9. NOISE AND VIBRATION

This chapter presents Section of Environmental Analysis' (SEA's) analysis of potential noise and vibration impacts that would be expected from construction and operation of the proposed Northern Rail Extension (NRE). Section 9.1 provides applicable regulations and noise criteria. Section 9.2 discusses the affected environment, including both areas with existing rail traffic and areas with no existing rail traffic. Alaska Railroad Corporation's (ARRC's) existing Eielson Branch from the Fairbanks Intermodal Facility and Depot (FBX) to just south of the Chena River floodway is included in the analysis because anticipated rail traffic on the proposed NRE would travel over this portion of the Eielson Branch to reach FBX. Noise measurement data are also presented in this section. Section 9.3 discusses the analysis methodology and noise and vibration impacts, including modeled noise contours and estimated numbers of sensitive receptors potentially affected. Appendix J presents the equations and methods used in the noise and vibration analysis.

9.1 Applicable Regulations

9.1.1 Federal Regulations

Federal laws, regulations and guidelines that specify requirements and provide guidance on noise and vibration analysis and impact assessment include:

- Surface Transportation Board (STB or the Board) environmental regulations at 49 Code of Federal Regulations (CFR) 1105.7
- Noise Control Act of 1972 (42 United States Code [U.S.C.] 4910)
- Federal Railroad Administration (FRA) Guidelines (Report Number 293630-1, December 1998)
- Occupational Safety and Health Administration (OSHA) Occupational Noise Exposure; Hearing Conversation Amendment (*Federal Register* 48 (46), 9738–9785)
- U.S. Environmental Protection Agency (USEPA) Railroad Noise Emission Standards (40 CFR 201)
- FRA Railroad Noise Emission Compliance Regulations (49 CFR 210)
- FRA Final Rule on the Use of Locomotive Horns at Highway-Rail Grade Crossings (49 CFR Parts 222 and 229)
- Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06, May 2006)

The STB environmental review regulations for noise analysis (49 CFR 1105.7e(6)), have the following criteria:

- An increase in noise exposure as measured by a **day-night average noise level (DNL)** of 3 **A-weighted decibels (dBA)** or more.
- An increase to a noise level of 65 DNL or greater.

Day-night average noise level (DNL): The energy average of A-weighted decibels (dBA) sound level over a 24-hour period includes a 10 decibel adjustment factor for noise between 10 p.m. and 7 a.m. to account for the greater sensitivity of most people to noise during the night. The effect of nighttime adjustment is that one nighttime event, such as a train passing by between 10 p.m. and 7 a.m., is equivalent to 10 similar events during the daytime.

A-weighted decibels (dBA): A measure of noise level used to compare noise from various sources. A-weighting approximates the frequency response of the human ear.

If the estimated noise level increase at a location exceeds either of these criteria, SEA estimates the number of affected receptors (*e.g.*, schools, libraries, residences, retirement communities, nursing homes) and quantifies the noise increase. The two components (3 dBA increase, 65 DNL) of the STB criteria are implemented separately to determine an upper bound of the area of potential noise impact. However, recent noise research indicates that both criteria components must be met to cause an adverse noise impact (STB 2003, p. 4-82). That is, noise levels would have to be greater than or equal to 65 DNL and increase by 3 dBA or more for an adverse noise impact to occur. This assessment looks at both indicators in combination to evaluate potential impact.

9.1.2 State Regulations

The Alaska Administrative Code (AAC) does not include requirements applicable to railroad noise.

9.1.3 Local Regulations

The proposed NRE would be located in both the Fairbanks North Star Borough (FNSB) and the Southeast Fairbanks Census Area, an unincorporated area. The existing rail line also is in the FNSB, which does not have applicable noise restrictions. In addition, portions of the existing rail line that would be used by rail traffic from the proposed NRE would pass through the incorporated cities of Fairbanks and North Pole. The City of Fairbanks (Code of Ordinances, Article II, Section 46-42(a)(3)) and the City of North Pole (Ordinance 8.04 160-Noise Section B) regulate construction noise, but the proposed action would not involve construction within the city limits. Other City of Fairbanks regulations (Article II, Section 46-42(d)(1)) do not prohibit noise from safety signals or warning devices.

9.2 Affected Environment

Existing noise conditions vary considerably along the various alternative segments proposed for this project. In areas such as Salcha and Delta Junction, existing noise sources include vehicles on nearby roads, occasional aircraft, other human activities, and natural sources such as wind. Noise levels in the vicinity of the build alternatives near Eielson Air Force Base (AFB) also are influenced by aircraft noise (ASCG, 2006). In other areas, far away from major noise sources, ambient sound levels can be quite low.

Along the existing portion of the Eielson Branch that would be used by rail traffic from the proposed NRE, rail operations that produce noise include the diesel locomotive engine and wheel/rail noise (collectively referred to as wayside noise), as well as locomotive horn sounding at at-grade highway-rail grade crossings. This dominates the noise environment near the tracks. Other noise sources along the existing rail line include the aircraft and weapons firing range associated with Fort Wainwright (ASCG, 2006).

As indicated above, SEA's environmental regulations require counting receptors (noise sensitive locations) where the proposed NRE would result in 65 DNL or greater or would increase noise levels by 3 dBA or greater. Where there is existing rail traffic, existing noise levels can be calculated. Ambient sound measurements are used to characterize background noise levels in areas where there is no existing rail traffic.

SEA measured ambient sound levels for 24 hours at six locations during November 13 and 14, 2007. Table 9-1 shows the results of this sound level monitoring.

Table 9-1
Measured Ambient Sound Levels

Location No.	Description	DNL (dBA)[a]
1	Baptist Church Road	67
2	Stringer Road	49
3	Old Richardson Highway	50
4	Between Canaday and Munson Sloughs	33
5	Jack Warren Road	54
6	Nistler Road	54

[a] DNL = day-night average noise level; dBA = A-weighted decibels.

With the exception of location 1, sound level measurements fall within USEPA's 'small town residential' category, or lower (see Figure 9-1). The sound monitor at location 1 was near an at-grade road crossing of the existing track where locomotive horn sounding currently occurs. The noise measurement results from location 1 are reasonably consistent with the results of modeling of existing rail noise at this location. However, the long-term (annual) rail traffic volumes and speeds are likely more statistically reliable than a single day's noise measurement, and thus the calculated rail noise levels were used at this location. Location 1 would be situated in the 'very noisy urban residential' USEPA category.

[a] dBA = A-weighted decibels.
[b] Source: USEPA, 1974, p. 23.

Figure 9-1
Typical day-night average noise levels (DNL) for residential areas[b]

9.3 Environmental Consequences

9.3.1 Methodology

The following methods were used to evaluate whether the build alternatives would result in vibration impacts or rail line noise levels (attributable to wayside noise and locomotive warning horn) that would equal or exceed 65 DNL and/or result in an increase of 3 dBA or greater. Appendix J provides the equations and methods used in the noise and vibration analyses. Proposed mitigation for impacts to noise and vibration is presented in Chapter 20 of the Environmental Impact Statement (EIS).

- Noise models. SEA used Computer Aided Noise Abatement program (CADNA), an environmental noise computer program, and wayside and horn reference levels from previous studies to generate noise level contours. The overall noise model results are sensitive to the horn noise, locomotive and railcar noise, train length, train speed, and the shielding effects of buildings. SEA used train length and speed information provided by the Applicant. SEA based wayside noise estimates on information compiled for previous SEA analyses, including the Conrail Acquisition EIS and the Draft Environmental Assessment for the Canadian National/Illinois Central Railway Acquisition. SEA used data on horn noise compiled by FRA. These sources were used because of the size of their noise measurement database, statistical reliability, and other factors.

- Estimate or measure existing noise exposure. For areas that would be traversed by the proposed NRE, SEA measured ambient noise levels at selected locations to establish a baseline for determining if there would be a 3 dBA or greater increase in noise. For areas along the existing rail line that would be used by proposed NRE rail traffic, SEA calculated existing noise levels based on wayside and horn noise from current rail traffic.

- Estimate future noise exposure. SEA estimated noise exposure in terms of DNL using future rail operation plans and model outputs and information on distances and noise propagation paths to sensitive receptors.

- Identify and count noise-sensitive receptors. SEA estimated the number of noise sensitive receptors within the 65 DNL noise contours or where the DNL would increase by at least 3 dBA. SEA used digital aerial photographs and Geographic Information Systems (GIS) software to estimate the number of noise-sensitive receptors, including residences, schools, and places of worship, for future train volumes. The final result of this analysis was an estimate of the total number of sensitive receptors that would be exposed to 65 DNL or greater and the number of receptors where the DNL would increase by at least 3 dBA due to the proposed NRE. The accuracy of the estimated numbers of potentially affected receptors is limited by the resolution and age of the available aerial photographs and interpretation of these photographs.

- Estimate vibration levels. SEA based this analysis on published train and construction equipment vibration data resulting from both operation and construction of the rail line.

9.3.2 Common Impacts

Rail Operations Noise

Noise levels due to rail operations vary by location because of varying train speed, number of trains per day, and train length. Table 9-2 provides train operations data used to estimate distances from the centerline of the rail line to the 65 DNL noise contour. The average length of new trains is much shorter than for existing trains because the existing train traffic is exclusively freight traffic while most of the new trains (eight out of ten per day) would be much shorter passenger trains. As a result, the average length of trains on the new rail line would be substantially less than on the existing rail line (with the existing freight traffic). The noise contour modeling is based on one locomotive per train.

Table 9-2
Train Operations Data Inputs to Noise Modeling[a]

Alternative Segment[b]	Future average train length (feet)	Future average trains/ day	Existing average train length (feet)	Existing average trains/ day	Speed (miles per hour)
Delta 2	639	10	--	--	30
Salcha 2	639	10	--	--	76
Salcha 1	639	10	--	--	76
Eielson 1	639	10	--	--	76
Eielson 2	639	10	--	--	76
Eielson 3	639	10	--	--	76
North Common	639	10	--	--	76
Existing Track 4	639	11	635	1	20
Existing Track 3	1432	15	3223	5	20
Existing Track 2	1432	15	3223	5	20
Existing Track 1	1464	16	2838	6	20

[a] Sources: See Chapter 11

[b] Alternative segments listed are those for which SEA performed noise modeling. SEA did not model other segments because review of aerial photographs provided no indication that sensitive receptors would potentially be affected.

Existing Track 1: FBX depot to Fairbanks airport turn-off

Existing Track 2: Airport turn-off to SE corner of Fort Wainwright

Existing Track 3: SE corner of Fort Wainwright to North Pole Refinery

Existing Track 4: North Pole Refinery to Chena Flood Road (junction with proposed NRE)

Table 9-3 gives estimated distances to the 65 DNL noise contour for the various train operation scenarios used in the analysis.

Table 9-3
Distance to 65 DNL[a] Contour

Train Operations	Horn Noise Contour (feet)	Wayside Noise Contour (feet)
10 trains per day, 20 miles per hour	630	105
10 trains per day, 76 miles per hour	630	115
11 trains per day, 20 miles per hour	670	110
15 trains per day, 20 miles per hour	830	145
16 trains per day, 15 miles per hour	865	175

[a] DNL = day-night average noise level.

Figures 9-2 through 9-7 show 65 DNL and 3 dBA increase contours for the segments listed in Table 9-2 above. These figures show the estimated extent of day-night average noise levels equal to or greater than 65 decibels—the area enclosed by the red line—and increases in noise level of 3 A-weighted decibels or greater—the area shaded in light green. The sometimes "ragged" appearance of the 65 dBA contour (red line) illustrates the effect of buildings shielding areas farther from the rail line such that increases in noise levels would be reduced. In addition, the figures show the locations of noise measurements collected during preparation of the EIS and the locations of noise sensitive receptors, identified based on interpretation of the available aerial photography, with one exception. Siku Basin housing, which was constructed on Fort Wainwright near the existing Eielson Branch and just west of the Chena River after the aerial photography was taken, is included in the analysis.

SEA calculated the 3 dBA increase contours using the ambient sound measurements presented in Section 9.2 to define baseline (current) conditions for areas where there is currently no rail traffic. Published noise contours for Eielson AFB and Fort Wainwright were also used to determine the limits of 3 dBA increase contours in areas affected by those existing noise sources. The area within the 3 dBA increase contour can be quite large if the ambient sound level is sufficiently low. An example of this can be seen in the vicinity of sound measurement location 4 (Salcha area, Figure 9-6) where measured sound levels were relatively low. For areas with existing rail traffic, SEA based existing ambient noise levels on calculated noise levels resulting from existing rail traffic.

SEA did not perform noise level modeling in areas where no receptors were identified near the proposed rail line. Specifically, SEA did not model noise for Salcha Alternative Segment 1, Central Alternative Segments 1 and 2, Donnelly Alternative Segments 1 and 2, South Common Segment, and Delta Alternative Segment 1.

In areas densely packed with buildings, modeling of the shielding effects of buildings was performed to account for the fact that buildings can act as noise barriers, which can limit the size and change the shape of noise contours. This in turn can affect the number of receptors potentially included within a noise contour. An example of the effects of building shielding can be seen along the existing rail line between FBX and Fort Wainwright.

SEA used GIS software to count receptors identified (based on aerial photographs) within the modeled noise contours. The resulting receptor count information is presented in Table 9-4.

Table 9-4
Noise Receptor Counts for the Proposed NRE

Alternative Segment	65 DNL[a]	+ 3 dBA[b]	Increase in noise level within 65 DNL Contour (dBA)
Delta 2	0	3	
Salcha 2	32	163	15-30
Salcha 1	0	0	
Eielson 1	0	17	
Eielson 3	4	49	15
Eielson 2	0	0	
North Common Segment	0	0	
Existing Track	446	1643	4-10

[a] DNL = day-night average noise level.
[b] dBA = A-weighted decibels.

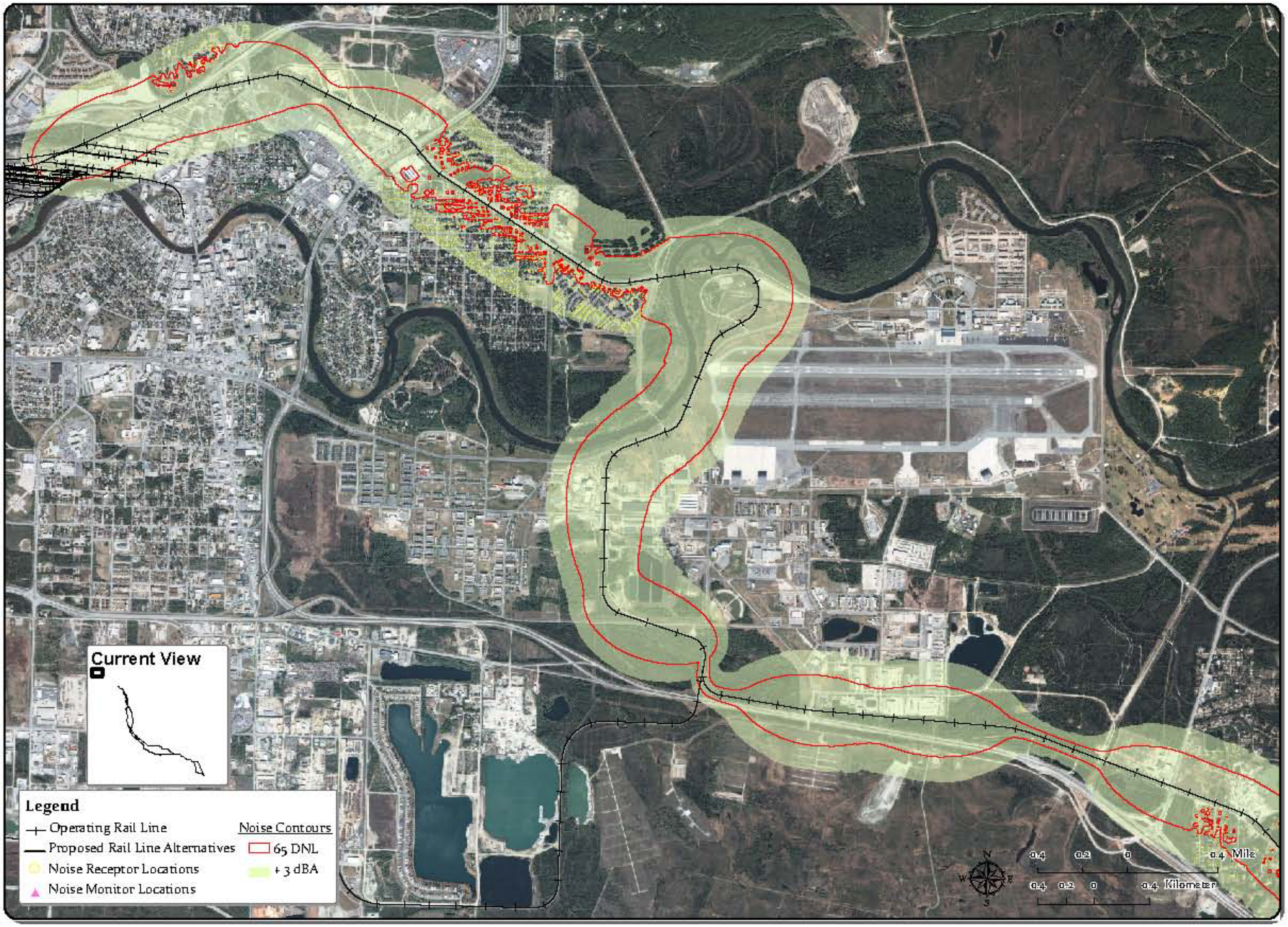

Figure 9-2 – Modeled Noise Contours – Eielson Branch Mile Post 0 to Mile Post 8.8

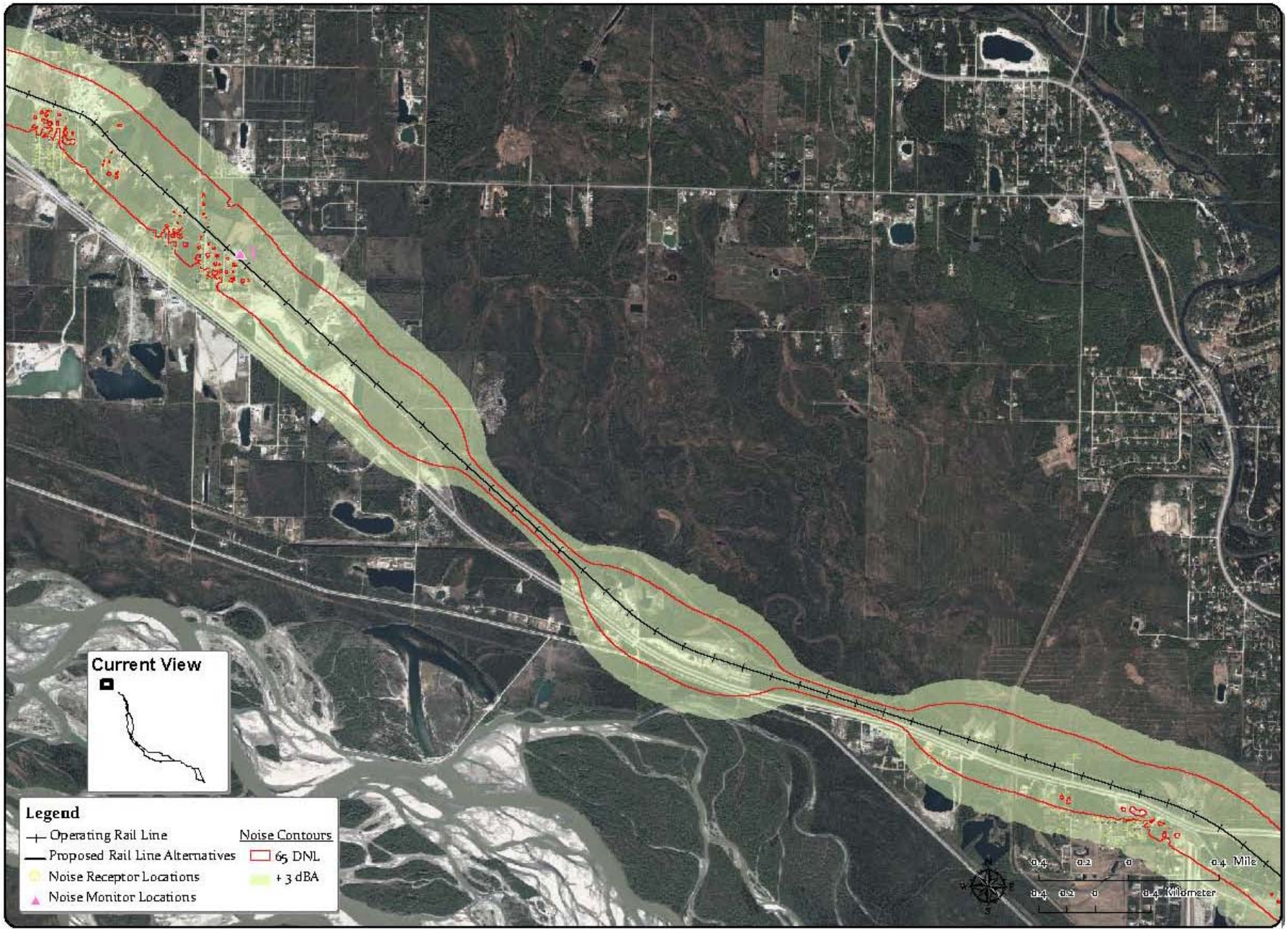

Figure 9-3 – Modeled Noise Contours – Eielson Branch Mile Post 8.3 to Mile Post 15

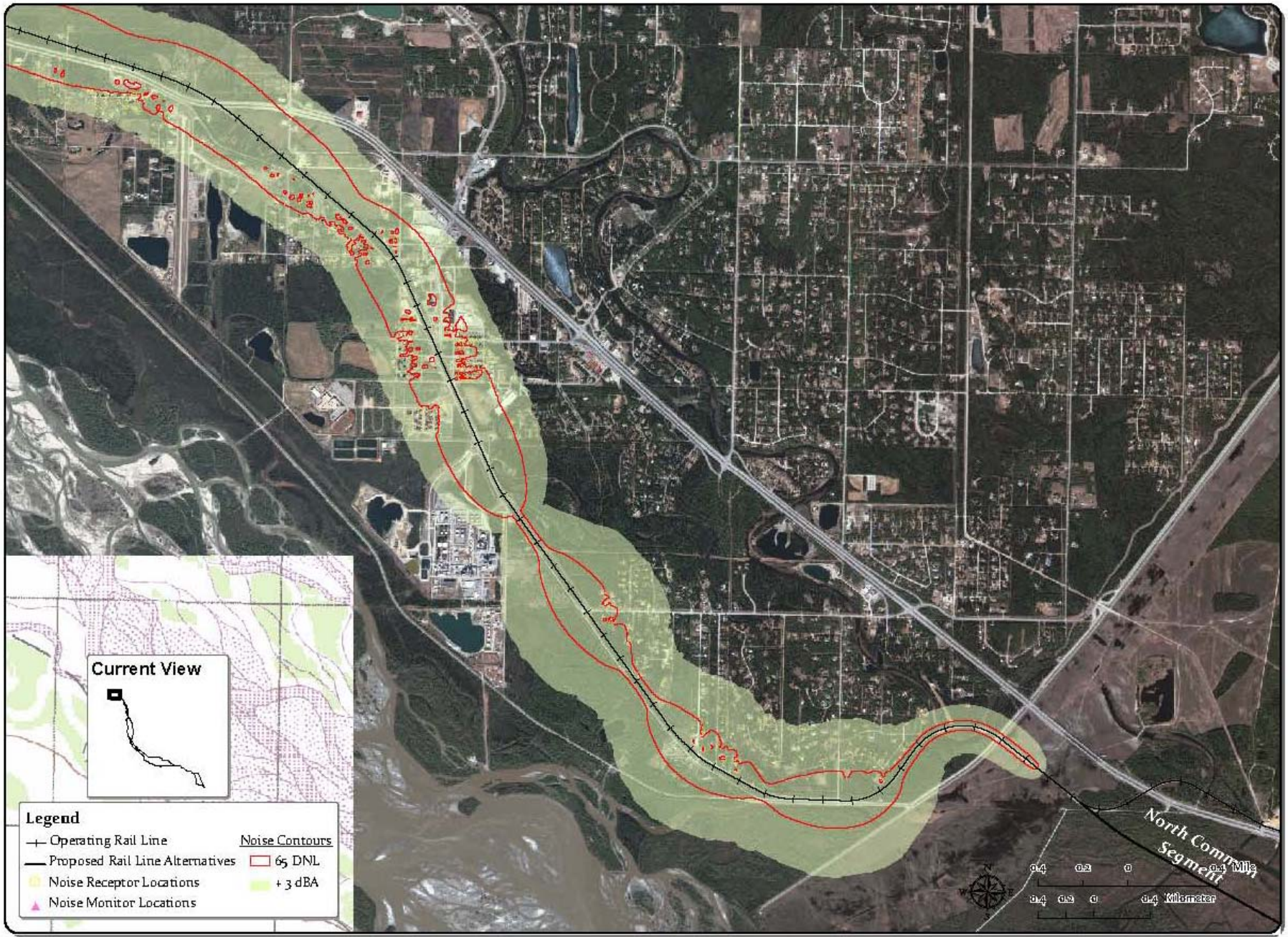

Figure 9-4 – Modeled Noise Contours – Eielson Branch Mile Post 14 to Mile Post 21

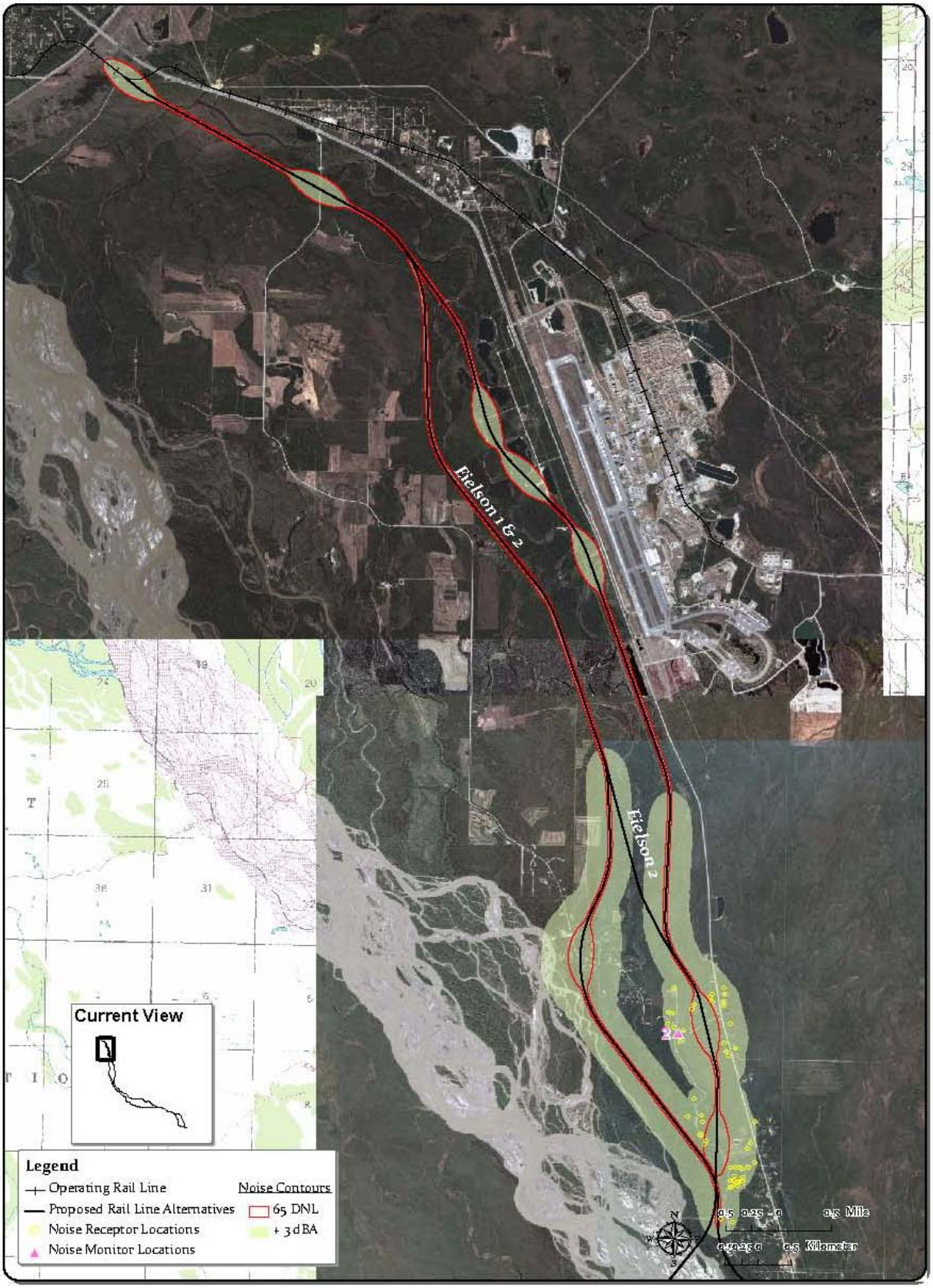

Figure 9-5 – Modeled Noise Contours – Eielson Alternative Segments

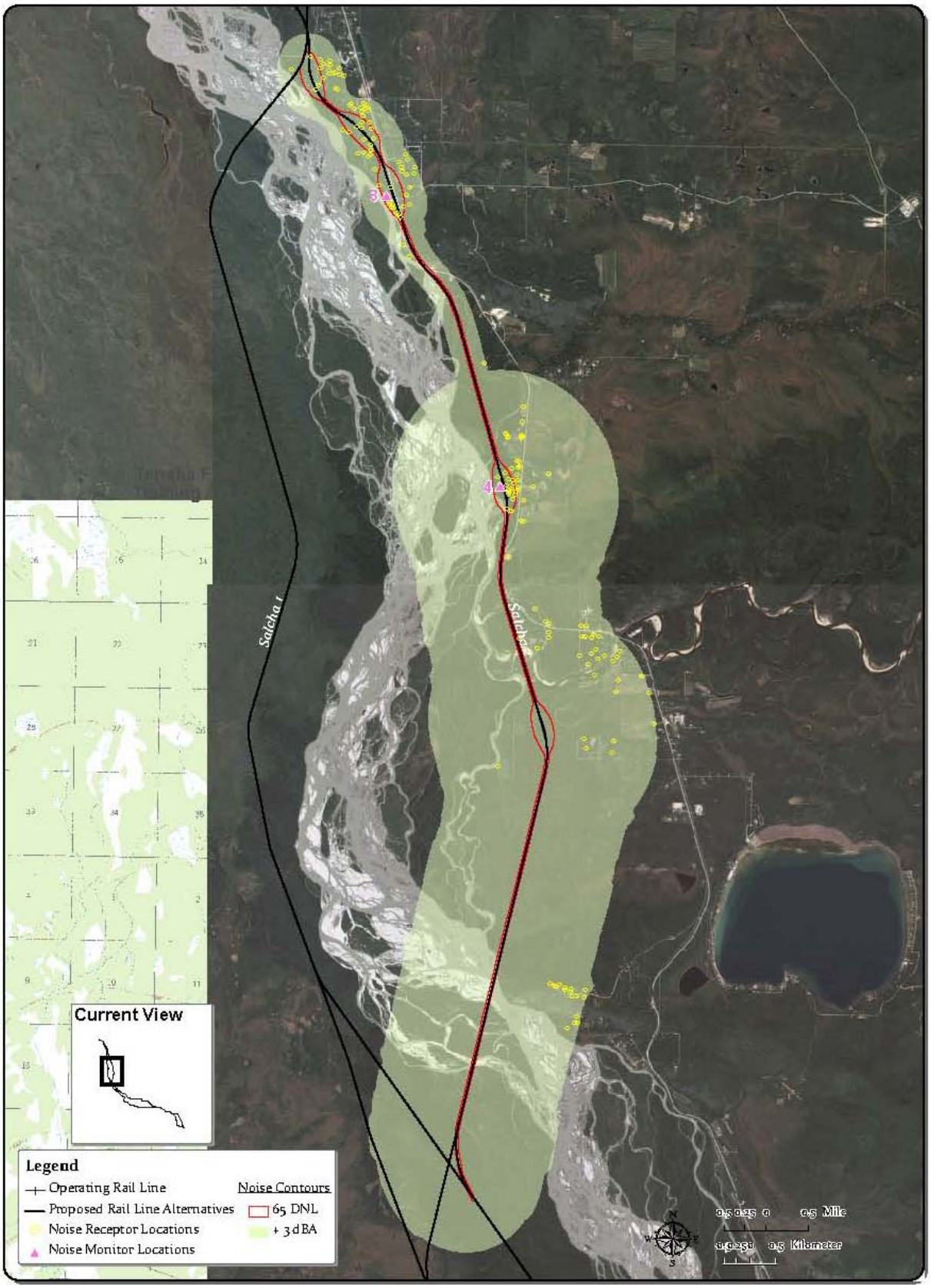

Figure 9-6 – Modeled Noise Contours – Salcha Alternative Segment 2

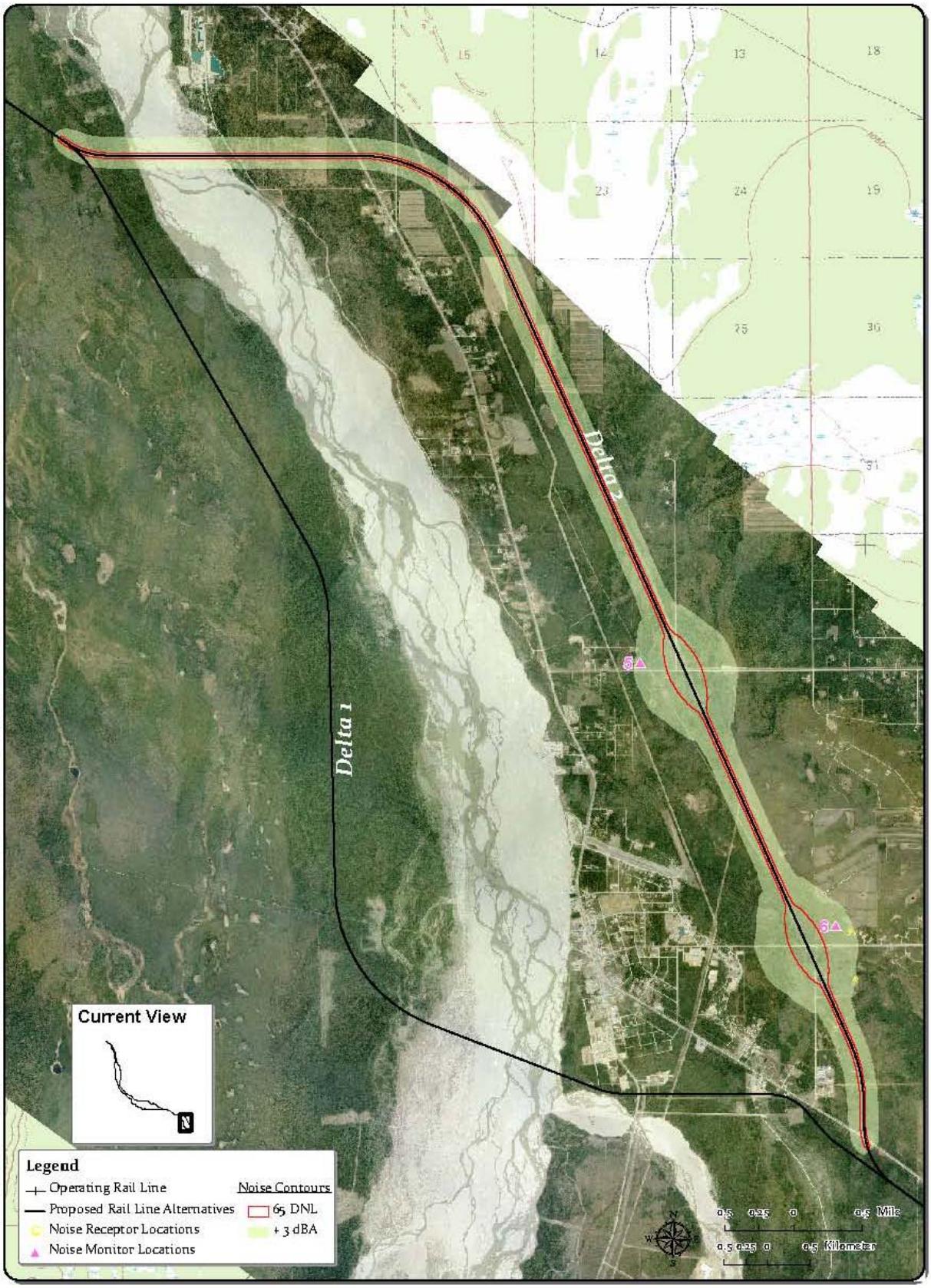

Figure 9-7 – Modeled Noise Contours – Delta Alternative Segment 2

Table 9-4 shows that an estimated 32 receptors near the Salcha Alternative Segment 2 would experience an adverse noise impact; they would be exposed to greater than or equal to 65 DNL and an increase in noise level of 15 to 30 dBA. Ambient noise levels are relatively low in this area, and the proposed NRE would cause a substantial increase in noise.

An estimated four receptors near the Eielson Alternative Segment 3 would experience an adverse noise impact; they would be exposed to greater than or equal to 65 DNL and would experience an increase in noise level up to 15 dBA.

An estimated 446 receptors along the Eielson Branch between FBX and the connection point for the proposed NRE would experience an adverse noise impact at greater than or equal to 65 DNL with an increase of 4 to 10 dBA as a result of the increased rail traffic anticipated in the Applicant's operating plans for the proposed NRE.

The estimated noise impacts along the Eielson Branch are based on the current location of the Eielson Branch track. SEA is aware that realignment of much of the Eielson Branch is under consideration with the goals of reducing transit times and improving safety, in part by reducing the number of at-grade highway rail grade crossings. Elimination of at-grade crossings would reduce locomotive horn noise and would reduce the estimated impacts presented here. In addition, some of the new alignments considered for the Eielson Branch would be farther from developed areas, which would further reduce noise impacts from increased rail traffic resulting from the proposed NRE. SEA used the existing Eielson Branch location in estimating potential impacts because it is uncertain whether or when a realignment of the Eielson Branch may occur and, if it occurs, where the new track location would be.

FRA regulations provide for the establishment of quiet zones in which locomotive horn sounding is not required at at-grade crossings if adequate safety protection is provided through other means. SEA examined the estimated effect that quiet zones could have on sensitive receptor exposure to noise levels of 65 DNL with an increase of 3 dBA or greater along the portion of the Eielson Branch that would be used by rail traffic associated with the proposed NRE. Table 9-5 shows the estimated number of receptors that would experience noise levels of 65 DNL or greater with an increase of 3 dBA or greater as a result of the proposed NRE if locomotive horns were not sounded on the Eielson Branch between FBX and junction with the proposed NRE at Milepost G20.18. The receptor counts in Table 9-5 are based on wayside noise only.

Table 9-5
Noise Receptor Counts with Quiet Zones

Segment[a]	65 DNL[b] & +3 dBA[c]
Existing Track 1	54
Existing Track 2 and 3	3
Existing Track 4	0

[a] See Table 9-2 for segment descriptions
[b] DNL = day-night average noise level.
[c] dBA = A-weighted decibels.

Rail Operations Vibration

There are two ground-vibration impacts of general concern for assessing effects: annoyance to humans and damage to buildings.

Assuming the top train speed anticipated for the proposed NRE, 76 miles per hour, a crest factor (the difference between average and peak vibration levels) of 4, and FTA's fragile building

damage criterion of 0.20 inch per second, the building damage contour width would be 25 feet from the tracks. No buildings would be located within 25 feet of the tracks, so no building damage would be expected.

Vibration impacts with respect to human annoyance are evaluated on the basis of maximum vibration level. Because train speed would not increase along the existing rail line, maximum vibration levels also would not change, and therefore no change in vibration impact would be expected along the existing rail line.

Assuming a maximum speed of 76 miles per hour, the vibration annoyance contour along the proposed new rail line, using FTA's infrequent event criterion of 80 VdB, would be 140 feet from the track centerline. There are four receptors within that distance along Salcha Alternative Segment 2 and SEA estimates that they would experience vibration levels in excess of 80 VdB.

Root-mean-square velocity (VdB) is a measure of ground vibration in decibels used to compare vibration from various sources.

Construction Noise and Vibration

SEA used FTA's general assessment method to evaluate potential construction noise and vibration impacts. This method is used when the details of the construction schedule are not known. The two noisiest pieces of general construction equipment are identified and it is assumed that both pieces of equipment would be operating simultaneously. Table 9-6 shows the assumed two noisiest construction pieces of equipment, corresponding noise levels, and combined noise level.

Table 9-6
Construction Equipment Noise Levels

	Equipment	Average Noise Level at 50 feet (dBA[a])
1	Heavy Truck	88
2	Bulldozer	85
3	1 and 2 Combined	90
4	Pile Driver	101

[a] dBA = A-weighted decibels.

The combined noise level is then estimated at the receptor nearest each alternative segment, and compared with the applicable criteria (see Appendix J, Table J-3). SEA also identified bridge locations where pile driving might occur and estimated pile driving noise and vibration levels at the nearest receptors.

Table 9-7 provides estimated construction noise levels by alternative segment.

Assuming daytime construction, the noise levels shown in Table 9-7 would be below FTA's construction noise limits; therefore no construction noise impacts would be expected.

Table 9-8 provides estimated construction vibration levels by alternative segment.

SEA used a bulldozer as the vibration source to estimate vibration from general construction because this is the type of general construction equipment that imparts the highest vibration levels to the ground. Estimated construction vibration levels at the nearest receptors are below FTA's 0.20 inch per second fragile building damage criterion; therefore no building damage due to vibration would be expected.

Table 9-7
Estimated Construction Noise Levels

Alternative Segment	General Construction		Pile Driving	
	Distance to nearest receptor (feet)	Noise Level at receptor (dBA[b])	Distance to nearest receptor (feet)[a]	Noise Level at receptor (dBA)
Delta 2	1639	59	1639	71
Salcha 2	105	83	1695	70
Salcha 1	410	71	--	--
Eielson 3	360	73	603	79
Eielson 2	2227	57	2227	68
Eielson 1	650	67	--	--

[a] "—" indicates that no receptors were identified near pile driving locations
[b] dBA = A-weighted decibels.

Table 9-8
Estimated Construction Vibration Levels

Alternative Segment	General Construction (Bulldozer)		Pile Driving	
	Distance to nearest receptor (feet)	Vibration Level at receptor (PPV, inches/second)[a]	Distance to nearest receptor (feet)[b]	Vibration Level at receptor (PPV, inches/second)
Delta 2	1,639	0.000168	1,639	0.0029
Salcha 2	105	0.010340	1,695	0.0027
Salcha 1	410	0.001340	–	–
Eielson 3	3,60	0.001629	603	0.0128
Eielson 2	2,227	0.000106	2,227	0.0018
Eielson 1	650	0.000671	–	–

[a] Peak Particle Velocity (PPV) is the instantaneous positive or negative peak of a vibration signal, measured as a distance per time.
[b] "–" indicates that no receptors were identified near pile-driving locations.

To support rail line construction, ARRC proposes to establish and use a rock storage and transfer facility adjacent to the Eielson Branch near Eielson AFB. This would be done if the Tanana River bridge construction would precede construction of the rail line extension to the bridge location. Under these circumstances, rock would be hauled by rail from the Curry quarry to the staging area and then hauled by truck from the staging area to the proposed Tanana River crossing location (for Salcha Alternative Segment 1 or 2). Additional noise would be generated by these construction activities, and would be more noticeable in areas where trucking/rail activity is low or does not currently exist. However, such increased noise due to construction would be temporary and would not constitute an adverse noise impact.

No-Action Alternative

Under the No-Action Alternative, there would be no additional noise or vibration impacts because rail operations would be unchanged from current conditions. SEA estimates that under current conditions, 159 sensitive receptors experience noise levels of 65 DNL or greater (see Table 9-9).

Table 9-9
Noise Receptor Counts for Current Conditions

Segment[a]	65 DNL[b]
Existing Track 1	66
Existing Track 2 and 3	92
Existing Track 4	1

[a] See Table 9-2 for segment descriptions
[b] DNL = day-night average noise level.

9.4 Summary of Noise and Vibration Impacts

Operational noise impacts resulting from increased rail traffic would be greatest in terms of the number of receptors affected on the existing rail line between Fairbanks Depot and the junction with the proposed NRE. An estimated 446 receptors would be exposed to 65 DNL with an increase of 4 to 10 dBA as a result of the additional rail traffic. The Salcha Alternative Segment 2 would have an estimated 32 receptors exposed to 65 DNL, with an increase of 15 to 30 dBA because of low existing ambient sound levels. The Eielson Alternative Segment 3 would have an estimated 4 receptors exposed to 65 DNL with an increase of 15 dBA. No receptors would be exposed to 65 DNL on the other proposed segments.

Four receptors along Salcha Alternative Segment 2 would experience vibration impacts exceeding FTA's 80 VdB criterion for human annoyance.

Assuming daytime construction only, there would be no construction noise and vibration impacts according to FTA's General Assessment method.