KABATA KNIK ARM CROSSING DOT&PF

KNIK ARM CROSSING
FINAL
Traffic Noise Technical Report

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Executive Summary

This technical report summarizes the traffic noise analysis performed for the proposed Knik Arm Crossing (KAC). The proposed KAC spans two distinct geographic regions in the Study Area: the Matanuska-Susitna Borough (Mat-Su) and Anchorage. The Mat-Su contains scattered residential and commercial development, and is largely undeveloped. The few noise-sensitive areas in the Mat-Su portion of the Study area consist of scattered, isolated residences along Point McKenzie Road. Land use in the Anchorage portion of the study area is diverse, including an active military air base, a commercial/industrial shipping port, a freight rail yard and corridor, commercial, residential and park lands. The residential and park areas are classified as noise-sensitive land uses.

The existing ambient acoustical environment in the Mat-Su portion of the Study Area is dominated by aviation noise and noise from occasional vehicular traffic on gravel roads. The existing ambient acoustical environment in the Anchorage portion of the project area is dominated by military and civilian (commercial and tourism-related) aviation noise, noise from the port of Anchorage and rail activities, and from roadway traffic noise.

Existing noise levels were measured at eight locations. Traffic noise impacts, as defined by the Federal Highway Administration (FHWA) and the Alaska Department of Transportation and Public Facilities (DOT&PF) do not presently occur in the Study Area according to the noise monitoring data. The FHWA Traffic Noise Model (TNM) version 2.5 was used to evaluate future traffic noise under a variety of No-Action and Build Alternatives.

Traffic noise impacts were evaluated for 16 noise receivers within the Study Area. Future predicted noise levels at each of the 16 receivers were below the Noise Abatement Criteria for the respective land use category. As a result, noise abatement is not warranted and is not recommended for the receivers in the Study Area.

Traffic noise contours were predicted for the Mat-Su in addition to the three receivers in that portion of the Study Area. The contours indicate the distance that noise impacts extend from the roadway centerline. Residential developers should incorporate traffic noise abatement measures if their developments are built inside the predicted noise impact contour distances in the Mat-Su.

This analysis also evaluated construction-related pile driving in the Knik Arm. Pile driving-induced underwater noise emissions have potential to disturb marine life, particularly beluga whales. Pile driving-induced underwater noise levels, and the resulting underwater propagation and attenuation rates were estimated. The National Oceanic and Atmospheric Administration (NOAA) provided guidelines for safe exposure to underwater impulsive (or pulsed) noise levels. This analysis concluded that deep water and shallow water pile driving-induced noise levels at distances beyond 2,133 feet and 1,083 feet, respectively, will attenuate below the NOAA safe exposure levels for cetaceans.

1.0 Introduction

This Technical Report provides documentation of the Traffic Noise Analysis in the Matanuska-Susitna Borough (Mat-Su) and the Municipality of Anchorage (Anchorage) that would be affected by the proposed Knik Arm Crossing (KAC) project. This report is limited to portions of the Anchorage and Mat-Su Study Area that are within approximately 500 feet of the proposed roadways, and the alternatives forwarded in the Draft Environmental Impact Statement (EIS), which are described below.

2.0 Project Description

More than 80 years of transportation, land use, and economic plans and studies for the Upper Cook Inlet region of Alaska have addressed the need for a Knik Arm crossing project to connect Anchorage with the Mat-Su.

In 2003, the Alaska State Legislature established the Knik Arm Bridge and Toll Authority (KABATA) as a public corporation and an instrumentality of the State of Alaska within the Alaska Department of Transportation and Public Facilities (ADOT&PF). The specific mission of KABATA is to "… develop, stimulate, and advance the economic welfare of the state and further the development of public transportation systems in the vicinity of the Upper Cook Inlet with construction of a bridge to span Knik Arm and connect the Municipality of Anchorage and the Matanuska-Susitna Borough" (Alaska Statutes [AS] chapter 19.75).

In accordance with this mission, the purpose of the proposed KAC project would be to provide improved access and connectivity between Anchorage and the Mat-Su through an efficient and financially feasible crossing of Knik Arm, including adequate connections to the committed roadway network on both sides of Knick Arm. A Knik Arm crossing would:

- improve regional transportation infrastructure to meet existing and projected population growth in Upper Cook Inlet
- enhance the movement of people, freight, and goods between Anchorage, the Mat-Su, and Interior Alaska
- offer safe, alternative connections between regional airports, ports, hospitals, and fire, police, and disaster relief services for emergency response and evacuation.

The length of the proposed bridge crossing of Knik Arm would be approximately 2.5 miles and located approximately 1.25 miles north of Cairn Point (see Figure 1.1). The roadway connection on the Mat-Su side of Knik Arm would be Point MacKenzie Road near the Port MacKenzie District. The roadway connections on the Anchorage side of Knik Arm would be the A-C and Ingra-Gambell Couplets, generally in the Port of Anchorage/Government Hill/Ship Creek area. The total length of the project from the intersection of Point MacKenzie and Burma Roads to the intersections of the A-C and Ingra-Gambell Couplets with Third Avenue would be approximately 19 miles.

The proposed project would be a controlled access toll facility with a toll plaza located in the Mat-Su near the western bluff of Knik Arm. The proposed project would be classified as a rural principal arterial in the Mat-Su and across Knik Arm, transitioning to an urban principal arterial in Anchorage in the vicinity of the Port of Anchorage. The proposed project would be phase-constructed as travel demand warrants and would be anticipated to generally be an initial two-lane facility with expansion to a four-lane facility by 2030, the design year. Initial construction would include a connection to the existing A-C Couplet and, by approximately 2022–2025, to a new viaduct (elevated bridge) connection across the Ship Creek rail yard. The viaduct would be constructed to connect with the Ingra-Gambell Couplet.

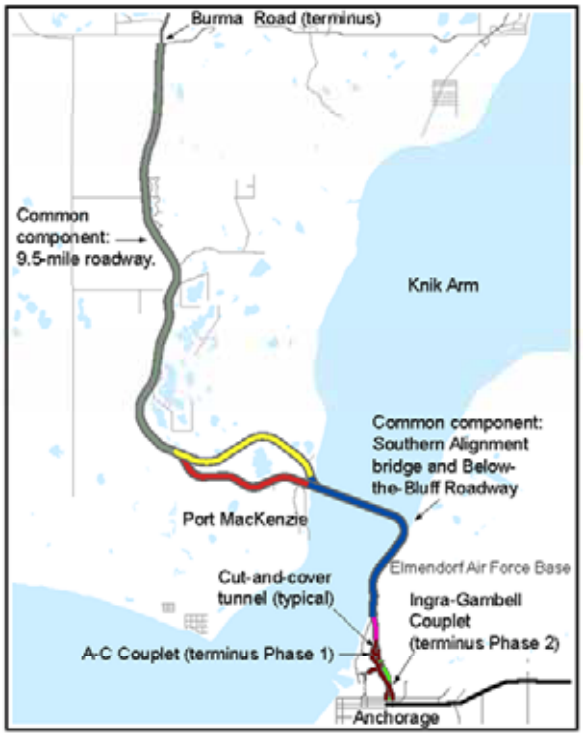


Figure 1.1 shows that the proposed project begins at Burma Road and ends in Downtown Anchorage. Components common to all routes being considered are also identified.

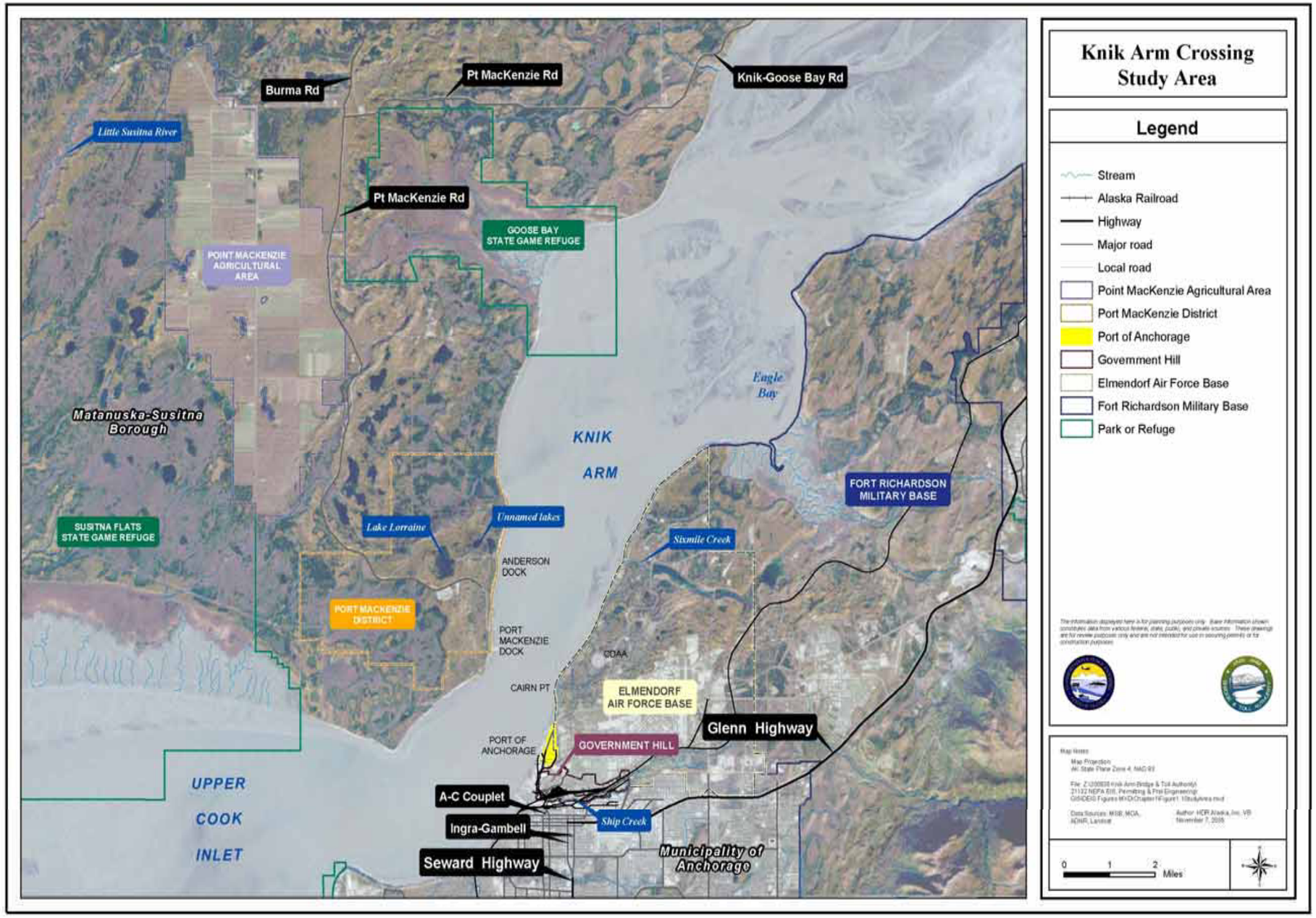
Right-of-way widths for the project vary from approximately 400 to 450 feet in the Mat-Su, approximately 66 feet of pile-supported bridge deck structure across Knik Arm, approximately 83 feet below the east bluff along the Anchorage approach, approximately 83–95 feet between the Port of Anchorage (POA) and Elmendorf Air Force Base (Elmendorf), transitioning to a cut-and-cover tunnel under Government Hill either along a Degan Street or Erickson Street area alignment, and extending southward to the project terminus at Third Avenue along approximately 80 feet of pier-supported viaduct across the Ship Creek rail yard.

The Federal Highway Administration (FHWA) is preparing an EIS as part of the National Environmental Policy Act (NEPA) process to evaluate a Knik Arm crossing sponsored by the Knik Arm Bridge and Toll Authority (KABATA).

2.1 Description of the Proposed KAC Project Study Area

The Study Area for the proposed KAC project is located within the boundaries of Anchorage and the Mat-Su in the Upper Cook Inlet region of Southcentral Alaska (Figure 1.2). This area has a combined population of nearly 350,000, which represents over 50 percent of Alaska's total population. Separating the Anchorage and Mat-Su portions of the Study Area is a 30-mile-long waterway, Knik Arm, which varies in width from 2 to 6 miles. Anchorage is just 2 to 3 miles from Port MacKenzie and its adjacent industrial district in the Mat-Su.

Figure 1.2 KAC Draft EIS Study Area. The Study Area has no specific, fixed boundaries because the Study Team has created a unique one for each resource or issue assessed in the Draft EIS. Study Area, thus, has a context-specific meaning that shifts from one resource to another.



Although this physical separation consists of only a short span of waterway, the only current surface transportation access between Anchorage and the Port MacKenzie District (port district) is by 80 miles of existing roadway around the head of Knik Arm.

Located along the eastern shore of Knik Arm, Anchorage consists of 1,961 square miles, 84 percent of which is occupied by National Forest, State Parklands, and tidelands. With an additional 6 percent occupied by military reservations, only about 10 percent of the entire municipality is inhabited and available to accommodate existing and future growth. Most residents of Anchorage live in the Anchorage Bowl, the most urbanized portion of the municipality. The Anchorage Bowl occupies approximately 112 square miles and is bounded by Chugach State Park, Knik and Turnagain Arms, Elmendorf, and Fort Richardson Military Base (Fort Richardson). Anchorage residents outside the Anchorage Bowl live either further north in the suburban communities of Chugiak-Eagle River or in small residential areas along the Glenn Highway and Turnagain Arm. Also located within this portion of the Study Area are the POA—a vital intermodal facility—and the adjacent Ship Creek industrial area.

On the western shore of Knik Arm, the Mat-Su consists of an area of 24,683 square miles, which encompasses approximately 23 percent of all private land in the state of Alaska. Because the Mat-Su has substantial undeveloped land available, it creates an alternative to more costly and limited residential, commercial, and industrial lands within Anchorage. This has resulted in numerous changes that have recently taken place or will be occurring in the Mat-Su, including construction of Port MacKenzie in the late 1990s, existing and planned expansion of the connecting transportation network to and from Port MacKenzie, and planned development of the 10,000-acre port district. The Mat-Su Borough is also developing a ferry link between Port MacKenzie and the POA; the ferry is projected to begin operation in 2007–2008.

2.2 Alternatives

The proposed KAC project would begin at the intersection of Point MacKenzie and Burma Roads and follow the existing roadway alignment south to the western boundary of the port district. From here, there would be two alternative routes for getting to the proposed bridge crossing. The proposed Point MacKenzie Road Alternative would use the existing Point MacKenzie Road most of the way through the port district before deviating from the established road and heading toward the bridge crossing near the western bluff. The proposed Northern Access Alternative would skirt the core port area on the north side on a new alignment. With either proposed alternative, there would be a toll plaza and intersection/access road to allow access to and from Port MacKenzie.

The proposed crossing itself would measure approximately 2.5 miles, bluff-to-bluff, across Knik Arm. The proposed bridge would begin approximately 1,500 feet south of Anderson Dock on the Mat-Su side and end 1.25 miles north of Cairn Point on the Anchorage side.

From the eastern bridge abutment, the proposed Anchorage approach road would travel southwest on fill along the tidelands and below the bluff, toward Cairn Point, then turn southward, closely following the natural curve of the shoreline, where the proposed roadway would climb to and parallel the eastern boundary of the POA. From this point, the remainder of

the route would connect to the A-C Viaduct and the proposed Ingra-Gambell Viaduct by way of either of two routes: the Erickson Alternative or the Degan Alternative.

The proposed Degan Alternative would follow the alignment of Degan Street through a cut-and-cover tunnel that would initially connect to East Loop Road with an at-grade, T-intersection (Phase 1). As travel demand would warrant, the route would continue on the proposed new Ingra-Gambell Viaduct over the Ship Creek rail yard before tying into the Ingra-Gambell Couplet at 3rd Avenue. At that time, Loop Road would be elevated over the proposed KAC route to provide access to Government Hill and Elmendorf. The proposed Erickson Alternative would be similar, but the cut-and-cover tunnel would align with Erickson Street and connect directly into Loop Road in Phase 1 (ramps would continue to provide access to Government Hill and Elmendorf). When travel demand would warrant, or Phase 2, the route would continue in a parallel cut-and-cover tunnel under Erickson Street onto the proposed Ingra-Gambell Viaduct, tying into the Ingra-Gambell Couplet at 3rd Avenue.

2.3 Preferred Alternative

FHWA screened the range of alternatives against criteria for purpose and need and technical criteria to identify reasonable alternatives for detailed study in the Draft EIS. Based on these screening criteria and subsequent detailed evaluations, FHWA has identified a Preferred Alternative.

The preferred approach route to the proposed Knik Arm Bridge on the Mat-Su side is Point MacKenzie Road from the intersection with Burma Road south to the Port MacKenzie District and connecting to the Northern Access Alternative through the port district. FHWA chose this route because it would avoid wetlands, would not impact Port MacKenzie operations, and is favored by Mat-Su Borough and Port MacKenzie officials.

The proposed Southern Alignment is the preferred route for the bridge to cross Knik Arm. The Southern Alignment, with its accompanying Below-the-Bluff Roadway on the Anchorage approach, would be the most technically feasible and practical alignment that would avoid the Cairn Point Trench (a submarine trough), would not impact military mission and operations at Elmendorf, and would minimize potential impacts to beluga whales that congregate in areas of Knik Arm further to the north.

An 8,200-foot-long pier-supported bridge is preferred over a 14,000-foot-long bridge because a shorter bridge would require fewer piers, result in less construction noise and pile driving impacts that might adversely affect beluga whales and marine fishes, would require shorter in-water construction time, and would have substantially lower construction costs.

The preferred Anchorage approach to the proposed bridge would be a cut-and-cover tunnel under Government Hill, along either of the proposed Degan or Erickson Street alignments, to connect initially to the A-C Couplet, and ultimately to the Ingra-Gambell Couplet.

All reasonable alternatives evaluated in the Draft EIS are under consideration and have been developed to a comparable level of detail. Final identification of a Recommended Alternative will not occur until the alternatives, impacts, written comments on the Draft EIS, and comments

received at the public hearings have been fully evaluated and considered. The Recommended Alternative will be provided in the Final EIS.

3.0 Methodology

Noise is defined as unwanted sound. It may consist of a variety of sounds of different intensities across the entire frequency spectrum. Noise is measured in units of decibels (dB), on a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight." The A-weighted decibel scale (dBA) corresponds to the sensitivity range for human hearing. A noise level change of 3 dBA is barely perceptible to average human hearing, whereas a 5-dBA change in noise level is clearly noticeable. A 10-dBA change in noise level is perceived as a doubling of noise loudness. Table 3-1 shows noise levels associated with common, everyday sources and places in context the magnitude of noise levels discussed here.

Table 3-1. Common noise sources and levels

Sound pressure level (dBA)	Typical sources
120	Jet aircraft takeoff at 100 feet
110	Same aircraft at 400 feet
90	Motorcycle at 25 feet
80	Garbage disposal
70	City street corner
60	Conversational speech
50	Typical office
40	Living room (without TV)
30	Quiet bedroom at night

Source: Environmental Impact Analysis Handbook, ed. by Rau and Wooten, 1980

Environmental noise is typically expressed using a descriptor that characterizes both the volume (or intensity level of the noise) and the time associated with the noise event. L_{eq} is the noise level that contains the same amount of acoustic energy as the time-varying levels of the actual measured (or modeled) noise event. In other words, it is an energy-based average noise level. This study uses the one-hour equivalent level, or $L_{eq(h)}$.

The FHWA established Noise Abatement Criteria (NAC) to help determine the noise impacts associated with highway development projects. The NAC are noise levels assigned to various land uses (e.g., picnic areas, churches, commercial land, and undeveloped land) grouped by their sensitivity to traffic noise levels. The NAC represent the maximum traffic noise levels that allow uninterrupted use within each activity category. Table 3-1 lists the land activity categories included in the FHWA-established NAC, and the sound level (occurring over a one-hour period, or $L_{eq(h)}$) that triggers noise abatement considerations for that land use category. Sound levels are reported in decibels using the A-weighted scale (dBA).

The FHWA definition of a traffic noise impact (23 CFR § 772) contains two criteria; only one is required to be met. Traffic noise impacts are defined as impacts that occur when the predicted future traffic noise levels:

- approach or exceed the NAC given in Table 3- (ADOT&PF has defined "approach" as described below)
- substantially exceed the existing noise levels (ADOT&PF has defined "substantially exceed" as described below)

Table 3-2. Noise abatement criteria

Activity category	$L_{eq(h)}$	Description of activity category
A	57 dBA (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 dBA (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 dBA (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	No limit	Undeveloped lands
E	52 dBA (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: Federal-Aid Highway Program Manual 7-7-3, "Procedures for Abatement of Highway Traffic Noise and Construction Noise," 1982

The ADOT&PF Noise Abatement Policy states that a noise level of 65 dBA approaches the NAC (for category B) and a 10-dBA increase from existing noise levels is a substantial increase.

The FHWA Traffic Noise Model (TNM), version 2.5, was used to predict future traffic noise levels. TNM is a three-dimensional computer model that calculates traffic noise levels using:

- vehicle mix and volume, using five default vehicle types
- vehicle speeds
- three-dimensional roadway geometry
- receiver locations (homes, parks, schools, etc.)
- ground cover and terrain between the roadway and receivers
- a database of acoustical measurements

This analysis evaluated traffic noise under the No-Action Alternative and the six build alternatives. Existing noise levels were measured in the Study Area (presented in Section 3.5.2). The noise environment in the Study Area consists of noise from the current and planned roadway network, as well as non-traffic noise sources, such as aircraft, railroad, and industrial noise. Although these non-traffic noise sources contribute to the overall noise environment, the calculations of future noise levels include only traffic-related noise for comparison with the NAC

(see Table 3-), consistent with FHWA policy and guidance. The comparison of projected noise levels from the project under study to the NAC determines where noise impacts are projected to occur and where noise abatement should be considered. Noise abatement considerations include various feasibility and reasonableness criteria contained in the ADOT&PF Noise Abatement Policy.

4.0 Affected Environment

The proposed KAC spans two distinct geographic regions in the Study Area: the Matanuska-Susitna Borough and Anchorage. The two regions are connected by the Knik Arm Crossing.

Matanuska-Susitna Borough. The few noise-sensitive land uses that exist in the Mat-Su portion of the Study Area consist of scattered, isolated residences along Point McKenzie Road. A university agricultural research station has facilities for overnight sleep—although at the time of a late summer 2005 Study Team reconnaissance, it did not appear to be in active use. For the purposes of the traffic noise analysis, the Study Team considered it to be a residential land use.

The Crossing. Water on the surface of the Knik Arm is classified as an Activity Category D land use (undeveloped). There is no NAC established for Activity Category D land uses, which are not considered noise-sensitive and therefore do not warrant noise abatement. In addition, the POA and Port MacKenzie industrial facilities are classified as Activity Category C land uses. Activity Category C land uses are generally not considered noise-sensitive and noise abatement is usually considered unreasonable for these types of land uses.

Anchorage. Land use in the Anchorage portion of the Study Area is diverse. Land use in the vicinity of the initial proposed bridge touch-down area is undeveloped. The POA is an industrial facility and not considered noise-sensitive. Elmendorf Air Force Base (AFB) is a large, active military campus with residential and administrative areas, including a heavily used airport facility. Additional residential areas exist off-site of Elmendorf AFB, primarily in the nearby Government Hill neighborhood. Occupying most of a peninsula-like area, Government Hill is almost entirely residential, with small areas of commercial land use and park lands; two park areas, Harvard Park and Sunset Park, are of interest to this Study. Harvard Park includes facilities for tennis, dancing, and the sport of curling. This area exists between Harvard Avenue and Loop Road. Across Loop Road lies Sunset Park, an open space available for public recreation. Another residential area lies adjacent to this park, south of Elmendorf AFB. Government Hill School, an elementary school, lies between Elmendorf AFB and the residential areas of Government Hill.

Moving south through the Anchorage portion of the Study Area, Ship Creek lies at the base of a steep but shallow valley. The Alaska Railroad passenger service tracks and freight train tracks serving the POA share the valley floor with Ship Creek, along with some commercial/light industrial land uses and a restaurant. To the south, terrain rises to meet densely developed Downtown Anchorage. Land use in the vicinity of the project terminus in Downtown Anchorage includes commercial businesses, hotels, parking lots, and some residential homes.

4.1 Existing noise levels

The ambient acoustic environment in the Mat-Su portion of the Study Area is dominated by aircraft noise and noise from intermittent roadway traffic. Traffic in this portion of the Mat-Su is very light and infrequent. The ambient acoustic environment in the Anchorage portion of the Study Area is dominated by frequent military, commercial, and recreational aircraft noise events; locomotive and freight train noise; noise from the POA; noise from traffic on existing roadways; and noise from other daily activities (lawn mowing, landscaping, recreation, etc.). Aircraft and train noise and noise from occasional local roadway traffic dominate the acoustic environment in the residential areas of Government Hill. Traffic noise and aircraft and train noise dominate the ambient acoustic environment in the southern portions of the Study Area (Downtown Anchorage).

Table 4- shows existing noise levels measured in the Study Area during peak traffic periods. Noise levels are expressed using the L_{eq} descriptor (explained above). Figure 4.1 displays the locations of these noise measurements as well as other sites evaluated in this noise analysis. In addition to the eight noise measurement sites, eight additional noise receiver sites were evaluated for this noise study. All 16 noise receiver sites were evaluated for future noise conditions using the No-Action and build alternatives, as described in Section 5.

Table 4-1. Existing noise levels in selected Study Area locations

Receiver identification	Description or location	Receiver type	Existing L_{eq} (dBA)
3	Private driveway off Point MacKenzie Road	Residential	57
4	Government Hill School	School	51
6	309 Harvard Avenue	Residential	59
9	Sunset Park south of Vine Avenue	Recreational	60
13	C Street and 3rd Avenue	Commercial	63
14	A Street and 3rd Avenue	Commercial	66
15	Gambell Street and 3rd Avenue	Residential	64
16	Ingra Street and 3rd Avenue	Commercial	67

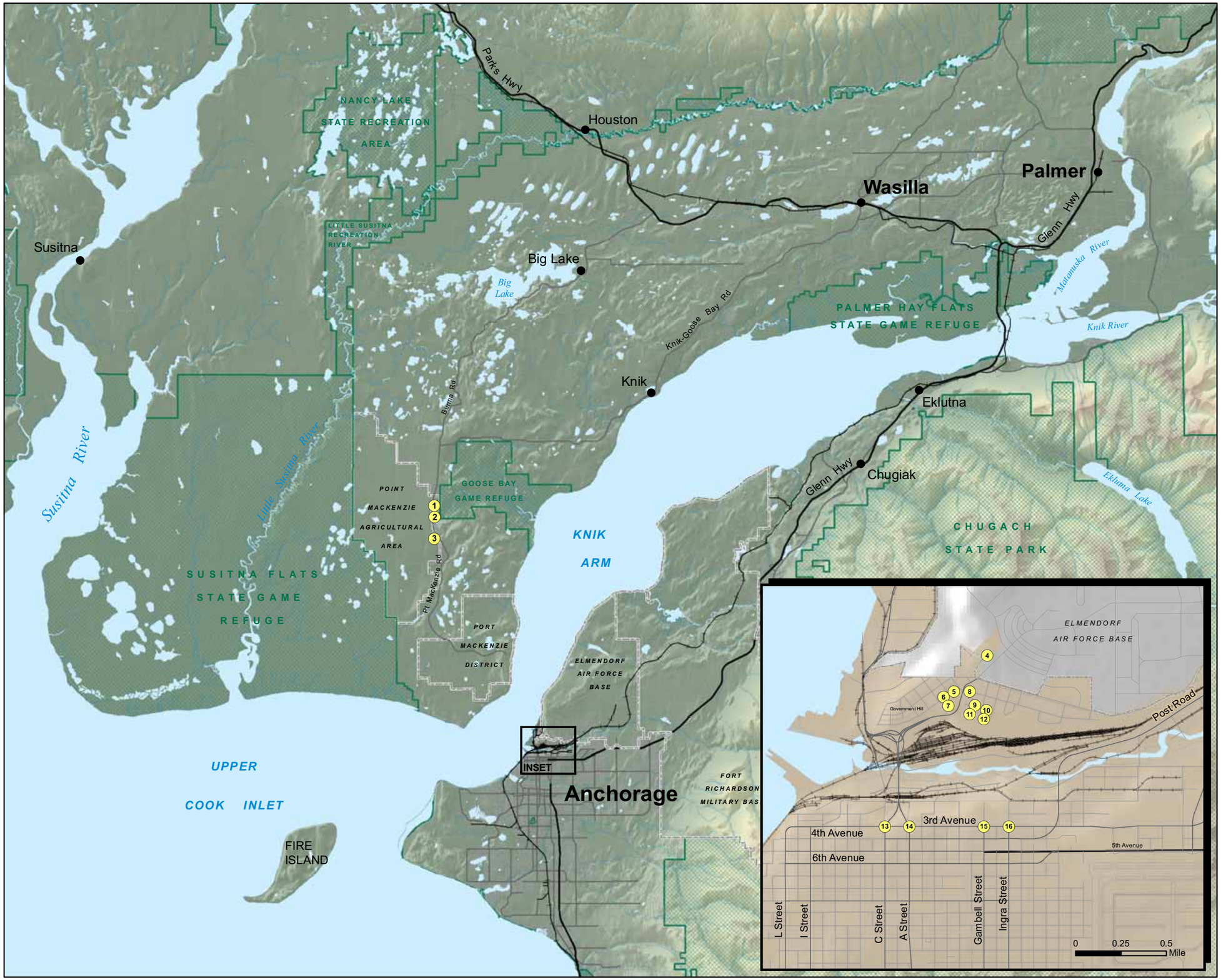
5.0 Impacts and Environmental Consequences

The traffic noise analysis completed for the proposed KAC project identified existing and predicted future traffic noise levels from the project. Traffic noise impacts were evaluated in accordance with FHWA and ADOT&PF policies and guidelines.

Noise Monitoring and Receiver Locations

Legend

- Noise receiver
- Alaska Railroad
- Highway
- Major road
- Local road
- Stream
- Park or refuge



The information displayed here is for planning purposes only. Base information shown constitutes data from various federal, state, public, and private sources. These drawings are for review purposes only and are not intended for use in securing permits or for construction purposes.

Map Notes:

Map Projection:
AK State Plane Zone 4, NAD 83

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Data Sources: MSB, MOA, HDR, GeoNorth

Author: HDR Alaska, Inc. JC
April 10, 2006

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5.1 No Action Alternative

Anchorage. Under the No-Action Alternative, traffic volumes on the existing roadway network increase as population grows in the Anchorage portion of the Study Area. The existing roadway network was modeled in TNM with the projected future traffic conditions to evaluate the No-Action Alternative. Traffic noise analysis results indicated an increase in traffic noise corresponding to the increase in traffic volumes. Table shows TNM results for the No-Action Alternative.

The Crossing. The No-Action Alternative does not introduce a new traffic noise source to the surface of the Knik Arm. The ambient acoustic environment continues to be dominated by noise from aviation, POA and Port MacKenzie, and nature (wind, waves, etc.).

Matanuska-Susitna Borough. The No-Action noise levels incorporate projected new development in the Port MacKenzie facility and the associated increase in traffic volumes and truck traffic along Port MacKenzie Road. No-Action noise levels show a 3-dBA to 5-dBA increase over existing noise levels in 2020 and a 6-dBA to 7-dBA increase over existing noise levels in 2030. Table shows TNM results for the No-Action Alternative.

5.2 Build Alternatives

The following sections describe the direct and indirect impacts anticipated with operation of the proposed project. Each alternative and variations within each alternative are described separately because of their respective impacts.

As previously mentioned, the noise environment in the study area includes non-traffic noise from the POA facility, planned POA expansions, ARRC operations, aircraft flights from the Elmendorf AFB and the Ted Stevens Anchorage International Airport. Noise from these non-traffic sources is expected to continue during operation of the proposed KAC facility and will contribute to the overall noise environment within the study area.

Matanuska-Susitna Borough. Noise-sensitive land uses in the Mat-Su are isolated and scattered. Predicted future traffic noise levels were evaluated at three individual receivers within the Mat-Su portion of the Study Area. Table shows TNM results for the Mat-Su area receivers.

Future build noise levels for each of the three receivers in the Mat-Su area are projected to range from 60 dBA to 64 dBA, depending on the alternative, and are not expected to approach the NAC for residential areas. As a result, noise abatement is not warranted for the three receivers.

To facilitate noise-compatible land use planning for future development in the Mat-Su, separate calculations were conducted and expressed as a distance from the centerline to the point at which traffic noise impacts would occur at residential land uses (the traffic noise contour distance). TNM results indicated that traffic noise impacts would be predicted to occur within 200 feet of

Table 5-1. Existing and predicted noise levels

Receiver		Existing and predicted noise levels (L_{eq} [dBA])							
		Noise abatement criteria noise level	Existing noise level	2020 alternative			2030 alternative		
				No-Action	Degan Phase 1	Erickson Phase 1	No-Action	Degan Phase 2	Erickson Phase 2
Mat-Su area									
1	Sleeping quarters	65	57	62	64	64	64	63	63
2	House in Holsten Heights	65	57	60	63	63	63	61	61
3	Farm house on Pt. McKenzie	65	57	62	64	64	64	63	63
Government Hill area									
4	Government Hill School	65	51	43	48	49	44	49	49
5	Harvard Ave. and Erickson St.	65	59	58	61	62	58	63	62
6	Harvard Ave.	65	59	52	56	55	53	59	55
7	Harvard Park	65	59	56	59	63	57	62	63
8	Ash Pl. and Hollywood Dr.	65	60	52	54	57	53	57	58
9	Birch St. and Vine Ave.	65	59	52	51	56	52	58	61
10	Birch St. and Sunset Dr.	65	59	49	47	51	49	60	64
11	Sunset Park	65	60	57	58	61	58	63	62
12	Sunset Drive	65	60	46	46	50	46	60	64
Downtown Anchorage area									
13	C St. and 3rd Ave.	70	63	65	67	68	66	66	66
14	A St. and 3rd Ave.	70	66	62	64	64	62	62	63
15	Gambell St. and 3rd Ave.	65	64	57	53	56	58	62	64
16	Ingra St. and 3rd Ave.	70	67	60	61	63	59	66	67

the centerline of the proposed ROW. Therefore, any future residential land uses immediately adjacent to the ROW could be impacted by traffic noise. More noise-compatible uses, such as commercial or retail activities, would not be affected at this distance. In areas where the ROW might be wider than 400 feet, traffic noise impacts are not predicted at the ROW.

The Crossing. The surface of the Knik Arm is classified as an Activity Category D land use (undeveloped). There is no NAC established for Activity Category D land uses, which are not considered noise-sensitive and therefore do not warrant noise abatement. No receivers were evaluated on the surface of the Knik Arm.

Anchorage. The Anchorage side of the Study Area includes two primary alignment alternatives: the Degan Alternative and the Erickson Alternative. In the traffic noise analysis, the Study Team evaluated both alternatives and also both phases of each alternative (the A-C Couplet and the proposed Ingra-Gambell Couplet).

Near the Government Hill neighborhood, either proposed alignments would be in a cut-and-cover tunnel, which would dramatically reduce the proposed roadway's traffic noise impacts to adjacent properties and would allow continued at-grade uses above the tunnel following completion of the project's construction. The TNM analysis incorporated an evaluation of the roadway in a simulated tunnel through this portion of the Study Area.

Degan Alternative

A-C Couplet

Under this phase of the Degan Alternative, the proposed roadway would be in a tunnel beneath the west Government Hill neighborhood. The proposed roadway would connect with Loop Road, and traffic would travel on A and C Streets in Downtown Anchorage. Table shows the TNM results for this build alternative under Phase 1 of the proposed project.

The nine modeled receivers in the Government Hill area would experience noise levels from Phase 1 of this alternative ranging from 47 dBA to 61 dBA. The four receivers in the Downtown Anchorage area, three of which are commercial land uses, would experience noise levels from this phase of the alternative ranging from 53 dBA to 67 dBA. None of the receivers is projected to approach the NAC; therefore, noise abatement is not warranted for these receivers under this phase of the Degan Alternative.

Ingra-Gambell Couplet

Under the second phase of the Degan Alternative, the proposed roadway would connect with Ingra and Gambell Streets in Downtown Anchorage. Table shows TNM results for this alternative under Phase 2 of the proposed project.

The nine modeled receivers in the Government Hill area would experience noise levels from Phase 2 of this alternative ranging from 49 dBA to 63 dBA. The retaining walls immediately outside of the cut and cover tunnel provide effective shielding for the nearby Sunset Park and the east Government Hill neighborhood. The four receivers in the Downtown Anchorage area would experience noise levels from this phase of the alternative ranging from 62 dBA to 66 dBA. None

of the receivers is projected to approach the NAC; therefore, noise abatement is not warranted for these receivers under this phase of the Degan Alternative.

Erickson Alternative

A-C Couplet

Under this phase of the Erickson Alternative, the proposed roadway would be in a tunnel beneath the west Government Hill neighborhood. The proposed roadway would connect with Loop Road with traffic traveling on the existing A-C Couplet in Downtown Anchorage. Table shows TNM results for this alternative under Phase 1 of the proposed project.

The nine modeled receivers in the Government Hill area would experience noise levels from Phase 1 of this alternative ranging from 49 dBA to 63 dBA. The four receivers in the Downtown Anchorage area, three of which are commercial land uses, would experience noise levels from this phase of the alternative ranging from 56 dBA to 68 dBA. None of the receivers is projected to approach the NAC; therefore, noise abatement is not warranted for these receivers under this phase of the Erickson Alternative.

Ingra-Gambell Couplet

Under the second phase of the Erickson Alternative, the proposed roadway would connect with Ingra and Gambell Streets in Downtown Anchorage. Table shows TNM results for this alternative under Phase 2 of the proposed project.

The nine modeled receivers in the Government Hill area would experience noise levels from Phase 2 of this alternative ranging from 49 dBA to 64 dBA. The retaining walls immediately outside of the cut and cover tunnel provide effective shielding for the nearby Sunset Park and the east Government Hill neighborhood. The four receivers in the Downtown Anchorage area would experience noise levels from this phase of the alternative ranging from 63 dBA to 67 dBA. None of the receivers is projected to approach the NAC; therefore, noise abatement is not warranted for these receivers under this phase of the Erickson Alternative.

5.3 Construction Noise Impacts

Short-term noise impacts may be experienced during the construction of any part of the proposed improvements. The quantification of such impacts is difficult without data on this project's construction schedule and equipment use. Therefore, several assumptions were made in order to predict the approximate noise levels at the ROW. These predictions are based on the use of the noisiest equipment expected to be used during each construction stage of a typical roadway project. Data on construction equipment noise are available from the U.S. Department of Transportation document entitled *Highway Construction Noise: Measurement, Prediction and Mitigation* (USDOT, 1977).

Because of the short-term nature of construction noise, it is measured using the maximum noise level (L_{max}) descriptor, which represents the highest instantaneous noise level expected to occur. The noisiest phase of a roadway construction project is typically the grading and earthwork phase, with maximum noise levels around 93 dBA L_{max} measured at the ROW. Site clearing

activities typically generate noise levels around 88 dBA L_{max} at the ROW, while base preparation and foundation work typically generates noise levels around 85 dBA L_{max}. Although these noise levels would be present for only a short period of time, they could impact noise-sensitive receivers located near the ROW. Provisions should be included in the plans and specifications to require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as restrictions on night time operations, compliance with the local noise codes, and maintenance of muffler systems and insulator housings.

As previously mentioned, the noise environment in the study area includes non-traffic noise from the POA facility, planned POA expansions, ARRC operations, aircraft flights from the Elmendorf AFB and the Ted Stevens Anchorage International Airport. Noise from these non-traffic sources is expected to continue during construction of the proposed KAC facility and will contribute to the overall noise environment within the study area.

During construction of the proposed bridge alternative, pile-driving would be necessary. Accompanying impact pile-driving construction techniques would be the production of strong pulses of underwater sound. Because of the effect such sounds could have on marine life, particularly beluga whales, the Study Team sought to estimate the intensity, dominant frequency ranges, instantaneous peak pressures, depths, and propagation loss distances such sounds would likely entail. The primary source of these estimates is from underwater recordings of vibratory and impact pile driving sounds made during modifications to the Port MacKenzie dock in August 2004 (Blackwell 2005).

Blackwell (2005) analyzed impact pile-driving pulses using a time series analysis routine that had been previously developed for transient pulses less than a second in duration. Four parameters are associated with each pulse:

- peak pressure – the instantaneous maximum of the absolute value of the sound pressure, in dB re 1 µPa (sound intensity, in decibels, referenced to 1 micro-Pascal [air reference level = dB re 20 µPa])
- pulse duration – the time interval between the arrival of 5 percent and 95 percent of the total estimated sound energy in the pulse, in seconds (s)
- pulse sound pressure level (SPL) – averaged over the pulse duration, in dB re 1 µPa
- pulse sound exposure level (SEL) – the squared instantaneous sound pressure integrated over the pulse duration, in dB re 1 $\mu Pa^2 \cdot s$. This measure is roughly related to the energy in the pulse. It excludes the contributions of background sound as characterized by measurements between pulses.

NOAA Fisheries does not have any current guidelines for safe exposure levels of cetaceans or other vertebrates to *continuous* sounds underwater (such as those associated with vibratory pile driving); guidelines do exist, however, for *pulsed* sounds (such as those associated with impact pile driving). NOAA Fisheries specifies that cetaceans should not be exposed to pulsed sounds exceeding 180 dB re 1 µPa SPL.

The broadband SPLs propagated during the Port MacKenzie pile driving reached 189 and 190 dB re 1 µPa, as recorded by deep and shallow hydrophones, respectively, at 203 feet from

the sound source. At the same distance, and using the same hydrophones, Blackwell (2005) recorded peak levels of 206 and 204 dB re 1 µPa, and SELs reached 178 and 180 dB re 1 $\mu Pa^2 \cdot s$. Blackwell reported that received levels decreased with distance from the source by 16–18 and 21–23 dB per tenfold change in distance for the deep and shallow hydrophones, respectively. While peaks were at 350–450 Hz, Blackwell found that pulse energy was mainly in the range of 100–2,000 Hz.

Blackwell calculated that the distances beyond which SPLs would decrease below 180 dB re 1 µPa, the NOAA Fisheries threshold for cetaceans, would be 2,133 feet and 1,083 feet for the deep and shallow hydrophones, respectively.

Vibratory pile-driving produced mean values of 163–164 dB re 1 µPa at a distance of 184 feet from the driven pipe for the deep and shallow hydrophone depths. These levels decreased with distance from the source by about 22 and 29 dB per tenfold change in distance for the two hydrophone depths, respectively. Blackwell recorded energy during the vibrating activity in the range of 400–2,500 Hz.

5.4 Mitigation Measures and Permit Requirements

Based on the noise analysis, noise mitigation is not warranted for any of the receivers in the project area.

Having updated, well-maintained equipment, effective muffler systems, insulated housings for generator motors, and a keen understanding of the daily work location when scheduling operations would substantially reduce construction noise impacts. For those sensitive areas in Anchorage, the builder would be required to obtain a noise ordinance permit for any evening or early morning operations, which may restrict such operations to the hours of 6am to 10pm. In the Mat-Su, the contractor should use due care in night hauling and otherwise schedule operations during normal daytime hours.

This noise analysis should be confirmed during the final design stage to evaluate the potential that changes in the final design may produce traffic noise in excess of those predicted in this analysis.

As new residential development occurs, especially in the Mat-Su portion of the Study Area, developers may choose to install noise barriers if they locate residences within the noise impact contour distances identified in this report.

6.0 References

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