CITY OF BETHEL
PLANNING COMMISSION
THURSDAY, NOVEMBER 9, 2023, 6:30 PM
LOCATION: 300 CHIEF EDDIE HOFFMAN HIGHWAY, BETHEL ALASKA

Join Zoom Meeting: https://us06web.zoom.us/j/86346034837?pwd=K1pRalhlblg0VDBpdGt5b3lRQlcxQT09
Meeting ID: 863 4603 4837 Passcode: 221221
Phone Toll Free: 888 475 4499 833 548 0276
833 548 0282 877 853 5257

MEMBERS		STAFF
Kathy Hanson, Chair	Lorin Bradbury, Vice Chair	Pauline Boratko, Ex Officio Member
Sophie Swope, Council Rep.		planning@cityofbethel.net
Alex Wasierski	Stosh Hoffman	907-543-5301
Haley Hanson	Greg Morgan, Alternate 1	
Shadi Rabi	Vacant Seat, Alternate 2	

I. CALL TO ORDER

II. ROLL CALL

III. PEOPLE TO BE HEARD – FIVE MINUTES PER PERSON

A. Please submit written public comments to planning@cityofbethel.net by 4:00 p.m. the day of the meeting.

IV. APPROVAL OF AGENDA

V. APPROVAL OF MEETING MINUTES

A. Approval of October 2023 Meeting Minutes

VI. UNFINISHED BUSINESS

VII. NEW BUSINESS

A. Review of Chapter 8 of the comprehensive plan prior to final adoption.

VIII. EX OFFICIO REPORT

A. spplist/atten.log

IX. MEMBER COMMENTS

X. ADJOURNMENT

Posted <<DATE>> at City Hall, AC Co., Swanson's, and the Post Office.

_____
Name, Ex-Officio Staff

City of Bethel, Alaska
Planning Commission

October 12, 2023 Regular Meeting Bethel, Alaska

I. CALL TO ORDER:

A regular meeting of the Planning Commission was held virtually via Zoom and in person at the City Hall Council Chambers in Bethel, Alaska on October 12, 2023. The Chair of the commission, Kathy Hanson called the meeting to order at 6:30 PM.

II. ROLL CALL:

Compromising a quorum of the Commission, the following members were present for roll call: Kathy Hanson, Alex Wasierski, Stosh Hoffman, Shadi Rabi, and Haley Hanson, and Council Rep., Sophie Swope
Excused absence: Lorin Bradbury and Greg Morgan
Also Present: Pauline Boratko, Recorder and LaQuita Chmielowski, DOWL.

III. PEOPLE TO BE HEARD:

IV. APPROVAL OF THE AGENDA:

MOVED:	Haley Hanson	Motion to approve the agenda.
SECONDED:	Sophie Swope	
VOTE ON MOTION	Unanimous	

V. APPROVAL OF THE MINUTES:

MOVED:	Haley Hanson	Motion to approve August 10, 2023 meeting minutes.
SECONDED:	Sophie Swope	
VOTE ON MOTION	Unanimous	

MOVED:	Haley Hanson	Motion to approve August 10, 2023 meeting minutes with correction the motion names to: moved by Haley Hanson seconded by Greg Morgan.
SECONDED:	Sophie Swope	
VOTE ON MOTION	Unanimous	

VI. SPECIAL ORDER OF BUSINESS

VII. UNFINISHED BUSINESS:

VIII. NEW BUSINESS:

IX. PLANNER'S REPORT:

X. COMMISSIONER'S COMMENTS:

K.Hanson- Pleased to see more site plan permits.
S. Swope- no comment.
A. Wasierski- no comment.
H. Hanson- no comment.
S. Rabi- no comment.
S. Hoffman- no comment.

X. ADJOURNMENT:

MOVED:	Haley Hanson	Motion to adjourn the meeting.
SECONDED:	Sophie Swope	
VOTE ON MOTION	Unanimous	

With no further business the meeting adjourned 6:40 pm

APPROVED THIS _____ DAY OF _____, 2023

_____
Kathy Hanson, Chair

_____
ATTEST: Pauline Boratko, Recorder

CHAPTER 8
People & Economy

8: People & Economy

To restate the community's Vision Statement,

Bethel is the hub that connects the communities of the rural Yukon-Kuskokwim Delta region.

Bethel is a growing, diverse community that strives to improve quality of life, affordability, and opportunities through strategic development that responds to Bethel's remote location.

As a remote hub city, Bethel provides opportunities to build businesses, careers, homes, and community connections. Its economic development strategy should be tied to attracting, retaining, and connecting the people who make the community great. The economy is dominated by employment in local government (city, tribal, and school) as well as government-funded organizations (like the Association of Village Council Presidents and Yukon Kuskokwim Health Corporation), but there are opportunities to expand local commercial activity. Partnerships between public and private entities, including non-profit organizations and businesses, can yield innovative new programs. With investments in local people and culture, locally generated economic growth is expected to follow.

8.1 Education and Career Training

As the regional hub of the Yukon-Kuskokwim Delta, Bethel is the also the de facto educational hub for the surrounding villages. Schools and career training are an important piece of Bethel's economic sustainability and growth. Bethel is home to many educational facilities, as listed in Chapter 2 – Existing Conditions. However, Bethel (like many remote Alaskan communities) struggles to fill job vacancies with local community members who have the appropriate training. It may be that residents with more education and training locally are moving to larger communities such as Anchorage, in part due to the high cost of living in Bethel.

Facing the continued rise in cost of living, Bethel should continue to encourage residents to seek out job training and explore new ideas for the retention and recruitment of local and regional talent. This will not only build local recruitment pipelines, but it will also give more Bethel residents higher-paying jobs and contribute to the overall resiliency of the community. These goals will require quality education at all levels.

GOAL 1: Promote broad access to education, training, and employment opportunities in Bethel.

Strategy 1: Identify community priorities for education and career training.

Action A: City of Bethel staffing is an important priority; see Chapter 7 – Public Facilities & Services, Goal 1: "*Enhance the reliability and efficiency of the City workforce.*" HR
Action B: Work with City departments and community partners to identify key community staffing needs. CM
Action C: Identify gaps between community unemployment and community job openings. CM*
Action D: Working with community partners and the business community, monitor which employment sectors are likely to increase in importance and which employment sectors are likely to decrease in importance in 2045. CM*

Strategy 2: Foster a city-wide culture of emphasizing local hiring and training for specific local opportunities.

Action A: Lead the community in the creation of a local "job board" that helps businesses find suitable hires. HR
Action B: Create a focused internship and apprenticeship program that offers introductory training and support leading to employment with City of Bethel or through partnerships with community organizations or businesses. HR

8.2 Donlin Mine

The Donlin Mine has long been discussed as a controversial project on the horizon that may have significant impacts on Bethel. After years of uncertainty about whether the project would proceed, it now seems to be moving forward; as such, it will be important to plan for the potential impacts. In the future, there could be other major projects in the Bethel region to prepare for and track.

The Donlin Gold Project would include development of an open pit mine approximately 150 miles northeast of Bethel. All key federal and state approvals have been obtained, and planning for construction is in progress. Bethel (along with a barge landing on the Kenai Peninsula) would be a primary accumulation point for pipeline materials during construction. Construction of the mine site, transportation facilities, and pipeline is anticipated to take about 3-4 years. This would begin with moving equipment, supplies, and personnel to the project site using various transportation modes. The Donlin Mine is expected to cost approximately $1.2 billion in labor; at peak construction, the proposed Donlin Gold Project would annually require up to 3,200 workers, including 2,500 for mine site and transportation facilities construction and 650 for natural gas pipeline construction.

The Donlin Gold Project would occur over a period of approximately 30 years, representing nearly a full generation of workers and residents. Approximately 50 to 60 percent of the peak year workforce would be drawn from communities within the Y-K region, and there are strong training programs to support local hiring. Employment during operations would be less but still substantial, estimated to impact 4 to 4.5 percent of households in the region. A portion of those

employees at the Donlin Gold Mine may relocate their household outside of the region. Based on experience at Red Dog Mine, about 50 percent of employees would out-migrate to Bethel or Anchorage.

As part of mine development, an EIS was conducted which evaluated potential impacts to Bethel, including the following:

- Increased employment and income from the mine may go to residents of Bethel, which could increase the population above current projections by the Alaska Department of Labor and may also change Bethel's cultural composition (e.g., percentage of Alaska Natives and non-Natives).
- Infrastructure improvements for the Port of Bethel would be necessary, as the project is expected to approximately double the number of freight and fuel barges annually.
- Some local businesses in the Y-K region could experience an increase in activity during construction (likely concentrated in Bethel, as there are few retail and service outlets in smaller communities).
- An influx of capital and labor to small communities such as Bethel (small when viewed from a state-wide perspective) as a result of project construction could also have a negative economic effect in the form of inflationary pressure. Basically, this could increase the prices of goods and services for residents, especially impacting those not employed by the project.

GOAL 2: Minimize potential negative impacts to Bethel from the Donlin Mine efforts and maximize potential benefits.

Strategy 1: Ensure effective coordination with the Donlin Mine Project.

Action A: Develop a Memorandum of Understanding with Donlin Mine project leaders for ongoing coordination, including holding annual strategy meeting for conflict resolution and identify partnering opportunities. CM

Action B: Establish a communications plan to outline ways to keep Bethel residents informed of construction schedules and status of barge traffic, as well as to keep Donlin informed of the location and timing of commercial and subsistence fishing activities and other concerns or questions. CM

Strategy 2: Work with the Donlin project to plan for additional traffic associated with Donlin Mine.

Action A: Obtain full details about the planned dock construction south of the Bethel petroleum dock (associated with the Donlin Mine project). PO

Action B: Given Donlin's significant anticipated impacts to the Port of Bethel, jointly work with Donlin on port and waterway studies and improvements needed. PO

Action C: Coordinate with DOT&PF to monitor potential impacts to the capacity of Chief Eddie Hoffman Highway and whether improvements would be needed. PW

8.3 Fishing and Subsistence

For decades, commercial fishing was a key source of income in Bethel. Recently, however, commercial fishing has declined significantly due to falling fish population and prices. Since the 1990s, revenue from commercial fishing in Bethel decreased by nearly 50 percent. In 2016, the Coastal Villages Region Fund (CVRF) stopped buying and processing fish from the Kuskokwim region. CVRF was the largest buyer for 20 villages surrounding Bethel in Western Alaska. Since 2016, the region has been without a processor, making it nearly impossible to sell fish. Local fishermen tried to organize a cooperative to work with an external fish processor but had no success.

Many residents in Bethel and the broader region participate in subsistence fishing, just as people in the Yup'ik villages in the area had done long before the establishment of Bethel. Many people have small boats and travel along the river to fish camps. Subsistence food, including fish, makes up nearly half of residents' annual diet. However, salmon runs have been extremely low in recent years, causing Alaska Department of Fish and Game (ADFG) to limit how many fish people can catch. This has put strain on Bethel and other river communities as they are forced to rely more heavily on expensive imported groceries and less on traditional subsistence ways of life.

In additional to fish in the river, there are many other subsistence foods harvested around Bethel that supplement residents' diets. Beyond food, harvested materials can be used for clothing, tools, crafts, shelter, and more. These practices are important to the local culture and way of life for many Bethel residents, including but not limited to Alaska Natives. Most harvesting occurs during the summer and fall months, when the growing season and typical hunting season occur. Year-round, there is also informal sharing and trading of subsistence foods.

Many City of Bethel residents will continue to be impacted by the local salmon decline and other environmental challenges that are likely to impact subsistence resources (like climate change, which is already changing characteristics of the tundra). While the City cannot directly interfere with ADFG or U.S. Fish and Wildlife Service resource management policies, there may be opportunities to provide information or other resources to assist with local organizations' research and advocacy efforts.

Several organizations in the region are involved in advocacy to address issues impacting salmon populations, including climate change, pollution, and salmon bycatch in the Bering Sea pollock fishery. One example is the Kuskokwim River Inter-Tribal Fish Commission, which advocates for stricter restrictions on salmon bycatch in the Bering Sea and continued coordination with Alaska Native tribes that can provide traditional ecological knowledge. Other groups include the ONC Fisheries Department and the Kuskokwim River Salmon Management Working Group.

GOAL 3: Support subsistence rights and access to subsistence resources in Bethel and the surrounding region.
Strategy 1: Protect physical access to subsistence resources around Bethel. **Action A:** Maintain the small boat harbor facility, and identify future expansion needs and priorities for funding to ensure sufficient access for subsistence users. PO **Action B:** Require the dedication of parks and/or open spaces, such as green belts, in new subdivisions in order to maintain access to the undeveloped tundra. PL **Action C:** Work to obtain public access easements over trails used to access fishing, hunting, or plant harvesting areas. PL
Strategy 2: Support research and advocacy efforts that seek to protect access to subsistence resources. **Action A:** As opportunities arise, provide information or resources to support the activities of subsistence resource advocacy groups. PO

8.4 Climate Resilience Planning

As discussed in Chapter 2 – Existing Conditions, and according to the Alaska Department of Community & Regional Affairs (DCRA), Bethel is considered an Environmentally Threatened Community at risk from infrastructure damage caused primarily by flood, erosion, and permafrost degradation exacerbated by climate change. DCRA assistance may be available to help Bethel plan for mitigating the impacts of climate change. The City should take advantage of this and other programs that may exist, as any of these efforts could help protect human life and property.

The primary assistance available to communities to mitigate natural and other hazards is from the Federal Emergency Management Agency (FEMA) through development of a Hazard Mitigation Plan. Bethel's Hazard Mitigation Plan was completed in 2017 and is overdue for an update. These collaborative plans include a risk and capability assessment which identifies hazards and develops a mitigation strategy to be implemented by the City to prepare for natural and man-made hazards that could occur in the future.

Other communities have developed Climate Action Plans or Climate Adaptation Plans to more comprehensively address climate change. However, Hazard Mitigation Plans offer similar benefits as all are collaborative efforts involving various City departments as well as community members and other organizations. With more awareness of potential hazards, the community and surrounding region's people and local economies can be more prepared and resilient in the face of climate change. The City should also consult with DCRA to determine if a more focused Climate Adaptation Plan should be prepared as well.

GOAL 4: Prepare the City for a broad range of potential climate change impacts.

Strategy 1: Using the help of state and/or federal climate resilience resources, create City plans for climate adaptation and community resilience.

Action A: Update the City's Hazard Mitigation Plan every five years. CM PL

Action B: Consult with DCRA and consider preparing a Community Resilience and Climate Adaptation Plan. PL CM

Action C: Monitor other funding or support resources that may become available. GM

8.5 Local History and Culture

As the hub city for the YK Delta region, Bethel is both the gateway to the villages of the region and the gateway from the region to the rest of the world. Bethel represents a confluence of cultures, and community members referred to it as the "heartland of the Yup'ik people" and a very diverse community. Due to its remote location, community members describe a strong sense of interconnectedness, community, and self-reliance. At times, large numbers of people from around the region, state, and world come together in Bethel around traditional activities and expressions of community and culture. The cultural environment in Bethel includes not only Yup'ik traditions that have existed for thousands of years, but also contemporary sports that bring people together and a common value for the beauty of the river and the tundra. The City can play a role in supporting the cultural fabric that makes Bethel a great community in which to live, with a strong sense of place and local identity and pride.

Bethel Farmers Market shed.

8.6 Local Businesses

Community members report that it is very difficult to start a small business in Bethel. The City should try to help foster a local business friendly environment, as local production and commerce is a great way to decrease reliance on imports, oftentimes lowering the cost of living and keeping money flowing in the local economy.

The right balance between regulations and policies that ease the way for small businesses needs to be found. In the past, it was sometimes difficult for the City to enforce business licensing that allows the City to collect sales tax, an important source of City revenue to fund public facilities and services. When Covid-19 relief money came into the community to assist businesses, more businesses were forced to get licenses in order to access funding; this is an example of an incentive that helped formalize more businesses in Bethel.

The City could start getting more involved with supporting local businesses by designating a Business Community Liaison. Currently, there is no Chamber of Commerce in Bethel, but a Business Community Liaison could work with business leaders to reinvigorate the Chamber, opening more regular lines of communication and opportunities for the City and business leaders to collaborate on community events and programs that build up the local economy.

GOAL 6: Foster a thriving local business community.

Strategy 1: Encourage the reinvigoration of the Chamber of Commerce.

Action A: Assign a staff person within the City (likely in the Finance Department) to serve as the Business Community Liaison. CM

Action B: Identify and reach out to business leaders in the community about the City's interest in more coordination with the business community, including potentially supporting the reinvigoration of the Chamber of Commerce. FI

Action C: Organize a City space for representatives from the business community / Chamber of Commerce to meet on a quarterly basis. FI

Strategy 2: Expand resources to help people start local businesses.

Action A: Continue to provide information on licensing and permitting required, as well as enforcement. FI

Action B: Pursue a partnership with an organization such as UAF to offer business planning assistance. FI

Action C: Raise awareness about resources available to help small businesses, such as the Alaska Small Business Development Center and related guides or workshops. FI

Strategy 3: Create a business-friendly environment in Bethel.

Action A: Identify any barriers that the City may be able to address to assist with starting and running businesses. FI

Action B: Examine BMC to consider allowing some small businesses to be a legal in residential zoned areas. PL

Action C: Develop a directory of local businesses that is updated regularly. FI

Action D: Work with the business community to organize events that highlight local businesses, such as markets or events that encourage people to visit businesses around town. CM*

8.7 Visitor Experience

People visit Bethel for a variety of reasons. The most common group visiting the area is made up of people visiting friends and relatives, known in tourism research as VFRs. Other common reasons for visiting Bethel include business trips, medical care, shopping, and community events. There is also a small segment of visitors seeking birdwatching, hunting, or flyfishing experiences. Each of these groups may be encouraged to spend more time in Bethel if investments are made in marketing and better accessibility of information about local attractions and amenities. This should increase spending and in turn help fund improvements to attractions for visitors, also improving the local quality of life and community sense of pride.

GOAL 7: Support and expand tourism and visitation to Bethel.

Strategy 1: Expand information and marketing for visitors.

Action A: Provide general visitor information on the City website, including information such as lodging, dining, and transportation (in collaboration with the Chamber of Commerce). CM*

Action B: Create regularly updated visitor marketing materials specific to different visitor groups:

Family-friendly – focused on people visiting friends and relatives (aka VFRs) with children and/or seniors in their groups

Business travelers – focused on coffee / breakfast, lunch and dinner dining, catering for meetings, wifi hangout spots, the fitness center, and "quick" attractions to visit

Nature tourists – focused on in-town attractions, equipment shops or rental services, and regional transportation and wilderness guiding services

Visitors from villages – focused on resources they may be coming to access and include Yup'ik translation

New residents – overview of key community resources as well as popular spots for locals and residents to help people who recently moved to "get to know Bethel" CM*

Action C: In collaboration with the Chamber of Commerce, encourage businesses and community facilities to provide up-to-date contact, website information, and photos on Google Maps. FI

Action D: In collaboration with organizers of large annual events and the Chamber of Commerce, assess the capacity of Bethel lodging available relative to expected peak demands to determine if shortages are anticipated and how the community could address this if/as visitation is expected to grow. CM*

Strategy 2: Improve attractions for visitors.

Action A: Emphasize locally specific natural and cultural attractions. PR
Action B: Work with the Chamber of Commerce and other organizations to develop a calendar of community events. PR
Action C: Develop and implement a beautification plan for the downtown area (roughly between the Cultural Center and Brown's Slough) and the waterfront. PR

Waterfront trail in Bethel.

THE STATE of ALASKA
GOVERNOR BILL WALKER

Department of Natural Resources
OFFICE OF PROJECT MANAGEMENT AND PERMITTING
550 W 7th Ave, Suite 1430
Anchorage AK, 99501
Main: 907.269.8690

May 24th, 2016

Attn: Mr. Keith Gordon
Regulatory Division
US Army Corps of Engineers
PO Box 6898
Joint Base Elmendorf Richardson, AK 99506-0898

Mr. Gordon

Attached you will find the State of Alaska, Department of Health and Social Service's (DHSS), draft Health Impact Assessment (HIA) for the Donlin Gold mine. Please add this document into the Donlin EIS casefile and use it by reference as needed in the final EIS. Please note that this is a standalone document intended to assist with the Human Health sections of the EIS and it is not a public document, so it should not be distributed beyond necessary internal use.

The State would like to request a copy of any public comments received on the draft EIS related to human health. Depending on comments received related to human health and as additional information comes in it is anticipated that some revisions may be needed and therefore this documents is still in draft form and is still in the deliberative process. If the USACE or AECOM have any questions related to this document, please let me know and I will work with DHSS to answer any questions you might have.

Thank you,

Jeff Bruno
Deputy Director
Office of Project Management and Permitting
State of Alaska
Department of Natural Resources
907-269-7476

Draft Health Impact Assessment

Donlin Gold Project

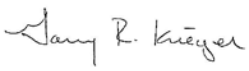
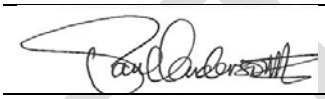
February 2016

Prepared by:

STATE of ALASKA
Department of Health and Social Services

NewFields

DO NOT DISCLOSE: DELIBERATIVE PROCESS PRIVILEGE

NewFields Companies LLC	**State of Alaska HIA Program**
Printed Name:	**Printed Name: Paul J. Anderson**
Gary R. Krieger, MD, MPH, DABT, DTM&H	**Paul J. Anderson, MD, MPH**
	
Title: Managing Partner	**Title: Program Manager**
Date: 21 September 2015	**Date: 21 September 2015**

ACKNOWLEDGEMENT:

With special thanks to the Yukon-Kuskokwim Health Corporation and the Alaska Native Epidemiology Center, Alaska Native Tribal Health Consortium for the use of the data summaries and graphics in the Regional Health Profile for Yukon-Kuskokwim Health Corporation and the Alaska Native Health Status Report.

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GLOSSARY

This report is intended for readers both with and without a background in public health. Definitions of technical terms that are used throughout the report are provided below:

Rate: A rate is defined as the number of events or cases occurring in a specified time period, divided by the number of people in the population during that period.

Prevalence: A common descriptive statistic, prevalence refers to the total number of cases, new or old, of a disease, condition, or characteristic existing at a point in time divided by the total population at the point in time, generally multiplied by a factor of 100–100,000 (depending on how common or rare the disease is). The prevalence of a disease in a population depends on the number of people who get the disease as well as how long they live with the disease.

Age-adjusted rate: An age-adjusted rate is a mathematically weighted average of the age-specific actual (crude) rates of a disease or condition. The "weight" of each age group is determined by the proportion of persons in that age group in a standard population (commonly the 2000 U.S. standard population). Disease rates are typically age-adjusted to allow comparisons between populations with different age distributions. For example, if one population has a higher proportion of older people, that population is likely to have a higher death rate from heart disease, while a younger population may have relatively higher death rate from motor vehicle accidents. To compare death rates in these two populations, the rates can be adjusted to control for the effect of age.

Crude rate: A crude rate is calculated by dividing the actual number of observed events or cases in a population by the total population, generally multiplied by a factor of 100–100,000 (depending on how common or rare the disease is).

Health impact: A health impact is a positive or negative change in a specific health outcome or health determinant. Health impacts are: *potential* changes in health outcomes or determinants, not general changes in environmental conditions; specific health outcomes or determinants, not general statements about health status; and, quantifiable, whenever possible. Health impacts in the context of an HIA are different from the use of 'impact' in an Environmental Impact Statement (EIS), as health impacts are potential rather than actual impacts, include factors such as importance/concern, and do not have the same ranking methodology as in an EIS.

Morbidity rate: The morbidity rate is the relative occurrence of a particular disease in a specific location during a given year per unit of population.

Mortality rate: The mortality rate, sometimes also called a death rate, is the total number of deaths in a population (from a specific cause or all causes combined) during a year, divided by the total population, generally multiplied by a factor of 100,000.

Infant mortality rate (IMR): IMR refers to the number of deaths in infants less than 1 year of age during a year, divided by the total number of live births during that year, generally multiplied by a factor of 1000.

Micronutrients: Nutrients required by humans and other organisms throughout life in small quantities to orchestrate a range of physiological functions.

Neonatal mortality rate: The neonatal mortality rate is a subclassification of infant mortality rate, referring to the number of deaths in infants less than 28 days of age during a year, divided by the total number of live births during the year, generally multiplied by a factor of 1000.

Neoplasm: An abnormal mass of tissue as a result of neoplasia**,** the abnormal proliferation of cells. Neoplasms may be benign, pre-malignant (carcinoma *in situ*) or malignant (cancer).

Otitis media (Latin): Inflammation of the middle ear, or middle ear infection.

Post-neonatal mortality rate: The post-neonatal mortality rate refers to the number of deaths in infants between 28 days and 1 year of age during a year, divided by the total number of live births during that year, generally multiplied by a factor of 1000.

Refractive error: An error in the focusing of light by the eye and a frequent reason for reduced visual acuity.

Sudden infant death syndrome (SIDS): SIDS refers to the sudden, unexplained death of an infant from an unknown cause.

LIST OF ACRONYMS

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADHSS	Alaska Department of Health and Social Services
ADOT	Alaska Department of Transportation and Public Facilities
ADNR	Alaska Division of Natural Resources
AFN	Alaska Federation of Natives
AIP	Arctic Investigations Program of the CDC
ANCSA	Alaska Native Claim Settlement Act of 1971
AN EpiCenter	Alaska Native Epidemiology Center
ANMC	Alaska Native Medical Center
ANTHC	Alaska Native Tribal Health Consortium
AST	Alaska State Trooper
ATR	Alaska Trauma Registry
ATSDR	Agency for Toxic Substances and Disease Registry
BLL	Blood lead level
BLM	U.S. Bureau of Land Management
BRFSS	Behavioral Risk Factor Surveillance System
BWN	Boil water notice
Calista	Calista Corporation
CDC	Center for Disease Control and Prevention
CHAP	Community Health Aide Program
CIL	Carbon in leach
CIRI	Cook Inlet Region, Inc.
CIS	Community Information Summaries
COPD	Chronic obstructive pulmonary disease
CS	contaminated site
DBA	ADEC Brownfield Assessment
DHHS	U.S. Department of Health and Human Services
DNR	Alaska Department of Natural Resources
DTP	Diphtheria-tetanus-pertussis
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FAS	Fetal Alcohol Syndrome
FCS	Food Cost Survey
FMDR	Full mouth dental reconstruction
FUD	Formerly used defense site
HAPs	Hazardous air pollutants
HEC	Health Effect Category
HDD	Horizontal directional drilling
HIA	Health Impact Assessment
Hib	Haemophilis Influenza type B
HIPPA	Health Insurance Portability and Privacy Act of 1996
HIV/AIDS	Human immunodeficiency virus/acquired immune deficiency syndrome
IFC	International Finance Corporation

IPV	Intimate partner violence
KPB	Kenai Peninsula Borough
Mat-Su	Matanuska–Susitna Borough
MCL	Maximum contamination level
MMR	Measles-mumps-rubella
µg/dL	Micrograms per deciliter
mg/dL	Milligrams per deciliter
MP	Mile post
NCD	Non-Communicable Diseases
NEPA	National Environmental Policy Act
PAC	Potentially affected community
PACs	Potentially affected communities
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PID	Pelvic inflammatory disease
PM	Particulate matter
ppm	parts per million
P.S.D.	Prevention of Significant Deterioration
SDH	Social Determinants of Health
SIDS	Sudden Infant Death Syndrome
STIs	Sexually transmitted infections
TANF	Temporary Assistance for Needy Families
TCC	Tanana Chiefs Conference
TKC	The Kuskokwim Corporation
TMDL	Total maximum daily load
TRI	Toxics Release Inventory
UAF	University of Alaska Fairbanks
U.S.	United States
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VDRS	Alaska Violent Death Reporting System
VOCs	Volatile organic compounds
VPSO	Village Public Safety Officer
WHO	World Health Organization
WIC	Women's, Infants, and Children assistance program
WQS	Water quality standards
YKHC	Yukon-Kuskokwim Health Corporation

EXECUTIVE SUMMARY

Background

Donlin Gold Health Impact Assessment (HIA)

Donlin Gold LLC (Donlin Gold) is proposing the development of an open pit, hard rock gold mine located 277 miles (446 km) west of Anchorage, 145 miles (233 km) northeast of Bethel, and 10 miles (16 km) north of the village of Crooked Creek.

This HIA provides information to decision-makers about potential positive and negative human health impacts related to the proposed Donlin Gold Mine. The report culminates with a ranking of these impacts and provides recommended action steps and monitoring approaches for the highest rated health impacts. Please note that health impacts represent a potential positive or negative change in a specific health outcome or health determinant, and differ from the use of 'impacts' in Environmental Impact Statements (as defined in the glossary).

This HIA has been included as part of the National Environmental Policy Act (NEPA) Review/Environmental Impact Statement (EIS) at the request of the lead federal agency, the United States Army Corps of Engineers (USACE). The Alaska Department of Natural Resources (DNR) consulted with the Alaska Department of Health and Social Services (ADHSS) HIA Program as a "best practices" approach to responsible natural resources development. The Donlin Gold HIA was developed using the strategies and methodologies described in the Alaska HIA Toolkit.

It is important to underscore that this HIA is not a regulatory document; the action steps and monitoring approaches that are presented in this document become regulated items only if a federal or state agency decides to include them as stipulations in permitting decisions.

Health Impact Assessment

HIA is a combination of procedures, methods and tools by which a policy, program, or project may be judged as to its potential and sometimes unintended effects on the health of a population, and the distribution of those effects within the population.

An HIA will:

- Provide a formal mechanism to engage the relevant stakeholders and key regulatory decision-makers;
- Review proposed project plans;
- Review the physical and general environmental setting of the proposed project;
- Identify potentially affected communities (PACs);
- Generate a baseline profile of health in the region;
- Identify potential health impacts using both a set of defined health effects categories (HECs) and input from stakeholder meetings;
- Conduct semi-quantitative impact rating and importance ranking; and,
- Propose a series of recommendations tied to the most important potential impacts.

Scoping Process

The HIA team performed (i) extensive literature and document reviews, (ii) close coordination with the EIS team, (iii) community observations and household surveys, and (iv) limited field visits to the project area. This HIA reviews the proposed Donlin Gold Project based on the following information:

- Numerous State of Alaska databases and reports;
- Permit application materials submitted by the project proponent, Donlin Gold;
- Stakeholder concerns as presented in the scoping reports; and
- General parameters developed by the "Alaska Technical Guidance for Health Impact Assessment".

Stakeholder Engagement

The ADHSS HIA program organized and participated in multiple community listening sessions for the Donlin Gold Mine, facilitated by Dr. Joseph Klejka with the Yukon Kuskokwim Health Corporation (YKHC). The HIA team has reviewed the written notes associated with community meetings held by the relevant State of Alaska agencies. This stakeholder engagement process resulted in a wide-ranging list of perceived impacts, which are discussed at length in Section 4 of the HIA.

Baseline Data Collection

The HIA Program also reviewed baseline data from a variety of sources (e.g., Alaska Native Regional Health Status Reports, Alaska Behavioral Risk Factor Surveillance Survey, and the U.S. Census) and organized the information into eight health effect categories (HEC). The baseline health summary in Section 5 creates a point of reference regarding the health status of the potentially affected communities prior to development of the proposed Donlin Gold Mine; it also describes an overall health profile for the area. Decision-makers can use their knowledge about the features of the proposed Project and the health profile of the region to better consider health in their deliberations.

Identification of Health Impacts

The ultimate goal of an HIA is to identify the potential health impacts of the proposed Project and use this information to maximize benefits and minimize adverse consequences to the public's health. Health impacts include positive and negative changes in specific health outcomes (e.g., asthma rates, gonorrhea rates, motor vehicle fatality rates) and health determinants (e.g., access to health care, air and water quality, household income).

The table below (Table ES1) displays a list of the important potential health impacts (both positive [+] and negative [-]) identified in the HIA for the Donlin Gold Mine, and the rating of the importance of each impact on an ordinal scale (i.e., Category 1, 2, 3, or 4). Importance rating categories are developed by reviewing the dimensions of each impact (health effect, duration, magnitude, and extent) and assigning a score for each dimension (0, 1, 2, or 3). Scores are then totaled and assigned a likelihood rating. Category ratings account for the score and likelihood rating. Section 8 discusses the ranking and rating of impacts in greater detail.

Importance Rating of Health Impacts Related to the Donlin Gold Mine

The primary purpose of an importance rating is to help decision-makers prioritize their consideration of health impacts, action steps, and monitoring activities. Impacts rated as Category 3 or 4, are considered by the HIA to be NEPA significant; however, the HIA recognizes that the final determination is made by statutory decision–makers. Within a NEPA framework, the HIA develops its analysis of "importance" by considering both the context and intensity of potential health impacts across the proposed project and alternatives. Context and intensity are considered within and across several dimensions as described in Section 8.0. The full suite of potential impacts by HEC is presented in Section 8.0. Similarly, recommendations and potential action steps are presented in Section 8.3 for all identified potential health impacts.

Category 2 and 3 potential impacts, positive and negative to human health, are described below and an overall summary table of the importance ratings is presented in Table ES-1 (shown below).

1. Potential impacts rated as Category 3

- *"Increase in mortality and morbidity rates related to surface, air, and water transport"*
  Especially during construction, transportation by air, water, and land could experience a marked increase. As a result, it will be important to consider the action steps and monitoring approaches related to changes in transportation (surface, air, and water) of people and materials.

- *"Decrease in the percentage of food secure households and decrease in subsistence consumption based on harvest survey data"*
  Food security and the continuation of subsistence practices are important to the health and well-being of communities in the Yukon-Kuskokwim (Y-K) region. A variety of factors could influence food security or the consumption of subsistence foods. Actions steps and monitoring efforts aimed at encouraging subsistence foods and enabling participation in the subsistence harvest are of high importance for decision-makers.

- *"Increase in the rates of morbidity and mortality data for chronic diseases such as diabetes, obesity, and hyperlipidemia"*
  Cultural and social changes, particularly driven by changes in household income, strongly influence patterns of non-communicable diseases (NCDs) through factors such as diet, physical activity, stress, and social norms. For example, social and cultural changes that result in consumption of more highly processed calorie-dense convenience foods, increased social and work stressors, and decreased physical activity and community connection could all contribute to higher rates of NCDs. As such, given the scope of this project and its potential impact on surrounding communities, it will be important to consider action steps and monitoring approaches related to NCDs.

- *"Increase in median household income; decrease in percent of households living below poverty line"*
  The project could produce positive health impacts through an increase in median household income and a decrease in the % of households below the poverty line. Attention to the recommended actions and monitoring measures will help maximize the influence of these benefits in communities throughout the region.

2. Potential impacts rated as Category 2

- *"Increase in highest level of educational attainment; decrease in percent of unemployment"*
  Donlin Gold has already invested millions of dollars into the regional economy during exploration activity. If permitted, the project could produce positive health impacts through a decrease in unemployment and a slight increase in highest level of educational attainment. Attention to the recommended actions and monitoring measures will help maximize the influence of these benefits in communities throughout the region.

- *"Increase in morbidity and mortality data related to psychosocial distress such as depression, anxiety, suicide, substance abuse, and changes to family structure"*
  Psychosocial distress is difficult to quantify, and while it received a medium ranking in this analysis, psychosocial distress contributes to many of the most pressing health challenges in the region, including suicide, child abuse, domestic violence, family instability, substance abuse, and unwanted pregnancy. Action steps and monitoring recommendations that aim to minimize psychosocial distress will be very important to consider during permitting decisions.

- *"Increase in adverse health outcomes resulting from potential changes in mercury exposure due to fish consumption"*
  Hair mercury levels in the region are currently far below toxic levels; however, the size and duration of the planned Donlin Gold mining activities, coupled with the heavy regional dependence on fish consumption, makes this a high importance health topic. While the proposed Donlin project has a detailed mercury management program, and estimates of the maximum potential increase in mercury are below standards set by the Environmental Protection Agency (EPA), it will still be important to consider the action steps and monitoring approaches related to any changes in mercury levels in fish, wildlife, and plant species and the potential for subsequent changes in mercury body burden in local residents.

- *"Increase in the rates of STI such as gonorrhea, chlamydia, syphilis and HIV"*
  Some sexually transmitted infections already occur at high rates in the Yukon-Kuskokwim region, and rural mining operations could lead to higher rates of sexually transmitted infections (STI). This health impact received a Category 2 importance rating and the associated action steps and monitoring approaches merit consideration during permitting review.

- *"Increase in the rates of respiratory diseases, vaccine preventable diseases, and foodborne illnesses"*
  Influx of a large non-resident workforce into a remote rural region increases the exposure risk for residents of the Y-K area. Some workers may be incubating respiratory or vaccine preventable diseases not commonly seen in Alaska and bring them to the region (e.g., measles, influenza, etc.). This health impact received a Category 2 importance rating and the action steps and monitoring approaches merit serious consideration during permitting review.

- *"Decrease in access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems"*
  The influx of a large workforce has the potential to place strain on existing health care resources in the region. In addition, the likely higher wages offered by the Donlin project could trigger a movement of existing health staff towards project employment. Currently, there are limited transportation options and capacity for local residents. If the proposed project "absorbs" current transport carriers (i.e., transport carriers preferentially direct capacity to the project versus local needs) there could be a shortfall in transportation options for local villages. It will be important to consider the action steps and monitoring approaches related to health outcomes that depend on health care infrastructure and access. If resources were made available to help improve transportation options and local health care infrastructure, this could result in a net positive impact in the region.

Workforce Management and Materials Management

One of the most important ways to avoid adverse health impacts to surrounding communities is to carefully manage the housing and movement of workers and mining materials--especially during construction, when rapid workforce influx can produce a cascade of potentially important adverse health impacts where workers live and carry out their duties. In addition, sharply increased demand for surface, air, and water transport of people and materials can also have tremendous impacts on the health of the region.

Closed (secure, limited access), alcohol- and drug-free work camps have been highly successful in other regions of Alaska (e.g., Prudhoe Bay). Carefully controlling access to and from work camps is a critical consideration for workers near Bethel, Aniak, Jungjuk, and other transportation hubs that may be developed.

Outmigration of the local population is another possible result of development. Increased income may allow some individuals to relocate to Anchorage or other large communities and work at the Donlin mine as commuters. This could have the effect of removing a large number of healthy, skilled, motivated, and resourceful individuals from local communities on a permanent or intermittent basis.

Workforce education regarding a number of health and wellness topics will be important in order to influence worker behaviors, but also to provide health and wellness training for local hires. Local workers can act as "peer educators" and leaders for local communities. Workforce education regarding personal finances, health, safety, and wellness topics can serve as a catalyst for improved health in the region. The provision of adequate on-site fitness and entertainment

facilities in camps can also improve morale and confer health benefits to workers and families in the region.

Careful planning for transportation of materials and people will also be essential to minimizing adverse health impacts. With large port facilities planned for the city of Bethel, control of barge traffic and control of barge contents will be important. While the HIA is not designed to evaluate catastrophic events, river incidents that involve barge transport of hazardous materials used in the gold mining process (e.g. cyanide) or a catastrophic failure of tailings facilities could be devastating to the region. Though the likelihood of these events is low, emergency response planning exercises for such events are essential to minimize adverse impacts should they occur.

This HIA's focus on the workforce and its interaction with local communities is driven by several factors: (i) expectation that a certain percent of the workforce will be derived from local and regional communities, (ii) communicable diseases can easily move back and forth from community to workforce and vice versa, and (iii) positive impacts can occur in local communities by improving workforce education on "health." Therefore, while the HIA recognizes that (i) Donlin has long-term positive experience with local communities during the exploration phase and (ii) has a sophisticated workforce management system, continued emphasis on workforce-community interface and interaction is critical in order to minimize negative impacts and maximize the potential for positive benefits to local communities.

Table ES1 Potential Health Impacts to Affected Communities, Rated by Health Effect Category		
Potential Health Impacts	**Positive (+)* Negative (-)**	**Importance Rating Category†**
Social Determinants of Health		
Increase in morbidity and mortality related to psychosocial distress such as depression, anxiety, suicide, substance abuse, and changes to family structure	**(-)**	2
Increase in median household income	**(+)**	3
Decrease in % unemployment	**(+)**	2
Decrease in the percentage of households living below poverty line	**(+)**	3
Increase in educational attainment data	**(+)**	2
Accidents and Injuries		
Increase in morbidity and mortality related to surface and air transport incidents	**(-)**	3
Increase in morbidity and mortality related to vessel transport incidents	**(-)**	3
Exposure to potentially Hazardous Materials		
Increase in adverse health outcomes resulting from potential changes in mercury exposure due to fish consumption	**(-)**	2
Increase in respiratory disease mortality and morbidity data related to PM10, PM 2.5, and VOCs	**(-)**	1
Food, Nutrition and Subsistence		
Decrease in regional food costs expressed as a % of median household income	**(+)**	1
Decrease in the percentage of food secure households and decrease in subsistence consumption based on harvest survey data	**(-)**	3
Infectious Diseases including STIs		
Increase in the rates of STI such as gonorrhea, chlamydia, syphilis and HIV	**(-)**	2
Increase in the rates of respiratory infectious diseases	**(-)**	2
Increase in the rates of vaccine preventable diseases	**(-)**	2
Increase in morbidity and mortality rates from foodborne illness	**(-)**	2
Chronic Non-Communicable Diseases		
Increase in morbidity and mortality for chronic diseases such as obesity, diabetes, and hyperlipidemia	**(-)**	3
Water and Sanitation		
Increase in morbidity and mortality due to conditions affected by limited water access, quality, or quantity of water and sanitation facilities	**(-)**	1
Health Infrastructure and Capacity		
Increase in morbidity and mortality due to conditions affected by access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems	**(-)**	2

***+/- refers to "+" beneficial impacts or "-"negative impacts to human health**

***†Importance rating:** The primary purpose of an importance rating is to help decision-makers prioritize their consideration of health impacts, action steps, and monitoring activities. If decision-makers choose to implement recommended action steps or monitoring approaches from the HIA, they should start by examining impacts rated as Category 3 (as there were no Category 4 impacts identified in this HIA), followed by impacts rated as Category 2, and so on.*

Summary of Recommendations

Recommendations were provided for the HECs with health impacts that received an importance rating of Category 2 or higher. Action steps and monitoring approaches were developed for each of these HECs and summarized in the table below (Table ES2). The action steps and monitoring approaches are provided as recommendations to decision-makers, based on the predicted health impacts. Stakeholders are encouraged to review the potential impacts and consider ways to use this information to maximize benefits and minimize harms to persons living in the PACs.

It is important to underscore that this HIA is not a regulatory document; the action steps and monitoring approaches that are presented in this document become regulated items only if a federal or state agency decides to include them as stipulations in permitting decisions.

Table ES2 Recommendations by Health Effect Category

Potential Impact	Action Steps	Monitoring and Evaluation Approaches
Social Determinants of Health		
Increase in morbidity and mortality related to psychosocial issues such as depression, anxiety, suicide, substance abuse, and changes to family structure **Increase in median household income** **Decrease in % of households living below poverty line** **Decrease in % unemployment** **Increase in educational attainment**	**Provide worker education and support community programs regarding** • Suicide prevention, mental health, and personal wellness • Substance abuse prevention and smoking cessation • Family cohesion, prevention of domestic violence and child abuse • Sexual health and preventing unwanted pregnancy • Financial planning • Community engagement with mining project and plans **Implement best practices for workforce management** • Dry, drug-free, and closed work camps • Workplace alcohol, drug, and sexual harassment policies • Prioritize local hire according to project needs	**Monitor health outcomes** • Suicide rates • Substance use/abuse/treatment rates • Intimate partner violence, sexual assault, child abuse • Unwanted pregnancy rates **Monitor health determinants** • Divorce rates • Verify closed work camps through site audits • Median household income, % unemployment • % living below poverty line • % workers who complete health and wellness course • Population influx and outmigration • Crime statistics, school absences, academic achievement • Housing inflation, food costs **Evaluate best practices for workforce management** • Use of closed, dry, drug-free work camps • % local hire suitable to project needs • Work shift schedules suitable to cultural and family cohesion

Table ES2 Recommendations by Health Effect Category

Potential Impact	Action Steps	Monitoring and Evaluation Approaches
	Accidents and Injuries	
Increase in morbidity and mortality related to surface transport, air transport, and vessel transport	**Provide workplace training and certification modules** • Assure driver/operator training and annual certification • Implement strict alcohol and drug policies • Implement fatigue management policies • Investigate all accidents • Implement journey management plans **Employ transportation planning cycles** • Identify key interaction points between project transport activities and community transportation needs • Establish emergency response plans for off-site accidents, injuries, and hazardous materials releases • Perform drills coordinated with local emergency response services • Limit barging during peak fishing activity	**Monitor health outcomes** • Fatal and non-fatal transportation incidents • All fatal and non-fatal injuries **Monitor health determinants** • VPSO presence in communities • % of incidents that involve alcohol or drugs • Monitor Alaska Trauma Registry data annually • Effectiveness of workplace motor vehicle safety programs
	Exposure to Potentially Hazardous Materials	
Increase in adverse health outcomes from potential changes in mercury exposure due to fish consumption	**Follow standard regulatory requirements for mercury management**	**Monitor for key health outcomes** • Maternal and community hair mercury levels **Monitor for key health determinants** • Changes in fish consumption from ADF&G surveys • Subsistence participation rates
	Food, Nutrition and Subsistence	
Decrease in the percentage of food secure households **Decrease in subsistence consumption based on harvest survey data**	**Provide workforce and community education regarding** • Health benefits and safety of subsistence foods • Healthy diet and nutritional practices • Results of fish and wildlife sampling **Provide workforce opportunities for subsistence participation**	**Monitor key health outcomes** • Rates and trends for diabetes, obesity, metabolic syndrome **Monitor key health determinants** • Change in the percentage of food secure households • Changes to subsistence consumption estimated from harvest

Table ES2 Recommendations by Health Effect Category		
Potential Impact	**Action Steps**	**Monitoring and Evaluation Approaches**
		surveys
	Infectious Diseases	
Increase in the rates of Sexually Transmitted Infections (STI) such as gonorrhea, chlamydia, syphilis and HIV	**Implement closed alcohol and drug-free camps for non-resident workforce at the mine site, and at major transport/construction sites** • Mandatory STI education for all new employees • Diagnosis and treatment of STIs at the occupational medicine clinics sponsored by applicant • Offer Expedited Partner Therapy (EPT) and promptly report cases of workers diagnosed with chlamydia, gonorrhea, syphilis, and HIV	**Monitor key health outcomes** • Regional rates of STI **Monitor key health determinants** • Presence of STI education programs for workers • Presence of disease intervention resources in the community
Increase in the rates of infectious respiratory diseases such as influenza and pneumonia	**Implement a respiratory disease prevention and control strategy in the workplace** • Assure that all workers are given annual influenza vaccination • Provide worker education on respiratory hygiene • Assure worker tuberculosis testing/treatment • Assure written policies and procedures for appropriate isolation of ill-workers in camps • Construct work camps according to OSHA and international best practices for space per occupant and ventilation requirements • Make hand sanitizer readily available in communal areas of work camps	**Monitor key health outcomes** • Regional rates of infectious respiratory disease • Regional outbreaks of respiratory disease **Monitor key health determinants** • Occupancy rates/ overcrowding in work camp accommodations • Presence of respiratory disease prevention programs for TB, influenza, pneumonia in workforce • Presence of selected screening programs (e.g., tuberculosis) for non-resident workers
Increase in the rates of vaccine preventable diseases	**Require documentation that all workers are up-to-date with all CDC-recommended vaccines for adults**	**Monitor key health outcomes** • Review the vaccination status of all workers annually • Monitor rates of vaccine preventable disease • Monitor regional outbreaks of vaccine preventable diseases
Increase in mortality and morbidity related to foodborne illness outbreaks	**Implement food safety and disposal strategy in the workplace that emphasizes** • Adequate hand washing and sanitary policies for all catering services • Industry standard food storage, preparation, and disposal policies	**Monitor health outcomes** • Foodborne illness or outbreaks in camps or in local communities.
	Non Communicable and Chronic Diseases	
Increase in morbidity and	**Provide workforce education and support community education regarding**	**Monitor key health outcomes**

Table ES2 Recommendations by Health Effect Category		
Potential Impact	**Action Steps**	**Monitoring and Evaluation Approaches**
mortality for chronic diseases such as obesity, diabetes, and hyperlipidemia	• Health benefits and safety of subsistence foods • Healthy diet choices and nutritional practices • Healthy physical activity habits • Importance of screening for chronic diseases • Depression and anxiety **Provide workplace wellness programming that includes fitness facilities, screening for chronic diseases, and incentives for physical wellness** • Obesity and overweight • Diabetes • Hyperlipidemia • Hypertension • Smoking cessation • Increasing physical activity	• Regional rates of chronic diseases such as obesity, diabetes, hyperlipidemia, hypertension • Regional rates of lung cancer and colon cancer • Regional rates of heart disease and cerebrovascular diseases **Monitor Key health determinants** • Cost of regional food items • Culturally and regionally appropriate opportunities for increasing physical activity • Screening rates for chronic diseases including cancer
Health Infrastructure and Capacity		
Increase in morbidity and mortality due to conditions affected by access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems	**Consider the importance of regular air, land, and water shuttles to health care centers during transportation planning that provides for** • Maternal/child health visits • Preventative screening for colon cancer and breast cancer • Emergency perinatal transport • Expanded EMS services **Plan for emergencies or influx trends that could overwhelm existing healthcare infrastructure and decrease access to care, increase costs for local residents, or lower patient-to-provider ratios**	**Monitor key health outcomes influenced by health care infrastructure and capacity, such as** • % receiving adequate or better pre-natal care • % screened for chronic diseases including cancer **Monitor key health determinants related to health care infrastructure and capacity** • Number of community health aide practitioners present in the region • Presence of collaborative emergency response plans

1.0 INTRODUCTION AND OVERVIEW

1.1 Project Overview and Description

Donlin Gold LLC1 (Donlin Gold) is proposing the development of an open pit, hard rock gold mine located 277 miles (446 km) west of Anchorage, 145 miles (233 km) northeast of Bethel, and 10 miles (16 km) north of the village of Crooked Creek (Figure 1 Crooked Creek).

1.2 HIA Overview

This HIA provides information to decision-makers about potential positive and negative human health impacts related to the proposed Donlin Gold Mine.

1.3 Legal, Administrative and Legislative Requirements for Health Impact Assessment (HIA)

The State of Alaska has developed an HIA Toolkit to guide HIA practitioners in the state. At the request of the lead federal agency, the United States Army Corps of Engineers (USACE), this HIA is included as part of the National Environmental Policy Act (NEPA) Review/Environmental Impact Statement (EIS). The USACE has not yet authorized this project, which is currently in the National Environmental Policy Act (NEPA) Review/Environmental Impact Statement (EIS) process. Where appropriate, the HIA refers to detailed technical sections of the EIS that contain careful descriptions of the affected environment, project-specific engineering, and a comprehensive analysis of the potentially affected communities (PACs).

1.4 Project Requirement for HIA

As a "best practices" approach to responsible natural resources development, the Alaska Department of Natural Resources (DNR) consulted with the Alaska Department of Health and Social Services (ADHSS) HIA Program. The ADHSS HIA program has developed this HIA as part of the NEPA Review/EIS for the Donlin Gold Project.

1.5 HIA Framework and Methodology

1.5.1 HIA Definition

Health impact assessment is a combination of procedures, methods and tools by which a policy, program, or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population.

1.5.2 HIA Methods

As presented in the July 2011 Alaska "Technical Guidance for Health Impact Assessment,"[1] the Donlin Gold HIA will:

- Provide a formal mechanism to engage the relevant stakeholders and key regulatory decision-makers;
- Review proposed project plans;

- Review the physical and general environmental setting of the proposed project;
- Identify potentially affected communities (PACs);
- Generate a baseline profile of health in the region;
- Identify potential health impacts using both a set of defined health effects categories (HECs) and input from stakeholder meetings;
- Conduct semi-qualitative impact rating and importance ranking; and,
- Propose a series of recommendations tied to the most important potential impacts.

1.5.3 HIA Type

An HIA can be a short desktop exercise that takes an expert practitioner less than 2 weeks to prepare, a rapid assessment that takes several months, or a comprehensive report that requires a year or more to complete (see below). Each type involves different approaches to baseline data collection and stakeholder engagement. The type of HIA chosen by the practitioner depends on a variety of factors including the type of project, the timeframe available for HIA completion, and the resources available for performing the HIA.

1.5.3.1 Desktop HIA

The desktop HIA is a qualitative assessment and is most appropriate for projects with few anticipated health impacts. The HIA team often does not pursue extensive stakeholder engagement, although some involvement is usually required. The desktop HIA is useful for determining whether a more detailed review is needed. From a State of Alaska perspective, a desktop HIA doubles as a screening exercise and it can reveal the need for further work.

1.5.3.2 Rapid Appraisal HIA

A rapid appraisal HIA is considered to be a site-specific HIA that uses available health information *without* conducting new field survey work. Data sources may include peer-reviewed scientific literature, health department databases and tribal health service data sources. A rapid appraisal HIA may evolve into a comprehensive HIA.

1.5.3.3 Comprehensive HIA

The hallmark of the comprehensive HIA is collection of new data, to address important data gaps identified during the scoping process. A comprehensive HIA also pursues extensive stakeholder engagement. A comprehensive HIA may be appropriate for projects that involve:

- Resettlement of existing communities;
- Population influx;
- Major disruption of subsistence practices;
- Major impacts to key social determinants of health; and,
- Information gaps related to a well-known aspect of a project.

The Donlin Gold Project HIA utilizes a comprehensive strategy.

A major goal of this HIA is to accurately inform decision-makers and stakeholders regarding potential impacts based on the current set of available data. The HIA identifies the areas where additional data, including field investigation, would enhance the analysis.

1.5.4 HIA Scope

The HIA team performed (i) extensive literature and document reviews, (ii) close coordination with the EIS team, (iii) community observations and household surveys, and (iv) limited field visits to the project area. This HIA reviews the proposed Donlin Gold Project based on the following information:

- Numerous State databases and reports,
- Permit application materials submitted by the project proponent, Donlin Gold;
- Stakeholder concerns as presented in the scoping reports;
- General parameters developed by the July 2011 "Alaska Technical Guidance for Health Impact Assessment".

1.5.4.1 Areas outside the scope of the HIA

The study does not address classic occupational health impacts (e.g., physical hazards or environmental hazards encountered by workers), which are referred to as 'inside the fence' and are addressed by federally mandated health and safety protocols enforced by the Occupational Safety and Health Administration (OSHA) and the Mining Safety and Health Administration (MSHA).

1.5.4.2 HIA Limitations

This HIA has several important limitations. First, it does not address classic occupational health impacts (*e.g.* physical hazards or environmental hazards encountered while working), which are referred to as 'inside the fence' and are thoroughly addressed by federally mandated health and safety protocols. However, "cross-over" issues (*e.g.* health issues that arise as workers interact with local communities such as roadway traffic) are analyzed within the HIA. Second, this HIA does not evaluate the global implications of Alaskan developments such as the contribution of the Donlin Gold Project to the global economy or climate change. Third, this HIA was executed in the presence of data gaps in subject areas that strongly influence human health, such as health indicators in small, economics and sociological matters. This report utilizes the most currently available public data. For some baseline health key performance indicators (i.e. those available from the Yukon Kuskokwim Regional Health Profile), the most current data may date back to 2000-2008.

1.5.4.3 Health Effect Categories (HECs)

The Alaska HECs, shown below in Table 1, are a standard set of health effects categories that have been developed and discussed in the July 2011, "Technical Guidance for Health Impact Assessment (HIA) in Alaska."[1]

Table 1 Health Effects Categories

Health Effects Category	Pathway Description
Social Determinants of Health (SDH)	The SDH are the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power, access, and resources at global, national, state, regional, and local levels. The SDH are mostly responsible for health inequities -- the unfair and avoidable differences in health status seen within and between countries. This category reviews outcomes and determinants related to mental health, maternal and child health, substance use, social exclusion, psychosocial distress, historical trauma, family dynamics, economic status, educational status, social support systems, and employment status.
Accidents and Injuries	This category contains health outcomes and determinants related to accidents and injuries. The key outcomes considered are increases and decreases in intentional and unintentional injuries with fatal and nonfatal results. The key determinants in this category include items such as the presence of law enforcement, traffic patterns, alcohol involvement, distance to emergency services, and the presence of prevention programs.
Exposure to potentially hazardous materials	This category contains health outcomes and determinants that may arise from exposure to hazardous materials. The key health outcomes considered are increases and decreases in documented illnesses or exacerbation of illnesses commonly associated with pollutants of potential concern. These may be mediated through inhalation, ingestion, or physical contact.
Food, Nutrition, and Subsistence Activity	This category includes health outcomes and determinants related to food security, dietary choices, and the consumption of subsistence foods. The key health outcomes considered are nutrient levels, malnutrition or improvements in nutrient intake, and the subsequent increases or decreases in related diseases. The key determinants include diet composition, food security, and the consumption of subsistence foods.
Infectious Disease	This category includes health outcomes and determinants that result from infectious diseases. The key health outcomes include rates of increase or decrease for a range of infectious diseases, such as sexually transmitted infections (STI), respiratory illness, or skin infections. Important health determinants may include immunization rates, and the presence of infectious disease prevention efforts.

Table 1 Health Effects Categories

Health Effects Category	Pathway Description
Water and Sanitation	This category includes changes to access, quantity, and quality of water supplies. Key determinants reviewed may include distance to clean water, water fluoridation, indoor plumbing, water treatment facilities, adequate volume of water resources, and the existence of community facilities, such as a washeteria and/or community.
Non-communicable and Chronic Diseases	This category includes health outcomes and determinants related to chronic disease. Important outcomes include increases or decreases in mortality and morbidity rates of cancer, cardiovascular and cerebrovascular diseases, diabetes, respiratory diseases, and mental health disorders. Key determinants for chronic diseases may include smoking rates, rates of alcohol and drug abuse, physical activity levels, presence of recreation centers, as well as cancer screening rates.
Health Services Infrastructure and Capacity	This category considers health outcomes and determinants related to health care access and health care infrastructure. Important outcomes include the increase or decrease in the number of medical evacuations, clinics or hospital visit trends, health expenditures, and medication usage. Health determinants may include distance to health facilities, medevac facilities/aircraft, the presence of community health aides, and the frequency of physician visits to the area.

HECs have been developed to identify the full spectrum of possible health impacts related to a specific project. In general, while each HEC may not be relevant for a given project, it is still important to systematically analyze the potential for project related impacts (positive, negative or neutral) by careful consideration of each HEC.

2.0 PLACE, PROJECT, PERSONS

2.1 The Place-Proposed Donlin Gold Project Location and Environs

2.1.1 History

Placer gold was first discovered at Snow Gulch, a tributary of Donlin Creek, in 1909. Resource Associates of Alaska (RAA) carried out a regional evaluation for Calista in 1974 to 1975, identifying mineral potential in the area. The Calista Corporation was established during the Alaska Native Claims Settlement Act (ANCSA, 1971) and holds the subsurface (mineral) estate for ANCSA lands in the region. In addition to the subsurface estate, Calista owns some surface estate lands in the lease area. A Surface Use Agreement with The Kuskokwim Corporation (TKC), an ANCSA village corporation, grants surface use rights.

Calista prospected the area and conducted limited exploration activities in 1984. Westgold carried out the first substantial exploration program in 1988 to 1989. Teck operated the project briefly in 1993. Placer Dome U.S. (PDUS) explored the property from 1995 to 2000, formed the Donlin Creek Joint Venture (DCJV) with NovaGold as operator in 2001, and then reassumed management of the DCJV as operator in February 2003. Barrick Gold merged with Placer Dome in 2006 and acquired the PDUS interest in the DCJV. In December 2007, Barrick Gold U.S. and NovaGold Resources Alaska, Inc. formed Donlin Creek LLC as a limited liability company with 50/50 ownership. In 2011, Donlin Creek LLC changed its name to Donlin Gold LLC. From 1988 through 2010, a total of 1,834 exploration and development diamond core and reverse circulation (RC) drill holes have been completed, for an aggregate 1,337,321 ft (407,720 m).

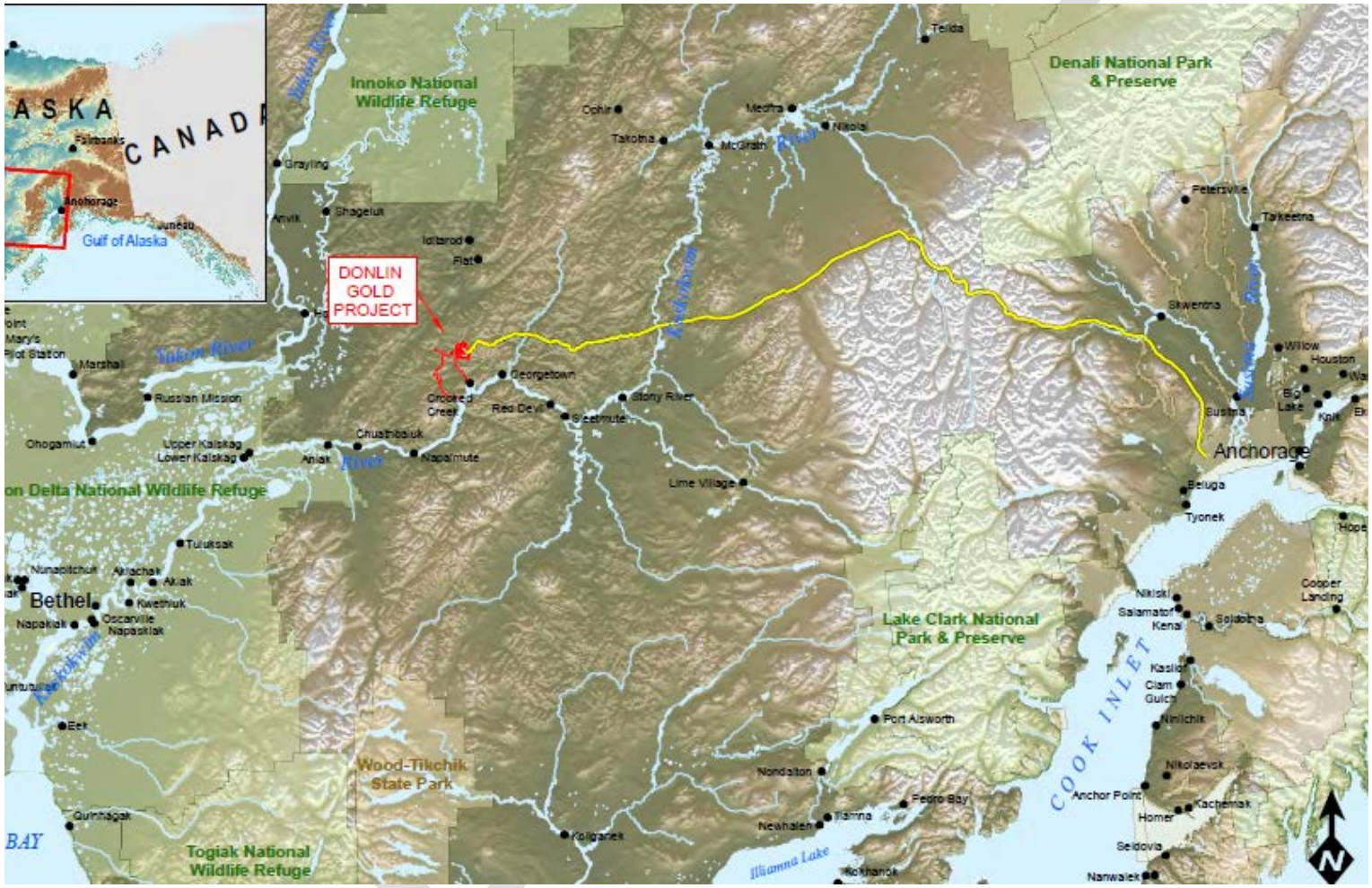
2.1.2 Location and Physical Features

Donlin Gold LLC1 (Donlin Gold) is proposing the development of an open pit, hardrock gold mine located 277 miles (446 km) west of Anchorage, 145 miles (233 km) northeast of Bethel, and 10 miles (16 km) north of the village of Crooked Creek (Figure 2 Project Location).

Figure 1 Crooked Creek

Source: NewFields, 2012

Figure 2 Project Location[2]



Source: Donlin Gold EIS Project Description, 2014

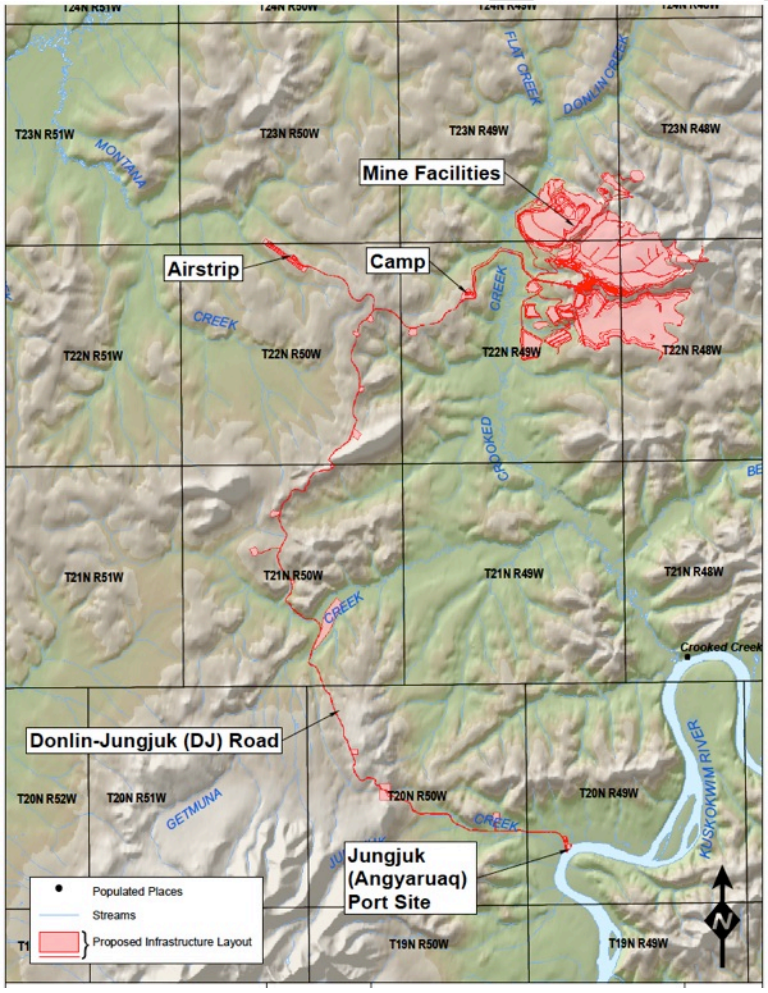
2.1.3 Land Use in the Project Area

The proposed Donlin Gold Project includes land leased from Calista Corporation, state and federal lands.

2.1.4 Land Administration in the Project Area

Bethel, the largest community in western Alaska [2012 population 6,371 (http://www.city-data.com/city/Bethel-Alaska.html)][3], is the administrative and transportation center of the Yukon–Kuskokwim Delta. The proposed Jungjuk (Angyaruaq) Port site is about 177 river miles (285 km) upstream of Bethel and about 57 river miles (92 km) upstream of Aniak, the regional transportation center for the middle Kuskokwim Valley (See Figure 3).

Figure 3 Port and Access Road



Source: Donlin Gold EIS Project Description, 2014

2.1.5 Project Timing

The proposed Donlin Gold project would require three to four years to construct and have an active mine life of approximately 27.5 years. The mine is proposed to be a year-round, conventional "truck and shovel" operation using both bulk and selective mining methods.

2.1.6 Project Production

The operation would have a projected average mining rate of 383,000 t/d, or 140 Mt/a, and an average mill production rate of 53,500 t/d. Milling components include a gyratory crusher, semi-autogenous grinding (SAG) and ball mills, followed by flotation, concentration, pressure oxidation, and carbon-in-leach (CIL) process circuits. Conventional carbon stripping and electrolytic gold recovery would produce an end product of gold doré bars, which would be shipped to a custom refinery for further processing. State-of-the-art mercury abatement controls would be installed at each of the major thermal sources, including the autoclave, carbon kiln, gold furnaces, and retort.

2.1.7 Tailings Storage

Tailings storage would encompass an area of 2,351 acres (951 ha) with a total capacity of approximately 335,000 acre-ft (413 Mm3) of mill tailings; decant water, and storm water. Total waste rock material is estimated at 2,720 Mt, with approximately 2,232 Mt to be placed in a waste rock facility located outside the mine pit and the remaining waste rock backfilled in the pit.

2.1.8 Power Supply

Electric power for the proposed Donlin Gold project site will be generated on site from a dual-fueled (natural gas as primary and diesel as secondary) reciprocating engine power plant with a steam turbine utilizing waste heat recovery from the engines. The power plant would consist of two equal halves, each consisting of six reciprocating engines, and a single separate steam turbine for a total connected load of 227 MW, an average running load of 153 MW, and a peak load of 184 MW.

2.1.9 Transportation

General cargo for operations would be transported to Bethel by marine barge from terminals in Seattle, Washington, Vancouver, BC, or Dutch Harbor, Alaska. At Bethel, cargo would be transferred to the dock for temporary storage or loaded onto river barges for transport up the Kuskokwim River to a port constructed at Jungjuk Creek. A 30-mile (48 km) all-season access road would be constructed from the proposed Jungjuk Port to the mine site (Figure 3 Port and Access Road).

Fuel would be transported to Dutch Harbor by tanker, then to Bethel by marine barge. At Bethel fuel would either be transferred directly to double-hull river barges for transport to Jungjuk, or be off-loaded for temporary storage. From Jungjuk Port fuel would be delivered to the mine site fuel storage facility by tanker trucks.

Natural gas would be transported to the Donlin Gold mine site via a 313-mile (503 km), 14-inch (35.5 cm) diameter buried steel pipeline originating from an existing 20-inch (51 cm) natural gas pipeline near Beluga, Alaska.

The City of Bethel is the main port in the Yukon–Kuskokwim Delta. It is anticipated that a cargo terminal, with berth and mooring facilities, would be constructed in Bethel to receive ocean barges originating from the Vancouver / Seattle area and Dutch Harbor. Shipments would either be placed into storage or transferred to river barges for seasonal shipment to the Jungjuk Port.

Currently there is no road or rail access to the site, and all personnel and supplies are transported by air. The project is completely isolated from existing power and other infrastructure. The existing exploration camp at the site is an all-season facility that can accommodate a workforce of up to 160 people engaged in exploration, environmental, geotechnical, and engineering studies. All equipment, supplies, and personnel are transported by air to an existing 5,000-ft (1,524 m) airstrip capable of handling aircraft as large as a C-130 Hercules. In addition, the project site is currently serviced by charter air services out of Anchorage and Aniak.

The Jungjuk (Angyaruaq) Port site would serve as a terminus between barge transport from Bethel and road transport to the mine. Proposed facilities include barge berths, a barge ramp, container-handling equipment, seasonal storage for containers, break-bulk cargo, and fuel, and barge-season office/lunchroom facilities. Electricity would be provided by two 600 kW diesel-powered generators (one primary and one standby). Fire protection water would be provided from a heated and insulated aboveground 240,000 gal (900 m3) dedicated water storage tank. Containers, fuel, and other cargo would be off-loaded at the port terminal and trucked to the mine throughout the barging season. For protection against ice loading, a sheetpile bulkhead earth-retaining system would be constructed for the dock. The dock area would be 5 acres (2 ha) in size, sited at an elevation above the high water line. A 7.5 acre (3 ha) container storage area behind the dock area would have sufficient space for trucks to drop off empty trailers and pick up loaded containers for delivery to the proposed mine site.

Commercial shippers would transport diesel fuel by ocean barge to Bethel for storage before being shipped upriver to Jungjuk Port in double-hulled river barges. A 6 Mgal (23 ML) fuel storage facility would be provided at Bethel, and a single 2.8 Mgal (10.6 ML) capacity tank would be provided at Jungjuk Port for temporary storage.[4] The tanks at both Bethel and Jungjuk Port would be installed in lined containment areas. Less storage would be needed at Jungjuk Port because it is intended to move fuel and other cargoes to the mine site as soon as possible, particularly during the construction period.

2.1.10 Project Design

Design and workforce information is described in Table 2 below.

Table 2 Project Design

Item / Parameter	Value / Description
PROJECT MINE LIFE	27.5 years
WORK FORCE	
Construction phase	Up to 2,560
Natural gas pipeline construction	650
Permanent	600 to 1,000
Living accommodations	On site
OPERATIONAL PERIOD	
Daily	24 hours
Annual	365 days
PRODUCTION RATE	
Nominal mill throughput	53,500 tonnes per day
Based on 92% availability	19.8 million short tons per year
PIT DIMENSIONS	
Ultimate pit footprint	Approximately 2.2 miles long x 1 mile wide (3,470 m x 2,543 m). Covers 1,462 acres (591.7 ha)
Lewis pit depth	1,653 ft (504 m) from upper highwall to final pit bottom
ACMA pit depth	1,850 ft (564 m) from upper highwall to final pit bottom
Bench height	40 ft (12 m)
Spilt bench height	20 ft (6 m)
Overall slope angle	23° to 42°
Average ramp width	131 ft (40 m) at maximum 10% grade
ORE AND DEVELOPMENT ROCK	
Ore	556 million short tons
Development rock (waste rock)	3,048 million short tons
Average tons mined during production	422,000 short tons per day
Strip ratio average	5.5:1.0 (waste tons to ore)
Overburden stockpiles	46.6 million short tons
Waste rock used for construction	114 million short tons
Waste rock stored in waste rock facility (WRF)	2,460 million short tons
Waste rock backfilled to pit	467 million short tons
PRIMARY MINING EQUIPMENT OVER MINE LIFE	
Electric hydraulic shovels	6 x 50 $yd.^3$ (38 m^3)
Diesel hydraulic shovel	1 x 50 $yd.^3$ (38 m^3)
Front-end loaders	2 x 53 $yd.^3$ (40.52 m^3)
Haul trucks	69 x 400 short tons
Haul trucks	10 x 150 short tons
CRUSHING/CONVEYING	
Gyratory crusher	60 x 89 inches (152 x 226 cm)
Crush size	80% passing 5 inches (13 cm)

Item / Parameter	Value / Description
Conveyor	54 inches wide x 0.72 miles long (1.4 m x 1.161 km)
Covered stockpile live capacity	42,000 short tons
Covered stockpile total capacity	192,000 short tons
MILLING	
SAG mill	
Size	38 ft diameter x 25 ft long (11.6 x 7.6 m)
Drive	Powered by 26,800 horse power (20 MW) wrap-around variable-speed drive
Pebble crusher (cone crusher) drive	1,006 hp (750 kW)
Ball mills	One primary and one secondary regrind mill
Size	26 ft diameter x 45 ft long (7.9 x 13.7 m)
Drive	Trunnion-supported 24,140 hp (18 MW) wrap-around
Cyclone clusters	
Primary cyclones	12 x 33 inches (30 x 83.5 cm)
Secondary cyclones	28 x 15 inches (71 x 38 cm)
Flotation circuit	
Residence time	114 minutes
Primary rougher flotation circuit	2 trains, 11 cells each
Secondary rougher flotation circuit	2 trains, 11 cells each
Rougher flotation	
Primary acid conditioning tank	Copper sulfate ($CuSO_4$) added to promote sulfide flotation
Secondary conditioning tank	Methyl isobutyl carbinol (MIBC) frother and potassium amyl xanthate collector (PAX) added
Primary rougher concentrate	Sent to concentrate thickener
Rougher tails	Sent to secondary ball mill for regrind before secondary flotation, cleaner flotation, and final cleaner scavenger flotation
Grind	80% passing 270 mesh (50 µm)
Secondary rougher and cleaner scavenger tails	Sent to flotation tails thickener and then to tailings storage facility (TSF)
Autoclaves	2 units: parallel operation with 50-minute retention time each to convert sulfide flotation concentrate slurry to oxide concentrate slurry at high temperature and pressure, and with sulfuric acid
Solid/liquid separation	Solids report to leach; acidic overflow solution neutralized with flotation tailings and lime
Carbon-in-leach (CIL)	6 tanks in series, 24-hour retention time
Carbon density	15 gL
Advance rate	40 st (36 t) carbon per day
Item / Parameter	**Value / Description**
Carbon stripping	Conventional
Gold recovery	Electrolytic
Overall gold recovery	Approximately 90%
CIL slurry	Sent to cyanide detoxification circuit (sulfur dioxide cyanide detoxification [SO_2/Air] process)

Item / Parameter	Value / Description
Tailings	Discharged to TSF at 36% solids by weight
TAILINGS STORAGE FACILITY (TSF)	
Capacity	568 million short tons
Tailings density	78.0 lb./ft^3
Size	2,351 acres
Features:	
Cross-valley dam	
Ultimate height measured from downstream toe to crest	464 ft (141.5 m)
Ultimate length from north abutment to south abutment	5,863 ft (1,787 m)
Linear low-density polyethylene (LLDPE) synthetic liner	60 mil (1.5 mm)
Seepage collection system	Pond, diversion ditches, collection wells
Zero-discharge facility	
Water reclaim to mill	Reclaim barges and pipeline
Temporary freshwater reservoirs	2 reservoirs directly east of TSF back dam to control water during early construction of TSF starter dam (first three years)
NATURAL GAS PIPELINE	
Dimensions	313 miles (503 km) x 14 inch (36 cm) diameter
Source	Beluga, Alaska
Natural gas use	Fuel source for generating electricity, heating, and processing ore
POWER	
Total connected load	227 MW
Engines	12 natural gas fueled combined-cycle reciprocating type with heat recovery and steam cogeneration systems
Emergency power	1 generation set
Average running load	153 MW
Average natural gas consumption	307 Mm^3 per year
Generators at the Jungjuk Port site	2 x 600 kW, one primary, one standby
Generators at the airstrip	2 x 200 kW, one primary, one standby
WATER SUPPLY	
Water supply for processing	Contact water pond, dewatering wells, and freshwater reservoirs
If not required for process:	
Water from pit perimeter dewatering wells	To be treated to meet expected effluent limits before being discharged

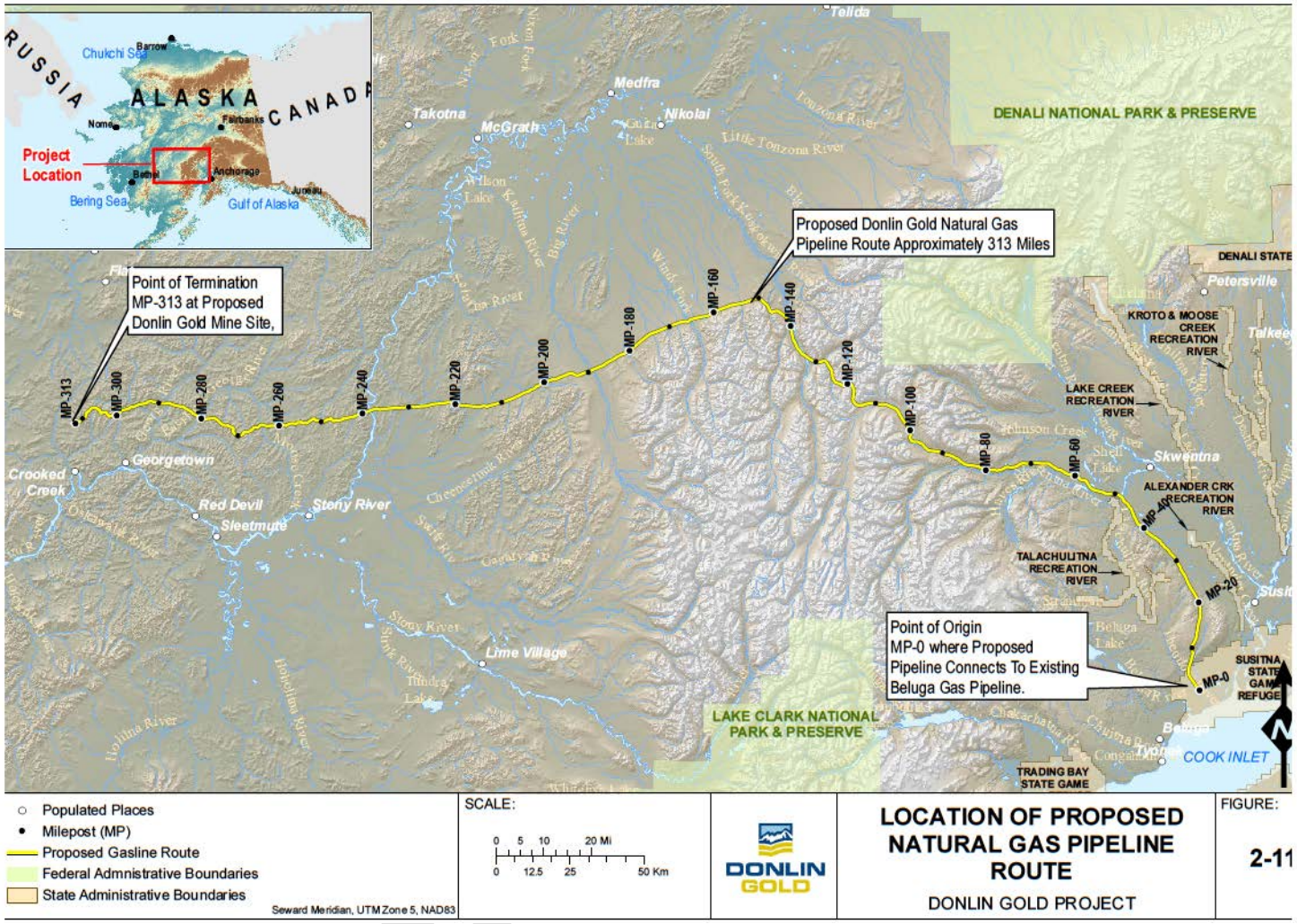
Source: Donlin Gold EIS Project Description, 2014

2.1.11 Pipeline

A 14-inch (356 mm) diameter steel pipeline would be constructed to transport natural gas approximately 313 miles (503 km) from an existing 20-inch (508 mm) gas pipeline near Beluga to the proposed Donlin Gold mine site (Figure 4). The pipeline would require one compressor station at Milepost (MP) 5 to compress the gas to the necessary pressure for transportation. At the mine site, natural gas would be used primarily as a fuel source for heating and generating electricity.

Except for two above ground fault crossings, each approximately 1,300 ft (396 m) long, the pipeline would be buried entirely within a permanent, 50-foot (15 m) wide right-of-way (ROW). To mitigate impacts to aquatic resources, construction techniques such as horizontal directional drilling (HDD) and winter trenching would be used to bury the pipeline beneath stream and river crossings. Small surface check-valve stations would be installed every 20 miles (32 km) along the route, and a pigging station would be provided at approximately the halfway mark (Figure 4 Pipeline Route).

Figure 4 Pipeline Route



Source: Donlin Gold EIS Project Description, 2014

2.1.12 Airstrip and Fuel Storage

Mine development would include the construction of a 5,000 ft long x 150 ft wide (1,524 m x 45 m) gravel airstrip on a ridge top approximately 9 road miles (14.5 km) west of the mine site. The existing airstrip and project site are shown in Figure 5 below.

Figure 5 Existing Airstrip at Project Site

Source: NewFields, 2012

Two 13,200 gal (50,000 L) fuel storage tanks, one containing Jet "A" fuel and the other 100 LL (low lead) aviation gasoline, would be provided at the airstrip site. A small 5,000 gal (18,900 L) diesel tank would store fuel for two 200 kW generators (one primary, one standby) to provide power to the airstrip facilities.

The airstrip design is based on U.S. Department of Transportation (USDOT), Federal Aviation Administration (FAA) standards. The specified aircraft are the DHC Dash 8 and the Hercules C-130. The airstrip would be accessed from a 3-mile (4.8 km) long spur road beginning at mile 5.4 (8.7 km) of the Donlin-Jungjuk road.

2.1.13 Project Employment

Workers would be employed to build the mine site infrastructure, transportation facilities, and natural gas pipeline. At peak construction, the proposed Donlin Gold Project would annually require up to 3,200 workers, including 2,500 for mine site and transportation facilities construction and 650 for natural gas

pipeline construction. Project construction jobs would be temporary and seasonal, with employment highest during the summer months.[5] The magnitude of project construction labor requirements (annual and, more importantly, peak requirements), together with the limited number of workers in Alaska with the specialized skills required for mill construction, suggests that some construction jobs may be filled by workers from outside Alaska. One factor that would affect the number of nonresidents in the project construction labor force is the number and scale of other construction projects occurring simultaneously. Developments such as the utility and infrastructure projects, potential oil and gas construction, and other construction for normal residential and commercial development would compete for skilled labor during the project construction period, particularly during the summer construction season.[5] The socioeconomic analysis [5] estimates that 50 to 60 percent of the workforce during the peak year of the project's construction phase, or about 1,600 to 1,900 workers, would be drawn from communities within the Y-K region. It is estimated that during the four-year project construction period, an additional 7,300 jobs and $390 million in wages would be generated statewide through multiplier effects. Sales in Alaska would increase by an additional $1.1 billion.[5]

2.1.14 Worker Housing

Mine Site

Construction workers for the project components would follow a fly-in/fly-out commute work arrangement whereby they would spend a certain number of days working on-site, after which they would return home for a specified rest period. Donlin Gold would organize and pay for transportation to and from the worksites as well as worker accommodations and other services at or near the worksites.[5]

The Donlin Gold project would include a permanent camp operation accessible primarily by a 5,000-ft (1,524 m) gravel airstrip. The camp would be capable of housing 638 workers. The construction camp would be built near the proposed plant. The camp would include 14 stand-alone, three-story dormitories designed to accommodate up to 2,560 people, and a stand-alone, single-story administrative office facility. Detailed worker housing design describing space per occupant and ventilation capacity is not currently available.

All units would be pre-fabricated complete with all services, furnishings, appliances, and recreation and kitchen equipment, as appropriate, to permit modular construction. The modules would be transported by barge to Jungjuk Port and then trucked to the site. Each of the 14 dormitories would be designed as three-story wings with double-occupancy bedrooms and a common wash module on each floor containing toilets, showers, and personnel laundry facilities. Housekeeping and mechanical/electrical rooms would be provided on every floor in each wing. The dormitory wings would be attached to the core and dining services area by heated link corridors. The construction camp modules would be disassembled and demobilized after construction is complete.

In addition to housing facilities, the camps would be equipped with appropriate emergency medical facilities, electrical power generation, fuel storage, and facilities for sewage treatment and solid waste disposal and management. Potable water for the camps would be trucked in or sourced from on-site wells. Figure 6 is depicts temporary housing at the exploration camp.

Pipeline

A full camp will be associated with each pipeline spread during construction. The camp would be temporary, in that it would be moved along the pipeline alignment as needed during construction.

Ports

During construction, accommodations will be provided within the city of Bethel for the Bethel Port workers; Jungjuk Port employees will be housed at the mine site main camp.

Figure 6 Donlin Exploration Camp Housing

Source: NewFields, 2012

2.2 Potentially Affected Communities

The Alaska HIA Toolkit defines a potentially affected community (PAC) as an area, community, or village where project-related health impacts may reasonably be expected to occur.[1]

The DRAFT EIS identified these areas in the Social Affected Environment chapter, as potentially affected by the Project.

Table 3 Social PACs

	Mine Site Infrastructure and Processes Area	Transportation Facilities Area	Natural Gas Pipeline Area
Y-K Region [1]	■		■
Bethel Census Area	■		■
Wade Hampton Census Area	■		■
City of Bethel	■	■	■
City of Unalaska		■	
Kuskokwim River Communities[1]		■	
Kenai Peninsula Borough			■
Matanuska-Susitna Borough			■
Municipality of Anchorage	■		■
State of Alaska	■		■

The Environmental Justice section of the DRAFT EIS identifies these areas as PACs from an EJ perspective.

Table 4 Environmental Justice PACs

Mine Site	Y-K Region– Mine site and associated jobs Bethel Census Area – Mine site footprint and associated jobs Yukon-Koyukuk Census Area – Associated jobs Kusilvak Census Area* – Associated jobs Calista Corporation shareholders
Transportation Facilities	City of Bethel – Cargo terminal, berth and mooring facilities near the Port of Bethel, and associated jobs City of Unalaska – Barge fuel storage location & associated jobs Bethel Census Area – Kuskokwim River Communities – Barging on the Kuskokwim River
Pipeline	Yukon-Koyukuk Census Area and small portion of Bethel Census Area – pipeline footprint Matanuska-Susitna Borough/Skwentna Census Designated Place – pipeline footprint, airport construction, staging of materials, and camp Kenai Peninsula Borough/Native Village of Tyonek – staging and camp at Beluga Calista Corporation shareholders

*Formerly Wade Hampton Census Area

This HIA study refers to three zones of potentially affected communities (PACs). Potentially affected communities are separated according to potential impacts; distance from mine operations and movement of materials (Table 5 HIA PACs) are also considered. Zone 1 Communities are expected to be directly affected by Project activities during construction and operations. At Bethel, cargo would be transferred to the dock for temporary storage or loaded onto river barges for transport up the

Kuskokwim River to a port constructed at Jungjuk Creek. The Project will also provide accommodations for port workers in Bethel, however details regarding whether this will entail construction of a work camp or whether workers will be housed in existing rentals, are unavailable at this time. As described in Section 8.1.1 of this report "Community Influx", Bethel may experience in-migration of Project employees and their families, as this city will be a fly-in/fly-out hub (i.e. the Project will provide transportation for employees from Bethel to the site).

A 30 mile (48 km) all-season access road would be constructed from the proposed Jungjuk Port to the mine site. Crooked Creek is the nearest village downstream from the mine site near this port. Aniak and Tyonek may also be affected by port activities and/or serve as transport hubs. Fuel and general cargo for operations may be transported from Dutch Harbor to Bethel. If Dutch Harbor is selected as a port, additional fuel storage would be needed however, currently, no detailed plans have been developed for infrastructure in Dutch Harbor.

Zone 2 communities are those that may be potentially affected during construction and operations by barging operations, hazardous spills, and subsistence (especially Kuskokwim River use). Bethel and Aniak are in both Zones 1 and 2, as they would also be affected by barging activity. Zone 3 communities are those that may experience subsistence impacts during construction of the pipeline.

Table 5 HIA PACs

Zone 1	Zone 2	Zone 3
Crooked Creek (nearest village downstream from mine site, near Jungjuk) **Aniak** (port area, transport area) **Bethel** (port area, transport hub, work camp – FI/FO hub) **Tyonek** (port area, transport area)	**Chuathbaluk** **Aniak*** **Upper Kalskag** **Lower Kalskag** **Tuluksak** **Akiak** **Akiachak** **Kwethluk** **Bethel*** **Oscarville** **Napaskiak** **Napakiak** **Tuntutliak**	**Georgetown** **Red Devil** **Sleetmute** **Stony River** **Farewell** **Skwentna** **Susitna** **McGrath** **Nikolai** **Takotna**
* Zone 1 communities that will also be affected by barging		

3.0 BASELINE SITUATION

The baseline data focuses on those PACs that would be considered to be the most likely to be directly impacted (positively or negatively) by the Project.

3.1.1 Organizing Baseline Health Data

Based on extensive international experience with the health impacts of extractive industries, the International Finance Corporation (IFC) developed a standard set of environmental health areas (EHAs) that allowed for an efficient but detailed analysis of potential project impacts. The State of Alaska has developed a specific resource document entitled "Technical Guidance for Health Impact Assessment (HIA) in Alaska"[1] which is built on the IFC methodology and refined the IFC EHAs into 8 Alaska-specific "health effects categories (HECs)." An HEC contains a routine set of health concerns that are commonly grouped together such as accidents and injuries. Table 1 presents the standard list of health effects categories that have been published by the State of Alaska HIA Program for resource development projects, e.g., oil/gas and mining. Past HIA experience in Alaska has demonstrated that the HEC framework is useful for analyzing, rating and ranking potential impacts, both positive and negative. Furthermore, the HIA Program has learned that it is efficient to organize the available baseline data by HECs, as these data will be used to provide objective data support to the overall rating and ranking process. Therefore, this Baseline Community Health Data Assessment organizes and presents the available and relevant data within the HEC framework. Health-specific stakeholder engagement data are treated in a similar fashion. Specific outcomes and determinants can be found at http://www.epi.hss.state.ak.us/hia/data.htm.

4.0 HIA SPECIFIC BASELINE STAKEHOLDER ENGAGEMENT

The ADHSS HIA program organized and participated in multiple community listening sessions for the Donlin Gold Mine. The HIA team has reviewed the written notes associated with community meetings held by the relevant State of Alaska agencies.

4.1 Public Issues and Concerns

Depending on the regulatory and geographical context, stakeholder input may be gathered by a variety of acceptable methods that include formal public scoping meetings, submission of written comments, or more informally in a small focus group format. The HIA team anticipates employing all of these methods.

Dr. Joseph Klejka, Medical Director of the Yukon Kuskokwim Health Corporation (YKHC); Dr. Joseph McLaughlin, State Epidemiologist and Chief, ADHSS SOE; Ed Fogels, Deputy Commissioner of the ADNR; and Dr. Gary Krieger, Principal of NewFields LLC toured the 10 villages of TKC on the middle Kuskokwim between June 11 and 15, 2010, in order to listen to people's concerns about the Project. The Project was performing exploratory drilling during the field visit and employed some people from some of the potentially affected communities.

In addition to the June 2010 field visits, the HIA program gathered input through several community meetings arranged by ADHSS/HIA and the YKHC, which sought to identify community concerns and to ask for support for future fieldwork in the communities. Dr. Paul Anderson, ADHSS/HIA, and Dr. Joseph Klejka, YKHC, solicited and documented public health concerns at these meetings as listed in Table 6. All stakeholder meetings used an open format with a brief introduction to the purpose and process of the HIA, followed by a session for questions and comments.

Table 6 ADHSS/HIA Group Meetings: Locations, Dates, and Times

Date	Meeting	Location
April 20, 2011	Village of Aniak Tribal Council	Aniak, AK
April 20, 2011	Chuathbaluk Traditional Council	Chuathbaluk, AK
April 19, 2011	Village of Crooked Creek Tribal Council	Crooked Creek, AK
March 16, 2011	Villages of Lower and Upper Kalskag	Lower Kalskag, AK

The Project held over 30 meetings across the potentially affected communities between February and May 2011. The HIA team reviewed the draft summaries of these meetings and included the comments in Table 7.

This process generated a list of potential benefits and concerns from stakeholders who are both opposed to and in favor of the mine (Table 7). All of these data are organized by health effects categories (HECs).

Table 7 Preliminary Issue Identification

Health Effects Category	Health Concern	Contact
Social Determinants of Health (SDH)	Potential increase in alcoholism with increased income (the group mentioned that this trend has been observed with other increases in income like the Permanent Fund Dividend (PFD) or 1-2 week jobs that fund an alcohol binge)	ADHSS/HIA Chuathbaluk Tribal Council
	Potential for reduced drinking because Donlin Gold would have alcohol and drug policies	ADHSS/HIA Crooked Creek Tribal Council
	Potential increase in drug abuse, particularly marijuana.	ADHSS/HIA Chuathbaluk Tribal Council Donlin Gold Sleetmute public meeting
	Population influx related problems with drugs and alcohol (workers who would move to Aniak)	ADHSS/HIA Aniak Tribal Council
	Increase in marital problems and divorce because of long stays at the work camp and isolation (potential). Family disruption due to shift work	ADHSS/HIA Chuathbaluk Tribal Council Donlin Gold Kalskag public meeting
	Improved self-esteem for men; noted that there had been fewer social problems when men worked at Donlin before	ADHSS/HIA Crooked Creek Tribal Council
	Increase in jobs, particularly for young people which may reduce suicide among the youth	ADHSS/HIA Chuathbaluk Tribal Council ADHSS/HIA Aniak Tribal Council Donlin Gold Sleetmute public meeting
	Impact on way of life Don't like change Afraid of the potential for unknown problems	ADHSS/HIA Crooked Creek Tribal Council Donlin Gold Akiak public meeting Donlin Gold Sleetmute public meeting
	Need for job counseling and drug testing for employment Donlin Gold has zero tolerance for alcohol and drugs	Donlin Gold Aniak public meeting Donlin Gold Bethel public meeting Donlin Gold Kwethluk public meeting Donlin Gold Sleetmute public meeting
	Impacts to social and mental health	Donlin Gold Kalskag public meeting
	Aniak may become an economic hub for the area allowing more development, more flights, better	ADHSS/HIA Aniak Tribal Council

	access	
	Are there any health benefits to mining?	Donlin Gold St. Mary's public meeting
Accidents and Injuries	Increased barge traffic on the Kuskokwim River ◆ Increased risk of a diesel spill on the river ◆ Increased bank erosion ◆ Impact on commercial fishing ◆ Will you need to dredge the river to accommodate barges ◆ Can the barges crack and spill contents	Donlin Gold Akiak public meeting Donlin Gold Bethel public meeting Donlin Gold Kalskag public meeting Donlin Gold Kwethluk public meeting Donlin Gold Napaimute public meeting Donlin Gold Quinhagak public meeting Donlin Gold Sleetmute public meeting Donlin Gold St. Mary's public meeting
	Mercury spills down the river; spills from the tailings pond	Donlin Gold Akiachak public meeting Donlin Gold Russian Mission public meeting
	Increased need for VPSO in villages	Donlin Gold Goodnews Bay public meeting
	Need spill prevention plan on the runway which drains into the Yukon	Donlin Gold St. Mary's public meeting
Exposure to Potentially Hazardous Materials	Potential for acid rock drainage (ARD) ◆ What is a 'little bit' of ARD? ◆ What safeguards will be in place	Donlin Gold Akiachak public meeting Donlin Gold Grayling public meeting Donlin Gold Quinhagak public meeting
	Potential for mercury contamination like at Red Devil. ◆ What safeguards will be in place ◆ How effective will the control technologies be at capturing mercury from every point source ◆ How will mercury emissions from both point and fugitive sources be monitored, including after mine closure	Donlin Gold Akiachak public meeting Donlin Gold Akiak public meeting Donlin Gold Kalskag public meeting Donlin Gold Mountain Village public meeting Donlin Gold Russian Mission public meeting
	Potential for mercury contamination ◆ Thousands of pounds of toxic mercury freed from waste rock ◆ Transportation off-site of many tons of mercury per year ◆ Mercury leaching ◆ Mercury in dust as it leaves the stacks	Donlin Gold Goodnews Bay public meeting Donlin Gold Grayling public meeting Donlin Gold Kalskag public meeting Donlin Gold Quinhagak public

	◆ Mercury vapor comes down as rain ◆ Can mercury be brought home on workers' clothes and contaminate family members ◆ How will Donlin reduce emissions from fugitive sources both during operations and after closure ◆ How will mercury captured from point sources, how and where will that mercury be stored on site; how will it be transferred off site and where will it be stored permanently. ◆ How will workers be protected from mercury exposure at the mine	meeting Donlin Gold Sleetmute public meeting Donlin Gold St. Mary's public meeting Donlin Gold Tuluksak public meeting
	Will mercury be captured and sold? How will mercury be shipped off-site?	Donlin Gold Nikolai public meeting Donlin Gold Quinhagak public meeting
	Effects of cyanide usage at the mine ◆ Breakdown products of nitrate ◆ Combines with cobalt ◆ How is cyanide detoxified? ◆ Is there existing cyanide pollution at the site? ◆ Will there be cyanide used on the pipeline? ◆ Will cyanide leach from the waste rock?	Donlin Gold Akiak public meeting Donlin Gold Aniak public meeting Donlin Gold Bethel public meeting Donlin Gold Goodnews Bay public meeting Donlin Gold Kalskag public meeting Donlin Gold Russian Mission public meeting Donlin Gold Sleetmute public meeting Donlin Gold Tuluksak public meeting
	Is arsenic a potential concern?	Donlin Gold Sleetmute public meeting
	Will explosives be delivered by air; can they explode in the air?	Donlin Gold Kwethluk public meeting
	Does exposure to cyanide (direct or through fish consumption) cause cancer?	Donlin Gold Tuntutuliak public meeting
	Who already has high mercury levels; are pregnant women monitored for mercury?	Donlin Gold Mountain Village meeting
	What metals will be in the tailings pond?	Donlin Gold Napakiak public meeting
Food, Nutrition, and Subsistence Activity	Potential for mercury contamination ◆ Impacts on fish populations ◆ Impacts on wildlife through contamination of vegetation ◆ Impacts of moose drinking from tailings ponds ◆ Will contamination leach to vegetation? ◆ Impacts on birds landing on tailings pond ◆ How will subsistence resources be	Donlin Gold Akiak public meeting Donlin Gold Bethel public meeting Donlin Gold Napaimute public meeting Donlin Gold Napakiak public meeting Donlin Gold Nikolai public meeting

	monitored for impacts from mercury emissions and what protections and controls will be put in place if there is an impact?	
	Impact of cyanide on vegetation and therefore into subsistence animals Effect of cyanide on fish	Donlin Gold Goodnews Bay public meeting Donlin Gold Tuntutuliak public meeting
	Potential fuel spills will impact subsistence resources	Donlin Gold Quinhagak public meeting
	Noise from the Project will chase animals away	Donlin Gold Kalskag public meeting
	Loss of Traditional Knowledge about fish	Donlin Gold Kwethluk public meeting
	Will Project affect fish spawning? How many streams will be destroyed thereby losing the subsistence resources?	Donlin Gold McGrath public meeting Donlin Gold Nikolai public meeting
Infectious Disease	No issues or concerns raised	
Water and Sanitation	Fuel leaks into domestic water supply	Donlin Gold Kwethluk public meeting
	How will you monitor dump stations?	Donlin Gold Nikolai public meeting
Non-communicable Chronic Disease	No issues or concerns raised.	
Health Infrastructure and Services	Do current Donlin mine workers have health problems?	Donlin Gold Goodnews Bay public meeting
	Better access to health care if there are more flights	ADHSS/HIA Aniak Tribal Council

4.2 Summary of Stakeholder Engagement Concerns, by HEC

4.2.1 Social Determinants of Health

A number of stakeholder comments focused on issues that belong to the social determinants of health category. Many stakeholders expressed their expectations about the benefits of new mine jobs bringing increased incomes and self-esteem for individuals and for Calista. However, stakeholders were also concerned about new jobs increasing drug and alcohol use and disrupting family stability.

Summarized in the project scoping studies report[6] and in the ADHSS sessions discussed previously**,** community members' comments included:

- Benefits of new jobs, income and cash
- More cash available to fund subsistence activities
- Need for education and training for new jobs
- Might be harder to maintain traditional practices and languages
- "Boom and bust" cycle
- Effects on passing traditional values to future generations

Subsistence traditions concerns included:

- Reduction of animal populations
- Less access to subsistence food
- Contamination of subsistence resources
- Increased competition for subsistence resources

Water related concerns included:

- Spills of chemicals during transport
- Impacts on streams and groundwater
- Where waterborne pollutants would go
- Amount of water used by mine and amount needed by villages
- Contamination from acid rock drainage and mine runoff

Comments regarding fish included:

- Damage to salmon habitat
- Contribution to declining salmon runs
- Effects of barge traffic on salmon and other fish
- Contamination from mining chemicals and spills
- Pipeline stream crossings blocking fish passage

People expressed concern about the effects of mercury and other hazardous materials for fish, animal, and human health. Comments included:

- Contamination from emissions and tailings
- Disturbing mercury in Central Kuskokwim rock
- Contamination from past mining (Red Devil Mine)
- Assessments, handling & disposal

Health related concerns included:

- Worker safety
- Lifestyle changes
- Behavioral health
- Contaminants
- Local communities' public health & infrastructure

4.2.2 Accidents and Injuries

Many stakeholder comments raised issues in the accidents and injuries health effect category. The most prominent concern related to the potential for accidents and related spills due to increased barge traffic.

4.2.3 Exposure to Potentially Hazardous Materials

The exposure to potentially hazardous materials category received the largest number of comments. Stakeholders repeatedly raised a wide spectrum of concerns that were concerned with the potential for mercury contamination to the human, subsistence and water resources. Stakeholders also expressed concern about the potential for cyanide, arsenic, and acid rock drainage contamination.

4.2.4 Food, Nutrition, and Subsistence

Stakeholders raised concerns about how the proposed mine might affect issues that belong to the food, nutrition, and subsistence category. Most comments can be summarized as concerns about how the proposed mining activities could negatively affect the quantity and quality of subsistence wildlife and plant life through possible negative changes to local habitat. Stakeholders identified subsistence resources as both an important food source and a cultural component of the existing lifestyle.

4.2.5 Infectious Diseases

Stakeholders did not raise any concerns related to the infectious disease health effect category.

4.2.6 Water and Sanitation

There were a few comments related to the water and sanitation health effect category, and these focused on concerns over the potential for contamination of the domestic water supply.

4.2.7 Non-communicable Chronic Diseases

Stakeholders did not raise concerns related to the chronic diseases health effect category that were not derived from concerns related to other categories such as exposure to potentially hazardous materials.

4.2.8 Health Services Infrastructure and Capacity

Stakeholders did not raise concerns related to the health services infrastructure and capacity category.

5.0 BASELINE COMMUNITY HEALTH DATA

5.1 Introduction and Background

Baseline health conditions form a fundamental context for the overall health impact assessment process. The baseline health summary creates a point of reference for the health status of a community prior to development of a proposed project and also describes an overall health profile for an area. The health profile can inform decision-makers about health vulnerabilities in a region as well as positive health traits present in a population. Decision-makers can use their knowledge about the features of a project and the health profile of a region to better consider health in their deliberations.

For Alaska, baseline health information resides in public health surveillance systems maintained by the State of Alaska, the Alaska Native Tribal Health Consortium (ANTHC), and occasionally local, borough, and tribal entities. This chapter focuses on a review of existing public health surveillance data. All health information is presented according to (i) the requirements of the Health Insurance Portability and Privacy Act of 1996 (HIPPA) and (ii) the published State of Alaska HIA Guidance.[1]

Alaska public health agencies routinely report public health surveillance data at the statewide or regional level. These agencies do not typically report village or community-level data to avoid stigmatization and individual privacy violations. In addition, there are analytic problems when reported case numbers are small. In general, the State of Alaska does not release disaggregated results if case numbers are less than six. For many health topics, this baseline summary only represents the entire Bethel Census Area and does not report individual community level data.

Many rural Alaskan communities contain a high percentage of Alaska Natives. These communities may occasionally track health information in a centralized computerized database. Permission from tribal communities is required to access these records.

5.2 Sources of Information

Specific health data are taken from these sources:

- Alaska Native Regional Health Status Reports (ANTHC)
  - Alaska Native Health Status Report, 2009
  - Regional Health Profile for Yukon-Kuskokwim Health Corporation (YKHC), 2007
- State of Alaska Department of Labor and Workforce Development
- 2000 and 2010 U.S. Census
- U.S. Census Bureau, American Community Surveys 2005-2012
- Alaska Bureau of Vital Statistics (BVS)
- Alaska Behavioral Risk Factor Surveillance Survey (BRFSS)
- ADHSS, Section of Epidemiology (SOE)
- Alaska Trauma Registry (ATR)
- ADHSS, Cancer Registry
- County Health Rankings (University of Wisconsin)

Baseline community health data are organized and presented by specific HECs. The report focuses on health data that, based on experience with similar types of projects, is likely to be relevant for future impact rating and ranking. The data gathering and review exercise has been extensive; however, the report is not designed to be "encyclopaedic", but rather focused and relevant for both the Project permit needs and development of this Draft HIA.

5.3 Donlin Gold Project: The Mine

The baseline community health data for the proposed Donlin Gold Mine focuses on the Bethel Census Area, the YKHC service area, and the Health PAC communities in each zone.

5.3.1 HEC 1: Social Determinants of Health

The World Health Organization (WHO) and CDC define the social determinants of health as, "the circumstances in which people are born, grow up, live, work, and age, and the systems put in place to deal with illness" and asserts that "the social determinants of health are mostly responsible for health inequities - the unfair and avoidable differences in health status seen within and between countries."[7]

Both health outcomes data and health determinant data are used to establish baseline health status according to the social determinants of health. An outcome is a health event that has actually occurred, while a determinant is a "setting" or context that strongly influences health outcomes and overall health status.

Life expectancy, maternal and child health, intimate partner violence and sexual violence, oral health, suicide rates, and substance dependence are health outcomes used as general indicators of physical and social wellness. Health determinants include family structure, economic status, educational attainment, family stability, and cultural continuity which may be associated with positive and negative health outcomes. YK Regional information is compared to information for all Alaska Natives, Alaskans statewide, and to the U.S. population, where possible.

5.3.1.1 Life expectancy

Life expectancy is the expected duration of life at birth and it gives some indication of the overall health of a population. For the State of Alaska, the life expectancy at birth for the total population in 2000 was 74.9 years for males and 79.7 years for females. This was similar to the most recently reported life expectancy for the United States, with a life expectancy of 74.0 years for males and 79.4 years for females in 2000.[8] Consistent with global life expectancy trends, Alaska has seen an increase in life expectancy since 1950; however, both Alaska and the U.S. have seen a slower rate of increase in life expectancy than has been experienced by the 10 nations with the best life expectancy during this period.[9] Life expectancy for Alaskans in 2007 increased slightly to 75.9 years for males and 80.5 years for females (Table 8).[9]

Table 8 Life Expectancies of Males and Females in Alaska and the United States, 2007

	Male Life Expectancy (yrs.)	Female Life Expectancy (yrs.)
Alaska	75.9	80.5
United States	75.6	80.8

Source: Kulkarni et al, 2011

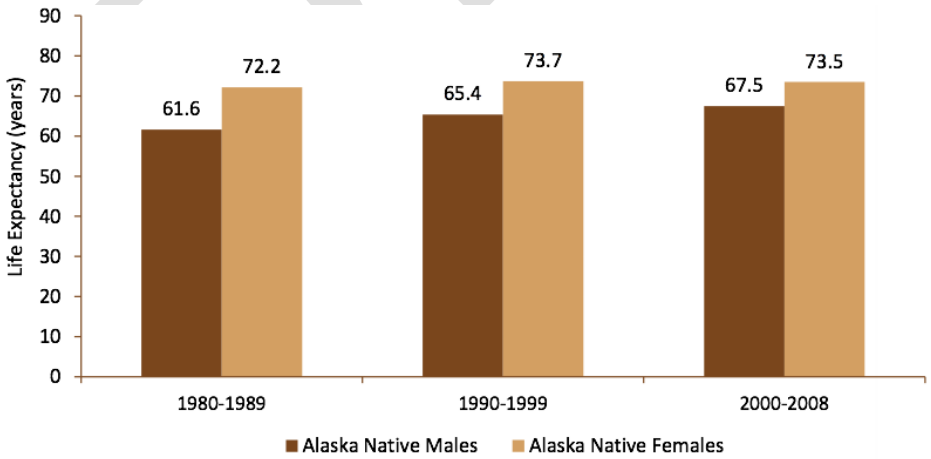
Life expectancy varies by racial/ethnic group and geographic location, with Alaska Natives experiencing a lower life expectancy than the Alaska White population (Table 9)[10]. Alaska Native females have a higher average life expectancy than males (73.5 vs. 67.5 years), however, the gender gap has decreased with each decade since 1980 (Figure 7)[10]. Alaska Native life expectancy varies by tribal health region, ranging from 67.6 years to 72.6 years. Life expectancy in the YKHC was similar to the statewide life expectancy for Alaska Natives (70.0; Table 9).

Table 9 Life Expectancies among Alaska Natives and Alaskans Statewide, 1980-2008

	Life Expectancy at Birth (yrs.)
Alaska Natives	70.5
Alaska White Population	77.7
YKHC	70.0

Source: AN EpiCenter, 2014

Figure 7 Alaska Native Life Expectancy by Gender, 1980-2008



Source: AN EpiCenter, 2014

5.3.1.2 Maternal and Child Health

In the United States, more than 80% of women will become pregnant and give birth to at least one child in their lifetime.[11] Maternal and child health outcomes (e.g. low birth-weight) can profoundly influence youth and adult health status and can suggest current or future challenges (or improvements) to human health.[12] This HIA presents critical components of maternal and child health including initiation of prenatal care, infant mortality, low-birth weight, teen-birth rates, and substance use during pregnancy.

Infant mortality

Table 10 Infant Deaths and Infant Mortality Rates for Bethel Census Area and Alaska, 2010 to 2012

Infant Deaths	Bethel Census Area		State of Alaska	United States
	Number of deaths	Rate per 1000 live births	Rate per 1000 live births	Rate per 1000 live births (2007)
Neonatal (infants less than 28 days of age)	6	4.5*	2.4	4.05
Post-neonatal (infants 28 days to 1 year of age)	4	**	1.9	2.1
Infant Mortality Rate		7.5*	4.3	6.75

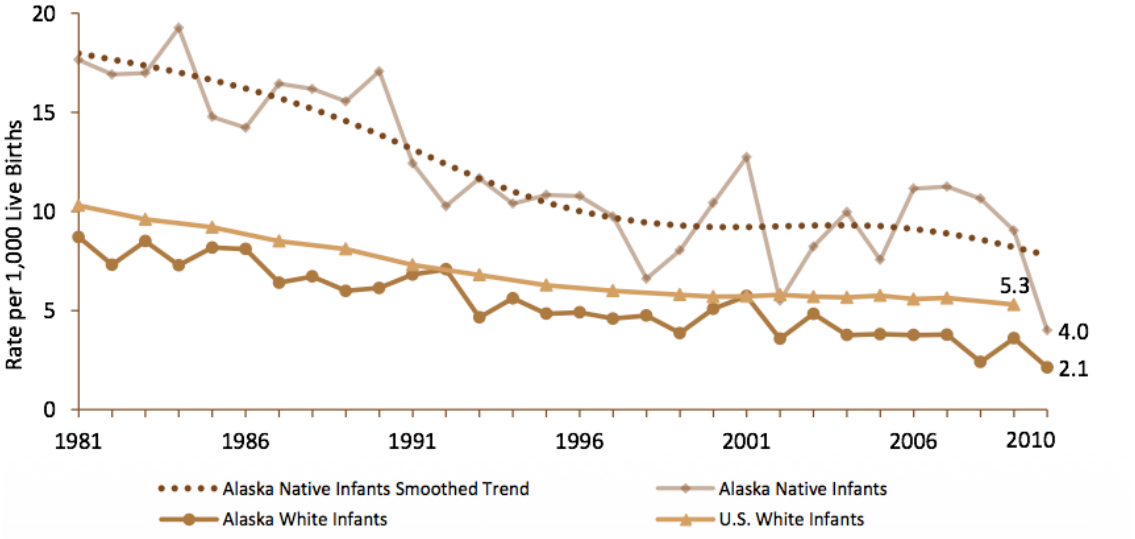
Source: Alaska Bureau of Vital Statistics, 2014; United States: National Vital Statistics Reports. Deaths: Final Data for 2010, Accessed December 9, 2014*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution. **Rates based on fewer than 6 occurrences are not reported.

Infant mortality is an important indicator for population health and is influenced by living conditions, food security, domestic conflict, socio-economic wellbeing, and access to health services. The infant mortality rate is an estimate of the number of infant deaths for every 1,000 live births.[13] This rate is often used as an indicator to measure the health and well-being of a nation, because factors affecting the health of entire populations can also impact the mortality rate of infants. Infant mortality can be separated into neonatal deaths, which occur during the first 28 days of life, and post-neonatal deaths, which occur from the 28th day to 1 year of life. Whereas neonatal deaths are associated with the quality of prenatal and perinatal health care, post-neonatal deaths are more closely associated with socio-economic conditions.[11]

The Bethel Census Area had infant mortality rates that were nearly 2 times higher than the State of Alaska but just slightly higher than that of the United States from 2010 to 2012.[14,15] These data suggest that the post-natal experience, which is affected by socio-economic conditions, is of real concern in the Bethel Census Area compared to Alaska overall.

Infant mortality among Alaska Native infants declined between 1981-2010, as it has for Non-Native Alaskans and nationwide (Figure 8).[10] During this period, the rate of infant mortality for Alaska Native infants statewide decreased 77.3%, a noticeable decline over the time period ($p<0.01$).

Figure 8 Statewide Infant Mortality Rate by Alaska Native Status, 1981-2010

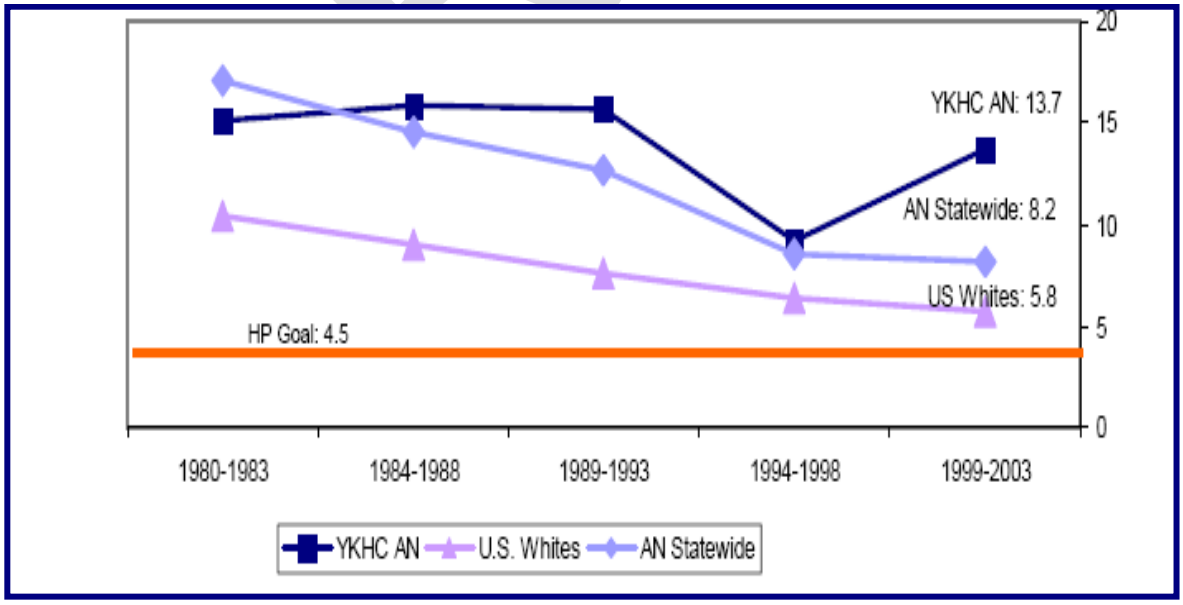


Source: AN EpiCenter, 2014

Since 1984, the infant mortality rates in YKHC service area have been similar to the rate experienced by Alaska Natives statewide. However, between the periods 1994 to 1998 and 1999 to 2003, the infant mortality rate among YKHC Alaska Natives increased from less than 9 deaths per 1000 live births to 13.7 deaths per 1000 live births; however, during the same time period, the mortality rate for Alaska Natives statewide decreased slightly (Figure 9)[16]. The potential causes for the observed disparity are unknown. No data are available at the village level.

The most current infant mortality data available for the Y-K Region are from 2010. Between 2006 and 2010, the infant mortality rate among Y-K Alaska Natives was 15.2 deaths per 1000 live births.[14]

Figure 9 Infant Mortality Rates, (Deaths per 1,000) 5-year intervals, 1980 to 2003



Source: AN EpiCenter, 2007

Adequacy of prenatal care

Initiation of prenatal care during the first trimester is an important marker as adequate prenatal care and has been shown to increase the likelihood of a healthy pregnancy and reduce the likelihood of adverse birth outcomes.[17] Prenatal care not only identifies women at risk for complications during delivery, but also enables screening and treatment of medical conditions that may arise during pregnancy. Some conditions, such as pre-eclampsia, hemorrhage, and intra-partum infection, may be life threatening to both the mother and developing fetus. Prenatal appointments further allow for interventions involving behavioral risk factors associated with poor birth outcomes, such as smoking.[18, 11]

The Adequate Prenatal Care Utilization Index (APCNU) is a measure that combines the initiation of prenatal care and the number of prenatal visits. A ratio of actual to recommended visits is calculated; if the ratio is 110% or greater, care is considered "adequate plus" prenatal care. If the ratio is greater than 80% but less than 110%, care is considered "adequate". A ratio between 50% and 79% is considered "intermediate" and a ratio of less than 50% is considered "inadequate".[14] The categories of "adequate" and "adequate plus" were combined to create the category "adequate or better".

In remote regions such as the Bethel Census Area, data regarding prenatal care should be viewed with caution since they only represent visits for prenatal care in Bethel. Prenatal visits that occur in the local communities are not captured by these data. As a result, the current data likely underestimates the adequacy of prenatal care in the Bethel Census area.

With this in view, 40% of all pregnant women in the Bethel Census Area were documented on the birth certificate as having received adequate or better prenatal care in 2012.[14] In the State of Alaska, 62% of all pregnant women reported experiencing adequate or better prenatal care (Table 11)[14] and among all Alaska Natives, 52% received adequate or better care in 2012. There were also 36.8% fewer Alaska Native women receiving adequate or better prenatal care than white women living in the Bethel Census Area. A large portion of these apparent care inequalities could be explained by the cost and difficulty of traveling to Bethel for prenatal visits. On the whole, the percentage of women receiving adequate or better care improved in all groups in the Bethel Census Area from 2007 to 2009.[14]

Of all mothers in the State of Alaska, approximately 21% fewer Alaska Native mothers received adequate prenatal care as compared to all Alaska white mothers (Figure 11).[10] Once again, this may be due to the difficulty of traveling for prenatal care and inaccurate documentation on birth certificate forms; however, given the magnitude of this discrepancy, it may not account for the entire difference. In the 30-year period from 1981 to 2010, rates of documented adequate prenatal care varied among women giving birth to Alaska Native infants. The proportion of Alaska Native infants born to women who received adequate prenatal care peaked during the early 1990's.[10] During the same time period, the proportion of Alaska White infants born to mothers receiving adequate prenatal care varied similarly, but at higher levels than that of Alaska Native infants.

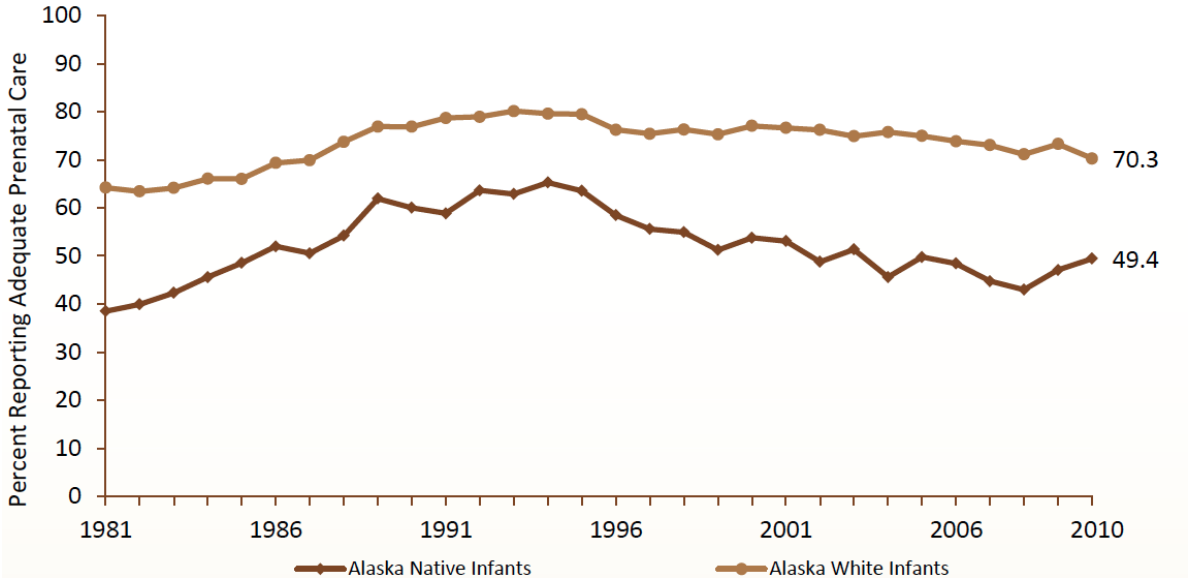
The most recent data from the YKHC were gathered from 2006 to 2010 (Table 12)[14]. In the YKHC service area, 23.3% of Alaska Native mothers received adequate prenatal care during this time period. This was the lowest coverage among all of the tribal health regions. During 2006 to 2010, adequate prenatal care varied by tribal health region. No specific rural community data are available.

Table 11 Adequacy of Prenatal Care for Females in the Bethel Census Area and the State of Alaska, 2012

Adequacy of Prenatal Care (APNCU Index)	ALL RACES		WHITE		ALASKA NATIVE	
	Births (No.)	Percent (%)	Births (No.)	Percent (%)	Births (No.)	Percent (%)
Bethel Census Area						
Adequate plus	94	21.9	6	19.4	88	22.1
Adequate	77	17.9	8	25.8	69	17.3
Intermediate	133	30.9	11	35.5	122	30.7
Inadequate	126	29.3	6	19.4	119	29.9
State of Alaska						
Adequate plus	2,371	23.0	1,426	23.2	627	23.2
Adequate	3,987	38.6	2,678	43.5	770	28.5
Intermediate	2,159	20.9	1,227	19.9	644	23.9
Inadequate	1,807	17.5	826	13.4	659	24.4

Source: Alaska Bureau of Vital Statistics, 2014

Figure 10 Adequate Prenatal Care by Alaska Native Status, 1981 - 2010



Source: AN EpiCenter, 2014

Table 12 Adequate Prenatal Care Among Alaska Native Infants, by Tribal Health Region, 2006-2010

Tribal Health Region	Percent	Lower CI	Upper CI
Aleutians & Pribilofs	85.3	79.6	90.4
Kenai Peninsula	69.5	65.4	73.6
Southeast	66.7	64.4	69.0
Kodiak	66.3	60.2	72.7
Copper River/Prince William Sound	59.5	52.1	66.9
Anchorage/Mat-Su	58.6	57.2	60.0
Norton Sound	51.4	48.5	54.4
Interior	41.9	39.5	44.3
Bristol Bay	32.1	28.5	35.1
Northwest Arctic	31.3	28.6	34.1
Arctic Slope	31.0	27.5	34.6
Yukon-Kuskokwim	23.3	21.8	24.7
Statewide			

Source: AN EpiCenter, 2014

Prenatal Smoking

Prenatal smoking includes women who self-reported tobacco use during pregnancy as documented on the birth certificate. Harmful effects of exposure to tobacco smoke include reduced fertility, adverse effects on fetal and child development and adverse pregnancy outcomes such as premature birth, low birth weight, stillbirth, and infant mortality.[10] During 1989-2010, the percentage of Alaska Native mothers who smoked during pregnancy decreased by more than 50%. Among those who reported smoking, the amount of cigarettes consumed per day also declined, from 59% consuming ½ a pack or more per day in 1989 to 17% in 2010. During 1989-2010, the percentage of Alaska Native mothers reporting prenatal smoking was consistently higher than Alaska White mothers. During 2006-2010, there was variation between tribal health regions in the percent of Alaska Native mothers reporting smoking, ranging from 18.5% to 52.4%. The Yukon Kuskokwim had among the lowest percentage of Alaska Native mothers reporting smoking at 24.5%, which was below the overall rate statewide (Table 13).

Table 13 Percent of Mothers Reporting Smoking During Pregnancy, by Tribal Health Region, 2006-2010

Tribal Health Region	Percent	Lower CI	Upper CI
Norton Sound	52.4	49.5	55.3
Arctic Slope	46.6	42.8	50.4
Northwest Arctic	45.8	42.8	48.7
Bristol Bay	37.4	33.7	41.1
Aleutians & Pribilofs	37.2	29.5	44.9
Copper River/Prince William Sound	34.5	27.4	41.7
Interior	31.4	29.2	33.6
Kenai Peninsula	26.3	22.5	30.3
Anchorage/Mat-Su	25.6	24.4	26.8
Yukon-Kuskokwim	24.5	23.0	26.0
Kodiak Area	20.2	15.0	25.8
Southeast	18.5	16.6	20.4
Statewide	**30.0**	**29.3**	**30.7**

Source: AN EpiCenter, 2014

Prenatal smokeless tobacco use can also contribute to adverse pregnancy outcomes. Smokeless tobacco includes spit tobacco and Iq'mik (also known as Blackbull). For the period of 2007-2010, women in the Yukon-Kuskokwim region had the highest rate of prenatal smokeless tobacco use in Alaska (53.4% in Southwest Alaska; in the next highest region, Bristol Bay, 23% reported prenatal smokeless tobacco use).[10]

Low birth weight

Low birthweight (LBW), as defined by the World Health Organization (WHO), is a weight at birth of less than 2500 g, (5.5 lbs.).[18] Typically, LBW is a result of poor delivery of nutrients and oxygen to the fetus, which, in turn, is directly related to the health of the mother. LBW is associated with an increased risk of lifelong disability and a 20-fold increased risk of death.[18] Therefore, LBW is both an indicator of the health of the maternal population and a determinant of the health of the infant.

The percentage of LBW infants in the Bethel Census Area in 2009 was slightly less than in the State of Alaska (Table 14).[14] This percentage has remained relatively stable in this region since 1990, at roughly between 5 and 6%. The percentage of Alaska Native infants with low birth weight born in the YKHC service area between 2006 and 2010 was similar to that for Alaska Natives statewide during the same period (Table 15).[10] During 1980-2010, the percentage of low birth weight Alaska Native infants did not change noticeably. YKHC data are not currently available for this period.

Table 14 Percentage of Infants with Low Birth Weight Born in Bethel Census Area and Alaska, 2009

	Bethel Census Area	State of Alaska	United States
Percentage of infants born with low birth weight (%)	5.1	5.9	8.16

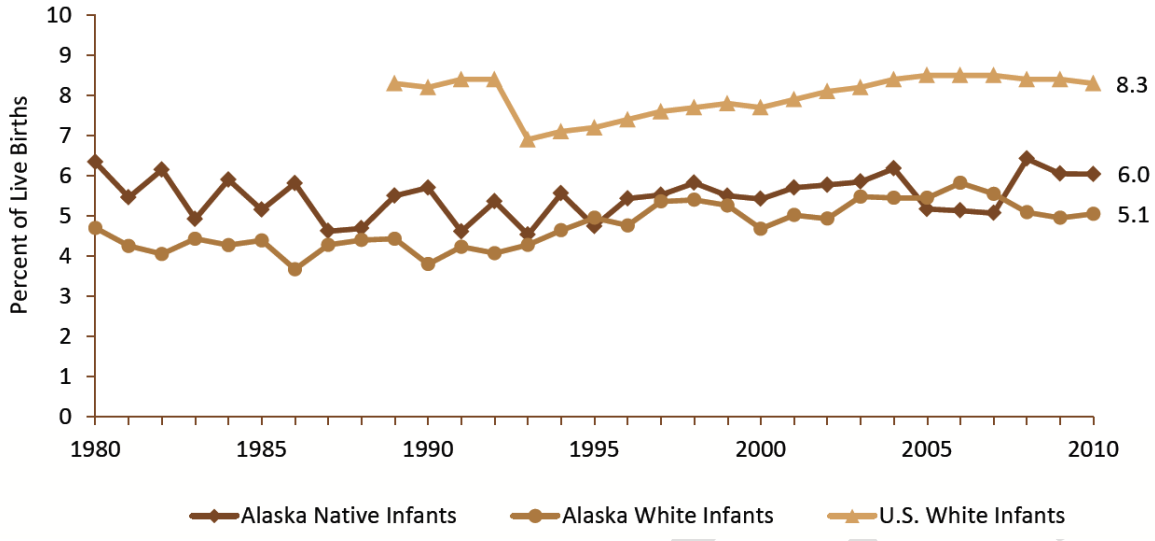
Sources: Alaska Bureau of Vital Statistics, 2011
CDC Key Birth Statistics 2009

Table 15 Alaska Native Low Birth Weight by Tribal Health Region, 2006-2010

Tribal Health Region	Percent	Lower CI	Upper CI
Copper River/Prince William Sound	8.3	4.1	12.4
Arctic Slope	7.2	5.3	9.1
Interior	6.6	5.4	7.9
Kenai Peninsula	6.4	4.2	8.5
Norton Sound	6.4	5.0	7.9
Northwest Arctic	6.2	4.8	7.7
Kodiak	6.0	2.8	9.2
Aleutians & Pribilofs	5.8	2.1	9.4
Yukon-Kuskokwim	5.7	4.9	6.5
Anchorage/Mat-Su	5.6	5.0	6.2
Bristol Bay	4.8	3.2	6.5
Southeast	3.9	3.0	4.9
Statewide	**5.8**	**5.4**	**6.1**

Source: AN EpiCenter, 2014

Figure 11 Low Birth Weight by Alaska Native Status, 1980-2010



Source: AN EpiCenter, 2014

Substance Use during Pregnancy

Substance use during pregnancy refers to the consumption of alcohol, tobacco, and/or drugs during the partum period. Substance use is dangerous for both the mother and the fetus and can lead to premature detachment of the placenta, sudden infant death syndrome (SIDS), and developmental problems in childhood.[18] Excessive alcohol use during pregnancy puts infants at risk for Fetal Alcohol Syndrome (FAS), the leading preventable cause of birth defects and mental retardation.[19]

In the Bethel Census Area, the percentage of infants born to mothers who reported drinking alcohol during the pregnancy is slightly below the percentage for the State of Alaska.[14] While no specific information on FAS in the Bethel Census Area is currently available, there is some indication that FAS is declining among Native Alaskans. For infants born between 1996 and 2002 and diagnosed by 2008 (age 6), the rate of FAS births declined among Native Alaskans from 20 per 10,000 births to 13.5 per 10,000 births.[20]

Smoking during pregnancy is the single most important contributor to low birth weight.[21,22,23] In the Bethel Census Area, 22.3% of infants were born to mothers who reported smoking during pregnancy, a higher percentage than for the State of Alaska, (14.5%) (Table 16).[14]

Table 16 Infants Born to Mothers Reporting Substance Use during Pregnancy in Bethel Census Area and the State of Alaska, 2010 to 2012

	Bethel Census Area		State of Alaska	
	Births (No.)	Percent (%)	Births (No.)	Percent (%)
Reported drinking	28	2.1	980	2.9
Reported smoking	297	22.3	4,871	14.5

Source: Alaska Bureau of Vital Statistics, 2014

5.3.1.3 Teen Birth Rates

Infants born to teen-age mothers (defined by AN EpiCenter as women aged 15 to 19 years) are at increased risk of preterm birth, low birth weight, and death during infancy. Teen-age mothers are more likely to have health problems as children, to drop out of school, to be incarcerated during adolescence, and to be unemployed as a young adult.[24] Teen-age mothers are less likely to receive a high school diploma[11], which may negatively impact their future health.

In 2012, the percentage of total births to mothers less than 20 years of age in the Bethel Census Area was 12.4%, lower than statewide percentages for Alaska Native mothers (12.7%), but higher than for all mothers (7.5%) (Table 17).[14] There were no births to mothers less than 15 years of age in the Bethel Census Area in 2012. From 1990 through 2009, the teen birth rate (15 to 19 years of age) in the Bethel Census Area has declined slightly from 82.7 live births per 1000 teen population in 1990 to 1992, to 77 live births per 1000 teen population from 2007 to 2009. The rate for the State of Alaska, however, has declined much more dramatically, by 1.6 times, over this same period.[14]

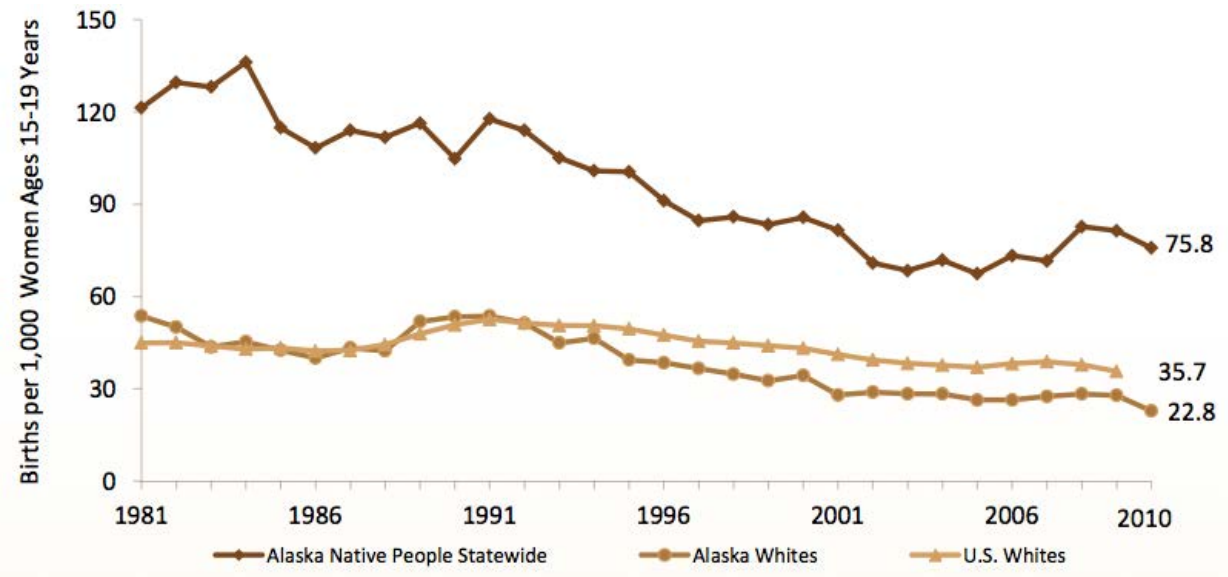
Table 17 Teen Birth Rates among Alaska Natives and All Mothers in Bethel Census Area and the State of Alaska, 2012

	Births to Alaska Native mothers < 20 years		Births to all mothers <20 years	
	Bethel Census Area	State of Alaska	Bethel Census Area	State of Alaska
Percent of total births (%)	12.4	12.7	11.5	7.5

Source: Alaska Bureau of Vital Statistics, 2014

During 2006 to 2010, rates of teen birth varied by tribal health region. For this time period the teen birth rate (15 to 19 years) in the YKHC service area ranked fifth among tribal health regions at a rate of 80.2 per 100,000 population (Table 18).[10] In 2010, the teen birth rate among Alaska Native women (75.8 live births per 1,000 teens ages 15-19 years) was more than three times that of Alaska Whites (Figure 12).[10] From 2000 to 2004, one-third of Alaska Native high school students reported themselves as sexually active. Of those students, 68% used a condom at last intercourse.[16]

Figure 12 Teen Birth Rate by Alaska Native Status and Year, 1981-2010



Source: AN EpiCenter, 2014

Table 18 Alaska Native Teen Birth Rate by Tribal Health Region, 2006-2010

Tribal Health Region	Births	Births per 1,000 Population
Arctic Slope	132	116.0
Norton Sound	215	104.0
Northwest Arctic	195	101.7
Interior	205	91.5
Yukon-Kuskokwim	582	80.2
Anchorage/Mat-Su	552	69.7
Kodiak	36	68.6
Bristol Bay	107	65.1
Aleutians & Pribilofs	20	63.1
Southeast	192	55.7
Copper River/Prince William Sound	23	52.2
Kenai Peninsula	52	44.5

Source: AN EpiCenter, 2014

5.3.1.4 Child Abuse and Out-of-Home Placement

Child abuse is a major contributor to childhood morbidity and mortality. In addition to its direct impact on health, child abuse has been linked to long-term effects on cognitive development and on physical and mental health. Childhood physical abuse predicts a graded increase in depression, anxiety, and severe ill health, as well as multiple medical diagnoses and physical symptoms.[25, 26, 27, 28]

Child abuse rates are not aggregated specifically for the Bethel Census Area or the YKHC service area. Instead, the Alaska Office of Children's Services (OCS) publishes child abuse rates for each of five regions (Table 19). The Western Region, which includes the Bethel Census Area, has the highest rate of substantiated allegations of child abuse (450 per 100,000 children), as well as the highest rate of child abuse victims (216 per 10,000 children) (Table 20).[29] The Western Region had the second highest rate of children in out-of-home placement (132 per 10,000 children) (Table 21).[29,30] It is important to note that an allegation of child abuse means that someone - the child, a teacher, a neighbor - makes an assertion that a child has been harmed by abuse or neglect with little or no proof. A substantiated allegation of child abuse means that the OCS finds the available facts indicate that a child suffered harm as a result of abuse or neglect. There is not enough staff to investigate every alleged case of child abuse, so it is possible that substantiated cases of abuse could underestimate actual cases of abuse in the region. Nevertheless, this information is the best available data on this topic.

The Western Region and the Bethel Census Area are vast areas and the number of communities in the Donlin Gold Mine Project area that are located in the region is small; it is not possible to determine the actual number of cases substantiated in each community.

Table 19 Allegations of Child Abuse Substantiated in Calendar 2010, by Region

Region	Census Areas	Total allegations substantiated in 2010	Total population under 18 years	Rate per 10,000 children
Anchorage	Municipality of Anchorage	1459	82,067	178
Northern Region	Yukon-Koyukuk Census Area Fairbanks North Star Borough North Slope Borough Northwest Arctic Borough Nome Census Area Southeast Fairbanks Census Area Denali Borough	1198	40,999	292
South Central Region	Aleutians East Borough Aleutians West Census Area Bristol Bay Borough Kenai Peninsula Borough Kodiak Island Borough Lake and Peninsula Borough Dillingham Census Area Valdez-Cordova Census Area Matanuska-Susitna Borough	1188	48,855	243
Western Region[a]	Bethel Census Area Kusilvak[b] Census Area	479	10,636	450
Southeastern Region	Haines Borough City and Borough of Juneau Ketchikan Gateway Borough City and Borough of Sitka Municipality of Skagway Borough City and Borough of Wrangell City and Borough of Yakutat Hoonah-Angoon Census Area Prince of Wales-Hyder Census Area Petersburg Census Area	331	17,216	192

Source: Department of Health and Social Services, Office of Children's Services (OCS): Allegations of child abuse statistics, 2011
[a]Western Region includes Bethel Census Area
[b]Formerly Wade Hampton Census Area

Table 20 Victims of One or More Substantiated Allegation of Child Abuse by Region, 2010

Region	Total Victims	Population under 18	Rate per 10,000 children
Anchorage	867	82,067	106
Northern Region	570	40,999	139
South Central Region	495	48,855	101
Western Region[a]	230	10,636	216
Southeastern Region	123	17,216	71

Source: Department of Health and Social Services, Office of Child Services (OCS): Allegations of child abuse statistics, 2011
[a]Western Region includes Bethel Census Area

Table 21 Children in Out-of-Home Placement by Region, 2010

Region	Children in Out of Home Care	Population under 18	Rate per 100,000 children
Anchorage	650	82,067	79
Northern Region	312	40,999	76
South Central Region	171	48,855	35
Western Region [a]	227	17,216	132
Southeastern Region	512	10,636	481
Statewide	1,872	199,773	94

Source: Department of Health and Social Services, Office of Child Services (OCS): Children in Placement, 2011
[a]Western Region includes Bethel Census Area

5.3.1.5 Intimate Partner Violence

Intimate partner violence (IPV) and sexual violence cause an array of direct physical and psychological injuries to victims. In one study, abuse was linked to numerous adverse medical effects including arthritis, chronic neck or back pain, migraine, sexually transmitted infections including HIV/AIDS, chronic pelvic pain, peptic ulcers, irritable bowel syndrome, and frequent indigestion, diarrhea, or constipation.[31] Abuse of pregnant women can cause pregnancy complications such as low weight gain, anemia, infection, and first and second trimester bleeding, as well as elevated rates of depression,

suicide attempts, and substance abuse among mothers.[32] Exposure to high levels of intimate partner violence has also been shown to have an association with IQ suppression in young children.[33]

Alaska's rate of forcible rape (sexual violence) is 2.3 times the national average.[34] The Alaska Victimization Survey is modeled after the National Intimate Partner and Sexual Violence Surveillance System, which has not been published. In 2010, the Alaska Victimization Survey estimated that nearly half of all women in Alaska will experience IPV in their lifetime, and more than 37% will be victims of sexual violence.[35] The lifetime estimate of IPV the United States was half that as experienced in Alaska, while the 2009 estimate of IPV was 1.3% in the United States and 8.6% in Alaska (Table 22 and Table 23).[35] According to these data, the lifetime and past year likelihood of experiencing IPV among women in Alaska is much greater than the United States overall.

In 2012, 514 adult women from the Bethel and Kusilvak (formerly Wade Hampton) census areas participated in the Alaska Victimization Survey (Yukon-Koyukuk census area villages: Grayling, Anvik, Shageluk, and Holy Cross were not included). The overall rate of IPV and the rate sexual violence among English speaking adult women in the Y-K Delta, were below that of the state (Table 22). Previous year survey estimates of forcible sexual assault were 0.3% for women nationally, compared to a past year estimate of 2.5% in Alaska and 1.8% in the Y-K Delta.[34] The percentage of English speaking adult women in the Y-K Delta who had reportedly experienced IPV in the past year was higher than that in the state overall.

In 2012, the Alaska Behavioral Risk Factor Surveillance System (BRFSS) data revealed that English-speaking Alaska Native females from rural areas (including the Bethel Census Area) were the most likely subpopulation to experience IPV in their lifetime. Populations living in rural areas are less likely to experience unwanted sexual activity (Table 24).[36] Again, these data should be interpreted with caution, as a variety of regional and cultural groups are included in the category of 'rural.' Specific regional information on the Bethel Census Area is not available, but the census area was included in the 'rural region,' which spans much of the landmass of the state.[36]

Table 22 Lifetime Estimates of IPV and Sexual Violence among English-Speaking Adult Women in the Y-K Delta, Alaska, and the United States

Lifetime Estimates	Yukon Kuskokwim Delta, 2012 (%)	State of Alaska, 2010 (%)	United States, 2010 (%)
Intimate Partner Violence[a]	44.6	47.6	ND
Threats	20.1	31.0	ND
Physical Violence	43.8	44.8	22.1
Sexual Violence	25.4	37.1	ND
Alcohol or Drug Involved Sexual Assault	20.1	26.8	ND
Forcible Sexual Assault	15.1	25.6	14.8

Source: Alaska Victimization Survey, 2010 & 2012
[a]Includes both threats of physical violence and physical violence by intimate partners
ND: No data

Table 23 Past Year Estimates of IPV and Sexual Violence Among English-Speaking Adult Women in Alaska and the United States

Estimates	Yukon Kuskokwim Delta, 2011 (%)	State of Alaska, 2009 (%)	United States, 2009 (%)
Intimate Partner Violence[a]	13.6	9.4	ND
Threats	4.2	5.8	ND
Physical Violence	13.0	8.6	1.3
Sexual Violence[b]	5.1	4.3	ND
Alcohol- or Drug-Involved Sexual Assault	4.3	3.6	ND
Forcible Sexual Assault	1.8	2.5	0.3

Source: Alaska Victimization Survey, 2010 & 2012
[a]Includes both threats of physical violence and physical violence by intimate partners
[b]Includes both alcohol or drug involved sexual assault and forcible sexual assault
ND: No data

Table 24 Lifetime Prevalence of Intimate Partner Violence and Unwanted Sexual Activity among English-Speaking Adults in Alaska by Public Health Region (2012) and Bethel (2006-2012)

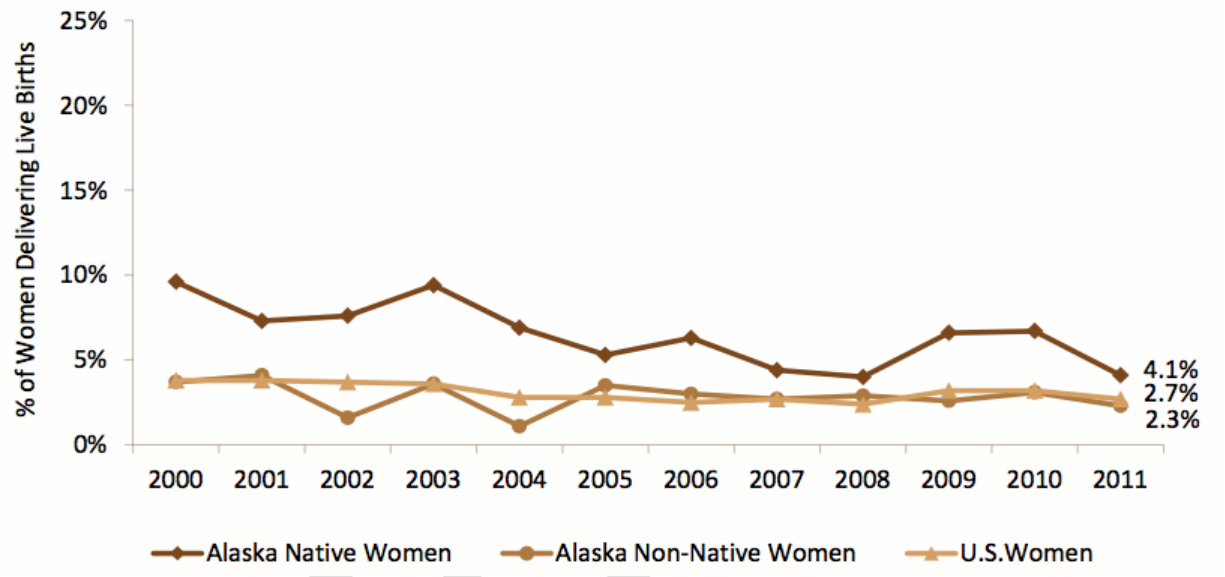
Risk Factor	Intimate Partner Violence (%)	Unwanted Sexual Activity (%)
Race		
American Indian/Alaska Native	31	21.9
Total population	22.4	16.9
Location		
Anchorage/Mat-Su	23	17.6
Interior	19	17.7
Gulf Coast	23	15.8
Southeast	21	18.6
Southwest[a]	26	10.3
Bethel Census Area (2006-2012)	27.2	12.7
Kenai Peninsula Borough	26.0	18.1
Matanuska-Susitna Borough	22.4	18.3
Yukon Koyukuk Census Area	26.4	13.0

Source: ADHSS. Sexual Violence/Intimate Partner Violence, 2011
[a]Includes Bethel Census Area

Prenatal Intimate Partner Violence

Prenatal intimate partner violence can include both physical and emotional abuse by a husband or partner during pregnancy.[10] Prenatal physical abuse includes women who reported that their husband or partner pushed, hit, slapped, kicked, choked, or physically hurt them in any other way during their most recent pregnancy. The percentage of Alaska Native women reporting physical abuse by a husband or partner during pregnancy was 4.1% in 2011, a 57% decrease from 9.6% in 2000.[10] In 2011, the prevalence of prenatal physical abuse among Alaska Native women was 1.8 times that of non-Native women.

Figure 13 Prenatal Intimate Partner Violence, Alaska Women and U.S. Women, 2000-2011



Source: AN EpiCenter, 2014

Childhood Witness to Violence

Childhood witness to violence includes people who have witnessed domestic violence or abuse in person as a child. Witnessing violence can lead to the development of negative outcomes including inappropriate attitudes towards violence, behavioral problems, and emotional problems.[10] Child witnesses to violence are more likely to be victims of physical and sexual abuse themselves. Among Alaska Native mothers of 3 year olds, 9.4% reported in 2010-2011 that their child saw violence or abuse in person.[10] This was greater than both the statewide rate and the rate for non-Native Alaskans statewide (Table 25). Approximately one third of Alaska Native adults reported witnessing domestic violence as a child during, higher than the proportion among Alaska White adults. No data was available for the Bethel Census Area or the YKHC service area.

Table 25 Childhood Witness to Violence, Alaska Children, 2010-2011

	Alaska Natives Statewide (%)	Alaska Whites Statewide (%)	Alaska Total Statewide (%)
Childhood Witness to Domestic Violence, 3 Year Old Children (2010-2011)[a]	9.4	6.1	6.9
Childhood Witness to Domestic Violence, Adults 18 Years and Older (2006-2012)[b]	34.1	17.8	ND

Source: AN EpiCenter, 2014
[a] as reported by mothers of 3 year olds includes those who report that their child has ever seen violence or physical abuse in person.
[b] as reported by adults includes those who report that as a child, they saw or heard a parent or guardian being hit, slapped, punched, shoved, kicked, or otherwise physically hurt by their spouse or partner.
ND: No data

5.3.1.6 Oral Health

Oral health is an important and often-overlooked component of overall health. In May 2000, the U.S. Surgeon General released the first-ever report on oral health in response to what he termed a "silent epidemic" of dental and oral health morbidity.[37]

Regular dental visits are important for identifying oral diseases, the most common of which are dental caries (cavities), gingivitis, and periodontal disease.[19] In addition, many systemic diseases and medical conditions have early oral symptoms and are discovered during dental visits.[37] Of particular importance is the detection of oral and pharyngeal cancers, more than 75% of which are attributable to tobacco use.[19] As the percentage of smokers in the YKHC service area is nearly twice the national average and the percentage of smokeless tobacco users is greater than 8 times that of Alaska non-Natives statewide, routine dental visits are critical for this population.

Specific data for the Bethel Census Area on oral health are not available. Only 20% of Alaska Natives had a dental visit in the year 2008, compared to 25% of American Indian/Alaska Natives overall (Table 26).[38] This is much less than among the U.S. population where 65% of Americans reported a dental visit during 2008.[39]

Table 26 Prevalence of Dental Visits among Alaska Natives, All U.S. American Indians/Alaska Natives, and United States Population in the Past Year, 2009

	Alaska Natives (%)	All U.S. American Indians/Alaska Natives (%)	United States (%)
Dental visit in the past year (2008)	20.0	25.0	65.1

Source: AN EpiCenter, 2009

In 2005, ADHSS found that 75% of Alaska Native children had dental caries. Although there were no differences by gender, the proportion of Alaska Native children in need of dental treatment was twice that of white Alaskan children.[40]

In April 2008, the AIP and the ADHSS conducted a study among children to investigate associated risk factors for dental caries in a remote region of Alaska comprised of 85% Yup'ik Eskimo.[41] Despite a small sample size, the study found that among children 4 to 5 years and 12 to 15 years, 87% and 91% respectively, had dental caries compared with 35% and 51% of all U.S. children in those age groups. Also, those children aged 4 to 5 years and 12 to 15 years had 4.5 and 2.8 times the number of dental caries, respectively, than in the same-aged U.S. children. The AIP and ADHSS study also identified that lack of water fluoridation and consumption of soda pop was associated with dental caries severity. Children living in villages without fluoridated water had 1.2 to 2.9 times higher mean number of decayed teeth and decayed, missing, and filled permanent teeth than children living in villages with fluoridated drinking water.[41]

Between 2010-2011, more than one in three (38.3%) Alaska Native mothers of 3-year olds reported that a health care provider had ever said their child had tooth decay, compared to 10.4% of non-Native mothers.[10] During this same time period, nearly two out of three (63.3%) of Alaska Native kindergarten children had experience with dental caries, a higher proportion than Alaska Whites (28.0%). In 2010-2011, over four out of five (83.4%) Alaska Native 3rd grade children had experience with dental caries compared to about half (48.4%) of Alaska Whites.

Table 27 Prevalence of Dental Caries Experience Among Alaska Children, 2010-2011

	Alaska Native (%)	Non-Native Statewide (%)	Alaska Total Statewide (%)
Dental Caries Experience, 3 Year Old Children	38.3	10.4	17.1
Dental Caries Experience, Kindergarten Children	63.3	28.0	41.1
Dental Caries Experience, Third Grade Children	83.4	48.4	61.6

Source: AN EpiCenter, 2014

Given the magnitude of the prevalence of severe dental caries within a predominately Alaska Native population above that of U.S. children, it is reasonable to assume a similar pattern in the Bethel Census Area and YKHC service area.

5.3.1.7 Suicide

Suicide is an important health outcome that can indicate mental health wellness in a population. Suicide was the fourth leading cause of death in the Bethel Census Area and the sixth leading cause of death in the State of Alaska from 2007 to 2009. Age-adjusted suicide rates in the Bethel Census Area and the YKHC service area from 2007 to 2009 were 3 times greater than for the State of Alaska (Table 28).[42] More than half of the suicides in the Bethel Census Area were due to firearms.[42]

Statewide by age group from 2007 to 2009, suicide was the third leading cause of death among Alaska Natives ages 5 to 14; the number 2 cause of death for Alaska Natives ages 15 to 24 and 25 to 34; and the third leading cause of death in those age 35 to 44.[42]

Table 28 Suicide Rates in the State of Alaska, Bethel Census Area, and the YKHC Service Area, 2004 to 2009

	Number of Deaths	Age-adjusted Rate per 100,000 Population[a]
State of Alaska (2007-2009)	456	22.7
Bethel Census Area (2007-2009)	30	61.6
Yukon-Kuskokwim Health Corporation Service Area (2004-2007)	ND	62.1

Sources: Bureau of Vital Statistics, 2011
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
ND: No data

5.3.1.8 Substance Abuse

"Substance abuse refers to a set of conditions associated with the consumption of mind- and behavior-altering substances that have negative behavioral and health outcomes."[26] Substance abuse can directly cause health problems and strongly influences many related health outcomes such as accidents and injuries.[17]

Between 2003 and 2009, the percentage of adults in the Bethel Census Area who self-reported excessive drinking (encompassing both binge-drinking and heavy drinking) was lower than in the State of Alaska (Table 29)[43]; however, data based on self-report severely underestimates actual consumption.[19] The County Health Rankings (the data source presented in the following table) are produced by the University of Wisconsin Population Health Institute and are based on BRFSS survey data.

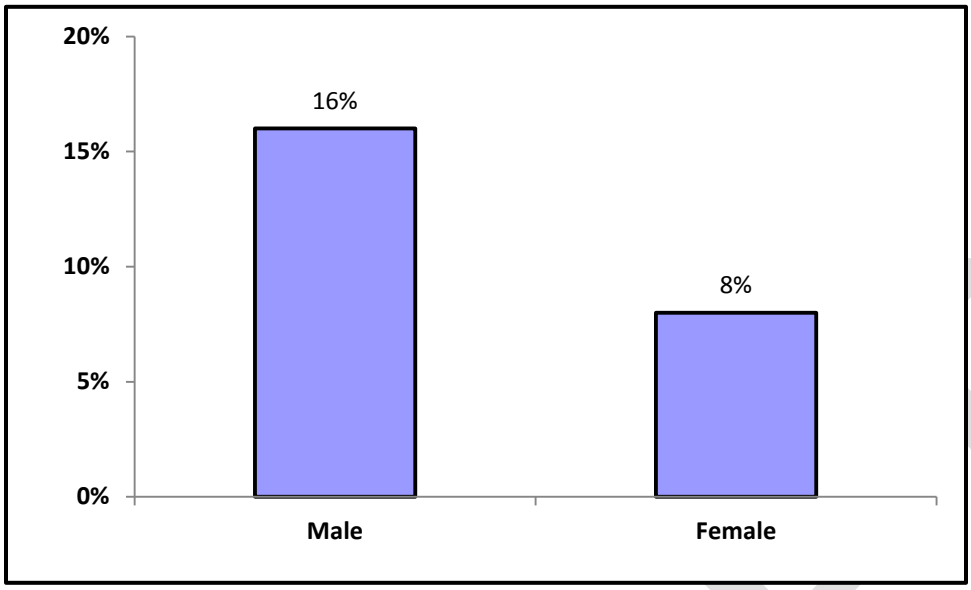
Table 29 Excessive Drinking Rates for Bethel Census Area and Statewide, All Adult Residents, 2003 to 2009

	Bethel Census Area	Alaska Statewide
Percentage of adults reporting excessive drinking[a] (%)	17	19

Source: County Health Rankings, 2011
[a]Excessive drinking encompasses both binge drinking and heavy drinking

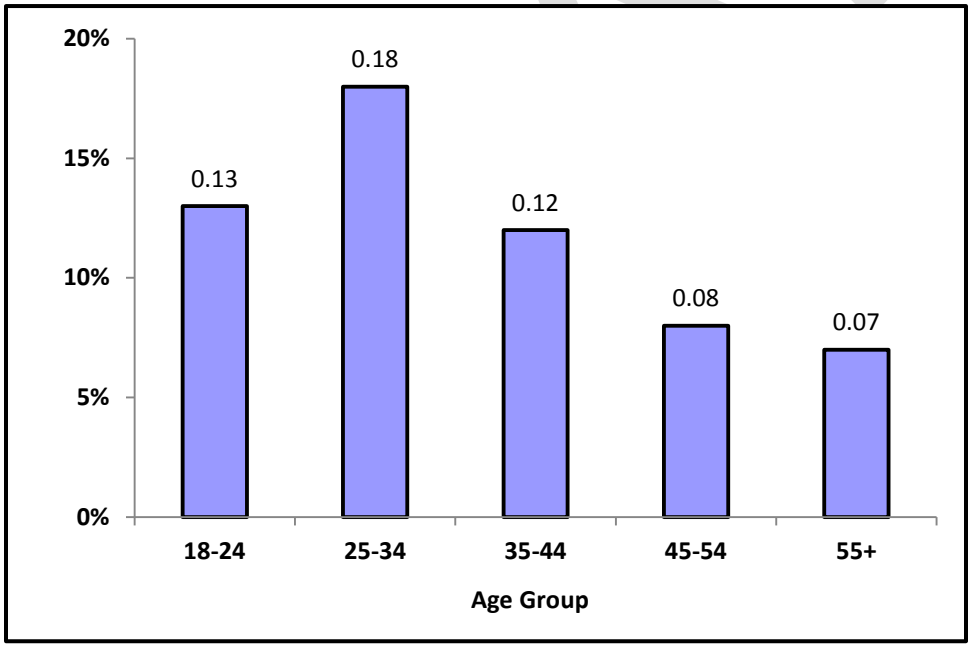
The self-reported incidence of binge drinking among YKHC Alaska Natives decreased slightly between 1993 and 2004 and was slightly lower than the binge drinking levels for Alaska Natives statewide. Self-reported percentages of binge drinking were double that in males than females among YKHC service area residents. Age group data are available for 2000 and 2004; the data reveal that YKHC Alaska Natives between 25 to 34 years of age had the highest self-reported rates of binge drinking (18%) (Figure 14).[16]

Figure 14 Binge Drinking by Gender, YKHC Alaska Natives, 18 yrs. and older, 2000 to 2004



Source: AN EpiCenter, 2007

Figure 15 Binge Drinking by Age Group, YKHC Alaska Natives, 18 years and older, 2000 to 2004



Source: AN EpiCenter, 2007

According to the Alaska Native Health Status Report (2009)[38], substance abuse among adolescents is defined as having used alcohol, marijuana or cocaine in the past 30-day and the report summarizes adolescent substance abuse in 2009 as:

- The percent of Alaska Native high school students who report having at least one drink of alcohol on one or more of the past 30 days is not measurably different from Alaska non-Native or U.S. students.
- Almost one-third (32%) of Alaska Native high school students report using marijuana during one or more of the past 30 days compared to 17% of Alaska non-Native high school students ($p < 0.05$).
- The percent of Alaska Native high school students who used any form of cocaine in the last month was similar to that for Alaska non-Native students. This rate is much lower than for U.S. high school students ($p < 0.05$).

No specific data on alcohol and drug use in the Donlin Gold Mine Project area is available; however, the data presented in HEC 2: Accidents and Injuries indicates that substance abuse is an important issue given that the age-adjusted rate of poisoning (by alcohol) is the leading injury fatality (24.1 deaths per 100,000 people), almost 1.5 times higher than the rate for the state as a whole.

5.3.1.9 Economic Indicators

Previous studies have documented the relationship between socioeconomic status and health. Households/individuals living in poverty have the worst health; however, even middle-class individuals have worse health outcomes than those who are more affluent.

The U.S. Census Bureau collects data on median household income via the American Communities Survey (ACS). Median means that half of the households have higher income and half of the households have lower income. Income includes all monetary sources of income including wages, the Permanent Fund Dividend, Corporation Dividends and Public Assistance.[44] Income does not include any dollar equivalent of subsistence resources. For 2012, the estimated median household income in the Bethel Census Area was $52,349; for Alaska it was $69,917 (Table 30).[45] The range of median household income in the HIA Zone communities ranged from $6,667 to $60,500.

Due to the larger household size and the increased cost of living in the Bethel Census Area, the increase seen in median household income compared to the State of Alaska may not accurately reflect the socioeconomic status of household members.

The 2012 per capita income in the Bethel Census Area was considerably lower than in the State of Alaska: $19,055 in the Bethel Census Area, compared to a per capita income of $32,537 in the State of Alaska. The per capita income in several of the villages was even lower than the Bethel Census Area overall (Table 30).[45]

Table 30 Social Determinants of Health of the Donlin Gold Mine Project Area Communities – Economic Indicators

Location	Per Capita Income ($)	Median Household Income ($)	% of People Living Below the Poverty Limit	Unemployment Rate (%)
State of Alaska	32,537	69,917	9.6	5.8
Bethel Census Area	19,055	52,349	21.8	11.3
Aniak	21,582	60,500	15.9	7.3
Chuathbaluk	16,343	60,179	34.9	20.0
Crooked Creek	10,391	31,750	18.4	14.6
Lower Kalskag	11,794	45,179	23.1	16.2
Red Devil	53,615	32,083	25.9	0.0
Sleetmute	22,405	28,438	20.8	11.8
Stony River	6,667	3,240	97.5	5.3
Upper Kalskag	14,818	41,563	18.9	11.9

Sources: 2008-2012 American Community Survey 2012 5-Year Estimates
Unemployment Rates are not seasonally adjusted Unemployment Rates are not seasonally adjusted and are based on population 16 years and older in the labor force:
http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=01000US&-qr_name=ACS_2009_5YR_G00_DP5YR3&-ds_name=&-_lang=en&-redoLog=false&-format=
ND: No data

The U.S. Census defines poverty in a way that does not take into account the higher cost of living in Alaska. However, the ADHSS adjusts poverty guidelines for entitlement programs such as Women, Infants and Children (WIC), and Temporary Assistance for Needy Families (TANF) for local factors. For a single person, the 2009 ADHSS poverty level for Alaska was $13,530 and for a four-person household it was $27,570 (Table 31). In 2009, the percent of residents living below the federal poverty level in the Bethel Census Area was over 18% compared to 9.6% for all of Alaska (Table 30). The variation between villages is high, ranging from 11% to over 70%. All villages had a higher percentage of residents living below the poverty line than the State of Alaska as a whole, but many were less than the Bethel Census Area.[45]

Table 31 Poverty Guidelines, 2009

Persons in family	Alaska	48 Contiguous States and DC
1	$13,530	$10,830
2	18,210	14,570
3	22,890	18,310
4	27,570	22,050
5	32,250	25,790
6	36,930	29,530
7	41,610	33,270
8	46,290	37,010
	For families with more than 8 persons, add $4,680 for each additional person.	For families with more than 8 persons, add $3,740 for each additional

Source: 2009/2010 Federal Poverty Guidelines, as published in the Federal Register, 2011

Employment is another key demographic factor that influences health.[38] According to AN EpiCenter 2009, unemployment included anyone who had made an active attempt to find work in the 4-week period up to and including the week that included the 12th of the referenced month.[38] Due to the scarcity of employment opportunities in rural Alaska, many individuals did not meet the official definition of unemployed because they were not conducting active job searches. Unemployment stood at 21.8% in the Bethel Census Area (2008-2012 ACS 5 year estimate), more than twice the percentage for the State of Alaska (Table 30).[45]

5.3.1.10 Educational Attainment

Internationally, household educational attainment is associated with overall family health status.[46] Household head educational attainment level also predicts challenges or opportunities that will occur in regards to local hiring programs.

High school graduates have been found to live an average of 6 to 9 years longer than high school dropouts.[47] Adults with low educational attainment are more likely to die from cardiovascular disease, cancer, and lung disease.[48]

Compared to the State of Alaska, the Bethel Census Area has a slightly lower percentage of adults with a high school diploma and a much lower percentage of adults with a bachelor's degree or higher (Table 32).[45] The percentage of adults who are high school graduates varies considerably among the 8 villages, from a low of 33% in Stony River to a high of 100% in Red Devil. The percentage of adults with a bachelor's degree or above is lower than in the State of Alaska in every village except for Red Devil.

Table 32 Social Determinants of Health of the Donlin Gold Mine Project Area Communities – Education Indicators, 2005 to 2009

Location	Educational Attainment of Population 25 Years and Over		High School Drop-out Rate (%)	Community Literacy Rate (%)
	High School Graduate or Higher (%)	Bachelor's Degree or Higher (%)		
State of Alaska	90.8	26.6	7.3	91
Bethel Census Area	79.1	14.4	ND	86
Aniak	89.5	20.7	4.35	ND
Chuathbaluk	83.7	8.2	14.29	ND
Crooked Creek	44.3	0	16.67	ND
Lower Kalskag	83.6	15.8	16.98	ND
Red Devil	100.0	46.7	ND	ND
Sleetmute	56.5	9.7	28.57	ND
Stony River (2000)	33.3	0	0	ND
Upper Kalskag	79.3	12.6	16.98	ND

Sources: Alaska data: Community Literacy Rate: 2003 National Assessment of Adult Literacy
Educational Attainment: 2009 American Community Survey 1-Year Estimates
High School Drop-Out Rate: National Center for Education Statistics, Public School Graduates and Dropouts 2007-2008, Table 4
Village data: Educational Attainment: 2005-2009 American Community Survey 5-Year Estimates
State of Alaska Report Card, 2009-2010 School Year
Stony River data: Census 2000 Demographic Profile Highlights
ND: No data

5.3.1.11 Family Stability

Family stability has been found to have positive effects on children's health behaviors and outcomes.[49] Family stability exists in families whose parents are healthy and earning incomes; whose members experience housing changes only infrequently; and whose family members stay together with infrequent divorce and remarriage, or few separations due to immigration and job-seeking reasons.[50]

The divorce rate can serve as a partial indicator of family stability but it is important to remember that long term cohabitation and other living arrangements are common. Divorce rates provide a starting point for reviewing this health determinant. The Alaska Bureau of Vital Statistics maintains a database on divorce for the state, boroughs, and census areas, although the numbers of occurrences are not kept for census areas.[51] Table 33 below presents the divorce rate for females and males in the State of Alaska and the Bethel Census Area, and shows a much lower rate of divorce in the Bethel Census Area than in the State of Alaska.[51]

Table 33 Divorce Rates, State of Alaska and the Bethel Census Area, 2009

	Female Rate per 1000 Population	Male Rate per 1000 Population
Alaska	7.9	7.3
Bethel Census Area	1.7	1.3

Source: Alaska Bureau of Vital Statistics, 2011

Using single parenthood as another marker of family stability, the Bethel Census Area has a slightly higher percentage of households headed by females without husbands than the State of Alaska (Table 34).[45] The villages of Aniak, Chuathbaluk, Crooked Creek, and Lower Kalskag have a higher percentage of households with no husband present. In Lower Kalskag, females head more than 36% of households only, more than 3 times the statewide percentage. This indicator would suggest decreased family stability in the region; however, when considering other markers of family stability such as divorce, the statistics may not be conclusive.[45]

Table 34 Social Determinants of Health of the Donlin Gold Mine Project Area Communities – Household Characteristics, 2010 Census

Location	Number of Households	Average Household size	Percent of Family Households	Female Headed Households, No Husband Present (Percent of Family Households)	Two-Parent Households with own Children Present < 18 (Percent of Family Households)
State of Alaska	258,058	2.7	66.2	16.2	49.9
Bethel Census Area	4,651	3.6	73.9	14.0	38.5
Aniak	166	3.0	72.3	17.5	32.5
Chuathbaluk	36	3.3	80.6	37.9	20.7
Crooked Creek	38	2.8	68.4	50.0	19.2
Lower Kalskag	77	3.8	73.3	36.4	32.7
Red Devil	12	1.9	41.7	20.0	0
Sleetmute	36	2.4	52.8	26.3	26.3
Stony River	20	2.7	50.0	20.0	50.0
Upper Kalskag	60	3.5	73.3	29.5	38.6

Source: American Community Survey, 2005-2009

5.3.1.12 Cultural Indicators

Cultural continuity has been linked to numerous health outcomes including reduced rates of suicide.[52,53] Speaking a native language and participating in subsistence activities have been highlighted by circumpolar Natives as important signifiers of community health and cultural continuity.[54]

In the Bethel Census Area, 86.7% of the population is Alaska Native. Between 2005 and 2009, more than 70% of the population spoke a language other than English at home (most commonly Yup'ik) (Table 35).[45,55] There are marked differences in the percentages of residents in the 8 Zone 1 villages who speak another language at home compared to the Bethel Census Area overall. Within individual villages cultural continuity may be quite variable.

Participation in subsistence activities is high throughout the region. At least 80% of the adult population participates in subsistence activities in each of the villages in HIA Zones 1, 2 and 3.[55]

Table 35 Social Determinants of Health of the Donlin Gold Mine Project Area Communities – Cultural Indicators

Location	Primary Cultural Group(s)	Percent Speaking a Language Other than English at Home (2005 to 2009) (%)[a]	Percent Participating in Subsistence Activities (2009) (%)[b]
State of Alaska		15.5	ND
Bethel Census Area		70.6	ND
Aniak	Yup'ik Tanaina Athabascans	31	90
Chuathbaluk	Yup'ik Tanaina Athabascans	15.5	93
Crooked Creek	Yup'ik Ingalik Athabascan	10.1	94
Lower Kalskag	Yup'ik	47.4	90
Red Devil	Yup'ik Tanaina Athabascan Non-Natives	0	82
Sleetmute	Ingalik	62.2	100
Stony River	Athabascan, Yup'ik	70	83
Upper Kalskag	Yup'ik	42.1	98

[a]American Community Survey 2005-2009
[b]Brown et al., 2012
ND: No data

5.3.1.13 Summary

Alaska Natives in the PACs face notable health challenges with marked disparities across a variety of health outcomes. Alaska Natives fared worse in every health indicator for which data was available by ethnicity:

- Lower life expectancies
- Fewer women appear to receive adequate or better prenatal care
- Higher percentage of total births are to teen-age mothers
- IPV and unwanted sexual activity rates are higher
- Percentage of Alaska Natives statewide who had received a dental visit in the past year was lower
- Suicide rates were 2.5 times greater among Alaska Natives in Bethel Census Area than among whites statewide
- The "rural" region (which includes the Bethel Census Area) had the highest rates of child abuse in the state
- Percentage of households with no husband present is higher in the Bethel Census Area than statewide, and is higher still in the majority of the PAC villages

Nevertheless, residents fared better on several important health indicators and health determinants:

- Fewer infants were born with low birth weight
- Neonatal infant mortality rate was lower than both Alaska and the U.S.
- According to the publicly available data, substance dependence, while high, is less prevalent in the YKHC service area than in the State of Alaska
- Rates of heavy drinking and binge drinking are comparatively low, and rates of alcohol use during pregnancy are equivalent to statewide rates
- A slightly greater percentage of women in the Bethel Census Area reported smoking during pregnancy than in the state

5.3.1.14 Data Gaps

- Current data on IPV, child abuse and substance abuse

5.3.2 HEC 2: Accidents and Injuries

Accidents and Injuries are an important cause of mortality and morbidity in Alaska. The term unintentional injury refers to causes of injury or death other than suicide and homicide. Fatal injury information is drawn from death certificates and the Alaska Violent Death Reporting System (VDRS) while non-fatal injuries are typically obtained from the Alaska Trauma Registry (ATR). Alcohol use is a powerful risk factor for accidents and injuries and so alcohol related injury events are reported. The presence of law enforcement or village public safety officers (VPSO) also influences safety in rural communities.

5.3.2.1 Fatal Injuries

Between 2010 and 2012, there were 49 unintentional fatal injuries in the Bethel Census Area. The leading age-adjusted rate of unintentional injury fatality was due to motor vehicle accidents at 19.1 deaths per 100,000 people (Table 36). The age-adjusted rate of poisoning was the second the leading injury fatality (18.1 deaths per 100,000 people), which was similar to the rate for the state as a whole (Table 36).[42] Poisoning (the majority of which are alcohol overdose), motor vehicle accidents (the majority of which are snow machine accidents), and water transport accidents were the other most common causes of unintentional injury deaths in the Bethel Census Area for the previous decade, with rates changing little during this time.

Table 36 Major Causes of Unintentional Injury Deaths, Bethel Census Area and State of Alaska, 2010 to 2012

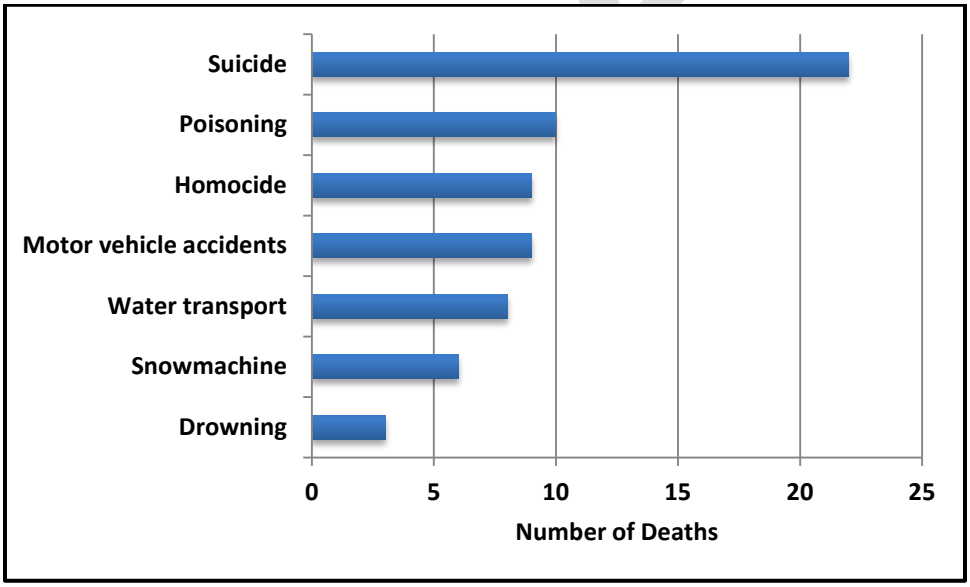
	Bethel Census Area		State of Alaska	
Cause of Death	Number of Deaths	Age-adjusted Rate[a]	Number of Deaths	Age-adjusted Rate[a]
Unintentional Injuries	**49**	**102.9**	**1110**	**56.6**
Motor vehicle accidents	9	19.1*	242	11.6
Snowmachine[b]	6	11.5*	39	1.8
ATV[c]	0	0.0	21	1.0

Table 36 Major Causes of Unintentional Injury Deaths, Bethel Census Area and State of Alaska, 2010 to 2012

Water transport	8	13.3	26	1.1
Air transport	3	**	53	2.6
Other transport accidents	1	**	76	3.5
Falls	0	0.0	31	5.6
Accidental discharge of firearms	0	0.0	6	8*
Drowning and submersion	3	**	76	3.5
Smoke, fire and flame	1	**	36	2.0
Poisoning	10	18.1*	382	17.1

Source: Alaska Bureau of Vital Statistics, 2014
[a] Age-adjusted rates are per 100,000 U.S. year 2000 standard population
[b] Deaths to an operator or passenger related to the use of a snow machine
[c] Deaths to an operator or passenger related to the use of an ATV
* Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
** Rates based on fewer than 6 occurrences are not reported

Figure 16 Fatal Injuries in the Bethel Census Area, 2010-2012



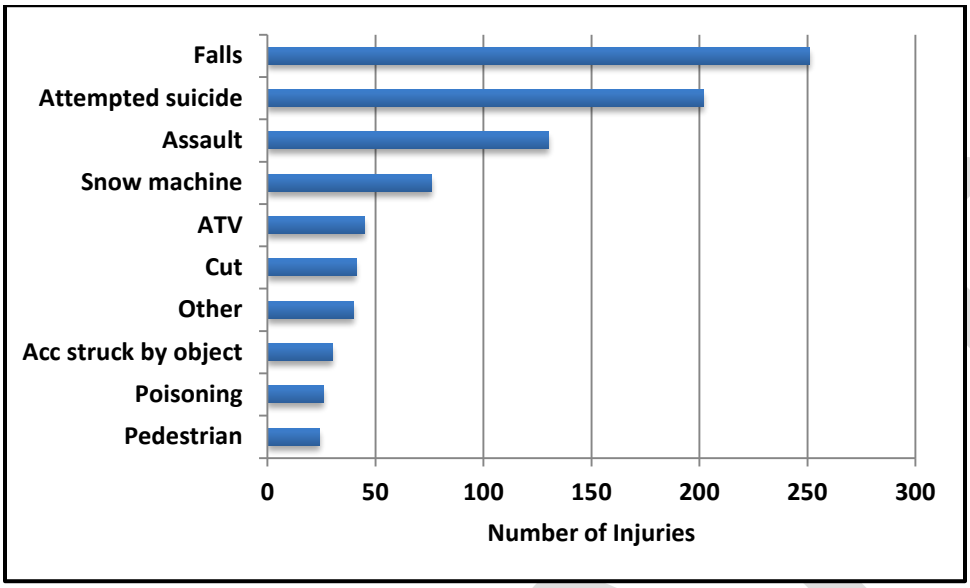
Source: Alaska Bureau of Vital Statistics, 2014

5.3.2.2 Non-fatal Injuries

The ATR records non-fatal injuries that are serious enough to require admission to a health care facility. From 2007 to 2011, the ATR recorded 1026 non-fatal accidents and injuries in the Bethel Census Area with an average of 205 injuries per year.[56] Males accounted for 57% of these injuries. Individuals

between 15 and 29 years of age accounted for 37% of these injuries. Figure 17 lists the 10 most common non-fatal injuries in this census area.

Figure 17 Leading Causes of Non-fatal Injury in the Bethel Census Area, 2007-2011



Source: Alaska Trauma Registry, 2014
* Starting 1/1/2013: Adults (18 years and older) were no longer included in the ATR due to intentional, self-inflicted, suicidal overdoses.

The most common cause of non-fatal injury requiring hospitalization in the Bethel Census Area was falls (24% of all non-fatal injuries), followed by attempted suicide (20%), and assault (13%). These three causes of injury alone accounted for 57% of all non-fatal injuries during this period.[56]

5.3.2.3 Accidents and Injuries among Alaska Natives

Fatal injuries among Alaska Natives

From 2008 to 2011, the average annual age-adjusted death rate from unintentional injury in the YKHC was somewhat lower than for all Alaska Natives, as shown in Table 37.[10] Suicide (33.6%), drowning (18.4%), and off-road vehicle incidents (7.9%) were the three leading causes of injury death during 1992-2011 among Yukon-Kuskokwim Alaska Natives; comprising more than half of all Y-K injury deaths (59.9%; Table 38).[57] The drowning death rate for Y-K Alaska Native people was higher (31.0/100,000; rate ratio = 1.6) than that for Alaska Native people statewide (19.2 /100,000).

Table 37 Average Annual Age-adjusted Unintentional Injury Death Rates per 100,000 by Region, Alaska Natives, 2008 to 2011

Tribal Health Region	Number	Rate	Confidence Interval
Bristol Bay	31	153.6	101.5 - 231.0
Northwest Arctic	34	152.7	102.7 - 226.1
Interior	51	150.2	109.8 - 210.9
Norton Sound	36	150.1	98.6 - 231.1
Arctic Slope	15	122.8	56.6 - 250.8
Copper River/Prince William Sound	7	117.8 *	45.7 - 270.2
Yukon-Kuskokwim	84	88.2	68.9 - 113.4
Kodiak	6	81.0 *	28.8 - 199.9
Kenai Peninsula	15	73.0 *	40.4 - 150.1
Southeast	35	69.9	47.7 - 101.2
Aleutians & Pribilofs	4	64.2 *	16.1-228.0
Statewide	**434**	**106.9**	**96.3-118.8**

Source: AN EpiCenter, 2014

* Rates based on fewer than 20 deaths may be statistically unreliable and should be used with caution. Data are not shown if the number of deaths is <3.

Table 38 Leading Causes of Yukon-Kuskokwim Injury Deaths Among Alaska Natives, 1992-2011

	Yukon-Kuskokwim Region			
Cause of Death	**Deaths**	**Percent**	**Age-adjusted Rate[1]**	**Y-K AN/AI vs. Alaska AN/AI[2]**
Total Intentional Injuries	**270**	**41.0**	**65.8**	**1.2***
Suicide	221	33.6	52.5	1.3*
Homicide	49	7.4	13.3	0.9
Total Unintentional Injuries	**372**	**56.5**	**102.1**	**0.9***
Motor vehicle accidents	19	2.9	4.5**	0.3*
Off-road vehicle	52	7.9	13.3	1.5*
Excessive cold	47	7.1	14.5	1.5*
Poisoning	42	6.4	12.2	0.6*
Exposure to smoke and fire	19	2.9	5.2**	1.0
Threats to breathing	11	1.7	2.0**	0.4*

Drowning	121	18.4	31.0	1.6*
Other	61	9.2	NA	NA
Undetermined Intent	16	2.4	NA	NA
Total	**90**	**100.0**	**109.4**	**0.6***

Source: AN EpiCenter, 2014
[1] Age-Adjusted rates are per 100,000 U.S. year 2000 standard population
[2] Rate Ratio indicates if the injury risk is greater (>1) or less (<1) than the risk for AN/AI statewide
**Rate is based on 10-19 deaths and should be interpreted with caution
* Statistically significant difference between rates, p<0.0
NA: Not applicable

Non-fatal injuries among Alaska Natives

Falls (23.9%), suicide attempts (18.0%), and assaults (12.1%) were the three leading causes of injury hospitalizations during 1992-2011 among Yukon-Kuskokwim Alaska Natives representing more than half of all Y-K injury hospitalizations (54.0%; Table 39).[57]

Off-road vehicles were an important cause of injury hospitalizations among Y-K Alaska Native people. The snow machine and all-terrain vehicle injury hospitalization rates for Y-K Alaska Native people were higher (rate ratio = 1.9 and 1.2, respectively) than those for Alaska Native people statewide (14.1/7.2 and 7.2/6.1 per 10,000, respectively, p<0.05). [57]

Table 39 Leading Causes of Yukon-Kuskokwim Injury Hospitalization Among Alaska Natives, 1992-2011

	Yukon-Kuskokwim Region			
Cause of Death	**Hospitalizations**	**Percent**	**Age-adjusted Rate[1]**	**Y-K AN/AI vs. Alaska AN/AI[2]**
Total Intentional Injuries	**1626**	**30.1**	**39.4**	**0.9***
Suicide attempt or self harm	973	18.0	21.5	0.9
Assault	653	12.1	18.0	0.9*
Total Unintentional Injuries	**3724**	**69.0**	**106.0**	**0.9***
Falls	1292	23.9	46.9	0.8*
Snow machine	530	9.8	14.1	1.9*
ATV	306	5.7	7.2	1.2*
Struck by person/object	148	2.7	4.1	1.2*
Cut	243	4.5	5.9	1.4*
Other vehicle	182	3.4	4.4	0.9*
Natural and environmental	155	2.9	3.9	1.2
Other	868	16.1	NA	NA
Undetermined Intent	49	0.9	NA	NA
Total	**5399**	**100.0**	**146.6**	**0.9***

Source: AN EpiCenter, 2014
[1] Age-Adjusted rates are per 100,000 U.S. year 2000 standard population

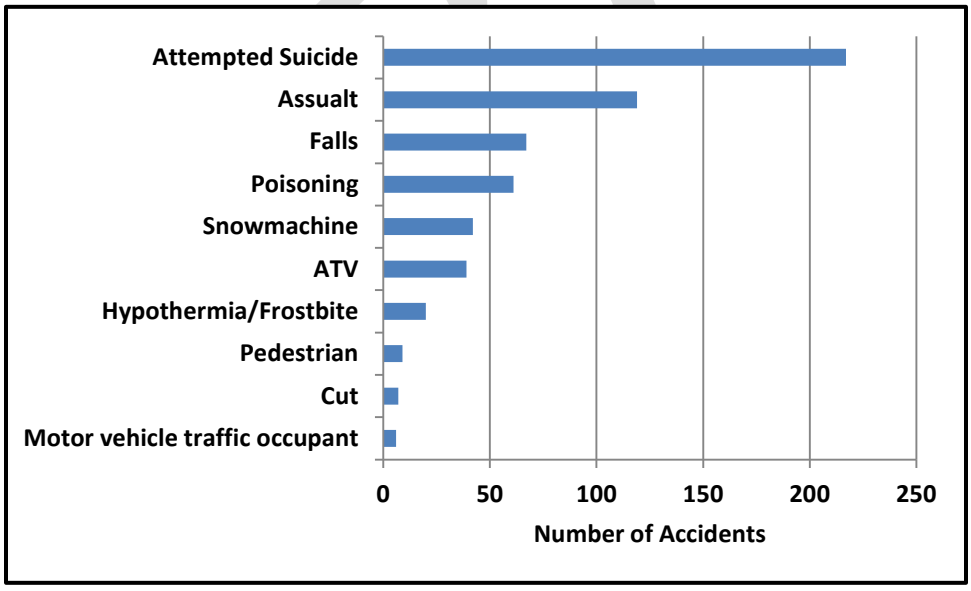
[2]Rate Ratio indicates if the injury risk is greater (>1) or less (<1) than the risk for AN/AI statewide
**Rate is based on 10-19 deaths and should be interpreted with caution
* Statistically significant difference between rates, p<0.05
NA: Not applicable

5.3.2.4 Alcohol Related Accidents and Injuries

Alcohol consumption and injury death are strongly related. In 1997, Landen et al. reported that in injury fatality cases where blood alcohol was actually recorded, more than 65% had a blood alcohol concentration (BAC) of ≥80 mg/dL (0.1%). The legal limit for BACs in the majority of states is 80 mg/dL (0.08%). The authors also report that living in a wet village was an independent risk factor for injury death.[58]

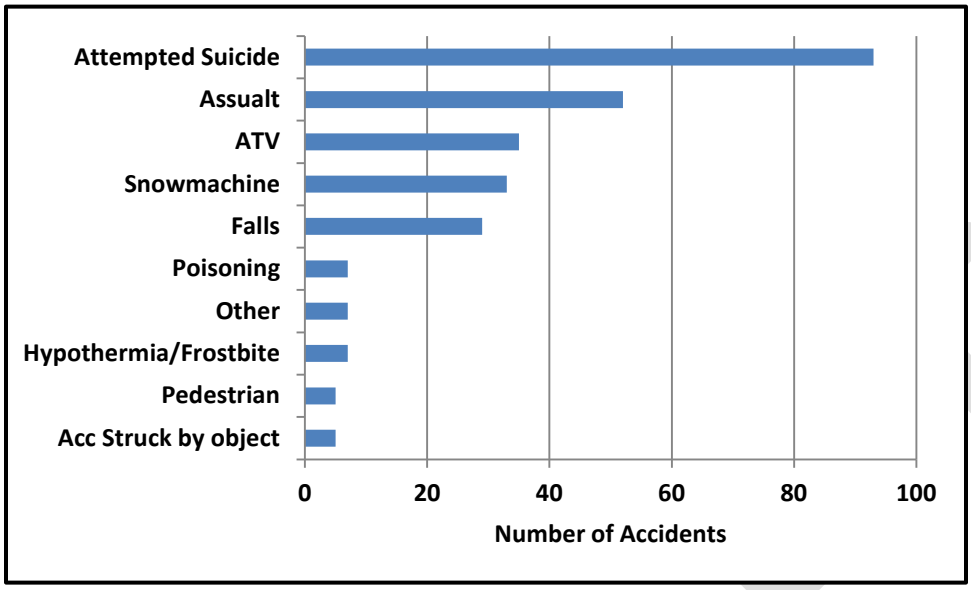
From 2004 to 2008, alcohol use was documented in 34.8% of all non-fatal injury cases in the Yukon-Kuskokwim Region. As of the fall of 2015, the city of Bethel is considering legislation to allow the sale and possession of alcohol. In order to gain a better understanding of the influence of the city of Bethel on alcohol related non-fatal injury rates for the Yukon-Kuskokwim Region, analyses were conducted separately for the Region as a whole and excluding Bethel. For the region excluding the city, 27% of all non-fatal injury cases were documented as involving alcohol use. The age distribution of alcohol related non-fatal injury rates were similar for the Y-K Region as a whole and excluding the city, with the greatest number of injuries occurring among 15-24 year olds. Figure 18 and Figure 19 present a ranking of the top 10 causes of non-fatal injury involving alcohol, in the Yukon Kuskokwim Region and region excluding Bethel, respectively. [56] For both areas, attempted suicide was the top alcohol related non-fatal injury, followed by assault. However, whereas falls and poisoning ranked third and fourth in the Y-K Region, ATV and snow machine accidents ranked third and fourth, respectively, when Bethel was excluded.

Figure 18 Top Ten Non-fatal Injuries involving Alcohol in the Yukon Kuskokwim Region, 2004 to 2008



Source: Alaska Trauma Registry, 2011

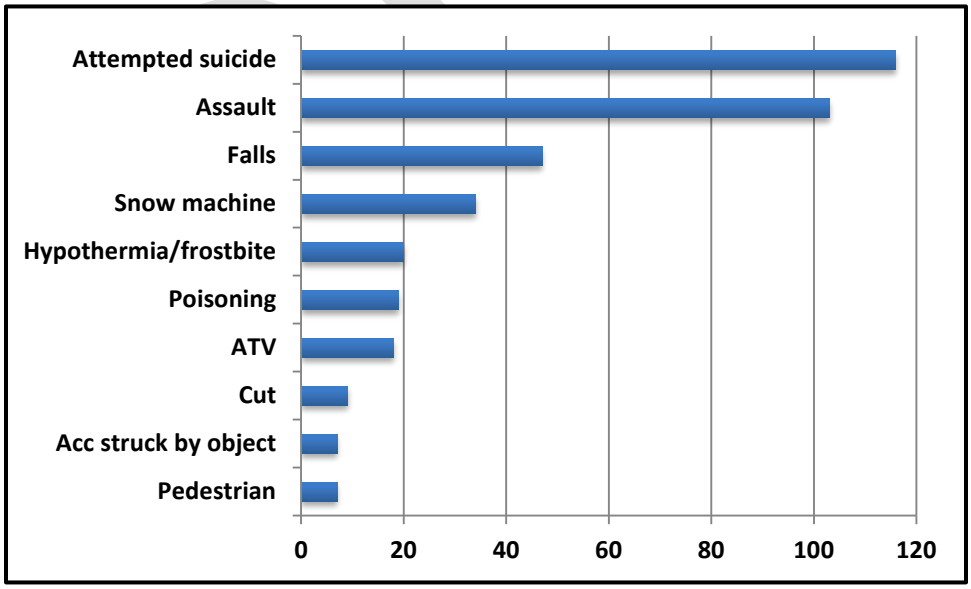
Figure 19 Top Ten Non-fatal Injuries involving Alcohol in the Yukon Kuskokwim Region, excluding the City of Bethel, 2004 to 2008



Source: Alaska Trauma Registry, 2011

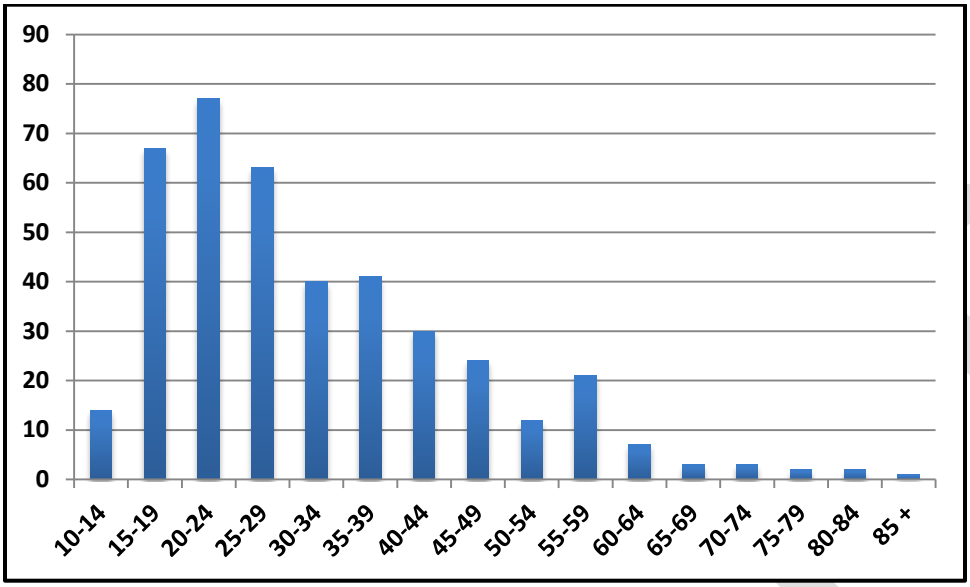
From 2007 to 2011, ATR records revealed that alcohol use was documented in 39.7% of all non-fatal injury cases in the Bethel Census Area.[56] The two leading causes alcohol related non-fatal injury were the same for the Bethel Census area as for the Y-K Region during 2004-2008, attempted suicide and assault (Figure 20). The age distribution was also similar with the greatest number of alcohol related non-fatal injuries occurring among 15-24 year olds (Figure 20).

Figure 20 Top Ten Non-fatal Injuries involving Alcohol in the Bethel Census Area, 2007-2011



Source: Alaska Trauma Registry, 2014

Figure 21 Alcohol related Non-Fatal Injuries by Age, Bethel Census Area, 2007-2011



Source: Alaska Trauma Registry, 2014

5.3.2.5 Traffic and Accidents

Motor vehicles, airplanes, boats and barges, snow machines, and all-terrain vehicles are common modes of transportation in the area. There is daily jet service between Bethel and Anchorage for passengers and cargo while smaller air taxis service surrounding villages.

Pedestrian and motor vehicle injuries are included in the fatal and non-fatal injury figures above. Motor vehicle accidents accounted for 11 deaths in the Bethel Census Area from 2007 to 2009, or 15% (see Figure 18). For non-fatal injuries in the Yukon Kuskokwim Region from 2004 to 2008, there were 21 injuries to occupants of motor vehicles and 35 pedestrian injuries, or 1.2% and 2.0% respectively of total non-fatal injuries. For the Yukon Kuskokwim Region excluding the City of Bethel, there were 8 non-fatal injuries to occupants of motor vehicles and 23 pedestrian injuries from 2004 to 2008, or 0.7% and 2.1% respectively.

Kuskokwim River traffic and accidents

The Kuskokwim and adjacent rivers accommodate riverboats and barges. The Port of Bethel is the northern-most medium draft port in the United States. River travel is the primary means of local transportation in the summer. A barge service based in Bethel transports goods to the Kuskokwim villages. In the winter, the Kuskokwim River becomes a 150-mile ice road to surrounding villages.[59] Table 37 is a list of docks along the Kuskokwim River, and Table 38 contains the number of trips for all traffic types along the river in 2009.[60] No information is currently available about the number of accidents and spills that occur annually on the Kuskokwim River.

Table 40 Docks on the Kuskokwim River, 2009

Dock	City or Town	Borough or Census Area	Mile up River
Hately Dock	Bethel	Bethel	65
Kwethluk Village	Bethel	Bethel	85
Akiachak Village	Kwethluk	Bethel	93
Akiak	Kwethluk	Bethel	105
Tuluksak	Akiak	Bethel	123
Lower Kalskag Village	Tuluksak	Bethel	165
Kalskag Village	Tulusak	Bethel	178
Birchtree	Lower Kalskag	Bethel	194
Aniak Village	Lower Kalskag	Bethel	210
Chuathbaluk Beach	Kalskag	Bethel	222
Napaimute Village	Kalskag	Bethel	240
Crooked Creek Village	Aniak	Bethel	280
Red Devil Beach	Crooked Creek	Bethel	324
Georgetown Village	Crooked Creek	Bethel	324
Parks Village	Crooked Creek	Bethel	325
Sleetmute Village	Crooked Creek	Bethel	330
Stony Creek Village	Red Devil	Bethel	360
Lisky's Landing	Sleetmute	Bethel	426
Devil's Elbow	Sleetmute	Bethel	428
Sterling Landing Village	Takotna	Yukon-Koyukuk	473
McGrath Village	Takotna	Yukon-Koyukuk	488
Medfra Village	Nilolai	Yukon-Koyukuk	573
Nikolai Village & Beach (Nikolai)	McGrath	Yukon-Koyukuk	605
City of Bethel, Cargo and Small Boat Harbor Floats	Bethel	Bethel	65
City of Bethel, Beach 1.	Bethel	Bethel	
City of Bethel, Small Boat Harbor Floats.	Bethel	Bethel	
City of Bethel, Slough Dock.	Bethel	Bethel	
City of Bethel, Cargo Dock.	Bethel	Bethel	

Table 40 Docks on the Kuskokwim River, 2009

Dock	City or Town	Borough or Census Area	Mile up River
City of Bethel, Seawall Dock.	Bethel	Bethel	
City of Bethel, Beach 2.	Bethel	Bethel	
City of Bethel, Petroleum Dock	Bethel	Bethel	65

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center, Navigation Data Center, 2011

Table 41 Kuskokwim River Number of Trips for All Traffic Types (Domestic & Foreign), 2012

	All Vessel Types			Self-Propelled Dry Cargo			Self-Propelled Tanker		
All Drafts	All Traffic Directions	Upbound	Downbound	All Traffic Directions	Upbound	Downbound	All Traffic Directions	Upbound	Downbound
0-5 ft.	264	144	120	2	1	1	0	0	0
6-9 ft.	107	68	39	0	0	0	0	0	0
10-12 ft.	11	6	5	0	0	0	0	0	0
13-14 ft.	3	1	2	0	0	0	0	0	0
15-17 ft.	8	5	3	0	0	0	0	0	0
18-20 ft.	9	3	6	0	0	0	0	0	0
>20 ft.	0	0	0	0	0	0	0	0	0

	Self-Propelled Towboat			Non-Self Propelled Dry Cargo			Non-Self Propelled Tanker Liquid Barge		
All Drafts	All Traffic Directions	Upbound	Downbound	All Traffic Directions	Upbound	Downbound	All Traffic Directions	Upbound	Downbound
0-5 ft.	50	29	21	110	53	57	102	61	41
6-9 ft.	81	46	35	23	20	3	3	2	1
10-12 ft.	6	3	3	3	1	2	2	2	0
13-14 ft.	3	1	2	0	0	0	0	0	0
15-17 ft.	7	4	3	0	0	0	1	1	0
18-20 ft.	0	0	0	0	0	0	0	0	0
>20 ft.	0	0	0	0	0	0	0	0	0

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center, Navigation Data Center, 2014

5.3.2.6 Law Enforcement

The Alaska State Troopers (AST) 2010 Annual Report provides details regarding the law enforcement in the area.[59] The AST is a division of the Alaska Department of Public Safety. In addition to State Troopers, the Village Public Safety Officers (VPSO) program was established as a means of providing rural Alaskan communities with needed public safety services at the local level. In 2010, the program had 86 funded positions, 78 of which were filled by the end of the year.

AST maintain posts in Bethel and in Aniak. According to the Annual Report, the Bethel post includes 2 Sergeants, 10 Troopers, 1 State Pilot, and 2 Office Assistants. Bethel has its own police department, but staffing numbers have fluctuated over the years and has on occasion, asked Alaska State Troopers for assistance with investigating serious crimes. Air taxis are the primary means of transportation for troopers responding to calls for service in the villages. The Aniak post includes 1 Sergeant, 3 Troopers, and 1 Office Assistant. Aniak is also authorized to have VPSOs, and currently has 2 officers assigned. Aniak does not have its own police department. The Aniak AST sergeant supervises the posts in McGrath, St. Mary's, and Emmonak and makes frequent trips to these villages. Troopers at the Aniak post provide oversight to the VPSO in Upper Kalskag, the only VPSO position filled in the area in 2010. The post serves 14 communities in addition to Aniak (a Zone 1 PAC):

- Anvik
- Chuathbaluk (Zone 1 PAC)
- Crooked Creek (Zone 1 PAC)
- Georgetown
- Grayling
- Holy Cross
- Lime Village
- Lower Kalskag (Zone 1 PAC)
- Napaimute
- Red Devil (Zone 1 PAC)
- Shageluk
- Sleetmute (Zone 1 PAC)
- Stony River (Zone 1 PAC)
- Upper Kalskag (Zone 1 PAC)

5.3.2.7 Dry/Wet/Moist Community

Alaska Native villages have enacted policies that designate a community as dry (alcohol sale and consumption prohibited), damp (sale of alcohol illegal, but possession allowed), and wet (sale, importation and possession allowed). As of June 2011, 3 Zone 1 communities have adopted "local option laws" to prohibit alcohol: Lower and Upper Kalskag and Red Devil.[61] Alcohol is permitted in the other Zone 1 communities.

5.3.2.8 Summary

- Accidents and injuries were second leading cause of death in the Bethel Census Area between 2007 and 2009. The most common causes of unintentional injury deaths among all residents and among Alaska Natives were:
  - Poisoning (typically caused by alcohol ingestion),
  - Motor vehicle accidents (the majority of which are snow machine accidents), and
  - Drowning and submersion.

- Falls, suicide attempts, and assaults were the most common causes of non-fatal injury hospitalization in the YKHC service area and for all Alaska Natives.

5.3.2.9 Data Gaps

- Traffic and accident datasets

5.3.3 HEC 3: Exposure to Potentially Hazardous Materials

When gathering data on exposure to potentially hazardous materials, the HIA team reports on *outcomes* such as the prevalence of illnesses that result from exposures to hazardous materials including asthma/chronic obstructive pulmonary disease (COPD), cancer, thyroid disorders, developmental delays, and birth defects. For health *determinants,* the HIA includes information, where available, on monitoring data on soil, water, and air to understand the types and quantities of contamination that might be present. ADHSS routinely monitors two heavy metal toxins: methyl mercury, through hair samples of pregnant women, and lead (a reportable condition in Alaska) as discussed below. The following sections describe baseline environmental health according to available data sources. A Project specific toxicity assessment is provided in Section 6.0 Exposure Assessment.

5.3.3.1 Physical Hazards

There are no readily available data on illnesses related to physical hazards such as radiation, noise, vibration, light, temperature extremes, or wildlife interactions.

5.3.3.2 Air Quality

There is no specific information available on air quality in the Donlin Gold Mine project area in the public domain at the current time. Information developed during the EIS baseline gathering process will be incorporated into this baseline report when the data is available.

According to the EPA, tribes in Alaska face unique challenges to protecting air quality and reducing health risks in their communities[62]:

- Most Tribes do not have a reservation or defined lands where they can assert jurisdiction to address air quality issues.
- Frozen ground prevents burying waste in landfills, and many communities resort to burning trash that creates air pollution.
- Electricity primarily comes from diesel generators that produce particulate and other air pollutants.
- The cold climate means people spend a lot of time indoors in air tight homes and buildings where indoor air pollution and humidity can rise to unhealthy levels.
- Many homes have older wood stoves that can be inefficient and create air pollution.
- Dust from unpaved roads may contain pollutants that can be inhaled or deposited on subsistence food sources.

5.3.3.3 Water Quality

The ADEC has identified the following land use activities in the Kuskokwim Delta that have a potential to serve as determinants of water quality and influence human health: landfills, wastewater treatment plants, honeybucket disposal areas, airports, incinerators, boatyards/marinas, cemeteries, electric power generation, firehouses, gasoline stations, class V injection wells, washaterias (laundromats), medical facilities, motor vehicle repair shops, and petroleum storage.

ADEC, Division of Environmental Health, Drinking Water Program requires Public Water Systems (PWS) to be in compliance with the state drinking water regulations, in accordance with the Federal Safe Drinking Water Act and Amendments, for the public health protection of the residents and visitors to the State of Alaska. Regulated contaminants are divided into six categories: Bacteria/Viruses, Nitrate/Nitrites, Inorganic and Heavy Metals, Volatile Organics, Synthetic Organics, and Other Organics.

There are 60 individually identified PWS in the Yukon-Kuskokwim basin that are subject to ADEC regulations. Results of the most recent regulated contaminant sampling can be found on the public water systems' Source Water Assessment website.[63] Typically, drinking water within the basin meets the maximum contaminant levels (MCL) for all regulated contaminants with the exception of arsenic. The MCL is the maximum level of contaminant allowed to exist in drinking water and still be consumed without harmful effects. The State of Alaska has some of the highest levels of naturally occurring arsenic in drinking water in the U.S. Historically drinking water wells have been found to contain concentrations of arsenic up to 10,000 µg/liter.[64] In 2005, the ADEC Kuskokwim Delta factsheet reported that 19 PWS had an average arsenic level above the MCL of 10 ppb.[65]

The U.S. EPA Clean Water Act mandates that each state develop a program to monitor and report on the quality of its surface and groundwaters and prepare a report describing the status of its water quality. The State of Alaska conducts surface and groundwater water quality monitoring investigations regularly and updates its report every 2 years.

The Integrated Water Quality Assessment Report[66] 2010 categorizes waterbodies by the degree to which water quality goals are attained. The 5 categories and 3 subcategories are described here:

- Category 1. All water quality standards (WQS) for all designated uses are attained.
- Category 2. Some WQS for the designated uses are attained, but data and information to determine whether the WQS for the remaining uses are attained are insufficient or absent.
- Category 3. Data or information is insufficient to determine whether the WQS for any designated uses are attained.
- Category 4. The waterbody is determined to be impaired but does not need a total maximum daily load (TMDL).
    - Category 4a. An established and EPA-approved TMDL exists for the impaired water.
    - Category 4b. Requirements from other pollution controls have been identified to meet WQS for the impaired water.
    - Category 4c. Failure to meet a water quality standard for the impaired water is not caused by a pollutant; instead, the impairment is caused by a source of pollution such as nuisance aquatic plants, degraded habitat, or a dam that affects flow.
- Category 5. WQS for one or more designated uses are not attained and the waterbody requires a TMDL or recovery plan.

The majority of Alaskan waters fall into category 1. There are 44 waterbodies in category 2, 304 in category 3, 33 in category 4a, 4 in category 4b, 0 in category 4C, and 28 in category 5. In Red Devil, portions of both the Kuskokwim River and Red Devil Creek are designated as category 5 waterbodies due to the presence of mercury, antimony, and arsenic from historic mining activities. This includes 1000 feet down river of the Kuskokwim to 100 feet upriver from mouth of Red Devil Creek and 0.5 mile of Red Devil Creek.

5.3.3.4 Potentially Hazardous Materials

Mercury in Burbot and Pike in the middle Kuskokwim River area

The middle Kuskokwim River area is a historic mining district, and also has naturally high concentrations of mercury in bedrock and sediments.[71] Pike, an important subsistence resource for peoples of this region, are long-lived predatory fish. These fish typically contain higher levels of mercury than other Alaskan fish due to mercury contamination from historic mining activities and biomagnification within the food chain. The U.S. Fish and Wildlife Service examined levels of mercury in Northern Pike from the Yukon Delta National Wildlife Refuge[67] in 2005 and 2006. Based on these data, ADHSS developed consumption advice for Northern Pike with fish classified according to size. Like the statewide fish consumption advice, the guidance applies to women of childbearing age and children only; men, elders and teenage boys can eat unlimited quantities of pike. In June 2011, ADHSS released a fact sheet specific for mercury in Burbot and Pike in the middle Kuskokwim River from fish sampled in 2010. Preliminary consumption guidance was developed based on fish species, tissue, and location according to the levels of mercury measured (Table 42).[68] Pike meat from the George River had the highest levels of mercury. A maximum of four meals per month is recommended for women of childbearing age and children. Guidance according to fish size is not yet available.

Table 42 Preliminary Consumption Guidelines for Women and Children Who Eat Pike and Burbot (Lush) from the Middle Kuskokwim River Area

Fish species, tissue, and location	Mercury concentration (average, mg/kg, wet weight)	Recommended meals per month
Burbot liver from the Mid-Kuskokwim River	0-0.15	Unlimited
Burbot liver from the George River Pike meat from the Stony River Pike meat from the Mid-Kuskokwim River	0.15-0.32	up to 16
Burbot meat from the Mid-Kuskokwim River	0.32-0.40	up to 12
Pike meat from the Holitna River Burbot meat from the George River	0.40-0.64	up to 8
Pike meat from the George River	0.64-1.2	up to 4

Source: ADHSS Fact Sheet: Mercury in Burbot (Lush) and Pike from the Middle Kuskokwim River Area – June 2, 2011

The ADHSS monitors 2 pollutants: methylmercury (through hair samples of pregnant women) and exposures to lead.

ADHSS mercury biomonitoring

Mercury is a naturally occurring metal found in rock known as cinnabar, which is present in the Yukon-Kuskokwim Delta. Mercury can co-occur with gold deposits and is released as a by-product when the gold is processed. It is released into the environment via both natural (e.g. volcanic activity, wildfires, and erosion) and unnatural sources (e.g. coal-fired power plants, gold mines, and solid waste biomass burning). Methyl mercury, the more toxic form of mercury, may be formed from inorganic, metallic mercury in water and soil by bacteria. Methyl mercury (but not metallic mercury) accumulates in the tissues of fish, with larger and older fish having higher levels of methyl mercury. At high levels, mercury is a neurotoxin that can impair neurological development of fetuses, infants, and children.[69]

WHO estimated a tolerable concentration of 0.2 µg/m^3 for long-term inhalation exposure to elemental mercury vapor, and a tolerable intake of total mercury of 2 µg/kg bodyweight per day.[70] People are most commonly exposed to mercury through consumption of fish and marine mammals. In July 2002, the ADHSS SOE began the Statewide Maternal Hair Mercury Biomonitoring Program, which offers free and confidential hair mercury testing to all pregnant women and all women of childbearing age (i.e., women aged 15 to 45 years) in Alaska.

Through May 31, 2010, the Alaska State Public Health Laboratory analyzed hair samples from 308 pregnant women and 505 women of childbearing age who lived in 113 communities throughout Alaska. Of the 153 women who resided in the Southwest Region (including the Bethel Census Area and the YKHC service area), the median hair mercury level was 0.78 ppm with the highest level at 7.82 ppm, among the highest values seen in the state. The Agency for Toxic Substances and Disease Registry (ATSDR)

reported that there were no adverse health effects to the fetus associated with maternal hair mercury levels less than 15.3 ppm.[71]

ADHSS mercury biomonitoring in Donlin Zone 1

In 2012, ADHSS offered mercury hair sampling to all residents of the Zone 1 PACs. With support from communities, the HIA Program collected a convenience sample of hair specimens from women of childbearing age (WCBA); i.e., women aged 15–45 years) and other adults in selected upper Kuskokwim River communities during May–September 2012. The HIA Program selected communities based on their proximity to the proposed gold mine and solicited volunteers during visits to various community offices. A total of 186 hair samples were obtained from eight UKR communities. The overall median hair mercury level was 0.51 parts per million (ppm; range: 0.03–3.71 ppm) (Table 43; ADHSS, 2014). Median hair mercury levels were 0.38 ppm (range: 0.03–2.63 ppm) for WCBA (n=79), 0.58 ppm (range: 0.05–3.71 ppm) for women aged >45 years (n=66), and 0.77 ppm (range: 0.13–3.64 ppm) for males (n=41). Overall, increasing median hair mercury levels were weakly associated with increasing age (r^2=0.28, $p<0.05$); the difference in mercury levels between communities did not reach statistical significance. The median hair mercury levels among WCBA were lower than the statewide median (0.44 ppm, range: 0.01–7.82). All results fell below the Agency for Toxic Substances and Disease Registry's No Observed Adverse Effect Level of 15.3 ppm.[72]

Table 43 Summary of data collected by gender, Donlin, 2012

Population	Number of Samples	Mean Age (years)	Age Range (years)	Median Hg (ppm)	Range Hg (ppm)
Total	186	44	15-74	0.510	0.030-3.707
Male	41	50	22-74	0.768	0.126-3.640
Female	145	43	15-74	0.557	0.033-3.707

Source: ADHSS, 2014

Results for each of the participating communities were summarized to obtain general baseline hair mercury levels[72] (Table 44). Statistical comparisons between the communities were not made.

Table 44 Summary of hair mercury results by community, 2012

Community	Number of Samples	Mean Age (years)	Age Range (years)	Median Hg (ppm)	Range Hg (ppm)
Aniak	61	42	15-71	0.330	0.033-1.323
Chuathbaluk	11	39	24-70	0.327	0.125-0.763
Crooked Creek	20	44	20-74	0.377	0.132-2.136
Lower Kalskag	46	47	21-72	0.971	0.167-3.640
Red Devil	6	45	23-71	0.428	0.116-1.364
Sleetmute	9	52	28-74	0.275	0.129-2.946
Stony River	6	50	22-74	0.478	0.163-1.054
Upper Kalskag	27	44	21-67	0.649	0.173-3.707

Source: ADHSS, 2014

These data provide reassurance to program participants and community members in the region at large that they are not being exposed to concentrations of environmental mercury that represent an imminent health threat. These data also help promote the consumption of subsistence foods, which confer numerous health, social/cultural, and economic benefits to potentially affected Donlin Gold project communities.

ADHSS lead surveillance

Although lead will not be mined at the Donlin Mine, it is potentially a by-product from the process of refining precious metals, which will occur on site. While lead occurs naturally in small amounts in the earth's crust, the levels in the Donlin ore body are considered low and the company does not predict a large amount of lead emissions. Much of human exposure to lead comes from human activities including burning fossil fuels, mining, and manufacturing. Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.

Harmful health effects of lead exposure include dose-dependent intellectual and behavioral deficits in children, and cardiovascular, central nervous, renal, reproductive, and hematologic system damage in adults. Children under the age of six are more susceptible to the adverse health impacts of lead exposure because they absorb more lead due to their rapid growth. In addition, they also tend to have increased exposure due to hand-to-mouth activities.

Alaska regulations require laboratories and health care providers to report all blood lead level (BLL) results ≥10 micrograms per deciliter (µg/dL) to the ADHSS SOE; however, most laboratories report all blood lead level (BLL) results. The Centers for Disease Control and Prevention (CDC) has established a level of 10 µg/dL or more in adults and of 5 µg/dL or more in children as "reporting thresholds".[73]

The major sources of lead exposure among children under 6 years of age in the contiguous United States, such as lead-contaminated dust, deteriorated lead-based paint, and lead contaminated soil, are uncommon in Alaska, where the primary risk factors are recent immigration from abroad, air gun pellets, and pica (i.e. a pattern of eating non-food materials, such as dirt, paper, etc).[74] In 2012, the rate of elevated BLL (≥5 µg/dL) among Alaska children aged <6 years was considerably lower than the 2012 national rate (23 vs. 565 cases per 100,000 persons.[75] For children (<18 years) tested between 2002 and 2012 in the Bethel and the Yukon Kuskokwim Census Areas, median BLLs were 1.7 µg/dL and 1.29 µg/dL, respectively.

5.3.3.5 Existing contaminated sites

The ADEC Division of Spill Response and Prevention protects human health and the environment by managing the cleanup of contaminated soil and groundwater in Alaska. The program maintains a public database, which catalogues activity on contaminated sites throughout the state. The HIA team reviewed the database to determine the presence and nature of existing contamination in PACs. There are a total of 15 open ADEC recognized contaminated sites (CS) among the PACs including 4 EPA Superfund sites and 1 Formerly Used Defense (FUD) site.[76]

The majority of the sites were located in Aniak that has a FUD site and 3 of the 4 Superfund sites. The Aniak Middle School building and property were initially developed and used by the Air Force in the 1950s in the military/civilian "White Alice" communication system during the Cold War. By the late 1970s the military facility was obsolete and was turned over to the School District, which renovated the main building and used it for a school from 1981 until 2003. During White Alice operations and renovation of the school by contractors, fluids containing PCBs were spilled in and around the generator room and onto the ground outside the building, resulting in soil contamination. Clean-up is not yet complete.[76]

There are 2 former mercury mines in the area (both Superfund sites) with resulting mercury contamination of surrounding soils and sediments. The remaining sites in Aniak are associated with the

Alaska Department of Transportation (ADOT) and Federal Aviation Administration (FAA). There is contamination with petroleum derivatives such as diesel range organics (DROs); gasoline range organics (GROs); and benzene, toluene, ethylbenzene, and xylenes from heating and jet oils around old several structures at the airport. In addition, there is reported contamination of soils with pesticides such as DDT as well as polycyclic aromatic hydrocarbons (PAHs).[76]

Groundwater samples collected in Aniak at known contaminated sites have been shown to contain petroleum hydrocarbons, chlorinated pesticides, metal (including lead) and nitrates. The existence of this degradation of water quality in Aniak is the primary cause of concern that contaminants may migrate toward the more heavily populated areas of Aniak, a community that is dependent on groundwater for drinking water. The groundwater contamination associated with the known contaminated sites has appeared in the past to be localized around the release areas and not migrating from the sites. See file 2404.38.015 in the ADEC CS database for further detail on this investigation.[76]

The Village of Lower Kalskag applied for an ADEC Brownfield Assessment (DBA) during the spring 2008 for the Old Alaska Village Electric Cooperative Tank Farm site. The property is not actively used but the heating oil tanks and structures remain. According to the ADEC database, no spills have been reported and no previous assessment has been conducted. The community would like to have the site assessed for environmental conditions to allow reuse of the property.[76]

Red Devil Mine is an abandoned mercury mine located on the banks of the Kuskokwim River 1.5 miles southeast of Red Devil. It is located on 10 acres of land managed by the BLM. Mine features included a housing complex, equipment and chemical storage buildings, a shop pad (laboratory), engine shop, mine portals, power plant, retort building, three settling ponds, and five above ground petroleum storage tanks. Although a complete human health risk assessment has not been conducted, plans for remediation are underway as several contaminants including mercury, arsenic, antimony and PAH's are present well above ADEC clean-up levels in soils, groundwater, and in sediment samples in Red Devil Creek. In July 2014, a clean-up plan was approved.[76]

In Stony River, lead paint, asbestos and oil drums were found in old airport structures, and oil contamination of soil is present around the old Lime Village School. In addition, there is a landfill in Stony River that was used by the military as a disposal area for construction debris, asbestos, incinerator ash, and drums. In Sleetmute, there is a heating oil spill at the school. In Red Devil, there have been several historic spills from the above ground storage tank farm and associated pipeline that supplies the Middle Kuskokwim Electric Cooperative power plant. The former tank farm was situated in the flood plain of the Kuskokwim River and flooding resulting in contamination of soils that has been partially remediated.[76]

There were no open contaminated sites listed in the database for Chuathbaluk, Crooked Creek, or Upper Kalskag (Table 45).[76]

Table 45 Contaminated Sites in the Potentially Affected Communities

Borough/Census Area	Village	Total CS	Superfund	FUD
Bethel	**Aniak**	9	3	1
Bethel	**Chuathbaluk**	0	0	0
Bethel	**Crooked Creek**	0	0	0
Bethel	**Lower Kalskag**	1	0	0
Bethel	**Red Devil**	2	1	0
Bethel	**Sleetmute**	1	0	0
Bethel	**Stony River**	3	0	1
Bethel	**Upper Kalskag**	0	0	0
Total		**15**	**4**	**2**

CS=contaminated site; FUD= formerly used defense site.
Source: ADEC Contaminated Sites Program

5.3.3.6 Natural Environmental Patterns

Some hazardous exposures may emerge from natural environmental patterns such as flooding, wind and weather patterns that create air quality problems (i.e. inversions or high particulate matter content), or secondary effects from climate change**.** The weather in the YKHC service area presents many challenges and risks, from extreme cold to thin ice. According to the ADEC, Division of Spill Prevention and Response, heavy snow melt and ice jams caused the Kuskokwim River to rise causing flooding in Red Devil and Crooked Creek in early May 2011. The flood damaged homes, businesses, and public infrastructure. In addition, the flood waters and ice flow damaged or displaced numerous fuel tanks, drums, and other containers. There were several petroleum spills in the community and the flood waters impacted some private drinking water wells.

The ADEC Drinking Water Program issued a Boil Water Notice (BWN) on May 10, 2011, to the public water system in Crooked Creek.[77] The YKHC collected water samples from the water system for coliform bacteria analysis. All samples were negative for bacteria and the BWN was lifted on May 13, 2011.

5.3.3.7 Summary

- The middle Kuskokwim River area is a historic mining district, and has naturally high concentrations of mercury in bedrock and sediments
- There are a total of 15 open ADEC recognized contaminated sites in Aniak, Lower Kalskag, Red Devil, Sleetmute, and Stony River including 4 EPA Superfund sites and 1 Formerly Used Defense sites.
- Based on hair mercury sampling, community members in the region are not being exposed to concentrations of environmental mercury that represent an imminent health threat and should continue consumption of subsistence foods, which confer numerous health, social/cultural, and economic benefits to the people of Alaska.

5.3.4 HEC 4: Food, Nutrition, and Subsistence Activity

The Alaska Federation of Natives (AFN) describes subsistence as "the hunting, fishing, and gathering activities which traditionally constituted the economic base of life for Alaska's Native peoples and which continue to flourish in many areas of the state today".[78]

Subsistence is part of a rural economic system, called a "mixed, subsistence-market" economy, wherein families invest money into small-scale, efficient technologies to harvest wild foods. Fishing and hunting for subsistence resources provide a reliable economic base for many rural regions. Subsistence is focused toward meeting the self-limiting needs of families and small communities.[79] Participants in this mixed economy in rural Alaska augment their subsistence production by cash employment. Cash (from commercial fishing, trapping, and/or wages from public sector employment, construction, firefighting, oil and gas industry, or other services) provide the means to purchase the equipment, supplies, and gas used in subsistence activities. The combination of traditional and commercial-wage activities provide the economic basis for the way of life so highly valued in rural communities.[79]

The State of Alaska, Department of Fish and Game (ADF&G) confirms that subsistence fishing (Figure 23) and hunting are important sources of employment and nutrition in almost all rural communities.[55] Traditional fishing, hunting, and gathering is a source of nutrition for residents in areas of Alaska where food prices are high. While some people earn income from employment, these and other residents rely on subsistence to supplement their diets throughout the year. Furthermore, traditional and cultural activities support a healthy diet and contribute to residents' overall wellbeing.

Figure 22 ADF&G Subsistence Fishing Kuskokwim River

Source: ADF&G, 2014

5.3.4.1 Micronutrient Deficiencies

Micronutrients are nutrients required by humans and other organisms throughout life in small quantities to orchestrate a range of physiological functions. There are no reported deaths by malnutrition in the Bethel Census Area or by nutritional disorders such as scurvy, marasmus, vitamin B12, or other deficiencies. Information on clinical visits for these conditions is not available at this time, but incidence is generally low and not likely related to involuntary nutritional limitations. Vitamin D deficiency is a health challenge for children and adults in Alaska and can lead to bone diseases such as rickets.[80]

5.3.4.2 Child Growth Standards

Physical growth curves in children serve as milestones for nutritional health and markers of acute and chronic malnutrition. Indicators for acute malnutrition are weight-for-height of below 2 standard deviations (z score, a statistical measure of significance) from WHO standards of childhood growth, and for chronic malnutrition as height-for-age (z score < -2).[81] These cut offs were created because children are at a much higher risk of death. These WHO growth standards have shown that effects of the environment on growth of infants is much greater than any ethnic differences in populations, and thus should be an appropriate indicator for nutritional and environmental health.[82]

5.3.4.3 Contribution of Subsistence Activities

The ADF&G completed harvest studies in central Kuskokwim in 2010, surveying the period of January through December 2009. Table 46 presents a summary of the analysis of the harvest surveys taken from Technical Paper 365[55] for middle Kuskokwim PACs.

Table 46 Wild Food Harvest in the Middle Kuskokwim Villages

Community	Percent of Households Surveyed Attempting to Harvest	Total Wild Food Harvest (lbs.)	Harvest per Household (lbs.)	Harvest per Person (lbs.)
Aniak (2009)	90	122,185	852	306
Chuathbaluk (2009)	93	24,895	829	244
Crooked Creek (2009)	94	23,505	706	245
Georgetown (2010)	71	10,870	518	173
Lower Kalskag (2009)	90	46,866	743	187
Red Devil (2009)	82	8,296	749	305
Sleetmute (2009)	100	31,420	988	405
Stony River (2009)	83	20,235	1,686	533
Upper Kalskag (2009)	98	55,722	929	344

Source: Brown et al., 2012 & Brown et al., 2013

In all middle Kuskokwim PACs, salmon (chinook, sockeye, coho, and chum) and other fish consistently rank in the top 10 of harvested resources. In 2012, the HIA team conducted consumption surveys in eight Central Kuskokwim communities in order to supplement information regarding harvest to better elucidate consumption patterns. Harvest and consumption are not necessarily equivalent due to the fact that communities tend to share subsistence resources. Survey results indicated that the most common subsistence foods consumed among all eight communities surveyed were: salmon, moose, berries, and whitefish.[83] Some communities also reported consuming birds and/or caribou. Salmon was consumed more frequently than whitefish. Resident fish such as pike, burbot (lush) have a greater concentration of mercury than do salmon because of their residence (see Section 5.3.3). Moose is the land mammal most often harvested and consumed. [83]

The County Ranking systems states that, "Access to healthy foods is measured as the percent of zip codes in a county with a healthy food outlet, defined as a grocery store or produce stand/farmers' market.[43] The Bethel Census Area was not ranked, although Aniak has an AC supermarket and several of the other communities have small grocery stores which supply market goods such as beef and chicken; breads, rice and pasta; canned vegetables and fruits and fruit juices, and beverages. In the household consumption survey, residents reported that the most commonly consumed store-bought foods were cheese, milk, eggs, rice, and wheat bread. The most common store bought food used in place of subsistence foods was frozen meat.[83]

The ADF&G also conducted harvest surveys for the lower Kuskokwim PACs between 1998 and 2012 listed in Table 47.[84, 85, 86] The Bethel results have not been published in a Technical Report, so incomplete information is currently available. Bethel did, however, have the lowest per capita harvest among the lower Kuskokwim PACs (168 lbs.), while Akiachak had the highest at 1328 lbs. It should be noted however, that the most recent survey for Akiachak was conducted in 1998, therefore the data are not directly comparable as harvest rates overall have declined with time.[84] In 2012, over 90 percent of Bethel households used wild resources. Resources used by most households included moose, Chinook salmon, coho salmon, sockeye salmon, caribou, and chum salmon. Over 50 percent of households fished for salmon and non-salmon fish species, while 30 percent harvested land mammals, 43 percent harvested birds and eggs, and 77 percent harvest vegetation such as berries or greens.[84]

The current harvest patterns of Oscarville, Kwethluk, Akiak, and Tuluksak reflect historical patterns of the lower-middle Kuskokwim region, which is largely comprised of fish and land mammals, supplemented by harvests of marine mammals, migratory birds and eggs, and a wide variety of plants.[84] For the year 2010, residents of these four lower Kuskokwim PACs harvested and estimated total of 693,542 edible pounds of subsistence resources, or 429 pounds per capita.[85] Salmon and freshwater fish comprised 70 percent of the total regional subsistence harvest. Moose contributed 7 percent, caribou 4 percent, and berries, plants, and various species of small game provided the other 19 percent.

Table 47 Wild Food Harvest in the Lower Kuskokwim Villages

Community	Percent of Households Surveyed Attempting to Harvest	Total Wild Food Harvest (lbs.)	Harvest per Household (lbs.)	Harvest per Person (lbs.)
Bethel (2012)	ND	ND	ND	168
Tuluksak (2010)	97	163,606	1902	359
Akiak (2010)	94	237,441	2668	616
Akiachak (1998)	84	694,676	5887	1328
Kwethluk (2010)	97	259,699	1676	364
Oscarville (2010)	100	32,796	2343	521
Napakiak (2011)	93	154,785	1739	489
Napaskiak (2011)	95	410	196,763	410

ND: Data unavailable
Source: Donlin Gold PDEIS Section 3.21, 2015; Brown et al., 2013; Coffing et al., 1998

5.3.4.4 Food Security

Food security is defined by the WHO as "existing when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life."[7] Food security is based on the availability, access (both physical and economical), and use of food, and is related to health through malnutrition. There are no documented acute shortages of major dietary components (proteins, carbohydrates, grains, fruits, or vegetables) in any of the PACs. While many residents in the communities engage in subsistence hunting, fishing, and gathering as a part of their diets, it is not known what percent of their food supply comes from subsistence activities.

ADF&G queried respondents (Table 48) about how they viewed their level of food security, adhering to US Department of Agriculture definitions,[87] which break down food security into four subcategories:

- "High" food security households are those households who do not report any indications of food access problems or limitations.
- "Marginal" food security households are those households who report one or two instances per week of food access problems or limitations, typically anxiety over food sufficiency or shortage of food in the house; they give little or no indication of changes in diets or food intake.
- "Low" food security households are those households that report reduced quality, variety, or desirability of their diet; they too give little indication of reduced food intake.
- "Very low" food security households are those households that report multiple instances of disrupted eating patterns and reduced food intake.

Table 48 Percentage of Food Secure Households in the Middle Kuskokwim Villages 2009

Community	Total Food Security* (%)	Low Food Security (%)	Very Low Food Security (%)
United States	87	8	5
Alaska	87	8	5
Aniak	89	6	5
Chuathbaluk	76	17	7
Crooked Creek	82	18	0
Georgetown (2010)	85	10	5
Lower Kalskag	52	25	22
Red Devil	73	18	9
Sleetmute	69	22	9
Stony River	75	17	8
Upper Kalskag	77	10	13

Source: Brown et al., 2012 & Brown et al., 2013
*Includes High and Marginal Food Security subcategories

Table 49 Percentage of Food Secure Households in the Lower Kuskokwim Villages

Community	Total Food Security* (%)	Low Food Security (%)	Very Low Food Security (%)
United States (2010)	86	8	9
Alaska (2008-2010)	86	8	9
Tuluksak (2010)	56	31	15
Akiak (2010)	75	14	11
Kwethluk (2010)	72	18	10
Oscarville (2010)	92	8	0
Napakiak (2011)	79	13	9
Napaskiak (2011)	89	11	0

Source: Brown et al., 2013
*Includes High and Marginal Food Security subcategories
Note: Bethel & Akiachak were not included because there were no data available

As shown, total food security in many of the middle and lower Kuskokwim PACs is well below total food security statewide, with a greater percentage of residents experiencing "low" and "very low" food security. The communities with the highest percentage of "very low" food security were Lower Kalskag (22%) and Tuluksak (15%).These data could indicate that there is a food security issue in PACs. However, levels of "total" food security do not automatically indicate adequate or above adequate nutritional status. Nutritional status is not available on an individual level.

During the ADF&G 2010 survey, which included gathering Traditional Knowledge, residents in many of the villages said they preferred eating wild harvested subsistence foods because they are healthier and more filling than market foods.[55] Residents noted that they could not get the amount or kinds of food they wanted because of a lack of resources needed to hunt, fish, gather, or buy food. Some residents expressed concern about the negative dietary impact of being dependent on market food or *Kass'aq* (Western food).

5.3.4.5 Food Costs

The University of Alaska Fairbanks (UAF), Cooperative Extension Service, performs a Food Cost Survey (FCS) every quarter. Information on the specific vegetables, fruits, grains, carbohydrates and proteins included as well as quarterly results for the last 10 years is available online.

The UAF CFS reports that in September 2011 (the last quarter available) it cost a family of four $270.58 a week (over $14,000 per year) to purchase the 104 items in the market basket at a grocery store in Bethel, almost twice what the same products cost in Anchorage ($144.42 per week or $7,500 per year).[88] Table 50 presents information on the impact of this cost on the Zone 1 rural communities and demonstrates the potential differences in market food costs if a family purchased all of their weekly food supplies at grocery stores.[45,88]

Table 50 Comparison of Annual Foodbasket Costs as a Percent of Median Family Income

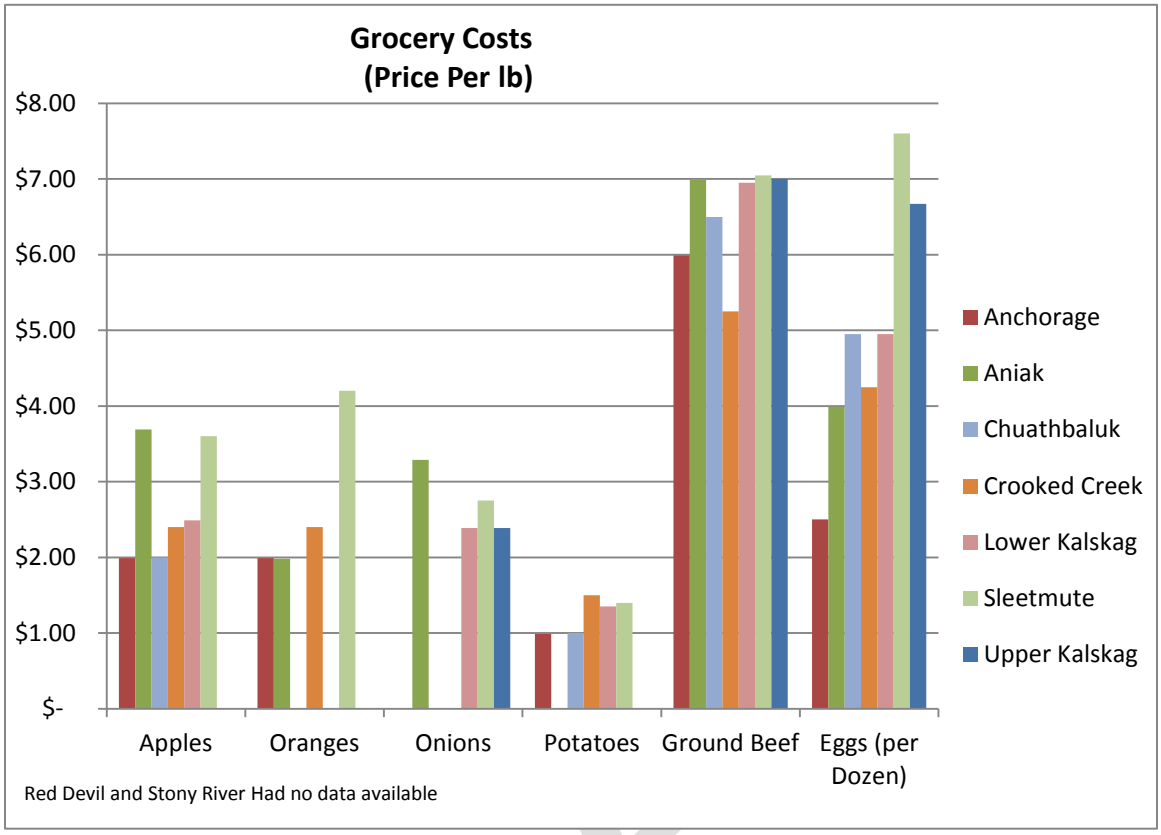
Location	Median Family Income (2009)[a] ($)	Annual Cost of Foodbasket (2010)[b] ($)	Percent of Income on Foodbasket (%)
Anchorage	$81,348	$7,510	9.2
Bethel Census Area	58,543	14,070	24.0
Bethel	95,673	14,070	14.7
Aniak	63,542	14,070	22.1
Chuathbaluk	54,375	14,070	25.9
Crooked Creek	19,688	14,070	71.5
Lower Kalskag	42,857	14,070	32.8
Red Devil	57,813	14,070	24.3
Sleetmute	41,250	14,070	34.1
Stony River	11,250	14,070	125.0
Upper Kalskag	26,250	14,070	53.6

[a] US Census, American Community Survey, 2005-2009
[b] Weekly cost of the foodbasket in Anchorage ($144.42) times 52 weeks = $7,510
Weekly cost of the foodbasket in Bethel ($270.58) times 52 weeks = $14,070

While the percent of median family income spent on food is less than 10% in Anchorage, it rises to almost 15% in the City of Bethel. Within the Zone 1 rural communities, the percent of median family income required to purchase all food supplies varies widely ranging from a low of 22% in Aniak, which is still over twice that spent in Anchorage, to over 125% in Stony River.[88]

Spot checks on food costs during ADHSS community survey sessions in the zone 1 communities indicated over 50% cost differences between Anchorage and some of the zone 1 communities, particularly fruits and eggs (Figure 23).[83]

Figure 23 Community Food Cost Observations



Source: ADHSS, 2012

These data confirm the importance of subsistence as a source of food and also exposes potential communities that are vulnerable to malnutrition and other micronutrient deficiencies in this region.

Up to half of the households in each of the villages participate in the USDA Food Stamp program. The dollar value of the food stamps is included in the median family income amount as is the Permanent Fund Distribution and any Alaska Native Corporation dividends.[88]

5.3.4.6 Consumption of Fruits and Vegetables

A measure that can be used to assess diet is consumption of fruits and vegetables. Between 2007-2011, 9.2% of Alaska Native adults reported consuming at least two servings of fruit and three servings of vegetables per day, a lower prevalence than Alaska White adults (13.6%; Figure 24). Fruit and vegetable consumption varies by tribal health region and estimates ranged from 2.5% to 23% in 2003-2011, with an Alaska Native statewide mean of 10.4%.[10]

Figure 24 Alaska Native Fruit and Vegetable Consumption (2+ Fruits and 3+ Vegetables per Day) by Tribal Health Region, 2003-2011

Source:AN EpiCenter, 2014

5.3.4.7 Summary

- There are no reported deaths by malnutrition or by nutritional disorders in the Bethel Census Area.
- Between 82 and 100% of households surveyed by ADF&G in the Zone 1 communities attempted to harvest wild resources during 2009.
- Between 69 and 89% of households surveyed by ADF&G in the Zone 1 communities reported being food secure during 2009. Many of these are Alaska Native households.
- Market food costs are a larger percent of household income in the Zone 1 communities than in the City of Bethel or Anchorage. Many of these are Alaska Native households.

5.3.5 HEC 5: Infectious Diseases including STIs

5.3.5.1 Infectious Diseases

Reportable communicable diseases include infectious and parasitic diseases, such as tuberculosis, septicemia, viral hepatitis, HIV, and sexually transmitted infectious (STIs) as well as influenza and pneumonia. Communicable diseases disproportionally affect poor populations and Alaska Natives and are exacerbated by unsanitary conditions, unsafe water, and inadequate personal hygiene. Children and adults without proper immunization are at higher risk of contracting infections and left untreated, chronic infections can lead to cancers, such as cervical (caused by HPV) and liver cancer (Hepatitis B and C).[89]

Reportable communicable diseases were the fifth leading cause of death to all races in the Bethel Census Area, with 16 deaths between 2010 and 2012 (Table 51).[14] Pneumonia, septicemia and viral hepatitis / "other infectious diseases" were the top 3 causes of death due to infectious diseases. No influenza deaths were reported during the same time period. Over the previous decade, deaths due to infectious and parasitic diseases have remained relatively stable, while the number of deaths due to pneumonia appears to be decreasing slightly. Age-adjusted rates of death from communicable diseases have been consistently higher than those experienced in the State of Alaska since 2000.[14]

The Bureau of Vital Statistics does not report infectious disease data by race. Therefore, data from AN EpiCenter is used as a representation of infectious disease burden for Alaska Natives. Overall reportable infectious disease cases for all Alaska Natives from 2007 to 2008 are shown in Table 52.[38]

Table 51 Infectious and Parasitic Disease Caused Deaths, Bethel Census Area and State of Alaska, 2010 to 2012

Cause of Death	Bethel Census Area Deaths	Bethel Census Area Age-adjusted Rate[a]	Alaska Deaths	Alaska Age-adjusted Rate[a]
Infectious and Parasitic Disease	**14**	**50.0***	**265**	**15.5**
Tuberculosis	2	**	11	7*
Septicemia	6	23.0*	114	7.6
Viral Hepatitis	3	**	68	2.7
HIV Disease	0	**	18	8*
All Other Infectious Disease	3	**	54	3.6
Influenza and Pneumonia	**6**	**22.7***	**174**	**12.5**
Influenza	0	0.0	7	4*
Pneumonia	6	22.7*	167	12.1

Source: Alaska Bureau of Vital Statistics, 2014
[a] Age-adjusted rates are per 100,000 U.S. year 2000 standard population
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
** Rates based on fewer than 6 occurrences are not reported

Table 52 Reportable Infectious Disease Cases, Alaska Natives, January 1, 2007 to October 3, 2008

Infectious Disease	Cases	Percent of Total
Chlamydia	4103	79.3
Gonorrhea	476	9.2
Hepatitis C	198	3.8
Pneumococcal invasive	135	2.6
Tuberculosis, Pulmonary	52	1.0
Chlamydia, PID	37	0.7
Pertussis	32	0.6
Salmonella	25	0.5
GAS invasive disease	24	0.5
GBS invasive disease	18	0.3
Chicken Pox	15	0.3
Botulism, Foodborne	13	0.3
Campylobacter	12	0.2
Gonorrhea, PID	9	0.2
Invasive H Flu, Not Meningitis	7	0.1
Giardia	5	0.1
Hepatitis B	3	0.1
Meningitis, Haemophilus	3	0.1
Other Infectious Diseases	10	0.2
Total	**5177**	**100.0**

Source: AN EpiCenter, 2009

5.3.5.2 Sexually Transmitted Infections (STIs)

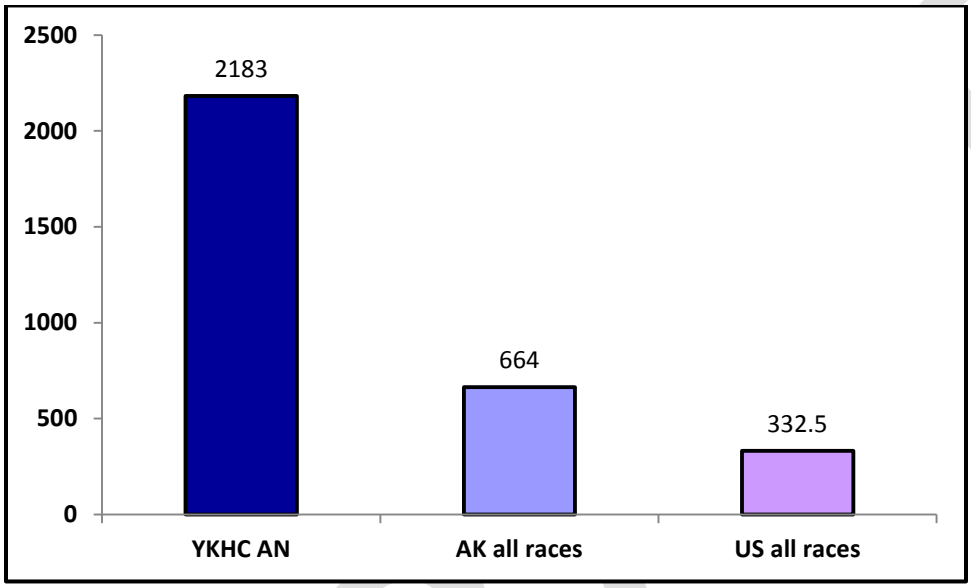
Between 2007 and 2008, STIs comprised 89.4% of all Alaska Native reportable infectious disease cases as shown in Table 52.[38] *Chlamydia trachomatis* was by far the most commonly reported infectious disease, accounting for 80% of all reported infectious diseases, followed by Gonorrhea, with 10-fold fewer cases. Chlamydia is a bacterium that can cause pelvic inflammatory disease (PID), ectopic pregnancy, infertility, and preterm labor. Infants born to infected women are at risk for neonatal conjunctivitis and pneumonia. Untreated Chlamydia infections in men can cause epididymitis, Reiter syndrome, and infertility.[84]

STIs among Alaska residents are distributed by race, gender, and age. Alaskan women (66%), adolescents and young adults (68% were under 25 years of age) are disproportionally impacted by Chlamydia. The Chlamydia rate reported for Alaska Native men is about 4 times greater than is reported

for Alaska white men. The Chlamydia rate reported for Alaska Native women is about 7 times greater than is reported for Alaska white women.[38]

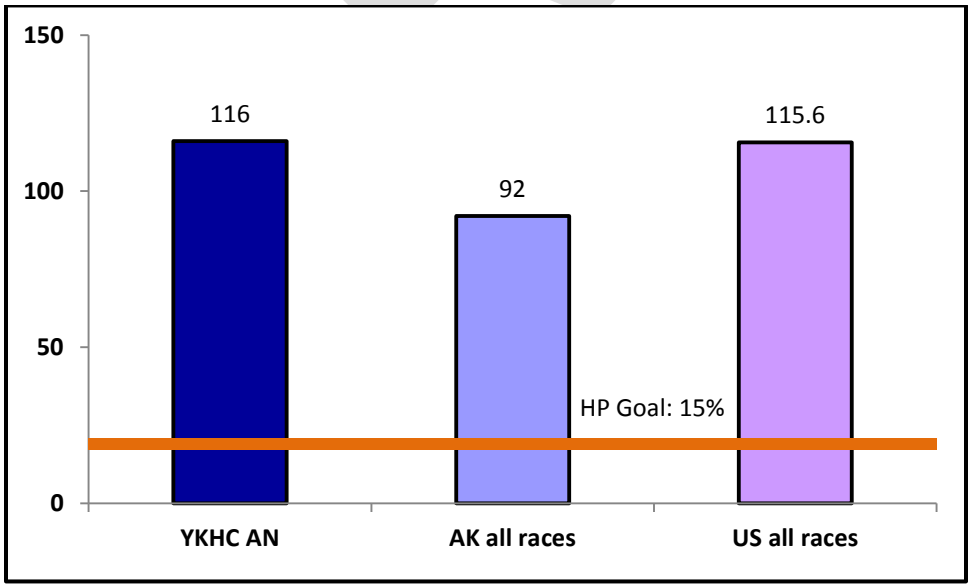
In 2005, the Chlamydia infection rate for Alaska Natives living in the YKHC service area (2,183 cases per 100,000 population) was more than 3 times that for all Alaskans (Figure 25).[16] The YKHC service area has a Gonorrhea rate of 116 cases per 100,000 population, which is also greater than that for all Alaskans (Figure 26).[16]

Figure 25 Chlamydia Rate per 100,000 Population, 2005



Source: AN EpiCenter, 2007

Figure 26 Gonorrhea Rate per 100,000 Population, 2005



Source: AN EpiCenter, 2007

Gonorrhea is an STI caused by the bacterium *Neisseria Gonorrhea*. The 2010 increase in co-infection with Chlamydia is likely associated with the recent statewide increase in gonococcal infection.[90]

In the 2011 County Health Rankings, the Chlamydia rate in the Bethel Census Area had climbed even further from 2005 levels, reaching 2,321 cases per 100,000 population; the state's rate increased as well to 711 cases per 100,000 population.[43]

5.3.5.2.1 STI Education Efforts and Practices

To address the elevated rates of Chlamydia in Alaska, expedited partner therapy as a means to promote safe sexual behavior has been promoted.[91]

5.3.5.3 Immunizations

Immunization is the best defense against pneumonia, and immunization rates (with a critical coverage goal of greater than 80%) for both children and adults serve as critical performance indicators. By 2 years of age, it is recommended that all children have received 4 doses of diphtheria-tetanus-pertussis (DTP), 3 doses of polio, 1 dose of measles-mumps-rubella (MMR), 3 doses of Hepatitis B, and 3 doses of Haemophilis Influenza, type B (Hib) vaccines. This recommendation is referred to in shorthand as "4:3:1:3:3."

In 2011, the State Office of Epidemiology reported a decrease in the number of Alaskan children vaccinated in 2009. According to an Epidemiology Bulletin, "In 2009, completion of the 4:3:1:3:3 ("0" = Hib series, which was excluded from the 2009 analysis due to a national shortage of this vaccine that year) standard series coverage rate in Alaska was 56.6%. With this coverage rate, Alaska ranked 48th in the country for 1+ MMR (85.2%) and 50th for 1+ varicella (76.0%). Alaska also ranked in the bottom 10% of states for completion of 4+ DTaP and 3+ rotavirus vaccines".[92]

According to AN EPiCenter (2007), 90% of people in the YKHC service area had received the 4:3:1:3:3 series. This rate exceeds the nationwide Indian Health Service rate (78.0%).[16] In addition, 46% of people in the YKHC service area 65 years and older had received an influenza shot in the past year, and 91% of people in the YKHC service area 65 years and older had ever received a pneumococcal vaccination.

Pneumonia, a respiratory disease, most often causes illness in children under 5 years and older adults (>65 years). Also at higher risk are those with other medical conditions, such as chronic liver, heart or lung disease.[93] Since 2000, pneumonia has been the most common cause of death from an infectious disease in the Bethel Census Area.[14]

5.3.5.4 Summary

- Reportable communicable diseases were the fifth leading cause of death to all races in the Bethel Census Area, with 16 deaths between 2007 and 2009; pneumonia was the major contributor.
- In 2010, the Chlamydia rate in the Bethel Census Area reached 2,321 cases per 100,000 population; More than 3 times the state's rate of 711 cases per 100,000 population and more than 6 times the rate in the greater United States.

5.3.6 HEC 6: Water and Sanitation

The lack of clean running water and proper sewage disposal is a leading cause of preventable disease in rural Alaska villages and is directly linked to infectious disease mortality and morbidity. Respiratory, gastrointestinal and skin diseases are common in areas without safe water supplies. In rural Alaska, a high proportion of Alaska Natives live without basic sanitation facilities and adequate in-home water sources.

In a study conducted in 6 regions in Alaska[94], researchers found that regions with a lower proportion of in-home water service had a 2.5-fold higher hospitalization rate for pneumonia and influenza, a 1.9-fold increase in rate of skin or soft tissue infection, and over 3 times the rate of respiratory syncytial virus among those younger than 5 years, than did higher-service regions. Rate ratios (RR) are used to compare rates between groups with differing demographics and measure the difference of incidence rates. In one example, infants from villages with less than 10% of homes served had higher hospitalization rates for pneumonia (RR = 1.3) and respiratory syncytial virus (RR = 1.2) than did infants from villages with more than 80% served. Outpatient *Staphylococcus aureus* infections (RR = 5.1, all ages) and skin infection hospitalizations (RR = 2.7, all ages) were higher in low-service than in high-service villages.[94] While there are no community-level data available for the Bethel Census Area or YKHC, the data presented here should provide insight into water source and sanitization facility conditions in the region, which is mostly rural and predominantly Alaska Native villages.

5.3.6.1 Service Rates

A housing unit is considered to have water and sewer service if it has water/sewer pipes or closed haul services.[38] The information presented below is provided by the Alaska Department of Community and Regional Affairs Community Information Services (http://www.commerce.state.ak.us/dca/commdb/CF_CIS.htm). A housing unit is considered to have water and sewer service if it has water/sewer pipes or closed haul services.

Aniak: The majority of homes (155 or 99%) are plumbed and have community water. The water is not fluoridated. A central well was completed in 1988 by the village corporation; there are also wells at Auntie Marie Nicoli School and the Joe Parent Voc Ed Center. Only 21 households haul water. A central piped sewage system serves most residents, with the exception of the school, the clinic, and the Napat subdivision across Aniak Slough. The system has four lift stations, and wastewater is treated in a lagoon. Some homes use individual septic tanks, but permafrost has caused drainfield problems, so most of the unserved homes use pit privies. The city provides septic pumping services. A washateria is operated by the village council. The village also operates a permitted landfill.

Chuathbaluk: According to Census 2010, there were 41 housing units in the community and 36 were occupied. Water is pumped from a 105-foot well into a storage tank, then treated and piped from this point by 100% of the residents. A washateria is available. The school has its own watering point, and some homes have individual wells, but none have complete plumbing. Honeybuckets and privies are used by most residents for waste disposal; a few homes have septic tanks. The school and clinic have a septic tank/leachfield system, as do several homes. The septic systems are failing due to clay and silt. Refuse is collected weekly, and the community has a permitted landfill.

Crooked Creek: According to Census 2010, there were 47 housing units in the community and 38 were occupied. Almost 95% of the homes lack plumbing; residents haul water and use honeybuckets. A well provides treated water, and a washateria is also available. The school, store, and three homes have

individual wells, septic tanks, and plumbing. There is a landfill in Crooked Creek that is currently permitted.

Lower Kalskag: According to Census 2010, there were 82 housing units in the community and 75 were occupied. An 85-foot well provides water, which is treated and piped to 90% of the homes and the school; the water is not fluroidated. The school, clinic, and over 40 percent of homes use individual septic tanks and have complete plumbing. A 10,000-gallon community septic tank allows for piped sewage collection to part of the village. Refuse is burned or buried at a permitted landfill located between Upper Kalskag and Lower Kalskag.

Red Devil: According to Census 2010, there were 23 housing units in the community and 12 were occupied. Water is derived from individual wells or hauled from the school well; the water is not treated. Four of the 12 occupied homes are fully plumbed. Sewage is disposed of on an individual basis. The school and teacher's housing uses individual septic tanks and drain fields; others use pit privies. There is a landfill in Red Devil although it is unclear if it is currently permitted.

Sleetmute: According to Census 2010, there were 49 housing units in the community and 36 were occupied. A central well with treated water serves 90% of the residents and several houses have individual wells. Water is pumped by hand to fill gravity storage tanks at each house. Privies, honeybuckets, and seepage pits are used by 25 homes. Eleven homes and the school use individual systems and are completely plumbed. There is a landfill in Sleetmute although it the permit is currently expired.

Stony River: According to Census 2010, there were 26 housing units in the community and 20 were occupied. Water is derived from individual wells; the school, washateria, and clinic each have a well. Septic tanks and some outhouses are used for sewage disposal and 75% of residents have piped water in their homes. Residents are reliant on the washateria for laundry and bathing, since no homes are plumbed. The school uses a septic tank/drainfield system; there is a landfill a half-mile from the school although it is not permitted.

Upper Kalskag: According to Census 2010, there were 74 housing units in the community and 60 were occupied. The school, the store, and nearly all homes (75%) have individual wells with potable water and indoor plumbing. The water is not fluoridated. A piped gravity sewage system with lift stations, force main, and lagoon serves over 50% of the households and facilities. Refuse is burned or buried at a permitted landfill located between Upper Kalskag and Lower Kalskag.

As of 2008, 58% of the communities in the YKHC service area had water and sewer service, a level lower than the majority of other Native Regional Health Corporations (Table 53).

Table 53 Water and Sanitation Service Rates by Region, 2008

Regional Health Corporation	2008 Housing Units with Pipes or Close Haul	2008 Total Housing Units	Percent Served
Aleutian Pribilofs Islands Association (APIA)	271	324	84
Arctic Slope Native Association (ASNA)	462	491	94
Bristol Bay Area Health Corporation (BBAHC)	1364	1572	87
Chugachmuit	179	189	95
Copper River Native Association	343	397	86
Eastern Aleutian Tribes	507	541	94
Kodiak Area Native Association	349	356	98
Maniilaq Association	865	1140	76
Norton Sound Health Corporation	970	1509	64
Southcentral Foundation	212	238	89
Southeast Alaska Regional Health Consortium	2288	2329	98
Tanana Chiefs Conference	1150	1930	60
Yukon-Kuskokwim Health Corporation	2753	4760	58
Independent	1437	1556	92
Total	**13,150**	**17,332**	**76**

Source: AN EpiCenter, 2009

5.3.6.2 Summary

- In 2008 less than 60% of housing units in the YKHC service area had water and sewer service in 2008. This is the lowest of any other regional service area in Alaska.

5.3.6.3 Data Gaps

- Updated water and sanitation service rates by tribal health region.

5.3.7 HEC 7: Non-communicable Diseases

5.3.7.1 Cancer

Malignant neoplasm (cancer) was the leading cause of death, accounting for 21.6% of all deaths in the Bethel Census Area between 2007 and 2009 and throughout the previous decade. The age-adjusted death rate due to malignant cancer in the Bethel Census Area since 1999 was consistently higher than the rate in the State of Alaska, with the exception of 2002 to 2004 during which rates were equivalent.[14]

Table 54 presents the absolute number and age-adjusted rates of cancer deaths in the Bethel Census Area by cancer type in 2010 to 2012. These data show that cancer death rates are higher than those experienced statewide. Lung cancer is the most common type of cancer at 73.4 deaths per 100,000 persons, followed by colorectal cancers at 44.8 deaths per 100,000 persons. These rates should be interpreted with caution due to the small number of occurrences.[14]

Figure 27 presents the leading causes of cancer death for Alaska Natives between 2001 and 2005.[38] The lung/bronchus cancer rates are strongly related to the extremely high tobacco usage that occurs in Alaska Native populations. Smoking rates in Alaska Natives are elevated versus U.S. white populations. Colon/rectal cancers are also a leading cause of cancer death. There are multiple colon cancer risk factors including age, family history, inflammatory bowel disease, inherited genetic diseases, and numerous lifestyle factors, e.g., lack of exercise, a high-fat low-fiber diet, obesity, smoking and high intake of alcoholic beverages.[95] Access to screening for colorectal cancer (colonoscopy) is an acute problem for rural Alaska native communities.

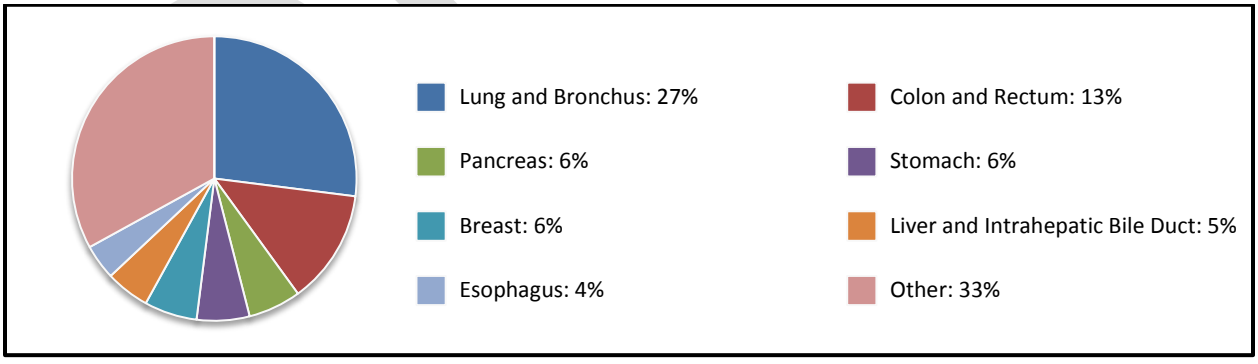
In 2009, 54 cancer cases were diagnosed in the Bethel Census Area including 23 cases of cancer of the digestive system (211.6 cases per 100,000 persons) of which 15 were colorectal cancers (131.6 cases per 100,000 persons), and 10 cases of cancers of the respiratory system all of which were lung and bronchus cancers (98.8 cases per 100,000 persons).[14]

Table 54 Cancer Deaths by Type, Bethel Census Area and the State of Alaska, 2010 to 2012

Cause of Death	Bethel Census Area		State of Alaska	
	Number of Deaths	Age-adjusted Rate[a]	Number of Deaths	Age-adjusted Rate[a]
Malignant Neoplasms	**67**	**235.2**	**2736**	**169.9**
Colon, rectum and anus	16	44.8*	249	15.2
Liver and intrahepatic bile ducts	5	**	104	5.2
Lung	19	73.4*	763	49.0
Breast[b]	2	**	178	19.9
Prostate[b]	0	0	118	20.2
Lymphoid & hematopoietic	1	**	243	16.5
Non-hodgkin's lymphoma	1	**	100	6.7
Leukemia	0	0	88	6.4
All other lymphoid & hematopoietic	0	0	58	4.0
All other malignant neoplasms	24	46	1081	64.5

Source: Alaska Bureau of Vital Statistics, 2014
http://www.hss.state.ak.us/dph/bvs/death_statistics/Detailed_Causes_Census/frame.html
[a] Age-Adjusted rates are per 100,000 U.S. year 2000 standard population
[b] Breast cancer rates are for females only and prostate cancer rates are for males only
* Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
** Rates based on fewer than 6 occurrences are not reported

Figure 27 Leading Causes of Cancer Death in Alaska Natives



Source: AN EpiCenter, 2009

As shown in Table 55, the most common types of cancer in the YKHC service area are lung, breast, kidney, and stomach cancer.[16] It is important to note, however, that these are not deaths but incidence of cancer, which can be equally important as mortality but even more burdensome in terms of affected daily productivity and economic requirements of treatment.

Table 55 Most Common Types of Cancer in the YKHC Service Area, 1989 to 2005

Cancer Type	Alaska Natives YKHC Service Area Percent of All Cancer 1989 – 2003 (%)	All Alaska Natives Percent of All Cancer 1989 – 2003 (%)	Alaska Natives YKHC Service Area Percent of All Cancer 2001 – 2005 (%)
Colon/rectum	23.8	18.4	13
Lung	20.7	17.4	27
Breast	7.7	15.4	6
Kidney	5.9	4.1	-
Stomach	5.2	4.7	6

Source: AN EpiCenter, 2007

5.3.7.2 Cardiovascular Diseases

Cardiovascular disease includes coronary artery disease, other diseases of the heart, arteriosclerosis, hypertension and cerebrovascular disease. Like many diseases, major risk factors for heart disease are age, diet, obesity, diabetes high blood pressure and abnormal cholesterol levels. Cardiovascular disease is one of the leading causes of death in Alaska Natives.

Age-adjusted cardiovascular disease mortality rates in the Bethel Census Area are higher than that of the state as a whole (Table 56) between 2010 and 2012**.** Diseases of the heart were the third most common cause of death in the Bethel Census Area during this time (205.4 deaths per 100,000 people). Since 1992, the number and rate of deaths due to major cardiovascular disease has remained relatively stable, with the mortality rate in the Bethel Census Area from heart disease consistently lower than statewide, and the rate from cerebrovascular disease (stroke) consistently higher than statewide. Over the previous 2 decades, the mortality rate due to cardiovascular heart disease has been decreasing while the mortality rate due to stroke has been increasing.[14]

Heart disease is the second leading cause of death among Alaska Native people, with a mortality rate of 201.5 per 100,000 during 2008-2011 (Table 57). For the same time period, the rate of heart disease mortality in the YKHC service area (133.3 per 100,000) was lower than the rate for Alaska Natives statewide. Between 1980 and 2011, heart disease mortality rates among Alaska Native people decreased (Figure 28). Alaska Native people once had much lower rates of heart disease mortality than both non-Native and U.S. White populations, however in the most recent time period have experienced a higher rate. Men in all population groups have higher heart disease mortality rates than females. In Alaska Native men, the heart disease mortality rate is 1.8 times higher than for Alaska Native females.

Table 56 Major Cardiovascular Disease Deaths, Bethel Census Area and the State of Alaska, 2010 to 2012

Cause of Death	Bethel Census Area		State of Alaska	
	Number of Deaths	Age-adjusted Rate[a]	Number of Deaths	Age-adjusted Rate[a]
Major Cardiovascular Diseases	**64**	**277.2**	**2841**	**196.4**
Heart Disease	48	202.7	2145	143.4
Ischemic heart disease	21	87.2	1225	78.3
Acute myocardial infarction	5	**	248	16.9
Atherosclerotic cardiovascular disease	7	13.4*	461	24.5
All other ischemic heart disease	9	17.2*	516	36.8
All other heart disease	27	51.8	920	63.5
Cerebrovascular disease	13	24.9*	523	43.1
All other cardiovascular diseases	3	**	173	10.7

Source: Alaska Bureau of Vital Statistics, 2014
[a] Age-adjusted rates are per 100,000 U.S. year 2000 standard population.
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
** Rates based on fewer than 6 occurrences are not reported.

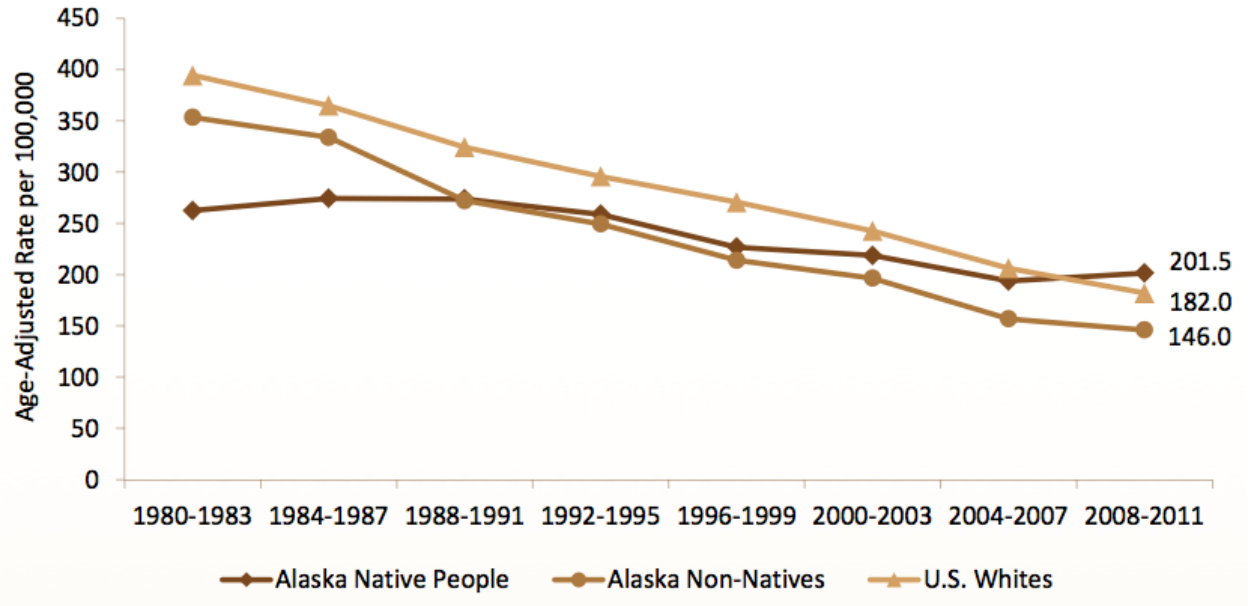
Table 57 Average Annual Age-Adjusted Heart Disease Mortality Rates Per 100,000 Population By Tribal Health Region, Alaska Native People, 2008-2011

Tribal Health Region	Number	Rate	Confidence Interval
Kodiak	22	391.6	48.6 - 323.9
Interior	63	331.2	246.6 - 440.1
Norton Sound	48	287.7	204.6 - 401.4
Arctic Slope	24	254.9	149.2-420.6
Bristol Bay	29	205.1	134.6 - 304.0
Kenai Peninsula	21	189.4	106.5 - 320.9
Southeast	80	188.7	147.8 - 238.9
Anchorage/Mat-Su	142	185.5	151.9 - 226.2
Yukon-Kuskokwim Health Corporation	74	133.3	102.7 - 171.3
Aleutians & Pribilofs	8	131.4 ǂ	48.6 - 323.9
Copper River/Prince William Sound	5	105.4 ǂ	31.7 - 267.6
Statewide	**556**	**201.5**	**183.7 - 220.9**

Table 57 Average Annual Age-Adjusted Heart Disease Mortality Rates Per 100,000 Population By Tribal Health Region, Alaska Native People, 2008-2011

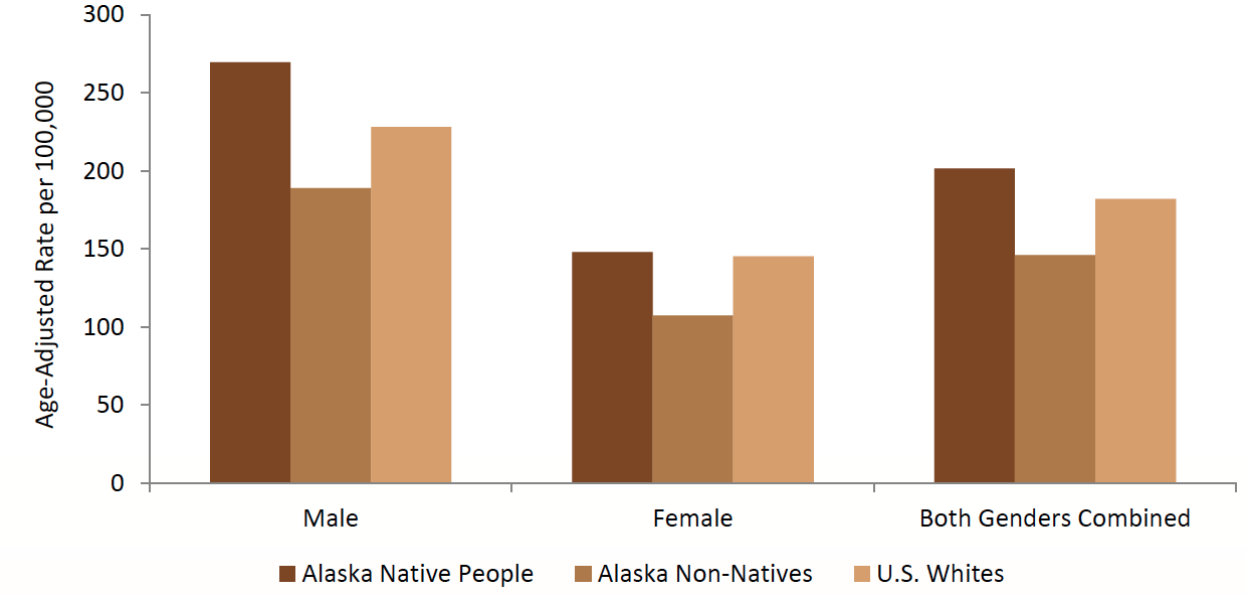
* Rates based on fewer than 20 deaths may be statistically unreliable and should be used with caution. Data are not shown if the number of deaths is <3.
Source: AN EpiCenter, 2014

Figure 28 Average Annual Age-Adjusted Heart Disease Mortality Rates per 100,000 Population, 1980-2011



Source: AN EpiCenter, 2014

Figure 29 Average Annual Age-Adjusted Heart Disease Mortality Rates Per 100,000 Population, By Gender, 2008-2011



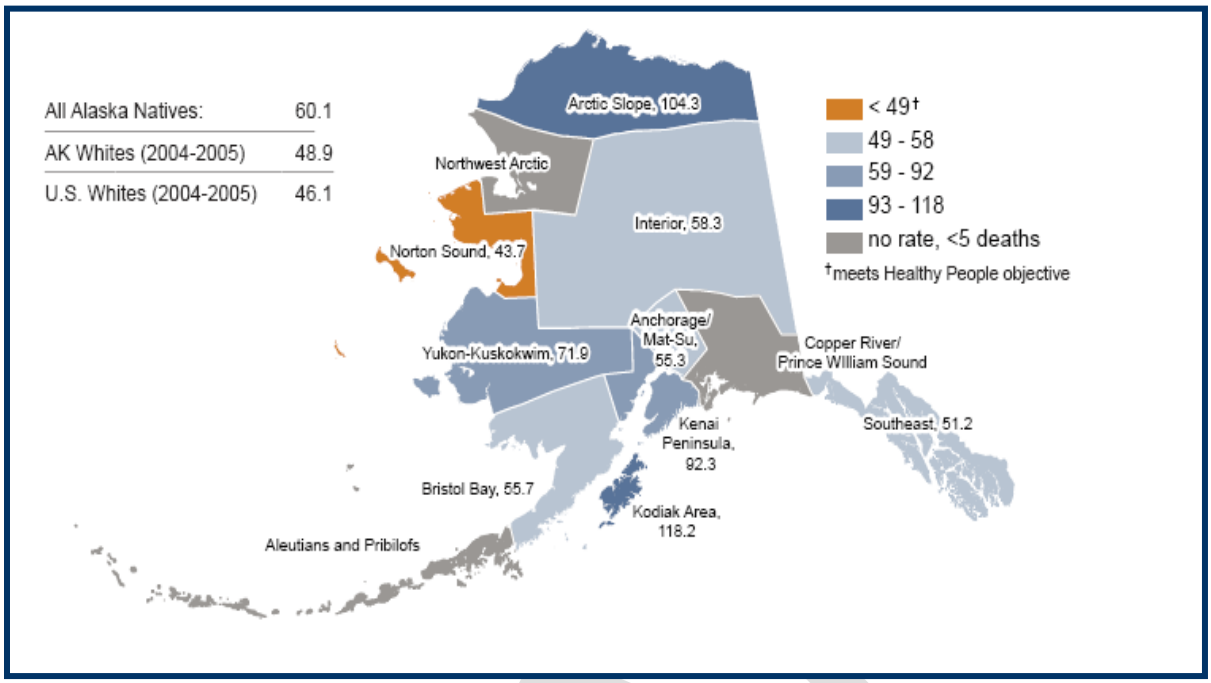
Source: AN EpiCenter, 2014

5.3.7.3 Cerebrovascular Diseases

Cerebrovascular disease, or stroke, is one of the leading causes of death in Alaska Natives. From 2010 to 2012 the age-adjusted cerebrovascular mortality rate in the Bethel Census Area for all races was 59.2 deaths per 100,000 people, higher than the state rate of 40.6 deaths per 100,000 people.[14] Since 1992, the mortality rate due to stroke has slowly increased in the Bethel Census Area despite a steadily decreasing rate statewide.

In general, the prevalence of cerebrovascular diseases has decreased among Alaska Native people; however, the decrease is small. During 2004 to 2007, the Alaska Native cerebrovascular disease rate was 30% higher than for U.S. whites; no data were available for Alaskans statewide. The cerebrovascular disease death rate for Alaska Natives in the YKHC between 2004 and 2007 was 71.9 deaths per 100,000 persons (Figure 30).[38] Although there appear to be variations between regions for cerebrovascular disease rates in Figure 30, none of the regions had statistically significant differences in their rates when compared with all other regions combined.[38]

Figure 30 Average Annual Age-adjusted Cerebrovascular Disease Death Rates per 100,000 by Region Alaska Natives, 2004 to 2007



Source: AN EpiCenter, 2009

5.3.7.4 Chronic Lower Respiratory Diseases

Chronic lower respiratory diseases (e.g., asthma, chronic obstructive pulmonary disease, bronchitis, emphysema) were among the top 5 leading causes of death in the Bethel Census Area from 2007 to 2009, accounting for 12 deaths. The mortality rate due to chronic lower respiratory disease in the Bethel Census Area over the past decade has been similar to that experienced statewide, with an approximate average rate of 45 deaths per 100,000 persons. Neither the rate in the Bethel Census Area nor the death rate for the State of Alaska has changed substantially over the last 10 years.[14]

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) refers to a group of lung diseases that block airflow and make breathing difficult. Risk factors include tobacco smoking, underlying asthma plus smoking, age, genetics and chronic exposure to chemical fumes, vapors and dusts.[96]

From 1999 to 2003, COPD was the fifth leading cause of death in Alaska Natives in the YKHC service area, similar to other regions within the state. Approximately 4% of the deaths in the YKHC service area are attributed to COPD between 1999 and 2003.[16] More recent data show that COPD is the fifth leading cause of death among Alaska Native people, with a mortality rate of 73.5 per 100,000 during 2008-2011 (Table 58).[10] The variation in COPD mortality rates by region ranges from a low of 52.8 to a high of 169.4 per 100,000 population. During this same time period, the rate of COPD seen among Alaska Natives in the Yukon Kuskokwim was slightly lower than the statewide rate at 67.0 cases per 100,000 persons (Table 58). Between 1980 and 2011, COPD mortality rates for the Alaska Native population have increased at an average annual increase of approximately 2% per year. Alaska Native people

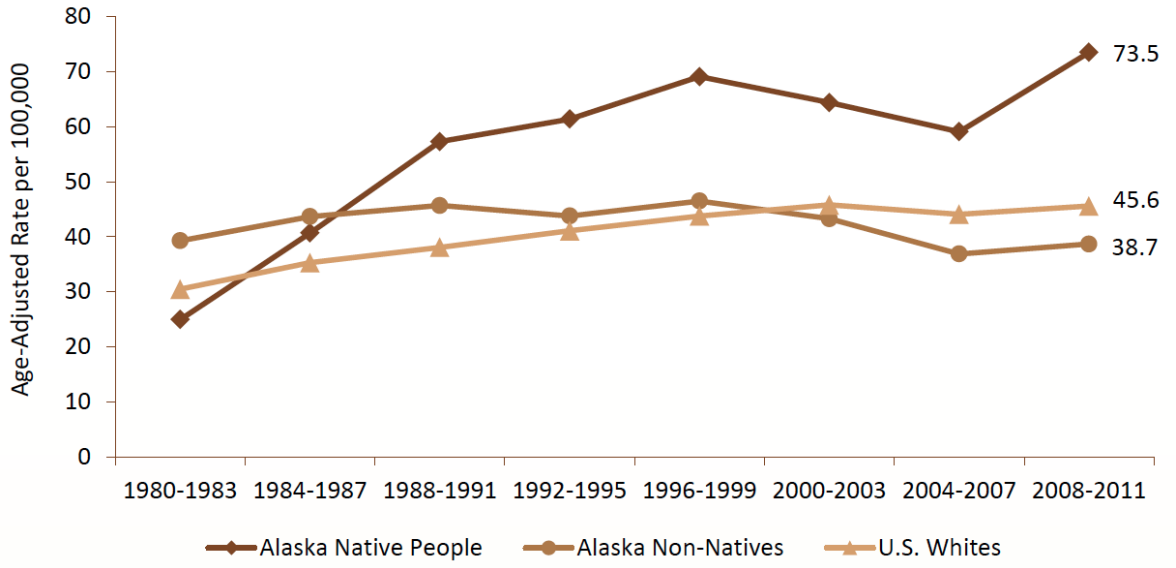
experienced a COPD mortality rate 1.9 times higher than non-Natives and 1.6 times higher than U.S. Whites (p<0.01) in 2008-2011.

Table 58 Average Annual Age-Adjusted COPD Mortality Rates Per 100,000 Population By Tribal Health Region, Alaska Native People, 2008-2011

Tribal Health Region	Number	Rate	Confidence Interval
Arctic Slope	12	169.4 *	81.9 - 321.6
Interior	22	137.9	82.8 - 219.5
Norton Sound	15	114.3 *	60.5 - 203.0
Kenai Peninsula	7	85.7 *	31.4 - 194.6
Bristol Bay	9	71.9 *	31.9 - 143.2
Yukon-Kuskokwim	31	67.0	44.6 - 97.5
Anchorage/Mat-Su	41	62.7	43.5 - 89.5
Southeast	22	53.4	32.8 - 84.0
Northwest Arctic	8	52.8	22.7 - 110.8
Statewide	**174**	**73.5**	**62.4 - 86.2**

* Rates based on fewer than 20 deaths may be statistically unreliable and should be used with caution. Data are not shown if the number of deaths is <3. Note: Totals include 7 Alaska Native persons with unknown tribal health region.
Source: AN EpiCenter, 2014

Figure 31 Average Annual Age-Adjusted COPD Mortality Rates per 100,000 Population, 1980-2011



Note: U.S. White data in the last time period are for 2008-2010. Rates are age-adjusted to the 2000 U.S. Standard Population.
Source: AN EpiCenter, 2014

5.3.7.5 Mental Health Disorders

Mental health, or behavioral health, is a critical component of overall health and is linked to physical health and wellbeing for people at all ages. Mental health includes reactions to stress, depression and difficulty coping with emotion.[97] According to the State's Behavioral Risk Factor Surveillance System (BRFSS) database, between 2008 and 2010, Bethel Census Area residents self-reported having 2.3 days in the past 30 days in which their mental health was not good; 5.9% reported having periods of frequent mental distress (defined by BRFSS as 14 or more days of poor mental health). These numbers were lower than the mean of all Alaska residents who self-reported 2.8 days in which their mental health was not good, and 8.0% who reported having periods of frequent mental distress.[98]

5.3.7.6 Dietary Diseases

Obesity and overweight

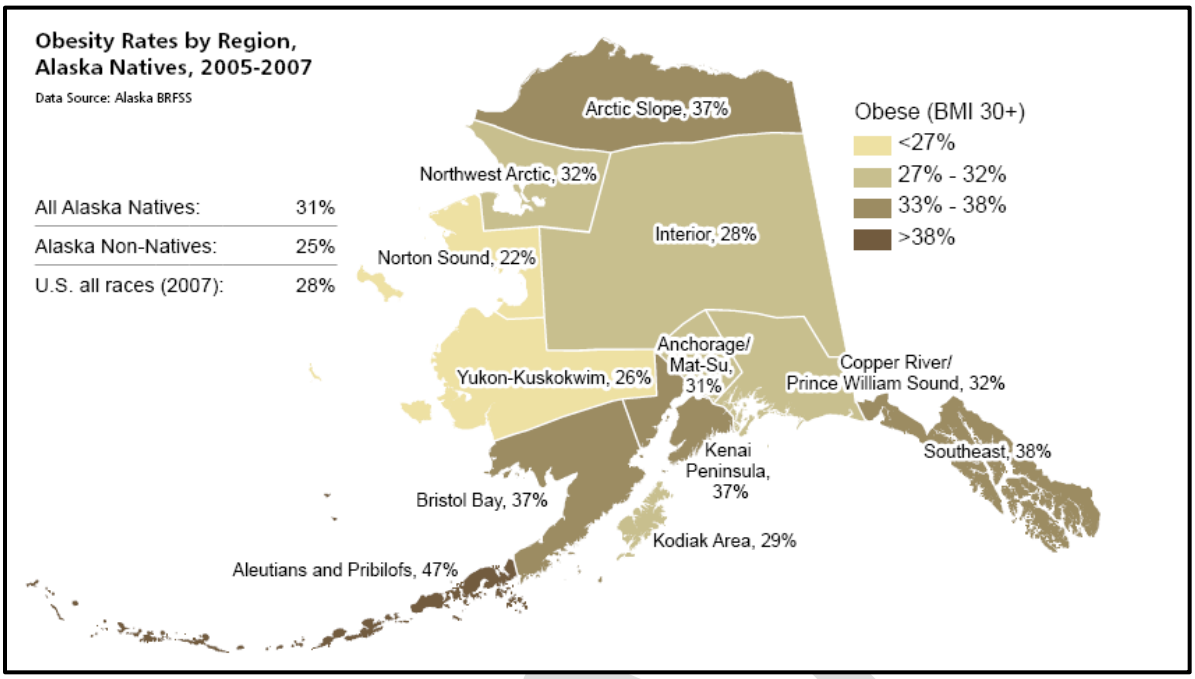
Obesity and overweight are terms that define an accumulation of fat that is greater than what is considered healthy. Being overweight or obese increases the risk of diabetes, diseases of the heart (mainly stroke and heart disease), cancer and even death.[99] Obesity rates in the Bethel Census Area are similar to other parts of Alaska.

According to AN EpiCenter 2009, body mass index (BMI) is a common indicator of obesity and overweight status.[38] Current BMI assessment requires that height and weight be collected within the last 5 years or if over age 50, within the last 2 years. Children must have been assessed within the last year. These terms are defined as:

- Overweight (adults 19 – 74 years): Persons who have a current BMI assessment with a BMI of 25 to 29.9.
- Obese (adults 19 – 74 years): Persons who have a current BMI assessment with a BMI of 30 or greater.
- Overweight (children 18 and younger): Persons who have a current BMI assessment with a BMI greater than or equal to the 85th percentile using age-specific growth charts are considered 'at risk of overweight'.
- Obese (children 18 years and younger): Persons who have a current BMI assessment with a BMI greater than or equal to the 95th percentile using age-specific growth charts are considered obese.

The County Health Rankings, which are derived from BRFSS data, indicated that 32% of the residents of Bethel Census Area were classified as obese in 2011, 4% more than for the state as a whole.[43] In 2008, the CDC reported an age-adjusted percentage of adults that were obese in the Bethel Census Area of 32.1%. The Alaska BRFSS database reveals that between 2008 and 2010, 65.6% of Bethel Census Area adults self-reported as being overweight or obese with 26.5% of those responding as being obese.[98] Both overweight/obese and obese percentages were similar to those reported as the Alaska mean with 65.8% and 27.2%, respectively. Since 2004, the age-adjusted percentage of adults who were obese in the Bethel Census Area increased by 5%, which is consistent with state and U.S. trends. As shown in Figure 32, from 2005 to 2007, 26% of Alaska Natives living in the Yukon-Kuskokwim Region were classified as obese.[38]

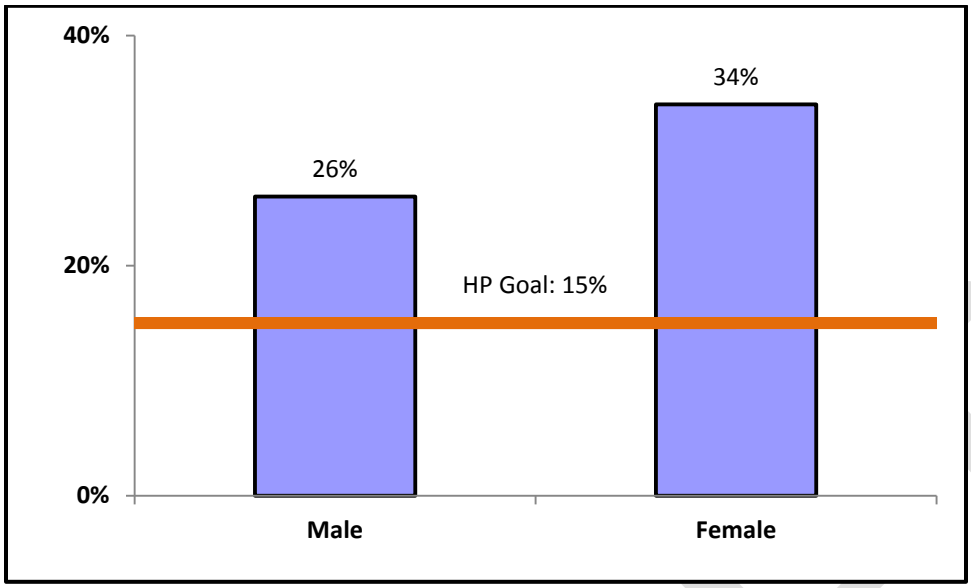
Figure 32 Obesity Rates by Region, 2005 to 2007



Source: AN EpiCenter, 2009

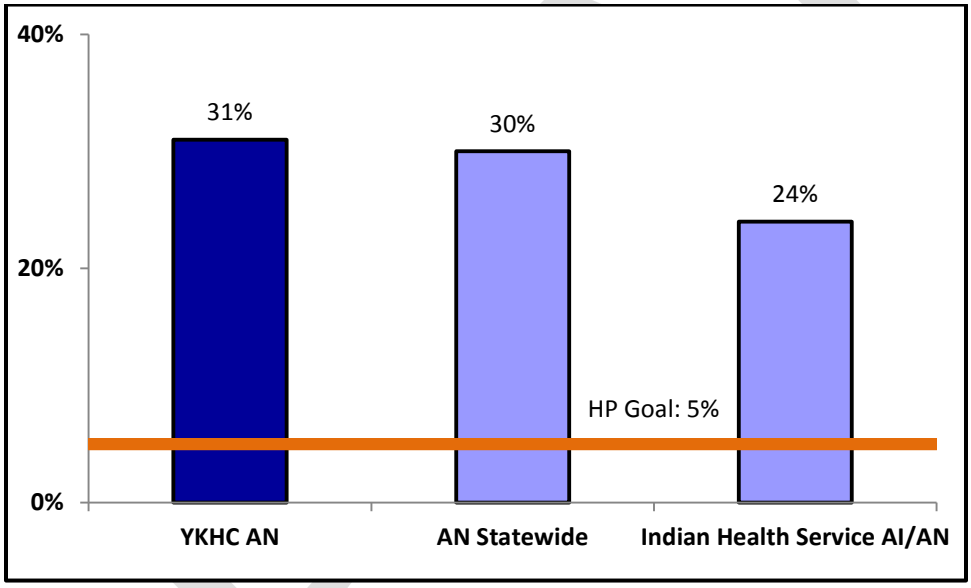
The following information, as reported in AN EpiCenter 2007, is derived from patient visits to a YKHC medical facility in 2006. It is important to note that these data exclude any patients with fewer than 2 visits to a medical clinic within the past 3 years (since 2006), so data should be interpreted with caution as the number of people excluded could influence interpretation of data. According to this study, in 2006, almost one-third of YKHC Alaska Native patients (2 to 74 years) were obese. A greater percentage of females were obese than males, 34% and 26%, respectively (Figure 33).[16] The rate of obesity among YKHC Alaska Native patients (2 to 74 years) only increased by 1% between 2002 and 2006. Almost one-third of YKHC Alaska Native patients aged 2 to 5 years were overweight (Figure 34).[16] According to data from the 2003 Youth Risk Behavior Survey, 14% of Alaska Native high school students were overweight. This is slightly higher than the rate for non-Alaska Natives.[38]

Figure 33 Obesity by Gender YKHC Alaska Natives, 2 to 74 years, 2006



Source: AN EpiCenter, 2007

Figure 34 Percent of Children who are Overweight by Population, 2 to 5 years, 2006



Source: AN EpiCenter, 2007

Diabetes

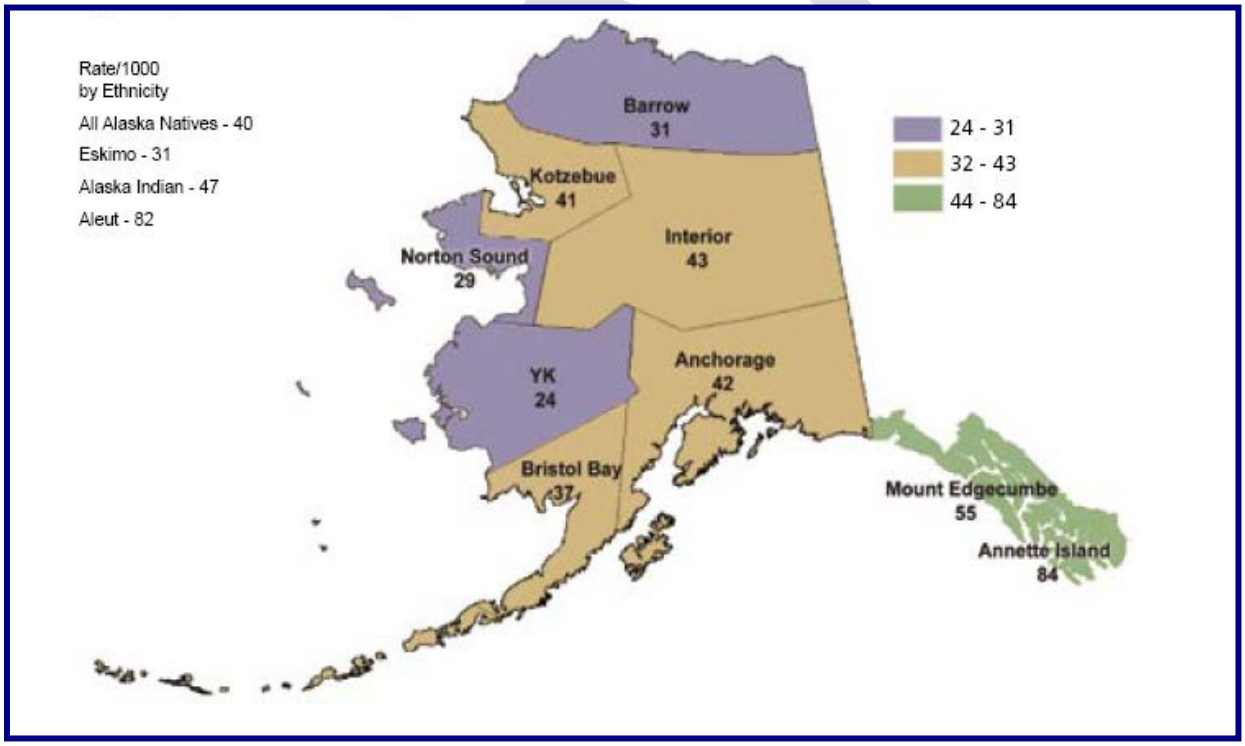
Diabetes mellitus is a metabolic disease characterized by high blood sugar levels, which result from defects in insulin secretion, insulin resistance, or both. As both a risk factor for many diseases and a serious medical condition needing treatment itself, diabetes is an extremely serious public health challenge with tremendous population health impacts.

The Bureau of Vital Statistics (2011) reported that 1 person died in the Bethel Census Area between 2007 and 2009 of causes related to diabetes.[14] The number of deaths was too small to determine an age-adjusted rate; however, during the same time period, the age-adjusted rate of mortality for the State of Alaska was 21.3 deaths per 100,000 population. Since 1992, the number of deaths due to diabetes in the Bethel Census Area as remained below 5 deaths per 100,000 people per year and has remained consistent over that time period. This is well below the statewide rate of 21 deaths per 100,000 people.[14]

The ADHSS Division of Public Health BRFSS database reported that 3.7% of Bethel Census Area adults over the age of 18 years reported having been told by a doctor that they had diabetes (2008 to 2010 data).[98] This is less than half that of the state mean of 6.8%. It is important to note, however, that 8.1% of Bethel Census Area adults reported being told by a doctor or other health professional that they were borderline or pre-diabetic. This is similar to the state average of 8.2%, suggesting that a higher number of Bethel Census Area adults will be diagnosed with diabetes in the future.[98]

Among all Alaska Native people, the prevalence of diagnosed diabetes in 2007 was 40 per 1000 people. The prevalence was 24 per 1000 people in the Yukon Kuskokwim Region and 37 per 1000 people in the Bristol Bay region during this time period (Figure 35).[38]

Figure 35 Diabetes Prevalence by Region, 2007



Source: AN EpiCenter, 2009

5.3.7.7 Physical Activity

Physical activity, which is defined as any bodily movement that requires energy expenditure[99], can help reduce the risk of heart disease and some cancer, improve mental health, control weight, and is

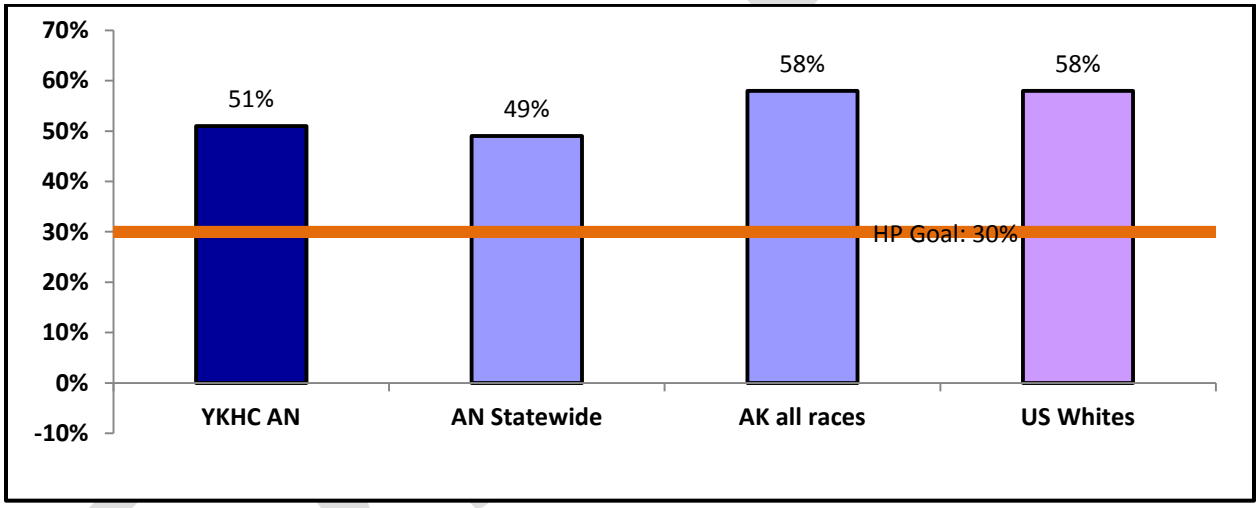
essential for overall health.[100] For substantial health benefits, the U.S. Department of Health and Human Services recommends that "adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous intensity aerobic activity".[100]

The CDC collects information on trends in physical inactivity for all states by census tract. The age-adjusted estimate of percentage of adults (>20 years) who are physically inactive in the Bethel Census Area in 2008 (most recent) was 28.2%. In 2004, the age-adjusted percentage was the same at 28.2%, indicating that trends in physical activity are not changing in this region.[98]

In the BRFSS 2008 to 2010 report, 72.7% of residents of the Bethel Census Area self-reported that they participated in leisure time physical activities, which is similar to the 79% of Alaskans statewide. BRFSS does not define the amount of time spent in physical activities.[98]

The percent of Alaska Natives in the YKHC service area who met physical activity recommendations in 2003 was approximately 2% higher (51% versus 49%) than for all Alaska Natives, but 7% less than that for all Alaskans (Figure 36).[16]

Figure 36 Meets Moderate or Vigorous Physical Activity Recommendations, 2003



Source: AN EpiCenter, 2007

5.3.7.8 Tobacco Use

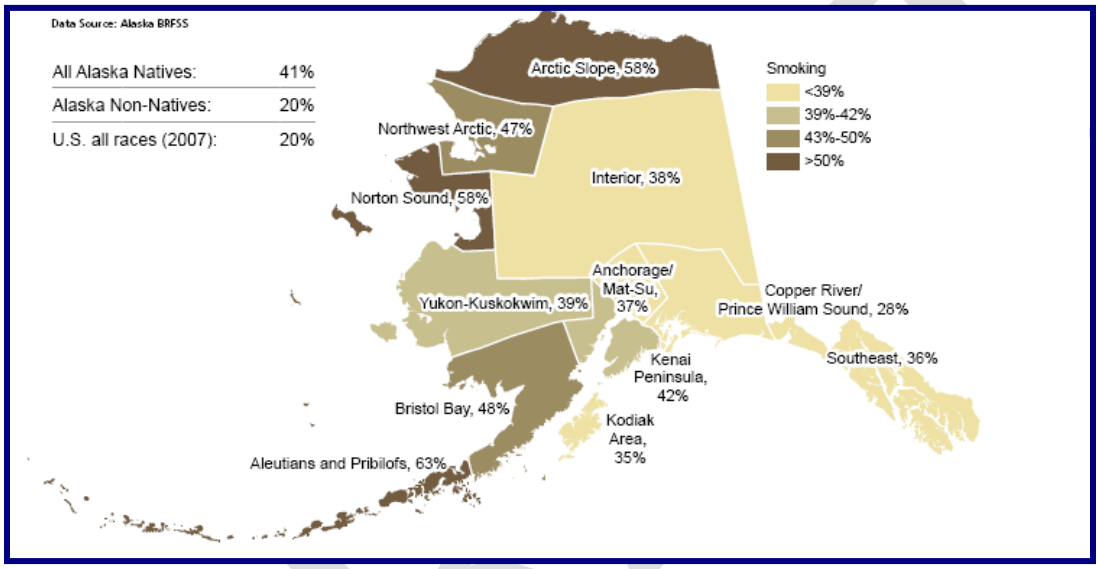
According to the Office of the Surgeon General, there is no safe level of exposure to tobacco smoke. Smoking has been directly linked to one-third of all cancer deaths each year and is the cause of 85% of all lung cancers in the U.S. In addition, smoking increases the risk of adverse pregnancy outcomes, such as miscarriage and low birth weight, and can lead to DNA damage in sperm that might reduce fertility.[101]

The County Health Rankings report (2011) defines smokers as adults who currently smoke every day or most days and have smoked at least 100 cigarettes in their lifetime.[43] As reported in 2011, 34% of all adults in the Bethel Census Area were smokers. This was higher than the 23% of all Alaskans who were reported as current smokers.[43]

BRFSS included questions regarding people's smoking habits. During the 2008 to 2010 time period, over 6% of Bethel Census Area adults self-reported that they or someone else had smoked cigarettes, cigars, or pipes within their homes in the past year, which is similar to the 8% of all Alaska adults who self-reported smoking within their homes.[98]

Overall regional smoking rate data for Alaska Natives is shown in Figure 37.[16] The percentage of adults smoking from 2005 to 2007 for Alaska Natives in the Yukon-Kuskokwim Region (39%) is less than the rate for all Alaska Natives (41%) but almost twice the rate of Alaska non-Natives. Smoking prevalence among all Alaska Natives has not changed since 1990s, and typically young adults and males are more likely to smoke than women and older adults.[16]

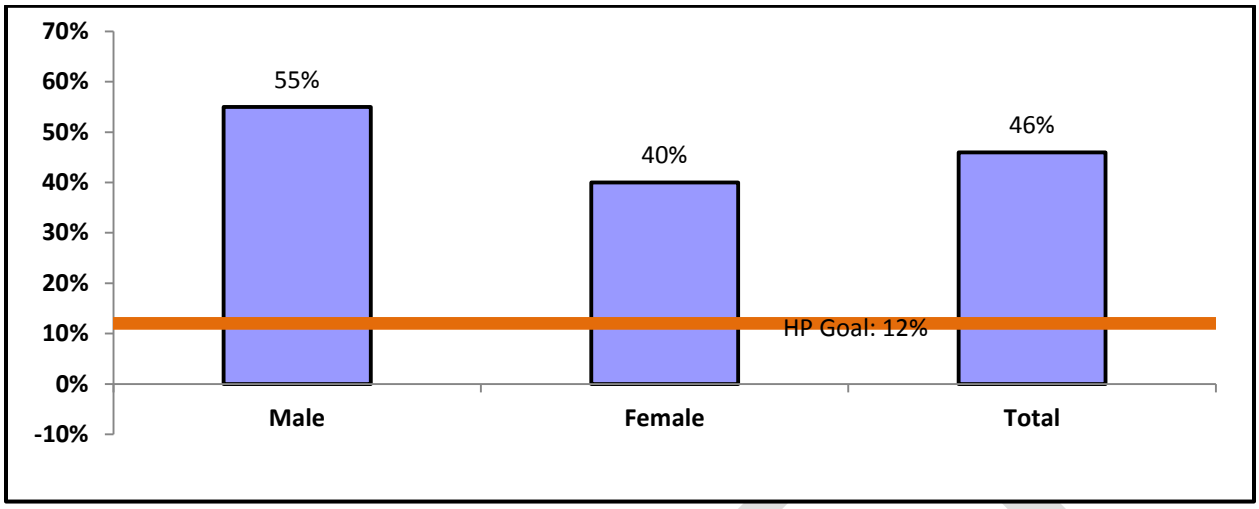
Figure 37 Smoking Rates by Region, Alaska Natives, 2005 to 2007



Source: AN EpiCenter, 2009

More Alaska Native males (5 years and older) in the YKHC service area smoked in 2006 (55%) than females (40%; Figure 38).[16]

Figure 38 Current Smokers by Gender, YKHC Alaska Natives, 5 Years and Older, 2006



Source: AN EpiCenter, 2007

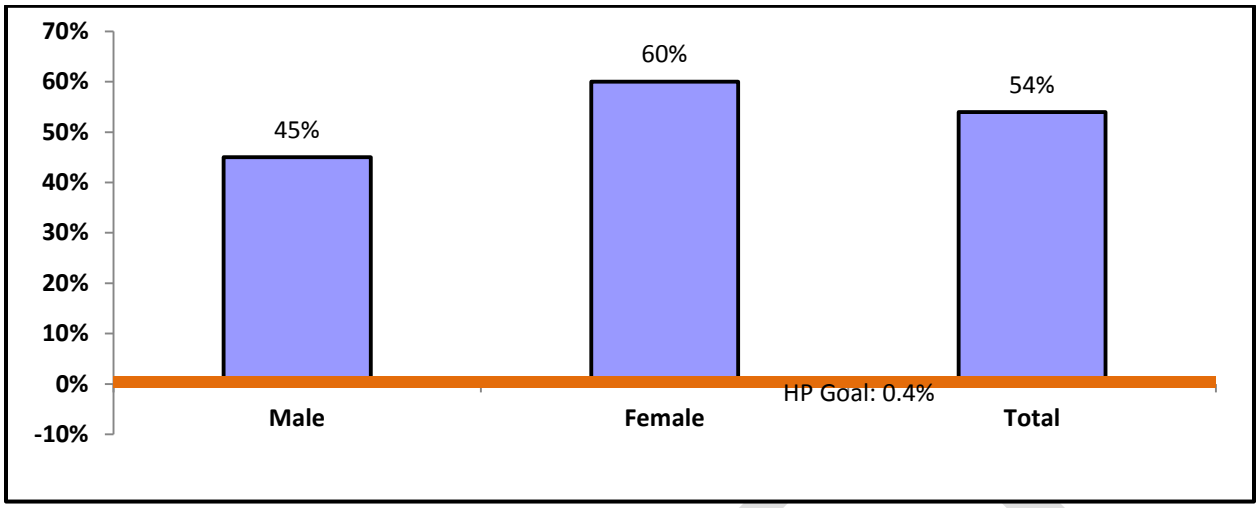
According to the BRFSS self-reported telephone survey, 18 to 24 year olds had the highest smoking rates among Alaska Natives in the YKHC service area. From 2000 to 2004, more than half (54%) in this age group were current smokers.[98] BRFSS defines current smokers as adults who have smoked at least 100 cigarettes in their lifetime and currently smoke every day or some days. During this same time period, 34% of all YKHC Alaska Natives were current smokers.[98]

Adolescent cigarette use is defined as having smoked one or more cigarettes on one or more of the past 30 days.[98] In 2007, 31.7% of Alaska Native high school students smoked cigarettes on one or more of the past 30 days. In 2007, 16.6% of Alaska Native high school students who had used chewing tobacco or snuff during the past 30 days. This was 50% higher than the percentage of Alaska Non-natives. In 2003, 44% of Alaska Natives high school students smoked cigarettes on one or more of the past 30 days, an 18% decrease from 1995.[38]

Smokeless tobacco, defined as chewing tobacco, snuff or both[98] usage in the YKHC service area was approximately 3 times higher than that of Alaska Natives statewide (34% versus 11%) from 2005 to 2007. Six out of every 10 females were current smokeless tobacco users, and more females than males used smokeless tobacco (Figure 39).[16] The percent of Alaska Native high school students who used chewing tobacco or snuff during the past 30 days did not decrease between 1995 and 2003, unlike the percent of non-Native high school students, which decreased by half over the 8-year period (15% to 7%).[16]

The BRFSS report asks questions on the use of smokeless tobacco products such as chewing tobacco, snuff, or Iq-mik or Blackbull (brand names for smokeless tobacco products). From 2008 to 2010 almost 25% of Bethel Census Area adults self-reported that they had used such products, which was more than 5 times greater than the use of smokeless tobacco products by all Alaska adults (4.8%).[98] No BRFSS information is available for individual villages.

Figure 39 Current Smokeless Tobacco Users by Gender, YKHC Alaska Natives, 2006



Source: AN EpiCenter, 2007

5.3.7.9 Cancer Screening

"Early detection of cancer greatly increases the chances for successful treatment. The success of screening depends on having sufficient numbers of personnel to perform the screening tests and on the availability of facilities that can undertake subsequent diagnosis, treatment, and follow-up".[102] Screening can help prevent mortality and reduce cost of treatment for advanced cancer and is a crucial aspect of population health in this region given that cancer was one of the leading causes of death over the previous decade.

As previously discussed, the most frequently diagnosed invasive cancers for Yukon Kuskokwim Alaska Native people from 1989 to 2003 were colon/rectum (132 cases), lung (115 cases), and breast (43 cases). These 3 cancers accounted for over half (52.2%) of all cancers diagnosed.[16]

Sixty-five percent (65%) of Alaska Native women in the YKHC service area aged 52 to 64 years received a mammogram within 2 years of the end of 2006. This is 24% higher than for IHS American Indian/Alaska Native women nationwide.[16] In 2008, 74% of Alaska Native women aged 21 to 64 years had a documented Pap test within the preceding 3-year period. The range for the facilities reporting was from 33.3% to 84.9%. Eight out of 10 YKHC Alaska Native women had received a cervical cancer screening within 3 years of the end of 2006. This is 22% higher than that for Indian Health Service (IHS) American Indian/Alaska Native nationwide.[38]

In 2008, approximately 1 out of every 4 (27%) YKHC Alaska Natives age 50 years and older reported ever having a sigmoidoscopy or colonoscopy.[38] In contrast, 50.1% of all Alaska Native patients, age 51 to 80 years, had received colorectal cancer screening. The range for the facilities reporting was from 7.2% to 64%.

5.3.7.10 Summary

- Heart disease was the third most common cause of death in the Bethel Census Area between 2007 and 2009 for all residents and for Alaska Natives.
- The prevalence of diagnosed diabetes in 2007 was 24 per 1000 Alaska Native people in the Yukon Kuskokwim Region; less that the rate of 40 per 1000 people for all Alaska Natives.

- 34% of all adults in the Bethel Census Area were smokers in 2010; 11% higher than the 23% of all Alaskans who were reported as smokers. 39% of Alaska Natives in the Yukon Kuskokwim Region reported being smokers between 2005 and 2007.
- Cancer was the leading cause of death in the Bethel Census Area between 1999 and 2009. The most common forms of cancer are lung and colorectal for all residents and for Alaska Natives.
- Screening rates for colon cancer are lower among Alaska Natives age 50 years and older in the YKHC (27%) than among all Alaska Natives age 50 years or older (50%).

5.3.8 HEC 8: Health Services Infrastructure and Capacity

5.3.8.1 Hospitalizations

Morbidity (illness) is tracked by following hospitalization and outpatient department data. In the YKHC service area, the four leading causes of hospitalizations were childbirth, pneumonia, psychoses, and alcohol abuse, accounting for over 50% of all hospitalizations in 2005 (Table 59).[16] The leading causes of inpatient days at the Yukon Kuskokwim Delta Regional Hospital were alcohol abuse, psychoses, pneumonia, and childbirth (Table 60).[16] In the YKHC service area, the primary reasons for outpatient visits included upper respiratory problems, hospital medical/surgical follow-up visits and pregnancy, childbirth, and puerperium, as shown on Table 61.[16]

Table 59 Top 15 Hospital Discharges by ICD Recode[a] All Ages, Fiscal Year 2005 Yukon-Kuskokwim Delta Regional Hospital

ICD Recode	Rank	Number of Discharges	Percent of YKHC Totals	Alaska Totals Rank
Deliveries (Childbirth)	1	383	21.7	1
Pneumonia	2	254	14.4	3
Psychoses	3	136	7.7	10
Alcohol Abuse	4	134	7.6	7
Bronchitis, Emphysema	5	123	7.0	8
Infected Skin	6	121	6.9	5
Accidents and Injuries	7	106	6.0	2
Neuroses and Personality Disorders	8	86	4.9	Not in top 15
Complications of Pregnancy	9	76	4.3	4
Heart Disease	10	46	2.6	6
Urinary Tract Diseases	11	44	2.5	11
Nutritional and Metabolic Disorders	12	27	1.5	Not in top 15
Perinatal Conditions	13	26	1.5	Not in top 15
Abdominal Pain	14	23	1.3	Not in top 15

Table 59 Top 15 Hospital Discharges by ICD Recode[a] All Ages, Fiscal Year 2005 Yukon-Kuskokwim Delta Regional Hospital

Asthma	15	23	1.3	Not in top 15
Other Discharges		158	9.0	
Total Number of Discharges		**1,766**		

Source: AN EpiCenter, 2007
[a] ICD Recode combines similar primary diagnoses into categories

Table 60 Top 15 Inpatient Days by ICD Recode[a] All Ages, Fiscal Year 2005 Yukon-Kuskokwim Delta Regional Hospital

ICD Recode	Rank	Number of Inpatient Days	Percent of YKHC Totals	Alaska Totals Rank
Alcohol Abuse	1	2,738	33.6	4
Psychoses	2	979	12.0	7
Pneumonia	3	975	12.0	3
Deliveries (Childbirth)	4	835	10.2	2
Infected Skin	5	453	5.6	6
Bronchitis, Emphysema	6	446	5.5	10
Accidents and Injuries	7	341	4.2	1
Neuroses and Personality Disorders	8	181	2.2	Not in top 15
Urinary Tract Diseases	9	159	1.9	11
Heart Disease	10	123	1.5	8
Complications of Pregnancy	11	115	1.4	13
Nutritional and Metabolic Disorders	12	104	1.3	Not in top 15
Perinatal Conditions	13	94	1.2	Not in top 15
Asthma	14	91	1.1	Not in top 15
Viral Diseases	15	76	0.9	Not in top15
Other Conditions		444	5.4	
Total Number of Inpatient Days		**8,154**		

Source: AN EpiCenter, 2007
[a] ICD Recode combines similar primary diagnoses into categories

Table 61 Top 15 Outpatient Visits by ICD Recode[a] All ages, Fiscal Year 2005, Yukon-Kuskokwim Delta Regional Hospital

ICD Recode	Rank	Number of Outpatient Visits	Percent of YKHC Totals	Alaska Totals Rank
Upper Respiratory Problems	1	4,742	10.0	1
Hospital Med/Surgical Follow-up	2	4,552	9.6	4
Pregnancy, Childbirth and Puerperium	3	4,331	9.1	3
Refractive Error (eye disorders, poor vision)	4	2,907	6.1	12
Accidents and Injuries	5	2,444	5.1	2
Infected Skin and Abrasions	6	2,094	4.4	Not in top 15
Neuroses and Non-psychotic Disorders	7	2,065	4.3	7
Assessment of Symptoms	8	2,041	4.3	6
Bone and Joint Disorders	9	1,614	3.4	5
Tests only (Lab, X-ray, Screening)	10	1,405	3.0	8
Otitis Media (middle ear infection)	11	1,369	2.9	11
Hypertension	12	1,294	2.7	10
Well Child Care	13	1,110	2.3	Not in top 15
Alcohol Abuse	14	1,092	2.3	Not in top 15
Pneumonia	15	1,067	2.2	Not in top 15
Other Outpatient Visits		13,390	28.2	
Total Number of Outpatient Visits		**47,517**		

Source: AN EpiCenter, 2007
[a] ICD Recode combines similar primary diagnoses into categories

5.3.8.2 Health Services

Health services are provided by a variety of organizations in Alaska, some designed for all people and others that focus on the health needs of Alaska Natives.

The Alaska Native Medical Center (ANMC), in Anchorage, is owned and managed by the Cook Inlet Region, Inc. (CIRI), an Alaska Native Corporation that organizes and manages services to Alaska Natives and the Alaska Native Tribal Health Consortium (ANTHC). The medical center is the state-wide referral center and gatekeeper for specialty care for Alaska Natives. The Alaska Native Epidemiology Center (AN EpiCenter) maintains health statistics on the YKHC service area, which are dominated by the City of Bethel population.

Residents of the Donlin Gold Mine Project area are part of the Yukon-Kuskokwim Health Corporation (YKHC), which manages a comprehensive healthcare system on behalf of 58 federally recognized Tribes for 50 rural communities in southwest Alaska (Figure 40). The system includes community clinics, sub-regional clinics, a regional hospital, dental and optical services, mental health services, substance abuse counseling and treatment, health promotion and disease prevention programs, and environmental health service. The primary hospital providing acute care in the area is the Yukon-Kuskokwim Delta Regional hospital (YKDRH).

The YKDRH is a 50-bed general acute care medical facility located in Bethel. The single-story 100,000 square foot steel frame structure is fully accredited by the Joint Commission on Accreditation of Healthcare Organizations. YKDRH provides the following care:

- Emergency medicine
- Routine physical exams
- Women's health
- Prenatal
- Well baby and immunization
- Family planning
- Behavioral health services
- Preventative medicine
- Chronic illness
- Optical
- Dental
- Pharmacy
- Laboratory

In addition, the YKHC provides sub-regional clinics that provide health care close to villages while maintaining a strong central system with YKDRH. Sub-regional clinics, like the Clara Morgan Sub-Regional Clinic in Aniak, offer qualified medical staff; urgent care with a cardiac monitor, defibrillator IV equipment oxygen, casting equipment and other advanced life support equipment; a laboratory capable of doing routine diagnostic tests and taking X-rays; specialty clinics in dental care, optometry physical therapy, orthopedics, ear-nose-throat, pediatrics, and mammograms; and outpatient mental health and substance abuse screening, assessments, interventions, and treatments.[103] YKHC sub-regional clinics are shown with larger colored dots in the map below, while community health aide services are indicated by smaller colored dots.

Figure 40 YKHC Sub Regional and Community Aide Services

Source: Yukon Kuskokwim Health Corporation, 2014

YKHC operates the Community Health Aide Program (CHAP) in six villages within the Donlin Gold Mine Project area, including Chuathbaluk, Crooked Creek, Lower Kalskag, Sleetmute, Stony River, and Upper Kalskag. CHAP provides village-based health promotion prevention activities and primary health care, including acute, chronic, and emergency care. There are no services available to residents of Red Devil who must travel to Bethel or Anchorage to receive health care. The HIA team visited these six clinics during the community observations. The following is an overview of the services provided at each at the time they were observed by the HIA team in 2012.

Chuathbaluk

- No resident Community Health Aide (CHA).
- Telemedicine unit for dermatology, orthopedics, and ENT consults.
- Referrals to Clara Morgan Sub-Regional Clinic in Aniak then to Bethel.

Crooked Creek

- In 2012, there was no resident CHA present for over one year; CHAs from the YKHC pool are scheduled to be in Crooked Creek approximately one week per month, as available
- Primary health care
- Blood/urine collection

- Basic pharmacy
- Minor surgery
- Immunizations
- EKG, oxygen, defibrillator, life support

Lower Kalskag

- Residents from Lower Kalskag are cared for in the clinic in Upper Kalskag, approximately 1 mile away

Sleetmute

- Two resident CHAs and one receptionist
- Primary health care
- Room for dental exams (but no dental chair)
- Room for a behavioral health technician
- Patients may be referred to Aniak, Bethel, or Anchorage

Stony River

- CHAs use the telemedicine system for consultations when the internet is functional
- Patients without Medicaid are sent to Anchorage

Upper Kalskag

- Two resident CHAs (rotating shifts) with one always on-call, and one receptionist
- One part-time behavioral health technician
- One part-time dentist

Behavioral Health Services

The Phillips Ayagnirvik Treatment Center (PATC) is a long standing in Bethel provides outpatient, partial hospitalization, residential short-term treatment, and residential long-term treatment care. The primary focus is substance abuse treatment care. The current treatment center, PATC, is in a building well past its expected lifespan. The program was founded in the early 70s by Francis J. Phillips, MD, who was instrumental in opening the first alcohol treatment facility in Bethel. A new $12.6 million facility was being built to replace the aging Phillips Ayagnirvik Treatment Center (PATC) building, which has served the region's need for alcohol and substance abuse treatment since the 1970s, however the newly constructed building was leveled by a fire on October 27th, 2014.

Ten years ago, the Yukon-Kuskokwim Health Corporation began operating the Bethel Prematernal Home, previously a stand-alone agency with a 40-year-old dilapidated building where expectant mothers around the Delta came for their last month of pregnancy. A recently constructed new facility is a certified and licensed facility established to provide residence for expectant mothers, or moms with sick infant children (under the age of one) who must seek care at Bethel's Yukon-Kuskokwim Delta Regional Hospital. All healthy expectant mothers, in their last month of pregnancy, must travel to Bethel, often leaving other family members and children behind in the village, one month prior to their delivery due date to minimize any health risk to them or their newborn.

The McCann Treatment Center (MTC) is a Residential Psychiatric Treatment Center (RPTC) located in Bethel, Alaska, which provides clinical psychiatric and substance abuse services for Alaskan youth between the ages of 10 and 18. The Center specializes in serving youth with serious emotional and behavioral problems and also in providing care for youth who have developed problems with inhalants and other substances.

5.3.8.3 Summary

- In 2005, the four leading causes of hospitalizations were childbirth, pneumonia, psychoses, and alcohol abuse, accounting for over 50% of all hospitalizations in the YKHC service area.
- Comprehensive health services are available throughout the YKHC service area.

5.3.8.4 Data Gaps

- Hospital records from the YKHC are not available from 2007 to 2011, which would provide more comprehensive data.

5.4 Donlin Gold Project: The Pipeline

The Project is proposing to develop a 313-mile natural gas pipeline from Enstar's gas pipeline at Beluga to the proposed Donlin Gold Mine Project on the west side of the Alaska Range, north of Crooked Creek. The pipeline would be built in rugged unpopulated areas; the nearest community to the pipeline is Beluga (10 miles to the southwest); the most distant town is McGrath, which is 160 river miles north of the pipeline. There is no existing road access from any pipeline section to any community. The proposed right-of-way is often in proximity to the Iditarod Trail, and several of the communities are check points on the run.

The baseline community health data for the proposed Donlin Gold Pipeline focuses on the Kenai Peninsula Borough (KPB) communities of Beluga and Tyonek; the Matanusk-Susitna (Mat-Su) Borough communities of Susitna and Skwetna; the Yukon-Koyukuk Census Area communities of McGrath, Nikolai, and Takotna; and the Bethel Census Area communities of Crooked Creek, Red Devil, Sleetmute, and Stony River.

5.4.1 HEC 1: Social Determinants of Health

A background description of social determinants of health (SDH) as well as data on the national and state level can be found in Section 5.3.1; only data specific to the Donlin Gold Pipeline project area, if available, is presented in the following section.

5.4.1.1 Life expectancy

No borough or census area data are available.

5.4.1.2 Maternal and Child Health

Initiation of prenatal care

About 27% fewer Alaska Native mothers appear to have received adequate prenatal care as compared to Alaska white mothers statewide.[14] The Interior and Yukon-Kuskokwim regions had lower rates of documented adequate prenatal care than Alaska Natives statewide.

Infant mortality

Rates of infant mortality differ across the recording jurisdictions (Table 62).

Table 62 Infant Mortality Rates for Donlin Gold Pipeline Project Area

Recording Jurisdiction	Rates per 1000 Live Births		
	Neonatal (infants less than 28 days of age)	Post-neonatal (infants 28 days to 1 year of age)	Total Infant Deaths
Kenai Peninsula Borough (2010-2012)	**	**	3.2*
Matanuska-Susitna Borough (2010-2012)	2.2*	1.7*	1.9
Yukon Koyukuk Census Area (2008-2012)	0	**	**
Bethel Census Area (2010-2012)	4.5*	**	7.5*

Source: State of Alaska: Alaska Bureau of Vital Statistics, 2014
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution.
**Rates based on fewer than 6 occurrences are not reported.

Low birth weight (LBW)

Data are shown in the tables below in Table 63.[14]

Table 63 Maternal and Child Health Outcomes, Donlin Gold Pipeline Project Area, 2010 to 2012

	Health Outcomes			
	Low Birth Weight (% of all Births)	Teen Birth Rates (% of all Births)	% of Mothers who Reported Drinking during Pregnancy	% of Mothers who Reported Smoking during Pregnancy
Kenai Peninsula Borough				
All races	4.7	6.3	2.0	13.7
White	4.1	5.4	2.0	11.9
Alaska Native	7.8	12.2	2.4	25.7
Matanuska-Susitna Borough				
All races	5.8	7.9	2.0	12.8
White	5.6	7.1	1.8	11.5
Alaska Native	6.6	13.5	3.5	23.4
Yukon-Koyukuk Census Area				
All Races	6.2	8.4	7.4	33.8
White	4.8	2.4	0	9.8
Alaska Native	6.4	9.5	9.1	38.2
Bethel Census Area				
All Races	5.3	15.7	2.8	22.3
White	2.5	0	1.5	0
Alaska Native	5.5	16.7	2.8	23.9

Source: Alaska Bureau of Vital Statistics, 2014

Teen birth rates

Teen mothers are more common in the Yukon-Koyukuk and Bethel census areas; teen mothers were more likely to be Alaska Native in all the reporting jurisdictions (Table 64).[14]

Table 64 Maternal and Child Health Outcomes, Donlin Gold Pipeline Project Area, 2007 to 2009

	Health Outcomes			
	Low Birth Weight (% of all Births)	Teen Birth Rates (% of all Births)	% of Mothers who Reported Drinking during Pregnancy	% of Mothers who Reported Smoking during Pregnancy
Kenai Peninsula Borough				
All races	4.1	10.1	1.6	15.8
White	4.0	9.7	1.6	14.5
Alaska Native	5.0	14.6	2.3	30.2
Matanuska-Susitna Borough				
All races	6.1	9.1	1.6	14.4
White	6.0	8.4	1.5	13.4
Alaska Native	5.3	15.4	1.8	25.5
Yukon-Koyukuk Census Area				
All Races	3.8	17.9	5.6	34.5
White	4.7	14.0	2.3	16.3
Alaska Native	3.9	18.1	6.5	39.1
Bethel Census Area				
All Races	5.1	15.6	2.8	22.6
White	1.5	2.9	1.5	2.9
Alaska Native	5.3	16.3	2.8	23.8

Source: Bethel Census Area and State of Alaska: Alaska Bureau of Vital Statistics, 2014

Substance use during pregnancy

Less than 9% of mothers of all races in the Donlin Gold Pipeline Project area report using alcohol during pregnancy compared to 2.9% of all mothers statewide; Alaska Native mothers in all reporting jurisdictions are more like to drink during pregnancy than white mothers.[14] Alaskan mothers of all races are much more likely to smoke during pregnancy than to drink; statewide, 15.5% report smoking during pregnancy including 10% of white mothers and over 30% of Alaska Native mothers. Almost 40% of Alaska Native mothers living in the Yukon-Koyukuk Census Area report smoking during pregnancy, the

highest percentage in the Donlin Gold Pipeline Project area (Table 64).[14] No specific information on FAS in the Donlin Gold Pipeline Project area is available.

5.4.1.3 Child Abuse

Child abuse rates are not aggregated specifically for the Donlin Gold Pipeline Project area. The Alaska Office of Children's Services publishes child abuse rates in each of five regions (as described in Table 65). The regions that contain the Yukon-Koyukuk Census Area (Northern Region), Kenai Peninsula Borough and Mat-Su Borough (South Central Region) and the Bethel Census Area (Western Region) have some of the highest rates of substantiated allegations of child abuse, as well as the highest rate of child abuse victims. This is a vast geographic area and the number of communities in the study area that are located in each region is small; it is not possible to determine the actual number of cases substantiated in each community. Additional SDH data regarding child abuse are shown in Table 65.[29,30]

5.4.1.4 Intimate Partner Violence and Sexual Violence

Local borough, census area, or community data are not available. Specific data on IPV and sexual violence for the Donlin Gold Pipeline Project area are not available; however, data at the state level are available (Table 22 and Table 23)[35] and at a Rural location designation (Table 24).[36] The Donlin Gold Pipeline Project area and its PACs are a small portion of the state and the rural location; it is not possible to determine the actual number of IPV cases substantiated in each community.

5.4.1.5 Oral Health

Local borough, census area, or community data are not available. Data covering the state indicates that only 20% of Alaska Natives had a dental visit in the year 2008, compared to 25% of American Indian/Alaska Natives overall (Table 26).[38] This is much less than among the U.S. population where 65% of Americans reported a dental visit during 2008.[39] Given the magnitude of the prevalence of severe dental caries within a predominately Alaska Native population above that of U.S. children, it is reasonable to assume a similar pattern in the Donlin Gold Pipeline Project area.

Table 65 Allegations of Child Abuse Substantiated in Calendar 2010, by Region

Region	Census Areas	Total allegations substantiated in 2010	Total population under 18 years	Rate per 10,000 children
Anchorage	Municipality of Anchorage	1459	82,067	178
Northern Region	Yukon-Koyukuk Census Area Fairbanks North Star Borough North Slope Borough Northwest Arctic Borough Nome Census Area Southeast Fairbanks Census Area Denali Borough	1198	40,999	292
South Central Region	Aleutians East Borough Aleutians West Census Area Bristol Bay Borough Kenai Peninsula Borough Kodiak Island Borough Lake and Peninsula Borough Dillingham Census Area Valdez-Cordova Census Area Matanuska-Susitna Borough	1188	48,855	243
Western Region	Bethel Census Area Kusilvak Census Area	479	10,636	450
Southeastern Region	Haines Borough City and Borough of Juneau Ketchikan Gateway Borough City and Borough of Sitka Municipality of Skagway Borough City and Borough of Wrangell City and Borough of Yakutat Hoonah-Angoon Census Area Prince of Wales-Hyder Census Area Petersburg Census Area	331	17,216	192

Source: Population under 18 calculated from total population and population 18+ from State of Alaska Department of Labor and Workforce Development Research and Analysis. "Alaska Population Overview: 2009 Estimates." (http://labor.state.ak.us/research/pop/estimates)
Allegations of child abuse statistics from Department of Health and Social Services, Office of Children's Services (http://www.hss.state.ak.us/ocs/Statistics/pdf/Annual_Allgs_10.pdf)

5.4.1.6 Suicide

Intentional self-harm is in the top five causes of death in two of the four jurisdictions in the Donlin Gold Pipeline Project area (Table 66).[42] Data by local community are not available.

Table 66 Suicide (Intentional Self-Harm) Deaths, 2010-2012

Location	Cause of Death Rank	Number of Deaths	Age-adjusted Rate[a]
Kenai Peninsula Borough	ND – not on top 5 list	46	23.8
Mat-Su Borough	ND – not on top 5 list	46	15.2
Yukon-Koyukuk Census Area	4	14	60.2[b]
Bethel Census Area	4	22	17.6

Source: Alaska Bureau of Vital Statistics, 2014
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
[b]Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
ND: No data

5.4.1.7 Median household income

The range of median household income in the Donlin Gold Pipeline Project area communities (Table 67) ranged from $6.667 to $66,090.[45]

Employment

The unemployment rate varied in the communities of interest from 0% to 24.2%. Many of the communities depend on recreational activity employment. The State of Alaska Department of Labor adjusts the unemployment rate to reflect this variation (Table 67).

Table 67 Social Determinants of Health of the Donlin Gold Pipeline Project Area Communities – Economic Indicators

Jurisdiction / Community	Median Household income ($)	Per Capita Income ($)	% of People below the US Poverty Limit	Unemployment Rate (%)
Kenai Peninsula Borough	**59,421**	**30,789**	**9.1**	**5.6**
Beluga	66,090	61,574	ND	0
Tyonek	38,125	21,730	30.2	9.8
Matanuska-Susitna Borough	**70,728**	**29,465**	**9.9**	**6.8**
Susitna	46,932	47,217	0	0
Skwentna	ND	ND	ND	0
Yukon Koyukuk Census Area	**35,559**	**20,109**	**17.8**	**14.0**
Nikolai	15,000	11,996	55.3	24.2
McGrath	66,111	26,871	13.7	6.2
Takotna	53,750	8,070	39.1	0
Bethel Census Area	19,055	52,349	21.8	**11.3**
Stony River	6,667	3,240	97.5	5.3
Sleetmute	22,405	28,438	20.8	11.8
Red Devil	53,615	32,083	25.9	0.0
Crooked Creek	10,391	31,750	18.4	20.0

Sources: 2008-2012 American Community Survey 2012 5-Year Estimates
Unemployment Rates are not seasonally adjusted and are based on population 16 years and older in the labor force.
http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=01000US&-qr_name=ACS_2009_5YR_G00_DP5YR3&-ds_name=&-_lang=en&-redoLog=false&-format=
ND: No data

5.4.1.8 Educational Attainment and Workforce Development

The Bethel Census Area has the lowest graduation rate (79.1%) and the lowest literacy rate (86%) (Table 68).[45]

Table 68 Social Determinants of Health of the Donlin Gold Pipeline Project Area – Education Indicators

Jurisdiction / Community	Educational attainment persons 25 years and older		High School Drop-out rate (%)	Community Literacy Rate (%)
	High School Grads or more (%)	Bachelor's degree or higher (%)		
Kenai Peninsula Borough	**91.1**	**20.7**	**4.58**	**92**
Beluga	100	100	25	ND
Tyonek	72.4	0	25	ND
Matanuska-Susitna Borough	**90.6**	**19.9**	**5.19**	**92**
Susitna	100	72.7	9.2	ND
Skwentna	ND	ND	ND	ND
Yukon-Koyukuk Census Area	**78.7**	**12.9**	**9.9**	**86**
Nikolai	83.9	8.1	0	ND
McGrath	94.8	31.9	0	ND
Takotna	76.5	0	0	ND
Bethel Census Area	**79.1**	**14.4**	**ND**	**86**
Stony River	0	0	0	ND
Sleetmute	56.5	9.7	28.57	ND
Red Devil	100.0	46.7	ND	ND
Crooked Creek	44.3	0	ND	ND

Sources: 2003 National Assessment of Adult Literacy
2009 American Community Survey 1-Year Estimates
National Center for Education Statistics, Public School Graduates and Dropouts 2007-2008, Table 4
State of Alaska Report Card, 2009-2010 School Year, Kenai Peninsula Borough School District
State of Alaska Report Card, 2009-10 School Year, Tebughna School
State of Alaska Report Card, 2009-2010 School Year, Matanuska-Susitna Borough School District
State of Alaska Report Card, 2009-10 School Year, Susitna Valley High School
State of Alaska Report Card, 2009-10 School Year, Top of the Kuskokwim School
State of Alaska Report Card, 2009-10 School Year, McGrath School
State of Alaska Report Card, 2009-10 School Year, Takotna Community School
ND: No data

5.4.1.9 Family Structure

Table 69 below presents information about family characteristics in the Donlin Gold Pipeline Project area.[45] There were approximately 426 households in the study area in 2010, less than 1% of the households in the state. This small number of households makes generalization difficult.

Table 69 Social Determinants of Health of the Donlin Gold Pipeline Project Area Communities – Household Characteristics, 2010

Jurisdiction / Community	Number of Households	Average Household size	% of Family Households	% of Female Headed Households, No Husband Present (% of Family Households)	% of 2-Parent Households with own Children Present < 18 (% of Family Households)
Kenai Peninsula Borough	22,161	2.4	64.2	12.6	30.1
Beluga	10	2.0	40.0	0	10.0
Tyonek	70	2.4	55.7	35.9	48.7
Matanuska-Susitna Borough	31,824	2.8	70.9	12.3	36.9
Susitna	10	1.8	70.0	0	0
Skwentna	20	1.9	65.0	0	5.0
Yukon-Koyukuk Census Area	2,217	2.5	59.4	28.7	23.0
Nikolai	37	2.5	54.1	10.0	20.0
McGrath	147	2.4	60.1	18.0	25.8
Takotna	26	2.0	47.1	10.4	28.0
Bethel Census Area	4,651	3.6	73.9	14.0	38.5
Stony River	20	2.7	50.0	20.0	50.0
Sleetmute	36	2.4	52.8	26.3	26.3
Red Devil	12	1.9	41.7	20.0	0
Crooked Creek	38	2.8	68.4	50.0	19.2

Source: 2010 Census, US Department of Commerce as accessed at http://live.laborstats.alaska.gov/cen/dparea.cfm

Divorce is another indicator of family stability. The Alaska Bureau of Vital Statistics data for the Bethel Census Area can be found in Table 33.[51]

5.4.1.10 Cultural Indicators

The Alaska Department of Fish and Game (ADF&G), in the 2006 Community Subsistence Information System[104], estimate that almost 96% of households in Tyonek and 100% of Beluga households participate in subsistence activities. Brown et al. (2012)[55] reports that 94% of households in Crooked Creek, 82% of households in Red Devil, 100% of households in Sleetmute, and 83% of households in Stony River attempt to harvest at least one subsistence resource. Information on subsistence participation for the other communities is not available.

5.4.1.11 Summary

- There are more teen mothers and more women who drink and smoke during pregnancy in the Yukon-Koyukuk and Bethel census areas than in the KPB or the Mat-Su Borough although the percentage of babies with low birth weight is not higher.
- Residents of the census areas are generally poorer and less well educated than residents of the boroughs.

5.4.2 HEC 2: Accidents and Injuries

Accidents and Injuries are an important cause of mortality and morbidity in Alaska. The term unintentional injury refers to causes of injury or death other than suicide and homicide. Fatal injury information is drawn from death certificates and the Alaska Violent Death Reporting System (VDRS) while non-fatal injuries are typically obtained from the Alaska Trauma Registry (ATR). Alcohol use is a powerful risk factor for accidents and injuries and so alcohol related injury events are reported. The presence of law enforcement or village public safety officers (VPSO) also influences safety in rural communities. Information on the national and state level can be found in Section 5.3.2; data specific to the Donlin Gold Pipeline project area, if available, is presented in the following section.

5.4.2.1 Fatal Injuries

The two most common causes of fatal injury in the Donlin Gold Pipeline Project area are poisoning, generally by alcohol, and motor vehicle accidents, including snow machine accidents as in the Yukon Koyukuk and Bethel census areas.[42] The Bethel Census Area had nearly twice the age-adjusted rate of fatal accidents than the State of Alaska as a whole. All three Project census areas had higher age adjusted rates of poisoning deaths than the state; the rate for Bethel was more than twice that of the state. Age-adjusted rates of poisoning were greater than motor vehicle accident rates in all three Project census areas between 2010-2012 (Table 70).[42]

Poisoning accidents accounted for the majority of fatal injuries in the KPB and the Yukon-Koyukuk and Bethel census areas between 2010 and 2012 (Table 70). The highest accidental death rate presented was composed of poisoning in the Yukon Koyukuk Census Area (39.5 deaths per 100,000 population).[42]

5.4.2.1 Alcohol Related Accidents and Injuries

Alcohol consumption and injury death are strongly related; alcohol poisoning is among the top 2 causes of injury death in the state and in the Donlin Gold Pipeline Project area.

Table 70 Major Causes of Accidental Deaths, State of Alaska and the Donlin Gold Pipeline Project Area, 2010 to 2012, Age-adjusted Rates[a]

Location	Total Accidental Death	Motor Vehicle Accidents	Snow-machine[b-]	Poisoning
State of Alaska	**49.2**	**8.8**	**5.5***	**15.3**
Kenai Peninsula Borough	49.5	12.6*	**	17.4*
Matanuska-Susitna Borough	57.3	13.1	**	18.0
Yukon Koyukuk Census Area	176.0	28.9*	**	39.5*
Bethel Census Area	82.1	14.7*	9.9*	17.7

Source: Alaska Bureau of Vital Statistics, 2014
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
[b]Deaths to an operator or passenger related to the use of a snow machine
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution.
Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution.
**Rates based on fewer than 6 occurrences are not reported.

5.4.2.2 Non-fatal Injuries

According to the Alaska Trauma Registry (ATR), in 2010, the crude unintentional injury rate for the Southcentral Foundation (covering Alaska Natives in the KPB and the Mat-Su Borough) was 102.8 injuries per 10,000 population while the crude rate for the Tanana Chiefs Conference (covering Alaska Natives in the Yukon-Koyukuk Census Area) is 99.7 injuries per 10,000 population.[56] The YKHC (covering Alaska Natives in the Bethel Census Area) unintentional injury hospitalization rate was 91 injuries per 10,000, all less than that for Alaska Natives statewide (108.1 injuries per 10,000) the same year.[56]

5.4.2.3 Village Public Safety Officer Program

There is no police coverage in Tyonek, Beluga, Susitna, or Skwentna. Service is provided by State Troopers based in Anchorage who maintain VPSOs posts in McGrath, which covers Nikolai and Takotna and Aniak that provides coverage for Stony River, Sleetmute, Red Devil, and Crooked Creek.[59]

5.4.2.4 Dry/Wet/Moist Community

As of June 2011, 2 Donlin Gold Pipeline Project area communities have adopted “local option laws” to regulate alcohol. Nikolai has banned the sale, importation, and possession of alcohol, and Red Devil has banned the sale of alcohol.[61] Alcohol is permitted in the other communities.

5.4.2.5 Summary

- Poisoning, generally by alcohol, and motor vehicle accidents, including snowmachine accidents are the two most common accidents in the Yukon Koyukuk and Bethel census areas.
- The Yukon Koyukuk Census Area had over twice the age-adjusted rate of fatal accidents than the State of Alaska as a whole; only the Mat-Su Borough had a lower rate than the state as a whole.
- The Bethel Census Area had a higher age adjusted rate of poisoning deaths than the state.
- Alcohol consumption and injury death are strongly related.

5.4.3 HEC 3: Exposure to Potentially Hazardous Materials

When gathering data on exposure to potentially hazardous materials, the HIA team reports on *outcomes* such as the prevalence of illnesses that result from exposures to hazardous materials including asthma/COPD, cancer, thyroid disorders, developmental delays, and birth defects. For health *determinants,* we include information, where available, on monitoring data for soil, water, and air to understand the types and quantities of contamination that might be present. Information on the national and state level can be found in Section 5.3.3; data specific to the Donlin Gold Pipeline project area, if available, is presented in the following sections. A Project specific toxicity assessment is provided in Section 6.0 Exposure Assessment.

5.4.3.1 Physical Hazards

There are no data available on illnesses that relate to physical hazards such as radiation, noise, vibration, light, temperature extremes, or wildlife interactions in the Donlin Gold Pipeline Project area.

5.4.3.2 Air Quality

The State of Alaska does not regularly conduct air quality monitoring investigations into particulate matter concentrations in the Bethel Census Area, the Yukon-Koyukuk Census Area or in the Kenai Peninsula Borough. The ADEC has been conducting air quality monitoring investigations into particulate matter concentrations in the Mat-Su Valley since 1998 due to the presence of wind-blown dust off the Matanuska and Knik River drainages. Several air quality alerts are issued each year in the spring and fall because of windblown dust events. However, the closest monitoring station to the proposed pipeline Mat-Su Borough PACs, Susitna and Skwentna, is located in Wasilla, 35 and 70 miles away, respectively. Therefore, data from this site is not likely to be representative of air quality in either Mat-Su community.

5.4.3.3 Existing Contaminated Sites

There are a total of 50 open ADEC recognized contaminated sites among the PACs including one EPA Superfund and one FUD site (Table 71).[76]

Among the KPB PACs, there are a total of 18 open contaminated sites listed in the database and are located within Tyonek. The majority of these sites involve oil industry releases of petroleum products. The remainder of the sites are associated with fuel infrastructure for other industry in the area. Petroleum derivatives are the main contaminant of concern.[76]

There are four open contaminated sites among the Mat-Su PACs; all are located in Skwentna and owned by the FAA. Contaminants associated are petroleum derivatives such as diesel range organics (DRO) and

gasoline range organics (GRO) from heating oil, and fuel line infrastructure. There is also a dump station where leachate is present in surface water and shifting of the Skwentna River is causing erosion of capped debris[76].

Of the Yukon-Koyukuk Census Area PACs, all 22 open contaminated sites are listed in McGrath and none are in Nikolai or Takotna. Six of sites in McGrath are associated with a FUD site. The majority of the FUD site-associated contamination consists of petroleum derivatives, but there are also two large landfills that contain incinerator ash, demolition and construction debris, and oil drums. An old sanitary sewer system and lagoon is also a source of contamination in the area. Other contaminated sites in McGrath are mostly heating oil releases associated with the FAA owned communications complex.[76]

There are six open contaminated sites listed for the Bethel Census area PACs that are discussed in Section 5.3.3.

5.4.3.4 Natural Environmental Patterns

Some hazardous exposures may emerge from natural environmental patterns such as flooding, wind and weather patterns that create air quality problems (i.e. inversions or high particulate matter content), or secondary effects from climate change**.** The weather in the Donlin Gold Pipeline Project area presents many challenges and risks from extreme cold to thin ice. See Section 5.3.3 for a full discussion of the flood on the Kuskokwim River in 2011 that impacted Red Devil and Crooked Creek.[77]

Table 71 Contaminated Sites in the Donlin Gold Pipeline Project Communities

Borough/Census Area	Village	Total CS	Superfund	FUD
Kenai Peninsula	Tyonek	18	0	0
Kenai Peninsula	Beluga	0	0	0
Matanuska-Susitna	Skwentna	4	0	0
Matanuska-Susitna	Susitna	0	0	0
Yukon-Kuskokwim	McGrath	22	0	1
Yukon-Kuskokwim	Nikolai	0	0	0
Yukon-Kuskokwim	Takotna	0	0	0
Bethel	Stony River	3	0	1
Bethel	Sleetmute	1	0	0
Bethel	Crooked Creek	0	0	0
Bethel	Red Devil	2	1	0
Total		**50**	**1**	**2**

CS=contaminated site; FUD= formerly used defense site
Source: ADEC Contaminated Sites Program, 2011

5.4.3.5 Summary

- There are a total of 50 open ADEC recognized contaminated sites among the PACs including one EPA Superfund and one FUD site.

5.4.4 HEC 4: Food, Nutrition, and Subsistence Activity

A description of this HEC is provided in Section 5.3.4.

5.4.4.1 Micronutrient Deficiencies

There are no reported deaths by malnutrition or by nutritional disorders such as scurvy, marasmus, B_{12}, or other deficiencies in any of the Donlin Gold Pipeline Project area communities. Information on clinical visits for these conditions is not available at this time.

5.4.4.2 Contribution of Subsistence Activities

As reported in Section 3.3.4, the ADF&G completed harvest studies (January- December 2009) in the middle Kuskokwim in 2010. The department had previously completed harvest studies in Tyonek and Beluga in 2006 (Table 72).[104] More recent studies have been completed for Susitna and Skwentna in 2012[105] and in Nikolai, McGrath, and Takotna in 2011.[106]

Between January and December 2011, residents of upper Kuskokwim PACs: Nikolai, McGrath, and Takotna; harvested an estimated total of 151,053 pounds of subsistence resources, with an estimated harvest of 288 pounds per capita.[106] Nikolai saw the largest overall and harvest per capita of these upper Kuskokwim communities (Table 72). The current harvest patterns of these communities reflect their historical heavy reliance on moose and salmon supplemented by harvests of small game, non-salmon fish species, migratory birds and eggs, and a wide variety of edible plants. Moose was the primary species harvested, followed by Chinook salmon.[106]

Tyonek residents harvested 217 pounds of subsistence resources per capita, and Beluga residents harvested 204 pounds per person. In both communities, salmon comprised the largest portion of the harvest, but land mammals, other fish, birds, small game, marine invertebrates, and wild plants were also important, as were marine mammals in Tyonek.

Table 72 Wild Food Harvest in the Donlin Gold Pipeline Project Area

Location	Total Wild Food Harvest (lbs.)	Harvest per Household (lbs.)	Harvest per Person (lbs.)
Beluga (2005-2006)	8086	539	204
Tyonek (2005-2006)	43,829	664	217
McGrath (2011)	84,2545	593	237
Takotna (2011)	8382	381	162
Nikolai (2011)	58,416	1498	499
Skwentna (2012)	9966	287	161
Susitna (2012)	5175	398	219

Sources: Stanek et al., 2007; Ikuta et al., 2014 & Holen et al., 2014

The HIA team conducted household consumption surveys in Tyonek in September 2013. Of 72 people who answered the question “In a normal week, how many times a day on average are wild foods such as salmon, moose, caribou, non-salmon fish, birds, etc. served in your household?; the greatest percentage (43%) answered 1-2 time per day. The second greatest percentage (38%) answered that they ate wild foods less than once a day and 10% reported eating wild foods 2-3 times per day.[107]

Similarly for the middle Kuskokwim communities, the subsistence foods most commonly consumed in Tyonek were: salmon, moose, berries, birds, and whitefish. Salmon, followed by moose, was by far the most frequently consumed. Tyonek residents consumed whitefish less frequently than middle Kuskokwim residents. The survey also included questions regarding how many times per week residents reported consuming specific store bought food items. The greatest percentage (90%) of residents reported eating rice on the most frequent basis (more than once a week). Beef was the most second popular food consumed more than once per week (75%), followed by canned fruits or vegetables (74%), eggs (71%), cheese (69%), milk (63%), white bread (60%), and pilot bread (54%).[107]

The HIA team also observed community gardens during the community observation visit (Figure 5.34). Such gardens may be an important contributor to residents' nutrition as a supplement to the harvest of wild foods.

Figure 41 Gardens in Tyonek

Source: NewFields, 2012

5.4.4.3 Food Security

The issue of food security in the communities of Crooked Creek, Red Devil, Sleetmute, and Stony River is discussed in Section 5.3.4.4. Food security among the pipeline Project area communities was much lower in Takotna and Nikolai as compared to the state and the US (Table 73), while McGrath had better food security in comparison.[106] McGrath is the only village among the pipeline PACs that has a grocery store (AC Value Center).

Table 73 Food Security in the Pipeline Project Area

Community	Total Food Security* (%)	Low Food Security (%)	Very Low Food Security (%)
United States (2010)	86	8	9
Alaska (2008-2010)	86	8	9
McGrath	92	5	4
Takotna	71	14	14
Nikolai	65	23	12

Source: Ikuta et al., 2014
*Includes High and Marginal Food Security subcategories
Note: Tyonek, Beluga, Swentna, & Susitna were not included because there were no data available

5.4.4.4 Summary

- Almost 96% of households in Tyonek and 100% of Beluga households participate in subsistence activities.
- 94% of households in Crooked Creek, 82% of households in Red Devil, 100% of households in Sleetmute, and 83% of households in Stony River attempt to harvest at least one wild resource.

5.4.4.5 Data Gaps

- Updated ADF&G harvest survey data for Tyonek and Beluga.

5.4.5 HEC 5: Infectious Diseases including STIs

5.4.5.1 Infectious Diseases

Reportable infectious diseases were the cause of 70 deaths in the two boroughs and two census areas between 2010 and 2012. Results must be generalized from the borough and census area totals to the small communities in the Donlin Gold Pipeline Project area. Pneumonia, septicemia (blood poisoning), and viral hepatitis were the major contributors to the number of deaths (see Table 74).[14] Influenza deaths were only reported in the Kenai Peninsula during the same time period within the communities of the Donlin Gold Pipeline project area. Infectious disease is not a leading cause of death in these communities.

The Bureau of Vital Statistics does not report infectious disease data by race; data from the Alaska Native EpiCenter is used to discuss the data for Alaska Natives. Overall reportable infectious disease cases for all Alaska Natives between January 2007 and October 2008 are shown in Table 52.[38]

According to Alaska County Health Rankings[43] in 2010, the CT rates for all Alaskans were highest in the Bethel Census Area (2,321 cases per 100,000 persons), followed by the Yukon Koyukuk Census Area (860

cases per 100,000 persons), the Mat-Su Borough (317 cases per 100,000 persons), and the KPB (281 cases per 100,000 persons). The Alaska rate was 711 cases per 100,000 persons compared to 83 cases per 100,000 persons for the US.

Table 74 Infectious and Parasitic Disease Caused Deaths, Age-adjusted Rate[a] Donlin Gold Pipeline Project Area, 2010 to 2012

Cause of Death	KPB Census Area	Mat-Su Borough	Yukon Koyukuk Census Area	Bethel Census Area
INFECTIOUS AND PARASITIC DISEASE	16.3	10.7	**	50.0*
Tuberculosis	**	0	0	**
Septicemia	8.7*	2.3*	**	23.0
Viral Hepatitis	2.7*	3.1*	0	0
HIV Disease	0	**	0	0
All Other Infectious Disease	4.3*	4.8*	0	**
INFLUENZA AND PNEUMONIA	10.4*	10.1*	**	22.7*
Influenza	**	0	0	0
Pneumonia	9.5*	10.1*	**	22.7*

Source: Alaska Bureau of Vital Statistics, 2014
http://www.hss.state.ak.us/dph/bvs/death_statistics/Detailed_Causes_Census/frame.html
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
* Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution.
**Rates based on fewer than 6 occurrences are not reported.

5.4.5.2 STI Education Efforts and Practices

To address the elevated rates of Chlamydia in Alaska, expedited partner therapy as a means to promote safe sexual behavior has been promoted.[108]

5.4.5.3 Immunizations

No information specific to the communities in the Donlin Gold Pipeline Project area is available.

5.4.5.4 Summary

- Although results must be generalized from the borough and census area totals to the small communities in the Donlin Gold Pipeline Project area, it appears that infectious disease is not a leading cause of death in these communities.
- In 2010, the Chlamydia rates for all Alaskans were higher than the state rate in the Bethel and Yukon-Koyukuk census areas.

5.4.5.5 Data Gaps

- There are no data summaries and analyses for the Tanana Chief's Regional Health Services Department.

5.4.6 HEC 6: Water and Sanitation

The lack of clean running water and proper sewage disposal is a leading cause of preventable disease in rural Alaska villages such as those in the Donlin Gold Pipeline Project area. Respiratory, gastrointestinal, and skin diseases are common in areas without safe water supplies. Many Alaska villages continue to need adequate sources of water that are safe to drink and facilities that can safely dispose of their wastewater.[94]

5.4.6.1 Services

The information presented below is provided by the Alaska Department of Community and Regional Affairs Community Information Services (http://commerce.state.ak.us/cra/DCRAExternal/community) and includes all the PACs in the Donlin Gold Pipeline Project area. A housing unit is considered to have water and sewer service if it has water/sewer pipes or closed haul services.

Beluga: The US Census counted 53 houses in Beluga during the 2010 census; 10 of which are occupied. The vacant houses are used for seasonal, recreational, or occasionally use. All occupied homes are fully plumbed. There are three permitted landfill sites in the area.

Tyonek: According to the 2010 Census, there were 144 housing units in the community and 70 were occupied. A piped water and sewer system serves the entire community -- approximately 90 homes and facilities. Water is derived from Second Lake and is treated and stored in a 175,000-gallon tank. Back-up water supplies are available from a lake near the airport. A small coin-operated washateria, with one washer and dryer, is available. Refuse disposal is available in Beluga.

Susitna: According to the 2010 Census, there were 133 housing units in the community, and 10 were occupied full time; the other housing units provide recreational or seasonal housing. A majority of homes use creek water, but some have individual wells. Outhouses are the primary means of sewage disposal; only a few homes have septic tanks. Almost 85% of homes have running water in the kitchen, but only a minority has complete plumbing. No information is available about refuse disposal or a landfill.

Skwentna: According to the 2010 US Census, there were 353 housing units in the community, and 20 were occupied. Most of the housing units are used for recreational and seasonal housing. A number of homes have individual water wells and septic systems, but very few homes are fully plumbed. Outhouses are the primary means of sewage disposal. A community refuse incinerator is available at the unpermitted dumpsite near the airport, operated by the borough. Several families are currently using the site, but most residents burn and bury their own refuse.

Nikolai: According to the 2010 Census, there were 48 housing units in the community, and 37 were occupied. All households and facilities use individual wells; of these, only 2 units lack plumbing. Thirty-three (33) homes, including 10 HUD housing units north of the airport, are connected to the piped sewage system. The remaining 15 homes use septic tanks. There is a landfill in Nikolai although it is unclear if it is currently permitted.

McGrath: According to the 2010 Census, there were 195 housing units in the community and 147 were occupied. McGrath operates a piped water system that serves nearly all households; a few homes have individual wells or haul water. The majority of residents uses individual septic tanks; a limited city sewage system serves approximately 34 homes. A private firm, McGrath Trash & Refuse, collects refuse for disposal at the city landfill.

Takotna: According to the 2010 Census, there were 41 housing units in the community and 22 were occupied. Water from Gold Creek is treated and hauled by residents from the washateria. Water is also hauled from the Takotna Waterworks. Approximately 20% of homes have storage tanks with running water for the kitchen, but no homes are completely plumbed. Community buildings use individual wells and septic tanks. Honeybuckets and outhouses are used for sewage disposal. The high school has no running water or restrooms. The community has a permitted landfill.

Stony River: According to Census 2010, there were 26 housing units in the community and 20 were occupied. In 2012, Stony River received funds to facilitate the installation of 10 wells and four septic systems. Water is derived from individual wells; the school, washateria, and clinic each have a well. Septic tanks and some outhouses are used for sewage disposal. According to the community observation conducted by the HIA team in September 2012, 75% of homes had running water. The school uses a septic tank/drainfield system; there is a landfill a half-mile from the school that is not currently permitted.

Sleetmute: According to Census 2010, there were 49 housing units in the community and 36 were occupied. A central well with treated water serves 95% of the residents and several houses have individual wells. According to the community observation conducted by the HIA team in September 2012, 75% of homes had piped water. Water is pumped by hand to fill gravity storage tanks at each house. Privies, honeybuckets, and seepage pits are used by 25 homes. Eleven homes and the school use individual systems and are completely plumbed. There is a landfill in Sleetmute that is not currently permitted.

Red Devil: According to Census 2010, there were 23 housing units in the community and 12 were occupied. According to the community observation conducted by the HIA team in September 2012, 75% of homes had piped water. Water is derived from individual wells or hauled from the school well; the water is not treated. Four of the 12 occupied homes are fully plumbed. Sewage is disposed of on an individual basis. The school and teacher's housing uses individual septic tanks and drain fields; others use pit privies. There is a landfill in Red Devil, although its permit expired in 2009.

Crooked Creek: According to Census 2010, there were 47 housing units in the community and 38 were occupied. Almost 95% of the homes lack plumbing; residents haul water and use honeybuckets. A well provides treated water, and a washateria is also available. The school, store, and three homes have individual wells, septic tanks, and plumbing. There is a landfill in Crooked Creek that is currently permitted.

Table 75 presents information about the level of water and sanitation in Alaska Native regional health corporation across the State of Alaska.[38] Of the PACs, the Southcentral Foundation (Beluga, Tyonek, Susitna, and Skwentna), the Tanana Chiefs Conference (Nikolai, McGrath, and Takotna) and the Yukon-Kuskokwim Health Corporation (Stony River, Sleetmute, Red Devil, and Crooked Creek) are included in this data.

5.4.6.2 Summary

- Only the Southcentral Foundation (Beluga and Tyonek) approaches full water and sanitation services in the Alaska Native regions.

5.4.6.3 Data Gaps

- Updated data for water and sanitation service rates by tribal health region.

Table 75 Water and Sanitation Service Rates by Region, 2008

Regional Health Corporation	2008 Housing Units with Pipes or Close Haul	2008 Total Housing Units	Percent Served
Aleutian Pribilofs Islands Association	271	324	84
Arctic Slope Native Association	462	491	94
Bristol Bay Area Health Corporation	1364	1572	87
Chugachmuit	179	189	95
Copper River Native Association	343	397	86
Eastern Aleutian Tribes	507	541	94
Kodiak Area Native Association	349	356	98
Maniilaq Association	865	1140	76
Norton Sound Health Corporation	970	1509	64
Southcentral Foundation	212	238	89
Southeast Alaska Regional Health Consortium	2288	2329	98
Tanana Chiefs Conference	1150	1930	60
Yukon-Kuskokwim Health Corporation	2753	4760	58
Independent	1437	1556	92
Total	**13,150**	**17,332**	**76**

Source: AN EpiCenter, 2009

5.4.7 HEC 7: Non-communicable and Chronic Diseases

5.4.7.1 Cancer

Cancer was the leading cause of death in the State, Kenai Peninsula Borough, and Mat-Su Borough in 2012, and in the Bethel Census Area between 2010 and 2012 (Table 76).[14] The age-adjusted death rate due to cancer in the Donlin Gold Pipeline Project area was consistently higher than the rate in the State of Alaska, with the exception of the Kenai Peninsula Borough. It was, however, only the third leading cause of death in the Yukon-Koyukuk Census Area.

Table 76 Cancer (Malignant Neoplasms) as a Cause of Death in the State of Alaska and the Donlin Gold Pipeline Project Area

Location	Rank	Number of Deaths	Age-adjusted Rate[a]
Alaska (2012)	1	923	163.3
Kenai Peninsula Borough (2012)	1	86	143.5
Mat-Su Borough (2012)	1	135	177.5
Yukon-Koyukuk Census Area (2010-2012)	3	31	202.6
Bethel Census Area (2010-2012)	1	67	236.8

Source: Alaska Bureau of Vital Statistics, 2014
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population

Between 2010 and 2012, lung cancer was the most common type of cancer in all 4 of the jurisdictions in the Donlin Gold Pipeline Project area, running between 49 and 73 cases per 100,000 persons (Table 77).[14] Rates of prostate cancer and cancers of the colon, rectum and anus were similar to the State overall in the Kenai Peninsula and Mat-Su Boroughs; however the rate of cancers of the colon, rectum, anus in the Bethel Census Area was nearly three times that of the State.

Table 77 Most Common Types of Cancer in the State of Alaska and the Donlin Gold Pipeline Project Area, Age-adjusted Prevalence Rates[a], 2010 to 2012

Site	Alaska	Kenai Peninsula Borough	Mat-Su Borough	Yukon Koyukuk Census Area	Bethel Census Area
All cancers	169.9	158.2	187.1	202.6	235.2
Lung	49	49.6	54.8	48.5*	73.4*
Breast	19.9	24.7	21.0	**	**
Prostate	20.2	24.4*	23.0*	0	0
Colon, rectum, anus	15.2	16.3	14.1	**	44.8*
Lymphoid	16.5	12.8	20.2	**	**

Source: Alaska Bureau of Vital Statistics, 2014
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
**Rates based on fewer than 6 occurrences are not reported

5.4.7.2 Heart Disease/ Cardiovascular Diseases

Heart diseases are the second most prevalent cause of death in Alaska and the second or third most prevalent cause of death in the four jurisdictions in the Donlin Gold Pipeline project area. The age-adjusted rate for the state is 155.9 cases per 100,000 population while the prevalence rate ranges from 110.0 cases per 100,000 persons in the Bethel Census Area to 228.5 cases per 100,000 persons in the Kenai Peninsula Borough (Table 78).[14]

Table 78 Diseases of the Heart as a Cause of Death, in the State of Alaska and the Donlin Gold Pipeline Project Area, 2007 to 2009

Location	Rank	Number of Deaths	Age-Adjusted Rate[a]
Alaska (2009)	2	710	155.9
Kenai Peninsula Borough (2009)	2	81	228.5
Mat-Su Borough (2009)	2	72	149.6
Yukon-Koyukuk Census Area (2007-2009)	3	17	146.7[b]
Bethel Census Area (2007-2009)	3	31	110

Source: Alaska Bureau of Vital Statistics. Available on line at http://hss.state.ak.us/dph/bvs/death_statistics/Leading_Causes_Census/frame.html

[a]Age-Adjusted rates are per 100,000 U.S. year 2000 standard population

[b]Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution

Statewide, the data for Alaska Natives with cardiovascular diseases is complex, although there appear to be variations between regions for heart disease death rates.

5.4.7.3 Diabetes

The Bureau of Vital Statistics (BVS) reports on deaths of all Alaskans caused by diabetes and deaths in which diabetes is cited as a contributing cause. The prevalence of the disease, the number of deaths per 100,000 persons, is presented in Table 79 rather than the specific number of deaths because of the differing time periods.[14] Residents of the Yukon-Koyukuk Census Area have a much greater prevalence of diabetes and diabetes related deaths although the actual number of deaths requires caution when interpreting the statistics.

Table 79 Prevalence of Diabetes and Diabetes related Deaths, in the State of Alaska and the Donlin Gold Pipeline Project Area, 2007 to 2009

Location	Prevalence of Diabetes Deaths[a]	Prevalence of Diabetes, any mention, Deaths[a]
Alaska (2009)	18.1	62.8
Kenai Peninsula Borough (2009)	14.3	65.3
Mat-Su Borough (2009)	18.1	73.7
Yukon-Koyukuk Census Area (2007-2009)	71.1*	102.1*
Bethel Census Area (2007-2009)	**	**

Source: Alaska Bureau of Vital Statistics, 2011

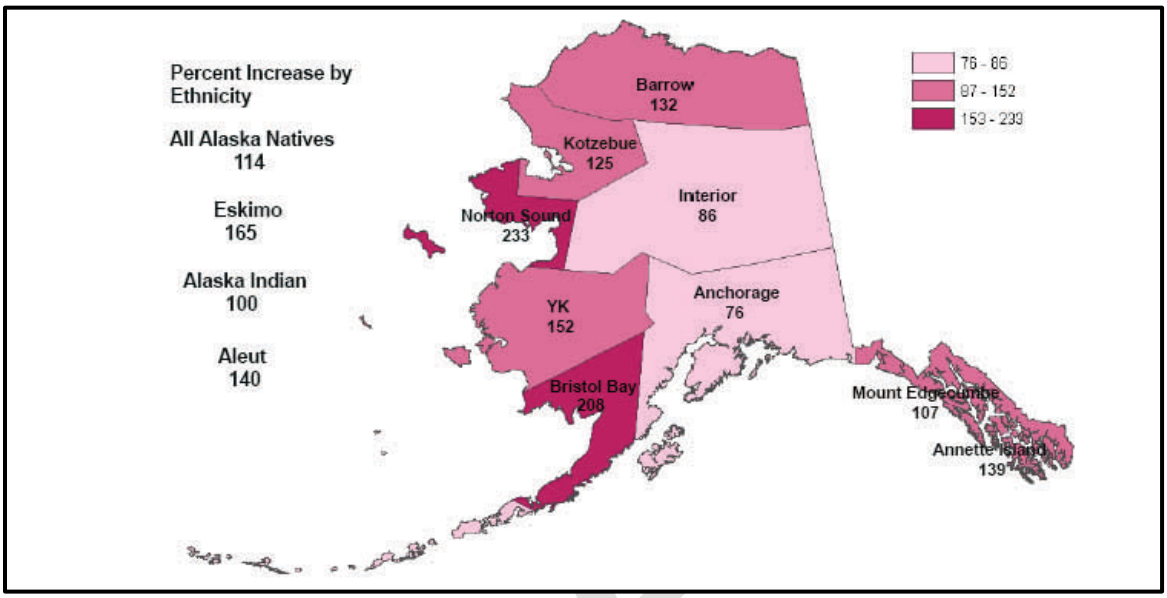
[a]Age-Adjusted rates are per 100,000 U.S. year 2000 standard population

*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution

**Rates based on fewer than 6 occurrences are not reported

The prevalence of diagnosed diabetes among Alaska Native people for 2007 is presented in graphic form Figure 35. The prevalence of diabetes has increased in every region of the state between 1990 and 2006. The rate of increase was the greatest in Norton Sound (201%) and Bristol Bay (200%). The rate of diabetes has increased by 152% from 1990 to 2006 among Alaska Natives in the YKHC service area (Figure 42).[38]

Figure 42 Percent Increase in Diabetes Prevalence among Alaska Natives, 1990 to 2006



Source: AN EpiCenter, 2009

5.4.7.4 Chronic Lower Respiratory Disease

Chronic lower respiratory disease was the fourth leading cause of death in Alaska, the KPB, and the Mat-Su Borough in 2012, accounting for 227 deaths. It was not ranked in the top 5 in the Yukon-Koyukuk or the Bethel census areas between 2010 and 2012, with 24 deaths during that same time period. The prevalence of the disease is approximately the same in the Donlin Gold Pipeline Project area with the exception of the Yukon-Koyukuk Census Area where there were too few deaths to establish a statistically reliable age-adjusted rate.[14]

Table 80 Prevalence of Chronic Lower Respiratory Disease Deaths

Location	Rank	Number of Deaths	Age-adjusted Rate[a]
Alaska (2012)	4	189	40.1
Kenai Peninsula Borough (2012)	4	16	25.4
Mat-Su Borough (2012)	4	22	54.6
Yukon-Koyukuk Census Area (2010-2012)	5	8	57.2*
Bethel Census Area (2010-2012)	5	16	81.5*

Source: Alaska Bureau of Vital Statistics, 2014
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution

5.4.7.5 Cerebrovascular Diseases

The prevalence of cerebrovascular diseases as a cause of death was highest in the Bethel Census Area (2010-2012) and lowest in Kenai Peninsula Borough (2012). Age-adjusted rates in 2012 were lower in the two Project Boroughs as compared to the State overall the same year (Table 81).[14]

Table 81 Prevalence of Death caused by Cerebrovascular Diseases in the State of Alaska and the Donlin Gold Pipeline Project Area

Location	Rank	Number of Deaths	Age-adjusted Rate
Alaska (2012)	5	187	40.6
Kenai Peninsula Borough (2012)	Not ranked	15	32.1*
Mat-Su Borough (2012)	5	20	33.6
Yukon-Koyukuk Census Area (2010-2012)	Not ranked	4	**
Bethel Census Area (2010-2012)	Not ranked	13	59.2

Source: Alaska Bureau of Vital Statistics, 2014
*Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
**Rates based on fewer than 6 occurrences are not reported

Cerebrovascular diseases are another important cause of mortality among Alaska Natives, as shown in Figure 30.

5.4.7.6 Chronic Liver Disease and Cirrhosis

Chronic liver disease and cirrhosis was the ninth leading cause of death in Alaska in 2012 and was not among the top five leading causes of death in any of the Project communities for the period 2010-2012 (Table 82).[14] It is directly related to the rates of alcohol poisoning.

Table 82 Prevalence of Death Caused by Chronic Liver Disease and Cirrhosis in the State of Alaska and the Donlin Gold Pipeline Project Area

Location	Rank	Number of Deaths	Age-adjusted Rate[a]
Alaska (2012)	9	89	12.4
Kenai Peninsula Borough (2010-2012)	ND – not in top 5	31	14.8
Mat-Su Borough (2010-2012)	ND – not in top 5	25	8.1
Yukon-Koyukuk Census Area	ND – not in top 5	5	**
Bethel Census Area (2010-2012)	ND – not in top 5	2	**

Source: Alaska Bureau of Vital Statistics, 2014
[a]Age-adjusted rates are per 100,000 U.S. year 2000 standard population
[b]Rates based on fewer than 20 occurrences are statistically unreliable and should be used with caution
**Rates based on fewer than 6 occurrences are not reported ND: No data

5.4.7.7 Mental Health Disorders

Residents of the Yukon-Koyukuk and Bethel census areas report fewer days in the past 30 days in which their mental health was not good than Alaska residents or residents of the KPB and the Mat-Su Borough (Table 83). A smaller percentage of residents of the Yukon-Koyukuk and Bethel census areas report periods of frequent mental distress (defined as 14 or more days of poor mental health than Alaska residents or residents of the KPB and the Mat-Su Borough).[98] No specific information is available for local communities.

Table 83 Mental Health Indicators in the Donlin Gold Pipeline Project Area, 2008-2010.

Location	Number of days in the last 30 when mental health was not good	% experiencing frequent mental distress
Alaska	2.8 days	8.0
Kenai Peninsula Borough	3.3 days	10.3
Mat-Su Borough	3.0 days	8.3
Yukon-Koyukuk Census Area	2.0 days	4.7
Bethel Census Area	2.3 days	5.9

Source: BRFSS, 2011

A risk factor is something that affects a person's chance of getting a disease. Some risk factors, like smoking, can be controlled. Others, such as a person's age, can't be changed.

5.4.7.8 Tobacco Use

Residents of the Yukon-Koyukuk Census Area are the most likely to smoke (43%) while 23% of all Alaskan residents smoke compared to only 15% of all US residents. Overall regional smoking rate data for Alaska Natives is shown in Figure 37. The percentage of adults smoking between 2005 and 2007 for Alaska Natives in the Kenai Peninsula Borough (42%) was the only Alaska Natives with a higher rate than for all Alaska Natives (41%), and over twice the rate of Alaska non-Natives and all races in the United States.

5.4.7.9 Substance Abuse

Overall Alaska Native regional data for binge drinking are shown in Figure 15.[16] Between 2005 and 2007, residents of the Interior Region, which includes the Yukon-Koyukuk Census Area report percentages of binge drinking (22%) higher than the statewide Alaska Native percentage (18%).[43]

5.4.7.10 Physical Activity

In the BRFSS 2008 – 2010, 79.0% of Alaskans; 80.2% of residents of the KPB; 76.7% of residents of the Mat-Su Borough; 64.2% of Yukon-Koyukuk Census Area residents; and 72.7% of the residents of the Bethel Census Area self-reported that they participate in leisure time physical activities.[98] Subsistence activities can increase the levels of physical activity. No information is available about whether the amount of time spent in physical activities meets sufficiency guidelines.

Figure 36 reports on the amount of moderate or vigorous physical activity performed by Alaska Natives in 2003. According to AN EpiCenter 2009, there is no statistically significant difference in physical activity levels between the regions' although a greater percentage of Alaska Native people report meeting physical activity recommendations than do the U.S. all races population.[38]

5.4.7.11 Obesity and Overweight

28% of all residents in the Mat-Su Borough are obese according to the 2010 County Health Rankings.[43] This level of reported obesity is the same percentage as for the state as a whole. Thirty percent (30%) of Kenai Peninsula Borough are obese; and 32% of residents of the Yukon-Koyukuk and Bethel census areas are obese. Between 2005 and 2007 Alaska Natives were more likely to be classified as obese as Alaska non-Natives and all U.S. citizens.[43]

5.4.7.12 Summary

- Cancer was the leading cause of death in all jurisdictions of the Donlin Gold Pipeline Project area between 2007 and 2009 and the age-adjusted death rate was consistently higher than the rate in the State of Alaska, with the exception of the Mat-Su Borough.
- Lung and colorectal are the most common types of cancer.
- Heart diseases are the second most prevalent cause of death in Alaska and the second or third most prevalent cause of death in the four jurisdictions in the Donlin Gold Pipeline Project area.
- Residents of the Yukon-Koyukuk Census Area have a much greater prevalence of diabetes and diabetes related deaths than residents of the state or the other jurisdictions in the Donlin Gold Pipeline Project area although the actual number of deaths requires caution when interpreting the statistics.
- Residents of the Yukon-Koyukuk Census Area are the most likely to smoke (43%) while 23% of all Alaskan residents smoke compared to only 15% of all US residents.

5.4.8 HEC 8: Health Services Infrastructure and Capacity

The Tanana Chiefs Regional Health Board is the advisory board to the Tanana Chiefs Conference (TCC), Inc. with respect to health services and health policies of the organization.[109] The TCC Department of Health Services was established in 1973 and now provides health care services to over 10,000 Alaska Natives living in Fairbanks and in the villages of Interior Alaska, including Nikolai, McGrath, and Takotna. Specific programs managed by the Department of Health Services are outlined here:

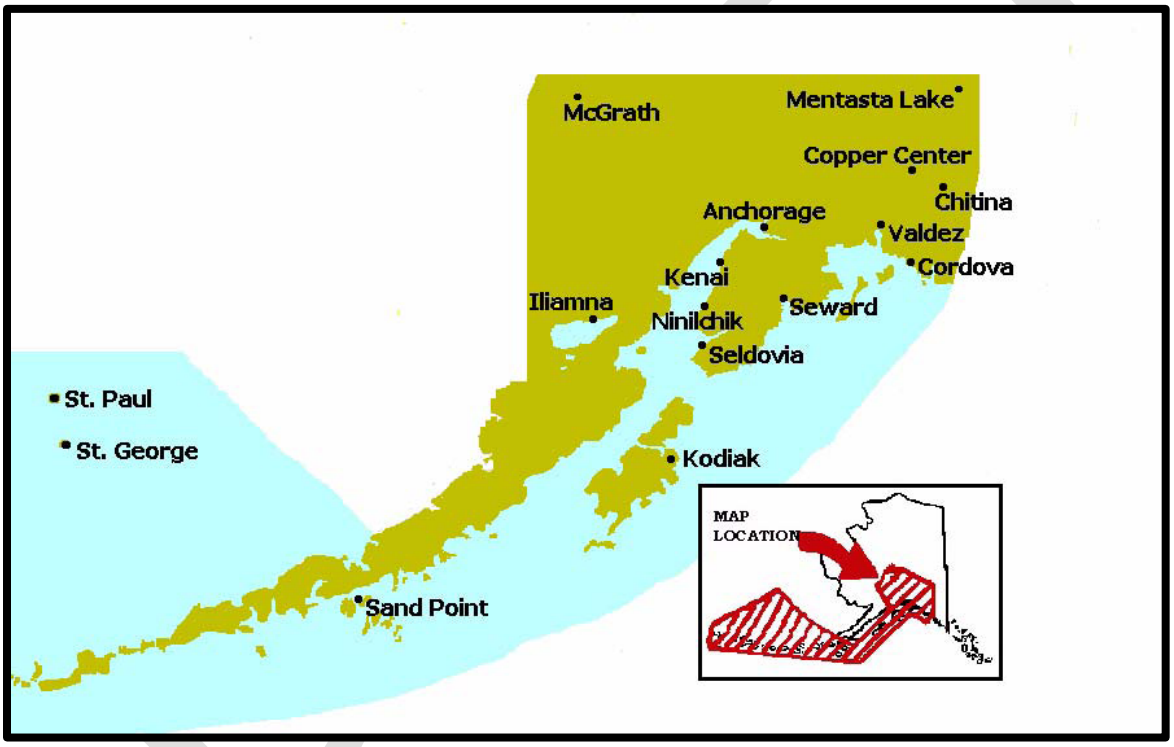
- Chief Andrew Isaac Health Center (CAIHC), located adjacent to the Fairbanks Memorial Hospital, is the major Alaska Native health facility for the region. The CAIHC employs about 110 health care professionals and support staff who provide outpatient services, medical services for patients hospitalized in Fairbanks, and itinerant medical services for 35 Interior villages. Specific functions include medical services, nursing and public health nursing services, pharmacy services, patient education, medical records, nutrition services and social outreach services.

- The McGrath Health Center is a sub-regional hospital operated by TCC and staffed by physician assistants. The clinic is a qualified Emergency Care Center. The health center provides support for Community Health Aides in surrounding communities, arranges medical evacuations as necessary, and provides routine preventive and treatment services.

- The Community Health Aide/Practitioner Program employs 50 Community Health Aides (CHAs) and Community Health Practitioners (CHPs) in 30 villages, including Nikolai and Takotna.[109]

The Cook Inlet Region, Inc. (CIRI) is the Alaska Native Corporation, which organizes and manages services to Alaska Natives within the Mat-Su Borough and Yukon-Koyukuk Census Area of the Donlin Gold Pipeline Project area. Health services are provided via the Southcentral Foundation to the Anchorage Service Unit. The Anchorage Service Unit measures approximately 107,413 square miles, and extends east to the Canadian border, north to Cantwell, west to the upper Kuskokwim Valley, and southwest to the Aleutian Pribilof Islands. The unit has the largest urban population in the state and the most diverse rural population. Over 75% of Anchorage Service Unit residents live in the Municipality of Anchorage. CIRI and the Southcentral Foundation serve the residents of Tyonek. The Southcentral Foundation maintains clinics in both Kenai and Tyonek (see Figure 43) for the location of villages within CIRI). There are no medical facilities in Beluga, Susitna, or Skwentna.

Figure 43 The Anchorage Service Unit



In the Kenai Peninsula Borough, health services are provided by both private and public organizations for both Alaska Natives and non-Natives such as the Central Kenai Peninsula Hospital and clinics and providers throughout the borough, including the Dena'ina Health Center in Kenai. Health statistics for borough residents are collected and analyzed by the Department of Health and Social Services and include Alaska Natives and non-natives in their totals.

As described in Section 5.3.8, the YKHC provides health services to residents in the Bethel Census Area operating the YKDRH in Bethel, the Clara Morgan Sub-Regional Clinic in Aniak, and the CHAP in Stony River, Sleetmute, and Crooked Creek. There are no medical services available in Red Devil; residents of Red Devil rely on medical services available in Sleetmute and Aniak.

5.4.8.1 Summary

- Limited comprehensive health care is available to residents of the Donlin Gold Pipeline Project area.

5.4.8.2 Data Gaps

- Hospital records from the Tanana Chiefs Council are not available.

6.0 EXPOSURE ASSESSMENT METHODOLOGY

As described in the Technical Guidance for Health Impact Assessment (HIA) in Alaska, health regulatory agencies throughout the world have agreed on a conceptual framework and investigative methodology to evaluate community exposure to potentially hazardous materials.[1] This framework is described in many standard textbooks of occupational/environmental medicine and toxicology [110,111], and integrated into international regulatory guidance documents published by (among many others) the National Research Council (NRC)[112,113], Environmental Protection Agency (EPA)[114,115], the World Health Organization (WHO)[116,117], the Agency for Toxic Substances and Disease Registry[118] (ATSDR), the American Society for Testing and Materials (ASTM)[119,120], and the Alaska Department of Environmental Conservation[121,122].

According to this consensus approach, a scientifically defensible conclusion that exposure to one or more chemicals of potential concern (COPCs) can cause a given adverse health effect, or that any individual or group is at increased risk of adverse effects from a certain chemical exposure, requires rigorous elucidation of each element of the logical sequence. COPCs are defined as chemicals that are associated with a site and/or its operations, and present in environmental media at concentrations higher than background levels or conservative risk-based screening levels.[114]

Source → Exposure → Dose → Health Effect(s)

This evaluation requires the following steps:

- Establish the presence of a complete exposure pathway linking a chemical source(s) to the human receptor. A pathway is defined as "the course a chemical or physical agent takes from a source to an exposed organism." A complete exposure pathway includes a source or release from a source, an environmental transport/exposure medium (or media), an exposure point (location of potential contact between a receptor and a chemical or physical agent), and an exposure route (i.e., ingestion, inhalation, dermal contact).[114]
- Measure or calculate via modeling the concentration(s) of any chemical(s) of potential concern (COPCs) at logical exposure points (locations where receptors [people, animals, and plants] could be present).
- Measure or calculate via modeling the dose received by receptors at the exposure point.
- Evaluate the potential health effects of the chemical(s) under investigation based upon the route of exposure and chemical-specific dose-response relationship(s).

This logical sequence is the basis for health impact assessment, as illustrated in Figure 44.

Figure 44 Factors Affecting Whether Environmental Contamination May Result in Harmful Effects

Source: ATSDR. 2005. Public Health Assessment Guidance Manual (Update)

These basic principles underlie the process of quantitative human health risk assessment that has been developed by regulatory authorities such as EPA, ATSDR, and ADEC. The risk assessment process consists of three basic elements:

- Exposure Assessment: Determination of the extent of human exposure based on potentially complete pathways is summarized in the exposure pathway conceptual site model (CSM).
- Toxicity Assessment: Identification of the type(s) of adverse health effects associated with COPCs, and determination of the relationship between exposure (dose) to a COPC and the probability of occurrence of these adverse health effects (response).
- Risk Characterization: Synthesis of exposure and toxicity information to determine the nature and magnitude of potential health risks at a site, including attendant uncertainties.

The following sections present relevant information on the first two risk assessment elements, exposure assessment and toxicity assessment.

6.1 Exposure Assessment – Donlin Gold

The proposed Donlin Gold project would require three to four years to construct and have an active mine life of approximately 27.5 years. The mine is proposed to be a year-round, conventional "truck and shovel" operation using both bulk and selective mining methods. Conventional carbon stripping and electrolytic gold recovery would produce an end product of gold doré bars, which would be shipped to a custom refinery for further processing. State-of-the-art mercury abatement controls would be installed at each of the major thermal sources, including the autoclave, carbon kiln, gold furnaces, and retort.[2]

Developing an exposure pathway conceptual site model (CSM) is a critical step in evaluating potential human exposures to chemicals. The CSM comprehensively represents current site conditions. It characterizes the distribution of contaminant concentrations across the site and identifies all potential exposure pathways, migration routes, and potential receptors for further analysis. As such, the CSM guides data gathering efforts. The CSM should distinguish between complete and incomplete exposure pathways. Exposure pathways consist of four elements:

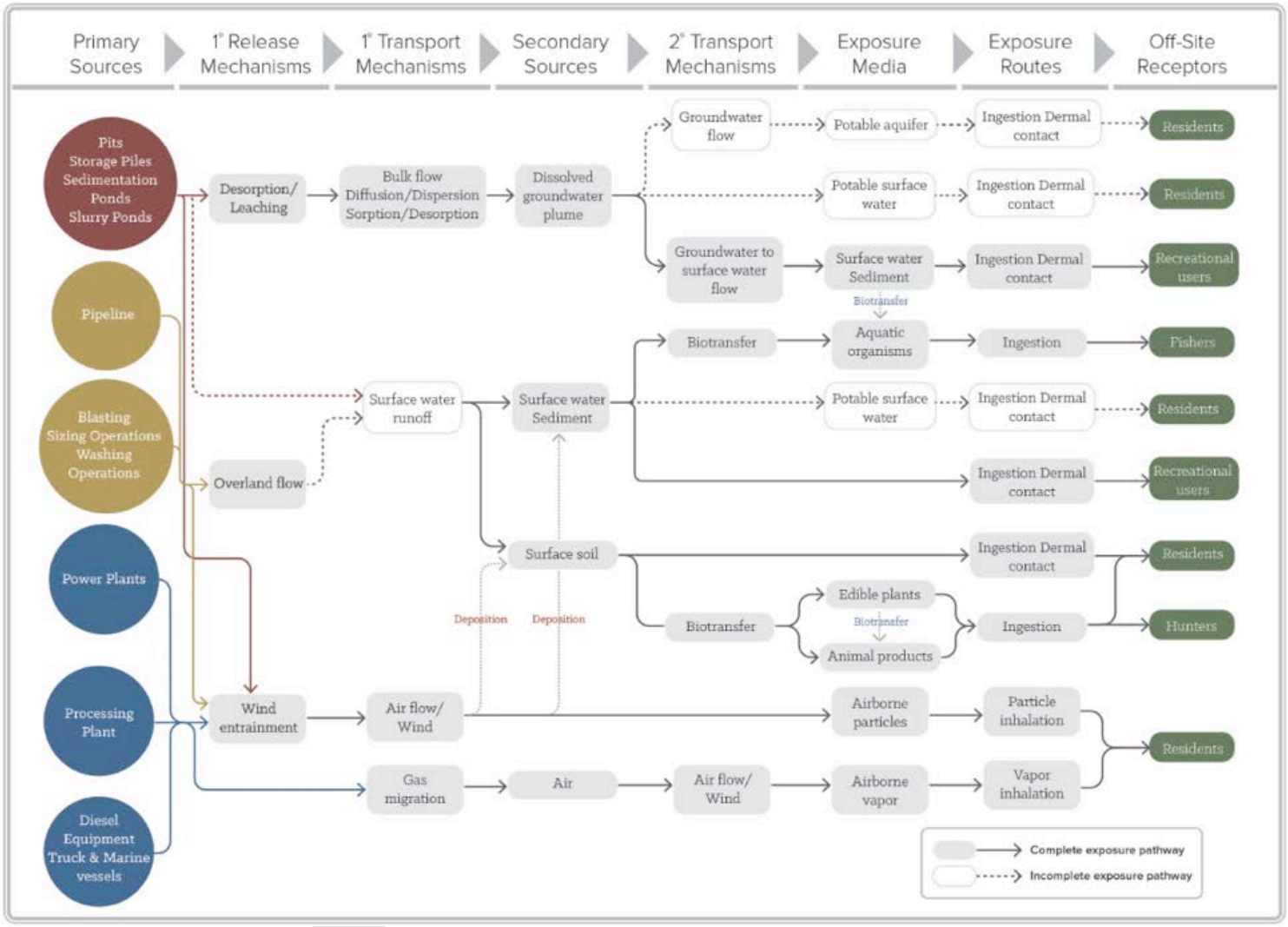
- A source and mechanism(s) of analyte release to the environment
- An environmental transport medium for the released analyte
- A point of potential human contact with the affected medium
- A route of entry into humans (inhalation, ingestion, or dermal contact with the affected medium)

If any of these components is missing, then the pathway is incomplete and does not contribute to receptor exposure. Complete pathways should include both currently complete pathways and any that may be complete in the future based on changes in operations, contaminants of potential concern (COPC) migration, or changes in land use. *It is important to understand that identifying a pathway as complete does not automatically mean there is actual harm or risk to humans or the environment*. Rather, it means that exposure across the pathway needs further evaluation to determine if it presents a risk. As shown in Figure 45, the CSM includes:

- Known or potential sources of COPCs

- Environmental media that may contain COPCs, including surface soil, subsurface soil, mined material, groundwater, air, and vegetation
- Primary and secondary release mechanisms that may be associated with each affected medium
- Potential exposure pathways for defined receptors, based on collected data or expected pathways
- Potential human receptor population.

Figure 45 Preliminary Exposure Pathway Conceptual Site Model for the Donlin Gold Project Based on Project Description



A brief discussion of the components of and rationale for the CSM for the Donlin Gold Mining and Processing Operation is presented in the following sections

6.1.1 Potential Sources of COPCs associated with the Donlin Gold Project Mining Activities

Donlin Gold project will be an open-pit gold mine that would process approximately 59,000 short tons of ore per day. Extracting the gold at the Donlin Gold site will require a large amount of processing and generate various waste streams associated with following potential sources of COPCs:

Solid waste

- Extraction processes -- overburden material (i.e. soil, waste rock, and vegetation)
- Tailings from ore preparation processes

Air quality

- Mercury from processing stack emissions
- Mercury fugitive emissions (i.e. waste rock and tailings)
- Exhaust from diesel-powered heavy equipment, motor vehicles and marine vessels
- Dust from earth moving and blasting operations
- Dust from traffic on haul roads
- VOC vapors associated with power plants and usage of fuel for heavy equipment

Water quality

- Mercury deposition onto surface waters
- Water treatment plant discharges
- Acidic discharges
    - ARD/AMD runoff (waste rock and tailings)

6.1.1.1 Ore Processing and Waste Rock

Ore processing steps include crushing, grinding, flotation, pressure oxidation, cyanide leaching, gold refining, cyanide detoxification, and discharge of tailings to the TSF.

Sodium Cyanide

Cyanide will be used to dissolve gold and other metals in processing the crushed ore. An annual average of 2,375 tonnes of sodium cyanide (NaCN) briquettes will be delivered dry in the form and then dissolved in water and caustic to make a solution for use.[124] The resulting tailings slurry from the carbon in leach (CIL) circuit would then flow by gravity through an INCO sulfur dioxide (SO_2) air cyanide detoxification process. The INCO SO2/Air process is a patented process that, after adjustment of pH and addition of a copper catalyst, uses sulfur dioxide and air to chemically change cyanide to cyanate. The cyanate is becomes unstable and changes into carbonate and ammonium ions. The carbonate ion, which is essentially dissolved carbon dioxide, precipitates as calcium carbonate. The ammonium ion is converted to ammonia and nitrates. Once the detoxified tailings from the CIL and the tailings from the flotation processes are combined, they would be discharged to the TSF. Remaining trace amounts of cyanide in the tailings are expected to breakdown further under natural conditions.

Mercury

Mercury present in the pit walls, ore, and waste rock is in the solid and stable cinnabar form. The most important releases of mercury are likely to occur via:

- Gaseous mercury released from point sources (i.e. mercury not captured from stacks at the processing facility); and
- Leaching of mercury from the solid phase due to dissolution of sulfide minerals from reaction with rain and snow that will flow over and infiltrate the pit walls, ore stockpile, and waste rock facility (WRF).

Based on an operating rate of 59,000 tons/day and average ore mercury content of 1.7 mg/kg, approximately 37 tons/year of mercury is estimated to move through the ore processing facility. Over half of the mercury entering the mill is expected end up in the TSF (approximately 19 tons/year). Mercury volatized during processing steps (involving heat) is expected to be controlled such that only 0.2% of the mercury passing through the mill will be emitted to the air. The combined air emission point sources would emit approximately 128 lbs./year (58 kg/year) of mercury to the air, subject to authorization under an air quality permit issued by ADEC. At the end of mine-life mercury emissions from the tailings storage facility (TSF) are predicted to become the second largest source after stack air emissions. Gaseous mercury emissions post-closure were estimated to vary from 8.2 lbs./year (3.7 kg/year) to 65.7 lbs./year (29.8 kg/year) since the amount of exposed surface area will vary over the life of the mine.[123]

6.1.1.2 Waste Rock Facility (WRF)

Concentrations of arsenic, antimony, and mercury found in the ore are above global crustal averages. One of the major sources of toxic metals associated with mining is acid mine drainage (AMD). When waste rock excavated from the mine is exposed to air (oxygen) and water it may react to form several acids, including sulfuric acid. Approximately 2.5 billion tons of rock will be placed in a waste rock facility (WRF) covering an area of 3.5 square miles.[124] As discussed in Section 3.7.2.4.1 of the EIS, Donlin Gold has conducted an extensive geochemical characterization of the waste rock that would be generated by the proposed mining. The results indicated that most of the waste rock has metal leaching potential, especially for arsenic, selenium, and antimony, which are soluble in the neutral to basic solutions likely to be generated by the non-acid generating (NAG) rocks. The characterization also indicated that about 7 to 8% of the waste rock is potentially acid generating (PAG). Notably, water quality predictions for waste rock also indicate arsenic has the potential to be leached from waste rock under both acidic and non-acidic conditions. [124]

6.1.1.3 Tailings Storage Facility (TSF)

During the process of gold extraction, wet tailings resembling silt are a byproduct of the milling process. Tailings deposited to the TSF during the operations phase will consist of flotation tailings, wash thickener overflow, and the detoxified cyanide slurry from the CIL circuit. Cyanide-contaminated soil would be reintroduced into the appropriate process stream or placed within the TSF, as allowed under a waste management permit. The TSF constructed in Anaconda Creek Valley is designed for zero discharge; water contained in the TSF would not be discharged. The TSF will be lined and assuming a liner defect ratio of 0.16 inches of flaw per acre, modeling

studies have estimated that up to 18 gpm of water would leak from the facility. The TSF would be designed with a rock underdrain serving to:

- Capture and direct any TSF leakage to a Seepage Recovery System (SRS) located immediately down gradient of the TSF dam; and
- Collect groundwater from areas up gradient of the TSF and direct it to the SRS.

At mine closure, the quantity of groundwater captured by this system is estimated to be 440 gpm. [125]

6.1.1.4 Diesel Operated Equipment, Motor Vehicles, and Marine Vessels

Diesel operated equipment, motor vehicles, and marine vessels will be a source of diesel engine exhaust (DEE), particulate matter (PM), and volatile organic compounds (VOCs).

6.1.1.5 Pipeline

The Project is proposing to build a buried natural gas pipeline to supply gas to power the project. The 312-mile-long, 14-inch steel pipeline would transport natural gas from the Cook Inlet region, over the Alaska Range, to the project site. The pipeline itself is a potential source of COPCs, but not under normal operating procedures.

6.1.1.6 Power Plants

There will be two power plants associated with the mine; one that will power the mine at the Project site and the existing Chugach Electric Association, Inc.'s Beluga power plant.

6.1.1.7 Water Treatment Plants (WTP)

Two water treatment plants would be constructed over the life of the proposed project to treat flows with different chemical qualities during the construction/operations and closure process. The pit dewatering water treatment plant (WTP) will be used to treat contact water prior to discharge into Crooked Creek. Contact water is surface or groundwater that has contacted mining infrastructure. This includes "mine drainage," as well as storm water runoff and seepage from mining infrastructure. A post-closure WTP is also planned that would use conventional chemical precipitation technology to reduce levels of target metals such as arsenic, manganese, antimony, and mercury. Selenium removal would be through an Octolig resin column treatment package to reduce selenium levels to below the 5 µg/L level before the treated water is discharged to the environment. It should be noted, however, that a review of selenium removal technologies conducted for North American Metals Council found that results of tests run using the Octolig were inconclusive.[126]

6.1.2 COPCs associated with the Donlin Gold Project Mining Activities

6.1.2.1 Cyanide

Cyanide is a chemical group consisting of one atom of carbon connected to one atom of nitrogen by a triple molecular bond. Examples of simple cyanide compounds are hydrogen cyanide, sodium cyanide and potassium cyanide. Certain bacteria, fungi, and algae can produce cyanide, and cyanide is found in a number of foods and plants. In certain plant foods, including

almonds, millet sprouts, lima beans, soy, spinach, bamboo shoots, and cassava roots (which are a major source of food in tropical countries), cyanides occur naturally as part of sugars or other naturally-occurring compounds.[127] According to the Agency for Toxic Substances and Disease Registry (ATSDR), individuals are unlikely to be exposed to large enough amounts of cyanide in the environment (i.e. background levels) to cause adverse health effects.

As a class of chemicals, cyanides are highly toxic. Short- term exposure can cause rapid breathing, tremors and other neurological effects. Long-term exposure can cause weight loss, thyroid disease and nerve damage.[128] The severity of the harmful effects following cyanide exposure depends in part on the form of cyanide, such as hydrogen cyanide gas or cyanide salts (e.g. sodium cyanide). Sodium cyanide is classified as an extremely hazardous substance (EHS) by the EPA and is an acute hazardous waste if disposed. Skin contact with hydrogen cyanide or cyanide salts can irritate and produce sores. There are no reports that cyanide can cause cancer in people or animals. EPA has determined that cyanide is not classifiable as to its human carcinogenicity.[127]

Unlike elemental constituents of surface waters (such as arsenic and mercury), cyanides can be destroyed by oxidation reactions, which predominantly yield less-toxic cyanate as a reaction product that can be subsequently hydrolyzed, ultimately yielding ammonium and bicarbonate ions. Such reactions may occur both naturally and by human design. Because many cyanide compounds are potentially toxic, and because cyanide would be used in the gold extraction process at the proposed mine, the baseline concentrations of cyanides in surface waters are an important piece of water quality data for future monitoring. Most cyanide in surface water will form hydrogen cyanide and evaporate. Cyanide in water does not build up in the bodies of fish.

6.1.2.2 Mercury

Mercury is naturally present in the environment and is often found in association with gold deposits, such as the Kuskokwim Gold Belt. Mercury is a toxic metal that, in low concentrations, can impair fertility, suppress the immune system or cause nerve damage that can create symptoms such as irritability in people or reduced ability to hunt in animals. In higher concentrations, mercury can delay speech and walking in young children and produce a syndrome resembling cerebral palsy. Higher concentrations in adults may produce tremors, deafness, and even death. Minamata disease associated with the consumption of mercury-contaminated fish and other seafood in Minamata, Japan, is probably the most thoroughly documented health situation.[129] The state of Alaska Division of Environmental Health (http://dec.alaska.gov/eh/mercury) has a detailed summary of current toxicity information and regulatory standards, updated in November 2014.

Methylmercury is harmful to humans, wildlife, and fish at low levels as compared to other forms of mercury. While mercury is present in all environmental media (air, soils, water), aquatic systems experience the greatest exposure due to bioaccumulation.[130] As a result of these properties, methylmercury is the most common pollutant contributing to fish consumption advisories in the U.S. The State of Alaska Department of Health and Social Services (ADHSS) has issued statewide and some region-specific guidelines for fish consumption. In 2011, ADHSS issued preliminary consumption guidelines to women and children who eat pike and burbot from the Middle Kuskokwim River region.[68] Sources of mercury in the Middle Kuskokwim

include a combination of naturally high concentrations of mercury in bedrock and sediments, and historic mining activities, as well as background contributions from global sources.[68]

6.1.2.3 Arsenic

Arsenic exists naturally in the Earth's crust and is often associated with ore deposits in the form of arsenopyrite, realgar, and orpiment. Arsenic is also a potential contaminant of concern due to its tendency to bioaccumulate in aquatic communities and ability to impact higher trophic level organisms. For example, studies have documented water snakes, which feed on fish and amphibians, with arsenic tissue concentrations higher than their prey.[131] Elevated arsenic tissue concentrations are associated with several biological impacts such as liver tissue death, developmental abnormalities, and reduced growth.[131, 132]

Arsenic is soluble in near-neutral pH and in alkaline conditions. Because of these solubility characteristics, arsenic is highly mobile and is frequently observed at elevated concentrations at sites located downstream from mine wastewater impoundments.[132] It should be noted that the toxicity and bioavailability of arsenic varies with species and valence state. For example, when arsenic is dissolved in water, it is mostly present as arsenate (+5), but in anaerobic conditions, it is likely to be present as arsenite (+3). Both pentavalent and trivalent soluble arsenic compounds are rapidly and extensively absorbed from the gastrointestinal tract. Trivalent compounds are more toxic than pentavalent compounds of arsenic and ingested organoarsenicals (i.e. from fish and shellfish) are much less extensively metabolized and more rapidly eliminated in urine than inorganic forms arsenic.

Acute arsenic intoxication associated with the ingestion of well water containing very high concentrations (21.0 mg/l) of arsenic has been reported. Signs of chronic arsenicism, including dermal lesions such as hyperpigmentation and hypopigmentation, peripheral neuropathy, skin cancer, bladder and lung cancers and peripheral vascular disease, have been observed in populations ingesting arsenic- contaminated drinking-water. Dermal lesions were the most commonly observed symptom, occurring after minimum exposure periods of approximately 5 years. Effects on the cardiovascular system were observed in children consuming arsenic-contaminated water (mean concentration 0.6 mg/l) for an average of 7 years. Numerous epidemiological studies have examined the risk of cancers associated with arsenic ingestion through drinking water. The International Programme on Chemical Safety (IPCS) concluded that long-term exposure to arsenic in drinking water is causally related to increased risks of cancer in the skin, lungs, bladder and kidney, as well as other skin changes, such as hyperkeratosis and pigmentation changes. Inorganic arsenic compounds are classified by IARC in Group 1 (carcinogenic to humans) on the basis of sufficient evidence for carcinogenicity in humans and limited evidence for carcinogenicity in animals.

6.1.2.4 Antimony

Antimony is found in the earth's crust in small quantities and enters the environment during the mining and processing of its ores and in the production of antimony metal, alloys, antimony oxide, and combinations of antimony with other substances. Antimony does not appear to accumulate in fish and other aquatic animals.[133] Chronic oral animal studies have reported effects on the blood, liver, central nervous system (CNS), and gastrointestinal effects.[133] A National Toxicology Program (NTP) 14-day drinking water study of potassium antimony tartrate

reported an increase in relative liver and kidney weights in the high dose group (females only). A 13-week intraperitoneal injection study, also by the NTP, reported inflammation and/or fibrosis of the liver in mice dosed with potassium antimony tartrate.[134] The EPA has not classified antimony for carcinogenicity.

The EPA has set a limit of 145 ppb in lakes and streams to protect human health from the harmful effects of antimony via ingestion of water and contaminated fish and shellfish. [133] In drinking water, this level should not exceed 0.006 ppm and environmental spills or discharges of ≥2267.96 kg must be reported.

6.1.2.5 Selenium

Selenium is a naturally occurring substance that is toxic at high concentrations but is also a nutritionally essential element. Epidemiological studies of humans chronically exposed to high levels of selenium in food and water have reported discoloration of the skin, pathological deformation and loss of nails, loss of hair, excessive tooth decay and discoloration, lack of mental alertness, and listlessness.[135] Epidemiological studies have reported an inverse association between selenium levels in the blood and cancer occurrence and animal studies have reported that selenium supplementation, as sodium selenate, sodium selenite, and organic forms of selenium, results in a reduced incidence of several tumor types. The only selenium compound that has been shown to be carcinogenic in animals is selenium sulfide, which resulted in an increase in liver tumors from oral exposure. EPA has classified elemental selenium as a Group D, not classifiable as to human carcinogenicity, and selenium sulfide as a Group B2, probable human carcinogen.[135]

The EPA has focused on selenium in fish tissue because, similar to mercury, it has bioaccumulative potential. The toxic potential of selenium is related to its chemical form (i.e., selenite, selenate, elemental selenium) and solubility. The predominate forms of selenium in aquatic systems that receive mining discharges are selenite and selenite.[136] The bioavailability of selenium is dependent upon: dissolved oxygen levels, hardness, pH, salinity, temperature, and the other chemical constituents present in wastewater.[137]

Selenium has been tied to fish kills, and to developmental and reproductive failure in fish, reptiles, and birds. In a 1991 study, Sorensen found that selenium levels as low as 3-8 µg/L in aquatic environments can be life threatening to fish.[137] The consumption of contaminated fish can trigger a range of effects in birds and humans. Birds that eat selenium-contaminated fish experience effects such as deformation of their beaks and jaws and problems producing viable eggs, while humans can suffer neurological damage as well as hair and nail loss. The EPA has documented numerous damage cases where selenium in coal combustion wastewater discharges resulted in the issuance of fish consumption advisories in surface waters and the exceedance of selenium MCLs in groundwater, suggesting that selenium concentrations in exceedance of MCLs can pose a human health risk.[132,138]

6.1.2.6 Particulate Matter

PM is one of six principal (or criteria) pollutants for which EPA has established National Ambient Air Quality Standards (NAAQS). Airborne PM is a complex mixture of organic and inorganic, solid and liquid, primary and secondary particles that can vary greatly in composition and concentration depending on source, geographic location, season, weather conditions, and time

of day. Major sources of PM and its precursor pollutants included fugitive dust, biomass burning, agriculture, wind erosion, and fossil fuel combustion.

High levels of PM have long been recognized as harmful to human health. More recently, acute (short-term) and chronic (long-term) exposures to much lower levels have been consistently associated with increased human mortality and morbidity, especially from cardiopulmonary diseases, including lung cancer.[139,140] The principal sources of these results have been ecologic or semi-ecologic epidemiological studies in which health effects in the population within a geographic area are related to average measurements of PM and related air quality indices at fixed monitoring locations in the area. However, these results are generally supported by controlled human exposure and toxicological studies.

6.1.2.7 Diesel Engine Exhaust

The vast majority of the mass of DEE consists of gases and vapors, primarily carbon dioxide, water vapor, carbon monoxide, nitrates, sulfate, and hydrocarbon-based gases and vapors. Organic gases and vapors are emitted as unburned and partially burned fuel, and to a lesser extent, lubrication oil. The compositional profile reflects the chemical composition of the diesel fuel. Organics include both lighter volatile organic compounds (VOCs) and heavier semi-volatile organic compounds (SVOCs). Gas-phase aldehydes are largely formaldehyde, but include acetaldehyde and higher molecular weight aldehydes. Lighter PAHs such as naphthalene are also found in the gas phase and are dominant, by mass, over the PAHs in the DPM.[141] Chlorinated dioxins and furans may also be emitted as a result of incomplete combustion. The current inventory value used by the EPA to approximate the dioxin/furan emissions from diesel engines is 172 picograms (pg.) (one trillionth of a gram) toxic equivalency (TEQ) per kilometer.[142] However, recent emission factor results from a modern diesel engine equipped with catalyzed emission control systems suggest a one to four orders-of-magnitude reduction in dioxin/furan emissions, indicating that modern diesel engines are a minor contributor to the U.S. dioxin/furan inventory.[143]

6.1.3 Potential Migration Pathways

The great majority of Project-related COPCs are expected to be metals and metalloids. These substances are naturally occurring, and undergo extensive biogeochemical cycling – that is, they are neither created nor destroyed, but may change chemical form and hence bioaccessibility and bioavailability may also change. As a result, the relationships between the sources, exposure, and effects of metals on human (and ecological) receptors are complex, and depend on conditions that may be specific to a particular site, environmental condition, and receptor organism. One or more of the following general mechanisms could affect the concentration and distribution of Project-related COPCs in environmental media on- and off-site:

- Suspension and dispersion in air of particles (soil, mined material, waste material)
- Airborne dispersion of PM and vapors from diesel-fueled heavy equipment engines and heaters
- Deposition of airborne particles on soil and surface water/sediment
- Suspension and dispersion of particles in surface water runoff
- Desorption of COPCs and leaching into underlying groundwater
- Migration of dissolved COPCs in groundwater
- Groundwater-to-surface water transfer of dissolved COPCs

- Uptake of COPCs into edible plants from soil, deposited particulate matter, and/or water
- Biotransfer of COPCs in surface water and/or sediment into tissues of aquatic animals used as human food
- Trophic transfer of COPCs in soil, deposited particulate matter, and/or water into tissues of terrestrial domestic, game, and subsistence species used as human food,
- Biological or chemical transformation of COPCs
- Climate change induced issues (regarding cycling of methyl mercury)

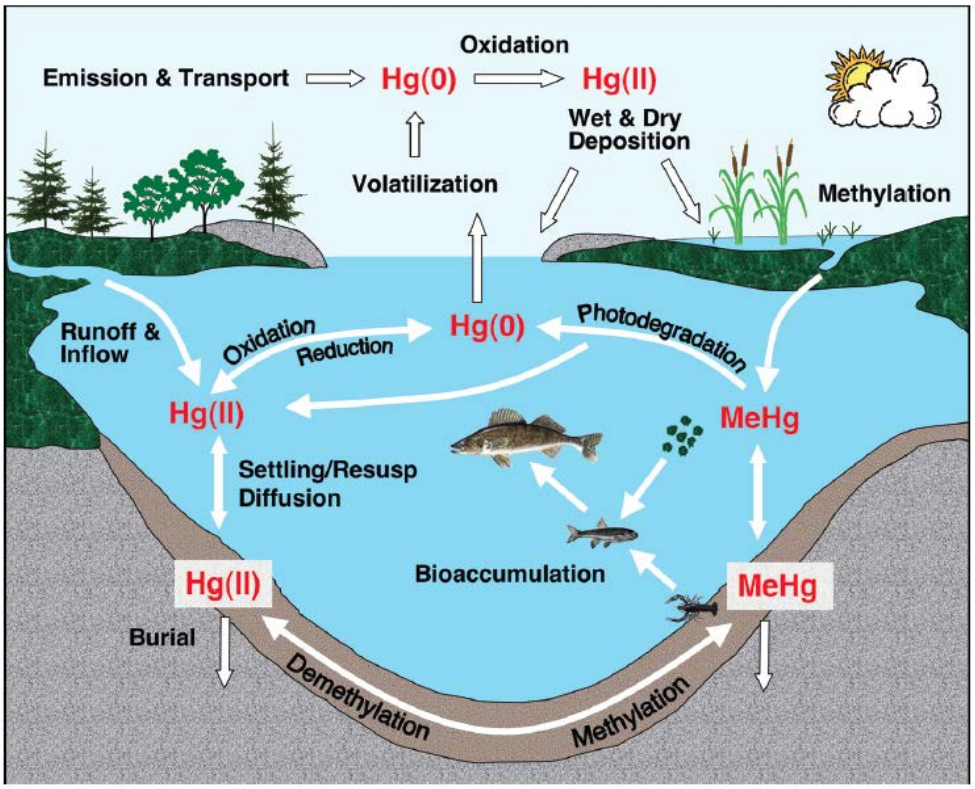
6.1.3.1 Mercury Cycling

Gaseous mercury emissions are the main pathway by which mercury is predicted to be transported from Project sources, however some mercury is also expected be released as fugitive dust (e.g. from crushing and blasting) and wastewater discharges from the site.

The residence of mercury vapor in the atmosphere is approximately 1 year at which time it is converted to the soluble form (Hg2+) and returned to the earth by rainwater. It may be converted back to vapor by microorganisms and reemitted to the atmosphere, thus it may circulate for long periods of time. Methylmercury is formed by biological reactions between microorganisms in wetlands and surface waters and inorganic mercury (that might already be present in the wetlands and surface waters or that might be deposited from other sources).

Rates of methylation can vary substantially due to a variety of abiotic factors including water pH[144,145], dissolved organic carbon (DOC[146]), geographic region[147], chlorophyll a, and climate change.[145] Microbial methylation rates increase in acidic and anoxic environments with high concentrations of organic matter. Despite all of this environmental variation, many studies have linked mercury accumulation in biota directly to atmospheric mercury loading.[148, 149] Methylmercury is readily absorbed by aquatic life and is not eliminated from fish tissue and therefore concentrations increase (bioaccumulate) up the food chain.

Figure 46 Mercury Cycling in Aquatic Systems



Source: Rodgers, 1994

6.1.3.2 Metals Leaching

Acid mine drainage (AMD) can contaminate both surface as well as ground water. According to the EPA, the variable size and mineral composition of waste rock makes accurate prediction of AMD difficult.[150]

6.1.4 Potential Exposure Media

As a result of the various release and transport mechanisms, a number of media both on and off the Project site could potentially be affected. On-site media that Project workers could be directly exposed to include: air, soil (surface and subsurface), and sediment and surface water in any on-site drainage features. However, on-site impacts to Project workers are outside of the scope of the HIA, which focuses on potential impacts to community receptors. Potential off-site exposure media include air, surface soil, and surface water and sediment. In addition to these abiotic media, COPCs may be bio-transferred into edible tissues of plants, fish, and domestic and game animals.

6.1.5 Potential Receptor Populations

Receptor populations include residents living where power plant and stack emissions may migrate offsite and subsistence users fishing from water bodies that may experience increases in

mercury deposition. Residents using groundwater and surface water constitute receptors for potential water contamination (e.g. arsenic). Fugitive dust from crushing and blasting operations would not be expected to reach the village of Crooked Creek, however dust from Project vehicles utilizing transportation routes to the ports in Bethel or Aniak may reach community receptors.

6.1.6 Potentially Complete Exposure Pathways

The rationale for selection of potentially complete exposure pathways is discussed in the following sections.

6.1.6.1 Exposure to Mercury

Adverse health effects from exposure to mercury differ depending on the form and route of exposure. The primary route of exposure to elemental mercury is inhalation of its colorless and odorless vapors. The symptoms of acute toxicity following high-level exposure to mercury vapor occur within hours of the exposure. Elemental mercury is essentially nontoxic when ingested because less than 0.1% is absorbed.[151] Dermal exposure or absorption of elemental mercury through the skin is also considered a minor exposure route. Methyl mercury is commonly found in fresh or salt-water fish as a result of bioaccumulation. The most important exposure pathway to mercury for humans is via ingestion of methyl mercury in fish. Methyl mercury has the highest potential for toxicity relative to inorganic and elemental mercury forms.

There are numerous sources of mercury air emissions that contribute to baseline/background levels in the environment. These include natural sources, such as forest fires and volcanoes and anthropogenic sources such as emissions from power plants. Once mercury enters air, it travels from its source and falls to the ground (i.e. dry deposition) or with rain and snow (i.e. wet deposition). The distance over which mercury travels and deposits from its source depends upon a number of factors including the form that is released and atmospheric conditions. Some forms of mercury can travel over long distances and deposit at locations far from the primary source. Other forms of mercury deposit closer to the source.

Mercury emitted during mining operations may migrate off the Site and be (1) inhaled by local residents, and (2) deposited on surface soil and surface water. Potentially complete indirect exposure pathways include the bioaccumulation of methylmercury in fish tissue. Consumption of fish is the major route of exposure to methylmercury. Mercury in the atmosphere and in drinking water does not constitute an important source of exposure to the general population.[152]

Project mercury air emissions

Process stack mercury emissions provided by Donlin are approximately 58 kg/yr., distributed among Hg(0) (97.2%), Hg(II) (1.3%), and Hg(p) (1.5%).[153] Gaseous mercury emitted from ore stockpile, waste rock facility (WRF), and the pit wall is referred to as “fugitive” since it cannot be collected through a traditional point-source (such as a stack). The amount of gaseous mercury emissions from these sources over the life of the mine is estimated in the report “Modeling of Local Impacts of Mercury Emissions from Stacks and Fugitive Sources”.[154]

All gaseous fugitive emissions are assumed to be Hg(0) because this is the form of mercury that readily volatilizes. Gaseous mercury emissions from the WRF, ore stockpile, and open pit mine were estimated to range from 0.071 to 2.15 lb./year, 0.077 to 0.139 lb./year, and 0.108 to 1.63 lb./year, respectively.[154] Fugitive gaseous were predicted to constitute 35% of the total Donlin Hg emissions inventory of 91 kg/yr.[155] Tailings emissions constitute approximately 90% of the total fugitive emissions. It should be noted however, that there is no widely accepted method for estimating gaseous mercury emissions from fugitive sources because gaseous emissions from waste rock and tailings storage facilities have only recently become a subject of evaluation for mining operations.

Increases in methyl mercury are of concern owing to the potentially small margin of safety between background levels of exposure and concentrations that can harm humans and other organisms (see Section 6.1.2.2).[131] Estimated mercury air concentrations attributable to Donlin stacks and fugitive sources when added to measured baseline air concentrations were below ambient air mercury guidelines for the annual average and peak 1-hour concentration of elemental Hg.[155] The maximum predicted mercury air concentration due to both fugitive and stack emissions anywhere outside the Donlin lease area was less than 1% of the most stringent guideline, and at Crooked Creek Village and Aniak was less than 0.75% of the most stringent guideline.

Table 84 Comparison of Donlin Stack and Fugitive Emission Mercury Concentrations to Guidelines

Guideline µg/m^3	Baseline at Donlin Camp µg/m^3	Modeled Maximum concentration due to stack + fugitive sources µg/m^3			Baseline + Modeled Maximum µg/m^3			Meets Guideline?
		Donlin Camp	Crooked Creek Village	Aniak	Donlin Camp	Crooked Creek Village	Aniak	
Chronic inhalation =**0.3** annual average (IRIS,EPA)	0.0014	0.0003	0.000077	0.000004	0.0017	0.001477	0.001404	yes
No observed adverse effect level (NOEL)+**0.2** annual average (WHO)	0.0014	0.0003	0.000077	0.000004	0.0017	0.001477	0.001404	yes
Acute inhalation = **1700** max 1-hour (EPA)	0.002	0.0001	0.004	0.0000036	0.102	0.006	0.002	yes

Source: ENVIRON, 2014

Project mercury water emissions

The Project plans to reduce the soluble mercury content in recirculating plant waters by adding mercury precipitation reagents in order to convert soluble mercury to a stable mercury sulfide (HgS) product.[155] The Cherokee Chemical University of Nevada-Reno (UNR 829) reagent is a proprietary reagent that is used at operating mine sites in the U.S. to reduce the soluble mercury levels leached into solution from the autoclave process (mercury containing cyanide solution that does not adsorb onto carbon) to low levels within the reclaim water stream recycled from the TSF.

Emissions are projected to increase the average concentration of total mercury in surface water to 11.6 ng/L.[154] This is below EPA-approved aquatic life criteria of 2,400 ng/L (acute) and 12 ng/L

(chronic[156]), the EPA drinking water standard of 2,000 ng/L[157], and the Alaska water quality standard of 50 ng/L[158] for total recoverable mercury. With projected increases, the resulting surface water concentrations of total mercury would, in some instances, exceed chronic criterion of 12 ng/L. It should be noted however (as described in EIS Section 3.7.2.1.1) concentrations of total mercury in surface water measured as part of the Donlin Gold water quality characterization program exceeded the 12 ng/L chronic criterion in 81 of the 465 samples (collected between June 2005 and June 2013), at baseline. As mentioned previously, past activities associated with the Red Devil Mine contributed substantial concentrations of mercury, arsenic, and antimony to the surface waters of Red Devil Creek, a tributary of the Kuskokwim River.

6.1.6.2 Exposure to Other Gases and Vapors

Power plants will emit VOCs that will migrate offsite and potentially be inhaled by local residents. Project activities will also include the operation of diesel equipment, motor vehicles, and marine vessels. Emissions from such equipment include both gases and respirable PM. Vapors that migrate beyond site boundaries and from transportation routes, could be inhaled by local residents, however the closest residents are located at Crooked Creek 10 miles from the Project site.

6.1.6.3 Exposure to COPCs in Groundwater

Some mercury will also be released into the water table via dust emissions and possible wastewater discharges from the site. Fugitive dust Hg emissions were estimated at 2% of the total Donlin Hg emissions inventory of 91 kg/yr. Ponds used to hold leachate and runoff could provide a source of dissolved COPCs to underlying groundwater (e.g. arsenic, antimony, mercury). As noted in the baseline, there are 60 individually identified PWS in the Yukon-Kuskokwim basin that are subject to ADEC regulations. Of the PWS, 53 are derived from groundwater sources. In 2005, the ADEC Kuskokwim Delta factsheet reported that 19 PWS had an average arsenic level above the MCL of 10 ppb.[56] Some communities utilize private wells, which are not subject to regulation.

Because concentrations of arsenic, antimony, and selenium in the waste rock facility (WRF) seepage are expected to exceed the most stringent AWQC, the magnitude of direct adverse impacts to groundwater quality were considered be high in the EIS. Groundwater modeling studies suggested that the spatial extent of impacts to groundwater quality would be limited to areas immediately adjacent to the WRF and between the WRF and the pit, because the affected groundwater would be intercepted by the pit and the pit dewatering system.[159], impacts to groundwater quality outside of the pit cone of depression were determined as low intensity. The magnitude of impacts to groundwater resources was considered high locally, as the quality of groundwater would not meet regulatory criteria at certain discrete locations within the proposed Project area, but low magnitude outside the cone of depression. Because groundwater impacts would be locally limited, there would not be a completed exposure pathway to off-site receptors (i.e. residents utilizing groundwater as a drinking source).

6.1.6.4 Exposure to COPCs in Surface Water and Sediment

The Project has designated surface water quality in the vicinity into three categories (Donlin Gold EIS Section 3.7 Water Quality, 2014):

- **Category 1**: waters draining undisturbed areas and areas outside of the mineralized area of interest (background sites)
- **Category 2**: waters draining the area of defined mineralized zone only, with no placer mining activities (background sites)
- **Category 3**: waters draining from areas of both placer mining and the mineralized zone of the proposed Donlin Gold project (baseline sites)

Based on the available information, potentially complete exposure pathways associated with surface water include:

- Potable use (ingestion, inhalation, dermal contact)
- Ingestion of fish

Cyanide

Project sodium cyanide handling and storage practices and processes will be planned in accordance with the International Cyanide Management Code (Code), as developed by the International Cyanide Management Institute, and to all applicable laws and regulations.[160] The Code covers the production, transport, storage, and use of cyanide and the decommissioning of cyanide facilities. Companies that wish to receive certification under the Code must undergo an independent third-party verification audit. The Code comprises two major elements: principles that broadly state commitments to manage cyanide in a responsible manner; and the associated standards of practice, which identify performance goals and objectives needed to comply with the principles. The key principles comprised in the Code can be found in Section 2.16.2 of the Integrated Waste Management Plan.[160] Principles of the Code related to community health include the following:

- Protect communities and the environment during cyanide transport.
- Manage cyanide process solutions and waste streams to protect human health and the environment.
- Protect communities and the environment from cyanide through development and implementation of decommissioning plans for cyanide facilities.
- Protect communities and the environment through the development of emergency response strategies and capabilities.
- Engage in public consultation and disclosure.

As described in Section 6.1.2.1, unlike elemental constituents of surface waters (such as arsenic and mercury), cyanides can be destroyed by oxidation reactions, which predominantly yield less-toxic cyanate as a reaction product that can be subsequently hydrolyzed, ultimately yielding ammonium and bicarbonate ions. The Project has plans to detoxify the cyanate prior to release to the TSF. According to the EIS[161], expected effluent levels of weak acid dissociable (WAD) cyanide for treated discharge into Crooked Creek were <0.005 mg/L, which is below 0.0052 mg/L the most stringent applicable water quality criteria.

Acid Mine Drainage (AMD)

Several extensive geochemical characterization studies have been completed in order to define the geochemistry of waste rock materials associated with the Project. These studies concluded that the majority of the waste rock at the Project has a low potential for AMD with neutralization potential/acid generating potential (NP/AP) well above 2.[2] However, some

samples did fall in the range of uncertainty (i.e., 1<NP/AP<2) or are PAG based on a site-specific criterion of NP/AP <1.3. Measures to prevent ARD formation include the blending of NAG 1-4 rock with PAG 5 rock in the interior of the WRF.[162]

Metal Leaching (ML) - Tailings

According to the Water Resources Management Plan[163], metallurgical testing produced pilot tailings liquor that would be elevated in a number of constituents relative to Alaska drinking water and aquatic life water quality standards. The tailings liquid pH is predicted to remain approximately 7.6 to 7.7, but could have concentrations of sulfate in the range of 2,500 to 4,600 mg/L and arsenic concentrations in the range of 0.43 to 1.1 mg/L. The tailings liquid is predicted to exceed AWQC for cobalt, mercury, manganese, magnesium, molybdenum, antimony, and selenium.[164] The concentrations of constituents in the TSF pond and porewater could increase beyond the results by as much as a factor of five due to re-circulation of tailings water into the flotation and hydrometallurgical processes.[165] Thus, the impact of the tailings on recycled water quality was predicted as high intensity, but local in extent. [166]

Table 85 Final Plant Tailings Liquor - Metals Analysis

Parameter	Unit	[1]AWQC	Feasibility Pilot (Phase 2) Final Tailings Filtrate Oct 2007		Feasibility Pilot (Phase 1) Final Tailings Filtrate Feb 2007		Pre-Feasibility Pilot Final Tailings Filtrate Oct 2006	
			Total	Dissolved	Total	Dissolved	Total	Dissolved
Ag	mg/L	--	0.00003	<0.00001	0.00056	0.00055	0.00042	0.00027
Al	mg/L	--	0.02	0.01	0.0324	0.0046	0.06	0.01
As	mg/L	[2]0.01	1.11	1.09	0.467	0.483	0.454	0.432
B	mg/L	--	0.198	0.190	1.17	1.31	0.428	0.445
Ba	mg/L	[2]2	0.0229	0.0224	0.0278	0.0256	0.0231	0.0227
Be	mg/L	[2]0.004	<0.00002	<0.00002	<0.00004	<0.00004	<0.00004	<0.00004
Bi	mg/L	--	<0.00001	<0.00001	<0.00002	<0.00002	--	--
Ca	mg/L	--	449	500	427	437	531	516
Cd	mg/L	[2]0.005	0.000242	0.000241	0.00011	0.00018	0.00039	0.00042
Ce	mg/L	--	<0.00007	<0.00007	<0.00009	<0.00009	0.00012	<0.00009
Co	mg/L	[6]0.050	0.00644	0.0072	0.114	0.141	0.0251	0.0266
Cr	mg/L	[2]0.1	0.0039	0.0035	0.0014	0.001	0.0015	0.0018
Cs	mg/L	--	<0.0004	<0.0004	0.0052	0.00572	0.00523	0.0047
Cu	mg/L	[6]0.20	0.0077	0.0072	0.115	0.135	0.102	0.116
Fe	mg/L	[4]1	0.27	0.17	0.02	0.05	0.19	<0.01
Ga	mg/L	--	<0.00001	0.00011	0.00033	0.00033	0.00104	0.0011
Ge	mg/L	--	0.00027	0.00025	0.0005	0.0017	<0.0001	0.0009
Hf	mg/L	---	0.000548	0.00005	0.00022	0.00007	0.00103	0.00064

Table 85 Final Plant Tailings Liquor - Metals Analysis

Parameter	Unit	[1]AWQC	Feasibility Pilot (Phase 2) Final Tailings Filtrate Oct 2007		Feasibility Pilot (Phase 1) Final Tailings Filtrate Feb 2007		Pre-Feasibility Pilot Final Tailings Filtrate Oct 2006	
			Total	Dissolved	Total	Dissolved	Total	Dissolved
Hg	mg/L	[3]0.000012	0.00004	0.00002	0.00028	--	0.0242	--
In	mg/L	--	<0.00001	<0.00001	<0.00004	<0.00004	<0.00004	0.0001
K	mg/L	--	40.4	45.3	63.8	62.5	50.1	48.7
La	mg/L	--	<0.00004	<0.00004	0.00007	0.00004	0.00008	0.00007
Li	mg/L	[6]0.25	<0.002	0.005	0.016	0.016	0.747	0.743
Mg	mg/L	--	150	160	820	833	682	659
Mn	mg/L	[3]0.05	0.676	0.677	18.1	18.4	15.7	13.2
Mo	mg/L	[6]0.010	0.0781	0.0736	0.106	0.114	0.302	0.259
Na	mg/L	--	376	275	93	95.9	120	116
Nb	mg/L	--	0.00002	<0.000001	<0.0001	<0.0001	0.0006	<0.0001
Ni	mg/L	[2]0.1	0.0208	0.0124	0.0574	0.0641	0.0477	0.0567
Pb	mg/L	[6]0.05	0.001	0.0003	0.00302	0.00048	0.00057	<0.00002
Rb	mg/L	--	0.0290	0.0288	0.119	0.13	0.185	0.103
Re	mg/L	--	<0.0002	<0.0002	0.00012	0.00018	0.00046	0.00046
Sb	mg/L	[2]0.006	0.0459	0.0449	0.0319	0.0343	0.386	0.341
Se	mg/L	[4]0.005	0.014	0.016	0.042	0.044	0.028	0.033
Si	mg/L	--	2.34	2.56	3.07	2.92	--	--
Sn		--	0.00011	0.00015	0.001	0.0008	--	--
Sr		--	2.63	2.34	3.83	3.69	2.46	2.54
Ta	mg/L	--	0.00002	<0.000001	<0.00003	<0.00003	0.00024	<0.00003

Notes:
1 Applicable water quality criteria
2 Drinking water primary max. contaminant levels
3 The previously approved aquatic life criteria for mercury (2.4 ug/l acute and 0.012 ug/l chronic, both as total recoverable) remain the applicable criteria for CWA purposes
4 Aquatic life criteria for fresh waters (chronic)

Source: SRK, 2012: Water Resources Management Plan, Donlin Gold Project, July.

Contact and Pit Water

The predicted average water quality from the pit dewatering wells does not meet the most stringent AWQS without treatment. Modeling indicates specific parameters that would exceed the criteria include aluminum, arsenic, iron, lead, manganese, and molybdenum. As described in Donlin Gold EIS Section 3.7, a WTP would be designed to treat the pit well water to all applicable water quality standards before release to the environment. The treatment system would operate at elevated pH levels through lime addition to precipitate arsenic and manganese. Ferric

sulfate would be used as needed to precipitate metals present at elevated concentrations. Aluminum would be reduced to concentrations below the AWQS by ferric co-precipitation and filtration.

The lower and upper contact water dam (CWD) ponds would be built in American Creek for the purpose of managing runoff from the WRF and pit, and preventing mine contact water from release to the environment.[161] Mine contact water will also be treated at the WTP prior to discharge. The WTPs have been designed to ensure that all water discharged from the site meets AWQS.

Tailings Storage Facility and Water Dam

The Tailings Storage Facility and Water Dam Operations and Maintenance Plan were not available for review at the time of the writing of this report. The impacts to surface water quality resulting from the reclaimed tailings facility at closure would ultimately depend upon the long-term performance of the engineered cover and the TSF liner. Assuming that the cover achieves the goal of minimizing infiltration of precipitation into the covered tailings and seepage is successfully directed to the SRS, the impact of the covered tailings on surface water quality was considered negligible in the EIS. The EIS notes that while the performance of these systems can be reasonably assured over decadal timescales, reliability of such engineered systems over thousands of years (i.e. in perpetuity) has not been demonstrated.[161]

7.0 DATA GAPS

A substantial body of environmental and social information has been reviewed. In addition, new data have been collected (section 3.3 for the Mine and section 3.4 for the Pipeline) from numerous data sources.

A standard step in any HIA is the data gaps analysis. The key data gaps are listed in Table 86, by HEC and Project component.

Table 86 Key Data Gaps by Health Effect Category

HEC 1 Social Determinants of Health (SDH)	• Specific information about worker accommodations in the city of Bethel (if there will be a work camp, will it be open versus closed camp, number of inhabitants, space per person, ventilation requirements, will workers be housed in hotels, etc. utilizing existing infrastructure).
HEC 2: Accidents and Injuries	• None
HEC 3 Exposure to potentially Hazardous Materials	**Unavailable Documents/Sections – Requires further interdependency coordination with Environmental** • Tailing Storage Facility and Water Dam Operations and Maintenance Plan, Donlin Gold. • Mercury Management Plan, Donlin Gold.
HEC 4 Food, Nutrition and Subsistence	• Updated ADF&G harvest survey data for Tyonek and Beluga. • Magnitude of potential out-migration of residents primarily responsible for providing subsistence resources within their household/community.
HEC 5 Infectious Diseases including STIs	• In-migration patterns (place of origin of household members, professional status of household members) o Extent of influx to Bethel • Project catering, food waste management plan, and integrated pest management plan. • Accommodations for Bethel Port workers (camp versus hotels, open or closed camp, etc.) • Project outbreak management plan for workers
HEC 6 Chronic Non-Communicable Diseases (NCDs)	• Current YKHC data. • Anemia prevalence. • Anthropometric measurements of young children.
HEC 7 Water and Sanitation (WATSAN)	• Updated data for water and sanitation service rates by tribal health region are not available. • Extent of surface water use by residents in Crooked Creek.

Table 86 Key Data Gaps by Health Effect Category

HEC 8 Health Infrastructure and Capacity	• The Emergency Response Plan (ERP) must be reviewed when complete. • Will there be first aid station at the Bethel camp? • Details of ERP coordination, i.e. with YKDRH and other local emergency services. • Pharmacy supplies of specific categories of drugs (available for some communities).

Any critical data gaps can be closed by either collection of specific data sets by the Project or via collaboration with local health officials. If there is a need for additional community health data, the effort is best managed as a collaborative effort with the relevant local, state and national health authorities.

8.0 PRIORITIZING HEALTH IMPACTS

The goal of an HIA is to identify potential health impacts and communicate these impacts to decision-makers during the planning and permitting process. The most important key health impacts related to the proposed Donlin Gold project are discussed in this section. The approach for rating and ranking health impacts is taken from Section 8 of the Alaska HIA Toolkit.[1]

A health impact is a positive or negative change in a specific health outcome or health determinant. Health impacts are:

- Changes in health outcomes or determinants, not general changes in environmental conditions;
- Specific health outcomes or determinants, not general statements about health status; and,
- Quantifiable, whenever possible.

Each HEC contains health impacts that fit the criteria above. Table 87 describes the interaction between Project design features or influences and health outcomes. Detailed analyses of potential negative impacts are described in Section 8.1.

Table 87 Donlin Nexus and Impacts

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
HEC1: Social Determinants of Health		
Life expectancy Challenge	General changes in: • Regional income • Employment • Educational attainment	Positive: Increased income, employment, and/or educational attainment could produce an improvement in life expectancy during the lifetime of the project. -If limited economic opportunities persist, life expectancy could remain the same.
% Receiving prenatal care Challenge	General changes in: • Transportation capacity • Regional income	Positive: Increased income, employment, and/or educational attainment could increase the percentage of expecting mothers receiving prenatal care. -If limited economic opportunities persist, the percentage of expecting mothers receiving prenatal care could remain low. Positive: Improved transportation capacity could increase percentage of expecting mothers receiving prenatal care. Negative: Further strain on transportation capacity could decrease the percentage of expecting mothers receiving prenatal care.
Teen birth rates Challenge	General changes in: • Regional income • Poverty rates • Worker influx	Positive: Improved economic opportunities could decrease teen pregnancy rates. -If limited economic opportunities persist teen birth rates could remain high. Negative: Unmanaged workforce influx could increase teen pregnancy rates throughout the lifetime of the project.
Intimate partner violence Challenge	General changes in: • Regional income • Economic opportunities • Shift work/Spousal separation	Positive: Increased income, employment, and/or educational attainment could decrease intimate partner violence in the region. Negative: Decreased marital stability, stemming from factors such as shift work, could slightly increase rates of

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
		intimate partner violence in the region.
Unwanted sexual activity Challenge	General changes in: • Regional income • Economic opportunities • Workforce influx	Positive: Increased income, employment, and/or educational attainment could decrease unwanted sexual activity. Negative: Increased interaction between local residents and project employees could produce an increase unwanted sexual activity.
% Receiving dental care Challenge	General changes in: • Regional income • Economic opportunities • Health care capacity • Transportation capacity	Positive Increased income, employment, and/or educational attainment could increase the percentage of residents receiving dental care. Positive: Improved capacities of health care facilities could increase the percentage of residents receiving dental care. Positive: Improved transportation capacity could improve the percentage of residents receiving dental care. -If limited economic opportunities persist, the percent of residents receiving dental care could remain low. Negative: Increased strain on the capacity of health care facilities could reduce the percentage of residents receiving dental care. Negative: Increased strain on transportation capacity could decrease the percentage of residents receiving dental care.
Suicide rates Challenge	General changes in: • Regional income • Economic opportunities	Positive: Improved economic activity could decrease suicide rates in the region. -If limited economic opportunities persist, suicide rates will likely remain high in the region.
Child abuse Challenge	General changes in: • Regional income • Economic opportunities	Positive: Improved economic opportunities could decrease rates of child abuse. -If limited economic opportunities persist, child abuse rates will likely remain high in the region.
% Single-parent families	Change in: • Shift work/spousal	Negative: Increases in marital instability increases (i.e., due to rotating work

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
Challenge	separation	schedules), could increase the percentage of single-parent families in the region.
% Smoking during pregnancy Challenge	General changes in: • Regional income • Economic opportunities	Positive: Increased income, employment, and/or educational attainment could increase the percent of expecting mothers receiving prenatal care. -If limited economic opportunities persist, the percent of expecting mothers smoking during pregnancy will remain high.
% Living below poverty line Challenge	General changes in: • Employment status • Regional Income	Positive: Increased income, employment, and/or educational attainment could decrease the percent of residents living below the poverty level. -If limited economic opportunities persist, the percent of residents living below the poverty level could remain high.
% Low birth weight Strength	General changes in: • Transportation capacity • Regional income	Positive: Increased economic opportunities could decrease the percent of low birth weight births throughout the lifetime of the project. -If limited economic opportunities persist or worsen, then the percent of low birth weight births could increase.
Neonatal infant mortality Strength	General changes in: • Transportation capacity • Regional income	Positive: Improved economic opportunities could decrease the percentage of low birth weight births. -If limited economic opportunities persist or worsen, then the percent of low birth weight births could increase.
Substance dependence Strength (compared to AK) Challenge (compared to US)	General changes in: • Regional income levels • Economic opportunity • Employment status with drug and alcohol testing	Positive: Workforce policies that require drug and alcohol testing for employment could decrease rates of heavy/binge drinking. Positive: Improved economic opportunities could decrease rates of heavy/binge drinking. -If limited economic opportunities persist or worsen, then rates of heavy/binge drinking could increase.

Outcome/Determinant (Strength/ Challenge)	**Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)**	**Potential Health Impact (What might be the result of the interaction?)**
Heavy/binge drinking rates Strength (compared to AK) Challenge (compared to US)	General changes in: • Regional income • Economic opportunity • Employment status with drug and alcohol testing	Positive: Workforce policies that require drug and alcohol testing for employment could decrease rates of substance dependence. Positive: Improved economic opportunities could decrease rates of substance dependence. -If limited economic opportunities persist or worsen, then rates of substance dependence could increase.
Alcohol use during pregnancy Strength	General changes in: • Regional income • Economic opportunity • Employment status with drug and alcohol testing	Positive: Workforce policies that require drug and alcohol testing for employment could decrease rates of alcohol use during pregnancy. Positive: Improved economic opportunities (e.g., income and employment) could decrease rates of alcohol use during pregnancy. -If limited economic opportunities persist or worsen, then rates of alcohol use during pregnancy could increase.
Educational attainment Challenge	General changes in: • Regional income • Economic opportunity • Workforce training programs	Positive: Improved economic opportunities could increase educational attainment. Positive: Workforce training/education programs could increase the percentage of residents with higher levels of educational attainment.
Psychosocial distress Challenge	General changes in: • Workforce influx • Feeling of encroachment • Anxiety regarding project-precipitated environmental changes	Positive: Improved economic opportunities could reduce the experience of psychosocial distress in the region. Negative: Increases in community stressors (e.g., lack of resources, encroachment on traditional lands, cultural isolation), could increase psychosocial distress in the region.
Cultural continuity Strength	General changes in: • Regional income • Economic opportunity • Cultural continuity	Positive: Improved economic opportunities could encourage residents to remain in their communities which would improve cultural continuity in the region. Negative: If the importance of culture is not maintained during work shifts, then cultural continuity in the region could experience a decrease throughout the

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
		lifetime of the project.
HEC2: Accidents and Injuries		
Fatal/non-fatal unintentional injuries Challenge	Changes in: • River transportation volume and patterns • Traffic volumes and patterns in Bethel • Air transportation volumes and patterns	Positive: Improved transportation and access to health care could decrease fatal and non-fatal unintentional injuries in the region. Negative: Increased transportation volume on the river could increase the number of fatal and non-fatal unintentional injuries. Negative: Increased transportation volume at the Bethel port could increase the number of fatal and non-fatal unintentional injuries in the area.
Fatal/non-fatal intentional injuries Challenge	Changes in: • Workforce influx and management • Regional income • Economic opportunity • Alcohol /substance use • Cultural continuity	Positive: Increased income, employment, and/or educational attainment could decrease fatal and non-fatal intentional injuries in the region. Positive: Decreased alcohol and/or other substance abuse could reduce fatal and non-fatal intentional injuries. Negative: Increased alcohol and/or other substance abuse could increase fatal and non-fatal intentional injuries. Negative: Decreased cultural continuity could increase fatal and non-fatal intentional injuries.
Deaths due to poisoning (primarily alcohol) Challenge	Changes in: • Regional Income • Economic opportunity • Availability and/or affordability of alcohol	Positive: Increased income, employment, and/or educational attainment could decrease the rate of poisoning deaths due to alcohol. Negative: Increased availability of alcohol could increase the rate of poisoning deaths from alcohol.
Law enforcement presence Challenge	Changes in: • Regional income • Economic opportunity • Workforce influx • Funding for law enforcement services	Positive: Increased income and economic opportunities could allow increased law enforcement presence in the region. -If limited economic conditions persist, the support for law enforcement services in the region could decrease.
HEC3: Exposure to Potentially Hazardous Materials		

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
MeHg hair concentrations Strength	Changes in: • Fish consumption • Fish availability • Water quality affecting MeHg concentrations in Fish	Negative: Increased mercury released into sources of groundwater or surface water (above accepted levels), then MeHg concentrations in residents could experience small, but important increase for a period of time after the event (if fish consumption patterns do not change).
Poor air quality days (exceedances) Strength	General changes in: • Air quality • Particulate Matter	Negative: If air quality pollutants (e.g., $PM_{2.5}$) are released into the air (above accepted levels), then the number of poor air quality days in the region will experience small, but important increase for the lifetime of the project.
HEC4: Food, Nutrition, and Subsistence		
Participation in subsistence Strength	Changes in: • Access to subsistence resources near project • Work schedules that may prohibit subsistence practices • Income from employment that may affect subsistence ability • Changes in subsistence utilization from perception of water quality changes	Positive: Increased economic opportunities could increase participation in subsistence due to increased affordability of hunting/fishing. Negative: Improved economic opportunities then participation in subsistence activities in the region could *decrease* due to increased affordability store-bought food. Negative: Decreased access to subsistence resources due to work schedules could reduce participation in subsistence activities. Negative: Decreased access to and/or quantity of subsistence resources due to river traffic or influx of workers could decrease participation in subsistence activities by local residents. Negative: Perception that subsistence resources have low quality could decrease participation in subsistence activities by local residents.
Food costs and availability Challenge	Change in: • Food prices due to workforce influx	Negative: Further strain on limited store resources could increase the cost of food in the region. Negative: Further strain on limited store resources could limit the availability of store-bought food in the region.

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
Micronutrient deficiencies	No likely nexus	No likely potential health impacts.
Food security Both	Changes in: • Regional income • Subsistence practices • Workforce Influx	Positive: Improved economic opportunities could improve food security in the region either due to increased affordability of hunting/fishing, new capital ventures or increased affordability of store-bought food. Negative: Further strain on limited store resources could decrease food security throughout the lifetime of the project. Negative: Decline in consumption of subsistence could decrease food security in the region throughout the lifetime of the project.
HEC5: Infectious Diseases		
Chlamydia rates Challenge	Changes in workforce influx	Positive: With STI education from workforce training/education programs, chlamydia rates could decrease throughout the lifetime of the project. Negative: If workforce influx is poorly managed, then chlamydia rates could experience an increase throughout the lifetime of the project.
Gonorrhea rates Challenge	Changes in workforce influx	Positive: With STI education from workforce training/education programs, gonorrhea rates could experience a decrease throughout the lifetime of the project. Negative: If workforce influx is poorly managed, then gonorrhea rates could experience an increase throughout the lifetime of the project.
Infectious respiratory disease rates (esp. TB, influenza, RSV, pneumonia) Challenge	Changes in: • Workforce influx (ill/unvaccinated) • Camp living conditions	Positive: With infection prevention education from workforce training/education programs, rates of infectious respiratory diseases (esp. TB, influenza, RSV, pneumonia) rates could decrease Negative: If an employee with the project is ill/unvaccinated and interacts with local residents (or other employees in the work camps), then rates of infectious respiratory diseases (esp. TB,

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
		influenza, RSV, pneumonia) could increase
Septicemia mortality Challenge	Changes in: • Water and sanitation services • Transportation and easy access to health centers	Positive: Improved transportation access to health care could decrease septicemia mortality Positive: Improved water and sanitation services could decrease septicemia mortality Negative: Further strain on access to health care could increase septicemia mortality rates Negative: Further strain on limited water and sanitation services could increase septicemia mortality rates
Vaccination rates Strength	Changes in vaccine availability and access to treatment	Positive: Improved access to health care and vaccination services could improve vaccination rates Positive: If the project requires standard immunizations for employment, then vaccination rates could slightly increase during the lifetime of the project.
HEC6: Water and Sanitation		
Housing units with water and sewer service Challenge	Changes in workforce influx	Positive: Improved economic opportunities could increase the percent of housing units with water and sewer service. Negative: Persistent limited economic opportunities could decrease the number of houses with sewer service. Negative: Further strain on water and sanitation services could decrease the percent of housing units with water and sewer service in the region.
HEC7: Non-communicable and Chronic Diseases		
Prevalence of diagnosed diabetes Strength (in YK) Challenge (in Yukon Koyukuk)	Change in: • Access to health care screening • Physical activity opportunity • Food availability • Regional income	Positive: If physical activity is encouraged at the workplace (during shifts requiring lodging at camp), then the prevalence of diabetes could experience a small decrease. Negative: Increased consumption of some store-bought could increase the prevalence of diabetes in the region.
Smoking rates	Change in:	Positive: Improved economic

Outcome/Determinant (Strength/ Challenge)	**Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)**	**Potential Health Impact (What might be the result of the interaction?)**
Challenge	• Regional income • Cost of tobacco products • Availability of tobacco products	opportunities could decrease the relative cost of smoking and rates of smoking could slightly increase throughout the lifetime of the project. -If economic opportunities persist or worsen, then rates of smoking could increase
Cancer mortality (esp. colon and lung) Challenge	Changes in: • Transportation ease • Access to screening and treatment	Positive: Improved transportation and access to health could decrease cancer mortality from some cancers in the region. Negative: Further strain on transportation and access to health care is further strained could produce a slight increase in cancer mortality.
Chronic respiratory disease rates Challenge	Changes in air quality	Negative: If air quality declines (esp. $PM_{2.5}$), chronic respiratory disease rates (e.g., COPD, asthma) could increase.
Cardiovascular disease mortality Challenge	Changes in: • Air quality • Workplace physical activity practices • Dietary intake patterns	Positive: If physical activity is encouraged at the workplace (during shifts requiring lodging at camp), then cardiovascular disease mortality could decrease. Negative: If air quality declines (esp. $PM_{2.5}$), chronic respiratory disease mortality (e.g., ischemic heart disease) could increase. Negative: If subsistence participation decreases and residents consume more store-bought foods, then cardiovascular disease could increase.
Cerebrovascular disease mortality Strength	Changes in: • Air quality • PM concentrations	Positive: If physical activity is encouraged at the workplace (during shifts requiring lodging at camp), then cerebrovascular disease mortality could decrease. Negative: If air quality declines (esp. $PM_{2.5}$), cerebrovascular disease mortality in the region could increase. Negative: If subsistence participation decreases and residents consume more store-bought foods, then cardiovascular disease could increase.
Obesity	Changes in: • Physical activity	Positive: If physical activity promotion in the workplace could produce a small

Outcome/Determinant (Strength/ Challenge)	Potential Project Nexus (What project features/influences might interact with the outcome/determinant?)	Potential Health Impact (What might be the result of the interaction?)
Strength (compared to AK) Challenge (compared to US)	opportunity • Food availability • Regional income	decrease in obesity rates. Negative: Increased consumption of store-bought foods could slightly increase obesity rates.
Use of smokeless tobacco Challenge	Change in availability and cost	Negative: Increases in income, employment, and/or educational attainment could decrease the relative cost of smokeless tobacco and the rates of smokeless tobacco use could experience a small increase.
HEC8: Health Services Infrastructure and Capacity		
Access to comprehensive care Challenge	Changes in: • Workforce Influx • Emergency services utilization • Regional income • Access to health insurance	Positive: Improved capacity of outlying health care facilities could improve access to more comprehensive care throughout the lifetime of the project. Positive: Increases in income, employment, and/or educational attainment could improve access to care. Negative: Further strain on capacity of health care facilities is further strained (e.g., higher demand due to workforce influx), access to health care could decline. -If limited economic opportunities persist, access to health care in the region could remain low.
Presence of clinic or community health aid Challenge	Changes in: • Number of health clinics • Health providers • Training programs	Positive: Improved capacity of health care facilities and/or the economic resources to supply them could improve availability of clinics and community health aids. Negative: Strain on the capacity of health care facilities in communities (e.g., higher demand due to workforce influx) could decrease the availability of clinics and community health aids in the region.

Given this list of potential health impacts, the next step is to establish which impacts are most important for decision-makers to address. This is determined by attempting to assign a score that describes the intensity of the impact and the likelihood that the impact could occur. The table below Describes the first step for assigning intensity to the four dimensions of each impact. Each dimension is reviewed and given a score of 0, 1, 2, or 3.

Table 88 Impact Dimensions

Step 1				
	Impact Dimensions			
Impact Rating Score	**A – Health Effect (+/-)**	**B- Duration**	**C-Magnitude**	**D- Extent**
0	Effect is not perceptible	Less than 1 month	Minor	Individual cases
1	(+/-) Minor benefits or risks to injury or illness patterns (no intervention needed)	Short-term: 1-12 months	Those impacted will 1.) be able to adapt to the impact with ease and maintain pre- impact level of health, 2.) see noticeable but limited and localized improvements to health conditions	Local: small limited impact to households
2	(+/-) Moderate benefits or risks to illness or injury patterns (Intervention needed, if negative)	Medium-term: 1 to 6 years	Those impacted will: 1.) be able to adapt to the health impact with some difficulty and will maintain pre-impact level of health with support, or 2.) experience beneficial impacts to health for specific population some maintenance may still be required	Entire Potentially Affected Communities (PACs); village level
3	(+/-) Severe benefits or risks: marked change in mortality and morbidity patterns (intervention needed, if negative)	Long-term: more than 6 years/life of project and beyond	Those impacted will: 1.) not be able to adapt to the health impact or to maintain pre-impact level of health 2.) see noticeable major improvements in health and overall quality of life	Extends beyond PACs; regional and state-wide levels

After the intensity level is determined, steps 2 and 3 allow the likelihood of the event to be evaluated and a final importance rating is assigned to the potential impact using the table below

(Table 89). The final result in step 4 is that each impact then receives an overall importance rating category of 1, 2, 3, or 4.

Table 89 Likelihood Rating

Step 2	**Step 3**						
Impact Level (Use Score from Step 1 to choose range)	**Likelihood Rating**						
	Extremely Unlikely (<1%)	**Very Unlikely (1-10%)**	**Unlikely (11-33%)**	**About as likely as Not (33-66%)**	**Likely (66-90%)**	**Very Likely (90-99%)**	**Virtually Certain (>99%)**
1-3	*	*	*	*	**	**	**
4-6	*	*	*	**	**	**	***
7-9	**	**	**	***	***	***	****
10-12	***	***	***	****	****	****	****
Step 4	**Impact Category**						
	Category 1 = * **Category 2 = **** **Category 3 = ***** **Category 4 = ********						

8.1 Rating and Ranking Health Impacts—what do the ratings mean?

The ratings assigned to health impacts are not statements of health risk. Rather, the rating of a health impact (category 1, 2, 3, or 4) tells decision-makers the importance of one particular health impact in relationship to the others. The ratings also allow decision-makers to consider what approach they could take towards action steps and monitoring efforts for particular health impacts.

Table 90 suggests an approach to the health impact importance ratings in this section.

Table 90 Impact Categories, monitoring approaches, and NEPA correlation

Category	**Action Steps**	**Monitoring**	**NEPA Correlation**
1	None	Standard health surveillance	Not Significant
2	Described	Standard health surveillance	Not Significant
3	Recommended	Impact specific monitoring	Significant
4	Strongly recommend	Impact specific monitoring	Significant

For impacts rated as **Category 1**, probably no action steps are needed and any monitoring of health impacts can be completed by standard public health surveillance methods already in effect. The HIA program will describe action steps for impacts rated as **Category 2** and these impacts may also be monitored using standard public health surveillance systems already in place. For impacts rated as **Category 3**, the HIA will describe action steps and make recommendations about how decision-makers implement them. Impacts rated **Category 3** or above are considered significant under NEPA and will also benefit from periodic active surveillance of the health data to monitor for change. If an impact were rated as **Category 4**

(which did not occur in this HIA), the HIA would describe appropriate action steps and strongly recommend that decision-makers take action to promote benefits or prevent negative impacts to health. Potential action steps and monitoring approaches for the key impacts associated with the Donlin Gold mine will be presented in Section 8.3 below.

The following sections describe the rating decisions for selected health impacts from each HEC. Those impacts rated as Category 1 will be discussed in general terms, while those that were rated Category 2 and 3 will be explained in more detail. No impacts were rated Category 4 in this HIA.

8.1.1 Community Influx

Influx can occur due to job seeking, commercial opportunities, small-scale trading, or extended-family in-migration. A large influx may strain fragile local infrastructures, introduce new diseases, or disrupt social patterns, but could also revitalize a community where extensive outmigration has occurred due to a previous lack of employment opportunities. Increases in population can lead to the re-opening of schools that closed due to outmigration. The return of extended families can also reinstate traditional subsistence sharing practices, strengthen traditional practices, and strengthen familial bonds. Community influx is most likely to occur at Project transport hubs. The Project plans to charter flights to transport employees from three major hubs: Fairbanks, Anchorage, and Bethel. Project induced in-migration could lead to increases in population that would be minor relative to the current population in the larger metropolitan areas of Fairbanks and Anchorage. These larger cities have the capacity to absorb slight increases in population due to the presence of extensive services and infrastructure. Bethel however is a much smaller community, and is thus more likely to be stressed by Project induced in-migration (PIIM). If the extent of influx is large relative to the current population in Bethel, a variety of impacts can be anticipated. The majority of these impacts fall under SDH, however, PIIM can also lead to changes in: rates of respiratory infection (i.e. due to overcrowding in homes, Section 8.1.4.2); accidents and injury (Section 8.1.3.1); and water and sanitation related disease (Section 0).

As described in Table 86, details regarding Project specific plans in Bethel (i.e. total number of workers to be housed, housing details, specific activities, ERP, etc.) were unavailable at the time of the writing of this report. While PIIM due to the Donlin Project alone may not result in impacts to the larger cities of Fairbanks and Anchorage, these communities may experience cumulative impacts due to the collective of projects occurring in the state over the long term.

In contrast to community influx, outmigration of the local population is another possible result of development. Increased income may allow some individuals to relocate to Anchorage or other large communities and work at the Donlin mine as commuters. This could have the effect of removing a large number of healthy, skilled, motivated, and resourceful individuals from local communities on a permanent or intermittent basis.

Outmigration was evaluated in the Red Dog Mine Extension Aqqualuk Project Supplemental Environmental Impact Statement. Researchers used a change in the zip code used to deliver annual permanent fund dividends (PFD) to indicate movement between communities (in and out of the Northwest Arctic Borough). Outmigration from 1992-2007 ranged from 10-13% of the local population per year. Mine employees accounted for 4-5% of this outmigration. While

the mine employees were more likely to move than other employees in the Northwest Arctic Borough (15-20% of total workforce outmigration), they were more likely to remain in Alaska than other out-migrants. Mine employees who relocated in-state generally became commuters from Anchorage or Kotzebue. The example of Red Dog demonstrates the potential for an outmigration of employees, which could happen during the Donlin Project, though the scale of outmigration and the interaction with community influx is unclear at this time.

8.1.2 Social Determinants of Health (SDH)

SDH describes how living conditions and social situations provide a context for the health of individuals and communities. One of the key areas associated with infrastructure development that can impact SDH are impacts associated with influx or Project Induced In Migration (PIIM).

8.1.2.1 Increase in morbidity and mortality related to psychosocial distress such as depression, anxiety, suicide, substance abuse, and changes to family structure.

Psychosocial distress is an important contributor to a host of human health behaviors. Persons who are distressed for prolonged periods are at increased risk for anxiety and depression, and other adverse health consequences such as substance abuse, relational problems, and occupational dysfunction.

As summarized in the Donlin EIS Section Environmental Analysis Section 3.18 Socioeconomics[5], the jobs that the project would create could stem out-migration from the smaller communities. Most of the communities in the Y-K region are small villages in which even marginal increases in employment rates can be important in maintaining economic viability. Economic stability could encourage existing residents in the region to stay, and possibly attract new residents. Stemming outward migration would help ensure that adequate public facilities, such as utilities, schools, and health clinics, are maintained in the communities. On the other hand, as discussed above, employment at the mine may facilitate community residents relocating to areas outside the Y-K region such as Anchorage or Fairbanks, though, as stated above, the scale of this potential outmigration is unclear at this time. Depopulation of Y-K region communities would have a negative effect on the range and level of services and facilities in the communities, which, in turn, could prompt further out-migration.

Residents of the smaller villages in the Y-K region may also move to Bethel or Aniak, as these communities will be an air hub for transporting employees to the Project site. As discussed in Section 8.1.1 Community Influx, influx to Bethel that is large relative to its population size can result in a variety of impacts, including psychosocial distress. In-migration can lead to changes in community cohesion, cross cultural conflict, crime levels, availability of illegal drugs, with potential for cascading effects on rates of domestic violence, drug abuse, and mental illness.

Psychosocial distress is a **negative** impact that may be perceived by some stakeholders. The health outcomes related to psychosocial distress will be difficult to quantify, but could potentially produce some very small increases in adverse mental health status reporting, clinical visits for mental health concerns, or other outcomes related to efforts to cope with psychosocial distress. Whether overall levels of health for an individual (versus the larger overall population) are adversely impacted is uncertain and difficult to prospectively predict and quantify.

- The *health effects* to the community are expected to be minor (score of 1);

- the *duration* of the impact will last for the life of the project (score of 3);
- the *magnitude* is received a score of 1, since it may be difficult for some people to fully cope with the outcome of the permitting decision, though it is difficult to determine whether overall levels of health for an individual (versus the larger overall population) are adversely impacted; and,
- the *extent* received a score of 1 since some household representatives have expressed opposing sentiments regarding the project but some are quite supportive.
- *Overall,* this impact receives an importance rating of **Category 2**** because it is "likely" (66-90%) that some stakeholders will be distressed by the development of the mine.

8.1.2.2 Increase in median household income

Economic status is a well-known health determinant that influences health and median household income is a common metric used to evaluate economic status. In general, changes to median household income in the region may be quite small, but for some individuals, particularly in the YK region, the proposed Donlin Gold mine would be an economic opportunity.

Overall, the potential health impact to median household income numbers should be **positive** because of the increased economic activity from the proposed mine.

- The *health effect* to the community received a score of 1 because some minor/modest benefits to health will likely occur;
- the *duration* will be for the length of the project (score of 3);
- the *magnitude* of the impact received a score of 1 since some benefits will be noticeable in localized areas and,
- the *extent* of the impact received a score of 2 since a proportion of households will benefit from employment at the mine.
- *Overall*, this positive impact of the increase in median household income receives an importance rating of **Category 3***** because it is "very likely" (90-99%).

8.1.2.3 Decrease in percentage of unemployment

Employment is an important determinant of health status. As stated previously, the socioeconomic analysis (EA, 2014) estimates that 50 to 60% of the workforce during the peak year of the project's construction phase, or about 1,600 to 1,900 workers, would be drawn from communities within the Y-K region.

- The *health effect* to the community received a score of 1;
- the *duration* will be for the length of the project (score of 3);
- the *magnitude* of the impact received a score of 1**,** since there would be a noticeable, but limited, impact to households where someone is employed; and,
- the *extent* received a score of 1 since a limited proportion of households will benefit from employment at the mine.
- *Overall*, this positive impact received an importance rating of **Category 2**** because it is "very likely" (90-99%).

8.1.2.4 Decrease in percentage of households living the below poverty line

Living below the poverty line is also an important determinant of health status. Impoverishment can be associated with decreased access to health care, increases in health disparities, and increased exposure to a variety of health risks. As described in the baseline information, the percent of residents living below the federal poverty level in the Bethel Census Area in 2009 was over 18%, nearly twice that of State of Alaska (9.6%). In general, the mine would produce a **positive** impact on poverty status for a small number of people employed at the Donlin site which would likely lead to wider economic uplift. Like other social determinants, the overall health effects of this change in unemployment would confer some minor/modest benefits but would be difficult to perceive.

- The *health effect* to the community received a score of 0;
- the *duration* will be for the length of the project (score of 3);
- the *magnitude* of the impact received a score of 2, since the effects of employment produce increase in quality of life and some health benefits; and,
- the *extent* received a score of 2 since a proportion of households will directly benefit from employment at the mine.
- O*verall*, this positive impact change in percentage of households living the below poverty line receives an importance rating of **Category 3*** ** because it is "about as likely as not" (33-66%).

8.1.2.5 Increase in educational attainment

Higher levels of educational attainment are associated with positive health outcomes such as delayed mortality (i.e. living longer) and decreases in cardiovascular disease, cancer, and lung disease. Compared to the State of Alaska, the Bethel Census Area has a slightly lower percentage of adults with a high school diploma and a much lower percentage of adults with a bachelor's degree or higher. Household head educational attainment level also predicts challenges or opportunities that will occur in regards to local hiring programs. This is especially true in mining where permanent positions may require robust technical skill sets.

In general, the project will exert a positive change to this health impact. Economic influx to an area such as Bethel can draw families that can support local schooling efforts as well as providing funds for individuals to use in the surrounding regions. The health effects of any changes in educational attainment would not occur until a future time, but in general these effects would be minor overall.

- The *health effect* to the community received a score of 0, since these effects will likely be difficult to perceive;
- the *duration* would be long term (score of 3);
- the *magnitude* of the positive change received a score of 1 because this health impact could be noticeable through initiation of new educational programs, and it would be localized; and,
- the *extent* received a score of 2 since entire communities could benefit from the education of individuals who either work at the mine or utilize potential new educational resources due to influx to the region.
- O*verall*, this impact is positive and receives an importance rating of **Category 2**** because it is "about as likely as not" (33-66%) to occur.

8.1.3 Accidents and Injuries

The accidents and injuries health effect category describes changes to fatal and non-fatal injury statistics that can be either intentional (suicide, homicide, assault, self-harm) or unintentional (motor vehicle crashes, falls).

8.1.3.1 Increase in morbidity and mortality related to surface and air transport incidents

As described in the Environmental Analysis for transportation[167], construction and operations at the mine site would remove or prohibit use of the few existing primitive trails that currently crisscross the area as well as the historically used trail that passes through or near the mine site. The mine site would be closed to public access. Since the trails and routes in the area currently do not support wheeled vehicles and are only occasionally used by snow machines and dog teams, potential direct and indirect effects associated with prohibiting use or removing these trails would likely affect a very small number of users.[167]

A new access road would traverse varied terrain from the mine site to the Angyaruaq (Jungjuk) Port site near the mouth of Jungjuk Creek. Direct and indirect impacts to surface transportation from the construction and operation of the proposed road from the mine site to the Angyaruaq (Jungjuk) Port site were predicted to be limited due to the remote location. The road would not pass near existing settlements or communities, nor connect with the existing road system (Figure 3).[167] Traffic on the road would be limited to vehicles associated with the Donlin Gold Project and would not be open to the public or The Kuskokwim Corporation shareholders during the operational life of the mine. At mine closure, the access road would remain in place and be maintained to provide access to the project area for perpetual monitoring and operation of the water treatment facility. As a result, the activities of the proposed Donlin Gold Project would not intersect or otherwise impact the limited surface transportation infrastructure connecting or within the villages on the Kuskokwim River or in the Kuskokwim River basin. Due to the relatively low volume of traffic, control of access, and the lack of connection to existing roads or rights-of-way, there would be no effects to existing surface transportation from construction, operation, or mine closure of the road from Angyaruaq (Jungjuk) Port to the mine site.[167]

Additional fuel storage would be needed in Dutch Harbor. Currently, no detailed plans have been developed for infrastructure in Dutch Harbor. If construction of additional fuel storage were to occur at Dutch Harbor, minimal traffic increases would occur on the local roads. The construction and maintenance of additional fuel storage in Bethel and Dutch Harbor was predicted to have a low intensity impact on local transportation in both communities because of the small number of additional trips that would be generated for surface transportation.[167]

Workers, time-sensitive supplies, and equipment would be transported by plane to an airstrip at the mine site. Donlin Gold proposes to operate the airstrip as a private airport and use unscheduled, chartered aircraft for flights from regional airport hubs (Bethel, Fairbanks, and Anchorage) to the mine site airstrip. Under normal operations, the airstrip would not be open to the public. In the event of an emergency, planes not associated with the Donlin Gold Project could use the airstrip. The proposed flights would increase local aviation operations to and from regional airport hubs, but would not create a new destination and access point for non-Project related air traffic within the region.

Local air traffic would increase by 5,148 annual operations during the 3-year construction period and 1,716 annual operations during mine operation and maintenance. Regionally, these additional operations would be distributed between Ted Stevens Anchorage International, Fairbanks International, and Bethel airports, which have combined annual operations that range from 119,898 to 271,168 flights. For these airports, the proposed annual operations for the Donlin Gold Project would represent less than 5% of the total operations.[167] Figure 47 depicts a commuter flight at the exploration camp.

Figure 47 Donlin Air Transportation

Source: NewFields, 2012

Construction of the cargo terminal and additional fuel storage in Bethel is expected to cause a slight increase the number of vehicles traveling over roads in Bethel. As outlined in Donlin Gold EIS, Environmental Analysis Section 3.23 Transportation, surface traffic levels in the community of Bethel are relatively low, and construction vehicle travel would result in only a slight increase in daily traffic in the community. This slight increase in traffic would be temporary (only during the construction phase) and is expected be easily accommodated by the existing road network. During the operation phase of the Bethel cargo terminal and fuel storage area, approximately one additional trip per day is estimated. While direct Project impacts (i.e. construction and operation activity) are anticipated to have a negligible effect on local traffic patterns and use in Bethel, community influx may potentially impact traffic levels considerably. If there is measurable population growth in Bethel due to in-migration, an increased number of vehicles on the road could lead to an elevated risk of traffic accidents. Influx and wages in the hands of residents can facilitate increased off-road vehicles as well. An increase in snow-machine and ATV ownership could increase the likelihood of accident and injury related to use of these vehicles. As noted in Section 5.3.2.1 motor vehicle, ATV, and snow machine related injury fatalities were the top three causes of fatal injuries in the Bethel Census Area. Snow machine and ATV injuries were also among the leading causal agents in accidents and injuries where alcohol was involved.

Overall, the estimated health effects due to surface and air transport are summarized below.

- The *health effect* to the community received a score of 2
- the *duration* of the impact would be throughout the life of the project (score of 3);
- the *magnitude* of the impact received a score of 2; and,
- the *extent* of the impact received a score of 2 since the accident risk in the entire communities of Bethel and Aniak could be potentially affected .
- O*verall*, this impact of change in morbidity and mortality incidents related to surface and air transport receives an importance rating of **Category 3*** ** because the likelihood of this impact is "likely" (66-90%).

8.1.3.2 Increase in morbidity and mortality related to vessel transport incidents

As described in the Environmental Analysis for transportation[167], the proposed Project will require approximately 122 cargo and fuel barge tows (round trips per season) from Bethel to supply the fuel and consumables to the mine site, during construction. These trips would result in a substantial increase in barge traffic along those segments of the river between Bethel and the Angyaruaq (Jungjuk) Port facility. These elevated barge traffic levels could present the potential for increased congestion and disturbance of the commercial and non-commercial vessel traffic using the Kuskokwim River, such as portrayed in Figure 48.

Figure 48 Kuskokwim River Use

Source: NewFields, 2012

The magnitude of effects to commercial and non-commercial vessel traffic on the Kuskokwim River between Bethel and Angyaruaq (Jungjuk) were predicted as high because of a large increase in summer shipping season barge traffic during the construction and operations phases. There would be a 280% increase, from a baseline of 68 to a peak of 190 barge tows per season.[167] In addition, existing barge trips are typically tows of one or two barges, whereas the Donlin Gold project barge traffic would be tows of four barges. The duration of these effects would be long-term since they would occur through the construction period (3-4 years) and the life of the mine (27.5 years) and would affect local communities along the Kuskokwim River from Bethel to Crooked Creek, which rely on the river as an important transportation system resource in a region not served by roads. The additional barge traffic during construction would represent a large increase in river traffic relative to the existing levels of use on the river. As noted in Section 5.3.2.1, water transport accidents were the fourth most common causes of unintentional injury deaths in the Bethel Census Area.

- The *health effect* to the community received a score of 2;
- the *duration* of the impact is for the life of the mine (score of 3);
- the *magnitude* of the impact received a score of 3; and,
- the *extent* of the impact received a score of 0 since it is limited to individual cases.
- O*verall*, this impact of change in morbidity and mortality data related to vessel transport incidents receives an importance rating of **Category 3***** because the likelihood of this impact is "very likely" (90-99%) due to the large increase in barge traffic and long duration of the Project.

8.1.4 Exposure to Potentially Hazardous Materials

8.1.4.1 Increase in adverse health outcomes resulting from potential changes in mercury exposure due to fish consumption

Project analyses concluded that atmospheric deposition of mercury to surface water resulting from the activities proposed under are expected to result in increases in the concentrations of total mercury in surface water, which could exceed AWQC at some locations but levels would remain below the EPA drinking water standard, thus potable use would not present a human health concern.[154] Based on the conceptual site model, the most important exposure route associated with the project is consumption of mercury contained in fish. Therefore, the Project conducted studies to estimate potential increases of mercury. Changes in fish tissue concentrations were estimated based on predicted changes in sediment concentrations and sediment-to-fish bioaccumulation factors. Mercury concentrations were estimated to increase by a maximum of 4.6% in soils and 2.5% in sediments over the project area.[123] While these increases are small, the increases may result in increases in the mercury content of fish, wildlife, and plants due to the bio-accumulative properties of mercury. The data presented in the model predict potential increases in fish tissue concentrations on the order of 2% to 3% in the Crooked Creek watershed;[154] results are provided in Table 91.

Table 91 Estimated Increases in fish Tissue Concentrations

Species	Age	Total mercury concentrations in fish tissue in the Crooked Creek Watershed (µg/kg wet weigh)	
		Current concentration	Estimated concentration at mine year 27
Coho	Not Specified	42	44
	YOY	24	25
	Juvenile	96	98
King	Not specified	55	56
	YOY	48	50
Northern pike	Juvenile	282	289
	Adult	558	572
Sculpin	Not specified	39	40
	YOY	117	120
	juvenile	120	123
Averages		138	142

Source: Arcadis, 2014

The Alaska-specific chronic oral Acceptable Daily Intake for methylmercury for women of childbearing age and children is 0.56 µg/kg body weight/day (meal size of 6 ounces raw).[168] A risk-based method was utilized to calculate monthly consumption allowances for Alaska using this value. The most current ADHSS guidance suggests limiting the number of meals per month of fish having an average concentration of mercury above 200 µg/kg. Both juvenile and adult Northern pike tested in the Crooked Creek Watershed exceeded these values at baseline and as estimated at the mine.[154] ADHSS recommends that women of child-bearing age and children, limit the number of meals of fish containing 200-340 µg/kg, to under 16 per month and 460-680 µg/kg, to less than eight meals per month. Burbot, which were not included in the Project study, generally have mercury levels similar to that of pike in a given water body, due to their similar life histories.[68] Pike and burbot are important subsistence resources in this region, thus although the Project is not expected to increase these consumption restrictions, risk communication regarding this health concern will be critical for preventing residents from changing consumption patterns based on fear of contamination.

- The *health effect* to the community received a score of 1,
- the *duration* of the impact would be for the life of the mine (score of 3);
- the *magnitude* of the impact received a score of 2 since consumption patterns of important subsistence resource could be altered (i.e. fish); and,
- the *extent* of the impact would be regional due to fish migration patterns (score of 3)
- O*verall*, this impact of increased adverse health outcomes resulting from potential changes in mercury exposure data due to fish consumption receives an importance rating of **Category 2**** because the likelihood of this impact is "unlikely" (11-33%). It is important to note that an unlikely rating does not mean that there is no risk, but reflects that the risk is low.

8.1.4.2 Increase in respiratory disease mortality and morbidity data related to PM10, PM 2.5, and VOCs

According to the Environmental Analysis for air quality[169], impacts to air quality were determined to be of low magnitude (below permit thresholds) for the construction and closure phases and medium magnitude (above permit thresholds but meeting standards) during the operations phase. The duration of impacts were considered temporary during the construction phase (not longer than 4 years) and reclamation phase (not longer than 4 years and would return to pre-activity levels), but would be long-term (through life of project) during mine site operations and for mine site post-reclamation activities. All impacts would be considered local in extent because effects would occur in the project vicinity. The overall air quality impacts at mine site were considered minor.

Indirect air quality impacts associated with the operation and maintenance phase of the pipeline would occur at Chugach Electric Association, Inc.'s Beluga power plant, due to the increase in electricity generation required to power the compressor station. The Beluga power plant is an existing source that currently operates under its own air quality permit. Because ADEC would not permit changes in emissions that would cause or contribute to a violation of the NAAQS or AAAQS, the magnitude was considered medium or low.[169]

Air quality impacts due to transportation facilities emissions were determined to be of low intensity because they were below permit thresholds. The duration of impacts would be temporary during the construction phase (3 to 4 years), but would be long-term (through life of project) during operation and maintenance, and closure and reclamation phases. Impacts would range from local to regional in extent because some of the impacts occur outside of the project area.[169]

- The *health effect* to the community received a score of 0;
- the *duration* of the impact is for the life of the mine (score of 3);
- the *magnitude* of the impact is expected to be minor (score of 0); and,
- the *extent* of the impact would be localized (score of 2).
- The O*verall*, impact received an importance rating of **Category 1*** because the likelihood of this impact is "unlikely" (11-33%).

8.1.5 Food, Nutrition and Subsistence Activity

This category considers health impacts related to food security, adequate nutrition, and availability of subsistence resources. Food security, nutritional status, and subsistence activities can all be influenced by development projects. The nutrition impacts will be further evaluated from an HIA perspective relative to health effects status in the next version of the HIA.

8.1.5.1 Decrease in regional food costs expressed as a % of median household income

If limited store resources are further strained due to higher demand resulting from worker influx, the cost of food in the region could experience a small increase throughout the lifetime of the project. In addition to inflation, the availability of store-bought food in the region could experience a small decrease throughout the lifetime of the project. Conversely, food availability could increase if new stores are established to meet increased demand and generate competition, which could potentially drive down grocery prices. These impacts would most likely occur in Bethel where influx is expected.

- The health effect of this impact received a score of 0;
- the *duration* of the impact is for the life of the mine (score of 3);
- the *magnitude* is expected to be low since the changes in income or cost of foods would be small (score of 0); and,
- the *extent* of the impact received a score of 1, limited to households that have a family member who obtains new employment.
- O*verall*, this impact of change in regional food costs expressed as a % of median household income receives an importance rating of **Category 1*** because it is "unlikely" (11-33%) that regional food costs will change as a result of the Project.

8.1.5.2 Decrease in the percentage of food secure households and decrease in subsistence consumption based on harvest survey data

Subsistence is essential to residents' diets because of the low availability of jobs and the high cost of food in grocery stores, especially in the smaller villages (Section 5.3.4.5). With the exception of Bethel, communities in the Y-K region have subsistence-based economies. Potential out-migration from the smaller PACs could negatively impact subsistence. For example, if the most productive subsistence harvesters relocate to a Project transport hub for employment at the mine, the availability of subsistence resources at the family level and community level (i.e. due to sharing) could diminish. Rotational and year-round work schedules could also negatively impact subsistence if this schedule interferes with established seasonal subsistence patterns and cooperative labor and processing. While potential out migration of residents' that supply their households and communities with subsistence resources, could decrease the consumption of subsistence foods for some, it could increase for others whose wages facilitate increased access (i.e. via ability to purchase fuel, equipment, etc.). In addition, the schedule may allow flexibility for some families to continue existing subsistence practices.

During the Subsistence and Traditional Ecological Knowledge (TEK) workshop held in March, 2014, people were asked what they thought the health impacts would be of changing their eating habits. Several respondents voiced concern that increased income could also result in the consumption of more unhealthy foods (e.g. processed foods, candy, soda) and decrease the reliance on subsistence resources.[170] Others noted that increased wages, especially for those currently reliant on food stamps, could positively impact health by facilitating the purchase of "better" foods.

As described above, fear of contamination could potentially drive people to avoid use of some subsistence resources. In this scenario, they might become more reliant on store bought foods, which may be limited and lacking in adequate healthy choices.

Figure 49 Fishing activities along the Kuskokwim

Source: NewFields, 2012

- The net *health effect* to the community received a score of 1 due to the simultaneous presence of both positive and negative impacts;
- the *duration* of the impact is for the life of the mine (score of 3);
- the *magnitude* of the impact received a score of 1; and,
- the *extent* of the impact received a score of 2, potentially affecting entire communities due the fact that resources are shared.
- O*verall*, the impact of change in diet composition, food security, and the consumption of subsistence foods receives an importance rating of **Category 3*** ** because the likelihood of this impact is "about as likely as not" (33-66%) due to the large size of the Project footprint.

8.1.6 Infectious Diseases

This HEC considers health impacts from infectious disease transmission and the development of new infectious diseases due to the proposed mine. As described previously influx can occur due to job seeking, commercial opportunities, small-scale trading, or extended-family in-migration. Influx can lead to changes in infectious disease prevalence.

8.1.6.1 Increase in the rates of STI such as gonorrhea, chlamydia, syphilis, and HIV.

As described in Section 5.3.5, STIs comprised 89.4% of all Alaska Native reportable infectious disease cases (2007-2008). In similar projects, presence of temporary "open" construction camps near communities can increase sexually transmitted infection (STI) rates and related diseases, via commercial and transactional sex. This is of lower likelihood for the mine site work

camp due to the remote location of the camp and because the Project will provide transportation to and from the site according to work shifts. At the port of Bethel, however, the risk is of higher likelihood because worker accommodations are planned within the city limits of Bethel, thus allowing for community interaction during their "off work hours". In addition, Bethel may experience Project induced in-migration of job seekers, and Project employees.

- The *health effect* to the community received a score of 1;
- the *duration* of the impact would be limited to construction (score of 2);
- the *magnitude* of the impact received a score of 1since the impacted individuals would be readily able to adapt and maintain good health via available medical therapies; and,
- the *extent* of the impact received a score of 0 as it is limited to individual cases.
- O*verall*, this impact of change in the rates of STI such as gonorrhea, chlamydia, syphilis, and HIV receives an importance rating of **Category 2**** because the likelihood of this impact is "about as likely as not" (33-66%).

8.1.6.2 Increase in the rates of infectious respiratory diseases such as influenza and pneumonia

Overcrowding in community homes to due influx of extended family can lead to an increase in prevalence of respiratory infections such as influenza and TB. In addition, outbreaks may occur at overcrowded work camps that could be transmitted back to the community by the rotating workforce.

- The *health effect* to the community received a score of 1;
- the *duration* of the impact would be limited to construction (score of 2);
- the *magnitude* of the impact received a score of 1 since the impacted individuals would be readily able to adapt and maintain good health via available medical therapies; and,
- the *extent* of the impact received a score of 0 as it is limited to individual cases.
- O*verall*, this impact receives an importance rating of **Category 2**** because the likelihood of this impact is "about as likely as not" (33-66%).

8.1.6.3 Increase in the rates of vaccine preventable diseases

The Project predicts that the workforce will predominantly be sourced from the State of Alaska, thus importation of bacterial and viral diseases endemic in other parts of the world or the contiguous 48 states infectious disease on a large scale is not anticipated. It is possible however, that this may change over time and that vaccine preventable disease outbreak (e.g. chicken pox, measles, etc.) may occur at the large mine site work camp depending on occupants. The mixing in work camps of adults with different underlying immunity levels has the potential to trigger an outbreak, which could be transmitted back to the community by the rotating workforce.

- The *health effect* to the community received a score of 1;
- the *duration* of the impact would be most intense during construction, but would last for the life of the project (score of 3);
- the *magnitude* of the impact received a score of 1 since the impacted individuals would be readily able to adapt and maintain good health via available medical therapies; and,
- the *extent* of the impact received a score of 0 as it is limited to individual cases.
- O*verall* this impact of change in the rates of vaccine preventable diseases receives an importance rating of **Category 2**** because the likelihood of this impact is "about as likely as not" (33-66%).

8.1.6.4 Increase in morbidity and mortality rates of foodborne illness

Food handler/catering issues are extremely important and a camp catered food-borne epidemic can rapidly spread from food handlers to camp residents and then to distant communities via rotating staff. Similarly, rotating local workers, can "import" local foods into the camp environment with potential adverse consequences. Camp catering plans and protocols were not available for review at the time of the writing of this report.

Lastly, the improper disposal of kitchen wastes, improper food safety practices at work camps (Figure 50) and/or feeding of wildlife (e.g. red fox), can lead to the congregation of these and similar hosts of human infectious and zoonotic disease at the Project site, potentially facilitating outbreaks of food related illness and epizootics (e.g. rabies, etc.).

- The *health effect* to the community received a score of 1;
- the *duration* of the impact would be limited to construction (score of 2);
- the *magnitude* of the impact received a score of 1 since the impacted individuals would be readily able to adapt and maintain good health via available medical therapies; and,
- the *extent* of the impact received a score of 0 as it is limited to individual cases.
- O*verall*, the impact of change in morbidity and mortality rates of foodborne illness receives an importance rating of **Category 2**** because the likelihood of this impact is "about as likely as not" (33-66%).

Figure 50 Donlin Camp Site Catering Service

Source: NewFields, 2012

8.1.7 Chronic non-communicable diseases

8.1.7.1 Increase in morbidity and mortality data for chronic diseases such as obesity, diabetes, and hyperlipidemia

The proposed project could influence behavioral changes at the household level such as alcohol use, smoking, or dietary changes that may contribute to a rise in non-communicable disease (NCD) outcomes. For example, increased smoking at work camps could transmit to increased smoking in the home environment. Increased wages can facilitate the purchase of cigarettes, alcohol, and unhealthy food choices but may also lessen the need for these coping strategies. Changes in diet from life in work camps may result in adverse health outcomes (i.e. weight gain, cardiovascular disease, diabetes, etc.) but could also result in health benefits through healthy food choices and exercise options on site. Furthermore, a shift from high physical activity to camp life may contribute to increased rates of NCDs. This could be of particular concern if community members are shifting from a subsistence lifestyle due to lack of time for hunting and/or avoidance of using subsistence resources out of fears of contamination.

- The *health effect* to the community received a score of 2;
- the *duration* of the impact is for the life of the mine (score of 3);
- the *magnitude* of the impact received a score of 2 since the impacted individuals would be able to adapt to the health impact with some difficulty; and,
- the *extent* of the impact received a score of 0 as it is limited to individual cases.
- O*verall*, this impact of change in morbidity and mortality data for chronic diseases such as obesity, diabetes, and hyperlipidemia receives an importance rating of **Category 3 ***** because the likelihood of this impact is "very likely" (90-99%) due to the large size of the workforce and long duration of the Project.

8.1.8 Water and Sanitation

8.1.8.1 Increase in morbidity and mortality due to conditions affected by limited water access, quality, or quantity of water and sanitation facilities Water diseases are often strongly related to the absolute per capita volume of water available for personal hygiene, e.g., bathing, hand washing, etc. As described in the baseline, the lack of clean running water and proper sewage disposal is a leading cause of preventable disease in rural Alaska villages and is directly linked to infectious disease mortality and morbidity.

Respiratory, gastrointestinal and skin diseases are common in areas without safe water supplies. Fewer than 60% of housing units in the YKHC service area had water and sewer service in 2008. If existing services and systems become overburdened due to community influx in Bethel, there could be a surge in water and sanitation related disease. According to the Environmental Analysis for groundwater[171] anticipated effects from the construction, operations, and closure of transportation facilities would be limited to small stresses on the aquifers tapped by water supply wells for new port facilities. These stresses were predicted to be within the capacity of aquifers to support without impacting other water users or nearby surface water resources. It is anticipated that there will be no indirect effects on groundwater as a result of the proposed transportation facilities. Thus, change in access to water is not expected as a direct result of the Project, however, Project induced in-migration of job seekers and camp followers may occur in Bethel adding stress to existing infrastructure.

- The *health effect* to the community received a score of 0;

- the *duration* of the impact would be limited to construction (score of 2);
- the *magnitude* of the impact received a score of 1since the effects would be fully reversible; and,
- the *extent* of the impact received a score of 0 as it is limited to individual cases of water and sanitation related disease.
- O*verall*, this impact receives an importance rating of **Category 1*** because the likelihood of this impact is "about as likely as not" (33-66%).

8.1.9 Health Services Infrastructure and Capacity

8.1.9.1 Increase in morbidity and mortality data due to conditions affected by access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems

Health services infrastructure and capacity refers to physical infrastructure, staffing levels and competencies, technical capabilities of health care facilities. Access to health care and health care capacity is often influenced by natural resources development projects. This can occur if the influx of job seekers and camp followers overwhelms health service capacity, thus limiting residents' access to health care. Access to care can also be adversely impacted if health care workers leave communities they currently serve to work for the Project, thus diminishing service capacity in that community. The Yukon-Kuskokwim Delta Regional Hospital (YKDRH) located in Bethel is the closest facility to the Zone 1 communities that can accommodate the triage for medical emergencies. If a Project related accident in Zone 1 communities occurs that involves multiple individuals, existing health services could be overwhelmed, as the hospital in Bethel is a relatively small facility (i.e. one emergency ward, 50 beds) and the sub regional health center in Aniak has limited capacity.

- The *health effect* to the community received a score of 1;
- the *duration* of the impact would be limited to construction (score of 2);
- the *magnitude* of the received a score of 1 since the effects would be reversible; and,
- the *extent* of the impact received a score of 2, since the entire community of Bethel could potentially be affected.
- O*verall*, this impact of change morbidity and mortality data due to conditions affected by access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems receives an importance rating of **Category 2**** because the likelihood of this impact is "about as likely as not" (33-66%).

8.2 Key Health Impacts by Health Effect Category

Table 92 displays a summary of the most important health impacts (positive and negative) that have been identified for each HEC.

Table 92 The Importance of Key Health Impacts by Health Effect Category

Social Determinants of Health								
Health Impact	**Positive (+) Or Negative (-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in morbidity and mortality related to psychosocial distress such as depression, anxiety, suicide, substance abuse, and changes to family structure.	**(-)**	1	3	1	1	6	66-90%	**Category 2 ****
Increase in median household income	**(+)**	1	3	1	2	7	90-99%	**Category 3 *****
Decrease in % unemployment	**(+)**	1	3	1	1	6	90-99%	**Category 2 ****
Decrease in the percentage of households living below poverty line	**(+)**	0	3	2	2	7	33-66%	**Category 3 *****
Increase in educational attainment data	**(+)**	0	3	1	2	6	33-66%	**Category 2 ****
Accidents and Injuries								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in morbidity and mortality related to surface and air transport incidents	**(-)**	2	3	2	2	9	66-90%	**Category 3 *****

Table 92 The Importance of Key Health Impacts by Health Effect Category								
Increase in morbidity and mortality related to vessel transport incidents	**(-)**	2	3	3	0	8	90-99%	**Category 3 *****
Exposure to Potentially Hazardous Materials								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in adverse health outcomes resulting from potential changes in mercury exposure due to fish consumption	**(-)**	1	3	2	3	9	11-33%	**Category 2 ****
Increase in respiratory disease mortality and morbidity related to PM10, PM 2.5, and VOCs	**(-)**	0	3	0	2	5	11-33%	**Category 1 ***
Food, Nutrition and Subsistence								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Decrease in regional food costs expressed as a % of median household income	**(+)**	0	3	0	1	4	11-33%	**Category 1 ***
Decrease in the percentage of food secure households and decrease in subsistence consumption based on harvest survey	**(-)**	1	3	1	2	7	33-66%	**Category 3 *****

Table 92 The Importance of Key Health Impacts by Health Effect Category								
data								
Infectious Diseases including STIs								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in the rates of STI such as gonorrhea, chlamydia, syphilis, and HIV.	**(-)**	1	2	1	0	4	33-66%	**Category 2 ****
Increase in the rates of infectious respiratory diseases such as influenza and pneumonia	**(-)**	1	2	1	0	4	33-66%	**Category 2 ****
Increase in the rates of vaccine preventable diseases	**(-)**	1	3	1	0	5	33-66%	**Category 2 ****
Increase in morbidity and mortality rates of foodborne illness	**(-)**	1	2	1	0	4	33-66%	**Category 2 ****
Chronic Non-Communicable Diseases								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in morbidity and mortality for chronic diseases such as obesity, diabetes, and hyperlipidemia	**(-)**	2	3	2	0	7	90-99%	**Category 3 *****
Water and Sanitation								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in	(-)	0	2	1	0	3	33-66%	**Category 1**

Table 92 The Importance of Key Health Impacts by Health Effect Category								
morbidity and mortality due to conditions affected by limited water access, quality, or quantity of water and sanitation facilities								*
Health Infrastructure and Capacity								
Health Impact	**Positive(+) Or Negative(-)**	**Effect**	**Durat'n**	**Mag**	**Ext**	**Total**	**Likelihood**	**Importance Rating**
Increase in morbidity and mortality due to conditions affected by access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems	**(-)**	1	2	1	2	6	33-66%	**Category 2 ****

8.3 Recommendations

8.3.1 Introduction

Recommendations in this section are based on the importance ratings from Table 92. It is important to re-state that an HIA does not *per se* create legal stipulations. This HIA is being conducted as part of the NEPA review process, which informs a Federal agency's decision to permit or not permit a project (CEQ, 2014). The action steps and monitoring approaches discussed in this section are provided as recommendations based on the impacts identified in the HIA.

Potential health impacts discussed in this HIA are both positive and negative. Positive impacts provide all stakeholders an opportunity to see how the proposed mine could benefit the health and wellbeing of the potentially affected communities (PACs). Stakeholders can review these potential positive impacts and consider ways to maximize the benefits of the project. Negative impacts provide stakeholders the opportunity to see how the proposed project could potentially create health challenges for the PACs and this can help inform action steps in order to (i)

prevent these impacts from occurring and (ii) develop mitigation and monitoring approaches that can be considered by relevant regulators and a broad spectrum of stakeholders.

8.3.2 Approach

ADHSS has used the outcomes of the risk assessment step to establish potential actions that can manage identified impacts. Potential mitigation strategies include participatory monitoring, health education and promotion. These strategies are all well established and recognized in the preventive medicine and public health literature. Some important considerations for health mitigations include:

- Type of prevention activity required, *e.g.*, primary versus secondary or tertiary prevention;
- Availability of different strategies (*e.g.*, engineering intervention affecting water quantity, sanitation, etc.);
- Availability of interim measures or modifications;
- Local stakeholder input regarding the proposed recommendations;
- Recognition of the primary role of environmental regulators/agencies in measuring, monitoring and managing potential impacts of hazardous materials; and,
- Roles and responsibilities for implementing the recommendations.

Potential impacts, both positive and negative, were developed based on detailed and extensive analysis of (i) project description, available environmental and social studies, (ii) characteristics of PACs, *e.g.*, communities along high use transportation corridors, project adjacent communities, etc. and (iii) within the framework of Alaska-specific health effects categories (HECs).

Because of the geographical size and contractual complexity of the project, a combination of health promotion/education and primary prevention is determined to be the most efficient and cost-effective method of managing potential impacts. Therefore, the management recommendations propose a series of practical approaches that are evidence based and consistent with existing local, state, and national health directives.

Finally, impact management strategies should consider that a variety of *positive* community-level impacts will occur. For example, rapid changes such as alleviation of “income poverty” may likely produce improvement in overall population-level health status. Therefore, the monitoring and management system should be capable of capturing a variety of positive and negative trends across the community over different time scales.

Monitoring and management strategies do not neatly fall into “internal project” and “external community” categories. The project workforce is both a separate inside the fence line community but also simultaneously part of the wider external rural/urban environment potentially affected by the project. Therefore, many of the proposed strategies originate inside the fence line and extend into specific project affected areas. Health management activities, whether directed towards workers, family members or the general community, should be carefully assessed and tied to appropriate outcome indicators.

8.3.3 Management Recommendations

This section presents a series of management strategies for each HEC. Recommendations are tied to the management of specific potential impacts identified in Section 8.2 Key Health Impacts. The HIA is a tool that proposes action steps that potentially benefit all stakeholders, including the project proponent.

Potential controversy associated with projects and community polarizations are known situations for companies in the extractive industries. There is substantial experience in the United States and other countries in managing this challenge. There are a series of "best practice" documents that have been developed by industry trade associations, and multi-lateral development agencies.[172, 173]

According to the International Finance Corporation (IFC, a member of the World Bank Group):

> "Companies need to be prepared for the fact that they are entering into a pre-existing yet dynamic context, with established histories and cultures, and often complex political, social, and economic relations between groups that can be thrown into flux by the advent of a project and the development process that accompanies it."

The HIA recognizes that a project can become politicized and complicated, leading to or exacerbating underlying community tensions. Adverse health outcomes can follow from this situation. It is very important to (i) manage the development process proactively and collaboratively, and (ii) consider some of the established good practice approaches and principles that have been developed over decades of worldwide experience in similar situations.

One of the overall resources for developing programs to manage potential impacts is informed by (i) public health strategies development by the US Centers for Disease Control and Prevention (CDC), (ii) published, peer-reviewed public health literature, (iii) State of Alaska public health department guidance, (iv) leading international development agencies, e.g., World Bank group and (iv) industry trade association such as the International Council on Mining and Metals.[173] Community-based participatory monitoring is a potential strategy that can be considered, as it is increasingly associated with enhanced community "buy-in." Regardless of strategy it is critical that a suite of measurable and objective key performance indicators (KPIs) be developed. Fortunately, there is an extensive and well-developed public health surveillance system managed by both the State and the Alaska Native Tribal Health Consortium (ANTHC).

Community health management actions are measures that aim to avoid, minimize, eliminate or remedy an adverse effect, or maximize a potential benefit. The process to develop health management programs should include a reassessment component to ensure that the strategies and programs selected are effective. Even companies that have a strong reputation can risk losing their credibility when they fail to put systematic approaches in place to ensure continued world-class performance and communication of positive impacts of the project.[174] Proposed impact management measures can be divided into different categories by the project proponent, based on the focus of the intervention:

- direct project control, and
- requiring action through others, e.g., (a) contractors and sub-contractors and/or (b) host government involvement and participation.[174]

For example, a project is directly responsible for worker activity while onsite or working in communities on project-related activities (e.g., sampling, transportation, etc.) on the job; however, when workers are off duty and away from the site, a project has little or no control over personal behaviors. Health management strategies that address these two categories are typically organized around anticipating, recognizing and evaluating impacts. Implementation plans focus on control strategies such as prevention, elimination and minimization.

8.3.4 Impact Management Summary

This section presents health impacts, mitigations and monitoring and evaluation strategies that have been developed in response to potential impacts. Additionally recommendations can feed into potential Project related community outreach efforts. In many situations, important public health issues surface as part of the analysis; however, it is very difficult to disaggregate causation between a project and large trends that are already occurring across populations/communities, *e.g.*, changes in non-communicable disease rates such as diabetes and asthma. In this situation, the HIA analysis tries to delineate those effects that can be (i) causally linked to the proposed project and (ii) are amenable to specific project mitigations.

The Impact Mitigation Summary is intended to provide a brief synopsis of the data presented in the sections above for those potential impacts rated at importance categories 2 and 3 (no impacts were given an importance rating of category 4). This information should serve as input for developing Company and Contractor Health Management Plans that include specific actions, responsibilities, timing, potential collaborators and performance indicators. Many of the management measures require collaboration with local community members and agencies and should be very carefully planned and coordinated with the project's community affairs group in order to maximize communication, cultural sensitivity and awareness.

Table 93 Health Management Plan

Recommendations by Health Effect Category		
Potential Impact	**Action Steps**	**Monitoring and Evaluation Approaches**
Social Determinants of Health		
Increase in morbidity and mortality related to psychosocial issues such as depression, anxiety, suicide, substance abuse, and changes to family structure **Increase in median household income** **Decrease in % of households living below poverty line** **Decrease in % unemployment** **Increase in educational attainment**	**Provide worker education and support community programs regarding** • Suicide prevention, mental health, and personal wellness • Substance abuse prevention and smoking cessation • Family cohesion, prevention of domestic violence and child abuse • Sexual health and preventing unwanted pregnancy • Financial planning • Community engagement with mining project and plans **Implement best practices for workforce management** • Dry, drug-free, and closed work camps • Workplace alcohol, drug, and sexual harassment policies • Prioritize local hire according to project needs	**Monitor health outcomes** • Suicide rates • Substance use/abuse/treatment rates • Intimate partner violence, sexual assault, child abuse • Unwanted pregnancy rates **Monitor health determinants** • Divorce rates • Verify closed work camps through site audits • Median household income, % unemployment • % living below poverty line • % workers who complete health and wellness course • Population influx and outmigration • Crime statistics, school absences, academic achievement • Housing inflation, food costs **Evaluate best practices for workforce management** • Use of closed, dry, drug-free work camps • % local hire suitable to project needs • Work shift schedules suitable to cultural and family cohesion
Accidents and Injuries		
Increase in morbidity and mortality related to surface transport, air transport, and vessel transport	**Provide workplace training and certification modules** • Assure driver/operator training and annual certification • Implement strict alcohol and drug policies • Implement fatigue management policies • Investigate all accidents • Implement journey management plans **Employ transportation planning cycles**	**Monitor health outcomes** • Fatal and non-fatal transportation incidents • All fatal and non-fatal injuries **Monitor health determinants** • VPSO presence in communities • % of incidents that involve alcohol or drugs • Monitor Alaska Trauma Registry data annually

Recommendations by Health Effect Category		
Potential Impact	**Action Steps**	**Monitoring and Evaluation Approaches**
	• Identify key interaction points between project transport activities and community transportation needs • Establish emergency response plans for off-site accidents, injuries, and hazardous materials releases • Perform drills coordinated with local emergency response services • Limit barging during peak fishing activity	• Effectiveness of workplace motor vehicle safety programs
Exposure to Potentially Hazardous Materials		
Increase in adverse health outcomes resulting from potential changes in mercury exposure due to fish consumption	**Follow standard regulatory requirements for mercury management**	**Monitor for key health outcomes** • Maternal and community hair mercury levels **Monitor for key health determinants** • Changes in fish consumption from ADF&G surveys • Subsistence participation rates
Food, Nutrition and Subsistence		
Decrease in the percentage of food secure households **Decrease in subsistence consumption based on harvest survey data**	**Provide workforce and community education regarding** • Health benefits and safety of subsistence foods • Healthy diet and nutritional practices • Results of fish and wildlife sampling **Provide workforce opportunities for subsistence participation**	**Monitor key health outcomes** • Rates and trends for diabetes, obesity, metabolic syndrome **Monitor key health determinants** • Change in the percentage of food secure households • Changes to subsistence consumption estimated from harvest surveys
Infectious Diseases		
Increase in the rates of Sexually Transmitted Infections (STI) such as gonorrhea, chlamydia, syphilis and HIV	**Implement closed alcohol and drug-free camps for non-resident workforce at the mine site, and at major transport/construction sites** • Mandatory STI education for all new employees • Diagnosis and treatment of STIs at the occupational medicine clinics sponsored by applicant	**Monitor key health outcomes** • Regional rates of STI **Monitor key health determinants** • Presence of STI education programs for workers

Recommendations by Health Effect Category		
Potential Impact	**Action Steps**	**Monitoring and Evaluation Approaches**
	• Offer Expedited Partner Therapy (EPT) and promptly report cases of workers diagnosed with chlamydia, gonorrhea, syphilis, and HIV	• Presence of disease intervention resources in the community
Increase in the rates of infectious respiratory diseases such as influenza and pneumonia	**Implement a respiratory disease prevention and control strategy in the workplace that includes** • Assure that all workers are given annual influenza vaccination • Provide worker education on respiratory hygiene • Assure worker tuberculosis testing/treatment • Assure written policies and procedures for appropriate isolation of ill-workers in camps • Construct work camps according to OSHA and international best practices for space per occupant and ventilation requirements • Make hand sanitizer readily available in communal areas of work camps	**Monitor key health outcomes** • Regional rates of infectious respiratory disease • Regional outbreaks of respiratory disease **Monitor key health determinants** • Occupancy rates/ overcrowding in work camp accommodations • Presence of respiratory disease prevention programs for TB, influenza, pneumonia in workforce • Presence of selected screening programs (e.g., tuberculosis) for non-resident workers
Increase in the rates of vaccine preventable diseases	**Require documentation that all workers are up-to-date with all CDC-recommended vaccines for adults**	**Monitor key health outcomes** • Review the vaccination status of all workers annually • Monitor rates of vaccine preventable disease • Monitor regional outbreaks of vaccine preventable diseases
Increase in mortality and morbidity related to foodborne illness outbreaks	**Implement food safety and disposal strategy in the workplace that emphasizes** • Adequate hand washing and sanitary policies for all catering services • Industry standard food storage, preparation, and disposal policies	**Monitor health outcomes** • Foodborne illness or outbreaks in camps or in local communities**.**
Non Communicable and Chronic Diseases		
Increase in morbidity and mortality for chronic diseases such as obesity, diabetes, and hyperlipidemia	**Provide workforce education and support community education regarding** • Health benefits and safety of subsistence foods • Healthy diet choices and nutritional practices • Healthy physical activity habits • Importance of screening for chronic diseases • Depression and anxiety **Provide workplace wellness programming that includes fitness facilities, screening for chronic diseases, and incentives for physical wellness**	**Monitor key health outcomes** • Regional rates of chronic diseases such as obesity, diabetes, hyperlipidemia, hypertension • Regional rates of lung cancer and colon cancer • Regional rates of heart disease and cerebrovascular diseases **Monitor Key health determinants** • Cost of regional food items • Culturally and regionally appropriate opportunities for

Recommendations by Health Effect Category		
Potential Impact	**Action Steps**	**Monitoring and Evaluation Approaches**
	• Obesity and overweight • Diabetes • Hyperlipidemia • Hypertension • Smoking cessation • Increasing physical activity	increasing physical activity • Screening rates for chronic diseases including cancer
	Health Infrastructure and Capacity	
Increase in morbidity and mortality due to conditions affected by access to preventive screening, regular health monitoring, and definitive care for acute or emergency health problems	**Consider the importance of regular air, land, and water shuttles to health care centers during transportation planning that provides for** • Maternal/child health visits • Preventative screening for colon cancer and breast cancer • Emergency perinatal transport • Expanded EMS services **Plan for emergencies or influx trends that could overwhelm existing healthcare infrastructure and decrease access to care, increase costs for local residents, or lower patient-to-provider ratios**	**Monitor key health outcomes influenced by health care infrastructure and capacity, such as** • % receiving adequate or better pre-natal care • % screened for chronic diseases including cancer **Monitor key health determinants related to health care infrastructure and capacity** • Number of community health aide practitioners present in the region • Presence of collaborative emergency response plans

9.0 REFERENCES

[1] HIA Toolkit. 2011. Health Impact Assessment Guidance Manual, Alaska Department of Health and Human Services, Section of Epidemiology, Health Impact Assessment Program, July.
[2] SRK Consulting, Inc. Donlin Gold, Project Description, Plan of Operations, Vol I, July 2012.
[3] 2012 population 6.371 [Online]: http://www.city-data.com/city/Bethel-Alaska.html)
[4] Donlin Gold Project, SRK 2012.
[5] Donlin Gold EIS, 3.0 Environmental Analysis, 3.18 Socioeconomics, 2014.
[6] Donlin Gold EIS. 2013. Scoping Report. [Online]: http://donlingoldeis.com/Documents/Donlin%20EIS%20FINAL%20Scoping%20Report.pdf
[7] WHO. 2011. Social determinants of health. [Online]: http://www.who.int/social_determinants/en/
[8] Alaska Department of Labor, Alaska Population Projections 2010 – 2034. 2009. [Online]: http://labor.alaska.gov/research/pop/popproj.htm
[9] Kulkarni, Levin-Rector, Ezzati and Murray. 2011. "Falling behind: life expectancy in US counties from 2000 to 2007 in an international context." Kulkarni, Sandeep, Alison Levin-Rector, Majid Ezzati and Christopher JL Murr. Population Health Metrics. 9:16
[10] AN EpiCenter. 2014. Statewide Alaska Native Health Status Report, Alaska Native Epidemiology Center, Alaska Native Tribal Health Consortium. [Online]: http://www.anthctoday.org/epicenter/data/regions/statewide/index.html
[11] Division of Reproductive Health, Centers for Disease Control and Prevention. Maternal and Infant Health Research: Pregnancy Complications. Atlanta, GA: 2010. [Online]: http://www.cdc.gov/reproductivehealth/maternalinfanthealth/PregComplications.htm
[12] AMAP. 2009. Arctic Monitoring and Assessment Programme (AMAP) "Human Health in the Arctic," Oslo, Norway.
[13] CDC. 2014. Infant mortality rate. [Online]: http://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm
[14] ADHSS. 2007-2014. Bureau of Vital Statistics. Data & Statistics. [Online]: http://www.hss.state.ak.us/dph/bvs/data/default.htm
[15] National Vital Statistics Reports. 2007. Deaths: Final Data for 2007. [Online]: http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf
[16] AN EpiCenter. 2007. Regional Health Profile for Yukon-Kuskokwim Health Corporation, Alaska Native Epidemiology Center, Alaska Native Tribal Health Consortium, June.
[17] Krueger, PM and Scholl. 2000. Adequacy of prenatal care and pregnancy outcome. Journal of American Osteopathic Association, August.
[18] WHO. 2005. Make every mother and child count. The World Health Report 2005. World Health Organization. [Online]: http://www.who.int/whr/2005/whr2005_en.pdf
[19] ADHSS. 2010. *Healthy Alaska 2010, Volume I: Targets for Improved Health.* [Online]: http://www.hss.state.ak.us/dph/targets/ha2010/volume_1.htm
[20] CADCA. 2010. "Fetal Alcohol Syndrome Rate in Alaska Declines." CDC. Community Anti-Drug Coalition of American. [Online]: http://www.cadca.org/resources/detail/fetal-alcohol-syndrome-rate-alaska-declines
[21] CDC. 2004. CDC Surgeon General Report 2004. U.S. Department of Health and Human Services. The Health Consequences of Smoking: A Report of the Surgeon General, 2004. Centers for Disease Control and Prevention, Office on Smoking and Health, Atlanta, GA, May 2004.
[22] Brooke 1989. Brook, Anderson, Bland, Peacock, Stewart. 1989. Effects on birth weight of smoking, alcohol, caffeine, socioeconomic factors, and psychosocial stress. Brook, OG, HR Anderson, JM Bland, JL Peacock, and CM Stewart. British Medical Journal Mar 25;298(6676):795-801.
[23] Kramer MS. 1987. Determinants of low birth weight: methodological assessment and meta-analysis.

[24] Ventura et. al. 2011. U.S. Teenage Birth Rate Resumes Decline. Ventura S, Hamilton B. CDC National Center for Health Statistics, NCHS Brief # 58, February 2011. [Online]: http://www.cdc.gov/nchs/data/databriefs/db58.htm

[25] Springer KW, J Sheridan, D Kuo, and M Carnes. 2007. Long-term physical and mental health consequences of childhood physical abuse: results from a large population-based sample of men and women. *Child Abuse and Neglect*. 31(5):517-30.

[26] Healthy People 2020. "Injury and Violence." [Online]: http://www.healthypeople.gov/2020/LHI/injuryViolence.aspx#two

[27] Chartier MJ, Walker JR, Naimark B. 2007. Childhood abuse, adult health, and health care utilization: results from a representative community sample. Am J Epidemiol. 165: 1031-8 doi: 10.1093/aje/kwk113 pmid: 17309899.

[28] WHO 1987. World Health Organization. 1987; 65(5): 663–737. PMCID: PMC2491072

[29] ADHSS. 2012. Office of Children's Services (OCS) Child Protective Services Manual. [Online]: http://hss.state.ak.us/ocs/Publications/CPSManual/cps-manual.pdf, http://www.hss.state.ak.us/ocs/Statistics/pdf/Annual_Allgs_10.pdf

[30] Alaska Department of Labor and Workforce Development Research and Analysis. 2009. "Alaska Population Overview: 2009 Estimates." [Online]: http://labor.state.ak.us/research/pop/estimates

[31] Coker, Smith, King, and McKeown. 2000. "Physical Health Consequences of Physical and Psychological Intimate Partner Violence," Coker, A., P. Smith, L Bethea, M King, and R McKeown. *Archives of Family Medicine*, Vol. 9.

[32] The Family Violence Prevention Fund. 2004. National Consensus Guidelines on Identifying and Responding to Domestic Violence Victimization in Health Care Settings. [Online]: http://www.aap.org/pubserv/PSVpreview/pages/Files/Consensus.pdf

[33] Koenen, Moffitt, Caspi, Taylor, and Purcel. 2003. Domestic violence is associated with environmental suppression of IQ in young children. Koenen, KC, TE Moffitt, A Caspi, A Taylor, and S Purcell Developmental Psychopathology, Spring;15(2):297-311. [Online]: http://www.ncbi.nlm.nih.gov/pubmed/12931829

[34] Council on Domestic Violence and Sexual Assault. 2010. "Annual Report, Fiscal Year 2010." [Online]: http://dps.state.ak.us/cdvsa/docs/CDVSAAnnualReport2010.pdf

[35] Rosay, Samaniego, Rivera, Myrstol, Wood, and Morto. 2010. 2010 Alaska Victimization Survey (Powerpoint slide presentation). Rosay, André B, Sandy Samaniego, Marny Rivera, Brad Myrstol, Darryl S. Wood, and Lauree Morto Slide presentation presented at University of Alaska Anchorage, Anchorage, AK, 30 Sep 2010. [Online]: http://justice.uaa.alaska.edu/research/2010/1004.victimization/1004.01.avs.pdf

[36] Utermohle, Wells. 2009. "Sexual Violence/Intimate Partner Violence: Socioeconomic and Mental Health Correlates of High Prevalence." Utermohle, Charles and Rebecca Wells State of Alaska, Department of Health and Social Services, Division of Public Health, Section of Chronic Disease Prevention and Health Promotion. Available at http://www.hss.state.ak.us/dph/chronic/hsl/brfss/pubs/SV_IPV_2009.pdf.

[37] U.S. Department of Health and Human Service. 2000. "Oral health in America: A report of the Surgeon General—Executive summary." Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health. [Online]: http://www.surgeongeneral.gov/library/oralhealth/

[38] AN EpiCenter. 2009. Alaska Native Health Status Report, Alaska Native Epidemiology Center, Alaska Native Tribal Health Consortium, August.

[39] National Center for Health Statistics. 2011. "Health, United States, 2010: With Special Feature on Death and Dying." Hyattsville, MD 2011.

[40] ADHSS. 2005. Results of the 2005 oral health survey of Alaskan kindergarteners: Alaska oral health basic screening survey. Contractor's report for the Oral Health Program, Alaska Department of Health and Social Services; 2006. Accessed September 16, 2011. [Online]: http://www.hss.state.ak.us/dph/wcfh/oralhealth/docs/2005_oralhealth_k.pdf

[41] CDC Morbidity and Mortality Weekly Dental Caries in Rural Alaska Native Children, Alaska 2008, September 23, 2011/ 60(37); 1275-1278

[42] ADHSS. Bureau of Vital Statistics. Data & Statistics. Death Statistics. Detailed Causes. Census Areas. Accessed August 2011 and December 2014. [Online]: http://www.hss.state.ak.us/dph/bvs/death_statistics/Detailed_Causes_Census/frame.html

[43] University of Wisconsin. 2011. County Health Rankings, Population Health Institute [Online]: http://www.countyhealthrankings.org/alaska/bethel/49

[44] U.S. Census. 2000. Summary File 4: Technical Documentation, 2003, U.S. Department of Commerce. [Online]: http://www.census.gov/prod/cen2000/doc/sf4.pdf

[45] Alaska Department of Labor and Workforce Development, American Community Survey 2005 to 2009 and 2008-2012. [Online]: http://labor.alaska.gov/research/census/

[46] Muennig. 2006. *State-level health cost-savings associated with improvements in high school graduation rates*. Muennig, P. Washington, DC: A report commissioned by the Alliance for Excellent Education.

[47] Wong, Shapiro, Boscardin, and Ettner. 2002. "Contribution of major diseases to disparities in mortality." Wong, M., M. Shapiro, W. Boscardin, and S. Ettner, *New England Journal of Medicine*, 347, 1585-1592.

[48] Muennig. 2005. *Health returns to education interventions.* Paper prepared for the Symposium on the Social Costs of Inadequate Education at Columbia University. New York.

[49] Harden. 2004. "Safety and Stability for Foster Children: A Developmental Perspective." Harden, Brenda Jones *Future of Children* (Princeton, New Jersey) 14, no.1 (Winter 2004).

[50] Patterson GR, Yoerger K. 2002. A developmental model for early- and late-onset antisocial behavior. In J. B. Reid, J. Snyder & G. R. Patterson (Eds.), Antisocial behavior in children and adolescents: A developmental analysis and model for intervention, (pp. 147-172). *Washington, DC: American Psychological Association*

[51] ADHSS. Bureau of Vital Statistics. Marriage and Divorce Rates for Alaska. 2011. [Online]: http://www.hss.state.ak.us/dph/bvs/marriage_divorce_statistics/Marriages_Divorces/frame.html

[52] Chandler M. 1998. Cultural continuity as a hedge against suicide in Canada's First Nations. In Sage Journals, Transcultural Psychiatry, June 1998, vol. 35 no. 2 191-219

[53] Chandler MJ, Lalonde C. 2004. Transferring whose knowledge? Exchanging whose best practices?: On knowing about indigenous knowledge and aboriginal suicide. In J. White, P. Maxim, & D. Beavon (Eds.), Aboriginal Policy Research: Setting the Agenda for Change, Vol.II. (pp.111-123) Toronto: Thompson Educational Publishing.

[54] Stevenson. 2009. The Suicidal Wound and Fieldwork among Canadian Inuit. In *Being There: the Fieldwork Encounter and the Making of Truth*. Lisa Stevenson. John Borneman, Abdellah Hammoudi, eds. California: University of California Press, 2009.

[55] Brown CL, JL Magdanz, DS Koster, NM Braem, editors. 2012. Subsistence Harvest in 8 Communities in the Central Kuskokwim River Drainage, 2009. Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 365. Fairbanks, Alaska.

[56] Alaska Trauma Registry. 2011.

[57] AN EpiCenter. 2014. Alaska Native Injury Atlas: An Update. October 2014.

[58] Landen, et al. 1997, "Alcohol-Related Injury Death and Alcohol Availability in Remote Alaska. JAMA. 1997; 278(21):1755-1758. doi: 10.1001/jama.1997.03550210053038.

[59] Alaska Department of Public Safety, Division of Alaska State Troopers (AST). 2010. The Alaska State Troopers Annual Report 2010.

[60] U.S. Army Corps of Engineers. 2009. Waterborne Commerce Statistics Center, 2009, Part 4, Sheet 49. Available at: http://www.ndc.iwr.usace.army.mil//wcsc/webpub09/Part4_WWYs_Tripsbydraft_CY2009.htm

[61] Alaska Department of Public Safety, Alcoholic Beverage Control Board. Update June 23, 2011. [Online]: http://www.dps.state.ak.us/abc/docs/localopt.pdf

[62] U. S. Environmental Protection Agency (EPA) Region 10: The Pacific Northwest. Tribal Air Quality. Accessed September 22, 2011. [Online]: http://yosemite.epa.gov/R10/TRIBAL.NSF/programs/tribalairalaska

[63] ADEC. Source Water Assessment. [Online]: https://dec.alaska.gov/eh/dw/DWP/complete.html

[64] Harrington JM, Middaugh JP, Morse DL, Housworth J. 1978. A survey of population exposed to high concentrations of arsenic in well water in Fairbanks, Alaska: American journal of Epidemiology, v. 108, p. 377-385.

[65] ADEC. 2005. Basin Fact Sheet for Kuskokwim Delta USGS HUC: 19030502. [Online]: https://dec.alaska.gov/eh/docs/dw/DWP/KuskokwimDelta.pdf

[66] ADEC. Alaska's Impaired Waters-2010. [Online]: https://dec.alaska.gov/water/wqsar/Docs/2010impairedwaters.pdf

[67] ADHSS. 2010. Mercury in Northern Pike from the Yukon Delta National Wildlife Refuge. [Online]: www.epi.alaska.gov/eh/fish/YKD_Pike_Mercury_Poster.pdf

[68] ADHSS. 2010. Fact Sheet: Mercury in Burbot (Lush) and Pike from the Middle Kuskokwim River Area – June 2, 2011. [Online]: http://www.epi.alaska.gov/eh/fish/MidKuskoPikeBurbotFactSheetJune2011.pdf

[69] ATSDR. 1999. Toxicological profile for mercury. [Online]: http://www.atsdr.cdc.gov/toxprofiles/tp46.html

[70] WHO. Mercury Factsheet. World Health Organization. [Online]: http://www.who.int/ipcs/assessment/public_health/mercury/en/index.html

[71] Alaska Division of Health and Social Services (ADHSS) Section of Epidemiology. 2010. Alaska Hair Mercury Biomonitoring Program Update, July 2002 to May 2010. Bulletin No. 18, June 24, 2010. [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/b2010_18.pdf

[72] ADHSS. 2014. Donlin Gold HIA Fieldwork Summary Hair Mercury Sampling

[73] CDC. 2013. Adult Blood Lead Epidemiology & Surveillance (Ables). [Online]: http://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm

[74] Alaska Section of Epidemiology, 2008 Alaska Division of Health and Social Services (ADHSS) Section of Epidemiology. 2008. Non-Occupational Exposures in Adults and Children – Alaska, 1995-2006. Bulletin No. 07, March 7, 2008. [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/b2008_07.pdf

[75] ADHSS. 2014. Blood Lead Surveillance in Children Aged <18 Years- Alaska, 1995-2012 [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/b2014_04.pdf

[76] ADEC. 2014. Contaminates Sites Program Database. [Online]: http://dec.alaska.gov/spar/csp/db_search.htm

[77] ADEC. 2011. Natural Disaster Situation Report: 2011 Spring Flooding. [Online]: http://dec.alaska.gov/spar/perp/response/sum_fy11/springflood2011/springflood2011_sr_01.pdf

[78] Alaska Federation of Natives. 1993. Alaska Federation of Natives, Guidelines for Research. Available at: www.ankn.uaf.edu

[79] Wolfe and Walker 1987: "Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts," Wolfe, Robert J. and Walker, Robert J., Arctic Anthropology 24(2):56-81

[80] Alaska Division of Health and Social Services (ADHSS) Section of Epidemiology. 2003. Vitamin D Deficiency is Common Among Otherwise Healthy Alaskan Children. Bulletin No. 37, December 11, 2003. [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/b2003_37.pdf

[81] WHO. 1995. Expert Committee on Physical Status. Physical status: the use and interpretation of anthropometry. World Health Organ Tech Report 854. [Online]: http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf?ua=1

[82] WHO, UNICEF. 2004. Low Birthweight. Country, Regional and Global Estimates. [Online]: http://whqlibdoc.who.int/publications/2004/9280638327.pdf

[83] ADHSS. 2012. Donlin Consumption Surveys and Community Observations.

[84] Donlin Gold PDEIS. 2015. Chapter 3 Environmental Analysis, Section 3.21 Subsistence; April 2015, Corrected.

[85] Brown CL, Ikuta H, Koster DS, Magdanz JS. 2013. Subsistence Harvests in 6 Communities in the Lower and Central Kuskokwim River Drainage, 2010; Technical Paper No. 379; Alaska Department of Fish and Game, Division of Subsistence.

[86] Coffing MW, Brown L, Jennings G, Utermohle CJ. 2001. The Subsistence Harvest and Use of Wild Resources in Akiachak, Alaska, 1998; Technical Paper No. 258; Alaska Department of Fish and Game, Division of Subsistence.

[87] USDA. 2010. Household Food Security in the United States in 2010. [Online]: http://www.ers.usda.gov/Publications/err125/

[88] University of Alaska Fairbanks. 2011. Food Cost Survey. [Online]: http://www.uaf.edu/ces/fcs/2011q3data.pdf

[89] WHO. 1999. Report on Infectious Diseases: Removing Obstacles to Healthy Development. [Online]: http://www.who.int/infectious-disease-report/pages/textonly.html. 1999

[90] ADHSS. 2010. Statewide Increase in Gonococcal Infection – Alaska 2009. Bulletin No. 6, March 9, 2010. [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/b2010_6.pdf

[91] ADHSS. 2011. An Assessment of Expedited Partner Therapy for Enhanced Gonorrhea and Chlamydia Control in Alaska. Volume 14, No. 1, January 12, 2011. [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/rr2011_01.pdf

[92] ADHSS. 2011. Improving Immunization Coverage Rates in Alaska's Children. Bulletin No. 2, February 17, 2011. [Online]: http://www.epi.alaska.gov/bulletins/docs/b2011_02.pdf

[93] National Institute of Allergy and Infectious Diseases (NIAID). 2011. Pneumococcal Pneumonia. [Online]: http://www.niaid.nih.gov/topics/pneumonia/pages/default.aspx

[94] Hennessy TW, Ritter T, Holman RC, Bruden DL, Yorita KL, Bulkow L, Cheek JE, Singleton RJ, Smith J. 2008. The relationship between in-home water service and the risk of respiratory tract, skin, and gastrointestinal tract infections among rural Alaska natives. Am J Public Health. Nov (11):2072-8. [Online]: http://www.ncbi.nlm.nih.gov/pubmed/18382002

[95] Marmot & Wilkinson, eds. 2006. "Social determinants of health". Marmot M & Wilkinson RG Oxford: Oxford University Press.

[96] Mayo Clinic. 2014. COPD. [Online]: http://www.mayoclinic.com/health/copd/DS00916

[97] WHO. 2012. Mental Health Factsheet. [Online]: http://www.who.int/mental_health/en/

[98] ADHSS. 2009. Health Risks in Alaska among Adults — Alaska Behavioral Risk Factor Survey Reports. [Online]: http://www.hss.state.ak.us/dph/chronic/hsl/brfss/publications.htm

[99] WHO. 2014. Physical Activity. [Online]: http://www.who.int/dietphysicalactivity/pa/en/index.html

[100] U.S. Department of Health and Human Services. 2008. *Physical Activity Guidelines for Americans.* Hyattsville, MD: U.S. Department of Health and Human Services, 2008. Accessed March 3, 2010. [Online]: http://www.health.gov/paguidelines

[101] U.S. Department of Health and Human Services. 2010. Surgeon General's Report—How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease. 2010. [Online]: http://www.surgeongeneral.gov/library/tobaccosmoke/report/executivesummary.pdf

[102] WHO. 2014. Cancer Factsheet. World Health Organization. [Online]: http://www.who.int/cancer/en/

[103] Yukon Kuskokwim Health Corporation (YKHC). 2014. [Online]: http://www.ykhc.org

[104] Stanek, R.T.; Holen, D. L.; Wassillie, C. 2007. Harvest and Uses of Wild Resources in Tyonek and Beluga, Alaska, 2005 – 2006, Technical Paper No. 321.; Alaska Department of Fish and Game, Division of Subsistence.

[105] Holen D, Hazell SM, Van Lanen JM, Ream JT, Desjardins SPA, Jones B, Zimpelman G. 2014. The Harvest and Use of Wild Resources in Cantwell, Chase, Talkeetna, Trapper Creek, Alexander/Susitna, and Skwentna, Alaska, 2012, Technical Paper No. 385; Alaska Department of Fish and Game, Division of Subsistence.

[106] Ikuta H, Brown CL, Koster DS. 2014. Subsistence Harvests in 8 Communities in the Kuskokwim River Drainage and Lower Yukon River, 2011, Technical Paper No. 396; Alaska Department of Fish and Game, Division of Subsistence.

[107] ADHSS. 2013. Tyonek Household Survey 2013.

[108] ADHSS. 2011. An Assessment of Expedited Partner Therapy for Enhanced Gonorrhea and Chlamydia Control in Alaska. Volume 14, No. 1, January 12, 2011. [Online]: http://www.epi.hss.state.ak.us/bulletins/docs/rr2011_01.pdf

[109] Tanana Chiefs Conference, Health Services. [Online]: http://www.tananachiefs.org/health_services.shtm

[110] Sullivan J, Krieger G, eds. *Clinical Environmental Health and Toxic Exposures.* 2nd ed: Lippinicott Williams & Wilkins; 2001.

[111] Klaassen C, ed Casarett & Doull's Toxicology: The Basic Science of Poisons. 7th ed: McGraw-Hill Professional; 2008.

[112]National Research Council. 1983. Risk assessment in the Federal Government: Managing the Process. Washington, D.C.: National Academy Press; 1983.

[113] National Research Council. 1994. *Science and Judgment in Risk Assessment*. Washington, D.C.: National Academy Press.

[114] U.S. Environmental Protection Agency. 1989. Office of Emergency and Remedial Response *Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A).* Office of Emergency and Remedial Response; EPA/540/1-89/002.

[115] U.S. Environmental Protection Agency. 2009. Office of Research and Development. *Integrated Science Assessment for Particulate Matter.* Office of Research and Development. U.S. Environmental Protection Agency.

[116] WHO. 1999. Principles for the Assessment of Risks to Human Health from Exposure to Chemicals. EHC No. 210.

[117] WHO. 2000. Human Exposure Assessment. EHC No. 214.

[118] ATSDR. 2005. Public Health Assessment Guidance Manual (Update).

[119] ASTM Standard E1739 - 95(2010)e1. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. West Conshohocken, PA: ASTM International. 1995, 10.1520/E1739-95R10E01.

[120] ASTM Standard E2081 - 00(2010)e1. Standard Guide for Risk-Based Corrective Action. West Conshohocken, PA: ASTM International. 2000, DOI: 10.1520/E2081-00R10E01.

[121] Alaska Dept. of Environmental Conservation. 2010. Policy Guidance on Developing Conceptual Site Models. Division of Spill Prevention and Response.

[122] Alaska Dept. of Environmental Conservation. 2010. Risk Assessment Procedures Manual. Division of Spill Prevention and Response.

[123] Environ 2014. Global Atmospheric Mercury Modeling to Determine Mercury Baseline and Source Attribution in Alaska and near the Donlin Gold Project, June 2014

[124] SRK. 2012. Plan of Operations-Volume I Project Description, Donlin Gold Project. July.

[125] BGC. 2014. Donlin Gold Project, Numerical Hydrogeologic Model, prepared for Donlin Gold, LLC, July 18, 2014.

[126] Sandy T, DiSante C. 2010. Review of Available Technologies for the Removal of Selenium from Water. [Online]: http://www.namc.org/docs/00062756.PDF.

[127] ATSDR. 2006. Toxicological Profile for Cyanide. [Online]: http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=71&tid=19

[128] A Khodadadi, M Abdolahi, P Teimoury. 2005. Detoxification of cyanide in gold processing wasterwater by hydrogen peroxide. Iran. J. Environ. Health. Sci. Eng., 2005, Vol. 2, No. 3, pp. 177-182.

[129] Harada M. 1995. Minimata disease: Methylmercury poisoning in Japan caused by environmental pollution. Crit. Rev. Toxicol. 25: 1-24.

[130] U.S. Environmental Protection Agency (EPA), Office of Science and Technology (4305T). 2010. Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion. April. [Online]: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/methylmercury/upload/mercury2010.pdf

[131] Rowe CL, Hopkins WA, Congdon JD. 2002. Ecotoxicological Implications of Aquatic Disposal of Coal Combustion Residues. Environmental Monitoring & Assessment 80(3): 207-276.

[132] National Research Council of the National Academies (NRC). 2006. Managing Coal Combustion Residues in Mines. National Academies Press, Washington, DC

[133] ATSDR. 1992. Public Health Statement for Antimony. [Online]: http://www.atsdr.cdc.gov/phs/phs.asp?id=330&tid=58

[134] National Toxicology Program (NTP). 1992. *Toxicity Studies of Antimony Potassium Tartrate* (CAS no.28300-74-5) in F344/N Rats and B6C3F1 Mice (Drinking Water and Intraperitoneal Injection Studies). Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health.

[135] ATSDR. 2003. Toxicological Profile for Selenium. [Online]: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=153&tid=28

[136] Besser JM, Giesy JP, Brown RW, Buell JM, Dawson GA. 1996. Selenium bioaccumulation and hazards in a fish community affected by coal fly ash effluent. Ecotoxicol. Environ. Saf. 35: 7-15.

[137] National Parks Service (NPS). 1997. Environmental Contaminants Encyclopedia Selenium Entry.

[138] U.S. Environmental Protection Agency (EPA). 2007. Coal Combustion Waste Damage Case Assessments. Office of Solid Waste. (9 July).

[139] U.S. Environmental Protection Agency. 2000. Office of Research and Development. An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States for the Years 1987, 1995, and 2000. Office of Research and Development; EPA/600/P-03/002F. 2006.

[140] World Health Organization. 2005. Air Quality Guidelines. Global Update 2005. Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. EHC No. 210. 2006.

[141] Holgate ST, Sandström T, Frew AJ, Stenfors N, Nördenhall C, Salvi S, Blomberg A, Helleday R, Söderberg M. 2002. Health Effects of Acute Exposure to Air Pollution Part I: Healthy and Asthmatic Subjects Exposed to Diesel Exhaust. Research Report 112. Health Effects Institute.

[142] U.S. Environmental Protection Agency (EPA). 2006. An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States for the Years 1987, 1995, and 2000. Office of Research and Development; EPA/600/P-03/002F.

[143] Laroo CA, Schenk CR, Sanchez LJ, McDonald J. 2011. Emissions of PCDD/Fs, PCBs, and PAHs from a Modern Diesel Engine Equipped with Catalyzed Emission Control Systems. *Environ. Sci. Technol.* 45(15):6420-6428.

[144] Chen CY, Stemberger RS, Kamman NC, Mayes BM, Folt CL. 2005. Patterns of mercury bioaccumulation and transfer in aquatic food webs across multi-lake studies in the northeast US. Ecotoxicology 14:135–147.

[145] Lange TR, Royals HE, Connor LL. 1993. Influence of water chemistry on mercury concentration in largemouth bass from Florida lakes. TAFS 122: 74.

[146] Ravichandran M. 2004. Interactions between mercury and dissolved organic matter–a review. Chemospere 55: 319–331.

[147] Sackett DK, Aday DD, Rice JA, Cope WG, Buchwalter D. 2010. Does proximity to coal-fired power plants influence fish tissue mercury? Ecotoxicology. Nov;19(8):1601-11.

[148] Hammerschmidt, CR, WF Fitzgerald. 2006. Photodecomposition of methylmercury in an arctic Alaskan lake. Environ. Sci. Technol. 40:1212–1216.

[149] Hutcheson MS, Smith CM, Wallace GT, Rose J, Eddy B, Sullivan J, Pancorbo O, West CR. 2008. Freshwater fish mercury concentrations in a regionally high mercury deposition area. Water Air Soil Pollut 199: 15–31.

[150] U.S. Environmental Protection Agency (EPA). 1994. Acid Mine Drainage Prediction: Technical Document [Online]: http://www.epa.gov/osw/nonhaz/industrial/special/mining/techdocs/amd.pdf

[151] ATSDR 2014. Medical Management Guidelines for Mercury. Available online at http://www.atsdr.cdc.gov/mmg/mmg.asp?id=106&tid=24. Accessed July 2014. [Online]:

[152] ATSDR. 1999. Toxicological profile for mercury (Update). U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry.

[153] Environ. 2014. Global Atmospheric Mercury Modeling to Determine Mercury Baseline and Source Attribution in Alaska and near the Donlin Gold Project, June 2014.

[154] Arcadis 2014. Assessment of Mercury Fate in the Environment from Changes to Atmospheric Deposition, Donlin Gold Project, June, 2014.

[155] SRK. 2014. Mercury White Paper, Donlin Gold Project, July 2014.

[156] EPA. 2014. National Recommended Water Quality Criteria. [Online]: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

[157] EPA. 2015. Basic Information about Mercury (inorganic) in Drinking Water. [Online]: http://water.epa.gov/drink/contaminants/basicinformation/mercury.cfm#nine

[158] ADEC. 2012. 18 AAC 70 Alaska Water Quality Standards; Amended as of April 8, 2012. [Online]: http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2070.pdf

[159] BGC. 2014. Donlin Gold Project, Numerical Hydrogeologic Model, prepared for Donlin Gold, LLC, July 18, 2014.

[160] SRK. 2012. Integrated Waste Management Monitoring Plan, Plan of Operations-Volume III A, Donlin Gold Project, July.
[161] Donlin Gold EIS. 2014. Environmental Analysis Section 3.7 Water Quality.
[162] SRK. 2012. Waste Rock Management Plan, Donlin Gold Project, July.
[163] SRK. 2012. Water Resources Management Plan, Donlin Gold Project, July.
[164] Donlin Gold EIS. 2014. Environmental Analysis Section 3.7 Water Quality.
[165] SRK Consulting (U.S.), Inc. (SRK). 2007. Waste Rock Metal Leaching and Acid Rock Drainage Assessment for Feasibility Study, Donlin Creek Project, Alaska. September.
[166] Donlin Gold EIS. 2014. Environmental Analysis Section 3.7 Water Quality.
[167] Donlin Gold EIS. 2014. Environmental Analysis Section 3.2 Transportation.
[168] ADHSS. 2014. Fish Consumption Advice for Alaskans-A Risk Management Strategy to Optimize the Public's Health. [Online]: http://www.epi.alaska.gov/eh/fish/FishConsumptionAdvice2014.pdf
[169] Donlin Gold EIS. 2014. Environmental Analysis Section 3.8 Air Quality.
[170] AECOM. 2015. Socio-Cultural Impacts To Subsistence Practices: Technical Report. Prepared for Donlin Gold in March 2015.
[171] Donlin Gold EIS. 2014. Environmental Analysis Section 3.6 Groundwater.
[172] International Finance Corporation (IFC). Community Health and Safety. Good Practice Notes for Performance Standard #4. International Finance Corporation. New York, NY. 2007. [Online] http://www.ifc.org/ifcext/sustainability.nsf/Content/Pu
[173] International Council on Mining and Minerals (ICMM). *Good Practice Guidance on Health Impact Assessments.* International Council on Mining and Minerals. London, England. 2012. [Online} (http://www.icmm.com/document/4080).
[174] IPIECA. *DRAFT Guidance for Health Impact Assessment*. IPIECA, London, England. 2015 (to be released June, 2015).

Planning Commission 2023 Attendance

Regular Meetings

Member Name	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Kathy Hanson, Chair	NO MTG	NO MTG	P	P	P	P	P	P	P	P		
Lorin Bradbury, Vice Chair	NO MTG	NO MTG	P	P	P	P	E	U	P	E		
Alex Wasierski	NO MTG	NO MTG	P	P	P	P	P	P	U	P		
Shadi Rabi	NO MTG	NO MTG	P	P	P	U	E	E	P	P		
Stanley Hoffman Jr.	NO MTG	NO MTG	E	E	P	U	P	U	E	P		
Haley Hanson	NO MTG	NO MTG	P	P	P	E	E	U	P	P		
Jessica Schroeder	NO MTG	NO MTG	U	XX	XX	XX	XX	XX	XX	XX	XX	XX
Greg Morgan	NO MTG	NO MTG	U	P	E	P	E	P	P	E		
Sophie Swope	NO MTG	NO MTG	P	P	E	P	P	P	E	P		

Special Meetings

Member Name	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Kathy Hanson, Chair												
Lorin Bradbury, Co-Chair												
Alex Wasierski												
Shadi Rabi												
Stanley Hoffman Jr.												
Haley Hanson												
Jessica Schroeder												
Greg Morgan												

Vacancy shall be declared by the body when a member:		
Fails to attend 3 regular meetings without being excused by the body Fails to attend 3 special meetings without being excused by the body Fails to attned 65% of regular meetings Fails to attend 65% of special meetigns.	**P=Present** **E=Excused** **U=Unexcused** **T= Tardy**	Chair determines excused/unexcused during roll call. If a member disagrees with the the chair, a motion to overule the decision of the chair can be made.

xx: not yet appointed/left commission

2023 SITE PLAN PERMITS ISSUED

Number	Housing Type	Date arrived in Planning	Approval Date	FILL	Lot	Block	Subdivision	Name of Applicant	Land Owner	Address
23-01	24 Unit Apt Building	7/14/05	3/6/23		Tract H2	2	Turnkey III	Bethel Supportive Housing	City of Bethel	127 Atsaq Street
23-02	demo house, clear debris	4/25/23	5/12/23	25 loads	38	6	City Subdivision	Sahmi Pellubi	Sahmi Pellumbi	331 Akiachak
23-03	GCI Infastructure modifcation	5/5/23	5/19/23		5		US Survey 4117	GCI	GCI	910 Chief Eddie Hoffman Highway
23-04	fill for maitnenace and repair/addition to home	5/5/23	5/26/23	10 loads	9	8	Tundra Ridge	MaryBeth Hessler	MaryBeth Hessler	9141 Ptrarmigan Street
23-05	fill for maintenace and repair	5/23/23	5/26/23	150 cu yds	42	1	Blueberry Fields	Carrie Lambert	Carrie Lambert	126 Cranberry
23-06	fill for maintenace and repair	4/24/23	5/30/23	15 loads	7	1	US Survey 3230AB	Carlos Zelaya	Carlos Zelaya	480 3rd Road
23-07	fill for maintenace and repair	5/23/23	5/30/23	200 cu yds	11A	11	Tundra Ridge	Brian Lefferts/Lori Strickler	Brian Lefferts/Lori Strickler	9119 Ptarmigan
23-08	add fill for maintenance and repair/expand pad	6/6/2023	7/20/2023	87.3 cu yds	18	1	Larson Subdivisin	Jeffrey Evon	Jeffrey Evon	4034 Tunralik Rd
23-09	fill for maintenace and repair	6/6/23	6/9/23	2 loads	48	1	Blueberry Fields	Richard and Kathy Hanson	Richard and Kathy Hanson	162 Cranberry
23-10	fill for maintenace and repair	6/5/23	6/12/23	100 cu yds	14	9	Tundra Ridge	Kyle Kaganak	Kyle Kaganak	233 Kaligtuq Road
23-11	fill for maintenace and repair	6/12/23	6/13/23	22 loads	7	24	Plat 97-23	Tania Erickson-Grant	Tania Erickson-Grant	530 Kusko Court
23-12	fill for maintenace and repair	6/12/23	6/19/23	10 loads	3	23	Plat 78-1	Musa Saliu	Musa Saliu	1004 Mallard Lane
23-13	fill for maintenace and repair	6/16/23	6/19/23	32 loads	14	6	US Survey 3230AB	Steven Chung	Steven Chung	230A 2nd Avenue
23-14	construct 4 bedroom house	6/22/23	6/23/23		16	3	Ciulkulek Subdivision	ONC	ONC	1742 Nuqalpiaq
23-15	construct 4 bedroom house	6/22/23	6/23/23		8	3	Ciulkulek Subdivision	ONC	ONC	1726 Qugcuun
23-16	construct 4 bedroom house	6/22/23	6/23/23		15	3	Ciulkulek Subdivision	ONC	ONC	1744 Nuqalpiaq
23-17	construct 4 bedroom house	6/22/23	6/23/23		14	3	Ciulkulek Subdivision	ONC	ONC	1746 Nuqalpiaq
23-18	fill for maintenace and repair	6/26/23	6/28/23	2 loads	30	1	Blueberry Fields	Todd Fredericks	Todd Frederiks	174 Blackberry
23-19	add fill to create pad	4/24/23	7/14/23	1359 cu yds	3	3	Ciulkulek Subdivision	ONC	ONC	
23-20	add fill to create pad	4/24/23	7/14/23	1301 cu yds	4	3	Ciulkulek Subdivision	ONC	ONC	
23-21	add fill to create pad	4/24/23	7/14/23	1867 cu yds	5	3	Ciulkulek Subdivision	ONC	ONC	

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23-22	add fill to create pad	4/24/23	7/14/23	1541 cu yds	17	3	Ciulkulek Subdivision	ONC	ONC	
23-23	construct 2 story shop/apt	6/27/23	7/17/23		19	4		Spencer Wilson	Spencer Wilsom	680 Setter Drive
23-24	add fill for maintenance and repair	7/13/23	7/17/23	5 loads	23	9	Tundra Ridge	Michael and Nellie Husa	Michael and Nellie Husa	9232 Makqalria
23-25	add fill for maintenance and repair	7/19/23	7/21/23	16 loads	Tract F		Turnkey III	AVCP RHA	AVCP RHA	105 Atsaq
23-26	add fill for maintenance and repair	7/21/23	8/8/23	126 cu yds	4A	18	Blueberry Fields	Joshua & Jennifer Charlie	Joshua & Jennifer Charlie	121 Blackberry Street
23-27	fill for maint. and add 22'x10' building to lot	5/18/23	8/17/23	10 loads	4	8	City Subdivision	Catholic Chruch	Catholic Church	227 Akiak Drive
23-28	add fill for maintenace and repair	8/10/23	8/22/23	10 loads	16	2	Tundra Ridge	William Murdock	William Murdock	9419 Ayaginar Drive
23-29	add fill for maintenace and repair	8/22/23	8/22/23	12	32B		BSC Subdivision	Bethel Community Service	Bethel Community Service	1775 Chief Eddie Hoffman Hwy
23-30	add fill for maintenace and repair	8/10/23	8/23/23	25 loads	1	7	City Subdivision	Carvalena Oster	Carvalena Oster	506 Mission Drive
23-31	add fill to extend pad and repair, demo building	8/23/23	9/6/23	150 loads	7A	6		Kuqo Construction	Kuqo Construction	211 3rd Avenue
23-32	add fencing	8/31/23	9/6/23		2		Martina Oscar	Juan & Beatrice Sosa	Juan & Beatrice Sosa	517 Owl Street
23-33	constuct fire training tower	6/6/23	9/7/23		TRACT E			City of Bethel Fire Dept	City of Bethel Fire Dept	
23-34	demo house, clear debris add fill	8/30/23	9//2023	200 loads	1B	12	Plat 82-12	Prparim Selmani	Pprarim Selmani	352 Tundra Way
23-35	add fill to creat pad	8/25/23	9/21/23	10,700 cu yds	52A		Plat 2017-21	YKHC	YKHC	1320 Chief Eddie Hoffman Highway
23-36	add fill for maintenace and repair	5/9/23	9/25/23	100 loads	16 A&B	15	Plat 84-6	Harry Faulkner Jr	Harry Faulkner Jr	295 Tundra Way
23-37	add fill and constuct church	8/30/33	10/4/23	5 loads	6	13	Plat 98-3	Kuqo Construction	Kuskokwim Congreation of Jehovah's Witness	5303 Noel Polty Blvd
23-38	add fill for maintence and repair	9/25/23	9/26/23	10 loads	4C	5	US Survey 3770	Bethel United Pentacostal Church	Bethel United Pentacostal Church	431 Ridgecrest
23-39	fill, construct steam house, add ramp/deck	6/5/23	9/26/23	1180 cu yds	13	1	Plat 96-18	Kyle/David Kaganak	Kyle/David Kaganak	4024 Tundra Ridge
23-40	add fill to create pad	9/20/23	9/28/23	890 cu yds	12	6	Plat 98-3	Norman Ayagalria	Norman Ayagalria	5912 Nacaullek Street
23-41	add fill to create pad	9/20/23	10/16/23	913 cu yds	6	6	Plat 2021-2	April Blake	April Blake	Bluesky Subdivision
23-42	add fill to create pad	10/11/23	10/26/23	200 loads	Tract D-6		Plat 84-9	Janet Kaiser	Janet Kaiser	Blueberry Subdivision

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21-43	demo fire damaged apartment unit	10/12/23	10/26/23		2	5A	Ptarmigan	AVCP RHA	AVCP RHA	209 Ptarmigan Street

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Number	Housing Type	Date arrived in Planning	Approval Date	FILL	Lot	Block	Subdivision	Name of Applicant	Land Owner	Address

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Number	Housing Type	Date arrived in Planning	Approval Date	FILL	Lot	Block	Subdivision	Name of Applicant	Land Owner	Address