3.4 CLIMATE CHANGE

3.4.1 Introduction and Scope of Analysis

The United Nations Framework Convention on Climate Change (United Nations 1992) defined climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Global climate is changing, and is projected to continue to change, with the degree of change varying based on different greenhouse gas (GHG) emissions scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) and regional geographic variation. Increasing variation in temperatures, precipitation, and snowpack, along with the increasing frequency and intensity of extreme weather events are indicators of a changing climate in Idaho (Runkle et al. 2017). These varying conditions on a regional scale may affect conditions in the analysis area.

GHGs consist of compounds in Earth's atmosphere that absorb outgoing long-wave radiation emitted from its surface, resulting in warming of the atmosphere, which affects Earth's climate. GHGs occur naturally from volcanoes, forest fires, and biological processes such as fermentation and aerobic decomposition; however, during the past century human activities have released increasingly large amounts of GHGs through the combustion of fuels, industrial processes, agricultural operations, waste management, and land use changes such as loss of farmland to urbanization. The most common anthropogenic GHG emissions are in the form of carbon dioxide (CO_2), followed by methane (CH_4) and nitrous oxide (N_2O) (United States [U.S.] Environmental Protection Agency [EPA] 2017a). Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful GHGs that are emitted from a variety of industrial processes.

A common property among GHGs is their relative chemical stability and persistence in the atmosphere, which allows the gases to accumulate and become relatively well-distributed in the atmosphere before eventually being decomposed by physical or chemical mechanisms. From 1880 to -2012, the global average combined land and ocean surface temperature data show a warming of 0.85 degrees Celsius (°C) (i.e., 1.5 degrees Fahrenheit [°F]) (IPCC 2014). This trend is expected to continue, which could cause large-scale changes including variability in precipitation, increases in annual average temperatures, and increases in extreme weather events (e.g., severe storms, prolonged droughts, flooding) (IPCC 2014). The time horizon for many of these effects is during the 21st century, though projections are subject to variability and uncertainty. The extent to which these effects can be predicted to occur in a given geographic area or be attributed to a single source is uncertain; however, given the potential for GHG emissions associated with the alternatives' components, these effects warrant discussion as a part of the analysis.

The tendency for GHGs to be stable and well distributed spreads their effects over a large region, beyond the initial location of the emissions. Additionally, climate is characterized on a regional scale, not by a specific boundary. Consequently, the overall potential effects on climate change attributable to GHGs are evaluated over large regional or global scales, rather than in a given airshed or project-specific area. As such, a specific analysis area for GHGs is not relevant to the assessment of potential GHG contributions by any one project and it is not currently feasible to quantify the effects of individual or multiple projects on global climate change (U.S. Forest Service [Forest Service] 2009).

The scope of analysis for the qualitative discussion of GHG emissions associated with the Stibnite Gold Project (SGP) is tied to the baseline GHG emissions and current climate conditions and trends that are discussed further in Section 3.4.3.1, GHG Inventory Information. The scope of analysis for the effects of climate change on resources in the analysis area is discussed within the context of the analysis area for each particular resource. The current climate change trends related to social, physical, and biological resources are discussed further in Section 3.4.3.2, Climate Change Trends, and Section 3.4.3.3, Current Climate Change Impacts to Resources in the SGP Area.

3.4.2 Relevant Laws, Regulations, Policies, and Plans

There are currently no federal or state regulatory programs that require GHG emission reductions or controls on new or existing facilities in Idaho. The sections below describe the limited regulatory guidance that exists for GHGs and climate change under the National Environmental Policy Act (NEPA) and from the Forest Service, as well as other guidance from the EPA and state of Idaho for monitoring, reporting, and reducing GHG emissions.

3.4.2.1 National Environmental Policy Act and Executive Order 13783

On August 1, 2016, the federal Council on Environmental Quality (CEQ) issued final guidance describing how federal departments and agencies should consider the effects of GHG emissions and climate change in their NEPA reviews (81 Federal Register 51866). Executive Order (EO) 13783 on Promoting Energy Independence and Economic Growth directed CEQ to rescind this final guidance, and the CEQ guidance was withdrawn on April 5, 2017 (82 Federal Register 16576). After further consideration of EO 13783, CEQ released draft guidance on June 26, 2019 (85 Federal Register 30097) on how NEPA analysis and documentation should address GHG emissions. The June 26, 2019 guidance would replace the August 2016 guidance, if finalized. The guidance states that agencies should utilize their expertise and experience to decide how and to what degree to analyze particular effects and a projection of the direct and reasonably foreseeable indirect GHG emissions from project components may be used as a proxy for assessing potential climate effects. Where GHG inventory information is available, local, regional, national, or sector-wide emission estimates may be referenced to provide context for understanding the relative magnitude of GHG emissions for a project. A qualitative analysis may be used in addition to GHG inventory information, or when the tools, methods, or data inputs necessary to quantify GHG emissions are not available, not of high quality, or the complexity of identifying emissions would make quantification overly speculative (CEQ 2019).

The draft 2019 CEQ guidance indicates that a monetary cost-benefit analysis of GHG emissions using any monetized Social Cost of Carbon estimates is not required in every project-level NEPA analysis (CEQ 2019):

> *"If an agency does consider costs and benefits that are relevant to the choice among environmentally different alternatives for a proposed action, such as in a rulemaking, the agency should incorporate by reference or append such analyses to the environmental impact statement as an aid in evaluating the environmental consequences."*

EO 13783 withdrew many of the technical documents and guidance described above that were issued between 2010 and 2016, which had provided the basis for Social Cost of Carbon analyses (The White House 2017). The EO directed that the Interagency Working Group on Social Cost of GHGs be disbanded, that technical documents issued by the Interagency Working Group be withdrawn as no longer representative of governmental policy, and stated that when monetizing the value of GHG emission changes, agencies are to ensure such estimates are consistent with guidance contained in U.S. Office of Management and Budget Circular A-4 (U.S. Office of Management and Budget 2003). For purposes of NEPA reviews, the pertinent theme of the 2003 guidance is that qualitative analysis is appropriate in cases when quantifying the costs and benefits of a particular policy decision (e.g., licensing, permitting, development of regulations) is not practically feasible, or subject to high uncertainty that would have the effect of impeding the decision.

3.4.2.2 National Forest Land and Resource Management Plans

There are no specific standards or guidelines related to climate change in the Payette National Forest Land and Resource Management Plan (Forest Service 2003) or the Boise National Forest Land and Resource Management Plan (Forest Service 2010). However, Climate Change Considerations in Project Level NEPA Analysis (Forest Service 2009) provides Forest Service guidance on how to consider climate change in project-level NEPA analysis and documentation. The following basic concepts are outlined in this document:

1. Climate change effects include the effects of agency action on global climate change and the effects of climate change on a proposed project.
2. The agency may propose projects to increase the adaptive capacity of ecosystems it manages, mitigate climate change effects on those ecosystems, or to sequester carbon.
3. It is not currently feasible to quantify the indirect effects of individual or multiple projects on global climate change; therefore, determining significant effects of those projects or project alternatives on global climate change cannot be made at any scale.
4. Some project proposals may present choices based on quantifiable differences in carbon storage and GHG emissions between alternatives.

3.4.2.3 Mandatory Reporting of Greenhouse Gases Rule

As an initial action under the federal Clean Air Act, the EPA established a program in October 2009 for Mandatory Reporting of Greenhouse Gases Rule (40 Code of Federal Regulations 98) (Mandatory Reporting Rule). This program requires monitoring and annual reporting of GHG emissions for over 40 source categories if the facility's annual emissions exceed 25,000 metric tons of GHGs (as carbon dioxide equivalent [CO_2eq] units). The Mandatory Reporting Rule defines CO_2eq as the number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of another GHG. Stationary fuel combustion emissions of CO_2, CH_4, and N_2O is identified in the Mandatory Reporting Rule as a separate category that may be present at facilities that qualify for reporting under another source category.

The Mandatory Reporting Rule facilitates collection of accurate and comprehensive emissions data to provide a basis for future EPA policy decisions and regulatory initiatives. This federal regulation stipulates the methodology for record keeping, emission estimation, and reporting of GHG emissions.

3.4.2.4 GHG Major Source Permitting – the Tailoring Rule

In June 2010, EPA issued a final rule (referred to as the Tailoring Rule) setting GHG emission thresholds for Clean Air Act preconstruction permits under the Prevention of Significant Deterioration and Title V permitting programs (75 Federal Register 31514). The Tailoring Rule established a Title V major source permitting threshold of 100,000 short tons per year for GHGs measured in CO_2eq. This framework was codified in several sections of 40 Code of Federal Regulations 51, 52, 70, and 71 (40 Code of Federal Regulations 51.166, 52.21, 52.22, 70.2, 70.12, 71.2, and 71.13). In addition, the Tailoring Rule also imposed the requirement for new major sources of GHG to implement best available control technology to reduce GHG emissions through the new source review process.

This rule was challenged in Utility Air Regulatory Group versus Environmental Protection Agency (134 S. Ct. 2427 [2014]). In June 2014, the Tailoring Rule provisions regarding GHG major source permitting were remanded by the U.S. Supreme Court (U.S. Supreme Court 2014). The Supreme Court upheld the rule in part and reversed it in part. The ruling allowed EPA to continue to regulate GHG for sources already subject to regulation as Prevention of Significant Deterioration or Title V sources for conventional criteria pollutants. However, the court also held that EPA had exceeded its authority when it issued an emissions threshold for GHGs alone that would trigger Prevention of Significant Deterioration or Title V permitting.

3.4.2.5 State of Idaho Actions

On May 16, 2007, the Governor of Idaho signed EO 2007-05, Establishing a State Policy Regarding the Role of State Government in Reducing Greenhouse Gases (Idaho Administrative Bulletin 2007). This EO recognized that, "the causes and effects of rising greenhouse gases, to the degree they are understood, may extend to the Western U.S. and the State of Idaho, and it is incumbent upon states to take a leadership role in developing responsive state-level policies and programs to reduce greenhouse gas emissions, develop alternative energy sources and use energy efficiently." The EO identified two types of actions to be taken: 1) the Director of the Idaho Department of Environmental Quality (IDEQ) is to take a lead role in coordinating GHG reduction efforts; and 2) the Director of IDEQ is to develop a state GHG emission inventory and develop recommendations on how to reduce GHG emissions in the state. Refer to **Table 3.4-1** showing the statewide GHG emissions inventory for Idaho (by sector). GHG emission reduction strategies and/or initiatives have not yet been identified for the state.

3.4.3 Existing Conditions

Existing conditions for climate change are discussed in terms of baseline GHG emissions in the analysis area, as well as potential effects from climate change on the social, physical, and biological resources in the analysis area.

3.4.3.1 GHG Inventory Information

The GHG compounds of interest are those that would be released due to proposed operation of diesel-fueled and gasoline-fueled engines, and propane combustion for either process needs or heating of buildings. The use or release of any hydrofluorocarbons or perfluorocarbons would not be necessary for the proposed SGP. To provide context for emissions associated with the SGP, this section also presents GHG inventory information for national and regional sources.

3.4.3.1.1 EPA PUBLICATION OF NATIONAL GHG INVENTORY DATA

Compared to 1990, annual GHG emissions in the U.S. have increased by about 3.5 percent, based on 2015 reported data (EPA 2017b). However, year-to-year emissions are shown to increase or decrease due to changes in the economy, the price of fuel, weather, and other factors.

The EPA reports that 2015 annual total emissions of CO_2 were 5.6 percent higher than 1990 totals, while total emissions of CH_4 were 16.0 percent lower, and total emissions of N_2O were 6.9 percent higher (EPA 2017b). GHG emissions in the U.S. were partly offset by carbon sequestration in managed forests, trees in urban areas, agricultural soils, landfilled yard trimmings, and coastal wetlands. In recent years, there has been a general nationwide trend of declining GHG emissions across most sectors (EPA 2017b).

In 2015, the latest reporting year available, electric power generation and transportation vehicles accounted for 34 and 27 percent, respectively, of U.S. emissions of GHG. Industrial sources (the reporting category that includes mining activities other than coal) accounts for 20 percent of GHG emissions nationwide. GHG emissions from industry are mainly associated with burning fossil fuels (e.g., coal, natural gas) for heat energy, as well as emissions from non-road vehicles and equipment, and manufacturing processes to produce goods from raw materials (EPA 2017b).

3.4.3.1.2 GHG Emission Inventory for Idaho

Table 3.4-1 shows reported statewide GHG emissions from all source sectors for 2000 through 2010. Idaho is a relatively small contributor to U.S. GHG emissions. Based on the 10-year average of 27.82 million metric tons of CO_2eq per year, Idaho's total GHG emissions accounted for less than 0.5 percent of U.S. GHG emissions during that period (IDEQ 2010). The three highest contributing sectors to Idaho GHG emissions are on-road transportation vehicles (31.4 percent), agriculture (33.0 percent), and residential/commercial/industrial fuel use (21.1 percent). The industrial process category is a smaller contributor at 4.3 percent of statewide GHG emissions. Mineral mining is not designated separately, and is assumed to be a small overall contributor.

3.4.3.2 Climate Change Trends

Climate change is often discussed in terms of plausible futures or scenarios based on precipitation and temperature projections. These scenarios are built on different trajectories of future GHG concentrations, land use, and other factors, due to the uncertainty associated with GHG emissions and concentrations, and uncertainty in climate functions. IPCC released new emission scenarios in 2013 called Representative Concentration Pathways (RCPs). RCPs are based on a range of potential future rates of factors such as economic growth, population, and energy consumption, which are translated into emissions and concentrations of GHGs over time and then run through climate models to predict future values of temperature and precipitation. RCP 8.5 represents a scenario where high emissions continue through 2100 (Federal Highway Administration 2017); the discussion of emissions and climate change trends throughout this section are based on the projected scenarios under RCP 8.5.

The IPCC Fifth Assessment Report documents evidence for the warming of the global climate system since the 1950s, based on observed changes over time periods ranging from decades to millennia (IPCC 2014). In this assessment, the IPCC reports the global average temperature has increased between 0.08 to 0.14°C (0.14 to 0.25°F) per decade since 1951, and each of the last three decades has been successively warmer than any preceding decade since 1850. In the Northern Hemisphere, 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years (IPCC 2014).

As described below, the effects of climate change in the analysis area can be seen by review of reported trends in the temperature, precipitation, snowpack, and other indicators of regional climatology. Similarly, statewide climate trends also reflect the measurable effects of regional climate change that will continue to affect the environmental conditions in the analysis area. These statewide and regional trends are used as a proxy to discuss current climate trends in the analysis area.

Table 3.4-1 Statewide GHG Emissions Inventory for Idaho, by Sector[1]

Source Category	Fuel Type or Process Activity	2000 MMT CO_2eq	2005 MMT CO_2eq	2010 [2] MMT CO_2eq	2010 Sector Portion of Annual Emissions (%)	2000-2010 Average MMT CO_2eq	% Change, 2000 to 2010
Electricity Generation - Statewide 2	Coal	0	0	0	0.0	0.0	0.0
Electricity Generation - Statewide 2	Natural Gas	0.09	0.62	0.70	2.4	0.47	678
Electricity Generation - Statewide 2	Petroleum (fuel or distillate oil) [3]	0.002	0	0	0.0	0.0	0.0
Electricity Generation - Statewide 2	***Subtotals of all Fuel Types***	***0.09***	***0.62***	***0.70***	***2.4***	***0.47***	***661***
Residential/Commercial/Industrial Fuel Use	Coal	1.30	1.07	0.95	3.2	1.11	-26.7
Residential/Commercial/Industrial Fuel Use	Natural Gas	3.49	3.19	3.45	11.8	3.38	-1.15
Residential/Commercial/Industrial Fuel Use	Petroleum (fuel or distillate oil)	1.97	2.24	1.79	6.1	2.0	-9.14
Residential/Commercial/Industrial Fuel Use	***Subtotals of all Fuel Types***	***6.76***	***6.50***	***6.19***	***21.1***	***6.48***	***-8.43***
Transportation Fuels	Cars, Light Trucks, Rail, Aircraft	**8.74**	**8.54**	**9.21**	**31.4**	**8.83**	**5.38**
Fossil Fuel Industry	Coal Mining (CH_4) [4]	0	0	0	0.0	0.0	0.0
Fossil Fuel Industry	Natural Gas Extraction/Transport	0.45	0.42	0.46	1.6	0.44	2.22
Fossil Fuel Industry	Petroleum Production/Refining [5]	0	0	0.0	0.0	0.0	0.0
Fossil Fuel Industry	***Subtotals of all Fuel Types***	***0.45***	***0.42***	***0.46***	***1.6***	***0.44***	***2.22***
Industrial Processes	Perfluorocarbons / sulfur hexafluoride / Cement/Lime Prod.	***0.77***	***1.05***	***1.27***	***4.3***	***1.03***	***64.94***
Waste Management	Solid Waste Management	1.18	1.50	1.63	5.6	1.44	38.14
Waste Management	Wastewater Management	0.14	0.15	0.16	0.5	0.15	14.29
Waste Management	***Subtotals of all Fuel Types***	***1.32***	***1.65***	***1.79***	***6.1***	***1.59***	***35.61***
Agriculture	Enteric Fermentation (CH_4)	3.30	3.88	4.08	13.9	3.75	23.64

Source Category	Fuel Type or Process Activity	2000 MMT CO_2eq	2005 MMT CO_2eq	2010 [2] MMT CO_2eq	2010 Sector Portion of Annual Emissions (%)	2000-2010 Average MMT CO_2eq	% Change, 2000 to 2010
Agriculture	Manure Management	1.6	2.13	2.36	8.1	2.03	47.50
Agriculture	Agricultural Soils (N_2O) and Residue Burning	2.71	3.64	3.23	11.0	3.19	19.19
Agriculture	***Subtotals of all Fuel Types***	***7.61***	***9.7***	***9.67***	***33.0***	***8.98***	***27.07***
Annual Totals	***All Subtotals except percentages***	***25.7***	***28.4***	***29.3***	***--***	***27.8***	***--***

Table Source: IDEQ 2010

Table Notes:

1 The emission values in **Table 3.4-1** for year 2010 are based on IDEQ projections presented in the 2010 report Idaho GHG Inventory and Reference Case Projections (IDEQ 2010).

2 The 2010 emissions values were projected by IDEQ from emissions inventory data available for the 2010 report. The projected emissions were based on anticipated population and economic growth rates.

3 The State of Idaho does not have in-state coal or petroleum electrical generation. The state has very high levels of renewable generation, and GHG sources in the electrical sector are predominately natural gas fired generation.

4 There is no coal mining industry in Idaho.

5 There is no petroleum production industry in Idaho.

-- There are no annual totals for 2010 Sector Portion of Annual Emissions Percentages or Percent Change, 2000 to 2010.

MMT = million metric tons.

Average annual temperature is an important climate indicator that directly reflects regional energy balance. Overall, temperature trends affect energy use, snowmelt and runoff, as well as a host of biological life functions. Most of Idaho has seen an increase in average temperatures of 0.56 to 1.1ºC (1 to 2 ºF) over the last century, with the last two decades being the warmest on record (EPA 2016). Temperatures have generally increased across the northwest region of the U.S. from 1895 to 2014, with a regionally averaged warming of about 0.83ºC (1.5°F). Average minimum and maximum temperatures for the middle Rockies region, which includes the Payette, Boise, Salmon-Challis, Sawtooth, and portions of the Caribou-Targhee National Forests, are projected to warm by about 5.6ºC (10°F) under RCP 8.5 by 2100, with increases projected to be the largest during summer months (Halofsky et al. 2018). The projected increase in minimum temperature in this region by the year 2100 under the RCP 8.5 scenario will bring the median temperature above freezing, suggesting that a biologically meaningful threshold could be crossed (Halofsky et al. 2018). Additionally, the intensity of heat waves is projected to increase, while cold wave intensity is projected to decrease (Runkle et al. 2017).

General precipitation trends in Idaho and the Pacific Northwest have been observed to be both increasing and decreasing among various locations, seasons, and time periods of analysis. Statewide precipitation is highly variable and showed no overall trend in annual average precipitation during the last century. However, the frequency of extreme precipitation events in Idaho has been above average over the past decade. Statewide winter and spring precipitation is expected to increase during the 21st Century, while precipitation in the summer is expected to decrease (Runkle et al. 2017). Overall, precipitation is projected to increase by 5 to 8 percent by the year 2100 under RCP 8.5 (Halofsky et al. 2018). Prolonged drought conditions, common throughout the 1920s and 1930s, have not been observed in recent decades (University of Idaho 2011); however, increased intensity of drought events is expected to occur throughout the 21st Century (Runkle et al. 2017). Future projections show a highly variable change in annual average precipitation throughout the northwest region of the U.S., within a range of an 11 percent decrease to a 12 percent increase for 2030 to 2059 and a 10 percent decrease to an 18 percent increase for 2070 to 2095 (Halofsky et al. 2018).

Changes in river-related flood risk depends on many factors, but warming is projected to increase flood risk the most in mixed basins (those with both winter rainfall and late spring snowmelt-related runoff peaks) and remain largely unchanged in snow-dominant basins (Mote et al. 2014). Across the northwest region, much of the water supply comes from mountain snowpack, which melts in spring and summer and runs off into rivers, filling reservoirs. As the climate warms, less precipitation falls as snow and more snow melts during the winter, which decreases the snowpack. Since the 1950s, Idaho's overall snowpack has been decreasing (EPA 2016). Lower snowpack and increased drought are likely to lead to lower base flows, reduced soil moisture, wetland loss, riparian area reduction or loss, and more frequent and possibly severe wildfire. Places that experience temperatures near the melting point of snow are expected to be more sensitive than places where temperatures remain below freezing throughout much of the winter, despite warming (Halofsky et al. 2018). The projected rise in temperatures is expected to increase the average lowest elevation where the snowpack reliably accumulates throughout the winter, which may cause the tree line to shift, as subalpine fir and other high- altitude trees become able to grow at higher elevations. Warmer temperatures may increase the frequency of precipitation falling as rain instead of snow, reducing overall water storage in the snowpack. Rising temperatures also could result in earlier melting of the snowpack, further decreasing water availability during the dry summer months (Runkle et al. 2017).

Increasing air temperatures and decreasing summer flows associated with climate change are expected to warm streams by increasing long-wave radiation and warming groundwater inputs (Isaak et al. 2017). Catastrophic fire and drought can drastically alter water quality and temperature, woody debris, bank vegetation, and stream flow characteristics. Reduced stream cover from changes in woody debris and bank vegetation also can result in increased stream temperatures (Halofsky et al. 2018). A transition from snow to rain, resulting in diminished snowpack and shifts in streamflow to earlier in the season, also could cause changes in groundwater recharge to aquifers and groundwater discharge to groundwater-dependent ecosystems. Mean annual streamflow projections suggest a slight increase; however, despite these projections, summer low flows are expected to decline. Furthermore, higher minimum temperatures reducing the longevity of snowpack will decrease the length of time aquifer recharge can occur, potentially leading to faster runoff and less groundwater recharge (Halofsky et al. 2018).

Climate controls the magnitude, duration, and frequency of weather events (e.g., wind, temperature, relative humidity, and precipitation), which, in turn, drive fire behavior (Halofsky et al. 2018). A warming climate and earlier snowmelt patterns have led to longer fire seasons, and these trends are expected to continue; however, fire activity is limited by the availability of fuels, and future climate projections that influence fire occurrence and behavior are uncertain at the regional and local scale. Most visible and significant short-term effects of climatic changes on forest ecosystems are caused by altered disturbance regimes, such as insects and fire. The size and duration of forest fires, the length of the fire season, and size of areas burned in the West have increased over the past 30 years (Halofsky et al. 2018). The annual area burned, as well as the occurrence of very large wildfires, is projected to continue increasing as temperatures rise and longer fire seasons combine with regionally dry fuels. Future wildfire severity will be dependent on vegetation changes and fuel conditions (Halofsky et al. 2018).

3.4.3.3 Current Climate Change Impacts to Resources in the SGP Area

Given that climate change impacts are likely to persist in the region, analysis area resource conditions are expected to be affected. Due to the nature of the resource, climate change is not expected to impact noise.

3.4.3.3.1 Geologic Resources And Geotechnical Hazards

Current climate change trends, such as increased heavy precipitation events and more precipitation falling as rain instead of snow, could lead to increased soil erosion and change in landcover, which could potentially impact slope stability in the analysis area. Damage due to seismic activity in the area also could be exacerbated by climate-induced instability in the analysis area.

3.4.3.3.2 Air Quality

Climate-induced changes in weather and seasonality can strongly affect air quality in a specific region. The criteria air pollutant of most concern, and may be most affected by changes in climate, is particulate matter (PM), which primarily consists of sulfate and nitrate compounds, organic carbon, elemental carbon, soil dust, and sea salt. Of most concern to human health are the first four pollutants, because they are typically present as fine particles less than 2.5 microns in diameter and can be inhaled deep into the lungs. Sulfate, nitrate, and organic carbon are produced in the atmosphere by oxidation of anthropogenic emissions of sulfur dioxide, nitrogen oxides, and non-methane volatile organic compounds. Carbon particles also are directly emitted by combustion. Seasonal variation of PM is complex and location dependent; precipitation is the main atmospheric sink for PM (Jacob and Winner 2009). An overall increase in precipitation levels may improve the cleansing of the atmosphere and may increase chemical deposition.

Hotter, drier weather can allow PM and other pollutants to accumulate in the atmosphere, or allow emitted PM precursors to persist longer in the atmosphere.

The effect of climate change on PM is complicated and uncertain. Precipitation frequency and mixing depth are important driving factors, but projections for these variables are often unreliable. As a result of climate change, more frequent and intensified wildfires could become an increasing PM source, and decreases in summer precipitation could exacerbate high PM concentrations caused by wildfires (Jacob and Winner 2009).

3.4.3.3.3 Soils and Reclamation Cover Materials

Reduced soil moisture is expected to result from lower snowpack due to higher variation in precipitation and increased annual average temperatures. Higher temperatures may increase the rate at which carbon stored in the soil degrades or is released by fire. In addition, carbon content in soils is expected to decrease in areas where the decomposition rate and wildfire frequency increase. More winter precipitation falling as rain instead of snow could generate a higher frequency of runoff and erosional processes from disturbance events, such as fire. Soil erosion by wind and/or water may result in loss of topsoil, which could lead to the degradation of soil quality (Halofsky et al. 2018).

3.4.3.3.4 Hazardous Materials

Although climate change would not impact the likelihood of a spill, it could potentially impact the severity of a spill. Warmer temperatures leading to shorter winters reduce the period of time that frozen ground could prevent a spill from reaching groundwater; however, lower groundwater tables from drier periods also would increase the distance for the substance (fuel or other hazardous material) to travel to reach the groundwater, reducing the potential severity of a spill. Periods of increased precipitation and flooding could have the highest impact on spill severity. Increased soil moisture content reduces the ability of oil to seep into the ground and increases the distance a spill could spread over land; however, this risk would be reduced in areas of decreased soil moisture. High streamflows after extreme precipitation events would mean a release into surface waters could travel longer distances before being contained; however, a spill occurring during a seasonal low-flow period would travel a shorter distance, reducing the risk of spill migration.

Although extreme precipitation events occur proportionally less than low-flow periods throughout the year, climate change is expected to increase their frequency and thus, the risk of coinciding spills migrating longer distances.

3.4.3.3.5 SURFACE WATER AND GROUNDWATER (QUALITY AND QUANTITY)

Streamflow, water quality, and water quantity is vital for the survival of numerous aquatic species, as well as for human use. Water is sensitive to several different physical factors, including precipitation, snowpack, evaporation, and runoff, making it an ideal indicator to determine the effects of climate variability and change. Observations compiled from 21 U.S. Geological Survey unregulated stream gauges across Idaho show a decrease in the cumulative water year streamflow by nearly 2 million cubic feet, or 15 percent, over the last half century (University of Idaho 2011). The magnitude of the peak streamflow is expected to increase slightly across the region; however, summer low flows are expected to decline (Halofsky et al. 2018). Additionally, the timing of peak streamflow from 1949 to 2008 has advanced about 1 week earlier into the spring. Advancement in the timing of peak streamflow is hypothesized to be indicative of changes in the timing of snowmelt and/or phase of precipitation (University of Idaho 2011). Spring and summer streamflows are expected to continue to decline in basins that have historically relied on snowmelt, and low flow periods are projected to be more prolonged and severe (May et al. 2018). The decline in streamflow is expected to reduce the rate of recharge of water supply in some basins (Halofsky et al. 2018).

The basin aquifer system in the central region of Idaho is recharged by precipitation and snowmelt, and reductions in the longevity of snowpack may lead to faster runoff and less groundwater recharge. The transition of watersheds from snow-dominated to rain-dominated, which diminishes snowpack and shifts streamflow to earlier in the season, would result in changes to groundwater recharge in aquifers and groundwater discharge to groundwater-dependent ecosystems (Halofsky et al. 2018). Because many biogeochemical processes are temperature-dependent, climate-induced changes in surface and groundwater temperature also could negatively impact the quality of these water resources (Halofsky et al. 2018).

Potential threats to surface water and groundwater from recent wildfires, such as the Pioneer fire in 2016, include flooding, debris flows, soil erosion and downstream sedimentation (Forest Service 2018). A growing number of wildfire-burned areas throughout the western U.S. are expected to increase soil erosion rates within watersheds; by 2050 the amount of sediment could more than double in more than one-third of watersheds and is projected to increase by more than 10 percent in nearly 90 percent of watersheds (Sankey et al. 2017).

3.4.3.3.6 Vegetation: General Vegetation Communities, Non-Native Plants, and Botanical Resources

Gradual changes in the distribution and abundance of dominant plant species and short-term impacts on vegetation structure and age classes are expected as a result of rising temperatures. The region is currently dominated by coniferous and other forested vegetation such as subalpine fir, Engelmann spruce, grand fir, Douglas fir, lodgepole pine, western larch, and whitebark pine; however, the frequency of nonnative plant species is expected to rise, displacing native species and altering fire regimes (i.e., the roles of fire in ecosystems and its interactions with dominant vegetation). Increased frequency and duration of drought could impact vegetation ecosystems through changes in soil moisture, which could cause mortality or result in higher species vulnerability to insects and disease. Dominance of nonnative species may be facilitated through more frequent and intense wildfires, causing increased disturbance where native species regenerate more slowly (e.g., sagebrush species). Consequentially, the dominance of nonnative plants could themselves encourage more frequent wildfires and cause changes in the ecology of vegetation assemblages (Halofsky et al. 2018).

Whitebark pine has suffered widespread mortality throughout its range from the combined effects of mountain pine beetle outbreaks and white pine blister-rust infection. Although it is not a dominant species in the area, it is a candidate species and an important tree species to high-elevation ecosystems of western North America (see Section 3.10.3.2.1, Endangered Species Act Threatened, Endangered, Candidate, and Proposed Species). Fire exclusion amplifies the climate change impacts from insects and disease by allowing succession to shade tolerant species, stressing mature whitebark pines, and limiting opportunities for seedling establishment. Projected warming and drying trends will likely further exacerbate this decline (Fryer 2002).

3.4.3.3.7 Wetlands and Riparian Resources

Changes in groundwater levels in wetlands can reduce groundwater inflow, leading to lower water table levels and altered wetland water balances. These altered water table elevations and streamflow volumes may affect riparian areas and their plant communities by reducing hydrological connectivity between uplands and riparian areas. Climate-induced changes in precipitation, drought, and streamflow would influence the distribution of riparian vegetation via changes in local hydrological regimes, especially if summer base flows decrease. If water table elevation can be assumed to be in equilibrium with water levels in the stream, reduced base flows could result in lower riparian water table elevations and subsequent drying of streamside areas, particularly in wide valley bottoms. Wetland and riparian plant communities will respond to climate-induced changes in hydrological variables differently as a function of species composition (Halofsky et al. 2018).

3.4.3.3.8 Fish Resources and Fish Habitat

Warmer air temperatures causing decreased snowpack and reduced stream flows can dramatically influence stream temperature and a host of ecosystem processes. Between 1976 and 2015 average August stream temperatures in the western U.S. showed a warming trend of 0.17°C (0.31°F) per decade. These temperatures are predicted to increase an average of

0.72°C (1.3°F) by 2040 and 1.4°C (2.6°F) by 2080 (Isaak et al. 2017). These warmer water temperatures and lower flows are expected to threaten salmon, trout, and other coldwater fish (EPA 2016). For species dependent upon cold water, such as the threatened bull trout, even small rises in temperature can significantly reduce spawning success (Knowles and Gumtow 1996). Additionally, increased wildfire may cause more extensive geomorphic disturbances and debris flows into streams, contributing to more variable environments and declining fluvial connectivity of aquatic habitats (Halofsky et al. 2018). Although the length of connected habitat needed to support cold water fish populations varies by local conditions, current estimates suggest a minimum of 20 to 30 miles for bull trout (30 miles is associated with a 90 percent probability of occupancy) and 3 to 6 miles for cutthroat trout (6 miles is associated with a 90 percent probability of occupancy) (Halofksy et al. 2018). Added to other stressors, such as habitat loss and fragmentation, invasive species, and disease, warmer stream temperatures could impact current spawning and rearing habitat (U.S. Fish and Wildlife Service 2010).

3.4.3.3.9 WILDLIFE AND WILDLIFE HABITAT

The complex habitats and communities that have been established by many species in the analysis area are being disrupted by climate change. The region is currently facing unprecedented rates of change in climatic conditions that may outpace the natural adaptive capacities of several native species (Halofsky et al. 2018). Increased climate variability and frequency of extreme conditions will favor species adapted to frequent disturbance, potentially increasing the abundance of invasive species. Impacts to terrestrial species as a result of climate change are already being experienced through habitat loss and fragmentation, physiological sensitivities, alterations in the timing of species life cycles (e.g., seasonal changes impacting migration, hibernation, and reproductive success), and indirect effects (e.g., disruption of species interaction across communities). Most species are expected to exhibit sensitivity to changes in the climate, especially those restricted to high elevations or surface water habitats. Of the special status wildlife species occurring in the analysis area, the flammulated owl (*Otus flammeolus*), wolverine (*Gulo gulo*), and Columbian spotted frog (*Rana luteiventris*) are expected to be the most vulnerable terrestrial populations in the region (Halofsky et al. 2018). Other special status species expected to be impacted include the Canada lynx (*Lynx canadensis*) and Rocky Mountain bighorn sheep (*Ovis canadensis*) (Halofsky et al. 2018).

3.4.3.3.10 TIMBER RESOURCES

Timber resources are an important ecosystem service (the natural environment providing benefits to humans) in the area. Forests in the interior Northwest are experiencing rapid change due to increasing wildfires and insect and disease damage, largely attributed to a changing climate (May et al. 2018). Changing climatic conditions are predicted to more than double the area in the Northwest burned by forest fires during an average year by the end of the 21st Century. An increase in wildfires would likely decrease the amount of timber available for harvests and degrade the soil, as well as threaten homes and pollute the air (EPA 2016). The area of pine forests in the Northwest infested with mountain pine beetles is expected to increase due to climate change over the next few decades, which also could lead to decreased timber harvests (EPA 2016).

Higher temperatures and decreased water availability can make trees more susceptible to pests and disease; consequentially, trees that have been damaged or killed burn more readily than living trees. Increases in spring and summer temperatures in recent decades are hypothesized to have increased the frequency of large fire seasons since the 1980s. An earlier snowmelt due to warmer temperatures can lead to greater drying of soils and vegetation, creating opportunities for earlier and larger wildfires (Westerling et al. 2006). Combined with other stressors exacerbated by climate, the rate of change in vegetation assemblages may be accelerated, reducing the productivity and carbon storage in most systems.

3.4.3.3.11 LAND USE AND LAND MANAGEMENT

Long-term temperature and other climatic changes may potentially affect how lands in the analysis area are used. The majority of the analysis area is National Forest System lands, which is frequently used for recreational purposes. Climate change may impact recreational use of the land by changing the range and types of species present through changing habitat conditions (e.g., water quality, temperatures, and streamflow), as well as accessibility for both humans and animal species to various areas through disturbance of roadways or degradation of habitat (e.g., avalanches, flooding, landslides, and wildfires).

3.4.3.3.12 ACCESS AND TRANSPORTATION

Higher annual average temperatures, extreme weather events such as heavy rainfall and extreme heat, as well as changes in freeze/thaw patterns and snowpack dynamics, can add stress to roadways and other infrastructure (e.g., bridges and culverts). Higher temperatures can add chronic damage to infrastructure systems, while extreme weather events can cause sudden catastrophic failures. Additionally, warmer overall temperatures could result in fewer freeze-thaw cycles, which could be beneficial to road longevity and minimize impacts from extreme heat and weather events. Roads and other infrastructure that are near or beyond their design life are at the highest risk to damage from flooding, geomorphic disturbances (e.g., landslides), and avalanches (Halofsky et al. 2018). An increase of these events could impact access to and infrastructure within the analysis area (e.g., floods, landslides, or avalanches washing out roads, bridges and culverts).

3.4.3.3.13 CULTURAL RESOURCES

Several archaeological sites have been identified in the analysis area, including sites within the Stibnite Historic District. Some aspects of climate change may exacerbate damage and loss of cultural resources in the analysis area. Increasing wildfires, flooding, melting of snowfields, and erosion can uncover, displace, or destroy artifacts and other cultural or historic resources before they have been identified. Additionally, large disturbances as a result of climate change can alter the condition of vegetation, streams, and other landscape features valued by native populations (Halofsky et al. 2018).

3.4.3.3.14 PUBLIC HEALTH AND SAFETY

Impacts from climate change on public health and safety could be experienced through poor air quality from wildfires, decreased water quality from lower streamflows, more frequent extreme heat events, as well as the hazards associated with flooding or other severe weather from more frequent extreme weather events. Additionally, wildfires, extreme heat, and weather events could impact worker health and their ability to perform work outside, while warmer winter temperatures may create safer and more comfortable working conditions.

3.4.3.3.15 Recreation

The changing climate is expected to alter the supply of and demand for outdoor recreation opportunities. Recreational use patterns could be impacted by variable precipitation and rising temperatures, and by the change in conditions that may alter the characteristics and ecological condition of recreation settings. For example, warmer temperatures may affect individual decisions to visit a certain area, and warmer stream temperatures may affect the quantity and quality of aquatic populations for recreational fishing. Higher temperatures and decreased snowpack would affect winter activities dependent on cold temperatures and snowfall, such as skiing and snowmobiling. Other activities may benefit from longer warm and dry seasons (e.g., hiking, camping, mountain biking), but the need for supplemental resources to manage and maintain these recreational areas for a longer period of time may cause personnel and budgetary issues (Halofsky et al. 2018).

3.4.3.3.16 Scenic Resources

Changing climatic conditions could affect viewers experience of the landscape within the analysis area. Large portions of the analysis area have been affected by wildfires, shifting the landscape from homogenous and continuous even-aged timber stands to a mosaic of tree species and structural conditions. In much of the area, stand-replacing fire have occurred, and other portions of the area have experienced understory surface fire while maintaining timbered overstory. This landscape is dependent on wildfire for regeneration with a stand-replacing fire-return interval of approximately 90 to 100 years. Climate change may increase the frequency, but frequent wildfires decrease fuel loading and fire severity. Additionally, fire return intervals in lethal and mixed regimes range from 75 to 130 years; however, small low intensity fires would likely occur with more frequency due to climate change (Halofsky et al. 2018).

3.4.3.3.17 Social and Economic Conditions

Changing climatic conditions could affect the viability of local communities. Communities near the analysis area are rural and rely heavily on tourism and the trade industry to support their economies. The social and economic conditions of the area could be both negatively or positively impacted by climate-induced changes in recreational use (e.g., degraded water quality and low streamflow could decrease recreational use, but increased temperatures could create longer seasons for recreating); however, it is difficult to discern the potential magnitude of these impacts on current socioeconomic conditions. Climate change also could increase the social and economic cost of some public services, such as road repair and transportation infrastructure maintenance, as a result of increased damages caused by extreme weather events; however, the impacts of climate change on infrastructure could add trade employment to the area.

3.4.3.3.18 ENVIRONMENTAL JUSTICE

Environmental justice populations, such as the tribal communities in the analysis area, are disproportionally vulnerable to climate change impacts (U.S. Global Change Research Program 2016). There are no census tract block groups in Valley and Adams counties that meet the definition of an environmental justice community; however, the Nez Perce Census County Subdivision, Fort Hall Reservation (reservation of the Shoshone-Bannock Tribes), and Duck Valley Reservation (reservation of the Shoshone-Paiute Tribes) and are considered environmental justice populations (see Section 3.22, Environmental Justice). The tribes also use these lands as a part of their traditional use areas. The viability of the environmental justice communities could be impacted by climate change, as it may exacerbate vulnerability to health threats, economic disadvantages, and social inequity (U.S. Global Change Research Program 2016). Environmental justice populations commonly do not have equitable access to resources to help cope with or adapt to changing environmental conditions, such as air conditioning for more frequent extreme heat events.

3.4.3.3.19 SPECIAL DESIGNATIONS

Areas of special designations in the analysis area include wilderness, Wild and Scenic Rivers, Inventoried Roadless Areas, and Research Natural Areas. Although climate change would not directly impact the designations, it could potentially affect the environmental conditions within these areas. Changes in resource availability and quality, or changes to characteristics in these areas could indirectly impact the designations of these areas.

This page intentionally left blank