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Stevenson-Metrogrove Properties Phase I & II Noise Analyses

City of Gaithersburg, Maryland

Report No. 240618b
Project No. CMH2201

For: Craftmark Homes

By: Erika Ebersole
Scott Harvey, PE, INCE Bd. Cert

1. EXECUTIVE SUMMARY

Phoenix Noise & Vibration has conducted an analysis of transportation noise impact upon the Stevenson-Metrogrove portion of the existing Parklands development in Gaithersburg, Maryland. Upon completion, the Stevenson-Metrogrove property will consist of 32 two-over-two condominiums (64 units) and 168 townhomes. This study was limited to noise impact from surrounding roadways, primarily I-270 and Watkins Mill Road, and the adjacent railway, and included:

- On-site 24-hour noise level measurements.
- Computer modeling.
- Determination of future noise levels.
- Specification of building construction requirements necessary to maintain interior noise levels below the 45 dBA Ldn limit.

Noise impact throughout Stevenson-Metrogrove will vary with height; therefore, impact has been presented at the ground level (5 feet above grade) and the upper level (25 feet above grade) to show how the noise level changes with height. Impact is presented in varying levels of noise indicating the future transportation noise level. All calculated noise levels are “mitigated,” accounting for the presence of existing surrounding buildings and topography, as well as all future site buildings and topography.

Results indicate that the site will be impacted by noise levels greater than 65 dBA Ldn at the ground level. However, most of the residences will be two-over-two condominiums and rear-load townhomes, all of which would not have rear yards or outdoor activity areas that require mitigation. The townhomes closest to I-270 will have rear yards impacted by noise levels greater than 65 dBA Ldn, for which noise barriers ranging from 11 to 15.5 feet tall will be required. Similarly, the pool area to be located at the south of the site will be exposed to noise levels greater than 65 dBA Ldn. The proposed 10-foot noise barrier and earthen berm between the site and the railway will adequately mitigate the noise levels below 65 dBA Ldn. The berm utilized for this analysis was provided on the site plan by Craftmark Homes. A 6-foot barrier at the southeast corner of the site will further mitigate noise levels at the City’s request.

Noise impact upon the Stevenson-Metrogrove buildings will be as follows:

- All 32 two-over-two condominiums and 168 townhomes will be exposed to noise levels greater than 65 dBA Ldn and up to 72 dBA Ldn upon the townhome lots near the railway crossing.
- Residential units exposed to noise levels above 65 dBA Ldn required further analysis to determine whether the proposed building construction will be capable of maintaining interior noise levels at 45 dBA Ldn, or whether modifications will be needed to do so. The results of this analysis found that interior noise levels throughout the site can be maintained below 45 dBA Ldn with upgraded exterior walls, windows, and/or doors.

Note that the majority of units within this project require upgraded windows and doors to some level.

2. NOISE TERMINOLOGY

2.1. dB vs. dBA

While the standard unit of measurement for sound is the decibel (dB), discussions of noise impacting the human ear use “dBA.” The “A” refers to a frequency weighting network used to simulate the human ear’s unequal sensitivity to different frequencies. The A-weighted noise level is therefore more representative of a human’s perception of a noise environment than the unweighted overall noise level in dB and is currently used in most all environmental noise studies.

2.2. Ldn

The day-night average noise level, or Ldn, is the equivalent sound pressure level averaged over a 24-hour period, obtained by adding 10 dB to sound pressure levels measured from 10:00 p.m. to 7:00 a.m. This 10 dB “penalty” accounts for the added sensitivity caused by noise generated during the nighttime hours. The Ldn is sometimes referred to as the “DNL,” however, both terms represent the same quantity.

The Ldn is NOT a measurement of the instantaneous noise level. It is very possible to have several short term events (tractor trailer, emergency vehicle siren, car horn, etc.) which generate a relatively high noise level (e.g. 85 dBA) during a given time period, yet have a more moderate overall Ldn value (e.g. 65 dBA Ldn).

2.3. Summing Noise Levels

Noise levels from multiple sources do not add arithmetically; i.e. when two noise sources generate 60 dB individually, they do not produce 120 dB when combined. Noise levels are measured using a logarithmic scale; therefore they must be summed logarithmically. In the decibel scale, two identical, non-coherent noise sources having the same noise level produce a 3 dB increase above the condition of one source alone (i.e. two 80 dB lawnmowers running at the same time generates 83 dB).

Similarly, two different noise sources with a difference of 10 dB in their individual levels results in no measurable increase in noise when they are combined. Put another way, the quieter noise source does not increase the overall noise generated by the louder source; i.e. adding an 80 dB lawnmower into a noise environment where a 90 dB lawnmower is already running does not increase the noise level above 90 dB.

3. NOISE LIMITS

The Stevenson-Metrogrove development is located within the City of Gaithersburg city limits. The City of Gaithersburg's noise guidelines state that transportation noise impact upon residential properties should be maintained below 65 dBA Ldn in exterior areas, and that residential building structures must be constructed to achieve interior noise levels below 45 dBA Ldn.

While not explicitly stated, the City of Gaithersburg typically requires noise levels in outdoor activity areas to be maintained below 65 dBA Ldn, although what is classified as an "outdoor activity area" is not explicitly defined. Therefore, noise levels in the outdoor activity areas at the Stevenson-Metrogrove will be evaluated to this 65 dBA Ldn limit.

4. SITE DESCRIPTION

Stevenson-Metrogrove Properties (shown in Figure 1) is located to the southwest of I-270, east of Watkins Mill Road, and north of a railway owned and operated by CSX on which MARC and Amtrak have trackage rights.

In the vicinity of the site, I-270 consists of four northbound and four southbound lanes with several on/off ramps throughout the area. Watkins Mill consists of two northbound and two southbound lanes. The railway consists of two tracks with a crossing located at the southeast corner of the site. Additionally, the Metropolitan Grove MARC station is located to the south of the site.

Figure 1: Existing site and surroundings (Stevenson-Metrogrove shown in red). Aerial image dated October 8, 2020, courtesy of Google Earth.



5. NOISE MEASUREMENTS

On March 9 - 10, 2021, Phoenix Noise & Vibration conducted an on-site noise measurement survey to determine existing transportation noise levels throughout the site. This involved continuous noise level measurements and monitoring for one 24-hour period. Measurements were made using two Type 140, and three two Type 139 Precision Integrating Sound Level Meters. All meters were calibrated prior to the survey traceable to National Institute of Standards and Technology (NIST). Each meter meets the ANSI S1.4 standard for Type 1 sound level meters.

During the 24-hour measurement, noise levels were recorded and averaged over five-minute time intervals. Noise measurements were then used to calculate the site’s 24-hour average day-night noise level (Ldn), which includes the 10 dBA penalty for noise levels measured during nighttime hours.

Noise level measurements were made at the locations shown on Drawing 1 of the Appendix. Measurements were made at 5 feet (“ground level”, GL) and 25 feet (“upper level”, UL) above existing grade to account for noise levels upon outdoor activity areas and upper floors of buildings, respectively.

Measurement results are presented in Table 1. Figures 2 and 3 present the measurement results graphically, showing the noise level as measured in five-minute increments throughout the 24-hour measurement period. Figures 2 and 3 indicate the actual measured values over the 24-hour period. While the 10 dBA nighttime penalty is not shown graphically, it was included in the Ldn calculations.

Figure 2 contains the measurement locations near the railway, while Figure 3 contains the measurement locations near the roadways. Note that while the measurements are separated based on either roadway and railway, the primary noise sources (I-270 and the railway) had some noise impact upon most measurement locations.

Table 1: 24-hour noise measurement results.

Measurement Location	Height Above Existing Grade (feet)	Measured Noise Level (dBA Ldn)	See Figure
C	5	72	2
D	5	76	
E	5	65	3
	25	67	
F	25	73	

Figure 2: Five-minute average noise levels recorded during 24-hour noise survey near the railway.

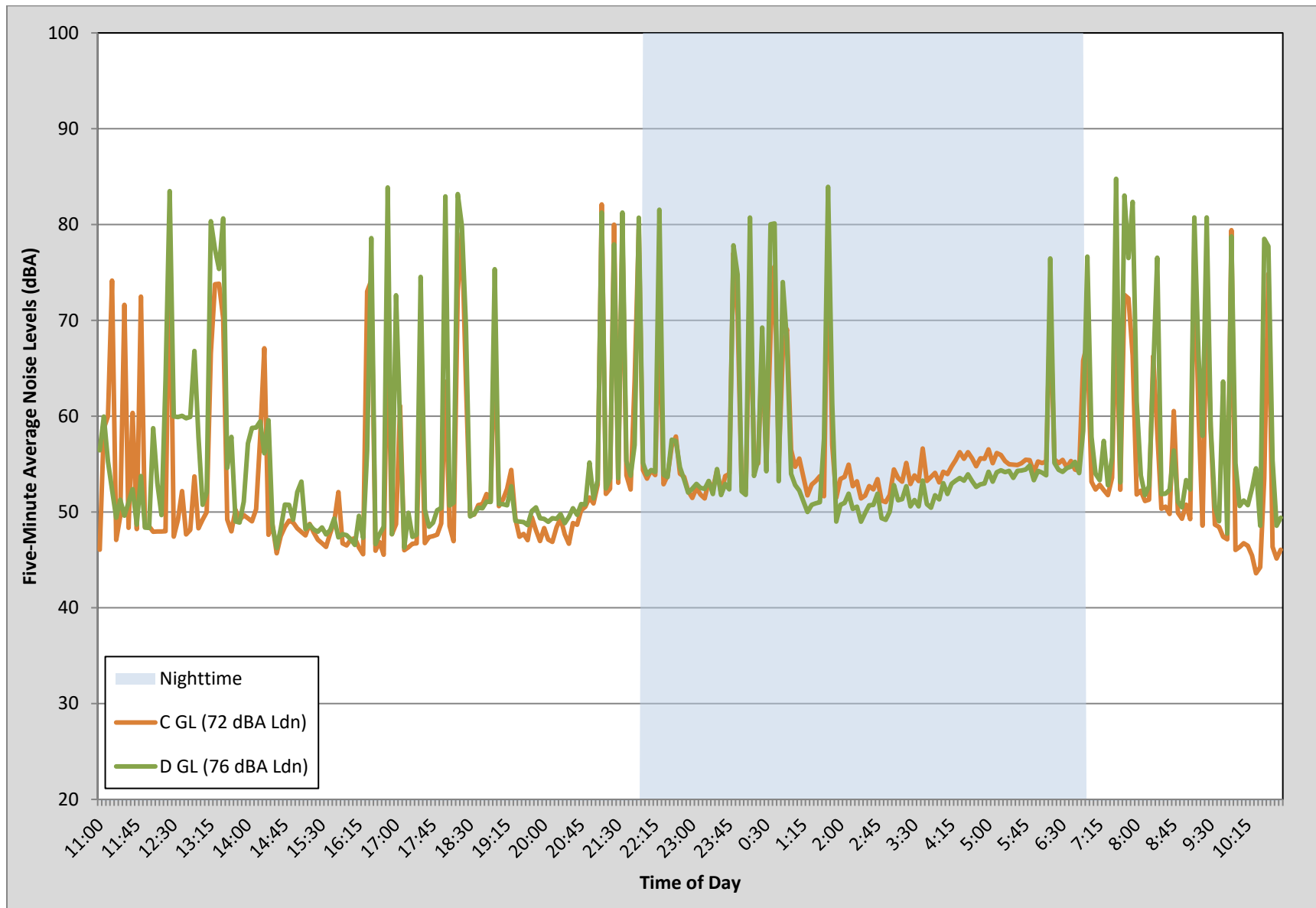
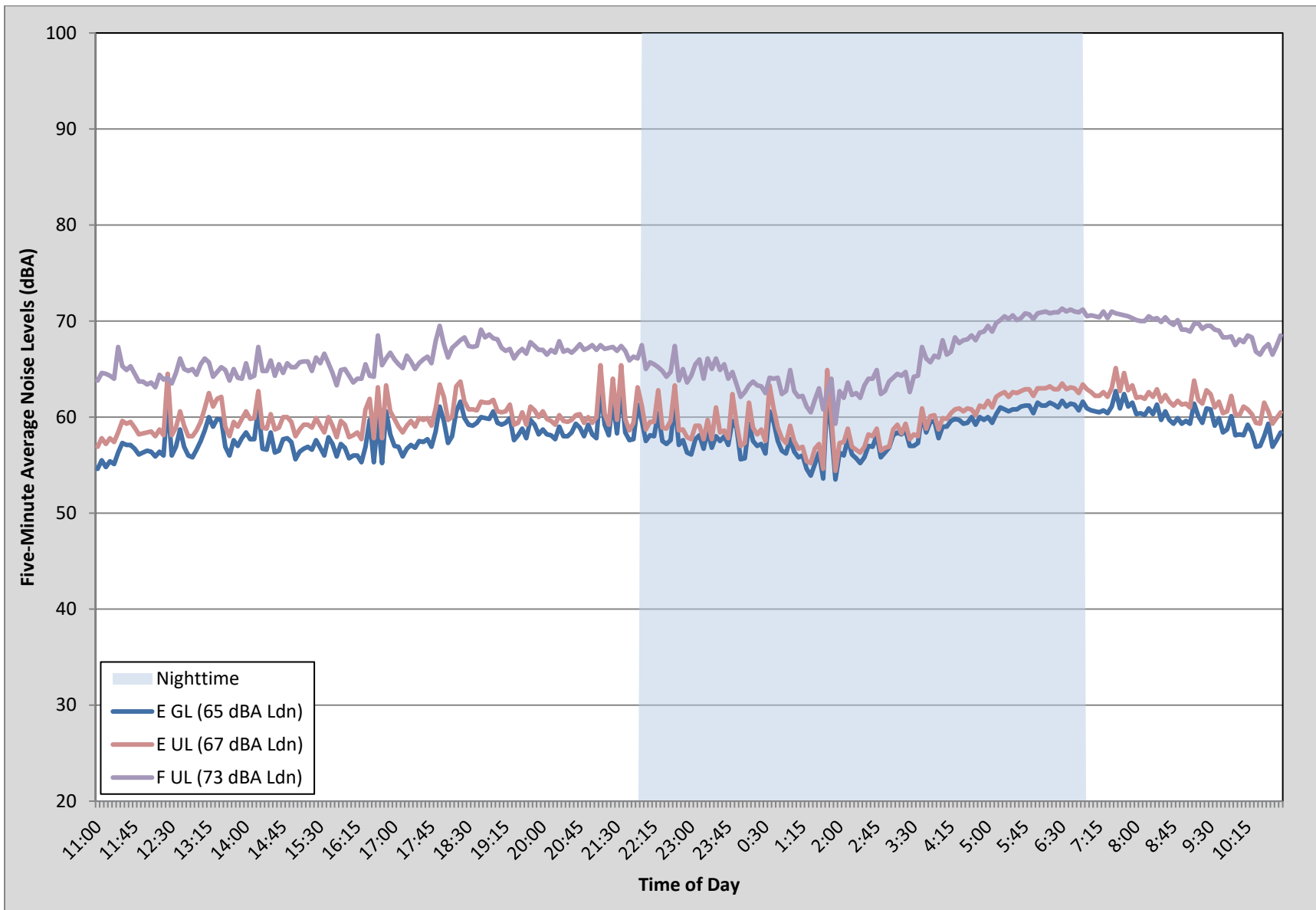


Figure 3: Five-minute average noise levels recorded during 24-hour noise survey near the roadways.



Throughout the survey, there were 32 instances in which a train passed by the site. At the time of the measurement survey, MARC indicated that MARC trains pass the site 8 times a day due to the COVID-19 pandemic, 4 in the morning and 4 in the evening. This was observed on-site during the survey. Before the COVID-19 pandemic, the MARC train passed by the site 19 times a day, 9 in the morning and 10 in the evening. At the time of this analysis, MARC has resumed pre-pandemic operations and the MARC train passes by the site 19 times a day, 9 in the morning and 10 in the evening.

To account for the noise level expected at the site during normal railway operation, 19 total MARC trains were modeled, instead of the observed 8. The average noise level from the morning and evening measured train events have each been replicated and inserted into the Ldn calculation to account for the 9 morning trains and 10 evening trains. The MARC current schedule used is provided in the Appendix.

6. COMPUTER MODELING

The existing and future sites were computer modeled using the CadnaA software program, a three-dimensional noise propagation model capable of determining the noise level impact from multiple noise sources across vertical and horizontal surfaces while accounting for factors such as topography, foliage, buildings, surface reflections, roadway data (traffic volumes, speeds, and vehicle classifications, etc.), and railway data. Noise levels can be presented either in spot locations or as noise contours of equal value throughout a defined surface area.

6.1. Current Model

A current model was developed to simulate the existing site and its surroundings using information provided on the existing site plan¹ and the Montgomery County GIS, inputting existing topography, roadway/railway alignments, and buildings. Transportation noise levels were calibrated using the on-site noise measurements by adjusting the modeled input until the modeled noise level output matched the measured values.

6.2. Future Model

A future model was developed by altering the calibrated current model to include projected roadway data and the future site buildings and topography. The railway noise output was unchanged from the current model due to the unavailability of future railway data. Currently there are no plans to alter any of the roadways in the vicinity of the site; therefore, the existing roadway alignments were used in the future model.

All noise levels are “mitigated” noise levels, calculated in the presence of the future buildings, as well as all existing surrounding buildings, topography, and significant structures. Mitigated noise levels account for the effect of buildings, barriers, and other significant structures in reducing and reflecting roadway noise propagation and are more representative of the noise level actually experienced at a specific location. The berm along the south of the site acts as such a barrier to reduce the noise levels experienced along the townhome and condominium elevations.

¹ Provided by Craftmark Homes on August 12, 2022.

6.3. Roadway Data

The onsite noise measurements were conducted approximately one year into the COVID-19 pandemic, during a time at which roadway volumes appear to be increasing compared to the beginning of the pandemic, yet also at a time where it is unclear if overall roadway activity and patterns have returned to “normal” (i.e. pre-pandemic) conditions. To account for any effect the changes to roadway activity may have on the resulting noise output from the roadway, traffic counts conducted during the onsite noise measurements were compared to the most recent available data from the Maryland State Highway Administration (MDSHA). For those roadways for which MDSHA maintains data, the average annual weekday daily traffic volume (AAWDT) and vehicle class percentages are provided in Table 2. MDSHA does not maintain traffic information for the ramp from I-270 southbound to Quince Orchard Road; therefore, the data used was based on on-site traffic counts. Note that while included in the model, the ramp does not have significant impact on the overall noise level at the site.

6.3.1. Data Validation (Current Model)

Automobiles and heavy trucks were counted at the site for a 30-minute period during the typical morning and evening peak hours, as well as at night to account for the nighttime traffic percentage.² The higher of the 30-minute peak hour counts (the evening count for this site) was doubled for an hourly count, and then used to calculate an AAWDT using the assumed K Factor of 10% and the following equation:

$$AAWDT = \frac{\text{Peak Hour Volume}}{K \text{ Factor}}$$

To determine the I-270 traffic counts for the day of the onsite noise measurements, an MDSHA traffic monitoring location along I-270 near the site was used. This monitoring location counts and reports the total traffic volume each day. The traffic volume for the March 9, 2021 was compared to the 2019 AAWDT at this location to determine the difference in traffic (which is assumed to primarily be due to the COVID-19 pandemic). It was determined that the traffic volume on this day was approximately 89% of the 2019 AAWDT (179,995).

The roadway noise outputs of the current model were calibrated according to the measured noise levels using the calculated AAWDTs and then adjusting the nighttime volume percentage and roadway speed. To determine a nighttime percentage, in the current model the nighttime volume percentage was adjusted until the modeled difference between the daytime and nighttime average noise levels matched the measured difference. After doing this, the modeled Ldn output was still slightly off, such that the modeled roadway speeds and truck percentages were altered to calibrate the measurement locations. With the roadway adjustments, the modeled Ldn, daytime average, and nighttime average noise levels all matched the measured values.

Table 2 presents the roadway data for I-270 and Watkins Mill Road based on the counts completed during the site measurements compared to the most recent data from MDSHA.

² Morning traffic counts occurred at 7:30 AM to 8:00 AM for Watkins Mill Road and 7:00 AM to 7:30 AM for the ramp. Evening traffic counts occurred at 3:30 PM to 4:00 PM for Watkins Mill Road and 5:30 PM to 6:00 PM for the ramp. Nighttime traffic counts occurred at 9:00 PM to 9:30 PM for Watkins Mill Road and 11:00 PM to 11:30 PM for the ramp.

Note that the AAWDT during the noise measurements was lower than that most recently reported by MDSHA for I-270, indicating that the roadway volume on the roadway may still be affected by changes attributed to the pandemic. To account for the higher roadway volume, the MDSHA published AAWDT was used, along with the other parameters needed to calibrate the modeled output to the measured noise levels at the site (as shown in Table 2). As such, the current model has been calibrated according to the noise levels measured at the site and adjusted according to the higher MDSHA AAWDT reported in a previous year.

Table 2: Roadway counts compared to MDSHA data for the roadways.

AAWDT	Data Based On MDSHA Traffic Volumes For March 9, 2021	2019 MDSHA Data	Data Used In Current Model
I-270	159,463	179,995	179,995
Watkins Mill Road	8,420 ^A	5,560	8,420
I-270 Southbound to Quince Orchard Road Ramp	6,440 ^A	N/A	6,440

Table 2 Notes:

- A. Traffic volumes for Watkins Mill Road and the ramp were based on traffic counts made during the survey.

6.3.2. Future Model

MDSHA does not typically provide future traffic data; therefore, a conservative, 2% increase in traffic compounded annually until 2042 was assumed for the roadways.³ All roadway data used in this analysis is shown in Table 3.

Table 3: Future roadway data.

Roadway	I-270	Watkins Mill Road	I-270 Southbound to Quince Orchard Road Ramp
2042 AAWDT	283,834	12,762	9,761
Nighttime Volume %	18%	9%	7%
Truck %	16%	2%	2%
Modeled Speed (mph)	55	35	55

Table 2 Notes:

- A. Traffic information for the ramp were based on traffic counts made during the survey.

³ Montgomery County typically requires that roadway noise impact studies be conducted using the projected traffic volumes 20 years from the date of the study.

6.4. Future Noise Impact

The future model calculated the projected noise levels throughout the site at the ground and upper levels as shown on Drawings 2 and 3 of the Appendix, respectively. Drawing 2 indicates that portions of the area around the townhomes and two-over-two condominiums nearest I-270 will be exposed to ground level noise levels greater than 65 dBA Ldn, as will the pool area just north of the railway.

As shown in Drawing 3, noise impact upon the residential buildings is as follows:

- All 32 two-over-two condominiums and 168 townhomes will be exposed to noise levels greater than 65 dBA Ldn and up to 72 dBA Ldn upon the two-over-two lots located to the southeast of the site near the railway crossing.
- Residential units exposed to noise levels above 65 dBA Ldn require further analysis to determine whether the proposed building construction will be capable of maintaining interior noise levels at 45 dBA Ldn, or whether modifications will be needed to do so. If necessary, interior noise levels can be maintained below 45 dBA Ldn with upgraded exterior walls, windows, and doors.

7. MITIGATION

According to the City of Gaithersburg's noise guidelines for residential development, residential sites and buildings impacted by noise levels above 65 dBA Ldn require further analysis to determine the mitigation measures necessary to maintain noise levels in outdoor activity areas and interior living spaces below 65 and 45 dBA Ldn, respectively.

7.1. Outdoor Noise Levels

While not clearly stated, the City of Gaithersburg typically requires noise levels in outdoor activity areas to be maintained below 65 dBA Ldn, although what is classified as an "outdoor activity area" is not explicitly defined. Therefore, outdoor activity areas for this site will include rear yards of front-loaded townhomes as well as the outdoor pool area at the south end of the site.

Drawing 2 indicates that future ground level noise levels will be above 65 dBA Ldn for a portion of the site located near a transportation noise source (i.e., those portions of the development closest to I-270 and the railway). While most of the site nearest the railway and a portion of the site nearest I-270 will be exposed to noise levels greater than 65 dBA Ldn, the only outdoor activity areas impacted are those rear yards closest to I-270 and the pool located just north of the railway.

A noise barrier analysis was conducted to determine the minimum height required to mitigate noise levels in these outdoor activity areas to below 65 dBA Ldn. The resulting noise barriers are presented on Drawing 4 of the Appendix. To maintain noise levels below 65 dBA Ldn within the rear yards, noise barriers would need to range from 11 to 15.5 feet tall and be localized along the rear lot lines of townhome buildings closest to I-270.

In addition, a noise barrier and berm has been proposed for the southern end of the site, localized along the southmost townhome elevations closest to the railway crossing. The berm utilized for this analysis is as shown on the site plan. The 10-foot-tall barrier will be placed directly on top of the 10-foot tall berm. Ground level noise levels throughout the outdoor pool area will be reduced below 65 dBA Ldn with this berm and barrier placement. Additionally, a 6-foot tall noise barrier has been proposed for the southeast corner of the site, which will add onto the 10-foot barrier on top of the berm. This 6-foot noise barrier will further reduce the ground level noise surrounding the southeast townhomes to below 70 dBA Ldn at the request of the City.

The noise barriers must be composed of masonry, concrete, vinyl, or wood. The noise barriers must be built into the grade without gaps or openings. If a vinyl or wood fence is to function as a noise barrier, it must be selected carefully as not all fences will provide the required noise reduction. One such vinyl noise barrier product is the Tuf-Barrier Noise Wall manufactured by AIL. Another similar product is SimTek. If a wood fence is to function as a noise barrier, it must be of board-on-board construction.

7.2. Interior Noise Levels

According to the future noise levels shown on Drawing 3, all of the townhomes and two-over-two condominiums will be exposed to transportation noise levels above 65 dBA Ldn. Further analysis of these residential units will be required to determine if modifications to the standard building construction will be needed.

Note that this analysis has been completed with the assumption that the five noise barriers and berm presented within Drawing 4 of the Appendix will be constructed as shown. If these proposed noise barriers are not constructed or the location and height of any barrier is modified, the results of this Interior Noise Analysis will need to be reevaluated to determine if the noise impact upon the townhomes or two-over-two condominiums has changed due to the modifications of the noise barrier.

7.2.1. Building Shell Analysis

All of the 32 two-over-two condominiums and 168 townhomes at Stevenson-Metrogrove will be exposed to transportation noise levels above 65 dBA Ldn. Residential buildings exposed to noise levels above 65 dBA Ldn require further analysis to determine whether the proposed building construction will be capable of maintaining interior noise levels below 45 dBA Ldn, or whether modifications will be required to do so.

This evaluation, or “building shell analysis” calculates the noise reduction provided by an exterior building partition (i.e., the composite assembly of the wall and any windows and doors) and the resulting indoor noise level when impacted by a specific outdoor noise level. The noise reduction provided by an exterior partition is dependent upon the surface area each building element composing the partition occupies and the STC rating of the individual elements.

STC ratings apply to one individual element. The composite STC rating is the overall STC rating of a partition with multiple elements (e.g., a wall with a window) and is usually controlled by the building element with the lowest individual STC rating. In residential construction, this is almost always the glass (windows and doors); therefore, the amount of exterior noise heard from within

a residence is primarily dependent upon the glass percentage and STC rating, not the wall STC rating.

A building shell analysis was completed for the Fairland, Bluemont, and Seneca townhome models to be constructed at Stevenson-Metrogrove, along with the two-over-two condominium model with an elevator (24' x48). Room dimensions, window/door sizes, and exterior facade construction were taken from architectural drawings provided by Craftmark Homes. This information was accounted for in the building shell analysis calculations to determine the building element STC ratings necessary to maintain interior noise levels below 45 dBA Ldn.

7.2.2. STC Ratings

The exterior noise impact upon each residence was first evaluated using Craftmark Homes' standard building construction (shown in Table 7) to determine if modifications (increased window and/or door STC ratings, exterior wall construction) will be required to maintain interior noise levels below 45 dBA DNL.

The window and door manufacturers have not been selected at the time of this analysis. Therefore, a common standard STC rating of 28 STC was used for all windows and 26 STC was used for all doors within each townhome and two-over-two model.

Table 4: Craftmark Homes' standard building construction.

Building Element	STC Rating
Exterior Walls	
<ul style="list-style-type: none"> Hardie Panel (est.) 43 STC Partition construction: siding, 7/16" osb sheathing, 2"x4" wood studs spaced 16" o.c., 5-1/2" R-21 batt insulation, one layer of 1/2" gypsum board. Brick (est.) 56 STC Partition construction: 3-5/8" brick, 7/16" osb. sheathing, 2"x4" wood studs spaced 16" o.c., 5-1/2" R-21 batt insulation, one layer of 1/2" gypsum board. 	
Operating Windows	28 STC
Sliding Glass Doors	26 STC
Patio Doors (French Doors)	26 STC
Unit Entry Doors	26 STC

If the proposed standard building construction was incapable of reducing exterior noise impact to the required interior level, exterior wall, window, and door STC ratings were increased accordingly. Window and door STC ratings shown in the analysis represent the minimum rating needed to reduce interior noise levels below 45 dBA Ldn. Therefore, if the necessary window rating is 30 STC and the window manufacturer only offers 29 STC or 32 STC windows, the 32 STC window will be necessary to meet the interior noise level requirement.

7.2.3. Building Construction Requirements

Building construction requirements are presented on Drawings 5, 6, and 7 of the Appendix, which indicates the specific lots that require modifications to Craftmark Homes' standard building construction in order to comply with the City of Gaithersburg's interior noise limit of 45 dBA DNL. These building construction requirements are presented by level. Regarding the building construction shown on Drawings 5, 6, and 7, note the following:

1. Drawings 5, 6, and 7 depict the building construction requirements for the first, second, and third/fourth floors of the townhomes and condominium units, respectively. Note that in most areas of the site, the noise level increases with height; therefore, higher STC-rated windows and doors are needed at the top levels of the townhomes and condominium units than at the lower, first floor levels.
2. While all 32 two-over-two condominiums and 169 townhomes at Stevenson-Metrogrove will be exposed to noise levels above 65 dBA DNL, not all residences will require modifications to Craftmark Homes' standard building construction in order to comply with the City of Gaithersburg's 45 dBA DNL interior noise limit.
3. Of the 32 two-over-two condominiums and 169 townhomes with noise impact over 65 dBA DNL, 2 two-over-two condominiums and 65 townhomes will require modifications to proposed standard exterior wall construction. These 67 units will require either full brick exterior walls or, if Hardie Panel siding is used, will require single-legged resilient channel. Note that screws must be long enough to attach gypsum board to resilient channel but not so long that they penetrate the wood studs (see detail WE-001 of the Appendix). Additionally, these 65 townhomes and 2 two-over-two condominiums will require windows and doors with increased STC ratings.

Of the remaining townhomes and two-over-two condominiums, 7 of the two-over three condominiums and all 103 of the townhomes will require windows and doors with upgraded STC ratings.

4. While upgraded construction for many of the townhomes and two-over-two condominiums is specified differently for one elevation or floor level (typically those directly or partially facing I-270 or the railway require higher STC ratings, as do the upper floor levels), it is recommended that the same upgraded window/door STC ratings be installed throughout an entire residence to avoid confusion during construction and to reduce the potential for a room receiving an incorrectly specified STC rated window/door.

For example, the townhomes closest to the railway crossing will be impacted by a noise level of 72 dBA DNL on the rear elevation (facing the railway) and a noise level of 67 on the front elevation. The rear and side elevations require 32 STC windows and either full brick construction or modified Hardie Panel siding, while the front elevation requires only 28 STC windows and can be constructed with Hardie Panel siding. It can be difficult during field installation to track and determine the location of the various window STC rating requirements within a townhome or two-over-two condominium, sometimes

resulting in an incorrectly installed window (i.e. a window with a lower STC rating being installed where a window with a higher STC rating was specified, thereby lowering the composite STC rating of that wall and resulting in an interior noise level above the required limit). Therefore, it is strongly recommended to apply the highest level of building construction requirements to all exterior elevations of the same residence.

5. The remaining two-over-two condominium residences require no building construction modifications. In other words, Craftmark Homes' proposed standard building construction will be capable of maintaining interior noise levels below 45 dBA DNL within these residences.

8. CONCLUSION

All of the townhomes and two-over-two condominiums will be exposed to noise levels greater than 65 dBA Ldn and up to 72 dBA Ldn for the townhomes closest to the railway at the southeast portion of the site. While exposed to noise levels above 65 dBA Ldn, compliance with the City of Gaithersburg's noise limits can be achieved through upgraded exterior wall construction and increased window and door STC ratings.

The rear yards of 28 townhomes closest to I-270 will be exposed to future roadway noise levels up to 70 dBA Ldn. While this is above the City of Gaithersburg's 65 dBA Ldn limit for outdoor activity areas, compliance with the limit can be achieved with noise barriers along rear yard lot lines.

Similarly, the proposed pool at the south of the site will be exposed to noise levels exceeding 65 dBA Ldn. Although this is above the City of Gaithersburg's 65 dBA Ldn limit for outdoor activity areas, compliance with the limit can be achieved with a noise barrier and berm along the southern end of the site, parallel to the railway.

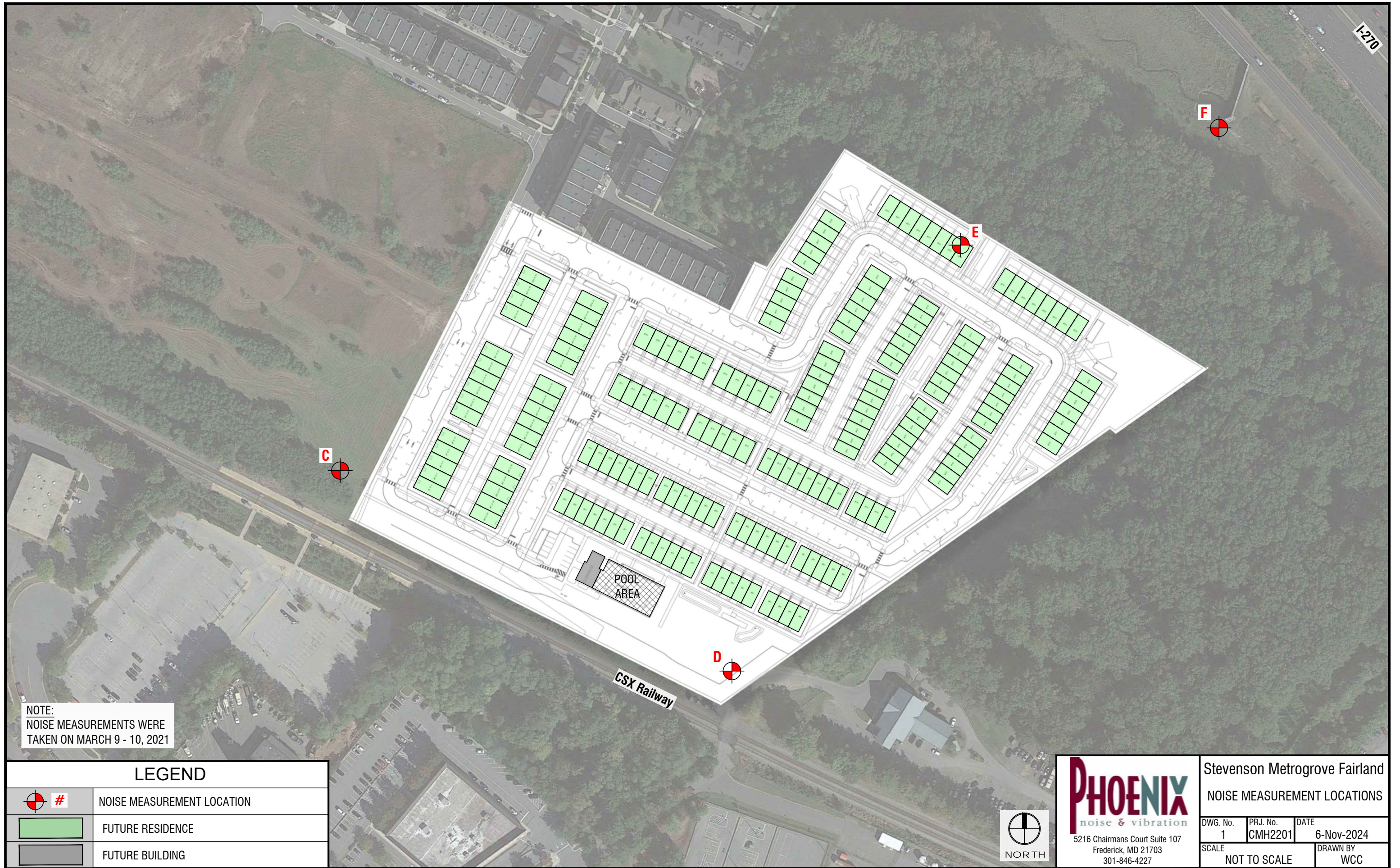
To maintain noise levels below 65 dBA Ldn within these outdoor activity areas, noise barriers ranging from 11 to 15.5 feet tall will be required along the rear lot lines of the townhomes closest to I-270. The remaining residences exposed to noise levels greater than 65 dBA Ldn at the ground level will not have rear yards and will therefore not require any noise barriers. The proposed 10-foot tall noise barrier directly on top of the 10-foot tall noise berm will also be required at the south of the site along the railway in order to maintain noise levels at the outdoor pool area below 65 dBA Ldn. A 6-foot tall noise barrier has been included to further mitigate ground level noise near the southeastern townhomes at the site to below 70 dBA Ldn.

All 32 two-over-two condominiums and 168 townhomes will be exposed to noise levels greater than 65 dBA Ldn and up to 72 dBA Ldn upon the townhome lots closest to the railway crossing at the southeast portion of the site. Depending upon the noise impact specific to each residence, all 168 townhomes and 9 of the two-over-two condominium units will require the specified minimum window and door STC ratings and/or slight exterior wall modifications in order to maintain interior noise levels below the City of Gaithersburg's required limit of 45 dBA Ldn.

The remaining 23 two-over-two condominiums will not require any building construction modifications. For these residences, Craftmark Homes' proposed standard building construction with a minimum window of 28 STC and door rating of 26 STC may be used without modification to maintain interior noise levels below 45 dBA Ldn.

Please note: The results of this Phase I & II Noise Analyses have been based upon the site information made available at the time of this study, including existing topography and projected roadway traffic volumes, and the proposed building layout and topography. Should any of this information be altered, additional analysis will be required to determine if the results and recommendations presented herein are still valid.

APPENDIX



NOTE:
NOISE MEASUREMENTS WERE
TAKEN ON MARCH 9 - 10, 2021

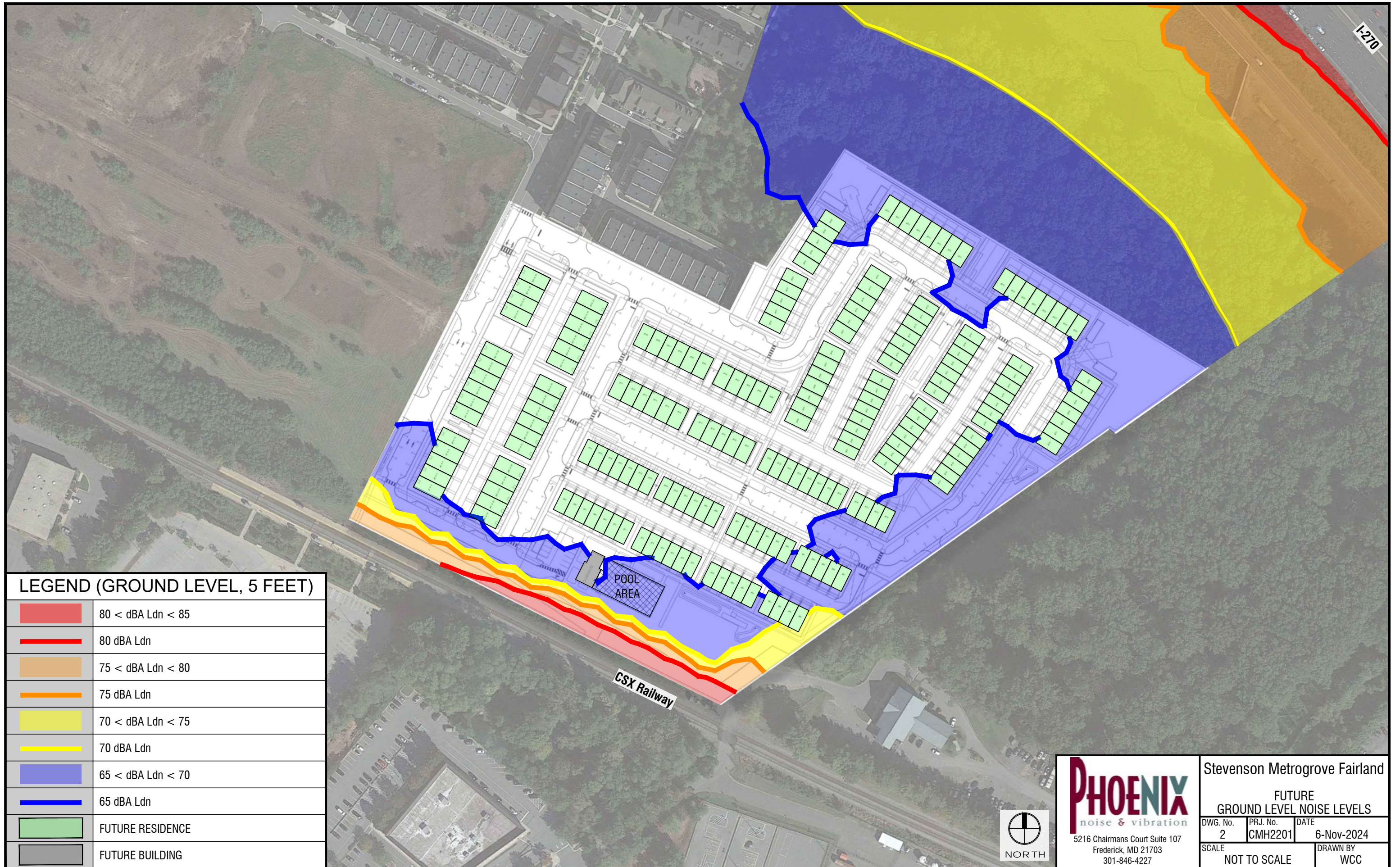
LEGEND

	NOISE MEASUREMENT LOCATION
	FUTURE RESIDENCE
	FUTURE BUILDING



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Stevenson Metrogrove Fairland		
NOISE MEASUREMENT LOCATIONS		
DWG. No. 1	PRJ. No. CMH2201	DATE 6-Nov-2024
SCALE NOT TO SCALE		DRAWN BY WCC



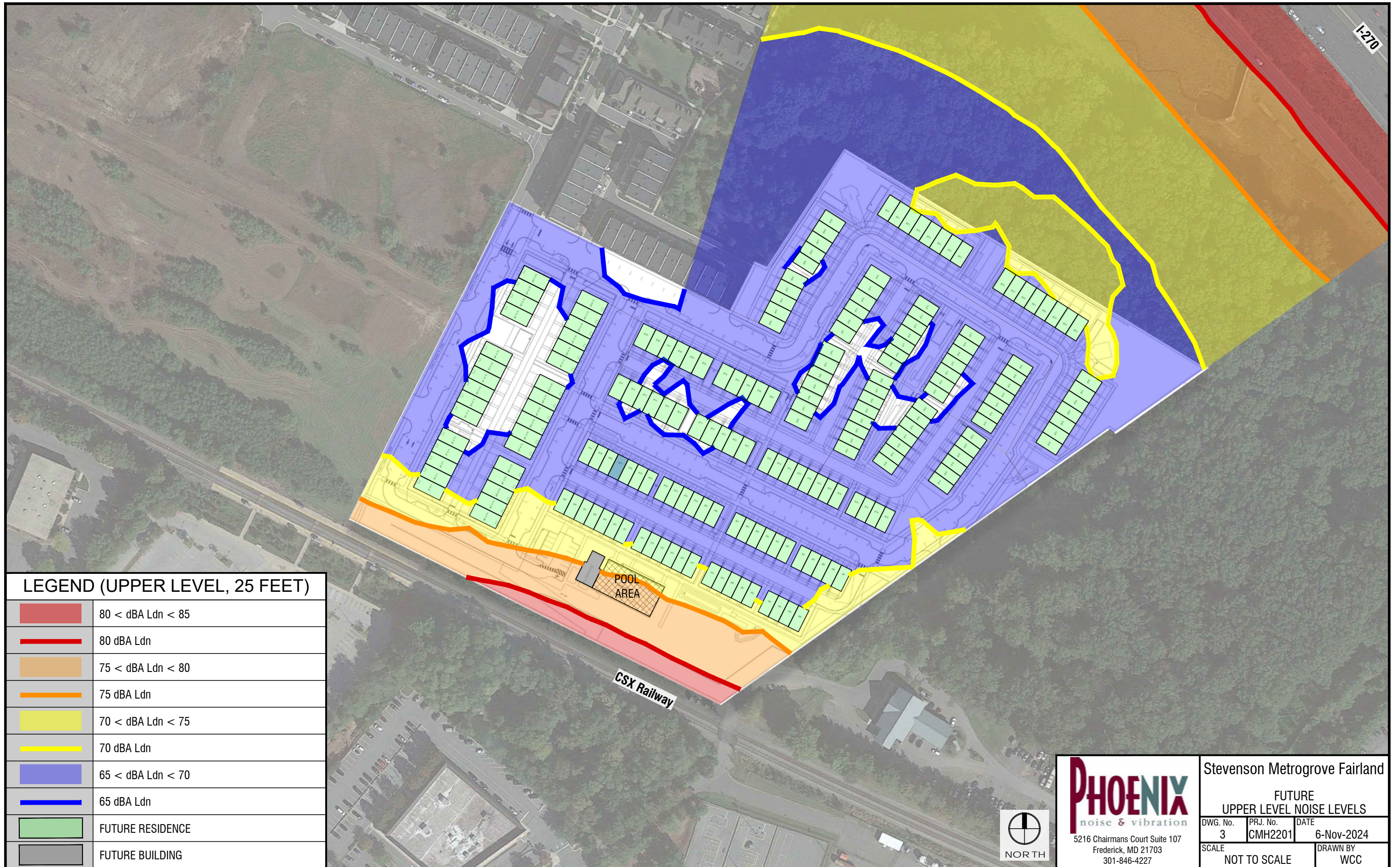
LEGEND (GROUND LEVEL, 5 FEET)

	80 < dBA Ldn < 85
	80 dBA Ldn
	75 < dBA Ldn < 80
	75 dBA Ldn
	70 < dBA Ldn < 75
	70 dBA Ldn
	65 < dBA Ldn < 70
	65 dBA Ldn
	FUTURE RESIDENCE
	FUTURE BUILDING



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Stevenson Metrogrove Fairland		
FUTURE GROUND LEVEL NOISE LEVELS		
DWG. No. 2	PRJ. No. CMH2201	DATE 6-Nov-2024
SCALE NOT TO SCALE		DRAWN BY WCC



LEGEND (UPPER LEVEL, 25 FEET)

	80 < dBA Ldn < 85
	80 dBA Ldn
	75 < dBA Ldn < 80
	75 dBA Ldn
	70 < dBA Ldn < 75
	70 dBA Ldn
	65 < dBA Ldn < 70
	65 dBA Ldn
	FUTURE RESIDENCE
	FUTURE BUILDING

POOL AREA

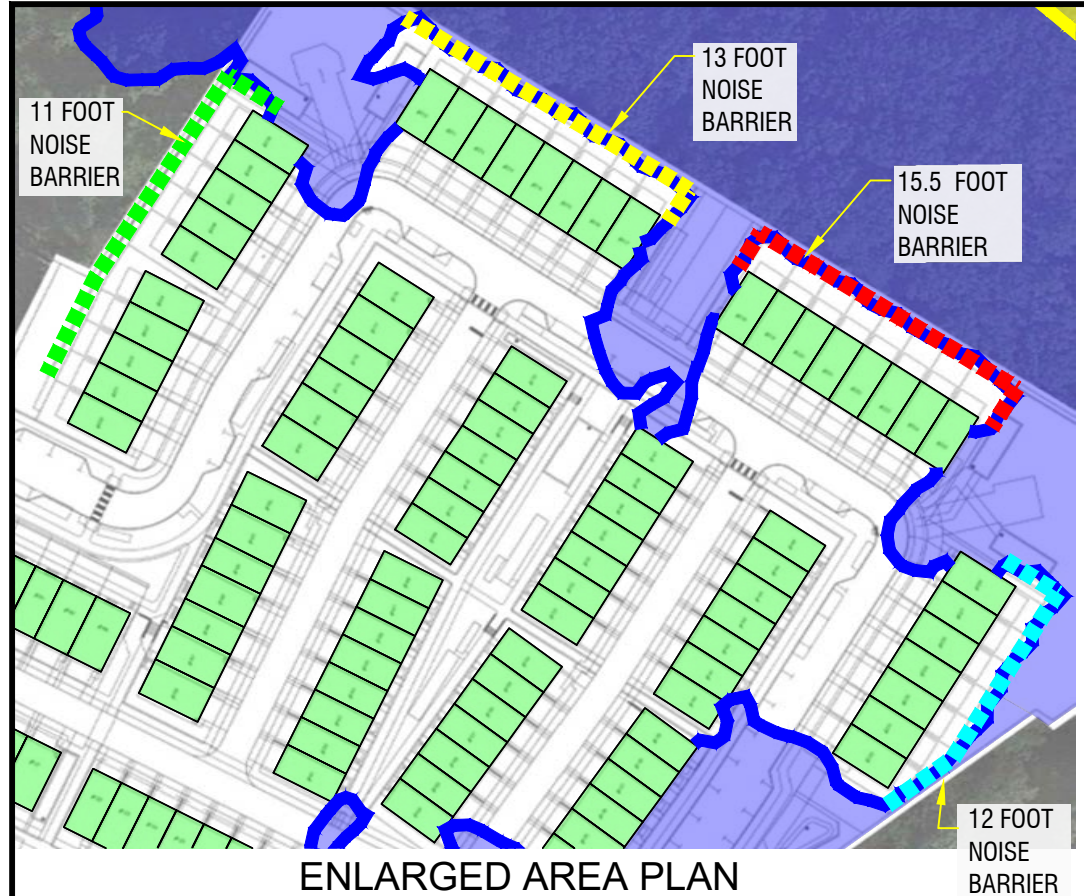
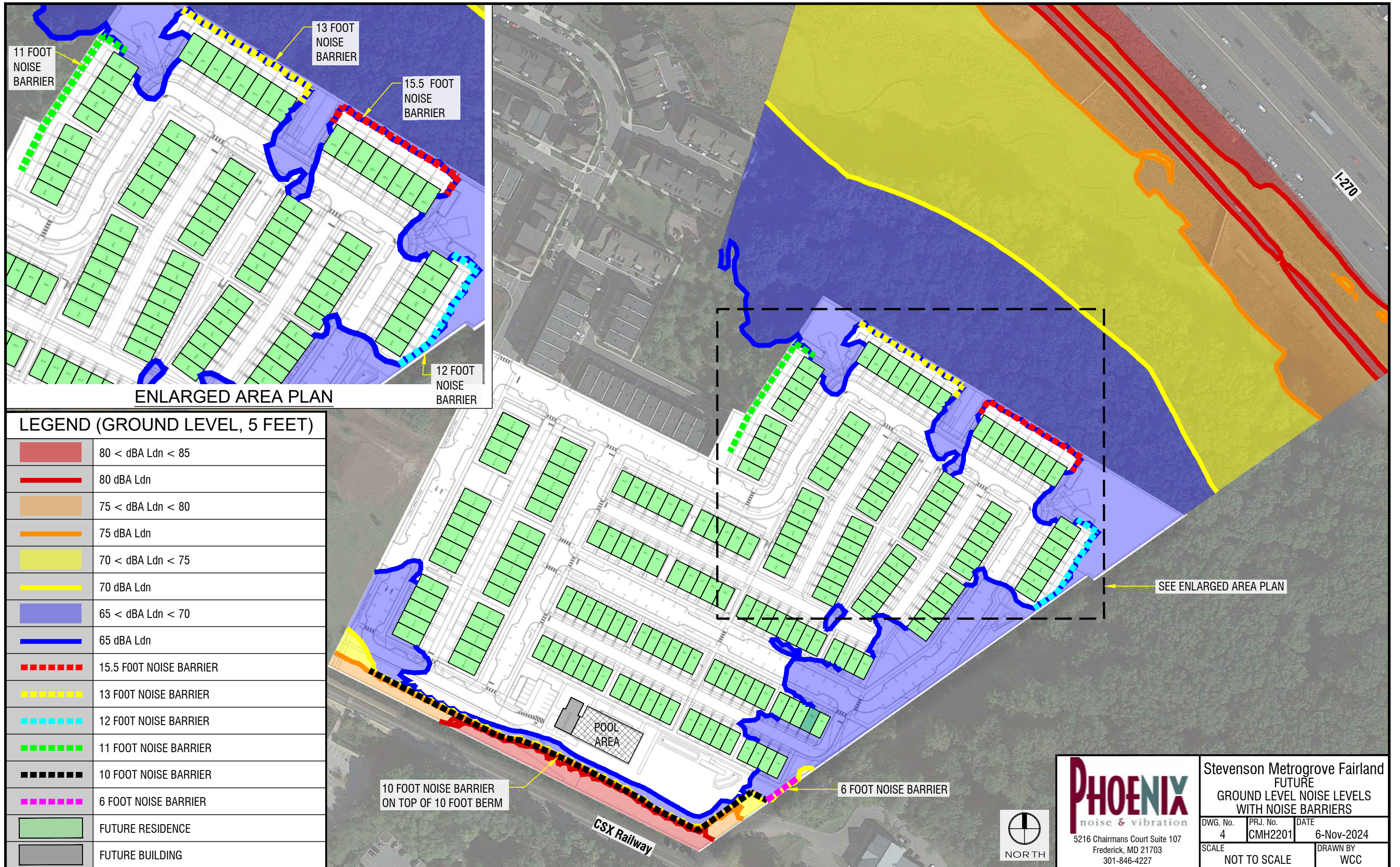
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I-270



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Stevenson Metrogrove Fairland		
FUTURE UPPER LEVEL NOISE LEVELS		
DWG. No. 3	PRJ. No. CMH2201	DATE 6-Nov-2024
SCALE NOT TO SCALE		DRAWN BY WCC



ENLARGED AREA PLAN

LEGEND (GROUND LEVEL, 5 FEET)

	80 < dBA Ldn < 85
	80 dBA Ldn
	75 < dBA Ldn < 80
	75 dBA Ldn
	70 < dBA Ldn < 75
	70 dBA Ldn
	65 < dBA Ldn < 70
	65 dBA Ldn
	15.5 FOOT NOISE BARRIER
	13 FOOT NOISE BARRIER
	12 FOOT NOISE BARRIER
	11 FOOT NOISE BARRIER
	10 FOOT NOISE BARRIER
	6 FOOT NOISE BARRIER
	FUTURE RESIDENCE
	FUTURE BUILDING

SEE ENLARGED AREA PLAN

10 FOOT NOISE BARRIER ON TOP OF 10 FOOT BERM

6 FOOT NOISE BARRIER

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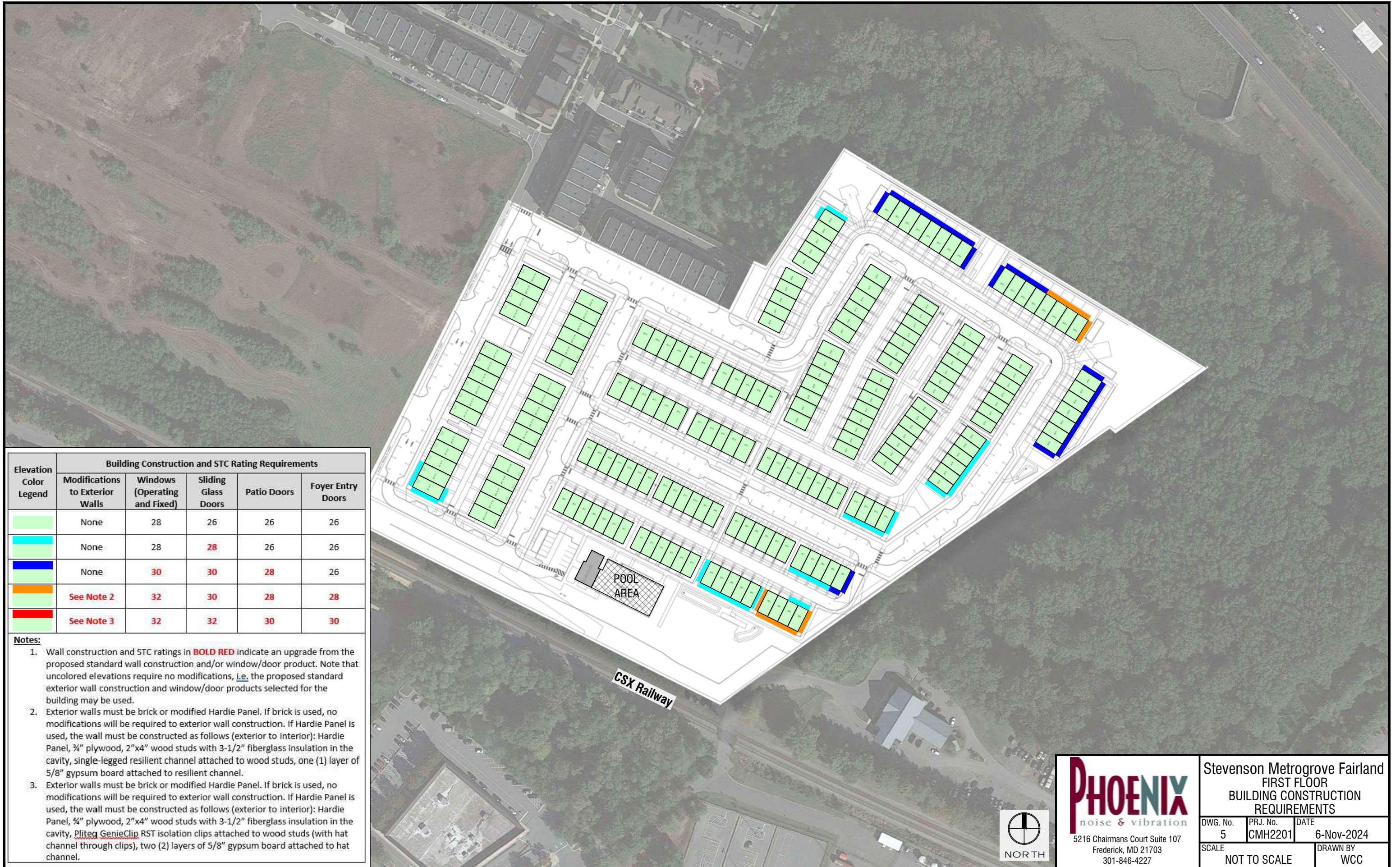
POOL AREA

1270



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Stevenson Metrogrove Fairland FUTURE		
GROUND LEVEL NOISE LEVELS WITH NOISE BARRIERS		
DWG. No.	PRJ. No.	DATE
4	CMH2201	6-Nov-2024
SCALE		DRAWN BY
NOT TO SCALE		WCC



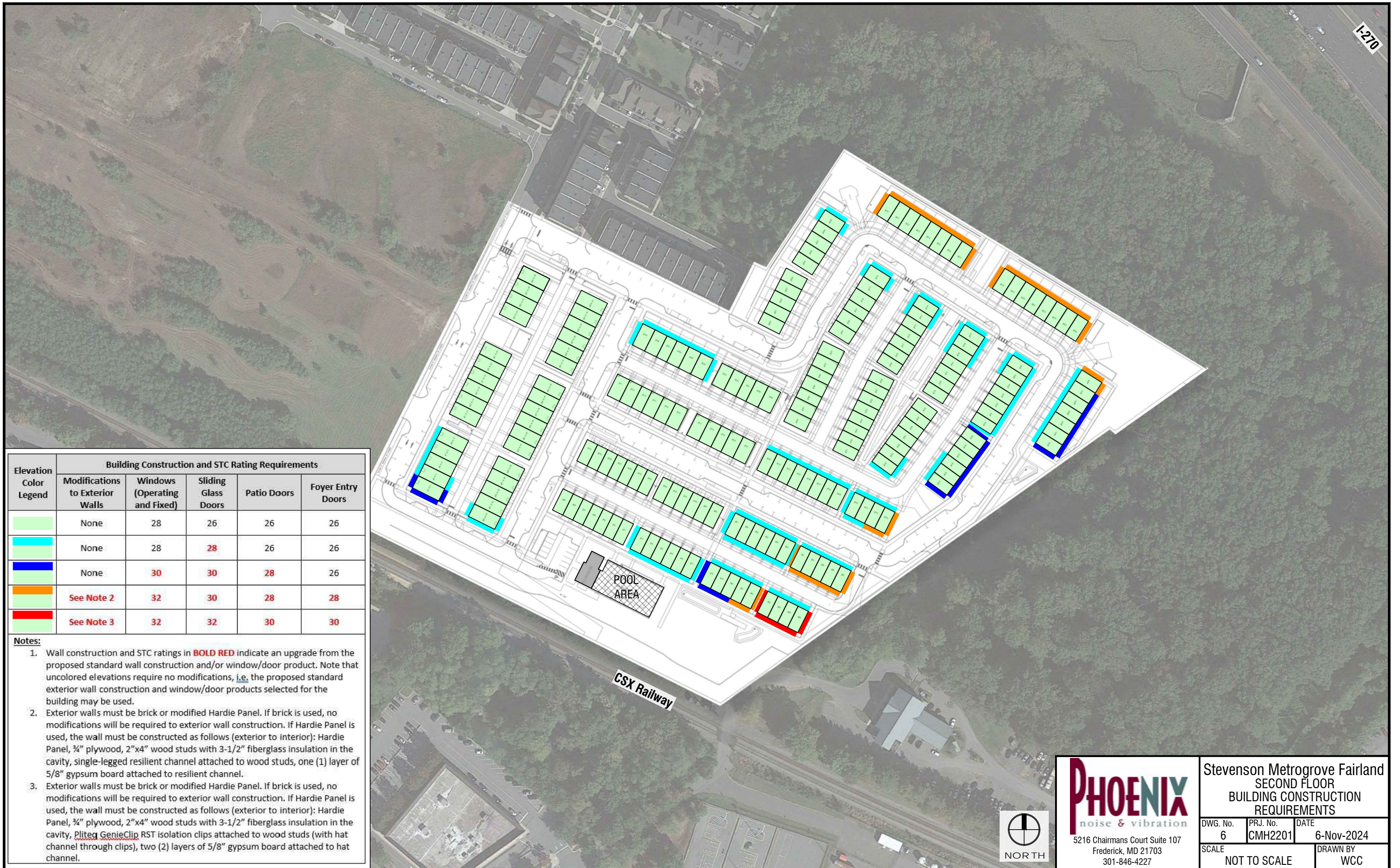
Elevation Color Legend	Building Construction and STC Rating Requirements				
	Modifications to Exterior Walls	Windows (Operating and Fixed)	Sliding Glass Doors	Patio Doors	Foyer Entry Doors
Light Green	None	28	26	26	26
Light Blue	None	28	28	26	26
Dark Blue	None	30	30	28	26
Orange	See Note 2	32	30	28	28
Red	See Note 3	32	32	30	30

- Notes:**
1. Wall construction and STC ratings in **BOLD RED** indicate an upgrade from the proposed standard wall construction and/or window/door product. Note that uncolored elevations require no modifications, *i.e.* the proposed standard exterior wall construction and window/door products selected for the building may be used.
 2. Exterior walls must be brick or modified Hardie Panel. If brick is used, no modifications will be required to exterior wall construction. If Hardie Panel is used, the wall must be constructed as follows (exterior to interior): Hardie Panel, 3/4" plywood, 2"x4" wood studs with 3-1/2" fiberglass insulation in the cavity, single-legged resilient channel attached to wood studs, one (1) layer of 5/8" gypsum board attached to resilient channel.
 3. Exterior walls must be brick or modified Hardie Panel. If brick is used, no modifications will be required to exterior wall construction. If Hardie Panel is used, the wall must be constructed as follows (exterior to interior): Hardie Panel, 3/4" plywood, 2"x4" wood studs with 3-1/2" fiberglass insulation in the cavity, Plitec GenieClip RST isolation clips attached to wood studs (with hat channel through clips), two (2) layers of 5/8" gypsum board attached to hat channel.



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Stevenson Metrogrove Fairland FIRST FLOOR BUILDING CONSTRUCTION REQUIREMENTS		
DWG. No. 5	PRJ. No. CMH2201	DATE 6-Nov-2024
SCALE NOT TO SCALE		DRAWN BY WCC



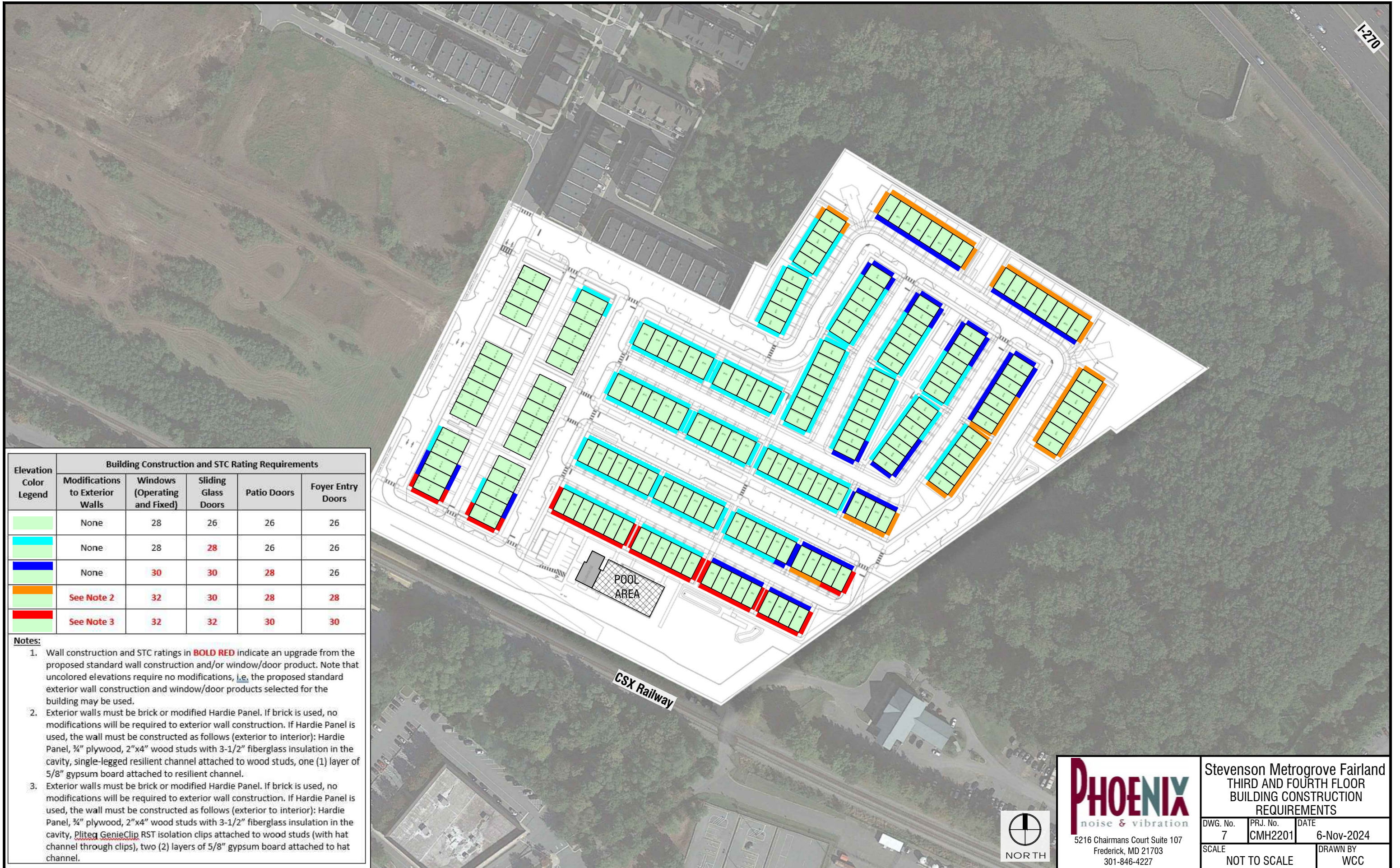
Elevation Color Legend	Building Construction and STC Rating Requirements				
	Modifications to Exterior Walls	Windows (Operating and Fixed)	Sliding Glass Doors	Patio Doors	Foyer Entry Doors
	None	28	26	26	26
	None	28	28	26	26
	None	30	30	28	26
	See Note 2	32	30	28	28
	See Note 3	32	32	30	30

- Notes:**
1. Wall construction and STC ratings in **BOLD RED** indicate an upgrade from the proposed standard wall construction and/or window/door product. Note that uncolored elevations require no modifications, *i.e.* the proposed standard exterior wall construction and window/door products selected for the building may be used.
 2. Exterior walls must be brick or modified Hardie Panel. If brick is used, no modifications will be required to exterior wall construction. If Hardie Panel is used, the wall must be constructed as follows (exterior to interior): Hardie Panel, 3/4" plywood, 2"x4" wood studs with 3-1/2" fiberglass insulation in the cavity, single-legged resilient channel attached to wood studs, one (1) layer of 5/8" gypsum board attached to resilient channel.
 3. Exterior walls must be brick or modified Hardie Panel. If brick is used, no modifications will be required to exterior wall construction. If Hardie Panel is used, the wall must be constructed as follows (exterior to interior): Hardie Panel, 3/4" plywood, 2"x4" wood studs with 3-1/2" fiberglass insulation in the cavity, Plitec GenieClip RST isolation clips attached to wood studs (with hat channel through clips), two (2) layers of 5/8" gypsum board attached to hat channel.



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Stevenson Metrogrove Fairland SECOND FLOOR BUILDING CONSTRUCTION REQUIREMENTS		
DWG. No. 6	PRJ. No. CMH2201	DATE 6-Nov-2024
SCALE NOT TO SCALE		DRAWN BY WCC



Elevation Color Legend	Building Construction and STC Rating Requirements				
	Modifications to Exterior Walls	Windows (Operating and Fixed)	Sliding Glass Doors	Patio Doors	Foyer Entry Doors
Light Green	None	28	26	26	26
Cyan	None	28	28	26	26
Blue	None	30	30	28	26
Orange	See Note 2	32	30	28	28
Red	See Note 3	32	32	30	30

Notes:

1. Wall construction and STC ratings in **BOLD RED** indicate an upgrade from the proposed standard wall construction and/or window/door product. Note that uncolored elevations require no modifications, i.e. the proposed standard exterior wall construction and window/door products selected for the building may be used.
2. Exterior walls must be brick or modified Hardie Panel. If brick is used, no modifications will be required to exterior wall construction. If Hardie Panel is used, the wall must be constructed as follows (exterior to interior): Hardie Panel, 3/4" plywood, 2"x4" wood studs with 3-1/2" fiberglass insulation in the cavity, single-legged resilient channel attached to wood studs, one (1) layer of 5/8" gypsum board attached to resilient channel.
3. Exterior walls must be brick or modified Hardie Panel. If brick is used, no modifications will be required to exterior wall construction. If Hardie Panel is used, the wall must be constructed as follows (exterior to interior): Hardie Panel, 3/4" plywood, 2"x4" wood studs with 3-1/2" fiberglass insulation in the cavity, Plitec GenieClip RST isolation clips attached to wood studs (with hat channel through clips), two (2) layers of 5/8" gypsum board attached to hat channel.

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Stevenson Metrogrove Fairland THIRD AND FOURTH FLOOR BUILDING CONSTRUCTION REQUIREMENTS		
DWG. No. 7	PRJ. No. CMH2201	DATE 6-Nov-2024
SCALE NOT TO SCALE		DRAWN BY WCC