



BICKFORD TOWNHOMES

2501 BICKFORD AVENUE
SNOHOMISH, WA 98290

ENVIRONMENTAL NOISE STUDY

Submitted to:

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14 February 2019

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1. INTRODUCTION

This letter serves to document the environmental noise assessment for Bickford Townhomes, a housing development proposed at 2501 Bickford Avenue in Snohomish, WA. The goal of the noise assessment is to ensure that environmental noise at the future residences is mitigated to within industry-standard limits.

The main environmental noise sources at the site are operations at the Home Depot to the north and traffic noise from Bickford Avenue to the West. To predict and analyze noise impact on the residences, noise measurements were conducted for a 72-hour period from 01/28/19 to 01/31/19. Measurement results are compared to industry standard noise criteria from the department of Housing and Urban Development and IGCC. Based on our noise model and the building envelope construction, glazing assembly and barrier recommendations are made to ensure adequate attenuation is achieved to comply with the design criteria.



Figure 1 – Bickford Townhomes site vicinity - Approximate site outlined in orange.

2. DESIGN CRITERIA

2.1. United States Housing of Urban Development (HUD)

2.1.1. Exterior Noise

Acceptable exterior site noise levels as defined by HUD are shown in the table below.

Table 1: HUD Site Acceptability – Exterior Noise

Acceptability	L _{DN} (dBA)	Special Approvals and Requirements
Acceptable	L _{DN} ≤ 65(1)	None
Normally Unacceptable	65 < L _{DN} ≤ 75	(2)(3)(4)
Unacceptable	75 < L _{DN}	(2)(3)(5)

- (1) Acceptable threshold may be shifted to 70 dB in special circumstances pursuant to § 51.105(a).
- (2) See § 51.104(b) for requirements.
- (3) See § 51.104(b) for requirements.
- (4) 5 dB additional attenuation required for sites above 65 dB, but not exceeding 70 dB and 10 dB additional attenuation required for sites above 70 dB, but not exceeding 75 dB. (See § 51.104(a).
- (5) Attenuation measures to be submitted to the Assistant Secretary for CPD for approval on a case-by-case basis.

2.1.2. Interior Noise

HUD specifies that interior noise levels shall not exceed an L_{DN} of 45. Attenuation measures to meet these interior goals, determined by the exterior L_{DN}, shall be employed where feasible. Emphasis shall be given to noise sensitive interior spaces such as bedrooms. Minimum attenuation requirements are prescribed in § 51.104(a).

2.2. IGCC 2018 Acoustical Control §801.3.3

The International Green Construction Code provides the following criteria for residential interior noise levels by L_{max} and L_{eq} :

Table 2: IGCC 2018 Acoustical Control – Interior Noise Guidelines

Room Type	L _{EQ}		L _{MAX}	
	dBA	dBC	dBA	dBC
Residential sleeping areas (22:00 to 7:00)	35	60	45	70
Residential living and sleeping areas (7:00 to 22:00)	40	60	50	70

3. NOISE MEASUREMENTS

3.1. Measurement Locations

Noise measurements were conducted at two locations at the proposed site. The first location, shown by green star in the figure below, was selected to capture traffic noise impact, and the second location, shown by the purple star in the figure below, was selected to capture noise from Home Depot operations.

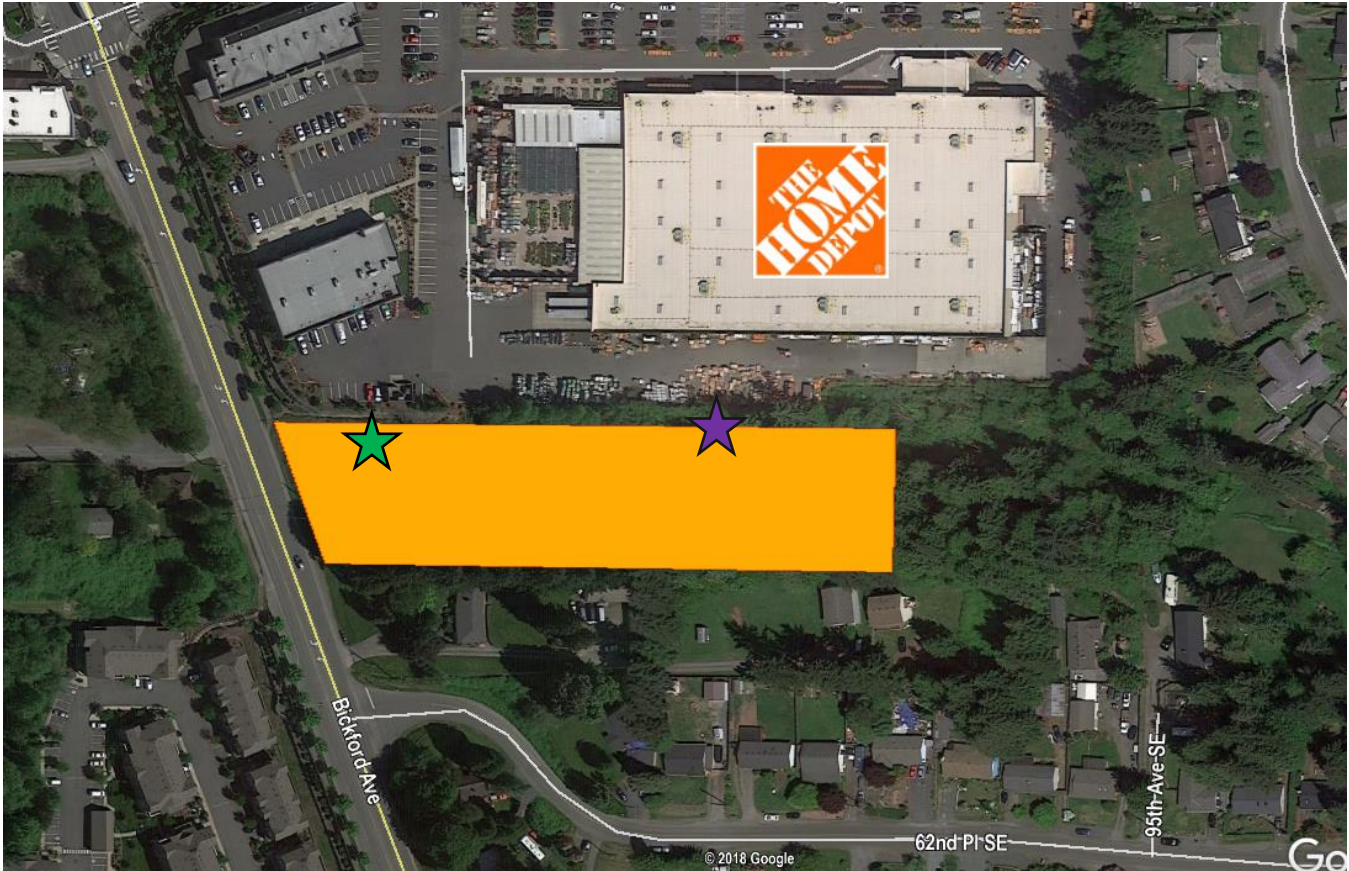


Figure 2 – Measurement Locations at Bickford Townhomes site – Measurement Location 1 shown in green; Measurement Location 2 shown in purple

3.2. Measurement Results

3.2.1. Hourly L_{EQ} /DNL

Measurement results at both locations by hourly L_{EQ} are shown in the following figures 3 through 6.

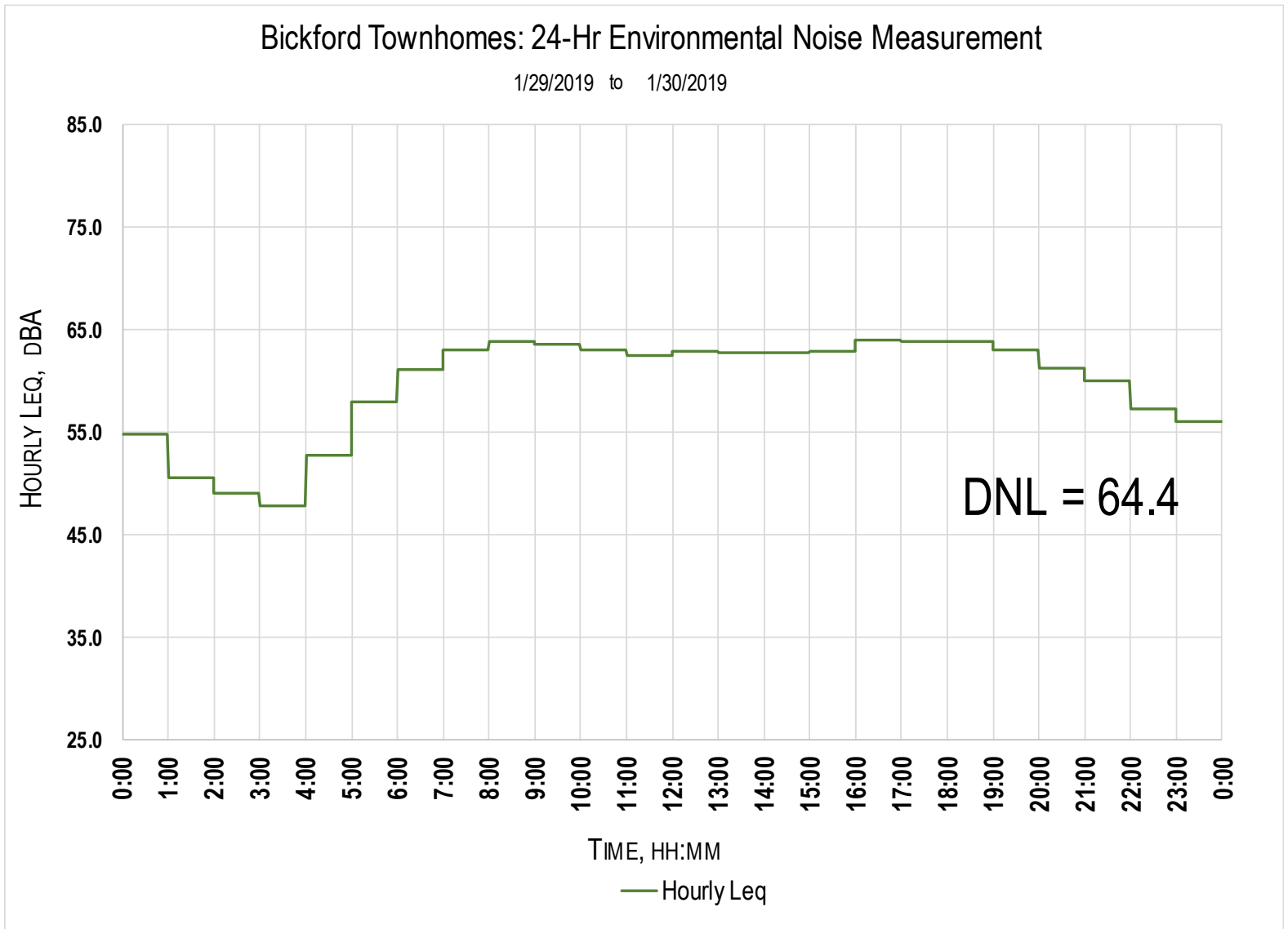


Figure 3 – Measurement Results – Measurement Location 1 – 01/29/19 to 01/30/19

Bickford Townhomes: 24-Hr Environmental Noise Measurement

1/30/2019 to 1/31/2019

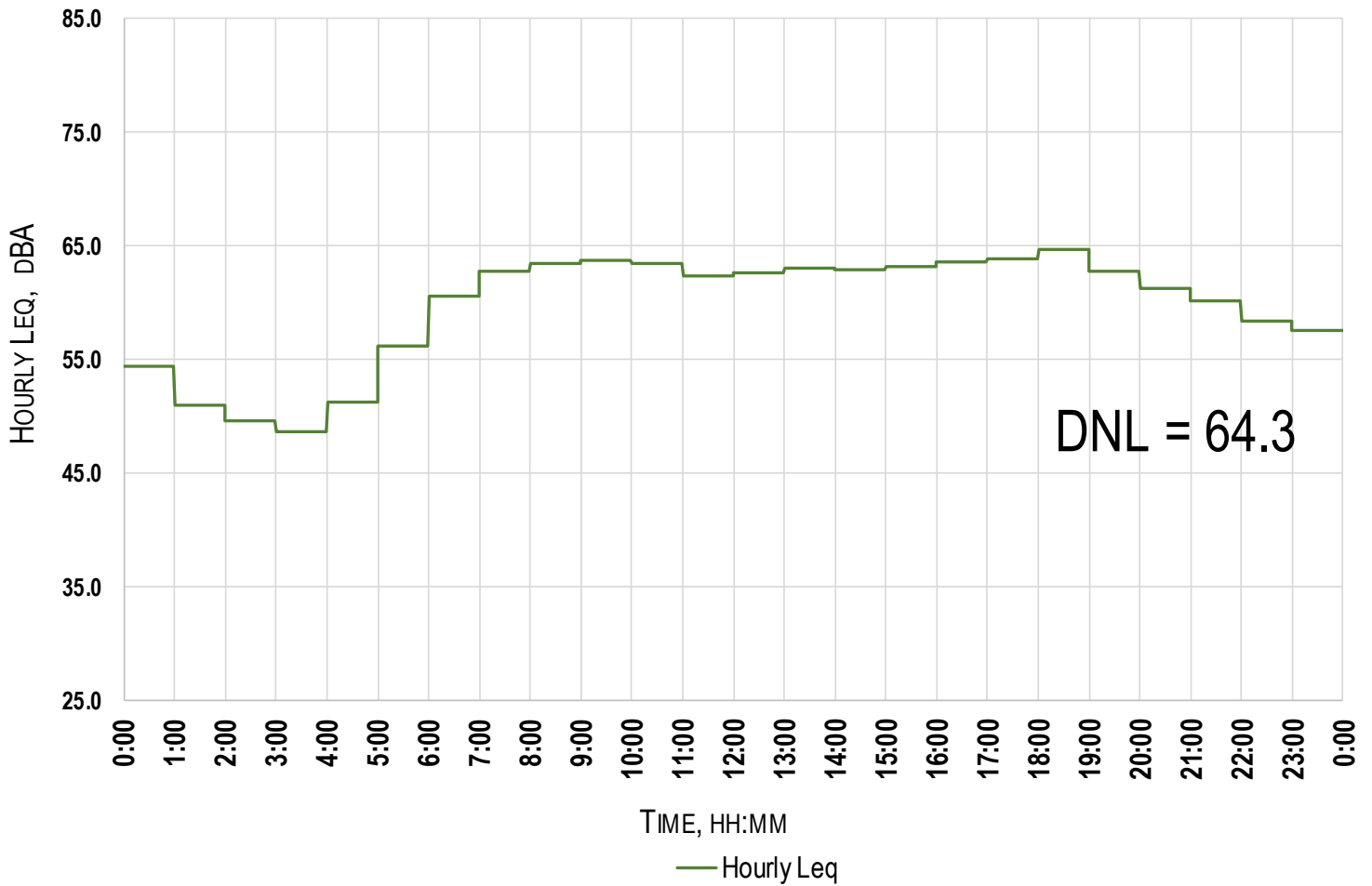


Figure 4 – Measurement Results – Measurement Location 1 – 01/30/19 to 01/31/19

Bickford Townhomes: 24-Hr Environmental Noise Measurement

1/29/2019 to 1/30/2019

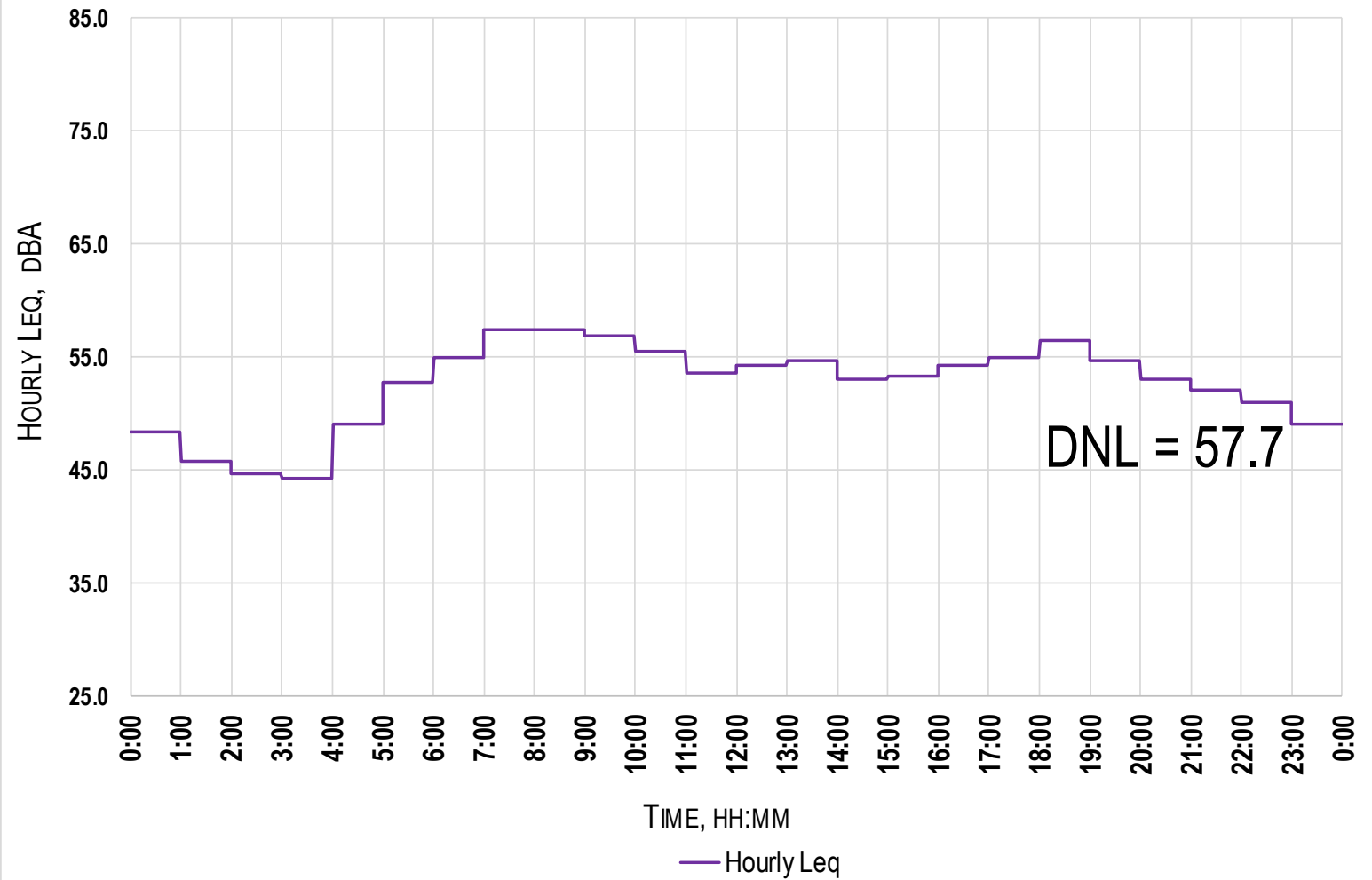


Figure 5 – Measurement Results – Measurement Location 2 – 01/29/19 to 01/30/19

Bickford Townhomes: 24-Hr Environmental Noise Measurement

1/30/2019 to 1/31/2019

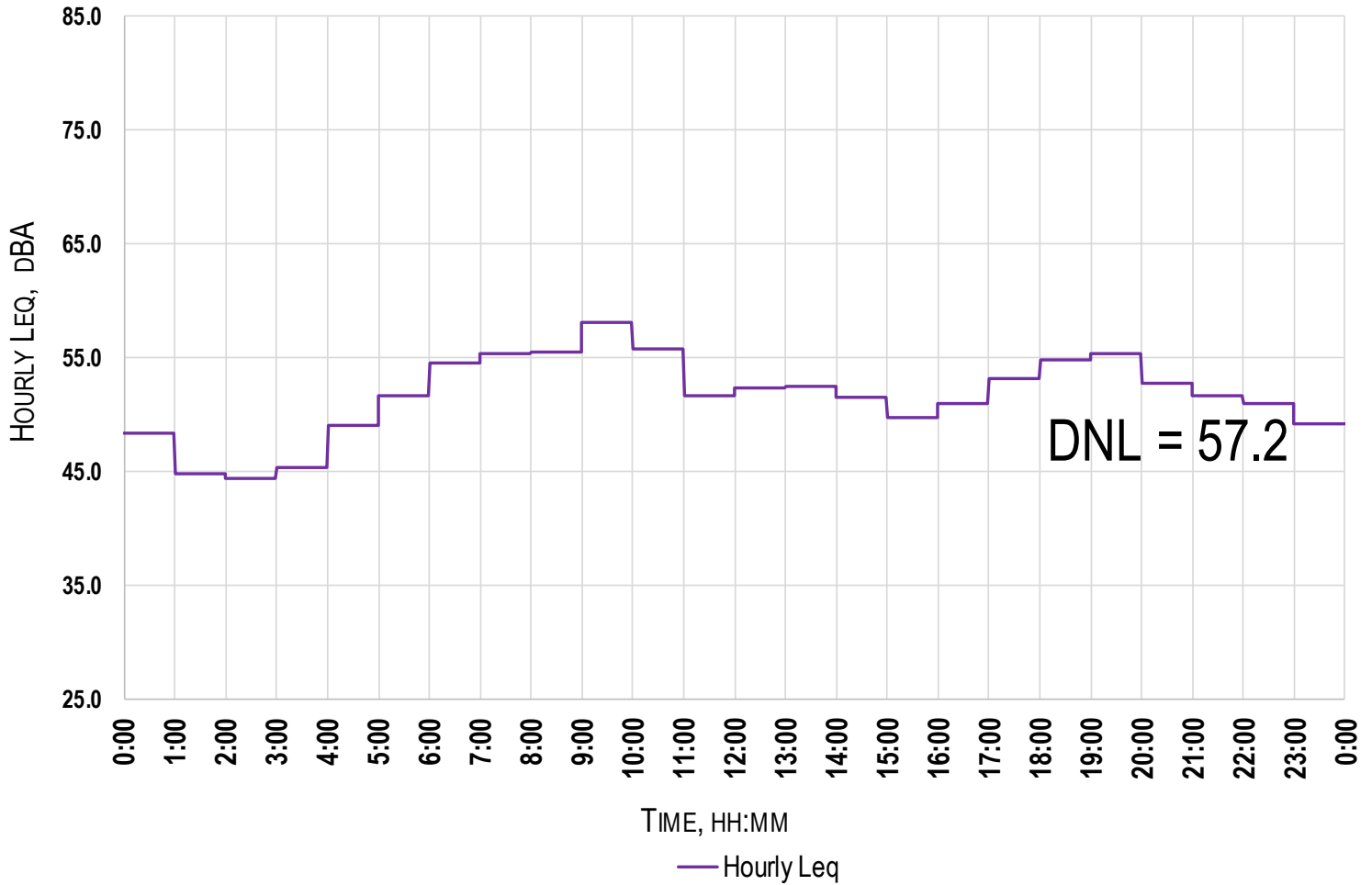


Figure 6 – Measurement Results – Measurement Location 2 – 01/30/19 to 01/31/19

As shown in the hourly measurement results, the site is within HUD's "acceptable" range for exterior noise and does not require noise mitigation.

3.2.2. L_{MAX} Events from Home Depot

The following table shows the worst-case scenario L_{max} events from Home Depot operations at measurement location 2.

Time	Description	63	125	250	500	1k	2k	4k	8k	dBA	dBC
1/29/2019 14:26:29	truck horn	78	66	61	75	78	74	63	43	81	83
1/29/2019 14:26:16	truck horn	70	57	58	76	75	69	59	43	78	80
1/29/2019 12:19:23	truck air brake	62	59	53	62	67	72	71	63	76	76
1/29/2019 13:05:13	truck air brake	60	54	54	58	68	70	70	66	76	75
1/30/2019 9:52:15	backup alarm	64	56	53	58	64	71	71	65	76	75
1/29/2019 8:50:30	truck air brake	59	59	53	57	68	70	68	65	75	74
1/30/2019 9:52:14	truck air brake	64	57	52	54	60	69	71	67	75	74
1/30/2019 7:33:03	truck acceleration	61	59	54	63	66	70	69	63	75	74
1/29/2019 4:01:36	impact, wood	64	69	66	68	70	67	59	49	73	75
1/29/2019 3:45:07	impact, wood	51	49	49	62	69	68	60	43	73	72
1/29/2019 4:37:48	truck acceleration	67	64	68	72	67	59	48	31	72	75
1/30/2019 7:33:02	truck drive by	60	57	53	69	67	54	43	30	70	71
1/29/2019 5:37:39	wood impacts	64	64	63	68	66	58	49	39	69	74
1/30/2019 6:05:23	truck drive by	65	56	53	56	62	61	58	46	66	69
1/29/2019 3:33:58	truck drive by	63	59	62	62	63	53	40	23	65	69
1/29/2019 4:01:03	impact, wood	69	75	63	58	58	57	52	42	65	76

While the exterior site noise is within HUD’s “acceptable” range when looking at the overall noise levels, both hourly and DNL, these events illustrate that noise from Home Depot has the potential to cause an adverse impact from noise events significantly above the background noise level at the Bickford townhomes for both indoor and outdoor use areas. Noise mitigation for areas adjacent to Home Depot operations are detailed in the following section.

4. MITIGATION MEASURES

4.1. Exterior Wall

To achieve the additional attenuation from the exterior envelope, standard exterior construction is acceptable, as the sound transmission loss performance is driven by the windows. The following standard exterior wall construction is recommended:

- ◆ (1) layer plywood or GWB and siding (exterior)
- ◆ 2 x 6 wood studs
- ◆ 5.5" batt insulation in the cavity
- ◆ (1) layer 5/8" thick GWB (interior)

Careful attention should be given to sound leaks. Sound leaks can reduce the performance of a wall by more than 10 STC points if not treated. The following recommendations should be implemented to reduce sound transmission due to sound leaks.

Notes:

- ◆ *Acoustic construction details are essential to the performance of any wall assembly. Refer to ASTM C919: Standard Practice of Use of Sealants in Acoustical Applications. In type I construction, the first layer of 5/8" gypsum board on the unit side should be sealed top and bottom with resilient caulk, as well as around the junction boxes.*
- ◆ *Window rough-in seams should be no greater than 1/4", and all seams should be caulked with resilient caulking.*
- ◆ *Seal, caulk, gasket or weather-strip all joints and seams to eliminate air leakage through these assemblies. This would include around window and doorframes; at penetrations through walls, and all other openings in the building envelope.*

4.2. Windows

Based on the third octave band spectrum of the 24-hour measurement interval, the following window assemblies are recommended to meet the HUD and IGCC interior noise design criteria of 35 dBA/60 dBC (L_{EQ}) and 45 dBA/70 dBC (L_{MAX}). Recommended locations for the window assemblies are shown in figure 7. Sliding glass windows and doors are not recommended.

STC of 32 (OITC 26) are recommended for townhomes shown in orange in figure 7. The following glazing assembly meets STC 32: 0.25" glass – 0.5" airspace – 0.25" glass

STC of 28 (OITC 24) windows are recommended for townhomes shown in blue in figure 7. The following glazing assembly meets STC 28: 0.125" glass – 0.5" glass – 0.125" glass

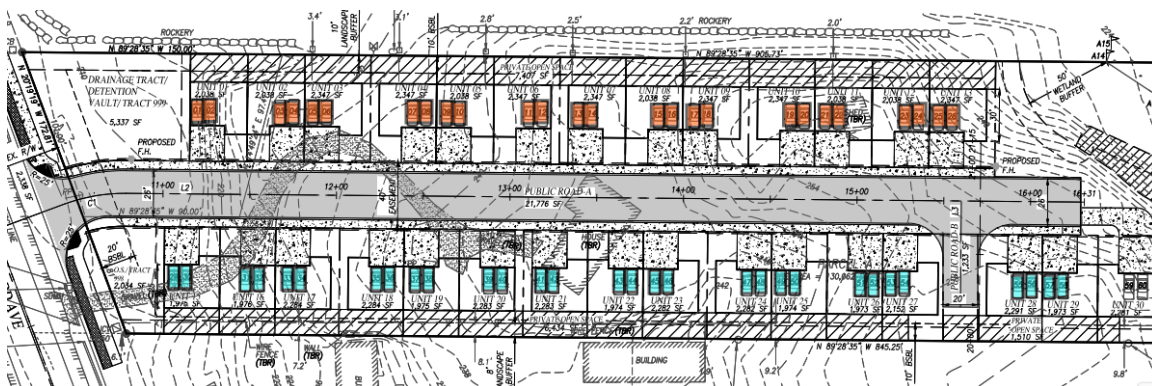


Figure 7 – Bickford Townhomes Window Recommendations

Notes:

- ◆ Windows are required to have a fixed sash or an efficiently weather-stripped, operable sash. The sash shall be rigid and weather-stripped with material that is compressed airtight when the window is closed, so as to conform to an infiltration rate not to exceed 0.5 cubic foot per minute per foot of crack length in accordance with ASTM E-283-65-T.
- ◆ Glass shall be sealed in an airtight manner with a non-hardening sealant or a soft elastomeric gasket or gasket tape.
- ◆ The perimeter of window and door frames shall be sealed airtight to the exterior wall construction with a sealant conforming to one of the following Federal specifications: TT-S-00227, TT-S-00230 or TT-S-00153.
- ◆ In case the ventilation is achieved through slots within the window case, we recommend using offset vents that maintain the STC rating of the window. Please note that a standard trickle vent is a straight hole in the window, which reduces the acoustical performance of the window significantly.
- ◆ Exterior doors should be sealed with perimeter gasketing and automatic door bottoms (mortised, semi-mortised, or surface mounted)

4.3. Noise Barriers

Though noise levels comply with both HUD and IGCC requirements within the building, noise transfer to the exterior areas behind the townhomes due to transient noise sources is likely to be audible and potentially intrusive from activity at the commercial area below. If this is a concern, this noise transfer path can be significantly mitigation through inclusion of a noise barrier. Recommended barrier extents are shown in figure 8 below. It is anticipated that this noise barrier will reduce sound transfer from the commercial area to the outdoor areas of the homes by at least half, if constructed per the recommendations.

- a) The noise barrier should be constructed out of a minimum 4 lb/psf material and have a minimum height of 6'-0".
- b) The noise barrier should be continuous, should be completely sealed and caulked and have no gaps at the seams or bottom.

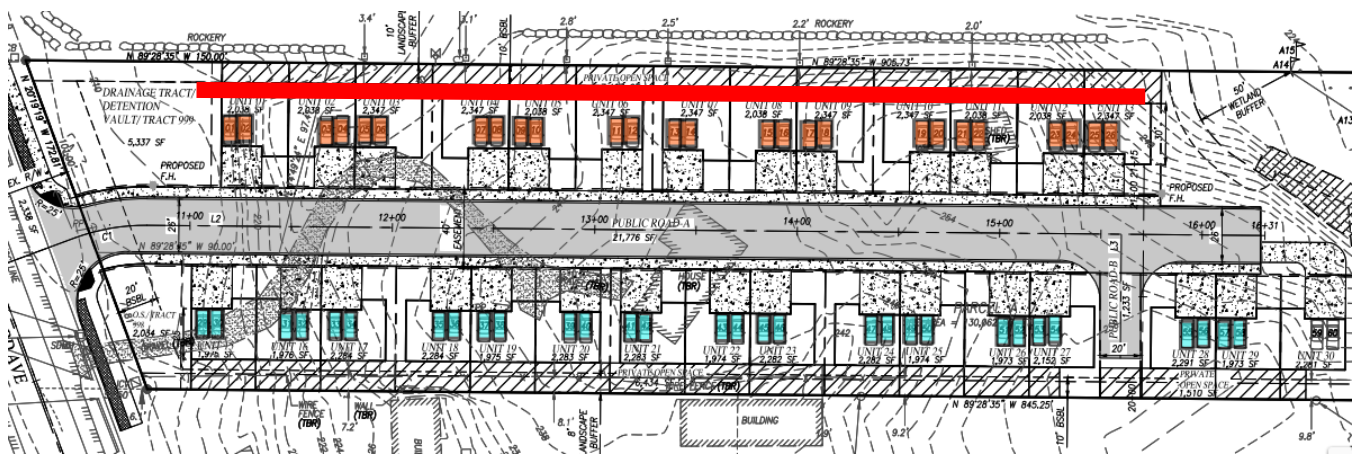


Figure 8 – Bickford Townhomes Horizontal Barrier Extent Recommendations

5. SUMMARY

Exterior site noise at the proposed Bickford Townhomes site is within HUD's "acceptable" range, below DNL 65. However, noise events above the background noise level from Home Depot operations bordering the north property line have the potential to cause an adverse impact on the future residents. These events were studied in comparison to the HUD interior noise limits and IGCC requirements.

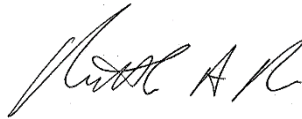
Based on our environmental noise measurements and analysis, the mitigation measures outlined in section 4 will ensure interior and exterior noise levels at the future residences will comply with HUD and IGCC noise criteria.

Please do not hesitate to contact us with any questions or concerns.

Sincerely,



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