Air Quality and Climate Change

Climate change and air pollution are related issues that have largely been separated in research and politics. Both were addressed at the Tongass National Forest level (USDA Forest Service 2016b). This section describes the air quality and climatic change conditions specific to the Wrangell Island project area. In terms of the spatial scale of analysis for climate and air quality, the Wrangell project area conditions would be considered similar to the Tongass National Forest. However, conclusions regarding carbon storage, carbon emissions, and ultimately sequestration can be strongly influenced by the temporal scale examined. These factors and how they related to the proposed alternatives are discussed in more detail below.

Affected Environment

Air Quality

Air quality in the project area is very good. The prevailing winds off the Pacific Ocean, the relatively low levels of industrial development, the small size of human population centers, and the low frequency of large-scale wildland fire smoke emissions all contribute to the maintenance of clean air in the region. However, localized air pollution from sources such as marine vessels and cruise ships, wood-burning stoves, vehicle exhaust, diesel power and asphalt plants, incinerators, and unpaved roads can contribute to deterioration of air quality at various scales (temporal and spatial) that could impact sensitive receptors such as lichenized fungi (USDA Forest Service 2016b).

Under the Forest Plan, the goal of air resource management is to maintain the current excellent air resource condition to protect the Forest’s ecosystems. To help resource managers evaluate the level of impacts of on- and off-Forest air pollution on sensitive receptors, the Forest Service established a network of permanent biomonitoring plots in 1989.

Additionally, the air quality objective under the current Forest Plan is to attain national and State ambient air quality standards forest-wide. To determine if national and State ambient air quality standards are being met in the region, an annual review of Environmental Protection Agency (EPA) and Alaska Department of Environmental (ADEC) Quality reports is conducted at the Forest level. Currently there is no non-attainment area in the vicinity of the project area.

Climate Change

Climate fundamentally shapes our surroundings. Climate is extremely important to local ecosystems as well as human health and infrastructure since temperature, precipitation, winds, and meteorological events (e.g., the timing of the first and last frost, the beginning and end of a rainy season, or a severe storm causing flooding) all influence the distribution of water, soils, plants, and wildlife across the globe. Significant, lasting change to existing weather patterns is commonly called “climate change.” The impacts of climate change - including an increase in prolonged periods of excessively high temperatures, more heavy downpours, an increase in wildfires, more severe droughts, permafrost thawing, ocean acidification, and sea-level rise - are already affecting communities, natural resources, ecosystems, economies, and public health across the nation.

The term “greenhouse gasses” (GHGs) refers to a variety of gases in the Earth’s atmosphere that react with sunlight in a way that influence global air temperature. GHGs are a function of air quality and include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (EO 13514). These GHGs are typically reported in units of carbon dioxide equivalent (CO_2e).

Long-term climate trends and decadal climate cycles have always occurred in Southeast Alaska, influencing air temperature and precipitation (Neal et al. 2002). There is a growing body of literature on the topic of climate change and likely effects on aquatic and terrestrial ecosystems of the Tongass National Forest (see USDA Forest Service 2016b for detailed discussion).

Carbon Sequestration

Carbon, primarily in the form of carbon dioxide, is one of the major greenhouse gases being released into the atmosphere through both natural and anthropogenic (i.e., human-driven) influences (McPherson and Simpson 1999, IPCC 2007). This atmospheric carbon, as well as other gases (e.g., methane, nitrous oxide, and water molecules), traps the sun's heat, thereby creating a natural "greenhouse effect" that makes life on earth possible (McPherson and Simpson 1999). The amount of carbon dioxide in the atmosphere is regulated by complex interactions between the atmosphere, terrestrial environment, marine environment, and geologic processes. Recent changes to the global carbon cycle, driven in large part by human activities, have been cited as one of the leading causes for global climate change and the general warming trend that has been detected (IPCC 2007). Forest ecosystems represent the largest terrestrial carbon sink on Earth, such that the United Nations Framework Convention on Climate Change (see United Nations Framework Convention on Climate Change website) has recognized their management as an effective strategy for offsetting GHG emissions (Wilson et al. 2013). For more on carbon sequestration, see the Forest Plan (USDA Forest Service 2016b).

Yellow-cedar Decline in Alaska

As discussed by Haufler et al. (2010), forest temperature and precipitation changes have an impact on NFS lands. In Southeast Alaska, these changes have been associated with a declining yellow-cedar (*Callitropsis nootkatensis*) distribution. Although distribution of yellow-cedar has been undergoing change over the last century, scientists are indicating that these distribution changes are increasing due to decreasing snow pack related to climate change (Hennon and Shaw 1997, Beier et al. 2008, Hennon et al. 2016).

For more detail on yellow-cedar decline, see "Forest Health and Natural Disturbance" in the Silviculture section of this chapter.

Greenhouse Gasses

Climate change due to GHGs is a global phenomenon, so the spatial context for this discussion is the global climate.

The most important GHGs directly emitted by humans include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several other fluorine-containing halogenated substances. Naturally occurring GHGs include water vapor, CO_2, CH_4, N_2O, and ozone (O_3). Although these GHGs occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. Atmospheric CO_2 concentration has increased from a pre-industrial value of 280 ppm to more than 390 ppm today, mostly due to carbon emissions from fossil-fuel burning and deforestation. GHGs trap heat and make the planet warmer.

The primary sources of GHG emissions in the Wrangell Island project area are from transportation emissions (from seaplane flights, ferry/cruise ship activity, mechanized equipment use, and vehicle travel) and emissions from fuel combustion associated with the community of Wrangell.

Environmental Consequences

Analysis of the effects of climate and air resources was qualitatively evaluated by comparing differences between alternatives. While quantification tools are widely available, they have vastly different levels of technical sophistication, data requirements, and GHG source profiles. No one analysis method has been vetted for use on the Tongass, or even the agency (USDA). A quantitative analysis of GHG emissions and carbon cycles is not always appropriate for every NEPA document. Most Forest Service projects are extremely small in the global CO_2 context; therefore any changes from the proposed activities would likely not provide a practical or meaningful effects analysis for project decisions. A qualitative discussion of greenhouse gases sequestered and emitted is appropriate for disclosing climate change implications at this scale. This qualitative analysis includes an evaluation of how climate change is likely to modify conditions on the project area and how the proposed actions in each alternative may influence levels of greenhouse gases and thus climate change.

Air Quality

The expected direct effects on air quality from forest management activities would be temporary and limited in nature, resulting from dust and vehicular emissions from logging operations, administrative and harvest-related use of Forest roads. None of the alternatives considered would include broadcast burning of slash following harvest, which is seldom, if ever, used on the Tongass National Forest.

Alternatives 1, 3, 4, 5 and 2 would result in progressively more potential total harvest, road construction/reconstruction, harvest-related vehicle use and/or helicopter use, and wood processing comparatively, which could subsequently result in progressively more potential emissions by alternative (including emissions of green-house gases). However, due to the short-lived nature of these activities coupled with dynamic weather patterns throughout Southeast Alaska (consistent wind and rain throughout the year), no significant adverse effects on air quality are anticipated from these activities under any of the alternatives considered.

Indirect effects on air quality can result from the use of trees harvested from this timber sale, such as in the operation of industrial processing sites and firewood burning, as well as emissions from private vehicles using Forest unpaved roads. These indirect effects on air quality can be aesthetically displeasing or have potential health risks to both humans and the Forest. EPA and ADEC have regulatory responsibility, under the Clean Air Act, for air quality related to these kinds of sources. The enforcement of the applicable regulations by these agencies is anticipated to keep any potential adverse effects within the standards for air quality; therefore, no significant indirect effects from the uses of the Wrangell Island Timber Sale should occur.

Climate Change and Carbon Sequestration

Each of the action alternatives considered for the 2016 Forest Plan Amendment FEIS would involve some harvesting of timber over a period of time (see Forest Plan FEIS, chapter 2). For the Wrangell Island Project, the no action alternative (Alternative 1) is the only one that does not propose timber harvest. As a result, each of the action alternatives would result in a net release of carbon to the atmosphere.

Alternative 1

Direct, Indirect and Cumulative Effects

Alternative 1 would likely result in a similar rate of climate change as the current condition, and would therefore have little or no effect on the rate of climate change in the Wrangell Island project area. The rate of carbon sequestration would likely remain at current levels for several years. However, for the purpose of this analysis, it is assumed that in the short term, "that harvesting forests with high biomass and planting new forest reduces overall C stocks more in the near term than if the forest were retained, even counting the C storage in harvested wood products" (Vose et al. 2012).

Alternative 1 is not expected to affect the current rate of climate change or carbon sequestration and thus would not add to the past, present, or reasonably foreseeable factors related to climate change.

Alternatives 2, 3, 4 and 5

Effects Common to All Action Alternatives

For all action alternatives, road construction activities, timber harvest operations, and administration of all operations by use of service vehicles throughout the life of the project would result in emissions of greenhouse gases. These activities involve removing vegetation, grading and re-contouring the ground surface, hardening the road, potential extraction of materials such as gravel, soil, and rock from on-island material sources, and constructing bridges all of which require fuel-burning construction machinery, an increase in construction-related vehicle traffic for a 3 to 10 year period. These construction actions would increase CO_2e emissions due to fuel combustion from construction equipment and the vehicles of construction crews.

The extent and scope of cumulative effects on climate change and carbon sequestration depends on the amount and condition of total forest land harvested (worldwide, as well as locally within Southeast Alaska); the use to which harvested wood is put; the use of the land post-harvest; how the lands of other ownership are managed (including private and State-managed lands within the U.S., as well as forests in other countries); the amount of carbon released during harvest, processing, and transporting wood products; decomposition rates of organic materials; factors such as the amount of new hydroelectric or other renewable energy power projects that are built (e.g., those that might replace diesel generated power); future community expansion and development; as well as, emissions from ongoing and future activities in the region.

It is anticipated that communities in the region and worldwide will continue to increase in some areas and decrease in others depending on local population sizes, as well as site-specific socioeconomic and other anthropogenic factors. It is uncertain how forested lands that are located outside of the U.S. would be managed by their respective governments or landowners (and the Forest Service would have no jurisdiction over these foreign lands or entities), but it is likely that many of these areas will continue to be managed under their respective government's current forest management practices, as well as responding to global markets including the influences of the Tongass forest products on those markets leading to some level of market leakage (e.g., Jonsson et al. 2012). It is likely that most of the State and private commercial forest land in Southeast Alaska, except for State parks and some other State lands, would be managed for the production of forest products under any of the alternatives considered in this analysis. If the products resulting from harvest are primarily lumber and other building materials, there is a potential that the carbon in these products would be stored for the life of the buildings, longer if the wood is recycled or placed in landfills. If the wood is used for paper products or fuel, carbon storage would be short term (Harmon et al. 1990). Any temporary storage of carbon in lumber products may be offset by carbon released during and after harvest, transportation, and processing. Each of the action alternatives would cumulatively add to the global effects of climate change by contributing to the net release of carbon to the atmosphere.

Climate change may also directly impact the resources currently managed by the Forest Service, as well as how the Forest Service manages the Tongass National Forest in the future. While there is general agreement among scientists that the climate of Southeast Alaska is warming, there is considerable uncertainty concerning the exact scope of the effects of climate change on the forests of Southeast Alaska and how best to deal with possible changes to the many resources managed on the Tongass. Shanley et al. (2015) predicted that the increased temperatures and precipitation events estimated to occur in the region as a result of climate change would have the following effects to coastal temperate rainforests like those found in the Tongass National Forest: increased frequency of flooding and rain-on-snow events; an elevated snowline and reduced snowpack; changes in the timing and magnitude of stream flow, freshwater thermal regimes, and riverine nutrient exports; changing non-forested habitats; altitudinal and latitudinal expansion of lowland and subalpine forest types; shifts in suitable habitat boundaries for vegetation and wildlife communities; adverse effects on dispersal-limited species or species with rare ecological niches; and shifts in anadromous salmon distribution and productivity (Shanley et al. 2015).

Other effects on forests in the Tongass National Forest could include increased blowdown; increased tree mortality from insects and disease; increased fire frequency and severity; adverse effects on air quality; and changes to subsistence use and recreation. If warmer winter weather results in higher insect populations and increased tree defoliation (as discussed above), there is a risk that increased dead material and warmer weather may spawn more fires than are normal for the area. However, as Berman et al. (1999) state, it is difficult to predict the magnitude of the area likely to be burned in a region without an historic fire record, but they estimate that most fires would be small and of low intensity, suggesting a scenario in which 5,000 acres might burn over a period of decades (an average of approximately 100 acres/year). Juday et al. (1998) and Shanley et al. (2015) suggest that the effects of fires on resources are likely to be low in this region, but that the effects of insects and disease may increase. For example, Shanley et al. (2015) stated "[a]ssuming that seasonality of precipitation does not change significantly, fire will remain unimportant as a disturbance agent, but higher [mean annual temperature] is anticipated to increase the incidence and severity of insect and disease in lowland forests.

Plant and animal species will respond to changing climates individually; and some species or individuals will be more sensitive and vulnerable than others (Millar et al. 2006). For example, forest losses (either from climate induced increases in insects, diseases, or fire) could harm wildlife habitat, which in turn could adversely affect subsistence resources; while conversely, Juday et al. (1998) suggested that warmer winters could result in sustained higher populations of Sitka black-tailed deer, one of the most important subsistence resources for residents of Southeast Alaska and a major prey species for wolves.

Juday et al. (1998) also postulate that warmer, drier conditions could increase stream temperatures and cause seasonal low flows, both of which could adversely affect salmon (EcoAdapt 2014). Berman et al. (1999) estimated that a 25 percent decline in salmon stocks would result in a loss of $25 million a year (approximately $31 million in current dollars). However, Oswood et al. (1992) state that melting glaciers would result in more runoff entering streams. This could offset any decrease in summer flows due to reduced summer precipitation, at least in the short run. In time, glacial mass would be reduced and their contribution to stream flow would decrease (EcoAdapt 2014). Oswood and others also believe that climate change would result in changes to the nutritional levels of leaf material entering streams, but could not predict whether this would have a positive or negative effect of fish. Some recent studies have postulated that watersheds currently fed by snow may transition to rain-fed systems, thereby altering water storage and flow dynamics that can affect salmon health (Wolken et al. 2011, Shanley and Albert 2014).

Warmer temperatures are expected to result in a loss of carbon stored in leaf litter and soil organic matter, due to increased soil respiration (Bachelet et al. 2005). The clearing of forested areas during harvesting or other development actions could increase this effect, by increasing the amount of solar energy that is allowed to reach the ground. Shanley et al. (2015) hypothesized that climate change could also affect the quality of timber products that could be harvested from this region, e.g., increased annual temperature would accelerate growth rates and in turn decrease wood density and grain quality of forest products from young-growth forests, relative to those harvested from primarily forests during the 20th century. Furthermore, some studies have found reduced productivity of forests throughout Alaska as a result of recent changes to climatic conditions (Wolken et al. 2011).

All of these factors and anticipated effects related to climate change can have both local and global implications to communities as well as associated social costs (Larsen et al. 2007; IPCC 2007; EcoAdapt 2014). These include changes to subsistence and recreational resources, impacts to infrastructure and land use, changes to transportation routes and options, and potential impacts to public health as a result of climate change.

The Forest Service will continue to work with local stakeholders and Pacific Northwest scientists to develop measures to alert the Forest Service to trends that may affect the health of the Tongass and the species that depend on it, as well as measures that could be implemented to minimize or adapt to the effects of climate change on managed resources. One monitoring effort that the Forest Service currently uses to track changes in vegetation is the Forest Inventory and Analysis-Forest Health Monitoring (FIA-FHM) program. Researchers have analyzed the existing FIA data from plots containing epiphytic lichen, and vascular plant data to develop air pollution and climate models (Root et al. 2014). Annual insect and disease surveys also provide information on how climate change may be affecting forests. Stream gauges, some of which provide long-term data on stream flow, are another tool used by the Forest Service to monitor the effects of climate change on the Tongass.

Direct, Indirect and Cumulative Effects

Overall, under the action alternatives, the rate of climate change and carbon sequestration would likely continue at the current rate for several years. Based on the literature review presented in the Forest Plan Amendment (2016), the rate of carbon sequestration would be higher under the no action alternative compared with the action alternatives. As Depro et al. (2007) found with longer periods of time (100 years) with no harvest, there would be an annual increase in carbon sequestration. Carbon sequestration levels for the action alternatives would be variable, but lower than Alternative 1, depending on the amount of harvest, regeneration rates, decomposition rates, etc. The net result of increased carbon sequestration from any of the action alternatives would not likely modify environmental conditions on the project area, in terms of either short-term or long-term ecological conditions or characteristics.

Yellow-cedar regeneration

Alternative 1

Direct, Indirect and Cumulative Effects

Alternative 1 would likely result in the same rate of yellow-cedar decline and current rates of regeneration, or at least would not have an effect on the rates of regeneration and/or decline. Over time, the rate of decline and mortality of yellow-cedar in Southeast Alaska may increase as a result of climate change (Hennon and Shaw 1997, Wolken et al. 2011, Hennon et al. 2016) and concomitant declines in snowpack in low-elevation areas that result in greater exposure of yellow-cedar’s fine roots to freezing, especially in the southern portion of the region. Since these factors are directly related to seasonal snow pack (loss of snow cover at lower elevations) and thawing cycles in late winter, the no action alternative would have no direct, indirect, or cumulative effects on overall yellow-cedar decline and/or regeneration.

Alternatives 2, 3, 4 and 5

Direct, Indirect and Cumulative Effects

Since yellow-cedar decline is associated with declines in snowpack, all action alternatives would likely result in the comparable rate of yellow-cedar decline and current rates of regeneration, or at least would not have an effect on the rates of regeneration and/or decline. While warmer temperatures are expected, the increased temperatures would not be directly or indirectly caused by the proposed activities of any action alternatives.

Greenhouse Gas Emissions

Alternative 1

Direct, Indirect and Cumulative Effects

Alternative 1 results in no project-related CO_2e emissions because no Forest Service construction or harvest operations would take place. However, CO_2e would continue to be produced in the Wrangell area annually as a result of existing vehicle, aviation, and ferry/cruise ship emissions. Therefore, GHGs emissions are likely to remain the same as current conditions under Alternative 1.

Alternatives 2, 3, 4 and 5

Direct, Indirect and Cumulative Effects

During timber sale operations, fuel combustion associated with harvesting timber would result in CO_2e emissions. Additionally, the distance vehicles travel to and from the harvest units, regardless of the location, would increase, during the life of the sale. Both of these changes would increase CO_2e emissions through additional fuel consumption.

For all action alternatives, construction activities—removing vegetation; grading and re-contouring the ground surface; hardening the roads; potential extraction of materials such as gravel, soil, and rock from on-island material sources, constructing bridges and operation of timber harvest machinery (yarders, shovels, loaders, log trucks) would require fuel-burning construction machinery, an increase in construction-related vehicle traffic, and two to three seasons of construction in addition to a 3- to 10-year timber harvest operation over the life of the sale. These construction actions would increase CO_2e emissions due to fuel combustion from construction equipment and the vehicles of construction crews.

The CO_2e emissions from construction were assessed qualitatively for all alternatives based on the duration and type of construction activity that would occur. The relative amounts of GHGs for each action alternative is proportional to the amount of road construction and harvest operations. Therefore, Alternative 2 would have the highest anticipated GHGs, followed by Alternatives 4, 3 and 5 which would have slightly lower levels.

Conclusion

Overall, the effects of this project on climate change and air quality would be negligible.

Although important on a global scale, it is estimated that the forests of the Tongass represent approximately only one-quarter of one percent of the stored carbon in forests worldwide (USDA Forest Service 2008b, p. 3-19). Therefore, it is reasonable to conclude that small, if even measurable, changes in carbon sequestration, greenhouse gasses, and yellow-cedar decline under any of the action alternatives would not be a relevant factor for choosing among alternatives. Additionally, as described above and in the Forest Plan, the task of understanding all the factors that influence climate change contains substantial uncertainty and for these reasons is not essential to a reasoned choice among alternatives.

None of the action alternatives are thought to measurably contribute to the cumulative effects on climate change.