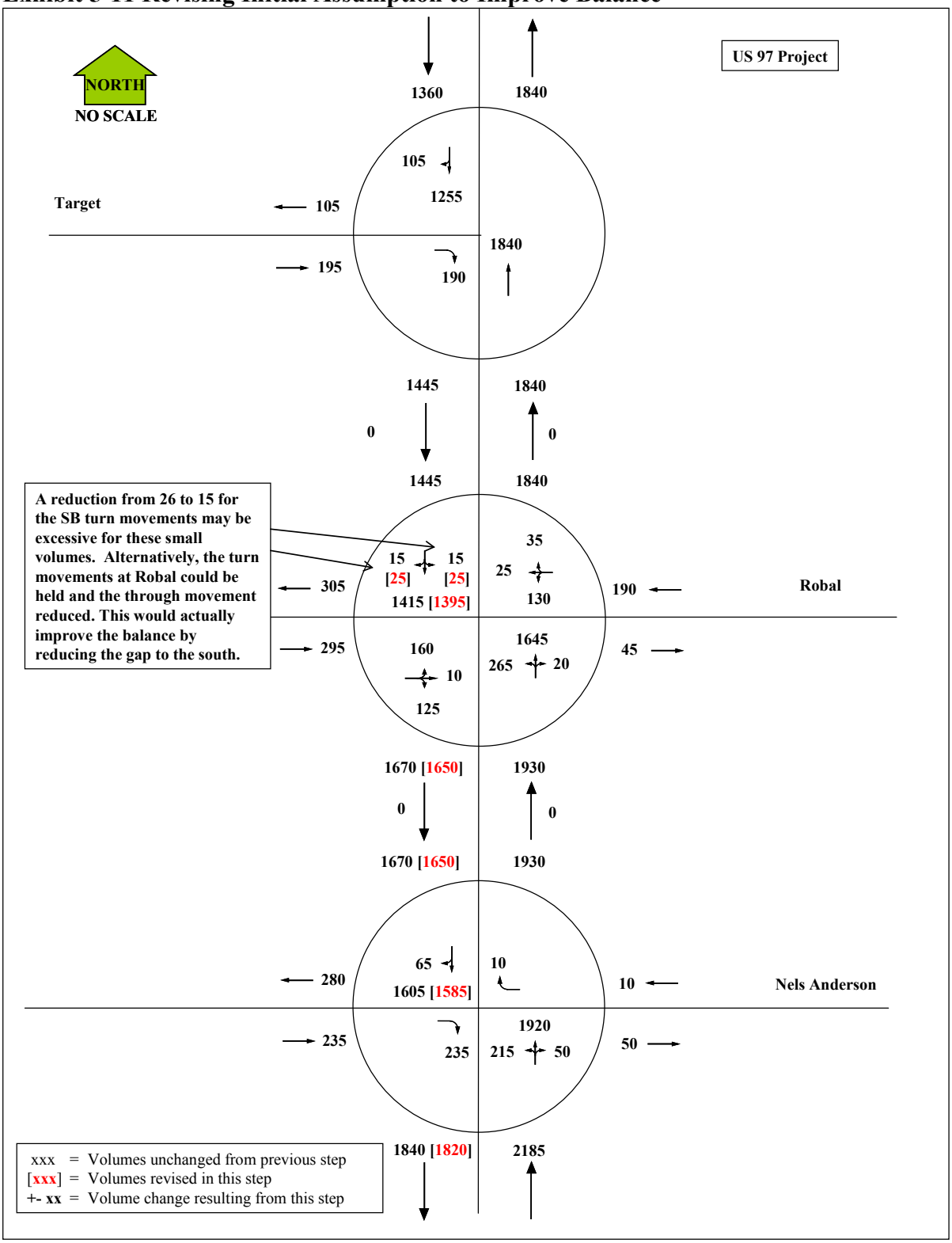
## Exhibit 5-9 Adjustment Between Robal and Target Driveway



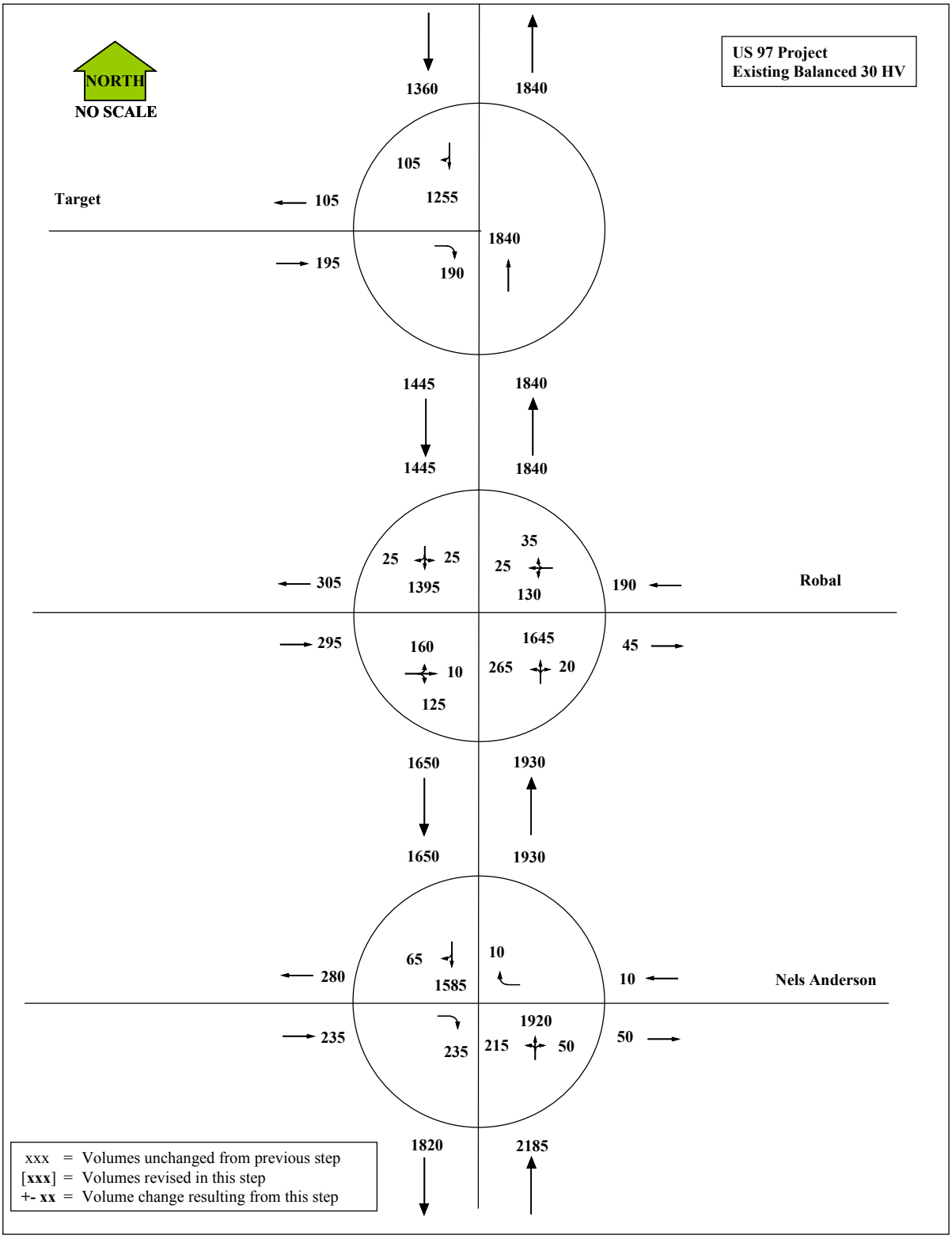
## Exhibit 5-10 Adjusting volumes on Side Streets and Off the Network



## Exhibit 5-11 Revising Initial Assumption to Improve Balance



## Exhibit 5-12 Final Balanced 30HV



### 5.5.2 Rounding

The final 30HV need to be rounded. The traffic volumes are not that precise to go down to one vehicle with the normal errors that occur within the counting and adjusting processes. For reduction of systematic error, balancing should occur before rounding of values. However, balancing the network can be easier if the network is not down to the individual vehicle. The analyst can choose a methodology, but the important thing is to stick with one method consistently through the entire project. Volumes should be rounded to the nearest five for the existing or base year. Volumes less than five vehicles should use the "<5" symbol instead of using zero.

### 5.5.3 Documentation

It is critical that after every step in the 30HV volume development process that all of the assumptions and factors are carefully documented, preferably on the graphical figures themselves. Count specifics, raw and system peak hours used, ATR's used, seasonal adjustments, ATR 30HV adjustments, and yearly growth factors are some of the items that need to be documented. If all is clearly documented then anyone can easily review the work or pick up on it quickly without questioning the assumptions made. The documentation figures will eventually end up in the final report or in the technical appendix. The volume documentation should include:

- Map-based figure showing (See Exhibit 5-13):
    - Roadway network and intersection lane configurations and control type
    - Raw traffic volumes showing raw peak hour
    - For each intersection, count date, duration, type, and raw peak hour time
- Map-based figure showing (See Exhibit 5-14):
    - Selected system peak hour time
    - Raw count data by movement for the selected system peak hour
- Map-based figure showing (See Exhibit 5-15):
    - Yearly growth and seasonal factors used for each intersection
    - Unbalanced factored 30HV
- Map-based figure showing (See Exhibit 5-16) balanced 30HV (this figure is used in an existing year analysis technical memorandum).

**Exhibit 5-13 Raw Traffic Counts**

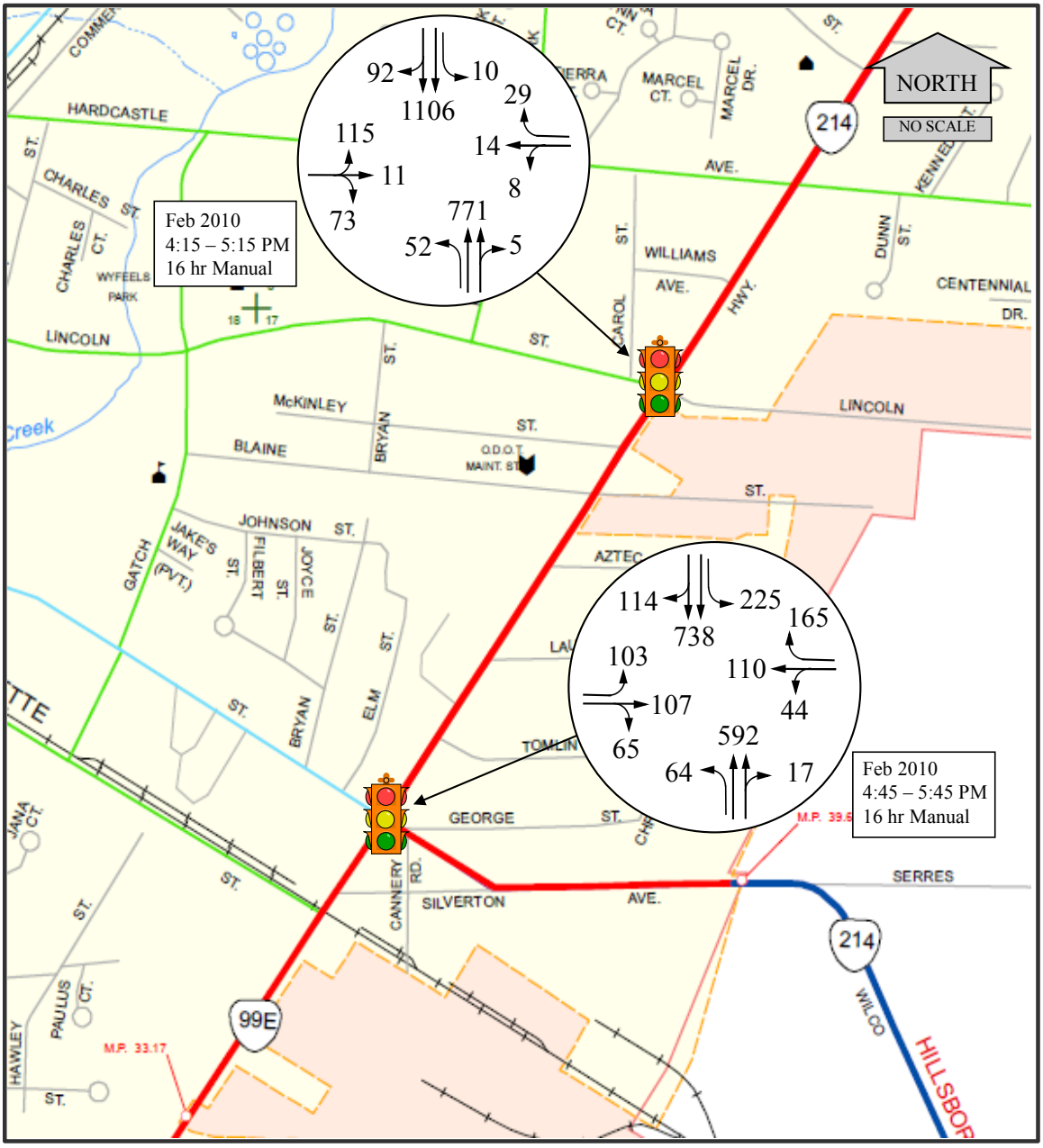


**Exhibit 5-14 System Peak Hour**

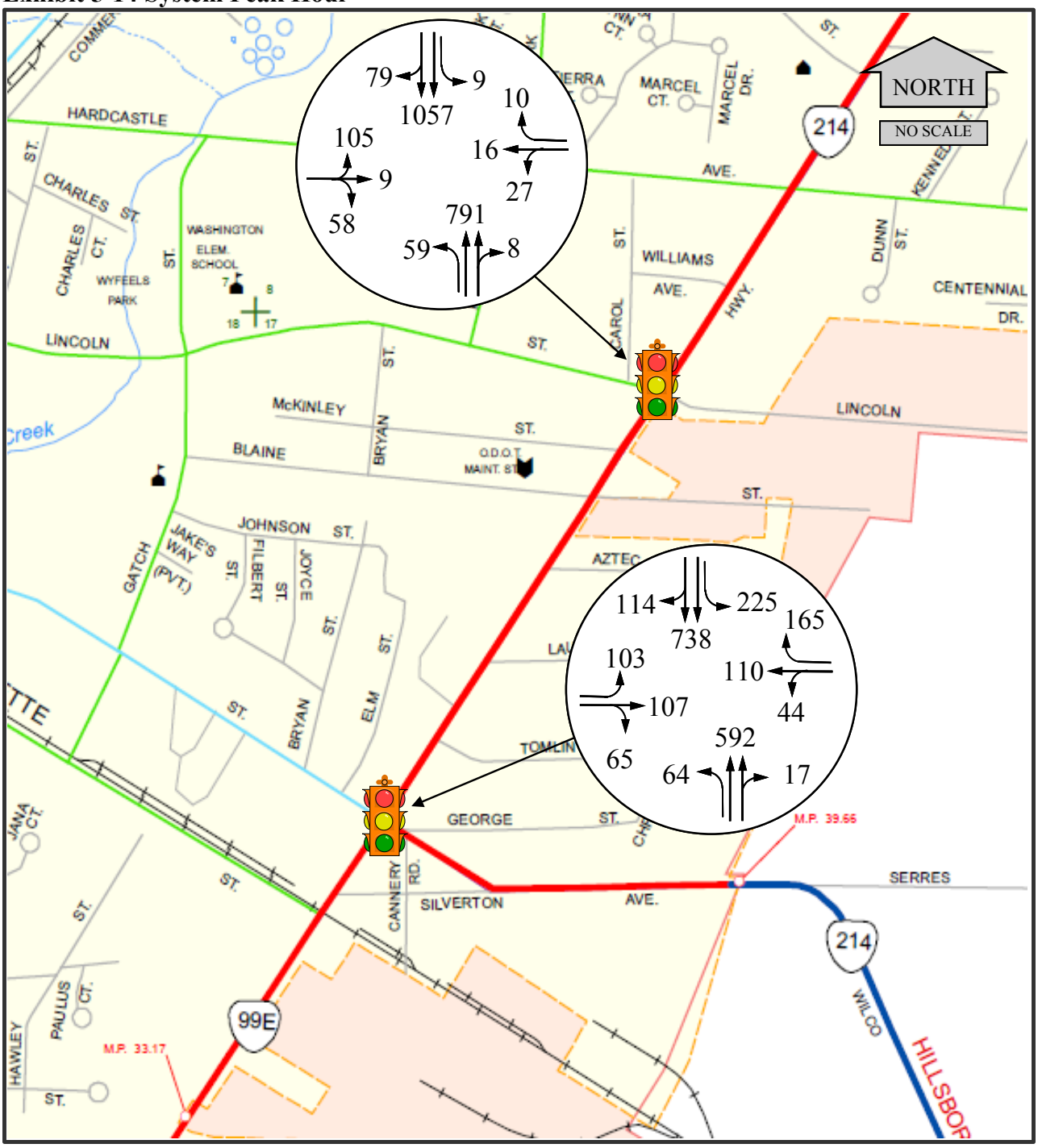


**Exhibit 5-15 Seasonal and Historical Growth**

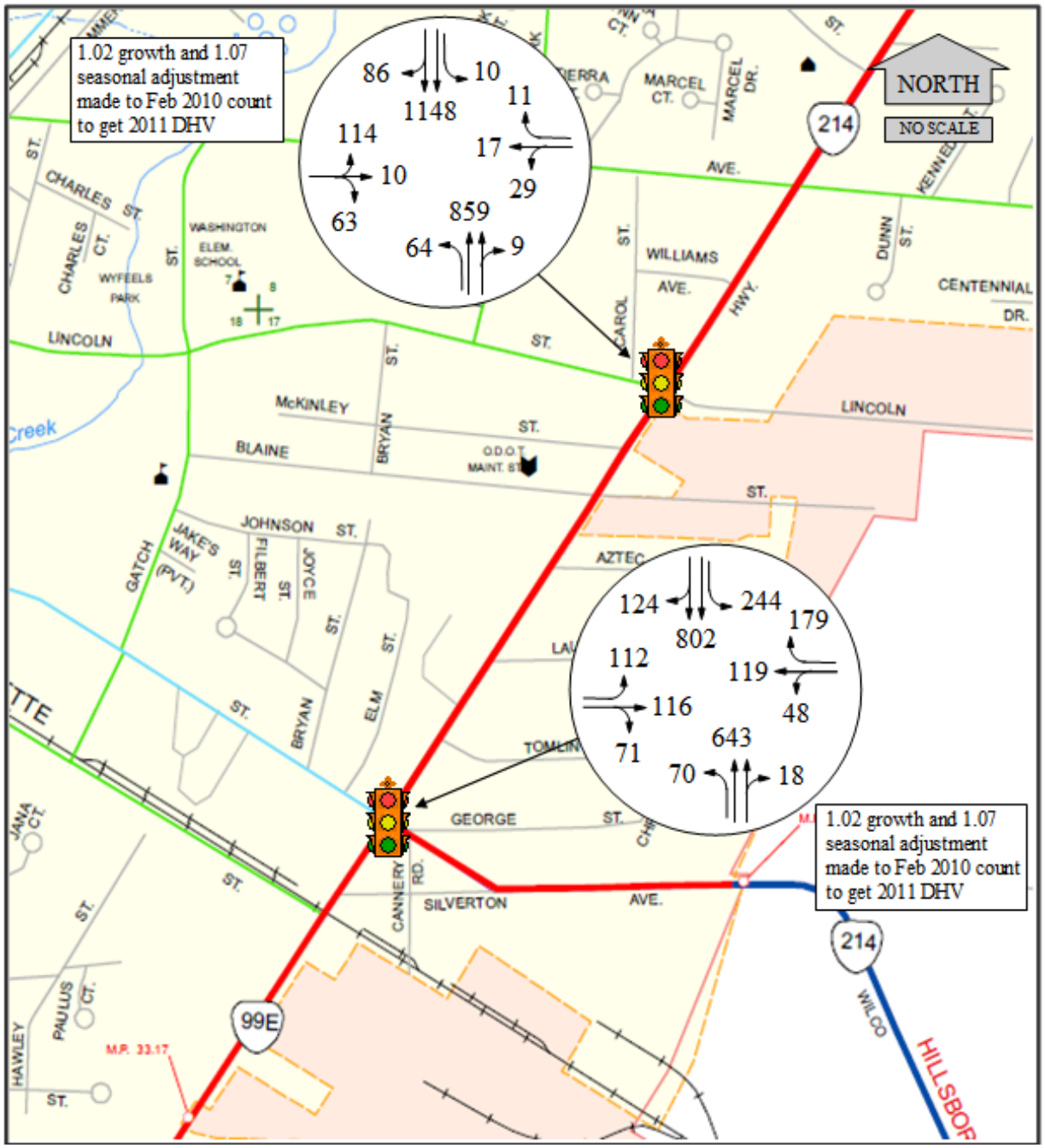
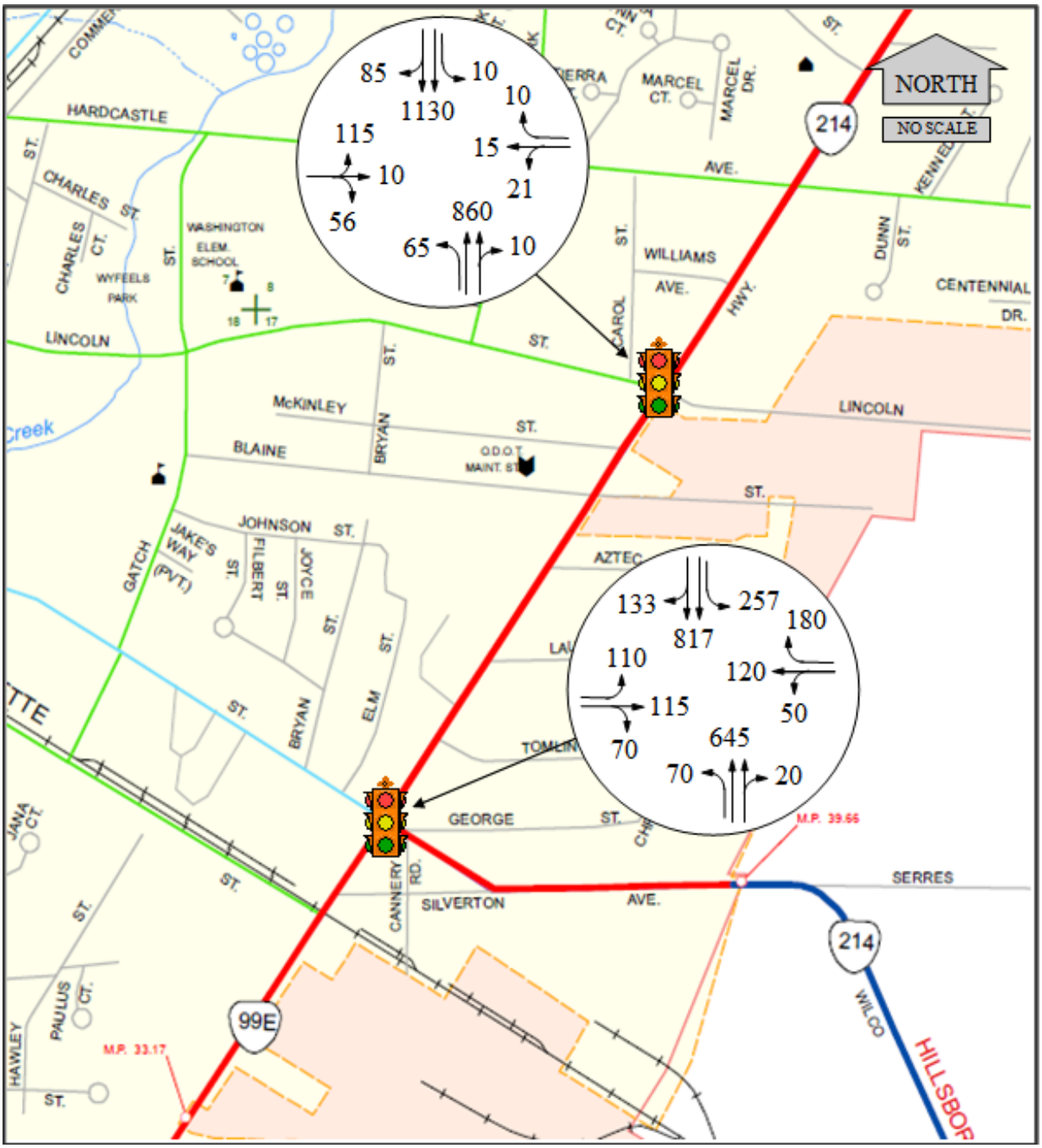


**Exhibit 5-16 Balanced Network**



## 5.6 K-30 Factor Development

For certain planning studies, such as a county TSP analysis, sketch planning level analysis of highway segments may be appropriate, for all or portions of the study. To develop planning-level design hour volumes, TVT AADT volumes can be used. The TVT AADT volumes are used to derive the 30HV by multiplying by the K-30 factor. A K factor is the ratio between a peak hour and the ADT. The K-30 factor is the ratio of the 30th highest hour to the AADT and should be used for this purpose. Short term count K factors should not be used for this purpose. A background report on this topic is available on the TPAU website[1].

K-30 factors are derived from ATRs and can be found in the TVT section on "Summary of Trends at ATR Stations". They are listed under Historical Traffic Data, Percent of ADT for the 30th Hour. A representative ATR needs to be identified following the procedures described in Section 5.4.

**Example 5-7 Converting AADT to DHV using the ($K_{30}$) factor**

This example illustrates how to calculate and apply the K-30 Factor.

Find the 30HV for sketch planning analysis for a segment of Kings Valley Highway No. 191 (OR 223) at MP 28.00.

- **Step 1: Transportation Volume Table** – The TVT is used to find the AADT for this segment.

The 2012 AADT from the Transportation Volume Table is found to be 1000.

- **Step 2: ATR Trend Summary** – ATR 02-005, located on Kings Valley Highway at MP 26.40, can be used for this location. The ATR number corresponds to a table in the last half of the TVT that contains yearly summaries for each ATR. From the column titled "Percent of AADT" the 30th Hour percent of AADT should be recorded for the past five years. The highest and lowest percentages should be eliminated to account for construction activity that may have occurred in the vicinity of the ATR during the five-year period. An average percent of AADT is then calculated for the remaining three years.

**K-30 Factors Using ATR #02-005**

| | 2012 | 2011 | 2010 | 2009 | 2008 |
|---|---|---|---|---|---|
| K-30 | 12.6% | 12.6% | 12.6% | 13.4% | 12.6% |

Note: Shaded values dropped from average calculation.

As shown in Example 5-1 Seasonal Factor – On-Site ATR, the percentage of AADT values listed during June and September for the past five years are reviewed to calculate the average. The

[1] Use of Short-Term Interval Counts to Determine K Factors, Don R. Crownover, P.E., ODOT Transportation Systems Monitoring (TSM) Unit, August, 2006.

highest and lowest values, shown as shaded, are dropped from this calculation. The average K-30 factor is determined as follows:

- The average K-30 factor is: (12.6% + 12.6% + 12.6%) / 3 = 12.6%.

Calculate the two-way 30HV:

30HV = (AADT) x (Average K-30 Factor) = 1000 x 0.126 = 126 vph.

Obtain the directional split for the 30th highest hour as defined by the D-30 factor from the TCM Ranked Hour report (see Traffic Count Management (TCM) Program Count Report Guide ).

From the 2012 Ranked Hour report for ATR 02-005
D-30 NB = 0.30 and D-30 SB = 0.70

Calculate the directional 30HV:

30HV NB = (30HV) x (D-30 factor) = 126 x 0.30 = 38 vph.
30HV = (30HV) x (1-D-30 factor) = 126 x 0.70 = 88 vph

---

## 5.7 Average Daily Traffic (ADT) Development

A number of operational analysis processes need to use ADT instead of 30HV. Some of these are the preliminary signal warrants (link) and air/noise data (link). Many sketch planning and the HCM Planning analysis methods use ADT. ADT is also more perceivable by the public and is frequently used in meetings, environmental documents, and other traffic-related efforts. ADT should be thought of as a "peak month" ADT as it is developed using 30HV. This is not the same as annual average daily traffic (AADT) as AADT is developed using ATR sites which count all days of the year so seasonal trends can be accounted for.

ADT can be created directly on a link basis from 24-hr counts but these counts are unlikely to be done comprehensively over a study area or may be just limited to tube counts which do not catch turning movements. More typically, ADT is created from the 30HV or peak hour volumes.

The ADT conversion process requires the use of counts that can support ADT calculations (12 hours or more). In most cases, ADT cannot be created from peak hour or peak period counts. Use of shorter counts may be acceptable for use in preliminary signal warrants and safety-based analyses. K30 factors are not to be used in ADT development regardless of count duration as those are too general for a project analysis. K-factors and D (directional) factors need to come straight from an ADT-capable count or be derived from counts on other study area intersections/roadways with similar characteristics.

The TruckSum spreadsheet is a good source for obtaining initial K's & D's for all intersection legs of a count at once. Use the TCM TruckSum report to get the input data in the correct format

for the spreadsheet (see TCM Program Count Report Guide and APM Version 1 Chapter 11). If non-cardinal directions (NW, SE, etc.) are included, the analyst will need to convert these to the cardinal directions (N, S, E, W) first before copying and pasting (Use Paste Special…Values Only) into the TruckSum Spreadsheet. As shown in Exhibit 5-17 below, the K-factors are shown explicitly and data is available to readily create the D-factor.

**Exhibit 5-17 TruckSum K and D-Factors**

Divide the directional volumes by the total volume to obtain the D-Factor. For the North leg, the directional split would be 23/51 = 45% NB and 28/51 = 55% SB.

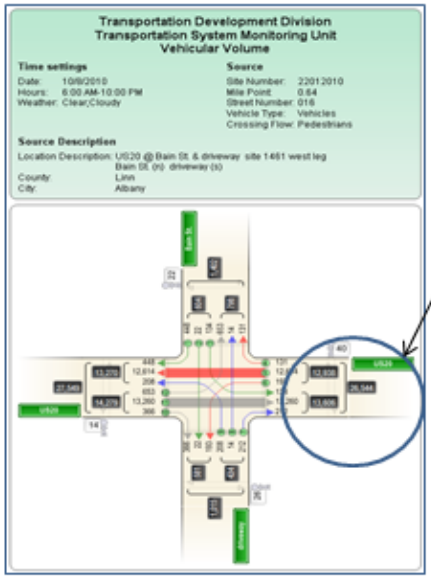
| All Vehicle ADT | | NORTH LEG | | EAST LEG | | SOUTH LEG | | WEST LEG | |
|---|---|---|---|---|---|---|---|---|---|
| Factor | 1.1 | | volume | | volume | | volume | | volume |
| | NB | | 23 | EB | 3626 | SB | 880 | WB | 1657 |
| | SB | | 28 | WB | 1958 | NB | 2464 | EB | 1736 |
| | TOTAL | | 51 | TOTAL | 5584 | TOTAL | 3344 | TOTAL | 3392 |

| All Vehicle PHV | | NORTH LEG | | EAST LEG | | SOUTH LEG | | WEST LEG | |
|---|---|---|---|---|---|---|---|---|---|
| | | volume | factor | | volume | factor | | volume | factor | | volume | factor |
| | NB | 4 | 0.173 | EB | 355 | 0.098 | SB | 64 | 0.073 | WB | 139 | 0.084 |
| | SB | 2 | 0.073 | WB | 155 | 0.079 | NB | 250 | 0.101 | EB | 155 | 0.089 |
| | TOTAL | 6 | 0.119 | TOTAL | 510 | 0.091 | TOTAL | 314 | 0.094 | TOTAL | 294 | 0.087 |

K-Factor shown in decimal form for each direction on an intersection leg.
For the north leg of the intersection, the K-factors would be 17.3% NB and 7.3% SB.

If a TruckSum spreadsheet is not available, develop Ks and Ds from the count. Exhibit 5-18 shows a typical intersection count output and where to pull the data needed for the calculations. Note that the system peak hour should be used to develop the K and D -factors, rather than the individual intersection peak hour. For each directional link, calculate the K factor by dividing the system peak hour volume by the 24-hour volume ADT.

**Exhibit 5-18 K & D – Factors from Counts**




## K and D- Factors from Counts

**K-Factor**

**Westbound**

$\frac{941}{12938} = 0.073$ or 7.3%

**Eastbound**

$\frac{1199}{13606} = 0.088$ or 8.8%

**D-Factor**

**Westbound**

$\frac{12938}{26544} = 0.49$ or 49%

**Eastbound**

$\frac{13606}{26544} = 0.51$ or 51%

**Summary of Traffic Count**
**Transportation Development Division**

| | | | |
|---|---|---|---|
| Site: | 22012010 | Date: | 10/8/2010 |
| County: | Linn | Hours: | 6:00 AM-10:00 PM |
| City: | Albany | Highway #: | 016 |
| | | | US20 @ Bain St. & driveway site |
| Milepoint: | 0.64 | Location: | 1461 west leg |
| Count Number: | 1.00 | Weather: | Clear;Cloudy |

| | Summary By Movements | | | | | | | | | | | | | | Entering Volumes | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time of Day | N-E | N-S | N-W | E-N | E-S | E-W | S-N | S-E | S-W | W-N | W-E | W-S | | TOTAL | North | East | South | West |
| 14:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 14:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 14:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 15:00 | 1 | 1 | 6 | 2 | 2 | 223 | 0 | 4 | 4 | 9 | 266 | 3 | | 521 | 8 | 227 | 8 | 278 |
| 15:15 | 1 | 0 | 6 | 0 | 0 | 233 | 0 | 3 | 2 | 8 | 277 | 8 | | 538 | 7 | 233 | 5 | 293 |
| | | | | | 0 | 236 | 1 | 2 | 6 | 12 | 267 | 6 | | 544 | 11 | 239 | 9 | 285 |
| | | | | | 2 | 216 | 0 | 1 | 3 | 13 | 251 | 7 | | 504 | 10 | 219 | 4 | 271 |
| 16:00 | 3 | 2 | 11 | 2 | 1 | 230 | 1 | 4 | 4 | 8 | 276 | 5 | | 550 | 16 | 236 | 9 | 289 |
| 16:15 | 4 | 0 | 11 | 2 | 2 | 216 | 0 | 3 | 5 | 9 | 248 | 13 | | 513 | 15 | 220 | 8 | 270 |
| 16:30 | 3 | 1 | 7 | 2 | 3 | 218 | 1 | 6 | 4 | 9 | 271 | 5 | | 530 | 11 | 223 | 11 | 285 |
| 16:45 | 2 | 1 | 8 | 1 | 3 | 253 | 1 | 3 | 1 | 13 | 228 | 7 | | 520 | 11 | 257 | 4 | 248 |
| 17:00 | 3 | 0 | 10 | 0 | 3 | 243 | 0 | 3 | 2 | 6 | 307 | 13 | | 590 | 13 | 246 | 5 | 326 |
| 17:15 | 0 | 0 | 7 | 3 | 2 | 232 | 1 | 4 | 2 | 18 | 308 | 4 | | 581 | [illegible] | 237 | 7 | 330 |
| 17:30 | 3 | 0 | 4 | 1 | 3 | 225 | 0 | 3 | 2 | 11 | 267 | 6 | | 525 | [illegible] | 229 | 5 | 284 |
| 17:45 | 0 | 0 | 11 | 2 | 1 | 226 | 0 | 3 | 3 | 10 | 298 | 5 | | 559 | 11 | 229 | 6 | 313 |
| 18:00 | 3 | 1 | 10 | 11 | 7 | 862 | 0 | 20 | 4 | 40 | 933 | 15 | | 1906 | 14 | 880 | 24 | 988 |
| 18:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| Total Count | 121 | 20 | 407 | 119 | 175 | 11467 | 12 | 192 | 189 | 593 | 12054 | 332 | | 25681 | 548 | 11761 | 393 | 12367 |
| 24hr Factor | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| 24hr Volume | 134 | 22 | 448 | 131 | 193 | 12614 | 14 | 212 | 208 | 653 | 13260 | 366 | | 26544 | 601 | 12938 | 431 | 13606 |

System Peak Hour

24-hour volume ADT

When the full 24-hour volume is not available, use the count expansion factors in Exhibit 5-19 to estimate from shorter duration counts.

**Exhibit 5-19 Count Expansion Factors**

| Count Length (hours) | Expansion Factor |
|---|---|
| 12 | 1.25 |
| 14 | 1.18 |
| 16 | 1.10 |
| 24 | 1.00 |

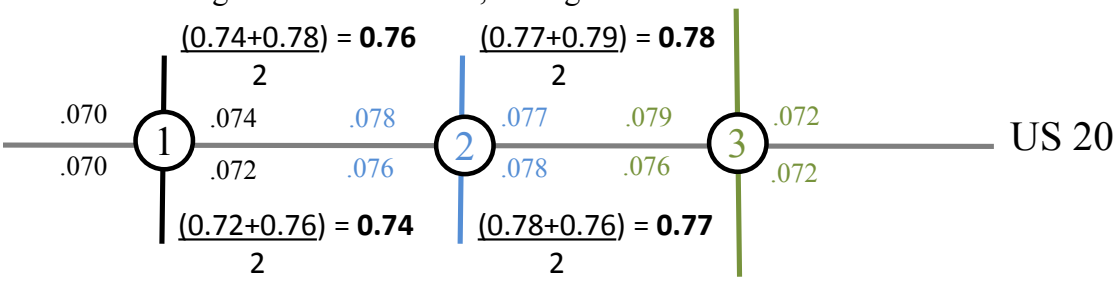
The D factor is calculated by dividing the highest 24-hour one-way volume by the two-way 24-hour volume.

Draw a link diagram of the study area. Label the K factors on one diagram and D factors on another diagram. Calculate average K factors between intersections. Links missing K or D factors (such as those using peak period counts) can be obtained (estimated) by averaging links with similar characteristics together in the study area. Divide the 30 HVs by the K factors to obtain the ADT on each directional link. Now sum the directional link ADTs to obtain two-way link ADTs. Now multiply the two-way ADTs by the D factor to obtain directional ADTs. The resulting splits may differ between the 30HV and ADT volumes.

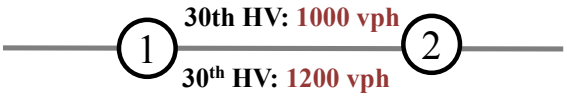
ADT's should be documented on a map-based figure on a link approach basis rather than showing individual turn movements.

**Example 5-8 ADT Calculations**

1. Label link diagram with K-Factors, average K-values between nodes:




2. Divide 30 HV by average link K-value (Step 1) to calculate ADT, sum ADT:

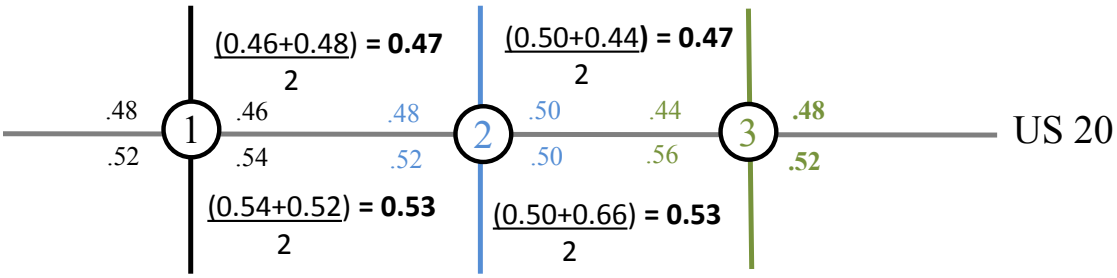



**1000/.076** = 13,158 ADT

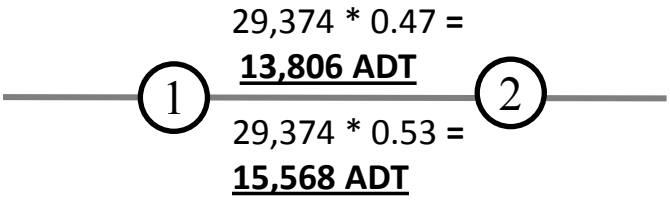
**1200/.074** = 16,216 ADT

**∑ 29,374**

3. Label link diagram with count D-Factors, average D-values between nodes:




4. Multiply ADT link sum (Step 2) by average D-value to calculate directional ADT:



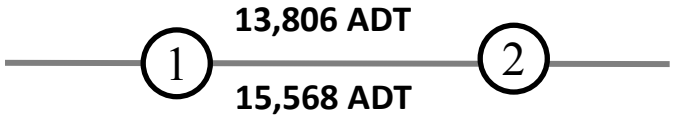

---

### 5.7.1 Converting ADT to AADT

ADT can be converted to AADT by applying the seasonal factor (See Section 5.4) straight instead of using the inverse in the 30HV process. This will convert the ADT to an average value (May/October). Example 5-9 ADT to AADT Conversions shows the typical calculations.

**Example 5-9 ADT to AADT Conversions**

Counts used to create the ADT values from the previous Example 5-8 ADT Calculations, were taken October 8th in a location characterized by a summer trend. After review of the ATR Characteristic Table it is determined that there are no characteristic ATR's that can be applied therefore, the Seasonal Trend Table must be used to convert the ADT to AADT.

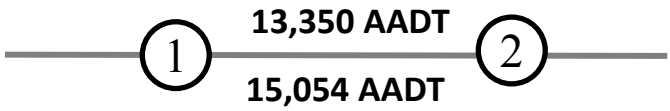



1. Using the Seasonal Trend Table under Summer Trend, averaging the October 1st and 15th column, the factor is 0.9670.

| TREND | 15-Feb | 1-Mar | 15-Mar | 1-Apr | 15-Apr | 1-Oct | 15-Oct | 1-Nov | 15-Nov | 1-Dec | 15-Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INTERSTATE URBANIZED | 1.0390 | 1.0322 | 1.0254 | 1.0050 | 0.9845 | 0.9849 | 0.9968 | 1.0130 | 1.0292 | 1.0414 | 1.0536 |
| INTERSTATE NONURBANIZED | 1.2265 | 1.1538 | 1.0811 | 1.0579 | 1.0347 | 0.9551 | 0.9989 | 1.0247 | 1.0506 | 1.1208 | 1.1910 |
| COMMUTER | 1.0352 | 1.0428 | 1.0503 | 1.0158 | 0.9813 | 0.9720 | 0.9803 | 1.0074 | 1.0346 | 1.0547 | 1.0749 |
| COASTAL DESTINATION | 1.0873 | 1.0993 | 1.1114 | 1.0737 | 1.0359 | 0.9635 | 1.0370 | 1.0906 | 1.1441 | 1.1672 | 1.1903 |
| COASTAL DESTINATION ROUTE | 1.2552 | 1.2561 | 1.2571 | 1.1881 | 1.1191 | 0.9389 | 1.0669 | 1.1473 | 1.2276 | 1.3028 | 1.3779 |
| AGRICULTURE | 1.2653 | 1.2511 | 1.2369 | 1.1493 | 1.0617 | 0.8622 | 0.9263 | 0.9984 | 1.0705 | 1.2224 | 1.3742 |
| RECREATIONAL SUMMER | 1.5130 | 1.4824 | 1.4519 | 1.3336 | 1.2152 | 0.9005 | 1.0231 | 1.1707 | 1.3183 | 1.4751 | 1.6319 |
| RECREATIONAL SUMMER WINTER | 0.9771 | 1.0169 | 1.0567 | 1.1357 | 1.2146 | 1.2207 | 1.4874 | 1.5592 | 1.6311 | 1.2701 | 0.9091 |
| RECREATIONAL WINTER | 0.6663 | 0.7094 | 0.7526 | 0.9446 | 1.1365 | 1.4499 | 1.7607 | 2.2112 | 2.6618 | 1.6508 | 0.6398 |
| SUMMER | 1.1778 | 1.1604 | 1.1430 | 1.0881 | 1.0332 | 0.9436 | 0.9904 | 1.0445 | 1.0985 | 1.1455 | 1.1925 |
| SUMMER < 2500 | 1.2418 | 1.2093 | 1.1768 | 1.1022 | 1.0276 | 0.9126 | 0.9590 | 1.0366 | 1.1142 | 1.1979 | 1.2816 |

*Seasonal Trend Table factors are based on previous year ATR data. The table is updated yearly.
*Grey shading indicates months were seasonal factor is greater than 30%

2. Multiply the factor times by ADT to convert to AADT




## 5.8 Development of Volume-based Analysis Inputs

### 5.8.1 Existing Peak Hour Factors

Peak hour factors (PHF) are used to account for the non-uniformity of traffic flow within the peak hour by converting hourly volumes to peak flow rates associated with a selected interval of time within the peak hour. The most common interval of time selected for traffic analysis is the peak 15 minutes. In areas near capacity the peak 15-minute flow can cause up to several hours of congestion. This typically happens when the demand exceeds the available capacity of the transportation system resulting in “peak hour spreading”, which is the extension of the peak period caused by a system breakdown. Therefore, it is often essential that the transportation system be designed to accommodate the peak 15 minutes of the peak hour.

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.

### 5.8.2 Calculation

The PHF is typically calculated using data from traffic counts. It is the traffic volume during the peak 60-minute period divided by four times the volume during the peak 15-minute period.

$$PHF = \frac{\text{Volume During Peak 60-Minute Period}}{4 \times (\text{Volume During Peak 15-Minute Period})}$$

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

### 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.

### 5.8.4 Truck Factor Development and Documentation

Most deterministic analyses will require truck percentages. These can be developed directly from the counts or from the TruckSum spreadsheets. Truck percentages are made up of the bus, single unit, single trailer, and multiple trailer vehicle classifications. Exhibit 5-20 shows a typical intersection count with the necessary fields highlighted.

## Exhibit 5-20 Truck Classifications to use in an intersection count

**Traffic Count Summary Sheet**
**Transportation Development Division (S-W)**

Site: 19796 | Date: 10/1/2012
County: Douglas | Hours: 6:00 AM-10:00 PM
City: Roseburg | Highway #: 001
Milepoint: 123.80 | Location: I-5 s/b ramps @ Harvard Ave. & Bellows St.
Count Number: 1.00 | Weather: Clear

| Time of Day | Passenger | | Other 2 axle | | Sgl. Unit Truck | | | Sgl. Trailer Truck | | | Dbl. Trailer Truck | | | Trp. Trailer Trucks | | | Bus | Motor-cycle | Vehicles | Bicycle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Car | Wtrlr | Other | Wtrlr | 2 Axl | 3 Axl | 4+ Axl | 4- Axl | 5 Axl | 6+ Axl | 5- Axl | 6 Axl | 7+ Axl | 7- Axl | 8 Axl | 9+ Axl | | | | |
| 12:00 | 111 | 0 | 89 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 205 | 0 |
| 12:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13:00 | 129 | 0 | 92 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 227 | 0 |
| 13:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14:00 | 169 | 0 | 136 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 313 | 0 |
| 14:15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14:45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15:00 | 40 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 | 0 |
| 15:15 | 36 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 0 |
| 15:30 | 32 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 0 |
| 15:45 | 34 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 | 0 |
| 16:00 | 33 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 0 |
| 16:15 | 34 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 0 |
| 16:30 | 36 | 0 | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 47 | 0 |
| 16:45 | 26 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 0 |

This is the peak hour. This line will need to be "pulled" from each sheet for each direction and movement.

In the count shown above, truck volumes need to be added up for this movement (S-W) for the system peak hour. To calculate the truck percentage for the northbound approach from the south leg, sum the trucks from the S-W, S-N and S-E movements and divide by the total entering volume from the south leg. To calculate the percent trucks for each movement, divide the truck volume by the total volume for that movement.

Example calculation for Northbound Truck % on west leg (Note: Don't forget to include buses)

$$NB\ Truck\% = \sum \frac{S{\rightarrow}N_{truck} + S{\rightarrow}E_{trucks} + S{\rightarrow}W_{trucks}}{All\ NB_{veh}}$$

$$NB\ Truck\% = \sum \frac{(0) + (3+2+7+3) + (1+1+5)}{28 + 530 + 626}$$

$$NB\ Truck\% = \frac{22}{1184} \qquad NB\ Truck\% = 0.01858 = 1.86\%$$

Example calculation for S-W Truck %

$$S{\rightarrow}W\ Truck\% = \sum \frac{S{\rightarrow}W_{truck}}{All\ S{\rightarrow}W_{veh}}$$

$$S{\rightarrow}W\ Truck\% = \sum \frac{(1+1+5)}{626}$$

$$S \rightarrow W\ Truck\% = \frac{7}{626} = 0.0118 = 1.12\%$$

Some analysis tools have different splits than just a "percent trucks." Highway Capacity Software (HCS) has bus and recreational vehicle splits. Buses can be obtained from the count directly but the recreational vehicle split has to be ignored as ODOT does not specifically call out this vehicle type. Once the appropriate classifications to use are identified, the values are summed up by intersection approach (or movement if desired).

Truck percentages can also be determined from the TruckSum Spreadsheets (if individual bus splits were not needed). The TruckSum spreadsheets split out trucks into medium and heavy categories. Medium trucks are two-axle single unit and buses while heavy trucks are the three-axle and greater single unit and all combination vehicles. See Exhibit 5-21for identification of the peak hour medium and heavy percentages. The medium and heavy percentages in TruckSum can be summed to determine the final truck percentage to be used in the analysis.

**Exhibit 5-21 TruckSum vehicle classifications**

Sum the medium and heavy trucks (expressed as decimals) together to obtain the truck percentage on an intersection leg. For the east leg, the total truck percentage is 3.7% medium trucks and 0.8% heavy trucks for a total of 4.5%.

| PHV Trucks Only | | NORTH LEG | | | EAST LEG | | | SOUTH LEG | | | WEST LEG | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | volume | factor* | | volume | factor* | | volume | factor* | | volume | factor* |
| All factors apply | Medium | 0 | 0.000 | Medium | 19 | 0.037 | Medium | 15 | 0.048 | Medium | 8 | 0.027 |
| to PHV for Trucks | Heavy | 0 | 0.000 | Heavy | 4 | 0.008 | Heavy | 0 | 0.000 | Heavy | 4 | 0.014 |

Generally, the truck percentages are entered into analysis software and used as is. However, in some projects and plans where truck movement is a large concern (or part of the project need)

*Just using approach volumes would create areas where truck volumes would be inconsistent either by having trucks "disappear" or "appear" in the middle of a link or between links that would not make sense.*

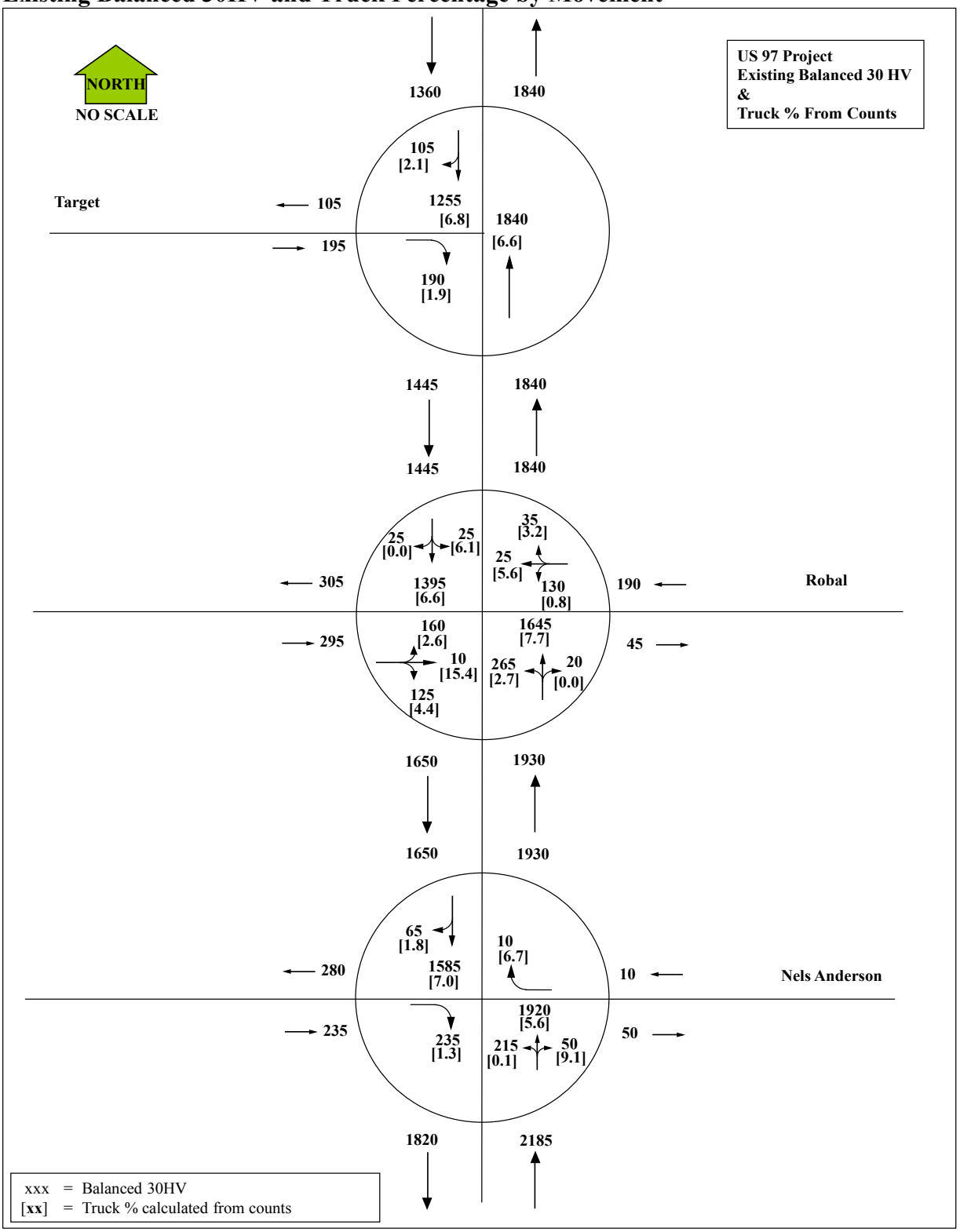
the truck percentages will need to be split out by movement and multiplied by the movement volume to determine the actual volume of trucks. This truck volume will need to be balanced as any other volume set and the actual truck percentages re-figured so the analysis is accurate. See Example 5-10 Actual Link Truck Factors.

## Example 5-10 Actual Link Truck Factors

When truck movements are of concern on a project, it may be necessary to balance the truck volumes. This requires the truck percentages from the counts as calculated above, as well as

balanced 30 HV volumes (see Exhibit 5-12). Truck volumes are not rounded as the final outputs desired are percentages. The Figure below shows the truck percentages that were calculated from the intersection counts and the balanced base year volumes.

**Existing Balanced 30HV and Truck Percentage by Movement**




Step 1: Calculate the 30HV Truck volumes by multiplying the calculated truck percentage and

the 30HV balanced total volume. Sample calculations for the Target intersection are shown below.

Sample Truck Volume Calculations for the Target intersection

$$Truck\ Vol = Truck\ \% \times Movement_{Total\ Vol}$$
$$N \rightarrow S_{truck\ vol} = 0.068 \times 1255 = 85.3 = 85\ Trucks$$
$$N \rightarrow W_{truck\ vol} = 0.021 \times 105 = 2.2 = 2\ Trucks$$
$$S \rightarrow N_{truck\ vol} = 0.066 \times 1840 = 121.4 = 121\ Trucks$$
$$W \rightarrow S_{truck\ vol} = 0.019 \times 190 = 3.61 = 4\ Trucks$$

Step 2: After calculating all raw truck volumes, they must now be balanced. Balance the truck volumes using the same procedure used to balance a network. In this example, the difference was split between Nels Anderson and Robal Rd. Then holding Robal Rd constant the volumes at Target were proportionally adjusted to balance the remainder of the network.

Step 3: Once the truck volumes have been balanced, a new balanced truck percentage must be calculated by dividing the balanced truck volume by the total balanced volume for each movement. Sample calculations for the balanced truck percentages for the Target intersection are shown below.

Sample Calculated Truck Percentages

$$Truck\ \% = \frac{Balanced\ Truck\ Vol}{Movement_{BalancedTotal\ Vol}}$$

$$N \rightarrow S_{Truck\ \%} = \frac{95}{1255} = 0.0756 = 7.6\%$$

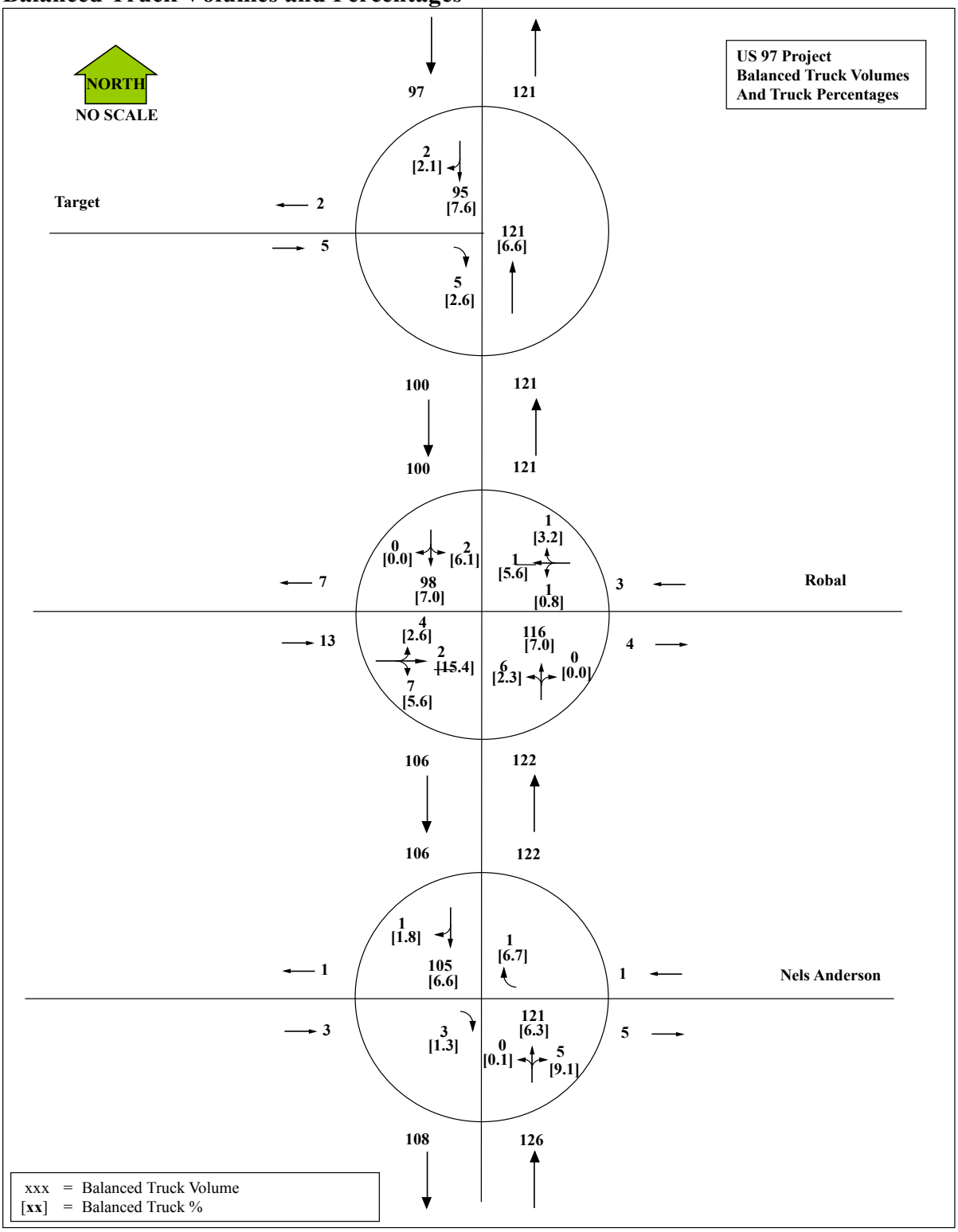
$$N \rightarrow W_{Truck\ \%} = \frac{2}{105} = 0.190 = 2.0\%$$

$$W \rightarrow S_{Truck\ \%} = \frac{5}{190} = 0.0263 = 2.6\%$$

$$S \rightarrow N_{Truck\ \%} = \frac{121}{1840} = 0.0657 = 6.6\%$$

The figure below shows the balanced truck volumes and the new calculated truck percentages. NOTE: The overall volumes do not change. The overall network is still balanced, no balanced volumes were changed. Only the truck volumes were changed and percentages adjusted to reflect the balancing of the truck volumes.

## Balanced Truck Volumes and Percentages



### 5.8.5 Analysis Input Documentation

It is recommended that the truck percentages for each approach be put on a figure for future reference and for ease of entering into software packages. On the same figure, approach PHF's, and K-factors should also be added. This will streamline the entering of data plus make it an easy reference for the preliminary signal warrant process (which uses K-factors). See Exhibit 5-22 for a sample figure.

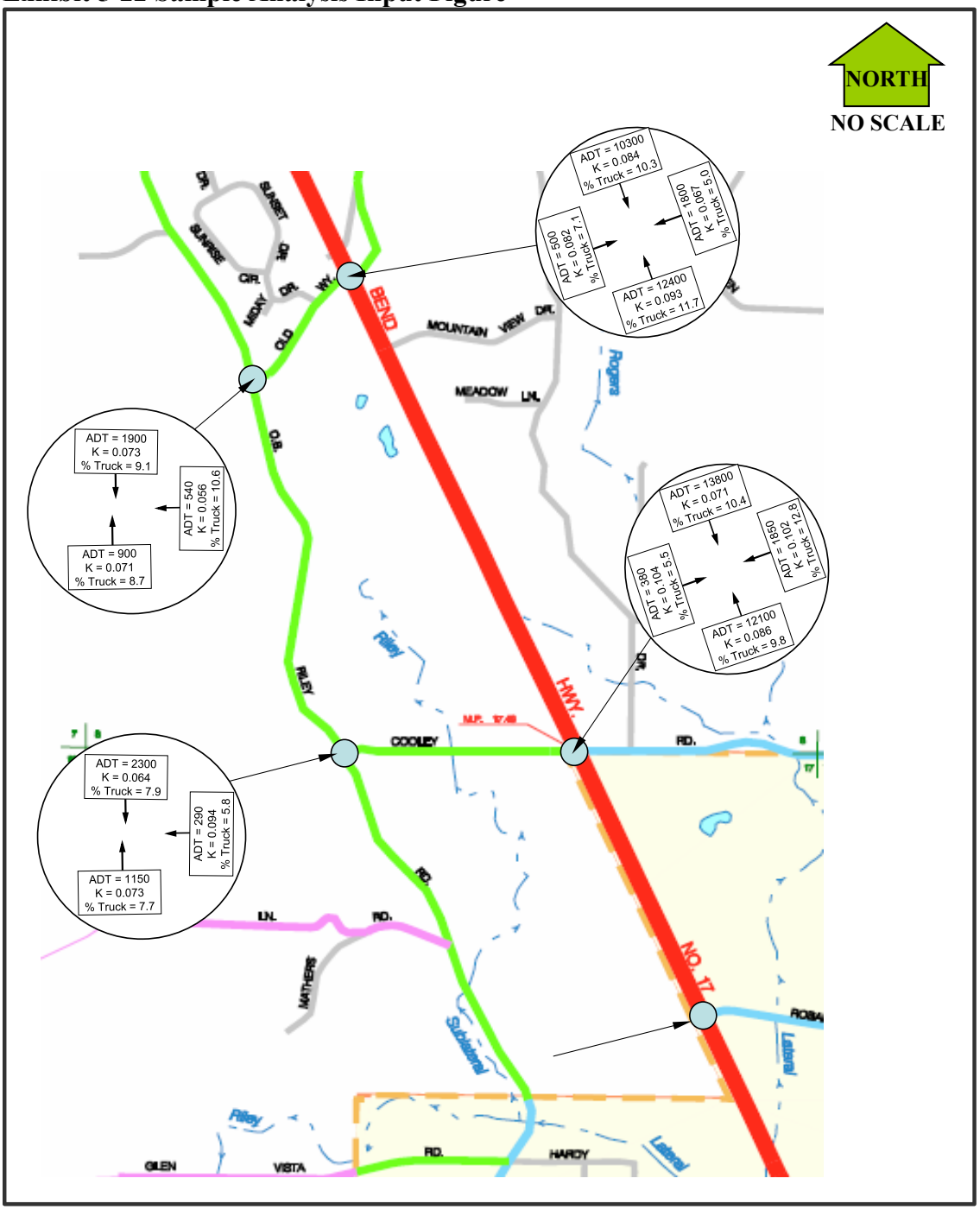



**Exhibit 5-22 Sample Analysis Input Figure**