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TECHNICAL MEMORANDUM #4

June 16, 2026 Project# 27003.058

To: John Lazur, Agency Project Manager, Oregon Department of Transportation (ODOT)

From: Edward Guo, Katie Popp, PE, and Nicholas Gross; Kittelson & Associates

RE: Cape Arago Highway Corridor Plan – Analysis Methodology and Assumptions – FINAL

Analysis Methodology and Assumptions Memorandum

Introduction

This memorandum documents the methodology and assumptions used to perform technical analysis for the Cape Arago Highway Corridor Plan (the "Project") including the evaluation of existing conditions, future conditions, alternatives analysis, and level of traffic stress (LTS). This memorandum describes the proposed methodology for the following assessments:

- Operational Analysis
- Safety Analysis
- Multimodal Analysis
- Access Management Analysis

Analyses will be informed by and conducted in accordance with the Oregon Department of Transportation (ODOT) *Analysis Procedures Manual* (APM), as well as relevant state, regional, and local planning standards.

Study Area

The Project study area is located in unincorporated Coos County, south of the City of Coos Bay limits. The study limits include the roadway facilities along Cape Arago Highway (OR540) within a state right-of-way from the Coos Bay city limits to the east abutment of the South Slough Bridge (mile point 4.49–8.2). The study locations identified for the Project include:

1. South Empire Boulevard/Fulton Avenue
2. Cape Arago Highway/Sunset Market
3. Cape Arago Highway/Charleston Fire Station
4. Cape Arago Highway/Miluk Drive
5. Cape Arago Highway/Hansons Barview Market

6. Cape Arago Highway/Wilshire Lane
7. Cape Arago Highway/Libby Lane

Study locations 1, 4, 6 and 7 are unsignalized intersections with traffic count data available through ODOT's Oregon Traffic Monitoring System (OTMS MS2). Study location 5 is located immediately adjacent to an unsignalized intersection (Cape Arago Highway/Windy Lane) with traffic count data available through OTMS MS2. These five locations (hereafter referred to as "study intersections") will be evaluated for vehicle operations, safety, and multimodal connectivity consistent with methodologies in the APM, as described in subsequent sections of this memorandum.

Study locations 2 and 3 are locations identified due to their proximity to transit stops and their relevance for walking and bicycling connections. Because these are not traditional intersections with available traffic volume data, operational analysis at these locations will not be performed. However, study locations 2 and 3 will be included in the multimodal analysis and reviewed for safety patterns and insights using available crash data, through a focused review rather than a full APM evaluation.

Figure 1 illustrates the study intersections based on their analysis type within the study area.

Figure 1. Study Area

Volume Development

The following sections describe how existing and forecast traffic volumes will be developed at the study intersections and how they will be used to evaluate existing and future traffic conditions in the Project study area. The 30th Highest Hour Volumes (30HV) for the Cape Arago Highway Corridor Plan will be developed based on historical traffic counts collected at the study intersections and the application of historical and seasonal adjustments consistent with methodologies identified in the APM.

TRAFFIC COUNTS

Sixteen-hour traffic counts for the five study intersections were obtained from the OTMS MS2 database (Attachment A) and will be converted to table format by Quality Counts for operational analysis.

Traffic counts for the following study intersections were collected on October 29, 2024, from 6 AM to 10 PM:

1. South Empire Boulevard/ Fulton Avenue
4. Cape Arago Highway/Miluk Drive
6. Cape Arago Highway/Wilshire Lane
7. Cape Arago Highway/Libby Lane

A traffic count for the following study intersection was collected on October 15, 2025, from 6 AM to 10PM:

5. Cape Arago Highway/Windy Lane

Counts include pedestrians, bicyclists, motor vehicles, and heavy vehicles that were at the intersection in 15-minute intervals.

HISTORICAL ADJUSTMENT

The Coos Bay/North Bend travel demand model (TDM) has a base model year of 2025. Therefore, the traffic counts at study intersections collected in 2024 will require a historical adjustment from 2024 to 2025 to reflect existing traffic conditions. According to Chapter 5 of the APM, historical adjustments are determined from information provided in ODOT's Future Volume Tables (FVT).

Six FVT sites are located on Cape Arago Highway within the study area and five of them (Site ID 3946 to 3950) fall within the Coos Bay/North Bend TDM area. The sixth most southern site (Site ID 3951) located outside of the TDM area has an R-squared value of 0.04. This R-squared value indicates a weak regression relationship; therefore, this site is not used in calculating the historical adjustment factor.

The annual growth rate for each of the five sites within the Coos Bay/North Bend TDM area was calculated based on the existing (2024) and forecast (2044) traffic volumes in the current FVT, consistent with the TDM. The average annual growth rate is approximately 0.10 percent. Because all study intersections requiring adjustment are located along the same corridor and the five FVT sites reflect similar growth trends, this average rate will be applied uniformly to all movements at all study intersections.

Historical adjustment calculations are displayed in Table 1, with an example calculation provided below.

Table 1. Historical Adjustment Information

Site ID	Mile Point	Description	Existing Daily Volumes (2024)	Future Daily Volumes (2044)	20-Year Growth Factor	Annual Growth Rate
3946	340	At south city limits of Coos Bay	10,000	10,300	1.03	0.15%
3947	5.09	South of Spaw Lane (0.02 mile)	9,400	9,600	1.02	0.11%
3948	5.95	South of Tarheel Lane (0.02 mile)	8,000	8,100	1.01	0.06%
3949	7.03	North of Henderson Lane (0.02 mile]	5,900	6,000	1.02	0.08%
3950	7.52	North of Wilshire Boulevard (0.02 mile)	5,500	5,600	1.02	0.09%
				Average annual growth rate of Site 3946 to 3950		***0.10%***

Example calculation for Site ID 3948:

20-year growth factor = 8,100/8,000 = 1.01

Annual growth rate = (1.01 – 1)/(2044 – 2024) = 0.06%

SEASONAL ADJUSTMENT METHODS

The APM identifies three methods for identifying seasonal adjustment factors for highway traffic volumes. All three methods utilize information provided by automatic traffic recorders (ATRs) located in select locations throughout the state highway system that collect traffic data 24 hours a day, 365 days a year. Each method was evaluated to determine the most appropriate method for the study intersections.

Below is a description of each seasonal adjustment method.

- **On-site ATR method**: Calculates seasonal adjustment factors based on local ATR locations. This method requires that no major study intersections be located within the ATR and the Project Area and Average Annual Daily Traffic (AADT) be within 10 percent of the AADT within the Project Area.
- **Characteristics table**: Calculates seasonal adjustment factors based on representative ATR sites from locations around the state based on AADT, seasonal traffic trends, area type, number of travel lanes, etc.
- **Seasonal trends table**: Calculates seasonal adjustment factors based on seasonal variation trends from representative travel patterns (summer, commuter, weekend, etc.).

Based on this evaluation, the seasonal trends table method will be used to develop a seasonal adjustment factor. This method is appropriate because there is no ATR located within the immediate study area. A review of historical count data from the broader Project vicinity indicates that August is generally the peak traffic month, and the traffic pattern most closely aligns with a commuter trend.

Table 2 summarizes the seasonal trends table factors from ODOT's 2024 Seasonal Trend Table used to calculate the seasonal adjustment factor. Seasonal adjustment factors were calculated for the commuter trend based on the factors from October 15 and November 1 and interpolated to October 29, as four study intersections had traffic counts collected on October 29.

Table 2. Commuter Trend Table Calculations

Date	Factor	Seasonal Trend Peak Period Factor	Seasonal Adjustment Factor
October 15	0.9565	0.9388	1.02
November 1	0.9968	0.9388	1.06
October 29*			1.05

*Interpolated based on October 15 and November 1 factors.

Example calculation for October 15:

Seasonal adjustment factor = 0.9565/ 0.9388 = 1.02

Based on the data shown in Table 2, a seasonal adjustment factor of 1.05 will be applied to the counts at the study intersections 1, 4, 6, and 7, which had their counts collected on October 29. The counts at study intersection 5 were collected on October 15, and will have a seasonal adjustment factor of 1.02 applied to its traffic counts.

PEAK HOUR SELECTION

Based on review of the historic traffic count data, the study intersections have the following peak hours:

- 1. South Empire Boulevard/Fulton Avenue: 4:30–5:30 PM (890 total entering vehicles [TEV])
- 4. Cape Arago Highway/Miluk Drive: 3:30–4:30 PM (686 TEV)
- 5. Cape Arago Highway/Windy Lane: 3:30–4:30 PM (602 TEV)
- 6. Cape Arago Highway/Wilshire Lane: 3:30–4:30 PM (473 TEV)
- 7. Cape Arago Highway/Libby Lane: 3:15–4:15 PM (497 TEV)

The South Empire Boulevard/Fulton Avenue intersection is located at the edge of the Project limits and within city boundaries and therefore may not be representative of conditions along most of the study corridor. For this reason, the Project team proposes using a system peak hour of 3:30–4:30 PM for analysis of the study intersections. This time period aligns with the identified peak hour at Miluk Drive, Windy Lane, and Wilshire Lane, and closely aligns with that at Libby Lane, making it more representative of conditions along most of the study corridor.

FORECAST TRAFFIC VOLUMES

Consistent with guidance provided in Chapter 6 of the APM and based on the available model outputs from the Coos Bay/North Bend TDM, the year 2045 was selected as the future analysis year. This reflects typical 20-year planning horizon from the model base year of 2025 and is aligned with the future output year for the Coos Bay/North Bend TDM.

Forecast traffic volumes for the 2045 analysis year will be developed in accordance with Chapter 6 of the APM, which outlines procedures and guidance for applying methodology identified in the National Cooperative Highway Research Program (NCHRP) Report 765 *Analytical Travel Forecasting Approaches for Project-Level Planning and Design*. As part of the NCHRP 765 methodology, the 2025 30HV volumes will serve as the basis for forecasting, and growth between years 2025 and 2045 will be derived from TDM base and future year outputs. Growth may be applied using the appropriate method based on guidance from Chapter 6 of the APM (i.e., growth method, difference method, weighted growth method, or an average of the difference method and the weighted growth method), depending on the observed difference between base and forecast model link volumes.

Because the TDM base year corresponds to the year of the developed 30HV for the existing analysis year, no interim base-year adjustment of link volumes is anticipated. Model base year volumes will be compared to 30HV volume data to confirm reasonable alignment. Any significant discrepancies between observed counts and model volumes will be reviewed, documented, and coordinated with the ODOT modeling team as necessary to confirm analysis assumptions.

Operational Analysis

The operational analysis will evaluate peak hour traffic operations of the study intersections under existing conditions and through the Project planning horizon to identify potential capacity constraints and alternatives. This section summarizes the traffic analysis methodology including applicable intersection operational standards and analysis parameters and assumptions.

INTERSECTION MOBILITY TARGETS

The study intersections include state and city-owned and maintained facilities. As such, mobility targets were determined from the applicable jurisdiction.

State Facilities

Cape Arago Highway is owned and maintained by ODOT south of Coos Bay city limits. Therefore, analysis of intersections on Cape Arago Highway (OR 540) will be evaluated against ODOT Mobility Targets provided in the *Oregon Highway Plan* (OHP) and ODOT *Highway Design Manual (HDM)*, as applicable.

Table 6 of the OHP and Table 1200-2 of the HDM provide maximum volume-to-capacity (v/c) ratios for all signalized and unsignalized intersections outside the Portland metro area. The OHP ratios are used to evaluate existing and future no-build conditions, while the HDM ratios are used to assess future design alternatives in the study area.

Cape Arago Highway is a district highway that is not a freight route, and the study intersections on the highway are located outside of the City of Coos Bay urban growth boundary (UGB), but within an unincorporated community. The OHP further states that non-state highway approaches to state highways are expected to meet or not to exceed the v/c ratios for district/local interest roads in OHP Table 6, except within the Portland metropolitan area UGB.

These characteristics were used to determine the mobility targets for the study intersection on the highway, as summarized in Table 3.

City Facilities

South Empire Boulevard and Fulton Avenue are both owned and maintained by the City of Coos Bay and subject to city mobility targets. According to the 2020 *Coos Bay Transportation System Plan*, city streets shall maintain a level of service (LOS) of "D" during the peak 15 minutes of the day. Therefore, this mobility target will be applied for intersection 1.

Table 3 summarizes intersection mobility targets for ODOT and city facilities.

Table 3. Intersection Mobility Targets

Map ID	Intersection	Jurisdiction	OHP Target	HDM Standard	Local Standard
1	South Empire Boulevard/Fulton Avenue	City	N/A	N/A	LOS D
4	Cape Arago Highway/Miluk Drive	ODOT	0.80	0.75	N/A
5	Cape Arago Highway/Windy Lane	ODOT	0.80	0.75	N/A
6	Cape Arago Highway/Wilshire Lane	ODOT	0.80	0.75	N/A
7	Cape Arago Highway/Libby Lane	ODOT	0.80	0.75	N/A

MODELING SOFTWARE AND PARAMETERS

The following data sources and methodologies are proposed for conducting traffic analysis. Analysis of state facilities will be conducted according to the APM, unless otherwise agreed upon by both ODOT's Transportation Planning and Analysis Unit (TPAU) and the consultant team.

- **Intersection/road geometry** (number of lanes, lane configurations, cross-section elements, etc.) will be collected through aerial photography and site visits. Available as-built data may also be used to verify existing roadway geometry. The analysis models will be constructed on scaled roadway line work from GIS or aerial photography.
- **Operational data** (posted speeds, intersection control, rail crossings, etc.) will be collected through aerial or on-street photography, ODOT's TransGIS platform, and confirmed through site visits.

- **Peak hour factors** (PHFs) will be calculated for each intersection and applied to the existing conditions analyses. Per the APM, the default PHF that will be used for the future conditions assessment if the existing calculated PHFs are lower than 0.85 for collector-collector or lower classification intersections. When the calculated PHFs are higher than 0.85, the calculated PHFs are used for the analysis.
- **Traffic volume development** is described in previous sections.
- **Synchro software, Version 12** will be used for the existing and future intersection analyses. The reported results will be the LOS, intersection delay, and v/c ratios generated by the *Highway Capacity Manual 7th Edition* report.

Table 4 summarizes the Synchro software and input assumptions for the traffic analysis.

Table 4. Existing/ Future Synchro Analysis Assumptions

Intersection Parameters	Existing Conditions Assumptions
Peak hour factor	From traffic counts (existing conditions); from APM Chapter 5, Section 5.9.3 (future analysis)
Conflicting bikes and pedestrians per Hour	From traffic counts (as available)
Area type	Based on local conditions
Ideal saturation flow rate (all movements)	1,750 passenger cars per hour per lane
Lane width	12 feet (unless field observations suggest otherwise)
Percent heavy vehicles (all movements)	From traffic counts (as available)
Percent grade	Estimated based on field observations
95th percentile and average vehicle queues	Synchro HCM summary output

Safety Analysis

The safety analysis will review the most recent 5 years of crash data at the study intersections and along the study area corridor reported by ODOT's Crash Analysis & Reporting Unit. The crash data will be analyzed at each intersection and the roadway segments in between for number, type, severity, and location to identify crash patterns. Intersection crash rates will be calculated in terms of crashes per million entering vehicles, and segment crash rates will be calculated in terms of crashes per million vehicle miles, consistent with APM Chapter 4 guidance.

The APM Chapter 4 outlines screening methods for Critical Crash Rate and Excess Proportion of Specific Crash Types with an emphasis on crashes involving people walking, biking, or rolling. However, based on the preliminary review of the available crash data, these statistical screening methods are not anticipated to be applicable. The APM indicates that both methods require a minimum reference population of at

least five similar intersections or segments to produce statistically valid results. Because this study includes four 3-legged roadway intersections and one 4-legged roadway intersection, application of the Critical Crash Rate and Excess Proportion screening methods would not meet APM validity thresholds.

Observed intersection crash rates will be compared to the 90th percentile crash rates in APM Exhibit 4.1; observed segment crash rates will be compared to the Statewide Crash Rate Table averages for rural areas. Locations exceeding the 90th percentile intersection rate or the statewide segment average rate will be flagged for further review.

These calculations will be provided in *Technical Memorandum #6*, which will document the safety analysis findings. An example calculation is provided below.

Example observed intersection crash rate calculation:

Step 1: Calculate the volume in MEV:

$$MEV = \frac{Average\ Annual\ Daily\ Traffic\ (AADT)\ \times 365\ \times\ n}{1{,}000{,}000}$$

$$MEV = million\ entering\ vehicles, n = number\ of\ years$$

Step 2: Calculate the crash rate at each intersection:

$$R = \frac{Crash\ total}{MEV_n}$$

$$R = Observed\ crash\ rate$$

ODOT-published AADT values will be used for the crash rate calculation, not raw count volumes.

In addition, ODOT's top 10 percent ODOT Safety Priority System sites will be reviewed, as appropriate. Any identified potential countermeasures and resulting crash percentage reductions for intersections and segments on Cape Arago Highway will be taken from the ODOT Crash Reduction Factor (CRF) Manual in consultation with ODOT for applicability and support.

Multimodal Analysis

The multimodal analysis will be performed for the Cape Arago Highway within the study area. Informal walkways or trails along roads within the study area will be noted as a qualitative observation.

Existing facility conditions, such as the presence of bike lanes or sidewalks, paved shoulder widths, physical buffers, or facility conditions will be collected through aerial photography, street view images, and site visits. Anticipated future facility conditions will be determined through the recommendations developed in the Cape Arago Highway Corridor Plan.

The multimodal analysis in this report consists of two components and will be conducted in accordance with the APM:

- **Qualitative multimodal analysis (QMA):** A QMA will be performed in accordance with Chapter 14 of the APM for transit facilities within the project area including Coos County Area Transit (CCAT) fixed-route stops. Transit stops will be assessed using qualitative criteria and assigned ratings of Excellent, Good, Fair, or Poor. Transit ridership data from public transit agencies serving the study corridor will be used to supplement the analysis.
- **Level of traffic stress (LTS) analysis**: A quantitative evaluation for pedestrians and bicyclists consisting of pedestrian LTS (PLTS) and bicycle LTS (BLTS). LTS analysis will be performed for the pedestrian and bicycle facilities using methods defined in Chapter 14 of the APM.

QMA and LTS findings are based on existing site conditions as reviewed via aerial and street-level imagery as well as a site visit. Any findings from this analysis will be compared to data provided in the Oregon Transportation Safety Data Explorer, particularly the BLTS and the Vulnerable Road User Assessment Pedestrian and Bicycle Risk scores. Any discrepancies will be described in the analysis and brought to the attention of ODOT, as appropriate.

Access Management Analysis

The access management analysis will consist of a corridor-level qualitative assessment of existing approaches, intersections, driveways, and access points along Cape Arago Highway within the Project Area. The assessment will identify access management characteristics, patterns, opportunities, and constraints, with a particular focus on locations where access conditions may contribute to pedestrian, bicycle, or motor vehicle safety concerns.

The review will be informed by available ODOT access inventory data, aerial imagery, and field observations collected during the site visit. Given the total number of 218 access points along the corridor based on ODOT Official Project Access List (OPAL) data as well as the planning-level nature of this study, the assessment will not include a parcel-by-parcel quantitative evaluation of individual access characteristics. Instead, the analysis will focus on identifying corridor-wide trends and locations where access management strategies could improve multimodal safety and operations.

As improvement concepts and alternatives are developed, potential impacts to existing accesses will be evaluated for consistency with applicable ODOT access management standards pursuant with OAR 734-051-4020 and highway design standards from the HDM in subsequent project development phases.

ACCESS MANAGEMENT STANDARDS

OAR 734-051-4020 defines the standards and criteria for approval of private approaches on State Highways, including channelization (Table 1), intersection sight distance (Table 2), and spacing (Tables 3-10). Cape Arago Highway within the study area is classified as a district highway with an AADT exceeding 5,000 vehicles, posted speeds of 35 to 40 miles per hour (mph), and location in unincorporated urban areas. Per OAR 734-051-4020 Table 6, the applicable access management spacing standards are 350 feet for segments with a posted speed of 35 mph and 500 feet for segments with a posted speed of 40 mph.

Next Steps

The details of this memorandum have been reviewed by the Project Management Team (PMT), ODOT technical staff, including ODOT's Transportation Planning Analysis Unit (TPAU) and will guide the analysis to be conducted in *Technical Memorandum #6*.