EAW Attachment C

Veneklasen Associates
Consultants in Acoustics | Noise | Vibration | AV | IT

June 18, 2019

BKV Group
222 North 2nd Street, Suite 101
Minneapolis, Minnesota 55401

Attention: John Stark, AIA, LEED AP

Subject: **Fort Snelling Upper Post; Minneapolis, Minnesota**
Acoustical Review
VA Project No. 4332-014

Dear John:

Veneklasen Associates, Inc. (VA) provides the following revised acoustical review for the subject project. This report documents our acoustical comments based on the updated detail sheet dated February 19, 2019, the drawings dated January 15, 2019, and measurements conducted in February 2019. Updated comments are indicated with underline or strikethrough text.

I. Exterior Noise Assessment

A. Measurements and Report

1. VA conducted acoustical measurements at the site related to exterior-to-interior sound isolation and exterior noise environment across the site. VA's recommendations were provided in the report dated March 8, 2019, updated May 22, 2019.

II. Interior Sound Isolation

A. Floor-Ceiling Assembly

1. VA conducted airborne and impact sound insulation measurements of the existing floor-ceiling assembly between levels 1 and 2 within building 156 on February 26, 2019. The measured airborne sound isolation was an ASTC rating of 42, and the measured impact sound isolation was an AIIC rating of 38.

2. Per the International Building Code (IBC) Section 1207 "Sound Transmission", minimum performance for airborne and impact sound isolation between units is ASTC/AIIC-45.

3. The goals identified for this project is to exceed the code-minimum ratings (per Section 1207 "Sound Transmission") by approximately 5 points. (ASTC/AIIC-50).

4. The tested assembly consists of finish flooring, wood subflooring, wood joists, and plaster on lath.

5. Modify the assembly as follows:

   a) Retain the original flooring and subflooring.

   ~~b)~~ Where flooring is replaced:

      (1) Where hard-surface flooring is installed, VA understands it will consist of luxury vinyl tile (LVT). LVT product shall be 5 mm thick, minimum. Provide foam pad below flooring. Foam shall be minimum 1.4 mm thick. Install flooring material as a floating system (no adhesive).

(2) Where carpet is installed, provide pad below carpet. Pad should be minimum 3/16-inch thick.

c) Remove existing plaster/lath.

d) For ceilings with resilient channel, install minimum 6-inch thick batt insulation within the cavity. For ceilings with wire-hung suspended systems, install minimum ~~9~~ 6-inch thick batt insulation.

(1) Install resilient channels (ClarkDietrich RCSD) to the joists. Provide sheet metal backing on face of channels where required for support of ceiling-suspended elements. Reduce channel spacing as required to support load of ceiling-suspended elements.

(2) Install one (1) layer of Pabco Quietrock to the resilient channels.

(3) Install one (1) layer of 5/8-inch gypsum board to the layer of Quietrock.

(4) Where occurs, install a suspended ceiling/soffit below the finish gypsum board layers of the floor-ceiling assembly. Anchorage for suspended ceiling/soffit shall be to resilient channels, not to joists above the channels. VA anticipates a minimum cavity depth of 6 inches between the fire-rated assembly and the suspended ceiling/soffit.

6. With these modifications, the impact insulation is predicted to be AIIC 49-53 and the predicted airborne insulation is ASTC 50-52. Where a lowered ceiling occurs, the impact rating will increase by 1-2 points and the airborne rating will increase by 2-4 points.

7. For locations where flooring will be replaced, provide resilient matting below new flooring. Inform VA where this occurs for material recommendations. This shall be required only where flooring is replaced throughout an entire room.

B. Demising Walls – Existing Assemblies

1. There was not a location within Building 156 where a measurement could be conducted on the existing demising wall assembly.

2. The project drawings indicate existing partitions consist of single-stud wood studs with plaster and lath on each side of the partition (partition type EX-WP per A602). Batt insulation is not indicated. Based on test reports for similar assemblies, this partition is expected to provide field performance of ASTC 35-38, which is below project design target.

3. Modify the existing assembly as follows:

a) Patch and repair existing plaster/lath to ensure there are no gaps or holes.

b) Remove plaster/lath on one side of partition.

c) Install batt insulation in all stud cavities.

d) Provide second row of studs, spaced minimum 1/2-inch off the face of the existing studs. Studs shall be self-supporting and may be narrow to minimize wall depth. Provide batt insulation in stud cavity and one (1) layer of 5/8-inch gypsum board.

e) This construction is anticipated to provide a field rating of ASTC 49-51, which exceeds minimum code requirements.

C. Demising Walls – New Assemblies

1. Provide partition type Q (A602) between units where new demising assemblies are to be provided.

2. No modifications are required to this assembly.

D. Corridor Walls – Existing Assemblies

1. Partition type EX-L (A602) is indicated for typical unit corridor walls. This partition consists of the same existing assembly as EX-WP, single-stud wood studs with plaster and lath on each side.

2. Option A indicates installation of sound channels on top of the plaster/lath on one side, with a finish of 5/8-inch gypsum board. This partition will provide an approximate ASTC rating of 35-38, which is below project design target. Do not utilize this option.

3. Option B indicates removal of plaster/lath from one side of the partition, installation of batt insulation, resilient channels, and one (1) layer of 5/8-inch gypsum board. Based on test reports for similar assemblies, this partition is expected to provide field ratings at the minimum code requirement (ASTC 45-46). This partition type is acceptable for typical corridor walls near unit entries.

4. Where bedrooms or living areas are located on a corridor wall assembly without a door, provide a total of two (2) layers of 5/8-inch gypsum board on the corridor wall.

E. Corridor Walls – New Assemblies

1. Partition type L (A602) is indicated for typical new unit corridor walls. This partition consists of single-stud wood stud walls with batt insulation, resilient channels on one side, and one (1) layer of 5/8-inch gypsum board on each side.

2. This partition is expected to provide field ratings at the minimum code requirement (ASTC 45-46). This partition type is acceptable for typical corridor walls near unit entries.

3. Where bedrooms or living areas are located on a corridor wall assembly without a door, provide a total of three (3) layers of 5/8-inch gypsum board on the corridor wall.

F. Balcony

1. In Building 57, there are unit balconies located directly over bedrooms of the unit below.

2. The existing balcony floor/ceiling assembly is unknown. Inform VA of the existing assembly. VA anticipates the following mitigation will be required:

   a) Resilient channels between the joists and the ceiling within the bedrooms below the balconies.

   b) Resilient matting below the finish surface on the balcony.

   c) Additional mass layers on the ceiling and/or balcony.

3. Apply these recommendations to any locations where balconies, terraces, or patios occur above an interior occupied living space.

G. Mechanical Room Walls

1. Mechanical Room/Unit Demising Assemblies. For locations with a common wall between mechanical rooms and units, provide type Q partition per A602, adding gypsum board to provide a total of four (4) layers.

2. Mechanical Room Corridor Wall Assemblies. For locations where mechanical rooms are adjacent to public corridors, provide a single-stud wood stud partition with batt insulation, resilient channels on one side, and two (2) layers of 5/8-inch gypsum board on each side. 1-inch plaster on lath may be substituted for the gypsum board layers.

3. Refer to section III.A for vibration isolation and noise control.

H. Mechanical Room Floor-Ceiling Assembly

1. Mechanical above units. Where mechanical units are located above occupied space, provide resilient channels between the joists and the ceiling. Provide two (2) layers of 5/8-inch gypsum board.

2. Mechanical below units. Provide wire-hung gypsum board ceiling within mechanical rooms located directly below residential units. Ceiling shall have a minimum cavity depth of 10 inches, batt insulation, minimum 6-inches thick, and one (1) layer of 5/8-inch gypsum board.

3. Refer to section III.A for vibration isolation and noise control.

I. Elevator

1. Where elevator shares a wall with residential units, provide a furred wall between the shaft and the unit. Furred wall framing shall be spaced off the face of the wall by 1/2 inch, minimum, with no contact between the framing and the shaft wall. Provide batt insulation and one (1) layer of 5/8-inch gypsum board.

2. The alignment of the rails should be within 1/16 inch of plumb at bracket locations. The rails shall be smooth, minimizing discontinuity.

3. The roller guide assemblies should be resilient and similar to Elsco Model C.

4. Hydraulic elevators:

   a) Vibration isolate pump unit with 1-inch deflection spring mounts, Mason Industries type SLF or approved equal.

   b) Vibration isolate full length of hydraulic lines with neoprene mounts. Mounts shall be Mason Industries type ND or approved equal, with 0.2-inch static deflection in compression or tension and 0.1-inch static deflection in shear. Cush-a-clamp, Hydrazorb, and similar are not approved vibration isolators.

   c) There shall be no rigid contact between hydraulic lines or pump unit and building structure.

   d) Provide flexible electrical conduit at all connections to motor/pump unit. Conduit shall be sufficiently long to form a loose loop.

J. Stairs

1. New stairs within units. If stairs are located on a common wall with an adjacent unit they should not be supported from the demising wall.

2. Existing stairs. VA understands existing flooring to remain on existing staircases. Footfall will be easily heard within nearby units. Inform VA if recommendations to mitigate this are desired.

K. General (This section applies to the entire document)

1. Demising walls:

   a) Where draft stopping is required across the studs, the draft stopping shall be mineral wool or fiberglass batt insulation stapled to the studs. No rigid material, like gypsum board, will be accepted.

   b) Where the partition intersects with another wall, the demising studs should not be in contact with the other wall's studs or gypsum/plaster.

   c) No materials shall be allowed in the air space between the stud rows.

   d) No shear material on the inside of the studs. All shear must be on the outer side of the wall.

   e) No gussets across the studs that are steel, wood, or any other rigid material.

   f) The perimeter of the wall must be acoustically sealed prior to taping and finishing.

   g) There should be no contact between any service penetrating the gypsum board and the gypsum board. A gap should be maintained and sealed. This includes all services (including electrical, mechanical and plumbing).

2. In demising construction, insulation shall be in the wall and joist cavity. Insulation shall be the depth of the cavity and shall be in all stud or joist cavities.

3. Walls including services (mechanical, electrical, plumbing, etc.) shall also include insulation. Insulation shall be the depth of the cavity.

4. Gypsum board shall be screwed, not nailed. Any gypsum board damaged in the installation shall be removed and replaced if the damage is equal to or greater than 1 inch.

5. The attachment of the gypsum board to the studs must use the minimum number of screws. Screws that are not required should be removed.

6. Electrical boxes shall be offset as required in the code.

7. Electrical box pads shall be installed behind all electrical boxes. Electrical boxes shall completely wrap the electrical boxes. If plastic electrical boxes are installed, any damaged or cracked electrical boxes shall be removed and replaced.

8. Electrical boxes shall be sealed to gypsum board with acoustical sealant.

9. In a demising wall condition and wherever possible, conduit (and all other services including mechanical, electrical and plumbing) shall be run on the stud side served.

10. A gap shall be maintained at the perimeter of all wall and floor ceiling assemblies. The gap shall be a minimum of 1/4 inch and be filled with permanently resilient non-hardening acoustical sealant or permanently resilient non-hardening fire rated sealant depending on the application. USG Sheetrock Fire Rated Acoustical Sealant in tube, or equal.

11. Where multiple layers of gypsum board occur, the caulking is only needed for the outermost layer.

12. Entry door assemblies shall have a minimum STC rating of 30 (including door frame and seals).

13. All resilient channels described within the documents shall be Clark Dietrich RCSD, no exceptions. All resilient channel shall be installed per manufacturer's recommendations with close attention paid to maintaining a gap between the structure and the channel at the perimeter, using the pre-drilled holes to screw to the joists, using a tech screw to hold the overlapping channels together, having no free flange in contact with the structure prior to the installation of gypsum board, marking the location of the joists to verify that no screw is potentially connecting to a joist.

14. All services run in the attic or roof joists, shall be installed as high in the joist bay as possible.

15. Routing of services in any unit shall be completed to avoid areas of acoustic sensitivity including bedrooms, living rooms and dining rooms. If services are installed and can be re-routed in a manner to avoid sensitive locations, this may be requested and required.

16. No plumbing manifolds, if employed, shall be installed in or above acoustically sensitive space.

17. Installation of gypsum board and all acoustical materials shall be completed in accordance with the appropriate UL rating, the USG Construction Handbook, manufacturer requirements and practices and ASTM practice standards for light wall construction. If these requirements contradict methods within this document, then during design the method should be discussed. If this occurs during construction, an RFI should be prepared and discussed. Practices utilized by contractors shall always be those that maximize acoustical performance.

III. Building Systems

A. Mechanical

1. VA has not received cut sheets or octave-band sound power data for the equipment.

2. Apartment Furnace or Water-Source Heat Pump. Provide flexible ductwork or a minimum 10-foot length of duct before the first supply diffuser to any unit. Vibration isolation should be Mason Industries type HG (suspended), Super W (supported) or equivalent. If anchor bolts are used through isolation pads, utilize HG grommets to isolate through-bolt.

3. Rooftop condensing units. Equipment mounting with a pad including 3-inch lightweight concrete and neoprene mounts (Mason Industries type ND having 0.2 inches of static deflection) on the equipment.

4. On-grade condensing units. Avoid direct line of sight from on-grade units through windows into occupied residential units and amenity areas.

5. Pumps

   a) On-grade. Provide 0.2-inch deflection neoprene isolation mounts/hangers, Mason Industries type ND/HD, or approved equal.

   b) Above grade. Provide 1-inch deflection spring isolation mounts/hangers, Mason Industries type SLF/30, or approved equal.

6. Grilles, registers and diffusers. Within apartments, the grilles should be NC-20, no greater. In the remainder of the public areas, grilles should be no greater than NC 30.

7. Condensing piping. Piping is isolated from the structure using Armaflex AP 1/2-inch-thick and wire tied (not crushed) at connection points to the structure.

8. Toilet, kitchen, dryer exhaust fans. Maximum sone level of 1.5 sones.

B. Plumbing Systems

1. VA has not received cut sheets or octave-band sound power data for the equipment.

2. General. There should be no contact between the piping for the building and other systems or each other. If contact is unavoidable, then the contractor should use a resilient material.

3. Waste piping. Provide cast iron waste piping.

4. Waste, vent, storm drain, and supply piping vibration isolation. All will be isolated from the structure using a minimum of 1/4-inch material and equivalent to Holdrite Silencer Series Felt 272-2. The felt shall not be crushed. Neoprene pads will be used at clamp locations. These shall be equal to Holdrite Silencer Series 276.

5. Equipment

    a) All equipment and piping shall be isolated from the structure.

    b) Pumps will be isolated with a spring having 1-inch minimum static deflection and equal to Mason Industries type SLF or 30.

If you have any questions, please do not hesitate to call.

Sincerely,
Veneklasen Associates, Inc.

Samantha Rawlings, *LEED AP BD+C*
Associate Principal

Veneklasen Associates
Consultants in Acoustics | Noise | Vibration | AV | IT

July 29, 2019

BKV Group
222 North 2nd Street, Suite 101
Minneapolis, Minnesota 55401

Attention: John Stark, AIA, LEED AP

Subject: **Fort Snelling Upper Post**
Minneapolis, Minnesota
Exterior Noise and Exterior Façade Acoustical Analysis
VA Project No. 4332-014

Dear John:

Veneklasen Associates, Inc. (VA) has completed our review of the Fort Snelling Upper Post project located in Minneapolis, Minnesota. This report addresses the assessment of exterior noise exposure at the site and mitigation recommendations for the project. This report represents the results of our findings.

1.0 INTRODUCTION

This study was conducted to determine the impact of the exterior noise sources on the Fort Snelling Upper Post project in Minneapolis, Minnesota. VA's scope of work included evaluating the exterior noise levels impacting the site and determining the method, if any, required to reduce the interior sound levels to meet recommended guidelines for the building type.

The project consists of 26 existing buildings on a site near the Minneapolis-St. Paul International Airport and Highway 5. The project is bounded by a golf course to the west, Highway 5 to the north and east, and Minneapolis-St. Paul International Airport to the south. The existing buildings are to be converted to affordable housing apartment units and amenities.

2.0 NOISE CRITERIA

There are no applicable code requirements for this project.

VA has utilized the Minnesota Pollution Control Agency (MPCA) Guide to Noise Control in Minnesota and The Regional 2040 Transportation Policy Plan – Appendix L criteria as guidelines to address aircraft noise exposure on the site.

DNL (Day-Night Level) is the 24-hour equivalent (average) sound pressure level in which the nighttime (10 pm – 7 am) noise is weighted by adding 10 dB to the hourly level. Since this is a 24-hour metric, short-duration noise events (truck pass-by's, buses, trains, etc.) are not as prominent in the analysis.

Leq (equivalent continuous sound level) is defined as the steady sound pressure level which, over a given period of time, has the same total energy as the actual fluctuating noise.

Ln represents the exterior noise level that is exceeded 'n' percent of a 24-hour period. L10 represents the level exceed 10 percent of the 24-hour period.

2.1 Minnesota Pollution Control Agency (MPCA) – A Guide to Noise Control in Minnesota

Section 7030, Noise Pollution, states that "any municipality having authority to regulate land use shall take all reasonable measures within its jurisdiction to prevent the establishment of land use activities listed in noise area classification (NAC) 1, 2, or 3 in any location where the standards established in part 7030.0040 will be violated immediately upon establishment of the land use."

Section 7030.040, 'Noise Standards', establishes the limiting levels of sound based the preservation of public health and welfare and is grouped according to land activities by the noise area classification (NAC) system. Noise standards are established for daytime and nighttime hours and use the L10 and L50 metrics. Below are the noise standards:

Subp. 2. Noise standards

Noise Area Classification	Daytime		Nighttime	
	L10	L50	L10	L50
1	65	60	55	50
2	70	65	70	65
3	80	75	80	75

The guide also states the noise area classification is based on the land use activity at the location of the receiver and determines the noise standards applicable to that land use activity unless an exception is applied under subpart 3. This project would be classified as NAC1 because it is residential.

Subpart 3, Exceptions, states the following:

The noise area classification for a land use may be changed in the following ways if the applicable conditions are met.

A) The daytime standards for noise area classification one shall be applied to noise area classification one during the nighttime if the land use activity does not include overnight lodging.
B) The standards for a building in a noise area classification two shall be applied to a building in a noise area classification one if the following conditions are met:

    1) The building is constructed in such a way that the exterior to interior sound level attenuation is at least 30 dB(A);
    2) The building has year-round climate control; and
    3) The building has no areas or accommodations that are intended for outdoor activities.

Based on VA's noise measurements and calculations, for buildings within the NAC-2 zone, the project will utilize the noise mitigation listed above under Subpart 3.B. The remainder of the buildings are within NAC-1 zone and do not require mitigation under these guidelines.

2.2 Regional 2040 Transportation Policy Plan - Appendix L: Aviation Land Use Compatibility Guidelines

Below are the applicable tables presented in Appendix L of the Regional 2040 Transportation Policy Plan (TPP).

VA measured an exterior level of 71 DNL at the southernmost project property line. This level decreases for buildings located remotely from the airport; at the northernmost boundary the measured DNL level was 66, and the sound level at that location was controlled by noise from the freeway, not the airport. Therefore, buildings within the project will be classified as either "Conditional" or "Provisional," depending on location. Under the TPP, residential occupancy within these zones is compatible as long as the interior sound levels from exterior sources do not exceed 45 DNL. As a result, VA will utilize 45 DNL as the target interior sound level from aircraft sources.

VA will utilize a target of 45 DNL for all buildings within the project scope for all exterior noise sources in order to maintain a consistent level of performance across the project.

Table L-4: Structure Performance Standard*

Land Use	Interior Sound Level**
Residential	45dba
Educational/Medical	45dba
Cultural/Entertainment/Recreational	50dba***
Office/Commercial/Retail	50dba
Services	50dba
Industrial/Communications/Utility	60dba
Agricultural Land/Water Area/Resource Extraction	60dba

* Do not apply to buildings, accessory buildings, or portions of buildings that are not normally occupied by people.

** The federal DNL descriptor is used to delineate all the system airport noise policy zones.

*** Special attention is required for certain noise sensitive uses, for example, concert halls.

Table L-3: Land Use Compatibility Guidelines for Aircraft Noise

Land Use Category	Compatibility with Aircraft Noise Levels									
Type of Development	New Development and Major Redevelopment					Infill Development and Reconstruction or Additions to Existing Structures				
Noise Exposure Zones	1 DNL 75+	2 DNL 74-70	3 DNL 69-65	4 DNL 64-60	Buffer Zone	1 DNL 75+	2 DNL 74-70	3 DNL 69-65	4 DNL 64-60	Buffer Zone
Residential										
Single / Multiplex with Individual Entrance	INCO	INCO	INCO	INCO		COND	COND	COND	COND	
Multiplex / Apartment with Shared Entrance	INCO	INCO	COND	PROV		COND	COND	PROV	PROV	
Mobile Home	INCO	INCO	INCO	COND		COND	COND	COND	COND	

If the windows must be closed to meet an interior level described, then a mechanical ventilating system or other means of natural ventilation shall be provided. The ventilation shall not compromise the acoustical isolation of the exterior façade.

2.3 Short-Duration Events

While not a code requirement, VA recommends a maximum interior sound level of 55 dBA (Lmax) from short-duration within living and sleeping areas in order to minimize potential for sleep awakening. This will apply primarily to buildings in close proximity to aircraft events.

3.0 EXTERIOR NOISE ENVIRONMENT

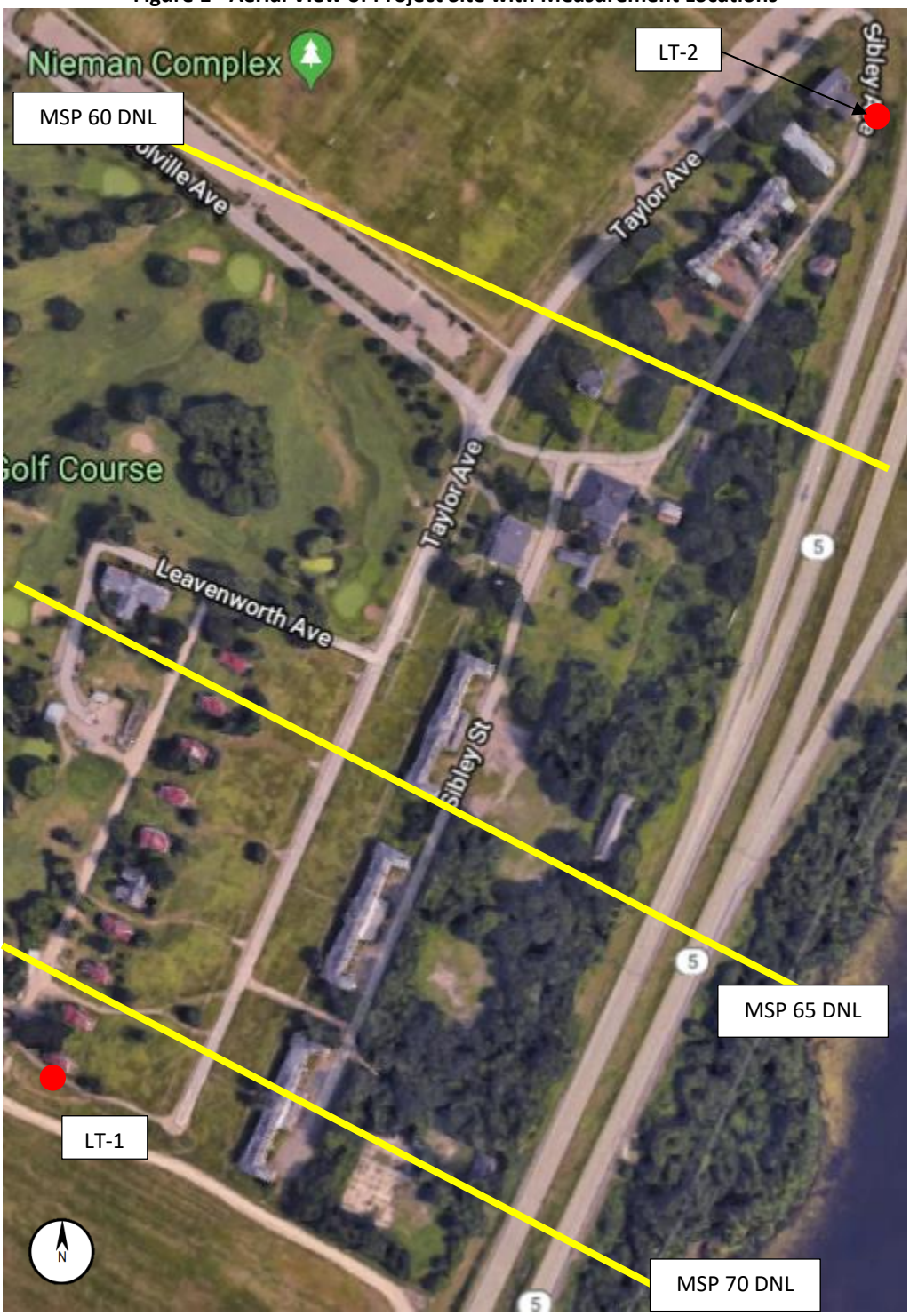
3.1 Noise Measurements

Vehicular traffic on Highway 5 and aircraft operations were the primary sources of noise affecting the site. VA visited the site on Tuesday, February 27, 2019, and placed meters at the northern and southern ends of the project site to capture the hourly sound levels on the site for a 24-hour period. Table 1 and Figure 1 show the location and summary of the noise measurements.

Table 1 – Measured Sound Levels

Location	L10 (dBA)	L50 (dBA)	Daytime Max, dBA	Nighttime Max, dBA	DNL
	Day/Night	Day/Night			
LT-1	66/60	50/50	92	86	71
LT-2	NA	NA	75	73	66

Figure 1 - Aerial View of Project Site with Measurement Locations



3.2 Minneapolis-St. Paul International Airport (MSP)

The project is located in close proximity to the northern runways serving MSP airport. VA observed aircraft operations on the runway including taxiing, takeoff, and landing. Exposure to the airport decreases, as does the airport noise contour in which a building is located, across the site. Table 1 illustrates the measurement location of LT-1 is near the airport and is in the NAC-2 classification zone. Mitigation is required for all buildings within that classification.

3.3 Overall Exterior Exposure

Based on the measurements, VA calculated the noise level at different locations across the project site. The predicted sound levels at each building are listed in Table 2 below.

Table 2 – Exterior Noise Levels

Location	Floor	Exterior Noise Level, DNL		NAC Zone	Short-duration Event Level, dBA	
		Aircraft	Freeway		Aircraft	Freeway
Building 53	All	<60	66	1	79	73
Building 54	1	<60	54	1	79	65
	2		66	1		73
Building 55	All	<60	<60	1	79	65
Building 56	All	60	<60	1	79	63
Building 57	All	61	<60	1	80	<60
Building 62	1	<60	65	1	78	73
Building 64	1	62	59	1	80	67
	2		65			73
Building 65*	All	62-63	NA	1	NA	NA
Building 66	All	63	<60	1	81	65
Building 67	All	63	<60	1	81	<60
Building 76	1	65	59	1	82	67
	2		66			73
Building 101	1	64-65	53	1	81	60
	2		62			69
Building 102	1	65-68	53	1	86	61
	2		62			69
Building 103	1	69-70	53	2	88	60
	2		62			69
Building 112	1	69	67	2	85	74
Building 151	All	65	<60	1	84	<60
Building 152	All	65	<60	1	84	<60
Building 153	All	65	<60	1	84	<60
Building 154	All	65	<60	1	85	<60
Building 155	All	66	<60	1	85	<60
Building 156	All	67	<60	1	85	<60
Building 157	All	68	<60	1	86	<60
Building 158	All	69	<60	1	88	<60
Building 159	All	69	<60	1	89	<60
Building 160	All	70	<60	2	89	<60
Building 161	All	71	<60	2	90	<60

*Amenity building, no residential uses.

4.0 INTERIOR NOISE CALCULATION

4.1 Exterior Facade Construction

VA measured the exterior-to-interior sound reduction for the exterior wall/window assembly at Building 156 on February 27, 2019. The window in the room that was selected was in good condition; sound leakage was not observed around the perimeter of the window or through the seals. Therefore, the measured results are understood to accurately represent the capability of the existing window assemblies.

The existing wall assemblies are to remain and be repaired where possible. VA understands the exterior wall in Building 156 (and typically for all buildings) consists of exterior masonry (brick) with plaster interior finish. Some walls may have wood furring strips between masonry and plaster finish, which are also scheduled to remain.

4.2 Mitigation Recommendations

VA utilized the measured exterior-to-interior sound reduction to predict interior sound levels and to determine recommended mitigation strategies in order to comply with the various criteria applicable to the different buildings on the site. Table 3 below summarizes the recommendations for each building for the exterior windows, walls, roofs, attics, openings, and ventilation system. Refer to Appendix II for locations of glazing zones for each building.

4.2.1 Exterior Window Assemblies

There are three recommendations for the exterior window assemblies:

- No additional mitigation; repair existing assemblies. These repairs should render windows, seals, and frames airtight, avoiding acoustical leaks.
- Added 1/4-inch monolithic pane. Added pane shall be spaced off face of existing pane by minimum 1-3/4 inches. System may be operable, similar to existing assemblies.
- Added 1/4-inch laminated pane. Added pane shall be spaced off face of existing pane by minimum 1-3/4 inches. System may be operable, similar to existing assemblies.
- Minimum acoustical performance requirements for windows specified in Appendix I.
- Glazing zones are indicated in figures per Appendix II.

4.2.2 Exterior Wall Assemblies

The existing exterior wall assemblies are understood to consist of masonry with plaster finish. No modifications are required to the existing exterior wall assemblies.

4.2.3 Roof Assemblies

There are several considerations for the roof assemblies. For buildings where the attic is to become occupied space, additional mitigation is required for the roof/wall assembly in the attic. VA recommends a furred assembly with the framing spaced off the existing roof/wall assembly by a minimum of 1/2 inch. Provide batt insulation equal in thickness to the depth of the framing (3-inch minimum) and one (1) layer of 5/8-inch gypsum board.

For buildings where the attic is not occupied space, provide resilient channels between the joists and the ceiling assembly on the upper level. Channels shall be ClarkDietrich RCSD, no substitutions. The ceiling material shall be one (1) layer of 5/8-inch gypsum board or plaster.

The attic vents also require coordination. Where attics are to be occupied space, fresh air should be ducted to the mechanical units. There should be no open vents into occupied space.

Where attics are to be unoccupied space, open vents can be used. For buildings close to the airport, VA recommends installation of an acoustically lined duct on the air vent within the attic. The duct shall be 24 inches long, minimum, and include 1-inch thick acoustical duct lining. For the remainder of the buildings, ducts are not required, but the size of the vents should be minimized.

4.2.4 Chimneys

The chimneys provide a channel for acoustical energy from aircraft events into the units. This detail requires additional review and coordination to develop mitigation strategies. VA anticipates that the chimneys will not be used and will be capped. Table 3 below identifies minimum weight requirements for the caps.

4.2.5 Mechanical Ventilation

Because the windows and doors must be closed to obtain the anticipated noise reduction, mechanical or other means of ventilation is recommended acoustically for all buildings except 53, 54, 55, 56, 62, and 65. The ventilation system shall not compromise the sound insulation capability of the exterior facade assembly.

Mechanical ventilation systems may be provided in any building but are only required acoustically as indicated.

Table 3 - Acoustical Mitigation Recommendations

Building	Exterior Window[1]	Exterior Wall	Roof	Roof/Ceiling below Attic	Attic Vents	Chimneys	Ventilation System
53	Repair to be airtight.	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 5 psf surface weight.	
54	Repair to be airtight.	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 5 psf surface weight.	
55	Repair to be airtight.	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Minimize vent size.	Seal chimney. Provide fill with minimum 5 psf surface weight.	
56	Repair to be airtight.	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 5 psf surface weight.	
57	Added pane, 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Minimize vent size.	Seal chimney. Provide fill with minimum 5 psf surface weight.	Yes
62	Repair to be airtight.	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 5 psf surface weight.	
64	Added pane, 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 10 psf surface weight.	Yes
65	Repair to be airtight.	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 10 psf surface weight.	

[1] Refer to Appendix II for locations of window upgrades.

Building	Exterior Window[1]	Exterior Wall	Roof	Roof/Ceiling below Attic	Attic Vents	Chimneys	Ventilation System
66	Added pane, 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 10 psf surface weight.	Yes
67	Added pane, 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Minimize vent size.	Seal chimney. Provide fill with minimum 10 psf surface weight.	Yes
76	Added pane, 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 10 psf surface weight.	Yes
101	Added pane, 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 10 psf surface weight.	Yes
102	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
103	Added pane, 1/4" laminated glass with 1-3/4" airspace (red) and 1/4" glass with 1" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
112	Added pane, 1/4" laminated glass with 1-3/4" airspace (red) and 1/4" glass with 1" airspace (yellow)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Acoustically lined duct	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
151	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Acoustically lined duct	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
152	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	No change	Resilient channels between joists and ceiling. One (1) layer 5/8-inch gyp. or plaster.	Acoustically lined duct	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes

Building	Exterior Window[1]	Exterior Wall	Roof	Roof/Ceiling below Attic	Attic Vents	Chimneys	Ventilation System
153	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
154	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
155	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
156	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
157	Added pane, 1/4" laminated glass with 1-3/4" airspace (red)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
158	Added pane, 1/4" laminated glass with 1-3/4" airspace (red) and 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
159	Added pane, 1/4" laminated glass with 1-3/4" airspace (red) and 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes

Building	Exterior Window[1]	Exterior Wall	Roof	Roof/Ceiling below Attic	Attic Vents	Chimneys	Ventilation System
160	Added pane, 1/4" laminated glass with 1-3/4" airspace (red) and 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes
161	Added pane, 1/4" laminated glass with 1-3/4" airspace (red) and 1/4" glass with 1-3/4" airspace (yellow)	No change to existing masonry	Furred assembly, framing spaced off existing assembly by 1/2-inch minimum, batt insulation, one (1) layer 5/8-inch gyp.	NA	Fresh air ducted directly to mechanical. No vents.	Seal chimney. Provide fill with minimum 25 psf surface weight.	Yes

5.0 SUMMARY

The following summarizes the acoustical recommendations for the subject project as described in this report.

Residential

- There are no applicable mandatory code requirements for this project. Due to its proximity to a highway and the airport, VA has utilized the MPAC Guide to Noise Control and 2040 Regional Transportation Policy Plan criteria as guidelines.
- Exterior noise level predictions are presented in Table 2.
- Recommended mitigation measures are presented in Table 3. These recommendations address the exterior windows, walls, roofs, penetrations, and ventilation systems.
- Refer to Appendix I for acoustical performance requirements for glazing assemblies.
- Refer to Appendix II for recommended locations for glazing assemblies.

Non-Residential

- Building 65 is an amenity building and does not have residential uses. As a result, less-stringent criteria are applied to that building.

Various noise mitigation methods may be utilized to satisfy the noise criteria described in this report. Alteration of mitigation methods that deviate from requirements should be reviewed by the acoustical consultant.

If you have any questions or comments regarding this report, please do not hesitate to contact us.

Sincerely,
Veneklasen Associates, Inc.

Samantha Rawlings, *LEED AP BD+C*
Associate Principal

APPENDIX I – GLAZING REQUIREMENTS

In order to meet the acoustical criteria for the project, the glazing shall meet the following requirements:

Table 4– Acoustical Glazing Requirements: Minimum Octave Band Transmission Loss and STC Rating

Nominal Thickness	Minimum Transmission Loss Octave Band Center Frequency (Hz)						Min. STC Rating
	125	250	500	1000	2000	4000	
1/4-inch monolithic	15	19	23	28	32	30	**30**
1/4-inch thick laminated	22	26	28	31	35	35	**35**

An assembly's frame and seals may limit the performance of the overall system. The window systems selected for the project shall not be selected on the basis of STC rating alone but must meet the system STC rating provided in Table 4 above. Additionally, the assemblies given above are provided as a basis of design, but regardless of construction, the octave band Transmission Loss (TL) of the particular system selected must meet the minimum values in Table 4 above. Therefore, systems selected must meet the minimum Transmission Loss values and STC ratings provided in Table 4.

Independent laboratory acoustical test reports should be provided for review by the design team to ensure compliance with glazing acoustical performance requirements. Lab shall be a current member of the National Voluntary Laboratory Accreditation Program (NVLAP) under the National Institute for Standards and Technology (NIST) for accreditation and shall be pre-approved by Veneklasen Associates, Inc. Tests are required to be completed in North America. Lab reports shall be in compliance with ASTM standard E90 and be no more than 10 years old (from date of submission on specific project). VA requires invitation to witness acoustical testing completed to demonstrate compliance with the requirements of this report and reserves the right to exclude test reports from laboratories that are not pre-approved by Veneklasen Associates, Inc. for the specific test standard. The tests shall be performed on the entire assembly, including frame and seals and hardware, if applicable to be used for the project. If test reports are not available for the assembly, VA would require that the assembly be tested at a third-party independent lab accredited through NVLAP for the ASTM E90.

APPENDIX II – ACOUSTICAL GLAZING ZONES

The figures within this appendix identify the building facades where the recommended glazing recommendations are applicable. The colors represent assemblies as described in the report; summarized here for convenience. Should any discrepancy occur, the recommendations in the report and transmission loss values per Appendix I supersede the information herein.

- Red solid line: 1/4-inch laminated pane, spaced off face of existing glass by 1-3/4 inch, minimum.
- Yellow dotted line: 1/4-inch monolithic pane, spaced off face of existing glass by 1-3/4 inch, minimum.
- For buildings with multiple stories, the specified glazing is intended for all floors.

Figure 2 - Glazing Zones, Bldgs. 53-55, 62

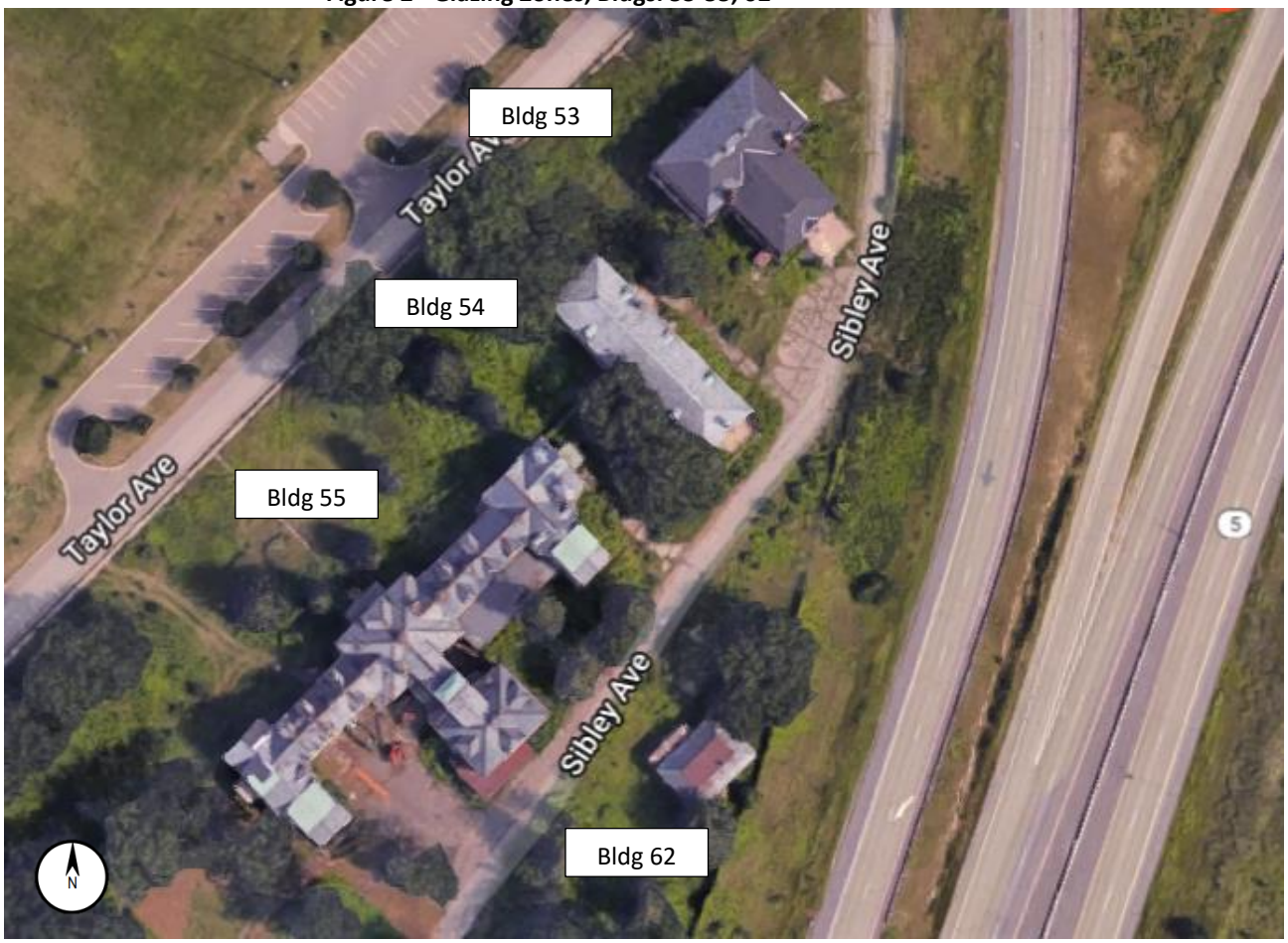


Figure 3 - Glazing Zones, Bldgs. 56, 57, 64-67

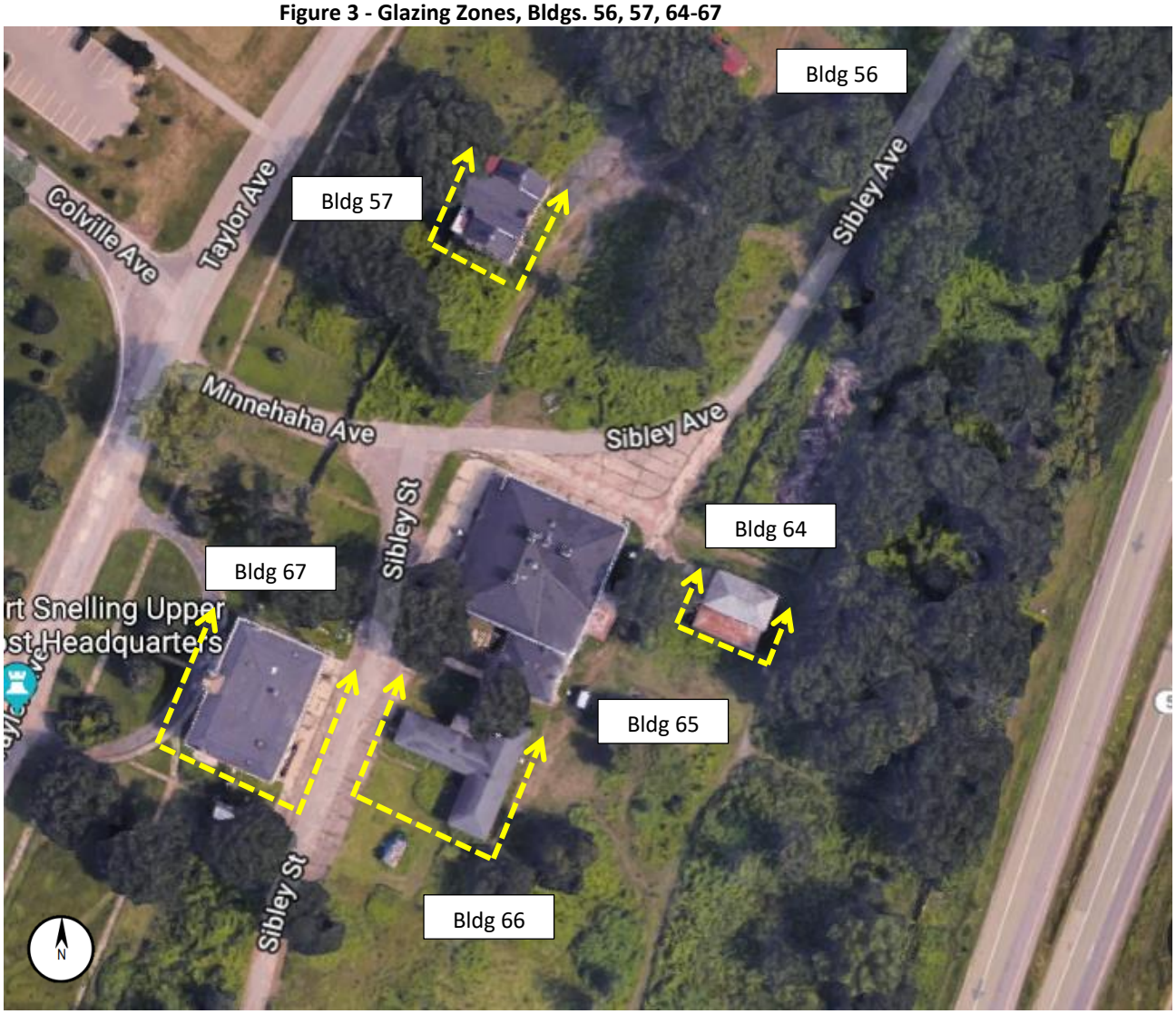


Figure 4 - Glazing Zones, Bldgs. 76, 101, 102

Figure 5 - Glazing Zones, Bldgs. 103, 112

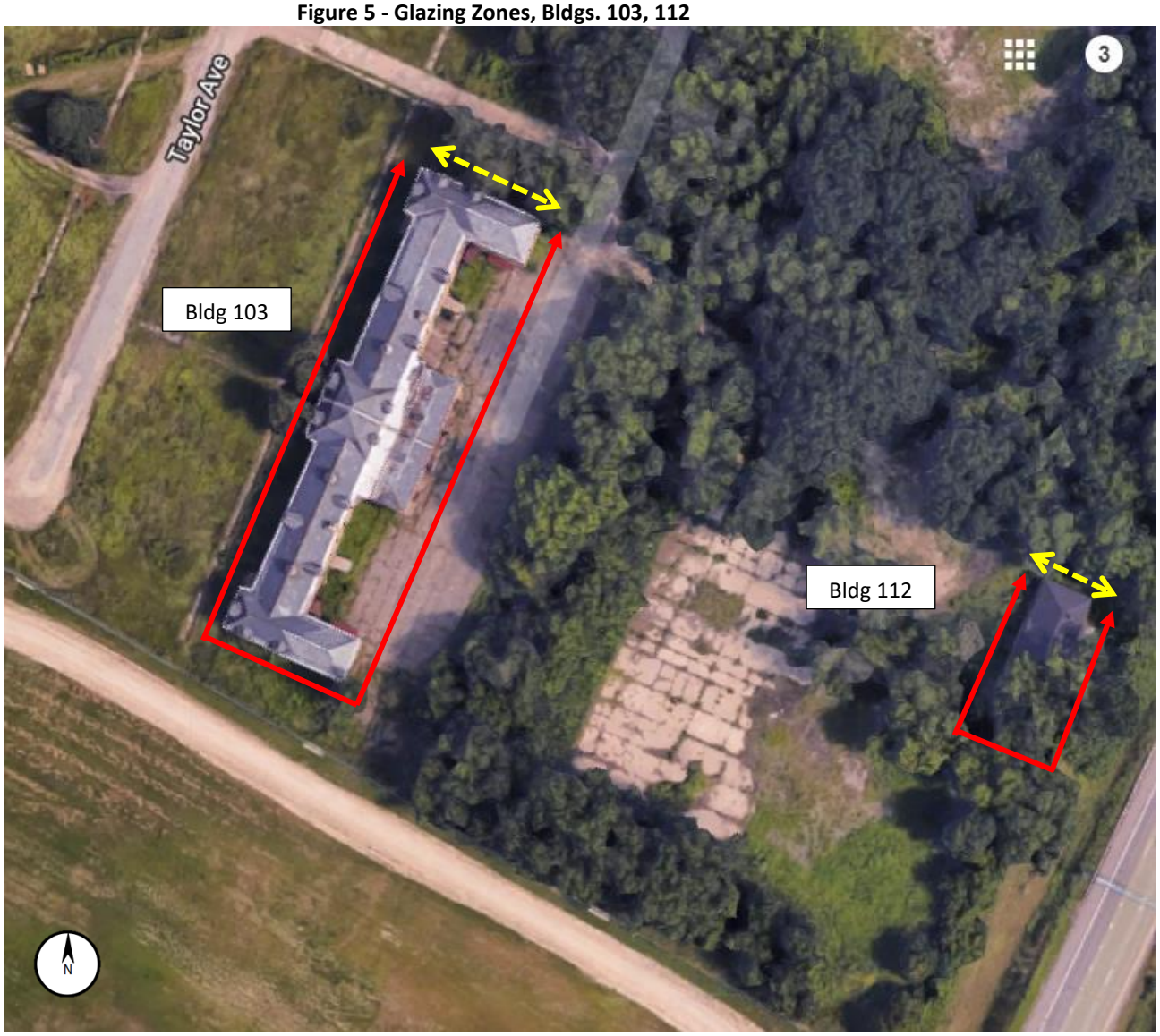


Figure 6 - Glazing Zones, Bldgs. 155-161

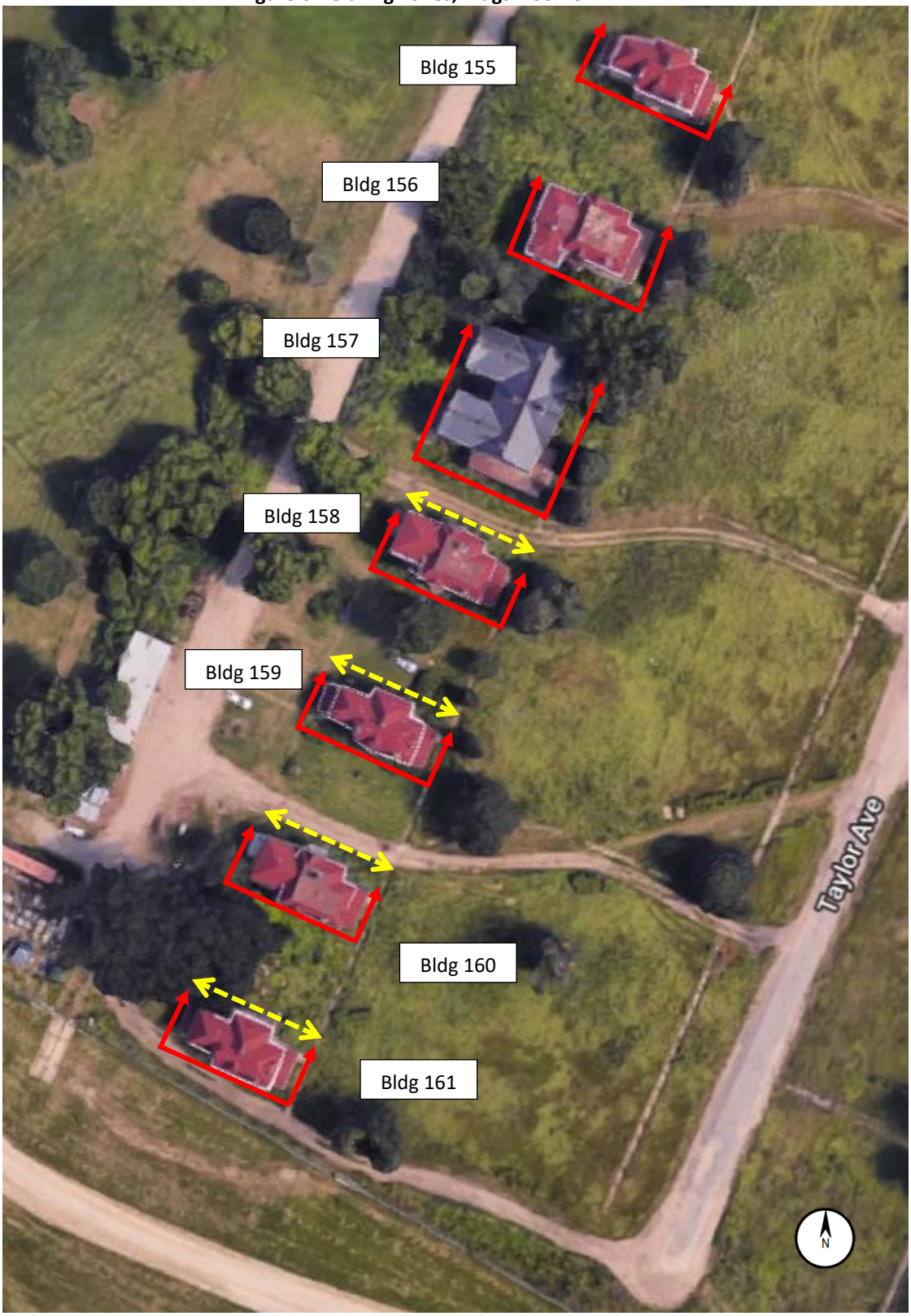


Figure 7 - Glazing Zones, Bldgs. 151-154