

DRAFT

Addressing Climate Change in the GMP

CHAPTER 1: INTRODUCTION

PLANNING ISSUES – CLIMATE CHANGE

The GMP needs to address the issue of climate change because law and policy requires the NPS to do so and because climate change is likely to affect the park and its visitors during the planning horizon of this GMP (15-20 years). The effects of climate change are described in more detail below, but include variables that could have direct implications to resource management and park operations and could influence the way visitors use and experience the park.

The plan will provide guidance on how to assess, respond to, and interpret the impacts of global climate change on park resources, and will identify objectives for reducing the carbon footprint.

Context

Climate change is perhaps the most far-reaching and irreversible threat the National Park System has ever faced (NPCA 2007). Climate change in this context refers to a suite of changes occurring in the earth's atmospheric, hydrologic, and oceanic systems. These changes, including increased global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level, provide unequivocal evidence that the climate system is warming (IPCC 2007). While a warming trend, commonly referred to as global warming, is discernable over the entire past century and a half, recent decades have exhibited an accelerated warming rate with eleven of the last twelve years ranking among the 12 warmest years on record. Most of the observed temperature increase can be attributed to human activities that contribute heat trapping gases to the atmosphere (IPCC 2007). These "greenhouse gases", particularly carbon dioxide from the burning of fossil fuels, cause Earth's atmosphere to act like a blanket and trap the sun's heat. While the insulating effect (or greenhouse effect) of our atmosphere is important to living systems, the rapid increase in greenhouse gases since the mid 19th century has turned the thermostat up higher than what our systems are adapted to.

While climate change is a global phenomenon, it manifests itself differently in different places. One of the most dramatic effects of global warming is the impact on extreme weather events. A disrupted climate could affect natural and cultural resources, and is likely to interfere with public use and enjoyment of the parks. Although many places in the world have already observed and recorded changes that can be attributed to climate change (including a 7 inch rise in sea levels recorded at Fort Point), the range of impacts to GOGA and MUWO have not been specifically determined and the actual implications within the lifespan of this general management plan are unknown. The IPCC affirms that climate change is occurring; however, the rate and severity of impacts at the parks is not

yet known. Climate change is a long-term phenomenon, and the likelihood that significant effects will be seen during the life of this GMP (15-20 years) is unknown at this time; however, acceleration of climate change impacts could have a more immediate effect on park resources and values.

Relevant Laws and Policies

Executive Order 13423 - Issued on January 24, 2007 by President George W. Bush, it requires federal agencies to “conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner.” It includes requirements for the reduction of greenhouse gases and other energy and water conservation measures. The order requires agencies to reduce greenhouse gas emissions by 3 % annually through the end of fiscal year 2015, or 30 % by the end of fiscal year 2015, relative to the baseline of the agency’s energy use in fiscal year 2003.

DOI Secretarial Order 3226 – Issued on January 19, 2001, the order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making.

NPS Management Policies 2006 –

Section 4.7.2 states that “Parks containing significant natural resources will gather and maintain baseline climatological data for reference.” Management Policies also state that “The Service will use all available authorities to protect park resources and values from potentially harmful activities...NPS managers must always seek ways to avoid, or minimize to the greatest degree possible, adverse impacts on park resources and values.”

Section 9.1.1.6 discusses sustainable energy design, requiring any facility development to include improvements in energy efficiency and reduction in greenhouse gas emissions for both the building envelope and the mechanical systems that support the facility. Additionally, projects that include visitor centers or major visitor services facilities must incorporate LEED (Leadership in Energy and Environmental Design) standards to achieve a silver rating.

Section 9.1.7 requires the NPS to interpret for the public the overall resource protection benefits from the efficient use of energy, and to actively educate and motivate park personnel and visitors to use sustainable practices in conserving energy.

NPS Pacific West Region Directive PW-047 – Adopted on October 31, 2006, this managerial directive encourages the use of renewable energy to minimize the contribution of greenhouse gases by parks.

NPS Pacific West Region Directive PW-xxx – Adopted on _____, this managerial directive establishes a goal for all parks within the Pacific West Region to be “carbon neutral” by 2016.

GOGA Climate Change Action Plan – Adopted on _____, this plan establishes the framework and actions needed to reduce greenhouse gas emissions in the park and be “carbon neutral” by 2016.

Other Recommendations

As an environmental leader, the park plans to make an effort to go above and beyond legal requirements in greenhouse gas emissions, and therefore takes into consideration the goals set forth by other relevant agencies and advisory boards.

San Francisco’s Climate Action Plan (2004) – San Francisco’s Department of the Environment and Public Utilities Commission completed a Climate Action Plan in 2004. The reduction target established in this plan is 20 % below 1990 levels by 2012.

California Global Warming Solutions Act of 2006 (AB32) – California has committed to reducing its greenhouse gas emissions to 2000 levels by 2010 (11 % below business as usual), to 1990 levels by 2020 (25 % below business as usual), and 80 % below 1990 levels by 2050.

Western States Initiative (2007) – The states of Arizona, California, New Mexico, Oregon, Utah, and Washington, as well as the Canadian provinces of British Columbia and Manitoba agreed to a regional greenhouse gas emissions target of 15 % below 2005 levels by 2020 (33 % below business-as-usual levels).

Issues & Known and Predicted Changes

The GGNRA is one of the top twelve western national parks most at risk from climate disruption (The Rocky Mountain Climate Organization 2006). Climate change is expected to affect human health; damage infrastructure; alter crop production, animal habitats, and many other features of our natural and managed environments. The loss of beaches and historical and archaeological resources could also occur in the park. The next section describes the major issues resulting from climate change, and the known and predicted changes related to those issues. Following this discussion, there is a description of the potential impacts that could be realized as a result of these issues.

Issue: Sea level rise

Known Changes:

- During the past century, sea levels along California’s coast have risen about seven inches. (California Climate Change Center 2006, and National Oceanic and

Atmospheric Administration). A 7-inch rise in sea level was observed and recorded at NOAA's Fort Point station over the last 150 years (NOAA).

Predicted Changes:

- Rising mean sea levels in combination with increasingly severe winter storms and high tides is expected to cause more frequent and severe flooding, erosion, and damage to coastal systems and structures.
- If carbon emissions continue and temperatures rise, sea level could rise an additional 22-35 inches by the end of the century (California Climate Change Center 2006).

Issue: Temperature increases

Known Changes:

Predicted Changes:

- The IPCC reports that global average temperatures will increase over this century even if greenhouse gas emissions are kept at 2000 levels (November 16, 2007 Report).
- Average temperatures in California are expected to rise between 3 and 10.5 degrees Fahrenheit by the end of the century, depending upon the level of emissions; in the next three decades, temperatures are expected to rise between 1 and 2.3 degrees Fahrenheit (California Climate Change Center 2007).

Issue: Increased fire activity

Known Changes:

- The average fire season at Golden Gate has extended due to longer, hotter summers.

Predicted Changes:

- Continued increase in fire season.
- Increase in fires and fire intensity.

Issue: Weather is less predictable and more extreme

Known Changes:

- Since 1950, the world wide number of heat waves has increased, flood events have increased, and many areas have experienced longer droughts (IPCC 2007).

Predicted Changes:

- In a warmer future climate, extreme weather events are likely to increase in frequency and intensity (IPCC 2007).

Issue: Hydrologic Changes

Known Changes:

- Observations show that global changes are occurring in the amount, intensity, frequency, and type of precipitation (IPCC 2007).

Predicted Changes:

- While projections show little change in total annual precipitation in California (California Climate Change Center 2007), even modest changes to precipitation, including changes to the seasonality of rainfall, could cause disruption to ecosystems that are conditioned to historical precipitation levels and patterns.
- Impacts to fog are still debated. (Point Reyes is considered one of the foggiest places in the world, but in 2004 and 2005, the amount and timing of summer fogs were reduced because nearshore waters were warm. The fog patterns changed due to increased nearshore sea surface temperatures.) (Neubacher,)
- The municipal water source for San Francisco, and part of Golden Gate NRA, is from the Hetch Hetchy reservoir in Yosemite National Park. Predicted earlier snowpack melt could result in a longer dry season and jeopardize fresh drinking water in the park. Water supply for other areas of the park are generally from local surface water and groundwater systems which will be affected by changes in precipitation.

Issue: Air quality worsens

Known Changes:

Predicted Changes:

- Air quality is worsened due to increases in ground level ozone and airborne particulate matter, which stem from increased emissions and temperature increases.

Issue: Ocean currents shift and the ocean becomes more acidic (NPCA 2007)

Known Changes:

- In 2005 and 2006, researchers documented very low krill populations off Point Reyes and Golden Gate National Recreation Area, resulting in breeding failure for the seabird, Cassin's Auklet. The low krill levels are a result of later upwelling of the ocean, which brings nutrients to the area. The Cassin's Auklets were not the only species affected, rockfish and penguin-like common murrelets both struggled during these years to find food. Scientists believe these disruptions in the food webs may be climate related, and indeed, climate change forecast models have predicted these events (Kay, San Francisco Chronicle, 2006 and Barth, PNAS, 2007).

Predicted Changes:

Management Goals and Guidance

Sustaining and restoring healthy parks will require the NPS to address many challenges - fiscal, ecological, and threats to the integrity of cultural and natural resources. The GMP describes the policy position that the parks will take to reduce their contribution to climate change, educate visitors on the topic, and adapt to climate change over the next 20 years. This information is independent of the alternatives and is considered park-wide guidance. While the parks are already undertaking projects that address climate change, such as reducing carbon emissions, there is more to be done. GOGA and MUWO aim to exceed legal requirements. The NPS intends to institutionalize the evaluation of climate change impacts into its decision making.

In order for GOGA and MUWO to respond to the issues and potential impacts associated with climate change as described in Chapter 1, the NPS has developed policy goals to guide the way climate change is addressed in the two parks. The park's Climate Change Action Plan is tiered to this GMP and outlines the actions that will be taken to accomplish these broad goals.

1. Reduce - Reduce CO2 emissions

National Parks can demonstrate how to minimize our contribution to global warming through practices such as energy efficiency and use of renewable energy. Since emissions from visitor driving contribute over 90% of the park's emissions at the time of this writing, the park will assist in the reduction of visitor greenhouse gases by providing opportunities for alternative transportation options.

Goal: Become a carbon neutral park by 2016 by: reducing the CO2 emissions of NPS and Partner operations, increasing the use of renewable energy and other sustainable practices, and reducing visitor emissions by lessening dependency on personal automobiles.

2. Educate - Education and interpretation

Through the efforts of employees, partners, and educational and interpretive media, the park can engage visitors on the topic of climate change, provide the latest park research and monitoring data and trends, inform the public about what response is being taken at the park, and inspire visitors to aid in that response.

Goal: Park visitors understand the process of global warming, climate change, the threats to the park, and how they can respond. Visitors are inspired to action through leadership and education.

3. Adapt - Assessing the impacts and responding to changing conditions

Climate change is a global phenomenon, outside the control of the parks. Therefore, the NPS will not have the ability to control the impacts of climate change on the parks through its own emissions reductions and education practices.

However, we will do our part to improve conditions and demonstrate environmental leadership.

The NPS will utilize and promote innovation, best practices, and partnerships to respond to the challenges of climate change and their effects on park resources. By using and developing tools and monitoring methods, including seeking outside assistance, the parks can better respond to climate change. The NPS will interpret climate change science and develop management strategies, which may include predicting and projecting expected changes more than it did in the past. The NPS is actively developing tools and strategies to help parks identify and manage climate change impacts. By adopting the best information on climate change as it becomes available, GOGA and MUWO will be positioned to respond quickly and appropriately to the local effects of climate change.

GOGA and MUWO may choose to use an adaptive management framework to respond to the effects of climate change. Temperature and precipitation changes may require that the parks no longer simply manage for natural communities, but that they manage for native biodiversity and ecosystem function. In most cases the parks would allow natural processes to continue unimpeded, except when public health and safety or the park's fundamental resources and values are threatened. Scenario planning would likely play a pivotal role in developing the park's responses to climate change. GOGA and MUWO would also work with other local, regional, and national agencies to collaborate in the effort to assess and adapt to climate change.

Goal: Proactively monitor, plan, and adapt to the effects of climate change by using the best information as it becomes available.

Other Potential Strategies

In July 2006, the World Heritage Committee (WHC), a United Nations body, adopted resolutions outlining a framework of action for protecting the world's most significant natural and cultural sites from the effects of climate change. The recommendations could apply to GOGA and MUWO.

The WHC identified options for planning and managing natural protected areas faced with climate change:

- Creating new protected areas
- Enlarging existing protected areas
- Creating replicates of existing protected areas
- Designating “stepping-stone” or corridor protected areas
- Creating buffer zones of natural habitat around protected areas
- Increasing habitat heterogeneity within protected areas (e.g. Altitudinal, latitudinal, and topographic)
- Restoring, regulating or maintaining disturbance regimes
- Removing or reducing invasive alien species

- Reducing other environmental stresses
- Restoration or rehabilitation of natural habitat
- Translocation, reintroduction or introduction of species

The WHC addressed protected cultural heritage sites by noting that more needs to be done on monitoring, research, and maintenance for cultural heritage than the natural heritage which has already recognized the impact of climate change. The process recommended includes choosing the site, describing the evidence of climate change, defining responses to climate change, and developing best practices. (UNESCO)

IMPACT TOPICS

Impact Topic	Retained or Dismissed	Rationale	Relevant Law, Regulation, or Policy
Natural Resource Impact Topics			
Carbon Footprint	Retained	Certain actions included in the alternatives of the plan would have an affect on the parks’ total greenhouse gas (carbon dioxide - CO2) emissions, known as the carbon footprint. Since some of the actions could increase CO2 emissions, like the construction of new facilities; and other actions could reduce CO2 emissions, like providing alternative transportation and reducing visitors’ dependency on personal automobiles, it is important to evaluate the impact that these actions could have on contributing to global warming. Therefore, this topic was retained and will be analyzed in detail.	Clean Air Act; EO 13423; DOI Secretarial Order 3226; NPS <i>Management Policies 2006</i> ; NPS Pacific West Region Directive PW-047
Energy Requirements and Conservation Potential	Dismissed?? [Depends on the outcome and integration of asset mgmt. planning and facility decisions in the GMP]	None of the alternatives presented in this plan would result in a major change in energy consumption, energy availability, or costs compared to current conditions. The parks’ focus on using renewable energy is a continuation of current management trends. The National Park Service would pursue sustainable practices whenever possible in all decisions regarding operations, facilities management, and development in the parks. Whenever possible, the National Park Service would use energy conservation technologies and renewable energy sources. Overall, the impact on energy requirements and conservation potential as a result of the actions included in this plan would be minor. Therefore, this topic was dismissed from detailed analysis.	<i>NPS Management Policies 2006</i>

CHAPTER 3 - AFFECTED ENVIRONMENT

Carbon Footprint

[Note: Define carbon footprint and list and describe greenhouse gases. Discuss the existing conditions of the carbon footprint for the two parks - current state of total greenhouse gas emissions (use figures from the inventory in the Climate Change Action Plan). Briefly describe the relationship between carbon footprint, global warming, and climate change.]

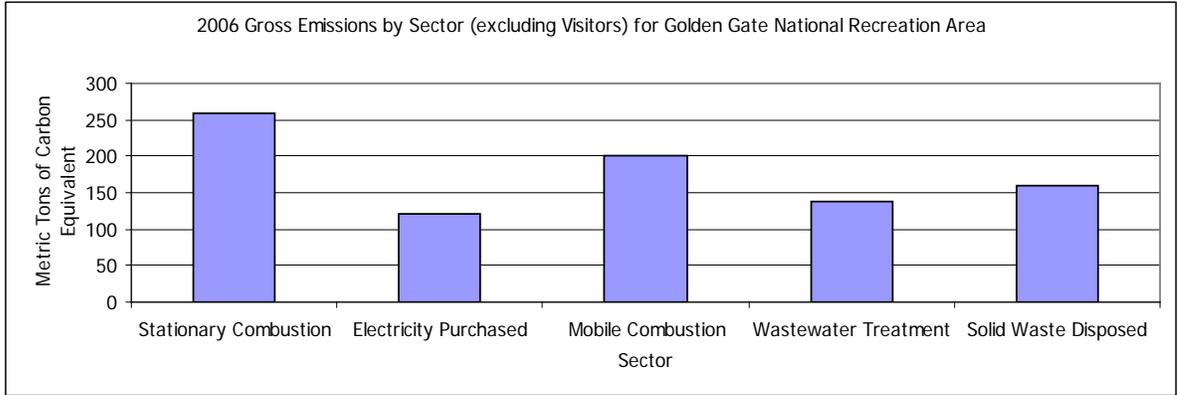
A “carbon footprint” is a measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide. The greenhouse effect is a natural phenomenon that keeps the earth’s temperature stable at an average of 60 degrees Fahrenheit. Without this natural warming effect our planet would be uninhabitable at an average temperature of 14 degrees Fahrenheit. However, human actions are disturbing this balance through over-production of large amounts of two main greenhouse gases, carbon dioxide (CO₂) and methane (CH₄). The increase in greenhouse gases is causing an overall warming of the planet, commonly referred to as *global warming*. The term *climate change* describes the variable consequences of global warming over time.

The parks have the goal of reducing their contribution to global warming and climate change through emissions reductions. To begin tracking the results of their efforts, GOGA inventoried its emissions in 2006. They did this using the NPS and EPA Climate Leadership in Parks (CLIP) tool. The CLIP tool converts emissions of various greenhouse gases into a common “metric tons of carbon equivalent” unit, which provides a basis for comparison among gases and simplifies reduction tracking. The conversion of a greenhouse gas to metric tons of carbon equivalent is based upon how strongly that particular gas contributes to the greenhouse effect, and how many tons of carbon emission would have the same effect.

Visitor emission totals consist of an approximation of how much gasoline is consumed while driving to various park locations. Using annual visitor vehicle counts to many of the different locations in the park, the total number of miles driven by visitors was approximated (based on the assumption that they were driving from somewhere in the Bay area). The resulting total vehicle miles driven by visitors was put into the CLIP tool. The CLIP tool then used assumptions about the different types of cars and the miles per gallon each had to determine approximate fuel consumption.

The following figure shows how GOGA’s own emissions are distributed among sectors when visitor emissions are excluded.

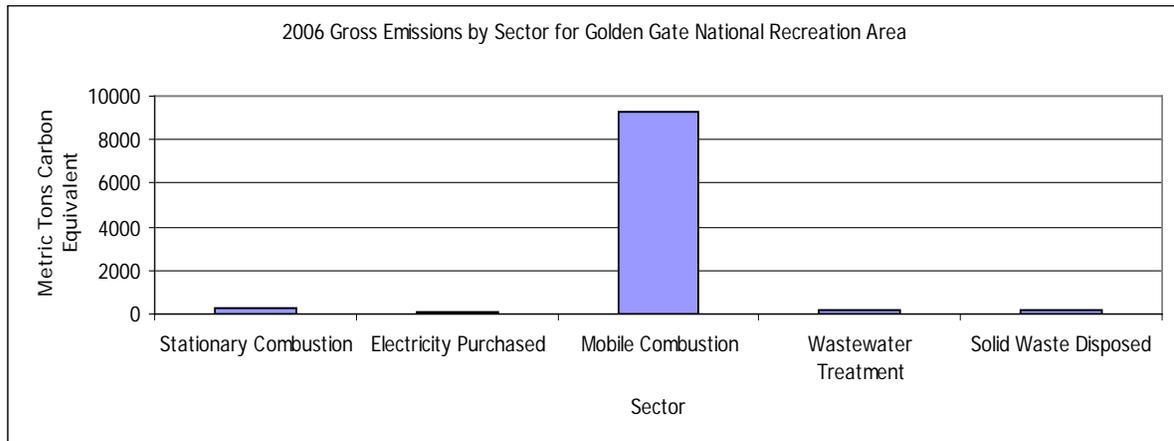
Park operations (i.e. without visitors), by sector:



Source: GOGA Climate Change Action Plan, August 2007

The following figure shows that when visitor emissions are included, the vast majority of GOGA greenhouse gas emissions come from mobile combustion. In fact, 19% of estimated emissions come from visitors driving.

Park emissions by sector, including visitors:



Source: GOGA Climate Change Action Plan, August 2007

The park partners have been encouraged to complete an emissions inventory which would be included in this analysis.

Potential Impacts of Known and Predicted Changes [on various impact topics]

The issues surrounding climate change will have synergistic effects that will result in profound and yet sometimes subtle alteration in our environment. Some of these changes may include:

Potential Impact: Loss of shoreline

- Erosion of GGNRA's 59 miles of coastal systems could occur.

Potential Impact: Altered terrestrial ecosystems

- Even modest changes in precipitation (including fog patterns), including changes in the seasonality of rainfall, could cause disruption of ecosystems that are conditioned to historical precipitation levels.
- Rising sea levels could infiltrate the fresh water resources, causing ecological and economic impacts.
- Rising sea levels could damage or destroy riparian habitats through coastal storm surges and flooding.
- Subtle changes in temperatures and seasonal variation could change vegetation patterns and influence the integrity of coastal plant communities.
- Ecosystem disruption could include wildlife extinction, invasion by non-native animals, range shifts poleward and up in elevation; stresses on wildlife from changes in seasonal timing, increased mortality due to pests and pathogens, and habitat fragmentation. Loss of beaches would also affect wintering habitat for the federally-endangered Western snowy plover and habitat for bluff bank swallows.
- Earlier, and more intense, stream flow and higher stream temperatures could impact stream and pond ecology.
- Temperature increases, along with precipitation changes could increase the risk of wildfire.
- Deterioration of scenic views and the quality of the night sky could occur.

Potential Impact: Altered marine ecosystems

- Stronger and more frequent El Nino events may promote harmful algal blooms that are toxic to seals, seabirds, and fish, and could poison shellfish (Stephens, UC Santa Cruz, November 2, 2006).
- The ocean temperature could increase and become more acidic, causing species to relocate or die.
- Changes in the timing of upwelling that brings important nutrients and food could adversely affect salmon that feed at sea. Global climate change may undermine extensive restoration efforts by NPS to improve stream habitat for salmon while the salmon starve at sea.
- GGNRA's marine resources contain a highly productive fishery that could be threatened by climate change.

Potential Impact: Damaged or lost assets and facilities

- Beaches could shrink or be lost, affecting both public recreation and enjoyment. A rise of three feet could inundate most if not all of the beaches if beach growth is unable to keep up with sea level rise. Heavily visited beaches to the north include Rodeo Beach, Stinson Beach, and Muir Beach; and to the south include Ocean Beach, China Beach, Crissy Field, and Baker Beach.
- Maintenance of historic buildings and facilities could become more difficult as weather has a greater influence on the sustainability of historic preservation. Rising sea levels could put some facilities and cultural resources partially or

wholly underwater and subject them to more intense wave energy. Not only could historical and archaeological sites become inaccessible, but they could be at risk of eroding or falling into the ocean. Examples of vulnerable sites are the Sutro Baths, Fort Cronkhite, Fort Point and the Fort Funston dunes.

- Several park roads, including the road to Fort Point, the Great Highway along Ocean Beach, the road into Fort Cronkhite in the Marin Headlands, and a section of Highway 1 at Richardson Bay in Sausalito, would be in jeopardy and access to park sites and facilities could be compromised or eliminated. Trails next to bluffs and shorelines would also be in jeopardy.
- Increases in fire frequency and intensity would impact the natural and man-made environments, including park facilities and historic structures, and other investments owned by park partners, inholdings, and park neighbors. The financial and staffing implications of this trend are significant, already resulting in an increase in park firefighting staff, supplies, funding, and interagency agreements and response.
- Storm intensity, flooding, etc...

Potential Impact: Disruptions in visitor use

- Reduced visitor access to sites and structures affected by climate change
- Disruption of visitor services and recreational opportunities.
- Severe erosion of sites during rainy season and after a large fire, as well as extended closure of sites after fires.
- Increased social pressures on park resources for consumptive uses and as a refuge from urban living could occur if a storm event made those resources scarce within the San Francisco metropolitan area.
- Changes in recreational use patterns

CHAPTER 4 – ENVIRONMENTAL CONSEQUENCES

METHODS AND ASSUMPTIONS FOR ANALYZING IMPACTS

NATURAL RESOURCES

Analysis of natural resources was based on research, knowledge of the area’s resources, and the best professional judgment of planners, resource specialists, and biologists who have experience with similar types of projects. The definitions for impact intensity of all impact topics is included in table 15; however, the criteria for characterizing the severity or intensity, as well as the duration, of certain impact topics is discussed below.

Carbon Footprint

The analysis of the effects of actions contained in this plan on the parks’ carbon footprint is based on a comparison with existing conditions. The baseline that is used for comparison is the carbon footprint (total greenhouse gas emissions) of the no-action alternative, which is included in Chapter 3, “Affected Environment”. GOGA inventoried its emissions in 2006 as part of their Climate Change Action Plan using the NPS and EPA Climate Leadership in Parks (CLIP) tool. The CLIP tool converts emissions of various greenhouse gases into a common “metric tons of carbon equivalent” unit, which provides a basis for comparison among gases and simplifies reduction tracking. The conversion of a greenhouse gas to metric tons of carbon equivalent is based upon how strongly that particular gas contributes to the greenhouse effect, and how many tons of carbon emission would have the same effect.

The impacts of greenhouse gas emissions for all actions under each of the alternatives is assessed in comparison to existing conditions. The nature of the impact assessment is general and qualitative, providing a course determination of whether or not the actions would have a beneficial, neutral, or adverse impact on the parks’ carbon footprint.

Table 1: Impact Threshold Definitions

Impact Topic and Duration	Negligible	Minor	Moderate	Major
NATURAL RESOURCES				
Carbon Footprint	The action would result in a change in total greenhouse gas emissions, but the change would be at the lowest level of	The action would result in a slight, but detectable, change in total greenhouse gas emissions.	The action would result in a modest change in total greenhouse gas emissions.	The action would result in a substantial change in total greenhouse gas emissions.

Impact Topic and Duration	Negligible	Minor	Moderate	Major
	detection, or not measurable.			

[Note: The baseline that we will use as a comparison is the total emissions/carbon footprint of the no-action alternative. Analyze the greenhouse gas emissions for all actions under each of the alternatives. Use the CLIP Tool to help quantify emissions (additions and reductions) to the extent possible. If the level of precision is inadequate, then just characterize the impacts qualitatively and discuss the general impact level – is the impact beneficial, neutral, or adverse compared to baseline conditions at the park or within the Bay Area?]

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