Section 4.7

Greenhouse Gas Emissions

4.7.1 Introduction

This section evaluates the greenhouse gas (GHG) emissions impacts of the proposed project and the consistency of the proposed project with relevant plans and programs that have jurisdiction within the proposed project area. The GHG emissions information in this section is based primarily on the November 2010 Air Quality and Greenhouse Gas Technical Report for the North Sky River Wind Project prepared by CH2MILL and the April 2011 Jawbone Wind Energy Project Air Quality Impact Technical Report prepared by Sapphos Environmental Inc. The complete technical reports are included within Appendix D. The impact assessment is based upon a review of relevant literature and technical reports that include, but are not limited to, information and guidelines by the California Air Resources Board (CARB), the United States Environmental Protection Agency (EPA), and the applicable provisions of the California Environmental Quality Act (CEQA).

4.7.2 Environmental Setting

GHGs and climate change are a cumulative global issue. The CARB and EPA regulate GHG missions within the State of California and the United States, respectively. While the CARB has the primary regulatory responsibility within California for GHG emissions, local agencies can also adopt policies for GHG emission reduction.

Climate Change

In the early 1960’s scientists recognized that carbon dioxide levels in the atmosphere were rising every year. It was also noted that several other gases, including methane and nitrous oxides were also increasing. Levels of these gases have increased by about 25% since large-scale industrialization began around 150 years ago, according to the EPA. After numerous computer-simulated model runs on the effects of these increases in the atmosphere, it was concluded that the rising concentrations almost always resulted in an increase of average global temperature. Rising temperatures may, in turn, produce changes in weather, sea levels and land use patterns, commonly referred to as “climate change” (EIA, 2010). There is general scientific consensus that climate change is occurring and that human activity contributes in some measure (perhaps substantially) to that change. Man-made emissions of GHGs, if not sufficiently curtailed, are likely to contribute further to continued increases in global temperatures. Increases in global temperature will cause a reduction in the polar ice caps and increase sea level, which will flood low lying areas of the world. Additionally, climate change will shift rainfall patterns that will cause significant impacts to agriculture and fresh water availability worldwide.

Greenhouse Gases (GHGs)

Many chemical compounds found in the Earth’s atmosphere act as GHGs, which allow sunlight to enter the atmosphere freely. When sunlight strikes the Earth’s surface, some of it is reflected back towards space as infrared radiation (heat). GHGs absorb this infrared radiation and trap the heat in the atmosphere. Over time, the amount of energy sent from the sun to the Earth’s surface should be about the same as the amount of energy radiated back into space, leaving the temperature of the Earth’s surface roughly constant. Many gases exhibit these “greenhouse” properties. Some of them
occur in nature (water vapor, carbon dioxide, methane, and nitrous oxide), while others are exclusively human-made (like gases used for aerosols). The most relevant GHGs are water vapor (H₂O), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF₆). These gases prevent heat from escaping to space.

The principal GHGs resulting from human activity that enter and accumulate in the atmosphere are listed below.

- **Carbon Dioxide (CO₂):** CO₂ enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and chemical reactions (e.g., the manufacture of cement). CO₂ is also removed from the atmosphere (or “sequestered”) when it is absorbed by plants as part of the biological carbon cycle.

- **Methane (CH₄):** CH₄ is emitted during the production and transport of coal, natural gas, and oil. CH₄ emissions also result from livestock and agricultural practices and the decay of organic waste in municipal solid waste landfills.

- **Nitrous Oxide (N₂O):** N₂O is emitted during agricultural and industrial activities as well as during combustion of fossil fuels and solid waste.

- **Fluorinated Gases:** HFCs, PFCs, and SF₆ are synthetic, powerful GHGs that are emitted from a variety of industrial processes. Fluorinated gases are often used as substitutes for ozone-depleting substances (i.e., chlorofluorocarbons, hydrochloro-fluorocarbons, and halons). These gases are typically emitted in smaller quantities, but because they are potent GHGs, they are sometimes referred to as high Global Warming Potential (GWP) gases.

Global warming potential is a relative measure, compared to carbon dioxide, of a compound’s residence time in the atmosphere and ability to warm the planet. Mass emissions of GHGs are converted into carbon dioxide equivalent (CO₂e) emissions for ease of comparison.

GHGs, in most cases, have both natural and anthropogenic sources. Natural mechanisms already exist as part of the ‘carbon cycle’ for removing GHGs from the atmosphere (often called land or ocean sinks). Levels of GHGs, due to the increase in anthropogenic sources, have exceeded the normal rates of natural absorption. This has resulted in increased atmospheric concentrations of GHGs and potentially human-induced global warming.

GHG emissions in the United States come mostly from energy use. These are driven largely by economic growth, fuel used for electricity generation, and weather patterns affecting heating and cooling needs. Energy-related carbon dioxide emissions, resulting from fossil fuel exploration and use account for three-quarters of the human-generated GHG emissions in the United States, primarily in the form of carbon dioxide emissions from burning fossil fuels. More than half the energy-related emissions come from large stationary sources such as power plants; a third comes from transportation; while industrial processes, agriculture, forestry, other land uses, and waste management make up a majority of the remainder of sources (USEPA, 2010).

As previously stated, generation of electricity can produce GHGs with the criteria air pollutants that have been traditionally regulated under the federal and State Clean Air Acts. For fossil fuel-fired power plants, the GHG emissions include primarily carbon dioxide, with much smaller amounts of nitrous oxide (N₂O, not NO or NO₂, which are commonly known as NOx or oxides of nitrogen), and methane (CH₄ – often from unburned natural gas). For wind power energy generation projects the stationary source GHG emissions are much smaller than fossil fuel-fired power plants, but the associated maintenance vehicle emissions are higher due to the different and far field maintenance
requirements that require more vehicles and more travel within the project site. Other sources of GHG emissions include SF₆ from high voltage equipment and HFCs and PFCs from refrigeration/chiller equipment. GHG emissions from the electricity sector are dominated by CO₂ emissions from carbon-based fuels; other sources of GHG emissions are small and also are more likely to be easily controlled or reused or recycled.

Global carbon dioxide emissions are expected to increase by 1.9 percent annually between 2001 and 2025 (EIA, 2010). Much of the increase in these emissions is expected to occur in the developing world where emerging economies are fueled with fossil energy, such as China and India. Around 2018, developing countries’ emissions are expected to surpass the emissions of industrialized countries; increasing by 2.7 percent annually between 2001 and 2025, faster than the world average.

Climate models predict that the average temperature at the Earth's surface could increase from 2.5 to 10.4°F above 1990 levels by the end of this century if GHGs continue to increase. Other aspects of the climate are also changing such as rainfall patterns, snow and ice cover, and sea level.

Climate change affects people, plants, and animals. Scientists are certain that increasing the concentration of GHGs will change the planet's climate; however, they are not sure by how much it will change, at what rate it will change, or what the exact effects will be globally or locally. They are working to better understand future climate change and how the effects will vary by region and over time.

Some changes to global climate are already occurring. These include; rise of sea level, shrinking glaciers, changes in the range and distribution of plants and animals, lengthening of growing seasons, trees blooming earlier, ice on rivers and lakes freezing later and breaking up earlier, and thawing of permafrost.

Scientists believe that most areas in the United States will continue to warm, although some will likely warm more than others. Predicting which parts of the country will become wetter or drier is extremely difficult, but scientists generally expect increased precipitation and evaporation, and drier soil in the middle parts of the country. The northern regions such as Alaska are expected to experience the most warming. In order to address climate change concerns, the United States government has established a comprehensive policy to deal with global warming. This policy has three basic components:

- Slowing the growth of emissions;
- Strengthening science, technology and institutions; and
- Enhancing international cooperation.

Currently, the federal government is using voluntary and incentive-based programs to reduce emissions and has established a variety of programs promoting climate technology and science. The United States prepared a comprehensive strategy in February 2002 to reduce the GHG intensity by 18% over the 10-year period from 2002 to 2012. GHG intensity is a measurement of GHG emissions per unit of economic activity. By meeting this commitment the United States will prevent the release of more than 500 million metric tons cumulatively between 2002 and 2012 (Climate Vision, 2007).

### 4.7.3 Regulatory Setting

In 1988, the United Nations and the World Metrological Organization established the Intergovernmental Panel on Climate Change to evaluate the impacts of global warming and to