3.20 AIR QUALITY

This section describes the current air quality for the Environmental Impact Statement (EIS) analysis area. The EIS analysis area for air quality analysis encompasses the mine site, port, transportation corridor, and natural gas pipeline corridor for each alternative and variants, as well as the larger geographical area that would experience indirect impacts. The air quality analyses presented are applicable for all alternatives, because they are generally in the same area.

3.20.1 Regional Air Quality

Air quality is defined by the concentration of criteria pollutants and their interactions in the atmosphere, Hazardous Air Pollutants (HAPs), and the magnitude of haze and acidic deposition generally referred to as Air Quality Related Values (AQRVs). An understanding of current conditions and trends of these air quality metrics also provides a baseline for comparison of potential future impacts. Recent trends in air quality are important to consider when evaluating potential future changes, independent of an individual project.

Air quality is assessed through the analysis of values measured by the monitors listed in Table 3.20-1. A map of the monitor locations is presented in Figure 3.20-1. Criteria pollutants were analyzed using data obtained from the Alaska Department of Environmental Conservation (ADEC). Existing visibility conditions were assessed using monitors from the Interagency Monitoring of Protected Environment (IMPROVE) network. The wet and dry deposition measurements are collected by the National Acid Deposition Program (NADP) and the Clean Air Status and Trends Network (CASTNET), respectively. Except for Denali National Park monitors, all monitors are within 200 miles of the mine site, which is typically close enough to be considered representative of the area.

3.20.1.1 Criteria Pollutants

The relative importance of criteria pollutant concentrations can be determined by comparison with the Alaska Ambient Air Quality Standards (AAAQS), which are equivalent to, or more stringent than, the National Ambient Air Quality Standards (NAAQS). Air pollutant concentrations that are lower than the AAAQS provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. In the region containing the analysis area, all pollutants are below the AAAQS. With the exception of locations near airfields, where lead emissions from aircraft exhaust has the potential to occur, regional sources of lead are minimal. Because the project is far from any airfields where lead emissions could occur, and potential project lead emissions are extremely low, ambient lead concentrations and comparisons to the lead AAAQS are not addressed further in this analysis.

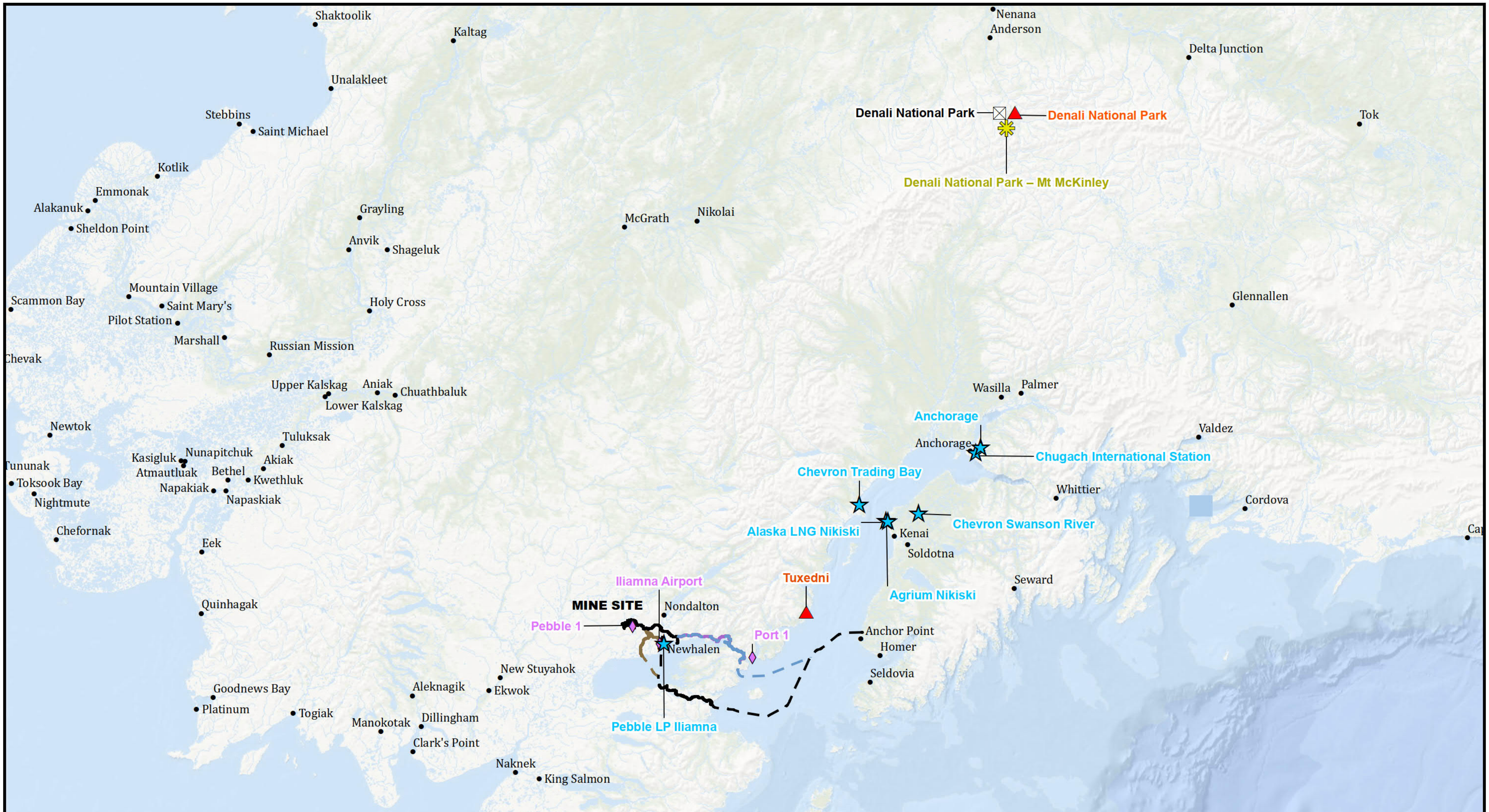
The Alaska Air Monitoring Network measures certain criteria pollutants of interest throughout Alaska, and can be used to assess the general air quality trends of the region. The nearest of these monitors are in relatively urbanized areas in and around Anchorage, and are distant from the analysis area (ADEC 2016a). Due to the increased anthropogenic activity, measurements at these monitors are expected to be elevated compared to what should be observed in the analysis area; however, the long-term measurement record available from this network can provide a valuable understanding of regional trends. The Alaska Air Monitoring Network only measures particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), ozone, and carbon monoxide (CO) close enough to the analysis area to be relevant. For the remaining criteria pollutants, long-term trends are not available for analysis.

Table 3.20-1: Monitor Name and Details Used in the Analysis

Network	Monitor Name	Monitoring Period	Monitored Parameters[1]	Monitor Purpose[2]	Approximate Distance from Mine Site
Private Industry Monitors[3]	Chevron Trading Bay	2008-2009	NO_2, CO	Maximum Impact	130 miles east
	Chevron Swanson River	2008-2009	NO_2, CO	Maximum Impact	160 miles east
	Agrium Nikiski	2013-2014	PM_{10}, $PM_{2.5}$, ozone	Maximum Impact	140 miles east
	Alaska LNG Nikiski	2015	NO_2, CO, PM_{10}, $PM_{2.5}$, SO_2, ozone	Background	140 miles east
	Chugach International Station	2011-2012	NO_2, ozone	Maximum Impact	200 miles east-southeast
	PLP Iliamna	2012-2013	NO_2, CO, PM_{10}, $PM_{2.5}$, SO_2, ozone	Background	30 miles southeast
Alaska Air Monitoring Network[4]	Select Anchorage monitors	2000-2014	$PM_{2.5}$, PM_{10}, ozone, CO	Background	180 miles east
IMPROVE[5]	Tuxedni	2008-2014	Visibility	Background	80 miles southeast
	Denali National Park	2008-2016	Visibility	Background	330 miles northeast
CASTNET[6]	Denali National Park	1999-2016	Dry Deposition	Background	330 miles northeast
NADP[7]	Denali National Park—Mount McKinley	1999-2015	Wet Deposition	Background	330 miles northeast

Notes:

[1]NO_2 = nitrogen dioxide, CO = carbon dioxide, PM_{10} = PM particulate matter with an aerodynamic diameter less than or equal to 10 microns, $PM_{2.5}$ = PM particulate matter with an aerodynamic diameter less than or equal to 2.5 microns, SO_2 = sulfur dioxide
[2]For the purpose of monitors presented, the data are collected either to provide background data or to capture maximum impacts from emission sources near the monitor location
[3]Data Obtained from ADEC 2018c
[4]ADEC 2016a
[5]IMPROVE 2018a, b
[6]EPA 2018b
[7]NADP 2018



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADEC, Alaska Air; IMPROVE; CASTNeT; NADP; Hoefler 2010a; WRCC

US Army Corps of Engineers®

25 0 25 50

Miles

Station Type

- Air Quality
- CastNet
- IMPROVE
- Meteorological
- NADP

Action Alternatives

- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 2
- Alternative 3

RELEVANT AIR QUALITY MONITORING STATIONS

PEBBLE PROJECT EIS

FIGURE 3.20-1

For $PM_{2.5}$ and PM_{10}, the frequency of AAAQS exceedances has increased since 2000 (ADEC 2016a). ADEC documents that this increase is due to an increase in the frequency of wildfires near the monitors. The more rural monitors that collect measurements are a closer representation of the analysis area, but are still higher than what would be expected given their proximity to sources; the measured concentrations have remained relatively constant, with reported annual $PM_{2.5}$ values near 6.5 micrograms per cubic meter ($\mu g/m^3$), and well below the AAAQS. The measured CO concentrations at the Anchorage monitor decreased to values consistently below 6 parts per million (ppm) from 2000 to 2014 (ADEC 2016a). An assessment of 4 years of ozone measurements at monitoring sites near Anchorage indicates that hourly ozone concentrations peak in the late spring and are lowest in winter (ADEC 2016a). This is consistent with global trends for this latitude.

Table 3.20-2 lists existing conditions measured at locations near the project study area, shown for all criteria pollutants except lead. Compared to the Anchorage monitors previously discussed, with the exception of the Chugach International Station, these monitors are in more remote areas, with fewer anthropogenic sources, aside from those associated with the large industrial facilities the data collection efforts were designed to support. None of the monitoring programs documented in Table 3.20-2 represent more than 1 year of data; therefore, multi-year averages that are required for the 1-hour nitrogen dioxide (NO_2), 1-hour sulfur dioxide (SO_2), and $PM_{2.5}$ AAAQS cannot be properly calculated. For those pollutants and averaging periods, the values presented in Table 3.20-2 are not directly comparable to the AAAQS, but are still a reliable indicator of recent air quality, and show if values in the vicinity of the analysis area are near AAAQS thresholds; however, a single year of data could represent an anomalous event.

All values listed in Table 3.20-2 are well below the AAAQS. Unlike the measurement locations themselves, the analysis area is far from large industrial emissions sources, with relatively sparse population. Therefore, measured concentrations in the analysis area are expected to be lower.

Secondary NAAQS set limits to protect public welfare, including protection against decreased visibility; endangerment to animals; and damage to crops, vegetation, and buildings. In most cases, the AAAQS are also protective of the health of plant and animal species because they are equal to or more stringent than the secondary NAAQS; however, for some species of lichens, which can be particularly sensitive to SO_2, ADEC (2016b) recommends supplementing these standards with an annual SO_2 threshold of 13 $\mu g/m^3$, which is more stringent than the annual SO_2 AAAQS. Annual SO_2 concentrations at the Alaska Liquefied Natural Gas (LNG) Nikiski monitor are reported as zero (Table 3.20-2), indicating that concentrations are less than 0.0005 ppm (1.4 $\mu g/m^3$), and well below the annual SO_2 threshold of 13 $\mu g/m^3$. Given that the analysis area has limited sources of anthropogenic SO_2, it is expected that the SO_2 concentrations in the analysis area would be similar to those measured at the Alaska LNG Nikiski monitor.

Table 3.20-2: Criteria Pollutant Data Complied by ADEC

Pollutant	Averaging Period	Rank[1]	AAAQS	Monitor Name					
				Chevron Trading Bay	Chevron Swanson River	Agrium Nikiski	Alaska LNG Nikiski	Chugach International Station	PLP Iliamna
NO_2	1-hour	98th Percentile of Daily Max	100 ppb	N/A	N/A	N/A	16.0 ppb	80.7 ppb	7.0 μg/m³
	Annual	Maximum Annual Average	53 ppb	3.0 ppb	7.0 ppb	N/A	1.0 ppb	15 ppb	0 μg/m³
SO_2	1-hour	99th Percentile of Daily Max	75 ppb	N/A	N/A	N/A	1.6 ppb	N/A	N/A
	3-hour	Second High	0.5 ppm	N/A	N/A	N/A	0 ppm	N/A	N/A
	24-hour	Second High	0.14 ppm	N/A	N/A	N/A	0 ppm	N/A	N/A
	Annual	Maximum Annual Average	0.030 ppm	N/A	N/A	N/A	0 ppm	N/A	N/A
PM_{10}	24-hour	Second High	150 μg/m³	N/A	N/A	58.5 μg/m³	30.0 μg/m³	N/A	12.4 μg/m³
$PM_{2.5}$	24-hour	98th Percentile	35 μg/m³	N/A	N/A	8.0 μg/m³	12 μg/m³	N/A	4.1
	Annual	Maximum Annual Average	12 μg/m³	N/A	N/A	3.6 μg/m³	3.7 μg/m³	N/A	0.9
CO	1-hour	Second High	35 ppm	1.5 ppm	1.7 ppm	N/A	1 ppm	N/A	N/A
	8-hour	Second High	9 ppm	1 ppm	0.9 ppm	N/A	1 ppm	N/A	686.0 μg/m³
Ozone	8-hour	Fourth High	0.070 ppm	N/A	N/A	0.051 ppm	0.047 ppm	0.047 ppm	102.4 μg/m³

Notes:
[1]As reported by ADEC. See ADEC 2019b for more information on calculations and applicability to direct comparisons to AAAQS
AAAQS = Alaska Ambient Air Quality Standards
ADEC = Alaska Department of Environmental Conservation
CO = carbon dioxide
LNG = liquefied natural gas
μg/m³ = micrograms per cubic meter
N/A = not available
NO_2 = nitrogen dioxide
PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
ppb = parts per billion
ppm = parts per million
SO_2 = sulfur dioxide

3.20.1.2 Hazardous Air Pollutants

HAPs can cause serious health effects or adverse environmental or ecological effects. Concentrations of HAPs are rarely measured, and there are no monitors measuring HAPs in the region; therefore, no data are available to assess the current concentrations or trends. HAPs are not generally measured, except in the vicinity of very specific large sources, such as refineries. The HAPs of primary concern are reactive and short-lived in the atmosphere. Therefore, absent large regional anthropogenic sources, there is no reason to expect measurable concentrations in the analysis area, except for what is biogenic in nature. For the same reasons, increasing or decreasing trends over time of HAPs in the analysis area are not expected.

3.20.1.3 Air Quality Related Values

Thresholds for AQRVs have been set to protect resources sensitive to acidic deposition and visibility degradation. These resources include vegetation, soils, water, fish, wildlife, and recreation. Visibility and deposition are reviewed in more detail below for the purpose of establishing baseline conditions pertinent to vegetation, soils, water, fish, and recreation.

Visibility

Visibility impairment primarily impacts the recreational value of a location, and is not a concern for vegetation, soil, water, and fish. Regional haze is a visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Visibility impairment is caused by particles and gases in the atmosphere that scatter or absorb light. Light scattering is the primary cause of regional haze in many parts of the country, resulting from fine particles (e.g., $PM_{2.5}$) in the atmosphere. Additionally, coarse particles between 2.5 and 10 microns in diameter can contribute to both light absorption and scattering, increasing regional haze. Coarse particles and $PM_{2.5}$ can be naturally occurring, or the result of human activity. The natural levels of coarse particles result in some level of visibility impairment in the absence of any human influences, and vary with season, daily meteorology, and geography (Malm 1999).

The US Environmental Protection Agency (EPA) and other agencies have been monitoring visibility in national parks and wilderness areas since 1988. Observations have shown that visibility at national parks and wilderness areas throughout the US was not as good as estimated natural background conditions (i.e., visibility is impaired relative to natural background conditions). The Regional Haze Rule was promulgated by the EPA in 1999 to establish Reasonable Progress Goals for improving visibility (EPA 2018c).

ADEC (2011) has determined that a primary source of visibility degradation for Alaska is short- and long-range transport of dust, and transport of combustion emissions from anthropogenic sources in Asia and northern Europe. The long-range transport of dust across the Pacific Ocean typically influences visibility in Alaska in spring and summer, while anthropogenic emissions from northern Europe and Russia reach Alaska during the winter and early spring. Additionally, particulate and gaseous emissions from wildfires influence visibility throughout Alaska. Wildfire season typically starts once snow melt occurs in late spring and ends in early fall (ADEC 2011).

Visibility impacts are expressed in deciviews (dv), which is a measure for describing perceived changes in visibility. Deciview values are calculated from either measured or estimated light extinction values in units of inverse megameters (Mm^{-1}). The smaller the dv value, the more pristine the atmosphere, and the greater distances that can be seen without visibility obstruction increasing, resulting in large visual range values. An estimate of 11 dv typically results in a visual range of 80 miles, while an estimate of 3 dv results in a visual range of 180 miles.

The IMPROVE program has calculated haze index values (expressed as dv) for the 20 percent best days (i.e., clearest), 20 percent worst days (i.e., haziest), and natural conditions. The natural condition haze index is an estimate of average visibility that would occur in an area during natural conditions. According to IMPROVE 2019 “natural conditions” are “prehistoric and pristine atmospheric states (i.e., atmospheric conditions) that are not affected by human activities.”

Using these metrics, visibility in the analysis area was inferred from the two closest visibility monitoring stations operated by the IMPROVE program, as listed in Table 3.20-1. Visibility values for the 20 percent best days, 20 percent worst days, and natural conditions are shown in Table 3.20-3 for these two IMPROVE stations during the period from 2011 to 2016, noting that the Tuxedni monitor does not have data after 2014.

Data in Table 3.20-3 indicate that for either the Tuxedni or Denali National Park monitor, the haziest days generally have haze index values between 7 and 13 dv, while the clearest days typically have haze index values less than 5 dv. When comparing the current haze index values at either monitoring station to the estimated natural conditions haze index values, both the haziest and clearest days have slightly worse visibility than those found under natural conditions.

Overall, at the Tuxedni monitor, which is closest to the analysis area, the annual average haze index is closer to the natural conditions on both the haziest and clearest days; whereas the measured visibility at Denali National Park is worse compared to the natural condition for both the haziest and clearest days. However, the values measured in 2016 are comparable to the natural conditions. Most importantly, regardless of the location, visibility has been steadily trending toward natural conditions.

Table 3.20-3: Visibility Values by Year

Monitor Name	Type	Annual Average Measured Haze Index (deciview)						
		2011	2012	2013	2014	2015	2016	Natural Condition Haze Index
Tuxedni	Haziest Days	12.3	11.6	12.4	13.2	N/A	N/A	11.3
	Clearest Days	4.3	3.9	3.6	3.8	N/A	N/A	3.1
Denali National Park	Haziest Days	9.1	8.7	9.6	8.6	12	7.3	7.3
	Clearest Days	2.7	2.7	2.2	2.3	2.2	1.9	1.8

Notes:
N/A = not available
Source: IMPROVE 2018a, b

Deposition

Deposition can be from both wet and dry processes. Wet deposition refers to acidic rain, fog, and snow; dry deposition refers to gases and particles the wind blows onto buildings, cars, homes, and trees. The effects of atmospheric deposition of nitrogen and sulfur compounds on terrestrial and aquatic ecosystems are well-documented for some ecosystems and have been shown to cause leaching of nutrients from soils, acidification of surface waters, injury to high-elevation vegetation, and changes in nutrient cycling and species composition. Given that the project would contribute minimal sulfur compounds to the atmosphere, it is not anticipated that the effects of acidification through sulfur deposition would be prevalent due to the project. Therefore, the focus of the atmospheric deposition discussion is on nitrogen deposition, because the project would emit nitrogen compounds to the atmosphere.

In Alaska, deposition is routinely measured at Denali National Park. However, given that both SO_2 and NO_x emissions contribute to both visibility impairment and deposition, and knowing that visibility degradation in Denali National Park is slightly worse than at Tuxedni, it is expected that deposition measurements in Denali National Park are conservatively representative of Tuxedni and the analysis area. Wet deposition measurements at Denali National Park are collected by NADP in micro-equivalent per liter (µeq/l), and dry deposition is estimated from ambient measurements collected by CASTNET in kilograms per hectare (kg/ha). Deposition measurements in Denali National Park indicate that total sulfate and nitrate wet deposition rates have slowly decreased since the start of the record, while dry deposition rates have remained relatively unchanged (Table 3.20-4).

Table 3.20-4: Wet and Dry Deposition at Denali National Park Monitoring Location

Year	Wet Deposition (µeq/l)[1]		Dry Deposition (kg/ha)[2]	
	Sulfur	Nitrogen	Sulfur	Nitrogen
2016	N/A	N/A	0.2	0.2
2015	1.8	1.5	0.2	0.3
2014	3.7	1.9	0.2	0.3
2013	2.5	1.5	0.2	0.3
2012	2.3	1.5	0.2	0.2
2011	2.4	1.0	0.2	0.2
2010	3.2	2.3	0.2	0.2
2009	6	1.7	0.3	0.4
2008	2.6	1.3	0.2	0.2
2007	3.4	1.2	0.2	0.3
2006	3.7	1.4	0.3	0.3
2005	3	2.2	0.2	0.4
2004	3.2	2	0.3	0.5
2003	3.1	2.4	0.3	0.3
2002	6.5	3.5	0.2	0.4
2001	4.6	2.9	0.3	0.3
2000	3.5	1.7	0.2	0.3
1999	2.2	2	0.3	0.3

Notes:
[1] Wet Deposition for station AK03 (NADP 2018)
[2] Dry Deposition for station DEN417 (EPA 2018b)
kg/ha = kilograms per hectare
µeq/l = micro-equivalent per liter

As discussed, for Alaska the focus is on nitrogen deposition. Currently, the National Park Service (NPS) is recommending the use of nutrient nitrogen-critical loads for the evaluation of deposition impacts in terrestrial and aquatic ecosystems. The nutrient nitrogen critical load thresholds are a tool used to assess and understand the impacts of nitrogen deposition to ecosystems. The nitrogen-critical loads are determined by amount of nitrogen deposition below which no harmful effects to an ecosystem are expected. This value varies based on the type of ecosystem present in an area. Estimates of nitrogen-critical load values in Denali National Park range from

1.2 kilograms of nitrogen per hectare per year (kgN/ha/yr) for lichens and bryophytes, to 17.0 kgN/ha/yr for forests and nitrate leaching (NPS 2018b). Although additional information would be needed to convert the wet deposition rates into appropriate units for comparison to critical load values, the estimates of dry deposition at Denali National Park are well below the lowest critical load value of 1.2 kgN/ha/yr (Table 3.20-4). The same is expected for the analysis area.

3.20.2 Regional Climate

The analysis area is in a transitional climatic zone with a strong maritime influence (Hoefler 2010a). Terrain changes and proximity to large waterbodies locally influence the climate. For example, the proximity of Cook Inlet more heavily influences the climate around the project port site than the vicinity of the mine site. Portions of the analysis area that are at higher elevation are likely to experience colder temperatures and differences in precipitation patterns relative to those areas at lower elevations. Summer temperatures are moderated by the open waters of Iliamna Lake, the Bering Sea, and Cook Inlet. During winter, ice forms on these open waters, resulting in a more continental temperature pattern. Overall, the weather systems arrive from the west and southwest, bringing cool to cold air that is often saturated with moisture. These systems result in frequent clouds, rain, and snow, with possible thunderstorm activity during the warm season.

Meteorological monitoring was conducted at the mine site and Cook Inlet by Hoefler (2010a, b) and SLR (2013a, 2015a). The Cook Inlet monitor (Port Site 1) is about 30 miles northeast of the Amakdedori port site. Table 3.20-5 presents monthly and annual averages for mean temperature, mean wind speed, and total precipitation for the mine site (Pebble Site 1) and Cook Inlet (Port Site 1) monitors, respectively. The Port Site 1 monitor has recorded slightly warmer average monthly temperatures than the Pebble Site 1 monitor (Table 3.20-5). At the Port Site 1 monitor, wind is generally from the north and northeast due to local terrain influences (Hoefler 2010b). At the Pebble Site 1 monitor, the wind is bimodal, generally from the northwest or the southeast (Hoefler 2010a). The differences in observations are likely due the influence of Cook Inlet and elevation of the monitors.

Monthly climate averages for Iliamna Airport are listed in Table 3.20-6. These averages are from 30 years of data collection and represent long-term averages compared to the Pebble Site 1 monitor, which collected data for 7 years. The 30-year record minimizes the naturally occurring year-to-year variability that can bias a shorter-term record. Overall, the Iliamna Airport has colder temperatures during the winter, and warmer temperatures during the summer, with less annual precipitation than the Pebble Site 1 and Port Site 1 monitoring sites.

Estimated predicted future temperature and precipitation values for Iliamna, Alaska are presented in Table 3.20-7**.** These data were obtained from the Scenarios Network for Alaska and Arctic Planning (SNAP) for scenario A1B (SNAP 2018). For the period from 2040-2049, the annual average temperatures are projected to increase relative to the Pebble Site 1 (Table 3.20-5) and Iliamna Airport (Table 3.20-6). Relative to the Iliamna Airport, all months, except July, are projected to have an increase in precipitation. An increase in temperatures, coupled with a decrease in precipitation during the summer months, could lead to an increase in drought and wildfire frequency, as well as more fires due to a longer fire season and higher temperatures that allow for drying out of vegetation (Peterson et al. 2014). Total areas burned by fire are projected to triple by the end of the century under some climate projections (ADEC 2010). An increase in wildfires would result in an increase of particulate matter emissions relative to the background conditions. Windblown dust and particulate matter could also increase from a reduction in vegetative cover that could result from plant stress caused by higher temperatures and lower precipitation.

Table 3.20-5: Monthly Climate Summary for Pebble Site 1 and Port Site 1 Monitors

Monitor	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pebble Site 1 Monitor, 2005-2012[1]	Average Temperature (°F)	24.9	27.5	26.5	30.8	34.2	36.1	37.8	36.9	35.5	31.3	26.3	26.8	31.2
	Average Wind Speed (mph)	18.7	21.3	18.5	17.5	15.9	14.8	14.7	14.3	15.8	16.9	20.3	20.9	17.5
	Average Total Precipitation (inches)	2.4	3.5	2.0	1.7	1.4	3.3	5.8	4.2	5.0	3.9	2.6	4.0	39.9
Port Site 1 Monitor, 2008-2012[2]	Average Temperature (°F)	28.8	30.1	30.2	33.1	35.8	37.4	38.5	38.8	37.3	34.3	30.6	30.0	33.7
	Average Wind Speed (mph)	12.3	12.9	12.2	10.0	8.3	6.8	8.0	7.1	9.6	10.2	12.1	13.5	10.2
	Average Total Precipitation (inches)	4.5	4.4	1.5	4.9	3.7	4.3	9.5	5.5	6.6	6.4	3.2	4.0	58.5

Notes:
[1]Period of record January 2005 through 2012; elevation 1,560 feet above mean sea level (amsl). Source: Hoefler 2010a; SLR 2015a
[2]Period of record: August 2008 through 2012; elevation: 50 feet amsl. Source: Hoefler 2010b; SLR 2013a
°F = degrees Fahrenheit
mph = miles per hour

Table 3.20-6: Monthly Climate Summary, Iliamna Airport, 1981-2010[1]

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (°F)	24.6	26.3	30.7	39.8	51.6	59.4	62.5	61.1	53.9	40.8	29.3	26.9	42.4
Average Minimum Temperature (°F)	12.8	13.4	16.7	25.9	36.6	44.2	49.2	48.4	42.1	29.6	18.1	15.0	29.4
Average Mean Temperature (°F)	18.7	19.9	23.7	32.9	44.1	51.8	55.9	54.8	48.0	35.2	23.7	21.0	35.9
Average Total Precipitation (inches)	1.35	1.09	0.91	0.92	1.09	1.26	2.61	4.04	4.46	3.30	2.08	1.58	24.69
Average Total Snow Fall (inches)[2]	10.8	9.5	9.8	5.3	1.0	0.0	0.0	0.0	0.0	2.5	8.5	11.8	59.2
Average Snow Depth (inches)[2]	8	10	11	7	0	0	0	0	0	0	2	5	4

Notes:
[1]Period of Record 1981-2010; elevation: 19 feet above mean sea level (amsl)
[2]Snow fall and snow depth are for period of record: February 1, 1920 to June 8, 2016
°F = degrees Fahrenheit
Source: WRCC 2018

Table 3.20-7: SNAP Data for Iliamna, 2040-2049[1]

Site	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Iliamna	Average Mean Temperature (°F)	24	25	30	38	47	53	58	58	51	39	31	24	40
	Average Total Precipitation (inches)	2	1	1	1	1	2	3	5	5	4	3	2	26

Notes:
[1]Numbers are calculated using SNAP data from A1B scenario (i.e., balance across all sources) and the 2040-2049 decade
°F = degrees Fahrenheit
Source: SNAP 2018