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Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook

Version 2 - November 2022

Revision History

Version	Date	Author	Description of Changes
External	29 Jun 23	AF/A4CP	Version approved for public distribution

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Introduction

IN.1 Purpose and Policy

Guidance from the Unified Facilities Criteria (UFC) 2-100-01, *Installation Master Planning*, and other Department of Defense (DoD) and Department of Air Force (DAF) documents mandate DAF installation professionals include **severe weather** and **climate** risk in Installation Development Plans (IDPs) and facility projects. Congress also continues to focus on this topic with language in the National Defense Authorization Act (NDAA) directing DoD to identify installations at risk and improve planning for **resilience**. **Appendix A** contains relevant definitions and a list of law and policies that require consideration of severe weather or climate risk and serve as drivers for screening and risk assessment processes.

The DAF Climate Action Plan, released 5 Oct 2022, requires full implementation of this Playbook for installations requiring an IDP, in accordance with Air Force Instruction (AFI) 32-1015, by the end of FY26 (key result 1.3). Future guidance will clarify how an installation can measure successful implementation.

The Severe Weather/Climate Hazard Screening and Risk Assessment Playbook (referred to here as SWCH Playbook) and accompanying **Screening Worksheet** in **Appendix B** provides a consistent and systematic framework to screen and assess severe weather and climate **hazards** and address their associated current/future risks at DAF installations. Updates to the SWCH playbook will occur as necessary to reflect any new or modified guidance.

The playbook establishes a minimum list of severe weather and climate phenomenon to be screened. It provides methods to determine whether an installation is exposed - or susceptible to - these severe weather and climate hazards and to assess their impact and relative risk. The last chapter provides ways to address risk, including integrating the screening and risk assessment outputs into existing planning and implementation plans, requirements development, design and construction projects, emergency management plans, mission sustainment risk reports (MSRRs), and other similar processes.

DEFINITIONS

Severe weather *- any weather condition that poses a hazard to property or life (Air Force Manual (AFMAN) 15-129, Air and Space Weather Operations)*

Climate change *- variations in average weather conditions that persist over multiple decades or longer that encompass increases and decreases in temperature, shifts in precipitation, and changing risk of certain types of severe weather events (Department of Defense Directive (DoDD) 4715.21, Climate Change Adaptation and Resilience)*

Hazard *- any real or potential condition that can cause mission degradation, injury, illness, death to personnel or damage to or loss of equipment or property. (Air Force Instruction (AFI) 90-2001, Mission Sustainment)*

The effects of climate change represent one of many potential hazards that an installation must address and manage. There may be circumstances where other hazards, such as access to airspace, water, spectrum, or energy, represent a more significant risk to the installation's mission. Therefore, it is critical to thoughtfully complete SWCH Playbook Phases 1 and 2 and address the risk(s) within Phase 3, including incorporating the findings and risk ratings into other plans and processes, as appropriate. For example, the MSRR, which includes climate/weather as one of seven hazard categories, should provide an overall risk assessment for the installation, placing climate/weather risks in context with the other potential hazards.

Individual planners, weather flight personnel, and cross-functional teams, such as the Installation Emergency Management Working Group (IEMWG) or Installation Mission Sustainment Team (IMST), should use this playbook to screen and assess severe weather and climate hazards, and address the risk(s).

IN.2 Severe Weather/Climate Hazard Screening and Risk Assessment Process

Figure 1 represents the three phases in the SWCH Playbook process. Each phase explains how to complete the **Screening Worksheet** in **Appendix B**. Any reference to the "Screening Worksheet" in this playbook is a reference to **Appendix B**.

Figure 1. Severe Weather/Climate Hazard Screening and Risk Assessment Process

Chapter 1 – Phase 1: Screen Hazards

The first phase in this screening process is to identify which severe weather and climate hazards apply to the location, describe each hazard and its impacts to the location, and determine the location's exposure to those hazards. Installation staff will document this information on the **Screening Worksheet**. This information will be useful for Installation Climate Resilience Plan (ICRP) completion, discussed in Section 3.1.1.

1.1 Hazard Information Resources to Identify Applicable Hazards

Installation staff should determine, at minimum, which typical hazards are relevant to the installation and identify other related hazards appropriate to the installation's location. An installation can choose to include geologic hazards as well.

Typical Hazards: storm surge flooding, non-storm surge events such as coastal and riverine flooding, hurricanes/typhoons, sea level change, high winds, tornadoes, extreme cold, extreme heat, drought, wildland fires, permafrost changes, desertification

Other Hazards: disease vectors, ecosystem shifts, mudslides, avalanches, fissures, subsidence/sinkholes, salt-water intrusion

Geologic hazards: volcanoes, earthquakes, and tsunamis

Appendix C lists these hazards and contains definitions and hazard and impact examples (**Figure 2**). Resources for current hazards are listed in Section 1.1.1, future hazards are listed in Section 1.1.2.

Figure 2. Excerpt: Appendix C - Severe Weather and Climate Phenomena: Definition and Examples

Severe Weather / Climate Phenomenon	Definition	Hazard Examples	Impact Examples
Storm surge flooding	Flooding caused by submersion of normally dry land due to an unusual increase in water level due to a storm, over and above the predicted astronomical tides (ocean or tidally influenced body of water) (DoD Screening Level Vulnerability Assessment Survey)	Flooding, wave damage	Undercutting, erosion or failure of facility or road foundation; temporary or permanent loss of access to structures or roads; loss of lower floor contents; damaged utilities; limited access to base, roads, runway, resources

→ Review **Appendices A** through **C** and be prepared to complete the **Screening Worksheet** (**Appendix B**). Appendices B and C are located within the Playbook spreadsheet in the Climate Planning Toolbox under the Playbook References folder.

Several existing information gathering efforts and installation plans are available to complete the Phase 1 and 2 portions of the SWCH Playbook. List all resources used to gather data/information in the *Source* columns on the **Phase I Screen Hazards** section of the **Screening Worksheet**.

Use the definitions and timeframes in the text box on page 4 to distinguish between 'current' and 'future' hazards.

TIP
One way to get started is to meet with your location's emergency management and local weather flight staff. These offices may already have significant information to feed into this process.

1.1.1 Current Hazard Information

DEFINITIONS

Current Hazard *– a hazard that has occurred at the base in the past or has the possibility of occurring based upon available data, studies, maps and/or historical events. E.g., the base has not experienced an earthquake, but is in a seismic zone. Timeframe: 0-25 years.*

Future Hazard *– a hazard that represents long-term changes to weather patterns, temperature, precipitation, hydrology, or sea level that creates a possibility of occurring at the base. Informed by data, studies and/or maps of the base. E.g., future sea level rise scenarios indicate that some areas may shift to wetlands; future temperature scenarios indicate possibility of increased number of black flag days. Timeframe: >25 years.*

The resources below can be used to document the hazard and impact descriptions in the **Screening Worksheet** and to determine 'current' exposure. 'Current' exposure includes historical events. Additional resources may be added during iterative updates to the Playbook.

a. **Installation Emergency Management Plan (IEMP).** Many installations have already assessed and included the risks associated with severe weather events / natural disasters in the base's IEMP, which is available from the Civil Engineer Squadron's (CES) Installation Office of Emergency Management. The installation's Office of Emergency Management can also provide local contacts to obtain local county/city hazard mitigation and action plans from local Emergency Management offices, which may contain relevant, already federally adopted data.

b. **Installation Energy Plan (IEP).** The base's IEP includes an initial assessment of the probability and severity of existing hazards, such as wildfire, flooding, earthquakes, winds, lightning, tsunamis, volcanic eruptions, winter storms, sinkholes, dam/levee failure, and any other impacts on critical energy and water infrastructure to the base. The IEP may also include recommended projects to mitigate the effects of severe weather/climate on infrastructure; these projects could inform Phase 3 this playbook process. The IEPs are located under the resources tab at the CE Dash.

c. **FY18 National Defense Authorization Act (NDAA) Sec 335 Report Data.** Located in the Air Force Engineer Center Climate Planning Toolbox, the "FY18 NDAA Sec 335 Primary…." spreadsheet contains the results of data collected during 2018-2019 in response to FY18 NDAA, Section 335 language, which required the Secretary of Defense to provide a report to Congress on the climate-related vulnerabilities of military installations and combatant commander requirements. While the Office of the Undersecretary of Defense for Acquisition and Sustainment (OUSD (A&S)) led this effort, Congressional queries resulted in each Service generating a list of the top ten most susceptible sites over the next 20 years. For the DAF, the spreadsheet identifies current and potential vulnerabilities to primary Air Force Base (AFB) and Space Force Base (SFB) sites to six climate-related events: coastal flooding, inland flooding, drought, desertification, wildfires, and thawing permafrost. For some installations, volcanic and seismic exposure data are also included, as those data elements were initially an OUSD(A&S) requirement.

d. **Screening Level Vulnerability Assessment Survey (SLVAS).** A web-based screening level survey was conducted across the DoD in 2014-2015 to collect information regarding observed effects from past severe weather events, such as flooding due to storm surge, flooding due to non-storm surge events, extreme hot and cold temperatures, wind, drought, and wildfire. The FY18 NDAA Sec 335 data referenced above incorporates this information. Surveys were completed for 1316 active DAF sites, 207 Guard sites, and 20 Reserve sites. Several spreadsheets can provide a good starting point regarding the effects of past extreme weather events (Climate Planning Toolbox).

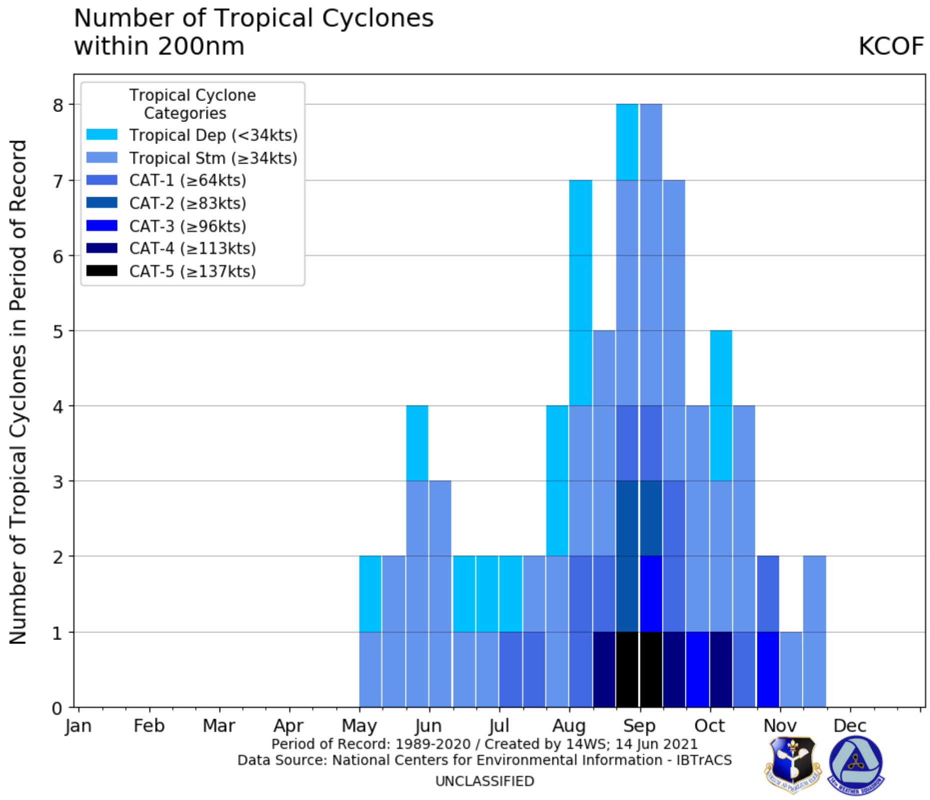
e. **Installation Weather Flight**: AF Weather (A3W) is the authoritative data provider for climate/weather information in support of all elements of the DoD (Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3810.01). Within the Operations Support Squadron (described in (f) below), there is a weather unit consisting of weather officers and enlisted forecasters/weather operations integrators of authoritative climate/severe weather information. The unit has many capabilities and can assess weather hazards by using field sensors at the installation. The local weather flight provides installation resource protection by issuing watches, warnings, and advisories for severe weather, in coordination with other parent/host and tenant organizations such as CES and Emergency Management (EM) (15-Series AFIs; **Appendix A**).

The local weather flight works closely with the 14th WS to provide weather information to support the mission and the Wing. What might be of particular interest is the installation datasheet page. The installation data page is hosted by an Operational Weather Squadron (OWS) (see paragraph g. below). The installation date page lists specific watches, warnings and advisories issued by the weather flight and other agreed upon weather support information. An example of an installation data page is on the 15th Operational Weather Squadron website. Installation planners, emergency managers, and installation mission sustainment teams should locate or request a current link from their local weather flight and coordinate changes that may be necessary. Note: Some installations may have a weather support plan in lieu of or in addition to the installation data page. The installation's weather flight leadership can provide the guiding documents for its specific installation.

f. Additional AF Weather Capabilities

14th Weather Squadron (WS) (Climate Services). The 14th WS, located in Asheville, NC, is the DoD's climate services unit that collects, protects, and distributes authoritative climate data to optimize military and intelligence operations and planning to maximize the combat effectiveness of DoD personnel and weapons systems. The 14th WS falls under the 557th Weather Wing (557 WW). The 557 WW, located at Offutt AFB, Nebraska, is the DoD's only special mission weather wing and provides an array of timely, accurate, relevant, consistent, and authorized terrestrial and space-environmental data, as well as analyses, threat-warning, mitigation products, and models. This information supports climate/weather operations integration at the installation level. The 14th WS's Climate Portal includes information on tropical cyclones and severe weather (see example in **Figure 3**), and temperature trends. The 14th WS Product Catalog provides background information for planners working with their local weather flight. Additional details about the AF Weather Force Structure can be found in AFI 15-128, *Weather Force Structure*.

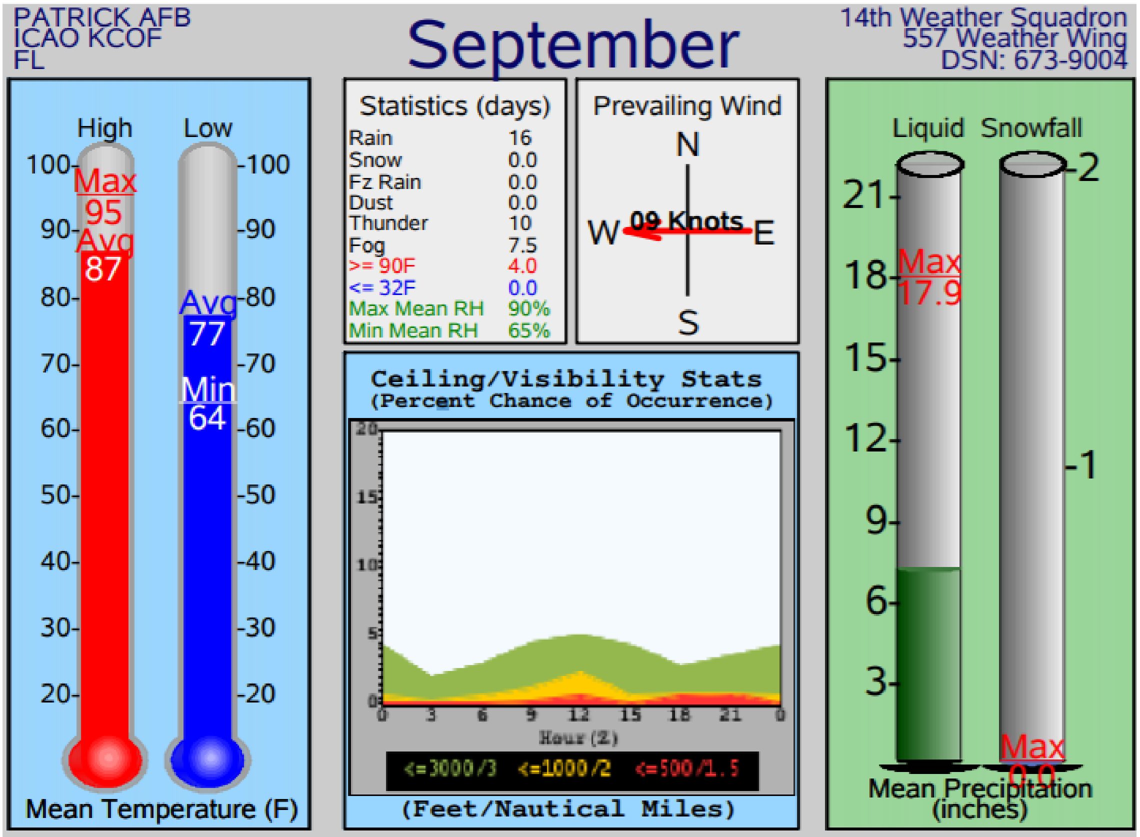
Figure 3. Example Tropical Cyclone Data for Patrick SFB



MAJCOM Weather Assessments: The 14th WS completed an initial assessment of current weather threats at all commands. The reports are available here. Installations can discuss this assessment with their local weather flight and potentially utilize data to help determine the frequency of an event. These assessments can be used as a collaboration tool between cross-functional teams, such as the IMST and IEMWG.

Operational Climatic Data Summary (OCDS/Climogram): The 14th WS maintains a web application that provides core climatology characterization of mean and extreme monthly and annual conditions at an installation. Data are available in HTML, XLS, XML, or plain text; a graphical product is also available (example Climogram shown in **Figure 4**). This data can be accessed by selecting a location, generating a default report, and selecting "Get climogram".

Figure 4. Example Monthly Climogram



<u>**Engineering Weather Data (EWD).**</u> Directed by UFC 3-400-02, *Design: Engineering Weather Data*, building designers/engineers, are required to use engineering weather data. The 14th WS produces site-specific climatology converted to values useful to the engineering community for designing or maintaining new/existing buildings and base infrastructure. This climatology data includes dry bulb temp, wet bulb temp, humidity ratio at specific percentile frequencies of occurrence; Ventilation Cooling Load Index (VCLI); average annual freeze-thaw cycles; average annual climate; annual temperature summary; annual humidity summary; cooling degree-days; heating degree-days; solar radiation data; and wind summary. (*Data Sources:* The Engineering Weather Data Handbook and Engineering Weather Data)

g. **Operational Weather Squadrons (OWS):** Operational Weather Squadrons (OWS) are assigned primary areas of interest aligned with geographic and functional combatant commands. When no Installation Weather Flight/Detachment is assigned or designated to provide services, and where no other authorities can provide a qualified forecast, OWSs will issue and/or amend weather Watches, Warnings, and Advisories (WWAs), for locations that require them. These OWSs are regional centers of expertise providing theater support, aviation services, and over-watch functions supporting the Installation Weather Flight/Detachment in the primary area of interest. In addition, OWSs issue Special Weather Statements (SWS). OWSs communicate the potential of severe weather events and provide threat assessments via SWSs. Installation Weather Flights/Detachments use this information to inform or alert emergency managers, civil engineers, and other installation management representatives. AF Visual Aid (AFVA) 15-137, Operational Weather Squadron Areas of Responsibility, provides a visual depiction of the areas of responsibility for OWSs.

h. **Geospatial Data**:

- DAF GEOBASE AFGIMS Analyze available Geographic Information Systems (GIS) data to determine if a hazard is relevant to your base (for example, flood plains or coastal zone management area data could indicate risk from storm surge).
- Defense Installations Spatial Data Infrastructure (DISDI) Portal and the DISDI Atlas Pro (Map Viewer) was used for the previously discussed FY18 NDAA Sec 335 report. DISDI contains information provided by the DAF plus other layers, some of which are dynamically updated.

i. Comprehensive Planning Platform (CPP): Select the installation, navigate to Installation Development, and then Constraint Considerations. The CPP constraints may identify wetlands and floodplains as a hazard.

j. **Legacy Installation Development Plan (IDP) Sustainability Development Indicators (SDI)**: Obtain legacy IDPs on the AFCEC Portal Installation Resources (search by MAJCOM then by base). Review the SDI chapter for insight on whether hazards are relevant.

k. **Legacy Installation Complex Encroachment Management Action Plan (ICEMAP)**: available on the AFCEC Portal Installation Resources. Search by MAJCOM, then by base to find your Legacy ICEMAP. This legacy document lists relevant natural factors/climate effects that impact the base, such as flooding, coastal erosion, wildfire, etc. ***Note: ICEMAPs are no longer being produced for installations and have been replaced by the Mission Sustainment Risk Report*.**

l. **Integrated Natural Resources Management Plan (INRMP)**: available on AFCEC Mapping Climate Change. The INRMPs are located at the bottom of the page under Climate Adaptation Content. INRMPs could mention a weather/climate related hazard as a concern.

m. **Sea Level Tracker:** The US Army Corps of Engineers developed a tool that allows a user to chart actual sea level changes versus three projected sea level change curves and answer the question, "What rate of sea level change is currently being observed at a selected tide gauge?" This source could validate installation observations of increased instances of high tides inundating parts of the base and be captured under the sea level change category.

1.1.2 Future Hazard Information

The resources listed below are for future climate projections, typically for conditions 20+ years in the future. They will be used primarily to inform responses in Section 1.2 – determining future hazard exposure, and Phase 2 – Assess Risk. Future changes in sea levels and precipitation and temperature patterns could result in a location being more or less exposed in the future or having a higher or lower risk rating. A future hazard is – *"a hazard that represents long-term changes to weather patterns, temperature, precipitation, hydrology, or sea level that creates a possibility of occurring at the base. Informed by data, studies and/or maps of the base. E.g., future sea level rise scenarios indicate that some areas may shift to wetlands; future temperature scenarios indicate possibility of increased number of black flag days. The timeframe is greater than 25 years."* (Definition from page 2.)

a. ***Sea Level Change*. DoD Regional Sea Level (DRSL) Database**: public URL here. Developed by an OSD-led inter-agency working group, the DRSL database provides site-specific adjustments for projected future global sea level change (SLC) and statistically aggregated historical data for four annual chance events (e.g., 100-yr, 20-yr, 10-yr, and 5-yr return interval storms). The database provides data for about 1,800 military sites worldwide with sea level change projections over three future timeframes—2035, 2065, and 2100—relevant to management and planning horizons. The projections are based on five global scenarios for sea level rise by 2100: 0.2, 0.5, 1.0, 1.5, and 2.0 meter rise.

It is important to note that uncertainties are inherent in projecting future climate. Scenarios are, therefore, non-probabilistic but plausible depictions of future conditions that enable decision-makers to constrain their risk based on the best available science. A peer-reviewed report accompanies the database. **Appendix D** of this Playbook describes how to use the data from this database.

Refer to section 1.1.1.m for information on the US Army Corps of Engineers' Sea Level Tracker to chart historical sea level change.

b. ***Temperature / Precipitation Projections***. The Climate Explorer, within the U.S. Climate Resilience Toolkit, provides graphs and maps of historical and projected climate variables (from current day until 2100, under lower and higher emission scenarios) for any county in the contiguous United States. **Figure 5** presents the included variables.

Figure 5. Climate Explorer Variables

Temperature		Precipitation	Other
Avg Daily Max Temp (°F)	Days w/ max > 105°F	Total Precipitation	Heating Degree Days
Avg Daily Min Temp (°F)	Days w/ max < 32°F	Days w/ > 1 in	Cooling Degree Days
Days w/ max > 90°F	Days w/ min < 32°F	Days w/ > 2 in	Growing Degree Days
Days w/ max > 95°F	Days w/ min > 80°F	Days w/ > 3 in	Mod. Growing Degree Days
Days w/ max > 100°F	Days w/ min > 90°F	Dry Days	

c. ***Future Climate Projections generated to help meet DoD requirements for inclusion of climate change effects in INRMPs***. Climate projections generated for 60+ DAF sites under a project funded by Air Force Civil Engineering Command (AFCEC) are available. These reports include summaries of climate projections over two timeframes – 2030 and 2050 – and two future emission scenarios – moderate and high. The report also includes the potential climate effects on natural resources, ecosystems, and biodiversity. Colorado State University (CSU), Center for Environmental Management of Military Lands (CEMML) also developed maps depicting the various future flooding scenarios, updated floodplain maps, and GIS storyboards.

d. ***DoD Climate Assessment Tool (DCAT).*** (The DCAT is available for CONUS, Alaska, and Hawaii locations and a separate version for Rest of the World locations. User guides are located within each site.) The Office of the Deputy Assistant Secretary of Defense (DASD), Environment and Energy Resilience (E&ER), extended its climate exposure assessment screening tool to include tabs for Army, Navy, and Air Force use to increase understanding of the exposure of DoD installations to climate impacts. It contains exposure analysis for two climate epochs (a 30-year average centered on 2050 (2035-2064) and another centered on 2085 (2070-2099), with lower (assumes more aggressive greenhouse gas mitigation and, therefore, lower rates of warming) and higher emission (assumes minimal greenhouse gas mitigation and therefore higher rates of warming) scenarios. The tool contains regional summary information from the National Climate Assessment, 'scores' for eight hazard categories, maps, and a link to shape files depicting a 1% annual exceedance probability (AEP) event (also known as the 100-year storm), 1% AEP + 2 or 3 feet of freeboard, and sea level rise (SLR) + surge. The tool does not currently depict SLR scenarios by themselves, which could portray potential new mean higher high-water levels or shoreline changes.

An installation extreme weather and climate change hazard report is also available. This report identifies a location's exposure to historical extreme weather events and provides data from the NOAA Storm Events Database and dominant future climate hazards. The dominant climate hazards information compares future hazard exposure to the location's exposure based on the modeled historical baseline (1950-2005) data.

→ Information compiled thus far should be inserted into the **Screening Worksheet**. See **Figure 6** for an example.

Figure 6. Screening Worksheet: Phase 1 - Example #1

			Base Exposure				
	Hazard Description	Impact Description	Current (Y/N/NATD)	Source	Future (Y/N)	Source	Hazard (Y/N/NATD)
Weather / Climate Phenomenon	Phase 1 - SCREEN HAZARDS						
Storm surge flooding	Flooding, wave damage	Limited access to base; erosion of road foundation					
Wildfire	Fire, smoke damage	Delayed training activities, damaged historic resources					

1.2 How to Determine Whether a Base is Exposed to a Hazard

Installation staff should screen the list of hazards to determine whether the location is currently and/or in the future potentially exposed (or susceptible) to a hazard. **For purposes of this screening level process, use the following timeframes** (these align with timeframes relative to current and future risk in Section 2.2):

- **Current** – *use a combination of the short-term (0-7 years) and mid-term (8-25 years) time horizons described in AFI 32-1015, Integrated Installation Planning*
- **Future** – *use the long-term (>25 years) time horizon described in AFI 32-1015, Integrated Installation Planning*

You may have already entered "Y" or "N" in the "Current" or "Future" column of the **Screening Worksheet** while reviewing the information resources above based upon records of past events or maps showing the base in a seismic, floodplain, or flood hazard zone. This will be an opportunity to revisit those entries.

As described in Section 1.1, resources are available to assess a base's exposure to current or future hazards. Many IEMPs, local county/city Emergency Plans, Hazard Mitigation Plans, IEPs, or the 14th WS MAJCOM Weather Assessment reports already include an existing list of relevant natural disasters for the base, to include information about a particular past event and/or the historical frequency of natural disasters. In addition, 14th WS data is readily available regarding past temperature, precipitation trends, and severe weather events. The local weather flight is also on hand at many installations to interpret this data.

Use these and other references (**Appendix C**) to form an initial understanding of base exposure to each hazard for discussion with those helping you to determine exposure. For example, how often have hurricanes occurred at your base, and what hurricane category were they?

As a rule of thumb during this screening process:

- If the results of the data gathered conclude that the base is currently exposed to a hazard, assume it may also be exposed in the future. Enter "Y" and "Y" in each column with the source(s) of the information leading to that determination.
- If the results of the data gathered conclude that your installation is not currently exposed to a hazard, additional analysis may be required to determine future exposure.
    - Some hazards are more 'stable' than others and may not require additional analysis. For example, if the installation is not currently within an earthquake, volcano, desertification, or permafrost zone, it is not likely it will be in the future. Enter "N" and "N" in each column with the source(s) of the information leading to that determination.
    - Some hazards may increase or decrease in the future. For example, extremely hot temperatures are not currently a hazard but are projected to be for the future. Enter "N" and "Y" in each column with the source(s) of the information leading to that determination.
- If there is no data to support a determination of a "Yes" or "No" exposure to a hazard, place NATD (Not able to determine) in the appropriate column(s), indicating what source(s) were used, if appropriate.

EXAMPLE:

Figure 3 depicts the number and types of tropical cyclones that have come within 200 nautical miles of Patrick SFB between 1989 and 2020; this serves as a good starting point but does not confirm that the location was impacted by past events. A search through existing resource documents, such as the IEMP, Mission Sustainment Risk Reports (if previously completed), SLVAS data, etc., could provide historical information about past hurricanes impacting the installation.

For Patrick SFB, SLVAS data states that 2004 Hurricane Jeanne flooded recreational lodging facilities and a swimming pool and includes storm surge elevation data. The 14th WS's Climate Portal includes information on the number of tropical cyclones, by month, occurring at Patrick SFB between 1989 and 2021 with the hurricane category. **For both the "Current" and "Future" columns for "Flooding due to storm surge," a "Y" entry would be appropriate based on the documented information.**

At Beale AFB, a review of its Installation Energy Plan identifies that major wildfire is a current risk. The wildfire risk has been assessed with a probability of frequent and a severity of catastrophic. A review of the SLVAS responses shows that the installation was negatively impacted by wildfire in 2001, 2004, 2009, and 2010, with impacts to training areas/ranges, environmental restoration sites, and historic/cultural resources. The NDAA Section 335 spreadsheet also indicates Beale has and/or could be exposed to wildfires. **For both the "Current" and "Future" columns for "Wildfires," a "Y" entry is appropriate based on the documented information.**

→ Complete Phase 1 of the Screening Worksheet, including documenting the source for each hazard; see **Figure 7** for an example. During Phase 2, only those hazards labeled as "Y" will be assessed; assessing hazards labeled "N" or "NATD" is not necessary.

Figure 7. Screening Worksheet: Phase 1 - Example #2

			Base Exposure				
	Hazard Description	Impact Description	Current (Y/N)	Source	Future (Y/N)	Source	Hazard (Y/N)
Weather / Climate Phenomenon	**Phase 1 - SCREEN HAZARDS**						
Flooding due to Storm Surge	Flooding, wave damage	Limited access to base; erosion of road foundation	Y	IEMP, SLVAS, 14th WS	Y	IEMP, SLVAS, 14th WS	Y
Wildfire	Fire, smoke damage	Delayed training activities, damaged historic resources	Y	IEP, SLVAS	Y	IEP, SLVAS	Y
Desertification	Land degradation in drylands	NA	N	Not in a desertification area per DISDI ecoregion map	N	Not in a desertification area per DISDI ecoregion map	N

Chapter 2 – Phase 2: Assess Risk

2.1 Why Assess Risk?

The installation team will assess the current and future **risk** for each hazard identified as a "Yes" during Phase 1 and document the risk ratings on the **Screening Worksheet** (**Figure 8**). This effort provides an initial assessment of overall hazard risk to the installation complex for consideration in larger installation planning efforts described in **Chapter 3**, rather than a narrower assessment of risk to particular facilities or resources from each hazard. This information will be useful for ICRP completion, discussed in Section 3.1.1.

Figure 8. Screening Worksheet: Phase 2 - Example #1

	Current Risk Rating				Future Risk Rating			
	Probability / Source	Severity / Source	Risk Rating	Rationale	Probability / Source	Severity / Source	Risk Rating	Rationale
Weather / Climate Phenomenon	Phase 2 - ASSESS RISK							
Flooding due to Storm Surge								
Wildfires								

The general process used to assess the risk of each severe weather/climate hazard follows the steps below, as outlined in AFI 90-802, Risk Management, and utilized in AFI 90-2001, Mission Sustainment. The steps may be familiar as they are similar to the process for assessing risk to a flying mission when developing a package for an airfield waiver.

A risk rating is derived by assigning a rating to the **probability** of the hazard occurring and the **severity** of the hazard's effect (see definitions below). The ratings can be based upon quantitative or qualitative data.

If able, draw upon existing risk assessments performed for the base's IEMP or IEP (or other resources listed in **Chapter 1**), which may include severe weather/climate hazards; these risk assessments should be evaluated first.

If no risk assessment of a particular hazard has occurred, the installation team should work together to provide their best assessment of current and future risks and rely on best available information. Document the source and rationale for probability and severity on the **Screening Worksheet**.

The installation weather flight can also serve as a key source of knowledge about an installation's vulnerabilities to different types of severe weather events. A representative from the weather flight will be on the installation mission

DEFINITIONS

Risk *– the probability and severity of loss or adverse impact from exposure to various hazards (AFI 90-802, Risk Management)*

Probability *– the likelihood that a hazard(s) will cause negative mission impacts and/or the frequency of occurrence over time. Probability can be determined through estimates or actual data (if available). The five ratings in the risk management model are unlikely, seldom, occasional, likely, and frequent (AFI 90-2001, Mission Sustainment)*

Severity *– the overall effect of a hazard(s) in terms of potential impact on personnel, equipment, mission, or activity. The severity ratings used for mission sustainment are in order of least to most severe: negligible, moderate, critical, and catastrophic (AFI 90-2001, Mission Sustainment)*

sustainment team, integrated with emergency management support, and is key to the process of identifying and assessing hazards.

2.2 Assess Hazard Probability

Figure 9 is a Risk Assessment Matrix as described in AFI 90-802. "Probability" is also labeled as "Frequency of Occurrence Over Time," and five different frequencies are available - "rarely" to "frequent." Unfortunately, there is no formal definition for "Over Time." **For purposes of this screening level process, use the following to represent time:**

- **Current Probability -** *use a combination of the short-term (0-7 years) and mid-term (8-25 years) time horizons described in AFI 32-1015, Integrated Installation Planning*
- **Future Probability –** *use the long-term (>25 years) time horizon described in AFI 32-1015, Integrated Installation Planning*

Although we define "Future Probability" as >25 years, keep in mind throughout the analysis that many planning decisions have a significantly longer lifespan than 25 years. For example, many facilities will be in place for 50-100 years or longer, which may be longer than the initial intended 'useful life.'

"Severity" in **Figure 9** is also characterized as "Effect of Hazard" and lists four different severity levels, from "negligible" to "catastrophic."

Figure 9. Risk Assessment Matrix (AFI 90-802 and AFI 90-2001)

RISK ASSESSMENT MATRIX	PROBABILITY FREQUENCY OF OCCURRENCE OVER TIME				
	FREQUENT Continuously experienced	LIKELY Will occur frequently	OCCASIONAL Will occur several times	SELDOM Unlikely; can be expected	RARELY Improbable, but possible
SEVERITY / EFFECT OF HAZARD: CATASTROPHIC Death, Loss of Asset, Mission Capability, or Unit Readiness	EH	EH	H	H	M
CRITICAL Severe Injury/Damage, Significantly Degraded Mission Capability or Unit Readiness	EH	H	H	M	L
MODERATE Minor Injury/Damage, Degraded Mission Capability or Unit Readiness	H	M	M	L	L
NEGLIGIBLE Minimal Injury/Damage, Little/No Impact to Mission Capability or Unit Readiness	M	L	L	L	L

Risk Assessment Levels: EH – Extremely High; H – High; M – Medium; L – Low

2.2.1 Assessment of Current Probability

During Phase 2, assess only the risk of those hazards labeled as "Y" or "Yes" during Phase 1; there is no need to assess the risk for hazards labeled as "N" or "No" or "NATD" or "Not able to determine".

Some IEPs and IEMPs already assess the current probability associated with some severe weather hazards using a risk framework. The 14th WS threat assessment reports may also contain information that can provide insight into the historic frequency of several severe weather events. If an existing document already includes a rating for a current hazard probability, the installation should document that existing rating, the source, and the rationale on the **Screening Worksheet**. It is possible that more than one document or process could assess a given hazard and document different probabilities. The installation should retain the higher of probability ratings and revisit the rating with the authors of conflicting reports, to adjust for consistency. If the installation has not completed an assessment of hazard probability, the installation team should utilize the **Figure 9** Risk Assessment Matrix descriptions along with available data to develop a current probability of risk.

> **WHAT IS A NAUTICAL MILE?**
> A nautical mile refers to the distance between any two locations and is measured by traveling from one point to the other in the air or over water.
> 1 mile = .86897624 nm

The installation team may also wish to consider the probability of different components of a hazard. For example, assess the flooding associated with a tropical depression or hurricane and separately assess the wind impacts. The installation can document these choices on the **Screening Worksheet** in the manner most beneficial to the installation.

In the hurricane example with Patrick SFB, one source of information is the IEMP, which contains a current probability of tidal surge rating of "likely" (**Figure 10**). The installation team could also visit the 14th WS Climate Portal to review information on the number of tropical cyclones, by month, which have occurred within 200 nautical miles of the installation between 1989 and 2021. **Figure 3** shows that 60+ tropical cyclones of all categories, tropical depression through category 5, have occurred within 200 nm of Patrick SFB in that 20-30 year period - more than one hurricane per year. The local team may conclude a probability of Seldom or Occasional could represent this frequency level. The local weather flight can also assist with a recommended probability.

In a Beale AFB example, SLVAS data lists four years when a wildfire impacted installation assets, and the Beale IEP discusses wildfire as a frequent occurrence. The mention of regular wildfires, including wildfires that have the potential to have catastrophic impacts on facilities, likely informed the IEP's assessment of current risk and will inform how the installation wishes to assess wildfire risk as part of this process.

→ Document the current probability rating and source(s) used for that determination for each hazard in the **Screening Worksheet**.

2.2.2 Assessment of Future Probability

The time horizon for future probability is the long-term (>25 years) time horizon described in AFI 32-1015, *Integrated Installation Planning.*

Future probability can be more challenging to estimate, but installation team members should make their best assessment of the event probability based on the current probability and available trend data and document the source to justify the risk ranking decision.

It is unlikely that existing installation documents such as the IEMP or IEP have assessed future probability based on the same time horizon noted above. Thus, the installation team should use the **Figure 9** Risk Assessment Matrix descriptions and refer to the climate projection resources in Section 1.1.2. For some hazard types, such as wind, science does not yet support providing future projections and scenarios to inform future probability. However, the installation could assume that future risk is not less probable than current risk and document that assessment on the **Screening Worksheet**.

Climate projections are based on the results and interpretations from modeling future climate scenarios. The resulting data, tools, and authoritative reports can be used to assess the probability of future hazards. Resources listed in Section 1.1.2 include data sources for coastal flooding, sea level change, extreme cold/heat, temperature projections, and precipitation projections. The DoD Regional Sea Level (DRSL) database should be used to provide a temporal perspective to the possibility of future permanent inundation, shoreline changes or exacerbated coastal flooding related to sea level change. **Appendix D** provides information on how to extract and use these and other useful data. The installation weather flight can assist planners with interpreting available data/products from the 14th WS to help determine whether the installation could be susceptible to extreme temperatures or increased precipitation in the future.

Figure 10. Example of Existing Probability Determination in IEMP

U.S. AIR FORCE

Headquarters 45th Space Wing (AFSPC)
Patrick AFB/Cape Canaveral AFS FL 32925
IEMP 10-2 5 March 2019

INSTALLATION HAZARD ASSESSMENT SUMMARY

A comprehensive hazard assessment has been conducted for PAFB and CCAFS. The hazard assessment was conducted by the All Hazards Response Planning Team and results have been briefed to the Emergency Management Working Group (EMWG). The hazard assessment has also been compared to historical data from the National Weather Service and the Brevard County Threat and Hazard Identification and Risk Assessment (THIRA) The following is a brief summary of the hazard assessment. Overall risk is determined as probability times severity. Only hazards that can affect PAFB or CCAFS are listed however many other hazards have been considered. The full hazard assessment is available from 45 CES/CEX.

Hazard	Impact	Probability 1 = Possible 6 - 40 % 2 = Likely 41- 80% 3 = Highly Likely > 81%
Natural Hazards Geological		
Tsunami	Coastal Structures and natural resources damaged or destroyed.	1
Subsidence (beach erosion, sink holes)	Damage to aircraft operating surfaces, roads, infrastructure.	2
Natural Hazards Meteorological		
Hail	Damage to buildings.	2
Extreme Heat	Increased injury risk to personnel.	2
Flooding (coastal, urban, inland)	Risk to personnel, disruption to ground operations and damage to infrastructure.	2
Tropical Storms	Risk to personnel, disruption of air and ground operations.	2
Hurricane Category (1, 2, 3, 4, or 5)	Risk to personnel. disruption of air and ground operations, damage to infrastructure.	1
High Winds >25 mph	Disruption of air and ground operations.	3
Severe Thunderstorms / Lightning	Flightline operations curtailed.	3
Tornadoes	Localized but high level of destruction.	2
Wildfire	Disruption to flying and ground.	1
Tidal Surge	Flooding, erosion.	2

In **Figure 10**, a Patrick SFB example, the installation already assessed the current probability of tidal surge in its IEMP, giving it a rating of "likely." In addition, information about previous instances of coastal flooding includes information about the facilities that had experienced damage and an estimated high-water mark. This data can also be found in the SLVAS report. The installation can assume future probability is equal to current probability or engage with the local weather flight to analyze Section 1.2.2 resources and determine if this data collectively influence the group to assume an increased future probability.

→ Document the future probability and source(s) used for that determination for each hazard in the **Screening Worksheet**.

2.3 Assess Hazard Severity

The next step in this process is to assign a current and future severity rating for each hazard. The definition of severity is the overall effect of a hazard(s) in terms of potential impact on personnel, equipment, mission, or activity. The severity ratings used in **Figure 9** are from least to most severe: negligible, moderate, critical, and catastrophic (Risk Assessment Matrix (AFI 90-802 and AFI 90-2001)).

2.3.1 Assessment of Current Severity

Some installation IEPs and IEMPs consider past installation incidents and assess the current severity of several severe weather hazards. If one of the installation's existing documents already includes an assessment of current hazard severity, the installation may document that severity rating and reference the source. One or more documents may rate a hazard and recommend different severities. The installation should retain the higher severity ratings and revisit the rating with the reports' authors to update the necessary adjustments. If there is an existing rating of a current hazard severity, document the rating, source, and rationale on the **Screening Worksheet**.

If the installation has not completed an assessment of hazard severity, the installation team should utilize the **Figure 9** Risk Assessment Matrix descriptions and available data to determine severity. The installation may assume that the future hazard severity rating is equal to the worst previously experienced event at the installation.

The installation team may also wish to consider the severity of different hazard components separately or at different levels of the same hazard. For Example:

- Different hazard components - hurricane wind effects of a hurricane separately from hurricane flooding effects (e.g., Saffir-Simpson scale for wind speeds (category 1-5) and estimate storm surge heights for flooding effects)
- Different levels of the same hazard - a tropical depression versus a hurricane

The installation can choose to document these on the **Screening Worksheet** in the manner most beneficial to the installation.

In the Patrick SFB example, the installation team would determine whether past events impacted the base and/or review the IEMP for possible impact characteristics and develop a current severity rating.

→ Document the current severity and source(s) used for that determination for each hazard in the **Screening Worksheet**.

2.3.2 Assessment of Future Severity

It is unlikely that existing installation products such as the IEMP or IEP assess future severity of severe weather hazards. Thus, the installation team should utilize the **Figure 9** Risk Assessment Matrix and available data to assign a rating of the future severity to the installation from each hazard.

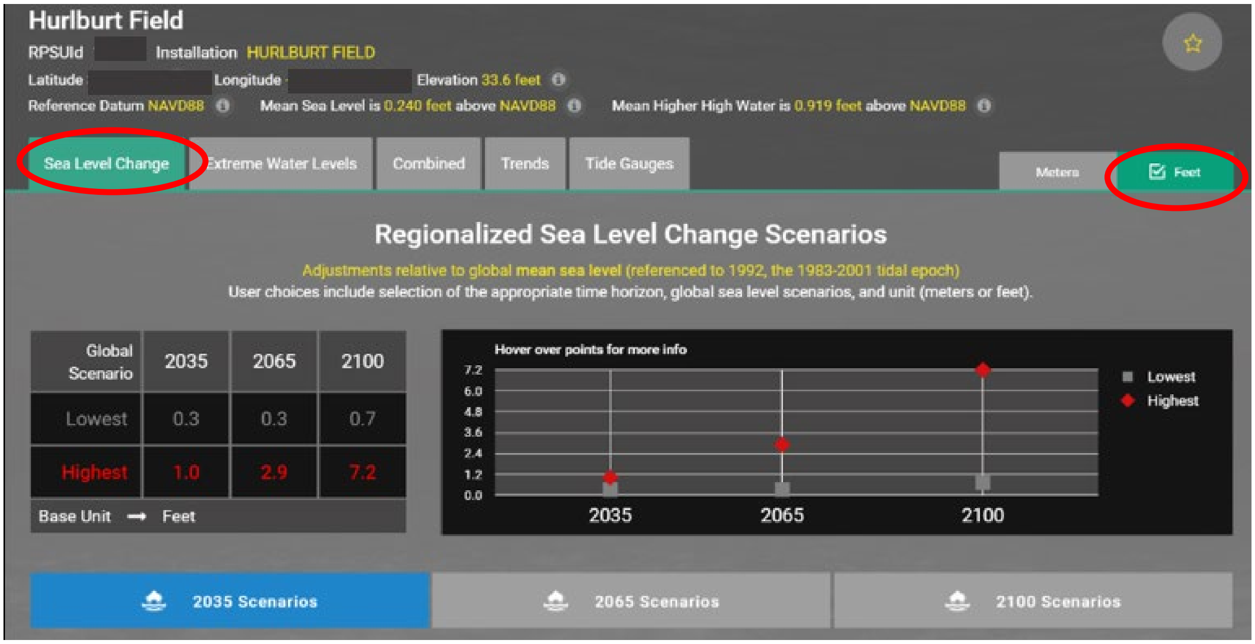
The installation should start with the assumption that the future severity hazard rating will be at least equal to the worst previously experienced event at the installation. The installation may also wish to consider impacts experienced at other installations in the same geographical region of the country. The installation team made up of planners, weather flight personnel, and emergency managers may also want to consider how different variations of a severe weather event could impact the installation. For example, the installation may wish to examine different hurricane levels or consider an event where the ground has been saturated from recent heavy rainfall. As noted in Section 2.3.1, the installation team may also wish to consider the severity of different hazard components separately.

Installations can also view data in the sources listed in Section 1.2.2 and determine if the data recorded influences the future severity assessment. An installation can extract the SLR projection data in the DRSL database and use GIS mapping to see if there is potential for increased flooding.

For more details on viewing and using DRSL data, see **Appendix D**. For example, as shown in **Figure 11**, the 2065 highest SLR projection for Hurlburt Field is 2.9 feet. For a simple screening level analysis, the installation could add that elevation to its current base flood elevation (100-year storm event) and determine how the flood hazard zone might increase. This may inform an increased future hazard severity rating. This future severity rating should be documented in the **Screening Worksheet.**

→ Document the future severity and source(s) used for that determination for each hazard in the **Screening Worksheet**.

Figure 11. Regionalized Sea Level Change Scenarios from DRSL Database



2.4 Determine Risk Levels and Complete Risk Assessment

2.4.1 Determine Risk for Individual Hazards

Combine the probability and severity ratings to determine the current and future risk rating associated with each severe weather/climate hazard. Relevant definitions for risk are shown to the right.

DEFINITIONS

Risk *– the probability and severity of loss or adverse impact from exposure to various hazards.*

Risk assessment *– the process of detecting hazards and their causes, and systematically assessing the associated risks.*

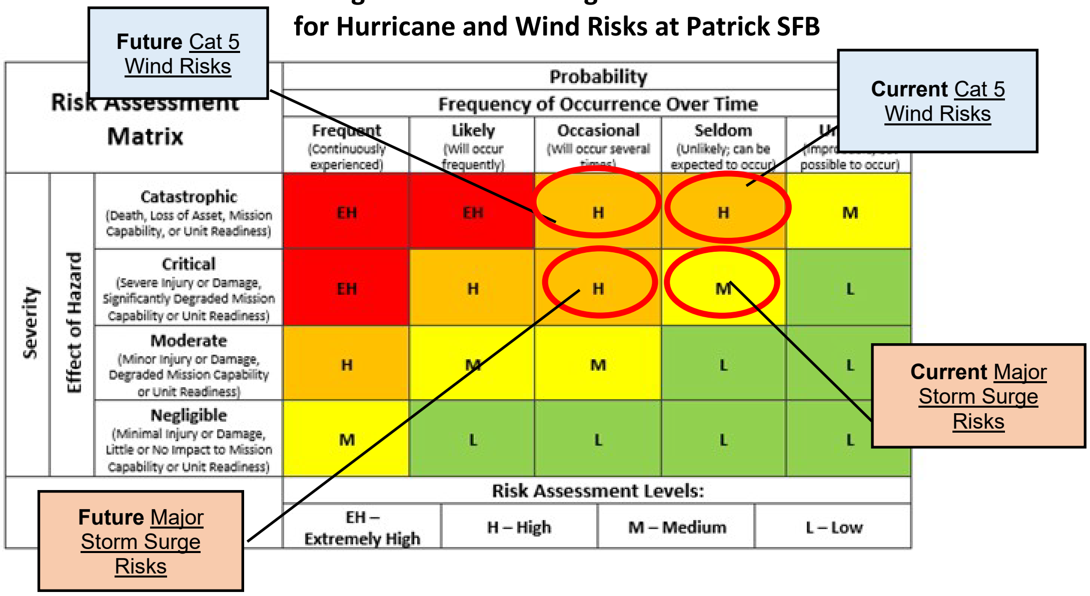
Risk management *– the systematic process of identifying hazards, assessing risk, making control decisions, implementing control decisions and supervising/reviewing the activity for effectiveness*

Source: AFI 90-802, Risk Management

Figure 12 illustrates this concept for a hypothetical Patrick SFB example. For hurricane or typhoon hazards, the installation determined the current probability of a category 5 storm surge event as seldom based upon historical data, and the current severity of such an event as critical. That combination yields a risk assessment level of “M” or “Medium.” The future risk rating moves to “H” or “High” if the installation uses a more conservative probability of occasional and maintains a severity of critical. Separating out the wind hazard associated with a category 5 hurricane also yields a “High,” which remains the same with a catastrophic severity, even after shifting probability from seldom to occasional.

→ Combine the probability and severity ratings to determine the current and future risk rating for each hazard. Document the risk ratings and the rationale for each hazard in the **Screening Worksheet**.

Figure 12. Risk Rating Determination for Hurricane and Wind Risks at Patrick SFB



2.4.2 Assessment of Combined and Cumulative Severe Weather/Climate Risk

In addition to considering the risk level for each distinct severe weather/climate hazard, installations may also wish to assess the risk rating associated with a combination of severe weather/climate hazards on their installation. For example, if your installation is subject to both wildfire risk and severe winds, those risks may be more severe if they occur together. Installation teams should utilize the **Figure 9** Risk Assessment Matrix to develop a risk level for the installation from a combination of relevant severe weather/climate hazards and record those accordingly.

→ Phase 2 of the **Screening Worksheet** should now be complete. See **Figure 13** for an example. If applicable, add new rows to the **Screening Worksheet** to capture combined or cumulative hazard risk.

Figure 13. Screening Worksheet: Phase 2 - Example #2

	Current Risk Rating				Future Risk Rating			
	Probability / Source	**Severity / Source**	**Risk Rating**	**Rationale**	**Probability / Source**	**Severity / Source**	**Risk Rating**	**Rationale**
Weather / Climate Phenomenon	**Phase 2 - ASSESS RISK**							
Cat 5 Storm Surge Flooding	**Seldom** / IEMP, 14th WS	**Critical** / team judgement	**M**	Temporary storm surge flooding may impact critical systems for short period of time	**Occasional** / IEMP, 14th WS	**Critical** / team judgement	**H**	Temporary storm surge flooding may impact critical systems for short period of time
Cat 5 Wind Event	**Seldom** / IEMP, 14th WS	**Catastrophic** / team judgement	**H**	Long duration wind event could cause much damage to base and surrounding support systems	**Occasional** / IEMP, 14th WS	**Catastrophic** / team judgement	**H**	Long duration wind event could cause much damage to base and surrounding support systems

Chapter 3 – Phase 3: Address Risk

Chapter 3 is intended to ensure the data and information captured during Phases 1 and 2 are utilized appropriately to address the risk(s) and inform future installation plans, processes, and activities. The next sections offer potential activities to address the hazard(s) and risk(s), organized by community planner actions and activities that should be led by others. It is not exhaustive; installation staff may identify and implement other appropriate actions. The **App B – Phase 3** worksheet includes potential actions relevant for each severe weather/climate hazard. The spreadsheet is not all-inclusive, and the installation may identify other relevant next steps.

As noted in the Introduction, the effects of climate change represent one of many potential hazards that an installation must address and manage. There may be circumstances where other hazards, such as access to airspace, water, spectrum, or energy, represent a more significant risk to the installation's mission. Phase 3 actions help determine potential courses of action to address identified risk(s).

→ Use the **App B – Phase 3** worksheet to track the actions and strategies the installation chooses to implement, as well as relevant OPRs/OCR, and the status of each mitigation task.

- Note that the installation team may wish to re-adjust the current and future risk rating, determined in earlier chapters of this document, for relevant risks if the completed actions change the risk profile. For example, a risk mitigation strategy may reduce the hazard severity, which may lower the overall risk rating for that hazard.

→ Installations should re-assess each relevant severe weather/climate risk at least every five years and make updates within the CPP accordingly following Facilities Board approval.

3.1 Community Planner Actions

Typical duties for which the planner is the OPR are listed in this section. These duties are primarily related to: developing or informing the ICRP; updating composite constraints in the Installation Development Plan (on the Comprehensive Planning Platform (CPP)); considering these constraints in future facility siting; and identifying existing facilities/assets in areas of high risk that should be evaluated further to determine how the risk should be addressed.

3.1.1 Develop or Inform the Installation Climate Resilience Plan

The FY20 and FY22 NDAAs directed DoD to develop a "military installation resilience component" within IDPs for major military installations and was incorporated into 10 U.S. Code (USC) §2864. This "component" is labeled the "Installation Climate Resilience Plan" in UFC 2-100-01. Only installations requiring an IDP in accordance with AFI 32-1015, *Integrated Installation Planning*, are required to develop an ICRP.

Phases 1 and 2 of this Playbook aid in completing an installation ICRP, which includes eight sections:

1. Severe Weather / Climate Risks and Threats
2. Assets and Infrastructure
3. Lessons Learned
4. Ongoing and Planned Risk Mitigation Projects
5. Community Infrastructure and Resources
6. Community Agreements in Effect or Planned
7. Coordination Efforts with Local Communities
8. Future Risks and Threats

Planners should be aware that ICRPs are intended to be executed, via contract, concurrent with IEPs, with a deadline no later than the end of FY26. Planners should review the ICRP template. ICRPs will help inform planning and programming processes to incorporate risk mitigation strategies into the design and construction of future facilities.

3.1.2 Update Composite Constraints in the CPP

A typical priority for planners is to work with GIS technicians to update constraints maps and make updates for each relevant composite constraint in the CPP. Note, in some cases, GIS maps may need to be updated by contract; contact AFCEC/CP for information on pending actions to update AF GIS layers by contract. Phase 3 of the **Screening Worksheet** (labeled "**App B – Phase 3**") details the specific updates that may be necessary in the relevant GIS constraint layers for each severe weather/climate hazard. The planner may not be the OPR for all GIS layers. In that case, the planner should work with the appropriate team members to develop proposed changes to a GIS composite constraint layer. ICRP development and/or SWCH Playbook Phases 1 and 2 **Screening Worksheet** validation may yield new information or data for which updated constraints maps are necessary.

The process of developing updated constraints maps may challenge installation perceptions about what is developable land, as it may result in new restrictions on previously developable areas such as projected flood zones, areas with erosion risk, lava flow areas, or forest fire buffer zones. Before making updates to GIS maps and to the CPP text relating to composite constraints, present recommended changes to the Facilities Board. Upon obtaining approval, upload updated GIS constraints maps and make edits to the CPP text. Specific tasks related to updating the CPP are below.

- Upload updated constraints maps for each severe weather/climate risk, if applicable.
- Update constraints considerations color rating for each relevant severe weather/climate risk based on your analysis in **Chapter 2**.
- Update synopsis in constraints considerations text boxes for each relevant severe weather/climate risk based on your analysis in **Chapter 2**.

3.1.3 Future Facility Siting

Once constraints have been identified in the appropriate GIS layers and within the CPP composite constraints, utilize this data to evaluate the siting of facilities accordingly, recognizing that most facilities have a 50-year life span. Examine the relative risks of the severe weather/climate hazards and determine whether avoiding the risk by not siting a new facility in areas such as future flood hazard areas, lava flow areas, forest fire buffer zones, areas prone to severe erosion, etc., is a possibility. Avoiding a risk should be considered. If development must occur in an area prone to a hazard due to mission imperatives and lack of feasible alternatives, ensure that project-specific risk mitigation measures are developed. When presenting the siting for Facilities Board approval, present these project-specific risk mitigation measures and capture relevant restrictions approved by your Facilities Board in the CPP. If sited within a recognized constraint, such as a 100-year floodplain, ensure compliance with requirements in UFC 3-201-01. Other potential tasks are described below.

- Update Installation Facility Standards.
- Make corresponding updates to development guidelines in Form-Based Planning (e.g., require the use of pavers and pervious pavers in areas with flood risk, adjust street tree guidance to address drought, adjust recommendations for underground utilities in high wind risk areas, add restrictions to construction in current and future floodplains, etc.)

- Adjust capacity considerations stoplight charts if a capacity is impacted by severe weather/climate risk.
- Note that UFC 1-200-01, *DoD Building Code*, UFC 2-100-01, *Installation Master Planning*, UFC 3-201-01, *Civil Engineering*, and AFI 32-1015 prohibit construction within or partially within floodplains without meeting relevant reporting and mitigation requirements.
- Ensure facilities and infrastructure investments (MILCON, Sustainment, Restoration, and Modernization (SRM), and other funded sources) are sited with relevant risk mitigation (see suggestions in **App B – Phase 3** worksheet). Work with programmers, engineers, and project designers to ensure project designs include relevant mitigation.
- See the **App B – Phase 3** worksheet for suggested siting strategies for some severe weather/climate hazards. Additional strategies can be found here:
    - AFCEC's Climate Adaptation and Resiliency Actions
    - [American Planning Association website]

3.1.4 Planning Actions – Mitigating Risk for Existing Facilities/Assets

Identifying composite constraints and updating development guidelines and capacity considerations could result in the formation of initial planning actions. Completion of ICRPs, IEPs, or Energy Resilience Readiness Exercises (ERREs) could also yield gaps and requirements for which planning actions are necessary. Planners should be able to identify existing facilities/assets located in areas of high risk that may require further evaluation. The planner may then consider initial options for the relocation or retrofit of an at-risk, critical functions as part of the relevant District Plan. Planning actions for severe weather/climate risk mitigation projects follow Regular DAF or Reserve Component prioritization and approval procedures. Other potential tasks are described below.

- Identify existing facilities/assets in areas of high risk. Ensure the facility is identified on the District Analysis page with the appropriate "Analysis Action" identified. Use the "Notes" section to identify this as a climate mitigation Planning Action.
- Initiate a Planning Action for facilities in high-risk areas. At a minimum the planning alternative development should consider status quo / "do nothing," relocation of the function, and retrofitting of the existing facility.
- Prioritize planning actions related to severe weather/climate on the installation's Integrated Action List. Note: also, make sure projects from your IEP related to severe weather/climate risk are also included.
- Work with programmers for actions prioritized for funding to ensure projects include relevant mitigation (see suggestions **App B – Phase 3** worksheet).
- Update mitigation alternatives in constraints considerations text boxes, if applicable.

It will not be possible to complete all mitigation actions at one time or even in the near future. Planning Actions should be prioritized for further development based on the risk rating and potential impact to mission. The Mission Dependency Index (MDI), as well as other planning products such as the Installation Energy Plan or the Mission Sustainment Risk Report, will assist in prioritizing Planning Actions for further development. In some cases, Planning Actions will provide the foundation for recovery actions or future planning, rather than proactive preventive measures. For example, an installation may choose to continue to use a low mission impact facility until it reaches the end of its useful life or is damaged by the severe weather phenomena, at which time the Planning Action analysis will have already provided a preferred alternative for relocation or replacement.

Planning Actions with preferred alternatives should also be incorporated into the next scheduled update of the District Plan. A district with significant changes to the constraints (e.g., significant reduction in developable areas or high number of at-risk facilities) may be considered for an out of cycle District Plan update.

3.1.5 Other District Development Strategies

The activity of identifying composite constraints, updating development guidelines, and capacity considerations may also result in the need to pursue other district development strategies to mitigate the risk. This includes such actions as the need to update the installation storm water management plan or identify projects to restore natural habitats. The planner may not be the OPR for these actions, in which case, they should work with the relevant installation personnel to identify risks, develop planning actions, prioritize projects, and assist in project planning efforts. Other potential tasks are described below.

- Identify existing resources at risk from severe weather/climate
- Consider planning actions to address the issue in relevant district plans
- Prioritize planning actions related to severe weather/climate on the installation's Integrated Action List (Note: make sure projects from your INRMP related to severe weather/climate risk are included)
- Work with environmental personnel for actions prioritized for funding to ensure projects include relevant mitigation (see suggestions **App B – Phase 3** worksheet)
- Update mitigation alternatives in constraints considerations text boxes, if applicable

3.2 Other Potential Actions

There are many other potential actions an installation could initiate, not all of which would be led by the installation community planner. For example, the planner may be the lead to work with the U.S. Department of Defense Office of Local Defense Community Cooperation (OLDCC) under the Office of the Under Secretary of Defense for Acquisition and Sustainment (A&S), for submitting proposed Readiness and Environmental Protection Initiative (REPI) projects, and for coordinating with off-installation partners on potential REPI Challenge projects. The Community Liaison, who typically works on the Wing Staff and often reports directly to the Wing Commander, may also perform these functions. Other examples include programmer developing DD1391 forms and project designers incorporating risk mitigation into project planning: incorporating a design flood elevation that factors in potential future sea level rise into a new facility or incorporating higher standards for wind load for a building in a hurricane-prone region, etc. For these actions, **the Community Planner is not the OPR**; however, the planner should be involved in coordinating potential actions and informing the OPR of the weather/climate hazards facing the installation. Other potential tasks are described below.

- Bases may submit a request for an Office of Local Defense Community Cooperation (OLDCC) Military Installation Resilience (MIR) study focused on severe weather/climate hazards that affect installations. MIR studies are funded by OSD's OLDCC. Requests for a MIR study from an installation must be funneled to the Directorate of Civil Engineers (A4C) through the appropriate operational headquarters: AFCEC/CPPR, NGB/A4, or AFRC/A4. Requests for MIRs and Compatible Use Program studies (formerly Joint Land Use Studies) can also go from host communities directly to OLDCC. They are sometimes combined into a hybrid compatible land use plan that includes planning for climate resilience initiatives. A MIR study may be the installation's best opportunity to obtain dedicated resources to identify both on and off-installation facilities at risk to severe weather/climate hazards and may be a source to identify proposed planning actions to mitigate risk. Bases that have completed climate-focused JLUS addendums include JB Langley-Eustis and MCAS Beaufort. Bases and communities may submit applications for MIR study consideration as part of annual data calls or through out-of-cycle requests. MIR and CUP funding is limited to planning and coordination activities. Construction funding is the purview of OLDCC's Defense Community Infrastructure Pilot Program. However, note that per AFI 32-1015, MIR or CUP requests must be vetted through the Facilities Board, and request letters must be signed by the Installation Commander. Installations should review their IEP to ensure MIRs are focused on risks and mitigation not addressed in the IEP. Planners should work with environmental staff to ensure proposed CUP strategies involving natural resources are consistent with the INRMP.

- Bases may submit a severe weather/climate related REPI project or may have relationships with local government personnel who may submit a REPI Challenge project. Follow typical procedures to submit a REPI project through AFCEC/CI (note: more information about REPI, including information on REPI Challenge projects is available https://www.repi.mil/). Please note that per AFI 32-1015, installation proposed REPI projects should be vetted through the Facilities Board. (For more information on how to use the new installation resiliency authority for the REPI program: https://www.repi.mil/Resources/Webinars/.) Planners must work with environmental team to ensure REPI projects impacting natural resources are consistent with the INRMP.

- Bases may work with local community partners, engineers, and programmers to identify potential defense access road projects. The projects can repair damage to or can mitigate (e.g., replace) existing defense access roads (highway or highway connections that provide access to the base) that might be shut off by recurrent or projected recurrent flooding, sea level fluctuation, a natural disaster, or any other current or projected change in applicable environmental conditions. Installations should follow typical procedures to prioritize and advocate for MILCON projects.

- Installation teams considering severe weather/climate risk as part of this process should coordinate with the leads for the Installation Emergency Management Plan, Installation Energy Plan, and/or INRMP if these plans also assess the severity and probability of a current risk and the assessment differ from the assessment developed as part of this process. Be an advocate for consistency in all documents. Installations might also conduct an annual cross-functional team exercise that addresses severe weather/climate risk.

- Installation teams should work with programmers to track projects implemented to adapt to or mitigate the effects of severe weather on installation assets. Information tracked should include title, a brief description of project, original cost estimate, and current working cost estimate. Such projects should be listed in the CPP as mitigation in composite constraints.

- Installation teams should work with programmers and project designers for MILCON and large SRM projects to ensure risk mitigation for severe weather/climate threats is incorporated in projects, as appropriate. Examples are included in the **App B – Phase 3** worksheet. Programmers and project designers should be reminded to incorporate requirements identified in relevant UFCs listed on the worksheet. More guidance for programmers and project designers is available in the NAVFAC Installation Adaptation and Resilience Climate Change Planning Handbook. Programmers and designers working on projects impacting natural resources can also obtain guidance in the DoD Climate Adaptation for Natural Resources Guide. Appendix 3 of DoD Installation Exposure to Climate Change at Home and Abroad, published 2021, provides an overview of possible resilience measures, including estimated costs.

- Installations should work with the local community and base logistics personnel to establish and track agreements (e.g., MOAs) and/or coordination in effect or planned with public or private entities to maintain or enhance the installation resilience of community infrastructure or resources that impact base mission. This information is also useful for ICRP completion. Logistics Squadron personnel have an existing list of MOAs, which may include relevant agreements. Logistics and Engineer personnel should work together to coordinate with the off-installation community on efforts that may mitigate severe weather/climate risk. Such agreements should be identified as mitigation in the composite constraints portion of the CPP. The need for new agreements of this nature may be developed as part of a CUP.
- Installation teams assessing severe weather/climate risk should coordinate with the installation mission sustainment team to ensure that the larger installation Mission Sustainment Risk Report is updated with individual and cumulative severe weather/climate hazard assessments, as determined by this process. Installation Risk Assessment Teams and senior leaders should agree with recommendations for risk levels and accept risk where appropriate.

APPENDICES

Appendix A – Law and Policies Addressing Severe Weather and Climate Risks and Relevant Definitions

Appendix B - Screening Worksheet - refer to "Severe Weather Playbook App B_App C Worksheet"

Appendix C - Severe Weather and Climate Phenomena: Definitions and Examples - refer to "Severe Weather Playbook App B_App C Worksheet"

Appendix D - Introduction to Using the DoD Regional Sea Level (DRSL) Database and Other Useful Resources

Appendix E - List of full hyperlink URLs embedded or listed in the playbook

APPENDIX A - Law and Policies Addressing Severe Weather and Climate Risks and Definitions

Laws and policies require consideration of severe weather or climate risk and serve as drivers for this screening and risk assessment process:

Law

NDAA FY20 Section 2801: modifies 10 US Code 2864 to require consideration of current and future risks and threats, including extreme weather events, mean sea level fluctuation, wildfires, flooding, and other changes in environmental conditions in a "military installation resilience component" to master plans (referred to as Installation Climate Resilience Plan in UFC 2-100-01)

NDAA FY22 Section 2832: further modifies 10 US Code 2864 by adding a new element to the 'military installation resilience' component

NDAA FY19 Section 2805: requires flood risk disclosure for MILCON, floodplain delineation, and minimum flood mitigation requirements language

Policies

DoDD 4715.21,*Climate Adaptation and Resilience* – assigns responsibilities across DoD to incorporate climate considerations into planning for infrastructure and operations in order to assess and mitigate climate risks

DoDI 4715.03, *Natural Resources Conservation Program* – requires climate considerations to be included in DoD land management practices

DoDI 6055.17, *DoD Emergency Management Program* – incorporates weather and climate in its all-hazards approach to manage risks

DoDM 4715.03, *Integrated Natural Resources Management Plan (INRMP) Implementation Manual* – includes a section on Planning for Climate Change Impacts to Natural Resources (impetus for AFI 32-7064)

UFC 1-200-02, *High Performance and Sustainable Building Requirements* – for new buildings provide building design solutions responsive to any Government-provided projections of climate change and determination of acceptable risk; Improve existing facilities and operations for climate resiliency

UFC 2-100-01, *Installation Master Planning* – addresses changes in climatic conditions, such as temperature, rainfall patterns, storm frequency, intensity, and water levels; use of reliable resources for climate projections. The FY20 and FY22 NDAAs directed DoD to develop a "military installation resilience component" within IDPs for primary military installations and was incorporated into 10 U.S. Code (USC) §2864. This "component" is labeled the Installation Climate Resilience Plan in UFC 2-100-01. Note: only DAF installations requiring an IDP, in accordance with AFI 32-1015, *Integrated Installation Planning*, are required to develop an ICRP

UFC 3-201-01, *Civil Engineering* – includes a requirement for a flood mitigation plan for all buildings sited within or partially within the 100-year floodplain according to the most recent Federal Emergency Management Agency flood hazard data; provides minimum design flood elevation guidance.

UFC 3-201-02, *Landscape Architecture* – addresses designing plantings for climate resiliency and natural hazards.

UFC 3-301-01, *Structural Engineering* – includes requirements for storm shelters and addresses wind load requirements for hurricane, tornado, and high wind load regions.

UFC 3-400-02, *Design: Engineering Weather Data* – Guidance for building designers accessing climate data available from the 14th WS, Engineering Weather Data Handbook,, for use by engineers designing government structures. This UFC is applicable to all service elements and contractors involved in the planning, design and construction of DoD facilities worldwide.

AFPD 15-1, *Weather Operations* – Establishes AF roles and responsibilities for terrestrial and solar weather, hydrologic, and climate (including climate change) assessments.

AFPD 32-70, *Environmental Considerations in Air Force Programs and Activities* – Requires the identification and assessment of effects, inclusion in plans, anticipation, and management of risks

AFPD 90-20, *Mission Sustainment* and AFI 90-2001: *Mission Sustainment* – Climate/Weather is 1 of 7 hazard categories (others: airspace, land/sea, spectrum, water, energy, natural/cultural resources) required to be assessed and mitigated as part of a broader installation assessment of risk to mission sustainment.

AFI 90-802, *Risk Management* - lays out the official DAF process for assessing severity, probability, and overall risks for various hazards and threats to the mission.

AFI 10-503, *Strategic Basing* – References the roles of A3W concerning severe weather/climate and in relation to the strategic basing process. The Encroachment Management Working Group is charged with recommending encroachment/compatible land use issues such as severe weather/climate for Strategic Basing Executive Steering Group review.

AFI 10-2501, *Air Force Emergency Management Program* – Establishes responsibilities, procedures, and standards for DAF mitigation and emergency response to threats, including natural disasters. Requires installations to develop Installation Emergency Management Plans (IEMP), which often include an assessment of the severity and probability of risk associated with existing natural disaster threats developed by the Installation Emergency Management Working Group (IEMWG)

AFI 15-128, *Weather Force Structure* - This publication implements Air Force (AF) Policy Directive (AFPD) 15-1, Weather Operations. This instruction defines the mission, organization, roles and, responsibilities of Air Force Weather (AFW) personnel.

AFI 15-157/AR 115-10, *Climatic, Hydrological, and Topographic Services, Weather Support and Services for the U.S. Army* - Regulation provides policy and states responsibilities for Air Force (AF) elements engaged in meteorological support of the Army's mission and provides guidance to the Army for supporting the AF in that role. It includes Army and AF responsibilities for the execution of installation, garrison, and deployed (combat or field) weather operations.

AFI 32-1015, *Integrated Installation Planning* – requires the assessment and management of risks associated with the effects of a changing climate on built and natural infrastructure; requires consideration of energy and climate resiliency in planning documents; address flood hazards

AFI 32-7001, *Environmental Management* – will provide more guidance to AFPD 32-70; may refer to Integrated Installation Planning AFI

AFI 32-7064, *Integrated Natural Resources Management* – effect of changing climate should be included in plans to restore native ecosystems; assess risks, vulnerabilities, and adaptation strategies

AFI 90-2001, *Mission Sustainment* – requires installations to identify and address issues that impact mission sustainment, including weather/climate risks. This enterprise-wide program, chaired by SAF/IEI, establishes Mission Sustainment Teams at the installation, Major Command (MAJCOM), Field Command (FIELDCOM), and DAF headquarters. The Installation Mission Sustainment Team should include the members of the IEMWG, required by AFI 10-2501, *Air Force Emergency Management*

Program, as well as additional personnel detailed in AFI 90-2001, and planners. This team should identify severe weather/climate related hazards, assess the probability/severity of impacts, and implement controls to reduce, mitigate, eliminate or prevent risk.

AFMAN 15-111, *Surface Weather Observations* - This manual prescribes AF surface weather observing and reporting procedures based on guidance issued by WMO, the International Civil Aviation Organization (ICAO), National Weather Service (NWS), Federal Aviation Administration (FAA), and Allied Publications. This manual applies to all AF Weather organizations and contractors performing weather observations in support of AF, Army, and or DoD wide operations.

AFMAN 15-129, *Air and Space Weather Operations* - This publication provides AF weather personnel and organizations guidance on accomplishing operations for weather forecast, observation, and integration processes.

AFVA 15-137, Operational Weather Squadron (OWS) Areas of Responsibility -This visual provides a geographical representation of what areas fall under the scope of a respective OWS.

Definitions

The following definitions include terms commonly used when discussing climate and severe weather.

Climate Change: Variations in average weather conditions that persist over multiple decades or longer that encompass increases and decreases in temperature, shifts in precipitation, and changing risk of certain types of severe weather events (DoD Joint Publication 1-02)

Current Hazard: a hazard that has occurred at the base in the past or has the possibility of occurring based upon available data, studies, maps, and historical events. E.g., the base has not experienced an earthquake but is in a seismic zone.

Future Hazard: A hazard that represents long-term changes to weather patterns, temperature, precipitation, hydrology, or sea level that creates a possibility of occurring at the base. Informed by data, studies and/or maps of the base. E.g., future sea level rise scenarios indicate that some areas may shift to wetlands; future temperature scenarios indicate possibility of increased number of black flag days.

Hazard: Any real or potential condition that can cause mission degradation, injury, illness, death to personnel or damage to or loss of equipment or property. (Air Force Instruction (AFI) 90-2001, Mission Sustainment)

Primary Site: A self-supporting site, with or without an aircraft operating area that has facilities for administrative and operating activities to carry out a given mission. For recording and reporting real property, this is typically the parent or control installation (AFI 32-9005, *Real Property Accountability*)

Probability: The likelihood that a hazard(s) will cause negative mission impacts and/or the frequency of occurrence over time. Probability can be determined through estimates or actual data (if available). The five ratings in the risk management model are unlikely, seldom, occasional, likely, and frequent (AFI 90-2001, Mission Sustainment)

Resilience: The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions (DoD Directive 4715.21, Climate Change Adaptation and Resilience)

Risk: The probability and severity of the loss or adverse impact from exposure to various hazards (AFI 90-802, Risk Management)

Risk Assessment: The process of detecting hazards and their causes, and systematically assessing the associated risks.

Risk Management: The systematic process of identifying hazards, assessing risk, making control decisions, implementing control decisions, and supervising/reviewing the activity for effectiveness.

Severe Weather: Any weather condition that poses a hazard to property or life (Air Force Manual (AFMAN) 15-129, Air and Space Weather Operations).

Severity: The overall effect of a hazard(s) in terms of potential impact on personnel, equipment, mission, or activity. The severity ratings used for mission sustainment are in order of least to most severe: negligible, moderate, critical, and catastrophic (AFI 90-2001, Mission Sustainment)

Acronyms

AEP – Annual Exceedance Probability

AF – Air Force

AFB- Air Force Base

AFCEC – Air Force Civil Engineer Center

AFI – Air Force Instruction

AFMAN – Air Force Manual

BFE – Base Flood Elevation

CEMML – Center for Environmental Management of Military Lands

CES – Civil Engineer Squadron

CPP – Comprehensive Planning Platform

CSU – Colorado State University

CUP – Compatible Use Program

DAF – Department of the Air Force

DISDI – Defense Installation Spatial Data Infrastructure

DRSL – DoD Regional Sea Level

DoD – Department of Defense

DoDD – Department of Defense Directive

DoDI – Department of Defense Instruction

EM – Emergency Management

EWL – Extreme Water Level

FIELDCOM – Field Command

GIS – Geographic Information Systems

ICEMAP – Installation complex Encroachment Management Action Plan

INRMP – Integrated Natural Resources Management Plan

IDP – Installation Development Plan

IEMWG – Installation Emergency Management Working Group

IEMP – Installation Emergency Management Plan

IEP – Installation Energy Plan

IMST – Installation Mission Sustainment Team

MAJCOM – Major Command

MHHW – Mean Higher High Water

MLLW – Mean Lower Low Water

MOA – Memorandum of Agreement

MSRR – Mission Sustainment Risk Report

NDAA – National Defense Authorization Act

OASD(S) – Office of the Assistant Secretary of Defense (Sustainment)

OCR – Office of Coordinating Responsibility

OPR – Office of Primary Responsibility

OWS – Operational Weather Squadron

REPI – Readiness and Environmental Protection Initiative

RPSUID – Real Property Site Unique Identifier

SDI – Sustainability Development Indicators

SLR – Sea Level Rise

SLVAS – Screening Level Vulnerability Assessment Survey

UFC – Unified Facilities Criteria

VCLI – Ventilation Cooling Load Index

WS – Weather Squadron

Appendix B - Screening Worksheet – refer to "Severe Weather Playbook App B_App C Worksheet"

Appendix C - Severe weather and Climate Phenomena: Definitions and Examples - refer to "Severe Weather Playbook App B_App C Worksheet"

Appendix D - Introduction to Using the DoD Regional Sea Level (DRSL) Database and Other Useful Resources

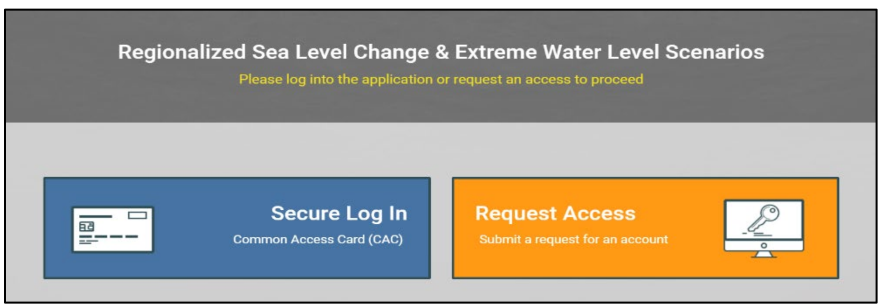
The USD (A&S) Memorandum, *Improving Defense Installation Resilience to Rising Sea levels*, requires the DoD to integrate the use of the DoD Regional Sea Level (DRSL) database "into installation and planning activities at **coastal** locations to account for future sea level change" and allows each Military Department to choose the planning horizon and regional scenario appropriate to the mission and risk tolerance. UFCs that address flood risk and mitigation, such as the UFC 2-100-01, *Installation Master Planning*, and UFC 3-201-01, *Civil Engineering*, will be modified to address the use of this database to reflect memo requirements. This playbook will be revised as additional guidance regarding timeframes and scenario choices become available. In the interim, this appendix provides initial guidance on using the DRSL database. It is divided into two sections: **D.1 How to Access and Retrieve Data from the DRSL Database and Other Useful Resources**, and **D.2 How to Use the DRSL Data** to develop future constraints maps and determine an installation design flood elevation.

NOTE: Uncertainties are inherent in projecting future climate. Scenarios are, therefore, non-probabilistic but plausible depictions of future conditions that enable decision-makers to bound their risk based on the best available science.

D.1 How to Access and Retrieve Data from the DRSL Database and Other Useful Resources

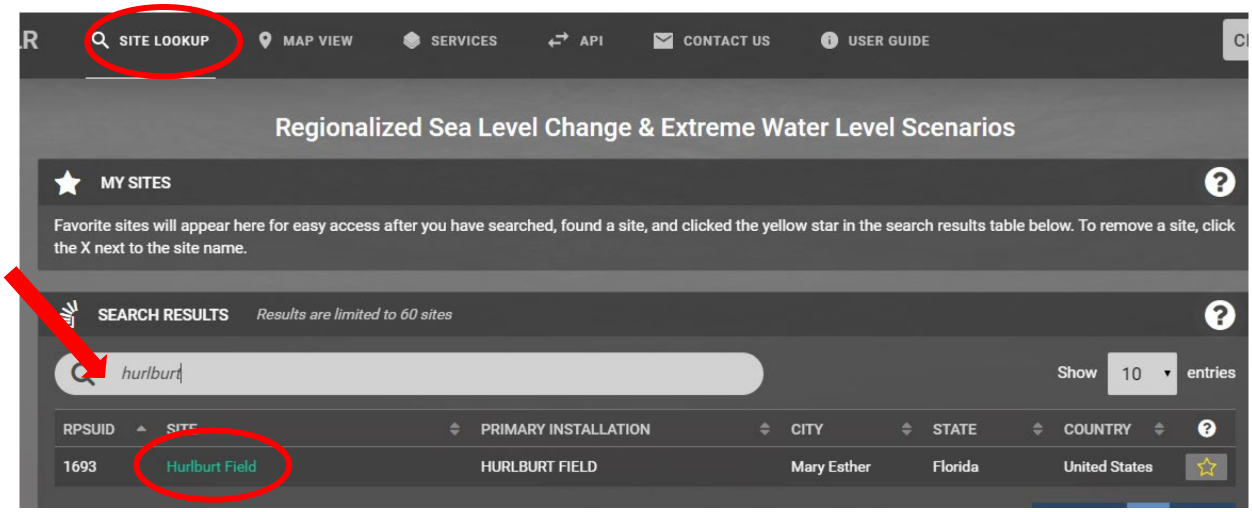
D.1.1 Access the DRSL Database. Go to the DRSL Database website and select "Secure Log In" or "Request Access" for registration (see **Figure D.1**) and follow the directions. Once logged in, users can access the database and the User Manual. If you do not have a CAC, you can use the public DRSL tool instead.

Figure D.1 - Requesting Access and Logging In



D.1.2 Find Your Coastal Installation. Click "Site Lookup," type your installation name in the search field, and then select the green hyperlink with your installation's name (**Figure D.2**). You can "Favorite" a site by clicking on the yellow star on the far-right side of the page; that site will then appear under "My Sites." Note: "Map View," located next to "Site Lookup," is another way to find your site.

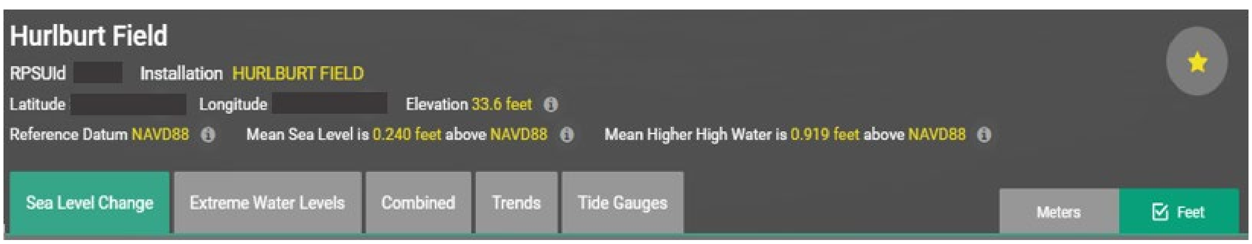
Figure D.2 - Find Your Coastal Installation



Site Information

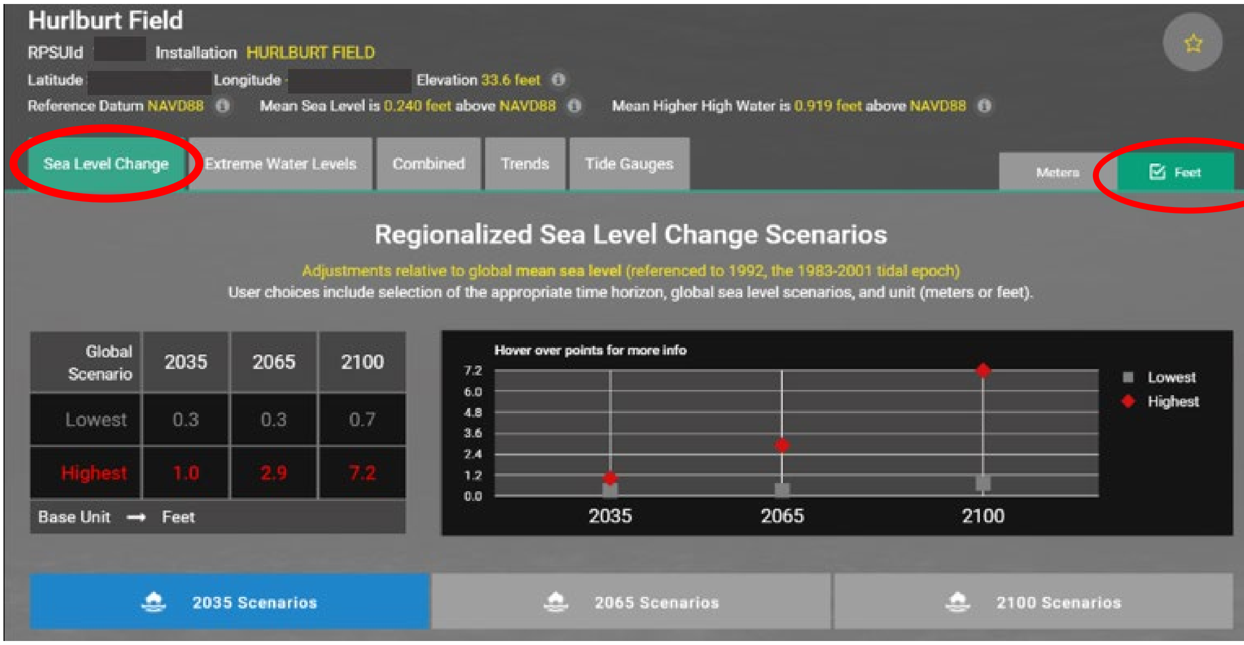
Once clicked on the Site Location Hyperlink, the Site Header (**Fig D.3**) - will remain the same throughout the application. Move your mouse over the information icons to learn more about the data. **NOTE: The RPSUID and Latitude/Longitude information are considered FOUO (now CUI) and should not be released to the public.**

Figure D.3 – Site Header



D.1.3 Gather Sea Level Change Data. Select the tab titled "Sea Level Change" underneath the Site Header and select your unit of measure – feet or meters (**Figure D.4**). After you complete this selection, data will be available for the selected site in three time frames and five Global Sea Level Rise Scenarios. The timeframes for future projections are 2035, 2065, and 2100. The five Global Sea Level Rise scenarios in **Figure D.4** represent global scenarios from lowest to highest of 0.3, 0.7, 1.0, 2.9, and 7.2 feet of rise by 2100. (The data in **Figure D.4** represents locally-adjusted figures in feet; your site may be different). The ability to select scenarios for the three timeframes are located below the graph and will highlight blue when selected. Note that this image shows only the highest and lowest scenarios; you will be able to see other scenarios in a different view (see **Figure D.5** below).

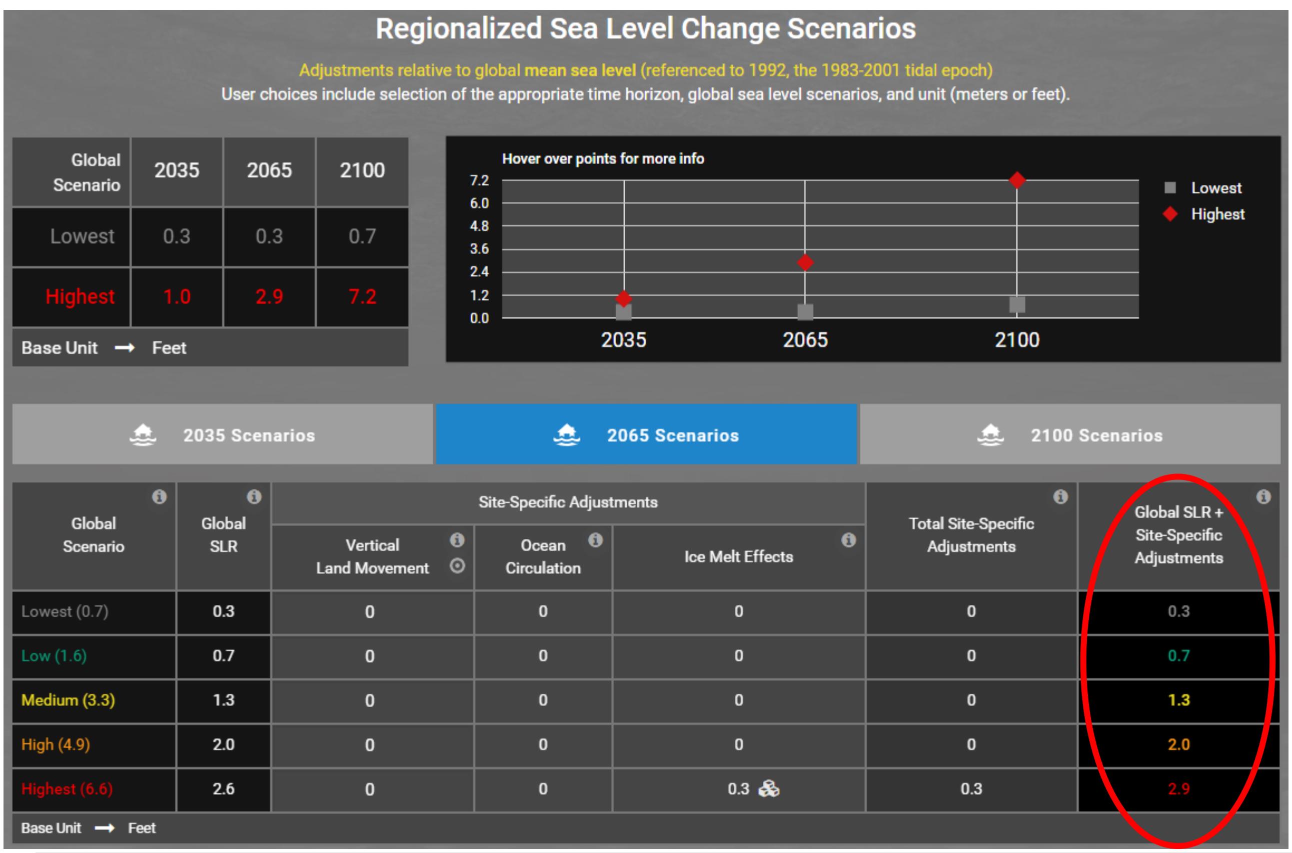
Figure D.4 - Obtaining SLR Data for your Installation



Global Scenario	2035	2065	2100
Lowest	0.3	0.3	0.7
Highest	1.0	2.9	7.2
Base Unit → Feet			

Figure D.5 identifies the site-specific adjustments made to the global scenario values to calculate the "Regionalized Sea Level Change Scenarios" for the 2065 Hurlburt Field example. Once 2035, 2065, or the 2100 scenario tab has been selected, the table below the selection will show three column categories. The left two columns identify the Global Scenario information, the middle

Figure D.5 – Site-Specific Adjustments



Global Scenario	2035	2065	2100
Lowest	0.3	0.3	0.7
Highest	1.0	2.9	7.2
Base Unit → Feet			

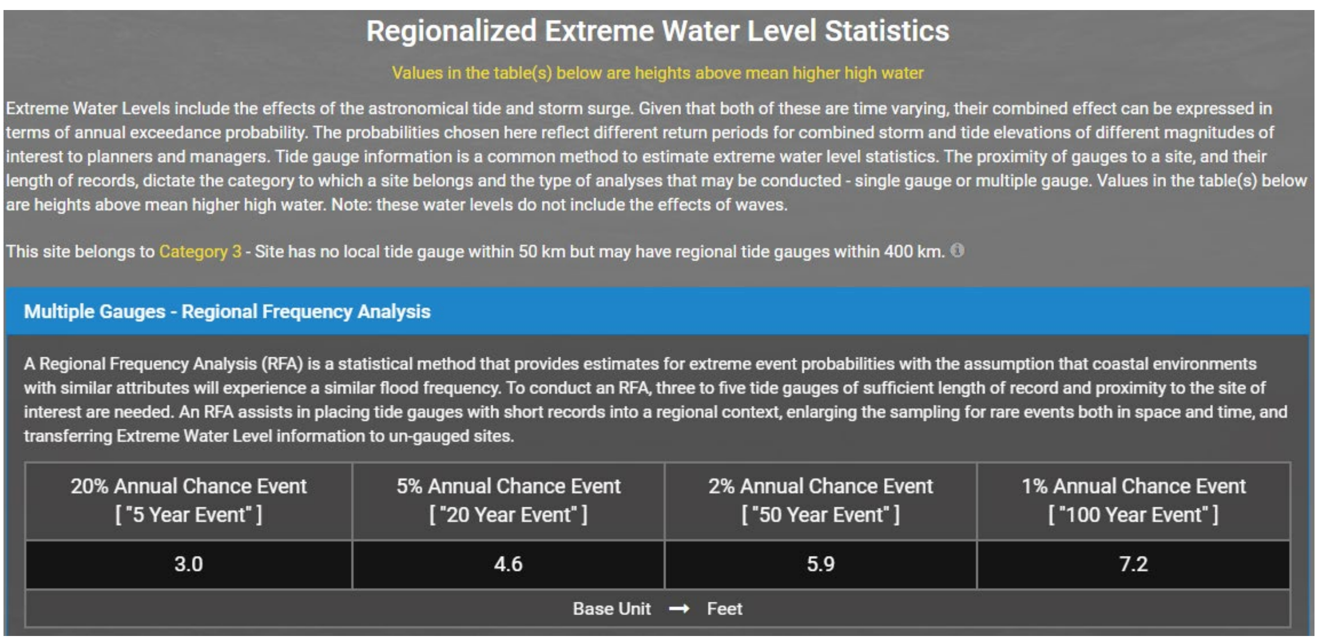
Global Scenario	Global SLR	Site-Specific Adjustments: Vertical Land Movement	Site-Specific Adjustments: Ocean Circulation	Site-Specific Adjustments: Ice Melt Effects	Total Site-Specific Adjustments	Global SLR + Site-Specific Adjustments
Lowest (0.7)	0.3	0	0	0	0	0.3
Low (1.6)	0.7	0	0	0	0	0.7
Medium (3.3)	1.3	0	0	0	0	1.3
High (4.9)	2.0	0	0	0	0	2.0
Highest (6.6)	2.6	0	0	0.3	0.3	2.9
Base Unit → Feet						

columns identify Site Specific Adjustments (Vertical Land Movement, Ocean Circulation, and Ice Melt Effects), and the right columns provide Total Site-Specific Adjustments and the Global SLR+ Site-Specific Adjustments. Remember the values in this table are shown in the unit of measure previously selected. As with the Site Header, you can move your mouse over the information icons to learn more about the data. Similar data is available for the years 2035 and 2100.

To print, right click while in this view and select print where you can print these results to PDF or a printer. When printed in this fashion, the Site Header information will not contain the RPSUID, lat/long information nor the SLR chart. The 'printout' will include the overall table (lowest and highest for 2035, 2065, and 2100) and one table for each timeframe with site-specific adjustments. "Unclassified/For Official Use Only" or "CUI" is a header and footer on each page. The data is not available print on a map nor exportable to a spreadsheet.

D.1.4 Gather Tide Gauge Information. In addition to SLC information, the DRSL database includes a tab with the tide gauges used to derive the Extreme Water Level (EWL) data contained in the database (example in **Figure D.6**). EWLs are expressed as the water elevation associated with specific storm return intervals: 5-yr, 20-yr, 50-yr, and 100-yr. The values do not include wave run-up onto the shore. These EWL values are based on statistical analyses of historic elevations of past storm events. The EWL dataset does not incorporate a climate change signal; it does illustrate storm surge levels that correspond to storm events with specified return intervals. Thus, the EWL elevation value given for a 5-yr storm at a site is the same in 2035, 2065, and 2100. These constant EWLs can be layered on top of changing sea level values to depict water levels that differ across future time periods. Note: the elevation associated with the site's current 100-year floodplain may be higher than the historical average for a 100-year storm presented in the DRSL database.

Figure D.6 – Example of Extreme Water Level Statistics from DRSL Database



Regionalized Extreme Water Level Statistics

Values in the table(s) below are heights above mean higher high water

Extreme Water Levels include the effects of the astronomical tide and storm surge. Given that both of these are time varying, their combined effect can be expressed in terms of annual exceedance probability. The probabilities chosen here reflect different return periods for combined storm and tide elevations of different magnitudes of interest to planners and managers. Tide gauge information is a common method to estimate extreme water level statistics. The proximity of gauges to a site, and their length of records, dictate the category to which a site belongs and the type of analyses that may be conducted - single gauge or multiple gauge. Values in the table(s) below are heights above mean higher high water. Note: these water levels do not include the effects of waves.

This site belongs to Category 3 - Site has no local tide gauge within 50 km but may have regional tide gauges within 400 km.

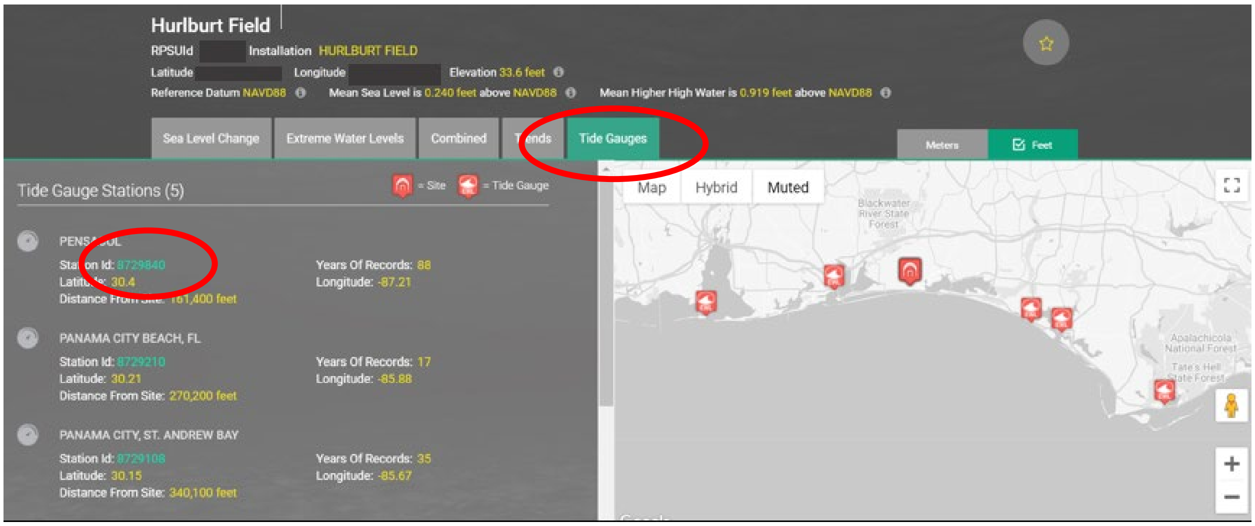
Multiple Gauges - Regional Frequency Analysis

A Regional Frequency Analysis (RFA) is a statistical method that provides estimates for extreme event probabilities with the assumption that coastal environments with similar attributes will experience a similar flood frequency. To conduct an RFA, three to five tide gauges of sufficient length of record and proximity to the site of interest are needed. An RFA assists in placing tide gauges with short records into a regional context, enlarging the sampling for rare events both in space and time, and transferring Extreme Water Level information to un-gauged sites.

20% Annual Chance Event ["5 Year Event"]	5% Annual Chance Event ["20 Year Event"]	2% Annual Chance Event ["50 Year Event"]	1% Annual Chance Event ["100 Year Event"]
3.0	4.6	5.9	7.2
Base Unit → Feet			

The highest observed water level can be determined in the tab titled "Tide Gauges" shown in **Figure D.7**. Once the tide gauge is selected, a map showing the nearby tide gauges near your site will appear. Recognize that more than one tide gauge is typically used to determine the site's historical EWL storm return intervals because not all gauges have the same record length nor experience the same storms.

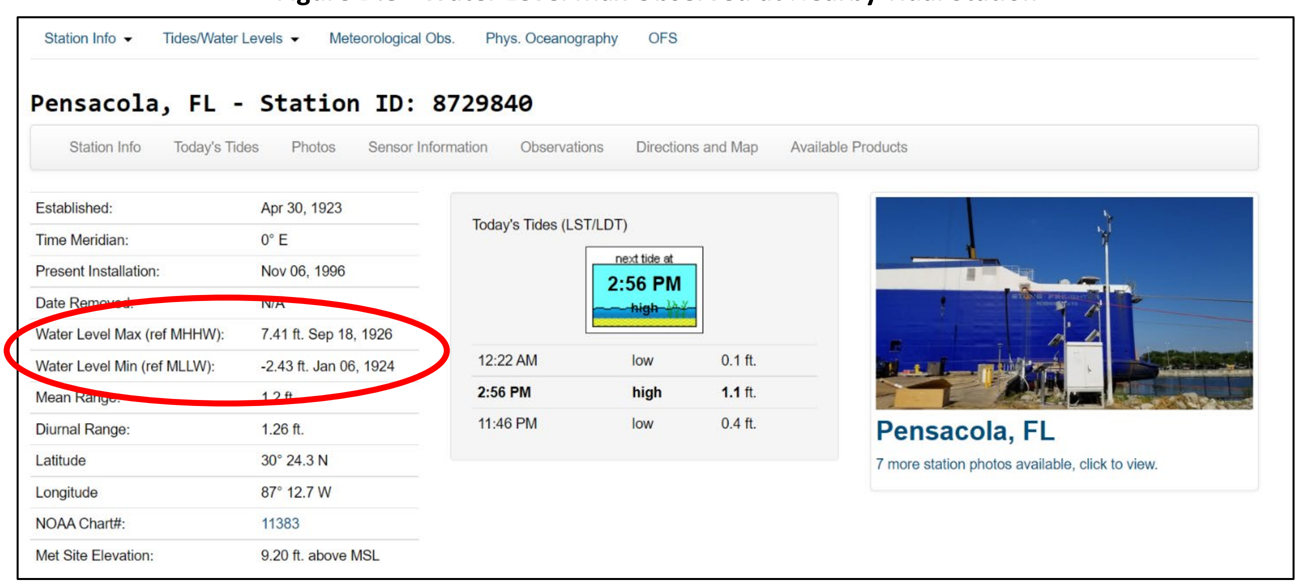
Figure D.7 - Tidal Gauges Near Your Installation



Selecting the station ID (in green text) for the desired tide gauge leads to the NOAA Tides and Currents website which contains helpful information, including the highest water level observed at the station (**Figure D.8**). This can serve as another data point for your planning consideration.

For this case, the gauge's highest observed "Water Level Max" was 7.41' on September 18, 1926. This level represents the highest Mean Higher High Water (MHHW, the average height of the highest tide recorded daily at a tide station). The "Water Level Min" is the lowest Mean Lower Low Water (MLLW, lowest of the two low tides per day (or the one low tide)). Looking up multiple data points for water level max at other nearby gauges may provide additional helpful information.

Figure D.8 - Water Level Max Observed at Nearby Tidal Station



D.1.5 Gather Floodplain Information. Installation planners are typically aware of the 100-year floodplain and avoid proposing development within this zone. Installation planners should also be familiar with the Base Flood Elevation (BFE) for their base.

The BFE is defined in UFC 3-201-01, Civil Engineering, as "the elevation of flooding, including wave height, having a 1% chance of being equaled or exceeded in a given year." BFE is also used to refer to the 100-year flood (or 1% annual chance event (ACE)). The AFCEC Environmental GIS portal provides enhanced floodplain mapping for many DAF installations and multiple installation reports. **Figure D.9** is what the full report for the U.S. Air Force Environmental GIS Data Floodplain Area Analysis for Hurlburt Field provided by Colorado State University cover page looks like. Please contact AFCEC/CZ if you don't see your installation to obtain information on report status.

Figure D.9 Example Coastal Base's CSU Floodplain Analysis

U.S. Air Force Environmental GIS Data
Floodplain Area Analysis

Hurlburt Field

Colorado State University

Asma Hanif and Ken Carlson
Department of Civil and Environmental Engineering

Shannon Voggesser and Gwynn Ellis
Center for Environmental Management of Military Lands

February 2020

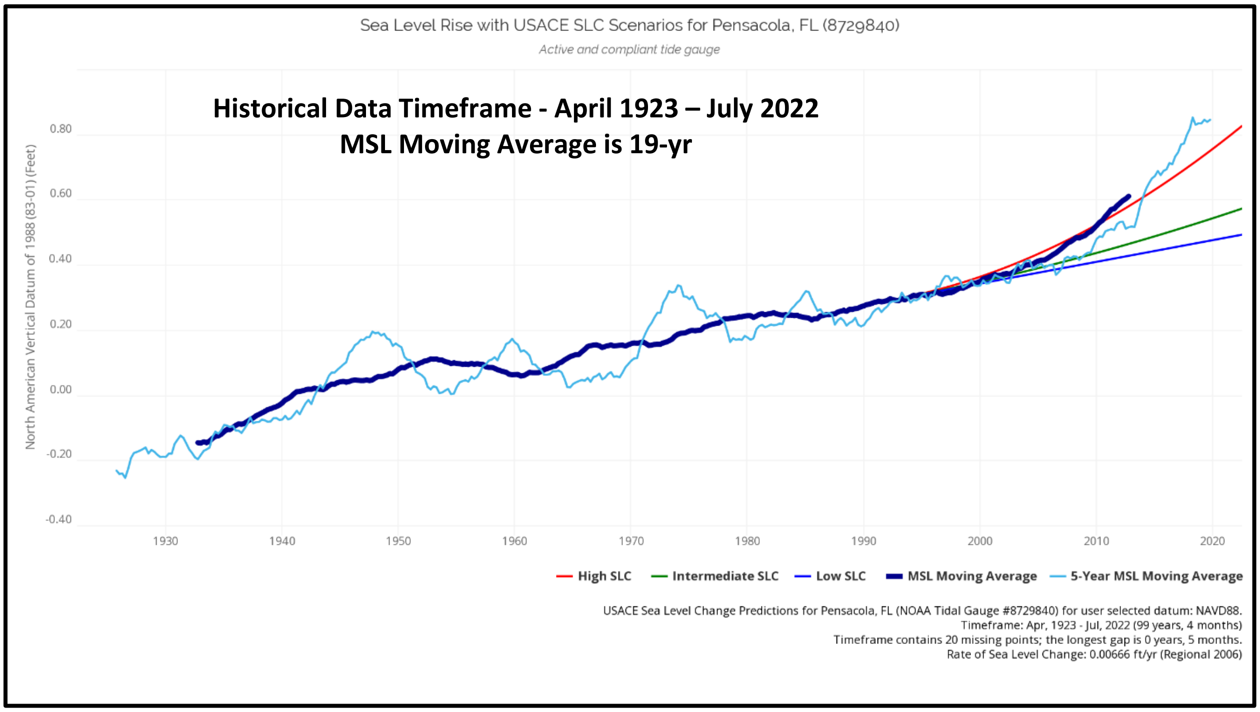
Omaha COE Cooperative Agreement #W9126G-13-2-0012

In the Hurlburt Field example, the 95th percentile maximum BFE for the 100-year storm is listed in the report as 5.1' and the elevation for the 500-year storm is 6.6'.

D.1.6 Gather Sea Level Tracking Information

As mentioned in section **1.1.1 (m)**, the Corps of Engineers created a Sea Level Tracker, compares actual sea level to three projected sea level change curves and answers the question, "What rate of sea level change is currently being observed at a selected gauge?" This can show a sense of how the mean sea level at the gauge closest to your site is tracking to future scenarios. **Figure D.10** is an example for Hurlburt and shows a snapshot in time, where both the mean sea level moving average and the 5-year mean sea level moving average are tracking on or above the USACE High curve. (Note: the USACE High curve is lower than the DRSL database highest curve.)

Figure D.10 – Sea Level Rise Moving Averages vs USACE Sea Level Change Scenarios for Pensacola, FL



D.2 How to Use DRSL Data

The following sections describe how to combine DRSL data with other data points and develop future constraints maps and design flood elevations.

D.2.1 Compiling DRSL Data with Other Data Points

It is recommended to compile DRSL data into a spreadsheet for documentation purposes and ease of use (note: the DRSL data are not available on a map nor is it available for export to a spreadsheet.) In addition, it might be helpful to capture the elevations for the 100-year and 500-year floodplains and nearby high-water marks (tide gauges or those measured on-site).

A database can compile the sea level rise and floodplain elevation data and even add elements such as existing UFC requirements (**Table D.1**). Finally, installations should research any state or local municipality requirements unique to your location and collect those relevant data points.

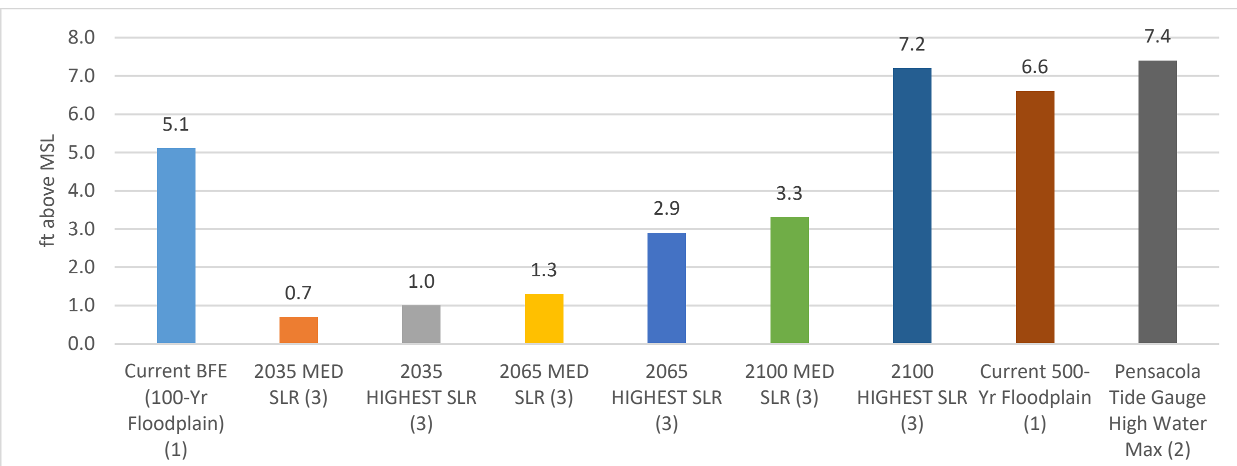
UFC requirement example: UFC 3-201-01, *Civil Engineering*, establishes minimum flood mitigation requirements for any facility built within or partially within a floodplain - it must be built 2’ above the BFE (if a non-mission critical facility) or 3’ above the BFE if a critical facility.

Table D.1 – Spreadsheet Data Elements

Data Element	Elevation (FT)
Current BFE (100-Yr Floodplain) (1)	5.1
Non-Critical Minimum (2') + BFE	7.1
Critical Minimum (3') + BFE	8.1
2035 MED SLR	0.7
2035 MED SLR + BFE	5.8
2035 HIGHEST SLR	1.0
2035 HIGHEST SLR + BFE	6.1
2065 MED SLR	1.3
2065 MED SLR + BFE	6.4
2065 HIGHEST SLR	2.9
2065 HIGHEST SLR + BFE	8.0
2100 MED SLR	3.3
2100 MED SLR + BFE	8.4
2100 HIGHEST SLR	7.2
2100 HIGHEST SLR + BFE	12.3
Current 500-Yr Floodplain (1)	6.6
Pensacola Tide Gauge High Water Max (2)	7.4

Compiling the information in this fashion allows the installation to chart different data elements. For example, one chart could show the current BFE, sea level change scenarios, 500-year floodplain, and local high-water mark (**Figure D.11**).

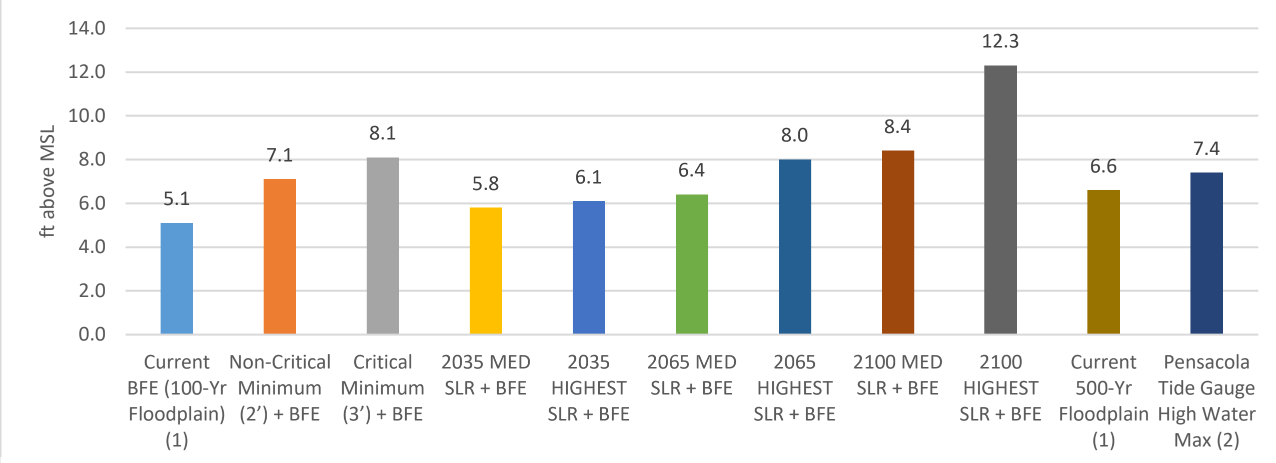
Figure D.11 – Floodplain, Sea Level Scenario and High-Water Mark Data Points



Alternatively, compiling data into a spreadsheet allows for the creation of charts that contains the sea level scenarios added to the BFE and the minimum flood mitigation requirements described in UFC 3-201-01, in addition to the 500-year floodplain and the local high water mark (**Figure D.12**).

Example – Hurlburt Field: the BFE for the 100-year floodplain is listed as 5.1'. When added to the various future sea level scenarios, you get values that range from 5.8' (2035 Medium scenario of 0.7' + 5.1') to 12.3' (2100 highest scenario of 7.2' + 5.1').

Figure D.12 – Base Flood Elevation, NDAA Minimums, Sea Level Scenarios, 500-year Floodplain, High Water Mark Data Points



(1) Colorado State University (CSU)
(2) NOAA Tides and Currents (https://tidesandcurrents.noaa.gov/)
(3) DoD Regional Sea Level (DRSL) Database

Charts are just one way of illustrating the range of potential scenarios to consider while planning.

Installations should consider available data and how it might influence planning decisions at the base. For example, installations might consider projection data for the year 2065 as a planning scenario for permanent facilities. Since many buildings will be around longer than 50 years, considering the planning scenario for the year 2100 may also be appropriate. 2035 as a planning scenario is generally not appropriate for buildings unless a temporary facility is under consideration whose lifespan will not exceed 2035.

Installations should begin thinking about a variety of scenarios, low, medium, or highest, but in general, understanding the "worst case" is beneficial, keeping in mind that the installation must also consider affordability. Other factors, such as the asset's value and relation to the installation's mission, can also be considered. Generally, a high-value, mission-critical asset should be planned referencing a more extreme flood scenario than a lower-value, non-mission-critical asset.

D.2.2 What to do with this Data?

This appendix will discuss two actions one can do with this information - develop future constraints maps and determine design flood elevations for the installation.

<u>Develop Future Constraints Maps</u>

If GIS expertise is available, understanding how future sea level scenarios may impact the installation through potential permanent inundation and/or higher storm surge flooding may be helpful. A bath-tub model approach could be used to depict the sea level rise by itself or the combination of existing floodplain elevation (or BFE) and each of the future sea level scenarios. Examining which assets might be exposed to these future constraint areas will assist in making educated planning decisions. *Note: other factors such as hydrology, hydraulics, infrastructure, and land use are contributing factors to determining flood hazard areas.*

This task may be outside the capabilities of the local GIS office, so the installation may wish to contact AFCEC (or the relevant Reserve Component HQ) to request new GIS support to depict future scenarios based on the DRSL data. Installation planners can then utilize these maps as a tool in planning and proceed accordingly (e.g., in addition to avoiding siting facilities in or partially within the current floodplain, the installation should also avoid siting a facility in or partially within a future floodplain). If an installation must site a facility in this area due to a lack of alternatives, they should review the UFC 3-201-01 and **App B – Phase 3** worksheet for recommendations.

Develop Design Flood Elevation

Planners may also wish to determine whether a Design Flood Elevation (DFE) or DFEs for your installation would be appropriate, considering the relevant data points collected above. For playbook purposes, a DFE is defined as the minimum elevation to design assets, considering not just the BFE but other factors such as historic storm surge data, sea level change, regulatory mandates, state or local requirements, building code requirements, and an asset owner's risk tolerance.

Generating a DFE for an installation is an installation-specific decision that must be developed based on a review of the available data, installation topography, infrastructure, land use, risk tolerance, and cost/priority considerations. Using local GIS data, an installation can identify which facilities are located within the current 100-year and 500-year floodplains and understand installation topography. The map in **Figure D.13** shows a close-up of the existing floodplain and topography at Hurlburt Field (note: elevation contours are not shown). In this example, facilities (housing) and a roadway are currently located within both the 100-year and 500-year floodplains. For this example, buildings constructed at 15' elevation are outside both current 100-year and 500-year floodplains. Housing constructed at 10' are within the 500-year floodplain, and housing at less than 10' are within the 100-year floodplain.

Installations could also map DRSL data points and past events that impacted the installation to help determine a DFE for the installation. Installation Civil Engineers and local weather flights know the impacts experienced during past storm events and can help inform a DFE. For example, from SLVAS report data (details in Section 1.2.1(d)), we learn that houses built at a height greater than the 12' storm surge experienced during Hurricane Ivan were not damaged during that storm.

In an ideal situation, if cost were not an object, the installation in **D.12** might choose to set a conservative DFE in the immediate coastal area of the installation. A DFE greater than 12.3' (the 2100 Highest SLR scenario of 7.2' + 5.1' current BFE) would place facilities outside or above the projected 100-year floodplain in 2100 (with the Highest SLR scenario). A higher DFE could be selected, based upon the observation above that buildings constructed at 15' elevation are outside both the current 100-year and 500-year floodplains. Additionally, an installation could elect to consider the effects of future SLR scenario on the 500-year floodplain.

Since the majority of the installation's facilities are higher than 15' north of the highway running through the base, setting the DFE at 12.3' or 15' may not result in extreme cost impacts; however, installation personnel must make an informed decision by considering the cost impacts and risk threshold acceptable to installation leadership. Per UFC 3-201-01, the DFE should not be set below the UFC minimum of 2' or 3' above the current BFE (7.1' and 8.1' with regards to the **Figure D.12** example).

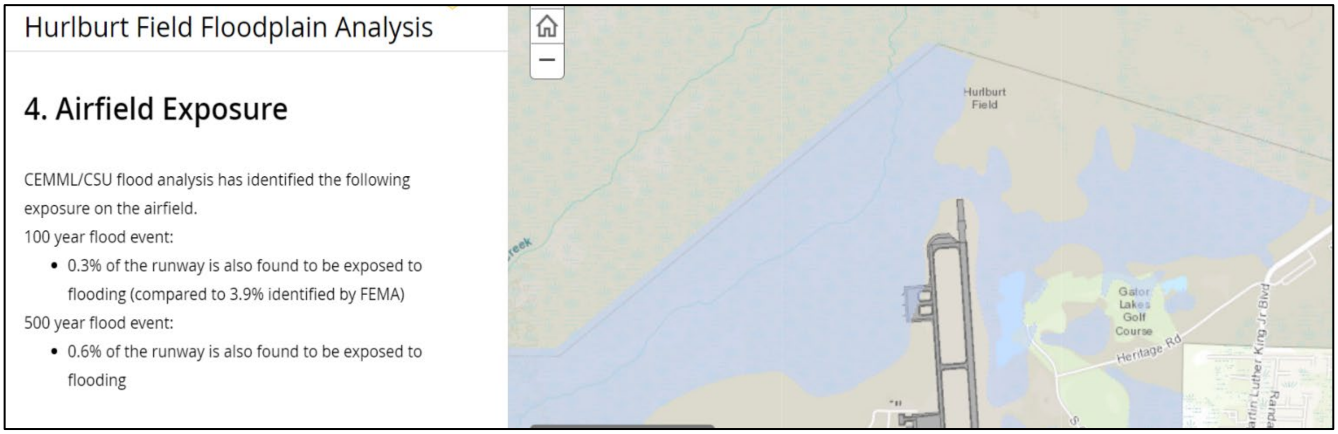
Installations should consider establishing as high a DFE as is affordable considering installation topography, risk tolerance, and cost. Please note that it may be appropriate to set more than one

Figure D.13 – Using GIS Layers to Analyze Installation Data Example #1

Figure 4 Differences in exposed infrastructure between FEMA's 100-year flood map and CEMML/CSU Engineering developed 100-year and 500-year flood map. FEMA's FIRM does not include a 500-year flood map for this region.

DFE for different areas of an installation due to the topography. For example, at Hurlburt (**Figure D.14**), the installation may wish to consider setting a second DFE for the north side of the installation where flooding may be experienced from an inland swamp. The northern, non-coastal portion of Hurlburt is at a higher elevation, 20-30’, but flooding from an inland swamp could impact critical airfield facilities. The airfield facilities shown are at 30’ or higher and are outside the existing 100-year floodplain. It might be appropriate to set a higher DFE for future construction in this installation area that also considers potential sea level rise scenarios. Again, the DFE set should consider cost impacts and the criticality of constructed facilities.

Figure D.14 - Using GIS Layers to Analyze Installation Data Example #2



D.2.3 Practical Caveats Relating to Visualizations

Those assessing site or asset vulnerability to a changing climate will likely want to develop visualizations that help depict the potential for future risks. However, data turned into images can take on a life of their own. This is especially true for maps, where a strong tie to a sense of place makes the data seem "real" even when the map is showing potential futures. To be clear on maps or visualizations developed, it is important to supply the following pieces of information:

1. Clearly state what the map shows (e.g., plausible SLC scenarios for a site or region for specific timeframe(s)).
2. Identify the scenarios selected for the visualization (i.e., 0.2, 0.5, 1.0, 1.5, and/or 2.0 m rise by 2100) and why.
3. Emphasize that scenarios are not projections of what is likely to happen at a site; they represent plausible futures that may aid in risk management discussions.
4. Provide background on the quality of the underlying map data, such as the elevation resolution. For example, if the underlying map data is accurate plus or minus 2 feet, then attempting to depict a 1-foot change over time may not be a legitimate exercise (for additional reading, refer to Section 5.2.3, Effects of topographic data quality on inundation mapping in the DoD Regional Sea Level Scenarios report).
5. Describe any alignments made to account for differences between land reference datums and tidal datums (i.e., addition or subtraction of offsets as described above).
6. Adaptation strategies may differ for each impact and timing of impacts. If maps show the combined effects of SLC and EWLs, it is advisable to prepare two separate maps. First, depict SLC scenarios, and then depicting EWLs. This may help illustrate the components that make up the combined map (storm surge added on top of SLC). In addition, it is helpful to distinguish between temporary flooding from storm surge and permanent inundation from SLC.

Appendix E - List of hyperlink URLs embedded or listed within the playbook

Links listed in order of appearance.

Planning Toolbox

AFCEC Portal Climate Planning Toolbox: CAC enabled:
https://portal.afcec.hedc.af.mil/CP/CPP/Climate_Planning_Toolbox/Forms/AllItems.aspx

- Severe Weather Playbook App B App C Worksheet
- References

CE Dash:
https://usaf.dps.mil/teams/CEDASH/SitePages/Topic Page.aspx?Topic=Installation%20Energy%20Plan%20(IEP)

- IEPs located under the resources tab

Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3810.01:
https://www.jcs.mil/Portals/36/Documents/Library/Instructions/CJCSI%203810.01F.pdf?ver=2019-05-28-101041-980

Example

15th OWS Offutt AFB Weather Data page (example):
https://15ows.us.af.mil/tech_ref/idp/index.cfm?icao=KOFF

Climate Portal

14th WS Climate Portal: https://climate.af.mil/

14th WS Cyclone data: https://climate.af.mil/cyclones_svr_wx

14th WS Temperature trend data: https://climate.af.mil/product_locator/?&product=trendplots

14th WS Product Catalog: https://climate.af.mil/data/datasets/product_catalog_14ws.pdf

14th WS MAJCOM Reports: https://climate.af.mil/threat_assessment_report

14th WS Climogram data: https://climate.af.mil/OCDS-II

14th WS Operational Climatic Data Summary handbook: https://climate.af.mil/OCDS-II/docs/ocds_monthly_climate_summary_help.pdf

14th WS Engineering Weather Data handbook:
https://climate.af.mil/static/docs/ewd_handbook_14WS.pdf

Geospatial Data

AF GeoBase AFGIMS: https://maps.af.mil/viewer/

Defense Installations Spatial Data Infrastructure (DISDI) Portal:
https://rsgisias.crrel.usace.army.mil/disdiportal/f?p=166:5

DISDI Atlas Pro (Map Viewer):
https://rsgisias.crrel.usace.army.mil/disdicm2/disdi.cm27.map?map=disdi6

Planning Components

Comprehensive Planning Platform:
https://cs2.eis.af.mil/sites/13391/Style%20Library/IDP/Prod/home.aspx

Legacy Installation Development Plan (IDP) Sustainability Development Indicators (SDI): https://portal.afcec.hedc.af.mil/CP/CPP/SitePg.s/Installation%20Resources.aspx

Legacy Installation Complex Encroachment Management Action Plans (ICEMAP): https://portal.afcec.hedc.af.mil/CP/CPP/SitePg.s/Installation%20Resources.aspx

Integrated Natural Resources Management Plan (INRMP): https://maps.af.mil/geoportal/apps/sites/#/environmental/pages/climate-change

Climate Sharepoint

SAF/IEIP Climate Adaptation and Resiliency SharePoint site: https://usaf.dps.mil/sites/13013/SAFIEI/IEIP/Climate1/Home.aspx

Sea Level

DoD Regional Sea Level (DRSL) Database, CAC-required: https://drsl.serdp-estcp.org/site

DoD Regional Sea Level (DRSL) Database, public-facing version: https://drsl.serdp-estcp.org/

Coastal Assessment Regional Scenario Working Group (CARSWG) Regional Sea Level Scenario

Report: https://drsl.serdp-estcp.org/Docs/CARSWG_SLR.pdf

USACE Sea Level Tracker: https://climate.sec.usace.army.mil/slr_app/#tab-4895-2

Climate Assessment and Projections

U.S. Climate Resilience Toolkit Climate Explorer: https://crt-climate-explorer.nemac.org/

AFCEC/CZTQ – CSU Study Future Flooding Scenario maps and reports: https://maps.af.mil/geoportal/apps/sites/#/environmental/pages/enhanced-floodplains

DoD Climate Assessment Tool (DCAT) – CONUS, Alaska, and Hawaii: https://dodclimate.sec.usace.army.mil/dcat_conus_ak_hi

DoD Climate Assessment Tool (DCAT) – Rest of the World: https://dodclimate.sec.usace.army.mil/dcat_row

Installation Climate Resilience Plan (ICRP) Template Folder

Word and PDF versions: https://portal.afcec.hedc.af.mil/CP/CPP/Climate_Planning_Toolbox/Installation%20Climate%20Resilience%20Plan%20(ICRP)%20Template

Regional Planning

American Planning Association: https://www.planning.org/

JBLE JLUS: https://hampton.gov/1788/Hampton-Langley-Joint-Land-Use-Study

Readiness and Environmental Protection Integration (REPI): https://www.repi.mil/

REPI Webinars: https://www.repi.mil/Resources/Webinars/

Defense Access Road Program: https://flh.fhwa.dot.gov/programs/dar/

Handbooks and Guides / Next Steps

NAVFAC Climate Change Planning Handbook: https://www.fedcenter.gov/Documents/index.cfm?id=31041

DoD Climate Adaptation for Natural Resources Guide:
https://www.denix.osd.mil/nr/dodadaptationguide/dod-adaptation-guide/guide-incorporating-climate-considerations-into-inrmps/

DoD Installation Exposure to Climate Change at Home and Abroad, Appendix 3:

https://media.defense.gov/2021/Apr/20/2002624613/-1/-1/1/DOD-INSTALLATION-EXPOSURE-TO-CLIMATE-CHANGE-AT-HOME-AND-ABROAD.PDF

Climate Data available

DRSL Database: https://sealevelscenarios.serdp-estcp.org/site

NOAA Tides and Currents website: https://tidesandcurrents.noaa.gov/

AFCEC/CZ Floodplain Analysis Report:
https://maps.af.mil/geoportal/apps/sites/#/environmental/pages/enhanced-floodplains