# Appendix E: Noise

# APPENDIX E-1

# NOISE ASSESSMENT FORMULAS

## A. GENERAL NOISE ASSESSMENT FORMULAS

For the General Noise Assessment, noise exposures were calculated at a reference distance of 50 feet from the track using the following equations.

For Locomotives:

$$L_{eq(h)} = SEL_{ref} + 10 \log (N_{locos}) - 10 \log (S/50) + 10 \log (V) - 35.6$$

For Rail Cars:

$$L_{eq(h)} = SEL_{ref} + 10 \log (N_{cars}) + 20 \log (S/50) + 10 \log (V) - 35.6$$

and where:

| | | |
|---|---|---|
| $N_{locos}$ | = | average number of locomotives per train |
| $N_{cars}$ | = | average number of cars per train |
| T | = | average throttle setting of diesel-electric locomotive |
| S | = | train speed, in miles per hour |
| V | = | average hourly volume of train traffic, in trains per hour |
| $V_d$ | = | average hourly daytime volume of traffic, in trains per hour or |
| | = | number of trains, 7 AM to 10 PM / 15 |
| $V_n$ | = | average hourly nighttime volume of traffic, in trains per hour or |
| | = | number of trains, 10 PM to 7 AM / 9 |
| $SEL_{ref}$ | = | reference SEL value, which equals 92 dBA for locomotives, and 82 for rail cars |

For the General Noise Assessment at Highbridge and Blissville the procedures contained in the FTA guidance manual were used, with calculations for 50 feet from the center of the site as follows:

$$L_{eq(h)} = SEL_{ref} + C_N - 35.6$$

$$L_{dn} = 10 \log [ (15) \times 10^{(Leq(day)/10)} + (9) \times 10^{(Leq(night)+10/10)}] - 13.8$$

where

$C_N = 10 \log (N_T/20)$ for rail yards and shops
$C_N = 10 \log (2N_T)$ for layover tracks
$N_T$ = Number of trains per hour
$SEL_{ref} = 118$ for rail yards and shops
$SEL_{ref} = 116$ for layover tracks

These values were adjusted for the appropriate distance.

# B. DETAILED NOISE ASSESSMENT FORMULAS

## RAIL NOISE PREDICTION METHODOLOGY

The FTA guidance manual procedure and formulas for calculating rail noise were utilized to determine noise from train operations. Using the FTA methodology, $L_{eq(1)}$ and $L_{dn}$, noise levels for free-field acoustic conditions (no reflections above ground) from fixed-rail sources are calculated at 50 feet, using the following equations:

For Locomotives:

$$L_{eq(h)} = SEL_{ref} + 10 \log (N_{locos}) + C_T - 10 \log (S/50) + 10 \log (V) - 35.6$$

where

$$C_T = \begin{cases} 0 \text{ for } T<6 \\ 2(T-5) \text{ for } T \geq 6 \end{cases}$$

For Rail Cars:

$$L_{eq(h)} = SEL_{ref} + 10 \log (N_{cars}) + C_T - 20 \log (S/50) + 10 \log (V) - 35.6$$

where FTA recommends use of the following adjustments as applicable:

+5 for Jointed Track
+3 for Embedded Track on Grade
+4 for aerial Structure with Slab Track

For Warning Horns:

$$L_{eq(h)} = SEL_{ref} - 10 \log (S/50) + 10 \log (V) - 35.6$$

Combined:

$$L_{eq\,(h)} = 10 \log [10^{(LeqL/10)} + 10^{(LeqC/10)} + 10^{(LeqH/10)}]$$

$$L_{dn} = 10 \log [(15) \times 10^{(Leq(day)/10)} + (9) \times 10^{(Leq(night) + 10/10)}]$$

where:

$N_{locos}$ = average number of locomotives per train
$N_{cars}$ = average number of cars per train
T = average throttle setting of diesel-electric locomotive
S = train speed, in miles per hour
V = average hourly volume of train traffic, in trains per hour
$V_d$ = average hourly daytime volume of traffic, in trains per hour
= number of trains, 7 AM to 10 PM / 15
$V_n$ = average hourly nighttime volume of traffic, in trains per hour
= number of trains, 10 PM to 7 AM / 9

$SEL_{ref}$ = 92 dBA for locomotive, 82 for rail cars and 108 for locomotive horn*

Noise levels calculated at 50 feet from the equations above were corrected for distance as follows:

$$(L_{dn} \text{ or } L_{eq(1)})_{at\ D\ feet} = (L_{dn} \text{ or } L_{eq(1)})_{at\ 50\ feet} - 10 \log (D/50) - 10G \log (D/42) - A_{shielding}$$

where

D = the distance from the source to the receptor in feet

G = the ground factor; for hard ground G = 0

for soft ground $G = 0.66 \quad H_{eff} < 5$

$$= 0.75 \left(1 - \frac{H_{eff}}{42}\right) \quad 5 < H_{eff} < 42$$

$$= 0 \qquad H_{eff} > 42$$

$H_{eff}$ = sum of average path heights on either side of barrier

$A_{shielding}$ = sound attenuation shielding between source and receiver (see section 6.3.2, FTA)

## C. DETAILED NOISE ASSESSMENT CALCULATIONS

The spreadsheets on the following pages detail the noise calculations for each of the 15 LIRR branch receptor sites on Long Island, as well as each of the seven sites at potential new rail yards on Long Island.

* The analysis assumes an $SEL_{ref}$ value of 108 for locomotive warning horn noise for Existing, No Action, and Build alternatives. LIRR has recently started a program to retrofit locomotives with a warning horn that will result in a significantly less-intrusive horn sound that will comply with the minimum 96 dB standard required by the Federal Railroad Administration.

# APPENDIX E-2

# NOISE ASSESSMENT CALCULATIONS: LIRR BRANCH SEGMENTS

## Adjusted to noise values at nearest residences

| Site | Distance | | Noise | Existing Noise Level | | No Build Noise Level | | Build Noise Level | | Project Noise Level | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Measured | Residence | Descriptor | Measured | Residence* | Calculated | Residence* | Calculated | Residence* | Calculated | Residence* |
| 1 | 70 | 90 | Ldn | 69.6 | 68.0 | 71.3 | 69.7 | 71.7 | 70.1 | 67.6 | 66.0 |
| 2 | 94 | 90 | Ldn | 71.0 | 71.3 | 72.7 | 73.0 | 73.2 | 73.5 | 69.2 | 69.5 |
| 3 | 65 | 95 | Ldn | 74.7 | 72.2 | 76.6 | 74.1 | 77.2 | 74.7 | 73.4 | 70.9 |
| 3 | 65 | NA | Leq | 77.6 | NA | 78.6 | NA | 79.3 | NA | 74.2 | NA |
| 4 | 65 | 60 | Ldn | 76.7 | 77.2 | 78.4 | 78.9 | 77.7 | 78.2 | 70.6 | 71.1 |
| 5 | 65 | 60 | Ldn | 75.8 | 76.3 | 76.6 | 77.1 | 76.7 | 77.2 | 69.5 | 70.0 |
| 6 | 55 | 55 | Ldn | 77.2 | 77.2 | 78.9 | 78.9 | 78.3 | 78.3 | 71.6 | 71.6 |
| 7 | 30 | 60 | Ldn | 80.8 | 76.3 | 82.8 | 78.3 | 81.2 | 76.7 | 70.3 | 65.8 |
| 8 | 70 | 70 | Ldn | 75.6 | 75.6 | 74.1 | 74.1 | 72.8 | 72.8 | 60.8 | 60.8 |
| 9 | 60 | NA | Leq | 69.0 | NA | 69.3 | NA | 70.1 | NA | 63.5 | NA |
| 10 | 100 | NA | Leq | 69.3 | NA | 69.3 | NA | 69.5 | NA | 57.1 | NA |
| 11 | 31 | 90 | Ldn | 86.1 | 79.2 | 87.7 | 80.8 | 87.7 | 80.8 | 82.8 | 75.9 |
| 12 | 115 | 60 | Ldn | 63.7 | 67.9 | 66.2 | 70.4 | 66.2 | 70.4 | 62.6 | 66.8 |
| 13 | 61 | 100 | Ldn | 70.5 | 67.3 | 73.2 | 70.0 | 73.2 | 70.0 | 69.9 | 66.7 |
| 14 | 70 | 80 | Ldn | 68.2 | 67.3 | 71.3 | 70.4 | 71.3 | 70.4 | 68.4 | 67.5 |
| 15 | 28 | 35 | Ldn | 79.0 | 77.6 | 81.9 | 80.5 | 81.9 | 80.5 | 78.8 | 77.4 |

* Approximately 4.5 dBA noise attenuation with doubling distance

dBA dropoff = 14.95log(Distance/50)  therefore, Distance=50(10^(dBA dropoff/14.95))

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 69.40 | 69.40 | 8709635.9 | 89.9 | 79.3 | 72.1 | 61.5 | 55.9 |
| 9:00 AM | 68.90 | 68.90 | 7762471.166 | 90.1 | 78.7 | 72.1 | 61.1 | 55.9 |
| 10:00 AM | 66.40 | 66.40 | 4365158.322 | 88.3 | 76.3 | 68.9 | 58.1 | 53.5 |
| 11:00 AM | 66.20 | 66.20 | 4168693.835 | 88.3 | 76.3 | 68.1 | 55.7 | 52.3 |
| 12:00 PM | 64.80 | 64.80 | 3019951.72 | 85.5 | 76.1 | 66.9 | 54.7 | 50.9 |
| 1:00 PM | 65.80 | 65.80 | 3801893.963 | 86.3 | 77.7 | 68.1 | 56.9 | 51.9 |
| 2:00 PM | 66.70 | 66.70 | 4677351.413 | 89.9 | 77.3 | 68.1 | 56.9 | 52.9 |
| 3:00 PM | 65.30 | 65.30 | 3388441.561 | 80.9 | 75.9 | 68.7 | 57.7 | 52.7 |
| 4:00 PM | 67.60 | 67.60 | 5754399.373 | 89.9 | 78.1 | 69.7 | 58.7 | 53.1 |
| 5:00 PM | 66.70 | 66.70 | 4677351.413 | 84.7 | 77.3 | 70.7 | 58.7 | 54.5 |
| 6:00 PM | 70.30 | 70.30 | 10715193.05 | 92.9 | 78.1 | 71.1 | 60.9 | 55.9 |
| 7:00 PM | 67.00 | 67.00 | 5011872.336 | 84.5 | 76.9 | 70.9 | 59.7 | 53.5 |
| 8:00 PM | 65.40 | 65.40 | 3467368.505 | 83.1 | 76.3 | 69.1 | 56.3 | 52.1 |
| 9:00 PM | 63.90 | 63.90 | 2454708.916 | 82.7 | 74.9 | 66.5 | 56.1 | 52.7 |
| 10:00 PM | 63.50 | 63.50 | 2238721.139 | 83.3 | 74.7 | 65.5 | 54.7 | 51.7 |
| 11:00 PM | 62.20 | 72.20 | 16595869.07 | 79.9 | 73.9 | 64.7 | 54.1 | 51.7 |
| 12:00 AM | 61.70 | 71.70 | 14791083.88 | 82.1 | 73.5 | 62.3 | 52.7 | 50.5 |
| 1:00 AM | 63.30 | 73.30 | 21379620.9 | 88.7 | 74.5 | 62.1 | 52.3 | 50.1 |
| 2:00 AM | 63.60 | 73.60 | 22908676.53 | 89.5 | 73.1 | 61.9 | 51.9 | 50.3 |
| 3:00 AM | 61.40 | 71.40 | 13803842.65 | 86.3 | 72.5 | 57.7 | 50.7 | 49.7 |
| 4:00 AM | 59.00 | 69.00 | 7943282.347 | 79.7 | 72.5 | 54.5 | 51.7 | 50.5 |
| 5:00 AM | 57.50 | 67.50 | 5623413.252 | 79.5 | 68.7 | 55.7 | 52.5 | 51.3 |
| 6:00 AM | 61.00 | 71.00 | 12589254.12 | 77.7 | 73.5 | 62.1 | 53.1 | 51.9 |
| 7:00 AM | 64.70 | 74.70 | 29512092.27 | 85.7 | 76.1 | 66.7 | 55.7 | 52.5 |
| Sum | | | 219360347.6 | | | | | |
| Ldn dBA | | | 69.6 | | | | | |
| Ldn dBA at nearest residences | | | 68.0 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 76.84 | - | 2.92 | - | 1.25 | - 5 |
| | = | 67.67 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.18 | - | 2.92 | - | 1.25 | - 5 |
| | = | 70.01 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 76.84 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.18 | with warning horns |
| D=Distance ft | = | 70 | |
| Heff (sum of average path heights) | = | 10.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 8 | |
| G=Ground factor | = | 0.56 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 5 | |
| R=number of rows of houses | = | 1 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Traffic $L_{dn}$*** = 10log(10^Ldn Measured/10-10^Ldn Calculated/10)
= 65.18

***Existing $L_{dn}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 69.61

***Existing $L_{dn\ with\ horns}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 71.24

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.19 | - | 2.92 | - | 1.25 | - | 5 |
| | = | 70.02 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 82.83 | - | 2.92 | - | 1.25 | - | 5 |
| | = | 73.66 | | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 79.19 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 82.83 | with warning horns |
| D=Distance ft | = | 70 | |
| Heff (sum of average path heights) | = | 10.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 8 | |
| G=Ground factor | = | 0.56 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 5 | |
| R=number of rows of houses | = | 1 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 71.25 |
| Ldn dBA at nearest residences | | 69.7 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 74.24 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.81 | - | 2.92 | - | 1.25 | - | 5 |
| | = | 70.64 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 83.21 | - | 2.92 | - | 1.25 | - | 5 |
| | = | 74.04 | | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 79.81 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 83.21 | with warning horns |
| D=Distance ft | = | 70 | |
| Heff (sum of average path heig | = | 10.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 8 | |
| G=Ground factor | = | 0.56 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 5 | |
| R=number of rows of houses | = | 1 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 71.73 |
| Ldn dBA at nearest residenc | | 70.07 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 74.57 |

**Build Increment**

**Calculated Ldn**

$L_{dn\ (without\ warning\ horns)}$ = $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Existing/10})$
= 67.59
at nearest residences = 65.97 IMPACT

$L_{dn\ (with\ warning\ horns)}$ = $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Existing/10})$
= 71.85

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | | |
| 42<=$L_E$<=71 | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 62.89 |
| $L_E$ >71 | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<44 | Lp= | 17.322+0.940LE | | |
| 44<=$L_E$<=77 | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 68.12 |
| $L_E$ >77 | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 69.10 | 69.10 | 8128305.162 | 85.1 | 81.1 | 73.7 | 56.7 | 51.6 |
| 9:00 AM | 68.00 | 68.00 | 6309573.445 | 85.3 | 80.7 | 69.7 | 55.1 | 50.7 |
| 10:00 AM | 66.90 | 66.90 | 4897788.194 | 84.3 | 80.1 | 69.5 | 54.5 | 49.9 |
| 11:00 AM | 66.40 | 66.40 | 4365158.322 | 84.3 | 80.5 | 61.7 | 51.5 | 47.5 |
| 12:00 PM | 69.80 | 69.80 | 9549925.86 | 84.7 | 80.5 | 73.9 | 52.5 | 46.9 |
| 1:00 PM | 72.80 | 72.80 | 19054607.18 | 86.1 | 82.3 | 75.3 | 71.7 | 53.7 |
| 2:00 PM | 67.00 | 67.00 | 5011872.336 | 84.9 | 80.7 | 65.7 | 55.1 | 48.5 |
| 3:00 PM | 65.20 | 65.20 | 3311311.215 | 83.3 | 80.5 | 59.3 | 51.3 | 46.9 |
| 4:00 PM | 66.60 | 66.60 | 4570881.896 | 84.9 | 80.5 | 63.7 | 51.9 | 47.9 |
| 5:00 PM | 68.80 | 68.80 | 7585775.75 | 86.1 | 82.3 | 69.1 | 52.7 | 47.9 |
| 6:00 PM | 71.40 | 71.40 | 13803842.65 | 88.3 | 84.1 | 74.7 | 61.3 | 57.1 |
| 7:00 PM | 72.10 | 72.10 | 16218100.97 | 92.9 | 84.7 | 74.5 | 55.7 | 49.7 |
| 8:00 PM | 68.00 | 68.00 | 6309573.445 | 84.9 | 81.9 | 67.3 | 54.7 | 50.1 |
| 9:00 PM | 65.20 | 65.20 | 3311311.215 | 83.3 | 79.9 | 63.7 | 54.7 | 50.3 |
| 10:00 PM | 64.70 | 64.70 | 2951209.227 | 84.3 | 79.1 | 61.9 | 53.1 | 49.7 |
| 11:00 PM | 65.10 | 75.10 | 32359365.69 | 82.1 | 78.7 | 65.3 | 55.5 | 51.3 |
| 12:00 AM | 63.30 | 73.30 | 21379620.9 | 82.3 | 78.7 | 60.1 | 53.1 | 51.1 |
| 1:00 AM | 63.10 | 73.10 | 20417379.45 | 84.7 | 78.3 | 58.7 | 52.7 | 50.7 |
| 2:00 AM | 61.80 | 71.80 | 15135612.48 | 81.1 | 78.1 | 54.3 | 50.3 | 48.7 |
| 3:00 AM | 61.00 | 71.00 | 12589254.12 | 82.7 | 76.3 | 54.5 | 49.7 | 47.9 |
| 4:00 AM | 63.50 | 73.50 | 22387211.39 | 85.1 | 79.1 | 51.9 | 49.9 | 48.7 |
| 5:00 AM | 59.50 | 69.50 | 8912509.381 | 81.3 | 73.7 | 52.5 | 50.3 | 48.9 |
| 6:00 AM | 63.60 | 73.60 | 22908676.53 | 82.1 | 78.9 | 55.1 | 51.5 | 50.3 |
| 7:00 AM | 65.10 | 75.10 | 32359365.69 | 82.7 | 78.7 | 60.1 | 52.5 | 50.9 |
| Sum | | | 303828232.5 | | | | | |
| Ldn dBA | | | 71.0 | | | | | |
| Ldn dBA at nearest residences | | | 71.3 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 76.84 | - | 5.48 | - | 2.06 | - | 0 |
| | = | 69.30 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.18 | - | 5.48 | - | 2.06 | - | 0 |
| | = | 71.64 | | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 76.84 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.18 | with warning horns |
| D=Distance ft | = | 94 | |
| Heff (sum of average path heights | = | 9 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 5 | |
| G=Ground factor | = | 0.59 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 66.20 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 71.03 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 72.73 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.19 | - | 5.48 | - | 2.06 | - | 0 |
| | = | 71.65 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 82.83 | - | 5.48 | - | 2.06 | - | 0 |
| | = | 75.29 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 79.19 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 82.83 | with warning horns |
| | D=Distance ft | = | 94 | |
| | Heff (sum of average path heights) | = | 9 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 5 | |
| | G=Ground factor | = | 0.59 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***N-B*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 72.73 |
| Ldn dBA at nearest residences | | 72.98 |
| ***N-B*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 75.79 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.81 | - | 5.48 | - | 2.06 | - | 0 |
| | = | 72.27 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 83.21 | - | 5.48 | - | 2.06 | - | 0 |
| | = | 75.67 | | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 79.81 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 83.21 | with warning horns |
| D=Distance ft | = | 94 | |
| Heff (sum of average path heig | = | 9 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 5 | |
| G=Ground factor | = | 0.59 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 73.22 |
| Ldn dBA at nearest residences | | 73.48 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 76.13 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 69.21 |
| at nearest residences | = | 69.50 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 73.48 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | | |
| 42<=$L_E$<=71 | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 65.36 |
| $L_E$ >71 | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<44 | Lp= | 17.322+0.940LE | | |
| 44<=$L_E$<=77 | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 70.42 |
| $L_E$ >77 | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 72.90 | 72.90 | 19498446 | 91.1 | 86.5 | 75.1 | 57.7 | 52.7 |
| 9:00 AM | 72.50 | 72.50 | 17782794.1 | 92.1 | 85.5 | 72.5 | 55.7 | 50.5 |
| 10:00 AM | 71.00 | 71.00 | 12589254.12 | 91.5 | 85.5 | 68.3 | 52.7 | 49.9 |
| 11:00 AM | 71.20 | 71.20 | 13182567.39 | 94.1 | 86.3 | 64.7 | 50.5 | 46.9 |
| 12:00 PM | 70.50 | 70.50 | 11220184.54 | 92.7 | 85.5 | 69.7 | 52.9 | 48.7 |
| 1:00 PM | 68.50 | 68.50 | 7079457.844 | 91.5 | 82.5 | 63.7 | 50.9 | 47.9 |
| 2:00 PM | 70.80 | 70.80 | 12022644.35 | 92.7 | 85.5 | 64.1 | 51.5 | 48.5 |
| 3:00 PM | 70.20 | 70.20 | 10471285.48 | 91.3 | 84.7 | 65.5 | 52.3 | 48.5 |
| 4:00 PM | 73.80 | 73.80 | 23988329.19 | 99.1 | 82.9 | 68.9 | 55.3 | 50.3 |
| 5:00 PM | 77.60 | 77.60 | 57543993.73 | 106.3 | 86.3 | 70.5 | 54.5 | 49.7 |
| 6:00 PM | 72.70 | 72.70 | 18620871.37 | 94.3 | 86.3 | 72.9 | 55.5 | 51.1 |
| 7:00 PM | 74.60 | 74.60 | 28840315.03 | 97.5 | 87.1 | 71.1 | 54.9 | 49.7 |
| 8:00 PM | 73.60 | 73.60 | 22908676.53 | 99.1 | 86.3 | 65.9 | 53.3 | 49.7 |
| 9:00 PM | 67.70 | 67.70 | 5888436.554 | 90.5 | 80.9 | 62.3 | 50.7 | 48.7 |
| 10:00 PM | 66.70 | 66.70 | 4677351.413 | 89.1 | 79.5 | 66.7 | 54.9 | 51.9 |
| 11:00 PM | 68.10 | 78.10 | 64565422.9 | 90.5 | 81.5 | 64.1 | 51.9 | 48.5 |
| 12:00 AM | 65.40 | 75.40 | 34673685.05 | 89.7 | 78.3 | 60.1 | 51.3 | 48.7 |
| 1:00 AM | 65.00 | 75.00 | 31622776.6 | 89.7 | 77.5 | 56.5 | 48.9 | 48.5 |
| 2:00 AM | 63.40 | 73.40 | 21877616.24 | 85.5 | 76.7 | 53.9 | 52.1 | 48.7 |
| 3:00 AM | 59.80 | 69.80 | 9549925.86 | 84.1 | 71.7 | 48.3 | 46.7 | 45.7 |
| 4:00 AM | 68.10 | 78.10 | 64565422.9 | 91.3 | 82.1 | 54.7 | 52.3 | 51.9 |
| 5:00 AM | 59.90 | 69.90 | 9772372.21 | 83.9 | 68.3 | 52.9 | 51.9 | 51.5 |
| 6:00 AM | 70.40 | 80.40 | 109647819.6 | 91.9 | 83.7 | 61.3 | 52.5 | 49.9 |
| 7:00 AM | 70.10 | 80.10 | 102329299.2 | 92.5 | 82.5 | 64.5 | 51.9 | 49.7 |
| Sum | | | 714918948.2 | | | | | |
| Ldn dBA | | | 74.7 | | | | | |
| Ldn dBA at nearest residences | | | 72.2 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - $A_{shielding}$ |
| | = | 76.84 | - | 2.28 | - | 1.03 | - 0 |
| | = | 73.53 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - $A_{shielding}$ |
| | = | 79.18 | - | 2.28 | - | 1.03 | - 0 |
| | = | 75.87 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 76.84 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.18 | with warning horns |
| D=Distance ft | = | 65 | |
| Heff (sum of average path heights | = | 11.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 68.62 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 74.74 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 76.62 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.19 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 75.88 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 82.83 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 79.52 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 79.19 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 82.83 | with warning horns |
| | D=Distance ft | = | 65 | |
| | Heff (sum of average path heights) | = | 11.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 10 | |
| | G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 76.63 |
| Ldn dBA at nearest residences | | 74.14 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 79.86 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - | $A_{shielding}$ |
| | = | 79.81 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 76.50 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - | $A_{shielding}$ |
| | = | 83.21 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 79.90 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 79.81 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 83.21 | with warning horns |
| | D=Distance ft | = | 65 | |
| | Heff (sum of average path heig | = | 11.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 10 | |
| | G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.15 |
| Ldn dBA at nearest residence | | 74.74 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 80.21 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 73.45 |
| at nearest residences | = | 70.90 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 77.71 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 66.07 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 71.08 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | | 0.00 | 1 | | | | | |
| 9:00 AM | | 0.00 | 1 | | | | | |
| 10:00 AM | | 0.00 | 1 | | | | | |
| 11:00 AM | | 0.00 | 1 | | | | | |
| 12:00 PM | | 0.00 | 1 | | | | | |
| 1:00 PM | | 0.00 | 1 | | | | | |
| 2:00 PM | | 0.00 | 1 | | | | | |
| 3:00 PM | | 0.00 | 1 | | | | | |
| 4:00 PM | | 0.00 | 1 | | | | | |
| 5:00 PM | 77.60 | 77.60 | 57543993.73 | 106.3 | 86.3 | 70.5 | 54.5 | 49.7 |
| 6:00 PM | | 0.00 | 1 | | | | | |
| 7:00 PM | | 0.00 | 1 | | | | | |
| 8:00 PM | | 0.00 | 1 | | | | | |
| 9:00 PM | | 0.00 | 1 | | | | | |
| 10:00 PM | | 0.00 | 1 | | | | | |
| 11:00 PM | | 10.00 | 10 | | | | | |
| 12:00 AM | | 10.00 | 10 | | | | | |
| 1:00 AM | | 10.00 | 10 | | | | | |
| 2:00 AM | | 10.00 | 10 | | | | | |
| 3:00 AM | | 10.00 | 10 | | | | | |
| 4:00 AM | | 10.00 | 10 | | | | | |
| 5:00 AM | | 10.00 | 10 | | | | | |
| 6:00 AM | | 10.00 | 10 | | | | | |
| 7:00 AM | | 10.00 | 10 | | | | | |
| Sum | | | | | | | | |
| Leq dBA | | | 77.60 | | | | | |

**Existing**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Leq (without warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - ***A shielding*** |
| | = | 77.26 | - | 2.28 | - | 1.03 | - 0 |
| | = | 73.95 | | | | | |
| ***Leq (with warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - ***A shielding*** |
| | = | 81.22 | - | 2.28 | - | 1.03 | - 0 |
| | = | 77.91 | | | | | |

| | | | |
|---|---|---|---|
| where: ***Leq at 50 ft*** | = | 77.26 | without warning horns |
| ***Leq at 50 ft*** | = | 81.22 | with warning horns |
| D=Distance ft | = | 65 | |
| Heff (sum of average path heights | = | 11.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Traffic $L_{eq}$*** = 10log(10^Ldn Measured/10-10^Ldn Calculated/10)
= 75.15

***Existing $L_{eq}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 77.60

***Existing $L_{eq\ with\ horns}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 79.75

**No Build**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Leq*** *(without warning horns)* | = | ***Leq*** $_{at\ 50\ ft}$ | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | $A_{shielding}$ |
| | = | 79.3 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 75.99 | | | | | | |
| ***Leq*** *(with warning horns)* | = | ***Leq*** $_{at\ 50\ ft}$ | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | $A_{shielding}$ |
| | = | 83.8 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 80.49 | | | | | | |

| | | | |
|---|---|---|---|
| where: ***Leq*** $_{at\ 50\ ft}$ | = | 79.3 | without warning horns |
| ***Leq*** $_{at\ 50\ ft}$ | = | 83.8 | with warning horns |
| D=Distance ft | = | 65 | |
| Heff (sum of average path heights) | = | 11.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***N-B L*** $_{eq}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 78.60 |
| ***N-B L*** $_{eq\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.60 |

**Build**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Leq (without warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A shielding*** |
| | = | 80.42 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 77.11 | | | | | | |
| ***Leq (with warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A shielding*** |
| | = | 84.35 | - | 2.28 | - | 1.03 | - | 0 |
| | = | 81.04 | | | | | | |

| | | | |
|---|---|---|---|
| where: ***Leq at 50 ft*** | = | 80.42 | without warning horns |
| ***Leq at 50 ft*** | = | 84.35 | with warning horns |
| D=Distance ft | = | 65 | |
| Heff (sum of average path heig | = | 11.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Build $L_{eq}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 79.25

***Build $L_{eq\ with\ horns}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 82.03

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| *Leq (without warning horns)* | = | *10log(10^L dn Build/10 - 10^L dn Esisting/10)* |
| | = | *74.24* IMPACT |
| *Leq (with warning horns)* | = | *10log(10^L dn Build/10 - 10^L dn Esisting/10)* |
| | = | *78.14* |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | | |
| 42<=$L_E$<=71 | Lp= | 71.662 - 1.164$L_E$ + 0.018$L_E^2$ - 4.088x10$^{-5}$$L_E^3$ | = | 70.62 |
| $L_E$ >71 | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<44 | Lp= | 17.322+0.940LE | | |
| 44<=$L_E$<=77 | Lp= | 96.725 - 1.992$L_E$ + 3.02x10$^{-2}$$L_E^2$ - 1.043xx10$^{-4}$$L_E^3$ | = | 75.26 |
| $L_E$ >77 | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 73.00 | 73.00 | 19952623.15 | 90.9 | 86.5 | 75.5 | 59.3 | 53.3 |
| 9:00 AM | 74.50 | 74.50 | 28183829.31 | 95.1 | 87.9 | 75.3 | 55.9 | 50.3 |
| 10:00 AM | 71.00 | 71.00 | 12589254.12 | 92.3 | 85.1 | 68.3 | 53.9 | 49.5 |
| 11:00 AM | 69.80 | 69.80 | 9549925.86 | 90.7 | 84.1 | 63.7 | 51.3 | 46.9 |
| 12:00 PM | 76.10 | 76.10 | 40738027.78 | 101.7 | 86.7 | 64.3 | 51.7 | 47.7 |
| 1:00 PM | 68.20 | 68.20 | 6606934.48 | 87.9 | 82.1 | 67.1 | 53.9 | 48.3 |
| 2:00 PM | 69.20 | 69.20 | 8317637.711 | 88.9 | 84.1 | 63.7 | 51.5 | 47.9 |
| 3:00 PM | 69.10 | 69.10 | 8128305.162 | 91.3 | 82.9 | 65.5 | 52.7 | 48.1 |
| 4:00 PM | 68.10 | 68.10 | 6456542.29 | 89.5 | 82.7 | 65.3 | 55.3 | 49.9 |
| 5:00 PM | 71.50 | 71.50 | 14125375.45 | 90.7 | 85.1 | 72.5 | 54.9 | 50.1 |
| 6:00 PM | 74.30 | 74.30 | 26915348.04 | 92.7 | 86.7 | 78.5 | 63.3 | 54.3 |
| 7:00 PM | 73.80 | 73.80 | 23988329.19 | 93.7 | 86.9 | 74.3 | 56.7 | 52.3 |
| 8:00 PM | 73.30 | 73.30 | 21379620.9 | 93.9 | 86.3 | 73.9 | 55.5 | 50.7 |
| 9:00 PM | 71.50 | 71.50 | 14125375.45 | 91.5 | 85.7 | 58.3 | 47.0 | 43.5 |
| 10:00 PM | 69.30 | 69.30 | 8511380.382 | 90.7 | 84.9 | 59.3 | 48.3 | 45.1 |
| 11:00 PM | 72.10 | 82.10 | 162181009.7 | 94.3 | 86.5 | 63.7 | 48.7 | 45.3 |
| 12:00 AM | 67.60 | 77.60 | 57543993.73 | 90.7 | 81.7 | 57.5 | 47.7 | 44.9 |
| 1:00 AM | 70.30 | 80.30 | 107151930.5 | 91.5 | 85.7 | 58.3 | 46.9 | 43.3 |
| 2:00 AM | 69.50 | 79.50 | 89125093.81 | 92.3 | 83.5 | 56.9 | 45.5 | 43.1 |
| 3:00 AM | 64.70 | 74.70 | 29512092.27 | 87.9 | 80.3 | 51.1 | 44.9 | 40.9 |
| 4:00 AM | 67.40 | 77.40 | 54954087.39 | 93.5 | 79.7 | 54.9 | 44.9 | 42.3 |
| 5:00 AM | 66.00 | 76.00 | 39810717.06 | 89.5 | 79.5 | 54.3 | 46.5 | 43.1 |
| 6:00 AM | 69.20 | 79.20 | 83176377.11 | 89.3 | 84.1 | 61.1 | 49.9 | 45.9 |
| 7:00 AM | 74.00 | 84.00 | 251188643.2 | 94.9 | 87.9 | 74.9 | 54.5 | 50.5 |
| Sum | | | 1124212454 | | | | | |
| Ldn dBA | | | 76.7 | | | | | |
| Ldn dBA at nearest residences | | | 77.2 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.13 | - | 2.28 | - | 0.95 | - 0 |
| | = | 75.90 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 82.54 | - | 2.28 | - | 0.95 | - 0 |
| | = | 79.31 | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 79.13 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 82.54 | with warning horns |
| | D=Distance ft | = | 65 | |
| | Heff (sum of average path heights | = | 14 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 15 | |
| | G=Ground factor | = | 0.50 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 69.00 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 76.71 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 79.70 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 81.1 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 77.87 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 84.81 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 81.58 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 81.1 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 84.81 | with warning horns |
| | D=Distance ft | = | 65 | |
| | Heff (sum of average path heights) | = | 14 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 15 | |
| | G=Ground factor | = | 0.50 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 78.40 |
| Ldn dBA at nearest residences | | 78.92 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.82 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 80.26 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 77.03 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 84.44 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 81.21 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 80.26 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 84.44 | with warning horns |
| | D=Distance ft | = | 65 | |
| | Heff (sum of average path heights) | = | 14 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 15 | |
| | G=Ground factor | = | 0.50 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.67 |
| Ldn dBA at nearest residences | | 78.22 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.47 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 70.63 |
| at nearest residences | = | 71.10 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 76.71 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | $11.450+0.953LE$ | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 70.27 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | $17.322+0.940LE$ | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 74.94 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 74.70 | 74.70 | 29512092.27 | 94.6 | 89.6 | 63.4 | 53.6 | 47.6 |
| 9:00 AM | 74.50 | 74.50 | 28183829.31 | 96.8 | 89.0 | 63.8 | 55.4 | 48.8 |
| 10:00 AM | 74.40 | 74.40 | 27542287.03 | 101.0 | 85.6 | 65.4 | 57.6 | 48.4 |
| 11:00 AM | 66.70 | 66.70 | 4677351.413 | 91.6 | 77.6 | 58.2 | 50.4 | 47.0 |
| 12:00 PM | 70.20 | 70.20 | 10471285.48 | 91.8 | 86.2 | 59.0 | 51.8 | 47.4 |
| 1:00 PM | 73.50 | 73.50 | 22387211.39 | 94.6 | 90.8 | 59.6 | 52.2 | 47.6 |
| 2:00 PM | 70.70 | 70.70 | 11748975.55 | 95.2 | 83.2 | 59.6 | 52.8 | 49.0 |
| 3:00 PM | 69.30 | 69.30 | 8511380.382 | 93.8 | 81.0 | 61.0 | 54.6 | 49.6 |
| 4:00 PM | 64.70 | 64.70 | 2951209.227 | 91.0 | 79.4 | 60.6 | 54.2 | 49.4 |
| 5:00 PM | 70.80 | 70.80 | 12022644.35 | 92.0 | 85.4 | 61.6 | 53.4 | 49.2 |
| 6:00 PM | 71.60 | 71.60 | 14454397.71 | 94.2 | 85.0 | 62.4 | 55.2 | 50.0 |
| 7:00 PM | 71.80 | 71.80 | 15135612.48 | 92.6 | 86.4 | 64.0 | 56.0 | 50.2 |
| 8:00 PM | 71.50 | 71.50 | 14125375.45 | 94.4 | 84.8 | 61.2 | 54.2 | 49.2 |
| 9:00 PM | 70.60 | 70.60 | 11481536.21 | 94.6 | 84.0 | 59.6 | 52.2 | 47.6 |
| 10:00 PM | 69.60 | 69.60 | 9120108.394 | 94.8 | 81.8 | 59.8 | 52.0 | 47.0 |
| 11:00 PM | 68.30 | 78.30 | 67608297.54 | 92.4 | 81.4 | 59.2 | 50.6 | 46.2 |
| 12:00 AM | 69.80 | 79.80 | 95499258.6 | 93.8 | 80.2 | 57.8 | 49.6 | 44.8 |
| 1:00 AM | 71.10 | 81.10 | 128824955.2 | 96.4 | 80.8 | 54.2 | 43.6 | 41.4 |
| 2:00 AM | 66.60 | 76.60 | 45708818.96 | 93.6 | 72.2 | 52.4 | 43.0 | 41.4 |
| 3:00 AM | 69.30 | 79.30 | 85113803.82 | 95.2 | 64.2 | 50.6 | 43.8 | 42.2 |
| 4:00 AM | 68.40 | 78.40 | 69183097.09 | 94.2 | 80.2 | 47.8 | 43.2 | 42.0 |
| 5:00 AM | 48.50 | 58.50 | 707945.7844 | 65.4 | 59.4 | 51.4 | 43.4 | 42.0 |
| 6:00 AM | 69.60 | 79.60 | 91201083.94 | 94.0 | 81.0 | 55.6 | 45.8 | 43.0 |
| 7:00 AM | 70.20 | 80.20 | 104712854.8 | 91.6 | 85.4 | 58.8 | 49.8 | 45.0 |
| Sum | | | 910885412.4 | | | | | |
| Ldn dBA | | | 75.8 | | | | | |
| Ldn dBA at nearest residences | | | 76.3 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 77.64 | - | 2.28 | - | 0.95 | - 0 |
| | = | 74.41 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.91 | - | 2.28 | - | 0.95 | - 0 |
| | = | 76.68 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 77.64 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.91 | with warning horns |
| D=Distance ft | = | 65 | |
| Heff (sum of average path heights | = | 14 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 15 | |
| G=Ground factor | = | 0.50 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 70.15 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 75.79 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.55 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 78.73 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 75.50 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 79.28 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 76.05 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 78.73 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 79.28 | with warning horns |
| | D=Distance ft | = | 65 | |
| | Heff (sum of average path heights) | = | 14 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 15 | |
| | G=Ground factor | = | 0.50 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 76.61 |
| Ldn dBA at nearest residences | | 77.12 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.05 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 78.86 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 75.63 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 79.8 | - | 2.28 | - | 0.95 | - | 0 |
| | = | 76.57 | | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 78.86 without warning horns

$L_{dn\ at\ 50\ ft}$ = 79.8 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 65 | |
| Heff (sum of average path heigl | = | 14 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 15 | |
| G=Ground factor | = | 0.50 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Build*** $L_{dn}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 76.71
Ldn dBA at nearest residen 77.22
***Build*** $L_{dn\ with\ horns}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 77.46

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 69.52 |
| at nearest residences | = | 70.00 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 69.48 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 74.22 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 73.30 | 73.30 | 21379620.9 | 92.1 | 87.9 | 68.3 | 51.7 | 47.9 |
| 9:00 AM | 75.20 | 75.20 | 33113112.15 | 95.1 | 89.7 | 64.9 | 50.7 | 46.3 |
| 10:00 AM | 72.00 | 72.00 | 15848931.92 | 92.3 | 88.3 | 53.9 | 47.7 | 43.9 |
| 11:00 AM | 69.30 | 69.30 | 8511380.382 | 92.1 | 83.5 | 53.5 | 46.7 | 42.3 |
| 12:00 PM | 70.00 | 70.00 | 10000000 | 92.3 | 84.9 | 55.9 | 47.1 | 42.3 |
| 1:00 PM | 69.60 | 69.60 | 9120108.394 | 91.9 | 83.9 | 54.5 | 47.1 | 42.3 |
| 2:00 PM | 69.10 | 69.10 | 8128305.162 | 92.7 | 80.7 | 54.9 | 47.5 | 43.7 |
| 3:00 PM | 70.10 | 70.10 | 10232929.92 | 93.1 | 84.5 | 55.9 | 48.5 | 44.7 |
| 4:00 PM | 67.20 | 67.20 | 5248074.602 | 89.1 | 83.5 | 57.3 | 49.7 | 44.7 |
| 5:00 PM | 70.60 | 70.60 | 11481536.21 | 91.5 | 85.1 | 63.1 | 53.1 | 47.3 |
| 6:00 PM | 74.50 | 74.50 | 28183829.31 | 93.1 | 89.5 | 69.1 | 53.1 | 47.3 |
| 7:00 PM | 74.60 | 74.60 | 28840315.03 | 94.5 | 89.5 | 62.1 | 50.1 | 45.7 |
| 8:00 PM | 74.50 | 74.50 | 28183829.31 | 95.7 | 88.7 | 60.7 | 49.1 | 45.3 |
| 9:00 PM | 71.70 | 71.70 | 14791083.88 | 92.3 | 87.7 | 56.5 | 48.5 | 44.7 |
| 10:00 PM | 72.50 | 72.50 | 17782794.1 | 95.1 | 87.7 | 56.7 | 46.7 | 42.9 |
| 11:00 PM | 71.50 | 81.50 | 141253754.5 | 92.0 | 88.1 | 53.0 | 47.7 | 43.5 |
| 12:00 AM | 69.90 | 79.90 | 97723722.1 | 94.5 | 83.9 | 50.3 | 44.9 | 42.5 |
| 1:00 AM | 71.10 | 81.10 | 128824955.2 | 93.7 | 85.7 | 47.9 | 41.9 | 39.7 |
| 2:00 AM | 71.00 | 81.00 | 125892541.2 | 91.9 | 85.5 | 47.9 | 40.3 | 38.1 |
| 3:00 AM | 68.00 | 78.00 | 63095734.45 | 93.7 | 68.9 | 45.7 | 38.7 | 37.1 |
| 4:00 AM | 65.40 | 75.40 | 34673685.05 | 87.7 | 80.9 | 45.1 | 39.5 | 37.3 |
| 5:00 AM | 65.20 | 75.20 | 33113112.15 | 87.9 | 77.3 | 45.9 | 40.7 | 38.9 |
| 6:00 AM | 68.90 | 78.90 | 77624711.66 | 91.1 | 84.7 | 51.1 | 43.9 | 41.5 |
| 7:00 AM | 74.80 | 84.80 | 301995172 | 95.3 | 90.1 | 57.3 | 49.1 | 46.3 |
| Sum | | | 1255043240 | | | | | |
| Ldn dBA | | | 77.2 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 78.36 | - | 0.83 | - | 0.62 | - | 0 |
| | = | 76.92 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 82.31 | - | 0.83 | - | 0.62 | - | 0 |
| | = | 80.87 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 78.36 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 82.31 | with warning horns |
| | D=Distance ft | = | 55 | |
| | Heff (sum of average path heights | = | 12.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 12 | |
| | G=Ground factor | = | 0.53 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 65.01 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.19 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 80.98 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 80.18 | - | 0.83 | - | 0.62 | - | 0 |
| | = | 78.74 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 84.38 | - | 0.83 | - | 0.62 | - | 0 |
| | = | 82.94 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 80.18 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 84.38 | with warning horns |
| | D=Distance ft | = | 55 | |
| | Heff (sum of average path heights) | = | 12.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 12 | |
| | G=Ground factor | = | 0.53 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 78.92 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 83.00 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 79.49 | - | 0.83 | - | 0.62 | - | 0 |
| | = | 78.05 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 84.11 | - | 0.83 | - | 0.62 | - | 0 |
| | = | 82.67 | | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 79.49 without warning horns

$L_{dn\ at\ 50\ ft}$ = 84.11 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 55 | |
| Heff (sum of average path | = | 12.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 12 | |
| G=Ground factor | = | 0.53 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of hous | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Build*** $L_{dn}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 78.26

***Build*** $L_{dn\ with\ horns}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 82.74

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 71.65 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 77.97 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | $11.450+0.953LE$ | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 70.26 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | $17.322+0.940LE$ | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 74.93 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 80.10 | 80.10 | 102329299.2 | 101.1 | 91.7 | 79.9 | 76.1 | 71.9 |
| 9:00 AM | 77.90 | 77.90 | 61659500.19 | 101.1 | 89.7 | 77.3 | 71.5 | 68.3 |
| 10:00 AM | 75.70 | 75.70 | 37153522.91 | 96.7 | 88.5 | 73.1 | 68.1 | 65.5 |
| 11:00 AM | 74.50 | 74.50 | 28183829.31 | 96.9 | 86.5 | 72.9 | 67.7 | 65.1 |
| 12:00 PM | 78.00 | 78.00 | 63095734.45 | 103.5 | 91.1 | 73.9 | 68.9 | 66.3 |
| 1:00 PM | 71.80 | 71.80 | 15135612.48 | 90.1 | 85.1 | 71.9 | 67.3 | 64.9 |
| 2:00 PM | 76.60 | 76.60 | 45708818.96 | 95.9 | 86.7 | 78.9 | 73.1 | 68.9 |
| 3:00 PM | 74.80 | 74.80 | 30199517.2 | 95.9 | 87.1 | 74.1 | 68.9 | 66.7 |
| 4:00 PM | 74.60 | 74.60 | 28840315.03 | 96.7 | 86.9 | 74.1 | 68.5 | 66.1 |
| 5:00 PM | 77.10 | 77.10 | 51286138.4 | 98.9 | 89.7 | 76.1 | 68.3 | 65.9 |
| 6:00 PM | 79.20 | 79.20 | 83176377.11 | 99.9 | 91.9 | 76.7 | 68.9 | 66.7 |
| 7:00 PM | 78.50 | 78.50 | 70794578.44 | 97.9 | 91.5 | 76.7 | 68.5 | 66.1 |
| 8:00 PM | 76.10 | 76.10 | 40738027.78 | 97.3 | 91.1 | 73.1 | 66.7 | 64.7 |
| 9:00 PM | 76.80 | 76.80 | 47863009.23 | 101.5 | 89.1 | 71.5 | 65.5 | 63.3 |
| 10:00 PM | 74.00 | 74.00 | 25118864.32 | 94.1 | 87.5 | 71.3 | 64.9 | 62.7 |
| 11:00 PM | 75.90 | 85.90 | 389045145 | 101.1 | 86.9 | 70.5 | 63.5 | 61.3 |
| 12:00 AM | 72.70 | 82.70 | 186208713.7 | 93.9 | 86.3 | 70.9 | 62.7 | 60.9 |
| 1:00 AM | 71.30 | 81.30 | 134896288.3 | 92.7 | 84.1 | 68.9 | 62.5 | 60.5 |
| 2:00 AM | 73.40 | 83.40 | 218776162.4 | 95.1 | 87.3 | 72.3 | 62.7 | 60.1 |
| 3:00 AM | 70.40 | 80.40 | 109647819.6 | 95.7 | 81.7 | 68.3 | 60.7 | 58.7 |
| 4:00 AM | 72.70 | 82.70 | 186208713.7 | 97.1 | 83.9 | 68.9 | 60.3 | 58.3 |
| 5:00 AM | 70.20 | 80.20 | 104712854.8 | 93.3 | 83.5 | 67.1 | 62.7 | 60.9 |
| 6:00 AM | 73.50 | 83.50 | 223872113.9 | 91.9 | 88.1 | 71.1 | 65.7 | 62.7 |
| 7:00 AM | 77.80 | 87.80 | 602559586.1 | 100.7 | 91.3 | 75.1 | 68.1 | 64.3 |
| Sum | | | 2887210542 | 101.1 | 91.7 | 79.9 | 76.1 | 71.9 |
| Ldn dBA | | | 80.8 | | | | | |
| Ldn dBA at nearest residences | | | 76.3 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - $A_{shielding}$ |
| | = | 75.24 | - | -4.44 | - | -0.87 | - 0 |
| | = | 80.55 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - $A_{shielding}$ |
| | = | 79.07 | - | -4.44 | - | -0.87 | - 0 |
| | = | 84.38 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 75.24 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.07 | with warning horns |
| D=Distance ft | = | 30 | |
| Heff (sum of average path heights | = | 8.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 4 | |
| G=Ground factor | = | 0.60 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 68.34 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 80.80 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 84.49 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 77.3 | - | -4.44 | - | -0.87 | - | 0 |
| | = | 82.61 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 82.58 | - | -4.44 | - | -0.87 | - | 0 |
| | = | 87.89 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 77.3 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 82.58 | with warning horns |
| | D=Distance ft | = | 30 | |
| | Heff (sum of average path heights) | = | 8.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 4 | |
| | G=Ground factor | = | 0.60 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 82.77 |
| Ldn dBA at nearest residences | | 78.30 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 87.94 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 75.63 | - | -4.44 | - | -0.87 | - | 0 |
| | = | 80.94 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 80.69 | - | -4.44 | - | -0.87 | - | 0 |
| | = | 86.00 | | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 75.63 without warning horns

$L_{dn\ at\ 50\ ft}$ = 80.69 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 30 | |
| Heff (sum of average path | = | 8.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 4 | |
| G=Ground factor | = | 0.60 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of hous | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.17 |
| Ldn dBA at nearest residences | | 76.70 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 86.07 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 70.28 |
| at nearest residences | = | 65.80 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 80.93 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 69.48 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 74.22 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 78.50 | 78.50 | 70794578.44 | 102.1 | 91.5 | 69.5 | 60.7 | 58.7 |
| 9:00 AM | 77.50 | 77.50 | 56234132.52 | 102.1 | 89.9 | 67.1 | 57.7 | 54.7 |
| 10:00 AM | 70.60 | 70.60 | 11481536.21 | 95.5 | 83.5 | 64.5 | 56.7 | 54.1 |
| 11:00 AM | 73.90 | 73.90 | 24547089.16 | 98.7 | 86.3 | 61.7 | 55.3 | 52.5 |
| 12:00 PM | 68.60 | 68.60 | 7244359.601 | 94.1 | 82.9 | 61.5 | 55.3 | 51.9 |
| 1:00 PM | 68.30 | 68.30 | 6760829.754 | 92.3 | 81.9 | 63.1 | 56.5 | 53.9 |
| 2:00 PM | 68.40 | 68.40 | 6918309.709 | 94.3 | 80.5 | 62.3 | 55.7 | 53.1 |
| 3:00 PM | 68.00 | 68.00 | 6309573.445 | 93.1 | 82.9 | 65.1 | 58.3 | 54.9 |
| 4:00 PM | 69.10 | 69.10 | 8128305.162 | 91.7 | 82.5 | 66.1 | 59.7 | 56.7 |
| 5:00 PM | 71.50 | 71.50 | 14125375.45 | 94.3 | 85.3 | 56.9 | 58.7 | 55.3 |
| 6:00 PM | 74.90 | 74.90 | 30902954.33 | 98.5 | 87.5 | 71.1 | 56.5 | 51.9 |
| 7:00 PM | 73.60 | 73.60 | 22908676.53 | 94.5 | 87.1 | 69.3 | 54.7 | 50.1 |
| 8:00 PM | 72.70 | 72.70 | 18620871.37 | 96.1 | 85.7 | 65.7 | 52.3 | 49.3 |
| 9:00 PM | 78.60 | 78.60 | 72443596.01 | 105.7 | 87.5 | 63.5 | 51.5 | 49.3 |
| 10:00 PM | 70.60 | 70.60 | 11481536.21 | 93.3 | 85.3 | 62.1 | 52.1 | 49.5 |
| 11:00 PM | 67.60 | 77.60 | 57543993.73 | 89.3 | 82.9 | 60.3 | 52.9 | 50.9 |
| 12:00 AM | 70.00 | 80.00 | 100000000 | 95.9 | 82.9 | 55.3 | 48.5 | 46.7 |
| 1:00 AM | 66.20 | 76.20 | 41686938.35 | 88.9 | 80.3 | 52.1 | 47.1 | 45.7 |
| 2:00 AM | 66.20 | 76.20 | 41686938.35 | 90.7 | 79.9 | 54.9 | 50.5 | 49.3 |
| 3:00 AM | 55.80 | 65.80 | 3801893.963 | 81.7 | 63.5 | 49.9 | 47.1 | 45.5 |
| 4:00 AM | 64.20 | 74.20 | 26302679.92 | 87.1 | 78.7 | 54.1 | 49.5 | 47.7 |
| 5:00 AM | 68.80 | 78.80 | 75857757.5 | 93.3 | 82.3 | 54.9 | 49.1 | 47.1 |
| 6:00 AM | 68.30 | 78.30 | 67608297.54 | 91.5 | 82.5 | 60.3 | 55.7 | 51.1 |
| 7:00 AM | 69.20 | 79.20 | 83176377.11 | 89.1 | 83.3 | 61.1 | 56.1 | 53.1 |
| Sum | | | 866566600.4 | | | | | |
| Ldn dBA | | | 75.6 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 75.24 | - | 2.80 | - | 1.37 | - 0 |
| | = | 71.08 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.07 | - | 2.80 | - | 1.37 | - 0 |
| | = | 74.91 | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 75.24 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 79.07 | with warning horns |
| | D=Distance ft | = | 69 | |
| | Heff (sum of average path heights | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 67.14 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 72.55 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 75.58 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 77.3 | - | 2.80 | - | 1.37 | - | 0 |
| | = | 73.14 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 82.58 | - | 2.80 | - | 1.37 | - | 0 |
| | = | 78.42 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 77.3 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 82.58 | with warning horns |
| | D=Distance ft | = | 69 | |
| | Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 74.11 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 78.73 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 75.63 | - | 2.80 | - | 1.37 | - | 0 |
| | = | 71.47 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 80.69 | - | 2.80 | - | 1.37 | - | 0 |
| | = | 76.53 | | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 75.63 without warning horns

$L_{dn\ at\ 50\ ft}$ = 80.69 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 69 | |
| Heff (sum of average path | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of hou: | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 72.83 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.00 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 60.80 No Impact |

| | | |
|---|---|---|
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 71.46 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 68.86 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 73.65 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | | 0.00 | 1 | | | | | |
| 9:00 AM | 68.98 | 68.98 | 7906786.28 | 93.1 | 78.9 | 57.3 | 54.3 | 52.5 |
| 10:00 AM | | 0.00 | 1 | | | | | |
| 11:00 AM | | 0.00 | 1 | | | | | |
| 12:00 PM | | 0.00 | 1 | | | | | |
| 1:00 PM | | 0.00 | 1 | | | | | |
| 2:00 PM | | 0.00 | 1 | | | | | |
| 3:00 PM | | 0.00 | 1 | | | | | |
| 4:00 PM | | 0.00 | 1 | | | | | |
| 5:00 PM | | 0.00 | 1 | | | | | |
| 6:00 PM | | 0.00 | 1 | | | | | |
| 7:00 PM | | 0.00 | 1 | | | | | |
| 8:00 PM | | 0.00 | 1 | | | | | |
| 9:00 PM | | 0.00 | 1 | | | | | |
| 10:00 PM | | 0.00 | 1 | | | | | |
| 11:00 PM | | 10.00 | 10 | | | | | |
| 12:00 AM | | 10.00 | 10 | | | | | |
| 1:00 AM | | 10.00 | 10 | | | | | |
| 2:00 AM | | 10.00 | 10 | | | | | |
| 3:00 AM | | 10.00 | 10 | | | | | |
| 4:00 AM | | 10.00 | 10 | | | | | |
| 5:00 AM | | 10.00 | 10 | | | | | |
| 6:00 AM | | 10.00 | 10 | | | | | |
| 7:00 AM | | 10.00 | 10 | | | | | |
| Sum | | | 7906890.28 | | | | | |
| Leq dBA | | | 69.0 | | | | | |

**Existing**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $Leq_{(without\ warning\ horns)}$ | = | $Leq_{at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - $A_{shielding}$ |
| | = | 71.53 | - | 1.58 | - | 0.98 | - 0 |
| | = | 68.96 | | | | | |
| $Leq_{(with\ warning\ horns)}$ | = | $Leq_{at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - $A_{shielding}$ |
| | = | 72.8 | - | 1.58 | - | 0.98 | - 0 |
| | = | 70.23 | | | | | |

| | | | |
|---|---|---|---|
| where: $Leq_{at\ 50\ ft}$ | = | 71.53 | without warning horns |
| $Leq_{at\ 50\ ft}$ | = | 72.8 | with warning horns |
| D=Distance ft | = | 60 | |
| Heff (sum of average path heights | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| $Traffic\ L_{eq}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 44.52 |
| $Existing\ L_{eq}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 68.98 |
| $Existing\ L_{eq\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 70.25 |

**No Build**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Leq (without warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A shielding*** |
| | = | 71.9 | - | 1.58 | - | 0.98 | - | 0 |
| | = | 69.33 | | | | | | |
| ***Leq (with warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A shielding*** |
| | = | 73.07 | - | 1.58 | - | 0.98 | - | 0 |
| | = | 70.50 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | ***Leq at 50 ft*** | = | 71.9 | without warning horns |
| | ***Leq at 50 ft*** | = | 73.07 | with warning horns |
| | D=Distance ft | = | 60 | |
| | Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***N-B L eq*** | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 69.35 |
| ***N-B L eq with horns*** | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 70.52 |

**Build**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Leq*** *(without warning horns)* | = | ***Leq*** *at 50 ft* | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A*** *shielding* |
| | = | 72.61 | - | 1.58 | - | 0.98 | - | 0 |
| | = | 70.04 | | | | | | |
| ***Leq*** *(with warning horns)* | = | ***Leq*** *at 50 ft* | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A*** *shielding* |
| | = | 73.82 | - | 1.58 | - | 0.98 | - | 0 |
| | = | 71.25 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | ***Leq*** *at 50 ft* | = | 72.61 | without warning horns |
| | ***Leq*** *at 50 ft* | = | 73.82 | with warning horns |
| | D=Distance ft | = | 60 | |
| | Heff (sum of average path heig | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

***Build*** $L_{eq}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 70.06

***Build*** $L_{eq\ with\ horns}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 71.26

**Build Increment**

**Calculated Ldn**

$L_{eq\ (without\ warning\ horns)}$ = $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$
= 63.47 NO IMPACT

$L_{eq\ (with\ warning\ horns)}$ = $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$
= 64.46

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | | |
| 42<=$L_E$<=71 | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 63.60 |
| $L_E$ >71 | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<44 | Lp= | 17.322+0.940LE | | |
| 44<=$L_E$<=77 | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 68.78 |
| $L_E$ >77 | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | | 0.00 | 1 | | | | | |
| 9:00 AM | 77.30 | 77.30 | 53703179.64 | 84.5 | 78.5 | 62.0 | 52.5 | 50.0 |
| 10:00 AM | | 0.00 | 1 | | | | | |
| 11:00 AM | | 0.00 | 1 | | | | | |
| 12:00 PM | | 0.00 | 1 | | | | | |
| 1:00 PM | | 0.00 | 1 | | | | | |
| 2:00 PM | | 0.00 | 1 | | | | | |
| 3:00 PM | | 0.00 | 1 | | | | | |
| 4:00 PM | | 0.00 | 1 | | | | | |
| 5:00 PM | | 0.00 | 1 | | | | | |
| 6:00 PM | | 0.00 | 1 | | | | | |
| 7:00 PM | | 0.00 | 1 | | | | | |
| 8:00 PM | | 0.00 | 1 | | | | | |
| 9:00 PM | | 0.00 | 1 | | | | | |
| 10:00 PM | | 0.00 | 1 | | | | | |
| 11:00 PM | | 10.00 | 10 | | | | | |
| 12:00 AM | | 10.00 | 10 | | | | | |
| 1:00 AM | | 10.00 | 10 | | | | | |
| 2:00 AM | | 10.00 | 10 | | | | | |
| 3:00 AM | | 10.00 | 10 | | | | | |
| 4:00 AM | | 10.00 | 10 | | | | | |
| 5:00 AM | | 10.00 | 10 | | | | | |
| 6:00 AM | | 10.00 | 10 | | | | | |
| 7:00 AM | | 10.00 | 10 | | | | | |
| Sum | | | 53703283.64 | | | | | |
| Leq dBA | | | 77.3 | | | | | |
| Leq dBA at nearest receptor at 100 ft | | | 69.3 | | | | | |

**Existing**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Leq*** *(without warning horns)* | = | ***Leq*** *at 50 ft* | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - ***A*** *shielding* |
| | = | 67.89 | - | 6.02 | - | 2.05 | - 0 |
| | = | 59.82 | | | | | |
| ***Leq*** *(with warning horns)* | = | ***Leq*** *at 50 ft* | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - ***A*** *shielding* |
| | = | 68.96 | - | 6.02 | - | 2.05 | - 0 |
| | = | 60.89 | | | | | |

| | | | |
|---|---|---|---|
| where: ***Leq*** *at 50 ft* | = | 67.89 | without warning horns |
| ***Leq*** *at 50 ft* | = | 68.96 | with warning horns |
| D=Distance ft | = | 100 | |
| Heff (sum of average path heights) | = | 11.5 | |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Traffic*** $L_{eq}$ = 10log(10^Ldn Measured/10-10^Ldn Calculated/10)
= 68.78

***Existing*** $L_{eq}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 69.30

***Existing*** $L_{eq\ with\ horns}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 69.43

**No Build**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Leq*** *(without warning horns)* | = | ***Leq*** *at 50 ft* | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A*** *shielding* |
| | = | 68.12 | - | 6.02 | - | 2.05 | - | 0 |
| | = | 60.05 | | | | | | |
| ***Leq*** *(with warning horns)* | = | ***Leq*** *at 50 ft* | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A*** *shielding* |
| | = | 69.14 | - | 6.02 | - | 2.05 | - | 0 |
| | = | 61.07 | | | | | | |

| | | | |
|---|---|---|---|
| where: ***Leq*** *at 50 ft* | = | 68.12 | without warning horns |
| ***Leq*** *at 50 ft* | = | 69.14 | with warning horns |
| D=Distance ft | = | 100 | |
| Heff (sum of average path heights) | = | 11.5 | |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***N-B L*** *eq* | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 69.33 |
| at 29 feet | | 77.40 |
| ***N-B L*** *eq with horns* | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 69.46 |

**Build**

**Calculated Leq ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Leq (without warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A shielding*** |
| | = | 69.73 | - | 6.02 | - | 2.05 | - | 0 |
| | = | 61.66 | | | | | | |
| ***Leq (with warning horns)*** | = | ***Leq at 50 ft*** | - | ***20log(D/50)*** | - | ***10Glog(D/42)*** | - | ***A shielding*** |
| | = | 70.84 | - | 6.02 | - | 2.05 | - | 0 |
| | = | 62.77 | | | | | | |

| | | | |
|---|---|---|---|
| where: ***Leq at 50 ft*** | = | 69.73 | without warning horns |
| ***Leq at 50 ft*** | = | 70.84 | with warning horns |
| D=Distance ft | = | 100 | |
| Heff (sum of average path heig | = | 11.5 | |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 10 | |
| G=Ground factor | = | 0.54 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Build L eq*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 69.55

***Build L eq with horns*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 69.75

**Build Increment**

**Calculated Ldn**

$L_{eq\ (without\ warning\ horns)}$ = $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$
= ***57.04*** No Impact

$L_{eq\ (with\ warning\ horns)}$ = $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$
= ***58.23***

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | | |
| 42<=$L_E$<=71 | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 63.84 |
| $L_E$ >71 | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E$<44 | Lp= | 17.322+0.940LE | | |
| 44<=$L_E$<=77 | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 69.00 |
| $L_E$ >77 | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 86.00 | 86.00 | 398107170.6 | 110.7 | 98.7 | 72.5 | 58.9 | 53.3 |
| 9:00 AM | 80.50 | 80.50 | 112201845.4 | 108.1 | 79.7 | 67.7 | 57.7 | 53.5 |
| 10:00 AM | 78.10 | 78.10 | 64565422.9 | 104.9 | 81.9 | 67.9 | 57.3 | 52.9 |
| 11:00 AM | 84.00 | 84.00 | 251188643.2 | 108.9 | 97.5 | 68.9 | 55.5 | 50.1 |
| 12:00 PM | 63.90 | 63.90 | 2454708.916 | 82.1 | 75.7 | 66.7 | 54.9 | 49.5 |
| 1:00 PM | 77.60 | 77.60 | 57543993.73 | 103.7 | 80.5 | 67.5 | 55.5 | 50.3 |
| 2:00 PM | 79.90 | 79.90 | 97723722.1 | 107.9 | 78.5 | 67.5 | 55.9 | 50.3 |
| 3:00 PM | 78.70 | 78.70 | 74131024.13 | 102.9 | 83.9 | 69.1 | 56.5 | 51.5 |
| 4:00 PM | 65.60 | 65.60 | 3630780.548 | 85.7 | 76.9 | 67.9 | 57.1 | 52.9 |
| 5:00 PM | 78.10 | 78.10 | 64565422.9 | 103.7 | 82.1 | 68.9 | 56.7 | 51.7 |
| 6:00 PM | 84.30 | 84.30 | 269153480.4 | 108.5 | 96.3 | 70.5 | 57.7 | 52.9 |
| 7:00 PM | 81.90 | 81.90 | 154881661.9 | 102.7 | 97.9 | 71.1 | 57.7 | 53.1 |
| 8:00 PM | 81.40 | 81.40 | 138038426.5 | 106.7 | 85.5 | 65.9 | 54.5 | 49.5 |
| 9:00 PM | 80.20 | 80.20 | 104712854.8 | 106.3 | 77.7 | 62.3 | 54.3 | 49.7 |
| 10:00 PM | 76.90 | 76.90 | 48977881.94 | 102.5 | 80.5 | 61.7 | 53.1 | 48.7 |
| 11:00 PM | 75.60 | 85.60 | 363078054.8 | 102.7 | 73.5 | 61.5 | 55.5 | 50.9 |
| 12:00 AM | 78.00 | 88.00 | 630957344.5 | 104.5 | 77.1 | 58.1 | 50.1 | 44.1 |
| 1:00 AM | 54.90 | 64.90 | 3090295.433 | 77.1 | 64.1 | 55.7 | 48.3 | 42.7 |
| 2:00 AM | 75.20 | 85.20 | 331131121.5 | 103.5 | 69.1 | 53.3 | 46.9 | 42.9 |
| 3:00 AM | 75.20 | 85.20 | 331131121.5 | 103.7 | 64.1 | 50.1 | 44.9 | 42.5 |
| 4:00 AM | 78.00 | 88.00 | 630957344.5 | 105.1 | 70.3 | 50.9 | 45.5 | 41.7 |
| 5:00 AM | 78.00 | 88.00 | 630957344.5 | 105.0 | 70.2 | 50.8 | 45.6 | 42.0 |
| 6:00 AM | 83.00 | 93.00 | 1995262315 | 111.3 | 78.5 | 54.9 | 47.1 | 44.3 |
| 7:00 AM | 84.70 | 94.70 | 2951209227 | 111.7 | 93.7 | 65.3 | 54.3 | 47.1 |
| Sum | | | 9709651208 | | | | | |
| Ldn dBA | | | 86.1 | | | | | |
| Ldn dBA at nearest residences | | | 79.2 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 71.75 | - | -4.15 | - | -0.84 | - 0 |
| | = | 76.74 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.84 | - | -4.15 | - | -0.84 | - 0 |
| | = | 84.83 | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 71.75 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 79.84 | with warning horns |
| | D=Distance ft | = | 31 | |
| | Heff (sum of average path heights | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 80.03 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.70 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 86.07 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 75.21 | - | -4.15 | - | -0.84 | - | 0 |
| | = | 80.20 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 81.9 | - | -4.15 | - | -0.84 | - | 0 |
| | = | 86.89 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 75.21 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 81.9 | with warning horns |
| | D=Distance ft | = | 31 | |
| | Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 83.13 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 87.70 |

Ldn dBA at nearest residences 80.78

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - $A_{shielding}$ |
| | = | 75.21 | - | -4.15 | - | -0.84 | - 0 |
| | = | 80.20 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - $A_{shielding}$ |
| | = | 81.94 | - | -4.15 | - | -0.84 | - 0 |
| | = | 86.93 | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 75.21 without warning horns

$L_{dn\ at\ 50\ ft}$ = 81.94 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 31 | |
| Heff (sum of average path | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of hous | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Build*** $L_{dn}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 83.13

***Build*** $L_{dn\ with\ horns}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 87.74

Ldn dBA at nearest residences 80.78

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 77.60 |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 82.76 |
| at nearest residences | = | 75.90 SEVERE IMPACT |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 72.07 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 76.58 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 63.90 | 63.90 | 2454708.916 | 87.9 | 75.1 | 60.3 | 51.7 | 48.9 |
| 9:00 AM | 61.60 | 61.60 | 1445439.771 | 85.7 | 71.9 | 61.9 | 52.3 | 48.3 |
| 10:00 AM | 62.50 | 62.50 | 1778279.41 | 83.5 | 75.1 | 60.7 | 49.3 | 46.1 |
| 11:00 AM | 58.00 | 58.00 | 630957.3445 | 79.7 | 67.3 | 60.1 | 48.9 | 45.9 |
| 12:00 PM | 64.50 | 64.50 | 2818382.931 | 90.7 | 74.7 | 55.1 | 48.7 | 45.9 |
| 1:00 PM | 54.90 | 54.90 | 309029.5433 | 77.9 | 66.5 | 53.5 | 47.7 | 44.3 |
| 2:00 PM | 51.70 | 51.70 | 147910.8388 | 73.7 | 60.5 | 51.9 | 46.7 | 43.3 |
| 3:00 PM | 56.70 | 56.70 | 467735.1413 | 80.9 | 66.1 | 56.3 | 48.7 | 45.1 |
| 4:00 PM | 57.90 | 57.90 | 616595.0019 | 79.7 | 68.3 | 59.7 | 50.3 | 45.9 |
| 5:00 PM | 62.40 | 62.40 | 1737800.829 | 79.1 | 74.1 | 58.9 | 51.1 | 47.9 |
| 6:00 PM | 59.70 | 59.70 | 933254.3008 | 85.1 | 69.1 | 57.5 | 50.9 | 48.3 |
| 7:00 PM | 63.40 | 63.40 | 2187761.624 | 87.3 | 77.5 | 58.1 | 51.9 | 49.7 |
| 8:00 PM | 69.70 | 69.70 | 9332543.008 | 81.1 | 80.5 | 77.7 | 51.5 | 48.7 |
| 9:00 PM | 54.40 | 54.40 | 275422.8703 | 74.7 | 66.1 | 54.5 | 50.1 | 47.5 |
| 10:00 PM | 61.70 | 61.70 | 1479108.388 | 84.7 | 74.3 | 61.1 | 44.7 | 40.7 |
| 11:00 PM | 52.20 | 62.20 | 1659586.907 | 77.1 | 62.7 | 48.1 | 42.5 | 39.7 |
| 12:00 AM | 56.00 | 66.00 | 3981071.706 | 81.3 | 67.1 | 53.3 | 42.1 | 38.5 |
| 1:00 AM | 41.60 | 51.60 | 144543.9771 | 56.5 | 53.5 | 42.5 | 38.3 | 36.1 |
| 2:00 AM | 47.10 | 57.10 | 512861.384 | 73.3 | 55.3 | 41.7 | 37.7 | 35.3 |
| 3:00 AM | 39.80 | 49.80 | 95499.2586 | 51.9 | 48.9 | 41.5 | 37.7 | 35.9 |
| 4:00 AM | 54.60 | 64.60 | 2884031.503 | 80.5 | 62.1 | 45.1 | 37.7 | 35.7 |
| 5:00 AM | 51.00 | 61.00 | 1258925.412 | 77.3 | 59.7 | 42.5 | 38.3 | 35.9 |
| 6:00 AM | 48.70 | 58.70 | 741310.2413 | 75.9 | 49.7 | 42.5 | 39.3 | 35.9 |
| 7:00 AM | 62.60 | 72.60 | 18197008.59 | 86.3 | 75.1 | 56.9 | 47.7 | 43.1 |
| Sum | | | 56089768.89 | | | | | |
| Ldn dBA | | | 63.7 | | | | | |
| Ldn dBA at nearest residences | | | 67.9 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 71.75 | - | 7.23 | - | 2.77 | - 0 |
| | = | 61.74 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.84 | - | 7.23 | - | 2.77 | - 0 |
| | = | 69.83 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 71.75 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.84 | with warning horns |
| D=Distance ft | = | 115 | |
| Heff (sum of average path heights | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 1 | |
| 0 for gaps more than 65 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 59.27 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 63.69 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 70.20 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 75.21 | - | 7.23 | - | 2.77 | - 0 |
| | = | 65.20 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 81.94 | - | 7.23 | - | 2.77 | - 0 |
| | = | 71.93 | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 75.21 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 81.94 | with warning horns |
| | D=Distance ft | = | 115 | |
| | Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 1 | |
| | 0 for gaps more than 65 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 66.19 |
| Ldn dBA at nearest residences | | 70.42 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 72.16 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 75.21 | - | 7.23 | - | 2.77 | - | 0 |
| | = | 65.20 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 81.94 | - | 7.23 | - | 2.77 | - | 0 |
| | = | 71.93 | | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 75.21 without warning horns

$L_{dn\ at\ 50\ ft}$ = 81.94 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 115 | |
| Heff (sum of average path | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of hous | = | 1 | |
| 0 for gaps more than 65 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 66.19 |
| Ldn dBA at nearest residences | | 70.42 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 72.16 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 62.60 |
| at nearest residences | = | 66.80 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 67.77 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 62.82 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 68.05 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 71.00 | 71.00 | 12589254.12 | 94.9 | 83.9 | 60.3 | 52.9 | 49.9 |
| 9:00 AM | 68.50 | 68.50 | 7079457.844 | 94.3 | 74.7 | 57.5 | 51.5 | 48.7 |
| 10:00 AM | 62.30 | 62.30 | 1698243.652 | 84.5 | 68.5 | 64.7 | 53.7 | 49.3 |
| 11:00 AM | 61.70 | 61.70 | 1479108.388 | 85.3 | 70.7 | 58.7 | 55.1 | 50.9 |
| 12:00 PM | 61.90 | 61.90 | 1548816.619 | 83.1 | 76.3 | 57.9 | 53.1 | 49.9 |
| 1:00 PM | 61.60 | 61.60 | 1445439.771 | 85.5 | 67.1 | 57.9 | 52.9 | 50.3 |
| 2:00 PM | 54.10 | 54.10 | 257039.5783 | 67.9 | 60.3 | 56.5 | 52.9 | 49.3 |
| 3:00 PM | 63.00 | 63.00 | 1995262.315 | 88.7 | 71.9 | 58.3 | 52.9 | 49.7 |
| 4:00 PM | 62.20 | 62.20 | 1659586.907 | 90.1 | 66.1 | 56.5 | 51.1 | 48.5 |
| 5:00 PM | 64.90 | 64.90 | 3090295.433 | 91.7 | 71.3 | 56.7 | 50.3 | 48.1 |
| 6:00 PM | 67.80 | 67.80 | 6025595.861 | 91.5 | 76.9 | 55.9 | 51.5 | 50.1 |
| 7:00 PM | 66.80 | 66.80 | 4786300.923 | 92.3 | 74.9 | 59.3 | 51.5 | 49.5 |
| 8:00 PM | 69.60 | 69.60 | 9120108.394 | 94.3 | 82.3 | 54.7 | 49.9 | 48.3 |
| 9:00 PM | 69.60 | 69.60 | 9120108.394 | 95.9 | 77.5 | 53.5 | 47.9 | 45.9 |
| 10:00 PM | 59.20 | 59.20 | 831763.7711 | 86.1 | 60.5 | 53.9 | 46.1 | 44.7 |
| 11:00 PM | 60.20 | 70.20 | 10471285.48 | 85.7 | 66.5 | 48.1 | 44.9 | 41.9 |
| 12:00 AM | 57.90 | 67.90 | 6165950.019 | 80.5 | 71.3 | 48.7 | 43.3 | 39.7 |
| 1:00 AM | 46.90 | 56.90 | 489778.8194 | 68.9 | 58.3 | 44.3 | 40.5 | 37.3 |
| 2:00 AM | 56.60 | 66.60 | 4570881.896 | 83.3 | 60.3 | 45.9 | 40.5 | 37.5 |
| 3:00 AM | 43.20 | 53.20 | 208929.6131 | 49.7 | 48.9 | 46.5 | 41.3 | 38.5 |
| 4:00 AM | 56.40 | 66.40 | 4365158.322 | 82.9 | 57.1 | 50.5 | 44.5 | 39.9 |
| 5:00 AM | 63.80 | 73.80 | 23988329.19 | 89.5 | 68.1 | 46.3 | 41.9 | 38.7 |
| 6:00 AM | 58.80 | 68.80 | 7585775.75 | 85.3 | 60.7 | 45.9 | 42.5 | 39.9 |
| 7:00 AM | 71.80 | 81.80 | 151356124.8 | 95.7 | 85.9 | 56.3 | 47.7 | 44.5 |
| Sum | | | 271928595.9 | | | | | |
| Ldn dBA | | | 70.5 | | | | | |
| Ldn dBA at nearest residences | | | 67.3 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 71.75 | - | 1.73 | - | 1.03 | - 0 |
| | = | 69.00 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.84 | - | 1.73 | - | 1.03 | - 0 |
| | = | 77.09 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 71.75 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.84 | with warning horns |
| D=Distance ft | = | 61 | |
| Heff (sum of average path heights | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Traffic $L_{dn}$*** = 10log(10^Ldn Measured/10-10^Ldn Calculated/10)
= 65.32

***Existing $L_{dn}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 70.54

***Existing $L_{dn\ with\ horns}$*** = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 77.37

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 75.21 | - | 1.73 | - | 1.03 | - | 0 |
| | = | 72.46 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 81.94 | - | 1.73 | - | 1.03 | - | 0 |
| | = | 79.19 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 75.21 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 81.94 | with warning horns |
| | D=Distance ft | = | 61 | |
| | Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 73.22 |
| Ldn dBA at nearest residences | | 69.99 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 79.36 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 75.21 | - | 1.73 | - | 1.03 | - | 0 |
| | = | 72.46 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - | $A_{shielding}$ |
| | = | 81.94 | - | 1.73 | - | 1.03 | - | 0 |
| | = | 79.19 | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 75.21 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 81.94 | with warning horns |
| | D=Distance ft | = | 61 | |
| | Heff (sum of average path height | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 0 | |
| | G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***Build*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 73.22 |
| Ldn dBA at nearest residences | | 69.99 |
| ***Build*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 79.36 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 69.85 |
| at nearest residences | = | 66.70 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 75.02 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 62.39 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 67.66 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 69.20 | 69.20 | 8317637.711 | 92.7 | 82.9 | 60.9 | 55.7 | 54.3 |
| 9:00 AM | 58.30 | 58.30 | 676082.9754 | 81.3 | 65.1 | 59.1 | 54.9 | 52.9 |
| 10:00 AM | 59.60 | 59.60 | 912010.8394 | 83.5 | 65.5 | 57.7 | 53.3 | 51.5 |
| 11:00 AM | 58.90 | 58.90 | 776247.1166 | 81.1 | 67.3 | 58.7 | 53.5 | 51.9 |
| 12:00 PM | 58.70 | 58.70 | 741310.2413 | 74.5 | 69.9 | 62.3 | 53.5 | 51.5 |
| 1:00 PM | 63.10 | 63.10 | 2041737.945 | 82.9 | 73.3 | 66.7 | 54.1 | 51.9 |
| 2:00 PM | 57.20 | 57.20 | 524807.4602 | 73.9 | 69.7 | 57.7 | 52.9 | 51.3 |
| 3:00 PM | 66.00 | 66.00 | 3981071.706 | 83.3 | 77.5 | 70.3 | 55.3 | 51.5 |
| 4:00 PM | 55.90 | 55.90 | 389045.145 | 71.9 | 64.7 | 57.5 | 53.7 | 51.3 |
| 5:00 PM | 59.50 | 59.50 | 891250.9381 | 81.5 | 70.7 | 56.7 | 53.9 | 52.3 |
| 6:00 PM | 68.10 | 68.10 | 6456542.29 | 93.1 | 78.9 | 57.3 | 54.3 | 52.5 |
| 7:00 PM | 64.60 | 64.60 | 2884031.503 | 89.3 | 69.3 | 56.9 | 54.1 | 52.9 |
| 8:00 PM | 65.80 | 65.80 | 3801893.963 | 91.1 | 77.9 | 56.5 | 53.7 | 52.1 |
| 9:00 PM | 58.70 | 58.70 | 741310.2413 | 82.9 | 65.5 | 55.3 | 53.1 | 52.1 |
| 10:00 PM | 56.60 | 56.60 | 457088.1896 | 82.1 | 57.9 | 54.7 | 52.9 | 51.9 |
| 11:00 PM | 57.10 | 67.10 | 5128613.84 | 80.9 | 62.7 | 54.3 | 52.1 | 50.5 |
| 12:00 AM | 58.30 | 68.30 | 6760829.754 | 82.3 | 62.3 | 55.3 | 52.5 | 51.1 |
| 1:00 AM | 52.00 | 62.00 | 1584893.192 | 60.7 | 56.3 | 53.7 | 51.1 | 50.1 |
| 2:00 AM | 56.10 | 66.10 | 4073802.778 | 81.5 | 58.3 | 53.9 | 50.9 | 49.9 |
| 3:00 AM | 51.50 | 61.50 | 1412537.545 | 55.3 | 54.3 | 53.7 | 50.5 | 49.7 |
| 4:00 AM | 64.70 | 74.70 | 29512092.27 | 91.5 | 68.9 | 54.5 | 50.7 | 49.3 |
| 5:00 AM | 57.20 | 67.20 | 5248074.602 | 82.9 | 59.1 | 55.3 | 52.1 | 50.1 |
| 6:00 AM | 54.80 | 64.80 | 3019951.72 | 76.1 | 58.9 | 55.3 | 52.5 | 50.9 |
| 7:00 AM | 68.40 | 78.40 | 69183097.09 | 91.9 | 80.3 | 57.3 | 55.3 | 52.7 |
| Sum | | | 159515961.1 | | | | | |
| Ldn dBA | | | 68.2 | | | | | |
| Ldn dBA at nearest residences | | | 67.3 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - | $A_{shielding}$ |
| | = | 71.75 | - | 2.92 | - | 1.31 | - | 0 |
| | = | 67.52 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50) | - | 10Glog(D/42) | - | $A_{shielding}$ |
| | = | 79.84 | - | 2.92 | - | 1.31 | - | 0 |
| | = | 75.61 | | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 71.75 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.84 | with warning horns |
| D=Distance ft | = | 70 | |
| Heff (sum of average path heights | = | 9 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 5 | |
| G=Ground factor | = | 0.59 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| ***Traffic*** $L_{dn}$ | = | 10log(10^Ldn Measured/10-10^Ldn Calculated/10) |
| | = | 60.00 |
| ***Existing*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 68.23 |
| ***Existing*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 75.73 |

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 75.21 | - | 2.92 | - | 1.31 | - 0 |
| | = | 70.98 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 81.94 | - | 2.92 | - | 1.31 | - 0 |
| | = | 77.71 | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | $L_{dn\ at\ 50\ ft}$ | = | 75.21 | without warning horns |
| | $L_{dn\ at\ 50\ ft}$ | = | 81.94 | with warning horns |
| | D=Distance ft | = | 70 | |
| | Heff (sum of average path heights) | = | 9 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| | Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| | Hr (receiver height) | = | 5 | |
| | Hb (barrier height) | = | 0 | |
| | Hc (cut or slope height ) | = | 5 | |
| | G=Ground factor | = | 0.59 | 0.75(1-Heff/42) for 5<Heff<42 |
| | A = Shielding at receiver | = | 0 | |
| | R=number of rows of houses | = | 0 | |
| | 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| $N\text{-}B\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 71.31 |
| Ldn dBA at nearest residences | | 70.43 |
| $N\text{-}B\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.78 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 10log(D/50 | - | 10Glog(D/4 | - | $A_{shielding}$ |
| | = | 75.21 | - | 2.92 | - | 1.31 | - | 0 |
| | = | 70.98 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 10log(D/50 | - | 10Glog(D/4 | - | $A_{shielding}$ |
| | = | 81.94 | - | 2.92 | - | 1.31 | - | 0 |
| | = | 77.71 | | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 75.21 without warning horns

$L_{dn\ at\ 50\ ft}$ = 81.94 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 70 | |
| Heff (sum of average path height | = | 9 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomot |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 5 | |
| G=Ground factor | = | 0.59 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| $Build\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 71.31 |
| Ldn dBA at nearest residences | | 70.43 |
| $Build\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 77.78 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 68.38 |
| at nearest residences | = | 67.50 IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 73.55 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 62.39 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

tives

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 67.66 |
| $L_E>77$ | Lp= | 75 | | |

**Existing**

**Meaured Noise levels in dBA**

| Hour | Leq | Leq+10 dB | 10^Leq/10 | L0.1 | L1 | L10 | L50 | L90 |
|---|---|---|---|---|---|---|---|---|
| 8:00 AM | 79.20 | 79.20 | 83176377.11 | 107.7 | 77.7 | 61.5 | 51.5 | 47.1 |
| 9:00 AM | 65.70 | 65.70 | 3715352.291 | 92.5 | 68.5 | 53.5 | 48.9 | 44.9 |
| 10:00 AM | 67.80 | 67.80 | 6025595.861 | 93.9 | 78.7 | 54.3 | 48.9 | 45.7 |
| 11:00 AM | 62.40 | 62.40 | 1737800.829 | 89.1 | 67.1 | 51.3 | 46.5 | 43.3 |
| 12:00 PM | 73.00 | 73.00 | 19952623.15 | 101.5 | 72.3 | 51.9 | 46.5 | 42.9 |
| 1:00 PM | 60.00 | 60.00 | 1000000 | 83.9 | 69.5 | 51.3 | 46.9 | 43.7 |
| 2:00 PM | 67.20 | 67.20 | 5248074.602 | 94.3 | 69.5 | 53.1 | 48.5 | 44.9 |
| 3:00 PM | 61.90 | 61.90 | 1548816.619 | 88.7 | 64.9 | 58.3 | 47.7 | 43.7 |
| 4:00 PM | 75.10 | 75.10 | 32359365.69 | 103.5 | 77.3 | 60.9 | 55.5 | 51.9 |
| 5:00 PM | 66.30 | 66.30 | 4265795.188 | 93.9 | 66.9 | 57.5 | 52.9 | 49.9 |
| 6:00 PM | 76.50 | 76.50 | 44668359.22 | 104.1 | 80.1 | 58.9 | 53.3 | 50.1 |
| 7:00 PM | 69.10 | 69.10 | 8128305.162 | 94.1 | 81.1 | 57.7 | 51.9 | 47.7 |
| 8:00 PM | 71.10 | 71.10 | 12882495.52 | 94.7 | 82.5 | 55.3 | 49.5 | 46.1 |
| 9:00 PM | 72.40 | 72.40 | 17378008.29 | 99.1 | 78.7 | 52.9 | 49.7 | 48.5 |
| 10:00 PM | 66.50 | 66.50 | 4466835.922 | 91.9 | 77.5 | 53.1 | 50.3 | 48.7 |
| 11:00 PM | 68.20 | 78.20 | 66069344.8 | 96.7 | 69.7 | 53.5 | 50.3 | 48.5 |
| 12:00 AM | 66.70 | 76.70 | 46773514.13 | 93.5 | 74.1 | 54.9 | 51.9 | 49.5 |
| 1:00 AM | 50.40 | 60.40 | 1096478.196 | 71.5 | 55.7 | 52.1 | 48.5 | 45.1 |
| 2:00 AM | 61.60 | 71.60 | 14454397.71 | 87.3 | 70.7 | 46.1 | 40.7 | 39.1 |
| 3:00 AM | 41.80 | 51.80 | 151356.1248 | 57.5 | 49.7 | 43.7 | 39.9 | 38.1 |
| 4:00 AM | 72.50 | 82.50 | 177827941 | 100.9 | 72.3 | 50.5 | 48.7 | 38.3 |
| 5:00 AM | 70.40 | 80.40 | 109647819.6 | 95.3 | 82.1 | 54.7 | 49.3 | 47.9 |
| 6:00 AM | 75.80 | 85.80 | 380189396.3 | 103.5 | 78.5 | 50.7 | 48.5 | 40.3 |
| 7:00 AM | 79.30 | 89.30 | 851138038.2 | 105.1 | 91.5 | 62.5 | 48.5 | 41.7 |
| Sum | | | 1893902092 | | | | | |
| Ldn dBA | | | 79.0 | | | | | |
| Ldn dBA at nearest residences | | | 77.6 | | | | | |

**Existing**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 71.75 | - | -5.04 | - | -1.12 | - 0 |
| | = | 77.90 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - $A_{shielding}$ |
| | = | 79.84 | - | -5.04 | - | -1.12 | - 0 |
| | = | 85.99 | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 71.75 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 79.84 | with warning horns |
| D=Distance ft | = | 28 | |
| Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

***Traffic*** $L_{dn}$ = 10log(10^Ldn Measured/10-10^Ldn Calculated/10)
= 72.37

***Existing*** $L_{dn}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 78.97

***Existing*** $L_{dn\ with\ horns}$ = 10log(10^Ldn Calculated/10+10^Ldn Traffic/10)
= 86.18

**No Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 75.21 | - | -5.04 | - | -1.12 | - | 0 |
| | = | 81.36 | | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | *20log(D/50)* | - | *10Glog(D/42)* | - | $A_{shielding}$ |
| | = | 81.94 | - | -5.04 | - | -1.12 | - | 0 |
| | = | 88.09 | | | | | | |

| | | | |
|---|---|---|---|
| where: $L_{dn\ at\ 50\ ft}$ | = | 75.21 | without warning horns |
| $L_{dn\ at\ 50\ ft}$ | = | 81.94 | with warning horns |
| D=Distance ft | = | 28 | |
| Heff (sum of average path heights) | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of houses | = | 0 | |
| 1.5(R-1)+5 for gaps less than 35 percent of the length of the row | | | |

| | | |
|---|---|---|
| ***N-B*** $L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.88 |
| Ldn dBA at nearest residences | | 80.45 |
| ***N-B*** $L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 88.21 |

**Build**

**Calculated Ldn ( Combined Propagation Character)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - $A_{shielding}$ |
| | = | 75.21 | - | -5.04 | - | -1.12 | - 0 |
| | = | 81.36 | | | | | |
| $L_{dn\ (with\ warning\ horns)}$ | = | $L_{dn\ at\ 50\ ft}$ | - | 20log(D/50, | - | 0Glog(D/4: | - $A_{shielding}$ |
| | = | 81.94 | - | -5.04 | - | -1.12 | - 0 |
| | = | 88.09 | | | | | |

where: $L_{dn\ at\ 50\ ft}$ = 75.21 without warning horns

$L_{dn\ at\ 50\ ft}$ = 81.94 with warning horns

| | | | |
|---|---|---|---|
| D=Distance ft | = | 28 | |
| Heff (sum of average path | = | 6.5 | Heff = (Hs+2Hb+Hc+Hr)/2 |
| Hs (source Height) | = | 8 | trains with diesel-electric locomotives |
| Hr (receiver height) | = | 5 | |
| Hb (barrier height) | = | 0 | |
| Hc (cut or slope height ) | = | 0 | |
| G=Ground factor | = | 0.63 | 0.75(1-Heff/42) for 5<Heff<42 |
| A = Shielding at receiver | = | 0 | |
| R=number of rows of hous | = | 0 | |

1.5(R-1)+5 for gaps less than 35 percent of the length of the row

| | | |
|---|---|---|
| $Build\ L_{dn}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 81.88 |
| Ldn dBA at nearest residences | | 80.45 |
| $Build\ L_{dn\ with\ horns}$ | = | 10log(10^Ldn Calculated/10+10^Ldn Traffic/10) |
| | = | 88.21 |

**Build Increment**

**Calculated Ldn**

| | | |
|---|---|---|
| $L_{dn\ (without\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 78.76 |
| at nearest residences | = | 77.40 SEVERE IMPACT |
| $L_{dn\ (with\ warning\ horns)}$ | = | $10log(10^{\wedge}L_{dn\ Build/10} - 10^{\wedge}L_{dn\ Esisting/10})$ |
| | = | 83.93 |

**Threshold of Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = | 70.62 |
| $L_E>71$ | Lp= | 65 | | |

**Threshold of Severe Impact - Land Use Category 1 and 2**

| | | | | |
|---|---|---|---|---|
| $L_E<44$ | Lp= | 17.322+0.940LE | | |
| $44<=L_E<=77$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043xx10^{-4}L_E^3$ | = | 75.26 |
| $L_E>77$ | Lp= | 75 | | |

# APPENDIX E-3

# NOISE ASSESSMENT CALCULATIONS
# LIRR STORAGE YARDS

## Site 1 - Cerro Wire Yard

### Existing Measured noise levels

| | |
|---|---|
| $Leq_{(measred)}$ | 58.9 |
| $Ldn_{(estimated)}$ | 56.9 |

### Build Increment

**Computation of Noise Exposure for Yards General Assessment - Day/Night**
**SEL ref (Rail Yards)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Daytime $L_{eq}$* | $L_{eq\ (day)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)* |
| | | = | 116.00 | + | -10.78 | - | 35.60 | - | 25.11 |
| | | = | 44.51 | | | | | | |
| *Nighttime $L_{eq}$* | $L_{eq\ (night)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)* |
| | | = | 116.00 | + | -14.09 | - | 35.60 | | 25.11 |
| | | = | 41.21 | | | | | | |
| $L_{dn}$ | $L_{dn\ (increment)}$ | = | *10log* | *[ (15)x10^($L_{eq(day)}$/10) +'9)x10^($L_{eq(night)}$ +10/10)] -* | | | | | *13.8* |
| | | = | 48.27 | | | | | | |
| | | | NO IMPACT | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | SELref (20 train in peak hour) | = | 118.00 | N/A |
| | SELref (1 train with diesel loc. Idling for 1h) | = | 116.00 | |
| | $N_T$ = average number of train per hour | = | 1.67 | d |
| | $N_T$ = average number of train per hour | = | 0.78 | n |
| | D = distance to yard center (feet) | = | 900 | |

### Build

**Computation of Total Build Noise Level - Day/Night**

$L_{dn\ (total)}$ = *10LOG(10^($L_{dn(Existing)}$/10+10^($L_{dn(Build\ Increment)}$/10)*
= 57.46

**Threshold of Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | |
| 42<=$L_E$<=71 | Lp= | 71.662 - 1.164$L_E$ + 0.018$L_E^2$ - 4.088x$10^{-5}$$L_E^3$ | = 56.18 |
| $L_E$ >71 | Lp= | 65 | |

**Threshold of Severe Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E$<42 | Lp= | 17.322+0.953LE | |
| 42<=$L_E$<=71 | Lp= | 96.725 - 1.992$L_E$ + 3.02x$10^{-2}$$L_E^2$ - 1.043x$10^{-4}$$L_E^3$ | = 61.94 |
| $L_E$ >71 | Lp= | 75 | |

## Site 2 - Babylon Yard

### Existing Measured noise levels

| | |
|---|---|
| $Leq_{(measred)}$ | 74.5 |
| $Ldn_{(estimated)}$ | 72.5 |

### Build Increment

**Computation of Noise Exposure for Yards General Assessment - Day/Night**
**SEL ref (Rail Yards)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Daytime $L_{eq}$*** | $L_{eq\ (day)}$ | = | ***SEL ref*** | + | ***10log(NT/20)*** | - | ***35.6*** | - | ***20log(D/50)*** |
| | | = | 116.00 | + | -15.23 | - | 35.60 | - | 9.54 |
| | | = | 55.63 | | | | | | |
| ***Nighttime $L_{eq}$*** | $L_{eq\ (night)}$ | = | ***SEL ref*** | + | ***10log(NT/20)*** | - | ***35.6*** | - | ***20log(D/50)*** |
| | | = | 116.00 | + | -17.78 | - | 35.60 | | 9.54 |
| | | = | 53.08 | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***$L_{dn}$*** | $L_{dn\ (increment)}$ | = | ***10log*** | ***[ (15)x10^($L_{eq(day)}$/10) + (9)x10^($L_{eq(night)}$+10/10)] -*** | | ***13.8*** |
| | | = | 59.96 | | | |
| | | | No IMPACT | | | |

| | | | | |
|---|---|---|---|---|
| where: | SELref (20 train in peak hour) | = | 118.00 | N/A |
| | SELref (1 train with diesel loc. Idling for 1h) | = | 116.00 | |
| | $N_T$ = average number of train per hour | = | 0.60 | d |
| | $N_T$ = average number of train per hour | = | 0.33 | n |
| | D = distance to yard center (feet) | = | 150 | |

### Build

**Computation of Total Build Noise Level - Day/Night**

$L_{dn\ (total)}$ = ***10LOG(10^($L_{dn(Existing)}$/10+10^($L_{dn(Build\ Increment)}$/10)***
= 72.74

**Threshold of Impact - Land Use Category 2**

| | | | | |
|---|---|---|---|---|
| **$L_E$<42** | **Lp=** | **11.450+0.953LE** | | |
| **42<=$L_E$<=71** | **Lp=** | **71.662 - 1.164$L_E$ + 0.018$L_E^2$ - 4.088x10$^{-5}$$L_E^3$** | = | 66.31 |
| **$L_E$ >71** | **Lp=** | **65** | | |

**Threshold of Severe Impact - Land Use Category 2**

| | | | | |
|---|---|---|---|---|
| **$L_E$<42** | **Lp=** | **17.322+0.953LE** | | |
| **42<=$L_E$<=71** | **Lp=** | **96.725 - 1.992$L_E$ + 3.02x10$^{-2}$$L_E^2$ - 1.043x10$^{-4}$$L_E^3$** | = | 71.30 |
| **$L_E$ >71** | **Lp=** | **75** | | |

## Site 3 - Yaphank East

### Existing Measured noise levels

| | | | | |
|---|---|---|---|---|
| *Leq (measred)* | 72.9 | Warning horn | 52.4 | No Warning horn |
| *Ldn (estimated)* | 70.9 | | 50.4 | |

### Build Increment

**Computation of Noise Exposure for Yards General Assessment - Day/Night**
**SEL ref (Rail Yards)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Daytime $L_{eq}$*** | ***$L_{eq\ (day)}$*** | = | ***SEL ref*** | + | ***10log(NT/20)*** | - | ***35.6*** | - | ***20log(D/50)*** |
| | | = | 116.00 | + | -16.99 | - | 35.60 | - | 24.08 |
| | | = | 39.33 | | | | | | |
| ***Nighttime $L_{eq}$*** | ***$L_{eq\ (night)}$*** | = | ***SEL ref*** | + | ***10log(NT/20)*** | - | ***35.6*** | - | ***20log(D/50)*** |
| | | = | 116.00 | + | -16.53 | - | 35.60 | | 24.08 |
| | | = | 39.79 | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***$L_{dn}$*** | ***$L_{dn\ (increment)}$*** | = | ***10log*** | ***[ (15)x10^($L_{eq(day)}$/10) +'9)x10^($L_{eq(night)}$+10/10)] -*** | | | ***13.8*** | |
| | | = | 46.13 | | | | | |
| | | | NO IMPACT | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | SELref (20 train in peak hour) | = | 118.00 | N/A |
| | SELref (1 train with diesel loc. Idling for 1h) | = | 116.00 | |
| | $N_T$ = average number of train per hour | = | 0.40 | d |
| | $N_T$ = average number of train per hour | = | 0.44 | n |
| | D = distance to yard center (feet) | = | 800 | |

### Build

**Computation of Total Build Noise Level - Day/Night**

| | | | | |
|---|---|---|---|---|
| | ***$L_{dn\ (total)}$*** | = | ***10LOG(10^($L_{dn(Existing)}$/10+10^($L_{dn(Build\ Increment)}$/10)*** | |
| | | = | 70.91 | Warning horn |
| | | | 51.78 | |

**Threshold of Impact - Land Use Category 2**

| | | | | | |
|---|---|---|---|---|---|
| **$L_E$<42** | **Lp=** | **11.450+0.953LE** | | | |
| **42<=$L_E$<=71** | **Lp=** | **71.662 - 1.164$L_E$ + 0.018$L_E^2$ - 4.088x10$^{-5}$$L_E^3$** | = | 65.05 | 53.49 |
| **$L_E$ >71** | **Lp=** | **65** | | Warning horn | |

**Threshold of Severe Impact - Land Use Category 2**

| | | | | | |
|---|---|---|---|---|---|
| **$L_E$<42** | **Lp=** | **17.322+0.953LE** | | | |
| **42<=$L_E$<=71** | **Lp=** | **96.725 - 1.992$L_E$ + 3.02x10$^{-2}$$L_E^2$ - 1.043x10$^{-4}$$L_E^3$** | = | 70.13 | 59.69 |
| **$L_E$ >71** | **Lp=** | **75** | | Warning horn | |

## Site 4 - Ronkonkoma

### Existing Measured noise levels

| | |
|---|---|
| $L_{eq\ (measred)}$ | 56.4 |
| $L_{dn\ (estimated)}$ | 54.4 |

### Build Increment

**Computation of Noise Exposure for Yards General Assessment - Day/Night**
**SEL ref (Rail Yards)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Daytime $L_{eq}$* | $L_{eq\ (day)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)+B* |
| | | = | 116.00 | + | -18.75 | - | 35.60 | - | 27.28 |
| | | = | 34.37 | | | | | | |
| *Nighttime $L_{eq}$* | $L_{eq\ (night)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)+B* |
| | | = | 116.00 | + | -19.54 | - | 35.60 | | 27.28 |
| | | = | 33.58 | | | | | | |

$L_{dn}$ $L_{dn\ (increment)} = 10log\ [\ (15)x10^{\wedge}(L_{eq(day)}/10) + (9)x10^{\wedge}(L_{eq(night)}+10/10)\ ] - 13.8$
$= 40.11$
NO IMPACT

| | | | | |
|---|---|---|---|---|
| where: | SELref (20 train in peak hour) | = | 118.00 | N/A |
| | SELref (1 train with diesel loc. Idling for 1h) | = | 116.00 | |
| | $N_T$ = average number of train per hour | = | 0.27 | d |
| | $N_T$ = average number of train per hour | = | 0.22 | n |
| | D = distance to yard center (feet) | = | 650 | |
| | B = Sound barrier close to residences | = | 5 | |

### Build

**Computation of Total Build Noise Level - Day/Night**

$L_{dn\ (total)} = 10LOG(10^{\wedge}(L_{dn(Existing)}/10+10^{\wedge}(L_{dn(Build\ Increment)}/10)$
$= 54.56$

**Threshold of Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E<42$ | Lp= | 11.450+0.953LE | |
| $42<=L_E<=71$ | Lp= | $71.662 - 1.164L_E + 0.018L_E^2 - 4.088x10^{-5}L_E^3$ | = 55.03 |
| $L_E>71$ | Lp= | 65 | |

**Threshold of Severe Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E<42$ | Lp= | 17.322+0.953LE | |
| $42<=L_E<=71$ | Lp= | $96.725 - 1.992L_E + 3.02x10^{-2}L_E^2 - 1.043x10^{-4}L_E^3$ | = 60.94 |
| $L_E>71$ | Lp= | 75 | |

## Site 5 - Pilgrim Hospital Yard

### Existing Measured noise levels

| | |
|---|---|
| $Leq_{(measred)}$ | 58.3 |
| $Ldn_{(estimated)}$ | 56.3 |

### Build Increment

**Computation of Noise Exposure for Yards General Assessment - Day/Night**
**SEL ref (Rail Yards)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Daytime $L_{eq}$* | $L_{eq\ (day)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)* |
| | | = | 116.00 | + | -18.75 | - | 35.60 | - | 27.60 |
| | | = | 34.05 | | | | | | |
| *Nighttime $L_{eq}$* | $L_{eq\ (night)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)* |
| | | = | 116.00 | + | -19.54 | - | 35.60 | | 27.60 |
| | | = | 33.25 | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *$L_{dn}$* | $L_{dn\ (increment)}$ | = | *10log* | *[ (15)x10^($L_{eq(day)}$/10) +(9)x10^($L_{eq(night)}$+10/10)] -* | | | *13.8* |
| | | = | 39.79 | | | | |
| | | | NO IMPACT | | | | |

| | | | | |
|---|---|---|---|---|
| where: | SELref (20 train in peak hour) | = | 118.00 | N/A |
| | SELref (1 train with diesel loc. Idling for 1h) | = | 116.00 | |
| | $N_T$ = average number of train per hour | = | 0.27 | d |
| | $N_T$ = average number of train per hour | = | 0.22 | n |
| | D = distance to yard center (feet) | = | 1200 | |

### Build

**Computation of Total Build Noise Level - Day/Night**

$L_{dn\ (total)}$ = *10LOG(10^($L_{dn(Existing)}$/10+10^($L_{dn(Build\ Increment)}$/10)*
= 56.40

**Threshold of Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | |
| 42<=$L_E$<=71 | Lp= | 71.662 - 1.164$L_E$ + 0.018$L_E^2$ - 4.088x10$^{-5}$$L_E^3$ | = 55.89 |
| $L_E$ >71 | Lp= | 65 | |

**Threshold of Severe Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E$<42 | Lp= | 17.322+0.953LE | |
| 42<=$L_E$<=71 | Lp= | 96.725 - 1.992$L_E$ + 3.02x10$^{-2}$$L_E^2$ - 1.043x10$^{-4}$$L_E^3$ | = 61.69 |
| $L_E$ >71 | Lp= | 75 | |

## Site 6 - Riverhead Yard

### Existing Measured noise levels

| | |
|---|---|
| $L_{eq\ (measrd)}$ | 52.9 |
| $L_{dn\ (estimated)}$ | 50.9 |

### Build Increment

**Computation of Noise Exposure for Yards General Assessment - Day/Night**
**SEL ref (Rail Yards)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Daytime $L_{eq}$* | $L_{eq\ (day)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)+B* |
| | | = | 116.00 | + | -20.00 | - | 35.60 | - | 24.96 |
| | | = | 35.44 | | | | | | |
| *Nighttime $L_{eq}$* | $L_{eq\ (night)}$ | = | *SEL ref* | + | *10log(NT/20)* | - | *35.6* | - | *20log(D/50)+B* |
| | | = | 116.00 | + | -17.78 | - | 35.60 | | 24.96 |
| | | = | 37.65 | | | | | | |
| *$L_{dn}$* | *$L_{dn\ (increment)}$* | = | *10log* | *[ (15)x10^($L_{eq(day)}$/10) + (9)x10^($L_{eq(night)}$+10/10)] -* | | | | | *13.8* |
| | | = | 43.81 | | | | | | |
| | | | NO IMPACT | | | | | | |

| | | | | |
|---|---|---|---|---|
| where: | SELref (20 train in peak hour) | = | 118.00 | N/A |
| | SELref (1 train with diesel loc. Idling for 1h) | = | 116.00 | |
| | $N_T$ = average number of train per hour | = | 0.20 | d |
| | $N_T$ = average number of train per hour | = | 0.33 | n |
| | D = distance to yard center (feet) | = | 280 | |
| | B = Sound barrier close to residences | = | 10 | |

### Build

**Computation of Total Build Noise Level - Day/Night**

$L_{dn\ (total)}$ = *10LOG(10^($L_{dn(Existing)}$/10+10^($L_{dn(Build\ Increment)}$/10)*
= 51.68

**Threshold of Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E$<42 | Lp= | 11.450+0.953LE | |
| 42<=$L_E$<=71 | Lp= | 71.662 - 1.164$L_E$ + 0.018$L_E^2$ - 4.088x10$^{-5}$$L_E^3$ | = 53.66 |
| $L_E$ >71 | Lp= | 65 | |

**Threshold of Severe Impact - Land Use Category 2**

| | | | |
|---|---|---|---|
| $L_E$<42 | Lp= | 17.322+0.953LE | |
| 42<=$L_E$<=71 | Lp= | 96.725 - 1.992$L_E$ + 3.02x10$^{-2}$$L_E^2$ - 1.043x10$^{-4}$$L_E^3$ | = 59.82 |
| $L_E$ >71 | Lp= | 75 | |

# Appendix E-4

# CONSTRUCTION NOISE ANALYSIS AT NEWCOMERS HIGH SCHOOL

# Appendix E-4: Analysis of Construction Noise at Newcomers High School

## A. INTRODUCTION

Newcomers High School faces 29th Street and is located on the block bounded by 29th Street on the south, 28th Street on the north, 41st Avenue on the south, and 40th Avenue on the north. The school is directly across 29th Street from the site proposed as part of the Long Island Rail Road East Side Access Project as a staging area for tunneling and other construction activities. The proposed construction site is currently used as a staging site for construction as part of the New York City Transit (NYCT) 63rd Street Connector Project.

To address concerns about possible noise impacts from construction activities of the East Side Access Project at Newcomers High School, a detailed construction noise assessment was undertaken. This assessment involved taking noise measurements at Newcomers High School to determine existing noise levels at the school and the level of attenuation provided by the building structure and windows for both open-window and closed-window conditions. Using this information, an analysis of the effects of construction noise was performed using estimates of the equipment expected on-site.

## B. EXISTING CONDITIONS

### SITE AND WINDOW DESCRIPTION

Newcomers High School is a 4-story building with a basement. The school building is relatively old, but most of the original windows have been replaced with new single-glazed, multipaned windows. According to building personnel, it is expected that shortly any parts of the building containing old windows will be retrofitted with new windows. For safety, the new windows have stops that allow them to be opened only approximately 8 inches from the bottom. Some of the classrooms and offices have through-the-window air conditioning units. Typically, two large units are installed in a classroom.

As described above, Newcomers High School is located directly across 29th Street from the proposed East Side Access staging area. Just south of the open staging area is Northern Boulevard, a busy arterial street. Northern Boulevard is also the route of an elevated New York City Transit (NYCT) subway.

### APPROACH AND METHODOLOGY

Measurements were performed to determine existing noise levels and to determine the level of attenuation provided by the window/wall. To accomplish this, two noise monitors were used to measure noise levels. All measurements were made on the side of the school building facing 29th Street.

A continuous 24-hour measurement was made using one instrument approximately 6 feet outside of a second-floor office (Room 221) on the northern edge of the building on 29th Street

(Receptor Site A). Measured values were tabulated every 20 minutes, and this location served as a control point room for the measurement program.

Spot 20-minute measurements were made at two adjacent classrooms on the second floor of the building facing 29th Street. At Room 219B, a classroom with new windows and no air conditioning, noise-level measurements were made approximately 6 feet outside the building (Receptor Site B1), and approximately 8 feet from the windows within the building (Receptor Site B2) for two conditions—with the windows open and with the windows closed. The noise-level measurements outside the building at Site B1 allowed comparison with the control point measurements at Receptor Site A, to account for differences in noise levels due to the location of construction equipment operations. At Room 217B, a classroom with new windows and two window air conditioners, noise level measurements were made approximately 6 feet outside the building (Receptor Site C1), and approximately 8 feet from the window within the building (Receptor Site C2) for conditions with the windows closed only. Again, the noise-level measurements outside the building at Site C1 allowed comparison with the control point measurements at Receptor Site A, to account for differences in noise levels due to the location of construction equipment operations.

The continuous 24-hour noise measurement at Site A was performed on July 11 and 12, 2000. The 20-minute spot measurements at Sites B1, B2, C1, and C2 were performed during the afternoon on July 11, 2000. The time available for spot measurements was limited to the time when classes were not in session (i.e., after 1 PM), and when noise from school construction projects (i.e., asbestos removal) did not bias the measurements.

The continuous 24-hour noise monitoring at Site A was conducted using a Brüel & Kjær Noise Level Analyzer Type 4427, a Brüel & Kjær Sound Level Calibrator Type 2431, a Brüel & Kjær ½-inch microphone Type 4189, and a Brüel & Kjær microphone preamplifier Type 2669. Measurements at this location were made on the A-scale (dBA) for a sampling period of 20 minutes. The data were digitally recorded by the noise analyzer and displayed at the end of the measurement period in units of dBA.

The 20-minute spot measurements at Sites B1, B2, C1, and C2 were conducted using a Larson Davis Labs (LDL) Sound Level Meter Type 700, a Brüel & Kjær ½-inch microphone Type 4176, and a Larson Davis microphone preamplifier Type 785. The meter was calibrated before and after readings with a Larson Davis Type CAL200 sound level calibrator using the appropriate adaptor. Measurements at each location were made on the A-scale (dBA) for a sampling period of 20 minutes at each site. The data were digitally recorded by the noise analyzer and displayed at the end of the measurement period in units of dBA.

At Sites A, B1, and C1, located outside the building, the microphone was approximately 6 feet away from any large sound-reflecting surface to avoid interference with sound propagation. A windscreen was used during sound measurements, except for calibration. At Sites B2 and C2, located within the building, the microphone was mounted at a height of approximately 5 feet above the floor surface on a tripod and 8 feet away from windows. Both the B&K analyzer and the Larson Davis meter were calibrated before and after readings. Measured quantities included $L_{eq}$, $L_1$, $L_{10}$, $L_{50}$, $L_{90}$, and $L_{max}$. All measurement procedures conformed with the requirements of ANSI Standard S1.13-1971 (R1976).

## RESULTS OF MEASUREMENTS

Table 1 summarizes the continuous 24-hour measurements taken outside the second-floor room on the 29th Street side of the school building on July 11 and 12, 2000 (Site A). The table shows hourly values of $L_{eq(1)}$, $L_{1(1)}$, $L_{10(1)}$, $L_{50(1)}$, and $L_{90(1)}$ noise levels. These values were obtained by calculating the equivalent sound levels of the three 20-minute measurements for each hour. In general, noise on the 29th Street side of the building is a function of three noise sources—traffic on 29th Street and on Northern Boulevard, noise from the elevated NYCT trains above Northern Boulevard, and noise from construction operations from the NYCT 63rd Street Connector Project taking place across 29th Street (on and adjacent to the site bounded by 40th Avenue, 29th Street, 40th Road, and Northern Boulevard). Construction activities included cement braking operations, use of backhoe and front loader equipment, and trucking operations.

**Table 1**

**Measured Existing Exterior Noise Levels at Second Floor of Newcomers High School (Site A)**

| Hour Ending | $L_{eq(1)}$ | $L_1$ | $L_{10}$ | $L_{50}$ | $L_{90}$ |
|---|---|---|---|---|---|
| 1 AM | 61.4 | 73.5 | 63.9 | 55.9 | 52.3 |
| 2 AM | 60.6 | 73.9 | 60.7 | 56.1 | 52.3 |
| 3 AM | 63.4 | 75.5 | 67.9 | 56.7 | 52.5 |
| 4 AM | 61.1 | 74.1 | 63.3 | 55.7 | 52.7 |
| 5 AM | 61.6 | 74.5 | 62.9 | 56.7 | 53.1 |
| 6 AM | 64.3 | 75.5 | 67.9 | 57.7 | 53.7 |
| 7 AM | 65.0 | 74.3 | 69.1 | 61.7 | 58.1 |
| 8 AM | 69.4 | 75.5 | 71.9 | 68.7 | 64.9 |
| 9 AM | 70.3 | 75.7 | 72.9 | 69.9 | 63.7 |
| 10 AM | 70.9 | 76.5 | 73.1 | 70.3 | 66.9 |
| 11 AM | 71.1 | 75.5 | 73.5 | 70.7 | 66.7 |
| Noon | 72.0 | 79.3 | 73.5 | 70.9 | 68.3 |
| 1 PM | 71.9 | 81.5 | 74.1 | 69.5 | 66.1 |
| 2 PM | 72.7 | 81.5 | 75.5 | 70.9 | 65.9 |
| 3 PM | 71.6 | 79.3 | 74.5 | 69.7 | 65.9 |
| 4 PM | 69.2 | 77.1 | 71.7 | 67.3 | 64.9 |
| 5 PM | 67.0 | 73.5 | 69.7 | 65.9 | 61.5 |
| 6 PM | 71.8 | 78.3 | 74.5 | 69.9 | 68.3 |
| 7 PM | 64.8 | 75.5 | 68.3 | 60.5 | 58.3 |
| 8 PM | 64.9 | 75.5 | 69.1 | 60.1 | 56.5 |
| 9 PM | 64.6 | 75.5 | 68.3 | 59.1 | 56.3 |
| 10 PM | 65.2 | 75.9 | 69.1 | 59.7 | 55.1 |
| 11 PM | 62.8 | 71.7 | 67.1 | 59.1 | 54.3 |
| Midnight | 62.3 | 73.5 | 64.9 | 57.5 | 53.5 |

As shown in the table, existing exterior one-hour equivalent ($L_{eq(1)}$) noise levels during school hours are relatively high, with $L_{eq(1)}$ values during typical school hours ranging from approximately 69 to 73 dBA, and $L_{10(1)}$ noise levels (the noise levels exceed 10 percent of the time) generally approximately 3 dBA higher than the $L_{eq(1)}$ values. Based on these measured values, the $L_{dn}$ value is 71.2 dBA. Peak noise levels during this time period range as high as approximately 85 dBA. Train passby noise ranged from approximately 71 to 76 dBA, depending on a number of factors such as whether there were one or two simultaneous train passbys, and whether the train was on the near or far track, the train speed, etc. Truck activities, such as garbage truck operation on 29th Street, produced noticeable noise levels in the low 80's. Between noon and 12:30, when construction workers at the NYCT 63rd Street Connector Project were having lunch and construction activity had stopped, noise levels dropped to approximately 68 dBA, 4 dBA lower than noise levels with construction activities. Therefore, without existing construction activities, existing exterior $L_{eq(1)}$ noise levels during school hours would be expected to generally range from approximately 63 to 69 dBA, and $L_{10(1)}$ noise levels generally would be expected to range from approximately 66 to 72 dBA.

In addition to the exterior noise level measurements shown in Table 1, simultaneous indoor-outdoor measurements were made to determine the level of attenuation provided by the window/ wall of the building for both open- and closed-window conditions. Table 2 shows the results of the 20-minute spot measurements at Site B1, B2, C1, and C2, and for comparison purposes, the corresponding 20-minute measurement made at Site A. For each site and measurement condition, 20-minute $L_{eq}$, $L_1$, $L_{10}$, $L_{50}$, and $L_{90}$ noise levels are shown. The measured noise levels at Site C were made with the two window air-conditioners in the classroom not operating. These two units were relatively noisy, and their operation would be expected to result in noise levels in the classrooms that would making teaching difficult. The measurements indicate that for open-window conditions, the window/wall provides approximately 13 dBA of attenuation, and for closed window conditions, the window/wall provides approximately 21 dBA of attenuation in classrooms with air conditioners and 25 dBA of attenuation in classrooms without air conditioners (see Table 3).

**Table 2**

## 20-Minute Measured Noise Levels

| Site | Location | Time | $L_{eq}$ | $L_1$ | $L_{10}$ | $L_{50}$ | $L_{90}$ |
|---|---|---|---|---|---|---|---|
| A | Outside R221 | 14:20 | 73.6 | 80.1 | 76.1 | 72.5 | 68.3 |
| B1 | Outside R219B | 14:20 | 72.6 | 80.0 | 75.0 | 71.0 | 67.0 |
| A | Outside R221 | 13:40 | 71.2 | 79.9 | 73.9 | 69.3 | 64.5 |
| B2 | Inside R219B (window opened) | 13:40 | 57.2 | 65.5 | 60.0 | 55.0 | 50.5 |
| A | Outside R221 | 13:20 | 72.7 | 81.5 | 75.5 | 70.9 | 65.9 |
| B2 | Inside R219B (window closed) | 13:20 | 46.9 | 55.0 | 49.0 | 45.0 | 42.0 |
| A | Outside R221 | 14:40 | 71.6 | 79.3 | 74.5 | 69.7 | 65.9 |
| C1 | Outside R217 | 14:40 | 69.9 | 77.5 | 73.0 | 67.5 | 64.0 |
| A | Outside R221 | 15:00 | 69.2 | 77.1 | 71.7 | 67.3 | 64.9 |
| C2 | Inside R217 (window closed) | 15:00 | 46.9 | 53.0 | 49.5 | 45.0 | 43.0 |

**Note:** Field measurements were performed by Allee King Rosen & Fleming, Inc., on July 11 and 12, 2000.

**Table 3**
**Window/Wall Attenuation**

| Window Condition | Window Air-Conditioners? | Attenuation |
|---|---|---|
| Open | No | 13 dBA |
| Closed | No | 25 dBA |
| Closed | Yes | 21 dBA |

### NOISE STANDARDS AND CRITERIA

There are no noise standards or impact criteria directly applicable to construction noise. The FTA's noise guidance manual (*Transit Noise and Vibration Impact Assessment*, April 1995) talks about construction noise, but does not provide any specific levels that should not be exceeded. The FTA guidance document discusses the need for detailed construction noise assessment when daytime $L_{eq(1)}$ values exceed 90, 100, or 100 dBA for residential, commercial, or industrial land uses, respectively, or when nighttime $L_{eq(1)}$ values exceed 80, 100, or 100 dBA for residential, commercial, or industrial land uses, respectively. However, no guidance is provided on what constitutes an impact or significant impact, or when mitigation is necessary.

The State Education Law, Section 155.5, Uniform Safety Standards for School Construction and Maintenance Projects, mandates that school construction and maintenance projects implement acoustical abatement measures when school construction operations produce noise in excess of 60 dBA. However, the East Side Access Project is not a school construction or maintenance project, and consequently this standard is not applicable.

New York City, as part of the City Environmental Quality Review (CEQR) process, as detailed in the *CEQR Technical Manual*, requires interior $L_{10(1)}$ values of 45 dBA or less. However, this does not apply to temporary construction-related noise levels. The School Construction Authority (SCA) has been designing new school in New York City with double-glazed windows and central air condition to achieve interior $L_{10(1)}$ noise levels of 45 dBA.

## C. NOISE LEVELS WITH EAST SIDE ACCESS CONSTRUCTION ACTIVITIES

A preliminary analysis of construction noise was performed to determine the approximate noise levels at both the exterior and interior of Newcomers High School during construction of the East Side Access Project. This analysis was based on estimates of the equipment on-site, equipment utilization rates, and approximately noise reference levels. The results of this analysis are summarized in Table 4, and show a worst-case exterior noise level of approximately 78.1 dBA at the school as a result of East Side Access Project construction activities alone (i.e., without noise from other local noise sources, such as traffic), assuming the maximum numbers of construction equipment operating simultaneously.

**Table 4**

## Noise Due to East Side Access Construction Activities Alone at Newcomers High School (in dBA)

| Equipment | Reference at 50 feet | No. on site | Utilization | Noise level at 50 feet | Distance attenuation | Barrier/ building shielding attenuation | Nearest receptor site |
|---|---|---|---|---|---|---|---|
| 1,200-CFM tunnel ventilation fan | 80 | 4 | 1.00 | 86 | 19 | 5 | 62 |
| 1,200 CFM electric air compressor | 81 | 2 | 1.00 | 84 | 19 | 5 | 60 |
| 150-ton diesel crawler crane | 93 | 1 | 1.00 | 93 | 20 | 5 | 68 |
| 980 Caterpillar diesel loader | 84 | 1 | 1.00 | 84 | 19 | 5 | 60 |
| Electric man elevator | 76 | 1 | 1.00 | 76 | 19 | 5 | 52 |
| Heavy equipment repair shop | 75 | 1 | 1.00 | 75 | 19 | 5 | 51 |
| 100-ton rock crusher | 90 | 1 | 1.00 | 90 | 20 | 5 | 65 |
| Conveyor | 80 | 1 | 1.00 | 80 | 19 | 5 | 56 |
| Truck | 88 | 6 | 0.33 | 91 | 14 | | 77 |
| **Total Noise Level** | | | | | | | **78.1** |

**Note:** These are estimated values based on noise drop-off rate of 6 dBA with each doubling of distance away from the source, and 5 dBA with barrier/building shielding effects.

Table 5 presents the results and conclusions of this analysis. As shown in Table 1, with current construction activities, existing exterior $L_{eq(1)}$ noise levels at Newcomers High School range from 67.0 to 72.7 dBA. Using the 72.7 dBA value, without current construction activities, exterior $L_{eq(1)}$ noise levels are estimated to be 68.7 dBA, and interior noise levels are estimated to be 55.7 and 43.7 dBA for open- and closed-window conditions, respectively. With East Side Access construction activities, exterior $L_{eq(1)}$ noise levels are estimated to be 78.6 dBA, and interior noise levels are estimated to be 65.6 and 53.6 dBA for open- and closed-window conditions, respectively. Therefore, East Side Access construction activities would result in an increase of up to approximately 10 dBA in interior $L_{eq(1)}$ noise levels (compared to noise levels without any East Side Access or other construction activities). An increase of this magnitude would subjectively be a doubling of loudness, and typically be construed as a significant increase in noise levels. While this increase would be temporary, lasting approximately 2½ years, the magnitude of the increase could potentially affect the learning environment in the classroom, and mitigation is warranted.

**Table 5**

**Comparison of Predicted Noise Levels (in dBA)**

| Location | Existing with Existing Construction Noise $L_{eq}$ | Existing without Existing Construction Noise $L_{eq}$ | ESA Construction Noise only $L_{eq}$ | Prediction Noise Level with ESA Construction Activities $L_{eq}$ |
|---|---|---|---|---|
| Outside building | 72.7 | 68.7 | 78.1 | 78.6 |
| Inside building (window opened) | 59.7 | 55.7 | 65.1 | 65.6 |
| Inside building (single-glazed window closed) | 47.7 | 43.7 | 53.1 | 53.6 |
| Inside building (double-glazed window closed) | NA | NA | NA | 48.6 |
| **Note:** Most equipment would contain sound attenuation devices such as mufflers. Noise levels reflect effect of truck operations and other mobile equipment. | | | | |

## D. MITIGATION MEASURES

A noise wall would effectively mitigate project-related noise impacts for the ground-floor classrooms, providing up to 15 dBA of attenuation. For other classrooms, noise mitigation could consist of providing better (double-glazed) windows and/or air conditioning, principally on the side of the building where construction operations would occur. Air conditioning would allow windows to be kept closed, providing approximately 12 dBA of attenuation. ❖