3.11 Noise and Vibration

3.11.1 Introduction

This section discusses the Project setting in relation to noise and vibration. It describes existing conditions, current regulatory setting, and potential impacts from operation and construction of the Build Alternatives and the No Project Alternative. Information in this section is based on the Eastside Transit Corridor Phase 2 Noise and Vibration Impacts Report (Appendix L).

3.11.2 Regulatory Framework

3.11.2.1 Definitions

3.11.2.1.1 Noise

Noise is defined as unwanted sound. Several factors affect the actual level and quality of sound (or noise) as perceived by the human ear: loudness, pitch (or frequency), and time variation. The loudness, or magnitude, of noise determines its intensity and is measured in decibels (dB) that can range from below 40 dB (the rustling of leaves) to over 100 dB (a rock concert). Pitch describes the character and frequency content of noise, such as the very low "rumbling" noise of stereo subwoofers or the very high-pitched noise of a piercing whistle. Finally, the time variation of noise sources can be characterized as continuous, such as a building ventilation fan; intermittent, such as the passing of trains; or impulsive, such as pile-driving activities during construction. From this point forward in the document, the word "noise" means "sound."

Various sound levels are used to quantify noise from transit sources, including a sound's loudness and tonal character. For example, the A-weighted decibel (dBA) is commonly used to describe the overall noise level because it more closely matches the human ear's response to audible frequencies. See **Table 3.11-1**.

Table 3.11-1. A-Weighted Noise Descriptors

Noise Metric	Description
Lmax	Represents the maximum noise level that occurs during an event such as a bus or train passing by.
Leq(h)	Represents a level of constant noise with the same acoustical energy as the fluctuating noise levels observed during a given interval, such as one hour.
Ldn	The 24-hour day-night noise level that includes a 10-dBA penalty for all nighttime activity between 10 pm and 7 am. The 10-dBA penalty is an adjustment factor added to all nighttime noise events to reflect the heightened sensitivity of residents who are sleeping.

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration (FTA), Washington DC, Sept 2018.
Key:
Lmax = maximum noise level Leq(h) = average hourly equivalent noise level Ldn = average day-night noise level

Since human hearing is less responsive to low frequency noise, the tonal character of A-weighted noise levels reflects mid- to high-frequency sounds, which are more audible to most listeners. Since the A-weighted decibel scale is logarithmic, a 10 dBA increase in a noise level is generally perceived as a doubling of loudness, while a 3 dBA increase in a noise level is just barely perceptible to the human ear.

3.11.2.1.2 Vibration

Ground-borne vibration (GBV) associated with vehicle movements is usually the result of uneven interactions between wheels and the road or rail surfaces. Examples of such interactions (and subsequent vibrations) include train wheels over a jointed rail, an untrue rail car wheel with "flats," and a motor vehicle wheel hitting a pothole, a manhole cover, or any other uneven surface. The typical background levels refer to ambient ground vibrations not related to any specific transportation source (e.g., naturally occurring ground vibration). This level is assumed to be fairly constant from site to site, except in the vicinity of active fault lines.

Transit vibration typically travels along the surface of the ground. Depending on the geological properties of the surrounding terrain and the type of building structure exposed to transit vibration, vibration propagation (i.e., the method by which vibration waves travels through a medium, such as the ground or building structures) can be more or less efficient. Buildings with a solid foundation set in bedrock are "coupled" more efficiently to the surrounding ground and experience relatively higher vibration levels than buildings located in sandier soil. On the other hand, heavier buildings (such as masonry structures) are less susceptible to GBV than wood-frame buildings because they absorb more of the vibration.

Vibration induced by passing vehicles can generally be discussed in terms of displacement, velocity, or acceleration. However, human responses and responses by monitoring instruments and other objects are most accurately described with velocity. Therefore, the vibration velocity level is used to assess vibration impacts from transit projects.

To describe the human response to vibration, the average vibration amplitude (called the root mean squared [RMS] amplitude) is used to assess impacts. The RMS velocity level is expressed in inches per second (ips) or VdB. All VdB vibration levels are referenced to 1 micro-inch per second (µips). Similar to noise dB, vibration dBs are dimensionless because they are referenced to (i.e., divided by) a standard level (such as $1x10^{-6}$ ips in the U.S.). This convention allows compression of the scale over which vibration occurs, such as 40-100 VdB rather than 0.0001 ips to 0.1 ips.

The FTA has established noise and vibration assessment methodologies and criteria for transit projects. These are applied here. For future construction, Metro would make every effort to be consistent with local noise ordinances based on Metro baseline specifications Section 015619, Construction Noise and Vibration Control, although as a state-chartered transportation agency it is not required to do so.

3.11.2.2 Federal

3.11.2.2.1 Noise

Operational Noise

The FTA's guidance manual, the *Transit Noise and Vibration Impact Assessment Manual*, September 2018, presents the basic concepts, methods, and procedures for evaluating the extent and severity of noise impacts from transit projects and is used in this analysis. Federal guidance from FTA is relevant to this CEQA assessment as the State of California does not provide a specific assessment methodology; therefore, the FTA guidance is applied to assess noise and vibration. Transit noise impacts are assessed based on land use categories and sensitivity to noise from transit sources under the FTA guidelines. As summarized in **Figure 3.11.1**, the FTA noise impact criteria are defined by two curves that allow project noise levels to increase as existing noise increases up to a point, beyond which an impact is determined to occur based on project noise alone. The FTA land use categories and applicable noise metrics are described in **Table 3.11-2**.

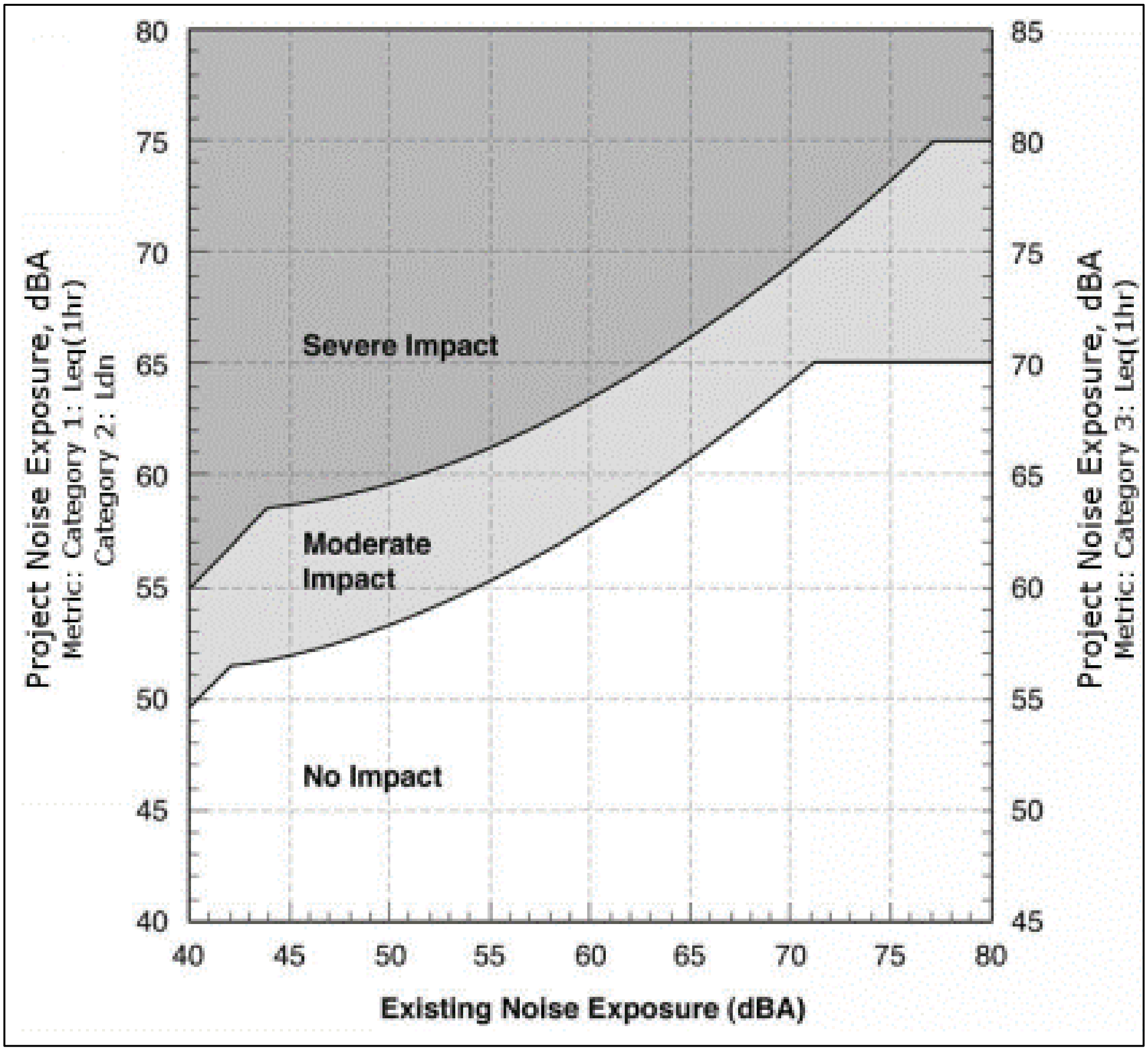
Table 3.11-2. FTA Land Use Categories and Noise Metrics

Land Use Category	Noise Metric	Description
1	Leq(h)	Tracts of land set aside for serenity and quiet, such as outdoor amphitheaters, concert pavilions, and historic landmarks.
2	Ldn	Buildings used for sleeping, such as residences, hospitals, hotels, and other areas where nighttime sensitivity to noise is of utmost importance.
3	Leq(h)	Institutional land uses with primarily daytime and evening uses, including schools, libraries, churches, museums, cemeteries, historic sites, parks, and certain recreational facilities used for study or meditation.

Source: Transit Noise and Vibration Impact Assessment Manual, FTA, Washington DC, Sept 2018.

The FTA noise criteria create two categories of impact: moderate and severe impact. The moderate impact threshold defines areas where the change in noise is noticeable, but may not be sufficient to cause a strong, adverse community reaction. The severe impact threshold defines the noise limits above which a significant percentage of the population would be highly annoyed by new noise. The level of impact at any specific site can be established by comparing the predicted future project noise level at the site to the existing noise level there. For example, for residences and other FTA Category 2 land uses with an existing noise level of 65 dBA, a moderate impact would occur with a future project noise level in the range from 61 to 66 dBA, while a severe impact would occur with a future project noise level greater than 66 dBA.

The FTA noise impact criteria for all three land use categories are summarized in **Figure 3.11.1.**



Source: Transit Noise and Vibration Impact Assessment Manual, FTA, Washington DC, Sept 2018.

Figure 3.11.1. Noise Impact Criteria for Transit Projects

The average day-night noise level (Ldn) over a 24-hour period is used to characterize noise exposure for residential areas (FTA Category 2). The Ldn descriptor describes a receptor's cumulative noise exposure from all events over a full 24 hours, with events between 10 pm and 7 am increased by 10 dB to account for greater nighttime sensitivity to noise. Similarly, the average hourly equivalent noise level (Leq(h)) during the facility's peak operating period is used to characterize noise exposure at all other noise-sensitive land uses, such as schools and libraries (FTA Category 3) or outdoor amphitheaters (FTA Category 1).

Construction Noise

The FTA guidelines suggest evaluating prototypical construction scenarios against local ordinances or the FTA one-hour Leq thresholds summarized in **Table 3.11-3** if no other applicable criteria are available. The FTA design guidelines, for example, are evaluated against noise levels from the two loudest pieces of equipment that, under worst-case conditions, are assumed to operate continuously for one hour during both the daytime (7 am to 10 pm) and nighttime (10 pm to 7 am) periods.

Table 3.11-3. FTA Recommended Construction Noise Limits (dBA)

Land Use Category	Construction Period	
	Daytime (7 am – 10 pm)	Nighttime (10 pm – 7 am)
Residential	90	80
Commercial (non-residential)	100	100
Industrial	100	100

Source: Transit Noise and Vibration Impact Assessment Manual, FTA, Washington DC, Sept 2018.
Note:
The recommended construction evaluation criteria are evaluated against the one-hour equivalent noise level from the two loudest pieces of equipment.

3.11.2.2.2 Vibration

Operational and Construction Vibration

The FTA vibration criteria for evaluating GBV impacts from transit operations (such as train passbys) and construction at nearby sensitive receptors are summarized in **Table 3.11-4**. These vibration criteria are related to RMS GBV levels that are expected to result in human annoyance. The FTA's criteria to distinguish projects with a frequent event category is defined as more than 70 events per day. The FTA frequent criteria were used to assess operational GBV impacts along the Build Alternatives. The FTA infrequent criteria were used to assess construction GBV along the Build Alternatives.

The vibration criteria levels summarized in **Table 3.11-4** are defined in terms of human annoyance for land use categories such as high sensitivity (Category 1), residential (Category 2), and institutional (Category 3). In general, the vibration threshold of human perceptibility is approximately 65 VdB.

For above-grade (i.e., at-grade or elevated) sections of transit systems, LRT operations are typically not a significant source of vibration-induced ground-borne noise (GBN), except for buildings that have sensitive interior spaces and that are well insulated from exterior noise. Airborne noise often masks GBN for above ground transit system sections.

GBN from underground sections of transit systems may be audible and the FTA's guidance manual, the *Transit Noise and Vibration Impact Assessment Manual*, September 2018, provides procedures for evaluating the extent and severity of noise impacts from below grade transit alignments. The FTA vibration criteria for evaluating GBN impacts from transit operations (such as train passbys) and construction at nearby sensitive receptors are summarized in **Table 3.11-4**. The frequent event category is applied for train passbys.

Table 3.11-4. Ground-Borne RMS Vibration Impact Criteria for Annoyance During Transit Operations and Construction (VdB)

Receptor Land Use		GBV Impact Levels RMS Vibration Levels (VdB)[1]			GBN Impact Levels dB re 20 micro Pascals		
Category	Description	Frequent Events[2]	Occasional Events[2]	Infrequent Events[2]	Frequent Events[2]	Occasional Events[2]	Infrequent Events[2]
1	Buildings where low vibration is essential for interior operations	65	65	65	N/A	N/A	N/A
2	Residences and buildings where people normally sleep	72	75	80	35 dBA	38 dBA	43 dBA
3	Daytime institutional and office use	75	78	83	40 dBA	43 dBA	48 dBA
Specific Buildings	TV/Recording Studios/Concert Halls	65	65	65	25 dBA	25 dBA	25 dBA
	Auditoriums	72	80	80	30 dBA	38 dBA	38 dBA
	Theaters	72	80	80	35 dBA	43 dBA	43 dBA

Source: Transit Noise and Vibration Impact Assessment Manual, FTA, Washington DC, Sept 2018.
Notes:
1 Ground-borne vibration levels are referenced to 1x10-6 inches per second (VdB re 1 micro-inch/sec).
2 The frequent event category is defined as more than 70 events per day, the occasional event category as 30 to 70 events per day, and the infrequent category as fewer than 30 events per day.
Key:
RMS = Root mean square N/A = not applicable dBA = A-weighted decibels vdB = vibration decibels

3.11.2.3 State

The state of California does not have applicable limits for operational or construction noise, or for operational or construction vibration.

3.11.2.4 Local

Local ordinances regarding noise and vibration are typically "qualitative" in that they refer to noise "annoyance" from public disturbances. However, several local jurisdictions do limit the period of construction activities to the daytime period when ambient noise levels are typically higher, and most people are not sleeping. During construction, Metro's contractor would conduct activities to be consistent with local noise ordinances whenever feasible and reasonable, although as a state-chartered transportation agency, Metro is not required to do so.

3.11.3 Methodology

3.11.3.1 Screening Assessment

A screening assessment using screen distances identified in Table 4-1 and Table 4-2 in Appendix L was conducted to identify the location and land use category of noise- and vibration-sensitive receptors along the Build Alternatives. These include residential areas and buildings such as hospitals, schools, churches, parks, and noise-sensitive historic resources. The list of noise-sensitive community facilities and historic resources was obtained through analysis from the Eastside Transit Corridor Phase 2 Cultural Resources Impacts Report (Appendix E) and the Community and Neighborhoods Impacts Report (Appendix M).

3.11.3.2 Noise Modeling Methodology

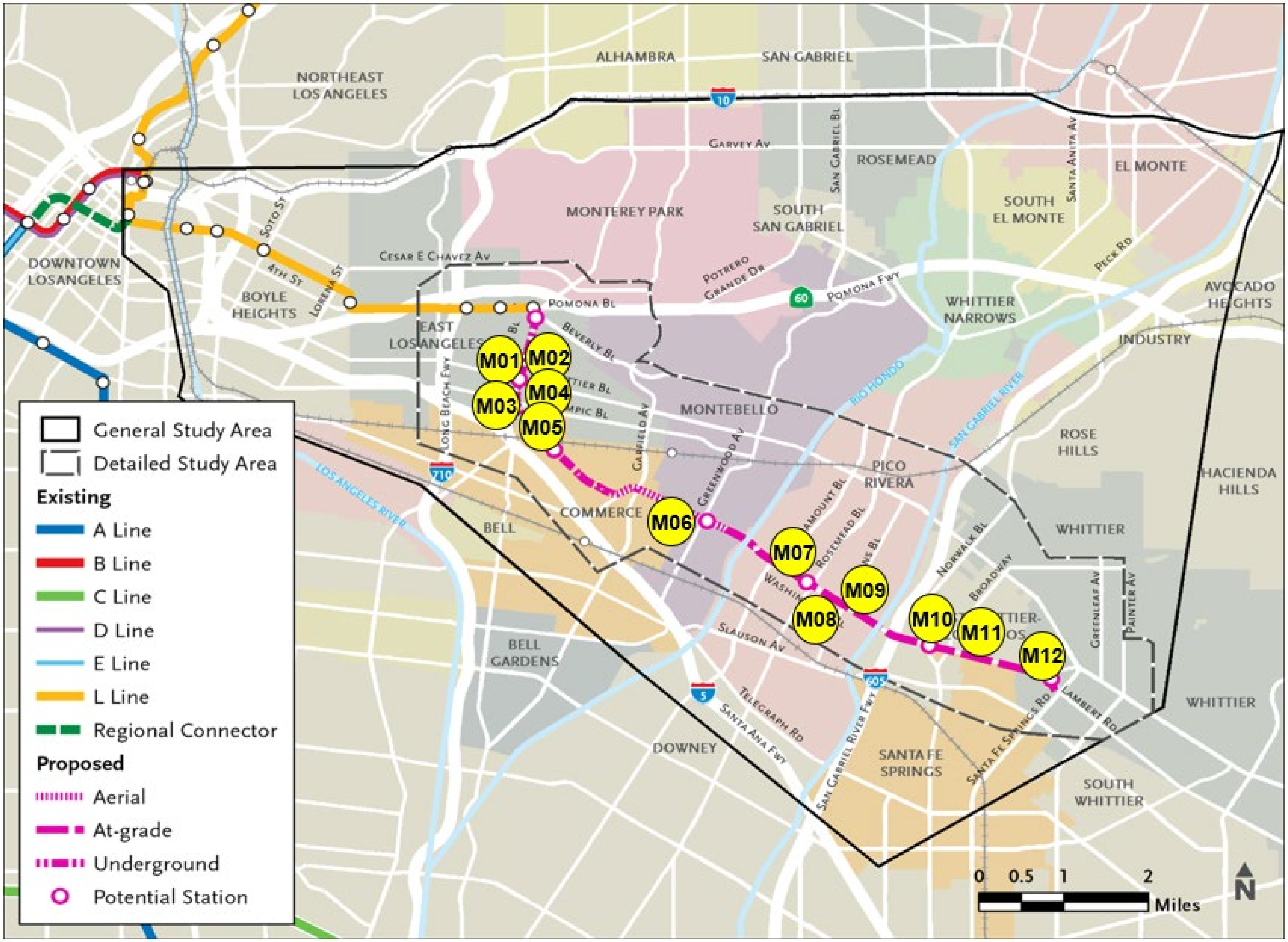
To determine the existing background noise levels at sensitive receptors in the vicinity of the proposed transit rail corridor alignment, a noise monitoring program was conducted at 12 representative locations selected based on the FTA guidelines (shown in **Figure 3.11.2**). An average hourly equivalent noise level (or Leq(h) in dBA) was measured during the peak hour at non-residential or institutional sites (such as schools and parks) and continuously over a 24-hour period at residential sites to determine the average ambient conditions during a typical weekday. The noise measurements document existing noise sources along the DSA, such as existing aircraft traffic overhead and background traffic. At residences and other FTA Category 2 land uses (described in **Table 3.11-2**), 24-hour Ldn were reported in accordance with the FTA guidelines. Similarly, peak-hour equivalent noise levels were measured at non-residential or institutional receptors such as schools and parks.

Sites were strategically selected to document existing noise exposure at different residential clusters along the proposed alignment. The noise levels from these existing sources were adjusted to reflect distance propagation to other nearby clusters of residences and other noise-sensitive uses where appropriate. The measured noise levels were applied to these other noise-sensitive receptor sites based on their similarities to nearby roadways and intersections, land use densities, and geographical distance from the monitoring sites.

The sound-level meters that were used to measure current noise conditions meet American National Standards Institute (ANSI) standards for Type I meters. The sound-level meters were calibrated before and after each measurement. All measurements were conducted according to ANSI Standard S1.13-2005, Measurement of Sound Pressure Levels in Air. All noise levels are reported in dBA, which approximate the sensitivity of human hearing.

3.11.3.3 Noise Evaluation

Noise impacts were evaluated using the FTA's "Detailed Assessment" guidelines to reflect the type of input data available more accurately. However, noise impacts from the stationary sources (such as the MSF site options) were evaluated using the FTA's "General Assessment" guidelines to reflect a single large stationary source (FTA 2018). Similarly, although baseline vibration measurements were not conducted, vibration impacts were evaluated using the FTA's "General Assessment" guidelines to reflect average or typical ground conditions.



Source: CDM Smith/AECOM JV, 2022.

Figure 3.11.2. Representative Noise Monitoring Locations

3.11.3.4 Construction Noise Assumptions

Construction noise differs from transit noise in two ways.

- Construction noise lasts for the duration of the construction contract, and it is usually limited to daylight hours when most human activity occurs. Construction activities are generally of a short duration and, depending on the nature of construction operations, could last from seconds (such as for a truck passing by) to months (such as when constructing a bridge at an overpass). Transit noise occurs during all periods of the day and night and is a permanent part of the acoustical environment.

- Construction noise is also intermittent and depends on the type of operation, location, and function of the equipment, as well as equipment use. Transit noise, on the other hand, is more continually present after construction activities are completed.

Details of the proposed construction activities are normally developed in the later project stages after a transit agency retains the services of the construction contractor for the Project. Therefore, short-term construction impacts from the Project were evaluated based on prototypical construction tasks and equipment summarized in the Eastside Transit Corridor Phase 2 Construction Impacts Report (Appendix P).

Based on the FTA guidelines, the two loudest pieces of equipment (such as jack hammers and dump trucks) were selected to operate at full power over a period of one hour. The cumulative noise level at the closest noise-sensitive receptor was used to estimate the level of impact. The resultant noise level was compared with the FTA recommended construction noise limits from **Table 3.11-3** to determine the onset of impact. Conservative assumptions (such as no shielding effects from existing structures or temporary noise barriers) were used to estimate the potential for impact.

The following construction scenarios were selected to be representative of the types of activities expected during Project construction: track-laying (at-grade), track-laying (aerial), excavation and boring, station construction, bridge construction, parking facility construction, and MSF site option construction. The equipment types and the maximum FTA reference noise levels are summarized in **Table 3.11-5** for the selected prototypical construction scenarios using the two loudest pieces of equipment.

Table 3.11-5. Construction Scenario Equipment Noise Reference Lmax Levels[1] for the Two Loudest Pieces of Equipment for Each Scenario (dBA)

Equipment Type	Construction Scenario		Stations	Bridges	Parking	MSF
	At-grade	Aerial				
Crane, Derrick	--	88	--	--	88	--
Grader	85	--	85	85	85	--
Jack Hammer	--	--	--	88	--	--
Loader	--	--	--	--	--	85
Tie Inserter	85	--	--	--	--	--
Truck	--	88	88	--	--	88

Source: Morgner, 2019 and 2021.
Notes:
1 Default FTA noise levels reported at a reference distance of 50 feet.
Key:
"--" = Equipment type not included in the selected construction scenario.

3.11.3.5 Operational Noise Assumptions

The reference noise levels for each of the proposed noise sources (such as train passbys and wheel squeal) and other operating characteristics (such as average dwell times and source heights), are summarized in **Table 3.11-6**. These data are based on default FTA data, as well as information included in other recent Metro studies, such as the *Crenshaw/LAX Transit Corridor Final Environmental Impact Statement (EIS)/EIR* (2011). Operations data is summarized in **Table 3.11-7** for various peak and off-peak periods of the day. The assumptions used in this evaluation are listed after the tables.

Table 3.11-6. Summary of Noise Source Reference Data

Noise Source			Duration (sec)	Height(ft)	Noise Level (dBA)[1]	
Category	Name	Description			Lmax	SEL
LRT	Passbys	Passby operations	--[2]	2	78[3]	80
	Warning device	Onboard bell	5	10	76[3]	79[3]
	Switches/ crossovers	Special trackwork	--	0	86[3]	88
	Wheel squeal	Curves <65 feet	4	0	100	136
	Auxiliary equipment	Stations only	30[4]	10	70	106
Crossing bell	Grade crossing bell	Grade crossing	15[3]	10	72[5]	108
Parking	Park and ride	Parking facility	--	10	56	92
Yard	Maintenance yard	Yard	--	2	82	118

Source: Morgner, 2019/2020.
Notes:
1 All noise levels are reported in A-weighted decibels at a reference distance of 50 feet and a reference speed of 50 mph for passbys only. Lmax represents the maximum noise level during an event and the sound exposure level (SEL) converts the cumulative noise energy of an event to one second. Default FTA reference levels are reported except where noted.
2 "--" means not applicable. Duration time is not used to compute passby and facility noise levels.
3 Noise levels and duration times are based on the *Metro Gold Line Phase II – Pasadena to Montclair Draft EIS/EIR Study* (April 2004).
4 The default dwell time is 30 seconds at all proposed stations.
5 The Lmax level for the crossing bell reflects a 5-dBA penalty to account for the intrusive character of the noise source.

Table 3.11-7. Build Alternatives Operating Characteristics

Time Period	Hours	Frequency of Service[1]	Consist Size[2]
Early morning	4:00 am to 6:30 am	15	3
AM peak	6:30 am to 8:30 am	5	3
Midday	8:30 am to 4:00 pm	10	3
PM peak	4:00 pm to 7:00 pm	5	3
Early evening	7:00 pm to 8:00 pm	10	3
Late evening	8:00 pm to 1:30 am	15	3

Source: Metro, 2010/2020.
Notes:
1 The frequency of service (or headway time) is reported in minutes.
2 Consist size is the number of LRT vehicles coupled together into one train.

- Total daily operations were determined based on 5-minute headways during peak periods of the day, 10-minute headways during off-peak periods, and 15-minute headways during the late night and early morning periods.
- Operations data is summarized in **Table 3.11-7** for various peak and off-peak periods of the day. This service frequency is representative of a typical weekday, which includes an operating period between 4:00 am and 1:30 am.
- A three-vehicle train was assumed for all periods of the day and night.
- At stations, an average idling time of 30 seconds was used at each of the designated station stops to compute the noise contribution from stationary or auxiliary vehicle noise (such as rooftop mechanical equipment).
- Proposed train operating speeds were taken from speed profiles included in the track alignment designs, based on vehicle performance characteristics and system speed limits for the Project corridor, with a minimum speed of 20 mph and a maximum of 55 mph.
- Following Metro operating practices, train operators sound the 75 dBA warning device (i.e., the "quacker") prior to all gate-protected crossings, starting approximately 300 feet prior to the crossing. At speeds greater than 35 mph, noise from the quacker adds less than 1 dB to the noise exposure caused by light-rail train operations. Because train speeds greater than 35 mph were assumed for all gate-protected crossings where the quacker would be sounded, the quacker was not included as a separate source in the noise analysis. It is assumed that emergency train horns would rarely be used and were not included in this analysis.
- The Project would operate on a concrete-embedded continuous welded rail (CWR) track at-grade.
- Wheel impacts at special trackwork are based on a Lmax of 86 dBA at 50 feet.
- Since all the curves along revenue-service track are expected to be longer than 65 feet (the distance associated with the onset of wheel squeal), no wheel squeal is predicted anywhere along the Build Alternatives. Although there is a possibility of wheel squeal at the MSF due to the shorter-radius curves, these events are expected to occur infrequently.

- The vibration impacts from LRT vehicle operations were predicted using the default FTA ground surface vibration curves summarized in Appendix L. These curves were adjusted to reflect local conditions such as changes in train speed, special trackwork such as switches, and coupling to building foundations for residential wood-frame houses.
- In lieu of a solid transit barrier or parapet, open railings with no acoustical properties were used as part of the noise modeling analysis for all elevated or aerial sections of the Build Alternatives. However, the edge of the aerial structure (which is a solid footing for the railing and has an approximate height of six inches) was included in the noise modeling analysis to provide some acoustical benefits.
- Vehicular noise from the activities at proposed parking facilities was also included in the modeling analysis using the FTA "General Assessment" guidelines.

3.11.3.6 Vibration Monitoring Methodology

Since the Project is proposed along an alignment without an existing rail corridor, no existing vibration measurements were conducted. In general, rubber-tired vehicles with a soft suspension system do not contribute to vibration impacts; therefore, since there are only rubber-tired vehicles in the area, no existing vibration measurements were conducted. Unlike noise, where the Project criteria are based on existing conditions, the vibration criteria are based on future service frequency alone.

The default FTA ground-surface vibration curves were used to predict future vibration levels from Metro LRT vehicles along the proposed Build Alternatives. The FTA "General Assessment" guidelines were used to determine future impacts from vibration under the proposed Build Alternatives.

3.11.3.7 Construction Vibration Assumptions

A qualitative analysis was prepared to estimate the potential for vibration impacts during temporary construction activities. Based on the FTA guidelines, the equipment with the highest reference level (such as pile drivers) was selected. The maximum vibration level at the closest vibration-sensitive receptor was used to estimate the level of impact. The resultant vibration levels were compared with the FTA ground-borne RMS vibration impact criteria for annoyance from **Table 3.11-4** to determine the onset of impact. Conservative assumptions were used to estimate the potential for impact.

3.11.3.8 Operational Vibration Assumptions

Future GBV levels from LRT passbys were predicted using the default FTA ground surface vibration curves summarized **Figure 3.11.1**. These curves were adjusted per the FTA methodology to reflect local conditions such as changes in train speed, special trackwork such as switches, aerial track structures, ground type and different building construction types (e.g., masonry versus timber).

3.11.3.9 Ground-Borne Noise

GBN can occur when a vibration source such as a train passby causes floors and walls to vibrate in nearby buildings, resulting in a low frequency rumble sound within the building. GBN is determined by applying adjustment factors to the predicted train vibration level that reflect the surrounding ground.

FTA has developed impact criteria to assess the potential for GBN due to transit project construction and operations (U.S. Department of Transportation 2006). Impacts of GBN typically occur from underground transit construction and operations. Where vibration impacts are predicted mitigation measures would be provided.

3.11.3.10 Roadway Traffic Noise Assumptions

Regarding traffic noise, there is a reduction in VMT between the No Project Alternative and Build Alternatives. As discussed in Section 3.14, Transportation and Traffic, and the Eastside Transit Corridor Phase 2 Transportation and Traffic Impacts Report (Appendix N), VMT decreases for all Build Alternatives as compared to the No Project. Since noise is logarithmic, it takes a halving of the traffic volumes (or a 50 percent decrease), or a doubling of the traffic volumes (or a 100 percent increase) for the noise levels to change by 3 dBA (FTA 2018). The decrease in VMT would not result in a halving of traffic volumes, and, thus, the decrease in VMT would not be acoustically perceptible. Therefore, the Build Alternatives would result in an insignificant change in traffic noise from the No Project Alternative. As a result, no further traffic noise analysis was conducted.

3.11.3.11 Area of Potential Impact

In accordance with the *FTA Transit Noise and Vibration Impact Assessment Manual* (FTA 2018), a screening assessment was conducted to determine the location and number of noise- and vibration-sensitive receptors along the Project corridor. The FTA screening distances of 350 feet (unobstructed noise screening distance) and 150 feet (unobstructed vibration screening distance) were used to develop the population of receptors included in the noise and vibration modeling analyses. The screening distances were applied from the centerline of the proposed transit corridors to determine the area of potential impact (API).

The API for construction activities varies, depending on factors such as types and numbers of construction equipment operating in an area at the same time and the specific location and distance between the construction activity and the sensitive receptor. The specific types and locations of equipment in any one location are difficult to predict at this stage of project development. Therefore, the API that is used to assess operational impacts is also used to assess the potential for construction impacts.

3.11.4 Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, a project would have a significant impact related to noise if it would result in:

Impact NOI-1: Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the Project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

Impact NOI-2: Generation of excessive ground-borne vibration or ground-borne noise levels.

Appendix G of the State CEQA Guidelines also includes a significance criterion for impacts relating to a project located within the vicinity of private airport airstrip or an airport land use plan, or that is located within two miles of public airport that does not have an adopted airport land use plan. The nearest public airport or airstrip to the Build Alternatives is Whittier Air Strip, which at the nearest point is over four miles to the north; therefore, this criterion is not applicable and was not evaluated.

CEQA does not provide quantitative thresholds for a substantial operational noise impact or a significant adverse vibration impact. The thresholds for determining the significance of operational impacts for this analysis are based on the *FTA Transit Noise and Vibration Impact Assessment Manual* (FTA 2018), also referred to as the FTA Guidance Manual, and are detailed below:

- Operational Noise: As discussed in **Section 3.11.2.2**, the FTA Guidance Manual presents both moderate and severe noise impact thresholds. The severe noise impact criteria are used as the operational noise significance threshold for the Project.
- Construction Noise: FTA suggests there may be adverse community reaction to daytime construction noise when levels exceed 80 dBA at residences for work at night, 90 dBA at residences for work during the day, and 100 dBA at commercial uses for work at night or during the day. Therefore, a significance threshold of 80 dBA and 90 dBA at residences during the night and day respectively and 100 dBA at commercial uses is used as the construction noise significance threshold for the Project.
- Operational Vibration: The FTA has established specific operational vibration criteria for transit projects in the FTA Guidance Manual. For frequent annoyance from operational vibration (i.e., more than 70 events per day), the FTA considers an exceedance of 72 VdB at residential or other Category 2 land uses as an impact. Therefore, a significance threshold of 72 VdB at residential or other Category 2 land use is considered as the operational vibration significance threshold for the Project.
- Construction Vibration: The FTA has established specific construction vibration criteria for transit projects in the FTA Guidance Manual.
    - For infrequent annoyance from construction vibration (i.e., less than 30 events per day), the FTA considers an exceedance of 80 VdB at residential or other Category 2 land uses as an impact. Therefore, a significance threshold of 80 VdB at residential or other Category 2 land use is considered as the construction vibration significance threshold for the Project.
    - For structural damage from construction vibration, the FTA considers an exceedance of ppv 0.2 ips for typical timber and masonry residences as an impact. An exceedance of ppv 0.2 ips for typical timber and masonry residences is Therefore, a significance threshold of ppv 0.2 ips for structural damage is considered as the construction vibration significance threshold for the Project.

3.11.5 Existing Setting

The locations at which existing background noise levels were measured are shown in **Figure 3.11.2** and identified in **Table 3.11-8**. **Table 3.11-8** also shows the measured day-night noise levels along the Project corridor Build Alternatives with noise levels ranging from 57 dBA to 71 dBA. Measured peak-hour noise levels along the Project corridor Build Alternatives range from 57 dBA to 73 dBA. These levels are representative of active urban land uses. Based on the monitoring results, the high ambient noise conditions identified in **Table 3.11-8** reflect the proximity of residences to heavily used transportation corridors.

The DSA for all Build Alternatives is dominated by busy auto-oriented corridors, including city streets and congested highways. Therefore, although no vibration measurements were conducted, current ambient vibration levels are dominated by vehicular traffic, particularly heavy trucks at locations adjacent to active roadways such as Atlantic Boulevard.

Table 3.11-8. Baseline Noise Levels Measured along the Project Corridor (in dBA)

Receptor		Alternative	Land Use		24-Hr Ldn	Pk-Hr Leq
ID No.[1]	Description		Type	FTA[2]		
M01	376 S Woods Avenue	1,2,3	SFR	2	62	63
M02	5224 ½ Via Corona Street	1,2,3	SFR	2	66	65
M03	743 Amalia Avenue	1,2,3	SFR	2	58	59
M04	740 ½ Woods Avenue	1,2,3	SFR	2	57	57
M05	668 S Atlantic Boulevard	1,2,3	School	3	--	63
M06	860 Washington Boulevard	1,2	SFR	2	71	68
M07	6735 Keltonview Drive	1	SFR	2	67	64
M08	9122 Washington Boulevard	1	Museum	3	--	73
M09	6768 Washington Boulevard	1	SFR	2	70	67
M10	7857 Milna Avenue	1	SFR	2	71	67
M11	7904 Broadway Avenue	1	SFR	2	66	63
M12	7972 Calobar Avenue	1	SFR	2	69	67

Source: AECOM, November 2010; Morgner, December 2019 and July 2021.
Notes:
1 Refer to **Figure 3.11.2** and Attachment A of Appendix L of the Draft EIR for locations of representative noise measurements.
2 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
Key:
SFR = Single-Family Residence "--" = The day-night noise level is not applicable to institutional land uses

3.11.6 Impact Evaluation

3.11.6.1 Impact NOI-1: Ambient Noise

Impact NOI-1: Would a Build Alternative result in generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

3.11.6.1.1 Alternative 1 Washington

Operational Impacts

At residences and other FTA Category 2 land uses sensitive to nighttime activity, such as hospitals, the Ldn descriptor was used to reflect the particularly heightened sensitivity to nighttime noise. To evaluate the change in noise levels from the existing condition, the predicted future noise levels from operation of Alternative 1 are summarized in **Table 3.11-9** for the same representative receptor locations used to monitor current noise levels (see **Figure 3.11.2**) based on FTA criteria. The criteria are based on land use category, existing noise levels, and projected Project noise levels.

The Ldn day-night noise levels at residences along the proposed alignment are predicted to range from 55 dBA at representative Receptor M11 (single-family residences along Broadway Avenue) to 66 dBA at representative Receptor M06 (single-family residence at 860 Washington Boulevard). At the selected representative receptors, only the noise levels at representative Receptors M06 and M07 are predicted to equal or barely exceed the FTA moderate impact criteria.

Corridor-wide Project noise levels along Alternative 1 are predicted to exceed the FTA moderate impact criteria at 28 residences and at one FTA Category 3 receptor (a contractor's license school along Washington Boulevard opposite Crossway Drive). These moderate impacts are discussed below. No noise level exceedances are predicted above the FTA severe impact criteria at sensitive receptors and thus, no significant noise impacts would occur. The predicted corridor-wide noise impacts are summarized in **Table 3.11-10** and shown in Attachment A of Appendix L. Note that the receptors identified in the table are representative receptors which are intended to characterize noise levels for given residential areas and do not each represent an individual property.

Table 3.11-9. Summary of Project Noise Levels at Representative Receptors from Alternative 1 Washington (in dBA)

Receptor		Land Use		Existing Noise	Build Noise[4]	FTA Criteria[2]		Significant Impact? (Build noise greater than FTA "Severe" Criteria)
ID No.[1]	Noise Measurement Location	Type	FTA[3]			"Moderate"	"Severe"	
M01	376 S Woods Avenue	SFR	2	62	N/A	59	65	No
M02	5224 ½ Via Corona Street	SFR	2	66	N/A	62	68	No
M03	743 Amalia Avenue	SFR	2	58	N/A	57	63	No
M04	740 ½ Woods Avenue	SFR	2	57	N/A	57	63	No
M05	668 S Atlantic Boulevard	School	3	63	N/A	65	71	No
M06	860 Washington Boulevard	SFR	2	71	**<u>66</u>**	66	71	No
M07	6735 Keltonview Drive	SFR	2	67	**<u>64</u>**	63	68	No
M08	9122 Washington Boulevard	Museum	3	73	61	71	77	No
M09	6768 Washington Boulevard	SFR	2	70	61	64	70	No
M10	7857 Milna Avenue	SFR	2	71	63	65	70	No
M11	7904 Broadway Avenue	SFR	2	66	55	62	68	No
M12	7972 Calobar Avenue	SFR	2	69	61	64	70	No

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** or Attachment A of Appendix L of the Draft EIR for receptor locations.
2 FTA moderate impacts are bold and underlined.
3 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
4 The "Build Noise" levels represent the future Project noise only. The cumulative future ambient noise with the Project would be equal to the "Existing Noise" logarithmically added to the "Build Noise."
Key:
SFR = Single-Family Residence MFR = Multi-Family Residence N/A = not applicable (no airborne noise along tunnel sections)

Table 3.11-10. Corridor-Wide Project Noise Impacts Along Alternative 1 Washington

Nearest ID No.	Location	Land Use Type	Impact (Moderate or Severe)	No. Residences Affected	Major Source(s) Contributing to Impact
M06	Kelly House, Washington Boulevard	SFR	Moderate	1	LRT passbys
M07	Washington Boulevard at Paramount Boulevard	MFR	Moderate	10	LRT Bells and LRT passbys
M09	Washington Boulevard at Bonnie Vale Place Washington Boulevard at Lemoran Avenue Pico Vista Road	SFR SFR SFR	Moderate Moderate Moderate	2 1 0	Switches and LRT passbys
M10	Washington Boulevard at Pioneer Boulevard	SFR	Moderate	3	LRT Bells and LRT passbys
M11	Washington Boulevard at Ridgeview Lane	SFR	Moderate	1	LRT passbys
M12	Sorensen Avenue	SFR	Moderate	8	LRT Bells and LRT passbys
	Crowndale Avenue	SFR MFR	Moderate Moderate	1 1	Switches and LRT passbys
Total FTA Category 2			Severe Moderate Total	0 28 28	

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Note:
See **Figure 3.11.2** and Attachment A of Appendix L of the Draft EIR for receptor locations.
Key:
SFR = Single-Family Residence MFR = Multi-Family Residence

Passby Impacts from LRT Vehicles

Noise along the Alternative 1 would be primarily due to passbys from LRT vehicles. Lmax's along the Alternative 1 from LRT train passbys are predicted to range from 67 dBA at Receptor M11 to 81 dBA at representative Receptor M06 (both single-family residences). The dominant noise sources from LRT passbys along the proposed transit corridor would be wheel-rail and aerodynamic noise. Noise generated by passby LRT vehicles would not exceed the FTA moderate noise impact criteria at any sensitive receptors along Alternative 1. The impact would be less than significant.

Impacts from At-Grade Crossings

There are 10 at-grade crossings along Alternative 1, all east of South Greenwood Avenue in Montebello. However, the closest noise-sensitive receptors at most grade crossings are shielded by commercial buildings. At Pioneer Boulevard, for example, Lmax noise levels from grade crossings at the closest residence where impacts are predicted are 76 dBA for LRT vehicle warning bells. FTA moderate noise impacts are predicted at 15 residences in the vicinity of at-grade crossings along Alternative 1. At Sorensen Avenue, Paramount Boulevard, and Pioneer Boulevard, these impacts would be partially due to LRT passbys and warning bells. The impact would be less than significant.

Impacts from Special Trackwork

Special trackwork (such as turnouts and crossovers) is proposed at several locations along Alternative 1 to provide operational flexibility. Turnouts or switches allow trains to move from one track to another, while crossovers allow trains to move between parallel tracks. Noise from switches or crossovers comes from a small gap in the central part of the switch known as a frog. When the steel LRT wheel hits this gap, train noise levels could increase up to 8 dBA in the vicinity of the switch. As shown in **Table 3.11-10**, switches are primary sources contributing to moderate noise impacts at representative Receptors M09 and M12. Noise generated by special trackwork would not exceed the FTA moderate noise impact criteria at any sensitive receptors along Alternative 1. The impact would be less than significant.

Impacts from Traction Power Substations

The traction power substations (TPSS) are transformers that "step-up" the voltage necessary to operate the trains. TPSS noise is a continuous hum caused by the constant expansion and contraction of the magnetically charged metal plates inside the casing. However, the absolute level of the TPSS is regulated by Metro's own specifications, thereby minimizing the potential for noise impact in the community.

TPSS would be installed at several locations along the proposed rail corridor to provide adequate electrical power for LRT service. As set forth in PM NOI-1 (described in **Section 3.11.7**), each TPSS would be designed in accordance with the Metro Rail Design Criteria (MRDC) of 45 dBA at 50 feet or at the setback line of the nearest building or occupied area, whichever is closer (Metro 2018). This operating noise level for the TPSS would be significantly lower than existing ambient noise levels (which range from 66 dBA Ldn to 73 dBA Leq) and LRT passby noise levels of 78 dBA at 50 feet. Therefore, noise generated by the TPSS would not exceed the FTA moderate noise impact criteria at any sensitive receptors along Alternative 1. The impact would be less than significant.

Operational Noise Impacts at Historic Properties

As summarized in **Table 3.11-11**, several historic properties were identified along Alternative 1. At historic residences, the Ldn descriptor was used to reflect the particularly heightened sensitivity to nighttime noise. At institutional (FTA Category 3) receptors (former Atchison, Topeka and Santa Fe Railway [AT&SF] Depot/Museum of Pico Rivera), the peak-hour Leq descriptor was used to reflect the sensitivity to daytime noise. Since the FTA does not consider commercial properties (historic or not) such as restaurants and stores to be sensitive to transit noise, the peak-hour Leq noise levels are reported at these sites (Steak Corral Restaurant) for informational purposes only and the impact was not assessed. Noise impacts would not exceed the FTA moderate noise impact criteria at any historic properties along Alternative 1. The impact would be less than significant.

Table 3.11-11. Summary of Project Noise Levels at Historic Properties Along the Alternative 1 Washington (in dBA)[1]

Receptor		Land Use		Existing Noise	Build Noise[4]	FTA Criteria	
ID No.[2]	Description	Type	FTA[3]			Moderate	Severe
HP2	Kelly House	Historic	2	71	65	65	70
HP3	Former AT&SF Depot[5]	Historic	3	73	61	70	77
HP4	Cliff May-designed Ranch House	Historic	2	70	62	64	70
HP5	Steak Corral Restaurant	Historic	--	63	63	--	--

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 Peak-hour Leq noise levels are reported for all institutional receptor Sites No. 106 and 108, while the 24-hour Ldn noise level is reported for Sites No. 104 and 107.
2 See **Figure 3.11.2** and Attachment A of Appendix L of the Draft EIR for receptor locations.
3 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
4 FTA moderate impacts are bold and underlined.
5 Current site of the Museum of Pico Rivera.

Operational Noise Impacts at Parks, Schools, and Other Institutional Receptors

As summarized in **Table 3.11-12**, several parks, schools, hospitals, and other non-residential receptors were identified along Alternative 1. At these non-residential sites, the peak-hour Leq descriptor was used to reflect the sensitivity to daytime noise. At the Presbyterian Intercommunity Hospital (PIH) in Whittier, which as shown in **Table 3.11-12** is predicted to be 46 dBA, the Ldn descriptor was used to reflect the particularly heightened sensitivity to nighttime noise. Project Leq noise levels at parks along Alternative 1 are predicted to range from 38 dBA at the Whittier Greenway to 56 dBA at the San Gabriel Coastal Basin Spreading Grounds.

Similarly, peak-hour Leq noise levels at institutional receptors are predicted to range from 40 dBA at the Tri-Cities Regional Occupational Program (ROP) in Whittier to 56 dBA at the San Gabriel Coastal Spreading Grounds and Greenwood Elementary School. However, none of the Project noise levels at the parks, schools, libraries, hospitals, or churches are predicted to exceed the FTA moderate or severe impact criteria along Alternative 1. The impact would be less than significant.

Table 3.11-12. Summary of Project Noise Levels at Parks, Schools, and Other Institutional Receptors Along Alternative 1 Washington (in dBA)[1]

Receptor		Land Use		Existing Noise	Build Noise[3]	FTA Criteria	
ID No.[2]	Description	Type	FTA[3]			Moderate	Severe
201	San Gabriel Coastal Basin Spreading Grounds	Park	3	67	56	67	73
202	Whittier Greenway	Park	3	67	38	67	73
206	Chet Holifield Park	Park	3	68	45	68	73
301	Chet Holifield Library	Library	3	68	48	68	73
304	Tri-Cities ROP	School	3	67	40	67	73
305	Washington Elementary School	School	3	63	51	65	70
306	Pioneer High School	School	3	67	51	67	73
308	Greenwood Elementary School	School	3	68	56	68	73
309	Brethren Christian School	School	3	67	54	67	73
313	Presbyterian Intercommunity Hospital	Hospital	2	67	46	67	73

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 Peak-hour Leq noise levels are reported for all institutional receptors Site No. 103, 201-312, while the 24-hour Ldn noise level is reported for Site No. 313 (Presbyterian Intercommunity Hospital).
2 See **Figure 3.11.2** and Attachment A of Appendix L of the Draft EIR for receptor locations.
3 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
4 FTA moderate impacts are bold and underlined.

Design Options

Atlantic/Pomona Station Option

The operational impacts for Alternative 1 with the Atlantic/Pomona Station Option would be the same as the base Alternative 1 because there is no difference in the number of sensitive receptors that would experience noise impacts exceeding the FTA severe impact criteria. The Atlantic/Pomona Station Option would be in a below grade cut and screened from the residences to the east. The Atlantic/Pomona Station Option would not change grade crossings, special trackwork, or TPSS locations compared to the base Alternative 1. There is one school, the Arts in Action Community Charter Elementary School, located approximately 200 feet from the Atlantic/Pomona Station Option site; however, the school is screened by existing structures and the trackwork at the Atlantic/Pomona Station Option site would be below grade and the predicted noise levels at the school would not exceed the FTA severe noise impact criteria. As shown in **Table 3.11-9** for the base Alternative 1, Alternative 1 with the Atlantic/Pomona Station Option is predicted to exceed the FTA moderate impact criteria at 28 residences and have no exceedances above the FTA severe impact criteria. The impact would be less than significant.

Montebello At-Grade Option

The operational impacts for Alternative 1 with the Montebello At-Grade Option would be very similar to the base Alternative 1 because there are no sensitive receptors adjacent to the Montebello At-Grade Option segment due to land use type (commercial and industrial). Therefore, as shown in **Table 3.11-9** for the base Alternative 1, Alternative 1 with the Montebello At-Grade Option is also predicted to exceed the FTA moderate impact criteria at 28 residences and have no exceedances above the FTA severe impact criteria.

The Montebello At-Grade Option would include additional LRT guideway running at-grade, with a slightly reduced distance between the LRT vehicles and first floors of buildings and as a result, a slightly increased noise level than with an aerial guideway; however, the area is commercial and industrial and there are no sensitive receptors that are exposed to passbys from LRT vehicles.

The Montebello At-Grade Option has grade crossings at Garfield Avenue, Vail Avenue, Maple Avenue, and Greenwood Avenue; however, the area is commercial and industrial and there would be no impacts from grade crossing LRT vehicle warning bells.

Special trackwork (such as turnouts and crossovers) is proposed at one additional location for the Montebello At-Grade Option at Stationing 355+00 to provide operational flexibility. There are no sensitive receptors that would be exposed to noise from this special trackwork.

The location of the TPSS remain the same for Alternative 1 with the Montebello At-Grade Option. The impact would be less than significant.

There is one historic property adjacent to the Montebello At-Grade Option, the Kelly House at 860 Washington Boulevard; there is a moderate noise impact at this location, which would also occur under the base Alternative 1. The impact would be less than significant.

There are no parks, schools, or other institutional receptors adjacent to the Montebello At-Grade Option alignment. The impacts would be the same as the base Alternative 1. The impact would be less than significant.

Construction Impacts

Construction of Alternative 1 would produce noise from various construction activities. Demolition and site preparation would generally involve breakers, backhoes, excavators, dump trucks, concrete saws, cranes, and trucks. Equipment would also include compressors, generators, and handheld pneumatic tools for temporary work to secure the sites and construct enabling works. Guideway construction equipment would generally consist of concrete trucks, rubber-tired excavators, loaders, rubber-tired compactors, graders and small bulldozers, and water trucks for dust control. For aerial guideway construction, activities would include the placement of piles or support columns and girders to create a span between the bents.

Equipment required for the temporary shoring of the cut and cover excavation, temporary shoring of the underground stations, and construction of the aerial guideway and bridge replacements at the Rio Hondo and San Gabriel River would include pile drivers (vibratory or impact), drilling rigs, possibly specialized water jet excavators, trucks to remove excavated soil, concrete trucks and concrete pumps, specialized truck trailers to deliver pre-cast concrete beams, cranes, trucks to deliver forms, reinforcing steel, pavement saws, pre-cast concrete post tensioning jacks and related equipment, and water trucks for dust control. It was assumed that potholing and utility relocation would occur ahead of major construction to prepare for underground work. Some utility relocations must be carried out at night because these can involve road closures.

Pile driving requires a heavy-duty machine that would hammer prefabricated steel beams (i.e. piles) and drive them into the ground. Application of this high-impact machinery would create ground disturbance through the displacement and compression of the surrounding soil and therefore increase vibration and noise levels. The use of pile drivers as construction equipment would result in a potentially significant impact to noise and vibration.

The Project also includes a tunnel section, which would involve excavation and shoring of the launching and receiving pits and tunneling with the use of the TBM. Ventilation would be required during construction and operation of Alternative 1 for adequate circulation of air flow in the tunnels. Tunnel vent fans would be located at ground surface level and their activation would increase ambient noise levels for their surrounding areas and would therefore result in a potentially significant impact. Tunneling activities would require the use of machinery to remove excavation spoils (i.e., muck) from the TBM. Muck removal and heavy machinery such as excavators and mini-excavators to move TBM spoils would be a source of noise during construction activities that could increase ambient noise levels.

In addition to the tunneling portion, the Project would require grading, excavation, the movement of excavated material, resulting in an increase in truck traffic and associated noise. As further described in the Section 3.8, Hazards and Hazardous Materials, and Section 3.14, Transportation and Traffic, haul routes would be located along the Project corridor right-of-way (ROW) and/or major streets connecting to construction staging areas and the nearest freeways (e.g., State Route (SR) 60, Interstate (I) 5, and I-605). These haul routes would be identified during final design in cooperation with the jurisdictions along the alignment and implemented throughout the construction process. As discussed under **Section 3.11.3.10**, it takes a doubling of traffic volumes for noise levels to change by 3 dBA (FTA 2018); even assuming a higher noise factor for haul trucks compared to passenger vehicles, the addition of haul truck trips would not be so substantial as to result in an acoustically perceptible change in ambient noise levels.

Noise levels during construction vary depending on the types of construction activity and the types of equipment used for each stage of work. Heavy machinery, the major source of noise in construction, moves in unpredictable patterns and is not typically at one location for a long duration of time. In addition, activities associated with construction staging and/or material laydown areas can result in adverse noise impacts if they take place in noise-sensitive areas. Construction normally occurs during daylight hours when some residents are not at home, when residents who are at home are less sensitive to construction activities, and when other community noise sources contribute to higher ambient noise levels. However, since the proposed construction is expected to last about 12 to 18 months at any one location, depending on the type of activity, potentially significant noise impacts would occur, particularly for those receptors adjacent to the alignment.

To evaluate the change in noise levels during construction, the predicted future noise levels from construction of Alternative 1 are summarized in **Table 3.11-13** for the same representative receptor locations used to monitor current noise levels (see **Figure 3.11.2**) based on FTA criteria. The criteria are based on land use category, existing noise levels, and worst case construction noise levels as specified in the FTA general assessment.

Table 3.11-13. Summary of Construction Noise Levels at Representative Receptors from Alternative 1 Washington (in dBA)

Receptor		Land Use		FTA Criteria[2]		Significant Impact? (Construction noise greater than FTA Criteria)
ID No.[1]	Noise Measurement Location	Type	Construction Noise[2,3]	Daytime	Nighttime	
M01	376 S Woods Avenue	Residential	103	90	80	**Yes**
M02	5224 ½ Via Corona Street	Residential	101	90	80	**Yes**
M03	743 Amalia Avenue	Residential	95	90	80	**Yes**
M04	740 ½ Woods Avenue	Residential	103	90	80	**Yes**
M05	668 S Atlantic Boulevard[4,5]	Commercial	-	100	100	No
M06	860 Washington Boulevard	Residential	93	90	80	**Yes**
M07	6735 Keltonview Drive	Residential	88	90	80	**Yes**
M08	9122 Washington Boulevard[4]	Commercial	97	100	100	**Yes**
M09	6768 Washington Boulevard	Residential	92	90	80	**Yes**
M10	7857 Milna Avenue	Residential	91	90	80	**Yes**
M11	7904 Broadway Avenue	Residential	79	90	80	No
M12	7972 Calobar Avenue	Residential	89	90	80	**Yes**

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** or Attachment A of Appendix L of the Draft EIR for receptor locations.
2 Based on worst case, two impact pile driving rigs. Operation taken as 20 percent on time
3 One hour Leq, dB(A).
4 FTA does not separately identify schools or museums Commercial category applied here.
5 Alignment in tunnel close to receptor.

Construction normally occurs during the day, therefore construction impacts were evaluated based on the FTA daytime noise limits of 90 dBA at residential receptors and 100 dBA at commercial receptors. The distances at which an exceedance of the FTA daytime noise limits of 90 dBA at residential receptors is predicted range from 32 feet during station construction to 40 feet during at-grade track laying. The distances at which an exceedance of the FTA daytime noise limits of 100 dBA at commercial receptors would occur range from 10 feet during station construction to 13 feet during at-grade track-laying. As a result of these construction noise estimates, construction activities are predicted to exceed the FTA daytime noise limits at 70 noise sensitive receivers for Alternative 1 and a significant impact would occur. Construction at night is not expected to occur under typical conditions; however, unforeseen schedule or operational limitations may require certain construction activities to occur at night at points along the alignment. If construction at night must occur, construction noise activities would be predicted to exceed the FTA nighttime noise limits of 80 dBA at nearby residential receptors; therefore, a significant impact would occur as shown in **Table 3.11-13**.

Compliance with project measures discussed in **Section 3.11.7.1** would reduce potential noise impacts. As described in PM NOI-1, each TPSS would be designed in accordance with the Metro Rail Design Criteria (MRDC) of 45 dBA at 50 feet or at the setback line of the nearest building or occupied area, whichever is closer (Metro 2018). Additionally, as described in PM NOI-2, all construction activities would be carried out in compliance with Metro's baseline specifications Section 015619, Construction Noise and Vibration Control to reduce noise generation associated with construction activities to the degree feasible by using methods that may include, but not be limited to, conducting construction in daytime hours, using construction equipment with noise-suppression devices, and using noise barriers or other noise control measures. Implementation of these project measures would reduce construction noise; however, additional mitigation measures identified in **Section 3.11.7.2** and summarized below would be required to further reduce noise impacts.

MM NOI-1 would require implementation of a noise control plan and construction monitoring plan that would meet, at minimum, the FTA general assessment noise criteria. MM NOI-2 would require Metro's contractor to use cast-in-drill hole (CIDH) or drilled piles rather than impact pile drivers except where these are impracticable to reduce excessive noise. MM NOI-3 would require the construction contractor to erect temporary noise barriers between noisy activities and noise sensitive receptors to ensure compliance with applicable noise limits. Noise barriers block the direct path of sound waves and would reduce noise impacts from receptors when applied. MM NOI-4 would require Metro's contractor to locate construction equipment and material staging areas away from sensitive receptors where practicable to increase the distance between receptors and noise generating construction equipment/material staging areas. MM NOI-5 would require construction traffic and haul route routing in areas without noise-sensitive receptors where practicable, thereby minimizing traffic noise. MM NOI-6 would require contractors to use best available control technologies (e.g., piling noise shrouds) to limit excessive noise when working near residences where practicable to muffle sounds created by Project-related construction equipment and therefore reduce noise levels. MM NOI-7 would require the contractor wherever practicable, to conduct construction activities during the daytime and during weekdays in residential areas, since noise is more disruptive at night and weekends when residents are more likely to be home. MM NOI-8 would require Metro to establish a Noise and Vibration Complaint Hotline to resolve noise issues arising from construction activities.

MM NOI-9 and MM NOI-10, identified in **Section 3.11.7.2**, would require using a muck removal conveyor for the TBM if practicable, with specifications to reduce noise generation, including using temporary tunnel track with smooth rail and wheels, limiting car speeds and removing the muck by truck during the day where the haul route impacts residences. Implementation of MM NOI-9 and MM NOI-10 would lessen noise associated with muck removal and minimize nighttime noise impacts. MM NOI-11 as discussed in in **Section 3.11.7.2** would reduce impacts from ventilation fans by requiring that they be placed away from sensitive receptors, thereby Increasing distance between sensitive receptors and noise generating ventilation fans.

Implementation of MM NOI-1 through MM NOI-11 would include implementation of noise control measures such as establishing a noise control plan that would specify construction noise limits for daytime or nighttime work near sensitive receivers. With implementation of mitigation measures, construction noise impacts would be reduced to less than significant.

Station Construction Staging Area Options

Two potential options have been identified for the construction staging area for each new or relocated station. The options and potential construction noise impacts are identified below. At staging sites occupied by existing structures, the existing structures would be demolished to accommodate the staging needs.

Atlantic Station (Relocated/Reconfigured) Construction Staging Area Options

Construction staging areas for the relocated/reconfigured Atlantic station, connection to the existing Metro system, and the TBM receiving pit would either be located on three commercial parcels to the west of the alignment, or on three parcels to the east of the alignment. The sites to the west would have a construction noise impact on 10 residential properties and the sites to the east would have a construction noise impact on nine residential properties. Either construction staging area option would have a significant impact. Alternative 1 with either staging area site would require implementation of MM NOI-1 through MM NOI-11 as summarized previously and identified in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

Commerce/Citadel Station Construction Staging Area Options

Construction staging areas for the underground Commerce/Citadel station would be either located on a property to the southwest of the alignment, or on a property to the northeast of the alignment. The site to the southwest and the site to the northeast would have no construction noise impact on adjacent properties. The impact would be less than significant.

Greenwood Station Construction Staging Area Options

Construction staging areas for Greenwood station would be located to the south of Washington Boulevard, either to the west or east. The site to the west would have construction noise impacts on two adjacent properties and the site to the east would have construction noise impacts on three residential properties. Either construction staging area option would have a significant impact. Alternative 1 with either staging area site would require implementation of MM NOI-1 through MM NOI-11 as summarized previously and identified in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

Rosemead Station Construction Staging Area Options

Construction staging areas for Rosemead station would be located either to the south of the alignment or to the north. The site to the south would have no construction noise impact on adjacent properties and therefore, no significant noise impact would occur if this location is selected. The site to the north would have one construction noise impact on an adjacent property, and therefore, a significant noise impact would occur if this location is selected. Alternative 1 with either staging area site would require implementation of MM NOI-1 through MM NOI-11 as summarized previously and identified in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

Norwalk Station Construction Staging Area Options

Construction staging areas for Norwalk station would be located either directly to the south of the station or southwest of the station. The site to the south would have no impact on adjacent properties and therefore, no significant noise impact would occur if this location is selected. The site to the southwest has construction noise impacts on eight residential properties, and therefore, a significant noise impact would occur if this location is selected. Alternative 1 with either staging area site would require implementation of MM NOI-1 through MM NOI-11 the Alternative 1 with the in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

Lambert Station Construction Staging Area

Construction staging areas for Lambert Road would be located adjacent to Lambert station and would have no construction noise impact on adjacent properties. The impact would be less than significant.

Design Options

<u>Atlantic/Pomona Station Option</u>

Construction activities are predicted to exceed the FTA daytime noise limits at 70 Noise Sensitive Receivers for Alternative 1 with the Atlantic/Pomona Station Option, which is the same as the base Alternative 1. Therefore, a significant impact would occur. The construction noise impacts and mitigation measures associated with Alternative 1 with the Atlantic/Pomona Station Option would be the same as for the base Alternative 1. Alternative 1 with the Atlantic/Pomona Station Option would require implementation of MM NOI-1 through MM NOI-11 as summarized previously and identified in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

<u>Montebello At-Grade Option</u>

Construction activities are predicted to exceed the FTA daytime noise limits at 70 Noise Sensitive Receivers for Alternative 1 with the Montebello At-Grade Option, which is the same as the base Alternative 1. Therefore, a significant impact would occur. The construction noise impacts and mitigation measures associated with the Montebello At-Grade Option would be the same as for the base Alternative 1. Alternative 1 with the Montebello At-Grade Option would require implementation of MM NOI-1 through MM NOI-11 as summarized previously and identified in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

3.11.6.1.2 Alternative 2 Atlantic to Commerce/Citadel IOS

Operational Impacts

Base Alternative and Design Option

<u>Passby Impacts from LRT Vehicles</u>

The base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would be underground except for where the alignment daylights after crossing Saybrook Avenue and transitioning to an aerial structure that then ends at the Commerce MSF. The area is commercial and industrial and there are no sensitive receptors within the screening distance for the LRT that are exposed to passbys from LRT vehicles. There would be no operational noise impacts from LRT passbys from the alignment.

<u>Impacts from At-Grade Crossings</u>

The base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would have no at-grade crossings, and, therefore, there would be no impacts from grade crossing LRT vehicle warning bells.

<u>Impacts from Special Trackwork</u>

Special trackwork (such as turnouts and crossovers) is proposed at several locations along the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option to provide operational flexibility. Noise from switches or crossovers comes from a small gap in the central part of the switch known as a frog. Airborne noise from frogs is not an issue because most of the alignment is underground, and the only aboveground section is commercial or industrial, and therefore there would be no impacts from special trackwork.

Impacts from Traction Power Substations

TPSS would be installed at several locations along the proposed rail corridor to provide adequate electrical power for LRT service. As identified in PM NOI-1, each TPSS would be located at-grade and designed in accordance with the MRDC noise guideline of 45 dBA at 50 feet or at the setback line of the nearest building or occupied area, whichever is closer. This operating noise level for the TPSS would be significantly lower than existing ambient noise levels (which range from 66 dBA Ldn to 73 dBA Leq) and LRT passby noise levels of 78 dBA at 50 feet. Therefore, noise generated by the TPSS would not exceed the FTA noise impact criteria at any receptors along the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option, and a less than significant noise impact would occur.

Operational Noise Impacts at Historic Properties

There are no historic properties close to the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option that would be affected by noise. No impact would occur.

Operational Noise Impacts at Parks, Schools, and Other Institutional Receptors

Chet Holifield Library, Chet Holifield Park and Greenwood Elementary School are not within the FTA screening distance for noise impacts from the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option. There are no parks, schools, and other institutional receptors adjacent to the alignment. No noise impact would occur.

Construction Impacts

Base Alternative and Design Option

Construction of the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would produce noise from the same types of construction activities as Alternative 1 and use the same types of equipment for those activities. Construction of the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would result in a significant noise impact from general construction activities which could include the use of pile drivers, nighttime noise, tunnel ventilation, tunneling activities, and on-road truck traffic. Construction normally occurs during the day, therefore construction impacts were evaluated based on the FTA daytime noise limits of 90 dBA at residential receptors and 100 dBA at commercial receptors. The distances at which an exceedance of the FTA daytime noise limits of 90 dBA at residential receptors is predicted range from 32 feet during station construction to 40 feet during at-grade track laying. The distances at which an exceedance of the FTA daytime noise limits of 100 dBA at commercial receptors would occur range from 10 feet during station construction to 13 feet during at-grade track-laying. As a result of these construction noise estimates, construction activities are predicted to exceed the FTA daytime noise limits at 17 noise sensitive receptors for the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option. Construction at night is not expected to occur under typical conditions; however, unforeseen schedule or operational limitations may require certain construction activities to occur at night at points along the alignment. If construction at night must occur, construction noise activities would be predicted to exceed the FTA nighttime noise limits of 80 dBA at nearby residential receptors; therefore, a significant impact would occur.

Compliance with project measures and mitigation measures summarized in the construction evaluation in **Section 3.11.6.1.1** and identified in **Section 3.11.7.1** would reduce potential noise impacts. TPSS would be designed in accordance with MRDC and all construction activities would be carried out in compliance with Metro's Construction Noise and Vibration Control specifications as required by PM NOI-1 and PM NO1-2. Additionally, MM NOI-1 through MM NOI-11 summarized in **Section 3.11.6.1.1** and identified in **Section 3.11.7.2** would reduce construction noise levels experienced by sensitive receptors through means such as use of noise buffers, maximizing the distance between noise generating activities and sensitive receptors to the degree feasible, minimizing noise generation such as through the use of equipment mufflers to the degree feasible, and establishing a Noise and Vibration Complaint Hotline to resolve noise issue. Implementation of MM NOI-1 through MM NOI-11 would reduce construction noise impacts from the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option to less than significant.

<u>Station Construction Staging Area Options</u>

Two options have been identified for the construction staging area for the two new or relocated station that would be implemented under the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option. See **Section 3.11.6.1.1** for additional information.

Atlantic Station (Relocated/Reconfigured) Construction Staging Area Options

As described in the construction evaluation in **Section 3.11.6.1.1,** construction staging for the relocated/reconfigured Atlantic station, connection to the existing Metro system, and the TBM receiving pit would have a significant construction noise impact on 10 residential properties if the staging area is located to the west of the alignment and a significant construction noise impact on nine residential properties if the staging area is located to the east of the alignment. The base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option with either staging area site would require implementation of MM NOI-1 through MM NOI-11 as described in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

Commerce/Citadel Station Construction Staging Area Options

Construction staging areas for the underground Commerce/Citadel station would have no construction noise impact on adjacent properties. The impact would be less than significant.

3.11.6.1.3 Alternative 3 Atlantic to Greenwood IOS

Operational Impacts

Base Alternative and Design Options

<u>Passby Impacts from LRT Vehicles</u>

The base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would be underground until the alignment daylights after crossing Saybrook Avenue and links to either the Commerce MSF site option or Montebello MSF site option and terminates in an aerial configuration at Greenwood station. The area is commercial and industrial and there are no sensitive receptors that are exposed to passbys from LRT vehicles. Therefore, no impact would occur.

Impacts from At-Grade Crossings

The base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option has no at-grade crossings, and, therefore, there would be no impacts from grade crossing LRT vehicle warning bells.

Impacts from Special Trackwork

Special trackwork (such as turnouts and crossovers) is proposed at several locations along the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option to provide operational flexibility. Airborne noise from frogs is not an issue because the land use surrounding the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option in its aboveground configuration is commercial or industrial. Therefore, no significant impact would occur.

Impacts from Traction Power Substations

TPSS would be installed at several locations along the proposed rail corridor to provide adequate electrical power for LRT service. As identified in PM NOI-1, each TPSS would be located at-grade and designed in accordance with the MRDC noise guideline of 45 dBA at 50 feet or at the setback line of the nearest building or occupied area, whichever is closer. This operating noise level for the TPSS would be significantly lower than existing ambient noise levels (which range from 66 dBA Ldn to 73 dBA Leq) and LRT passby noise levels of 78 dBA at 50 feet. Therefore, noise generated by the TPSS would not exceed the FTA noise impact criteria at any receptors along the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option, and a less than significant noise impact would occur.

Operational Noise Impacts at Historic Properties

There is one historic property, the Kelly House at 860 Washington Boulevard, that is adjacent to the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option. There would be a moderate noise impact at this location. This would be a less than significant impact.

Operational Noise Impacts at Parks, Schools, and Other Institutional Receptors

There are no parks, schools, or other institutional receptors adjacent to the aerial sections of the alignment and, therefore, no significant impacts would occur.

Construction Impacts

Base Alternative and Design Options

Construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would produce noise from the same types of construction activities as Alternative 1 and use the same types of equipment for those activities. Construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would result in a significant noise impact from general construction activities, the use of pile drivers, nighttime noise, tunnel ventilation, tunneling activities, and on-road truck traffic. Construction normally occurs during the day, therefore construction impacts were evaluated based on the FTA daytime noise limits of 90 dBA at residential receptors and 100 dBA at commercial receptors. The distances at which an exceedance of the FTA daytime noise limits of 90 dBA at residential receptors is predicted range from 32 feet during station construction to 40 feet during at-grade track laying. The distances at which an exceedance of the FTA daytime noise limits of 100 dBA at commercial receptors would occur range from 10 feet during station construction to 13 feet during at-grade track-laying. As a result of these construction noise estimates, construction activities are predicted to exceed the FTA daytime noise limits at 29 noise sensitive receptors for the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option. Construction at night is not expected to occur under typical conditions; however, unforeseen schedule or operational limitations may require certain construction activities to occur at night at points along the alignment. If construction at night must occur, construction noise activities would be predicted to exceed the FTA nighttime noise limits of 80 dBA at nearby residential receptors; therefore, a significant impact would occur.

Compliance with project measures and mitigation measures summarized in the construction evaluation in **Section 3.11.6.1.1** and identified in **Section 3.11.7.1** would reduce potential noise impacts. TPSS would be designed in accordance with MRDC and all construction activities would be carried out in compliance with Metro's Construction Noise and Vibration Control specifications as required by PM NOI-1 and PM NO1-2. Additionally, MM NOI-1 through MM NOI-11 summarized in **Section 3.11.6.1.1** and identified in **Section 3.11.7.2** would reduce construction noise levels experienced by sensitive receptors through means such as use of noise buffers, maximizing the distance between noise generating activities and sensitive receptors to the degree feasible, minimizing noise generation such as through the use of equipment mufflers to the degree feasible, and establishing a Noise and Vibration Complaint Hotline to resolve noise issue. Compliance with PM NOI-1 and PM NOI-2 and implementation of MM NOI-1 through MM NOI-11 would reduce construction noise impacts to less than significant.

Implementation of MM NOI-1 through MM NOI-11 would reduce construction noise impacts from construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option to less than significant.

Station Construction Staging Area Options

As described in **Section 3.11.6.1.1,** two options have been identified for the construction staging area for the three new or relocated stations to be constructed under the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option. The potential construction noise impacts are identified below. See **Section 3.11.6.1.1** for additional information.

Atlantic Station (Relocated/Reconfigured) Construction Staging Area Options

Construction staging areas for the relocated/reconfigured Atlantic station, connection to the existing Metro system, and the TBM receiving pit would have a significant construction noise impact on 10 residential properties if the staging area is located to the west of the alignment and a significant construction noise impact on nine residential properties if the staging area is located to the east of the alignment. The base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option with either staging area site would require implementation of MM NOI-1 through MM NOI-11 as described in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

Commerce/Citadel Station Construction Staging Area Options

Construction staging areas for the underground Commerce/Citadel station would have no construction noise impact on adjacent properties. The impact would be less than significant.

Greenwood Station Construction Staging Area Options

Construction staging areas for Greenwood station would be located to the south of Washington Boulevard would have a significant construction noise impact on two adjacent properties if the staging area is located to the west of the alignment and construction noise impacts on three residential properties if the staging area is located to the east of the alignment. The base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option with either staging area site would require implementation of MM NOI-1 through MM NOI-11 as described in **Section 3.11.7**, which would reduce construction noise impacts to less than significant.

3.11.6.1.4 Maintenance and Storage Facilities

Operational Impacts

MSF Site Options and Design Option

The Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would accommodate daily maintenance, inspection and repairs, and storage of the LRT vehicles. The MSF site options would require an at-grade crossing where crossing gates and bells would be activated when the LRT accesses the facility. The Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would be located in an industrial area and would have no noise-sensitive receptors (such as residences, schools, churches, or parks) within the FTA screening distance of 650 feet (where there are intervening buildings). Therefore, no moderate or severe noise impact would occur. The impact would be less than significant.

Construction Impacts

Commerce MSF

Construction of the Commerce MSF site option would require site demolition and facility construction, which would produce noise from various construction activities. Demolition and site preparation would generally involve breakers, backhoes, excavators, dump trucks, concrete saws, cranes, and trucks. Equipment would also include compressors, generators, and handheld pneumatic tools for temporary work to secure the sites and construct enabling works.

The Commerce MSF site option is located in an industrial area with the nearest sensitive receptors (such as residences, schools, churches, or parks) being more than 1,000 feet away with intervening buildings. Noise levels from construction would not exceed the FTA criteria for residential receivers of 90 dBA through the day or 80 dBA at night or 100 dBA through the day or night at commercial and industrial receivers. Impacts would be less than significant.

Montebello MSF and Montebello MSF At-Grade Option

Construction of the Montebello MSF site option or Montebello MSF At-Grade Option would be similar to that of the Commerce MSF site option described above. The Montebello MSF site option or Montebello MSF At-Grade Option is located in an industrial area with the nearest sensitive receptors (such as residences, schools, churches, or parks) being more than 1,000 feet away with intervening buildings. Noise levels from construction would not exceed the FTA criteria for residential receivers of 90 dBA through the day or 80 dBA at night. However, noise levels would exceed the FTA criteria for commercial or industrial receivers of 100 dBA through the day or 100 dBA at night at one industrial building immediately adjacent to the site. Therefore, a significant impact would occur.

Compliance with project measures and mitigation measures summarized in the construction evaluation in **Section 3.11.6.1.1** and identified in **Section 3.11.7.1** would reduce potential noise impacts. All construction activities would be carried out in compliance with Metro's Construction Noise and Vibration Control specifications as required by PM NO1-2. Additionally, MM NOI-1 through MM NOI-8 summarized in **Section 3.11.6.1.1** and identified in **Section 3.11.7.2** would reduce construction noise levels through means such as use of noise buffers, maximizing the distance between noise generating activities and sensitive receptors to the degree feasible, minimizing noise generation such as through the use of equipment mufflers to the degree feasible, and establishing a Noise and Vibration Complaint Hotline to resolve noise issues. Compliance with PM NOI-2 and implementation of MM NOI-1 through MM NOI-8 would reduce construction noise impacts to less than significant.

Implementation of MM NOI-1 through MM NOI-8 would reduce construction noise impacts to less than significant.

3.11.6.2 Impact NOI-2: Ground-Borne Vibration or Ground-Borne Noise

Impact NOI-2: Would a Build Alternative result in generation of excessive ground-borne vibration or ground-borne noise levels?

3.11.6.2.1 Alternative 1 Washington

Operational Impacts

Unlike noise, which is assessed using cumulative noise levels over a 24-hour period, transit vibration impacts are assessed based on individual events, such as when a train passes by, and the frequency of those events. The entire rail corridor would be constructed with CWR track. In the at-grade configuration, the track would be embedded. CWR track is continuous and therefore produces less vibration than non-CWR track because it does not have any breaks or gaps that could cause vibrations when a wheel passes over. Embedded track is vibration-isolated by a material which reduces transmitted vibration. Along aerial sections, elevated structures create additional separation between the train source and the ground-level receptors resulting in greater attenuation. At at-grade crossings, embedded track at cross streets is not expected to result in any vibration impacts, due to the short section limited to the width of the cross street. Along tunnel sections, train steel wheels over steel rails would input vibration into the track support structures and onwards to the ground. CWR track would reduce this vibration to some degree. All predicted vibration levels were compared with the FTA frequent impact criteria to assess the onset and severity of impact.

Alternative 1 would have three potential sources of vibration during operations, including LRT vehicle passbys along CWR track, LRT passbys through special trackwork such as switches along the corridor during revenue service, and switches at the MSF.

Passby Impacts from LRT Vehicles

To show the variation in vibration levels along Alternative 1, transit vibration levels were predicted at the same representative receptor locations as for the noise analysis. As summarized in **Table 3.11-14**, the maximum vibration levels from LRT vehicles are predicted to range from 48 VdB at representative Receptor M11 (a single-family residence along Broadway Avenue) to 80 VdB at representative Receptor M05 (Kipp Raices Academy on Atlantic Boulevard). Except for representative Receptors M05, M07 (single-family residence on Keltonview Drive), and M10 (single-family residence on Milna Avenue), all the vibration levels at the representative receptor sites are predicted to be below the FTA frequent impact criteria. As summarized in **Table 3.11-14**, the maximum vibration level from switches in the vicinity of representative Receptors M07 and M10 is predicted to exceed the FTA frequent criterion of 72 VdB for residential land uses along Alternative 1.

Table 3.11-14. Summary of Project Vibration Levels at Representative Receptors from Alternative 1 Washington (in VdB)

Receptor		Land Use		Build Vibration[3]	FTA Criteria	
ID No.[1]	Vibration Measurement Location	Type	FTA[2]		"Frequent"	Impact
M01	376 S Woods Avenue	SFR	2	66	72	No
M02	5224 ½ Via Corona Street	SFR	2	65	72	No
M03	743 Amalia Avenue	SFR	2	62	72	No
M04	740 ½ Woods Avenue	SFR	2	64	72	No
M05	668 S Atlantic Boulevard	School	2	**<u>80</u>**	75	**Yes**
M06	860 Washington Boulevard	SFR	2	70	72	No
M07	6735 Keltonview Drive	SFR	2	**<u>73</u>**	72	**Yes**
M08	9122 Washington Boulevard	Museum	3	69	75	No
M09	6768 Washington Boulevard	SFR	2	64	72	No
M10	7857 Milna Avenue	SFR	2	**<u>76</u>**	72	**Yes**
M11	7904 Broadway Avenue	SFR	2	48	72	No
M12	7972 Calobar Avenue	SFR	2	62	72	No

Source: AECOM, November 2010; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
3 Exceedances of the FTA frequent criteria are bold and underlined.
Key:
SFR = Single-family Residence

As summarized in **Table 3.11-15**, corridor-wide vibration levels are predicted to exceed the FTA frequent criterion of 72 VdB at 85 residences. These impacts are due to the proximity of residences to proposed switches and proximity to the tunnel section of the alignment. One vibration impact is predicted at an FTA Category 3 receptor, Kipp Raices Academy school close to the alignment at 668 Atlantic Boulevard. Additionally, vibration levels along Alternative 1 are predicted to exceed the FTA frequent criterion of 75 VdB at one other institutional receptor (a Contractors State License school along

Washington Boulevard at Keltonview Drive) due to the switches at Stationing 516+50. Therefore, a significant impact would occur. The predicted corridor-wide vibration impacts are shown graphically in Attachment A of Appendix L.

Table 3.11-15. Corridor-wide Project Vibration and GBN Impacts Along Alternative 1 Washington

Nearest ID No.[1]	Location	Type Use	Impact (Frequent)	No. Residences Affected	Major Source(s) Contributing to Impact[2]
FTA Category 2					
M01	376 South Woods Avenue	SFR	Frequent	10	Crossover/switch
M02	5224 ½ Via Corona Street	SFR MFR	Frequent	6 3	Crossover/switch
M07	Washington Boulevard at Keltonview Drive	SFR	Frequent	5	Crossover/switch
M10	Washington Boulevard at Milna Avenue	SFR	Frequent	15	Crossover/switch
M12	Calobar Avenue	SFR MFR	Frequent	1 1	Crossover/switch
M04	Area local to E Olympic Boulevard	SFR MFR	Frequent	28 7	Operations
Total FTA Category 2			Frequent	85	
FTA Category 3					
M05	668 S Atlantic Boulevard	School	Frequent	1	Operations
M07	8705 Washington Boulevard	School	Frequent	1	Operations
Total FTA Category 3			Frequent	2	
Total – All Uses			Total	87	

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 Major sources include LRT passbys, LRT warning bells, and switches or special trackwork. The MSF and TPSS are not expected to be a major source for impacts in any vibration-sensitive locations.
Key:
SFR = Single-Family Residence   MFR = Multi-Family Residence

Mitigation measures would be implemented to reduce vibration impacts. MM NOI-12, identified in **Section 3.11.7.2**, would require the use of track support systems that incorporate resilience, such as ballast mats, high resilience track fasteners, resiliently supported ties or floating track slabs, which would reduce vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at residences. Implementation of MM NOI-13 would reduce vibration impacts from gaps at switches by requiring installation of ballast mats under conventional switches or using a "gapless" spring frog or other low vibration switches, which would reduce the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts from passbys to less than significant.

Impacts from Special Trackwork

Special trackwork is proposed at several locations along Alternative 1 to provide operational flexibility. Turnouts or switches allow trains to move from one track to another, while crossovers allow trains to move between parallel tracks. Vibration from switches or crossovers comes from a small gap in the central part of the switch known as a frog. Due to the rail discontinuities at switches, vibration levels from LRT vehicle passbys are predicted to range from below background to 76 VdB at representative Receptor M10 (a single-family residence at Milna Avenue). The vibration levels from LRT passby over switches are predicted to exceed the FTA impact criterion of 72 VdB at 85 residential land uses (FTA Category 2) and two schools (FTA Category 3 land use). Therefore, a significant impact would occur.

Compliance with MM NOI-12 and MM NOI-13 summarized previously and identified in **Section 3.11.7.2** would minimize potential vibration impacts by reducing vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at residences and by reducing the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts from special trackwork to less than significant.

Operational Vibration Impacts at Historic Properties

As summarized in **Table 3.11-16,** maximum vibration levels at historic resources along the proposed Washington Alternative are predicted to range from 67 VdB at the Golden Gate Theater to 71 VdB at the Steak Corral Restaurant (along Washington Boulevard).

Due to the strategic location of switches, none of the vibration levels predicted at historic properties are predicted to exceed the FTA frequent impact criteria along Alternative 1. Since the vibration levels predicted at historic properties are not predicted to exceed the FTA frequent impact criteria along Alternative 1, the vibration levels would also not exceed the FTA structural damage criteria along Alternative 1 (since the structural damage threshold is higher than the frequent impact criteria). The impact would be less than significant.

Table 3.11-16. Summary of Project Vibration Levels at Historic Properties Alternative 1 Washington (in VdB)

Receptor		Land Use		Build Vibration[3]	FTA Criteria	
ID No.2[1]	Description	Type	FTA[1]		"Frequent"	Impact
HP1	Golden Gate Theater	Historic	2	67	75	No
HP2	Kelly House	Historic	2	68	72	No
HP3	Former AT&SF Depot	Historic	3	70	75	No
HP4	Cliff May-designed Ranch House	Historic	2	68	72	No
HP5	Steak Corral Restaurant	Historic	--	71	--	No

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
3 Exceedances of the FTA frequent criteria are bold and underlined.

Operational Vibration Impacts at Parks, Schools, and Other Institutional Receptors

As summarized in **Table 3.11-17**, maximum vibration levels at parks along Alternative 1 vary between below detectable levels at the Whittier Greenway and Chet Holifield Park to 64 VdB at the San Gabriel Coastal Basin Spreading Grounds.

Similarly, maximum vibration levels at schools and other institutional receptors along Alternative 1 are predicted to range from below detection at the Tri-Cities ROP, Washington Elementary School, and Pioneer High School to 80 VdB at the Kipp Raices Academy on Atlantic Boulevard. Based on the modeling analysis, the Kipp Raices Academy on Atlantic Boulevard is predicted to exceed the FTA frequent impact criteria. Therefore, a significant impact would occur.

Table 3.11-17. Summary of Project Vibration Levels at Parks, Schools, and Other Institutional Receptor Sites (in VdB)

Receptor		Land Use		Build Vibration	FTA Criteria	
ID No.	Description	Type	FTA		"Frequent"	Impact
201	San Gabriel Coastal Basin Spreading Grounds	Park	3	64	75	No
202	Whittier Greenway	Park	3	BD[1]	75	No
206	Chet Holifield Park	Park	3	BD[1]	75	No
301	Chet Holifield Library	Library	3	BD[1]	75	No
304	Tri-Cities ROP	School	3	BD[1]	75	No
305	Washington Elementary School	School	3	BD[1]	75	No
306	Pioneer High School	School	3	BD[1]	75	No
308	Greenwood Elementary School	School	3	22	75	No
M05	Kipp Raices Academy, 668 S Atlantic Boulevard	School	3	80	75	Yes
313	Presbyterian Intercommunity Hospital	Hospital	2	40	75	No

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Note:
Due to attenuation over large distances, the predicted vibration level is below detection level and well below the ambient background level. Therefore, it is not perceptible.

Compliance with MM NOI-12 and MM NOI-13 summarized previously and identified in **Section 3.11.7.2** would minimize potential vibration impacts by reducing vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at sensitive receptors and by reducing the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts on institutional receptors to less than significant.

Design Options

<u>Atlantic/Pomona Station Option</u>

The Atlantic/Pomona Station Option alignment is located east of Atlantic Boulevard and connects with the base Alternative 1 alignment just north of the proposed Atlantic/Whittier station. Because of the variation in the alignment, the location of the potential vibration impacts are different than that of the base Alternative 1. As summarized in **Table 3.11-18**, like the base Alternative 1, corridor-wide vibration levels are predicted to exceed the FTA frequent criterion of 72 VdB at 85 residences. These impacts are due to the proximity of residences to proposed switches and proximity to the tunnel section of the alignment. Also like the base Alternative 1, Alternative 1 with the Atlantic/Pomona Station Option would result in one predicted vibration impact at an FTA Category 3 receptor, Kipp Raices Academy school close to the alignment at 668 S Atlantic Boulevard, and one exceedance of the FTA frequent criterion of 75 VdB at one other institutional receptor (a Contractors State License school along Washington Boulevard at Keltonview Drive) due to crossover/switches. However, unlike the base Alternative 1, Alternative 1 with the Atlantic/Pomona Station Option would result in potential vibration impacts to fewer residences near representative receptor M01 and more residences near representative receptor M02. This is due to the variation in the track alignment that would be required for the Atlantic/Pomona Station Option. The impact would be significant. The predicted corridor-wide vibration impacts are shown graphically in Attachment A in Appendix L.

Table 3.11-18. Corridor-wide Project Vibration and GBN Impacts Along Alternative 1 Washington with the Atlantic/Pomona Station Option

ID No.[1]	Location	Type Use	Impact (Frequent)	No. Residences Affected	Major Source(s) Contributing to Impact[2]
FTA Category 2					
M02	5224 ½ Via Corona Street	SFR MFR	Frequent	15 6	Crossover/switch
M07	Washington Boulevard at Keltonview Drive	SFR	Frequent	5	Crossover/switch
M10	Washington Boulevard at Milna Avenue	SFR	Frequent	15	Crossover/switch
M12	Calobar Avenue	SFR MFR	Frequent	1 1	Crossover/switch
M04	Area local to E Olympic Boulevard	SFR MFR	Frequent	28 7	Operations
Total FTA Category 2			Frequent	85	
FTA Category 3					
M05	668 S Atlantic Boulevard	School	Frequent	1	Operations
M07	8705 Washington Boulevard	School	Frequent	1	Operations
Total FTA Category 3			Frequent	2	
Total – All Uses			Total	87	

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 Major sources include LRT passbys, LRT warning bells, and switches or special trackwork. The MSF and TPSS are not expected to be a major source for impacts in any vibration-sensitive locations.
Key:
SFR = Single-Family Residence   MFR = Multi-Family Residence

As with the base Alternative 1, Alternative 1 with the Atlantic/Pomona Station Option would require implementation of MM NOI-12 and MM NOI-13 as identified in **Section 3.11.7**, which would reduce operational vibration impacts to less than significant.

Montebello At-Grade Option

Alternative 1 with the Montebello At-Grade Option would have three potential sources of vibration during operations, including LRT vehicle passbys along CWR track, LRT passbys through special trackwork such as switches along the corridor during revenue service, and switches at the MSF site options. The corridor-wide Project vibration impacts along Alternative 1 with the Montebello At-Grade Option is the same as the base Alternative 1. The impact would be significant. As with the base Alternative 1, Alternative 1 with the Montebello At-Grade Option would require implementation of MM NOI-12 and MM NOI-13 as identified in **Section 3.11.7**, which would reduce operational vibration impacts to less than significant.

Construction Impacts

Vibration levels from construction activities are not cumulative but rather dependent on the type of activity and equipment used. Vibration is also dependent on the ground and terrain conditions, the presence of underground utilities, and the type and condition of the building at the receptor. As a result, except for digging and pounding activities in hard soils, most construction activities do not contribute to vibration impacts, due to the typically long distance between the activity and the sensitive receptor.

Tunneling activities could cause construction vibration. Operation of the TBM and machinery to remove excavation spoils from the TBM could result in vibration damage to structures and annoyance to residences and other FTA Category 2 land uses. Typically, vibration from the TBM would not be perceptible at any one residence for longer than one week in duration.

Other construction activities could cause construction vibration. Use of other construction related equipment and heavy-machinery such as bulldozers, dump trucks, vibratory rollers, and pile drivers could result in vibration damage to structures and annoyance to residences and other FTA Category 2 land uses.

In accordance with the FTA guidelines, the vibration limit is used to identify potential impacts. The FTA infrequent event category was used to assess impact from perceptible vibration events, since not all construction activity would be perceptible.

The distances at which an exceedance of the FTA vibration infrequent annoyance criterion of 80 VdB for residences and other FTA Category 2 land uses would occur range from 40 feet for trucks to 50 feet for bulldozers to 70 feet for vibratory rollers. The distances at which an exceedance of the FTA vibration damage criterion of 0.2 ips would occur (for typical timber and masonry residences) range from 15 feet for trucks to 20 feet for bulldozers to 35 feet for vibratory rollers, which is a much closer distance than the FTA vibration infrequent annoyance criterion. As a result of these preliminary construction vibration estimates, construction activities are predicted to exceed the FTA impact criteria at the closest residences and commercial properties. Therefore, a significant impact would occur.

Compliance with PM NOI-2 identified in **Section 3.11.7.1** would require all construction activities to be carried out in compliance with Metro's baseline specifications Section 015619, Construction Noise and Vibration Control, which would reduce vibration impacts. Additional mitigation measures identified in **Section 3.11.7.2** and summarized below to reduce construction vibration levels would be required to further reduce impacts.

MM NOI-2 would require Metro's contractor to use CIDH or drilled piles rather than impact pile drivers to reduce excessive vibration, except where these are impracticable, because pre-drilling reduces noise and vibration impacts by reducing the rate of displacement and compression of the surrounding soil. MM NOI-4 would require Metro’s contractor to locate construction equipment and material staging areas away from sensitive receptors to increase distance in relation to sensitive receptors and thereby reduce impacts. MM NOI-5 would require Metro's contractor to route construction traffic, and haul routes away from sensitive receptors where practicable to reduce vibratory impacts related to haul routes. MM NOI-7 would require the contractor wherever practicable, to conduct construction activities during the daytime and weekdays to reduce nighttime and weekend disruption when residents are more likely to be home. MM NOI-8 would require Metro to establish a Noise and Vibration Complaint Hotline to resolve vibration issues. MM NOI-9 would require using a muck removal conveyor for the TBM if practicable, with specifications to reduce vibration, including using temporary tunnel track with smooth rail and wheels.

MM NOI-14 would require Metro to conduct a survey of selected properties within 100 feet of the alignment to determine the baseline structural integrity and condition of walls and joints to provide a basis for comparison after construction is completed and to provide baseline data for monitoring vibration impacts and developing the construction vibration control plan and monitoring plan described in MM NOI-15. Under MM NOI-15, Metro would require the contractor to develop a construction vibration control plan and a construction vibration monitoring plan to minimize vibration impact and reduce the risk of damage to susceptible structures.

Implementation of MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI-8, MM NOI-9, MM NOI-14, and MM NOI-15 would reduce construction vibration impacts to less than significant.

Design Options

Atlantic/Pomona Station Option

The construction vibration impacts for Alternative 1 with the Atlantic/Pomona Station Option would be the same as the base Alternative 1. However, unlike the base Alternative 1, Alternative 1 with the Atlantic/Pomona Station Option would result in potential vibration impacts to fewer residences near representative receptor M01 and more residences near representative receptor M02. This is due to the variation in the track alignment that would be required for the Atlantic/Pomona Station Option. Construction activities are predicted to exceed the FTA impact criteria at the closest residences and commercial properties. Therefore, a significant impact would occur. Construction of Alternative 1 with the Atlantic/Pomona Station Option would require implementation of MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI-8, MM NOI-9, MM NOI-14, and MM NOI-15 as summarized above and identified in **Section 3.11.7**, which would reduce construction vibration impacts to less than significant.

Montebello At-Grade Option

Construction of Alternative 1 with the Montebello At-Grade Option would involve additional at-grade construction in place of aerial guideway construction as compared to the base Alternative 1. As discussed in **Section 3.11.6.1.1**, at-grade track laying or guideway construction equipment would generally consist of rubber-tired excavators, loaders, rubber-tired compactors, graders and small bulldozers, and water trucks for dust control.

As with the base Alternative 1, construction activities for Alternative 1 with the Montebello At-Grade Option are predicted to exceed the FTA impact criteria at the closest residences and commercial properties. Therefore, a significant impact would occur. Construction of Alternative 1 with the Montebello At-Grade Option would require implementation of MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI 8, MM NOI-9, MM NOI-14, and MM NOI-15 as summarized above and identified in **Section 3.11.7**, which would reduce construction vibration impacts to less than significant.

3.11.6.2.2 Alternative 2 Atlantic to Commerce/Citadel IOS

Operational Impacts

As with Alternative 1, the Alternative 2 rail corridor would be constructed with CWR track. In the at-grade configuration, the track would be embedded. CWR track is continuous and therefore produces less vibration than non-CWR track because it does not have any breaks or gaps that could cause vibrations when a wheel passes over. Embedded track is vibration-isolated by a material which reduces transmitted vibration. Along the aerial section, elevated structures create additional separation between the train source and the ground-level receptors resulting in greater attenuation. Along tunnel sections, train steel wheels over steel rails would input vibration into the track support structures and onwards to the ground. CWR track would reduce this vibration to some degree. All predicted vibration levels were compared with the FTA frequent impact criteria to assess the onset and severity of impact.

Alternative 2 would have three potential sources of vibration during operations, including LRT vehicle passbys along CWR track, LRT passbys through special trackwork such as switches along the corridor during revenue service, and switches at the Commerce MSF site option.

Passby Impacts from LRT Vehicles

To show the variation in vibration levels along Alternative 2, transit vibration levels were predicted at the same receptor locations as for the noise analysis. As summarized in **Table 3.11-19**, the maximum vibration levels from LRT vehicles are predicted to range from 62 VdB at representative Receptor M03 a single-family residence, to 80 VdB at representative Receptor M05 (Kipp Raices Academy at 668 S Atlantic Boulevard). Except for representative Receptor M05, all the vibration levels at the representative receptor sites are predicted to be below the FTA frequent impact criteria.

Table 3.11-19. Summary of Project Vibration Levels at Representative Receptors from Alternative 2 Atlantic to Commerce/Citadel IOS (in VdB)

Receptor		Land Use			FTA Criteria	
ID No.[1]	Vibration Measurement Location	Type	FTA[2]	Build Vibration[3]	"Frequent"	Impact
M01	376 S Woods Avenue	SFR	2	66	72	No
M02	5224 ½ Via Corona Street	SFR	2	65	72	No
M03	743 Amalia Avenue	SFR	2	62	72	No
M04	740 ½ Woods Avenue	SFR	2	64	72	No
M05	Kipp Raices Academy, 668 South Atlantic Boulevard	School	2	**<u>80</u>**	75	Yes

Source: AECOM, November 2010; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
3 Exceedances of the FTA frequent criteria are bold and underlined.
Key:
SFR = Single-family Residence

As summarized in **Table 3.11-20**, corridor-wide vibration levels are predicted to exceed the FTA frequent criterion of 72 VdB at 54 residences. These impacts are due to the proximity of residences to proposed switches, and proximity to the tunnel section of the alignment.

One vibration impact is predicted at an FTA Category 3 receptor, Kipp Raices Academy, at 668 Atlantic Boulevard. Therefore, a significant impact would occur. The predicted corridor-wide vibration impacts are shown in Attachment A of Appendix L.

Table 3.11-20. Corridor-wide Project Vibration and GBN Impacts Along Alternative 2 Atlantic to Commerce/Citadel IOS

Nearest ID No.[1]	Location	Type Use	Impact (Frequent)	No. Residences Affected	Major Source(s) Contributing to Impact[2]
FTA Category 2					
M01	376 S Woods Avenue	SFR	Frequent	10	Crossover
M02	5224 ½ Via Corona Street	SFR MFR	Frequent	6 3	Crossover
M04	Area local to East Olympic Boulevard	SFR MFR	Frequent	28 7	Operations
Total FTA Category 2			Frequent	54	
FTA Category 3					
M05	668 S Atlantic Boulevard	School	Frequent	1	Operations
Total FTA Category 3			Frequent	1	
Total – All Uses			Total	55	

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 Major sources include LRT passbys, and switches or special trackwork. The MSF and TPSS are not expected to be a major source for impacts in any noise-sensitive locations.
Key:
SFR = Single-family Residence MFR = Multi-family Residence

Mitigation measures would be implemented to reduce vibration impacts. As summarized in **Section 3.11.6.2.1** and identified in **Section 3.11.7.2**, MM NOI-12 would require the use of track support systems to reduce vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at residences and MM NOI-13 would reduce vibratory levels by reducing the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts from passbys to less than significant.

Operational Vibration Impacts at Historic Properties

Alternative 2 would not impact any vibration sensitive historic properties. Alternative 2 is primarily underground, and there are no historic properties located where they would be impacted by operational vibration. No impact would occur.

Operational Vibration Impacts at Parks, Schools, and Other Institutional Receptors

As summarized in **Table 3.11-21**, maximum vibration levels at one institutional receptor along Alternative 2 are predicted to reach 80 VdB at the Kipp Raices Academy on Atlantic Boulevard, exceeding the FTA frequent impact criteria. Therefore, a significant impact would occur.

Table 3.11-21. Summary of Project Vibration Levels at Parks, Schools, and Other Institutional Receptor Sites for Alternative 2 Atlantic to Commerce/Citadel IOS (in VdB)

Receptor		Land Use		Build Vibration[3]	FTA Criteria	
ID No.[1]	Description	Type	FTA[2]		"Frequent"	Impact
M05	Kipp Raices Academy, 668 South Atlantic Boulevard	School	3	**<u>80</u>**	75	Yes

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
3 Exceedances of the FTA frequent criteria are bold and underlined.

Compliance with MM NOI-12 and MM NOI-13 summarized in **Section 3.11.6.2.1** and identified in **Section 3.11.7.2** would minimize potential vibration impacts by reducing vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at sensitive receptors and by reducing the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts on institutional receptors to less than significant.

Design Option

Atlantic/Pomona Station Option

The Atlantic/Pomona Station Option guideway alignment is located east of Atlantic Boulevard and connects with the base Alternative 2 alignment just north of the proposed Atlantic/Whittier station. Because of the variation in the alignment, the location of the potential vibration impacts are different than that of the base Alternative 2. Like the base Alternative 2, corridor-wide vibration levels are predicted to exceed the FTA frequent criterion of 72 VdB at 54 residences. These impacts are due to the proximity of residences to proposed switches and proximity to the tunnel section of the alignment. Also like the base Alternative 2, Alternative 2 with the Atlantic/Pomona Station Option would result in one predicted vibration impact at an FTA Category 3 receptor, Kipp Raices Academy school close to the alignment at 668 Atlantic Boulevard. However, unlike the base Alternative 2, Alternative 2 with the Atlantic/Pomona Station Option would result in potential vibration impacts to fewer residences near representative receptor M01 and more residences near representative receptor M02. This is due to the variation in the track alignment that would be required for the Atlantic/Pomona Station Option. The impact would be significant. The predicted corridor-wide vibration impacts are shown graphically in Attachment A in Appendix L.

As with the base Alternative 2, Alternative 2 with the Atlantic/Pomona Station Option would require implementation of MM NOI-12 and MM NOI-13 as summarized in **Section 3.11.6.2.1** and identified in **Section 3.11.7**, which would reduce operational vibration impacts to less than significant.

Construction Impacts

Base Alternative and Design Option

Construction of Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would produce vibration from the same types of construction activities as Alternative 1 and use the same types of equipment for those activities. Use of construction related equipment and heavy-machinery such as TBMs, bulldozers, dump trucks, vibratory rollers, pile drivers, and machinery to remove excavation spoils from the TBM could result in vibration damage to structures and annoyance to residences and other FTA Category 2 land uses. The distances at which an exceedance of the FTA vibration infrequent annoyance criterion of 80 VdB for residences and other FTA Category 2 land uses would occur range from 40 feet for trucks to 50 feet for bulldozers to 70 feet for vibratory rollers. The distances at which an exceedance of the FTA vibration damage criterion of 0.2 ips would occur (for typical timber and masonry residences) range from 15 feet for trucks to 20 feet for bulldozers to 35 feet for vibratory rollers, which is a much closer distance than the FTA vibration infrequent annoyance criterion. As a result of these preliminary construction vibration estimates, construction activities are predicted to exceed the FTA impact criteria at the closest residences and commercial properties.

Compliance with PM NOI-2 identified in **Section 3.11.7.1** requiring construction activities would be carried out in compliance with Metro's baseline specifications Section 015619, Construction Noise and Vibration Control would reduce impacts. Additional mitigation measures summarized in the construction evaluation in **Section 3.11.6.2.1** and identified in **Section 3.11.7.2** would be required to further reduce impacts. MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI-8, MM NOI-9, MM NOI-14, and MM NOI-15 would reduce vibration effects through means such as requiring use of equipment that produces less vibration, maximizing the distance between vibration generating activities and sensitive receptors to the degree feasible, establishing a Noise and Vibration Complaint Hotline to resolve vibration issues, surveying properties to determine the baseline structural integrity and condition, and developing a construction vibration control plan and monitoring plan. Implementation of MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI-8, MM NOI-9, MM NOI-14, and MM NOI-15 would reduce construction vibration impacts from construction of the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option to less than significant.

3.11.6.2.3 Alternative 3 Atlantic to Greenwood IOS

Operational Impacts

Base Alternative and Montebello At Grade Option

As with Alternative 1, the base Alternative 3 or Alternative 3 with the Montebello At Grade Option rail corridor would be constructed with CWR track. In the at-grade configuration, the track would be embedded. CWR track is continuous and therefore produces less vibration than non-CWR track because it does not have any breaks or gaps that could cause vibrations when a wheel passes over. Embedded track is vibration-isolated by a material which reduces transmitted vibration. Along the aerial section, elevated structures create additional separation between the train source and the ground-level receptors resulting in greater attenuation. Along tunnel sections, train steel wheels over steel rails would input vibration into the track support structures and onwards to the ground. CWR track would reduce this vibration to some degree. All predicted vibration levels were compared with the FTA frequent impact criteria to assess the onset and severity of impact.

The base Alternative 3 or Alternative 3 with the Montebello At Grade Option would have three potential sources of vibration during operations, including LRT vehicle passbys along CWR track, LRT passbys through special trackwork such as switches along the corridor during revenue service, and switches at the MSF.

Passby Impacts from LRT Vehicles

To show the variation in vibration levels along the base Alternative 3 or Alternative 3 with the Montebello At Grade Option, transit vibration levels were predicted at the same receptor locations as for the noise analysis. As summarized in **Table 3.11-22**, the maximum vibration levels from LRT vehicles are predicted to range from 62 VdB at representative Receptor M03 a single-family residence, to 80 VdB at representative Receptor M05 (Kipp Raices Academy, 668 S Atlantic Boulevard). Except for representative Receptor M05, all of the vibration levels at the representative receptor sites are predicted to be below the FTA frequent impact criteria.

Table 3.11-22. Summary of Project Vibration Levels at Representative Receptors from Alternative 3 Atlantic to Greenwood IOS (in VdB)

Receptor		Land Use		Build Vibration[3]	FTA Criteria	
ID No.[1]	Vibration Measurement Location	Type	FTA[2]		"Frequent"	Impact
M01	376 S Woods Avenue	SFR	2	66	72	No
M02	5224 ½ Via Corona Street	SFR	2	65	72	No
M03	743 Amalia Avenue	SFR	2	62	72	No
M04	740 ½ Woods Avenue	SFR	2	64	72	No
M05	Kipp Raices Academy, 668 South Atlantic Boulevard	School	2	**<u>80</u>**	75	Yes

Source: AECOM, November 2010; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix L for receptor locations.
2 FTA Land Use Categories: Category 1 – high sensitivity, Category 2 – residential, and Category 3 – institutional.
3 Exceedances of the FTA frequent criteria are bold and underlined.
Key:
SFR = Single-family Residence

As summarized in **Table 3.11-23**, corridor-wide vibration levels are predicted to exceed the FTA frequent criterion of 72 VdB at 54 residences. These impacts are due to the proximity of residences to proposed switches, and proximity to the tunnel section of the alignment. One vibration impact is predicted at an FTA Category 3 receptor, Kipp Raices Academy, 668 Atlantic Boulevard close to the alignment. Therefore, a significant impact would occur. The predicted corridor-wide vibration impacts are shown in Attachment A of Appendix L.

Table 3.11-23. Corridor-wide Project Vibration and GBN Impacts Along Alternative 3 Atlantic to Greenwood IOS

Nearest ID No.[1]	Location	Type Use	Impact (Frequent)	No. Residences Affected	Major Source(s) Contributing to Impact[2]
FTA Category 2					
M01	376 South Woods Avenue	SFR	Frequent	10	Crossover
M02	5224 ½ Via Corona Street	SFR MFR	Frequent	6 3	Crossover
M04	Area local to East Olympic Boulevard	SFR MFR	Frequent	28 7	Operations
Total FTA Category 2			Frequent	54	
FTA Category 3					
M05	Kipp Raices Academy, 668 South Atlantic Boulevard	School	Frequent	1	Operations
Total FTA Category 3			Frequent	1	
Total – All Uses			Total	55	

Source: AECOM, February 2011; Morgner, December 2019 and July 2021.
Notes:
1 See **Figure 3.11.2** and Attachment A of Appendix Lfor receptor locations.
2 Major sources include LRT passbys, LRT warning bells, and switches or special trackwork. The MSF and TPSS are not expected to be a major source for impacts in any noise-sensitive locations.
Key:
SFR = Single-Family Residence   MFR = Multi-Family Residence.

Mitigation measures would be implemented to reduce vibration impacts. As summarized in **Section 3.11.6.2.1** and identified in **Section 3.11.7.2**, MM NOI-12 would require the use of track support systems to reduce vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at residences and MM NOI-13 would reduce vibratory levels by reducing the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts from passbys to less than significant.

Operational Vibration Impacts at Historic Properties

The base Alternative 3 or Alternative 3 with the Montebello At Grade Option would not impact any vibration sensitive historic properties. There are no historic properties located where they would be impacted by operational vibration. No impact would occur.

Operational Vibration Impacts at Parks, Schools, and Other Institutional Receptors

As with Alternative 2 and summarized in **Table 3.11-21** in **Section 3.11.6.2.2**, maximum vibration levels at one institutional receptor along the base Alternative 3 or Alternative 3 with the Montebello At Grade Option are predicted to reach 80 VdB at the Kipp Raices Academy on Atlantic Boulevard, exceeding the FTA frequent impact criteria. Therefore, a significant impact would occur. Compliance with MM NOI-12 and MM NOI-13 summarized in **Section 3.11.6.2.1** and identified in **Section 3.11.7.2** would minimize potential vibration impacts by reducing vibratory impacts caused by steel wheels rolling over steel rails at rail joints during the passby of LRT vehicles at sensitive receptors and by reducing the width of gaps at joints when steel wheels roll over steel rails at rail joints. Implementation of MM NOI-12 and MM NOI-13 would reduce operational vibration impacts on institutional receptors to less than significant.

Design Option

Atlantic/Pomona Station Option

The Atlantic/Pomona Station Option guideway alignment is located east of Atlantic Boulevard and connects with the base Alternative 3 alignment just north of the proposed Atlantic/Whittier station. Because of the variation in the alignment, the location of potential vibration impacts are different than that of the base Alternative 3. Like the base Alternative 3, corridor-wide vibration levels are predicted to exceed the FTA frequent criterion of 72 VdB at 54 residences. These impacts are due to the proximity of residences to proposed switches and proximity to the tunnel section of the alignment. Also like the base Alternative 3, Alternative 3 with the Atlantic/Pomona Station Option would result in one predicted vibration impact at an FTA Category 3 receptor, Kipp Raices Academy school close to the alignment at 668 S Atlantic Boulevard. However, unlike the base Alternative 3, Alternative 3 with the Atlantic/ Pomona Station Option would result in potential vibration impacts to fewer residences near representative receptor M01 and more residences near representative receptor M02. This is due to the variation in the track alignment that would be required for the Atlantic/Pomona Station Option. The impact would be significant. The predicted corridor-wide vibration impacts are shown graphically in Attachment A in Appendix L.

As with the base Alternative 3, Alternative 3 with the Atlantic/Pomona Station Option would require implementation of MM NOI-12 and MM NOI-13 summarized in **Section 3.11.6.2.1** and identified in **Section 3.11.7**, which would reduce operational vibration impacts to less than significant.

Construction Impacts

Base Alternative and Design Options

Construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would produce vibration from the same types of construction activities as Alternative 1 and use the same types of equipment for those activities. As with Alternative 1, use of construction related equipment and heavy-machinery such as TBMs, bulldozers, dump trucks, vibratory rollers, pile drivers, and machinery to remove excavation spoils from the TBM could result in vibration damage to structures and annoyance to residences and other FTA Category 2 land uses. As with Alternative 1, the distances at which an exceedance of the FTA vibration infrequent annoyance criterion of 80 VdB for residences and other FTA Category 2 land uses would occur range from 40 feet for trucks to 50 feet for bulldozers to 70 feet for vibratory rollers. The distances at which an exceedance of the FTA vibration damage criterion of 0.2 ips would occur (for typical timber and masonry residences) range from 15 feet for trucks to 20 feet for bulldozers to 35 feet for vibratory rollers, which is a much closer distance than the FTA vibration infrequent annoyance criterion. As a result of these preliminary construction vibration estimates, construction activities are predicted to exceed the FTA impact criteria at the closest residences and commercial properties.

Compliance with PM NOI-2 identified in **Section 3.11.7.1** requiring construction activities would be carried out in compliance with Metro's baseline specifications Section 015619, Construction Noise and Vibration Control would reduce impacts. Additional mitigation measures summarized in the construction evaluation in **Section 3.11.6.2.1** and identified in **Section 3.11.7.2** would be required to further reduce impacts. MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI-8, MM NOI-9, MM NOI-14, and MM NOI-15 would reduce vibration effects through means such as requiring use of equipment that produces less vibration, maximizing the distance between vibration generating activities and sensitive receptors to the degree feasible, establishing a Noise and Vibration Complaint Hotline to resolve vibration issues, surveying properties to determine the baseline structural integrity and condition, and developing a construction vibration control plan and monitoring plan. Implementation of MM NOI-2, MM NOI-4, MM NOI-5, MM NOI-7, MM NOI-8, MM NOI-9, MM NOI-14, and MM NOI-15 would reduce construction vibration impacts from the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option to less than significant.

3.11.6.2.4 Maintenance and Storage Facilities

Operational Impacts

MSF Site Options and Design Option

The Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would accommodate daily maintenance, inspection and repairs, and storage of the LRT vehicles. Unlike noise, which is assessed using cumulative noise levels over a 24-hour period, transit vibration impacts are assessed based on individual events, such as when a train passes by.

A potential source of vibration during operations would include LRT vehicle passbys along special trackwork such as switches at the MSFs. However, since the MSF site options are located in a predominantly industrial area, there are no vibration-sensitive receptors (such as residences, schools, churches, or parks) identified within the FTA screening distance of 150 feet. Therefore, vibration generated from slow-moving LRT vehicles over switches and other activities at the Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would not exceed the FTA vibration impact criteria at any of the closest receptors and a less than significant vibration impact would occur.

Construction Impacts

MSF Site Options and Design Option

The construction of the Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would involve similar work to installation of the alignment and construction of stations. Since the MSF site options are located in a predominantly industrial area, there are no adjacent vibration-sensitive receptors, and a less than significant vibration would occur.

3.11.7 Project Measures and Mitigation Measures

3.11.7.1 Project Measures

The following project measures are design features, best management practices, or other measures required by law and/or permit approvals. These measures are components of the Project and are applicable to all Build Alternatives, design options, and MSF site options and MSF design option.

Operational Project Measures include:

PM NOI-1: Operational (post-Project) design standards for the Build Alternative may include but are not limited to:

- Design efforts per Metro Rail Design Criteria (MRDC) to reduce operational noise of the TPSSs which would mandate the location of traction power substations (TPSS) to be 45 dBA at 50 feet or at the setback line of the nearest building or occupied area, whichever is closer (Metro 2018).

Construction Project Measures shall include:

PM NOI-2: Construction activities shall comply with Metro's baseline specifications Section 015619, Construction Noise and Vibration Control. Although Metro, as a state-chartered transportation agency, is exempt from local noise ordinances, the agency is committed to consistency with local construction noise limits whenever feasible and reasonable in accordance with its own construction specifications. Metro's contractor shall utilize control measures from Metro's specifications that effectively minimize noise and vibration impacts in the community. Some mitigation measures shown in **Section 3.11.7.2** are based on the provisions set forth in Section 015619 and are refined to have more specificity towards the Project-related impacts concerning noise and vibration. Under PM NOI-2, the Project shall comply with the entirety of Metro's baseline specifications Section 015619 and Metro's contractor would utilize control measures from its own specifications that effectively minimize noise and vibration impacts in the community, such as:

- Conducting construction activities during the daytime whenever practicable.
- Requiring special permits for construction within a specified distance and a specified time period for residential zones during the nighttime and weekends.
- Using construction equipment with effective noise-suppression devices whenever feasible.
- Using noise control measures, such as enclosures and noise barriers, as necessary to protect the public and achieve compliance with Metro's noise limits.
- Conducting all operations in a manner that will minimize, to the greatest extent practicable, disturbance to the public in areas adjacent to the construction activities and to occupants of nearby buildings.

3.11.7.2 Mitigation Measures

As identified in **Section 3.11.6**, the Build Alternatives and Build Alternatives with the design option(s), and the MSF site options would have significant impacts on construction noise and operational and construction vibration under Impact NOI-1 (Ambient Noise) and Impact NOI-2 (Ground-Borne Vibration). Mitigation measures to reduce the impacts are presented herein MM NOI-1 through MM NOI-15 would apply to all Build Alternatives and Build Alternatives with the design option(s) and MSF site option(s).

Following the mitigation measure, **Table 3.11-24** identifies the applicable mitigation measure and the combined impact after mitigation of the base alternatives with the associated MSF site option(s), and the alternatives with one or both design options (as applicable) with the associated MSF site option(s).

MM NOI-1: Metro shall require the Contractor to develop a construction noise control plan and a construction noise monitoring plan to minimize noise impacts. The construction noise plan shall include construction noise performance criteria. The performance criteria may not exceed the FTA general assessment construction noise criteria of 80 dBA for nighttime work and 90 dBA for daytime work at residential properties or 100 dBA at commercial or industrial properties for daytime or nighttime work, as measured at the boundary of any occupied property where the noise is being received.

MM NOI-2: Metro shall require the Contractor to use construction methods that avoid pile-driving at locations containing noise- and vibration-sensitive receptors, such as residences, schools, and hospitals where practicable. Metro's Contractor shall use cast-in-drilled-hole (CIDH) or drilled piles rather than impact pile drivers to reduce excessive noise, except where CIDH or drilled piles are impracticable.

MM NOI-3: Metro shall require the Contractor to erect temporary noise barriers between noisy activities and noise sensitive receptors to ensure compliance with applicable noise limits.

MM NOI-4: Metro shall require the Contractor to locate construction equipment and material staging areas away from sensitive receptors where practicable.

MM NOI-5: Metro shall require the Contractor to route construction traffic and haul routes along roads in areas without receptors sensitive to noise and vibration, where practicable.

MM NOI-6: Metro shall require contractors to use best available control technologies to limit excessive noise when working near residences (e.g., piling noise shrouds) where practicable.

MM NOI-7: Metro shall require the Contractor wherever practicable, to conduct construction activities during the daytime and during weekdays in residential areas.

MM NOI-8: Metro shall notify the public of construction operations and schedules. Metro shall provide a construction-alert publication and set up a Noise and Vibration Complaint Hotline that shall reply to complaints within 2 working days.

MM NOI-9: Metro shall require the Contractor to use a muck removal conveyor for the TBM unless otherwise impracticable. If a temporary tunnel track is installed it shall have smooth rail and wheels, and car speeds shall be limited to limit structure-borne noise and vibration.

MM NOI-10: Metro shall require the Contractor to store muck on site overnight where feasible and remove by truck through the day where the haul route traverses residential areas at night.

MM NOI-11: Metro shall require temporary and permanent tunnel vent fans to be located away from residences. Metro shall require that noise from these shall be attenuated to comply with the noise control plan and local code requirements for fixed stationary heating, ventilation, and air conditioning (HVAC) or other machinery noise.

MM NOI-12: Within the tunnel, Metro shall reduce operational vibration impacts through use of track support systems which incorporate resilience, such as ballast mats, high resilience track fasteners, resiliently supported ties or floating track slabs.

MM NOI-13: Metro shall reduce vibration impacts due to gaps at switches by installing ballast mats under conventional switches to "decouple" the train vibration from the track supporting structure or using a "gapless" spring frog or other low vibration switches for the entire alignment.

MM NOI-14: Metro shall conduct a survey of selected properties within 100 feet of the alignment to determine the baseline structural integrity and condition of walls and joints. These surveys shall include the installation of strain gauges or a photographic documentation of the interior walls and/or exterior façade as a basis for comparison after construction is completed.

MM NOI-15: Metro shall require the Contractor to develop a construction vibration control plan and a construction vibration monitoring plan to minimize vibration impact and reduce the risk of damage to susceptible structures. The construction vibration control plan shall specify implementation of vibration control measures to ensure that vibration during construction activities shall not exceed ppv 0.2 ips at any non-engineered timber and masonry building.

3.11.8 Significance After Mitigation

As identified in **Table 3.11-24**, with implementation of MM NOI-1 through MM NOI-15 for Impact NOI-1 and Impact NOI-2, **all impacts would be reduced to less than significant for all Build Alternatives and design options and MSF site option(s)**.

Table 3.11-24. Summary of Mitigation Measures and Impacts After Mitigation

CEQA Impact Topic		Alternative 1: Washington Boulevard								Alternative 2: Commerce/Citadel IOS		Alternative 3: Washington/Greenwood IOS							
		Base Alternative 1[1]		Alternative 1 + Atlantic/Pomona Station Option		Alternative 1 + Montebello At-Grade Option		Alternative 1 + Atlantic/Pomona Station Option + Montebello At-Grade Option		Base Alternative 2[2]	Alternative 2 + Atlantic/Pomona Station Option	Base Alternative 3[3]		Alternative 3 + Atlantic/Pomona Station Option		Alternative 3 + Montebello At-Grade Option		Alternative 3 + Atlantic/Pomona Station Option + Montebello At-Grade Option	
		Commerce MSF	Montebello MSF	Commerce MSF	Montebello MSF	Commerce MSF	Montebello MSF At-Grade Option	Commerce MSF	Montebello MSF At-Grade Option	Commerce MSF		Commerce MSF	Montebello MSF	Commerce MSF	Montebello MSF	Commerce MSF	Montebello MSF At-Grade Option	Commerce MSF	Montebello MSF At-Grade Option
NOI-1 Ambient Noise	Applicable Mitigation	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11	MM NOI-1 MM NOI-2 MM NOI-3 MM NOI-4 MM NOI-5 MM NOI-6 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-10 MM NOI-11
	Impacts After Mitigation	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
NOI-2 Ground Borne Vibration	Applicable Mitigation	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15	MM NOI-2 MM NOI-4 MM NOI-5 MM NOI-7 MM NOI-8 MM NOI-9 MM NOI-12 MM NOI-13 MM NOI-14 MM NOI-15
	Impacts After Mitigation	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS

Source: CDM Smith/AECOM JV, 2022.
Notes:
The Base Alternatives are shaded in light yellow. Design options are not shaded.
1 The Base Alternative 1 includes the Atlantic station (reconfigured/relocated) and aerial Greenwood station.
2 The Base Alternative 2 includes the Atlantic station (reconfigured/relocated).
3 The Base Alternative 3 includes the Atlantic station (reconfigured/relocated) and aerial Greenwood station.
Key:
NI = No Impact LTS = Less Than Significant SU = Significant and Unavoidable

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