Appendix A8-
Noise Analysis

Noise Report

East-West Corridor Project

Yakima County

Prepared on behalf of:

Yakima County
Department of County Roads
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Acronyms

dB(A)	The A-weighted sound level measured in decibels. A-weighted network = a frequency-equalizing function which approximates the sensitivity of human hearing to sounds of moderate SPL.
EB	East bound traffic lane
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
$L_{eq}(1h)$	The equivalent sound level (the logarithmic sum of sound exposure levels) over 1 hour
mph	Miles per hour
NAC	Noise Abatement Criteria
NB	North bound traffic lane
SB	South bound traffic lane
SEL	Sound Exposure Level
SPL	Sound Pressure Level
TNM	FHWA Traffic Noise Model – version 2.5
WB	West bound traffic lane
WSDOT	Washington State Department of Transportation

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Executive Summary

Widener & Associates undertook this study to analyze existing and predicted future traffic noise conditions in the vicinity of the proposed East-West Corridor project. Yakima County is proposing to construct an East-West Corridor in Yakima County, Washington from East H Street on the west side of Interstate 82 (I-82) in the City of Yakima to the eastern terminus at the Roza Canal Wasteway # 2 in the community of Terrace Heights. The proposed project is located within Sections 17 and 18 of Township 13 North and Range 19 East as well as Section 13 of Township 13 North and Range 18 East. The project is located within Yakima, Washington, and the Terrace Heights neighborhood in unincorporated Yakima County. Areas within the project footprint and adjacent properties are zoned as single- and multi-family residential, suburban residential, regional development, and light industrial.

The project proposes to create a new transportation corridor between the City of Yakima and the community of Terrace Heights. Upon project completion, the new section of the East-West corridor (Cascade Mill Parkway) will consist of a 5-lane roadway with two vehicular travel lanes in each direction, a center turn lane or median as appropriate, sidewalks and shared use path, curbing, gutters, and illumination. An extension of Bravo Company Boulevard will be constructed north from its current terminus to connect to Cascade Mill Parkway. The section of East H Street from North 1st Street east to North 7th Street will be widened to include an 11-foot wide travel lane in each direction, buffered bike lanes, and an 11-foot wide center turn lane. A new signal will be installed at the intersection with North 1st Street and remaining stop signs along H Street will be removed and placed to stop cross street traffic. The East-West Corridor project will involve the construction of new bridge crossings over the Yakima River and the Roza Canal Wastewater #2, as well as an undercrossing of I-82.

Sound levels for the Existing 2021, No Build 2044 and Build 2044 conditions were derived from the Traffic Noise Model (TNM) 2.5 and compared with the Federal Highway Administration (FHWA) and the Washington State Department of Transportation (WSDOT) standards and criteria. Sound level measurements and traffic data collected in the field were used to validate the model. WSDOT has defined ‘approach’ to be within 1 dB(A) below the FHWA noise abatement criteria for all land uses and has defined ‘substantially exceed’ to be a 10 dB(A) increase over

existing noise levels. The sound level recording and modeling was undertaken in accordance with FHWA guidelines and standards. A total of 38 receivers representing sixteen apartment units, 63 single-family homes, and one trail were modeled within the project area with an additional three validation locations. For the residences, apartments, playground and trail, the impact approach noise level criteria were 66 dB(A). Receiver O-1 is an office with an impact approach noise level criterion of 71 dB(A). As per WSDOT guidelines, all receivers were modeled for the worst-case hourly condition (the PM peak hour). Traffic data for the project area was provided by SCJ Alliance for the Existing 2021, No Build 2044, and Build 2044 conditions. Traffic for the Build 2044 condition assumes the planned I-82 interchange with Cascade Mill Parkway has been constructed.

This study shows that noise impact, as defined by FHWA/WSDOT, occur along the project corridor in all conditions. The 2044 Build scenario also predicts a substantial increase over the existing condition at several receivers. See table below for modeled results.

Summary of results for the Existing, No Build 2044, and Build 2044 conditions

Receivers and Validation Sites		Existing (2021) LAeq1hr	No Build (2044) LAeq1hr	Build (2044) LAeq1hr	Impact Approach Noise Level Criteria
Number	**Name/Description**				
V-1	Validation Site 1 – North 1st Street	73	75	77	N/A
V-2	Validation Site 2 – North 6th Street & East H Street	56	62	69	N/A
V-3	Validation Site 3 – Hartford Road	59	61	67	N/A
O-1	Office	66	68	69	71
T-1	Greenway Trail Crossing	67	67	68	66
A-1	Apartment Complex	61	66	67	66
A-2	Apartment Playground	56	59	60	66
R-1	Residence 1	59	64	66	66
R-2	Residence 2	59	62	63	66
R-3	Residence 3	58	61	62	66
R-4	Residence 4	55	63	64	66
R-5	Residence 5	53	60	61	66
R-6	Residence 6	55	64	64	66
R-7	Residence 7	57	67	68	66
R-8	Residence 8	53	61	62	66

Receivers and Validation Sites		Existing (2021) LAeq1hr	No Build (2044) LAeq1hr	Build (2044) LAeq1hr	Impact Approach Noise Level Criteria
Number	Name/Description				
R-9	Residence 9	54	63	63	66
R-10	Residence 10	56	64	65	66
R-11	Residence 11	56	60	62	66
R-12	Residence 12	60	65	66	66
R-13	Residence 13	57	62	64	66
R-14	Residence 14	55	59	61	66
R-15	Residence 15	53	56	62	66
R-16	Residence 16	53	56	65	66
R-17	Residence 17	54	56	64	66
R-18	Residence 18	53	55	63	66
R-19	Residence 19	54	55	65	66
R-20	Residence 20	52	53	62	66
R-21	Residence 21	54	55	59	66
R-22	Residence 22	55	56	58	66
R-23	Residence 23	51	52	55	66
R-24	Residence 24	52	54	56	66
R-25	Residence 25	60	61	63	66
R-26	Residence 26	60	61	64	66
R-27	Residence 27	59	60	61	66
R-28	Residence 28	58	59	62	66
R-29	Residence 29	54	55	61	66
R-30	Residence 30	53	54	61	66
R-31	Residence 31	52	53	63	66
R-32	Residence 32	51	53	59	66
R-33	Residence 33	52	54	58	66
R-34	Residence 34	62	65	66	66

- Impacted Receiver (sound level)
- Impacted Receiver (substantial increase)
- Impacted Receiver (Both)

Five receivers only exceeded the sound level criteria and five receivers only exceeded the substantial increase under the Build 2044 conditions. One receiver exceeded both the sound level and substantial increase criteria under the Build 2044 conditions. The greatest increase in sound level under the Build 2044 condition compared to existing conditions is 12 dB(A) at receiver R-16. The greatest sound level experienced under the Build 2044 condition at any receiver is 68 dB(A) at receivers T-1 and R-7. Eleven receivers are above the noise thresholds or experience substantial increases in noise due to the project. These receivers require abatement consideration in accordance with FHWA and WSDOT policy.

Barriers in several locations were considered to determine if they were feasible and reasonable. To be feasible, a noise wall must be constructed to achieve a reduction of at least 5 dB(A) for a minimum of 3 impacted first row receivers. To be reasonable, a noise reduction of at least 7 dB(A) at one sensitive receiver must be achieved in addition to being feasible. In addition, the proposed wall must meet cost-effective criteria to be reasonable. No barriers were found to be reasonable and feasible due to sight distance and access issues and failure to meet the noise reduction requirements.

As there are no noise abatement measures which must receive public input, the project public outreach will occur through the NEPA and SEPA process as needed for other project impacts.

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1. Introduction

The purpose of this report is to document and analyze existing traffic noise conditions and predict future traffic noise conditions in the vicinity of the East-West Corridor project, within the City of Yakima and the Terrace Heights neighborhood in unincorporated Yakima County, Washington. Sound levels for the Existing 2021, No Build 2044 and Build 2044 conditions were compared with the FHWA/WSDOT standards and criteria. Sound levels were derived from the FHWA approved noise model, TNM 2.5. The model design was verified using field measurements in accordance with FHWA and WSDOT requirements. This report was used to determine whether noise abatement measures should be warranted as part of the proposed project, and as appropriate, to make recommendations regarding such options.

1.1 Noise Characteristics and Measurement

1.1.1 Defining Noise

Noise is defined as unwanted sound (Maekawa and Lord., 1994; Bell *et al*., 1996; Berglund *et al.*, 1996). Noise is recognized as having both a physical and a psychological component. The physical component is set, while the psychological component (the degree of annoyance) depends on the listener and their physiological and psychological state as well as the frequency and time of the varying pattern of the sound. Low frequency (particularly anthropogenic sources) and impulse sounds are thought to result in higher levels of annoyance (Hall *et al.*, 1981; Maekawa and Lord, 1994; Bell *et al*., 1996; Berglund *et al*., 1996).

1.1.2 Measuring Noise

When measuring noise, the decibel scale, the A-weighted network, and the descriptor L_{eq} are usually used to describe and quantify the noise levels experienced by a receiver. These descriptors are described in the following paragraphs.

The decibel scale is a logarithmic scale, derived from the Pascal scale and based on sound pressure levels (the physical correlate of loudness). The threshold of human hearing is at 20 micropascals or 0 dB. A change of 20 dB corresponds to a ten-fold increase in micropascals. Thus, 20 dB is equivalent to 200 micropascals. However, the decibel scale provides a better approximation of the perception of loudness than the Pascal scale, 1 dB indicates the same fractional change in sound pressure at all levels. Generally, a 3 dB increase is barely perceptible

to human listeners. A 6 dB increase corresponds to a doubling of the sound pressure; however, a 10 dB increase is necessary for the sound to be perceived as being twice as loud (FHWA, 1995; Maekawa *et al.*, 1994; Boeker and Van Grondelle, 1995). Refer to Table 1 for examples of typical sound source levels.

Table 1: Sound Pressure Levels of Representative Sounds and Noises

Source	Decibels	Description
Large rocket engine (nearby)	**180**	
Jet take-off (nearby)	**150**	
Pneumatic riveter	**130**	**Pain threshold**
Jet take-off (60 meters)	**120**	
Construction noise (3 meters)	**110**	
Subway train	**100**	
Heavy truck (15 meters)	**90**	**Constant exposure endangers hearing**
Niagara Falls	**80**	
Average factory	**70**	
Normal conversation (1 meter)	**60**	
Quiet office	**50**	
Quiet Library	**40**	
Soft whisper (5 meters)	**30**	
Rustling leaves	**20**	
Normal breathing	**10**	**Very quiet**
Hearing threshold	**0**	**Barely audible**

Source: Tipler 1976

The type of weighting curve used in measuring sound is important in determining the accuracy of the result as a measure of the impact of the sound on those hearing it. The frequency of sound determines the ability of the human auditory system to detect it. As the sound of a constant sound pressure level decreases in frequency from about 1 kHz or increases in frequency from about 5 kHz, its perceived loudness decreases. Therefore, in order to measure what is actually being heard by humans, measurement of sound pressure level is adjusted to account for the relative loudness of the frequency through the use of weighting networks (A, B and C) in sound level meters. Networks are based on approximate equal-loudness contours rather than the hearing threshold curve. The A-weighted network is considered to most accurately represent human perception of noise (Maekawa and Lord, 1994; Boeker and Van Grondelle, 1995; Berglund *et al.*, 1996).

The descriptor used to measure traffic-induced sound levels in this study is dB(A) L_{eq}(1h), which is defined as the equivalent A-weighted sound level [the logarithmic sum of sound exposure levels (SELs)] over 1 hour.

2. Project Description

2.1 Location

The proposed project is located in the City of Yakima and the Terrace Heights neighborhood in unincorporated Yakima County. The proposed project is located from North 1st Street east along the East H Street corridor to Industrial Road west of I-82 in the City of Yakima, across the Yakima River and the Rosa Canal Wasteway # 2 in the Terrace Heights neighborhood.

The legal geographic area is Sections 7, 17, 18, 20, and 29 of Township 13N and Range 19E, Yakima County, Washington. Areas within the project footprint and adjacent properties are zoned as single- and multi-family residential, suburban residential, regional development, and light industrial (City of Yakima 2020, Yakima County 2020). Refer to Figure 1 for the project vicinity and Figure 2 for land use designations.

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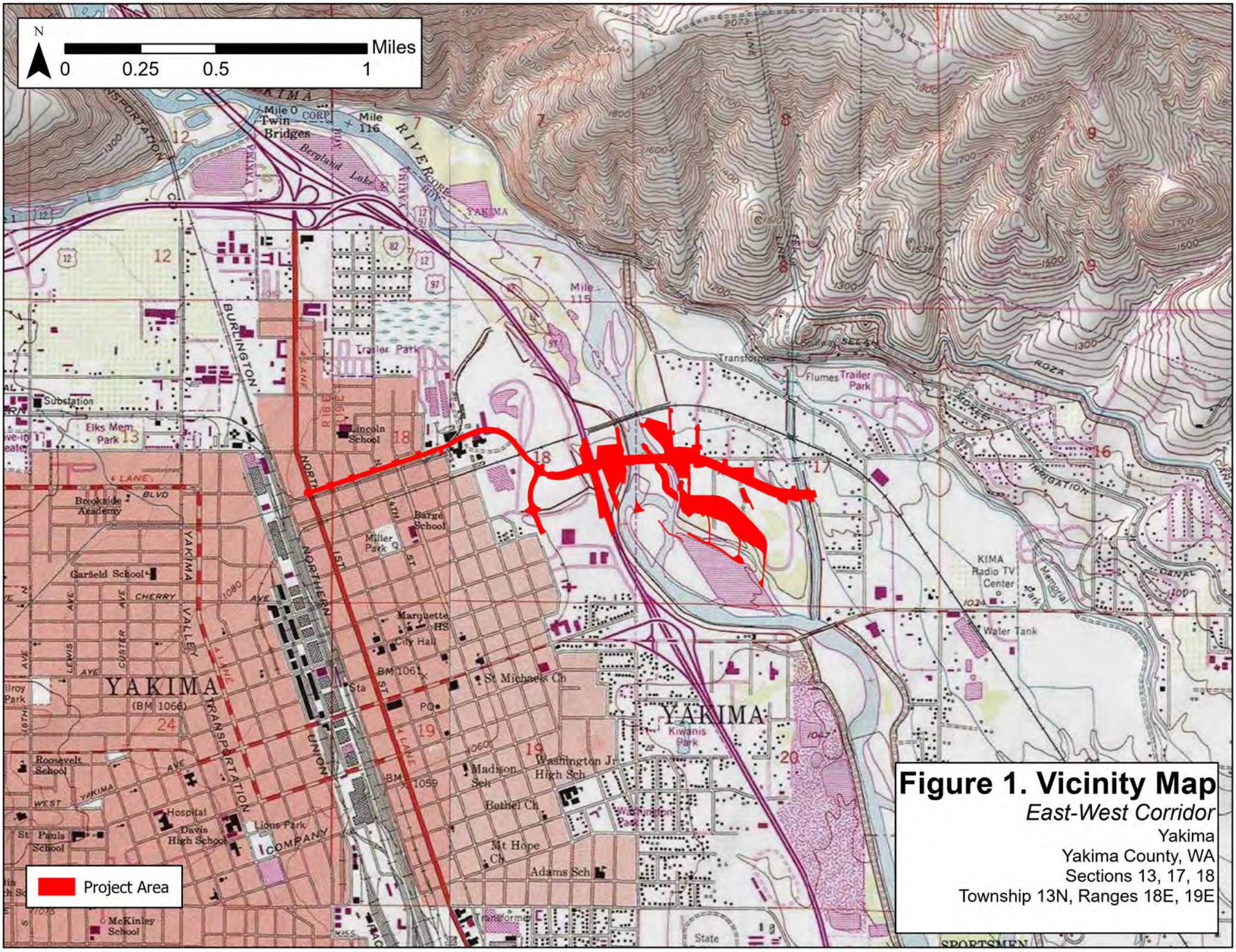
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Miles
Project Area
Figure 1. Vicinity Map
East-West Corridor
Yakima
Yakima County, WA
Sections 13, 17, 18
Township 13N, Ranges 18E, 19E

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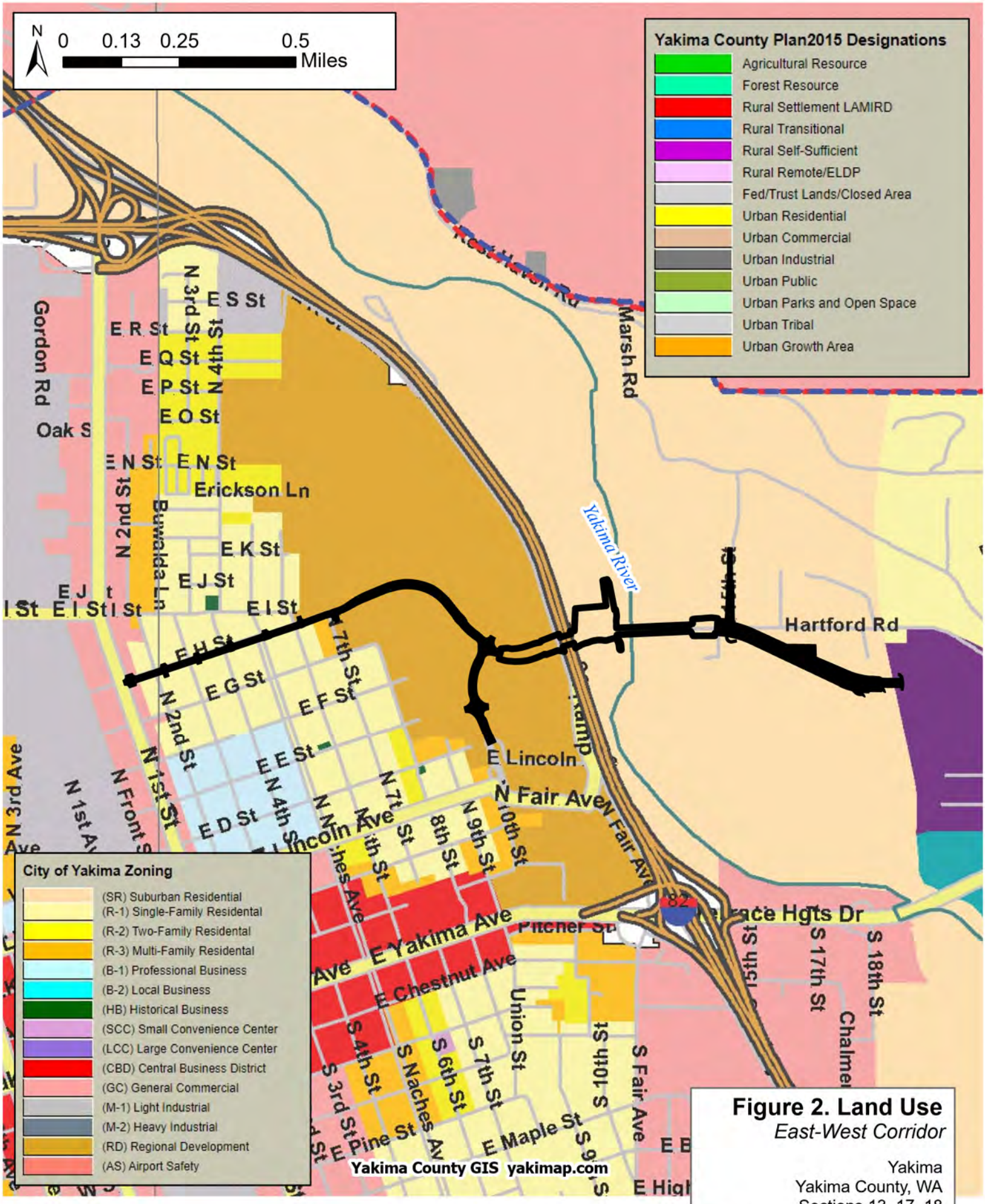

Figure 2. Land Use
East-West Corridor

Yakima
Yakima County, WA
Sections 13, 17, 18
Township 13N, Ranges 18E, 19E

Project Area

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2.2 Purpose and Need

The purpose of the proposed project is to reduce congestion and connect the growing neighborhood of Terrace Heights to the City of Yakima (as stated in the Purpose & Need for this project, dated March 22, 2022):

- Provide an alternative Yakima River crossing for east-west travel between the City of Yakima and Terrace Heights.
- Increase mobility, by decreasing travel delay, and relieving traffic congestion at the I-82/Yakima Avenue Interchange and on Terrace Heights Drive and Yakima Avenue.
- Construct the local road corridor which would allow for the consideration of construction of the recommended alternative for an interchange with I-82 identified in the WSDOT I-82/Yakima Avenue/Terrace Heights Drive IJR.
- Provide bicycle and pedestrian facilities including a connection to the Yakima Greenway Trail.
- Serve the existing approved transportation and land use planning along the roadway corridor as documented in the Yakima Valley Conference of Governments (YVCOG) 2020-2045 Metropolitan and Regional Transportation Plan.

The needs for the project include the following (as stated in the Purpose & Need for this project, dated March 22, 2022):

- **Congested Corridor** –The current road network cannot support the growth anticipated in the area under the current comprehensive plan. The Terrace Heights neighborhood lies just to the east of the City of Yakima. The neighborhood, an unincorporated part of Yakima County, has grown considerably over the last five decades, with its population increasing fivefold in the 30 years between 1970 and 2000, to a 2019 total of 8,507. Redevelopment of the Boise Cascade Mill Site consistent with the planned land use in the current City of Yakima Comprehensive Plan is also anticipated to increase traffic demand within the City of Yakima.

  The level of service (LOS) on the Yakima Avenue/Terrace Heights Drive corridor has been getting steadily worse and by 2035 it is expected to have multiple turning

movements operating at LOS E or F. LOS is a letter grade corresponding to the amount of congestion a road has when completed to a standard. LOS A is the best or the least congested grade. LOS F indicates failure because the demand for a road is more than its capacity.

The current LOS along the Yakima Avenue/Terrace Heights Drive corridor has triggered Yakima County's concurrency requirements, which limits new development permits along the corridor. In order to relax the restrictions, the County must either increase the capacity of the existing corridor or divert sufficient traffic volume onto another route. Right-of-way constraints along the existing Yakima Avenue/Terrace Heights Drive route prevent widening of the existing roadway. The future LOS at the Yakima Avenue interchange is also anticipated to cause back-ups onto the I-82 mainline.

- **Emergency Response** – The Yakima River poses a natural barrier to travel between Yakima and Terrace Heights. Historically, east-west traffic in the project vicinity has had only one option to travel between these two locations: the Yakima Avenue/Terrace Heights Drive corridor. A new corridor is needed to provide an alternative redundant route to Terrace Heights during any future closures of the Terrace Heights Bridge as well as an additional route for emergency services.

- **Lack of pedestrian and bicycle connectivity** – Access to the Greenway Trail is limited as it travels between I-82 and the Yakima River. The existing East H Street corridor does not include sidewalks or bike lanes and there is no access for pedestrians to the Greenway Trail from the surrounding residential neighborhood.

2.3 Proposed Work

Yakima County is proposing to construct an East-West Corridor in the City of Yakima and unincorporated Yakima County, Washington from North 1st Street and East H Street on the west side of Interstate 82 (I-82) in the City of Yakima to the eastern terminus on the east side of the Roza Canal Wasteway #2 in the community of Terrace Heights. This corridor will connect with Yakima County's Phase 1 of Cascade Mill Parkway (currently under construction) which will continue to Butterfield Road and North Keys Road. The project would include construction of three separate streets:

- **East H Street** –The existing road would be extended to the east from the current terminus at North 7th Street where it would connect to Bravo Company Boulevard as the road turns to the south. The existing portion from North 1st Street to North 7th Street would be widened. A new signal would be installed at the intersection with North 1st Street.

- **Bravo Company Boulevard** – An extension of Bravo Company Boulevard connecting to East H Street would be constructed which would turn south and connect to the current terminus near Fair Avenue. A roundabout intersection with Cascade Mill Parkway would be constructed along with one additional roundabout intersection to connect to an existing access road to the adjacent properties.

- **Cascade Mill Parkway** –Cascade Mill Parkway would connect to Bravo Company Boulevard at a roundabout intersection and then continue east beneath I-82 and across the Yakima River and Roza Canal Wasteway #2.

The East-West Corridor project will involve improvements to existing roadways, including transforming East H Street from a residential street to a free-flowing arterial between North 1st Street and North 7th Street; the building of new connections and roundabouts; non-motorized facilities including bike lanes, sidewalks, Americans with Disabilities Act (ADA) ramps, crosswalks, and a shared-use path that will connect to the Yakima Greenway Trail; and construction of four bridges: two to carry I-82 over the proposed roadway, one over the Yakima River, and one over the Roza Canal Wasteway #2. This project will also involve restoration and levee work along the Yakima River floodplain including removal and/or setback of levees and floodplain habitat restoration.

Due to the new roadways being constructed, a noise study is required.

3. Criteria for Determining Impacts

This section discusses applicable noise regulations and agency guidelines that provide the basis for evaluating potential noise impacts and mitigation or abatement for a proposed project. Noise regulations and guidelines for federally funded highway projects in Washington are established by WSDOT and the FHWA. The FHWA (23 C.F.R. §772.5(g)) defines traffic noise impacts to occur either when:

- predicted traffic noise levels approach or exceed the noise abatement criteria;
- predicted traffic noise levels substantially exceed the existing noise levels; or
- predicted traffic noise levels are severe noise levels

WSDOT has defined 'approach' to be within 1 dB(A) below the FHWA noise abatement criteria for all land uses and has defined 'substantially exceed' to be a 10 dB(A) increase over existing noise levels. A severe impact is defined as a level greater than 80 dB(A) L_{eq}(1h).

Therefore, a noise impact is determined to occur when predicted noise levels 'approach' or 'exceed' the FHWA noise abatement criteria[1] as given in Table 2 or when predicted noise levels are 10 dB(A) or greater over the existing level. For example, traffic noise impacts for Activity Category B (residences) would occur if predicted noise levels were to be equal or greater than 66 dB(A) L_{eq} (1h).

[1] Noise standards that specify exterior L_{eq}(h) noise levels for various land activity categories.

Table 2: FHWA noise abatement criteria

Activity Category	L_{eq}(1h) dB(A)	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Residential (single and multi-family units)
C	67 (exterior)	Active sports centers, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F. Includes undeveloped land permitted for these activities.
F	-	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, retail facilities, shipyards, utilities (water resources, water treatment, and electrical), and warehousing.
G	-	Undeveloped lands that are not permitted

Source: 23 C.F.R. Part 772

Sound levels generated by any proposed project are primarily compared to the FHWA/WSDOT standards and criteria rather than to the Existing condition or to the No Build 2044 condition. The project proponent is required to consider mitigation options when the proposed project meets or exceeds FHWA/WSDOT standards and criteria in the future build condition.

4. Methods

4.1 Field Data Collection

Sound levels were recorded in the field on May 8, 2020 between 3:30 and 5:30 PM at three sites along the project corridor. Measurements were taken when traffic was free flowing at all locations. Refer to Figure 3 and the data sheets provided in Appendix C. Recordings were made using a Larson and Davis Type 1 Sound Level Meter (model 820) and the following variables:

- Descriptor: L_{eq}
- Integration rate: Fast
- Sample rate, 15 minutes
- Weighting, A

The meter was correctly calibrated at the time of recording. The timing and source of other noises perceptible above the traffic noise were also noted. The sound level meter, microphone, and calibrator were within factory calibration. Calibration certificates for the meter, microphone, and calibrator are provided in Appendix A. The microphone was placed 5 feet off the ground and the site chosen was an area of potential outdoor human use (refer to Appendix C).

Traffic data collected in the field was used to validate the model in accordance with FHWA and WSDOT requirements. Traffic data and weather conditions collected in the field at the time of the sound recording were entered into the model. The following traffic data and baseline information was collected during each 15-minute sound recording interval:

- total numbers of each traffic type (automobiles, medium trucks [2 axles and 6 tires] heavy trucks [greater than 2 axles / 6 tires], buses, and motorbikes) directionally separated;
- average speed
- temperature
- humidity

Environmental conditions recorded during field measurements are as follows:

- Temperature, 75°F
- Relative Humidity, 25%

Sound levels at the field recording site was dominated by vehicular traffic. Refer to the data sheets provided in Appendix C.

4.1.1 Model Validation

Data from the site was compared to the modeled results (based on traffic data collected during the sound level recording) in order to validate the model in accordance with WSDOT requirements. Conditions were modeled using the FHWA Traffic Noise Model version 2.5 (TNM) using existing road elevations and surrounding land topography. WSDOT requires that the modeled results and the field measurements come within plus or minus 2 dB(A) of one another. Validation site one (V-1) was located on the sidewalk just north of the intersection of North 1st Street and East H Street. Site two (V-2) was located on the sidewalk on North 6th Street south of East H Street. Site three (V-3) was located east of the Yakima River on Hartford Road. These sites were chosen as they represent the conditions within the project area, however they do not require noise abatement consideration. All field validation sites are depicted on Figure 3. See Table 3 for validation results.

Table 3: Validation Model Results

Receivers		Measured (2020) LAeq15min	Validation Model LAeq1hr	Validation Model Difference from Measured Levels
Number	**Name/Description**			
V-1	North 1st Street & East H Street	72.5	70.6	-1.9
V-2	North 6th Street & East H Street	55.8	54.0	-1.8
V-3	Hartford Road, Terrace Heights	53.1	51.4	-1.7

Based on these measurements, the result is within the acceptable margin of error and modeling of all receivers under all conditions (Existing, No Build, and Build) could proceed.

4.2 Traffic Noise Model

The FHWA TNM version 2.5 was used to model the existing (2021) and future (Build 2044 and No Build 2044) road traffic-induced noise environment within the project area.

4.2.1 Receivers

A total of 38 receivers representing 63 single-family residences, sixteen apartment units, and one trail were modeled. All but three of the receivers are single or multi-family residences and are therefore characterized as 'Activity Category B' receivers. One receiver is the playground within the apartment complex near the existing turnaround of Bravo Company Boulevard and is characterized as a 'Activity Category C' receiver. One is the existing Greenway Trail east of I-82 which is also a 'Activity Category C' receiver. The final receiver is an office on North 1st Street which is classified as a 'Activity Category E' receiver. For all Category B and C receivers, the impact criterion is 66 dB(A). Category E receivers have an impact criterion of 71 dB(A). See Table 2 for further information regarding Activity Categories.

Receivers were chosen based on the following factors:

1. Proximity to the existing and proposed roadway. Sites most likely to be impacted were favored.
2. Location along the corridor. Receivers were selected along the length of the project corridor and extend out from the road to such a distance to ensure that all traffic noise impacts are included. Modeling limits are extended to reach any location which reaches 65 dB(A) to ensure the full impacted area is captured.
3. Primary areas of outdoor use. Receivers were placed at sites which appeared to have the most foot traffic.
4. Sites which would be removed as a result of the proposed project or which were too close to the roadway to model were not selected.

As per WSDOT guidelines, all receivers were modeled for the worst-case condition in the project area as a whole (the PM peak hour) for 2021 and 2044.

4.2.2 Traffic Data

4.2.2.1 Existing Condition

Modeled traffic data for the PM Peak Hour for existing conditions within the project area was provided by SCJ Alliance based on tube counts conducted in 2015 and 2021. Traffic was directionally separated, and percentages of heavy trucks were also provided for all roadways except I-82 (Refer to Appendix B). For a small number of minor streets not modeled, traffic from the nearest similar street or the street from which traffic originated was utilized. For example, 2nd Street was not modeled, therefore traffic from 3rd Street was used to establish the existing noise conditions. AADT and percentages of heavy trucks for I-82 was based on 2019 data obtained from the WSDOT Traffic Geoportal. In accordance with 2020 WSDOT guidelines, ten percent of the total daily volume was used to represent peak hour. Traffic is divided equally into eastbound and westbound traffic for I-82.

The percentage of medium trucks from H Street provided by SCJ Alliance are also used surrounding cross streets, no significant heavy truck use is expected given the residential nature of the neighborhood, the size of the existing streets and current H Street traffic being less than one percent heavy trucks. Speeds along the corridor were based on posted speed limits. Roundabout intersections were modeled at a speed of 25 mph in accordance with WSDOT TNM Guidance. See Table 4 for speed limits on all modeled roads.

Table 4: Posted Speed Limits for Modeled Roadways

Roadway	Posted Speed Limit used in Existing/No Build TNM Modelling
North 1st Street	35 mph
East H Street	25 mph
North 2nd – North 8th Streets	25 mph
Naches Avenue	25 mph
Hartford Road	30 mph
North 15th Street	25 mph
Butterfield Road	35mph
I-82	60 mph
Bravo Company Boulevard	30 mph
East Lincoln Avenue	30 mph
North Fair Avenue	30 mph
Martin Luther King Jr Boulevard	25 mph

4.2.2.2 No Build 2044 Condition

Traffic numbers for the no build condition were provided by SCJ Alliance. Traffic on I-82 was estimated from traffic used in the Existing condition by applying a one percent per year growth rate. Percentages of vehicle types were assumed to be the same as for the Existing condition. Refer to Appendix B for the traffic data and the vehicle percentages used to model the No Build 2044 condition. The posted speed for each roadway was used, resulting in the worst hourly noise conditions.

4.2.2.3 Build 2044 Condition

Traffic numbers for the new corridor were provided by SCJ Alliance. The traffic modelling assumed the construction of the planned I-82 interchange with Cascade Mill Parkway had been completed. Percentages of vehicle types were assumed to be the same as for the Existing condition apart from H Street which is also modeled with two percent heavy truck traffic as part of the new arterial corridor. See Table 5 for speed limits on all modeled roads following project construction. Refer to Appendix B for the data used to model the Build 2044 condition.

The Build condition modelling shown in Appendix B is based on a previous project design which includes one additional roundabout on Bravo Company Boulevard. The inclusion of this additional roundabout is not anticipated to create a meaningful difference in the modeled sound levels at any receiver from the final project design. It is located approximately 1,000 feet from any receiver. Any change in sound levels from the model to the current design are anticipated to be an insignificant reduction created by the removal of the acceleration modeled as vehicles exit the roundabout.

Table 5: Posted Speed Limits for Modeled Roadways

Roadway	Posted Speed Limit used in Build 2044 TNM Modelling
North 1st Street	35 mph
East H Street	35 mph
North 2nd – North 8th Streets	25 mph
Cascade Mill Parkway	35 mph
Naches Avenue	25 mph
Hartford Road	30 mph
North 15th Street	25 mph
Butterfield Road	35 mph
I-82	60 mph
Bravo Company Boulevard	30 mph
East Lincoln Avenue	30 mph
North Fair Avenue	30 mph
Martin Luther King Jr Boulevard	25 mph

Figure 3: Receiver Locations

East-West Corridor
Yakima County

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5. Results

5.1 Existing Noise Environment

One receiver modeled is currently at the impact approach noise level. The overall noise environment is predominantly created by the traffic noise from I-82 or North 1st Street which have significantly higher traffic than the remaining corridor.

5.2 Future Noise Environment

Five receivers only exceeded the sound level criteria and five receivers only exceeded the substantial increase under the Build 2044 conditions. One receiver exceeded both the sound level and substantial increase criteria under the Build 2044 conditions. The greatest increase in sound level under the Build 2044 condition compared to existing conditions is 12 dB(A) at receiver R-16. The greatest sound level experienced under the Build 2044 condition at any receiver is 68 dB(A) at receivers T-1 and R-7. Receiver T-1 exceeds the impact criteria in all conditions. Refer to Table 6 for the results of existing sound levels modeled at all receivers and to Figure 3 for the locations.

Table 6: Summary of results for the Existing, No Build 2044, and Build 2044 conditions

Receivers and Validation Sites		Existing (2021) LAeq1hr	No Build (2044) LAeq1hr	Build (2044) LAeq1hr	Impact Approach Noise Level Criteria
Number	**Name/Description**				
V-1	Validation Site 1 – North 1st Street	73	75	77	N/A
V-2	Validation Site 2 – North 6th Street & East H Street	56	62	69	N/A
V-3	Validation Site 3 – Hartford Road	59	61	67	N/A
O-1	Office	66	68	69	71
T-1	Greenway Trail Crossing	67	67	68	66
A-1	Apartment Complex	61	66	67	66
A-2	Apartment Playground	56	59	60	66
R-1	Residence 1	59	64	66	66
R-2	Residence 2	59	62	63	66
R-3	Residence 3	58	61	62	66
R-4	Residence 4	55	63	64	66
R-5	Residence 5	53	60	61	66

Receivers and Validation Sites		Existing (2021) LAeq1hr	No Build (2044) LAeq1hr	Build (2044) LAeq1hr	Impact Approach Noise Level Criteria
Number	Name/Description				
R-6	Residence 6	55	64	64	66
R-7	Residence 7	57	67	68	66
R-8	Residence 8	53	61	62	66
R-9	Residence 9	54	63	63	66
R-10	Residence 10	56	64	65	66
R-11	Residence 11	56	60	62	66
R-12	Residence 12	60	65	66	66
R-13	Residence 13	57	62	64	66
R-14	Residence 14	55	59	61	66
R-15	Residence 15	53	56	62	66
R-16	Residence 16	53	56	65	66
R-17	Residence 17	54	56	64	66
R-18	Residence 18	53	55	63	66
R-19	Residence 19	54	55	65	66
R-20	Residence 20	52	53	62	66
R-21	Residence 21	54	55	59	66
R-22	Residence 22	55	56	58	66
R-23	Residence 23	51	52	55	66
R-24	Residence 24	52	54	56	66
R-25	Residence 25	60	61	63	66
R-26	Residence 26	60	61	64	66
R-27	Residence 27	59	60	61	66
R-28	Residence 28	58	59	62	66
R-29	Residence 29	54	55	61	66
R-30	Residence 30	53	54	61	66
R-31	Residence 31	52	53	63	66
R-32	Residence 32	51	53	59	66
R-33	Residence 33	52	54	58	66
R-34	Residence 34	62	65	66	66

- Impacted Receiver (sound level)
- Impacted Receiver (substantial increase)
- Impacted Receiver (Both)

Based on the results of this study, eleven receivers experience traffic noise impacts as a result of the proposed project and abatement needs to be considered in accordance with FHWA and WSDOT policy.

5.4 Mitigation Needs

As discussed in Section 3, the project proponent is required to consider mitigation options when the proposed project meets or exceeds FHWA/ WSDOT criteria/standards regardless of whether or not the criteria/standards were met or exceeded under the Existing condition. As this study identifies noise impacts, mitigation measures need to be fully evaluated in accordance with FHWA and WSDOT noise abatement policy for receivers that would be impacted by the proposed project. FHWA and WSDOT require that construction of noise barriers be evaluated for feasibility and reasonableness.

Feasibility deals primarily with engineering considerations such as whether a meaningful reduction in sound levels can be achieved and whether abatement measures would affect property access. To be feasible, a noise wall must be constructed to achieve a reduction of at least 5 dB(A) for a minimum of 3 impacted first row receivers. Reasonableness assesses the practicality of the abatement measure including cost, the amount of noise reduction, and future traffic levels. To be reasonable, a noise reduction of at least 7 dB(A) at one sensitive receiver must be achieved in addition to being feasible. In addition, the proposed wall must meet cost-effective criteria to be reasonable. WSDOT noise mitigation cost per residence is given in the following table.

Table 7: Noise mitigation cost per residence

Design Year Traffic Noise Decibel Level	Noise level increase as a result of the project	Allowed Cost Per Household *	Equivalent Wall Surface Area Per Household
66 dBA		$36,127	700 ft^2
67 dBA		$39,636	768 ft^2
68 dBA		$43,146	836 ft^2
69 dBA		$46,665	904 ft^2
70 dBA		$50,165	972 ft^2
71 dBA	10 dBA	$53,674	1,040 ft^2
72 dBA	11 dBA	$57,184	1,108 ft^2
73 dBA	12 dBA	$60,693	1,176 ft^2
74 dBA	13 dBA	$64,203	1,244 ft^2

* Based on $51.61 per square foot constructed cost (WSDOT, 2020)

Greenway Trail (Receiver T-1)

The Greenway Trail located east of I-82 exceeds the noise level criteria in all conditions. The trail runs parallel to I-82 through the project corridor and I-82 is elevated on fill through the project area approximately 10-20 feet above the trail location. Therefore, in order to effectively shield the trail location with a constructable barrier, the modeled barrier for I-82 was placed along the elevated road corridor rather than the trail location. This would increase the cost of a noise barrier by requiring right-of-way purchase from WSDOT in addition to construction costs described below.

The allowable cost for this receiver was calculated based on the residential equivalency. This has been calculated based on the standard usage factor for parks of 0.17 and the average number of people per household in Yakima County 2015-2019 (US Census 2021). Average use of the trail at any one time was estimated based on approximately 50 available spaces at the Rotary Lake Park and Ride as well as benches, playground, and picnic facilities at Sunrise Rotary Park along the trail to the south.

Residential Equivalency

Usage Factor - Park (10 hrs/day, 7 days/week, 5 months/year)	0.17
Average number of users	*150
Number of people per household (Yakima County)	÷2.96
	8.6 residential equivalents

Table 8: Barrier Allowance Greenway Trail

Receiver		Build (2040) LAeq1hr	Residential Equivalency	Allowed Cost Per Residence	Row	Total Allowance
Number	Name/Description					
T-1	Greenway Trail Crossing	68	8.6	$46,146	1	$396,855

Two barriers were modeled along the portion of I-82 and Cascade Mill Parkway nearest the receiver. The total barrier length of approximately 1,500 feet with height of 8-10 feet resulted in a cost of about $700,000 dollars. Both barriers together were required to meet the minimal 5 dB(A) reduction requirement for receiver T-1, however no other impacted receiver would benefit from barriers in these locations. The barriers do not meet the 7 dB(A) reduction and exceeded the total allowance for this location. Therefore, no barrier was found to be reasonable or feasible.

Impacted Residences

One impacted receiver, A-2, is located within an apartment complex and represents seven apartment units. In order to maintain access to the parking lot at this location at the intersection of North 1st Street and East H Street, a noise wall would not be feasible.

The remaining nine impacted receivers are located in yards of residences. Eight of these receivers (R-1, R-7, R-12, and R-16 through R-20) are along East H Street and represent 15 total single-family residences. The residential neighborhood through which H Street runs is designed to have access to many homes via alleyway which begin on H Street between the cross streets. Also, several homes which face East H Street are accessed through driveways which would be cut off by noise wall construction. In order to maintain access to homes from the cross streets and alleys, a noise wall would not be feasible.

The final single-family residence, receiver R-34, is located with three others to the west of Bravo Company Boulevard on North 10th Street, near the roundabout intersection. Access to the front of the homes is via a driveway on Bravo Company Boulevard to North 10th Street. There is also access necessary via a driveway and alley on Lincoln Avenue. A noise wall for this location would not be feasible while maintaining access.

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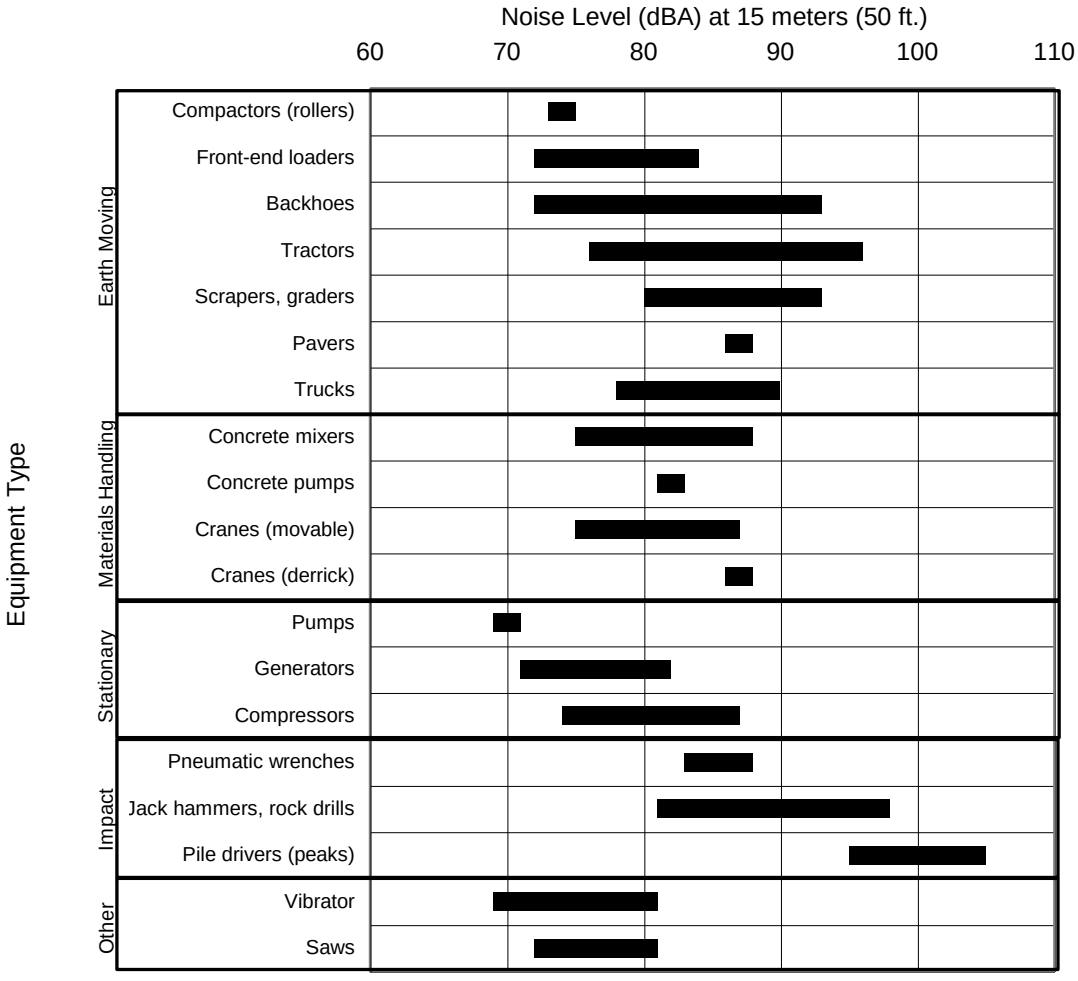
6. Construction Noise

Short-term noise impacts would occur as a result of construction activities. General construction activities (such as grading, laying base, and paving) would take place as part of the proposed project. Based on WSDOT guidance, short-term noise impacts are expected to radiate up to a maximum of one mile from the project area. Based on the data tabulated by the Environmental Protection Agency (EPA) and WSDOT, sound levels generated during construction are not expected to exceed 95 dB(A) during most work, however pile driving will be necessary which would create sound levels of about 110 dB(A). Construction equipment sounds (usually point source) decrease about 6 dB(A) with every doubling of distance. Table 7 depicts typical construction equipment sound levels 50 feet from the source. Surrounding areas would temporarily experience higher noise levels as a result of construction.

Table 9: Typical construction equipment noise levels



Source: EPA, 1971 and WSDOT, 1991.

The City of Yakima's municipal code, Chapter 6.04, section 6.04.180, exemption F-15 reads: "*Sounds created by construction or lawn and garden equipment from six a.m. to ten p.m. weekdays and from eight a.m. to ten p.m. Sundays and legal holidays*." Yakima County Code, Chapter 6.28, section 6.28.040(12) also exempts "*sounds created by construction or refuse removal equipment.*" Many areas surrounding the project are zoned for residential use; potential impacts to residential zones are possible. The construction noise from this project is exempt from the City of Yakima's municipal code during work hours and between the hours of 6 am and 10 pm and on weekdays and 8 am and 10 pm Sundays and holidays and is not required to be mitigated. If overnight work is necessary near I-82, a City of Yakima noise permit will be obtained.

7. Conclusion

Sound level modeling was undertaken in accordance with FHWA guidelines and standards. A total of 38 receivers representing sixteen apartment units, 63 single-family homes, and one trail were modeled within the project area for the worst-case hourly condition (the PM peak hour). Traffic data was collected in 2015 and 2021 and forecasted for the Existing 2021, No Build 2044, and Build 2044 conditions.

This study shows that established noise thresholds are exceeded along the project corridor in all conditions. Five receivers only exceeded the sound level criteria and five receivers only exceeded the substantial increase under the Build 2044 conditions. One receiver exceeded both the sound level and substantial increase criteria under the Build 2044 conditions. The greatest increase in sound level under the Build 2044 condition compared to existing conditions is 12 dB(A) at receiver R-16. The greatest sound level experienced under the Build 2044 condition at any receiver is 68 dB(A) at receivers T-1 and R-7.

Mitigation measures have been evaluated in accordance with FHWA and WSDOT noise abatement policy and no noise barriers have been determined to be reasonable and feasible.

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7. References

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WSDOT. 2020. Guidance for Noise Modeling Using FHWA's Traffic Noise Model (TNM) 2.5 For Projects in Washington State. September 1. https://wsdot.wa.gov/sites/default/files/2017/03/24/ENV-ANE-TNMGuidance2020.pdf

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Yakima County. County Code, Title 6. Accessed July 7, 2020 https://www.codepublishing.com/WA/YakimaCounty/

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Appendix A: Calibration Certificates

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Calibration Certificate

Certificate Number 2019009206

Customer:
Widener & Associates
1902 120th Place SouthEast
Suite 202
Everett, WA 98208, United States

Model Number	2560	***Procedure Number***	D0001.8387		
Serial Number	3513	***Technician***	Abraham Ortega		
Test Results	**Pass**	***Calibration Date***	24 Jul 2019		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	24 Jul 2020		
Description	1/2 inch Microphone - RI - 200V	***Temperature***	23.5	°C	± 0.01 °C
		Humidity	39.8	%RH	± 0.5 %RH
		Static Pressure	101.57	kPa	± 0.03 kPa

Evaluation Method Tested electrically using an electrostatic actuator.

Compliance Standards Compliant to Manufacturer Specifications.

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis Model 2900 Real Time Analyzer	07/01/2019	07/01/2020	001230
Microphone Calibration System	08/28/2018	08/28/2019	001233
1/2" Preamplifier	12/17/2018	12/17/2019	001274
Agilent 34401A DMM	12/07/2018	12/07/2019	001329
Larson Davis CAL250 Acoustic Calibrator	01/04/2019	01/04/2020	003030
1/2" Preamplifier	04/12/2019	04/12/2020	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/22/2018	08/22/2019	006507
1/2 inch Microphone - RI - 200V	11/12/2018	11/12/2019	006511
1/2 inch Microphone - RI - 200V	08/09/2018	08/09/2019	006519
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/22/2018	08/22/2019	006530
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/13/2018	08/11/2019	006531

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ACCREDITED Cert #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Certificate of Calibration and Conformance

Certificate Number 2019-208456

Instrument Model PRM828, Serial Number 2422, was calibrated on 23 Jul 2019. The instrument meets factory specifications per Procedure D0001.8135.

Instrument found to be in calibration as received: YES
Date Calibrated: 23 Jul 2019
Calibration due: 23 Jul 2020

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2900 / 2239	0608 / 0110	12 Months	26 Dec 2019	2018-207644
Hewlett Packard	34401A	US36023299	12 Months	22 Jul 2020	2019009025

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 34 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"AS RECEIVED" data same as shipped data.

Signed: 

Technician: Eric Olson

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Certificate of Calibration and Conformance

Certificate Number 2019-208458

Instrument Model 820, Serial Number 1518, was calibrated on 23 Jul 2019. The instrument meets factory specifications per Procedure D0001.8160, ANSI S1.4 1983, IEC 651-Type 1 1979, and IEC 804-Type 1 1985.

Instrument found to be in calibration as received: YES
Date Calibrated: 23 Jul 2019
Calibration due: 23 Jul 2020

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0445 / 0111	12 Months	4 Dec 2019	2018-207562

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 34 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"AS RECEIVED" data same as shipped data.
Tested with PRM828-2422

Signed: _____
Technician: Eric Olson

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Calibration Certificate

Certificate Number 2019009048

Customer:
Widener & Associates
1902 120th Place SouthEast
Suite 202
Everett, WA 98208, United States

Model Number	CAL200	***Procedure Number***	D0001.8386		
Serial Number	4920	***Technician***	Scott Montgomery		
Test Results	**Pass**	***Calibration Date***	22 Jul 2019		
Initial Condition	Adjusted	***Calibration Due***	22 Jul 2020		
		Temperature	23	°C	± 0.3 °C
Description	Larson Davis CAL200 Acoustic Calibrator	***Humidity***	38	%RH	± 3 %RH
		Static Pressure	101.4	kPa	± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	09/06/2018	09/06/2019	001021
Larson Davis Model 2900 Real Time Analyzer	04/02/2019	04/02/2020	001051
Microphone Calibration System	03/04/2019	03/04/2020	005446
1/2" Preamplifier	09/20/2018	09/20/2019	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/07/2018	08/07/2019	006507
1/2 inch Microphone - RI - 200V	11/12/2018	11/12/2019	006511
Pressure Transducer	06/24/2019	06/24/2020	007310

Appendix B: Data Used in Model

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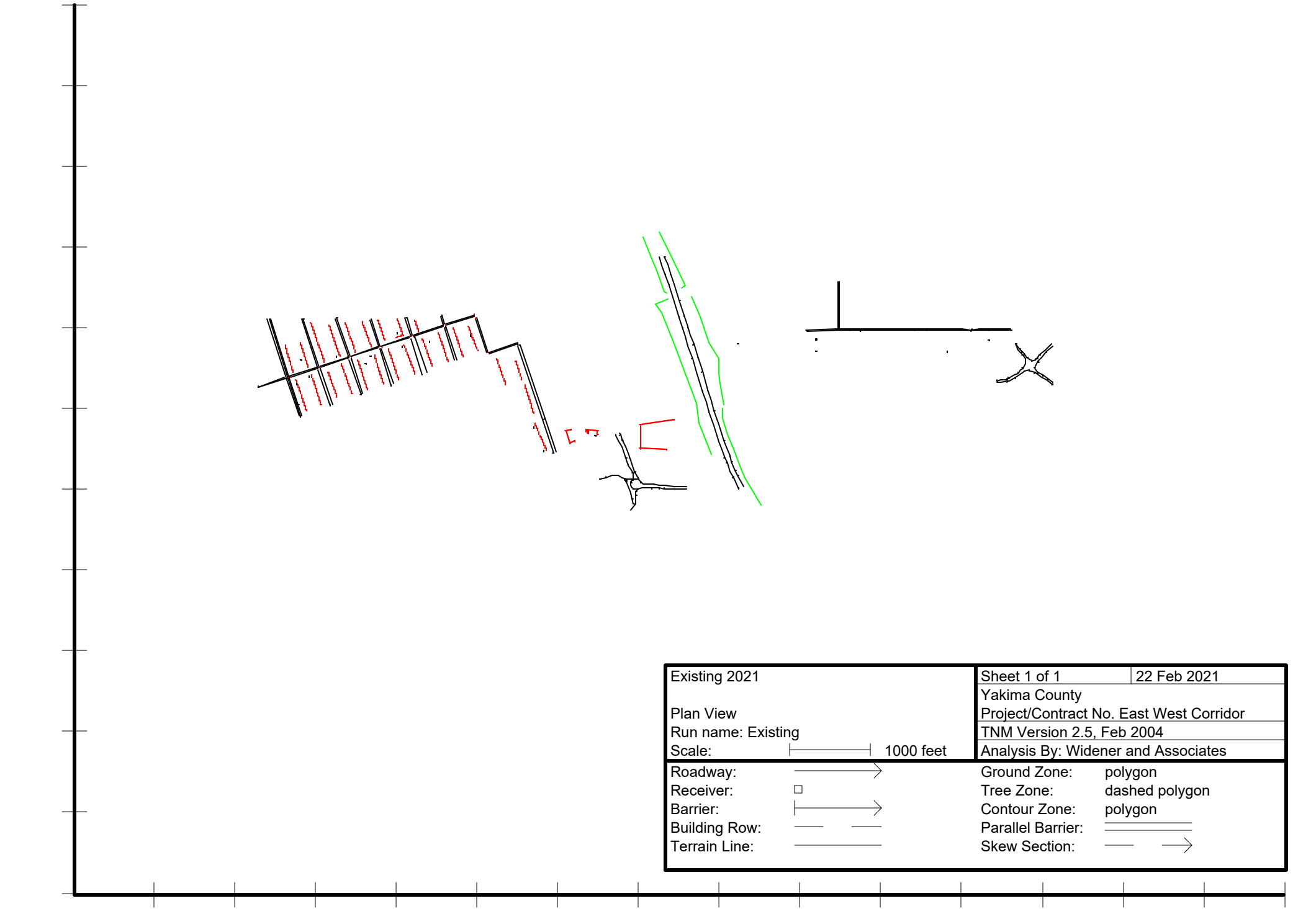


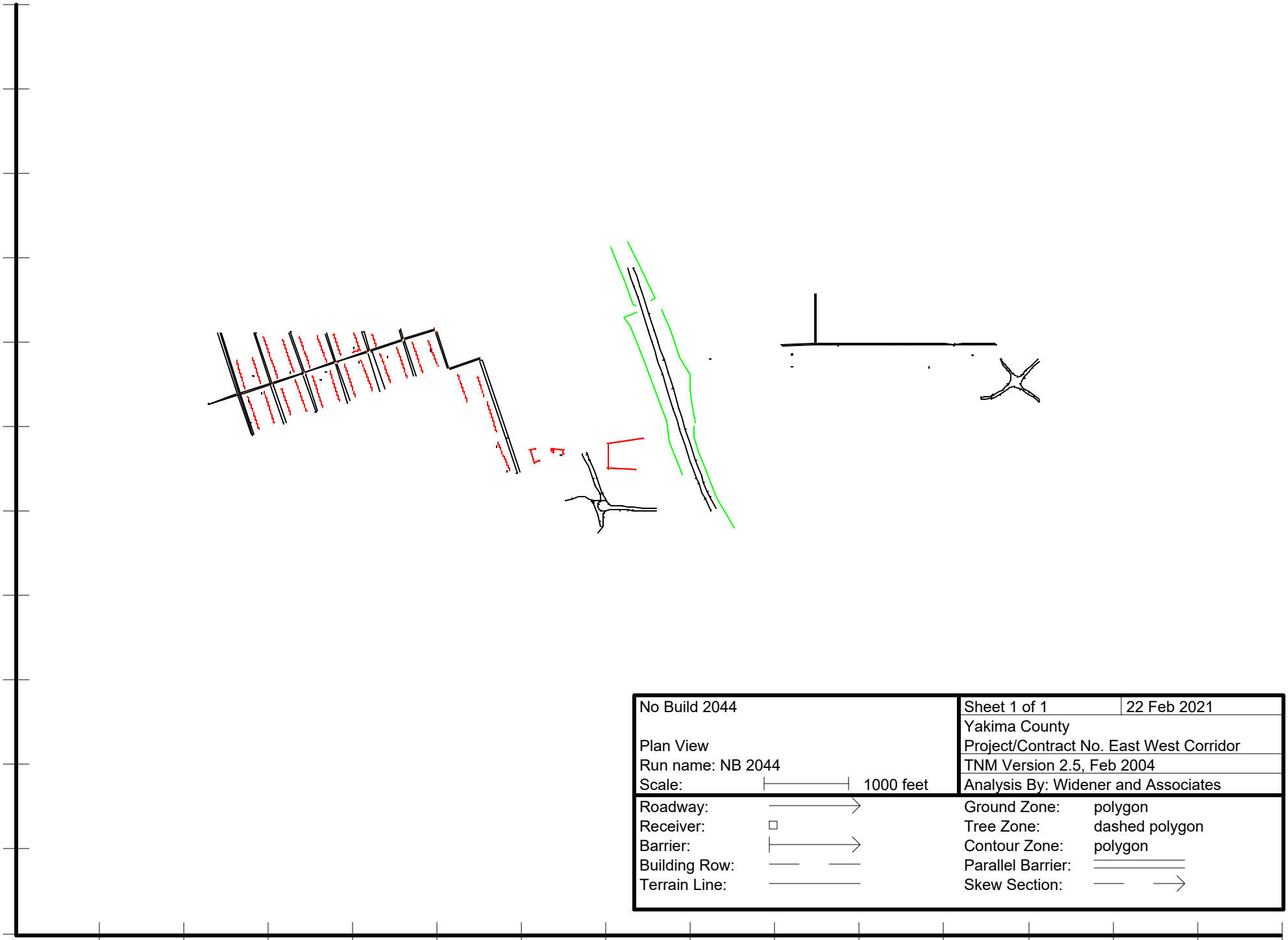
Existing 2021		Sheet 1 of 1	22 Feb 2021
		Yakima County	
Plan View		Project/Contract No. East West Corridor	
Run name: Existing		TNM Version 2.5, Feb 2004	
Scale:	1000 feet	Analysis By: Widener and Associates	
Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	

Existing

	2021	Car %	Cars	Med Truck %	Med Trucks	Heavy Truck %	Heavy Trucks
Intersection 1							
1st Street							
NB	1145	93	1065	5	57	2	23
SB	490	93	456	5	25	2	10
Intersection 2							
2nd Street							
NB	50	95	48	5	3	0	0
SB	40	95	38	5	2	0	0
South Leg							
NB	50	95	48	5	3	0	0
SB	40	95	38	5	2	0	0
H Street w/o 2nd							
EB	25	95	24	5	1	0	0
WB	5	95	5	5	0	0	0
Intersection 3							
3rd Street							
NB	50	95	48	5	3	0	0
SB	40	95	38	5	2	0	0
South Leg							
NB	50	95	48	5	3	0	0
SB	40	95	38	5	2	0	0
H Street w/o 3rd							
EB	20	95	19	5	1	0	0
WB	5	95	5	5	0	0	0
Intersection 4							
4th Street							
NB	120	95	114	5	6	0	0
SB	130	95	124	5	7	0	0
South Leg							
NB	20	95	19	5	1	0	0
SB	30	95	29	5	2	0	0
H Street w/o 4th							
EB	24	95	23	5	1	0	0
WB	22	95	21	5	1	0	0

Intersection 5							
Naches Avenue							
NB	5	95	5	5	0	0	0
SB	5	95	5	5	0	0	0
South Leg							
NB	100	95	95	5	5	0	0
SB	90	95	86	5	5	0	0
H Street w/o Naches							
EB	85	95	81	5	4	0	0
WB	65	95	62	5	3	0	0
Intersection 6							
6th Street							
NB	70	95	67	5	4	0	0
SB	40	95	38	5	2	0	0
South Leg							
NB	60	95	57	5	3	0	0
SB	40	95	38	5	2	0	0
H Street e/o Naches							
EB	10	95	10	5	1	0	0
WB	5	95	5	5	0	0	0
Intersection 7							
7th Street							
NB	5	95	5	5	0	0	0
SB	10	95	10	5	1	0	0
H Street							
EB	10	95	10	5	1	0	0
WB	5	95	5	5	0	0	0
G Street							
EB	10	95	10	5	1	0	0
WB	5	95	5	5	0	0	0
8th Street							
NB	5	95	5	5	0	0	0
SB	10	95	10	5	1	0	0

Bravo Company Blvd							
NB	20	93	19	5	1	2	0
SB	20	93	19	5	1	2	0
MLK Jr Blvd							
EB	586	93	545	5	29	2	12
Fair Ave							
EB	586	93	545	5	29	2	12
WB	700	93	651	5	35	2	14
Lincoln Ave							
WB	700	93	651	5	35	2	14
Terrace Heights							
15th							
NB and SB	21	97	20	5	1	2	0
Hartford							
EB and WB	21	97	20	5	1	2	0
Butterfield							
NB and SB	115	97	112	5	6	2	2
I-82							
EB and WB	5200	89	4628			11	572



No Build 2044		Sheet 1 of 1	22 Feb 2021
		Yakima County	
Plan View		Project/Contract No. East West Corridor	
Run name: NB 2044		TNM Version 2.5, Feb 2004	
Scale:	1000 feet	Analysis By: Widener and Associates	
Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	

No Build 2044

	2044 Total	Car %	Cars	Med Truck %	Med Trucks	Heavy Truck %	Heavy Trucks
Intersection 1							
1st Street n/o 1st							
NB	1305	93	1214	5	65	2	26
SB	1260	93	1172	5	63	2	25
1st Street s/o 1st							
NB	1365	93	1269	5	68	2	27
SB	1160	93	1079	5	58	2	23
Intersection 2							
2nd Street							
NB	150	95	143	5	8	0	0
SB	250	95	238	5	13	0	0
South Leg							
NB	90	95	86	5	5	0	0
SB	130	95	124	5	7	0	0
H Street w/o 2nd							
EB	250	95	238	5	13	0	0
WB	100	95	95	5	5	0	0
Intersection 3							
3rd Street							
NB	150	95	143	5	8	0	0
SB	250	95	238	5	13	0	0
South Leg							
NB	90	95	86	5	5	0	0
SB	130	95	124	5	7	0	0
H Street w/o 3rd							
EB	230	95	219	5	12	0	0
WB	80	95	76	5	4	0	0
Intersection 4							
4th Street							
NB	270	95	257	5	14	0	0
SB	200	95	190	5	10	0	0
South Leg							
NB	10	95	10	5	1	0	0
SB	10	95	10	5	1	0	0
H Street w/o 4th							
EB	380	95	361	5	19	0	0
WB	180	95	171	5	9	0	0

Intersection 5							
Naches Avenue							
NB	0	95	0	5	0	0	0
SB	0	95	0	5	0	0	0
South Leg							
NB	200	95	190	5	10	0	0
SB	250	95	238	5	13	0	0
H Street w/o Naches							
EB	230	95	219	5	12	0	0
WB	170	95	162	5	9	0	0
Intersection 6							
6th Street							
NB	200	95	190	5	10	0	0
SB	320	95	304	5	16	0	0
South Leg							
NB	270	95	257	5	14	0	0
SB	460	95	437	5	23	0	0
H Street e/o Naches							
EB	0	95	0	5	0	0	0
WB	0	95	0	5	0	0	0
Intersection 7							
7th Street							
NB	0	95	0	5	0	0	0
SB	0	95	0	5	0	0	0
H Street							
EB	0	95	0	5	0	0	0
WB	0	95	0	5	0	0	0
G Street							
EB	0	95	0	5	0	0	0
WB	0	95	0	5	0	0	0
8th Street							
NB	0	95	0	5	0	0	0
SB	0	95	0	5	0	0	0

Bravo Company Blvd							
NB	230	93	214	5	12	2	5
SB	750	93	698	5	38	2	15
MLK Jr Blvd							
EB	630	93	586	5	32	2	13
Fair Ave							
EB	540	93	502	5	27	2	11
WB	360	93	335	5	18	2	7
Lincoln Ave							
WB	1060	93	986	5	53	2	21
Terrace Heights							
15th							
NB and SB	26	97	25	5	1	2	1
Hartford							
EB and WB	26	97	25	5	1	2	1
Butterfield							
NB	380	97	369	5	19	2	8
SB	510	97	495	5	26	2	10
I-82							
EB and WB	6345	89	5647			11	698

Build 2044		Sheet 1 of 1	4 Mar 2021
		Yakima County	
Plan View		Project/Contract No. East West Corridor	
Run name: Build 2044		TNM Version 2.5, Feb 2004	
Scale:	1000 feet	Analysis By: Widener and Associates	
Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	

1636000 1637000 1638000 1639000 1640000 1641000 1642000 1643000 1644000 1645000 1646000 1647000 1648000 1649000 1650000

Build 2044

	2044 Total	Car %	Cars	Med Truck %	Med Trucks	Heavy Truck %	Heavy Trucks
Intersection 1							
1st Street n/o 1st							
NB	1335	93	1242	5	67	2	27
SB	660	93	614	5	33	2	13
1st Street s/o 1st							
NB	1275	93	1186	5	64	2	26
SB	695	93	646	5	35	2	14
Intersection 2							
2nd Street							
NB	180	95	171	5	9	0	0
SB	190	95	181	5	10	0	0
South Leg							
NB	70	95	67	5	4	0	0
SB	90	95	86	5	5	0	0
H Street w/o 2nd							
EB	280	93	260	5	14	2	6
WB	380	93	353	5	19	2	8
Intersection 3							
3rd Street							
NB	180	95	171	5	9	0	0
SB	190	95	181	5	10	0	0
South Leg							
NB	70	95	67	5	4	0	0
SB	90	95	86	5	5	0	0
H Street w/o 3rd							
EB	270	93	251	5	14	2	5
WB	370	93	344	5	19	2	7
Intersection 4							
4th Street							
NB	270	95	257	5	14	0	0
SB	180	95	171	5	9	0	0
South Leg							
NB	20	95	19	5	1	0	0
SB	40	95	38	5	2	0	0
H Street w/o 4th							
EB	450	93	419	5	23	2	9
WB	570	93	530	5	29	2	11

Intersection 5							
Naches Avenue							
NB	0	95	0	5	0	0	0
SB	10	95	10	5	1	0	0
South Leg							
NB	110	95	105	5	6	0	0
SB	190	95	181	5	10	0	0
H Street w/o Naches							
EB	460	93	428	5	23	2	9
WB	650	93	605	5	33	2	13
Intersection 6							
6th Street							
NB	350	95	333	5	18	0	0
SB	320	95	304	5	16	0	0
South Leg							
NB	220	95	209	5	11	0	0
SB	350	95	333	5	18	0	0
H Street e/o Naches							
EB	450	93	419	5	23	2	9
WB	720	93	670	5	36	2	14
Intersection 7							
7th Street							
NB	200	93	186	5	10	2	4
SB	200	93	186	5	10	2	4
H Street w/o 7th							
EB	800	93	744	5	40	2	16
WB	670	93	623	5	34	2	13
G Street							
EB	200	95	190	5	10	0	0
WB	200	95	190	5	10	0	0
8th Street							
NB	200	95	190	5	10	0	0
SB	200	95	190	5	10	0	0
H Street e/o 7th							
EB	1150	93	1070	5	58	2	23
WB	620	93	577	5	31	2	12

Bravo Company Blvd							
NB	830	93	772	5	42	2	17
SB	920	93	856	5	46	2	18
MLK Jr Blvd							
EB	650	93	605	5	33	2	13
Fair Ave							
EB	340	93	316	5	17	2	7
WB	500	93	465	5	25	2	10
Lincoln Ave							
WB	1390	93	1293	5	70	2	28
Terrace Heights							
15th							
NB and SB	26	97	25	5	1	2	1
Hartford							
EB and WB	26	97	25	5	1	2	1
Butterfield n/o Cascade Mill Parkway							
NB	460	97	446	5	23	2	9
SB	530	97	514	5	27	2	11
Butterfield s/o Cascade Mill Parkway							
NB	320	97	310	5	16	2	6
SB	370	97	359	5	19	2	7
I-82							
EB and WB	6345	89	5647			11	698
Cascade Mill Parkway							
e/o Bravo Company Blvd							
EB	1440	97	1397	5	72	2	29
WB	540	97	524	5	27	2	11
Cascade Mill Parkway							
e/o I-82							
EB	1080	97	1048	5	54	2	22
WB	630	97	611	5	32	2	13

Appendix C: Sound Level Data Sheets

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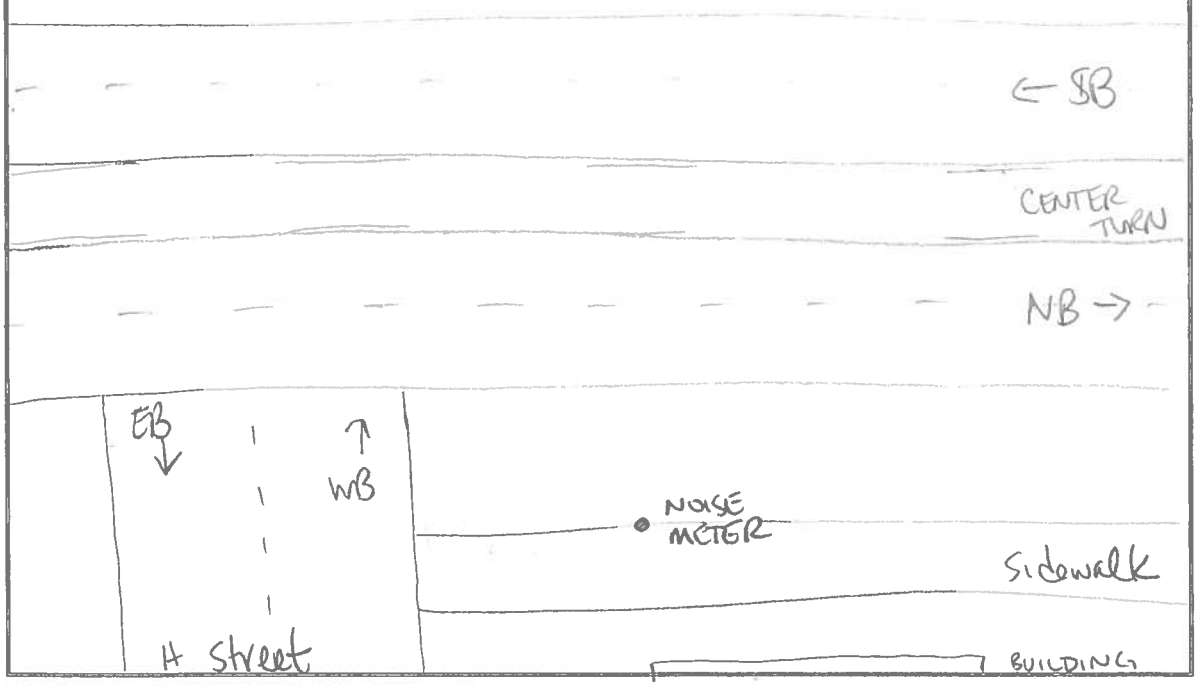
Sound Level Data Collection Sheet

DATE/TIME: 5/8 3:30PM	LOCATION: 1st Street & H Street
PROJECT NO.:	PERSONNEL: Christina Neff
SITE: 1	WIND SPEED: WIND. DIR:
REL. HUMIDITY: 25%	TEMP: Dry Bulb 75°F Wet Bulb

EQUIPMENT MODEL:	SERIAL NO.:
CALIBRATION: Initial_____ Final_____	PROBLEMS:
DESCRIPTOR:	INTEGRATION RATE:
WEIGHTING:	SAMPLE RATE:

SITE DESCRIPTION / DRAWING:



SOUND LEVEL 1: 72.5	SOUND LEVEL 2:

NOTES:

Traffic Counts 1st Street

Site Number: 1 Timing Number: 1 3:30 PM

Temp:
Wind Speed:

Relative Humidity:
Wind Direction:
Distance for Timed Cars:

Direction of Traffic: SB

Heavy Trucks	Medium Trucks	Cars	Bus	Bikes	Timed Cars
I (1)	III (3)	(124)	II (2)	II (2)	

Direction of Traffic: NB

Distance for Timed Cars:

Heavy Trucks	Medium Trucks	Cars	Bus	Bikes	Timed Cars
III (3)	III (3)	(167)	I (1)	I (1)	

- H Street ~~IIII~~ II (7) from 1st

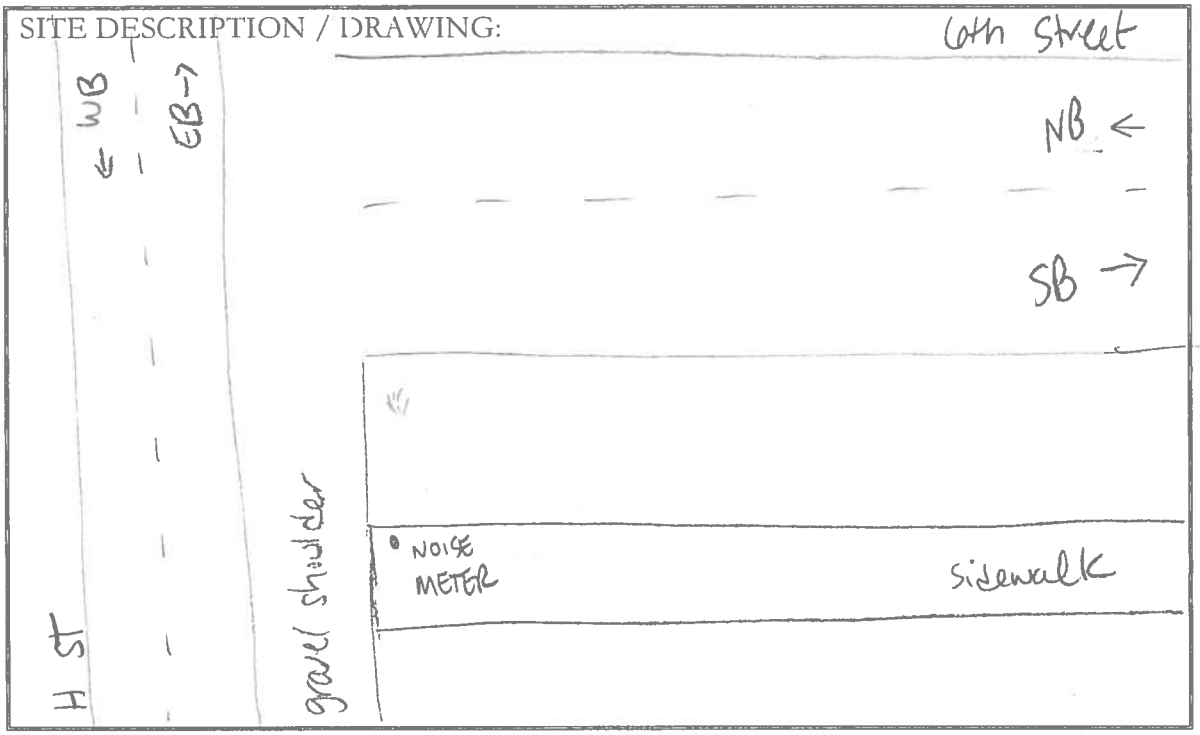
1 to 1st

Sound Level Data Collection Sheet

DATE/TIME: 5/8 4:15PM	LOCATION: 6th Street and H Street
PROJECT NO.:	PERSONNEL: Christina Neff
SITE: 2	WIND SPEED: WIND. DIR:
REL. HUMIDITY:	TEMP: Dry Bulb Wet Bulb

EQUIPMENT MODEL:	SERIAL NO.:
CALIBRATION: Initial_____ Final_____	PROBLEMS:
DESCRIPTOR:	INTEGRATION RATE:
WEIGHTING:	SAMPLE RATE:

SITE DESCRIPTION / DRAWING:



SOUND LEVEL 1: 55.8	SOUND LEVEL 2:

NOTES: Birds, dog barking, radio, 1 car idling in driveway
Some noise from I-82 is audible

Traffic Counts

Site Number: 2 Timing Number: 1

Temp: Relative Humidity:
Wind Speed: Wind Direction:
Distance for Timed Cars:

Direction of Traffic: 10th Street

Heavy Trucks	Medium Trucks	Cars	Bus	Bikes	Timed Cars
NB		𝍸 𝍸 || (12)			
SB		𝍸 |||| (9)			

Direction of Traffic: H Street

Distance for Timed Cars:

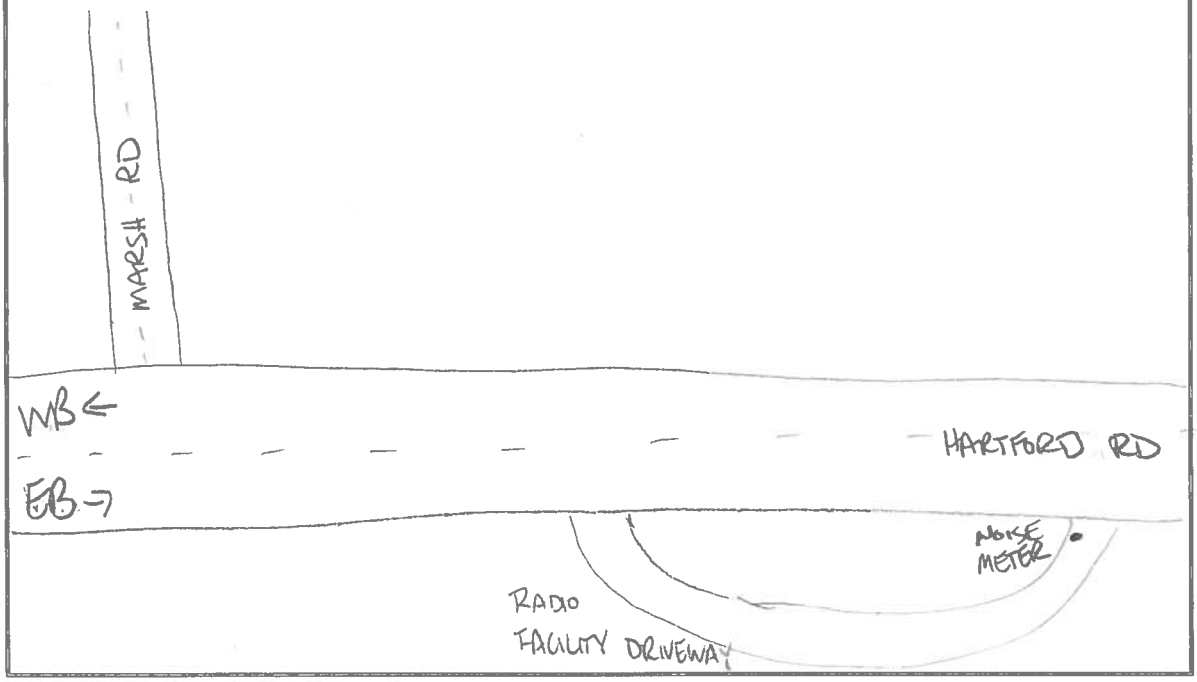
Heavy Trucks	Medium Trucks	Cars	Bus	Bikes	Timed Cars
WB		|| (2)			
EB		|||| (4)			

Sound Level Data Collection Sheet

DATE/TIME: 5/8 5PM	LOCATION: Hartford Rd Terrace Heights
PROJECT NO.:	PERSONNEL: Christina Neff
SITE: 3	WIND SPEED: 10 KPH WIND. DIR:
REL. HUMIDITY: 25%	TEMP: Dry Bulb 75°F Wet Bulb

EQUIPMENT MODEL:	SERIAL NO.:
CALIBRATION: Initial_____ Final_____	PROBLEMS:
DESCRIPTOR:	INTEGRATION RATE:
WEIGHTING:	SAMPLE RATE:

SITE DESCRIPTION / DRAWING:



SOUND LEVEL 1: 57.0	SOUND LEVEL 2: 53.1

NOTES: chickens, dogs, goats occasionally throughout from home across the street

Traffic Counts

Terrace Heights

Site Number: 3 Timing Number: 1 & 2

Temp: Relative Humidity:

Wind Speed: Wind Direction:

Direction of Traffic: WB Distance for Timed Cars:

	Heavy Trucks	Medium Trucks	Cars	Bus	Bikes	Timed Cars
TIME 1		I (1)	II (2)			
TIME 2			IIII (4)			

Direction of Traffic: EB Distance for Timed Cars:

	Heavy Trucks	Medium Trucks	Cars	Bus	Bikes	Timed Cars
TIME 1			II (2)			
TIME 2			I (1)			

Appendix A8-
Traffic Analysis

SCJ ALLIANCE
CONSULTING SERVICES

TECHNICAL MEMORANDUM

TO:	Dan Ireland, PE
FROM:	Anne Sylvester, PTE and Ryan Shea, PTP
DATE:	March 2, 2021
PROJECT #:	1907.01
SUBJECT:	Revised Traffic Forecasts and Analysis for Mill Parkway and H Street Study Areas

INTRODUCTION

This memo is intended to supplement, and update information contained in previous memos related to traffic forecasts for the Mill Parkway corridor dated January 21, 2021 and February 9, 2021. The focus of this memo is on highlighting existing (2021) traffic activity, as well as documenting future year (2024 and 2044) traffic forecasts for the study area. The focus of this effort is on evaluating "True" No Build conditions which do not include:

- Any improvements along H Street between 1st Street and 7th Street. The existing street cross-section and stop sign at the intersection with 1st Street is assumed.
- The proposed Mill Parkway improvements between the existing terminus of H Street and the eastern end of the project near Butterfield Road.
- Any extension of Bravo Company Boulevard north of its existing terminus at D Street near the Trampoline Park.

This memo also addresses updated traffic operations at the intersection of 1st Street with H Street for conditions including the existing (2021) base year, 2024 (year of project opening) and 2044 (design year) including both True No Build and project Build conditions with or without a new interchange at I-82.

Data and analysis in this memo will be used to support air quality and noise analysis as part of the Mill Parkway improvement project.

FORECASTING METHOD

As noted in the January 21, 2021 memo PM peak hour traffic forecasts were prepared using output from the regional travel demand model developed and maintained by the Yakima Valley COG (YVCOG). Eleven modeling scenarios were developed and evaluated including the 2015 base year, four scenarios reflecting 2024 no build and various build conditions, and six scenarios for 2044 also including various no build and build configurations.

As this memo focuses on augmenting the analysis documented in the earlier memoranda, results for most of the model alternatives are not repeated except for two alternatives that identify expected traffic volumes in 2024 and 2044 for conditions when a new interchange connection to the study area is provided on I-82. The forecasted link volume data and scenarios that best support the air quality and

noise analysis and provide a well-balanced assessment of expected traffic conditions in the study area including the following:

- ***Scenario 1c***: ***2024 True No Build*** - this alternative assumes the existing roadway system will be in place without any improvements to the H Street corridor, or development of the Bravo Boulevard and Mill Parkway corridors. Partial development is assumed for the Cascade Mill area, but this development is not assumed to occur in areas that would require connection to a new Bravo Boulevard or Mill Parkway or substantive improvements to H Street.
- ***Scenario 4c***: ***2044 True No Build*** – this alternative assumes the same roadway access and configurations as Scenario 1c but assumes full development of the Cascade Mill area.
- ***Scenario 6: 2044 Build with an I-82 interchange*** – this scenario includes both the new Mill Parkway and the proposed split diamond interchange connecting Yakima Avenue and Mill Parkway. It also includes the improvement of H Street and extension eastward to the proposed new roundabout that will connect with Mill Parkway at Bravo Company Boulevard. The entire Bravo Company Boulevard project would also be included. Full development of Cascade Mill area is assumed and direct access between this area and the H Street/Mill Parkway corridor is included.

Two other scenarios were developed that would be useful to document in this memo including:

- ***Scenario 3: 2024 Build with an I-82 interchange*** – as with Scenario 6, this scenario includes all proposed local roadway improvements on H Street, Mill Parkway and Bravo Boulevard and an I-82 interchange. Only partial, prorated development is assumed in the Cascade Mill area.
- ***Scenario 4d: 2044 Build without an I-82 interchange*** – as with Scenario 6, this scenario includes the improvement of H Street (including a signal at 1st Street) and its extension to Bravo Boulevard, construction of Bravo Boulevard south of H Street/Mill Parkway to its existing terminus near D Street, and construction of Mill Parkway through the entire study area. However, this scenario does not include either an interchange at I-82 or the extension of Bravo Boulevard north of Mill Parkway. Full development of the Cascade Mill area is assumed but direct access would not be provided to the Mill Parkway/H Street corridor. This alternative is useful in isolating the potential traffic impacts of the proposed local street improvement from impacts associated with Cascade Mill development. These volumes can be compared to Scenario 6 to identify how traffic movement is expected to change once the interchange is in place.

2024 and 2044 PM peak hour forecasts were developed using a multi-step approach depending on the availability of existing traffic counts. Using a 2017 count at the I-82 interchange with Yakima Avenue, 2015 model output was post-processed to account for the differences between the traffic model assignment and actual counts. These differences were applied to the 2024 and 2044 projections in the interchange area and were assumed to continue for the length of the Yakima Avenue/Terrace Heights Drive corridor.

Projections in the H Street study area relied on a February 3, 2021 turning movement count taken at the intersection of 1st Street with H Street. This count was modified to account for the effects of COVID 19 on traffic patterns in the region using a 15 percent increase in the counted volume based on comparisons with data collected at several locations in the vicinity. Using this data, model output for the

subject years was post-processed at the intersection and then analyzed to determine operational performance. Modeled volumes along H Street were also post-processed using the same data between 1st Street and Bravo Company Boulevard. Direct modeled volumes for the north/south streets along the corridor were also used for 3rd Street, 4th Street, Naches Street, and 6th Street. As post-processing only made slight modifications on H Street, this effort was discontinued for the long-range 2044 forecast.

Only one other set of traffic count data was available in the study area and this included for Butterfield Road and Keys Road north of Terrance Heights Drive. A comparison between 2015 model output and these counts indicated some differences but were not considered substantive. Lacking a directional split in this data, they were not used to post-process model output along these two roads.

For all roadway links in the study area other than Yakima Avenue/Terrace Heights Drive, and the H Street/1st Street intersection vicinity, model output was extensively reviewed and was ultimately used directly to produce the forecasts presented in this memo. Post-processing based on actual traffic counts (including intersection turning movements) would improve the accuracy of the forecasts but at this point data is considered sufficient to obtain a general idea of the level of PM peak hour traffic expected in 2024 and 2044.

Assumptions

- 2024 assumes partial development at Cascade Mill and in Terrace Heights/Highland (TAZ 355). 2044 assumes full development per data in the YVCOG regional travel demand model.
- True No Build is existing transportation system.
- Forecasts assume 4-lane Mill Parkway through Phases 2 and 3 of project (to east of Irrigation Canal). No analysis has been conducted of traffic control alternatives along Mill Parkway but forecasted ramp volumes to/from I-82 indicate that signal or roundabout control is likely to be needed in preference to stop signs.
- The design speed for Mill Parkway is 35 mph.
- Existing channelization, traffic control and speed limits on Yakima Avenue/Terrace Heights Drive would be unchanged in the future.
- Truck percentages at the intersection of 1st Street with H Street were 4.7 percent including 2-axle single unit vehicles (Class 5) through units with seven or more axles (Class 13). Fifteen Class 5 vehicles were counted and one Class 7. Classification count data is attached.
- The PM peak along H Street and the MLK/Lincoln couplet were assumed to represent 10.99 percent of daily volumes as counted by Yakima County along the H Street corridor. This percentage has been applied to the PM peak hour data presented in the tables illustrating projections for the general H Street study area to derive daily traffic volume estimates. Elsewhere in the study area along Yakima Avenue/Terrace Heights Drive and in the areas to the east of I-82 the PM peak is assumed to represent 13.1 percent of daily volumes based on the relationship of daily 2017 volumes at the permanent recorder on Terrace Heights Drive west of Keys Road and estimated PM peak volumes for this location developed from the 2017 I-82/Yakima Avenue count data. This percentage has been applied to the PM peak hour data presented in the tables that illustrate traffic outside of the H Street study area to derive daily traffic volume estimates.

H STREET STUDY AREA - PM PEAK AND DAILY TRAFFIC VOLUME PROJECTIONS

Existing 2021 Traffic Volumes for the H Street Study Area

Table 1 presents 2021 PM peak hour and daily traffic volume estimates for various street segments in the H Street study area. The table includes segments of H Street from the 1st Street intersection to east of 6th Street, as well as several intersecting north/south street between 1st Street and 6th Street inclusive. Data in this table is intended to directly support air quality and noise analysis.

Table 1. 2021 Traffic Volumes for H Street Corridor[1]

Segment Number	Roadway Segment	Existing 2021 PM Peak Hour EB	WB	Total	Daily
1	H Street e/o 1st Street	25	5	30	270
2	H Street w/o 3rd Street	20	5	25	230
3	H Street w/o 4th Street	20	5	25	230
4	H Street w/o Naches Street	85	65	150	1,360
5	H Street e/o Naches Street	10	5	15	140
6	H Street e/o 6th Street	10	5	15	140
7	H Street e/o 8th Street	-	-	-	-

2021 Traffic Volumes for North/South Streets[1]

Segment Number	Roadway Segment	Existing 2021 PM Peak Hour NB	SB	Total	Daily
1	1st Street n/o H Street	1,135	490	1,625	14,770
2	1st Street s/o H Street	1,145	480	1,625	14,770
3	3rd Street n/o H Street	50	40	90	820
4	3rd Street s/o H Street	50	40	90	820
5	4th Street n/o H Street	120	130	250	2,270
6	4th Street s/o H Street	20	30	50	450
7	Naches Street n/o H Street	5	5	10	90
8	Naches Street s/o H Street	100	90	190	1,730
9	6th Street n/o H Street	70	40	110	1,000
10	6th Street s/o H Street	60	40	100	910

[1] Data for both PM peak hour and daily traffic volumes represents the sum of both directions of travel. Daily volumes were calculated based on a calculated ratio with the PM peak hour of 10.99% which reflects the three-day H Street count average.

2044 PM Peak Hour Traffic Volumes for H Street Study Area

Table 2 presents 2044 PM peak hour and daily traffic volume projections for various street segments in the H Street study area. The table includes segments of H Street from the 1st Street intersection to east of 6th Street, as well as several intersecting north/south street between 1st Street and 6th Street inclusive. The table includes projections prepared for the True No Build scenario as well as Build scenarios that include Mill Parkway with and without a new interchange connection to I-82.

Table 2. 2044 Traffic Projections for H Street Study Area[1]

Segment Number	Roadway Segment	2044 True No Build (4c)				2044 Build No Interchange (4d)[2]				2044 Build With Interchange (6)			
		PM Peak Hour				PM Peak Hour				PM Peak Hour			
		EB	WB	Total	Daily	EB	WB	Total	Daily	EB	WB	Total	Daily
1	H Street e/o 1st Street	250	100	350	3,200	300	370	670	6,100	280	380	660	6,000
2	H Street w/o 3rd Street	230	80	310	2,800	280	350	630	5,700	270	370	640	5,800
3	H Street w/o 4th Street	380	180	560	5,100	530	380	910	8,300	450	570	1,020	9,300
4	H Street w/o Naches Street	430	320	750	6,800	630	680	1,310	11,900	460	650	1,110	10,100
5	H Street e/o Naches Street	230	170	400	3,600	630	630	1,260	11,500	450	720	1,170	10,600
6	H Street e/o 6th Street	0	0	0	0	650	540	1,190	10,800	800	670	1,470	13,400
7	H Street e/o 8th Street	0	0	0	0	990	550	1,540	14,000	1,150	620	1,770	16,100

2044 Projections for North/South Streets[1]

Segment Number	Roadway Segment	2044 True No Build (4c)				2044 Build No Interchange (4d)[2]				2044 Build With Interchange (6)			
		PM Peak Hour				PM Peak Hour				PM Peak Hour			
		NB	SB	Total	Daily	NB	SB	Total	Daily	NB	SB	Total	Daily
1	1st Street n/o H Street	1,305	1,260	2,565	23,300	1,335	1,220	2,555	23,200	1,340	660	2,000	18,200
2	1st Street s/o H Street	1,365	1,160	2,525	23,000	1,175	1,120	2,295	20,900	1,275	695	1,970	17,900
3	3rd Street n/o H Street	150	250	400	3,600	160	380	540	4,900	180	190	370	3,400
4	3rd Street s/o H Street	90	130	220	2,000	90	100	190	1,700	70	90	160	1,500
5	4th Street n/o H Street	270	200	470	4,300	380	230	610	5,600	270	180	450	4,100
6	4th Street s/o H Street	10	10	20	200	10	40	50	500	40	20	60	500
7	Naches Street n/o H Street	0	0	0	0	0	10	10	100	0	10	10	100
8	Naches Street s/o H Street	200	250	450	4,100	130	80	210	1,900	110	190	300	2,700
9	6th Street n/o H Street	200	320	520	4,700	270	420	690	6,300	350	320	670	6,100
10	6th Street s/o H Street	270	460	730	6,600	250	290	540	4,900	220	350	570	5,200

[1] Data for both PM peak hour and daily traffic volumes represents the sum of both directions of travel. Daily volumes were calculated based on a calculated ratio with the PM peak hour of 10.99% which reflects the three-day H Street count average.

[2] While this scenario assumes full development of the Cascade Mill area, it is not assumed to be connected to the H Street/Mill Parkway corridor. With this scenario Bravo Boulevard would only be constructed to the south of Mill Parkway.

Graphics illustrating the projected traffic volumes for each of these scenarios are attached to this memo.

PM PEAK HOUR TRAFFIC OPERATIONS AT 1ST/H STREET INTERSECTION

Table 3 presents the results of PM peak hour operations analysis at the intersection of 1st Street and H Street. Scenarios presented in this table include:

- Existing 2021
- 2024 opening year True No Build conditions,
- 2044 design year True No Build conditions,
- 2044 with the parkway but without an interchange at I-82, and
- 2044 with both the parkway and the new interchange.

All scenarios assume existing lane channelization. The existing conditions and True No Build analysis assumes side street stop sign control as is currently provided. With the substantive change in the function of H Street once Bravo Parkway is constructed and the Cascade Mill begins to develop, installation of a traffic signal at this intersection is assumed for all 2024 and 2044 Build scenarios.

As indicated in the table, the intersection is expected to operate at level of service C or better for all scenarios with the highest expected delay occurring in the 2044 PM peak hour (24.4 seconds of average delay). Intersection operations analysis worksheets are attached to this memo.

Table 3. PM Peak Hour Intersection Operations - First Street at H Street

Forecast Scenario	Delay	LOS
Existing 2021[1]	19.8	C
2024 True No Build (Scenario 1c)[1]	23.3	C
2024 With Interchange (Scenario 3)	10.0	A
2044 True No Build (Scenario 4c)[1]	47.4	E
2044 Build No Interchange (Scenario 4d)	20.4	C
2044 Build With Interchange (Scenario 6)	24.4	C

[1] Results are for worst-performing side street movement.

MILL PARKWAY STUDY AREA - PM PEAK AND DAILY TRAFFIC VOLUME PROJECTIONS

2024 PM Peak Hour Projections

Table 4 presents 2024 PM peak hour and daily traffic volume projections prepared for the True No Build scenario as well as a Build scenario that includes Mill Parkway, Bravo Boulevard, and an improved H Street with a new interchange connection to I-82. This table includes segments of Mill Parkway from west of 8th Street to east of Keys Road; Yakima Avenue/Terrace Heights Drive from west of the I-82 interchange to east of Keys Road; Bravo Company Boulevard both north and south of the future Mill Parkway roundabout; and H Street to the west of Bravo Boulevard.

Table 4. 2024 Traffic Projections[1]

	True No Build (1c)		Build with Interchange (3)	
Location	PM Peak Hour	Daily	PM Peak Hour	Daily
H Street e/o 1st Street	155	1,410	320	2,900
H Street e/o 4th Street	185	1,680	690	6,300
H Street e/o Naches Street	35	320	590	5,400
H Street e/o 8th Street	0	0	700	6,400
Mill Parkway e/o Bravo	NA	NA	990	7,600
Mill Parkway between I-82 Ramps	NA	NA	860	6,600
Mill Parkway e/o I-82	NA	NA	590	4,500
Mill Parkway e/o split to Butterfield	NA	NA	550	4,200
Butterfield Road w/o Keys Road	330	3,000	690	5,300
Butterfield Road e/o Keys Road	440	4,000	620	4,700
Yakima Avenue w/o I-82	2,450	18,700	2,220	17,000
Yakima Avenue between I-82 Ramps	2,810	21,500	2,400	18,30
Yakima Avenue e/o I-82	3,485	26,600	3,075	23,500
Terrace Heights Drive e/o 17th Street	3,130	23,900	2,690	20,500
Terrace Heights Drive e/o 18th Street	3,130	23,900	2,710	20,700
Terrace Heights Drive e/o Butterfield Road	2,640	20,200	2,420	18,500
Terrace Heights Drive e/o Keys Road	2,230	17,000	2,180	16,600
E Lincoln Avenue w/o 8th Street	530	4,820	650	5,910
E Martin Luther King Blvd w/o 8th Street	430	3,910	410	3,730
N Fair Avenue e/o Bravo Company Blvd	540	4,910	410	3,730
Bravo Company Blvd n/o Fair Avenue	NA	NA	660	6,000
Bravo Company Blvd n/o Mill Parkway	NA	NA	460	4,200

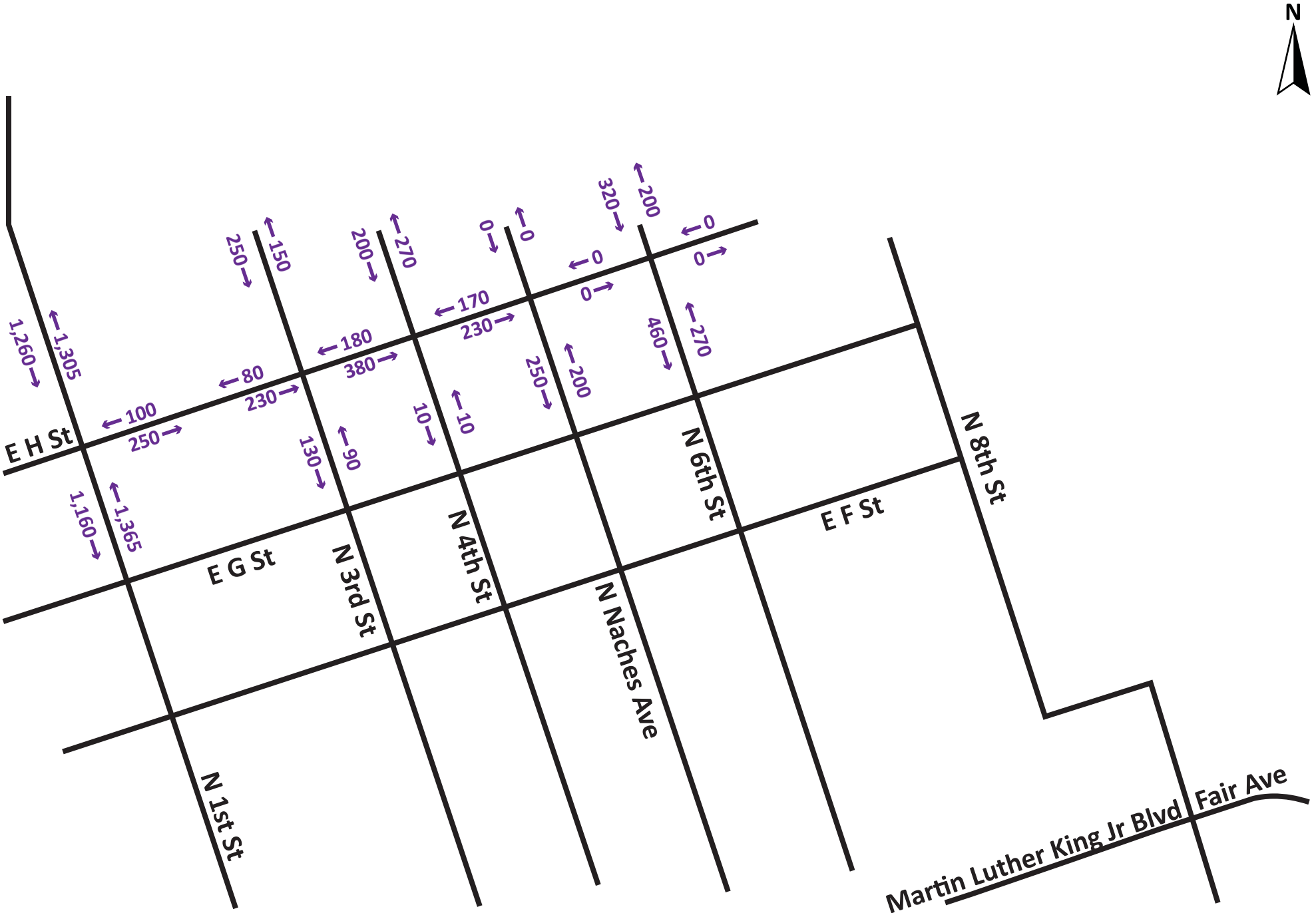
[1] Data for both PM peak hour and daily traffic volumes represents the sum of both directions of travel. Daily volumes were calculated based on a calculated ratio with the PM peak hour of 13.1%.

Table 5 presents 2044 PM peak hour and daily projections for the same roadway segments included in Table 4 (with the exception of H Street which is reported in Table 2) and reflects estimates for the True No Build scenario and two Build scenarios with and without the I-82 interchange.

The attached figures illustrate directional traffic projections by location. Data also includes ramp volume projections which were prepared to help evaluate and better understand the movement of traffic in the study area with the different roadway configuration alternatives.

Table 5. 2044 Traffic Projections

	True No Build (4c)		Build w/o Interchange (4d)		Build with Interchange (6)	
Location	PM Peak Hour	Daily	PM Peak Hour	Daily	PM Peak Hour	Daily
Mill Parkway e/o Bravo	NA	NA	1,540	11,800	1,980	15,100
Mill Parkway between I-92 Ramps	NA	NA	1,540	11,800	1,810	13,800
Mill Parkway e/o I-82	NA	NA	1,540	11,800	1,710	13,100
Butterfield Road w/o Keys Road	590	4,500	1,430	10,900	1,540	11,800
Butterfield Road e/o Keys Road	860	6,560	1,520	11,600	1,590	12,100
Yakima Avenue w/o I-82	2,900	22,140	2,470	18,900	2,480	18,900
Yakima Avenue between I-82 Ramps	3,560	27,180	2,970	22,700	2,940	22,400
Yakima Avenue e/o I-82	4,185	31,950	3,555	27,100	3,495	26,700
Terrace Heights Drive e/o 17th Street	4,070	31,070	3,330	25,400	3,200	24,400
Terrace Heights Drive e/o 18th Street	4,070	31,070	3,330	25,400	3,210	24,500
Terrace Heights Drive e/o Butterfield Road	3,370	25,730	3,130	23,900	3,060	23,400
Terrace Heights Drive e/o Keys Road	2,890	22,060	2,750	20,100	2,720	20,800
E Lincoln Avenue w/o 8th Street	1,060	9,650	1,000	9,100	1,390	12,600
E Martin Luther King Blvd w/o 8th Street	630	5,730	800	7,300	650	5,900
N Fair Avenue e/o Bravo Company Blvd	900	8,190	860	7,800	840	7,600
Bravo Blvd n/o Fair Avenue	NA	NA	1,220	11,100	1,750	15,900
Bravo Blvd n/o Mill Parkway	NA	NA	NA	NA	1,850	16,800



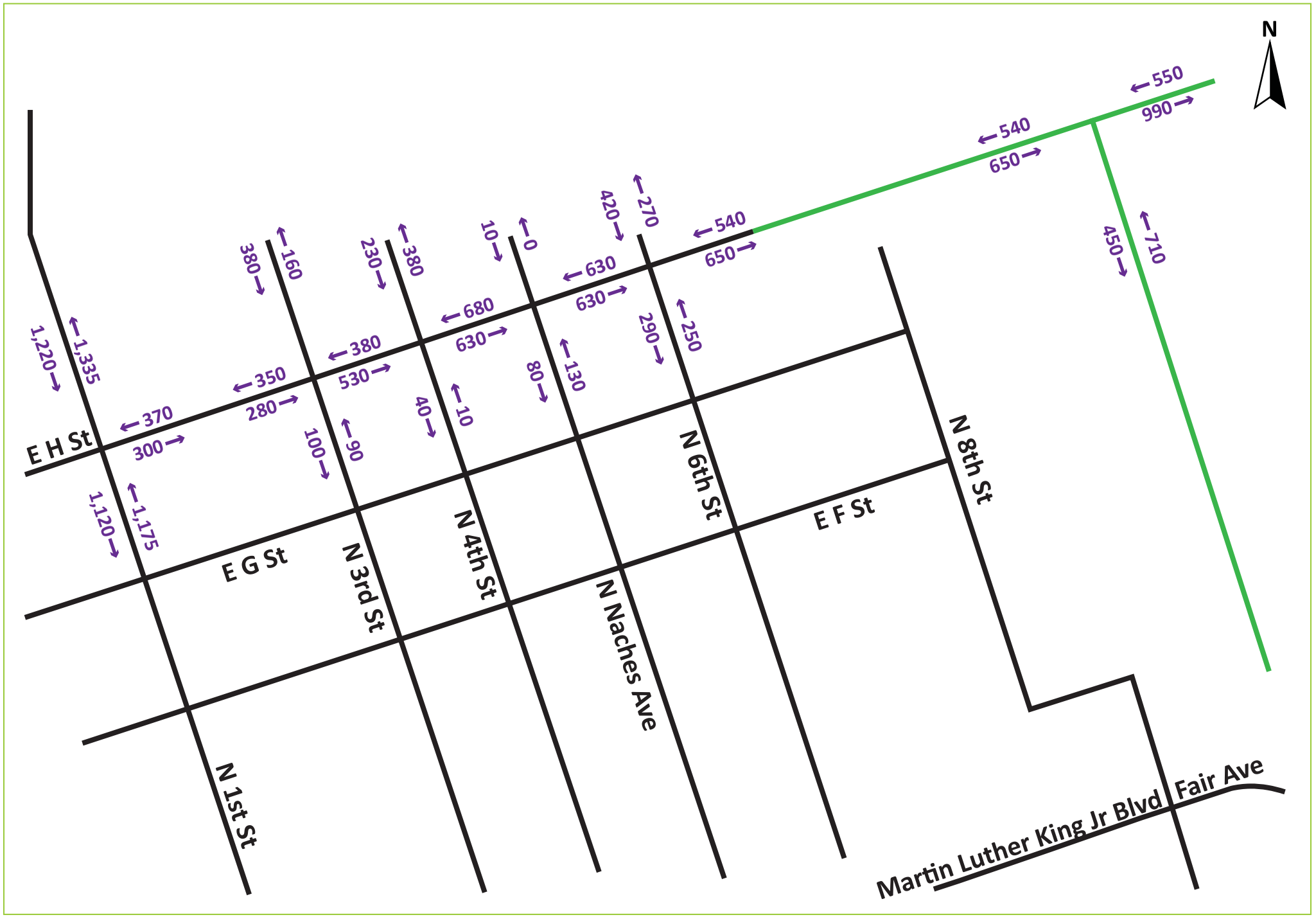
SCJ ALLIANCE
ENGINEERING AND PLANNING SERVICES

Mill Parkway

Yakima, Washington

Traffic Volume Forecast

Scenario 4c
2044 PM Peak Hour
True No-Build



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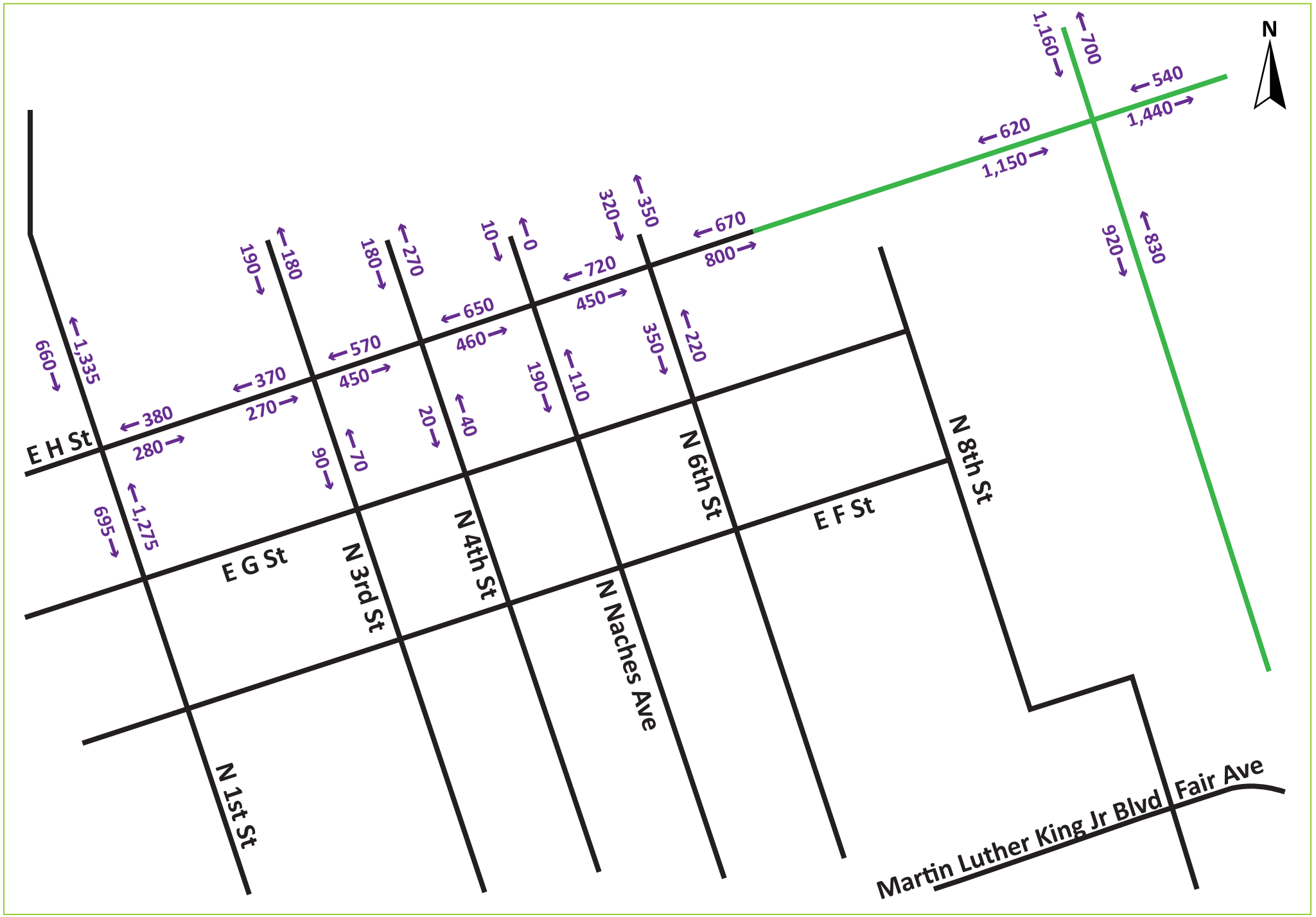
Mill Parkway

Yakima, Washington

Traffic Volume Forecast

Scenario 4d
2044 PM Peak Hour
No Interchange and No North Bravo



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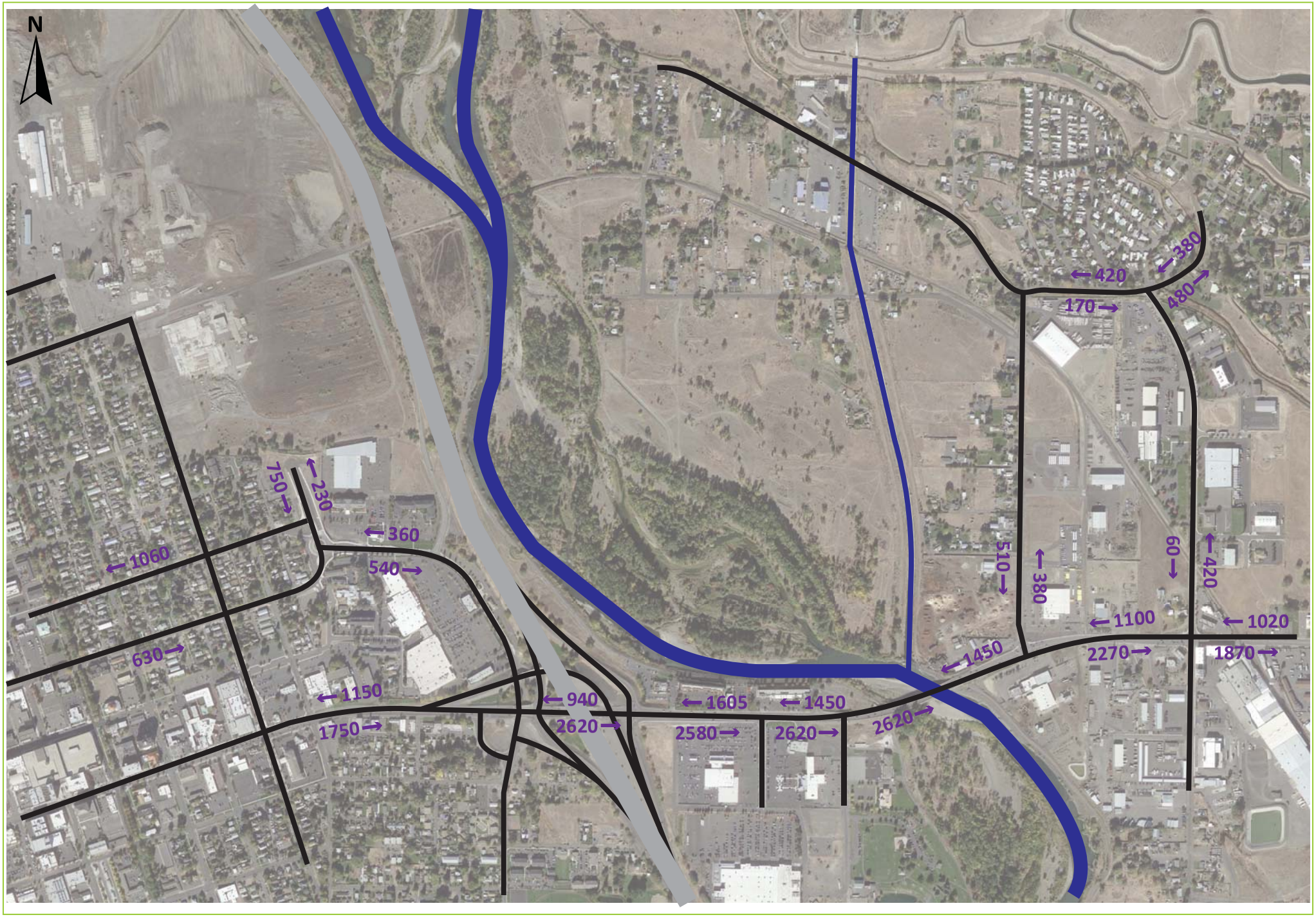
Mill Parkway

Yakima, Washington

Traffic Volume Forecast

Scenario 6
2044 PM Peak Hour
With Interchange and All
Local Street Improvements



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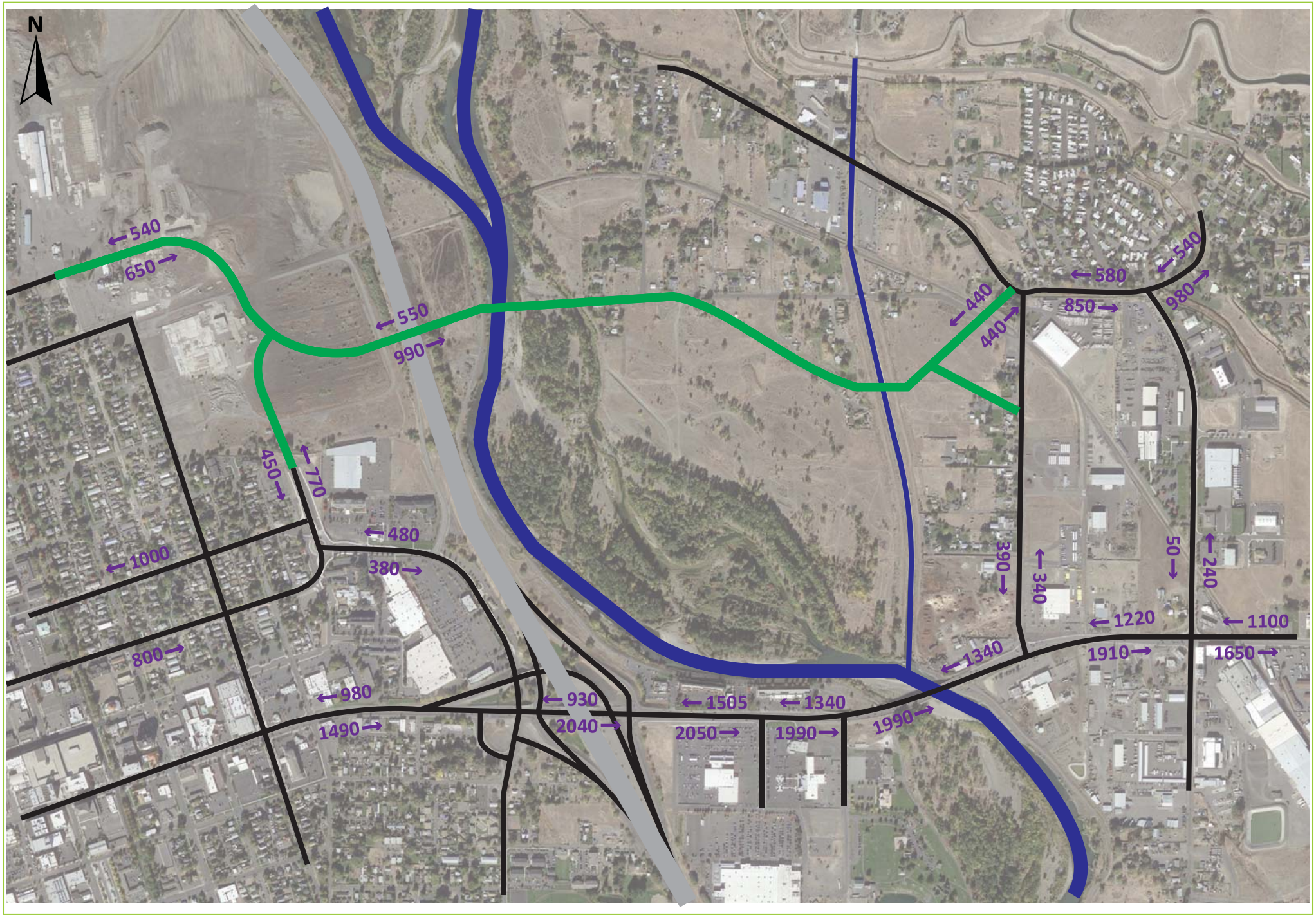
Mill Parkway

Yakima, Washington

Traffic Volume Forecast

Scenario 4c
2044 PM Peak Hour
True No Build



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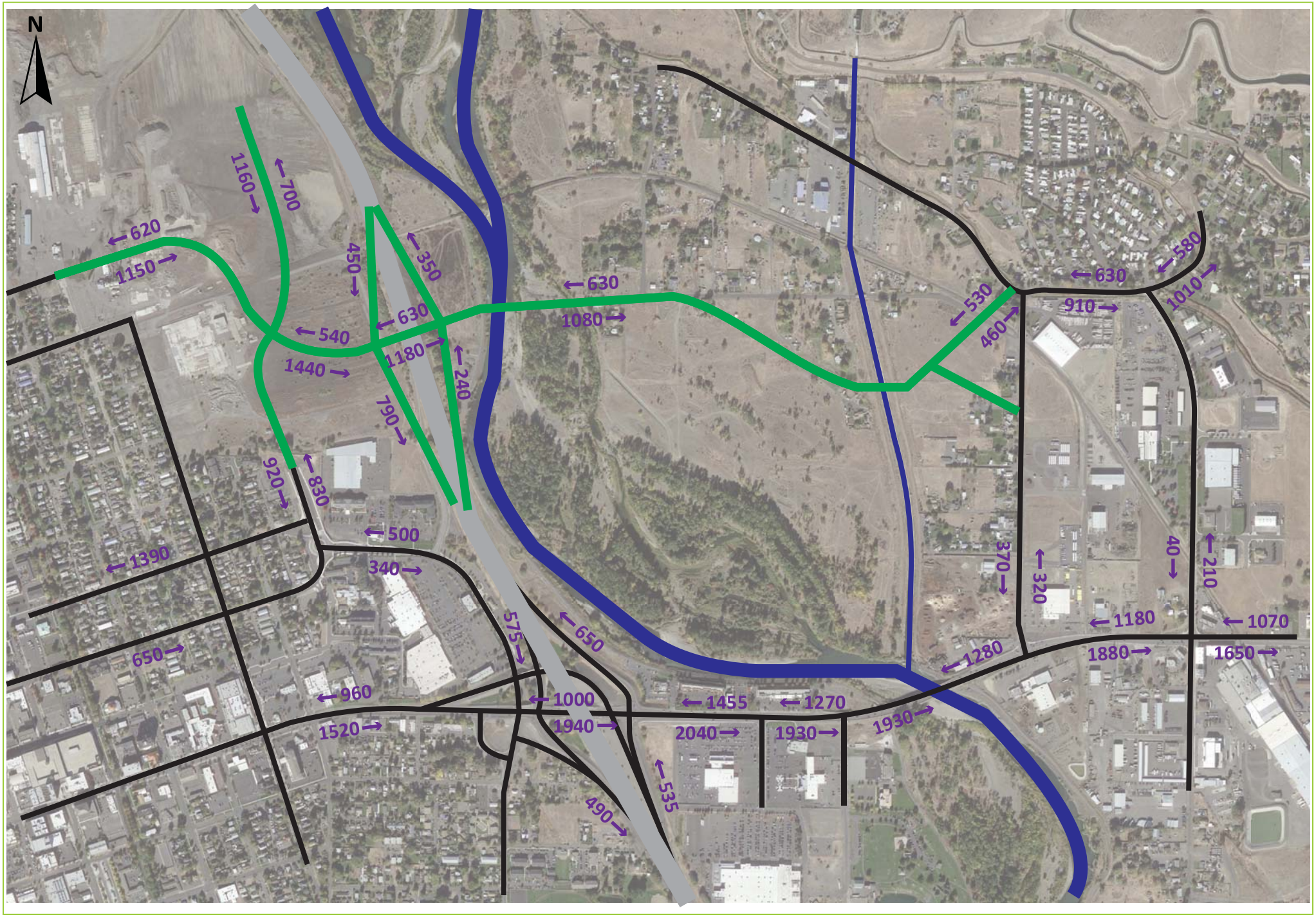
Mill Parkway

Yakima, Washington

Traffic Volume Forecast

Scenario 4d
2044 PM Peak Hour
No Interchange and no
North Bravo



SCJ ALLIANCE
ENGINEERING AND PLANNING SERVICES

Mill Parkway

Yakima, Washington

Traffic Volume Forecast

Scenario 6
2044 PM Peak Hour
With Interchange and all
Local Street Improvements

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	1	1	1	1	5	1	1135	10	15	475	1
Future Vol, veh/h	1	1	1	1	1	5	1	1135	10	15	475	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	100	-	-	100	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1	1	1	1	6	1	1335	12	18	559	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1266	1945	280	1659	1939	674	560	0	0	1347	0	0
Stage 1	596	596	-	1343	1343	-	-	-	-	-	-	-
Stage 2	670	1349	-	316	596	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	126	64	717	64	65	397	1007	-	-	507	-	-
Stage 1	457	490	-	160	219	-	-	-	-	-	-	-
Stage 2	413	217	-	670	490	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	120	62	717	62	63	397	1007	-	-	507	-	-
Mov Cap-2 Maneuver	245	150	-	133	161	-	-	-	-	-	-	-
Stage 1	457	472	-	160	219	-	-	-	-	-	-	-
Stage 2	404	217	-	644	472	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.8	19	0	0.4
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1007	-	-	247	266	507	-	-
HCM Lane V/C Ratio	0.001	-	-	0.014	0.031	0.035	-	-
HCM Control Delay (s)	8.6	-	-	19.8	19	12.4	-	-
HCM Lane LOS	A	-	-	C	C	B	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0.1	-	-

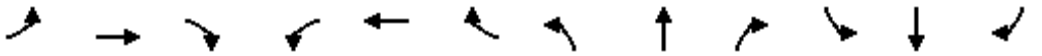
Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	1	1	5	1	50	1	1045	110	45	555	1
Future Vol, veh/h	1	1	1	5	1	50	1	1045	110	45	555	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	100	-	-	100	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1	1	6	1	59	1	1229	129	53	653	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1377	2120	327	1729	2056	679	654	0	0	1358	0	0
Stage 1	760	760	-	1296	1296	-	-	-	-	-	-	-
Stage 2	617	1360	-	433	760	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	104	50	669	57	55	394	929	-	-	502	-	-
Stage 1	364	413	-	171	231	-	-	-	-	-	-	-
Stage 2	444	215	-	571	413	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	81	45	669	52	49	394	929	-	-	502	-	-
Mov Cap-2 Maneuver	193	120	-	134	151	-	-	-	-	-	-	-
Stage 1	364	369	-	171	231	-	-	-	-	-	-	-
Stage 2	375	215	-	508	369	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	23.3	18.7	0	1
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	929	-	-	200	328	502	-	-
HCM Lane V/C Ratio	0.001	-	-	0.018	0.201	0.105	-	-
HCM Control Delay (s)	8.9	-	-	23.3	18.7	13	-	-
HCM Lane LOS	A	-	-	C	C	B	-	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.7	0.4	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1	1	35	1	100	1	990	85	50	450	1
Future Volume (veh/h)	1	1	1	35	1	100	1	990	85	50	450	1
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	1	1	1	41	1	118	1	1165	100	59	529	1
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	157	117	78	152	15	158	589	1567	134	106	2340	4
Arrive On Green	0.14	0.14	0.14	0.14	0.14	0.14	0.47	0.47	0.47	0.06	0.64	0.64
Sat Flow, veh/h	287	857	572	304	107	1154	874	3312	284	1781	3639	7
Grp Volume(v), veh/h	3	0	0	160	0	0	1	624	641	59	258	272
Grp Sat Flow(s),veh/h/ln	1716	0	0	1565	0	0	874	1777	1819	1781	1777	1869
Q Serve(g_s), s	0.0	0.0	0.0	2.7	0.0	0.0	0.0	11.7	11.7	1.3	2.5	2.5
Cycle Q Clear(g_c), s	0.1	0.0	0.0	4.0	0.0	0.0	0.0	11.7	11.7	1.3	2.5	2.5
Prop In Lane	0.33		0.33	0.26		0.74	1.00		0.16	1.00		0.00
Lane Grp Cap(c), veh/h	352	0	0	325	0	0	589	841	861	106	1143	1202
V/C Ratio(X)	0.01	0.00	0.00	0.49	0.00	0.00	0.00	0.74	0.74	0.55	0.23	0.23
Avail Cap(c_a), veh/h	823	0	0	795	0	0	674	1013	1037	222	1430	1504
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	15.3	0.0	0.0	16.9	0.0	0.0	5.7	8.7	8.8	18.7	3.0	3.0
Incr Delay (d2), s/veh	0.0	0.0	0.0	1.2	0.0	0.0	0.0	2.4	2.4	4.5	0.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	1.3	0.0	0.0	0.0	3.5	3.6	0.6	0.4	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	15.3	0.0	0.0	18.1	0.0	0.0	5.7	11.2	11.1	23.1	3.1	3.1
LnGrp LOS	B	A	A	B	A	A	A	B	B	C	A	A
Approach Vol, veh/h		3			160			1266			589	
Approach Delay, s/veh		15.3			18.1			11.1			5.1	
Approach LOS		B			B			B			A	

Timer - Assigned Phs	1	2		4		6		8				
Phs Duration (G+Y+Rc), s	6.9	23.8		10.1		30.8		10.1				
Change Period (Y+Rc), s	4.5	4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s	5.1	23.3		18.1		32.9		18.1				
Max Q Clear Time (g_c+I1), s	3.3	13.7		2.1		4.5		6.0				
Green Ext Time (p_c), s	0.0	5.6		0.0		3.4		0.6				

Intersection Summary			
HCM 6th Ctrl Delay		10.0	
HCM 6th LOS		A	

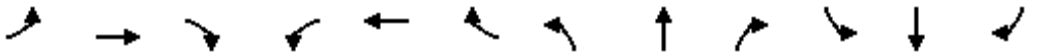
Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	1	1	5	1	60	1	1245	120	115	1150	1
Future Vol, veh/h	1	1	1	5	1	60	1	1245	120	115	1150	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	100	-	-	100	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1	1	5	1	63	1	1311	126	121	1211	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2112	2893	606	2224	2830	719	1212	0	0	1437	0	0
Stage 1	1454	1454	-	1376	1376	-	-	-	-	-	-	-
Stage 2	658	1439	-	848	1454	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	29	16	440	24	17	371	571	-	-	468	-	-
Stage 1	137	193	-	153	211	-	-	-	-	-	-	-
Stage 2	420	197	-	322	193	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	19	12	440	19	13	371	571	-	-	468	-	-
Mov Cap-2 Maneuver	86	50	-	93	83	-	-	-	-	-	-	-
Stage 1	137	143	-	153	211	-	-	-	-	-	-	-
Stage 2	346	197	-	236	143	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	47.4	21.3	0	1.4
HCM LOS	E	C		

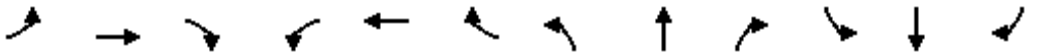
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	571	-	-	88	290	468	-	-
HCM Lane V/C Ratio	0.002	-	-	0.036	0.24	0.259	-	-
HCM Control Delay (s)	11.3	-	-	47.4	21.3	15.4	-	-
HCM Lane LOS	B	-	-	E	C	C	-	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.9	1	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1	1	85	1	250	1	1085	90	195	1030	1
Future Volume (veh/h)	1	1	1	85	1	250	1	1085	90	195	1030	1
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	1	1	1	89	1	263	1	1142	95	205	1084	1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	157	153	119	146	21	292	319	1359	113	250	2244	2
Arrive On Green	0.25	0.25	0.25	0.25	0.25	0.25	0.41	0.41	0.41	0.14	0.62	0.62
Sat Flow, veh/h	341	608	474	316	82	1162	520	3322	276	1781	3643	3
Grp Volume(v), veh/h	3	0	0	353	0	0	1	610	627	205	529	556
Grp Sat Flow(s),veh/h/ln	1423	0	0	1560	0	0	520	1777	1821	1781	1777	1870
Q Serve(g_s), s	0.0	0.0	0.0	11.6	0.0	0.0	0.1	21.0	21.1	7.6	11.1	11.1
Cycle Q Clear(g_c), s	0.1	0.0	0.0	14.8	0.0	0.0	0.1	21.0	21.1	7.6	11.1	11.1
Prop In Lane	0.33		0.33	0.25		0.75	1.00		0.15	1.00		0.00
Lane Grp Cap(c), veh/h	429	0	0	459	0	0	319	727	745	250	1094	1152
V/C Ratio(X)	0.01	0.00	0.00	0.77	0.00	0.00	0.00	0.84	0.84	0.82	0.48	0.48
Avail Cap(c_a), veh/h	450	0	0	481	0	0	342	808	828	328	1252	1318
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	0.0	0.0	24.5	0.0	0.0	11.9	18.1	18.1	28.4	7.1	7.1
Incr Delay (d2), s/veh	0.0	0.0	0.0	7.1	0.0	0.0	0.0	7.3	7.2	11.8	0.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	6.0	0.0	0.0	0.0	9.1	9.4	3.9	3.4	3.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.1	0.0	0.0	31.6	0.0	0.0	11.9	25.3	25.3	40.1	7.5	7.5
LnGrp LOS	B	A	A	C	A	A	B	C	C	D	A	A
Approach Vol, veh/h		3			353			1238			1290	
Approach Delay, s/veh		19.1			31.6			25.3			12.7	
Approach LOS		B			C			C			B	

Timer - Assigned Phs	1	2		4		6		8				
Phs Duration (G+Y+Rc), s	14.1	32.3		21.6		46.4		21.6				
Change Period (Y+Rc), s	4.5	4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s	12.5	30.9		18.1		47.9		18.1				
Max Q Clear Time (g_c+I1), s	9.6	23.1		2.1		13.1		16.8				
Green Ext Time (p_c), s	0.2	4.7		0.0		8.8		0.3				

Intersection Summary												
HCM 6th Ctrl Delay			20.4									
HCM 6th LOS			C									



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	1	1	1	155	1	225	1	1115	160	120	540	1
Future Volume (veh/h)	1	1	1	155	1	225	1	1115	160	120	540	1
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	1	1	1	163	1	237	1	1174	168	126	568	1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	172	169	137	234	14	256	469	1363	194	159	2144	4
Arrive On Green	0.28	0.28	0.28	0.28	0.28	0.28	0.44	0.44	0.44	0.09	0.59	0.59
Sat Flow, veh/h	367	596	482	573	50	901	843	3122	445	1781	3640	6
Grp Volume(v), veh/h	3	0	0	401	0	0	1	666	676	126	277	292
Grp Sat Flow(s),veh/h/ln	1445	0	0	1524	0	0	843	1777	1790	1781	1777	1869
Q Serve(g_s), s	0.0	0.0	0.0	16.8	0.0	0.0	0.0	24.1	24.3	4.9	5.4	5.4
Cycle Q Clear(g_c), s	0.1	0.0	0.0	18.2	0.0	0.0	0.0	24.1	24.3	4.9	5.4	5.4
Prop In Lane	0.33		0.33	0.41		0.59	1.00		0.25	1.00		0.00
Lane Grp Cap(c), veh/h	478	0	0	505	0	0	469	775	781	159	1047	1101
V/C Ratio(X)	0.01	0.00	0.00	0.79	0.00	0.00	0.00	0.86	0.86	0.79	0.26	0.26
Avail Cap(c_a), veh/h	483	0	0	510	0	0	497	836	842	188	1135	1194
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	18.3	0.0	0.0	24.7	0.0	0.0	11.3	18.1	18.2	31.8	7.1	7.1
Incr Delay (d2), s/veh	0.0	0.0	0.0	8.4	0.0	0.0	0.0	8.5	8.9	17.4	0.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	7.3	0.0	0.0	0.0	10.6	10.9	2.8	1.8	1.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	18.3	0.0	0.0	33.1	0.0	0.0	11.3	26.6	27.0	49.2	7.3	7.2
LnGrp LOS	B	A	A	C	A	A	B	C	C	D	A	A
Approach Vol, veh/h		3			401			1343			695	
Approach Delay, s/veh		18.3			33.1			26.8			14.9	
Approach LOS		B			C			C			B	

Timer - Assigned Phs	1	2		4		6		8				
Phs Duration (G+Y+Rc), s	10.9	35.6		24.8		46.5		24.8				
Change Period (Y+Rc), s	4.5	4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s	7.5	33.5		20.5		45.5		20.5				
Max Q Clear Time (g_c+I1), s	6.9	26.3		2.1		7.4		20.2				
Green Ext Time (p_c), s	0.0	4.8		0.0		3.8		0.1				

Intersection Summary			
HCM 6th Ctrl Delay		24.4	
HCM 6th LOS		C	