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TO: Neil Bhargava, Sr. Project Manager/Executive
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FROM: Henry Ashburn, Senior Consultant
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cc: Tony Hoover, Principal

SUBJECT: **SCF PCC1, PCC2, PCC3 HVAC – Acoustic Site Observation**
MCH Project #26002

DATE: **10 February 2026**

This memo summarizes the data and observations collected at SCF YAGHELI SHESH QENQ'A during site measurements conducted on January 18 and 19, 2026. MCH staff were accompanied by Patrick (SCF) throughout the assessment, and at times joined by Darren Toms (Neeser). The purpose of this visit was to document existing background noise conditions directly beneath the rooftop units (RTUs) prior to upcoming renovations. Two upper floor areas (RTU-2.1 and RTU-2.4) were specifically identified as having existing noise concerns with requests for recommendations to improve conditions, while remaining areas were assessed for pre-renovation documentation purposes only. No details were provided regarding the nature of the reported noise issues or complaints.

A. CONTENTS

B. TERMINOLOGY

Frequency (Hz) – Defines how quickly air particles vibrate back and forth. Humans can generally detect 20Hz to 20,000Hz (also referenced to as 20kHz). Although technically different, frequency is similar/related to the "pitch" of the sound. Smaller values are often considered "low frequencies" whereas larger values are often considered "high frequencies".

Sound Pressure Level (SPL or Lp) – A logarithmic measure, in decibels (dB) of the pressure relative to reference pressure (often 20 μPa in air). Dependent on environmental factors (reflections, absorption, propagation, etc). Used to denote noise levels occupants experience indoors and outdoors. Colloquially "how loud it is".

Equivalent Continuous Level (L_{eq}) – a single value that represents the same total sound energy as the fluctuating level measured over the measurement period. This is often considered or referenced as the "average sound level".

Noise Criterion (NC) – Industry standard metric used to rate background noise, specifically steady-state HVAC noise. Higher NC rating is louder.

A-Weighting (dBA) – Commonly used to represent decibels aligning with human perception of sound. Humans are generally less sensitive to low frequencies and have increased sensitivity to speech sounds. dBA de-emphases contribution of low-frequency sound to the overall sound level.

C-Weighting (dBC) – Commonly used in HVAC noise measurements and noise control as dBC maintains much of the low-frequency content (does not de-emphasize low frequencies as is done with A-Weighting). In HVAC contexts, dBC is typically a larger value than dBA.

C. MEASUREMENT PROCESS

Measurements were conducted in general accordance with applicable ASTM measurement methodologies using a B&K handheld sound level analyzer. The first round of measurements was performed with all HVAC systems powered off, followed by a second round conducted with the HVAC systems powered on.

Each measurement was performed as a spatial average to sample the occupied room within the allowable measurement space defined in the applicable standard. As such, each measurement is also a time-weighted Leq.

Each measurement was performed in an unoccupied setting with very minimal extraneous noises, noises from nearby rooms, or other building activity. A few exceptions:

1. In the Open Office area beneath RTU-2.4, the radiators/piping produced constant noise and that is present in most measurements.
2. Areas beneath RTU-3.1 and RTU-3.2 (near the Lobby) still sounded as though HVAC was operational, although RTUs on roof above were powered off per our visual observation. This noise may have been associated with RTU(s) on another area of the roof.
3. Exhaust fans serving restrooms remained operational, and therefore some associated noise is included in most sound pressure level measurements nearby restrooms.

D. MEASUREMENT RESULTS

Measurement results are provided in Table 1. Per common references (ASHRAE), hospital and clinic “patient rooms” goals are typically around NC 30, 35 dBA, and 60 dBC. Occupant sensitivity varies by person, however these common goals ensure general satisfaction by most users.

Table 1: Measurement Results

			OFF			ON		
Bldg	**Room # or Area**	**RTU Unit Above**	**NC OFF**	**dBA Leq OFF**	**dBC Leq OFF**	**NC ON**	**dBA Leq ON**	**dBC Leq ON**
PCC1	2806	1.1	Could not measure			24	33	71
PCC1	2808	1.1	Could not measure			24	32	67
PCC1	2834	1.1	Could not measure			32, [125 Hz]	39	70
PCC2	2313	2.1	44, [125 Hz]	43	59	44, [125 Hz]	45	75
PCC2	2307	2.1	52, [125 Hz]	49	65	54, [125 Hz]	50	75
PCC2	2214	2.1	43, [125 Hz]	41	58	42, [125 Hz]	46	76
PCC2	2210	2.1	43, [125 Hz]	43	59	54, [16 Hz]	52	82

PCC2	2206	2.1	46, [125 Hz]	44	61	48, [31.5 Hz]	49	78
PCC2	2211	2.1	36, [125 Hz]	37	54	41, [125 Hz]	45	75
PCC2	2207	2.1	31, [125 Hz]	37	53	40, [250 Hz]	45	74
PCC2	2215	2.2	31, [125 Hz]	34	51	37, [125 Hz]	41	74
PCC2	2213	2.2	31, [125 Hz]	36	52	38, [125 Hz]	44	74
PCC2	2114	2.2	25, [125 Hz]	30	49	37, [16 Hz]	41	74
PCC2	2112	2.2	31, [125 Hz]	35	52	38, [125 Hz]	44	72
PCC2	2115	2.2	24	32	50	39, [63 Hz]	41	74
PCC2	2113	2.2	28, [125 Hz]	34	51	39, [63 Hz]	43	73
PCC2	2109	2.3	30, [125 Hz]	36	55	36, [125 Hz]	42	71
PCC2	2107	2.3	32, [125 Hz]	38	57	36, [125 Hz]	41	71
PCC2	2008	2.3	32, [125 Hz]	37	55	52, [16 Hz]	43	79
PCC2	2006	2.3	32, [125 Hz]	35	54	36, [125 Hz]	41	72
PCC2	Open Office A	2.4	34, [250 Hz]	39	55	41, [250 Hz]	45	63
PCC2	Open Office B	2.4	30, [125 Hz]	37	54	39, [250 Hz]	45	67
PCC2	Open Office C	2.4	26, [250 Hz]	33	49	39, [250 Hz]	44	65
PCC2	Open Office D	2.4	25, [1000 Hz]	33	49	39, [250 Hz]	44	66
PCC2	Open Office E	2.4	26, [250 Hz]	35	52	39, [250 Hz]	44	69
PCC2	Open Office F	2.4	29, [250 Hz]	35	51	41, [250 Hz]	47	65
PCC2	Open Office G	2.4	26, [250 Hz]	34	49	47, [2000 Hz]	49	65
PCC2	Open Office H	2.4	26, [500 Hz]	34	49	40, [250 Hz]	45	65
PCC2	Open Office I	2.4	27, [250 Hz]	35	49	39, [250 Hz]	44	67
PCC2	Open Office J	2.4	28, [500 Hz]	36	49	41, [250 Hz]	46	68
PCC2	Open Office K	2.4	32, [500 Hz]	38	49	42, [250 Hz]	46	66
PCC2	Open Office L	2.4	30, [1000 Hz]	37	51	39, [250 Hz]	44	66
PCC2	Open Office M	2.4	33, [500 Hz]	40	49	41, [250 Hz]	46	67
PCC2	Open Office N	2.4	27, [1000 Hz]	34	51	40, [250 Hz]	47	67
PCC2	Open Office O	2.4	26, [125 Hz]	33	50	37, [250 Hz]	42	68
PCC2	Open Office P	2.4	25, [125 Hz]	33	49	38, [250 Hz]	43	67
PCC2	Open Office Q	2.4	26, [125 Hz]	34	50	37, [125 Hz]	43	67
PCC2	Open Office R	2.4	29, [1000 Hz]	35	49	38, [63 Hz]	44	68
PCC3	3136	3.1	30, [8000 Hz]	34	49	32, [1000 Hz]	38	57
PCC3	Reception Vestibule (west)	3.1	28, [1000 Hz]	35	53	28, [1000 Hz]	36	62
PCC3	3134	3.1	27, [125 Hz]	32	53	27, [250 Hz]	35	59
PCC3	RR near 3134	3.1	24, [125 Hz]	31	49	34, [1000 Hz]	40	58
PCC3	3143	3.1	23	31	50	28, [2000 Hz]	36	65
PCC3	3152	3.1	24, [125 Hz]	32	48	27, [31.5 Hz]	35	65
PCC3	3153	3.1	34, [125 Hz]	36	53	35, [125 Hz]	40	62
PCC3	3141	3.1	23	32	52	29, [63 Hz]	36	64
PCC3	Lobby RR (east)	3.2	31	38	59	30, [500 Hz]	37	60
PCC3	3196	3.2	33, [500 Hz]	38	60	33, [500 Hz]	38	61
PCC3	Reception (east)	3.2	31, [250 Hz]	38	60	31, [250 Hz]	38	61
PCC3	3206	3.2	32, [125 Hz]	36	56	33, [125 Hz]	39	62
PCC3	3224	3.2	23, [125 Hz]	31	50	29, [250 Hz]	37	61
PCC3	3223	3.2	23	32	52	30, [250 Hz]	36	61
PCC3	3213	3.2	41, [125 Hz]	42	58	41, [125 Hz]	44	63
PCC3	RR near 3206	3.2	35, [125 Hz]	37	54	35, [125 Hz]	41	57

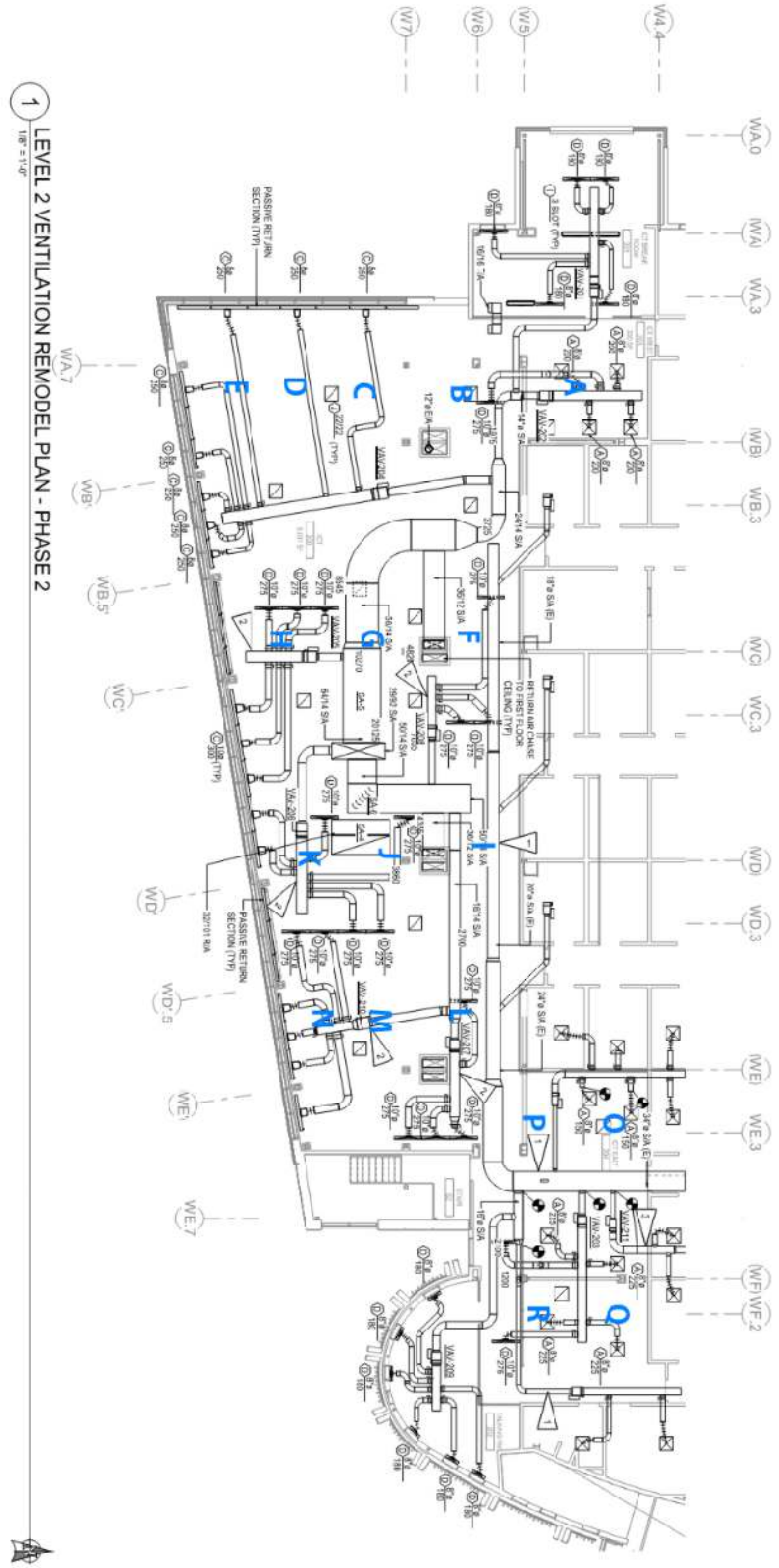


Figure 1: Open Office Measurement Locations

E. OBSERVATIONS

Areas beneath RTU-1.1, RTU-2.2, RTU-2.3, RTU-3.1, and RTU-3.2, and were appropriately quiet, as expected, since no noise complaints were described at the outset of the project.

Roof hatch to access RTU-1.1 was inoperable; therefore, *HVAC OFF* measurements could not be conducted in the areas beneath RTU-1.1 during our visit.

A few vibration-isolation issues were observed under the supply fans within RTU-2.2, RTU-3.1, and RTU-3.2. Several spring isolators appeared to be improperly adjusted and/or installed. See Figure 2.

Figure 2: Improperly adjusted spring isolators

Regarding areas with noted noise issues (RTU-2.1 and RTU-2.4):

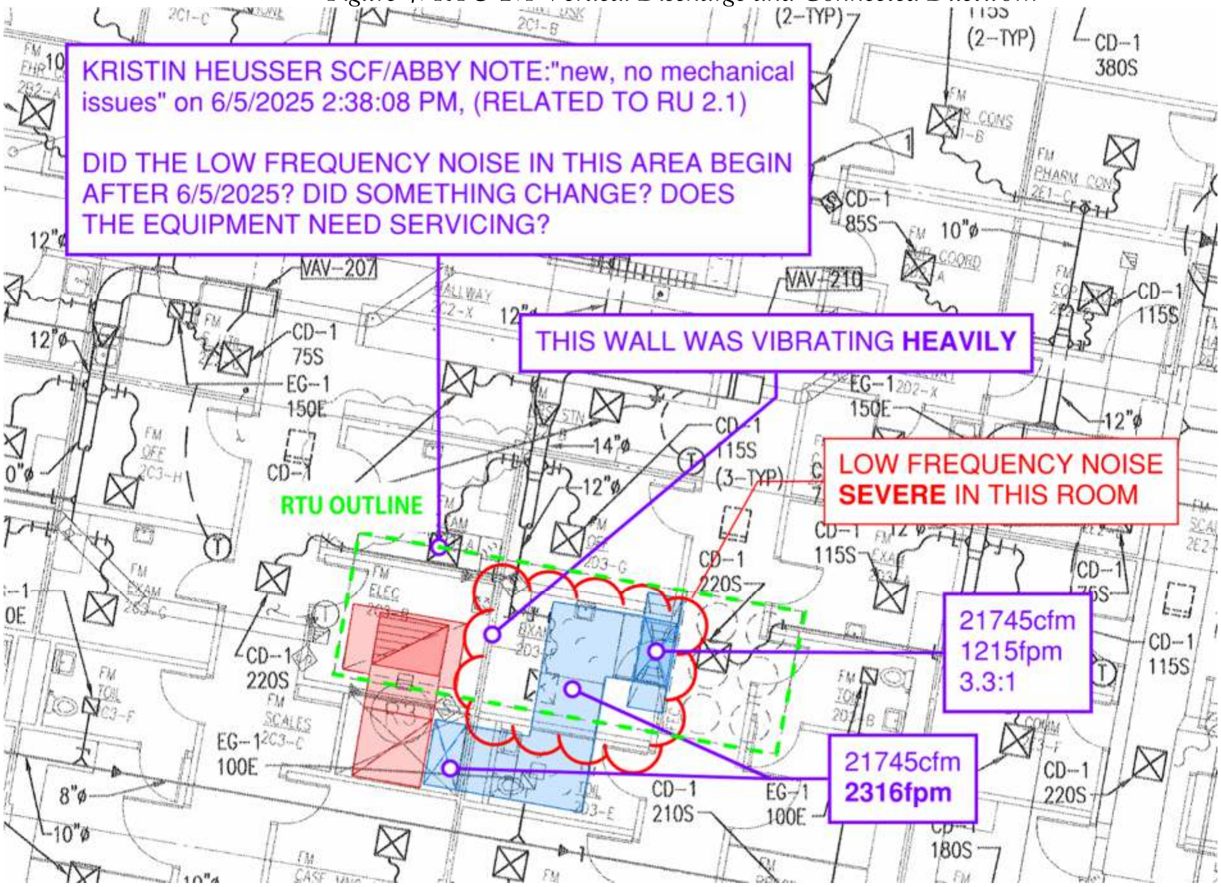
Patient rooms under RTU-2.1 exhibited two distinct types of noise:

1. Transformer Noise (electrical)
    a. The floor-mounted transformer in Electrical 2309 was improperly vibration-isolated (see Figure 3), and the surrounding constructions (walls and door assembly) were inadequate for blocking airborne sound radiated from the transformer housing.
    b. Readily perceptible vibrations from the transformer were present in the floor slab within Electrical 2309 and adjacent patient rooms.
    c. The front metal panel of the transformer resonated at a strong tonal frequency; however, this tone could be significantly reduced with the application of slight manual pressure.

Figure 3: Electrical 2309 transformer and existing support pads

2. <u>Low-Frequency HVAC Noise</u>
   a. Although a 6/5/2025 Bluebeam markup from Kristin Heusser SCF/Abby stated "new, no mechanical issues" for RTU-2.1, our site observations identified mechanically-related issues that produced excessive noise.
   b. Due to low frequency characteristics, it was omni-present and difficult to pinpoint to a single source.
   a. The most pronounced effects of RTU-2.1 were observed in Room 2210. Adjacent rooms were similarly affected, though to a slightly lesser degree.
   b. The west wall of Room 2210 was visibly shaking due to low-frequency energy; the gypsum board wall surface rattled, as did the attached cabinetry.
   c. The resultant noise appeared to be a combination of direct sound transmission from above and re-radiated sound from the vibrating western gypsum board wall.
   d. The western gypsum board wall is shared with Electrical 2309 and extended fully to structure, with robust steel connections to the underside of the roof deck supporting RTU-2.1. This was one of the few full-height walls in the ceiling plenum in this vicinity. We suspect this wall is load bearing and cannot be easily adjusted to reduce re-radiation.
   e. The low-frequency noise fluctuated randomly, suggesting the primary noise source may be turbulent airflow. Drawings indicate very high airflow velocities and multiple abrupt airflow direction changes (see Figure 4).

Figure 4: RTU 2.1 Vertical Discharge and Connected Ductwork



Areas under RTU-2.4 (open office) exhibited noise issues of various origins. See Figure 8 at the end of this section for visual and spatial markup of the observed conditions. Observations noted below are listed in decreasing order of perceived loudness.

1. <u>Excessive airflow through diffusers, Locations 1.1, 1.2, 1.3</u>
   The most apparent noise in this Open Office area was around Locations 1.1, 1.2, 1.3. Each area of concern was generally due to excessive airflow delivery to linear diffusers.

   At Location 1.1, the linear diffuser blades were nearly fully closed. This caused a large volume of air to be forced through an extremely narrow opening, resulting in additional mid-frequency and high-frequency noise.

   Diffuser blades at Locations 1.2 and 1.3 were fully open, yet the airflow volume was still high enough to generate audible airflow noise. Some diffusers exhibited nearly twice the airflow velocity of nearby diffusers, indicating poor system balancing.

2. <u>Radiated noise through perforated acoustic ceiling panels, Location 2.1, 2.2</u>
   Noises of various sorts (RTU-2.4 vertical discharge noise, piping flow noise, excessive airflow velocities) were audible through the wood-look perforated acoustic ceiling panels at Location 2.1,

2.2. It was not clear if these panel sections were being used for return air to the ceiling plenum, as there were various other return air grilles. The wood-look panels featured acoustic “fleece” backing for sound absorption benefit. This fleece is not used for blocking sound transmission. See Figure 5 below for visual depiction of the described wood-look ceiling panels.

Figure 5: Open Office areas with wood-look perforated ceiling panels

3. <u>Airflow noise, Location 3</u>
   Mid-frequency noise was present near VAV-202 near Location 3. This appeared to be partly caused by the abrupt, acute angles formed by the flex duct and subsequent transition to rigid duct, which likely contributed to poor and turbulent airflow. Airflow velocities are also calculated to be around 1847fpm which is excessive. Noise was audible through the open return air grille in very close proximity to noise source. These grilles are designed to allow passage of air, and therefore allow for passage of nearby noise as well. See Figure 6

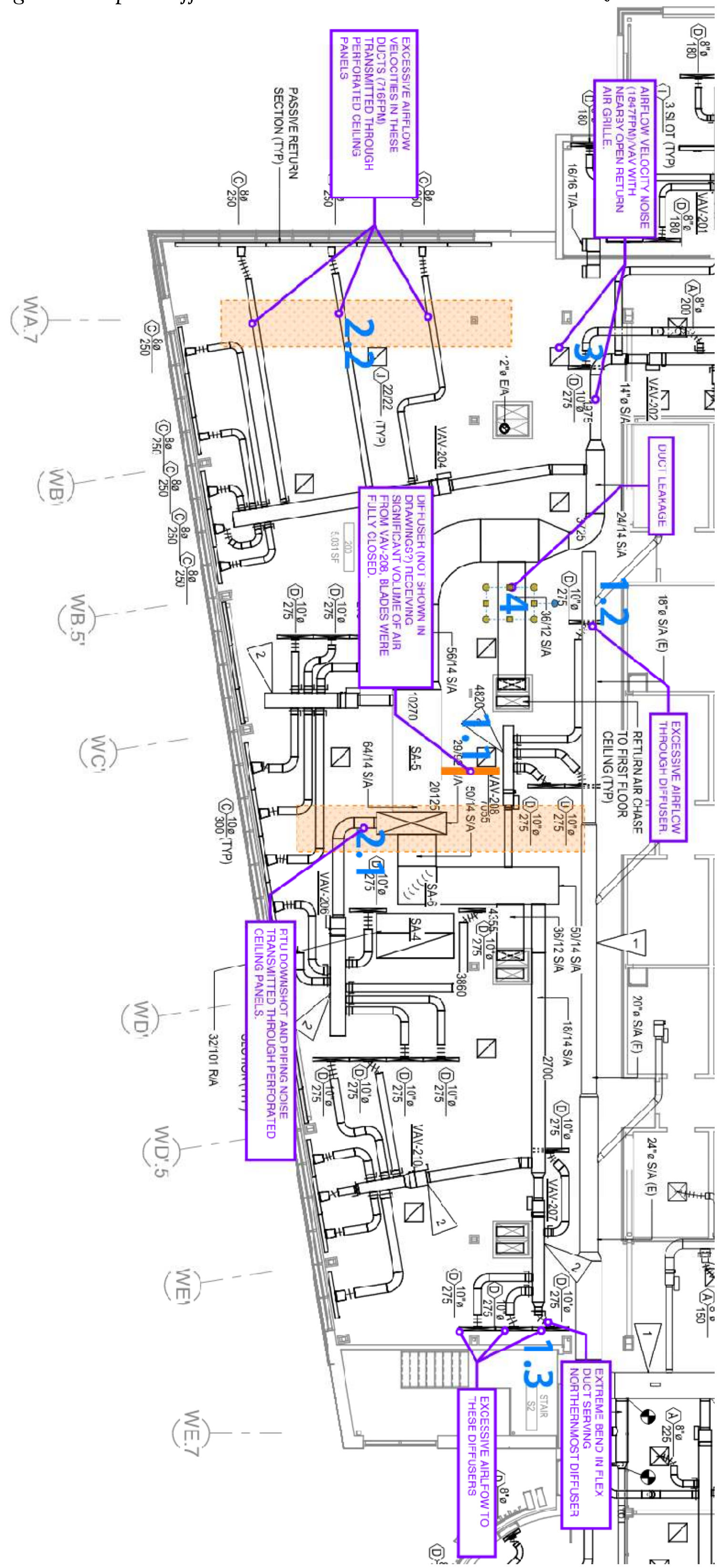
Figure 6: Section of duct with high airflow velocity and abrupt transition

4. <u>Duct leakage, Location 4</u>
   High frequency air leakage was observed at Location 4. This was due to poor duct connections, poor/lack of sealant, misalignment, or improper duct sizing.

5. <u>Vibration Isolation, internal to RTU-2.4</u>
   Internal vibration isolation supporting the supply fan closest to the unit access door on RTU-2.4 was improperly selected and/or adjusted. The fan mounting bracket was contacting the RTU housing, short circuiting the spring isolator, and reducing its effectiveness. See Figure 7.

Figure 7: Bottomed out spring isolator in RTU-2.4 (potentially overloaded)

Figure 8: Open Office Observation Locations & Summarized Remarks



F. RECOMMENDATIONS

1. RTU-2.1 areas

<u>Transformer Noise</u>

a. Adjust the front panel of the floor-mounted transformer in Electrical 2309 so the high-frequency panel resonance is minimized. This may involve tightening or loosening the screws securing the front plate or permanently applying pressure or damping material to alter the panel's natural resonance. Reattaching the front panel with elastomeric washers or similar might also work. Consult the transformer manufacturer before adjusting this panel.
b. Install the transformer in Electrical 2309 on captured neoprene mounts providing a minimum of 0.15in minimum static deflection under load. Mason Industries RBA or similar products can typically provide the required deflection while also offering tension, compression, and shear ratings for seismic performance. Consult Mason Industries and/or structural engineer for final selections and seismic concerns. Mason Industries will need to know unit weight and distribution to properly spec isolators.
c. Where possible, use flexible conduit on the transformer in Electrical 2309 to reduce vibration transfer into the structure. At minimum, support conduit connections with elastomeric or neoprene material/mounts to minimize structure-borne transmission.
d. If the door can accept a bottom gasket, consider gasketing the entire door to Electrical 2309 to minimize airborne transformer noise entering the corridor and adjacent rooms. Consider one or two rows of adhesive-backed triple find or teardrop gasketing (e.g., Pemko or Zero) and an adjustable stop gasket with a neoprene seal. Install an operable bottom gasket and ensure full contact with the threshold/floor. All perimeter gasketing (header, jambs, threshold) should be adjusted to achieve an airtight seal—no visible light leakage, and a business card should not be able to slide between the door and the gasket system.
e. If transformer noise persists after implementing the modifications above, consider more substantial architectural improvements. Substantial improvements would typically involve removing a layer of gypsum board from surrounding walls and reinstalling the layer on resilient isolation clips (e.g., PAC International RSIC-1) with required backer brackets for mounting as applicable. Ensure stud cavities contain full-depth batt insulation before reinstalling gypsum board. If RSIC-1 clips are not feasible due to excessive surface-mounted elements, consider constructing a separate furred wall with resilient bracing (e.g., Mason Industries DNSB or WIC). The goal is to decouple the gypsum board from the studs to reduce sound transmission from the transformer side of the wall to the adjacent exam rooms. The sway brace element (if required) would only be there for seismic considerations.

<u>Low frequency RTU noise</u>

f. Ensure the fans, motors, and other equipment within the RTU are properly maintained, balanced, and adjusted for proper operation.
g. Ensure vibration-isolation systems (new or existing) are properly selected for the operating weight of the equipment and are properly installed. Ensure spring isolators are correctly adjusted. If spring isolators were improperly selected for the fan/equipment weight, consider replacing them with new units providing the proper minimum static deflection under load.
h. Reduce RTU airflow delivery as much as possible while still providing the required amount of air to occupied spaces, and then rebalance the system.
i. Reconfigure ductwork to be much smoother and/or less restrictive. This may involve modifying duct dimensions, locations, lengths, or turning-vane configurations, or slightly

shifting the RTU during reinstallation and reconfiguring the unit for horizontal discharge instead of vertical discharge. For reference, other RTUs do not force full-RTU-quantity airflow at the unit discharge through four consecutive elbows in quick succession at 2,300 fpm+. Consider mimicking other, quieter RTU discharge ductwork schemes. Consider 45° diagonal duct runs to minimize the number of 90° turns. Turning vanes sometimes add to airflow turbulence issues when located at the unit discharge. Consider removal of vanes, if possible from a mechanical standpoint.

2. RTU-2.4 areas
   a. Adjust VAV and diffuser airflow delivery around Locations 1.1, 1.2, and 1.3 to ensure proper airflow quantities are delivered to the diffusers. Presuming the diffusers were selected for appropriate NC and airflow ratings, they should operate quietly when provided with the design airflow volume.
   b. If the wood-look perforated ceiling panels around Locations 2.1 & 2.2 are visual/acoustic only (i.e., not used for return air flow to the ceiling plenum), consider backing the ceiling panels with gypsum board or plywood to improve noise-blocking performance and reduce transmitted sound from vertical discharge and piping flow.
   c. Consider relocating the return air grille panel to a location further away from the noise source around Location 3. If noise issues persist, consider reducing airflow or increasing effective final runout duct diameter for slower airflow velocities and straightening sections of duct around Location 3 to promote smoother airflow.
   d. Seal duct connections around Location 4 with appropriate duct-seal material to minimize air leakage.
   e. Ensure all internal RTU vibration isolation is properly installed and adjusted Vibration isolated equipment should be free to move (albeit very small displacements) on their isolation systems.

3. RTU-1.1, RTU-3.1, RTU-3.2, RTU-2.2, & RTU-2.3 areas (recommendations not requested, informational only)
   a. Fix roof hatch to allow access to RTU-1.1.
   b. If any of these RTUs will be replaced with newer units, ensure that the discharge sound power of the new units does not exceed that of the existing units.
   c. Ensure any new RTUs do not deliver significantly greater quantities of air through the existing or remaining ductwork, as this may increase airflow velocities and the associated noise and turbulence. If increased air quantities are required, consider upsizing ductwork to maintain airflow velocities.
   d. Ensure vibration isolation systems (existing/reused or new) are properly selected for the operating weight of the equipment, and that they are properly installed. Ensure spring isolators are properly adjusted for free movement after installation.
   e. Ensure that ductwork connections to the unit are of the flexible variety to minimize vibration-energy transfer into the building.

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Please reach out with any clarifying questions. Thank you for the opportunity to review this facility!

Sincerely,

MCKAY CONANT HOOVER INC

Henry Ashburn
Senior Consultant