APPENDIX I:

CLIMATE CHANGE EVALUATION

NEPA CLIMATE ANALYSIS

Sitka Seaplane Base

1123.63021.01

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Federal Aviation Administration

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GRAPHICS

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ACRONYMS AND ABBREVIATIONS

º	degrees
ASCE	American Society of Civil Engineers
CBS	City and Borough of Sitka
CH_4	methane
CO_2	carbon dioxide
CO_2E	CO_2 Equivalent
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
ft/century	feet per century
g	grams
gal	gallon
GCM	global climate model
GHG	greenhouse gas
IAMs	integrated assessment models
in/year	inches per year
IPCC	Intergovernmental Panel on Climate Change
kg	kilograms
kW	kilowatt
LTOs	landing and takeoff operations
mm/year	millimeters per year
N_2O	nitrous oxide
NEPA	National Environmental Policy Act
PSF	pounds per square foot
SEA	Supplemental Environmental Assessment
SLAT	Sea Level Analysis Tool
SPB	Seaplane Base
SST	sea surface temperature
USACE	United States Army Corps of Engineers
USD	US Dollar
USGS	United States Geological Survey

1.0 INTRODUCTION

The Proposed Action considered by the Supplemental Environmental Assessment (SEA) will occur within the boundaries of lands currently owned by the City and Borough of Sitka (CBS), the existing Seaplane Base (SPB) and the proposed location for a new SPB.

The new SPB would replace the existing and deteriorating SPB that has been in operation for 65 years and is at the end of its useful life. The existing SPB is located across Sitka Channel from the proposed SPB on Baranof Island. The existing SPB has no potential for expansion.

The new SPB would be located near 1190 Seward Avenue on the northwest side of Japonski Island, approximately 1.4 miles west of downtown Sitka, Alaska and approximately 600 miles from Anchorage at 57.055418 Latitude: -135.363889 Longitude (Sec. 34 and 35, T55S, R63E, Copper River Meridian, United States Geological Survey [USGS] Quadrangle Sitka A5).

The current Proposed Action consists of the following:

Marine Components (0.97 acres)

- Seaplane Ramp Float (417 by 46 feet) to support 10 Cessna and 4 Beaver seaplane berths.
- Transient/Loading Dock (175 by 56 feet)
- Drive-Down Float (128 by 68 feet)
- Transfer Bridge (120 by 12 feet)
- Approach Dock (80 by 24 feet) foot approach dock on pile foundation

Upland Base Parking Area and Approach (1.96 acres)

- Seaplane Haulout Ramp (230 by 30 feet)
- Utilities include electricity, water, and lighting.
- Security fencing (934 linear feet)
- 14 Parking spaces
- Vegetative Buffer (0.12 acres)
- Access Driveway (200 by 23 feet)
- Covered Shelter
- Other Services (locations to be determined at next design phase)
    - Aircraft tie-downs
    - Maneuvering room
    - Fire Truck Access
    - Restroom

Existing Seaplane

- Deactivate and decommission once new SPB is operational.
- Remove existing floats and ramps but leave piles in place.

The proposed project is funded by Federal Aviation Administration (FAA). Therefore, the project is subject to the environmental review process under the National Environmental Policy Act (NEPA). Analysis contained herein followed FAA Order 1050.1F as it was initiated and generally completed prior to FAA Order 1050.1G.

2.0 QUANTIFYING PROJECT GHG EMISSIONS

This section identifies the GHG sources of both the existing SPB and proposes SPB and quantifies the reasonably foreseeable direct and indirect GHG emissions. The GHG emissions inventory and analysis for the project was conducted by licensed professional civil engineers and aviation designers to the calculation of direct and indirect GHG emissions that result from construction and built facility operations respective to current SPB operations emissions. Inventory and analysis methods incorporated available data regarding fuel consumption and final cumulative emissions are reported in CO_2 Equivalent[1](CO_2E) (EPA 2024).

The types of GHGs[2] analyzed are listed below for the Proposed Action and No Action:

- carbon dioxide (CO_2),
- methane (CH_4)
- nitrous oxide (N_2O)

Fuel combustion with associated GHG emission rates are listed below.

- One gallon of diesel emits:
  - 10.21 kilograms (kg) of CO2 (EPA 2023)
  - 6.41 grams (g) of CH4 (EPA 2023)
  - 0.17 g of N2O (EPA 2023)
- Gasoline – one gallon burned emits 8.78 kg CO2 emitted (EPA 2023)
- Aviation gasoline(avgas) one gallon burned emits:
  - 8.31 kg CO_2 (EPA 2023)
  - .11 g of N_2O (EPA 2023)
  - 7.06 g of CH_4 (EPA 2023)

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[1] The IPCC in 1990 started using a CO_2E value to standardize how large entities report their GHG footprint based on the global warming potential of distinct GHG in relation to CO_2. One gram of CH_4 has a GWP of approximately 28 grams of $C0_2$ and one gram of N_2O has a GWP of 237 grams of CO_2.

[2] GHG are gases in the earth's atmosphere that trap heat. GHG include carbon dioxide, methane, nitrous oxide, and fluorinated gases. Fluorinated gases are not commonly associated with construction or operations of aviation facilities.

- Production of steel – Production of one metric ton of steel emits 1.27 metric tons of CO_2 (IEA 2020)
- Production of asphalt -- Production of one metric ton of asphalt emits 52.1 kg CO_2e (NAPA 2022)
- Production of Aluminum – Production of one metric ton of aluminum emits 16 metric tons of CO_2.

Sources of GHG Emissions

Sources of emissions inventoried through this GHG analysis include those associated with activities that are required to operate the existing SPB, to establish baseline conditions for the no action alternative, and required to construct the Proposed Action.

Both are needed to determine the net change in emissions anticipated to result from expanding operation capacity for SPB because of increased fuel consumption. Substantive sources of emissions for the proposed new SPB:

Upstream

- Materials production
- Sourcing and transportation of materials

Downstream

- Demobilization of current facilities

Construction

- Equipment fuel consumption

Operations

- Aircraft (14)
- Ground access vehicles

Substantive sources of emissions for the existing SPB (No Action):

Operations

- Aircraft (8)
- Ground access vehicles

2.1 Direct and Indirect Effects of Project Emissions

The results of the new SPB refurbishment analysis were informed by the published 2024 FAA Hydaburg Seaplane Base Refurbishment (SFAPT00328) Climate analysis and verified through comparison to the built Metlakatla seaplane facility refurbishment (SFAPT00270), a project completed under a similar construction scope. Metlakatla and Hydaburg have comparable logistics to Sitka with required barging of materials and similar construction. Further using a real-world example (Metlakatla) for comparison in a deterministic approach verifies the proposed project impacts are thoroughly addressed.

2.1.1 Direct Effects

2.1.1.1 No Action

The No Action alternative is the baseline for which the Proposed Action's net emissions are measured. The current SPB having no auxiliary facilities, substantive emission sources are isolated to aircraft traffic arriving and departing, and ground vehicles to support passengers. Real time emissions analysis with in-situ sensors or monitoring devices was determined to not be practical or necessary for the level of analysis.

Current SPB operations are estimated to use 4.8 gallons of gasoline daily for ground vehicle passenger trips, or 1,732 gallons of gasoline annually. Estimates for air traffic were calculated based on SPB current seaplane traffic with the following assumptions:

- Design aircraft fuel economy for a manufactured:
  - Piper J-3 Cub (FAS)
  - Cessna 182 Float
  - DeHavilland DHC-2 Mk III Beaver Float
  - Cessna 208 Caravan
- Seaplane Landing take-off cycle (LTOs) i.e., traffic, consistent with the SPB environmental document noise analysis study.
- LTO duration of 30 minutes

It is estimated that currently there are 30 daily LTOs cycles that cumulatively use 208.7 gallons of aviation gasoline. To establish a baseline the current SPB is assumed to be kept operational for the new SPB project life[3]. Current SPB annual operations emit:

- 633.02 metric tons of CO_2
- 0.01 metric tons of N_2O
- 0.53 metric tons of CH_4

The No Action alterative would result in 32,411.4 MT of CO2 for fuel consumption, incorporating LTOs and ground vehicles. And 39,764.0 MT of CO_2e when accounting for CH_4 and N_2O emissions from aviation gasoline consumption.

2.1.1.2 Proposed Action

Direct effects are those that contribute GHG emissions to the atmosphere through activities in direct association with the facility and are considered point source emission. Examples of direct effects for this project would be emissions associated the construction of facilities, energy consumption for facility operations and maintenance, and seaplane LTOs cycles for the duration of the design life[4].

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[3]*A typical design life for SPB infrastructure is 35 to 40 years, however they are frequently kept in operation for additional years. An estimated 50-year design life for the proposed project was used in the analysis.*

[4] *A typical design life for SPB infrastructure is 35 to 40 years, however they are frequently kept in operation for additional years. An estimated 50-year design life for the proposed project was used in the analysis.*

Construction

Construction emissions are the most complex aspect of the SPB direct emissions analysis. The analysis considers:

- the quantity and types of equipment
- manufacturers' fuel consumption rates
- variables of equipment operation (e.g., estimated usage throughout duration of construction and estimated engine capacity while in use)
- hours of equipment operation
- time the equipment would be running at a reduced rate (based on estimated usage and engine capacity).

Construction for the project is assumed to take 96 working days or 16 weeks at six working days a week. Equipment operations were estimated by working days (10 hours) with reduced fuel consumption duration estimated to provide the proportion of the day when equipment is idling or not operating. Conservative assumptions were made in relation to exact equipment requirement to complete meaning there is overlap with equipment hours and purpose. For example, in-water pile driving may be complete by a Diesel Impact Hammer alone or a combination of Diesel Impact Hammer and Diesel Vibratory Hammer. There are implied limitations with the calculations requiring approximations to determine total fuel use, but conservative measures have been employed to fully capture the greatest extent of emissions generated during construction.

Both diesel and gasoline fuel are required for equipment operations, with an estimated 3,873 gallons of gasoline and 17,351 gal of diesel needed for construction.

Table 1. Construction Equipment and Fuel Consumption

Quantity	Equipment	Fuel Consumption Each Unit (gal/hour)	Reduced Fuel Consumption (gal/hour)[1]	Total Hours of Operation per Unit	Total Fuel Use (gal)[2,3,4]
1	230-ton Crawler Crane (pile driving/removal, drilling)	13.5	6.1	600	3,645
2	Deck Winches[5]	-	-	360	-
2	Generators (25-kW)[6]	1.8	0.8	960	1,555
3	Weld Machines (500-amp)	1.2	0.5	360	583
2	Gas Powered Skiffs	6.1	2.8	700	3,873
1	Diesel Impact Hammer (pile driving)	4.2	1.9	200	374
1	Diesel Vibratory Hammer with Power Generator (drilling)	28.4	12.8	340	4,345
2	Bulldozer (Crawler)	5.9	2.7	200	1,062
2	Excavator (Crawler)	3.7	1.7	360	1,199
1	Vibratory Soil Compactor (Roller)	3.5	1.6	200	315

1	Track Asphalt Paver	2.0	0.9	30	27
2	Tandem Vibratory Compactors (Rollers)	1.5	0.7	30	41
1	Tandem Vibratory Compactor (Utility/Finish Roller)	0.6	0.3	30	8
4	End Dump Trucks	3.2	1.4	400	2,304
1	Wheel Loader	3.7	1.7	700	1,166
1	Motor Grader	6.7	3.0	240	726

Notes: gallons (gal). kilowatt (kW),

[1]Reduced Fuel Consumption rate incorporates Estimated Usage for duration of project at 75 percent; and Estimated Capacity of equipment engine at 60 percent.
[2]Total fuel use = quantity of units x reduced fuel consumption x hours of operation
[3]Total fuel use does not incorporate rounding.
[4]All fuel use is diesel except gasoline-powered skiffs.
[5] Deck winches are included in the table for completeness of the equipment list. The weight of deck winches is accounted for in determining payload for barging and the deck winches fuel consumption is accounted for under the generators.
[6] Required for deck winch equipment operations.

Using the EPA conversions of gasoline and diesel to CO_2 emissions listed above in Section 2.1, total fuel consumption during construction will result in:

- 211.6 metric tons of CO_2 emissions
- 3,608 grams of N_2O emissions
- 13,0315 grams of CH_4 emissions

Totaling 215.4 metric tons of CO_2E[5].

Operations

Emissions that are defined under the operation phase (project life) begin following the close of construction activities, and include:

- Seaplane traffic
- ground vehicle access[6] traffic
- energy required for facilities (e.g., lights, heating)
- maintenance and repair activities

An analysis was completed for a conservative operations scenario in which the new SPB is operating at near full capacity, with consideration given to seasonal fluctuations. No quantification of emissions during facility operations or maintenance and repair activities has been performed for this analysis as they are expected to be negligible. CBS has a largely

5 CO2 Equivalent is based on the global warming potential (GWP) of a GHGs, CO2 is the reference gas with GWP of one. N2O has a GWP of 273, CH4 had a GWP of approximately 28.

[6] Defined as the motor vehicles traveling upon on- and off-airport roadways, within airport parking facilities, and idling along terminal curbsides

renewable energy grid with hydroelectricity providing 99.9% of the energy required by residents and local businesses (CBS 2023).

The GHG inventory for operations analyzes the net-change that could reasonably be calculated from SPB and the new SPB. Methods used to estimate emissions were based on the quantifiable difference in capacity for new facilities from those outlined in section 2.1.1.1 No Action. Design for the new seaplane ramp for SPB will increase seaplane tiedowns from 8 to 14, or by 57 percent. The increase was extrapolated to current LTOs[7] and the assumed associated ground access vehicle traffic.

Table 2: Average Daily Seaplane Fuel Consumption

Design Aircraft	No. of Daily Operations	Fuel Efficiency (GPH)	Current LTO Fuel Consumption	New LTO Fuel Consumption
Avid Flyer	2	5	5	7.1
Cessna 180	3	12	18	25.7
Cessna 185	3	15.8	23.7	33.9
Cessna 206	2	15	15	21.4
Cessna 208	4	48	96	137.1
DeHavilland Beaver	2	28	28	40.0
Husky A1	3	12	18	25.7
Piper Cub	2	5	5	7.1

Seaplane operations at the new SPB are estimated to burn an additional 89.4 gallons of avgas daily, or 32,646.6 gallons of avgas annually. Annual operations would cause a net-increase of:

- 271.3 metric tons of CO_2
- 0.0036 metric tons of N_2O
- 0.2 metric tons of CH_4

For the project life[8], the new SPB LTO traffic could result in a net-increase of:

- 13,564.7 metric tons of CO_2
- 0.2 metric tons of N_2O
- 11.5 metric tons of CH_4

For each additional daily flight operation, one additional ground vehicle trip to support passengers is assumed. An additional 1,299 gallons of gasoline annually, or 64,957.6 gallons and 570 metric tons of CO_2 over the project lifetime[9]. All operations could result in a net-increase of 16,716.0 metric tons of CO_2e over the 50-year project life.

Indirect Effects

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[7] LTOs and fleet mix were estimated for the SPB SEA noise analysis study, the best estimation for annual averaged daily seaplane operations.

[8] A typical design life for SPB infrastructure is 35 to 40 years, however they are frequently kept in operation for additional years. An estimated 50-year design life for the proposed project was used in the analysis.

[9]

Indirect effects are often referred to as “upstream and downstream” emissions. An example of upstream emissions during the project are those generated by energy consumption during production and transport of construction materials, such as steel production and transport. Downstream emissions could include those generated during waste disposal.

Material Production

Indirect emissions will largely result from steel production, a process that is considered a high CO_2 emitting process due to its reliance on coal. In addition to steel, asphalt and aluminum materials are required for upland paving and anodes for 24-inch pile, respectively. Electrical components and materials (wiring, junction boxes, light poles), water services (corrugated polyethylene pipe, hydrants, service lines), and float materials (glulam beams, float tank and tubs) were not figured into this analysis.

The production of materials will result in 413.3 Metric Tons of CO_2.

Table 3: CO_2 footprint from Material Production

Quantity	Item	Material	Total Weight ()	CO2 Emissions (MT)
4	Transfer Bridge Abutment Piles (60-ft)	Steel	9.94	12.6
6	Approach Dock Piles (60-ft)	Steel	14.91	18.9
6	Drive-Down Float Piles (80-ft)	Steel	30.15	38.3
2	Vehicle-Turnaround Float Piles (80-ft)	Steel	10.05	12.8
4	Transient Float Piles (80-ft)	Steel	20.10	25.5
2	Ramp Float Piles (80-ft)	Steel	10.05	12.8
5	Ramp Float Piles (100-ft)	Steel	31.40	39.9
106	Anodes (for 24-in pile)	Aluminum	13.78	200.0
-	HMA, Type II Class B (Aircraft Parking & Traffic)	Asphalt	84.11	3.98
-	HMA, Type II Class B (Vehicle Parking & Traffic)	Asphalt	1026.70	48.5
		Totals:	**1251.19**	**413.3**

Transport of Materials (Barging)

Additional upstream emissions are those produced during the transport of materials and equipment from their source to the project site. Sitka is in a remote setting on Baranof Island, located in the northwest area of the Alexander Archipelago. All components required for construction are assumed to be transported to the site by diesel-powered barges from locations where materials and equipment are readily available, such as Seattle, Washington.

The decommissioned SPB will only be complete following the commissioning of the new SPB and is to include the removal of floats and ramps with piles to stay in-place. The CBS Scrapyard will receive the floats and ramps. Seattle is approximately 1,015 miles (883 nautical miles) from Sitka and the project would require four barging trips between Sitka Seattle.

- one barge trip for materials during mobilization
- one barge trip for equipment during mobilization
- one barge trip for equipment during demobilization
- one barge trip for waste materials during demobilization[10]

Each barge trip will take an estimated 147 hours with each trip using an average fuel consumption of 45 gal of diesel per hour (Calculator Academy 2024). Total fuel consumption is estimated to be 26,460 gallons and 270 metric tons of CO_2.

A five percent contingency was added for unaccounted weight which would lead to a decrease in estimated fuel efficiency, resulting in a total fuel consumption of 27,802 gallons of diesel and 283 metric tons of CO_2.

2.1.2 Emissions Summary

Indirect emissions from upstream and downstream emissions, coupled with the direct emissions of the project will result in a total of 14,536,945.6 metric tons of CO_2e emitted as a result of the new SPB (Table 4).

Table 4: Summary of CO_2e emissions from fuel consumption

Phase	Fuel Use (gal)	CO_2e Emissions (metric tons)
Mobilization/Demobilization	27,802.0	283
Material Production	-	413.3
Construction	17,351.0	215.4
Operations	16,716.0	16,716.0
Totals:	**61,669.0**	**17,627.7**

3.0 ISCLOSING AND PROVIDING CONTEXT FOR GHG EMISSIONS AND CLIMATE EFFECTS

3.1 Contextualizing Emissions into a Comparable Quantity

Quantifying and disclosing the direct and indirect reasonably foreseeable GHG emissions are a component of evaluating a Proposed Action’s potential effect. However, quantities of emissions can be ambiguous for a reader; therefore, further analysis assists with understanding the magnitude of emissions. Placing GHG emissions into familiar metrics like the equivalent emissions from common GHG sources, or widely published climate goals, is recommended to help decision-makers and the public understand the context of the Proposed Action.

[10] *Although waste is anticipated to be received locally by the CBS scrapyard; a conservative estimate that considers all waste being exported to Seattle via barge was included.*

Cumulative emissions for the project are equivalent to 1,987,121,582 gallons of gasoline consumed, or the fuel required to power 3,390,819 gasoline-powered passenger vehicles for a year.

3.2 Climate Goals and Initiatives

FAA Order 1050.1F Interim Guidance encourages further contextualizing of project impacts through disclosing climate goals and initiatives from entities at different scales and how the impacts of the project support, deter, or have a negligible contribution to the published climate goals. Relevant examples of climate action plans are described below.

- The CBS initiated a Climate Action plan in 2007 by endorsing the U.S. Mayor's Climate Protection Agreement11. In 2009 CBS generated a greenhouse gas emissions report with the intent of quantifying the city's past and current annual emissions and set the goal of reducing "the City's emissions by 934 tons[eCO_2] per year by 2020". CBS transitioned to a permanent Sustainability Commission which continued to quantify emissions. The sustainability commission listed air travel to be included in the CBS GHG emissions data source in the 2024-2025 work plan (CBS 2024).

The SPB refurbishments and improvements will allow for sustained reliance on aviation transportation, a high CO_2 emitting sector. But coupling the scope of the proposed project with the needs of the community of Sitka and commitment to prioritize climate initiatives, and efforts by the aviation industry to improve on climate practices places less weight on the potential environmental impacts from the project emissions.

4.0 CONSIDERING THE EFFECTS OF CLIMATE ON A PROPOSED ACTION

4.1 Physical Effects of Climate

The environmental setting of a proposed project should be described as a basis for comparing the current and future state of a Proposed Action's setting. The effects of climate should be considered and incorporated into determining how the project might be affected by the projected impacts of climate over the course of the project's foreseeable design life. Identifying the physical effects of climate is accomplished by identifying climate factors that have potential to put the Proposed Action at risk and evaluating the Proposed Action's design resiliency.

4.2 Resilience and Adaptation

Once the factors of climate have been identified for a locale, a Proposed Action's resiliency can be measured against discrete parameters such as sea level rise, increased temperature, drought. The physical effects of climate should be evaluated against the project setting to understand vulnerable aspects of the proposed infrastructure and features.

4.2.1 Resiliency Analysis Methods

Applicable climate factors were identified through a review of the Federal Emergency Management Agency (FEMA) national risk assessment for the Sitka City and Borough (FEMA n.d.), common climate influences for coastal communities, scientific research, and consulting hazards identified by the CBS in their Multi-Hazard Mitigation Plan and climate threats discussed in their 2010 CBS Climate Action Plan.

Climate and environmental risks are only anticipated to increase through feedback processes from this century and into the next. The Intergovernmental Panel on Climate Change (IPCC) gives projections of climate impacts to the year 2100 allowing for a resiliency analysis for the Proposed Action's design life. Specific data for climate trends discussed are informed by a spectrum of data including global climate model (GCM), regional and local scientific research, and historical data records.

Resiliency and mitigation analyses were completed by professional licensed engineers through evaluation of design plans and anticipated climate factors that could pose hazardous to the proposed infrastructure.

4.2.2 Sea Level (altered water level)

In Southeast Alaska, like other heavily glaciated areas, effects on sea level can be dominated by isostatic rebound or post-glacial rebound causing net decreases or no net change in relative sea level[12], as has been observed in the Sitka area. The heaviest glaciated areas, Glacier Bay and Yakutat Ice Field, are the epicenters for isostatic rebound and studies support that the rate of land uplift diminishes with distance from these points.

Sitka is on a 2 millimeters per year (mm/year) or 0.8 inches per year (in/year) uplift contour interval (Motyka, et al. 2007). Sea level trends are measured *in situ* with tidal gauges in Sitka and indicate the relative sea level is currently decreasing at a trending rate of -0.1 in/year +/- 0.001 in/year, or -0.8 feet per century (ft/century) from 1919 to 2022 (National Oceanic and Atmospheric Administration [NOAA] 2024).

Accordingly, it can be assumed that isostatic rebound is currently outpacing sea level rise. Forecasting for the next 50 years; however, shows sea level rise outpacing isostatic rebound in the project area under GCM projections, which accounts for thermal expansion based off climate trends. United States Army Corps of Engineers' (USACE) Sea Level Analysis Tool (SLAT) models projections and includes three scenarios: low, medium, and high, see Graphic 1 (USACE 2022). Low projections align with current trends measured with tidal gauges and do not include climate projections, while intermediate and high projections incorporate the most recent IPCC reports that have informed GCM. In Sitka, sea level is projected to change between -.59 (low) and 2.28 (high) feet from 2024 to 2080.

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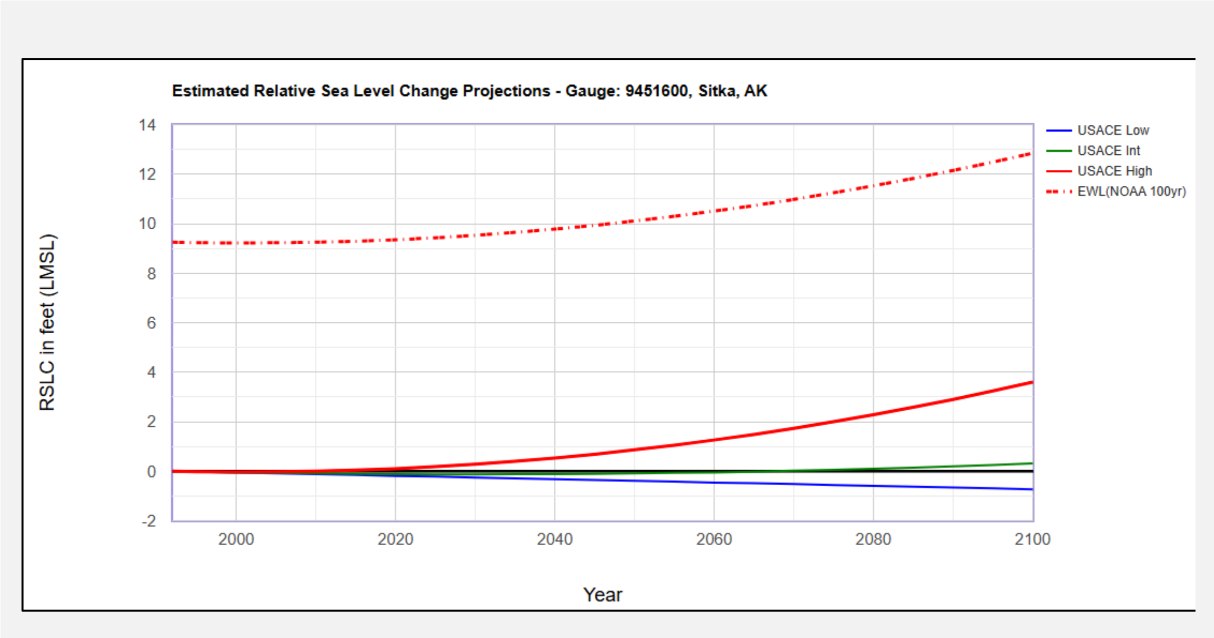
[12] Relative sea level refers to how the height of the ocean rises or falls relative to the land at a particular location.



Graphic 1: Estimated Relative Sea Level Change Projection (USACE 2022)

4.2.2.1 Resiliency and Mitigation

An increased high tidewater elevation could affect SPB structures, such as:

- Lateral wave forces may be applied at a higher elevation to the float restraint structure which could increase the overturning forces on the restraint structure; infrastructure may not be designed to withstand increased lateral wave forces.
- Decreased vertical clearance between the cap beams at the top of the float restraint structure and the float deck and steel gangway deck.
- Gangways may strike the float deck if the slope angle between them decreases.
- Sediment transport processes may increase rates of aggradation in the basin under the SPB float.

Aggradation of sediment around marine structures is common and may require periodic dredging of the basin to prevent the float from grounding at low tide. This will require mudline measurements during the life of the SPB float to ensure that excavation or dredging projects are programmed prior to sediment buildup becoming a risk to the float.

4.2.3 Water Quality

Water quality is a measure of the physical, chemical, and biological characteristics of water that affect its suitability for different uses. Water quality can be influenced by natural factors, such as weather, geology, and biology, as well as human activities, such as agriculture, urbanization, and recreation. Water temperature is commonly measured and compared by sea surface temperature (SST) is rising on average with Sitka seeing a 2.7° F change between 1982 and

2024 (ACCAP 2024). The complex mechanism which progressively decreases marine pH and carbonate ion concentration, driven by anthropogenic CO_2 uptake. This mechanism of change has already reduced the global surface ocean pH by about 0.1 units making the ocean 30 percent more acidic than in pre-industrial times. The average pH of the ocean is now approximately 8.1 and is projected to reach 7.93 by 210 (NOAA 2020). Carbonate ions in seawater partially neutralize this reaction and slow the decline in pH. However, this buffering mechanism makes it more difficult for organisms like mollusks and corals to create and maintain their hard shells and skeletons.

Salmonid species thrive in a cold highly oxygenated environment, when water temperatures reach levels beyond 64°F and oxygen levels drop, metabolism is disrupted, and fish become more susceptible to disease and toxins (ECYWA 2000). Coupled with ocean acidification which has tangible consequence in affecting the food chain for salmon and other marine species. The altered water quality has implications for the Sitka economy by way of impacting the fish industries that rely on a healthy marine ecosystem. “Sitka has the 6th largest port by value of seafood harvest in the United States, known for halibut, salmon, and sablefish” (Tolkova and Chamberlain 2024).

4.2.3.1 Resiliency and Mitigation

These water quality conditions could cause substantial changes in corrosion products and rates while chemically attacking the steel components in the SPB facility. To improve resiliency, the steel components should be hot-dipped galvanized and provided with welded anodes on each of the steel piles to provide adequate passive cathodic protection. Hot-dip galvanizing provides approximately 10 to 15 years of protection for the steel, and the additional cathodic protection system can greatly increase the protection for the steel. The cathodic protection anodes are self-sacrificing and will require periodic measurements and eventual replacement to provide effective protection during the structure’s design life.

4.2.4 Severe Weather Events

Mixed Precipitation and Snow Loading

Conditions – Rain-on-snow, freezing rain, ice storms, and other mixed precipitation events are anticipated to increase as the climate warms and seasonal temperature variability fluctuates between freezing and non-freezing temperatures. Each of these possess their own increased risk from higher snow loads on the floating structures, building degradation, and public hazard. FEMA estimates a measurable annual economic loss resulting from both winter weather and ice storms.

Resiliency and Mitigation – The American Society of Civil Engineers (ASCE) publication, “Minimum Design Loads for Buildings and Other Structures,” recommends designing the float for a ground snow load of 30 pounds per square foot (PSF) for a 50-year storm event. The proposed float has a pedestrian live-load design of 50 PSF which exceeds the probable snow load and will provide sufficient live load capacity to clear snow from the float after a large snowfall event.

4.2.5 Climate Factors not Requiring Resiliency Analysis

4.2.5.1 Tsunamis

Tsunamis are listed in the FEMA risk analysis as having the greatest threat for the community followed by earthquakes – with an estimated combined annual loss of approximately one million. The risk level can be attributed Sitka's direct position on the Gulf of Alaska while "facing the Fairweather-Queen Charlotte transform fault system, the most active part of the Pacific-North America plate boundary in Southeast Alaska." (Tolkova and Chamberlain 2024). The estimated loss is from the likelihood of death, complete shutdown of facilities and severe property damage if a catastrophic tsunami even were to occur (CBS 2010). Earthquakes are generally an unpredictable hazard that is not proven to be an increasing threat being exacerbated by climate. Landslides are another predictor of a tsunami and would a pose minimal risk to Sitka. Historical data indicates Sitka is statistically at a minimal risk for a tsunami event that would cause damage with only one recorded incident with the loss of one dock.

4.2.5.2 Landslides

Landslides are a type of natural hazard that can occur when soil, rock, or debris move rapidly down a slope and can be caused by factors such as heavy rainfall, snowmelt, earthquakes, and volcanic eruptions. Landslides can occur along the Blue Lake Road, Green Lake Road, and power line corridor. Landslides have occurred in the past destroying a remote section of the powerline (CBS 2010). These historical events prove landslides are not a large threats to the community or proposed facilities.

4.2.5.3 Avalanches

Avalanches are created when snowpack is triggered to slide – this process requires sufficient snow loading, a weak layer, and a slope angle greater than 25 degrees (º) to facilitate a slide. The mountains surrounding Sitka to the east have potential to produce avalanches. The community are not positioned in potential avalanche terrain and additionally, FEMA determines avalanches are not applicable for the census area.

4.2.5.4 Wildfires

Wildfires can be enabled by warmer temperatures and decrease in precipitation which generates wildfire fuel, like dry grasses, shrubs, trees. An example of this process is warming temperatures allowing invasive species or disease, like a sawfly's habitat expansion seen during the 2019 drought, to migrate further north and cause ecosystem destruction through forest degradation (Huntington 2023). Wildfires are increasingly becoming a hazard under climate and a potential risk for Sitka. In consideration of the project's land clearing requirements for upland parking facilities there is increased risk through land-use change(paving) which increase surface albedo and alter hydrology and element exposure causing vegetation to dry out acting as fire fuel. Although there is increased risk, the small footprint (1.8 acres) for upland paving and setting on Japonski island wildfires are not a major factor for infrastructure resiliency.

4.3 Resiliency Summary

Climate and subsequent resiliency and mitigation analysis was completed with the best available scientific and engineering resources. Climate factors were held in greater consideration when publications and research were more current and readily available, indicating increased focus by experts on those factors. Given the complexity of climate research and modeling, and the multitude of feedback systems at play, it is difficult to fully discern how the process will continue to manifest under additional stress.

Incorporating resiliency into infrastructure design is a proactive measure to mitigate for projected impacts of climate. If design specifications incorporate measures such as those described above (Section 4.2.2 through Section 4.2.4), the infrastructure will likely be resilient to projected climate factors for the design life of the project.

5.0 CONCLUSION

The FAA Order 1050.1F guidance outlines methods for quantifying, disclosing, and contextualizing climate impacts, while addressing the potential for exacerbated climate effects of (and on) a proposed federal action. A successful analysis should fully contextualize the project within the setting of climate. The guidance has created a more transparent process for stakeholders, the public, and decision makers to fully consider the impacts of the Proposed Action and place that project into the context of climate. A successful analysis should facilitate better decision making through weighing of alternatives, needed mitigation, and a cost-benefit analysis to the scope of the project.

Through the climate analysis of the Proposed Action, a disclosure of GHG emissions estimated to be produced by the project were placed into the greater context of economic impact and applicable policy. As well as a thorough assessment of climate factors and vulnerabilities, which was used to inform a technical resiliency analysis of the proposed infrastructure.

The Proposed Action would cause a measurable net-increase in GHG emissions for the 2025 construction year due to steel production, transport, and operation of heavy machinery during construction, and the potential for increased seaplane LTOs and ground vehicle trips.

Climate factors such as sea level change, water quality, and severe weather events are an increasing hazard for the SPB infrastructure. The resiliency analysis and proposed design considerations can mitigate the risks associated with climate impacts to a project.

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