SECTION 6-4-6
NOISE

In an environmental context, noise is generally defined as unwanted sound. The level of noise perceived at a receiver depends on numerous variables, including the noise level at the source, the distance from the noise source to the receiver, barriers present that may attenuate or block the noise reaching the receiver, and the sensitivity of the receiver.

The following three physical characteristics of noise have been identified as being important to the determination of noise acceptance: (1) intensity; (2) frequency; and (3) the time-varying nature of the noise.

Intensity is a measure of the magnitude or energy of the sound and is directly related to the sound pressure level. Sound pressure levels are expressed in terms of a logarithmic scale, with units called decibels (dB) that correspond to the way that the human ear senses noise. As the intensity of a noise increases, it is judged to be more annoying or less acceptable.

Frequency is a measure of the total qualities of sound. People are most sensitive to sounds in the middle to high frequencies; therefore, higher frequencies cause more annoyance. This sensitivity has led to the use of the A-weighted sound level, which provides a single number measure that weights different frequencies on a spectrum in a manner similar to the sensitivity of the human ear. Thus, the A-weighted sound level in decibels (dB(A)) provides a simple measure of intensity and frequency that correlates well with human hearing. Common noise levels are shown in **Table 6-4-6-1**.

Environmental noise is rarely constant with time. It is necessary to use a method of measure that will account for the time-varying nature of noise. The equivalent sound pressure level (L_{eq}) is defined as the continuous steady sound level that would have the same total A-weighted sound energy as the real fluctuating sound measured over the same period of time. L_{eq} is typically used for highway noise analysis. This unit of measure, therefore, has been used in the traffic and construction noise analyses performed for this Project.

6-4-6.1 TRAFFIC NOISE ANALYSIS FRAMEWORK

The I-81 Viaduct Project is a Federal-aid highway project and is defined as a Type I noise project under the criteria identified by 23 CFR 772 (Procedures for Abatement of Highway Traffic Noise and Construction Noise). Therefore, a quantitative traffic noise analysis was prepared. The traffic noise measurement and modeling methodology followed the NYSDOT TEM, Section 4.4.18, "Noise Analysis Policy and Procedures" (or "NYSDOT Noise Policy"). A quantitative traffic noise analysis was performed on the following scenarios:

- Field Measurement Conditions (2016) (for model validation)
- Existing Conditions (2013);
- No Build Alternative (year 2050);
- Viaduct Alternative (year 2050); and
- Community Grid Alternative (year 2050).

Table 6-4-6-1
Common Noise Levels

Sound Source	(dB(A))
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80–90
Busy city street, loud shout	80
Busy traffic intersection	70–80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50–60
Background noise in an office	50
Suburban areas with medium-density transportation	40–50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Note: A 10 dB(A) increase in level appears to double the loudness, and a 10 dB(A) decrease halves the apparent loudness.

Sources:

Cowan, James P. Handbook of Environmental Acoustics, Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

Field noise measurements were collected following the NYSDOT's "Field Measurement of Existing Noise Levels" manual. The FHWA Traffic Noise Model (TNM) 2.5 was used to perform the traffic noise analyses. The study area for the noise analysis is shown on the Traffic Field Noise Receiver Locations figure in Attachment A of **Appendix H**. The noise study area includes the limits of construction and streets that are likely to be associated with the proposed changes in traffic patterns. Based on guidance provided in FHWA's "Highway Traffic Noise: Analysis and Abatement Guidance," the noise study area was defined as 500 feet from involved highways and 200 feet from involved local roadways.

Twenty-one (21) short-term field noise measurements were performed within the noise study area, and the approximate locations of each are shown on the Traffic Field Noise Receiver Locations figure in Attachment A of **Appendix H**. Of the 21 receivers, six receivers were also used as locations for 24-hour measurements. Descriptions of each identified field noise measurement receiver site are provided in the Field Noise and Validation Model Results table in Attachment B of **Appendix H**.

FHWA has defined Activity Categories for assigning land uses to potentially affected areas. FHWA has also identified Noise Abatement Criteria (NAC) for the Activity Categories per 23 CFR 772. The Activity Categories and associated NACs are presented in **Table 6-4-6-2**. The potentially affected areas within the study area were first identified and categorized by FHWA Land Use Activity Category

Table 6-4-6-2
FHWA Noise Abatement Criteria and Activity Categories

Activity Category[1]	Interior or Exterior	L_{eq} (h) (dB(A))[2]	Activity Description
A	Exterior	57	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	Exterior	67	Residential
C[3]	Exterior	67	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	Interior	52	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	Exterior	72	Hotels, motels, offices, restaurants/bars and other developed lands, properties or activities not included in A-D or F.
F	---	---	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	---	---	Undeveloped lands that are not permitted.

Notes:
1. Activity Criteria are for impact determination only and are not design standards for noise abatement measures.
2. L_{eq} (h) means hourly equivalent sound pressure level, in dB(A).
3. Includes undeveloped lands permitted for this Activity Category.
Source: FHWA Noise Abatement Criteria and Activity Categories per 23 CFR 772.

(**Table-6-4-6-2**). Noise "receiver" points were then chosen as measurement locations within the identified noise receptor sites. A noise "receptor" is defined as a discrete or representative location of a noise sensitive area(s) for any of the Activity Categories listed in **Table 6-4-6-2**. A noise "receiver" is defined as a point where highway traffic noise levels are measured and/or modeled. An individual noise receiver may represent multiple receptors. Receivers were placed in exterior areas of frequent human use and the number of receptors per receiver was assigned based on the requirements of the NYSDOT Noise Policy. Assignment of receptors per receiver assumed the following:

- Each single family residence was counted as one receptor.
- Each residence in an impacted multifamily dwelling was counted as one receptor.
- For impacted hotels and motels that primarily provide long-term accommodations (i.e., one month or more per stay), each suite/unit was counted as one receptor.
- For parks, cemeteries, or other open lands in Activity Category C, the receptor assignment was based on the average lot size for the area. The procedure is as follows: Based on the local municipal zoning ordinance(s), determine the average minimum lot size for residential zoning districts near the project area. If a facility has more than one impacted exterior area of frequent human use, add the amounts of impacted land area together. Divide the total impacted land area by the average residential lot size to calculate an equivalent number of residential receptors. Round the number of receptors up to a whole number to obtain the number of impacted receptors within the facility.

As per NYSDOT Noise Policy, traffic noise impacts occur when:

- The predicted future traffic noise levels approach within 1 dB(A) or exceed the NAC; or
- The predicted future traffic noise levels substantially (by 6 dB(A) or more) exceed the existing levels.

Six locations were chosen, and 24-hour noise measurements were recorded at each location. The six locations were chosen based on geographic coverage and in consideration of Activity Categories along the corridor. The 24-hour noise measurements were used to identify the noisiest hours of the day/night (i.e., peak noise hours) within the project corridor. The results of the 24-hour measurements showed that the overall average peak noise hour for the Project is 7:30 AM to 8:30 AM. The peak noise hour identified through the 24-hour measurements was then used as the time of day for modeling of existing and proposed build year traffic noise. The 24-hour field noise measurements were collected from April 20 through May 5, 2016 under the following conditions:

- Typical traffic conditions: mid-week (i.e., Tuesday, Wednesday, or Thursday), during a non-holiday week, with schools in session;
- Temperature within the range of 31°F to 68°F;
- Wind speed generally less than 12 mph;
- Relative humidity between 5 and 90 percent;
- No precipitation; and
- Dry pavement.

One short-term (15 to 25 minutes) field noise measurement was collected at 21 field measurement receiver locations. The short-term field noise measurements were then used to validate the ability of the noise models to predict noise levels. The short-term field noise measurement locations were chosen to provide geographic coverage of the noise study area to be modeled. Short-term field noise measurements were collected from May 10, 2016 through May 12, 2016 under the following conditions:

- Typical traffic conditions: mid-week (i.e., Tuesday, Wednesday, or Thursday), during a non-holiday week, with schools in session;
- At least three, five-minute readings with last two readings stable;
- Within free flow conditions and speeds and volumes not substantially different from the noisiest traffic hour;
- Temperature within the range of 47°F to 86°F;
- Wind speed less than 11 mph;
- Relative humidity between 24 and 56 percent;
- No precipitation; and
- Dry pavement.

Traffic counts, speed observations, and vehicle classification categories consistent with the traffic analysis data were also recorded during the short-term field noise measurements. Noise levels measured by the sound level meter were recorded in units of equivalent noise level (L_{eq}).

For the validation modeling, noise models (reflecting site-specific conditions, geometry, traffic volumes, vehicle distributions, and speeds observed during the field noise measurements) were developed for each field measurement receiver site. The calculated noise levels from the validation modeling were compared with the field measured noise levels measured in the field. At all sites, the Project's TNM validation model results agreed with the field measured noise levels (differing by no more than 3 dB(A)), as shown in the Field Noise and Validation Model Results table in Attachment B of **Appendix H**. This result indicates that the Project's TNM models developed for the Project are validated and may be used for the prediction of noise levels.

The traffic noise analysis for the Project was conducted before the Project's ETC was changed to 2026, and therefore, the noise analysis year was 2050 rather than 2056. Changes to the traffic data between years 2050 and 2056 would not be substantial enough to result in a change to the overall noise analysis conclusions. Furthermore, noise analyses are typically conducted for ETC+20 or ETC+30; for this Project, year 2050 represents ETC+24, which falls within the acceptable range of noise analysis years. The year chosen for the existing noise level comparison was 2013 since traffic volumes were readily available for that year, and the changes in traffic volumes between 2013 and 2021 are not substantial.

Traffic volumes, speeds, and classifications for the existing and future peak noise hour were obtained from the SMTC travel demand model under the project's traffic modeling effort (see **Chapter 5, Transportation and Engineering Considerations** for further information on the traffic data). Vehicle classifications were estimated by roadway functional class.

Ground level elevations and structure elevations (e.g., bridges, buildings, walls) used within the noise models were obtained from CADD survey data when available; otherwise, elevations were estimated from United States Geological Survey (USGS) maps. Existing noise barriers within the corridor were included in the TNM modeling.

Receivers were identified at 2,817 locations representing 4,563 receptors. The added "model-only" receiver locations were based on locations within the noise study area that were considered sensitive to traffic noise and were within exterior areas of frequent human use. "Model-only" receivers were not field measured but were added to the noise models to allow for the assessment of receivers within the study area on an individual basis.

A review of local planning documents to identify proposed construction projects in the Project Area was performed as part of the existing conditions analysis for the EIS (see **Section 6-2-1, Neighborhood Character**). As a result, undeveloped lands for which a sensitive noise receiver is proposed and a building permit is granted are considered in this noise study.

It should be noted that following the publication of the preliminary DDR/DEIS in April 2019, design modifications were made to the Community Grid Alternative which required that the overall noise study area be increased. Therefore, after all noise models were initially completed, applicable areas of the noise models were revised and rerun to capture notable design changes. The results of the revised noise analyses for the current design are reflected in the results below.

6-4-6.2 AFFECTED ENVIRONMENT

6-4-6.2.1 EXISTING CONDITIONS

Various urban and rural land uses were researched to identify NAC categories that exist and would be appropriate for analysis within the noise study area. In addition to the identification of existing land uses, undeveloped lands adjacent to highways within the study area that have been granted a building permit were treated as developed when selecting receivers for the noise analysis. The noise analysis of the 2013 existing conditions identified 580 receivers, representing 1,013 receptors, at a noise level that approaches within 1 dB(A) or exceeds the NAC. Unless natural or manmade barriers are present, existing noise levels that approach or exceed the NAC have been predicted for almost all receivers within approximately 300 feet from I-81, I-481, and I-690. Existing noise levels that approach or exceed NACs have also been predicted adjacent to some of the larger roadways throughout Downtown Syracuse, such as North Clinton Street, North Salina Street, East Adams Street, West Street, and Irving Avenue.

The Noise Impact Summary - Model Results Table in Attachment C of **Appendix H** includes the noise levels for the existing receivers and their associated land use categories. A graphic representation of predicted noise results is presented on Existing 2013 - Noise Results Figures 1 through 12 in Attachment D of **Appendix H**, while the existing conditions plan views used in the model are depicted in Attachment N of **Appendix H**.

Noise ordinances defining acceptable noise levels are in place for many municipalities within the Project Area. Traffic noise is not typically governed by local noise ordinances; however, construction noise is restricted by noise ordinances at night and on some weekend days in various municipalities throughout the Project Area. Some municipalities within the Project Area also limit noise by decibel level. Noise ordinance construction restrictions for municipalities within the Project Area are presented in **Table 6-4-6-3**. The Project would comply with appropriate noise ordinances throughout the Project Area to the extent practicable; however, NYSDOT is exempt from local noise ordinances.

Table 6-4-6-3
Key Noise Ordinance Construction Restrictions

Municipality	Noise Ordinance Excerpt
Town of Cicero	Any construction activity before 7 am or after 8 pm on weekdays and before 8 am or after 8 pm on Saturday, or during anytime on Sunday is prohibited.
Town of Clay	Any construction activity before 7 am or after 7 pm on weekdays and before 8 am or after 5 pm on Saturday, or during anytime on Sunday is prohibited.
Town of DeWitt	Any construction activity before 7 am or after 7:30 pm during any day of the week (including Sunday) is prohibited. Noise levels that exceed 70 dB(A) between the hours of 7 am and 10 pm, or 50 dB(A) between 10 pm and 7 am, from any source of sound are prohibited.
Village of East Syracuse	Any construction activity before 7 am or after 10 pm on weekdays, or anytime on Sunday or holidays, is prohibited. Noise levels that exceed 65 dB(A) during the day (7 am-10 pm) or 50 dB(A) at night (10 pm-7 am) in residential areas is prohibited. Noise levels that exceed 65 dB(A) on Main Street or in general commercial areas are prohibited. Noise levels that exceed 75 dB(A) in industrial areas are prohibited.
Village of North Syracuse	Any construction activity before 7 am or after 10 pm on weekdays or anytime on Sunday or a holiday is prohibited.

Table 6-4-6-3 (cont'd)
Key Noise Ordinance Construction Restrictions

Municipality	Noise Ordinance Excerpt
Town of Onondaga	Any construction activity before 8 am or after 7 pm on any day of the week is prohibited. Construction noise levels that exceed 70 dB(A) during the day or 50 dB(A) at night are prohibited.
Town of Salina	Any construction activity before 7 am or after 9 pm during any day of the week is prohibited.
City of Syracuse	Any construction activity between the hours of 9 pm to 7 am Monday to Saturday and anytime on Sunday or holidays is prohibited.

Sources:
"Noise Control Law of the Town of Cicero" http://ecode360.com/12298675
"Noise Ordinance of the Town of Clay" http://www.ecode360.com/7206066
"Noise Control Law of the Town of DeWitt" http://ecode360.com/6813934
"Village of East Syracuse: Part 66 Noise Abatement" received by Village Office
"Village of North Syracuse, NY" http://ecode360.com/10880663
Town of Onondaga Noise Ordinance received by Town of Onondaga Code Enforcement
"Noise Control Code of the Town of Salina" http://ecode360.com/11092043
"Syracuse Noise Control Ordinance" https://www.municode.com/library/ny/syracuse/codes/code_of_ordinances?nodeId=REGEOR_CH40NOCOOR

6-4-6.3 NO BUILD ALTERNATIVE

Under the No Build Alternative, the existing roadways would remain with ongoing maintenance and repairs (see **Section 3.4.1** for more information about the No Build Alternative). No new roadways or associated supporting infrastructure related to this project would be constructed, and changes in future traffic noise levels on the corridor would be associated with normal changes in traffic or other projects unrelated to the I-81 Viaduct Project (i.e., those that would occur without the Project).

No Build conditions were modeled for the year 2050 and compared with the predicted noise levels under the Viaduct and Community Grid Alternatives in 2050. This analysis was conducted for informational purposes and not for the determination of impacts.

The results of the No Build analysis are presented within Attachment C of **Appendix H**. A graphic representation of predicted noise results is presented on 2050 No Build Alternative - Noise Results Figures 1 through 12 in Attachment E of **Appendix H**, while the 2050 No Build Alternative plan views utilized in the model are depicted in Attachment O of **Appendix H**.

6-4-6.4 ENVIRONMENTAL CONSEQUENCES OF THE VIADUCT ALTERNATIVE

6-4-6.4.1 PERMANENT/OPERATIONAL EFFECTS

Under the Viaduct Alternative for design year 2050, noise impacts were predicted at 675 (1,196 receptors) of the 2,817 receivers. Of the impacted receivers, 11 receivers, representing 25 receptors, are predicted to have noise levels that substantially (by 6 dB(A) or more) exceed the existing noise levels. For the 11 locations predicted to have a substantial increase in noise levels (by 6 dB(A) or more), six are at residential land uses, three are at outdoor seating areas throughout the downtown area of the City, one is at the Johnson Vocational Center (573 East Genesee Street, Syracuse, NY 13202), and one is at the Upstate University Hospital (750 East Adams Street, Syracuse, NY 13210).

A graphic representation of predicted noise results is presented on 2050 Viaduct Alternative - Noise Results Figures 1 through 12 in Attachment F of **Appendix H**, while the 2050 Viaduct Alternative plan views utilized in the model are depicted in Attachment P of **Appendix H**.

The highest L_{eq} noise level was 78 dB(A), and the lowest L_{eq} noise level was 43 dB(A) (see the Noise Impact Summary - Models Results table in Attachment C of **Appendix H**). As with the existing conditions, the highest noise levels were identified at the receivers located closest to I-81, I-690, and I-481 and the lower noise levels were identified in the suburban areas and behind large buildings or other structures. The modeling predicted 95 additional receivers, representing 183 receptors with noise levels above the NAC when compared to 2013 existing conditions (without the implementation of noise abatement measures).

In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is generally imperceptible to the human ear; therefore, a comparison was made to determine the number of receivers with changes of more than 3 dB(A) as compared to existing conditions and the No Build Alternative conditions. Noise level impacts are summarized in **Table 6-4-6-4** by Activity Category, and perceptible noise level increases are summarized in **Table 6-4-6-5** by Activity Category.

- Compared to the No Build Alternative conditions: Under the Viaduct Alternative, it is anticipated that traffic noise level increases would be perceptible at 32 receivers, representing 60 receptors, and decreases in traffic noise would be perceptible at 13 receivers, representing 21 receptors. Of the 675 impacted receivers, 27 receivers, representing 47 receptors, would have a perceptible increase in traffic noise levels at a noise-impacted location without noise abatement. The majority of receivers with a perceptible noise level increase are located within the Central Study Area where there would be changes to the physical width or location of the viaduct.
- Compared to the existing conditions: Under the Viaduct Alternative, it is anticipated that traffic noise level increases would be perceptible at 38 receivers, representing 94 receptors, and decreases in traffic noise would be perceptible at 10 receivers, representing 11 receptors. Of the 675 impacted receivers, 31 receivers, representing 71 receptors, would have a perceptible increase in traffic noise levels at a noise-impacted location without noise abatement. The majority of receivers with a perceptible noise level increase are located within the Central Study Area where there would be changes to the physical width or location of the viaduct.

Table 6-4-6-4
Receptors with Noise Levels Approaching/Exceeding the Noise Abatement Criteria

Activity Category	Existing (2013) NAC Exceedances*	2050 Viaduct Alternative Impacts
A	None	None
B – Residential	771	897
C – Cemetery	46	46
C – School/Daycare	12	31
C – Parks, Picnic, Sports, Trails, and Recreation Areas	152	184
C – Medical Facilities	26	30
C – Places of Worship	4	6
C - Memorials	2	2
TOTALS	1013	1196

Note: *Existing data are based on noise levels approaching or exceeding the NAC for the year 2013.

Table 6-4-6-5
Receptors with Perceptible Noise Level Increases (i.e., >3 dBA) by Activity Category

Activity Category	From Existing (2013) to 2050 Viaduct Alternative*	From 2050 No Build Alternative to 2050 Viaduct Alternative *
A	None	None
B – Residential	70	38
C – Cemetery	0	0
C – School/Daycare	1	1
C – Parks, Picnic, Sports, Trails, and Recreation Areas	20	21
C – Medical Facilities	2	0
C – Places of Worship	1	0
C – Memorials	0	0
TOTALS	94	60

Note: *Noise level increases are in relation to existing and No Build Alternative noise analysis results.

6-4-6.4.2 CONSTRUCTION EFFECTS

Construction Noise

Construction noise differs from traffic noise in the following ways:

- Construction noise lasts only for the duration of the construction contract;
- Construction activities are generally short term;
- Construction activities are usually limited to the daylight hours when most human activity takes place; and
- Construction noise is intermittent and depends on the type of operation.

Construction of the Project would include demolition, excavation, sub-base preparation, roadway/bridge construction, and other miscellaneous work. This work would result in temporary construction noise at nearby receivers. The levels of noise would vary widely, depending on the construction activities undertaken and the anticipated duration of the construction. The parameters that determine the nature and magnitude of construction noise include the type, age, and condition of construction equipment; operation cycles; the number of pieces of construction equipment operating simultaneously; the distance between the construction activities and receivers; and the location of haul routes with respect to receivers. Many of these parameters would not be fully defined until final design plans and specifications have been prepared; however, representative construction scenarios based on typical construction procedures have been identified for the Project and were used to assess effects.

To evaluate potential noise levels as a result of construction of the Viaduct Alternative, the Roadway Construction Noise Model (RCNM), developed by the FHWA, was employed. The proposed construction equipment and baseline noise levels for the selected receivers close to the construction area were entered into the RCNM, along with the approximate distance from the center of the construction area to the receivers. The construction noise analysis was performed to predict noise levels due to construction of the Viaduct Alternative at the following representative five sites for the Project Area:

- Site A: I-81 Northern Segment: a location along Basin Street that is representative of the residential houses in this area;
- Site B: West Street Interchange: the front yard of a residence that is representative of the church and residential houses in this area;
- Site C: I-81/I-690 Interchange (Location 1 of 2): the side yard of an apartment building that is representative of the residential land use in this area;
- Site D: I-81/I-690 Interchange (Location 2 of 2): a location within Forman Park that is representative of this area; and
- Site E: Almond Street Viaduct Area: a location within the Pioneer Homes development that is representative of this area.

The sites are shown on the Construction Noise Receiver Locations figure in Attachment A of **Appendix H**.

The simultaneous use of construction equipment during the proposed seven-year construction schedule would generate an elevated noise level, although this approach would allow for a shorter period of construction noise. Due to the logarithmic nature of adding noise sources, noise from the simultaneous use of additional construction equipment may, in some cases, have a negligible effect on perceptible noise levels; therefore, shorter construction duration may be desirable. A 3 dB(A) increase, which is normally the smallest change in noise levels that is perceptible to the human ear, would require a doubling of the noise energy produced by the construction equipment. Even in a case where the accelerated construction schedule creates a perceptible increase in noise levels, shorter construction duration may nonetheless be desirable to affected individuals.

The construction equipment, utilization percentage, and expected maximum noise level (L_{max}) values listed in **Table 6-4-6-6** were used within the model. **Table 6-4-6-7** presents the resulting noise levels for the selected sites within the Project Area for the Viaduct Alternative. In addition, the "Construction Equipment Noise Summary" tables in Attachment R of **Appendix H** show the total number of pieces of equipment proposed for use at each site and the individual and total noise levels that they would produce per the RCNM analysis. The FHWA RCNM software bases its Leq time period on the usage factor. Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.

The FHWA RCNM results indicate that all five sites would have noise levels of $L_{eq} \geq 80$ dB(A) due to Project construction (**Table 6-4-6-7**). The use of impact-related construction equipment (impact devices) is planned in all five locations. Impact construction equipment is equipment that generates short duration (generally less than one second), high intensity, and abrupt impulsive noise. While the noise levels for impact devices is below 80 dB(A) for four of the five locations (as represented by the L_{max} values in **Table 6-4-6-7**), impact devices can be more noticeable due to the abrupt changes in noise levels. Therefore, the five sites and the areas they represent may experience adverse construction noise effects. The implementation of abatement measures (as discussed in **Section 6-4-6.3.5**) would lessen these effects.

Table 6-4-6-6
Construction Equipment for the Viaduct Alternative

Equipment Description	Impact Device (Y or N)	Acoustical Usage Factor (%)*	L_{max} at 50 feet (dB(A))
Backhoe	N	40	78
Compactor (ground)	N	20	83
Crane	N	16	81
Dozer	N	40	82
Dump Truck	N	40	76
Excavator	N	40	81
Flat Bed Truck	N	40	74
Front End Loader	N	40	79
Jackhammer	Y	20	89
Mounted Impact Hammer	Y	20	90
Pickup Truck	N	40	75
Pneumatic Tools	N	50	85
Pumps	N	50	81
Roller	N	20	80
Vibratory Concrete Mixer	N	20	80
Welder/Torch	N	40	74

Notes:
L_{max} is the maximum sound level.
Construction equipment identified above corresponds to the types of construction equipment expected to be used on this Project.
*Acoustical Usage Factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation.
Source: Acoustical usage factor percentages and L_{max} values are from FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01 (Final Report, January 2006).

Table 6-4-6-7
RCNM Calculated Construction Noise Levels for the Viaduct Alternative

Construction Receiver Site	Description	Viaduct Alternative (dB(A))
Site A	I-81 Northern Segment	L_{max}= 76; L_{eq}= 81
Site B	West Street Interchange	L_{max}= 78; L_{eq}= 84
Site C	I-81/I-690 Interchange (Location 1 of 2)	L_{max}= 77; L_{eq}= 82
Site D	I-81/I-690 Interchange (Location 2 of 2)	L_{max}= 78; L_{eq}= 83
Site E	Almond Street Viaduct Area	L_{max}= 84; L_{eq}= 88

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Source: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

Based on RCNM results, without noise abatement measures, average noise levels, maximum noise levels, and the use of impact devices would be considered disruptive to nearby receivers. Worst-case distances (i.e., the closest representative receivers) from the construction equipment to the nearest receiver were generally used for the RCNM analysis; however, realistically, given the mobile nature of road construction, the distances between the construction activities and receivers would change as the construction operations move along the roadway centerline. In addition, construction operations are in constant flux, and the equipment and operations would not always be at the worst-case levels predicted herein. Construction noise abatement measures and shielding effects are discussed in the mitigation subsection below.

A qualitative assessment of traffic noise effects related to construction detours was prepared based on the detour routes described in **Chapter 4, Construction Means and Methods**. During certain phases of construction, various segments of roads would be closed. As a result, detour routes would be in effect to accommodate traffic through the construction zone. There would be an increase in traffic on local roads during construction; however, the detour routes would generally serve the main traffic increase, and therefore, noise levels at receivers adjacent to the detour routes were assessed.

The construction detour traffic noise analysis involved a qualitative assessment of the detour routes for the Viaduct Alternative to determine if the changes in traffic volumes could result in perceptible increases in noise. In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," when traffic volumes increase by at least 100 percent, a perceptible increase in noise levels (an increase of more than 3 dB(A)) can be expected in the surrounding area. The main changes to traffic flow throughout the corridor are expected to include the outlying highways (I-81, I-481, and I-690) and the detour routes. Changes in traffic volumes that are expected for the outlying highways would be due to motorists choosing alternate routes to avoid construction zones. It is anticipated that some motorists may choose to travel on I-481 and on some portions of I-690 to avoid construction lane restrictions and detours along I-81 and I-690. Therefore, there may be a decrease in traffic along I-81 and increases in traffic along I-481 and some portions of I-690. However, given the existing high volume of vehicles along these highways, it is not anticipated that the changes in noise levels would be perceptible since traffic along the outlying highways is not expected to increase by 100 percent.

There are eight detour routes that would potentially be used during construction of the Viaduct Alternative. Therefore, block-by-block comparisons were made and the average increase in traffic for each detour route was calculated to see if 100 percent increases in traffic volumes would be expected. These comparisons are meant to be a conservative approach because construction speeds are generally lower than normal speeds and lower speeds are generally known to produce lower noise levels than higher speeds. During the comparison, each detour route was divided into blocks between intersecting streets. The receivers used for the Project's TNM analysis were used to determine which blocks would be most sensitive to noise level increases. **Table 6-4-6-8** shows the average increases in traffic for each detour route, the number of blocks affected, and the range of noise levels along each detour route. Average noise levels shown in the table are based on AM peak hour traffic from the 2013 TNM noise analysis because the traffic volumes between 2013 and 2021 would be similar.

Table 6-4-6-8
Viaduct Alternative Traffic Detour Summary

Detour Route	Average Increase in Traffic[1]	Total Number of Blocks[2]	Number of Blocks Affected[3]	Total Number of Receivers Along Full Detour Route[4]	Number of Receivers Along Affected Blocks[5]	Range of Existing Noise Levels Along Detour Route (dB(A))[6]	Perceptible Increase in Noise Level Anticipated at Noise Sensitive Receivers (Y/N)
Salina St	59%	8	1	12	0	58-70	N
Pearl St Ramps to NB I-81	89%	5	1	4	1	58-69	Y
Clinton St	90%	7	3	15	9	65-70	Y
Ramps to I-81 NB from N State St	253%	2	1	0	0	N/A	N
S State St	51%	8	0	12	0	58-67	N
E Willow St	22%	1	0	0	0	N/A	N
Townsend St	62%	6	0	14	0	53-70	N
Almond St	100%	9	4	7	4	66-69	Y

Notes:
N/A - No noise sensitive receivers were identified along the detour route; therefore, there was no average noise level calculated for the detour route.
1. The percent average along the entire detour route. Even if the average is lower than 100 percent, there can still be affected blocks along the route that are greater than 100 percent.
2. The total number of blocks that are along a detour route.
3. The total number of blocks along a detour route that had an increase in traffic greater than 100 percent.
4. The total number of receivers along the entire detour route.
5. The total number of receivers near the affected blocks along the detour route.
6. The range of noise levels (from the 2013 TNM model results) for the receivers along the entire detour route.

Of the eight detour routes, two routes had overall increases in traffic equal to or greater than 100 percent. In addition, five routes had at least one block with an increase in traffic greater than 100 percent. These effects would likely be perceptible at noise sensitive receivers during the detour periods. The following sections of the detour routes throughout Downtown Syracuse were reviewed:

- **Salina Street:** Salina Street between Harrison Street and the ramp that leads to Pearl Street has been identified as a potential detour route. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 70 dB(A). This detour route would experience a predicted 59 percent average increase in traffic; therefore, it is anticipated that this detour route would not experience a perceptible increase in noise levels. One of the eight blocks (block between East Willow Street and Herald Place) along the detour route had an increase in traffic greater than 100 percent; however, no noise sensitive receivers were identified on this block.
- **Pearl Street Ramps to Northbound I-81:** This detour route includes the intersection between Pearl Street and East Willow Street, which leads to the on-ramps to northbound I-81 from Pearl Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 69 dB(A). There was an 89 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for the majority of this detour route. One of the five blocks (representing the ramp between

North Salina Street and Pearl Street) along this detour route had an increase in traffic greater than 100 percent. One noise sensitive receiver (a parklike sitting area) was identified near this block that could have a perceptible increase in noise levels.

- **Clinton Street:** The detour route along Clinton Street is between Harrison Street and the start of the exit ramp from southbound I-81 to Clinton Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 65 to 70 dB(A). There was a 90 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for most of this detour route. Three of the seven blocks (blocks between Herald Place and West Washington Street) along this detour route had predicted increases in traffic that were greater than 100 percent. Nine noise sensitive receivers (one residence, two outdoor dining areas, two outdoor seating areas, and four parklike sitting areas) were identified near these three blocks that could have perceptible increases in noise levels.
- **Ramps to Northbound I-81 from North State Street:** This detour route includes the on-ramps to northbound I-81 from both northbound and southbound North State Street. Existing AM peak hour noise levels were not calculated along this detour route since no noise sensitive receivers were identified in this immediate area. There was a 253 percent average increase in traffic predicted along this detour route. Therefore, this detour route had an increase in traffic greater than 100 percent; however, no noise sensitive receivers were identified along this route.
- **South State Street:** The detour route along South State Street is between Harrison Street and East Willow Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 67 dB(A). There was a 51 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for this detour route. There were no blocks along this detour route that had an increase in traffic greater than 100 percent.
- **East Willow Street:** The detour route along East Willow Street is between North State Street and North Townsend Street. Existing AM peak hour noise levels were not calculated along this detour route since no noise sensitive receivers were identified in this immediate area. There was a 22 percent average increase in traffic predicted along this route; therefore, it is anticipated that there would be no perceptible increase in noise levels for this detour route. There were no blocks along this detour route that had an increase in traffic greater than 100 percent.
- **Townsend Street:** The detour route along Townsend Street is between Harrison Street and East Willow Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 53 to 70 dB(A). There was a 62 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels for this detour route. There were no blocks along this detour route that had an increase in traffic greater than 100 percent.
- **Almond Street:** The detour route along Almond Street is between East Adams Street and Burnet Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 66 to 69 dB(A). There was a 100 percent average increase in traffic predicted along this detour route; therefore, it is anticipated that there would likely be a perceptible increase in noise levels for this detour route. Four of the nine blocks (blocks between East Fayette Street and Burnet Avenue) along this detour route had predicted increases in traffic of greater than 100

percent. Four noise sensitive receivers (one residence, one school (Syracuse Center of Excellence) and two outdoor seating areas) that could have perceptible increases in noise levels were identified near these four blocks.

As described in **Chapter 4, Construction Means and Methods**, NYSDOT would require the Contractor to implement construction protocols and practices to mitigate effects for the Project. These commitments would include measures to abate construction noise.

Construction Vibration

Construction activities have the potential to produce vibration levels that may result in structural or architectural damage, annoyance, and/or interference with vibration-sensitive activities. In general, vibration levels at a location are a function of the source strength (which is dependent upon the construction equipment and methods utilized), the distance between the equipment and the location, the characteristics of the transmitting medium, and the building construction type at the location. Construction equipment operation causes ground vibrations, which spread through the ground and decrease in strength with distance. Vehicular traffic, including construction-related vehicular and equipment traffic, typically does not result in perceptible vibration levels unless there are discontinuities in the roadway surface. Construction activities typically do not reach vibration levels that can cause architectural or structural damage, although fragile structures or buildings are more prone to be affected. However, construction work can produce vibration levels that may interfere with uses in adjacent buildings that are especially sensitive to vibration, including activities (such as surgery) or the use of equipment (such as microscopes and high tolerance manufacturing equipment). Levels may be perceptible and annoying in buildings very close to a construction site.

Vibration refers to oscillatory movement in a solid object (e.g., ground, structures) and can be quantified as acceleration, velocity, or displacement. These quantities can be measured on either linear or logarithmic scales, depending on the levels to be expressed. The assessment of construction vibration for the Project quantifies vibration in terms of peak particle velocity (PPV) as inches/second, and in terms of Root Means Square (RMS) of the PPV as vibration decibels (VdB) referenced to 1 micro-inch/second. Vibration levels expressed in VdB are expressed across a spectrum of frequencies for the vibration. Frequency is the rate at which acceleration, velocity, or displacement fluctuates in a cycle over a given quantity of time and is measured in Hertz (Hz), where 1 Hz equals 1 cycle per second. Vibration levels expressed as PPV refer to the total PPV across the full frequency spectrum.

There are no FHWA or NYSDOT requirements directed specifically toward traffic-induced or construction-related vibration. However, criteria from the Federal Transit Administration's (FTA) Transit Noise and Vibration Impact Assessment Manual were used to assess construction vibration.

- **Architectural or Structural Damage from Vibration:** For purposes of assessing potential structural or architectural damage, the determination of adverse effects was based on the vibration impact criterion of a PPV of 0.50 inches per second. For non-fragile buildings, vibration levels below 0.50 inches per second would not be expected to result in any structural or architectural damage. For fragile buildings, vibration levels should be below 0.20 inches per second.
- **Human Perceptibility and Annoyance from Vibration:** The FTA's guidance manual identifies threshold vibration levels that would be perceptible to humans within buildings and likely to result in annoyance, depending on the type of use (e.g., residential, school). Since the ability to perceive

vibration is subjective, a range of possible vibration levels is identified in the FTA guidance manual, specifically between 72 and 83 VdB. For the purposes of this analysis, the lower limit of the range (72 VdB) was used as the threshold at which vibration may result in human annoyance.

- **Vibration Assessment Criteria for Sensitive Equipment or Activities:** Vibration criteria specifically provided for equipment by the equipment's manufacturer provide the most accurate threshold by which to judge the potential effects of vibration on vibration-sensitive equipment. However, acceptable vibration-level specifications were not available for all vibration-sensitive equipment potentially operating in the numerous medical buildings in proximity to the project work areas. If the availability of manufacturer-provided equipment-specific vibration criteria was absent, general criteria outlined in the FTA Noise and Vibration Impact Assessment Manual, Chapter 8, was used for the vibration assessment (see **Table 6-4-6-9**).

For purposes of assessing potential structural or architectural damage, PPV was used, while the vibration level in VdB, $L_v(D)$, was used to assess potential annoyance or interference with vibration sensitive activities.

Table 6-4-6-10 shows vibration source levels for typical construction equipment. The equipment vibration levels were projected to the various receivers near proposed work areas to determine the level of vibration for various construction activities (e.g., pile driving, rock drilling). Under the Viaduct Alternative, construction activities with the highest potential to result in architectural damage due to vibration include pile driving and potentially some limited drilling in rock. However, it should be noted that disruptive construction activities (including pile driving) will be considered during final design to identify less disruptive means of completing operations. For additional information on construction methods, see **Chapter 4, Construction Means and Methods**.

Table 6-4-6-9
Vibration Criteria for Sensitive Equipment or Activity

Facility Equipment or Use	Max L_V (VdB)[2]
Residential Day: Barely feelable vibration. Adequate for computer equipment and low-power optical microscopes (up to 20X).	78
Residential Night, Operating Rooms: Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity.	72
VC-A[1]: Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment.	66
VC-B[1]: Adequate for high-power optical microscopes (1000X), inspection, and lithography equipment to 3-micron line widths.	60
VC-C[1]: Appropriate for most lithography and inspection equipment to 1-micron detail size.	54
VC-D[1]: Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capability.	48
VC-E[1]: The most demanding criterion for extremely vibration-sensitive equipment.	42

Notes:
1. Vibration Classifications (VC) from the Institute of Environmental Sciences and Technology, "Considerations in Clean Room Design," RR-CC012.1, 1993.
2. As measured in 1/3-octave bands of frequency over the frequency range 8 to 80 Hz.
Source: FTA Transit Noise and Vibration Impact Assessment Manual, 2006.

Table 6-4-6-10
Vibration Source Levels for Construction Equipment

Equipment		PPV ref at 25 feet (in/sec)	Approximate Lv at 25 feet (VdB)
Pile Driver (impact)	Upper Range	1.518	112
	Typical	0.644	104
Clam shovel drop (slurry wall)		0.202	94
Vibratory roller		0.210	94
Ram hoe		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58
Source: Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006.			

Architectural or Structural Damage from Vibration

In terms of potential vibration levels that would result in architectural damage, construction would have the most potential for producing levels that would exceed the 0.20 inches per second PPV limit for fragile buildings at locations within a distance of approximately 55 feet from the typical operation of an impact pile driver or approximately 15 feet from the operation of a drill rig. Construction would have the most potential for producing levels that would exceed the 0.50 inches per second PPV limit at locations within a distance of approximately 30 feet from the operation of an impact pile driver or approximately eight feet from the operation of a drill rig. Distances for potential structural damage were calculated using the reference values from **Table 6-4-6-10** and the damage assessment formula in Chapter 12 of the FTA Noise and Vibration Manual.

No buildings that would be considered fragile are located within the distance from the proposed construction work areas that could result in PPV levels that would potentially result in damage to fragile structures (i.e., within 55 feet). Buildings and structures located within 55 feet, but more than 30 feet, from the proposed construction work include modern structures built with contemporary building techniques and, consequently, would not be expected to experience construction vibration at a level that could potentially cause damage. As described in **Chapter 4, Construction Means and Methods**, NYSDOT would require that the Contractor comply with the construction practices and protocols developed for the Project. These requirements would include a construction vibration monitoring program to minimize the potential for such damage.

Human Perceptibility and Annoyance from Vibration

Pile driving would have the most potential for producing perceptible and annoying vibration levels exceeding the 72 VdB limit. Based on the reference values from **Table 6-4-6-10** and the annoyance assessment formula in Chapter 12 of the FTA Noise and Vibration Manual, it is likely that receivers (human activity conducted in buildings) within a distance of approximately 290 feet of typical pile driving operations would experience perceptible and annoying vibration levels. However, pile driving would only occur for limited periods of time at a particular location. Pile driving activities would progress along the project corridor at a rate of approximately 200 feet per week. Consequently, it is expected that the maximum duration that any receiver would experience perceptible/annoying levels of vibration would be three weeks. A construction vibration monitoring program will be in place to identify vibration concerns as construction progresses through the corridor. If the construction vibration monitoring program indicates a concern, abatement methodologies would be implemented, such as alternate construction methods to reduce or eliminate the impacts. For additional information on construction methods, see **Chapter 4, Construction Means and Methods**.

Vibration Assessment Criteria for Sensitive Equipment or Activities

As described above, the operation of specific equipment and specific activities can be affected by vibration even at levels lower than is perceptible or annoying to humans. Such equipment and activities, including microscopes, nuclear magnetic resonance (NMR) imaging equipment, and various types of surgery, are used or occur within various medical facilities and campuses located near the project work areas. **Table 6-4-6-10** shows predicted vibration levels at twenty-five feet from vibration-producing construction activities (e.g., jack hammering). It is assumed that pile driving would progress along the project corridor at a rate of approximately 200 feet per week.

Due to the sensitivity of adjacent land uses, which includes SUNY Upstate Medical University, MLK Elementary School, and residential housing, NYSDOT would implement measures during construction to minimize vibration between MLK Jr. East and Harrison Street (see **Table 4-7** in **Chapter 4, Construction Means and Methods**).

As part of its communications protocol during construction (see **Chapter 4, Construction Means and Methods**), NYSDOT and its Contractor would provide as much notice of construction activities to the medical facilities as possible and would coordinate with them to resolve schedule conflicts if construction activities would impact critical surgeries or procedures.

Based on the assessment of construction vibration presented above, no other adverse effects are expected to occur as a result of construction-generated vibration associated with the Viaduct Alternative.

6-4-6.4.3 INDIRECT EFFECTS

As discussed in **Section 6-2-1, Neighborhood Character**, the Viaduct Alternative represents the continuation of an existing use, and its implementation would not impede planned development or land use plans in the Project Area. Some new development may be attracted to the Northern Neighborhoods Subarea (north of I-690) associated with the Clinton Street improvements and to the Southwest Neighborhoods Subarea (Near Westside and Downtown) associated with the removal of the West Street ramps. Both areas would experience improved access and West Street would experience increased visual connections as a result of the Viaduct Alternative. However, in the majority of the study area, the Viaduct Alternative represents the continuation of an existing use present in the No Build Alternative. In areas south of I-690, the elevated highway would continue to influence development decisions within the study area in a manner similar to the No Build Alternative.

The land parcels that could be converted from transportation to other purposes would be subject to local land use regulations. Any development in those areas is likely to be relatively small and would not induce substantial changes to existing noise levels. Therefore, the Viaduct Alternative would not result in indirect noise effects.

6-4-6.4.4 CUMULATIVE EFFECTS

The traffic data that were used in the noise modeling accounted for traffic diversions associated with the Viaduct Alternative as well as traffic associated with known or reasonably foreseeable projects. Therefore, the results of the noise analysis reflect the traffic effects of the proposed action combined with other reasonably foreseeable actions identified within the Project Area.

6-4-6.4.5 ABATEMENT

Permanent/Operational Traffic Noise Abatement

Abatement Considerations and Procedures

When noise impacts are predicted for a project, noise abatement must be considered for the impacted areas. In accordance with the NYSDOT Noise Policy, for noise abatement measures to be recommended, an abatement measure must be both feasible and reasonable. Feasibility involves the practical capability of the noise abatement measure being built, as well as the capacity to achieve a minimum reduction in noise levels. Overall, feasibility deals primarily with engineering considerations (e.g., whether a barrier can be built given the topography of the location; whether a noise reduction can be achieved given certain access control, drainage, safety, or maintenance requirements; whether there are noise sources other than from the project present in the area). When noise abatement measures are being considered, every reasonable effort should be made to obtain noise reductions of 10 or more dB(A). For a measure to be deemed feasible, it must provide a minimum 5 dB(A) reduction to the majority of impacted receivers.

Reasonableness deals with the social, economic, and environmental factors to be considered when evaluating abatement measures. Reasonableness is based on viewpoints, cost, and noise reduction, as described below.

- **Viewpoints:** The NYSDOT must solicit and consider the viewpoints of the benefited property owners and residents in determining the reasonableness of abatement measures. The NYSDOT concludes that a noise abatement measure is reasonable if 50 percent or more of the benefited property owners and residents are in favor of the measure. The absence of a viewpoint/response is considered as acceptance of the abatement measure. The threshold of noise reduction that establishes a "benefited property" is at least 5 dB(A), determined at a point where frequent human use occurs and a lowered noise level would be of benefit. Viewpoints of those property owners and residents who would benefit from abatement will be obtained prior to the release of the Final EIS for the Project.
- **Cost:** NYSDOT has established the following reasonableness cost indices for abatement measures:
  - For noise berm or noise insulation, a cost index of $80,000 per benefited receptor is used, based on the total cost of the material installed.
  - For barrier walls, a maximum of 2,000 square feet of wall per benefited receptor is used.

  All owner-occupied and rental residential units; detached, duplex, and mobile homes; and multifamily apartment units must be counted if they are benefited, regardless of whether or not they were identified as impacted.

- **Noise Reduction:** The NYSDOT Noise Policy establishes a Noise Reduction Design Goal of 7 dB(A). For an abatement measure to be determined reasonable, a majority of the benefited receivers must achieve the design goal. For example, if 10 receivers were benefited, then at least six receivers must receive a 7 dB(A) noise reduction for the abatement measure to be considered reasonable under this criterion. Note that the other criteria above must also be met for the measure to be considered reasonable for implementation.

Based on these criteria, an assessment of noise abatement measures was performed for this Project. The following abatement measures were examined and evaluated:

- Traffic management measures, such as traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations;
- Alteration of horizontal and vertical alignments;
- Construction of noise barriers;
- Acquisition of real property to serve as a buffer zone; and
- Noise insulation of publicly owned school buildings.

An evaluation of feasibility and reasonableness for each of these potential abatement measures as they relate to the Viaduct Alternative is provided below. Noise barriers as an abatement measure are discussed in more detail in a separate section following the other measures, given that noise barriers have a greater applicability for this Project.

- **Traffic Management (Prohibition of Vehicle Types and Time-Use Restrictions):** Prohibition or time restrictions of heavy vehicles along the local roadways in these areas is not considered reasonable because the Central Study Area is a mix of commercial and residential land uses where most of the heavy vehicles are delivery trucks and buses. These vehicles are essential to commerce and public transportation within the study area and cannot be re-routed. In addition, prohibition or time restrictions of heavy vehicle use along I-81, I-481, and I-690 would not be considered reasonable as they are major commerce routes for the region and provide regional access to the local roadways in Downtown.
- **Traffic Management (Modified Speed Limits):** Speed limits can theoretically be reduced throughout the Project Area; however, generally a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels to occur. Speeds on the local roadway network are generally posted with a speed limit of 25 to 30 mph, such that a reduction in posted speed limit to achieve a noticeable reduction in noise level would not be reasonable. In addition, the highways within the overall study area (I-81, I-481, and I-690) would be anticipated to have posted speed limits of 55 to 65 miles per hour. These speed limits cannot be reduced sufficiently to have a noticeable reduction in noise level due to the highways' intended purpose of moving people and goods through the area quickly and efficiently. Given the design and function of these highways, posted speeds of 35 to 45 mph would not be reasonable under the scope of this Project.
- **Traffic Management (Exclusive Lane Designations):** Within the Central Study Area, exclusive lane designations would not be effective or practical since the existing and proposed roadways are local collectors with driveway and side street access that must be maintained at all

times for neighborhood residents, as well as for school buses and delivery trucks. Exclusive lane designations on elevated highways would not be effective in terms of noise reduction since the echo and indirect nature of the noise would not allow for a substantial reduction to occur. In addition, exclusive lane designations throughout I-81, I-481, and I-690 would not be effective as a noise abatement measure since they are not wide enough to make a difference in noise levels.

- **Alteration of Horizontal Alignments:** The use of this noise abatement measure is most applicable when a new facility alignment is proposed, rather than a widening or reconstruction along an existing alignment such as proposed for this Project. A horizontal alignment shift of more than 100 feet is generally required to yield noise reductions large enough to justify implementation of horizontal alignment change as an abatement measure. Therefore, this abatement measure would not be suitable in the Central Study Area or populated areas of the corridors where there are noise sensitive land uses or other developments on both sides of the corridor (i.e., moving the alignment away from one area of receivers may move the alignment closer to another, or cause direct encroachment impacts). In suburban areas where there may be noise sensitive uses on only one side of the road, a horizontal alignment shift may not be feasible from an engineering perspective because of the geometric requirements to transition back to the existing highway at each end. There are also other socioeconomic and environmental concerns that may exist on the other side of the highway where the horizontal shift may be made. In the case of the Viaduct Alternative, 10 locations along I-81 and I-481 were identified where the road could potentially be shifted to one side as a noise abatement measure to reduce noise levels on the impacted nearby receivers, although none of these locations were identified as being feasible or reasonable due to the extenuating circumstances identified below.
  - Greenfield Parkway vicinity along the I-81 Northern Segment near Interchange 24: Although land on the east side of I-81 appears to be vacant, a portion of the vacant land that exists is wetlands.
  - Bear Trap Creek Trail vicinity along the I-81 Northern Segment north of its interchange with I-90: Although land on the west side of I-81 appears to be vacant, a horizontal shift would likely require a non-standard bend in the road.
  - Taft Road vicinity between its intersection with I-481 and Northern Boulevard: Although land on the northeast side of I-481 appears to be vacant, wetlands are present on that side of I-481.
  - Brittonfield Parkway vicinity immediately north of the I-481 interchange with I-90: Although land on the east side of I-481 appears to be vacant, wetlands are present on that side of I-481.
  - Fly Road vicinity immediately south of the I-481 interchange with Kirkville Road: Although land on the east side of I-481 appears to be vacant, this is an interchange and there are wetlands on the east side of I-481 in this area.
  - Butternut Creek Trail vicinity along I-481 between Highway 5 and Kinne Road Bridge: Although land on the northwest side of I-481 appears to be vacant, there are wetlands on the west side of I-481 in this area.
  - Andrews Road vicinity along I-481 south of its interchange with Highway 5: Although land on the east side of I-481 appears to be vacant, there are wetlands on the east side of I-481 in this area.

  - Butternut Creek Golf Course along I-481 north of the Jamesville Road Bridge: Although land on the east side of I-481 appears to be vacant, there are houses outside of the immediate noise impact area that could potentially be affected by noise increases if I-481 was moved closer to them.
  - Church on Old Stonehouse Road near I-481 between Jamesville Road Bridge and the railroad bridge to the south: Although land on the south side of I-481 appears to be vacant, there are wetlands on the south side of I-481 in this area.
  - Rock Cut Road Trailer Park on Cliffside Park Road near I-481: I-481 could not be shifted northward and away from the noise receivers in this area due to wetlands and a railroad on the north side of I-481.
- **Alteration of Vertical Alignments:** Reduction of noise levels through modification of the vertical profile of the Viaduct Alternative could result from the elimination or reduction of the line-of-sight between the vehicular noise sources (tire noise and exhaust pipes) and the receivers. Most automobiles and light trucks have exhaust pipes located at approximately one to two feet above the roadway surface, although many trucks and buses have exhaust pipes that outlet at approximately 9.8 feet above the roadway surface. Options for changes in vertical alignment include the following:
  - Raising the roadway: The roadway would have to be raised approximately eight to 10 feet to begin to noticeably reduce noise levels to adjacent receivers. However, reduction of noise levels to an extent that would justify implementation of an abatement measure would likely require a more extreme change in the vertical alignment. Within the Downtown and residential areas of the Project, engineering obstacles for raising the roadway elevation include unacceptable driveway and yard pitches and the addition of undesirable visual and aesthetic concerns. Within suburban areas, this option would not be effective because the extreme raising of the roadway that would be required for the abatement measure would not be reasonable.
  - Lowering the roadway: Depending on the elevation of the receivers and their locations with respect to the roadway, the roadway would have to be lowered approximately four to six feet to begin to reduce noise levels. However, reduction of noise levels to an extent that would justify implementation of an abatement mitigation measure would likely require a more extreme change in the vertical alignment. Potential engineering obstacles for lowering the roadway elevation include a seasonally high groundwater table, potential flooding concerns, and the likely requirement of pumping stations for stormwater drainage along the corridor. Retaining walls could also be required (due to the grade change), which could, in part, function like noise barriers, while actual noise barriers may be a better solution. Lowering the roadway could also add undesirable visual and aesthetic concerns.
- **Acquisition of Real Property to Serve as a Buffer Zone:** This abatement measure allows for acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely impacted by traffic noise. This measure is not used to purchase homes or developed property to create a noise buffer zone; it is used to purchase unimproved property to preclude future noise impacts where development has not yet occurred. This would not be effective for the receivers located in the Central Study Area

since this Project is not meant to discourage development in this area. In addition, this option would not be reasonable in the suburban areas; however, NYSDOT would conduct outreach to local officials regarding noise-compatible land use planning.

- **Noise Insulation of Publicly Owned School Buildings:** Potential noise insulation of publicly owned school buildings located off the highway right-of-way was evaluated. Per NYSDOT Noise Policy, for this measure to be recommended, the NYSDOT Commissioner must determine that it is in the best interest of the State considering, among other factors, the cost and feasibility of other alternatives. The overall Project Area was investigated to identify public schools that could be impacted by this Project. Four public schools with potential predicted exterior noise impacts related to the Viaduct Alternative were identified within the overall Project Area. Based on exterior noise levels, interior noise levels were calculated and interior noise impacts are not predicted; therefore, for the reasons stated below, none of these schools is recommended for noise insulation specifically related to the proposed Project:
  - SUNY Upstate University Hospital, which is on East Adams Street near I-81 in Downtown Syracuse, has an exterior noise level of 72 dB(A). The actual school building was only recently constructed; therefore, it is anticipated that the building was constructed to be well insulated to general hospital standards. In general, calculation of interior noise level contributions from exterior noise sources is done through the use of building noise reduction factors. Thermal insulation that is applied to buildings, such as newer hospitals, inherently offers a high level of sound dampening that greatly reduces interior noise levels. It is anticipated that the noise reduction from the current insulation of a recently constructed building such as this would likely provide 30 dB(A) or more to the sensitive areas of the building. Therefore, the roadway contribution to interior noise levels is anticipated to be 42 dB(A) or less during the peak hour. Given that the NAC noise level for a Category D interior is 52 dB(A), the interior noise levels at this building are not anticipated to be above the NAC for a Category D land use; however, an exterior substantial increase in noise was identified for this area due to an expected increase in traffic volumes on nearby roadways. While a substantial noise impact is predicted for the exterior of the building, the calculated interior peak-hour noise level of 42 dB(A), or less, is below expected interior noise levels from sources unrelated to traffic (e.g., talking or other noise); therefore, it is not anticipated that additional noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building.
  - SUNY Upstate University Hospital has another building near Fly Road called Upstate University Neurology. Based on an exterior peak hour noise level of 64 dB(A) at a comparable receiver, it is not anticipated that there would be an exterior noise impact adjacent to the Upstate University Neurology building. In general, calculation of interior noise levels from exterior noise levels is done through the use of building noise reduction factors. Given the reinforced building structure of an institutional facility such as the SUNY Upstate University Hospital, a building noise reduction factor of approximately 25-30 dB(A) would be appropriate. Therefore, the contribution from area roadways to the interior noise levels is likely approximately 39 dB(A) or less during the peak hour. Given that the NAC noise level for a Category D interior is 52 dB(A), the interior noise levels at this building are not anticipated to be above the NAC for a Category D land use; therefore, noise abatement is not warranted. Additionally, since daytime interior noise levels from sources unrelated to traffic (e.g., talking or other noise) are expected to be in this range or above, it is not anticipated that additional

noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building.

- Roxboro Road Middle School is near the I-81 Northern Segment between its interchanges with I-90 and Brewerton Road. Noise Barrier 16A&B is recommended in this area for abatement of exterior noise impacts at the school sports fields. The two modeled receivers located on the school sports fields have unabated noise levels of 66 dB(A) and 62 dB(A) and abated noise levels of 58 dB(A) and 56 dB(A), respectively. The difference in noise levels between the two receiver locations is due to one receiver being closer to I-81 than the other. The actual school building is outside the noise study area at a further distance from I-81 than either of these receivers. Therefore, deductive reasoning indicates that the actual school building is far enough from I-81 that there would not be an exterior traffic noise impact adjacent to the building. In general, calculation of interior noise levels from exterior noise levels is done through the use of building noise reduction factors. Given the reinforced building structure of an educational facility such as the Roxboro Road Middle School, a building noise reduction factor of approximately 25-30 dB(A) would be appropriate. Therefore, even without Noise Barrier 16A&B, the contribution from area roadways to the interior noise levels is likely approximately 38 dB(A) or less during the peak noise hour. Given that the NAC noise level for a Category D interior is 52 dB(A), the interior noise levels at this building are not anticipated to be above the NAC for a Category D land use; therefore, noise abatement of the building for interior spaces is not warranted. Additionally, since daytime interior noise levels from sources unrelated to traffic (e.g., talking or other noise) are expected to be in this range or above already, it is not anticipated that additional noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building. It should also be noted that the recommendation of Noise Barrier 16A&B is related to exterior noise impacts at the sports fields and independent of the interior noise considerations discussed in this paragraph. Regardless, the abatement modeling shows that Noise Barrier 16A&B would tend to reduce overall noise levels within the school grounds and by approximately 6-8 dB(A) in the vicinity of the sports fields.
- Johnson Vocational Center located at 511 East Fayette Street is a vocational school owned by the City of Syracuse. The modeled receiver adjacent to this building had a noise level of 68 dB(A) for the Viaduct Alternative. In general, calculation of interior noise levels from exterior noise levels is done through the use of building noise reduction factors. Given the reinforced building structure of an institutional facility such as the Johnson Vocational Center, a building noise reduction factor of approximately 25-30 dB(A) would be appropriate. Therefore, the contribution from area roadways to the interior noise levels is likely approximately 43 dB(A) or less during the peak-hour. Given that the NAC noise level for a Category D interior is 52 dB(A), the interior noise levels at this building are not anticipated to be above the NAC for a Category D land use; however, an exterior substantial increase in noise was also identified for this area due to the relocation of I-81 and the removal of structures between this area and I-81. While a substantial noise impact is predicted for the exterior of the building, the calculated peak-hour interior noise level of 43 dB(A), or less, is below expected interior noise levels from sources unrelated to traffic (e.g., talking or other noise); therefore, it is not anticipated that additional noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building.

- **Noise Insulation of Other Activity Category D Buildings:** Activity Category D land uses are generally the interior of structures associated with the following: auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. There are 113 receivers within the noise study area that were identified as associated with Activity Category D structures. Given that the Activity Category D NAC is an interior noise level of 52 dB(A), and an interior noise impact is identified as a noise level within 1 dB(A) of the NAC, structures were assessed to determine if the noise emanating from the roadways would contribute an interior noise level of at least 51 dB(A). In general, based on the building construction type, building noise reduction factors can be assigned to calculate interior noise levels from exterior noise levels. While residential structures generally have a noise reduction factor of 20-25 dB(A) without noise insulation, institutional structures normally have a noise reduction factor of 25-30 dB(A) without noise insulation. Therefore, depending on the type of building construction in place, it is anticipated that it would take exterior noise levels in the range of at least 71 to 81 dB(A), and thus an interior noise level of 51 dB(A), for a structure to be considered impacted. Each of the structures associated with the 113 identified Activity Category D receivers were reviewed in relation to this criterion and none were predicted to have noise levels above their NAC for Activity Category D. Therefore, no noise impacts are anticipated for Activity Category D land use under this alternative.

Noise Barrier Analysis

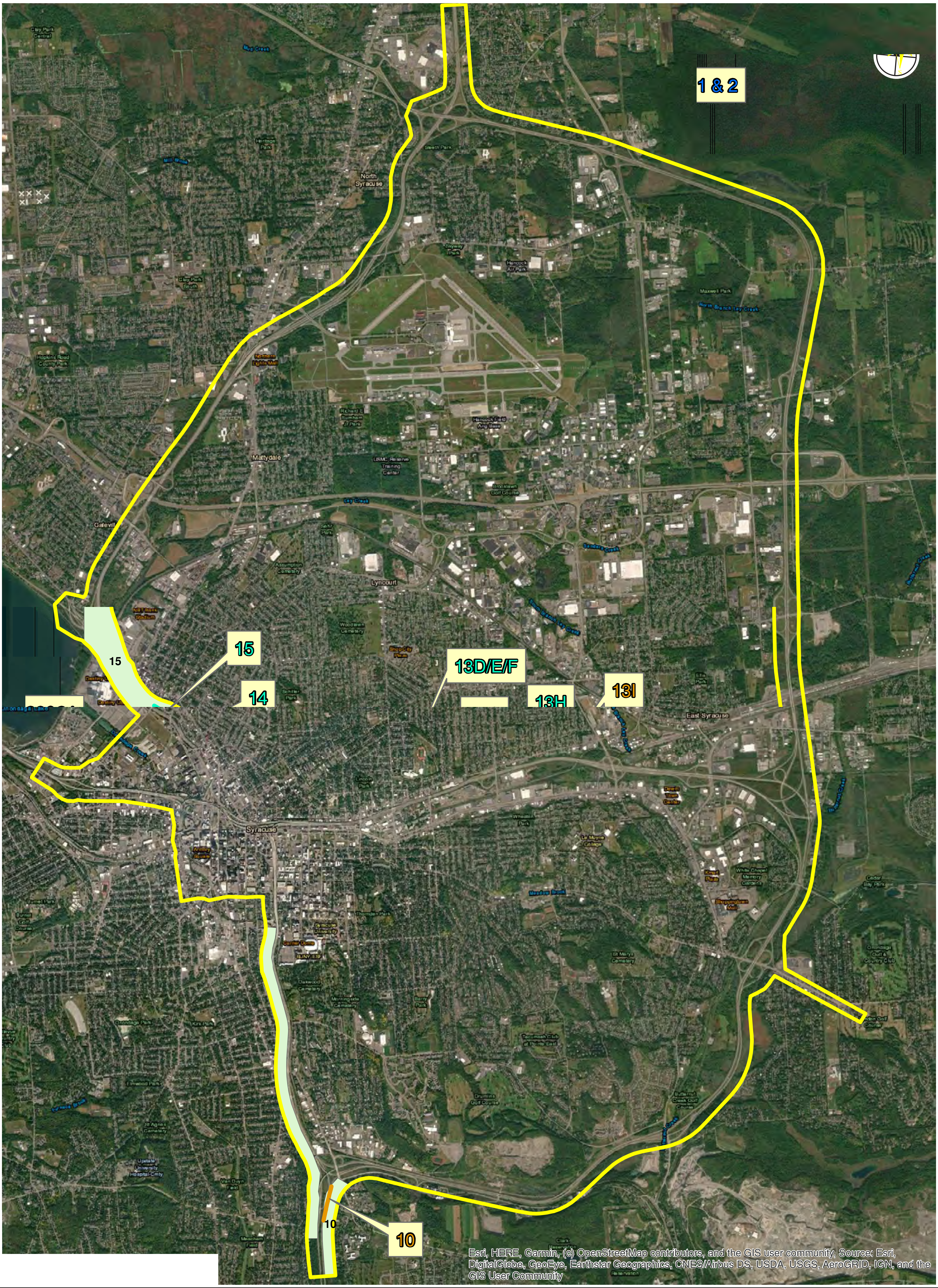
For the Viaduct Alternative, the most effective method of noise abatement would be the use of noise barriers, which can be constructed of brick, steel, or concrete. The use of an earthen berm instead of a noise barrier was not considered due to the amount of land area required for such berms, which generally cannot be accommodated within the limited space of a highway right-of-way. Aesthetic design of the noise barriers would be developed by a team of landscape architects during final design and in coordination with Project stakeholders and the Urban Design Technical Advisory Panel (UDTAP), which includes landscape architects, architects, and a city representative.

For a barrier to provide effective noise reduction, it must be continuous and designed to an elevation high enough to shield the receiver from the noise source. Noise barrier locations were chosen for study if there was a potential that noise barriers could be considered both feasible and reasonable. Noise barriers were not considered feasible along the local streets in much of the Central Study Area since openings for driveways would need to be provided for the residences and businesses that would negate the effectiveness of the noise barrier. Therefore, no detailed evaluation of such barriers in the Downtown area was conducted.

Twenty-one (21) general locations where traffic noise impacts have been predicted and a quantitative noise abatement analysis was considered appropriate were identified within the overall study area. Specifically, the areas located along the study area highways were assessed to determine whether the construction of one or more noise barriers within each of these areas would be feasible and reasonable for this Project. The locations of these 21 areas are shown in **Figure 6-4-6-1**.

The individual noise barriers within each of these areas that were developed, modeled, and evaluated in terms of their feasibility and reasonableness are also depicted in **Figure 6-4-6-1**, as well as the Viaduct Alternative Noise Abatement figures in Attachment G of **Appendix H**. The topography, length, and development patterns within each area were used to determine whether more than one

11.18.21



Source: Watts Architecture & Engineering

Project Study Area Limits

Downtown Exclusion Areas (Note: Some areas of Downtown Syracuse are shown as excluded from the study area due to their distance from the involved roadways.)

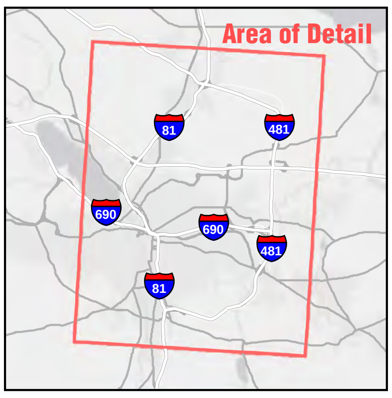
Abatement Study Areas

Existing Noise Barrier

Noise Barrier Recommended

Noise Barrier Not Recommended

Wooden Barrier System Restoration



0 3,000 6,000 12,000 Feet

Viaduct Alternative TNM Modeling Areas

Figure 6-4-6-1

noise barrier would be considered in each area. A total of 36 noise barriers and/or noise barrier systems[1] have been developed and evaluated throughout the Project Area for the Viaduct Alternative, with each keyed to the area in which it is located (e.g., Barriers 4A and 4B in Area 4). The evaluated barriers and their locations are listed below.

- **Barrier 1** is located along the right of way and shoulder of southbound I-81 in North Syracuse between the southbound I-481 connector to southbound I-81 and the southbound I-81 off-ramp to East Taft Road.
- **Barrier 2** is located along the right of way and shoulder of northbound I-81 as well as the property line of two residences on Verda Avenue in North Syracuse between the East Taft Road on-ramp and Verda Avenue.
- **Barrier 3A** is located along southbound I-81 in Cicero near West Pine Road and north South Bay Road.
- **Barrier 3B** is located along southbound I-81 in Cicero between South Bay Road and the southbound I-81 to northbound I-481 connector.
- **Barrier 4A and Wood 1&2** is located along the northbound I-481 connector to I-81 in Cicero between Bourdage Road and the Northern Boulevard on-ramp to northbound I-481. Wood 1&2 are existing barriers. Collectively, Barrier 4A and Wood 1&2 would be merged into one barrier, which would replace barriers Wood 1&2 and extend along the southbound I-81 to northbound I-481 connector to merge with previously modeled Barrier 4A.
- **Wood 3** is an existing barrier located along the northbound I-81 connector to I-481 North Syracuse.
- **Wood 4** is an existing barrier located along eastbound I-481 in Cicero between Thompson Road and Totman Road.
- **Barrier 4B** is located along the right of way and shoulder of northbound I-81 in Cicero between South Bay Road and Farrington Road.
- **Barrier 5** is located along southbound I-481 in East Syracuse between Northern Boulevard and East Taft Road.
- **Barrier 6** is located along northbound I-481 in East Syracuse between Bridgeport Road and East Taft Road.
- **Barrier 7A** is located along southbound I-481 in East Syracuse between East Genesee Street and Kinne Road.
- **Barrier 7B** is located along southbound I-481 in East Syracuse between I-690 and Kinne Road.
- **Barrier 8A** is located along northbound I-481 in East Syracuse between the Highway 5 on-ramp and Kinne Road.

[1] Barrier systems consist of two or more barriers (e.g., a barrier on both the mainline of the highway and the nearby ramp) needed to provide potential noise abatement.

- **Barrier 8B** is located along northbound I-481 in East Syracuse between Kinne Road and Heritage Landing Drive.
- **Barrier 9** is located along northbound I-481 in Jamesville between the Rock Cut Road on-ramp to northbound I-481 and Rams Gulch Road.
- **Barrier 10** is located along northbound I-81 in Syracuse between Arsenal Drive and the northbound I-81 to northbound I-481 connector.
- **Barrier 11A** is located along southbound I-81 in Syracuse between the South Salina Street on-ramp to southbound I-81 and the southbound I-81 connector to southbound I-481.
- **Barrier 11B** is located along southbound I-81 in Syracuse between the southbound I-81 off-ramp to South State Street and the South Salina Street on-ramp to southbound I-81.
- **Barrier 11C/D** is located along southbound I-81 in Syracuse between the MLK, Jr. East (formerly East Castle Street) on-ramp to southbound I-81 and the southbound I-81 off-ramp to South State Street.
- **Barrier 12A** is located along northbound I-81 in Syracuse between the East Colvin Street on-ramp to northbound I-81 and the northbound I-81 off-ramp to MLK, Jr. East.
- **Barrier 12B** is located along northbound I-81 in Syracuse between the South Salina Street on-ramp to northbound I-81 and the East Colvin Street on-ramp to northbound I-81.
- **Barrier 12C** is located on state right-of-way in Syracuse between the northbound I-81 off-ramp to South Salina Street and the South Salina Street on-ramp to northbound I-81.
- **Barrier 13A/B/C** is a three-barrier system located along westbound I-690 in Syracuse between Beech Street and the westbound I-690 connector to northbound I-81.
- **Barrier 13C (Partial)**, which is the westernmost portion of Barrier C included in the Barrier 13A/B/C system, is located along westbound I-690 in Syracuse immediately to the east of North Crouse Avenue.
- **Barrier 13D/E/F** is a three-barrier system located along westbound I-690 in Syracuse from a point just east of Peat Street to Beech Street.
- **Barrier 13G** is located along westbound I-690 in Syracuse between the westbound I-690 on-ramp from Midler Avenue to just east of Peat Street.
- **Barrier 13H** is located along westbound I-690 in Syracuse between the westbound I-690 off-ramp to Midler Avenue and the Midler Avenue overpass.
- **Barrier 13I** is located along westbound I-690 in Syracuse between Thompson Road and the westbound I-690 off-ramp to Midler Avenue.
- **Barrier 14** is located on state right-of-way along northbound I-81 in Syracuse between Spencer Street and Court Street.
- **Barrier 15** is located on state right-of-way on near northbound I-81 between Court Street and Bear Street.
- **Barrier 16A&B** is a two-barrier system located along northbound I-81 in Syracuse between I-90 and the northbound I-81 exit ramp to Highway 11.

- **Barrier 17** is located along southbound I-81 in Syracuse between South Bay Road and the Brewerton Road on-ramp to southbound I-81.
- **Barrier 18** is located along southbound 1-81 on-ramp from Route 5 in East Syracuse.
- **Barrier 19A&B** is a two-barrier system located along the I-81 off-ramp to Route 5 in East Syracuse.
- **Barrier 20&21** is a two-barrier system located along westbound I-690 near North Geddes Street and along the westbound I-690 off-ramp to North Geddes Street in Syracuse.
- **Barrier 22&23** is a two-barrier system located along eastbound I-690 near North Geddes Street and along the eastbound I-690 on-ramp from North Geddes Street in Syracuse.

Table 6-4-6-11 presents the results of the evaluation for each of the above-listed barriers and/or barrier systems, including the range of existing hourly L_{eq} noise levels at each location, the range of future hourly L_{eq} noise levels without and with a barrier for the receivers at each location, approximate barrier length, and average barrier height. The noise level reductions and the barrier dimensions as summarized in this table were then used to assess the feasibility and reasonableness of each barrier. Also indicated in the table is the corresponding figure number for each barrier, as shown in the Viaduct Alternative Noise Abatement figures in Attachment G of **Appendix H**. The modeling coordinates of all noise barriers evaluated for the Viaduct Alternative are presented in Attachment I of **Appendix H**.

As noted above in **Section 6-4-6.1**, following the publication of the preliminary DDR/DEIS in April 2019, design modifications were made to the Community Grid Alternative that required an increase in the overall noise study area, which is common to both alternatives. Enlargement of the noise study area required analysis of additional noise barriers as well as reanalysis of some of the barriers presented in the preliminary April 2019 DDR/DEIS for both alternatives. As a result of these additional analyses, new noise barriers were analyzed and assessed for feasibility and reasonableness (i.e., Barriers 18, 19A&B, 20, 21, 22, and 23). Opportunity for public comment on the new and modified barriers will be provided through the public hearing and subsequent public meetings.

Additionally, following the publication of the preliminary DDR/DEIS in April 2019, it was determined that the three existing wooden noise barriers near the I-81/I-481 northern interchange are beyond repair and will need to be replaced. These wooden barriers (noted in the tables as Wood 1&2, Wood 3, and Wood 4) were analyzed to determine an optimal replacement configuration in accordance with today's noise modeling software and standards. These three wooden barriers did not need to undergo the feasibility and reasonableness analysis since they are replacements of existing barriers; however, the existing noise barriers were modeled to determine if additional noise reduction could be achieved within the feasibility and reasonableness criteria.

For each of the above-listed barriers, an evaluation of feasibility and reasonableness was performed pursuant to the previously stated criteria. For each barrier evaluated, **Table 6-4-6-12** presents the total number of impacted and benefited receptors, the number and percentage of impacted receptors that achieve at least a 5 dB(A) reduction, the number of benefited receptors that achieve at least a 7 dB(A) reduction, total square footage of the barrier, square footage of the barrier per each benefited receptor, feasibility of the barrier, and reasonableness of the barrier.

As indicated in **Table 6-4-6-12**, of the 36 barriers and/or barrier systems evaluated for the Viaduct Alternative, 15 would meet the criteria for both feasibility and reasonableness and are, therefore, recommended for construction as traffic noise abatement measures, contingent on the viewpoints of benefited receptors. The 15 recommended barriers or barrier systems are 1, 2, 3A, 3B, 4B, 7B, 8B, 9, 11C/D, 12B, 13D/E/F, 13H, 14, 16A&B, and 15. Barrier 16A&B, which would be constructed between existing northbound I-81 and a multiuse path, would limit visibility to and from the multiuse path; therefore, transparent panels may be considered in this location. Barrier 12A met the feasibility and reasonableness noise reduction and cost criteria, however, the Oakwood Cemetery indicated that they are not in favor of a barrier. As such Barrier 12A does not meet the viewpoint reasonableness criteria and is therefore not recommended.

Noise barriers 20, 21, 22, and 23 are not reasonable for the following reasons:

1. Installing light weight noise barriers on six I-690 bridges between Van Rensselaer Street and Bear Street would require major bridge rehabilitation as the existing bridge parapet walls do not have sufficient carrying capacity to support additional loads. Major rehabilitation would consist of partial deck removal, deck overhang replacement, deck overlay, bearing replacement, approach slab replacement, bridge barrier upgrade with new single slope barrier, and minor substructure and steel repairs. The estimated construction cost for this work totals $11.5M. Cost break downs for each structure are as follows:
    - BIN 1053931, westbound I-690 over Bear Street: $2.2M (rehabilitation cost estimate);
    - BIN 1053932, eastbound I-690 over Bear Street: $2.2M;
    - BIN 1053941, westbound I-690 over Liberty Street: $1.3M;
    - BIN 1053942, eastbound I-690 over Liberty Street: $1.3M;
    - BIN 1050759, I-690 over Geddes Street: $2.3M; and
    - BIN 1053969, I-690 over Van Rensselaer Street: $2.2M.
2. The cost estimate assumes that the non-standard shoulder widths would be retained. However, if this work were included in the Project, it could result in determining that the shoulders would need to be widened to meet criteria, which would then require the addition of fascia girders and abutment widening on both sides of each directional bridge, further increasing the cost.
3. Each bridge has a general recommendation rating of 5, indicating that primary members and substructure are in good condition and do not need major repairs; bridge load capacity is not reduced, but other parts of the bridge, such as specific deck elements, may need repair; and girders may require repainting due to corrosion starting on the steel beams.
4. Based on the general recommendation, performing a major rehabilitation at this time is premature. It is expected major rehabilitation of the Liberty, Geddes, and Van Rensselaer Street bridges would be considered in at least 10 years. While the Bear Street bridges do have slightly more deterioration than the others, their rehabilitation would not be considered necessary until after I-81 Viaduct Project's estimated time of construction.
5. In addition to the engineering concerns, the traffic noise impacts to be abated by these barriers are mainly associated with existing NAC exceedances unrelated to the Project. For the Viaduct Alternative, 148 receptors were modeled behind Barriers 20-23. Fifty-two (52) of the 148 receptors were existing NAC exceedances and 56 noise impacts were predicted for the Viaduct Alternative. Therefore, only four of the 56 receptor impacts are considered "new" under the Viaduct Alternative without abatement.

Table 6-4-6-11
Viaduct Alternative: Results of Noise Barrier Modeling and Evaluation

Noise Barrier ID	Noise Abatement Figure Number in Appendix H*	Range of Existing Leq (1hr) Noise Levels	Range of Future Build Leq(1hr) Noise Levels, dB(A)		Barrier Characteristics	
			w/o Barrier	With Barrier	Approx. Length (ft)	Avg. Height (ft)
1	4	58-78	58-77	56-65	4158	12 to 14
2	4	61-76	60-76	56-64	1706	12
3A	4	60-68	61-72	57-62	1193	14
3B	4	61-76	62-75	56-64	2452	14
4A and Wood 1&2	4	58-67	58-67	55-62	7560	8 to 14
4B	4	61-74	61-74	57-69	2700	14
Wood 3	4	61-74	55-66	52-63	2997	14
Wood 4	4	61-74	62-69	58-61	1912	14
5	5	65-67	65-67	58	2805	12
6	6	61-68	61-68	56-66	2070	20
7A	8	68	68	64	1347	20
7B	7&8	59-74	60-71	56-70	1916	16
8A	8	63-73	63-73	57-61	3607	12
8B	7&8	62-73	62-73	55-61	2357	12 to 14
9	9	62-68	62-68	55-61	1643	12
10	10	58-70	58-69	56-67	1632	20
11A	10	43-72	62-72	54-68	2940	20
11B	10	59-71	62-70	56-70	2975	20
11C/D	1&10	57-72	59-72	52-70	4729	16
12A	1&10	61-72	60-70	54-66	2656	20
12B	10	60-72	60-72	55-65	2242	14
12C	10	58-69	63-70	60-65	1198	16 to 18
13A/B/C	1&11	57-70	56-72	50-72	7496	20
13C (Partial)	1&11	57-68	63-64	63-64	987	14
13D/E/F	11	62-71	58-71	57-69	4470	16
13G	11	58-72	64-71	59-63	1437	20
13H	11	59-75	64-74	61-65	1032	14
13I	11&12	59-72	62-72	59-66	3292	16
14	1&2	60-70	57-69	60-70	1358	16 to 18
15	2	56-68	60-70	57-68	842	14
16A&B	3	60-78	60-78	55-72	6070	8 to 16
17	3	61-69	62-69	57-67	2241	16
18	8	61-69	59-69	57-69	1582	18 to 20
19A&B	8	61-69	54-67	53-65	3974	20
20&21	2	56-68	62-68	56-64	1881	18 to 20
22&23	2	56-68	59-71	56-70	5075	16

Notes:
Barrier 11C/D is a single barrier; Barrier 4A and Wood 1&2 is a single barrier.
Barriers 16A&B, 19A&B, 20&21, and 22&23 each consist of two separate barriers comprising a single barrier system.
*Figures are found in Attachment G of **Appendix H**. The figure number refers to the figure page number within the set of 12 figures.

Table 6-4-6-12
Viaduct Alternative: Noise Barrier Feasibility and Reasonableness

Noise Barrier	Total # of Impacts	Number of Attenuated Locations: Total No. of Benefited Receptors	Impacted Receptors with ≥ 5 dB(A) Reduction: No.	Impacted Receptors with ≥ 5 dB(A) Reduction: Percent	Benefited Receptors with ≥ 7 dB(A) Reduction: No.	Benefited Receptors with ≥ 7 dB(A) Reduction: Percent	Sq-ft of Modeled Noise Barrier	Sq-ft of Wall Per Benefited Receptor	Feasible?(Y/N)	Reason-able? (Y/N)
1	50	81	39	78%	45	56%	50629	625	Y	Y
2	41	59	41	100%	48	81%	91470	1550	Y	Y
3A	5	9	5	100%	6	67%	16703	1856	Y	Y
3B	15	26	15	100%	17	65%	34328	1320	Y	Y
4A and Wood 1&2	2	46	2	100%	9	20%	89191	1939	N/A	N/A
4B	18	26	16	89%	18	69%	37800	1454	Y	Y
Wood 3	1	26	1	0%	18	69%	41959	1614	N/A	N/A
Wood 4	9	17	9	100%	9	53%	26775	1575	N/A	N/A
5	4	5	4	100%	5	100%	33661	6732	Y	N
6	2	6	1	50%	0	0%	41394	6899	Y	N
7A	1	0	0	0%	0	0%	26943	-	N	N
7B	17	18	11	65%	13	72%	30661	1703	Y	Y
8A	4	6	4	100%	5	83%	43283	7214	Y	N
8B	12	35	12	100%	35	100%	32792	937	Y	Y
9	11	36	11	100%	23	64%	19721	548	Y	Y
10	9	1	1	11%	0	0%	32630	32630	N	N
11A	19	10	4	21%	5	50%	58807	5881	N	N
11B	27	13	0	0%	0	0%	59504	4577	N	N
11C/D	86	189	68	79%	108	57%	75660	400	Y	Y
12A	43	70	35	81%	41	59%	52295	747	Y	N*
12B	24	43	20	83%	27	63%	27495	639	Y	Y
12C	8	7	7	88%	4	57%	20657	2951	Y	N
13A-C	19	16	0	0%	6	39%	149909	9369	N	N
13C (Partial)	0	0	0	-	0	0%	15098	0	-	N
13DEF	32	59	32	100%	31	53%	71529	1212	Y	Y
13G	8	10	8	100%	1	10%	28724	2872	Y	N
13H	8	8	8	100%	5	63%	14445	1806	Y	Y
13I	9	6	5	56%	5	83%	52671	8779	Y	N
14	28	18	15	54%	12	67%	23390	1299	Y	Y
15	25	22	20	80%	14	64%	11798	536	Y	Y
16A&B	33	69	31	94%	37	54%	54340	788	Y	Y
17	6	9	3	50%	1	11%	35857	3984	Y	N

Table 6-4-6-12 (cont'd)
Viaduct Alternative: Noise Barrier Feasibility and Reasonableness

Noise Barrier	Total # of Impacts	Number of Attenuated Locations					Sq-ft of Modeled Noise Barrier	Sq-ft of Wall Per Benefited Receptor	Feasible? (Y/N)	Reason-able? (Y/N)
		Total No. of Benefited Receptors	Impacted Receptors with ≥ 5 dB(A) Reduction		Benefited Receptors with ≥ 7 dB(A) Reduction					
			No.	Percent	No.	Percent				
18	2	6	1	50%	3	50%	28484	4747	Y	N
19A&B	2	0	0	0%	0	0%	66441	-	N	N
20&21	15	22	13	87%	12	57%	34731	1654	Y	N
22&23	41	45	23	56%	24	53%	81199	1804	Y	N

Notes:

Barriers that are shaded are considered Feasible and Reasonable and are recommended.

Barriers indicated as "Y" in the "Reasonable" column are contingent on the viewpoints of the benefited receptors.

Regarding the "Impacted Receptors with ≥ 5 dB(A) Reduction" column: For a measure to be deemed feasible, it must provide a minimum 5 dB(A) reduction to the majority of impacted receptors. A receptor is considered "benefited" if it would receive at least a 5 dB(A) noise reduction if the abatement measure were implemented.

Regarding the "Benefited Receptors with ≥ 7 dB(A) Reduction" column: This NYSDOT Noise Policy establishes a Noise Reduction Design Goal of 7 dB(A). For an abatement measure to be determined reasonable, a majority of the benefited receptors must achieve the design goal.

*Oakwood Cemetery indicated that they are not in favor of Barrier 12A, therefore, the barrier is considered unreasonable.

Barriers 20&21 and 22&23 are not reasonable as barrier construction would require major rehabilitation, including bridge deck and parapet wall replacement, of existing I-690 bridges.

Under the Viaduct Alternative, if each recommended abatement measure is constructed, the Project's TNM predicts impacts at 389 (823 receptors) of the 2,817 receivers. The Viaduct Alternative with abatement would result in an overall reduction of 191 receivers, and 190 receptors with noise levels that approach within 1 dB(A) or exceed the NAC when compared to 2013 existing conditions. Fewer receivers than receptors were reduced because the comparison involves two different impact data-sets based on numerous other variables (e.g., change in design and traffic increase over time) unrelated to mitigation; in addition, some of the multiple-receptor 2050 Viaduct Alternative noise impact receivers were not found to be impacts for existing conditions in 2013. The modeling also predicts a reduction of traffic noise impacts at 286 receivers, representing 373 receptors when compared with the Viaduct Alternative without the implementation of noise abatement. Regardless of the mitigation measures, 11 of the impacted receivers (representing 25 receptors) are predicted to have noise levels that substantially (by 6 dB(A) or more) exceed the existing noise levels. For the 11 locations predicted to have a substantial increase in noise levels (by 6 dB(A) or more), six are at residential land uses, three are at outdoor seating areas throughout the downtown area of the City, one is at the Johnson Vocational Center (573 East Genesee Street, Syracuse, NY 13202), and one is at the Upstate University Hospital (750 East Adams Street, Syracuse, NY 13210).

In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is barely perceptible to the human ear; therefore, a comparison was made to determine the number of receivers with changes of more than 3 dB(A) as compared to the No Build Alternative and existing conditions.

- Compared to No Build Alternative conditions: Under the Viaduct Alternative with abatement, it is anticipated that traffic noise level increases would be perceptible at 26 receivers, representing 53 receptors, and decreases in traffic noise would be perceptible at 591 receivers, representing 764 receptors.
- Compared to existing conditions: Under the Viaduct Alternative with abatement, it is anticipated that traffic noise level increases would be perceptible at 34 receivers, representing 89 receptors and decreases in traffic noise would be perceptible at 589 receivers, representing 755 receptors.

Most receivers with a perceptible noise level increase are located within the Central Study Area where there would be changes to the physical width or location of the viaduct. Noise level impacts with abatement measures implemented are summarized in **Table 6-4-6-13** by Activity Category and perceptible noise level increases with abatement measures implemented are summarized in **Table 6-4-6-14** by Activity Category.

All of the recommended barriers are located in areas where there would be at least five, and up to 86, impacted receptors without the barriers in place and at least eight, and up to 189, benefited receptors that would experience a noise level reduction of 5 dB(A) or greater as a result of the barriers.

At least 54 percent, and as much as 100 percent, of the impacted receptors in each recommended location would receive a 5 dB(A) or greater reduction benefit, thereby meeting the feasibility requirement that such reduction be achieved by a majority of impacted receptors. Refer to Viaduct Alternative Modeled Noise Reduction figures in Attachment H of **Appendix H** for a visual representation of the benefited receivers.

Table 6-4-6-13
Receptors with Noise Levels Approaching/Exceeding the Noise Abatement Criteria

Activity Category	Existing (2013) NAC Exceedances*	2050 Viaduct Alternative Impacts	2050 Viaduct Alternative w/ Abatement Impacts
A	None	None	None
B – Residential	771	897	570
C – Cemetery	46	46	46
C – School/Daycare	12	31	21
C – Parks, Picnic, Sports, Trails, and Recreation Areas	152	184	153
C – Medical Facilities	26	30	25
C – Places of Worship	4	6	6
C - Memorials	2	2	2
TOTALS	1013	1196	823

Note: *Existing data are based on noise levels approaching or exceeding the NAC for the year 2013.

Table 6-4-6-14
Receptors with Perceptible Noise Level Increases (i.e. >3 dBA) by Activity Category

Activity Category	From 2013 Existing to 2050 Viaduct Alternative	From 2013 Existing to 2050 Viaduct Alternative w/ Abatement	From 2050 No Build to 2050 Viaduct Alternative	From 2050 No Build to 2050 Viaduct Alternative w/ Abatement
A	None	None	None	None
B – Residential	70	65	38	31
C – Cemetery	0	0	0	0
C – School/Daycare	1	1	1	1
C – Parks, Picnic, Sports, Trails, and Recreation Areas	20	20	21	21
C – Medical Facilities	2	2	0	0
C – Places of Worship	1	1	0	0
C - Memorials	0	0	0	0
TOTALS	94	89	60	53

Note: Noise level increases are in relation to existing and No Build Alternative noise analysis results.

In terms of reasonableness, all the recommended barriers would be within the maximum allowed 2,000 square feet of wall per benefited receptor. Also, all of these barriers would result in at least 50 percent of the benefited receptors achieving a 7 dB(A) reduction.

In addition to the quantitative evaluation of noise barriers performed at the previously described locations, a qualitative assessment was performed in areas with receptors within the Downtown area and areas with isolated receptors or receptor clusters adjacent to the highways (e.g., areas where it was readily apparent that barriers would not be feasible and/or reasonable).

Under the Viaduct Alternative, the Central Study Area would consist mostly of city streets that are at grade with the adjacent land uses. The I-81 viaduct would be reconstructed, widened, and realigned. Almond Street would also be reconstructed at grade underneath and adjacent to the viaduct. Given the substantial noise contribution from dense local street traffic and other noise sources in the Downtown area, it was qualitatively determined that noise barriers along the shoulders of the reconstructed viaduct would not provide feasible or reasonable abatement in that area. For this qualitative analysis, the TNM model for the Viaduct Alternative was modified with the deletion of all traffic on the viaduct. The results were compared with the data from the original model (with traffic on the viaduct). Based on this comparison, it was determined that noise reductions of 5-7 dB(A) were not possible even with the complete removal of viaduct traffic; noise would continue to emanate from the traffic traveling on surface streets beneath the viaduct. Based on this qualitative comparison, it was determined that feasible and reasonable noise abatement for receptors located in the Downtown area cannot be achieved, because local street traffic is a substantial noise source in this area.

In addition, construction of noise barriers along Almond Street and other city streets that would be improved or would experience increased traffic as part of this alternative would not be feasible and/or reasonable. To be effective, barriers must be continuous and extend beyond the actual locations of impacted receptors, but the city street grid has many cross streets preventing this abatement design. Moreover, if barriers were placed on city streets, they would block visual and pedestrian access to and from city buildings, as well as vehicular access to driveways.

Noise barriers at areas with isolated groups of impacted receptors along the primary Project corridors were also qualitatively assessed. In accordance with NYSDOT Noise Policy, and as discussed previously, the constructed surface area of a proposed barrier must not exceed 2,000 square feet per benefited receptor for a noise barrier to be considered reasonable. Various barrier dimensions including height iterations of between 6 and 20 feet were reviewed for isolated receptor groups. A 12-foot height was found to be the minimum needed because it would eliminate the line-of-sight to truck exhaust pipes. In this regard, given a cluster of five receptors in an area that is surrounded by non-sensitive land uses, and an example noise barrier height of 12 feet, the maximum allowed length of the barrier would be 830 feet for it to be considered reasonable. Based on the noise barrier analysis that was conducted at other locations, it is assumed with good engineering judgment that a barrier with such dimensions would not provide the necessary 5 dB(A) of reduction to the majority of impacted receptors in that cluster, nor would such a barrier provide 7 dB(A) of reduction to the majority of benefited receptors. Therefore, wherever an isolated cluster of five or fewer receptors exists along a portion of highway, it was qualitatively concluded that a noise barrier would not be reasonable.

Viewpoints Analysis

To determine whether a proposed barrier is "reasonable," the viewpoints of those who would be benefited by the proposed barrier were solicited. "Benefited" means that the property would receive at least a 5 dB(A) reduction in noise from the barrier.

Approximately 679 mailers were sent out to benefited property owners and residents, in July 2019, via United States Postal Service Priority Mail with a tracking number. Mail delivery was confirmed via the tracking numbers and hand delivery or additional delivery attempts were made at undeliverable locations. Demolished or abandoned residences and addresses with structures slated for demolition were removed from the list of benefited receptors. Each mailer contained:

- A cover letter with an invitation to four noise barriers public meetings,
- A color informational brochure with maps and aerial photos showing the locations of the proposed noise barriers. The brochure also described the NYSDOT noise abatement process as it relates to the I-81 Viaduct Project,
- A noise barrier ballot with an option to select "in favor" or "not in favor" of noise barrier construction, and
- A pre-addressed/postage paid return envelope for the ballot return.

A public open house and a series of neighborhood and community meetings were held following the publication of the preliminary DDR/DEIS in 2019 (see **Chapter 9, Agency Coordination and Public Outreach,** for more information). In addition, four noise barriers public meetings, listed in **Table 6-4-6-15** below, were held. To convey information on the Project and its effects on traffic noise levels, the noise analysis process, and the proposed locations of noise barriers, the meetings included a PowerPoint presentation and approximately 30 informational boards on display. In addition, Project team members were on hand to respond to questions and to provide information to assist owners and residents in making an informed decision. Attendance at these meetings was not required for benefited property owners and residents to provide their viewpoint.

Table 6-4-6-15
Noise Barrier Workshop Dates and Locations

Meeting	Date	Location
Noise Barriers Meeting #1 (Closest to Barriers 9, 11C/D, 12A, and 12B)	Wednesday, July 24, 2019 4:00 to 7:00 PM	Dr. King Elementary School 416 E. Raynor Ave. Syracuse, NY 13202
Noise Barriers Meeting #2 (Closest to Barriers 1, 2, 3A, 3B, 4B)	Tuesday, July 30, 2019 4:00 to 7:00 PM	Cicero North Syracuse HS 6002 Route 31 Cicero, NY 13039
Noise Barriers Meeting #3 (Closest to Barriers 13C, 13D/E/F, 13H, 14A, and 15A/B)	Wednesday, August 14, 2019 4:00 to 7:00 PM	Henninger High School 600 Robinson St. Syracuse, NY 13206
Noise Barriers Meeting #4 (Closest to Barriers 7B and 8B)	Thursday, August 15, 2019 4:00 to 7:00 PM	DeWitt Community Room 148 Sanders Creek Pkwy. East Syracuse, NY 13057

For the 2019 viewpoints survey, benefited property owners and residents were able to submit their completed ballots by regular mail, via the Project website (as a photo scan), or at a noise barriers public meeting. Of the 679 ballots mailed out, 63 of the ballots were from properties that were either vacant, demolished, or slated for demolition; therefore, viewpoints could be received from a maximum of 616 ballots. In total, 164 viewpoint ballots were received with 151 in favor and 13 not in favor of the noise barriers (i.e., 92 percent in favor of the noise barriers). Five of the proposed noise barriers received a response from over half of the benefited receivers. Overall, the majority of the responses favored construction of the barriers, and only Barrier 12A (adjacent to the Oakwood Cemetery) was considered not reasonable based on the viewpoints survey.

Additional noise barrier outreach was performed after the publication of the DDR/DEIS in 2021. In addition, design changes were incorporated into the noise modeling. These design changes required updates to noise barriers 11C/D, 14, 15, and 16A&B, which resulted in 392 new benefited receptors; therefore, the 2021 outreach included mailers with surveys sent to 1,071 benefited receptors. The mailers included invitations to participate in the public hearing and visit the neighborhood meetings for the Project. Mail delivery was confirmed via the tracking numbers, and hand delivery or additional delivery attempts were made at undeliverable locations. Demolished or abandoned residences and addresses with structures slated for demolition were removed from the list of benefited receptors. It was noted in the mailer that benefited receptors who responded to the viewpoints survey in 2019 did not have to submit another response in 2021 unless they wanted to change their viewpoint. Due to a change in the NYSDOT Noise Policy since the 2019 viewpoints survey, it was also noted in the cover letter that the absence of a response would be considered acceptance of the noise barrier.

For the 2021 viewpoints survey, benefited property owners and residents were able to submit their completed ballots by regular mail, via email (as a photo scan), or at the public meetings. Of the 1,071 ballots mailed out, only 22 benefitted receivers responded as not-in-favor of their respective barrier. Therefore, only 2 percent of the responses were not-in-favor of noise barriers. As in the 2019 survey results, only Barrier 12A (adjacent to the Oakwood Cemetery) was considered not reasonable based on the viewpoints survey and the remainder of the barriers were favored and therefore considered reasonable.

Statement of Likelihood

Based on the studies performed thus far and the preliminary design described above, NYSDOT recommends abatement using the barriers described above for the Viaduct Alternative. If this alternative is progressed and these conditions change substantially during the final design phase, these barriers may no longer be recommended and not included in the Project's contract plans. A final decision on the recommendations will be made upon completion of the Project's design and public involvement processes.

Construction Noise and Vibration Abatement

Abatement of noise related to detour traffic was considered. The proposed detours are within the downtown roadway network, which is generally not conducive to the typical methods of traffic noise abatement (e.g., noise barriers, roadway realignment, or traffic management options, such as speed adjustments). Speeds are generally reduced in many areas of construction and along detour routes due to posting or congestion. The construction-related reduction of traffic speeds has potential to reduce traffic noise; however, it is not expected that speed reductions would result in noticeably lower noise levels. Generally, a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels. Therefore, speed limit reduction is not reasonable for abatement of detour traffic noise.

For construction equipment noise, abatement strategies would be included within the contract documents to the extent practicable. As indicated in **Table 4-7** in **Chapter 4, Construction Means and Methods**, NYSDOT has committed to the following noise-related measures to minimize community impacts during construction for this project**:**

- Implement a noise monitoring program during construction.
- Coordinate work operation to coincide with time periods that would least affect neighboring residences and businesses. Normal work hours would be scheduled between 6:00 a.m. and 9:00 p.m. Nighttime, Saturday morning, and Sunday construction activities would be limited to 70dB(A) Lmax at 50' in Noise Sensitive Areas when reasonable.
- Implement temporary construction noise abatement measures that would include shrouds or other noise curtains, acoustic fabric, soundproof housings, physical barriers, and/or enclosures to reduce noise from pile drivers, compressors, generators, pumps, and other loud equipment when reasonable.
- Restrict the use of impact and drilling equipment including pile drivers, jackhammers, hoe rams, core drills, direct push soil probes (e.g., Geoprobe), pavement breakers, pneumatic tools, and rock drills when reasonable.
- Require motorized construction equipment to be equipped with an appropriate well-maintained muffler and require silencers to be installed on both air intakes and air exhaust when reasonable.
- Require all construction devices with internal combustion engines to be operated with engine doors closed and with noise-insulating material mounted on the engine housing that does not interfere with the manufacture guidelines.

- Direct Contractor to transport construction equipment and vehicles carrying rock, concrete, or other materials along designated routes that would cause the least disturbance to noise sensitive receptors when reasonable.
- Require self-adjusting or manual audible back up alarms for vehicles and equipment used in areas adjacent to sensitive noise receptors.
- Direct Contractor to use pre-auguring equipment to reduce the duration of impact or vibratory pile driving when reasonable.
- Implement a communication and public outreach plan throughout the construction period.
- In the construction zone between MLK, Jr. East and Harrison Street: Direct Contractor to use saw cutting methods and prohibit impact hammers during the demolition of existing structures when reasonable; and direct Contractor to use drilled foundations on all bridge piers and other support structures and prohibit pile driving methods.
- NYSDOT and its Contractor would provide as much notice of construction activities to the medical facilities as possible and would coordinate with them to resolve schedule conflicts if construction activities would impact critical surgeries or procedures.

The RCNM User's Guide provides a list of simplified shielding factors and accompanying noise reduction levels for construction equipment. The list of shielding factors that could apply to the construction of this Project includes:

- Noise barrier or other obstruction (such as a dirt mound) just barely breaks the line-of-sight between the noise source and the receiver: 3 dB(A) noise reduction.
- Noise source is completely enclosed or completely shielded with a solid barrier located close to the source: 8 dB(A) noise reduction (enclosure and/or barrier has some gaps in it: 5 dB(A) noise reduction).
- Noise source is completely enclosed and completely shielded with a solid barrier located close to the source: 10 dB(A) noise reduction.
- Building stands between the noise source and receiver and completely shields the noise source: 15 dB(A) noise reduction.
- Noise source is enclosed or shielded with heavy vinyl noise curtain material (e.g., SoundSeal BBC-13-2" or equivalent): 5 dB(A) noise reduction.

At each of the construction sites that were analyzed, physical features were identified, if present, that could help in reducing the noise levels due to construction equipment. At Site B, the road elevation is lower than the surrounding area, creating a natural barrier between the receiver and the construction site. At Sites A, B, and C, there are various areas under bridges that could be used to store stationary equipment, which would help in reducing the noise levels. Sites D and E are along the viaduct and Almond Street, and there are no natural barriers around Sites D and E other than a few large buildings; however, other mitigation strategies, such as noise enclosures, could be employed in these areas.

Using the existing barriers currently in place (e.g., berms, retaining walls, elevation changes) and determining what pieces of construction equipment could be enclosed, shielding was applied under the RCNM analysis for each piece of equipment to predict whether there would be an overall reduction in noise levels. For the Viaduct Alternative, it was determined that stationary equipment, such as pumps, vibratory concrete mixers, jackhammers, welders/torches, and pneumatic tools, could be either partially or fully enclosed behind a noise barrier or an enclosure. Stationary equipment that needs less physical access would be able to be fully enclosed to allow for a higher shielding value. Site B construction equipment that was not stationary was given a shielding factor of 3 dB(A) because there is a natural barrier/noise barrier at Site B that breaks the line-of-sight between the noise source and the receiver. At Sites C, D, and E, much of the construction would be taking place along the viaduct; therefore, it is assumed that the stationary equipment would not be fully enclosed since construction is taking place above the receivers. **Table 6-4-6-16** shows the RCNM noise level results in the Viaduct Alternative for construction equipment with and without shielding. The use of abatement measures at construction Sites A, B, and C yielded predicted construction equipment noise levels below the L_{max} level of 80 dB(A).

Table 6-4-6-16
RCNM Calculated Construction Noise Levels With Shielding for the Viaduct Alternative

Construction Receiver Site	Without Shielding (dB(A))	With Shielding (dB(A))
Site A	L_{max}= 76; L_{eq}= 81	L_{max}= 76; L_{eq}= 78
Site B	L_{max}= 78; L_{eq}= 84	L_{max}= 75; L_{eq}= 79
Site C	L_{max}= 77; L_{eq}= 82	L_{max}= 77; L_{eq}= 79
Site D	L_{max}= 78; L_{eq}= 83	L_{max}= 78; L_{eq}= 80
Site E	L_{max}= 84; L_{eq}= 88	L_{max}= 84; L_{eq}= 86

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Source: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

Construction Vibration

To abate the potential effects from construction vibration, a monitoring program would be developed by the Contractor. The program would include the following provisions:

- When pile driving would occur within 30 feet of a structure, a construction vibration-monitoring program would be implemented to determine whether construction vibration would exceed 0.50 inches per second. If the structure does experience PPV values in excess of 0.50 inches per second as a result of construction vibration, construction means and methods would be re-evaluated to avoid producing vibration at this level, unless an engineer's inspection of the building determines that the level of construction vibration at the building does not have the potential to result in damage.
- The Contractor would make efforts to coordinate scheduling with the surrounding medical institutions to avoid vibration-producing construction activity during the most critical times of use of the medical facilities and minimize the potential for interference during those times.

6-4-6.5 ENVIRONMENTAL CONSEQUENCES OF THE COMMUNITY GRID ALTERNATIVE

6-4-6.5.1 PERMANENT/OPERATIONAL EFFECTS

Under the Community Grid Alternative for design year 2050, noise impacts were predicted at 557 (representing 963 receptors) of the 2,817 receivers. Of the impacted receivers, six receivers (representing 27 receptors) are predicted to have noise levels that substantially (by 6 dB(A) or more) exceed the existing noise levels. For the six locations predicted to have a substantial increase in noise levels (by 6 dB(A) or more), three are at residential land uses, one is at an outdoor seating area in the downtown area of the City, one is at the DaVita Central New York At Home medical facility (910 Erie Boulevard East, Syracuse, NY 13210), and one is at the Spectrum Your News Now (YNN) television studio (815 Erie Boulevard East, Syracuse, NY 13210); however, the television studio appears to have only infrequent outdoor use.

The highest L_{eq} noise level was 78 dB(A), and the lowest noise level was 41 dB(A) (see the Noise Impact Summary - Model Results table in Attachment C of **Appendix H**). A graphic representation of the results is presented on 2050 Community Grid Alternative - Noise Results Figures 1 through 12 in Attachment J of **Appendix H**, while the 2050 Community Grid Alternative plan views utilized in the model are depicted in Attachment Q of **Appendix H**.

Similar to the existing conditions, the highest noise levels were at the receivers closest to I-81, I-690, and I-481 and the lower noise levels were in the suburban areas and behind large buildings or other structures. One of the largest changes that would affect noise under the Community Grid Alternative is the elimination of the elevated highway between the NYS&W Railway bridge and the I-81/I-690 interchange. Much of the current noise from the overhead freeway is indirect (i.e., through vibration noise or echo) since the line-of-sight between the overhead freeway tire noise and most of the exhaust pipes (excluding some heavy trucks and buses) is obstructed by the bridge deck. Therefore, with the loss of the overhead freeway, indirect noise from the highway would be reduced; however, some of this reduction in noise would be offset by both the additional traffic that would be added to the at-grade street network and the new line-of-sight noise from the added traffic.

The modeling predicted 23 fewer receivers, representing 50 receptors with noise levels above the NAC when compared to 2013 existing conditions (without the implementation of noise abatement measures).

In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is barely perceptible to the human ear; therefore, a comparison was made to determine the number of impacted receivers with changes of more than 3 dB(A) as compared to existing conditions and the No Build Alternative conditions. Noise level impacts are summarized in **Table 6-4-6-17** by Activity Category and perceptible noise level increases are summarized in **Table 6-4-6-18** by Activity Category.

- Compared to the No Build Alternative conditions: Under the Community Grid Alternative, it is anticipated that traffic noise level increases would be perceptible at 29 receivers, representing 80 receptors, and decreases in traffic noise would be perceptible at 315 receivers, representing 712 receptors. Of the 557 impacted receivers, 19 receivers, representing 56 receptors, would have a perceptible increase in traffic noise levels at a noise-impacted location without noise abatement. The majority of the 29 receivers, representing 80 receptors, which would have a perceptible increase, are located within the Central Study Area where streets would accommodate more traffic and near the BL 81/I-481 northern interchange. The perceptible decreases in traffic noise predicted at the 315 receivers, representing 712 receptors, were due to decreases in traffic along the southern portion of BL 81 and the removal of the viaduct.

- Compared to existing conditions: Under the Community Grid Alternative, traffic noise level increases would be perceptible at 33 receivers, representing 86 receptors, and decreases in traffic noise would be perceptible at 270 receivers, representing 600 receptors. Of the 557 impacted receivers, 21 receivers, representing 59 receptors, would have a perceptible increase in traffic noise levels at a noise-impacted location without noise abatement. The majority of the 33 receivers, representing 86 receptors with a perceptible increase, are located within the Central Study Area where streets would accommodate more traffic and near the I-81/I-481 northern interchange. The perceptible decreases in traffic noise predicted at the 270 receivers, representing 600 receptors, were due to decreases in traffic along the southern portion of I-81 and the removal of the viaduct.

Table 6-4-6-17
Receptors with Noise Levels Approaching/Exceeding the Noise Abatement Criteria

Activity Category	Existing (2013) NAC Exceedances*	2050 Community Grid Alternative Impacts
A	None	None
B – Residential	771	699
C – Cemetery	46	0
C – School/Daycare	12	36
C – Parks, Picnic, Sports, Trails, and Recreation Areas	152	190
C – Medical Facilities	26	29
C – Places of Worship	4	7
C - Memorials	2	2
TOTALS	1013	963

Note: *Existing data are based on noise levels approaching or exceeding the NAC for the year 2013.

Table 6-4-6-18
Receptors with Perceptible Noise Level Increases (i.e., >3 dBA) by Activity Category

Activity Category	From Existing (2013) to 2050 Community Grid Alternative*	From 2050 No Build Alternative to 2050 Community Grid Alternative*
A	None	None
B – Residential	52	52
C – Cemetery	0	0
C – School/Daycare	5	0
C – Parks, Picnic, Sports, Trails, and Recreation Areas	22	22
C – Medical Facilities	4	4
C – Places of Worship	3	2
C - Memorials	0	0
TOTAL	86	80

Note: * Noise level increases are in relation to existing and No Build Alternative noise analysis results.

6-4-6.5.2 CONSTRUCTION EFFECTS

Construction Noise

Construction noise differs from traffic noise in the following ways:

- Construction noise lasts only for the duration of the construction contract;
- Construction activities are generally short term;
- Construction activities are usually limited to the daylight hours when most human activity takes place; and
- Construction noise is intermittent and depends on the type of operation.

Construction of the Project would potentially include demolition, excavation, sub-base preparation, roadway/bridge construction, and other miscellaneous work. This work would result in temporary construction noise at nearby receivers. The levels of noise would vary widely, depending on the construction activities undertaken and the anticipated duration of the construction. The parameters that determine the nature and magnitude of construction noise include the type, age, and condition of construction equipment; operation cycles; the number of pieces of construction equipment operating simultaneously; the distance between the construction activities and receivers; and the location of haul routes with respect to receivers. Many of these parameters would not be fully defined until final design plans and specifications have been prepared; however, representative construction scenarios based on typical construction procedures have been identified for the Project and were used to assess effects.

To evaluate potential noise levels as a result of construction of the Community Grid Alternative, the RCNM, developed by the FHWA, was employed. The proposed construction equipment and baseline noise levels for the selected receivers close to the construction area were entered into the RCNM, along with the approximate distance from the center of the construction area to the receivers. The construction noise analysis was performed to predict noise levels due to construction of the Community Grid Alternative at the following representative seven sites for the Project Area:

- Site A: I-81 Northern Segment: a location along Basin Street that is representative of the residential houses in this area.
- Site B: West Street Interchange: the front yard of a residence that is representative of the church and residential houses in this area.
- Site C: I-81/I-690 Interchange (Location 1 of 2): the side yard of an apartment building that is representative of the residential land use in this area.
- Site D: I-81/I-690 Interchange (Location 2 of 2): a location within Forman Park that is representative of this area.
- Site E: Almond Street Viaduct Area: a location within the Pioneer Homes development that is representative of this area.
- Site F: I-81/I-481 South Interchange (major construction would occur at this location only under the Community Grid Alternative): a location within the Loretto Health and Rehabilitation Center that is representative of this area.

- Site G: I-81/I-481 North Interchange (major construction would occur at this location only under the Community Grid Alternative): a location along Brigadier Drive that is representative of the residential houses in this area.

The sites are shown on the Construction Noise Receiver Locations figure in Attachment A of **Appendix H**.

The simultaneous use of construction equipment proposed during the six-year construction schedule could generate an elevated noise level, although it would allow for a shorter period of construction noise. Due to the logarithmic nature of adding noise sources, noise from the simultaneous use of additional construction equipment may, in some cases, have a negligible effect on perceptible noise levels; therefore, a shorter construction duration may be desirable. A 3 dB(A) increase, which is normally the smallest change in noise levels that is perceptible to the human ear, would require a doubling of the noise energy produced by the construction equipment. Even in a case where the accelerated construction schedule creates a perceptible increase in noise levels, shorter construction duration may nonetheless be desirable to affected individuals.

The construction equipment, utilization percentage, and expected L_{max} values listed in **Table 6-4-6-19** were used within the model. **Table 6-4-6-20** presents the resulting noise levels for the selected sites within the Project Area for the Community Grid Alternative. In addition, the "Construction Equipment Noise Summary" tables in Attachment S of **Appendix H** show the total number of pieces of equipment proposed for use at each site and the individual and total noise levels that they would produce per the RCNM analysis.

The RCNM results indicate that five of the seven sites (A through E) would have noise levels due to project construction of L_{eq} ≥80 dB(A). Sites F and G were < 80 dB(A). The use of impact-related construction equipment (impact devices) is planned at all seven locations. Impact construction equipment is equipment that generates short duration (generally less than one second), high intensity, and abrupt impulsive noise. While the noise levels for impact devices is below 80 dB(A) for six of the seven locations (as represented by the L_{max} values in **Table 6-4-6-20**), impact devices can be more noticeable due to the abrupt changes in noise levels. Therefore, five of the seven sites, and the areas in which they represent, may experience adverse construction noise effects. The implementation of abatement measures (as discussed in **Section 6-4-6.4.5**) would lessen these effects.

Based on RCNM results, without abatement measures, average noise levels and the use of impact devices would be considered disruptive to nearby receivers. Worst-case distances (i.e., the closest representative receivers) from the construction equipment to the nearest receiver were generally used for the analysis; however, realistically, given the mobile nature of road construction, the distances between the construction activities and receivers would change as the construction operations move along the roadway centerline. In addition, construction operations are in constant flux, and the equipment and operations would not always be at the levels predicted herein. Construction noise abatement measures and shielding effects are discussed in the mitigation subsection below.

Table 6-4-6-19
Construction Equipment for the Community Grid Alternative

Equipment Description	Impact Device (Y or N)	Acoustical Usage Factor (%)*	L_{max} at 50 feet (dB(A))
Backhoe	N	40	78
Compactor (ground)	N	20	83
Crane	N	16	81
Dozer	N	40	82
Dump Truck	N	40	76
Excavator	N	40	81
Flat Bed Truck	N	40	74
Front End Loader	N	40	79
Jackhammer	Y	20	89
Mounted Impact Hammer	Y	20	90
Pickup Truck	N	40	75
Pneumatic Tools	N	50	85
Pumps	N	50	81
Roller	N	20	80
Vibratory Concrete Mixer	N	20	80
Welder/Torch	N	40	74

Notes:
L_{max} is the maximum sound level.
Construction equipment identified above corresponds to the types of construction equipment expected to be used on this Project.
*Acoustical Usage Factor is an estimate of the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation.
Source: Acoustical usage factor percentages and L_{max} values are from FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, DOT-VNTSC-FHWA-05-01 (Final Report, January 2006).

Table 6-4-6-20
RCNM Calculated Construction Noise Levels for the Community Grid Alternative

Construction Receiver Site	Description	Community Grid Alternative (dB(A))
Site A	I-81 Northern Construction Area	L_{max}= 76; L_{eq}= 81
Site B	West Street Interchange	L_{max}= 78; L_{eq}= 84
Site C	I-81/I-690 Interchange (Location 1 of 2)	L_{max}= 77; L_{eq}= 82
Site D	I-81/I-690 Interchange (Location 2 of 2)	L_{max}= 78; L_{eq}= 83
Site E	Almond Street Viaduct Area	L_{max}= 84; L_{eq}= 89
Site F	I-81/I-481 Interchange to the South	L_{max}= 72; L_{eq}= 76
Site G	I-81/I-481 Interchange to the North	L_{max}= 75; L_{eq}= 79

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Source: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

A qualitative assessment of traffic noise effects related to construction detours was prepared based on the detour routes described in **Chapter 4, Construction Means and Methods**. During certain phases of construction, various segments of roads would be closed. As a result, detour routes would be in effect to accommodate traffic through the construction zone. There is an expected increase in traffic on local roads during construction; however, the detour routes would generally serve the main traffic increase, and therefore, noise levels at receivers adjacent to the detour routes were assessed.

The construction detour traffic noise analysis involved a qualitative assessment of the detour routes for the Community Grid Alternative to determine if the changes in traffic volumes could result in perceptible increases in noise. Generally, when traffic volumes increase by at least 100 percent, a perceptible increase in noise levels (an increase of more than 3 dB(A)) can be expected in the surrounding area. The main changes to traffic flow throughout the corridor are expected to include the outlying highways (I-81, I-481, and I-690) and the detour routes through the Central Study Area. Changes in traffic volumes that are expected for the outlying highways would be due to motorists choosing alternate routes to avoid construction. It is anticipated that some motorists may choose to travel on I-481 and on some portions of I-690 to avoid construction lane restrictions and detour zones along I-81 and I-690. Therefore, there may be a decrease in traffic along I-81 and increases in traffic along I-481 and some portions of I-690. However, given the existing high volume of vehicles along these highways, it is not anticipated that the changes in noise levels would be perceptible since traffic along these roadways is not expected to increase by 100 percent.

There are nine detour routes in the Central Study Area that would potentially be used during construction of the Community Grid Alternative. Therefore, block-by-block comparisons were made and the average increase in traffic for each detour route was calculated to see if 100 percent increases in traffic volumes would be expected. These comparisons are meant to be a conservative approach because construction speeds are generally lower than normal speeds and lower speeds are generally known to produce lower noise levels than higher speeds. During the comparison, each detour route was divided into blocks between intersecting streets. The receivers used for the Project's TNM analysis were used to identify which blocks would be most sensitive to noise level increases. **Table 6-4-6-21** shows the average increases in traffic for each detour route, the number of blocks that are affected, and the range of noise levels along each detour route. Average noise levels shown in the table are based on AM peak hour traffic from the 2013 TNM noise analysis because the traffic volumes between 2013 and 2020 are expected to be similar.

Of the nine detour routes, five routes had overall increases in traffic equal to or greater than 100 percent. All nine detour routes had at least one block with an increase in traffic greater than 100 percent. These effects would be perceptible at noise sensitive receivers during the detour periods. The following sections of the detour routes throughout Downtown Syracuse were reviewed:

- **West Genesee Street and Erie Boulevard:** The detour route along West Genesee Street and Erie Boulevard is between the exit ramp from North West Street and South Crouse Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 60 to 71 dB(A). A 99 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be an overall perceptible increase in noise levels for this detour route. Five of the twelve blocks (blocks between the I-690 off-ramp and North Franklin Street and between North McBride Street and South Crouse Avenue) along this detour route had predicted increases in traffic greater than 100 percent. Eight sensitive receivers (one residence, a church playground, Syracuse VA Dental Clinic, Time Warner Cable News studio, and four outdoor seating areas) near these five blocks could have a perceptible increase in noise levels.

Table 6-4-6-21
Community Grid Alternative Traffic Detour Summary

Detour Route	Average Increase in Traffic[1]	Total Number of Blocks[2]	Number of Blocks Affected[3]	Total Number of Receivers Along Full Detour Route[4]	Number of Receivers Along Affected Blocks[5]	Range of Existing Noise Levels Along Detour Route (dB(A))[6]	Perceptible Increase in Noise Level Anticipated at Noise Sensitive Receivers (Y/N)
W Genesee St + Erie Blvd	99%	12	5	19	8	60-71	Y
Washington St	75%	8	2	6	1	61-66	Y
Fayette St	48%	10	1	11	1	55-70	Y
S Crouse Ave	432%	7	7	12	12	53-65	Y
Irving Ave	602%	3	3	6	6	55-62	Y
Salina St	72%	8	1	12	0	63-70	N
Pearl St Ramps to NB I-81	152%	6	4	4	3	58-70	Y
Clinton St	73%	7	1	15	4	62-70	Y
Ramps to NB I-81 from N State St	296%	2	1	0	0	N/A	N

Notes:
N/A - No noise sensitive receivers were identified along the detour route; therefore, there was no average noise level calculated for the detour route.
1. The percent average along the entire detour route. Even if the average is lower than 100 percent, there can still be affected blocks along the route that are greater than 100 percent.
2. The total number of blocks that are along a detour route.
3. The total number of blocks along a detour route that had an increase in traffic greater than 100 percent.
4. The total number of receivers along the entire detour route.
5. The total number of receivers near the affected blocks along the detour route.
6. The range of noise levels (from the 2013 TNM model results) for the receivers along the entire detour route.

Of the nine detour routes, five routes had overall increases in traffic equal to or greater than 100 percent. All nine detour routes had at least one block with an increase in traffic greater than 100 percent. These effects would be perceptible at noise sensitive receivers during the detour periods. The following sections of the detour routes throughout Downtown Syracuse were reviewed:

- **West Genesee Street and Erie Boulevard:** The detour route along West Genesee Street and Erie Boulevard is between the exit ramp from North West Street and South Crouse Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 60 to 71 dB(A). A 99 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be an overall perceptible increase in noise levels for this detour route. Five of the twelve blocks (blocks between the I-690 off-ramp and North Franklin Street and between North McBride Street and South Crouse Avenue) along this detour route had predicted increases in traffic greater than 100 percent. Eight sensitive receivers (one residence, a church playground, Syracuse VA Dental Clinic, Time Warner Cable News studio, and four outdoor seating areas) near these five blocks could have a perceptible increase in noise levels.

- **Washington Street:** The detour route along Washington Street is between South Clinton Street and Forman Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 61 to 66 dB(A). A 75 percent average increase in traffic was predicted along this detour route; therefore, no perceptible increase in noise levels is anticipated along the majority of this detour route. Two of the eight blocks (blocks between South McBride Street and Forman Avenue) along the detour route had predicted increases in traffic greater than 100 percent. One sensitive receiver location (a school, Syracuse Center of Excellence) was identified near these two blocks that could have a perceptible increase in noise levels.
- **Fayette Street:** The detour route along Fayette Street is between South Clinton Street and South Crouse Avenue. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 55 to 70 dB(A). A 48 percent average increase in traffic was predicted along this detour route; therefore, no perceptible increase in noise levels is anticipated along the majority of this detour route. However, one of the ten blocks (block between Forman Avenue and Irving Avenue) along this detour route had predicted increases in traffic greater than 100 percent. One sensitive receiver location (an outdoor seating area) was identified near this block that could have a perceptible increase in noise levels.
- **South Crouse Avenue:** The detour route along South Crouse Avenue is between Harrison Street and the on-ramp from South Crouse Avenue to eastbound I-690. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 53 to 65 dB(A). A 432 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels along this detour route. All seven blocks along this detour route had predicted increases in traffic that were greater than 100 percent. Twelve (12) sensitive receivers (one outdoor vendor, seven residential areas, and four medical buildings--Hill Medical Center, Pulmonary Health Physicians, Arthritis Health Associates, and Crouse Medical Practice) were identified along this detour route that could have a perceptible increase in noise levels.
- **Irving Avenue:** The detour route along Irving Avenue is between East Genesee Street and Erie Boulevard. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 55 to 62 dB(A). A 602 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels along this detour route. All three blocks along this detour route had predicted increases in traffic that were greater than 100 percent. Six sensitive receivers (one church (First Fruit Ministries), one medical building (Syracuse VA Dental Clinic), an outdoor seating area, and three residential areas) were identified near this detour route that could have a perceptible increase in noise levels.
- **Salina Street:** The detour route along Salina Street is between Harrison Street and the ramp to Pearl Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 63 to 70 dB(A). A 72 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels along the majority of this detour route. One of the eight blocks (block between East Willow Street and Herald Place) along the detour route had a predicted increase in traffic greater than 100 percent; however, no sensitive receivers were identified near this block.

- **Pearl Street Ramps to Northbound I-81:** This detour route includes the segments of Hickory Street and East Willow Street that lead to Pearl Street and the on-ramps to northbound I-81. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 58 to 70 dB(A). A 152 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels along this detour route. Four of the six blocks (blocks between the ramp to Pearl Street and the ramp to I-81 from Pearl Street southbound and between Pearl Street and East Willow Street north of Pearl Street) had predicted increases in traffic that were greater than 100 percent. Two sensitive receivers (one parklike sitting area and one picnic area) were identified near these four blocks that could have a perceptible increase in noise levels.
- **Clinton Street:** The detour route along Clinton Street is between Gifford Street and the exit ramp from southbound I-81 to South Clinton Street. Traffic noise modeling indicated that existing AM peak hour noise levels along this route range from 62 to 70 dB(A). A 73 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be no perceptible increase in noise levels along the majority of this detour route. One of the seven blocks (block between Herald Place and James Street) along the detour route had a predicted increase in traffic that was greater than 100 percent. Four sensitive receivers (one residence, one outdoor seating area, and two outdoor dining areas) were identified near this block that could have a perceptible increase in noise levels.
- **Ramps to Northbound I-81 from North State Street:** This detour route includes the on-ramps to northbound I-81 from both northbound and southbound North State Street. Existing AM peak hour noise levels were not calculated along this detour route since no noise sensitive receivers were identified in this immediate area. A 296 percent average increase in traffic was predicted along this detour route; therefore, it is anticipated that there would be a perceptible increase in noise levels along this detour route. One of the two blocks (the ramp to northbound I-81 from southbound North State Street) along this detour route had a predicted increase in traffic greater than 100 percent, however no noise sensitive receivers were identified along this route.

As described in **Chapter 4, Construction Means and Methods**, NYSDOT would require the Contractor to implement construction protocols and practices to mitigate effects for the Project. These commitments would include measures to abate construction noise.

Construction Vibration

The methodology used to assess construction vibration was discussed above for the Viaduct Alternative (see **Section 6-4-6.3.2**). The same methodology and criteria are applicable to the analysis of the Community Grid Alternative. Vibration criteria and vibration source levels for construction equipment are presented in **Tables 6-4-6-8 and 6-4-6-9**, respectively. Under the Community Grid Alternative, construction activities with the highest potential to result in damage due to vibration include pile driving and potentially some limited drilling in rock. However, it should be noted that disruptive construction activities (including pile driving) will be considered during final design to identify less disruptive means of completing operations. For additional information on construction methods, see **Chapter 4, Construction Means and Methods**.

Architectural or Structural Damage from Vibration

In terms of potential vibration levels that would result in architectural damage, construction would have the most potential for producing levels that would exceed the 0.20 inches per second PPV limit for fragile buildings at locations within a distance of approximately 55 feet from the typical operation of an impact pile driver or approximately 15 feet from the operation of a drill rig. Construction would have the most potential for producing levels that would exceed the 0.50 inches per second PPV limit at locations within a distance of approximately 30 feet from the operation of an impact pile driver or approximately eight feet from the operation of a drill rig. Distances for potential structural damage were calculated using the reference values from **Table 6-4-6-10** and the damage assessment formula in Chapter 12 of the FTA Noise and Vibration Manual.

No buildings that would be considered fragile are located within the distance from the proposed construction work areas that could result in PPV levels that would potentially result in damage to fragile structures (i.e., within 55 feet). Buildings and structures located within 55 feet, but more than 30 feet, from the proposed construction work include modern structures built with contemporary building techniques, and consequently these would not be expected to experience construction vibration at a level that could potentially cause damage. As described in **Chapter 4, Construction Means and Methods**, NYSDOT would require that the Contractor comply with the construction protocols and practices developed for the Project. These requirements would include a construction vibration monitoring program to minimize the potential for such damage.

Human Perceptibility and Annoyance from Vibration

Pile driving would have the most potential for producing perceptible and annoying vibration levels exceeding the 72 VdB limit. Based on the reference values from **Table 6-4-6-10** and the annoyance assessment formula in Chapter 12 of the FTA Noise and Vibration Manual, it is likely that receivers (human activity conducted in buildings) within a distance of approximately 290 feet of typical pile driving operations would experience perceptible and annoying vibration levels. However, pile driving would occur for only limited periods of time at a particular location. Pile driving activities would progress along the project corridor at a rate of approximately 200 feet per week. Consequently, it is expected that the maximum duration that any receiver would experience perceptible/annoying levels of vibration would be three weeks. A construction vibration monitoring program will be in place to identify vibration concerns as construction progresses through the corridor. If the construction vibration monitoring program indicates a concern, abatement methodologies would be implemented, such as alternate construction methods to reduce or eliminate the impacts. For additional information on construction methods, see **Chapter 4, Construction Means and Methods**.

Vibration Assessment Criteria for Sensitive Equipment or Activities

As described above, the operation of specific equipment and specific activities can be affected by vibration even at levels lower than is perceptible or annoying to humans. Such equipment and activities, including microscopes, nuclear magnetic resonance (NMR) imaging equipment, and various types of surgery, are used or occur within various medical facilities and campuses located near the project work areas. **Table 6-4-6-10** shows predicted vibration levels at twenty-five feet from vibration-producing construction activities (e.g., pile driving). It is assumed that pile driving would progress along the project corridor at a rate of approximately 200 feet per week. Note that the levels in **Table 6-4-6-9** are for the basement level; vibration would be reduced at upper floors of buildings.

As part of its communications protocol during construction (see **Chapter 4, Construction Means and Methods**), NYSDOT and its Contractor would provide as much notice of construction activities to the medical facilities as possible and would coordinate with them to resolve schedule conflicts if construction activities would impact critical surgeries or procedures.

Based on the assessment of construction vibration presented above, no adverse effects are expected to occur as a result of construction-generated vibration associated with the Community Grid Alternative.

6-4-6.5.3 INDIRECT EFFECTS

As discussed in **Section 6-2-1, Neighborhood Character,** the Community Grid Alternative could lead to reinvestment in areas with poor accessibility due to the current viaduct, particularly along the Almond Street corridor south of I-690, and on land vacated from the removal of the viaduct. Although substantial development may occur, it is likely to occur on vacant land and not displace current uses. Infill development, such as residential or a mix of uses that includes residential, office, and ground floor retail, would further reconnect existing neighborhoods. The land parcels that could be converted from transportation to other uses would be subject to local land use regulations. Individual developments in these areas are likely to be relatively small and would not induce substantial changes in noise levels within the study area and, therefore, would not result in indirect effects.

6-4-6.5.4 CUMULATIVE EFFECTS

The traffic data that were used in the noise modeling accounted for traffic diversions associated with the Community Grid Alternative as well as traffic associated with known or reasonably foreseeable projects. Therefore, the results of the noise analysis reflect the traffic effects of the proposed action combined with that of reasonably foreseeable actions identified within the Project Area.

6-4-6.5.5 ABATEMENT

Permanent/Operational Traffic Noise Abatement

Abatement Considerations and Procedures

When noise impacts are predicted for a project, noise abatement must be considered for the impacted areas. In accordance with the NYSDOT Noise Policy, for noise abatement measures to be recommended, an abatement measure must be both feasible and reasonable. The procedures for identifying feasible and reasonable abatement measures are described in **Section 6-4-6.3.5**.

An evaluation of feasibility and reasonableness for each potential abatement measures as they relate to the Community Grid Alternative is provided below. Noise barriers as an abatement measure are discussed in more detail in a separate section following the other measures, given that noise barriers have a greater applicability for this Project.

- **Traffic Management (Prohibition of Vehicle Types and Time-Use Restrictions):** Prohibition or time restrictions of heavy vehicles along the local roadways in these areas is not considered reasonable because the Central Study Area is a mix of commercial and residential land uses where most of the heavy vehicles are delivery trucks and buses. These vehicles are essential to commerce and public transportation within the study area and cannot be re-routed. In addition, prohibition or time restrictions of heavy vehicle use along I-81, I-481, and I-690 would not be considered reasonable as they are major commerce routes for the region and provide regional access to the local roadways in Downtown Syracuse.

- **Traffic Management (Modified Speed Limits):** Speed limits can theoretically be reduced throughout the Project Area; however, generally a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels to occur. Speeds on the local roadway network are generally posted with a speed limit of 25 to 30 mph, such that a reduction in posted speed limit to achieve a noticeable reduction in noise level would not be reasonable. In addition, the highways within the overall study area (I-81, I-481, and I-690) would be anticipated to have posted speed limits of 55 to 65 miles per hour. These speed limits cannot be reduced sufficiently to have a noticeable reduction in noise level due to the highways' intended purpose of moving people and goods through the area quickly and efficiently. Given the design and function of these highways, posted speeds of 35 to 45 mph would not be reasonable under the scope of this Project.
- **Traffic Management (Exclusive Lane Designations):** Within the Central Study Area, exclusive lane designations would not be effective or practical since the existing and proposed roadways are local collectors with driveway and side street access that must be maintained at all times for neighborhood residents, as well as for school buses and delivery trucks. Exclusive lane designations on elevated highways would not be effective in terms of noise reduction since the echo and indirect nature of the noise would not allow for a substantial reduction to occur. In addition, exclusive lane designations throughout I-81, I-481, and I-690 would not be effective as a noise abatement measure since they are not wide enough to make a difference in noise levels.
- **Alteration of Horizontal Alignments:** The use of this noise abatement measure is most applicable when a new facility alignment is proposed, rather than a widening or reconstruction along an existing alignment such as proposed for this Project. A horizontal alignment shift of more than 100 feet is generally required to yield noise reductions large enough to justify implementation of horizontal alignment change as an abatement measure. Therefore, this abatement measure would not be suitable in the Central Study Area or populated areas of the corridors where there are noise sensitive land uses or other developments on both sides of the corridor (i.e., moving the alignment away from one area of receivers may move the alignment closer to another, or cause direct encroachment impacts). In suburban areas where there may be noise sensitive uses on only one side of the road, a horizontal alignment shift may not be feasible from an engineering perspective because of the geometric requirements to transition back to the existing highway at each end. There are also other socioeconomic and environmental concerns that may exist on the other side of the highway where the horizontal shift may be made. In the case of the Community Grid Alternative, 10 locations along I-81 and I-481 were identified where the road could potentially be shifted to one side as a noise abatement measure to reduce noise levels on the impacted nearby receivers, although none of these locations were identified as being feasible or reasonable due to the extenuating circumstances identified below.

- Greenfield Parkway vicinity along the I-81 Northern Segment near Interchange 24: Although land on the east side of I-81 appears to be vacant, a portion of the vacant land that exists is wetlands.
- Bear Trap Creek Trail vicinity along the I-81 Northern Segment north of its interchange with I-90: Although land on the west side of I-81 appears to be vacant, a horizontal shift would likely require a non-standard bend in the road.
- Taft Road vicinity between its intersection with I-481 and Northern Boulevard: Although land on the northeast side of I-481 appears to be vacant, wetlands are present on that side of I-481.
- Brittonfield Parkway vicinity immediately north of the I-481 interchange with I-90: Although land on the east side of I-481 appears to be vacant, wetlands are present on that side of I-481.
- Fly Road vicinity immediately south of the I-481 interchange with Kirkville Road: Although land on the east side of I-481 appears to be vacant, this is an interchange and there are wetlands on the east side of I-481 in this area.
- Butternut Creek Trail vicinity along I-481 between Highway 5 and Kinne Road Bridge: Although land on the northwest side of I-481 appears to be vacant, there are wetlands on the west side of I-481 in this area.
- Andrews Road vicinity along I-481 south of its interchange with Highway 5: Although land on the east side of I-481 appears to be vacant, there are wetlands on the east side of I-481 in this area.
- Butternut Creek Golf Course along I-481 north of the Jamesville Road Bridge: Although land on the east side of I-481 appears to be vacant, there are houses outside of the immediate noise impact area that could potentially be affected by noise increases if I-481 was moved closer to them.
- Church on Old Stonehouse Road near I-481 between Jamesville Road Bridge and the railroad bridge to the south: Although land on the south side of I-481 appears to be vacant, there are wetlands on the south side of I-481 in this area.
- Rock Cut Road Trailer Park on Cliffside Park Road near I-481: I-481 could not be shifted northward and away from the noise receivers in this area due to wetlands and a railroad on the north side of I-481.

- **Alteration of Vertical Alignments:** Reduction of noise levels through modification of the vertical profile of the Community Grid Alternative could result from the elimination or reduction of the line-of-sight between the vehicular noise sources (tire noise and exhaust pipes) and the receivers. Most automobiles and light trucks have exhaust pipes located at approximately one to two feet above the roadway surface, although many trucks and buses have exhaust pipes that outlet at approximately 9.8 feet above the roadway surface. Options for changes in vertical alignment include the following:
  - Raising the roadway: The roadway would have to be raised approximately eight to 10 feet to begin to noticeably reduce noise levels to adjacent receivers. However, reduction of noise levels to an extent that would justify implementation of an abatement measure would likely require a more extreme change in the vertical alignment. Within the Downtown and residential

areas of the Project, engineering obstacles for raising the roadway elevation include unacceptable driveway and yard pitches and the addition of undesirable visual and aesthetic concerns. Within suburban areas, this option would not be effective because the extreme raising of the roadway that would be required for justification of the abatement measure would not be reasonable.

- Lowering the roadway: In general, elimination of the existing I-81 viaduct as part of the Community Grid Alternative would already function, to an extent, as a form of noise abatement in that area of the Project. Throughout the rest of the Project Area, depending on the elevation of the receivers and their locations with respect to the roadway, the roadway would have to be lowered approximately four to six feet to begin to reduce noise levels. However, reduction of noise levels to an extent that would justify implementation of an abatement measure would likely require a more extreme change in the vertical alignment. Potential engineering obstacles for lowering the roadway elevation include a seasonally high groundwater table, potential flooding concerns, and the likely requirement of pumping stations for stormwater drainage along the corridor. Retaining walls could also be required (due to the grade change), which could, in part, function like noise barriers; actual noise barriers may be a better solution. Lowering the roadway could also add undesirable visual and aesthetic concerns.

- **Acquisition of Real Property to Serve as a Buffer Zone:** This abatement measure allows for acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely impacted by traffic noise. This measure is not used to purchase homes or developed property to create a noise buffer zone. It is used to purchase unimproved property to preclude future noise impacts where development has not yet occurred. This would not be effective for the receivers located in the Central Study Area since this Project is not meant to discourage additional development in this area. In addition, this option would not be reasonable in the suburban areas; however, NYSDOT would conduct outreach to local officials regarding noise-compatible land use planning.

- **Noise Insulation of Publicly Owned School Buildings:** Potential noise insulation of publicly owned school buildings located off the highway right-of-way was evaluated. Per NYSDOT Noise Policy, for this measure to be recommended, the NYSDOT Commissioner must determine that it is in the best interest of the State considering, among other factors, the cost and feasibility of other alternatives. The overall Project Area was investigated to identify public schools that could be impacted by this Project. Two public schools with potential predicted exterior noise impacts related to the Community Grid Alternative were identified within the overall Project Area. Based on exterior noise levels, interior noise levels were calculated and interior noise impacts are not predicted; therefore, for the reasons stated below, neither of these schools is recommended for noise insulation specifically related to the proposed Project.

  - SUNY Upstate University Hospital has a building near Fly Road called Upstate University Neurology. Based on an exterior peak hour noise level of 64 dB(A) at a comparable receiver, it is not anticipated that there would be an exterior noise impact adjacent to the Upstate University Neurology building. In general, calculation of interior noise levels from exterior noise levels is done through the use of building noise reduction factors. Given the reinforced building structure of an institutional facility such as the SUNY Upstate University Hospital, a building noise reduction factor of approximately 25-30 dB(A) would be appropriate. Therefore, the contribution from area roadways to the interior noise levels is likely approximately 39 dB(A) or less during the peak hour. Given that the NAC noise level for a Category D interior is 52 dB(A), the interior noise levels at this building are not anticipated to be above the NAC for a Category D land use; therefore, noise abatement is not warranted. Additionally, since daytime interior noise levels from sources unrelated to traffic (e.g., talking or other noise) are expected to be in this range or above, it is not anticipated that additional noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building.

- Roxboro Road Middle School is near the I-81 Northern Segment between its interchanges with I-90 and Brewerton Road. Noise Barrier 16A&B is recommended in this area for abatement of exterior noise impacts at the school sports fields. The two modeled receivers located on the school sports fields have unabated noise levels of 66 dB(A) and 62 dB(A) and abated noise levels of 58 dB(A) and 56 dB(A), respectively. The difference in noise levels between the two receiver locations is due to one receiver being closer to I-81 than the other. The actual school building is outside the noise study area at a further distance from I-81 than either of these receivers. Therefore, deductive reasoning indicates that the actual school building is far enough from I-81 that there would not be an exterior traffic noise impact adjacent to the building. In general, calculation of interior noise levels from exterior noise levels is done through the use of building noise reduction factors. Given the reinforced building structure of an educational facility such as the Roxboro Road Middle School, a building noise reduction factor of approximately 25-30 dB(A) would be appropriate. Therefore, even without Noise Barrier 16A&B, the contribution from area roadways to the interior noise levels is likely approximately 37 dB(A) or less during the peak noise hour. Given that the NAC noise level for a Category D interior is 52 dB(A), the interior noise levels at this building are not anticipated to be above the NAC for a Category D land use; therefore, noise abatement of the building for interior spaces is not warranted. Additionally, since daytime interior noise levels from sources unrelated to traffic (e.g., talking or other noise) are expected to be in this range or above already, it is not anticipated that additional noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building. It should also be noted that the recommendation of Noise Barrier 16A&B is related to exterior noise impacts at the sports fields and independent of the interior noise considerations discussed in this paragraph. Regardless, the abatement modeling shows that Noise Barrier 16A&B would tend to reduce overall noise levels within the school grounds and by approximately 6-8 dB(A) in the vicinity of the sports fields.

- **Noise Insulation of Other Activity Category D Buildings:** Activity Category D land uses are generally the interior of structures associated with the following: auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. There are 113 receivers within the noise study area that were identified as associated with Activity Category D structures. Given that the Activity Category D NAC is an interior noise level of 52 dB(A), and an interior noise impact is identified as a noise level within 1 dB(A) of the NAC, structures were assessed to determine if the noise emanating from the roadways would contribute an interior noise level of at least 51 dB(A). In general, based on the type of building construction, building noise reduction factors can be assigned to calculate interior noise levels from exterior noise levels. While residential structures generally have a noise reduction factor of 20-25 dB(A) without noise insulation, institutional structures normally have a noise reduction factor of 25-30 dB(A) without noise insulation. Therefore, depending on the type of building construction in place, it is anticipated that it would take exterior noise levels in the range of at least 71 to 81 dB(A), and thus an interior noise level of 51 dB(A), for an institutional structure to be considered impacted. Based on a review of each of the structures associated with the 113 identified Activity Category D receivers, none of the structures is predicted to have noise levels above its NAC for Activity Category D. However, the following two Activity Category D locations had an exterior substantial increase in noise:

- The Spectrum television studio at 815 Erie Boulevard East had a predicted substantial increase in the exterior noise level due to the expected increase in traffic volumes along Erie Boulevard East. The Spectrum television studio is a reinforced structure and is expected to be well insulated from exterior noise levels due to the nature of the studio's usage. It is anticipated that the building construction and insulation of the structure would provide a noise reduction factor at a minimum of 30 dB(A) or more to the critical areas of operation that require low noise levels. Given a predicted exterior noise level of 70 dB(A) at this location, peak-hour traffic noise contributions to the interior noise levels are estimated to be 40 dB(A) or less (i.e. below the Activity Category D NAC). Additionally, since daytime interior noise levels from sources unrelated to traffic (e.g. HVAC, office equipment, talking or other noise) are expected to be in this range or above, it is not anticipated that additional noise insulation beyond what is already in place would reduce interior noise levels to an extent that would justify noise abatement at this building; therefore, noise abatement is not warranted. Additionally, due to the existing ambient noise floor as described above, a 6 dB(A) increase from the traffic noise at the exterior of the building is not expected to result in the same 6 dB(A) increase in interior noise levels. The increase is expected to be much less pronounced and not easily perceptible. Consequently, no substantial increase in interior noise levels is anticipated.
- The medical building at 910 Erie Boulevard East had a predicted substantial increase in the exterior noise level due to the expected increase in traffic volumes along Erie Boulevard East. This structure houses medical uses including the DaVita Central New York At Home medical facility, the Central New York Dialysis Center, a veteran's pain management center, and a veteran's dental office. While portions of the building are leased by Veterans Administration facilities, it is owned by a private domestic limited liability company. This is an institutional facility with a reinforced building structure that would be expected to provide an inherent noise reduction factor of approximately 25-30 dB(A). Given a predicted exterior noise level of 71 dB(A) at this location, it is anticipated that peak-hour traffic noise contributions to the interior noise levels would potentially be in the range of 41-46 dB(A) (i.e., below the Activity Category D NAC). Additionally, since daytime interior noise levels from sources unrelated to traffic (e.g., talking or other noise) are expected to be in this range or above already, it is not anticipated that additional noise insulation would reduce interior noise levels to an extent that would justify noise abatement at this building; therefore, noise abatement is not warranted. Additionally, due to the existing ambient noise floor as described above, a 6 dB(A) increase from the traffic noise at the exterior of the building is not expected to result in the same 6 dB(A) increase in interior noise levels. The increase is expected to be much less pronounced

and not easily perceptible. Consequently, no substantial increase in interior noise levels is anticipated.

Noise Barrier Analysis

For the Community Grid Alternative, the most effective method of noise abatement has been determined to be the use of noise barriers, which can be constructed of brick, steel, or concrete. The use of an earthen berm instead of a noise barrier was not considered due to the amount of land area required for such berms, which generally cannot be accommodated within the limited space of a highway right-of-way. Aesthetic design of the noise barriers would be developed by a team of landscape architects during final design and in coordination with Project stakeholders and the Urban Design Technical Advisory Panel (UDTAP), which includes landscape architects, architects, and a city representative.

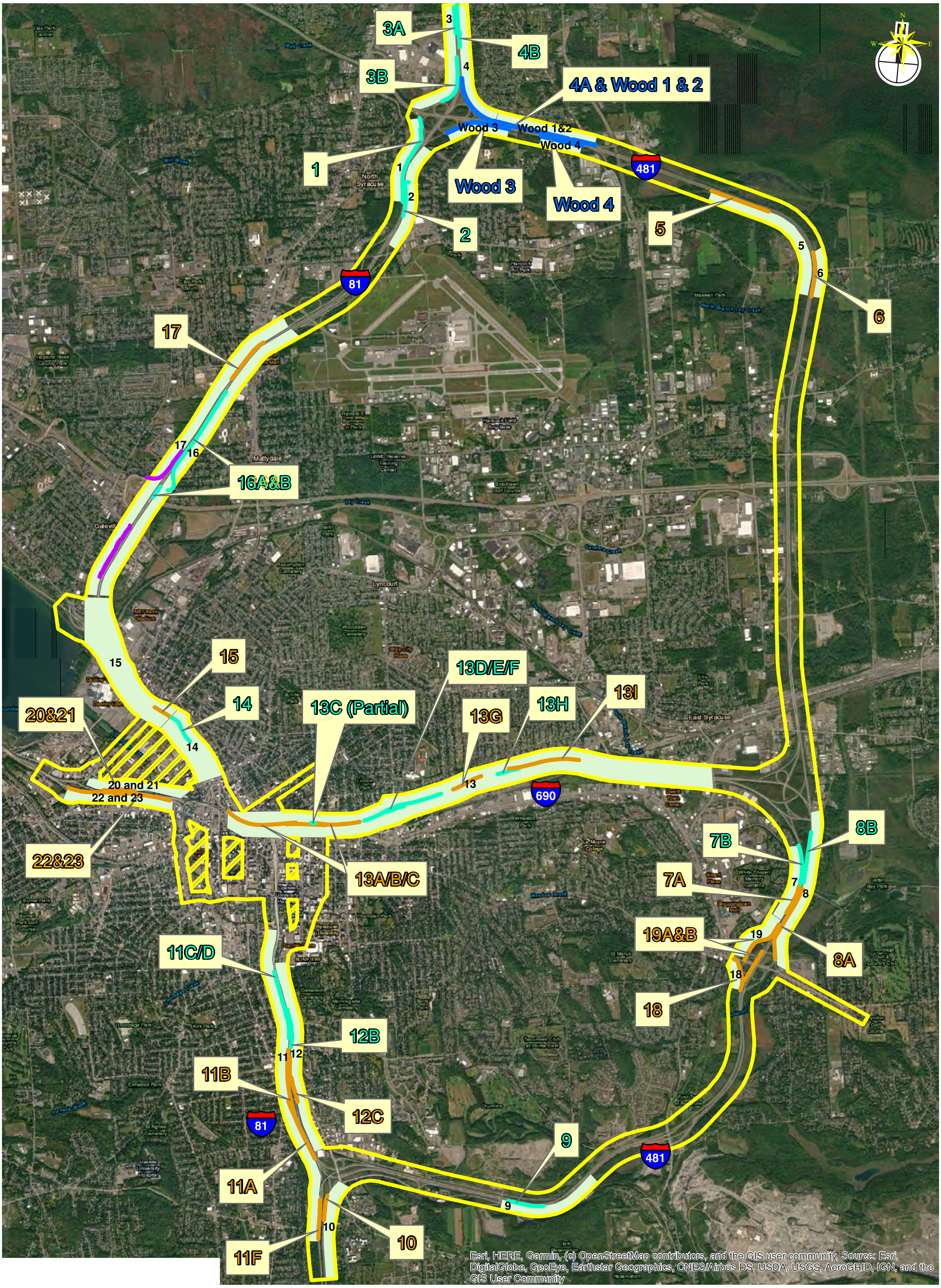
For a barrier to provide effective noise reduction, it must be continuous and designed to an elevation high enough to shield the receiver from the noise source. Noise barrier locations were chosen for study if there was a potential that noise barriers could be considered both feasible and reasonable. Noise barriers were not considered feasible along the local streets in much of the Central Study Area of the Project since openings for driveways would need to be provided for the residences and businesses, which would negate the effectiveness of the noise barrier. Therefore, no detailed evaluation of such barriers in the Downtown area was conducted.

Twenty one (21) general locations where traffic noise impacts have been predicted and a quantitative noise abatement analysis was considered appropriate were identified within the Project Area. Specifically, the areas located along the study area highways were assessed to determine whether the construction of one or more noise barriers within each of these areas would be feasible and reasonable for this Project. The locations of these 21 areas are shown in **Figure 6-4-6-2**.

The individual noise barriers within each of these areas that were developed, modeled, and evaluated in terms of their feasibility and reasonableness are also depicted in **Figure 6-4-6-2**, as well as in the Community Grid Noise Abatement figures in Attachment K of **Appendix H**. The topography, length, and development patterns within each area were used to determine whether more than one noise barrier was considered in each area. A total of 37 noise barriers have been developed and evaluated throughout the project area for the Community Grid Alternative, with each keyed to the area in which it is located (e.g., Barriers 4A and 4B in Area 4). The locations of all barriers evaluated are listed below:

- **Barrier 1** is located along the right of way and shoulder of southbound I-81 in North Syracuse between the southbound I-481 connector to southbound I-81 and the southbound I-81 off-ramp to East Taft Road.
- **Barrier 2** is located along northbound I-81 in North Syracuse between the East Taft Road on-ramp to northbound I-81 and the northbound I-81 to southbound I-481 connector.
- **Barrier 3A** is located along southbound I-81 in Cicero near West Pine Road and north South Bay Road.
- **Barrier 3B** is located along southbound I-81 in Cicero between South Bay Road and the southbound I-81 to northbound I-481 connector.

11.18.21



Source: *Watts Architecture & Engineering*

Project Study Area Limits

Downtown Exclusion Areas
(Note: Some areas of Downtown Syracuse are shown as excluded from the study area due to their distance from the involved roadways.)

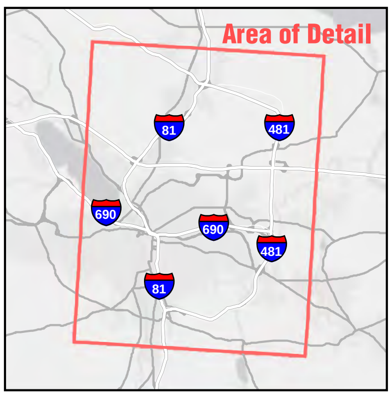
Abatement Study Areas

Existing Noise Barrier

Noise Barrier Recommended

Noise Barrier Not Recommended

Wooden Barrier System Restoration



0 3,000 6,000 12,000 Feet

I-81 Viaduct Project

Community Grid Alternative TNM Modeling Areas

Figure 6-4-6-2

- **Barrier 4A & Wood 1&2** is located along the northbound I-481 connector to I-81 in Cicero between Bourdage Road and the Northern Boulevard on-ramp to northbound I-481. Wood 1&2 are existing barriers. Collectively, Barrier 4A and Wood 1&2 would be merged into one barrier, which would replace barriers Wood 1&2 and extend along the southbound I-81 to northbound I-481 connector to merge with Barrier 4A.
- **Wood 3** is an existing barrier located along the northbound I-81 connector to I-481 North Syracuse.
- **Wood 4** is an existing barrier located along eastbound I-481 in Cicero between Thompson Road and Totman Road.
- **Barrier 4B** is located along the right of way and shoulder of northbound I-81 in Cicero between South Bay Road and Farrington Road.
- **Barrier 5** is located along southbound I-481 in East Syracuse between Northern Boulevard and East Taft Road.
- **Barrier 6** is located along northbound I-481 in East Syracuse between Bridgeport Road and East Taft Road.
- **Barrier 7A** is located along southbound I-481 in East Syracuse between East Genesee Street and Kinne Road.
- **Barrier 7B** is located along southbound I-481 in East Syracuse between I-690 and Kinne Road.
- **Barrier 8A** is located along northbound I-481 in East Syracuse between the Highway 5 on-ramp and Kinne Road.
- **Barrier 8B** is located along northbound I-481 in East Syracuse between Kinne Road and Heritage Landing Drive.
- **Barrier 9** is located along northbound I-481 in Jamesville between the Rock Cut Road on-ramp to northbound I-481 and Rams Gulch Road.
- **Barrier 10** is located along northbound I-81 in Syracuse between Arsenal Drive and the northbound I-81 to northbound I-481 connector.
- **Barrier 11A** is located along southbound I-81 in Syracuse between the South Salina Street on-ramp to southbound I-81 and the southbound I-81 connector to southbound I-481.
- **Barrier 11B** is located along southbound I-81 in Syracuse between the southbound I-81 off-ramp to South State Street and the South Salina Street on-ramp to southbound I-81.
- **Barrier 11C/D** is located along southbound I-81 in Syracuse between the MLK, Jr. East on-ramp to southbound I-81 and the southbound I-81 off-ramp to South State Street.
- **Barrier 11F** is located along the southbound I-481 to northbound I-81 connector in Syracuse between I-481 and Arsenal Drive.
- **Barrier 12B** is located along northbound I-81 in Syracuse between the South Salina Street on-ramp to northbound I-81 and the East Colvin Street on-ramp to northbound I-81.

- **Barrier 12C** is located on state right-of-way in Syracuse between the northbound I-81 off-ramp to South Salina Street and the South Salina Street on-ramp to northbound I-81.
- **Barrier 13A/B/C** is a three-barrier system located along westbound I-690 in Syracuse between Beech Street and the westbound I-690 connector to northbound I-81.
- **Barrier 13C (Partial)**, which is the westernmost portion of Barrier C included in the Barrier 13A/B/C system, is located along westbound I-690 in Syracuse immediately to the east of North Crouse Avenue.
- **Barrier 13D/E/F** is a three-barrier system located along westbound I-690 in Syracuse from a point just east of Peat Street to Beech Street.
- **Barrier 13G** is located along westbound I-690 in Syracuse between the westbound I-690 on-ramp from Midler Avenue to just east of Peat Street.
- **Barrier 13H** is located along westbound I-690 in Syracuse between the westbound I-690 off-ramp to Midler Avenue and the Midler Avenue overpass.
- **Barrier 13I** is located along westbound I-690 in Syracuse between Thompson Road and the westbound I-690 off-ramp to Midler Avenue.
- **Barrier 14** is located on state right-of-way along northbound I-81 in Syracuse between Spencer Street and Court Street.
- **Barrier 15** is on state right-of-way near northbound I-81 between Court Street and Bear Street.
- **Barrier 16A&B** is a two-barrier system located along northbound I-81 in Syracuse between I-90 and the northbound I-81 off-ramp to Highway 11.
- **Barrier 17** is located along southbound I-81 in Syracuse between South Bay Road and the Brewerton Road on-ramp to southbound I-81.
- **Barrier 18** is located along southbound 1-81 on ramp from Route 5 in East Syracuse.
- **Barrier 19A&B** is a two-barrier system located along I-81 off-ramp to Route 5 in East Syracuse.
- **Barrier 20&21** is a two-barrier system located along westbound I-690 near North Geddes Street and along westbound I-690 off-ramp to North Geddes Street in Syracuse.
- **Barrier 22&23** is a two-barrier system located along eastbound I-690 near North Geddes Street and along eastbound I-690 on-ramp from North Geddes Street in Syracuse.

Table 6-4-6-22 presents the results of the evaluation for each of the above-listed barriers and/or barrier systems, including the range of existing hourly L_{eq} noise levels at each location, the range of future hourly L_{eq} noise levels without and with a barrier for the receivers at each location, approximate barrier length, and average barrier height. The noise level reductions and the barrier dimensions as summarized in this table were then used to assess the feasibility and reasonableness of each barrier. Also indicated in the table is the corresponding figure number for each barrier, as shown in the Community Grid Noise Abatement figures in Attachment K of **Appendix H**. The modeling coordinates of all noise barriers evaluated for the Community Grid Alternative are presented in the Community Grid Noise Abatement tables in Attachment M in **Appendix H**.

Table 6-4-6-22
Community Grid Alternative: Results of Noise Barrier Modeling and Evaluation

Noise Barrier ID	Noise Abatement Figure Number in Appendix H*	Range of Existing Leq (1hr) Noise Levels	Range of Future Build Leq(1hr) Noise Levels, dB(A)		Barrier Characteristics	
			w/o Barrier	With Barrier	Approx. Length (ft)	Avg. Height (ft)
1	4	58-78	58-77	56-64	4158	12 to 14
2	4	61-76	60-76	56-64	1706	12
3A	4	60-68	61-71	57-62	1193	12
3B	4	61-76	62-76	57-63	2359	14
4A & Wood 1&2	4	58-67	60-66	55-63	7490	8 to 14
4B	4	61-74	62-73	57-69	2700	14 to 20
Wood 3	4	61-74	56-65	55-63	2997	14
Wood 4	4	61-74	64-67	56-60	1912	14
5	5	65-67	62-68	59-68	2805	12
6	6	61-68	61-68	56-66	2070	20
7A	8	68	69	65	1347	20
7B	7&8	59-74	61-72	57-71	1916	16
8A	8	62-73	64-73	58-63	3607	12
8B	7&8	63-73	63-73	56-64	2357	12 to 14
9	9	62-68	62-69	56-64	1643	12
10	10	58-70	56-68	56-68	1147	20
11A	10	50-72	62-70	59-67	2940	20
11B	10	61-71	62-68	59-68	2975	20
11C/D	1&10	57-72	55-67	48-66	3145	20
11F	10	55-68	64-68	64-68	1827	20
12B	10	60-72	60-66	56-61	2340	10 to 12
12C	10	58-69	62-66	57-64	2155	6 to 18
13A/B/C	1&11	57-70	56-73	48-68	7360	20
13C (Partial)	1&11	68	69-72	63-66	178	14
13D/E/F	11	62-71	62-71	57-64	4470	16
13G	11	58-72	64-71	60-63	1437	20
13H	11	59-75	64-75	62-65	1032	14
13I	11&12	59-72	62-72	58-65	3292	20
14	1&2	53-67	58-69	58-69	1408	14 to 18
15	2	56-68	58-69	58-69	843	18
16A&B	3	60-78	60-78	55-72	6070	8 to 16
17	3	61-69	62-69	56-67	2241	16
18	8	61-69	59-69	57-69	1582	18 to 20
19A&B	8	61-69	54-67	53-65	3974	20
20&21	2	61-69	62-67	56-64	1881	18 to 20
22&23	2	61-69	62-70	57-70	5137	16

Notes:
Barrier 11C/D is a single barrier that was modeled assuming that the embankment for certain abandoned portions of I-81 would remain after the pavement is removed.
Barrier 4A and Wood1&2 is a single barrier.
Barrier 12A was assessed for the DEIS; however, design changes made to the Community Grid Alternative after publication of the DEIS eliminated traffic noise impacts in this area and therefore Barrier 12A is no longer under consideration for this alternative.
Barriers 16A&B, 19A&B, 20&21, and 22&23 are separate barriers comprising a single barrier system.
*Figures are found in Attachment K of **Appendix H**. The figure number refers to the figure page number within the set of 12 figures.

As noted above in **Section 6-4-6.1**, following the publication of the preliminary DDR/DEIS in April 2019, design modifications were made to the Community Grid Alternative that required that the overall noise study area be increased. Enlargement of the noise study area required analysis of additional noise barriers as well as reanalysis of some of the barriers presented in the April 2019 preliminary DDR/DEIS for both alternatives. As a result of these additional analyses, new noise barriers were analyzed and assessed for feasibility and reasonableness (i.e., Barriers 18, 19, 20, 21, 22, and 23). Opportunity for public comment on the new and modified barriers were provided during the DDR/DEIS public comment period.

Additionally, following the publication of the preliminary DDR/DEIS in April 2019, it was determined that the three existing wooden noise barriers near the I-81/I-481 northern interchange are beyond repair and will need to be replaced. These wooden barriers (noted in the tables as Wood 1&2, Wood 3, and Wood 4) were analyzed to determine an optimal replacement configuration in accordance with today's noise modeling software and standards. These three wooden barriers did not need to undergo the feasibility and reasonableness analysis since they are replacements of existing barriers; however, under this alternative, the "Wood 1&2" barrier was combined with the proposed Barrier 4A.

For each of the above-listed barriers, an evaluation of feasibility and reasonableness was performed pursuant to the previously stated criteria. For each barrier evaluated, **Table 6-4-6-23** presents the total number of impacted and benefited receptors, the number and percentage of impacted receptors that achieve at least a 5 dB(A) reduction, the number of benefited receptors that achieve at least a 7 dB(A) reduction, total square footage of the barrier, square footage of the barrier per each benefited receptor, feasibility of the barrier, and reasonableness of the barrier.

As indicated in **Table 6-4-6-23**, of the 37 barriers and/or barrier systems evaluated for the Community Grid Alternative, 15 would meet the criteria for both feasibility and reasonableness and are recommended for construction as traffic noise abatement measures, contingent on the viewpoints of benefited receptors. The 15 recommended barriers are 1, 2, 3A, 3B, 4B, 7B, 8B, 9, 11C/D, 12B, 13C (Partial), 13D/E/F, 13H, 14, and 16A&B. Barrier 16A&B would be constructed between existing northbound I-81 and a multiuse path and would limit visibility to and from the multiuse path; therefore, transparent panels may be considered in this location.

Barrier 12A is adjacent to the Oakwood Cemetery and discussed under the Viaduct Alternative (see **Section 6-4-6.4.5**). Barrier 12A was assessed for the Community Grid Alternative under the DEIS; however, design changes made to that alternative after publication of the DEIS eliminated the impacts within the cemetery. Therefore, Barrier 12A is no longer under consideration for the Community Grid Alternative.

Noise barriers 20, 21, 22, and 23 are not reasonable for the following reasons:

1. Installing light weight noise barriers on six I-690 bridges between Van Rensselaer Street and Bear Street would require major bridge rehabilitation as the existing bridge parapet walls do not have sufficient carrying capacity to support additional loads. Major rehabilitation would consist of partial deck removal, deck overhang replacement, deck overlay, bearing replacement, approach slab replacement, bridge barrier upgrade with new single slope barrier, and minor substructure and steel repairs. The estimated construction cost for this work totals $11.5M. Cost break downs for each structure are as follows:

    - BIN 1053931, westbound I-690 over Bear Street: $2.2M (rehabilitation cost estimate);

- BIN 1053932, eastbound I-690 over Bear Street: $2.2M;
- BIN 1053941, westbound I-690 over Liberty Street: $1.3M;
- BIN 1053942, eastbound I-690 over Liberty Street: $1.3M;
- BIN 1050759, I-690 over Geddes Street: $2.3M; and
- BIN 1053969, I-690 over Van Rensselaer Street: $2.2M.

2. The cost estimate assumes that the non-standard shoulder widths would be retained. However, if this work were included in the Project, it could result in determining that the shoulders would need to be widened to meet criteria, which would then require the addition of fascia girders and abutment widening on both sides of each directional bridge, further increasing the cost.
3. Each bridge has a general recommendation rating of 5, indicating primary members and substructure are in good condition and do not need major repairs; bridge load capacity is not reduced but other parts of the bridge, such as specific deck elements, may need repair; and girders may require repainting due to corrosion starting on the steel beams.
4. Based on the general recommendation, performing a major rehabilitation at this time is premature. It is expected major rehabilitation of the Liberty, Geddes, and Van Rensselaer Street bridges would be considered in at least 10 years. While the Bear Street bridges do have slightly more deterioration than the others, their rehabilitation would not be considered necessary until after I-81 Viaduct Project's estimated time of construction.
5. In addition to the engineering concerns, the traffic noise impacts to be abated by these barriers are mainly associated with existing NAC exceedances unrelated to the Project. For the Community Grid Alternative, 139 receptors were modeled behind Barriers 20-23. Fifty-two (52) of the 139 receptors were existing NAC exceedances and 45 noise impacts were predicted for the Community Grid Alternative. Therefore, seven fewer impacts are predicted under the Community Grid Alternative even without abatement.

Table 6-4-6-23
Community Grid Alternative: Noise Barrier Feasibility and Reasonableness

Noise Barrier	Total # of Impacts	Number of Attenuated Locations					Sq-ft of Modeled Noise Barrier	Sq-ft of Wall Per Benefited Receptor	Feasible? (Y/N)	Reason-Able? (Y/N)
		Total No. of Benefited Receptors	Impacted Receptors with ≥ 5 dB(A) Reduction		Benefited Receptors with ≥ 7 dB(A) Reduction					
			No.	Percent	No.	Percent				
1	50	88	50	100%	46	52%	50629	575	Y	Y
2	29	43	29	100%	28	65%	20472	476	Y	Y
3A	5	8	5	100%	5	63%	14314	1789	Y	Y
3B	14	27	14	100%	14	52%	47188	1748	Y	Y
4A & Wood 1&2	8	46	7	88%	23	50%	87932	1912	N/A	N/A
4B	18	25	16	89%	17	68%	33799	1352	Y	Y
Wood 3	0	11	0	0%	0	0%	41959	3814	N/A	N/A
Wood 4	4	14	4	100%	9	64%	26775	1913	N/A	N/A
5	5	5	4	80%	4	80%	33661	6732	Y	N
6	3	6	1	33%	0	0%	41394	6899	N	N
7A	1	0	0	0%	0	0%	26942	-	N	N
8A	5	6	5	100%	5	83%	43283	7214	Y	N
8B	17	35	17	100%	18	51%	32632	932	Y	Y
9	17	36	17	100%	24	67%	19721	548	Y	Y
10	9	0	0	0%	0	0%	22931	-	N	N
11A	3	1	1	33%	1	100%	58807	58807	N	N
11B	5	0	0	0%	0	N/A	59504	-	N	N
11C/D	12	83	6	50%	42	51%	62892	758	Y	Y
11F	2	0	0	0%	0	0%	36542	-	N	N
12B	12	14	12	100%	8	57%	27141	1939	Y	Y
12C	2	6	2	100%	4	67%	26778	4463	Y	N
13A-C	42	11	8	19%	9	82%	147203	13382	N	N
13C (Partial)	8	8	8	100%	4	50%	2491	311	Y	Y
13DEF	32	59	32	100%	31	53%	71529	1212	Y	Y
13G	10	9	8	80%	1	11%	28724	3192	Y	N
13H	8	8	8	100%	7	88%	14445	1806	Y	Y
13I	9	7	6	67%	6	86%	65839	9406	Y	N
14	16	15	9	56%	9	60%	23245	1550	Y	Y
15	27	21	18	67%	5	24%	15169	722	Y	N
16A&B	31	69	30	97%	52	75%	54172	785	Y	Y
17	6	9	3	50%	2	22%	35857	3984	Y	N
18	2	7	1	50%	2	29%	28484	4069	Y	N
19A&B	8	0	0	0%	0	0%	79480	-	N	N
20&21	8	18	6	75%	9	50%	34670	1926	Y	N
22&23	37	49	24	65%	26	53%	84631	1727	Y	N

Notes:

Barriers that are shaded are considered Feasible and Reasonable and are recommended.

Barriers indicated as "Y" in the "Reasonable" column are contingent on the viewpoints of the benefited receptors.

Regarding the "Impacted Receptors with ≥ 5 dB(A) Reduction" column: For a measure to be deemed feasible, it must provide a minimum 5 dB(A) reduction to the majority of impacted receptors. A receptor is considered "benefited" if it would receive at least a 5 dB(A) noise reduction if the abatement measure were implemented.

Regarding the "Benefited Receptors with ≥ 7 dB(A) Reduction" column: This NYSDOT Noise Policy establishes a Noise Reduction Design Goal of 7 dB(A). For an abatement measure to be determined reasonable, a majority of the benefited receptors must achieve the design goal.

Barrier 12A was assessed for the DEIS; however, design changes made to the Community Grid Alternative after publication of the DEIS eliminated traffic noise impacts in this area and therefore Barrier 12A is no longer under consideration for this alternative.

Barriers 20&21 and 22&23 are not reasonable as barrier construction would require major rehabilitation, including bridge deck and parapet wall replacement, of existing I-690 bridges.

Under the Community Grid Alternative, if each recommended abatement measure is constructed, the Project's TNM predicts impacts at 338 (688 receptors) of the 2,817 receivers. The Community Grid Alternative with abatement would result in an overall reduction of 242 receivers, and 325 receptors with noise levels that approach within 1 dB(A) or exceed the NAC when compared to 2013 existing conditions. The modeling also predicts a reduction of traffic noise impacts at 219 receivers, representing 275 receptors when compared with the Community Grid Alternative without the implementation of noise abatement. Regardless of the mitigation measures, six of the impacted receivers (representing 27 receptors) are predicted to have noise levels that substantially (by 6 dB(A) or more) exceed the existing noise levels. For the six locations predicted to have a substantial increase in noise levels (by 6 dB(A) or more), three are at residential land uses, one is at an outdoor seating area in the downtown area of the City, one is at the DaVita Central New York At Home medical facility (910 Erie Boulevard East, Syracuse, NY 13210), and one is at the Spectrum Your News Now (YNN) television studio (815 Erie Boulevard East, Syracuse, NY 13210); however, the television studio appears to have only infrequent outdoor use.

In accordance with FHWA's "Highway Traffic Noise Analysis and Abatement Policy and Guidance," a noise level change of 3 dB(A) or less is barely perceptible to the human ear; therefore, a comparison was made to determine the number of receivers with changes of more than 3 dB(A) as compared to the No Build Alternative and existing conditions.

- Compared to No Build Alternative conditions: Under the Community Grid Alternative with abatement, it is anticipated that traffic noise level increases would be perceptible at 25 receivers, representing 74 receptors, and decreases in traffic noise would be perceptible at 708 receivers, representing 1,221 receptors.
- Compared to existing conditions: Under the Community Grid Alternative with abatement, it is anticipated that traffic noise level increases would be perceptible at 31 receivers, representing 82 receptors, and decreases in traffic noise would be perceptible at 670 receivers, representing 1,121 receptors.

Most receivers with a perceptible noise level increase are located within the Central Study Area where there would be changes to the physical width or location of the viaduct. Noise level impacts with abatement measures implemented are summarized in **Table 6-4-6-24** by Activity Category and perceptible noise level increases with abatement measures implemented are summarized in **Table 6-4-6-25** by Activity Category.

All of the recommended barriers are located in areas where there would be at least five, and up to 50, impacted receptors without the barriers in place and at least eight, and up to 88, benefited receptors that would experience a noise level reduction of 5 dB(A) or greater as a result of the barrier being in place.

At least 56 percent, and as much as 100 percent, of the impacted receptors in each recommended location would receive a 5 dB(A) or greater reduction benefit, thereby meeting the feasibility requirement that such reduction be achieved by a majority of impacted receptors. Refer to Community Grid Alternative Modeled Noise Reduction figures in Attachment L of **Appendix H** for a visual representation of the benefited receivers.

Table 6-4-6-24
Receptors with Noise Levels Approaching/Exceeding the Noise Abatement Criteria

Activity Category	Existing (2013) NAC Exceedances*	2050 Community Grid Alternative Impacts	2050 Community Grid Alternative w/ Abatement Impacts
A	None	None	None
B – Residential	771	699	476
C – Cemetery	46	0	0
C – School/Daycare	12	36	26
C – Parks, Picnic, Sports, Trails, and Recreation Areas	152	190	158
C – Medical Facilities	26	29	19
C – Places of Worship	4	7	7
C - Memorials	2	2	2
TOTALS	1013	963	688

Note: *Existing data are based on noise levels approaching or exceeding the NAC for the year 2013.

Table 6-4-6-25
Receptors with Perceptible Noise Level Increases (i.e. >3 dBA) by Activity Category

Activity Category	From 2013 Existing to 2050 Community Grid Alternative	From 2013 Existing to 2050 Community Grid Alternative w/ Abatement	From 2050 No Build to 2050 Community Grid Alternative	From 2050 No Build to 2050 Community Grid Alternative w/ Abatement
A	None	None	None	None
B – Residential	52	48	52	46
C – Cemetery	0	0	0	0
C – School/Daycare	5	5	0	0
C – Parks, Picnic, Sports, Trails, and Recreation Areas	22	22	22	22
C – Medical Facilities	4	4	4	4
C – Places of Worship	3	3	2	2
C - Memorials	0	0	0	0
TOTALS	86	82	80	74

Note: Noise level increases are in relation to existing and No Build Alternative noise analysis results.

In terms of reasonableness, all of the recommended would be within the maximum allowed 2,000 square feet of wall per benefited receptor. Also, all of these barriers would result in at least 50 percent of the benefited receptors achieving a 7 dB(A) reduction.

Under the Community Grid Alternative, the Central Study Area would continue to consist mostly of city streets that are at grade with the adjacent land uses. The I-81 viaduct would be demolished, and Almond Street would be reconstructed at grade. Construction of noise barriers along Almond Street and other city streets that would be improved or would experience increased traffic as part of this alternative are determined to be not feasible and/or reasonable. Since barriers must be continuous and extend beyond the actual locations of impacted receptors in order to be effective, the presence of many cross streets through Downtown corridors prevent the ability to achieve this abatement design. In addition, if barriers were placed on city streets, visual and pedestrian access to and from city buildings, as well as vehicular access to driveways, would be blocked.

Noise barriers at areas with isolated groups of impacted receptors along the primary Project corridors were qualitatively assessed. In accordance with NYSDOT Noise Policy, and as discussed previously, the constructed surface area of a proposed barrier must not exceed 2,000 square feet per benefited receptor for a noise barrier to be considered reasonable. Various barrier dimensions including height iterations of between 6 and 20 feet were reviewed for isolated receptor groups. A 12-foot height was considered the minimum needed because it would eliminate the line-of-sight to truck exhaust pipes. In this regard, given a cluster of five receptors in an area that is surrounded by non-sensitive land uses, and an example noise barrier height of 12 feet, the maximum allowed length of the barrier would be 830 feet in order for it to be considered reasonable. Based on the noise barrier analysis that was conducted at other locations, it is assumed with good engineering judgment that a barrier with such dimensions would not provide the necessary 5 dB(A) of reduction to the majority of the impacted receptors in that cluster, nor would such a barrier provide 7 dB(A) of reduction to the majority of benefited receptors. Therefore, wherever an isolated cluster of five or fewer receptors exists along a portion of highway, it was qualitatively concluded that a noise barrier would not be reasonable.

Viewpoints Analysis

To determine whether a proposed barrier is "reasonable," the viewpoints of those who would be benefited by the proposed barrier were solicited. "Benefited" means that the property would receive at least a 5 dB(A) reduction in noise from the barrier.

Approximately 679 mailers were sent out to benefited property owners and residents, in July 2019, via United States Postal Service Priority Mail with a tracking number. Mail delivery was confirmed via the tracking numbers and hand delivery or additional delivery attempts were made at undeliverable locations. Demolished or abandoned residences and addresses with structures slated for demolition were removed from the list of benefited receptors. Each mailer contained:

- A cover letter with an invitation to four noise barriers public meetings,
- A color informational brochure with maps and aerial photos showing the locations of the proposed noise barriers. The brochure also described the NYSDOT noise abatement process as it relates to the I-81 Viaduct Project,
- A noise barrier ballot with an option to select "in favor" or "not in favor" of noise barrier construction, and
- A pre-addressed/postage paid return envelope for the ballot return.

A public open house and a series of neighborhood and community meetings were held following the publication of the preliminary DDR/DEIS in 2019 (see **Chapter 9, Agency Coordination and Public Outreach**, for more information). In addition, four noise barriers public meetings, listed in **Table 6-4-6-26**, were held. To convey information on the Project and its effects on traffic noise levels, the noise analysis process, and the proposed locations of noise barriers, the meetings included a

PowerPoint presentation and approximately 30 informational boards on display. In addition, Project team members were on hand to respond to questions and to provide information to assist owners and residents in making an informed decision. Attendance at these meetings was not required for benefited property owners and residents to provide their viewpoint.

Table 6-4-6-26
Noise Barrier Workshop Dates and Locations

Meeting	Date	Location
Noise Barriers Meeting #1 (Closest to Barriers 9, 11C/D, 12A, and 12B)	Wednesday, July 24, 2019 4:00 to 7:00 PM	Dr. King Elementary School 416 E. Raynor Ave. Syracuse, NY 13202
Noise Barriers Meeting #2 (Closest to Barriers 1, 2, 3A, 3B, 4B)	Tuesday, July 30, 2019 4:00 to 7:00 PM	Cicero North Syracuse HS 6002 Route 31 Cicero, NY 13039
Noise Barriers Meeting #3 (Closest to Barriers 13C, 13D/E/F, 13H, 14A, and 15A/B)	Wednesday, August 14, 2019 4:00 to 7:00 PM	Henninger High School 600 Robinson St. Syracuse, NY 13206
Noise Barriers Meeting #4 (Closest to Barriers 7B and 8B)	Thursday, August 15, 2019 4:00 to 7:00 PM	DeWitt Community Room 148 Sanders Creek Pkwy. East Syracuse, NY 13057

For the 2019 viewpoints survey, benefited property owners and residents were able to submit their completed ballots by regular mail, via the Project website (as a photo scan), or at a noise barriers public meeting. Of the 679 ballots mailed out, 63 of the ballots were from properties that were either vacant, demolished, or slated for demolition; therefore, viewpoints could be received from a maximum of 616 ballots. In total, 164 viewpoint ballots were received with 151 in favor and 13 not in favor of the noise barriers (i.e., 92 percent in favor of the noise barriers). Five of the proposed noise barriers received a response from over half of the benefited receivers. Overall, the majority of the responses favored construction of the barriers.

Additional noise barrier outreach was performed after the publication of the DDR/DEIS in 2021. In addition, design changes were incorporated into the noise modeling. These design changes required updates to noise barriers 11C/D, 14, and 16A&B, which resulted in 392 new benefitted receptors; therefore, the 2021 outreach included mailers with surveys sent to a total of 1,071 benefited receptors. The mailers included invitations to participate in the public hearing and visit the neighborhood meetings for the Project. Mail delivery was confirmed via the tracking numbers and hand delivery or additional delivery attempts were made at undeliverable locations. Demolished or abandoned residences and addresses with structures slated for demolition were removed from the list of benefited receptors. It was noted in the mailer that benefited receptors who responded to the viewpoints survey in 2019 did not have to submit another response in 2021 unless they wanted to change their viewpoint. Due to a change in the NYSDOT Noise Policy since the 2019 viewpoints survey, it was also noted in the cover letter that the absence of a response would be considered acceptance of the noise barrier.

For the 2021 viewpoints survey, benefited property owners and residents were able to submit their completed ballots by regular mail, via email (as a photo scan), or at the public meetings. Of the 1,071 ballots mailed out, only 22 benefitted receivers responded as not-in-favor of their respective barrier. Therefore, only 2 percent of the responses were not-in-favor of noise barriers. Based on the 2021 viewpoints survey, all of the barriers recommended for this alternative were favored and therefore considered reasonable.

Statement of Likelihood

Based on the studies performed thus far and the preliminary design described above, NYSDOT recommends abatement using the barriers described above for the Community Grid Alternative. If this alternative is progressed and these conditions change substantially during the final design phase, these barriers may no longer be recommended and not included in the Project's contract plans. A final decision on the recommendations will be made upon completion of the Project's design and public involvement processes.

Construction Noise and Vibration Abatement

Abatement of noise related to detour traffic was considered. The proposed detours are within the downtown roadway network, which is generally not conducive to the methods of traffic noise abatement (e.g., noise barriers, roadway realignment, or traffic management, such as speed adjustments). Speeds are generally reduced in areas of construction and along detour routes due to posting or congestion. The construction-related reduction of traffic speeds would have potential to reduce traffic noise; however, it is not expected that speed reductions would result in noticeably lower noise levels. Generally, a 20+ mph reduction in speed is necessary for a noticeable decrease in noise levels. Therefore, speed limit reduction is not reasonable for abatement of construction detour traffic noise.

For construction equipment noise, abatement strategies would be included within the contract documents to the extent practicable. As indicated in **Table 4-7** in **Chapter 4, Construction Means and Methods**, NYSDOT has committed to the following noise-related measures to minimize community impacts during construction for this project**:**

- Implement a noise monitoring program during construction.
- Coordinate work operation to coincide with time periods that would least affect neighboring residences and businesses. Normal work hours would be scheduled between 6:00 a.m. and 9:00 p.m. Nighttime, Saturday morning, and Sunday construction activities would be limited to 70dB(A) Lmax at 50' in Noise Sensitive Areas when reasonable.
- Implement temporary construction noise abatement measures that would include shrouds or other noise curtains, acoustic fabric, soundproof housings, physical barriers, and/or enclosures to reduce noise from pile drivers, compressors, generators, pumps, and other loud equipment when reasonable.
- Restrict the use of impact and drilling equipment including pile drivers, jackhammers, hoe rams, core drills, direct push soil probes (e.g., Geoprobe), pavement breakers, pneumatic tools, and rock drills when reasonable.
- Require motorized construction equipment to be equipped with an appropriate well-maintained muffler and require silencers to be installed on both air intakes and air exhaust when reasonable.
- Require all construction devices with internal combustion engines to be operated with engine doors closed and with noise-insulating material mounted on the engine housing that does not interfere with the manufacture guidelines.

- Direct Contractor to transport construction equipment and vehicles carrying rock, concrete, or other materials along designated routes that would cause the least disturbance to noise sensitive receptors when reasonable.
- Require self-adjusting or manual audible back up alarms for vehicles and equipment used in areas adjacent to sensitive noise receptors.
- Direct Contractor to use pre-auguring equipment to reduce the duration of impact or vibratory pile driving when reasonable.
- Implement a communication and public outreach plan throughout the construction period.
- In the construction zone between MLK, Jr. East and Harrison Street: Direct Contractor to use saw cutting methods and prohibit impact hammers during the demolition of existing structures when reasonable; and direct Contractor to use drilled foundations on all bridge piers and other support structures and prohibit pile driving methods.
- NYSDOT and its Contractor would provide as much notice of construction activities to the medical facilities as possible and would coordinate with them to resolve schedule conflicts if construction activities would impact critical surgeries or procedures.

The RCNM User's Guide provides a list of simplified shielding factors and accompanying noise reduction levels for construction equipment. The list of shielding factors that could apply to the construction of this Project includes:

- Noise barrier or other obstruction (such as a dirt mound) just barely breaks the line-of-sight between the noise source and the receiver: 3 dB(A) noise reduction
- Noise source is completely enclosed or completely shielded with a solid barrier located close to the source: 8 dB(A) noise reduction (enclosure and/or barrier has some gaps in it: 5 dB(A) noise reduction).
- Noise source is completely enclosed and completely shielded with a solid barrier located close to the source: 10 dB(A) noise reduction.
- Building stands between the noise source and receiver and completely shields the noise source: 15 dB(A) noise reduction.
- Noise source is enclosed or shielded with heavy vinyl noise curtain material (e.g., SoundSeal BBC-13-2" or equivalent): 5 dB(A) noise reduction.

At each of the construction sites that were analyzed for the Community Grid Alternative, physical features were identified that could help in reducing the noise levels due to construction equipment. At Site B, the road elevation is lower than the surrounding area, creating a natural barrier between the receiver and the construction site. At Sites A, B, and C, there are various areas under bridges that could be used to store stationary equipment, which would help in reducing the noise levels. Sites D and E are along the viaduct and Almond Street, and there are no natural barriers around Sites D and E other than a few large buildings; however, other mitigation strategies, such as noise enclosures, could be employed in these areas. At Site F, there are various locations where there are embankments between the receiver and the construction site. These embankments could act as natural noise barriers, which would help in reducing noise levels during construction. Site G is mostly flat and open; therefore, there are no natural barriers that could help in reducing noise levels.

Using the barriers currently in place (e.g., berms, retaining walls, and elevation changes) and determining what pieces of construction equipment could be enclosed, shielding was applied under the RCNM analysis for each piece of equipment to predict whether there would be an overall reduction in noise levels. For the Community Grid Alternative, it was determined that stationary equipment, such as pumps, vibratory concrete mixers, jackhammers, welders/torches, and pneumatic tools, could be either partially or fully enclosed behind a noise barrier or an enclosure. For Site B, construction equipment that was not stationary was given a shielding factor of 3 dB(A) because there is a natural barrier at Site B that breaks the line-of-sight between the noise source and the receiver. Stationary equipment that needs less physical access would be able to be fully enclosed to allow for a higher shielding value. **Table 6-4-6-27** shows the noise level results in the Community Grid Alternative for construction equipment with and without shielding. According to **Table 6-4-6-27**, the use of abatement measures at Sites A, B, and C yielded predicted construction equipment noise levels below the L_{max} level of 80 dB(A). **Table 6-4-6-27** also indicates that Sites F and G were already predicted below the L_{max} level of 80 dB(A) without shielding; however, with shielding, noise levels at sites F and G were each reduced further by 2 dB(A).

Table 6-4-6-27
RCNM Calculated Construction Noise Levels With Shielding for the Community Grid Alternative

Construction Receiver Site	Without Shielding (dB(A))	With Shielding (dB(A))
Site A	L_{max}= 76; L_{eq}= 81	L_{max}= 76; L_{eq}= 78
Site B	L_{max}= 78; L_{eq}= 84	L_{max}= 75; L_{eq}= 79
Site C	L_{max}= 77; L_{eq}= 82	L_{max}= 77; L_{eq}= 79
Site D	L_{max}= 78; L_{eq}= 83	L_{max}= 78; L_{eq}= 80
Site E	L_{max}= 84; L_{eq}= 89	L_{max}= 84; L_{eq}= 86
Site F	L_{max}= 72; L_{eq}= 76	L_{max}= 72; L_{eq}= 74
Site G	L_{max}= 75; L_{eq}= 79	L_{max}= 75; L_{eq}= 77

Notes:
L_{max} is the maximum sound level.
L_{eq} (equivalent sound level) is the sound pressure level equivalent to the total sound energy over a given period of time.
Source: Analysis performed using FHWA Roadway Construction Noise Model (FHWA RCNM) Version 1.1.

Construction Vibration

To abate the potential effects from construction vibration, a monitoring program would be developed by the Contractor. The program would include the following provisions:

- When pile driving would occur within 30 feet of a structure, a construction vibration-monitoring program would be implemented to determine whether construction vibration would exceed 0.50 inches per second. If the structure does experience PPV values in excess of 0.50 inches per second as a result of construction vibration, construction means and methods would be re-evaluated to avoid producing vibration at this level, unless an engineer's inspection of the building determines that the level of construction vibration at the building does not have the potential to result in damage.

The Contractor would make efforts to coordinate scheduling with the surrounding medical institutions to avoid vibration-producing construction activity during the most critical times of use of the medical facilities and minimize the potential for interference during those times.

6-4-6.6 OUTREACH TO LOCAL OFFICIALS

Noise-compatible land use planning can help to minimize future traffic noise impacts in the vicinity of highway projects. The effective implementation of noise-compatible planning measures is a shared responsibility between NYSDOT (which analyzes highway noise impacts) and local governments (which regulate land uses).

NYSDOT has been conducting outreach to local officials throughout the development of this Project and will continue to do so. Outreach to local government officials specific to noise-compatible land use planning will be conducted in accordance with NYSDOT's Noise Policy, and will likely include correspondence and meetings.

This FDR/FEIS contains predicted future noise levels in proximity to the proposed highway improvements that may be helpful to the local communities. It also provides these communities with information that can be used for noise-compatible land use planning adjacent to the highways within the Project Area.