



# Climate Vulnerability Assessment Executive Summary



The City of Philadelphia Division of Aviation (DOA), which operates Philadelphia International Airport (PHL, or the Airport), conducted a Climate Vulnerability Assessment (CVA) in 2019. The CVA helps DOA better understand and prepare for the impacts of climate change on PHL's employees and visitors, services, neighbors, facilities, and assets.

## What Does Climate Change Look Like in Philadelphia?

In recent years, extreme weather events and changing weather patterns in the Philadelphia region have already stressed energy systems, caused flooding, and threatened the health and safety of residents, particularly vulnerable communities.

The following climate-related impacts are anticipated to worsen:



» **Increased Temperatures:** Increases in average temperature and the occurrence of more extreme heat and less extreme cold



» **Changing Precipitation:** Increases in average annual precipitation and the occurrence of heavy precipitation events

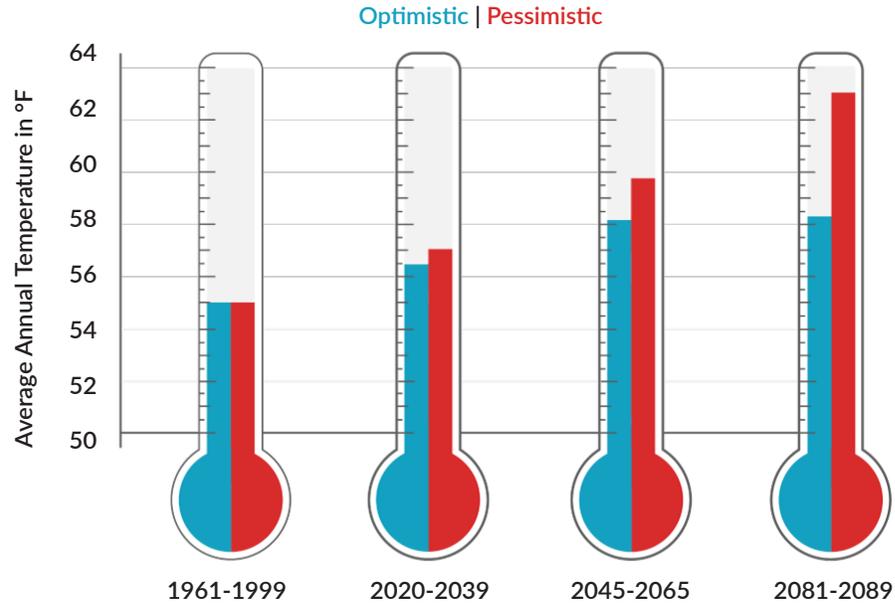


» **Extreme Storm Events:** The occurrence of more frequent and intense extreme storm events

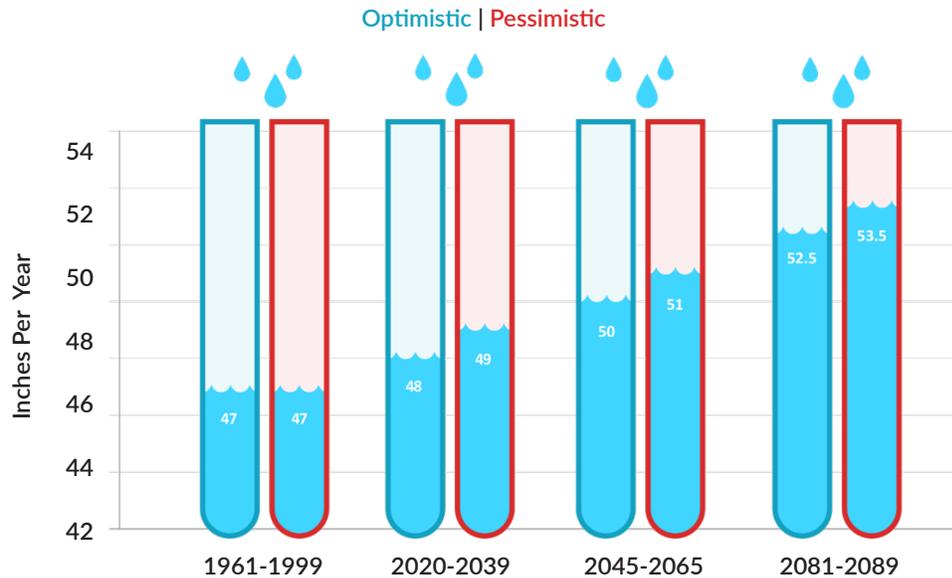


» **Sea Level Rise:** Increases in local sea level rise at a rate greater than that of global sea level rise, with associated high tide flooding and storm surge

## Average Annual Temperature in °F—Historic and Projected, Delaware Valley Regional Planning Commission (DVRPC) Region



## Average Annual Precipitation in Inches—Historic and Projected, Delaware Valley Regional Planning Commission (DVRPC) Region

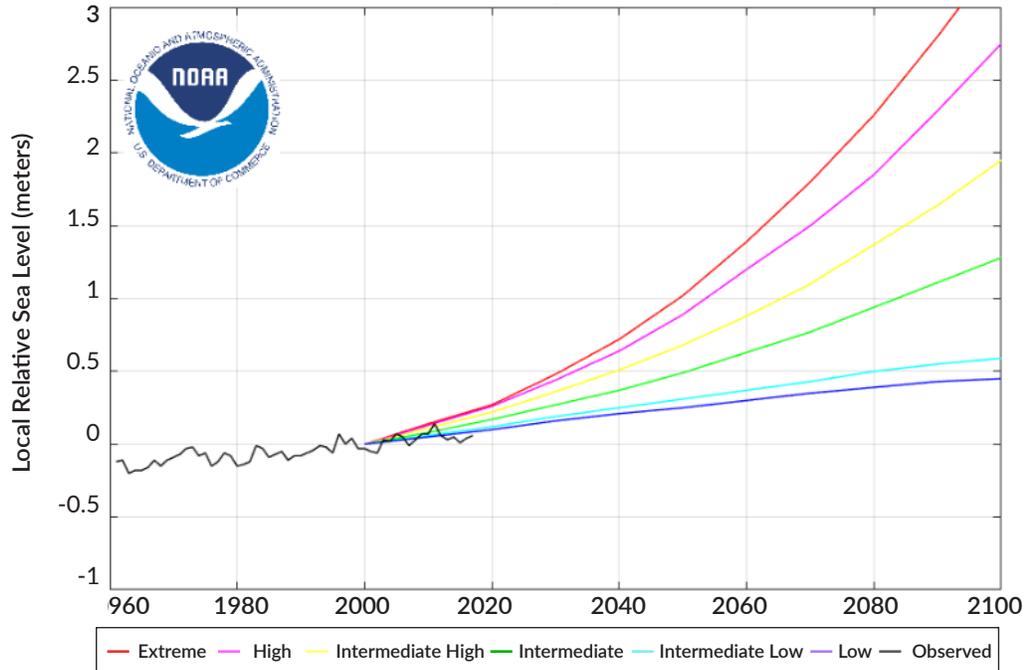


Source (both figures): Delaware Valley Regional Planning Commission. 2019. Municipal Management in a Changing Climate - Municipal Implementation Tool 31. <https://www.dvrpc.org/Reports/MIT031.pdf>. Data provided by ICF.

Note (both figures): Optimistic represents a lower carbon emissions scenario, or representative concentration pathway (RCP) 4.5. Pessimistic scenario represents a higher carbon emissions scenario, or RCP 8.5.



## Projected Sea Level Rise in Philadelphia, Pennsylvania



Source: National Oceanic and Atmospheric Administration. 2017. Technical Report NOS CO-OPS 083 - Global and Regional Sea Level Rise Scenarios for the United States. [https://tidesandcurrents.noaa.gov/publications/techrpt83\\_Global\\_and\\_Regional\\_SLR\\_Scenarios\\_for\\_the\\_US\\_final.pdf](https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf)

Note: The year 2000 is the “zero,” or baseline year, for the figure.

## Why Does Climate Change Matter to Airports?

According to the Federal Aviation Administration (FAA), the National Academy of Sciences, the Transportation Research Board, and the Airport Cooperative Research Program (ACRP), climate change impacts at airports will continue to:

- » Cause costly damage to airport structures and facilities
- » Threaten the health and safety of employees and passengers
- » Delay and ground flights, disrupting airline schedules
- » Harm the economic viability of airport operations

Climate changes could also compromise airports’ crucial role in the regional transport of goods, provision of food security, deployment of emergency management operations, and the livelihoods and health of employees from a range of socioeconomic backgrounds. Understanding the vulnerabilities specific to PHL is a critical first step in addressing these challenges.



# Ongoing Climate Action in Philadelphia

The PHL CVA complements ongoing climate action efforts at PHL, the City of Philadelphia (owner and operator of PHL), and state and regional planning organizations.



## Approach to the Climate Vulnerability Assessment

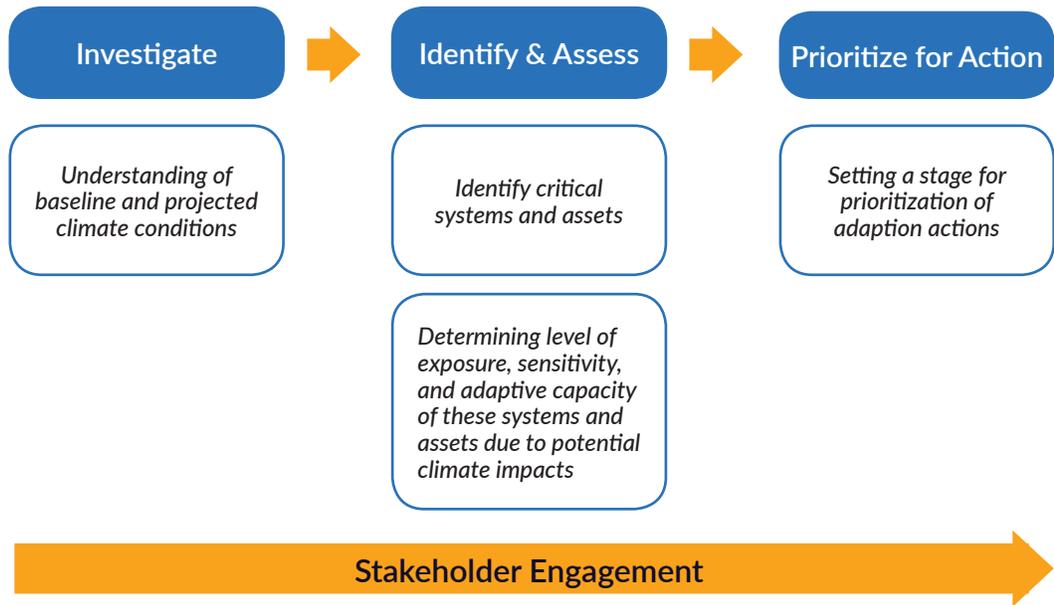
The CVA approach consisted of:

1. Investigating climate trends and projections for Philadelphia
2. Identifying and assessing key vulnerabilities at PHL
3. Identifying priority action areas to address these vulnerabilities

Throughout these three steps, the DOA conducted outreach to airport stakeholders to understand their perspectives on the vulnerabilities at PHL. The stakeholder engagement effort included two stakeholder workshops; an online survey of PHL staff, airlines, the Philadelphia Police Department, and the FAA; and small group interviews.



## Climate Vulnerability Assessment Approach



## Key Findings

DOA, in collaboration with stakeholders, identified the following “functional areas,” or groupings of key Airport assets, to understand their vulnerabilities.

### Functional Areas

- » **Passengers, employees, and human resources**
- » **Aircraft operations**
- » **Airfield operations**
- » **Passenger terminal facilities**
- » **Landside facilities and infrastructure**
- » **Airport non-terminal facilities**
- » **Utility systems**
- » **Information technology and telecommunications**

For each of these identified functional areas, the Project Team and stakeholders discussed which assets were exposed to the climate impacts presented above. *Exposure* considers the combined likelihood of potential climate impacts, where and when those impacts may occur, and which resources (man-made, natural, and human) may be exposed to those impacts. Accounting for this exposure, stakeholders then assessed the *sensitivity*, or the degree of impacts to the system due to climate change, and the *adaptive capacity*, or the ability of the system to respond and recover from these impacts. The combination of these two assessment categories yielded a vulnerability ranking.

### Functional Area Vulnerability Rankings

	Passengers, Employees, & Human Resources	Aircraft Operations	Airfield Operations	Passenger Terminal Facilities	Landside Facilities & Infrastructure	Airport Non-Terminal Facilities	Utility Systems	Information Technology & Telecommunications
Increase in temperature - days 95°F or higher	High Vulnerability	Low Vulnerability	Medium-Low Vulnerability	Medium-Low Vulnerability	Medium-Low Vulnerability	Medium-Low Vulnerability	Medium-Low Vulnerability	Medium-Low Vulnerability
Sea level rise	Medium-Low Vulnerability	High Vulnerability	High Vulnerability	Medium-High Vulnerability	Medium-High Vulnerability	Medium-High Vulnerability	Medium-High Vulnerability	Low Vulnerability
Changing precipitation (increased volume/frequency of extreme rainfall events)	Medium-Low Vulnerability	Medium-High Vulnerability	Medium-High Vulnerability	Medium-Low Vulnerability	High Vulnerability	Medium-High Vulnerability	High Vulnerability	Medium-Low Vulnerability
Increase in hurricanes/extreme storm events/storm surge	Medium-High Vulnerability	Medium-High Vulnerability	Medium-High Vulnerability	Medium-Low Vulnerability	High Vulnerability	High Vulnerability	High Vulnerability	Medium-High Vulnerability



# Key Recommendations and Next Steps

## Sea Level Rise Planning Horizons

The vulnerability rankings demonstrate that sea level rise, storm surge, and related flooding impacts could present potentially significant challenges for many assets at PHL. Based on these rankings, as well as a preliminary assessment of the existing water resources and flood studies as part of the climate data review, the following three planning horizons for assets at risk of flooding are recommended. These scenarios will be important as PHL considers key planning questions for its assets such as the long-term suitability of their current location, as well as the siting of new facilities and infrastructure.

Timeframe	Asset Risk-Tolerance Level	Asset Design Life	Sea Level Rise	NOAA Scenario
Short-Range	High	Shorter	1.6 feet	2050 Intermediate
Mid-Range	Low	Shorter	3.0 feet	2050 High
	High	Mid-Range		
Long-Range	Low	Longer	4.9 feet	2070 High 2085 Intermediate-High

Source: NOAA - National Oceanic and Atmospheric Administration, VHB.

### Preliminary Sea Level Rise Planning Horizons Recommended for PHL

Planners can use this table as a preliminary tool to choose the most appropriate sea level rise scenario, based on the risk-tolerance and design life of a particular asset. For example, for an asset with a high risk tolerance and shorter design life, planners may want to consider 1.6 feet of sea level rise; for an asset with a low risk tolerance and shorter design life, planners may want to consider 3.0 feet of sea level rise.

These increases in sea level, and forecasted increases in precipitation, have the potential to cause significant flood impacts to PHL during high tides and severe weather events. In order to fully understand the risk of flooding at PHL, and to begin planning adaptation and flood protection measures, a detailed hydrologic and hydraulic analysis is needed to analyze the forecasted flooding at PHL due to climate change.



## Suggested Strategies to Address Vulnerabilities

For all functional areas, suggested strategies to address vulnerabilities and future adaptation actions for PHL to consider pursuing include:

Suggested Strategy	Description
<b>Develop an Airport-specific Climate Action and Resiliency Plan</b>	<ul style="list-style-type: none"> <li>» Incorporate resiliency into the Airport’s day-to-day operations</li> <li>» Gather input from PHL stakeholders and other local entities</li> <li>» Identify strategies to address specific vulnerabilities</li> </ul>
<b>Integrate climate change related risks into training programs and communications protocols</b>	<ul style="list-style-type: none"> <li>» Build on existing informational and alert systems</li> <li>» Educate and train staff in response protocols</li> <li>» Ensure that all communications are accessible to a range of audiences</li> </ul>
<b>Integrate climate change risks into capital planning and asset management</b>	<ul style="list-style-type: none"> <li>» Develop design guidelines in accordance with risk</li> <li>» Maintain and fortify critical infrastructure</li> <li>» Integrate climate change considerations into budgeting process</li> <li>» Address potentially conflicting mitigation and adaptation strategies (e.g., electrification versus diverse back-up power sources)</li> <li>» Consider on-site energy generation</li> </ul>
<b>Evaluate specific flooding vulnerabilities and potential impacts</b>	<ul style="list-style-type: none"> <li>» Further evaluate existing conditions for local water bodies</li> <li>» Complete hydrologic and hydraulic modeling studies and evaluate potential flood adaptation measures</li> <li>» Ensure access roadways are navigable for employees and emergency vehicles during flood events</li> </ul>
<b>Work with local/regional/state entities to develop climate resilience partnerships and adopt best practices</b>	<ul style="list-style-type: none"> <li>» Develop transportation, utility, and infrastructure strategies with local authorities (Philadelphia Water Department, Southeastern Pennsylvania Transportation Authority [SEPTA], Philadelphia Gas Works, PECO)</li> <li>» Consider living shorelines and other natural adaptation measures in partnership with other state and regional bodies, including entities responsible for the Coastal Zone Management Program (NOAA, Pennsylvania Department of Environmental Protection)</li> </ul>

Moving forward, DOA should continue climate resiliency planning and preparedness efforts in concurrence with the PHL Master Plan Update and other efforts, prioritizing adaptation strategies based on the risk to PHL’s stakeholders, assets, and operations. As these specific planning efforts take place, DOA may want to consider a more detailed risk assessment that evaluates, in addition to vulnerability, the criticality or importance of particular assets to PHL’s operations, as well as the magnitude of a particular climate impact to which specific assets are exposed.

