EPA Office of Brownfields and Land Revitalization

Sea Level Rise Adaptation Training

Agenda

- Introduction: Brownfields Land Revitalization and Sea Level Rise (Ann Carroll, 10 minutes)
- Sea Level Rise Science and Screening Tools (Brenda Dix, 35 minutes)
- Q&A (20 minutes)
- Case Study: Philadelphia Delaware Avenue Extension (Brenda Dix, 10 minutes)
- Q&A (15 minutes)

Question

- How long have you been working in your current brownfields or site remediation position?
  - Less than 1 year
  - 1 - 4 years
  - 5 – 9 years
  - 10+ years

- What do you want to learn from this session?

Introduction: Brownfields and Sea Level Rise

Sea Level Rise Impacts on Brownfields Sites

Sea level rise will lead to more frequent and expansive flooding

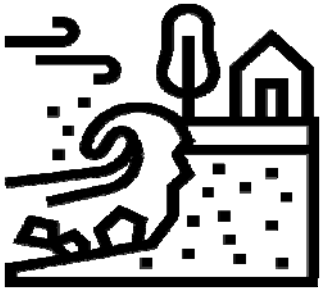
Floodwaters can mobilize brownfield site contaminants and debris

Impacts can increase environmental justice concerns

Sea Level Rise Causes…

More frequent flooding

More expansive flood events



Increased shoreline erosion

Elevated groundwater levels

Sea Level Rise Risks to Brownfield Sites

Mobilized debris and contaminants

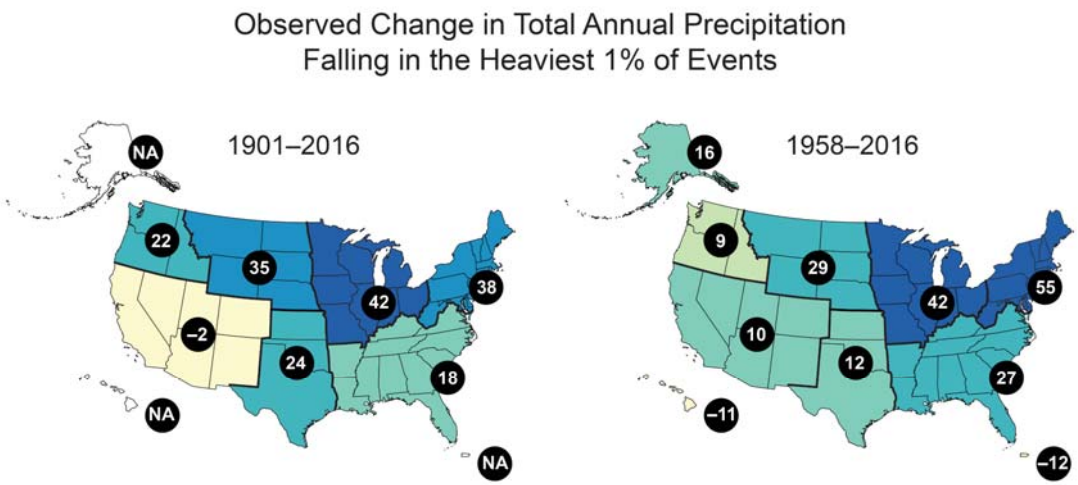
Impeded stormwater drainage

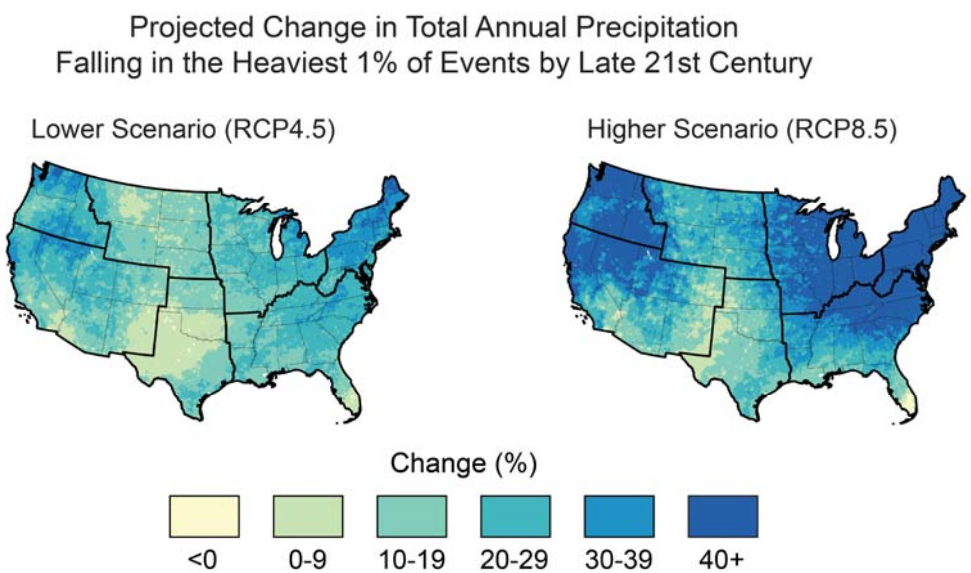
Damage to critical infrastructure

Damage to buildings

Inland Flooding

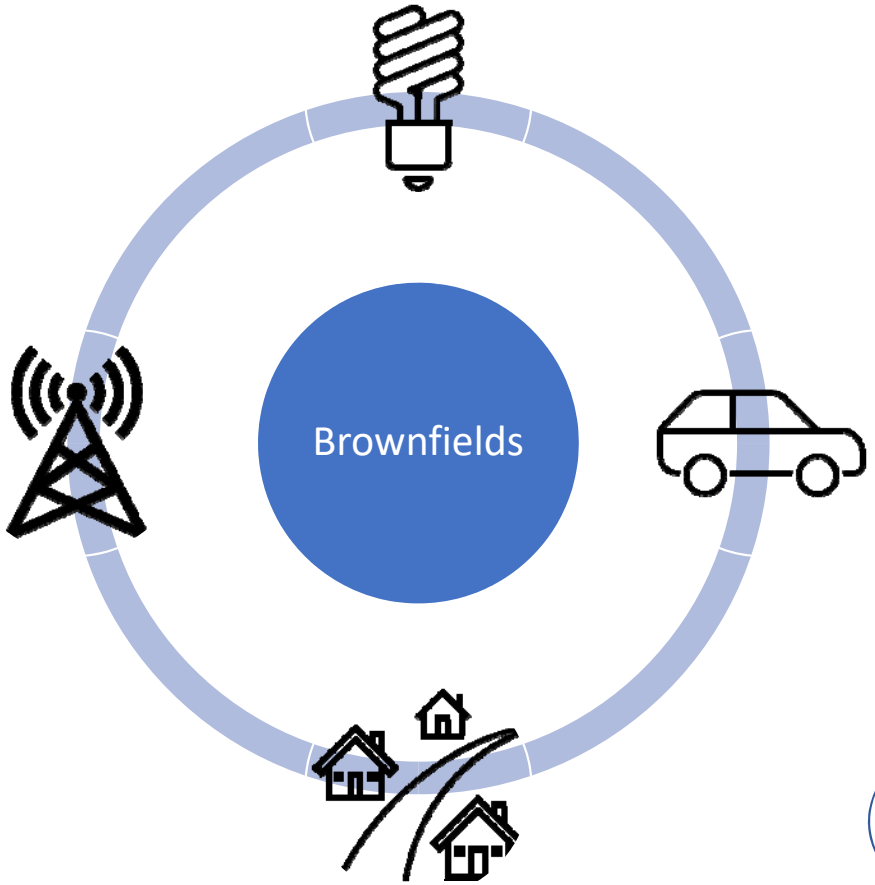
- Changes in precipitation patterns will increase the risk of inland flooding
- FEMA flood insurance rate maps do not reflect future risks
- FloodFactor is a screening tool that accounts for sea level rise and increased precipitation levels





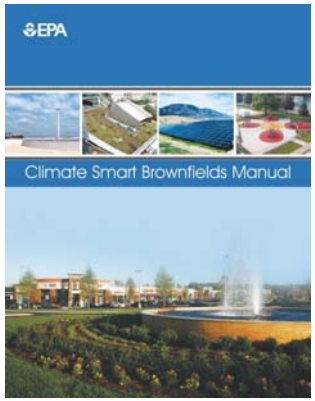
Infrastructure Connections

Sustainable redevelopment requires thoughtful consideration of connections to local infrastructure and communities.



Consider Sea Level Rise Early in the Brownfield Redevelopment Process

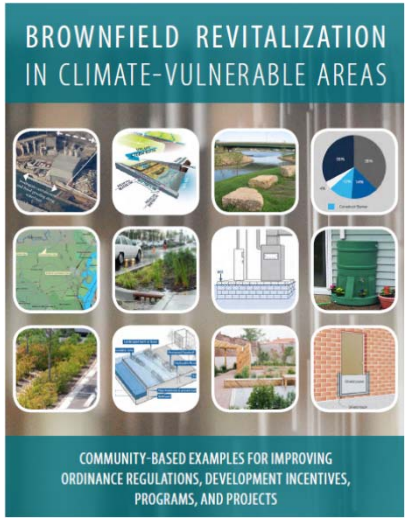
Brownfield and Land Revitalization Resources for Additional Information



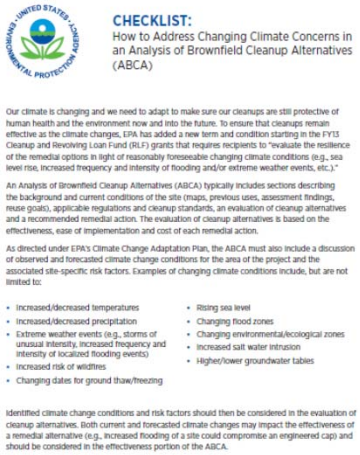
[U.S. EPA: Climate Smart Brownfield Manual]

[Adapting to Rising Tides: Contaminated Lands]

Brownfield and Land Revitalization Resources for Additional Information



U.S. EPA: Brownfield Revitalization in Climate-Vulnerable Areas



CHECKLIST:
How to Address Changing Climate Concerns in an Analysis of Brownfield Cleanup Alternatives (ABCA)

Our climate is changing and we need to adapt to make sure our cleanups are still protective of human health and the environment now and into the future. To ensure that cleanups remain effective as the climate changes, EPA has added a new term and condition starting in the FY13 Cleanup and Revolving Loan Fund (RLF) grants that requires recipients to "evaluate the resilience of the remedial options in light of reasonably foreseeable changing climate conditions (e.g., sea level rise, increased frequency and intensity of flooding and/or extreme weather events, etc.)."

An Analysis of Brownfield Cleanup Alternatives (ABCA) typically includes sections describing the background and current conditions of the site (maps, previous uses, assessment findings, reuse goals), applicable regulations and cleanup standards, an evaluation of cleanup alternatives and a recommended remedial action. The evaluation of cleanup alternatives is based on the effectiveness, ease of implementation and cost of each remedial action.

As directed under EPA's Climate Change Adaptation Plan, the ABCA must also include a discussion of observed and forecasted climate change conditions for the area of the project and the associated site-specific risk factors. Examples of changing climate conditions include, but are not limited to:

- Increased/decreased temperatures
- Increased/decreased precipitation
- Extreme weather events (e.g., storms of unusual intensity, increased frequency and intensity of localized flooding events)
- Increased risk of wildfires
- Changing dates for ground thaw/freezing
- Rising sea level
- Changing flood zones
- Changing environmental/ecological zones
- Increased salt water intrusion
- Higher/lower groundwater tables

Identified climate change conditions and risk factors should then be considered in the evaluation of cleanup alternatives. Both current and forecasted climate changes may impact the effectiveness of a remedial alternative (e.g., increased flooding of a site could compromise an engineered cap) and should be considered in the effectiveness portion of the ABCA.

Checklists to Consider Climate in Brownfield Cleanup

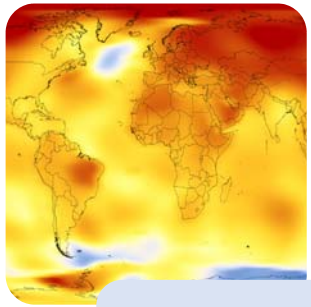
Sea Level Rise Science and Screening Tools

Question

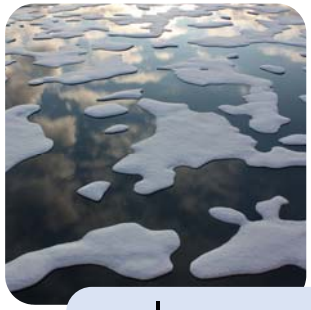
- What level of experience do you have with assessing sea level rise?
  - None
  - Have read some about sea level rise projections
  - Have used a sea level rise viewer to explore local impacts
  - Have conducted a site-specific impacts assessment
  - Have developed sea level rise adaptation strategies

Sea Level Rise Process

Increased global greenhouse gas emissions



Warmer atmospheric temperatures



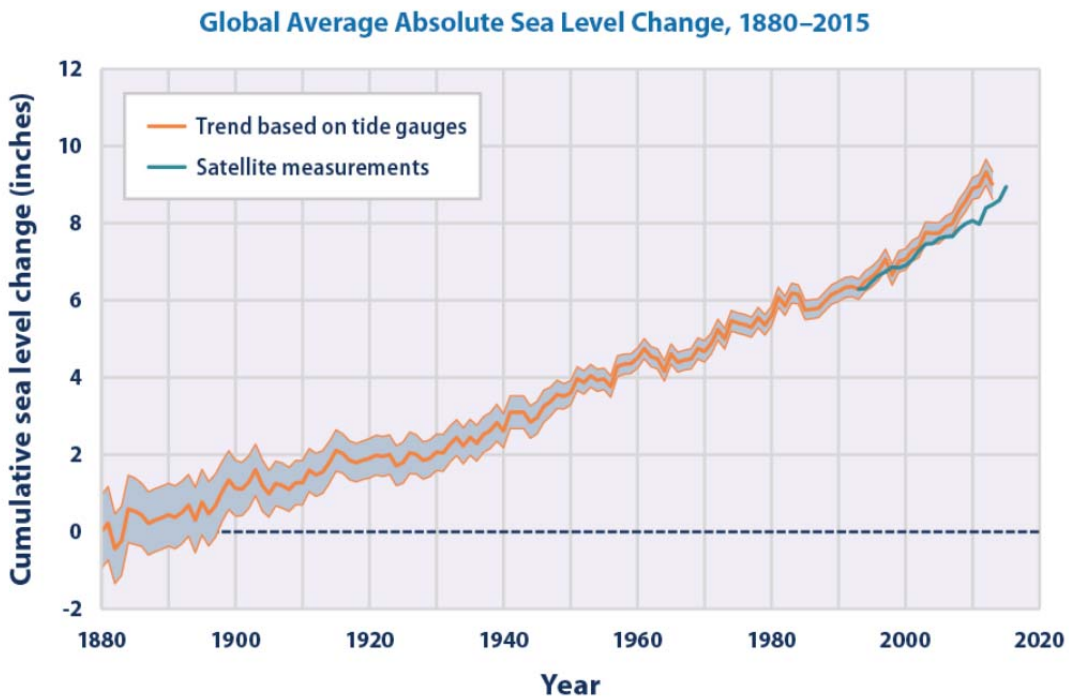
Increased polar ice melt and thermal expansion

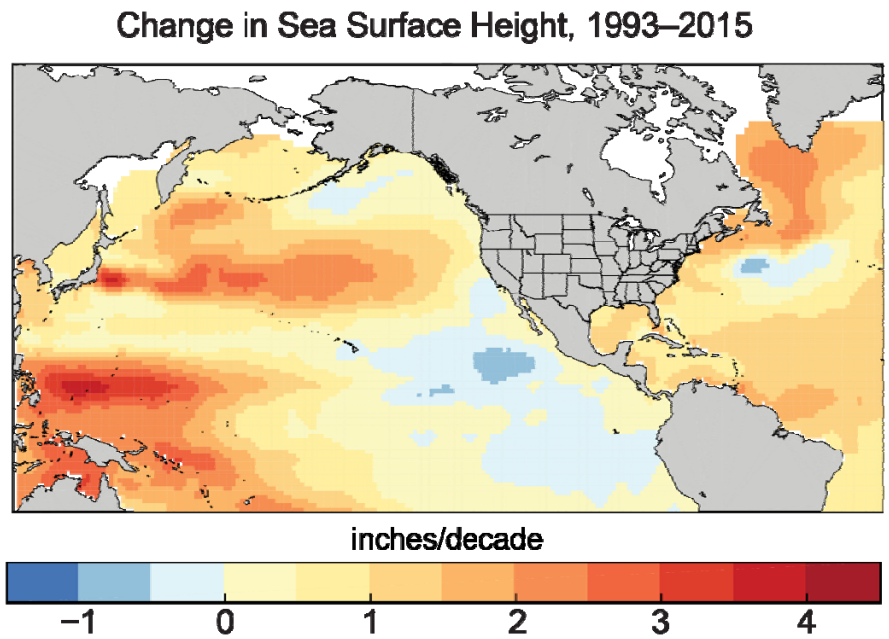
Regional subsidence/ uplift

Global Sea Level Rise

Regional Sea Level Rise

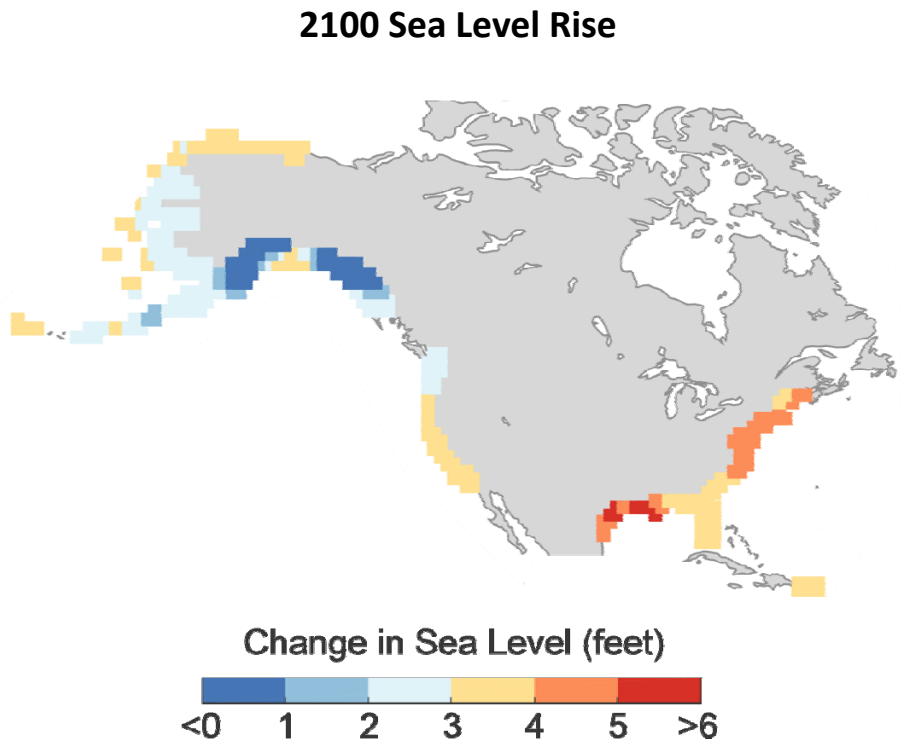
Past Sea Level Rise Trends





Future Sea Level Rise Rates

Rates of sea level rise will vary due to regional factors like land movement and ocean dynamics



Sea Level Rise Exposure Screening Process

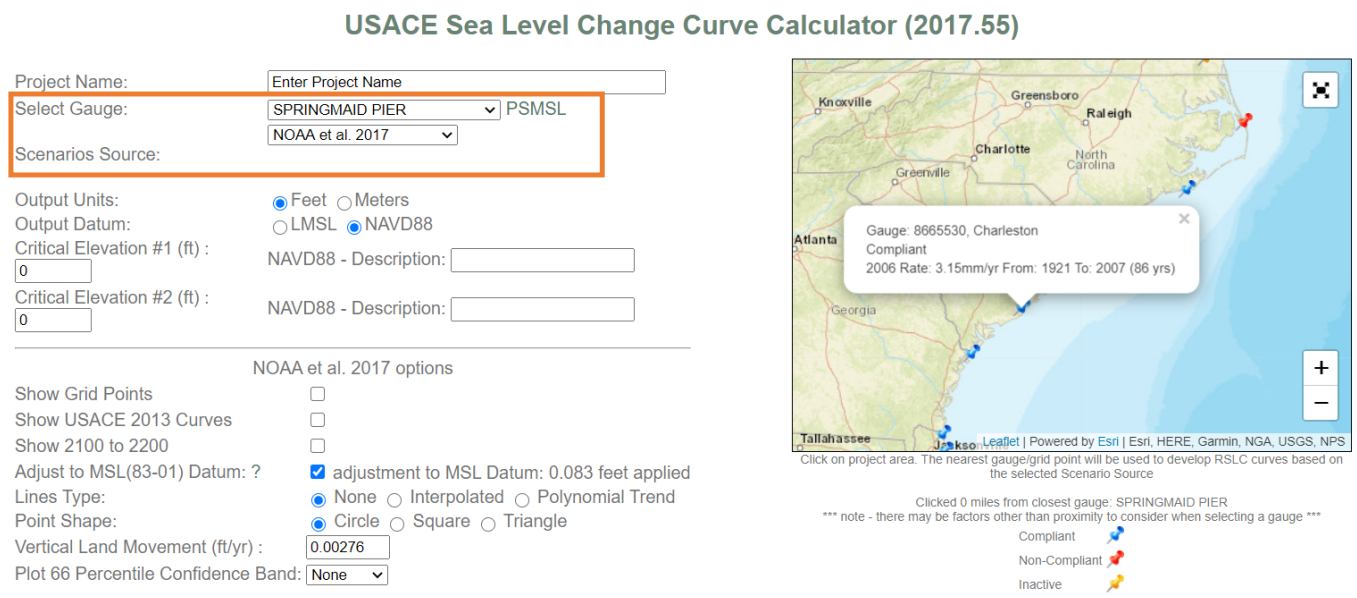
1. Explore sea level rise projections
2. Visualize potential flooding
3. Determine impacts
4. Develop adaptation strategies

Step 1: Explore SLR Projections

i.
- Use the U.S. Army Corps of Engineers Sea-Level Change Curve Calculator

ii.
- Define the project's time horizon

iii.
- Consider the project's risk tolerance



[U.S. Army Corps of Engineers Sea-Level Change Curve Calculator]

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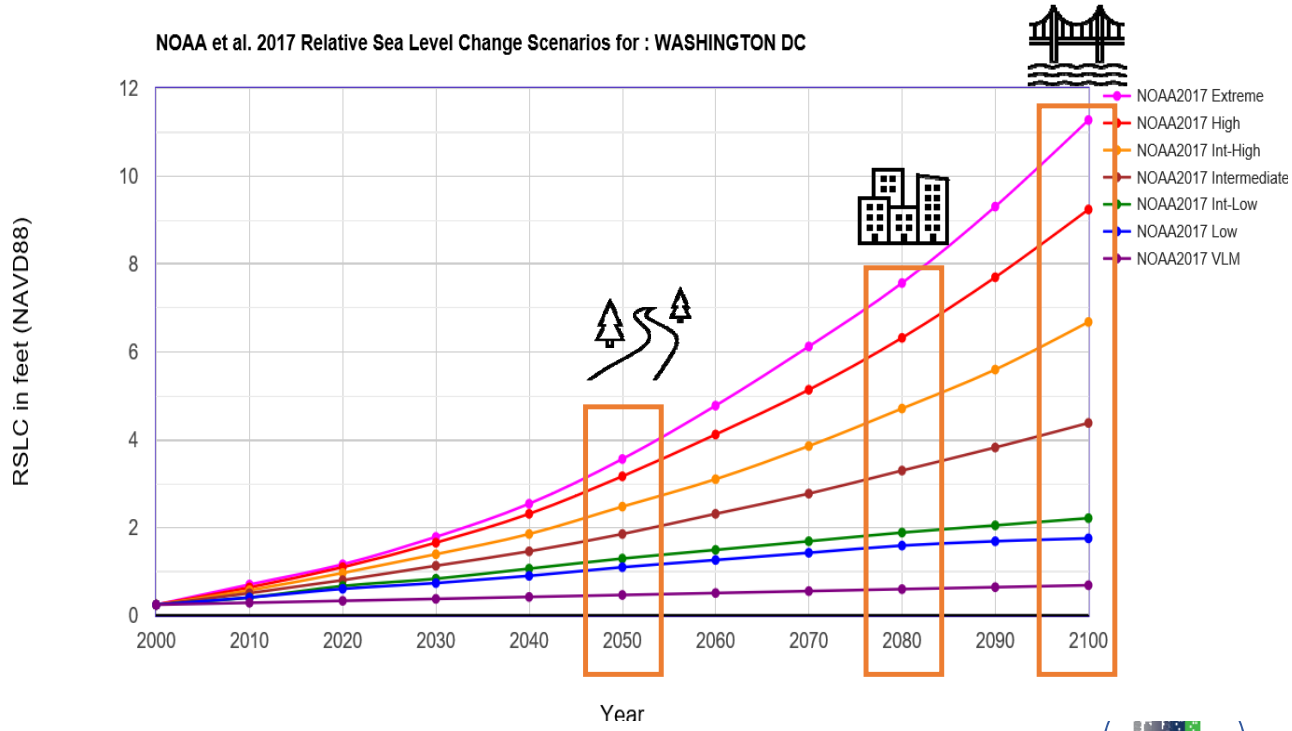

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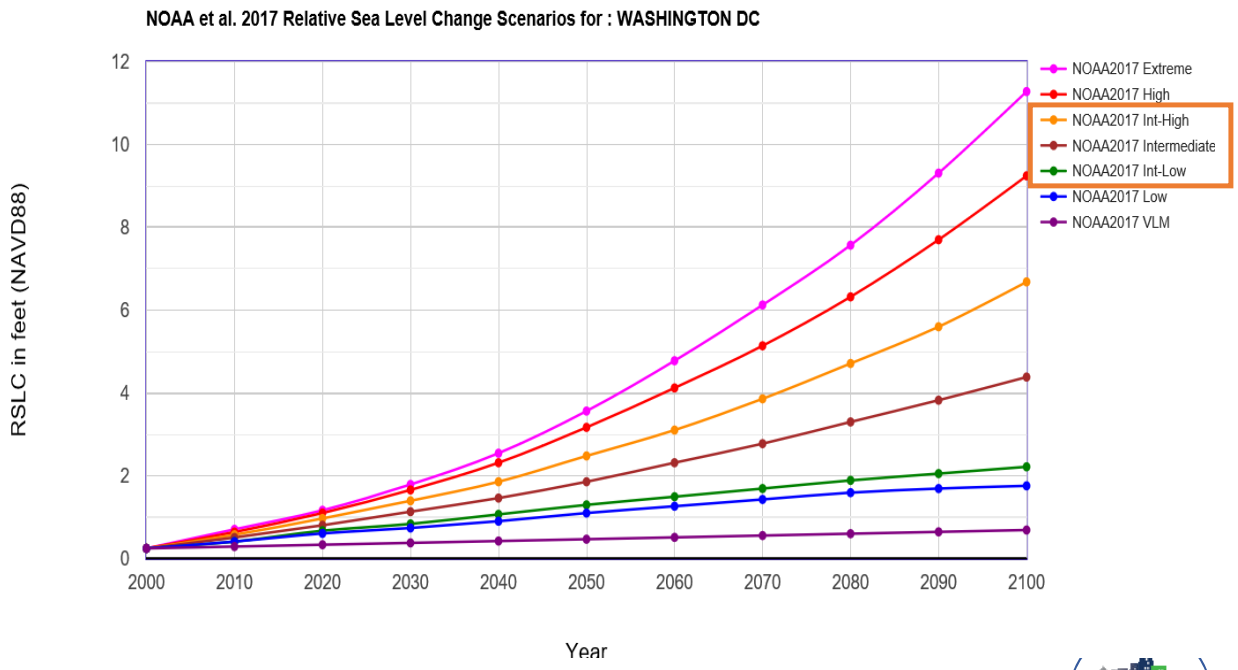

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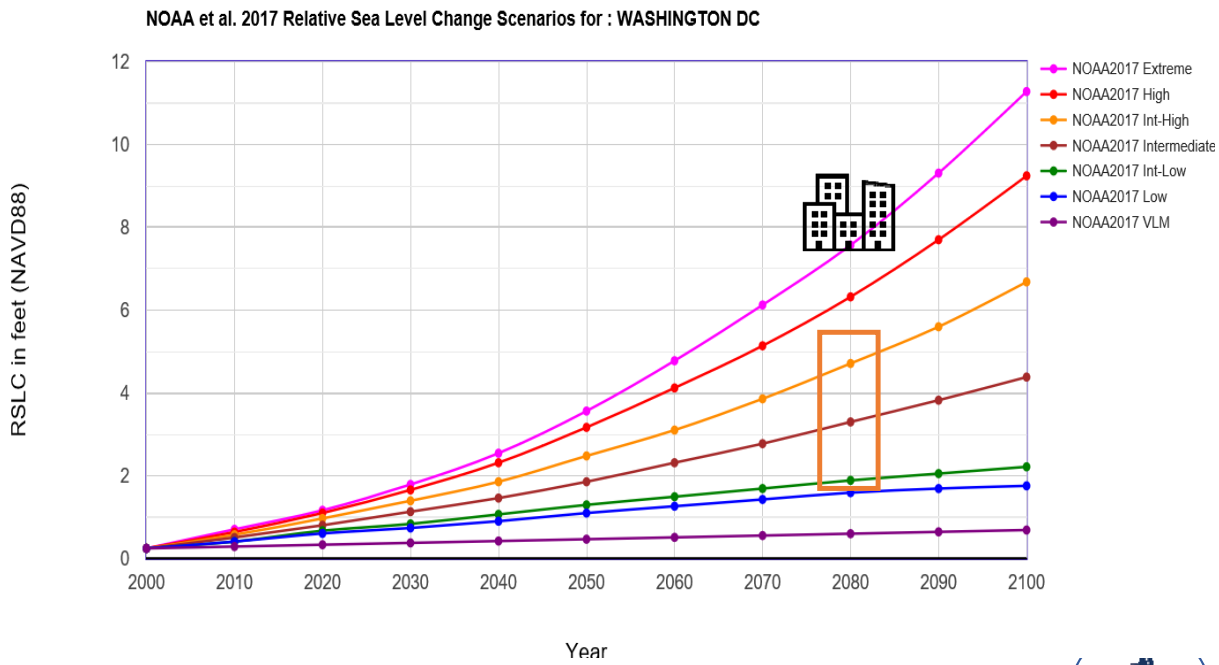


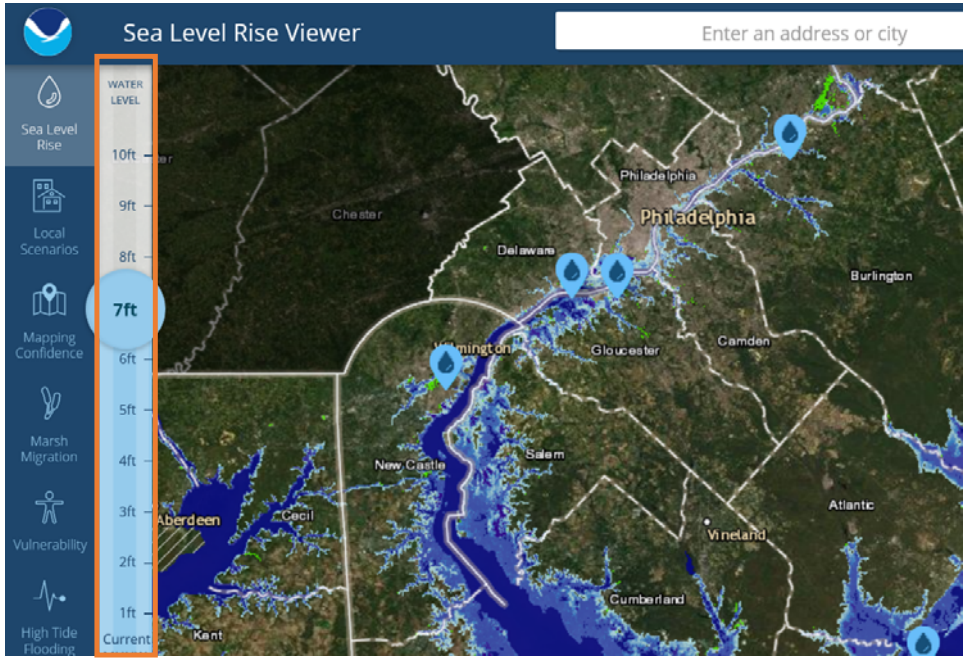
Example: A building that will be in use until 2080 should consider 2 to 5 feet of sea level rise.

Step 2: Visualize Potential Flooding

i. • Access NOAA's sea level rise viewer

ii. • Review exposure to projected daily high tide flooding

iii. • Review exposure to storm scenarios



[NOAA's Sea Level Rise Viewer]

For information on other sea level rise viewers available in your state visit [this link].

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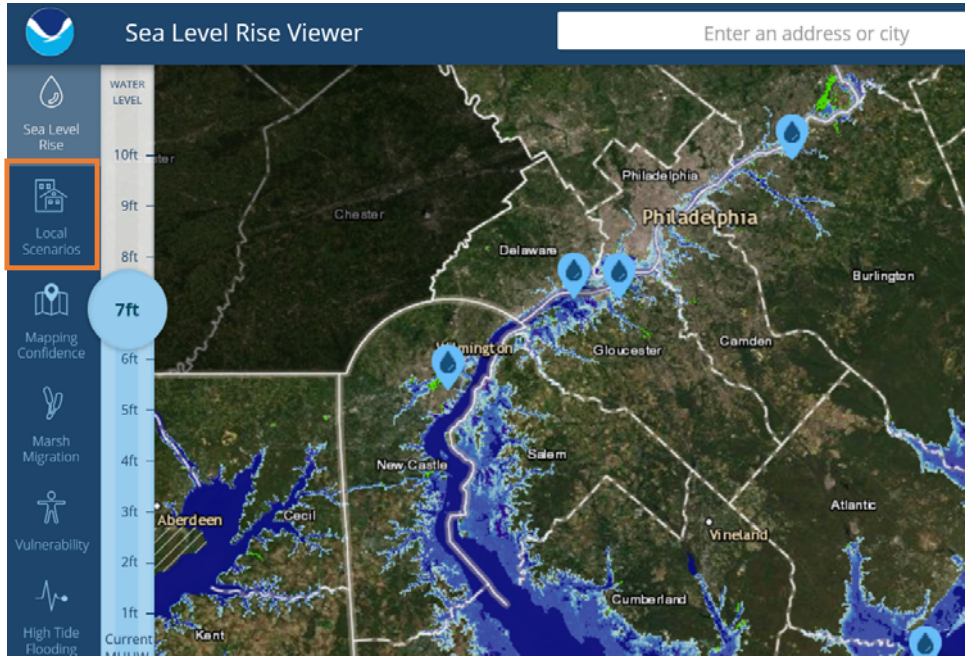

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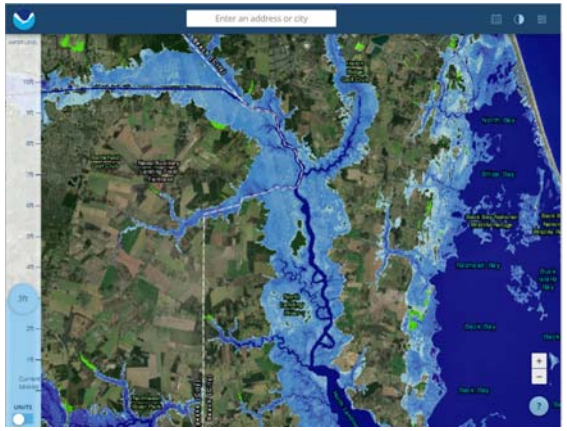
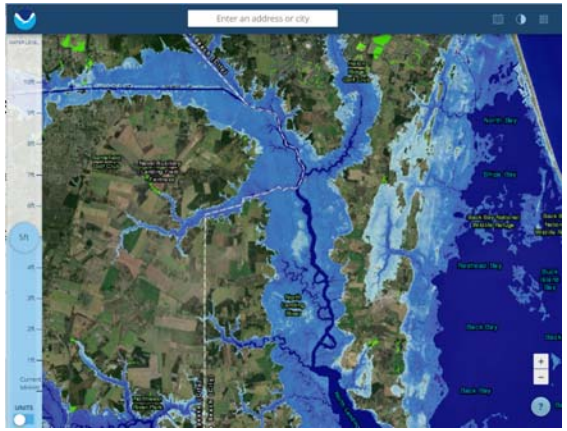


Daily inundation with 3 ft of SLR



Daily inundation with 5 ft of SLR

Step 2: Visualize Potential Flooding

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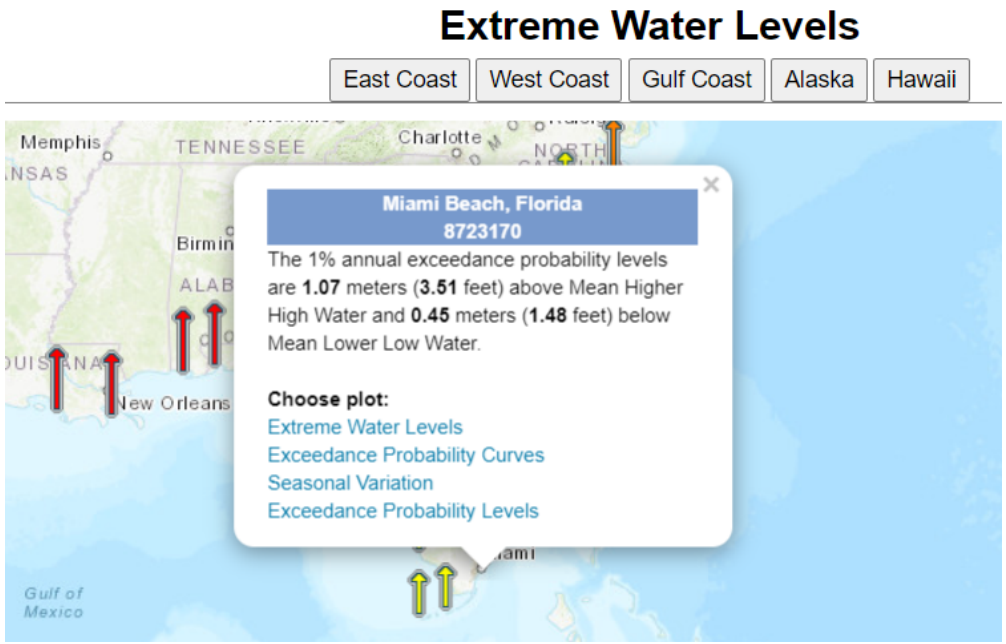
ii. • Review exposure to projected daily high tide flooding

iii. • Review exposure to storm scenarios



NOAA's Extreme Water Levels

Example: 5 feet SLR by 2080 + 3.5 feet 100-year storm surge = the 100-year storm surge in 2080 will be 8.5 feet above today's high tide level

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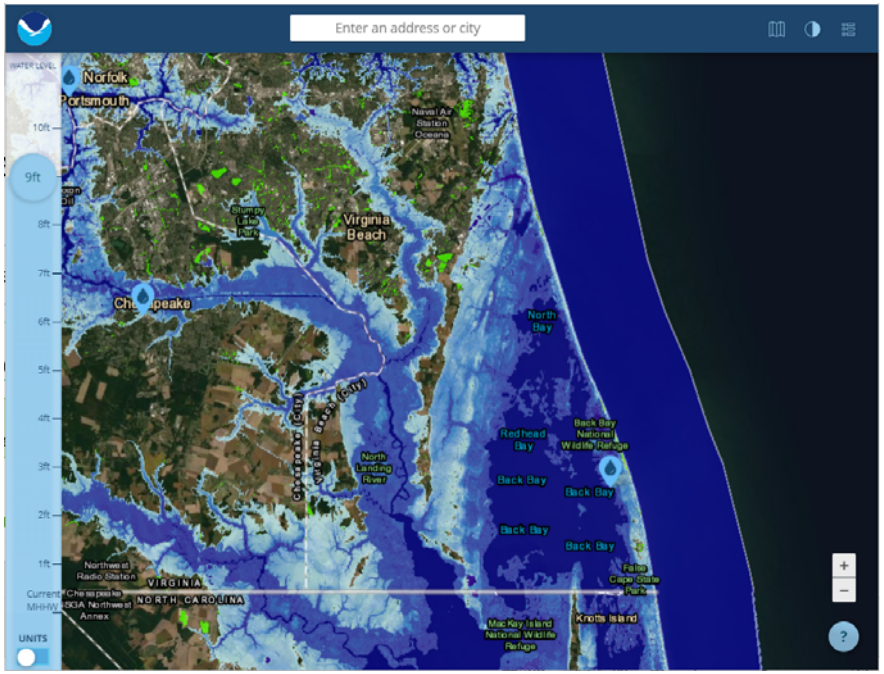


Example: 5 feet SLR by 2080 + 3.5 feet 100-year storm surge = the 100-year storm surge in 2080 will be 8.5 feet above today's high tide level

Step 3: Determine Potential Sea Level Rise Impacts

What is the planned reuse?

Will the site experience daily flooding or flooding during a storm event?

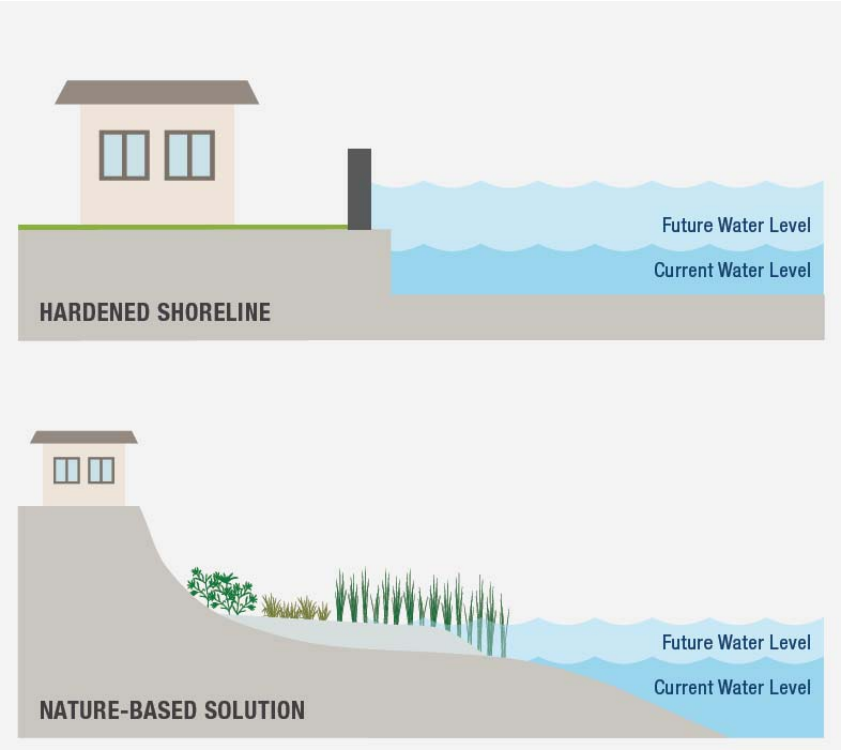
How might inundation, groundwater table rise, and erosion affect the use of the site?

Does the site have impervious surfaces that would exacerbate flooding?

Will nearby assets and the site's use be impacted?

How will nearby communities and the environment be affected?

Step 4: Consider a Range of Adaptation Strategies – Physical Strategies



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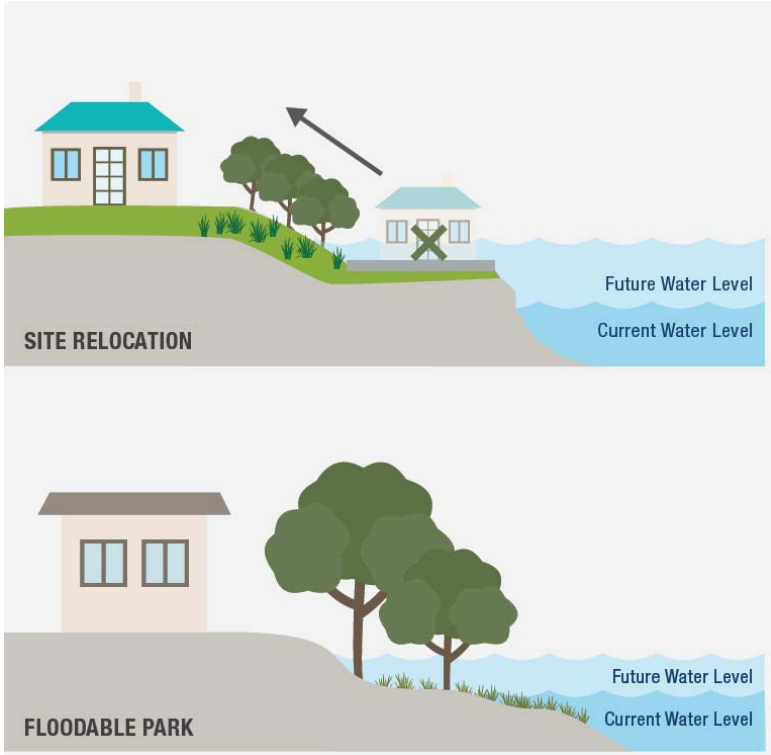


NYC Parks Design and Planning for Flood Resiliency

Step 4: Consider a Range of Adaptation Strategies – Planning Strategies

- Prioritize site assessment and cleanup to mitigate sea level rise consequences
- Monitor for mobilization of contaminants
- Consider resilient uses for the site (e.g., park space)
- Proactively plan and budget for increasingly frequent floods
- Conduct public outreach about potential impacts
- Coordinate with surrounding sites
- Solicit knowledge on historical flood impacts

Incorporate Adaptation into Decision-Making

- Consider sea level rise risks BEFORE key decisions
  - Site assessment prioritization
  - Cleanup level determination
  - Reuse visioning and planning
  - Site design

Stakeholder Engagement

Engage the **public** to achieve equitable resilience for local communities

Connect with **local and regional planning agencies** to ensure compatibility of plans

Infrastructure owners who service the site may also experience SLR impacts

Q&A

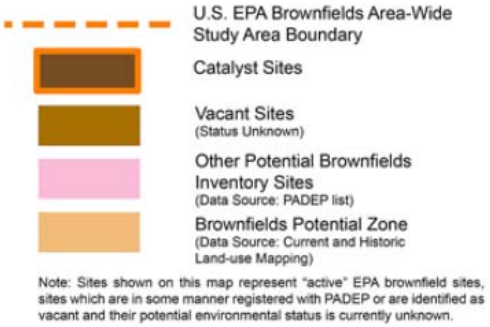
Case Study: Philadelphia Delaware Avenue Extension

Project Background

- Proposed roadway extension through brownfield and contaminated sites
- City of Philadelphia engaged with PennDOT to analyze potential flooding under future sea level rise scenarios
- Analysis funded by U.S. EPA Land Revitalization Program
- Recommendations do not reflect opinions of the City, PennDOT, or EPA

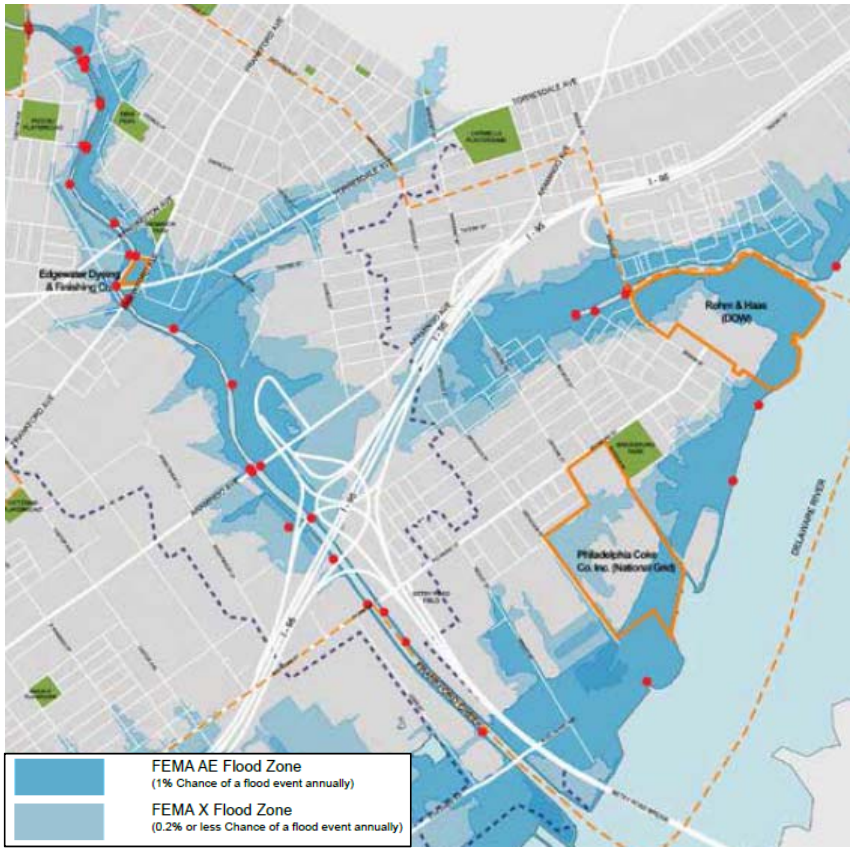
Site Background & Overview

- Lower Frankford Creek Watershed Brownfields Area-Wide Plan (2015) developed to explore reuse
- Roadway intended to serve potential catalyst sites



Existing conditions

- Portions of the proposed roadway alignment and adjacent areas are in the floodplain under current climate conditions

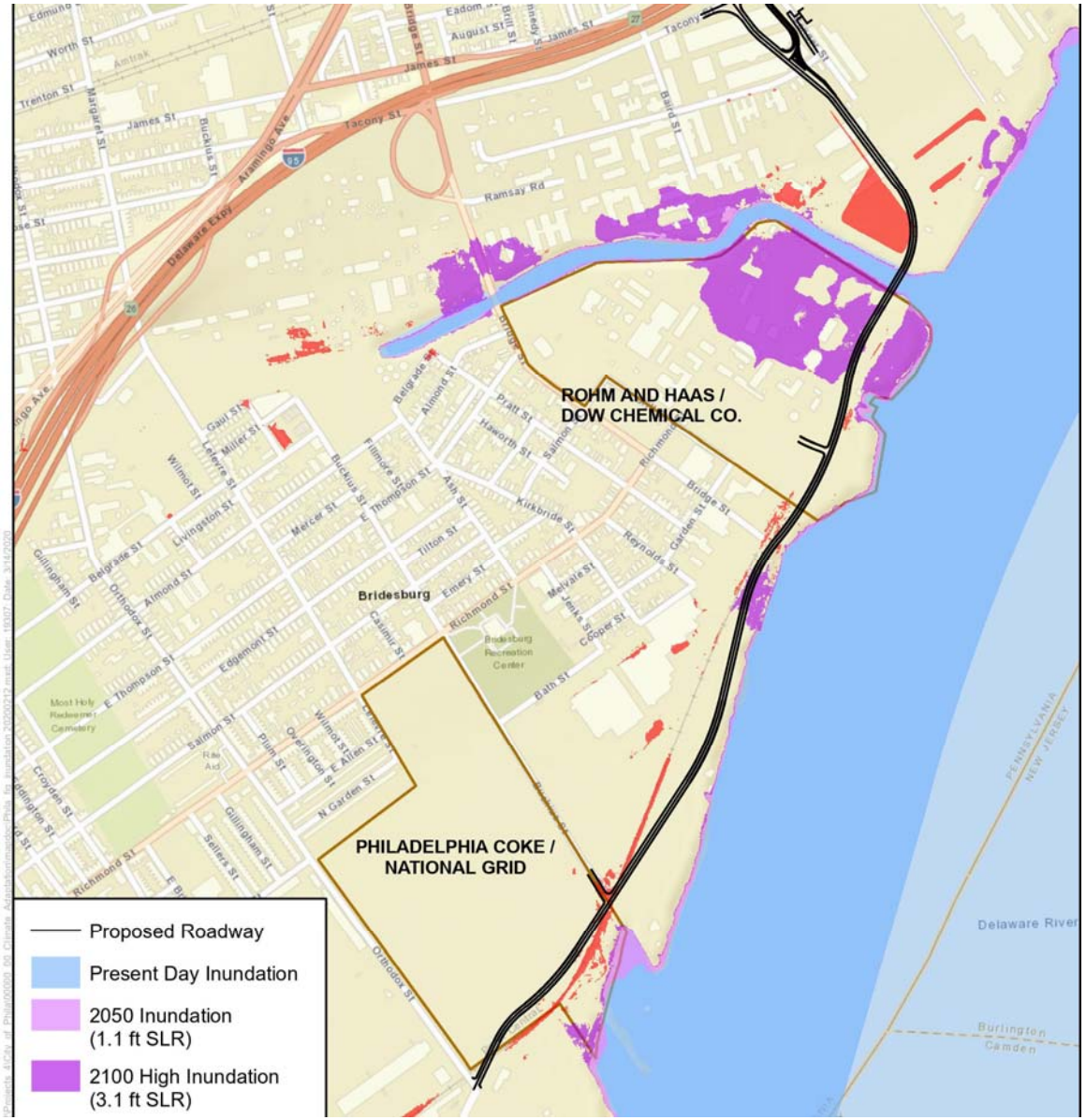


Findings: Future potential flooding

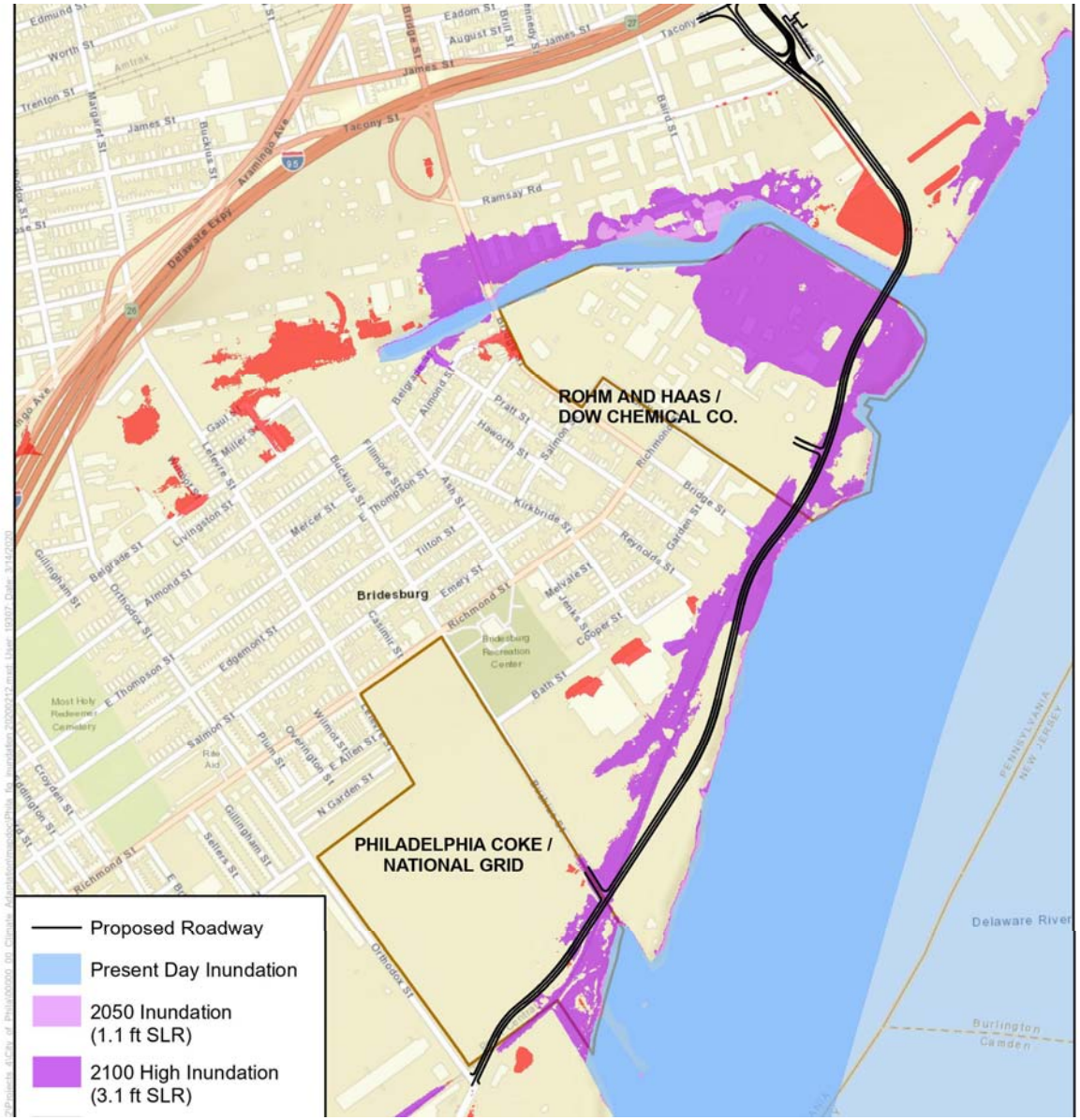
- 2050: More extensive and severe flooding during storm events
- 2100: Potential for daily high tide flooding and chronic flooding

	High Tide Flooding (MHHW)	Chronic Flooding	10% Annual Chance Storm	4% Annual Chance Storm	1% Annual Chance Storm
Today (2018)	🟢	🟢	🟠	🟠	🔴
2050 (1.1 ft sea level rise)	🟢	🟢	🔴	🔴	🔴
2100 (3.1 ft sea level rise)	🟠	🔴	🔴	🔴	🔴

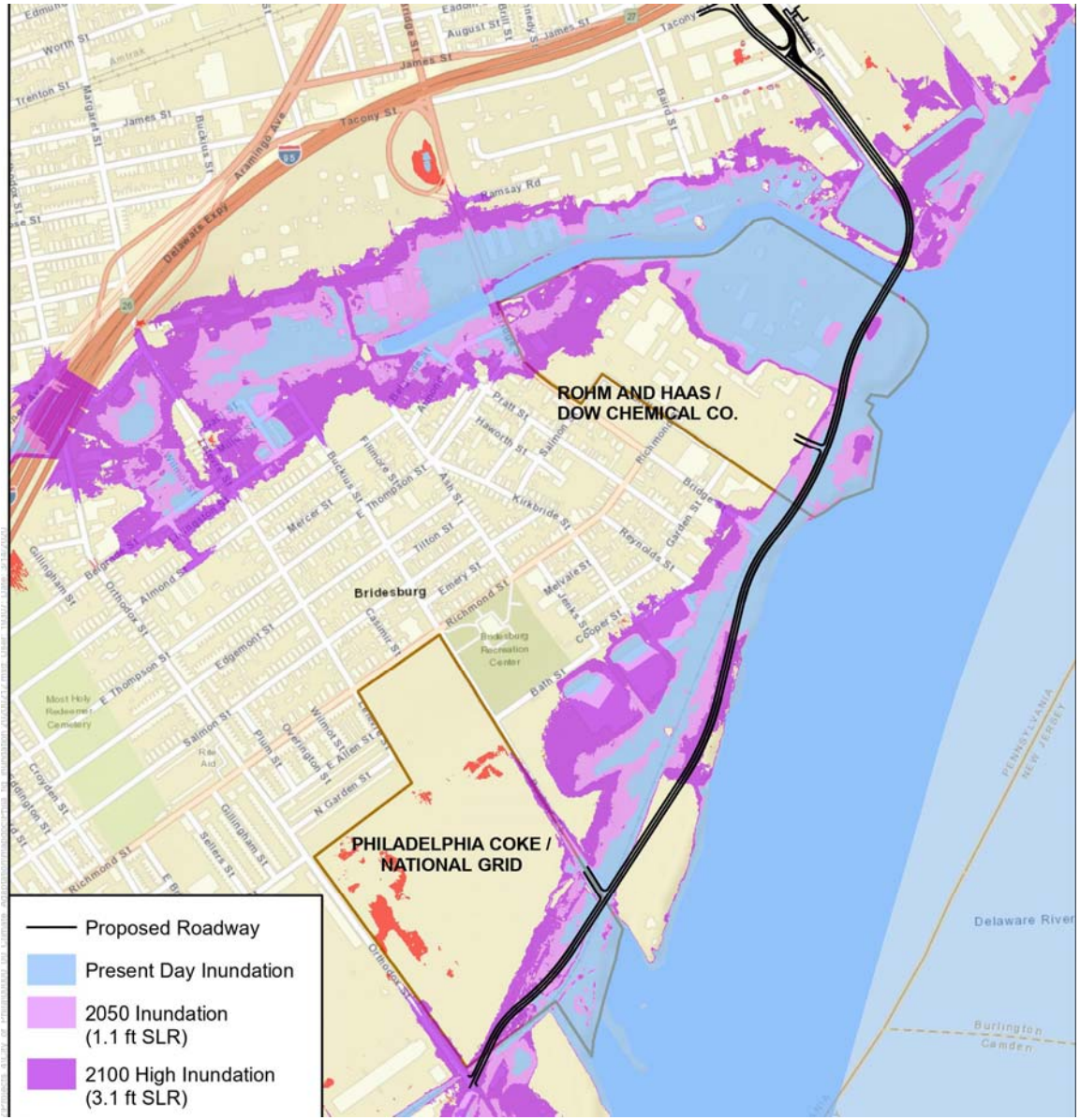
Daily Inundation



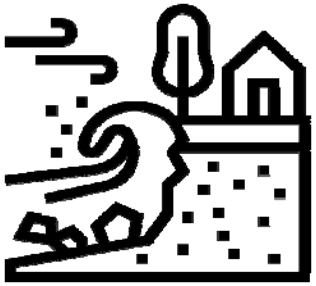
Chronic Inundation



100-year Inundation



Findings: Additional SLR Impacts for Philadelphia site



- Coastal erosion
- Groundwater elevation
  - Reduced ability to capture and store freshwater flows during precipitation events
    - Increases potential for inland flooding
    - Compounded risk with increase in severity and frequency of extreme precipitation events from climate change
  - Increase in the frequency and elevation of subgrade saturation
    - Damage to road and utility infrastructure
    - Increases the possibility of mobilizing hazardous materials at brownfield site

Potential resiliency strategies for Philadelphia site

Roadway Design

- Elevate to account for sea level rise
- Design for future loads associated with higher storm surge water levels
- Consider changes in design of drainage
- Design for flexibility for additional protection

Site/Area Wide Considerations

- Protect coastal edges from increased erosion due to sea level rise
- Elevate adjacent riverfront parks
- Coordinate flood protection with other infrastructure actors
- Disclose future flood risk to ensure resilient redevelopment of broader site

Additional Resources

Brownfields and Land Revitalization

- Climate Smart Brownfields Manual
- Brownfield Revitalization in Climate-Vulnerable Areas
- Checklist: How to Address Changing Climate Concerns

Superfund and Other Site Considerations

- Superfund Climate Resilience

Other EPA Resources

- CREAT Climate Resilience for Water Utilities
- ARC-X Climate Change Adaptation Resource Exchange

Q&A

Question

- Would you like more trainings of this nature?
  - Yes
  - No
- What other topics do you want to learn about?
  - Inland flooding
  - Extreme heat or heat waves
  - Wildfires
  - Extreme weather events
- How was the level of detail in this training?
  - Too simplistic
  - Just right
  - Too complex