

APPENDIX C

**SKAMANIA QUARRY; TRANSPORTATION IMPACT STUDY
PREPARED BY DKS
DATED FEBRUARY 19, 2020**

SKAMANIA QUARRY

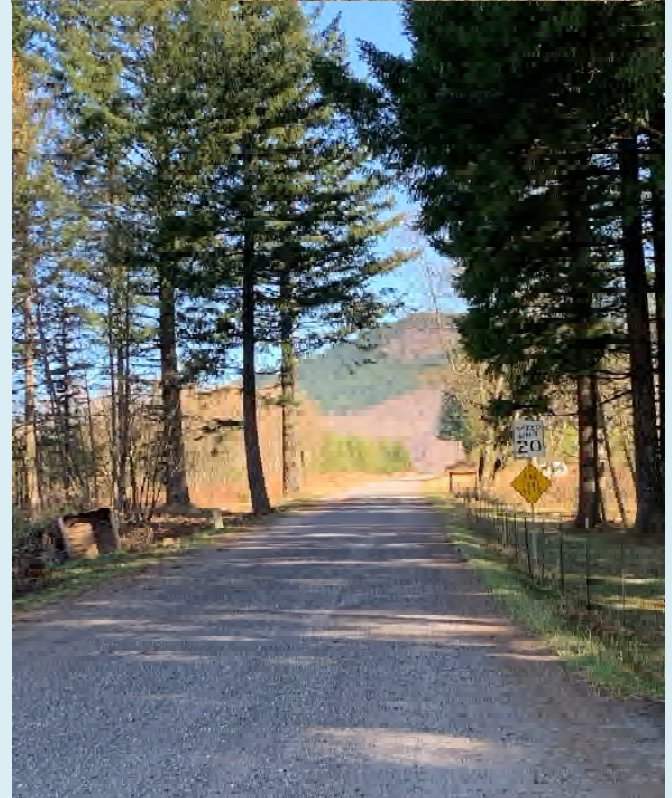
TRANSPORTATION IMPACT STUDY

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FEBRUARY 19, 2020





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BACKGROUND

A new rock quarry is being proposed in Skamania County, Washington. The report presents the transportation impact analysis and findings associated with the proposed development. The analysis investigated potential operational and safety impacts along Salmon Falls Road just north of Highway 14. The quarry would be located near the end of Mabee Mines Road, to the northeast. The impact analysis included an evaluation of study intersection operations for the year 2022 without and with the proposed project. The identified project impacts and recommended mitigations are presented in the following sections.

EXISTING CONDITIONS

The existing conditions section has been compiled to include an evaluation of the study area and descriptions of the study area roadway network, traffic volumes and operations. Collision data at study area intersections has also been summarized for the prior five years of full data.

Study Area Roadway Network

The roadway network analyzed included roads under the jurisdiction of Skamania County and Washington State Department of Transportation (WSDOT). Figure 1 shows the roadway network in the study area and the locations of the study intersections. A field visit was conducted on Tuesday November 5, 2019 to inventory roadway characteristics, pavement markings, traffic control type and observe peak period vehicle operations and safety. The study intersections included:

- Salmon Falls Road/ Highway 14
- Salmon Falls Road/ Canyon Creek Road/ Ryan-Tavelli Road
- Salmon Falls Road/ Mabee Mines Road

Three roadway sections were also analyzed for roadway conditions and measurements. These segments and their study lengths are:

- McCloskey Road - Proposed site access to Mabee Mines Road (0.7 miles)
- Mabee Mines Road - McCloskey Road to Salmon Falls Road (2.2 miles)
- Salmon Falls Road - Mabee Mines Road to Highway 14 (0.8 miles)



Figure 1: Study Area

Pedestrian Facilities

Pedestrians were counted with the study intersection turn movement data collected October 22, 2019 and no pedestrian activity was observed throughout the study area. There were no pedestrian facilities (such as sidewalks, ramps) at any of the study intersections during the morning or evening peak hours.

Bicycle Facilities

Bicycle facilities in the form of bike lanes or wide shoulders are not provided at any of the study intersections. Bicyclists were counted in the study intersection turn movement data collected October 22, 2019. No bicyclists were observed to ride through the study intersections during the morning or evening peak hours.



Roadway Facilities

Roadway Cross Sections

Cross sections were measured in the field for each study roadway segment. The roadway measurement represents the width of the paved roadway (not including gravel or dirt shoulder area). McCloskey Road, which is a single lane road, was measured to be between 16 to 20 feet, a width that was inconsistent along the length of the roadway.

From the field visit, it appeared that a 12-foot wide travel lane in each direction was present for the entire length of the Mabee Mines Road and Salmon Falls Road study segments. A 12-foot lane provides desirable clearances between large commercial vehicles traveling in opposite directions on straight two-lane, two-way rural highways when either high traffic volumes or high percentages of trucks are expected.¹

Shoulders

Along the three study roadway segments, no shoulders were present, except for Mabee Mines Road, which occasionally had a small compacted gravel shoulder.

Signing

Roadway signing along the study segments consisted of regulatory signs, warning signs, and guide signs. The majority of regulatory signs observed were STOP signs and SPEED signs, as well as signs indicating limited sight distance. McCloskey Road is signed to indicate that it is a single lane road. All signing appeared to be in good condition.

Pavement Markings

Pavement markings in good condition were observed along the length of the study roadway segments. The edge of pavement lines (fog lines) were present and clearly visible on both sides of the roadways. Centerline pavement markings and sign inventory can be seen in Figure 2. The centerline markings appeared to be correctly applied based on the roadway's horizontal and vertical curves. Figures 3 and 4 shows an example of the pavement markings within the study area.

¹ *Geometric Design of Highways and Streets*, Fifth Edition, Chapter 4 Cross Section Elements, page 311, American Association of State Highway and Transportation Officials (AASHTO), Washington, D.C., 2004.

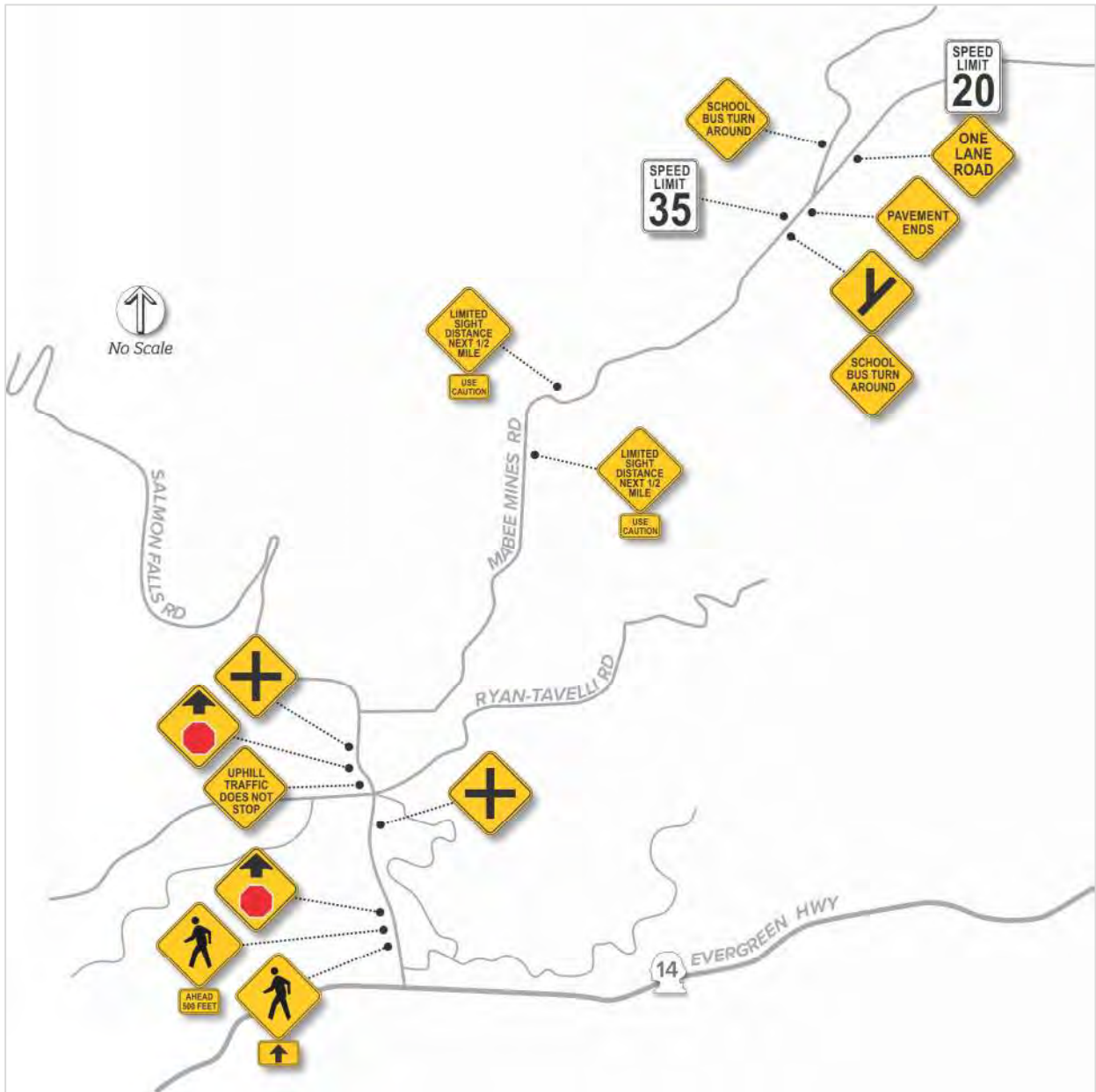


Figure 2: Sign Inventory and Centerline Pavement Markings



Figure 3: Example of Pavement Markings



Figure 4: Example of Pavement Markings

Pavement Conditions

The general pavement conditions along the corridor were noted as part of the field work performed. The existing pavement condition along Mabee Mines Road and Salmon Falls Road was in good condition. The pavement was generally smooth, with limited signs of surface distress. McCloskey Road was a compacted gravel one-lane road, as shown in Figure 5.



Figure 5: McCloskey Road



Sight Distance

Stopping sight distance and intersection sight distance were evaluated along the study roadway segments. Stopping sight distance is the space needed for a vehicle travelling at or near the design speed to stop before reaching a stationary object in its path. Intersection sight distance is the space needed for a driver accessing the major roadway from a minor roadway to make a left turn onto the major roadway and accelerate without unduly slowing oncoming traffic.

The sight distance evaluation was based on AASHTO sight distance requirements.² The evaluation identified a potential vertical sight distance issue at the intersection of Salmon Falls Road and Canyon Creek Road-Ryan Tavelli Road. There was an upward grade in the northbound direction. However, all approaches are stop sign controlled except for the northbound approach. No other sight distance issues were identified.

Motor Vehicle Volumes

Weekday motor vehicle turn movement counts³ were collected at the study intersections in October 2019. The raw count data was adjusted to represent seasonal high volumes for use in the operational analysis. The seasonal factor applied was calculated using available data from the closest WSDOT permanent traffic recording stations on SR 14 (at mile post 17.70). The seasonal adjustment factor for counts conducted in October is 1.00.⁴ This factor was applied to the SR 14 and Salmon Falls Road intersection counts.

No seasonal factor was applied to the remaining study intersections. The study intersections under County jurisdiction and were conducted in October when traffic volumes were estimated to be seasonally stable with little variation due to weather or recreation users. Figure 6 shows the motor vehicle turn movement volumes for the study area intersections with season adjustments (as applicable).

² AASHTO – *Geometric Design Highways and Streets*, 6th edition, 2011.

³ Traffic counts were conducted by Quality Counts on Tuesday, October 22, 2019 during the morning (6:00 to 8:00 a.m.) and evening (4:00 to 6:00 p.m.) peak periods.

⁴ 2016 Annual Traffic Report, Washington State Department of Transportation.

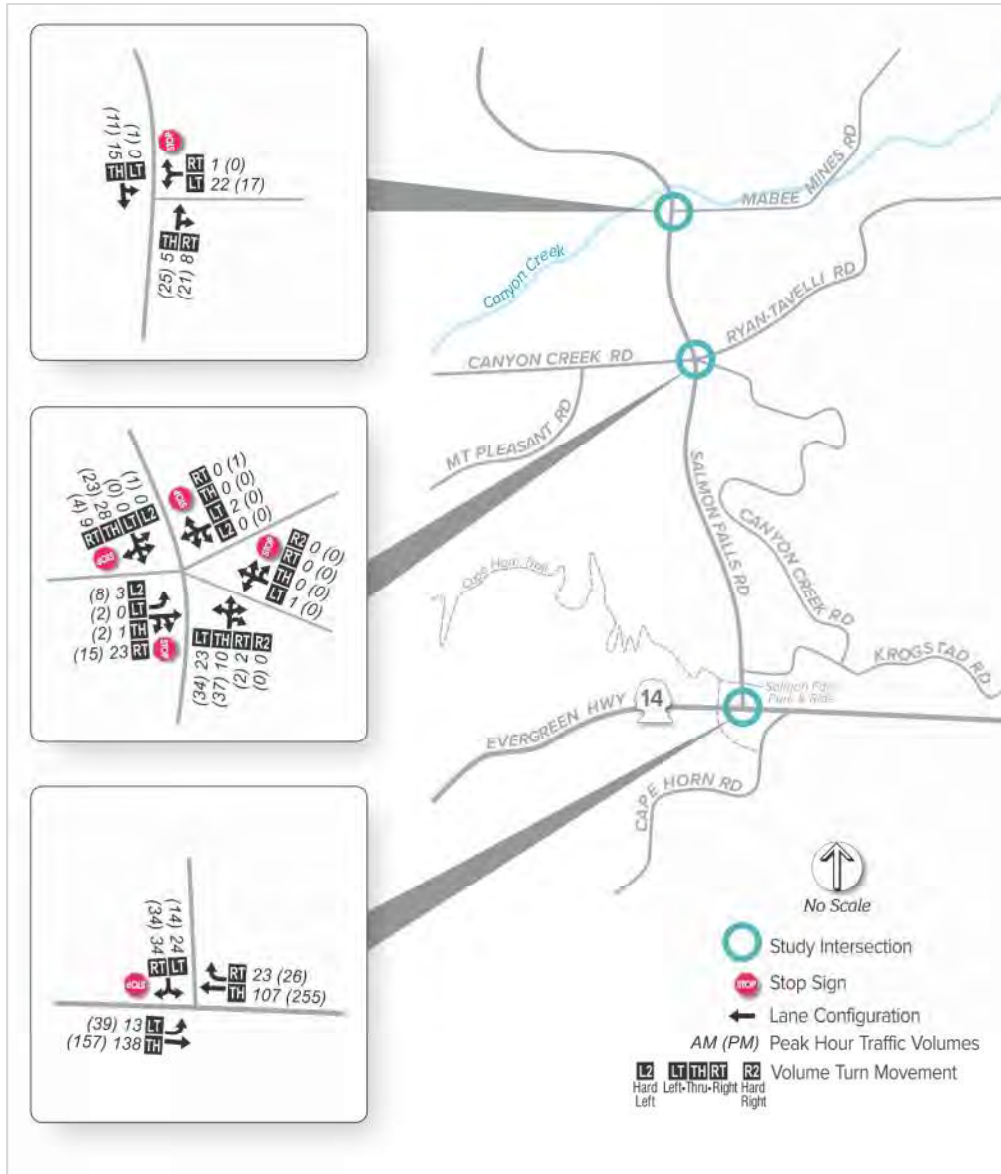


Figure 6: Existing Year 2019 Vehicle Volumes

Truck Volumes

Truck volumes entering the study intersections were recorded as part of the motor vehicle counts conducted on October 22, 2019. Figure 7 shows the total entering volume of trucks. The highest volume of vehicles and trucks was recorded at the intersection of SR 14 and Salmon Falls Road. The lowest volume of vehicles and trucks was recorded at the intersection of Salmon Falls Road, Canyon Creek Road and Ryan-Tavelli Road.

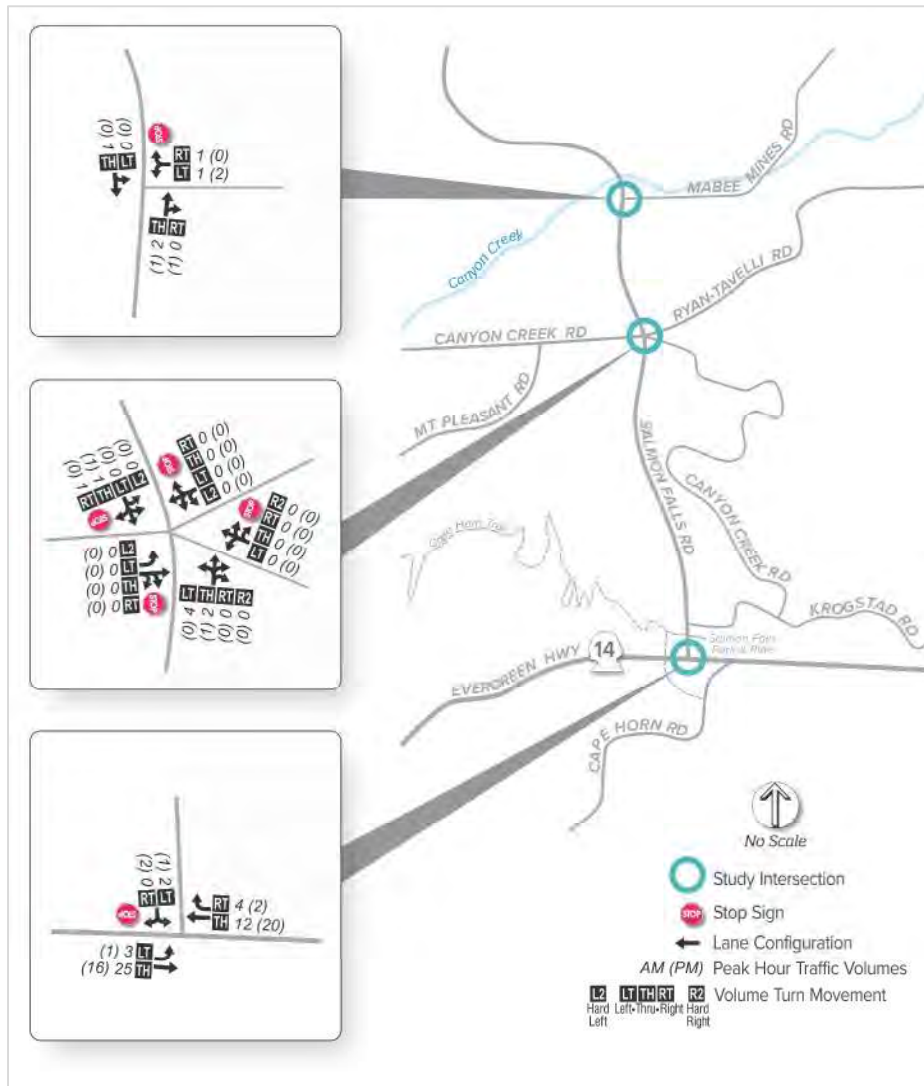


Figure 7: Existing Heavy Vehicle Volumes



Study Intersection Operational Analysis

An operational analysis of existing conditions was performed for the study intersections using the vehicle volumes developed for the morning and evening peak hours. This analysis includes a rating of the intersection’s performance based on average motor vehicle delay, a level of service (LOS), and a ratio of the volume of vehicles to the capacity of the intersection. Existing LOS was calculated using Synchro 10 software, which follows the *Highway Capacity Manual* (HCM) 6 methodology⁵.

An intersection’s LOS is similar to a “report card” rating, based on average vehicle delay. LOS A, B, and C indicate conditions where vehicles can move freely. Level of service D, E and F are progressively worse. Skamania County uses WSDOT level of service standards for determining the operating adequacy of both signalized and unsignalized intersections. The standard is LOS C in rural areas.⁶

It is important to understand that LOS for unsignalized intersections is computed differently and based on different criteria than signalized intersections. Whereas signalized intersection analysis provides an overall assessment of intersection or approach operating conditions, unsignalized intersection analysis provides LOS for individual movements at an intersection. At many unsignalized intersections, the majority of through moving vehicles on the major street travel through without any delay. The LOS designation of an unsignalized intersection is the LOS of the major street followed by the LOS of the minor street.

Volume to capacity ratio (v/c) is similar to LOS but is a ratio of the volume of vehicles traveling through an intersection to its calculated capacity. The v/c ratio is also an indicator of the amount of intersection capacity being used by traffic demand. A v/c ratio of 0.70 indicates that 70% of the intersection capacity is currently being used.

Table 1 shows the existing intersection performance (delay, LOS, and volume-to-capacity ratio) measures for the morning and evening peak hours. Under the existing conditions, intersection performance standards have been met at all the locations. Traffic count data and the HCM results are included in the Appendix.

Table 1: Existing Intersection Operations

Intersection	Morning Peak Hour			Evening Peak Hour			Agency Standard	Intersection Control
	Delay	LOS	V/C	Delay	LOS	V/C		
Evergreen Hwy (SR 14) and Salmon Falls Rd	7.8/9.9	A/A	0.01/0.08	8.0/11.0	A/B	0.03/0.08	C	Unsignalized 1-way stop
Salmon Falls Rd and Mabee Mines Rd	0.0/8.8	A/A	0.00/0.03	7.3/9.0	A/A	0.00/0.02	C	Unsignalized 1-way stop
Salmon Falls Rd, Canyon Creek Rd, and Ryan-Tavelli Rd	7.4/9.4	A/A	0.02/0.05	7.3/9.6	A/A	0.02/0.03	C	Unsignalized 4-way stop (NB Salmon Falls Rd does not stop)

Delay = Average delay per vehicle

LOS = Level of Service

Signalized (X) = Average LOS for intersection

Unsignalized (X/X) = Major Street/Minor Street

v/c = volume to capacity ratio

Agency Standard applied to mainline and minor street approaches

⁵ 2016 *Highway Capacity Manual*, Transportation Research Board, Washington, D.C. 2016.

⁶ *Design Manual*, Washington State Department of Transportation, Olympia, WA, 2011



Study Intersection Collision Analysis

A collision analysis was conducted for the study intersections. Collision data for the study intersections was obtained from WSDOT for the period from 2014 through 2019. The collision data and 2019 traffic counts were used to calculate the collision rates at the study intersections. Table 2 summarizes the collisions experienced at each study intersection, and the resulting collision rate in the number of collisions per million vehicles entering the intersection.

Within the study area, none of the study intersections had a collision rate higher than 1.0. Therefore, there is no indication of a safety problem at the study intersections.

Table 2: Collision Data Summary by Intersection (2014 through 2019)

Intersection	PDO	Injury	Fatal	Total	Collision Rate
Salmon Falls Rd @Canyon Creek Rd/Ryan Tavelli Rd	1	0	0	0	0.365
Canyon Creek Rd (west leg) @Salmon Creek Rd	0	0	0	0	0
Ryan Tavelli Rd (east leg) @Salmon Creek Rd	0	0	0	0	0
Salmon Falls Rd @ Mabee Mines Rd	0	0	0	0	0
Salmon Falls Rd @SR 14	0	0	0	0	0
SR 14 @Salmon Falls Rd	1	1	0	0	0.166

Note: Collision Rate is expressed in Collisions per Million Entering Vehicles

PDO = A collision that resulted in Property Damage Only

Injury = A collision that resulted in an injury

Fatal = A collision that resulted in a fatality



FUTURE 2022 CONDITIONS ANALYSIS

The future year 2022 conditions analysis includes a description of the reasonably funded projects assumed to be in place in the future, estimate of trip generation, trip distribution and study intersection operational analysis for the Baseline and Proposed Project Conditions scenarios.

There were no identified funded transportation projects within the study area.

2022 Baseline Conditions Analysis

Future volume forecasts for the Baseline Conditions were developed using a growth rate of one percent per year. Figure 8 shows the future 2022 Baseline Condition volumes at the study intersections with this applied growth rate.

Truck volumes for the future scenarios were developed similarly to the motor vehicle volumes. Figure 9 shows the truck volumes for the future 2022 Baseline Conditions.

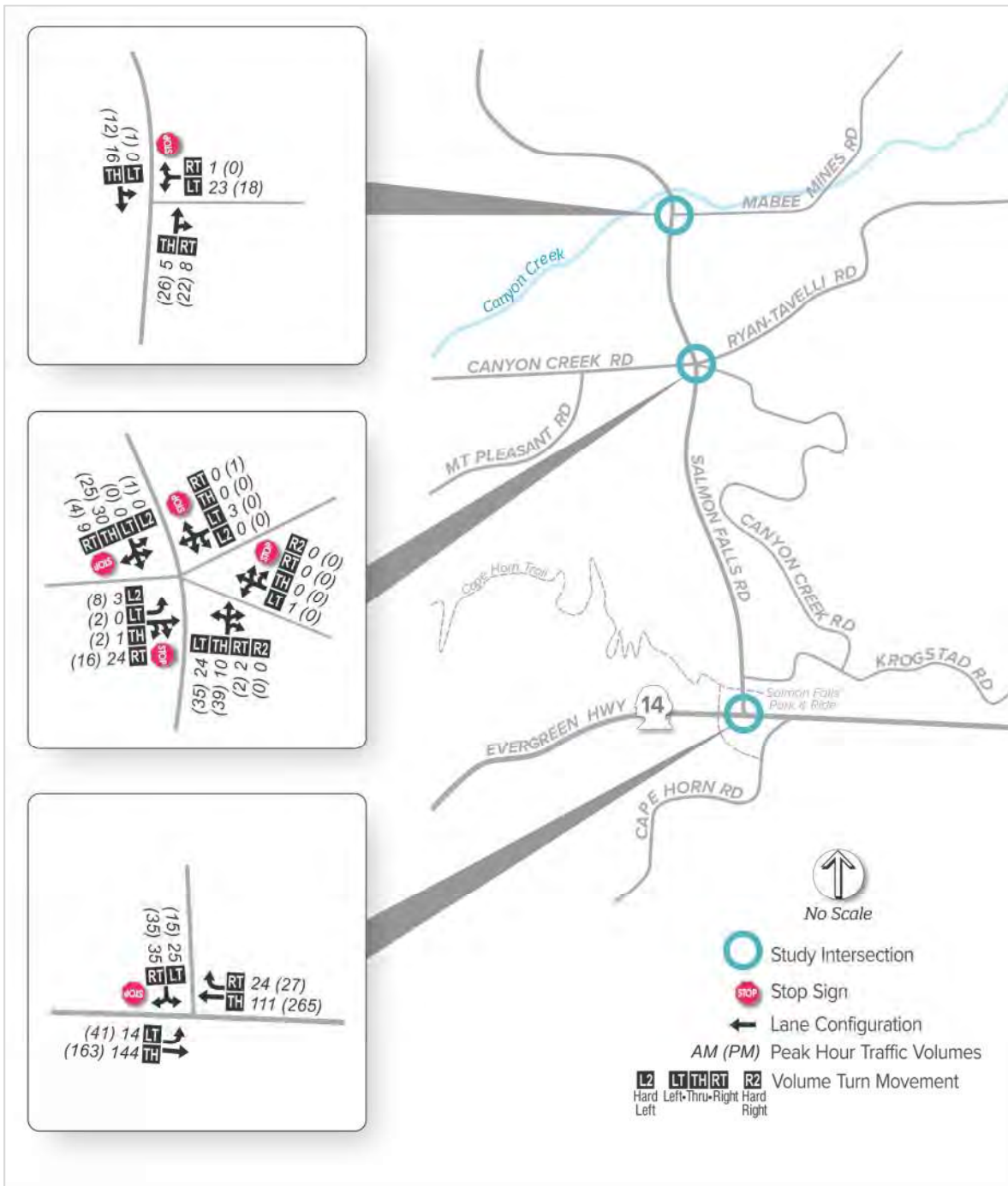


Figure 8: 2022 Baseline Vehicle Volumes

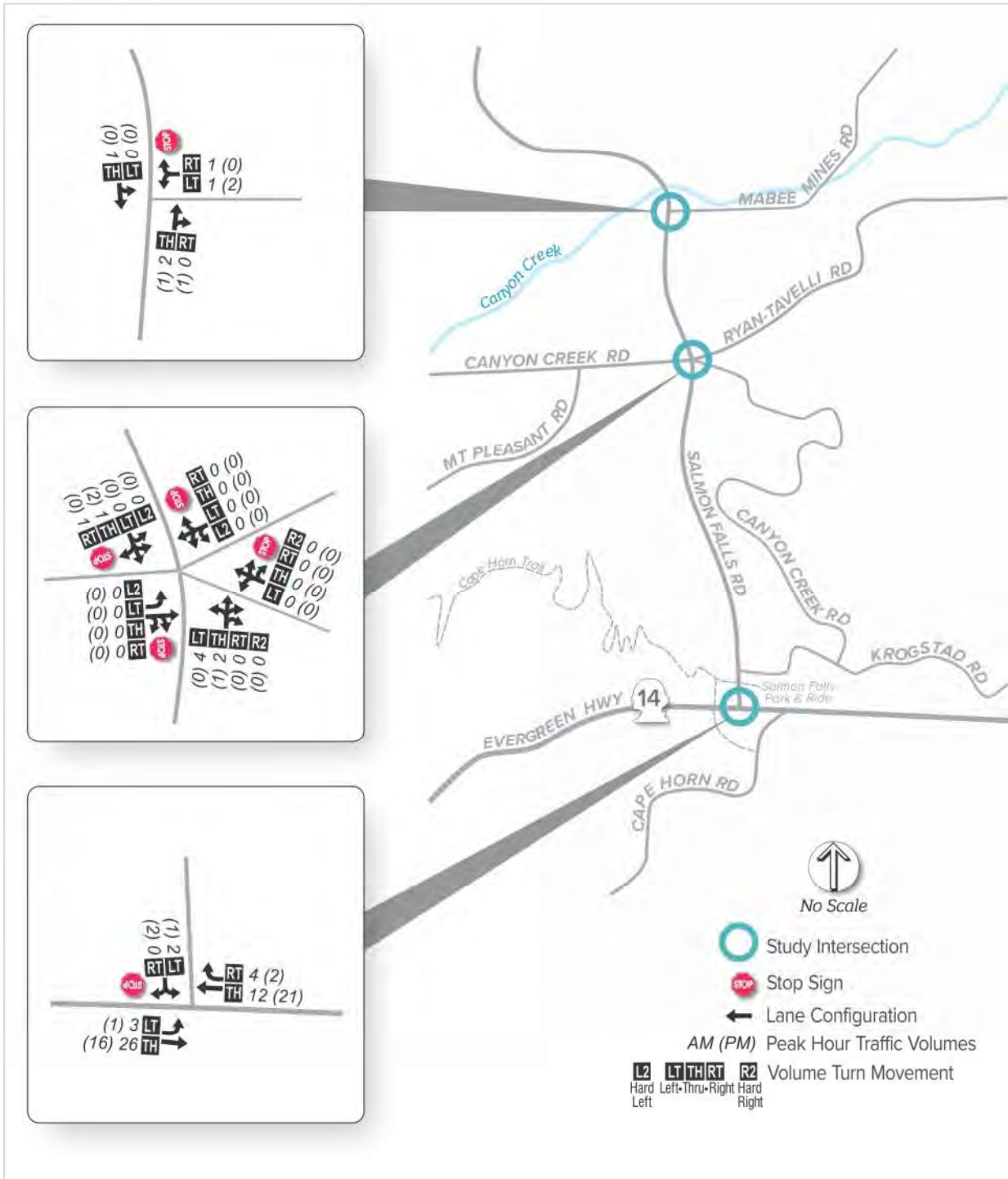


Figure 9: 2022 Baseline Heavy Vehicle Volumes



2022 Baseline Conditions - Operations Analysis

An operational analysis was performed for the study intersections using the future 2022 Baseline Condition volumes developed for the morning and evening peak hours. This analysis includes a rating of the intersection’s performance based on average motor vehicle delay, a level of service (LOS) and a ratio of the volume of vehicles to the capacity of the intersection.

Table 3 shows the future 2022 Baseline Condition intersection performance (delay, LOS, and volume-to-capacity ratio) measures for the morning and evening peak hours. Under the future 2022 Baseline Conditions, intersection performance standards have been met at all the locations. The HCM results are included in the Appendix. Under future Baseline Conditions, intersection performance standards have been met at all the locations.

Table 3: 2022 Baseline Conditions Intersection Operations

Intersection	Morning Peak Hour			Evening Peak Hour			Agency Standard	Intersection Control
	Delay	LOS	V/C	Delay	LOS	V/C		
Evergreen Hwy (SR 14) and Salmon Falls Rd	7.8/10.0	A/B	0.01/0.09	8.0/11.2	A/B	0.04/0.08	C	Unsignalized 1-way stop
Salmon Falls Rd and Mabee Mines Rd	0.0/8.8	A/A	0.00/0.03	7.3/9.0	A/A	0.00/0.02	C	Unsignalized 1-way stop
Salmon Falls Rd, Canyon Creek Rd, and Ryan-Tavelli Rd	7.4/9.5	A/A	0.02/0.05	7.3/9.6	A/A	0.02/0.03	C	Unsignalized 4-way stop (NB Salmon Falls Rd traffic does not stop)

Delay = Average delay per vehicle
 LOS = Level of Service
 Signalized (X) = Average LOS for intersection
 Unsignalized (X/X) = Major Street/Minor Street
 v/c = volume to capacity ratio
 Agency Standard applied to mainline and minor street approaches

2022 Baseline + Project Conditions Analysis

The proposed project would develop a new rock quarry near the end of Mabee Mines Road. Trip generation and distribution patterns were developed for the Proposed Project Conditions based of coordination with the project team. The quarry is expected to operate with up to 250 daily round trips (250 trips into the site and 250 trips leaving the site) during peak season and economic conditions. General hours of operation would be from 7 AM to 4:30 PM. Employees traveling in their personal vehicle would arrive to the site around 6:30 AM to prepare for a 7:00 AM start and leave by 5 PM. A few employees would perform maintenance services until 5:30 PM. Employees traveling in dump trucks would arrive around 7:00 AM and leave around 4:30 PM.

The estimated 500 daily total vehicle trips were separated into the AM and PM peak hours for the study intersection impact analysis. It was assumed 20 percent of the daily trips would occur during the AM peak hour and 20 percent would occur during the PM peak hour. This results in 100 (50 in/50 out) AM peak hour trips and 100 (50 in/50 out) PM peak hour trips. In the AM peak hour, employees arrive to the site in their passenger vehicle, and then exit the site in a gravel trucks to deliver material. In the PM peak hour, the reverse travel pattern occurs.

It was estimated that projects trips would access Highway 14 at Salmon Falls Road, with 80 percent of trips heading to or from the west and 20 percent of trips heading to or from the east. The trip distribution is shown in Figure 10.

The new project trips were added to the Baseline Conditions to create volumes for the 2022 Baseline + Project Conditions (Figure 11). Truck volumes were developed similarly to the motor vehicle volumes. Figure 12 shows the heavy truck volumes for the 2022 Baseline + Project Conditions.

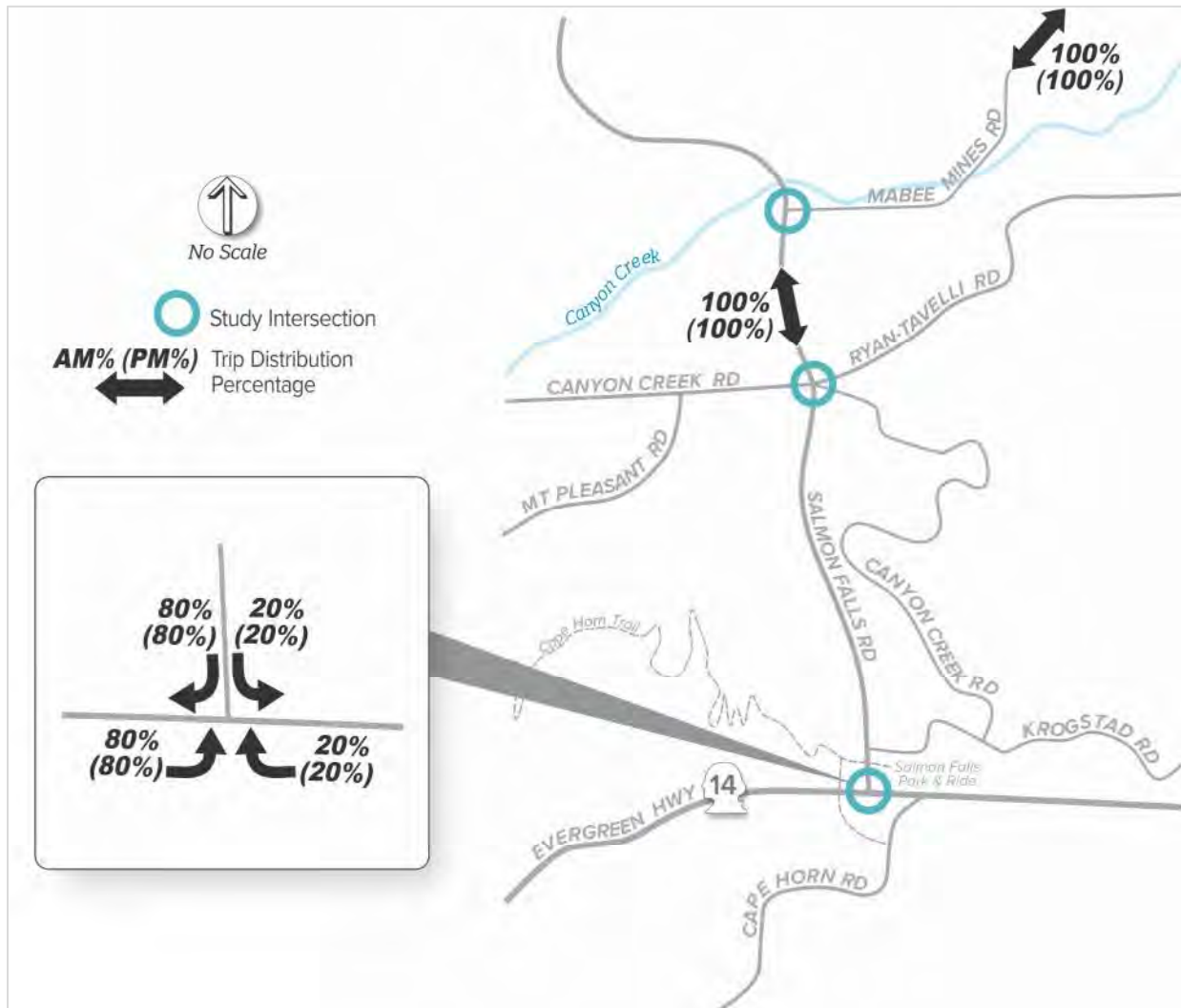


Figure 10: Trip Distribution

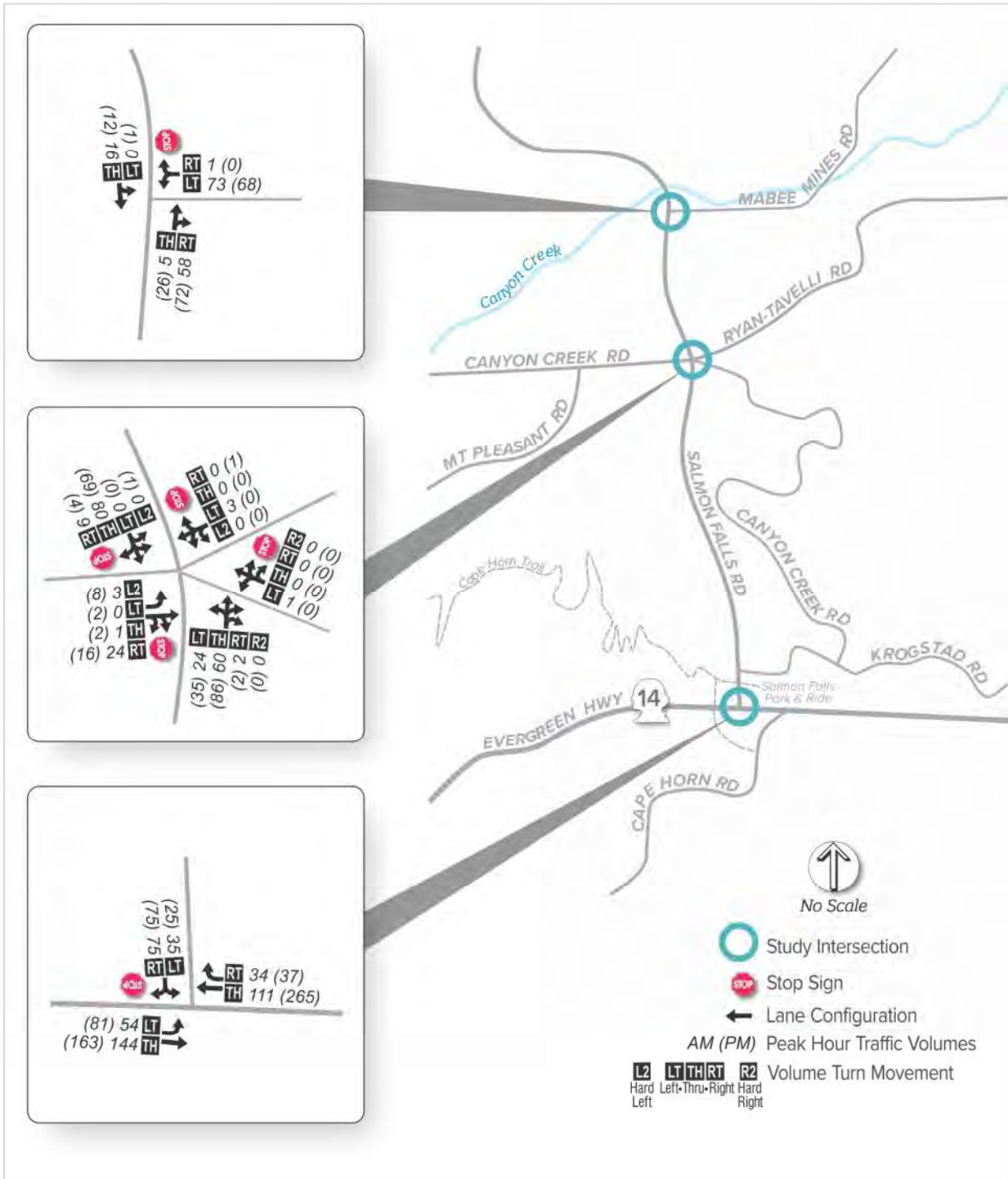


Figure 11: 2022 Baseline + Project Volumes

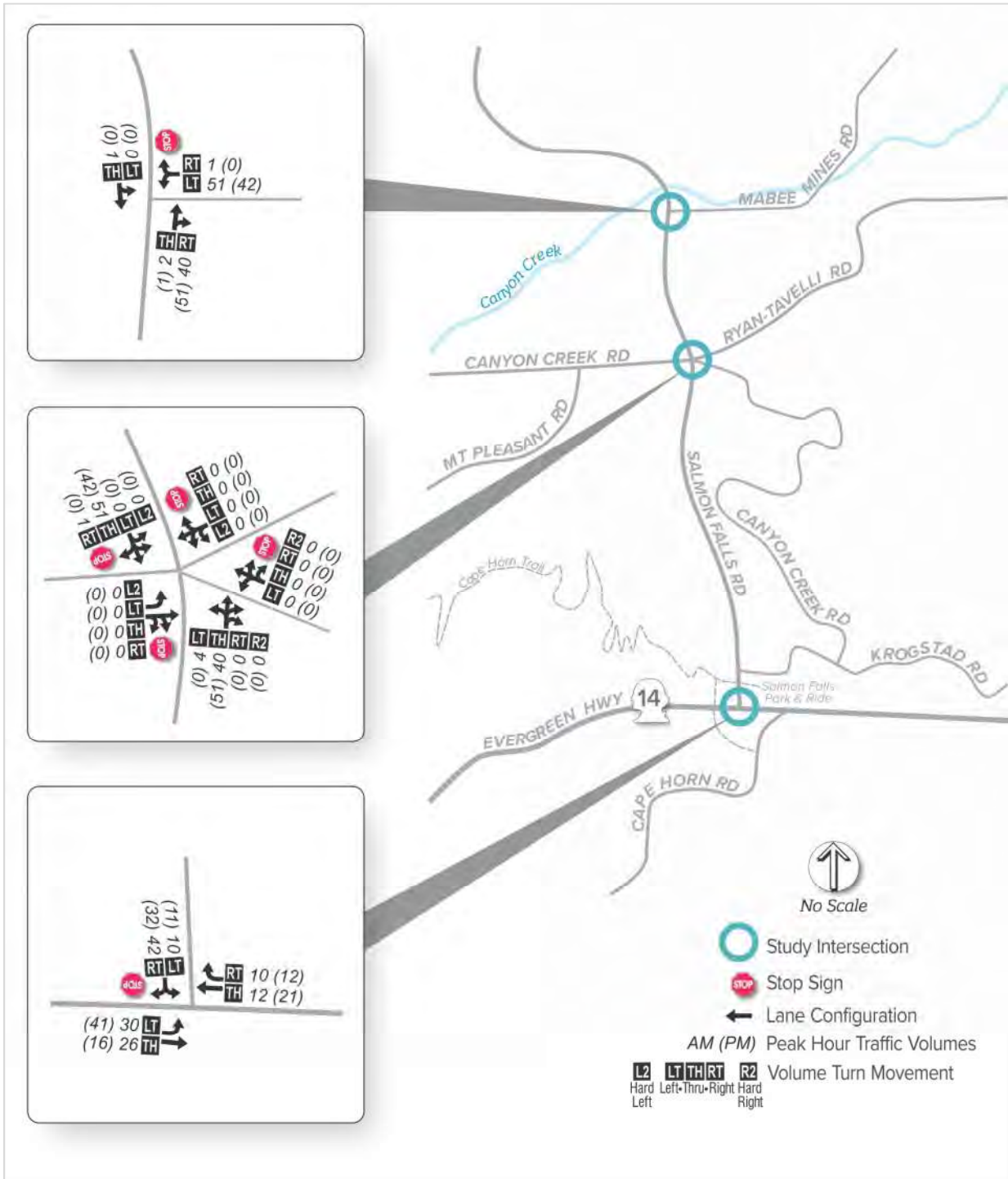


Figure 12: 2022 Baseline + Project Heavy Vehicle Volumes



2022 Baseline + Project Conditions - Operations Analysis

An operational analysis was performed for the study intersections for the 2022 Baseline + Project Conditions for the morning and evening peak hours. Table 4 shows the intersection performance measures (delay, LOS, and volume-to-capacity ratio). Under the future 2022 Baseline + Project Conditions, intersection performance standards have been met at all the locations. The HCM results are included in the Appendix.

Table 4: 2022 Baseline + Project Conditions Intersection Operations

Intersection	Morning Peak Hour			Evening Peak Hour			Agency Standard	Intersection Control
	Delay	LOS	V/C	Delay	LOS	V/C		
Evergreen Hwy (SR 14) and Salmon Falls Rd	8.6/11.3	A/B	0.06/0.18	8.9/13.2	A/B	0.09/0.19	C	Unsignalized 1-way stop
Salmon Falls Rd and Mabee Mines Rd	0.0/10.2	A/B	0.00/0.12	7.4/10.2	A/B	0.00/0.11	C	Unsignalized 1-way stop
Salmon Falls Rd, Canyon Creek Rd, and Ryan-Tavelli Rd	11.1/7.4	A/B	0.02/0.14	7.3/11.3	A/B	0.02/0.13	C	Unsignalized 4-way stop (NB Salmon Falls Rd traffic does not stop)

Delay = Average delay per vehicle

LOS = Level of Service

Signalized (X) = Average LOS for intersection

Unsignalized (X/X) = Major Street/Minor Street

v/c = volume to capacity ratio

Agency Standard applied to mainline and minor street approaches

PROJECT SUMMARY

The proposed rock quarry project is anticipated to result in the following impacts:

Trip Generation and Intersection Operations

- The proposed project is estimated to generate 500 daily trips (250 in/250 out) including 100 (50 in/50 out) AM peak hour trips and 100 (50 in/50 out) PM peak hour trips.
- All study intersections meet operating standards with the addition of site generated trips.

Roadway Segment Evaluation

- Salmon Falls Road and Mabee Mines Road will connect the project site to SR 14. Both facilities provide adequate pavement conditions and lane widths to accommodate heavy vehicles. Pavement markings (shoulder and lane striping) are in good condition.
- Roadway signs are provided to identify the limited sight distance segments of Mabee Mines Road.
- Roadway signs are provided to inform drivers “uphill traffic does not stop” at the Salmon Falls Road/Canyon Creek Road/Ryan-Tavelli Road intersection.
- McClosky Creek Road is a narrow roadway, measured to vary between 16 and 20 feet wide. Passenger vehicles require about 18 feet of pavement width to pass each other at low speeds. Large vehicles, such as gravel trucks, require a consistent 22 feet of roadway width to allow adequate space to safely pass each other at low speeds. The roadway should be widened to accommodate the proposed project.