PlanPrinceton

Community Workshop
November 1, 2024

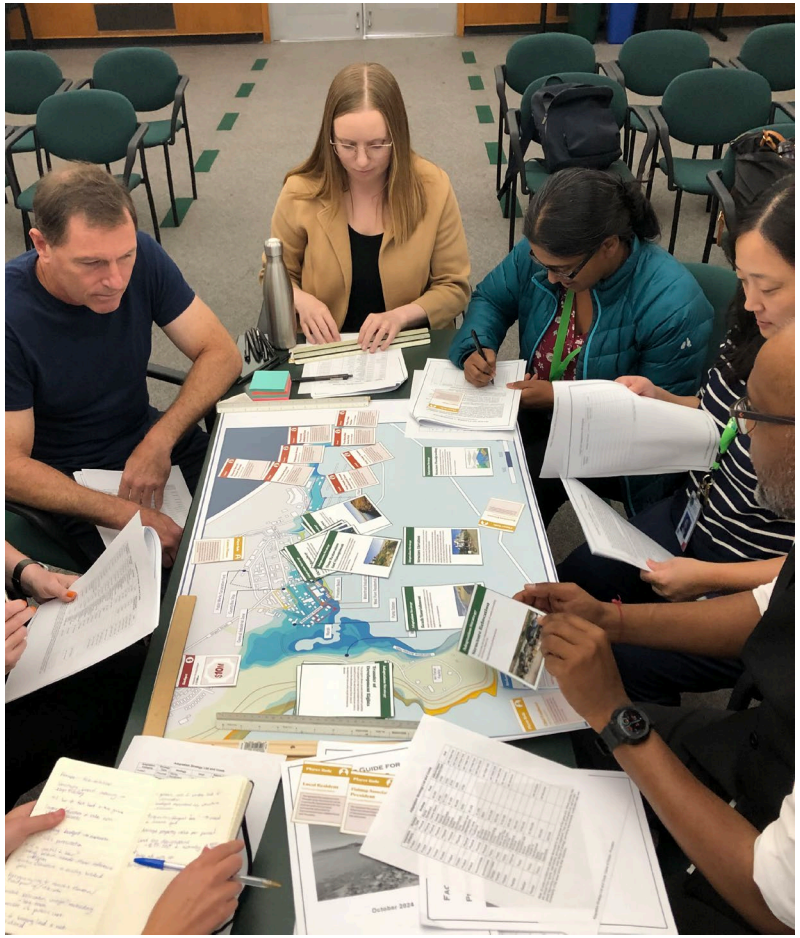
GAME OF FLOODS - PRINCETON

This game is based on an original game developed by Marin County and then evolved by engineering firm AECOM and the Urban Sustainability Directors Network, and now further refined by San Mateo County to be Princeton specific.

October 2024

Purpose of the Game of Floods - Princeton

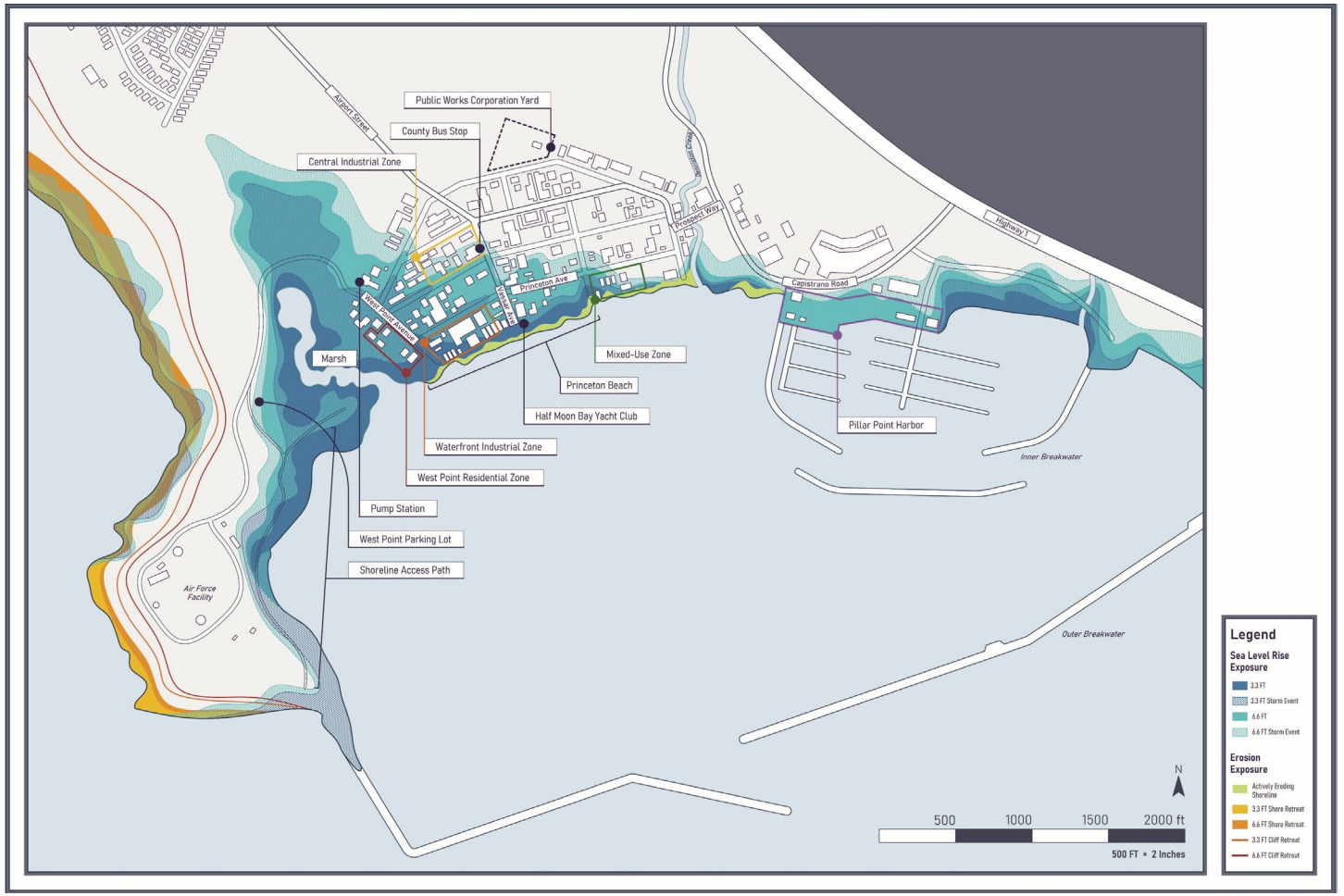
- Develop better understanding of how sea level rise and coastal erosion will impact life in Princeton
- Gain better understanding of policies and physical strategies that may help Princeton adapt to sea level rise
- Understand the complexities and trade-offs of adaptation planning!



Game play

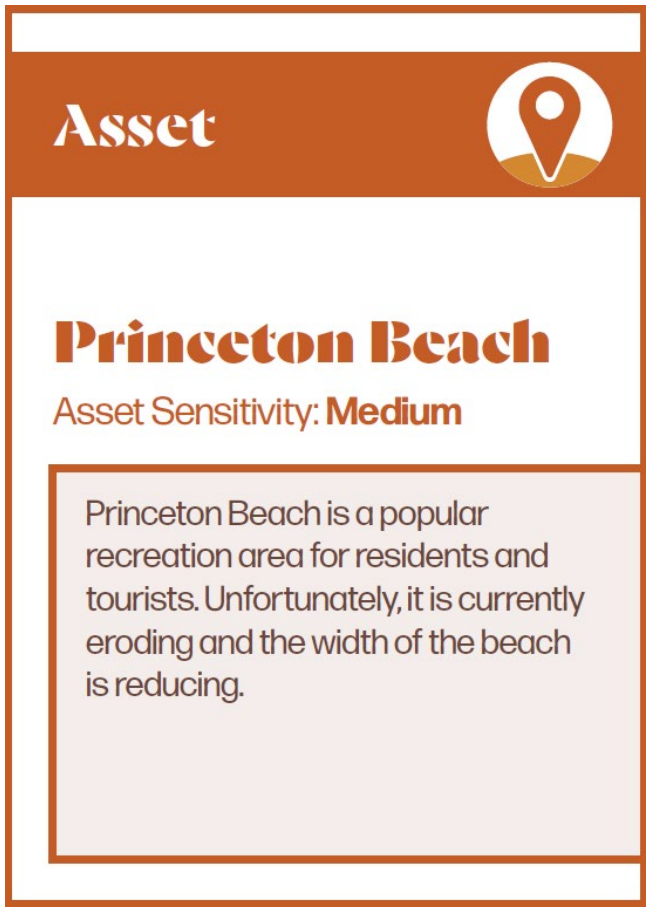
Game board – which shows:

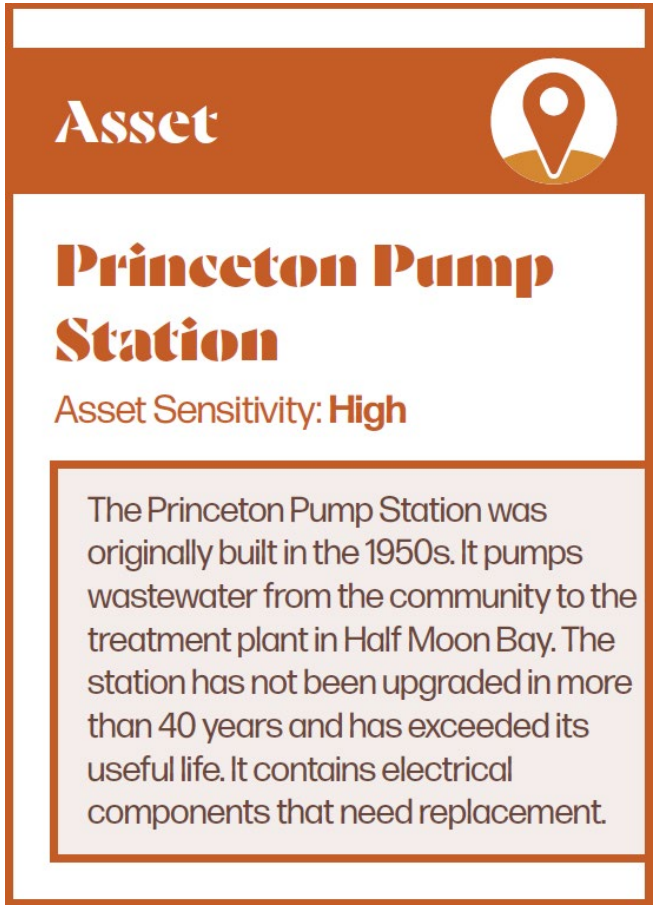
- Sea Level Rise exposure zones
- Erosion exposure zones
- Assets that we have selected for the purposes of the game



Game play

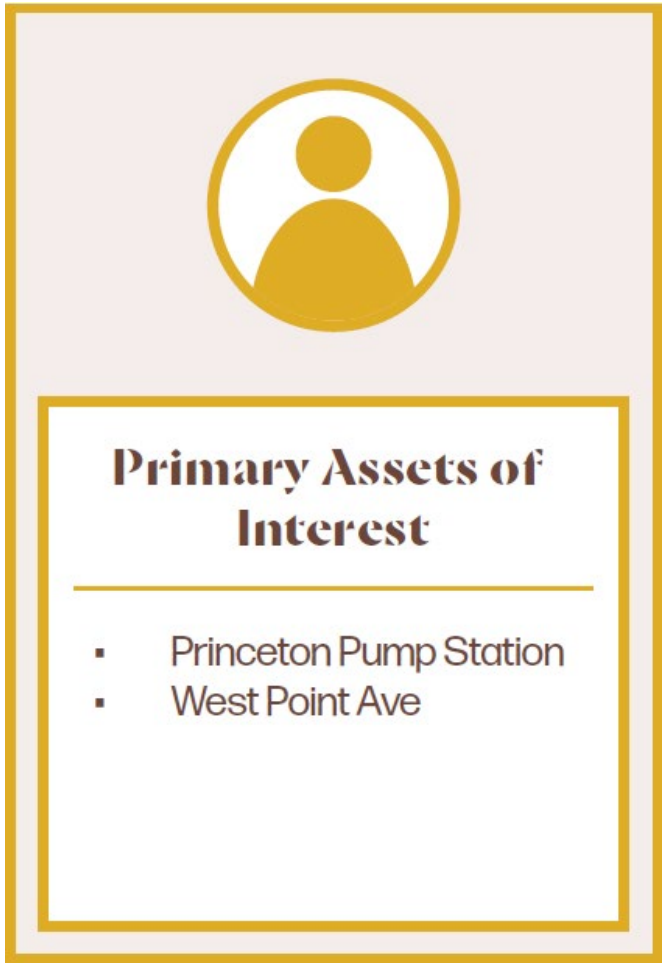
Asset cards – give details of the assets in Princeton that we have selected for the purposes of the game





Game play

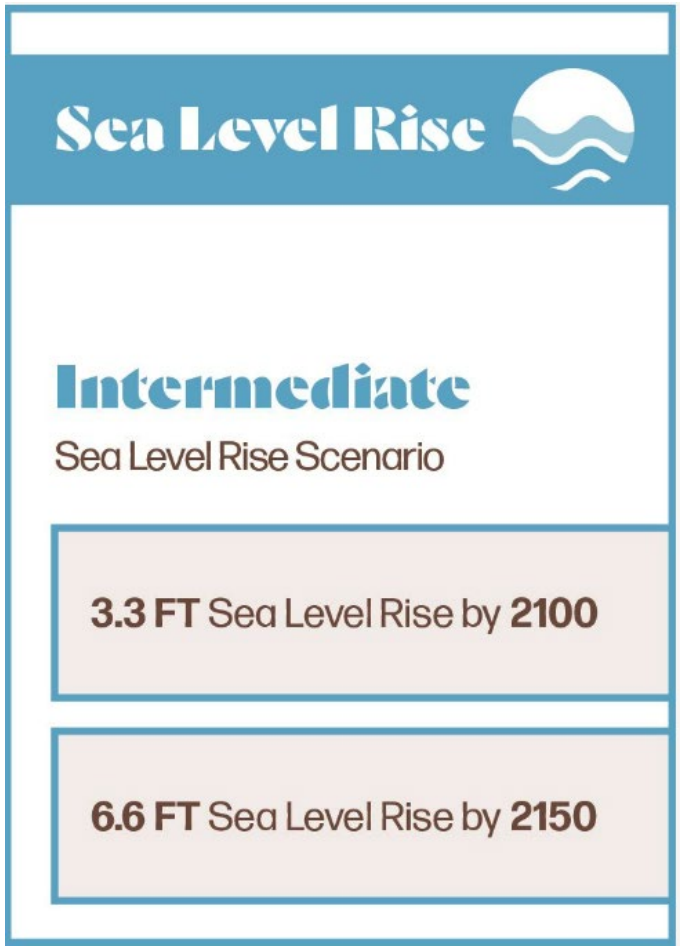
Role cards – representing various stakeholders within the community such as Residents, County Department staff, business owners. Each stakeholder may be interested in particular assets on the board!

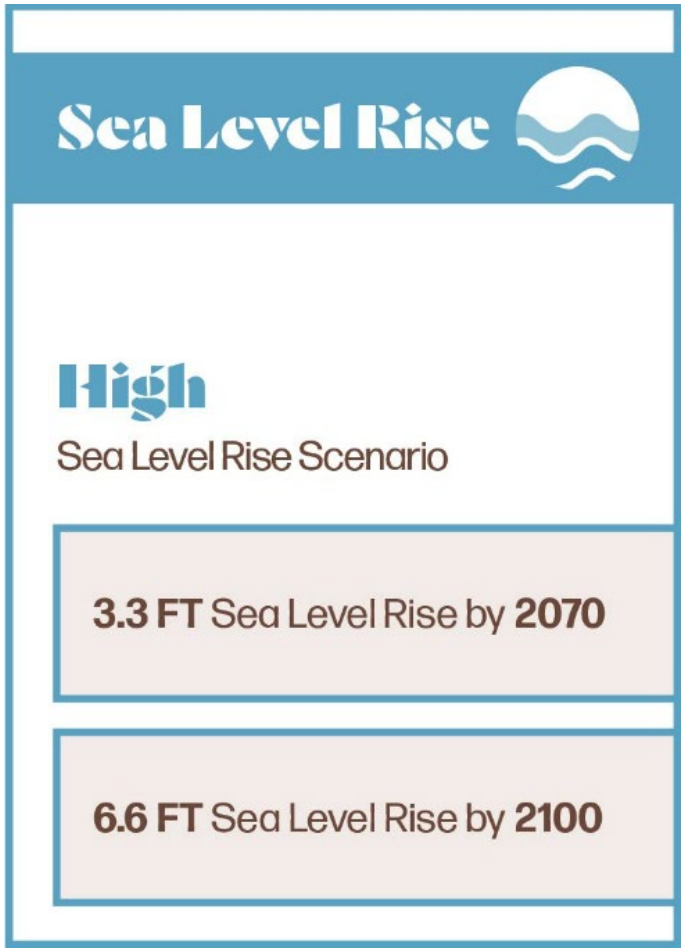


Game play

Sea Level Rise Scenario

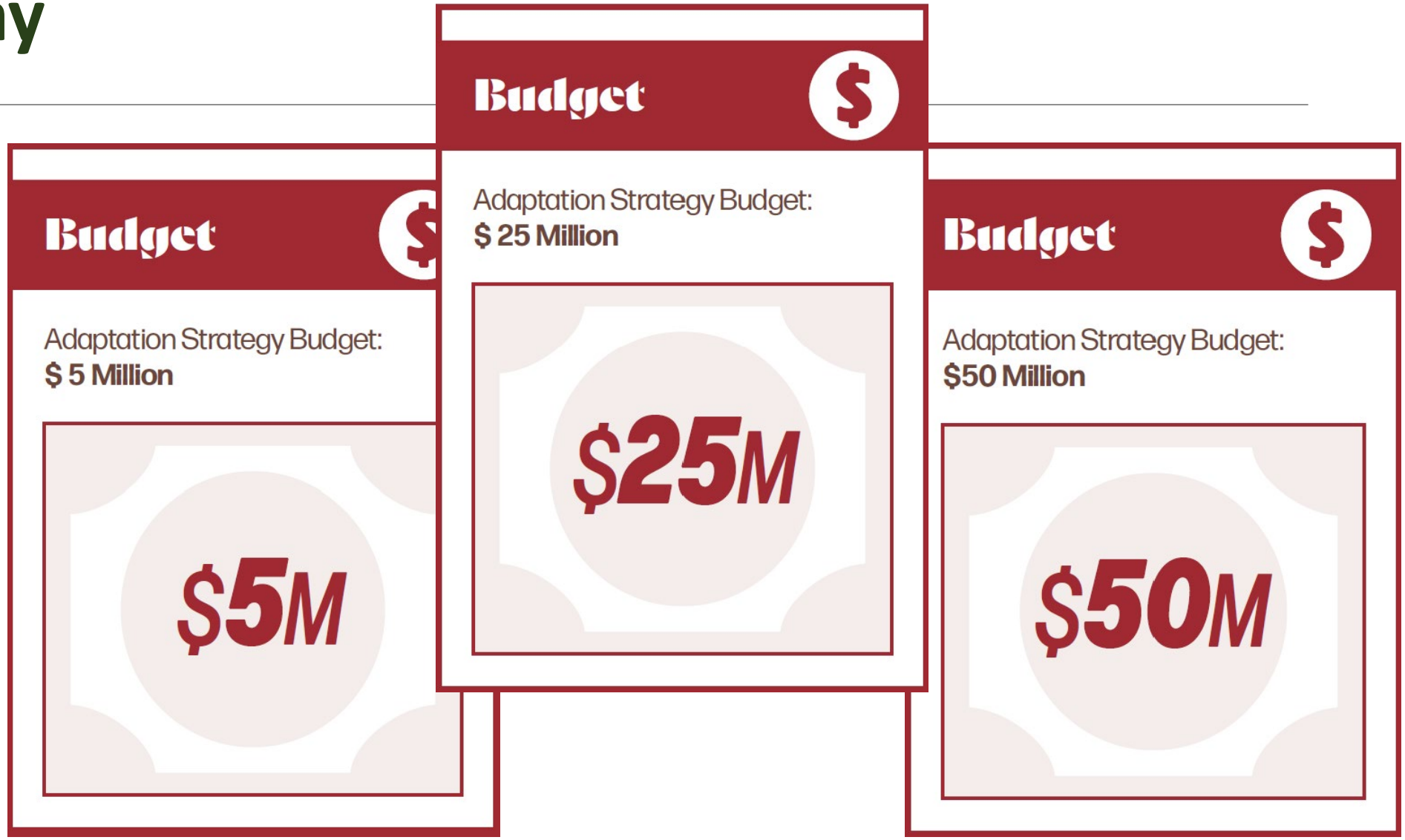
- Your team will be developing adaptation strategies to address this



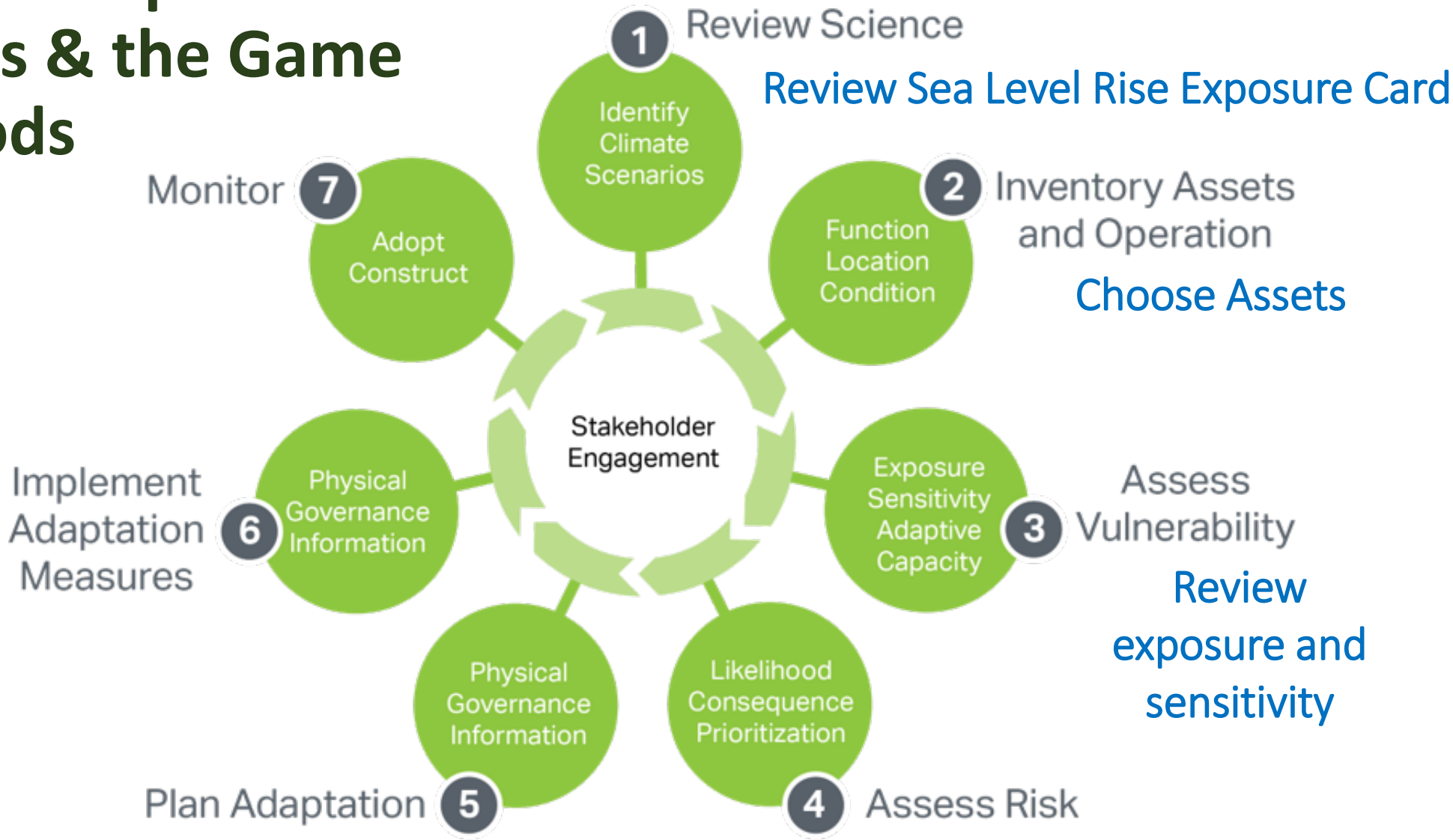


Game play

Budget card – your team will have a budget to develop strategies with



Typical Adaptation Process & the Game of Floods



Review Sea Level Rise Exposure Card

Choose Assets

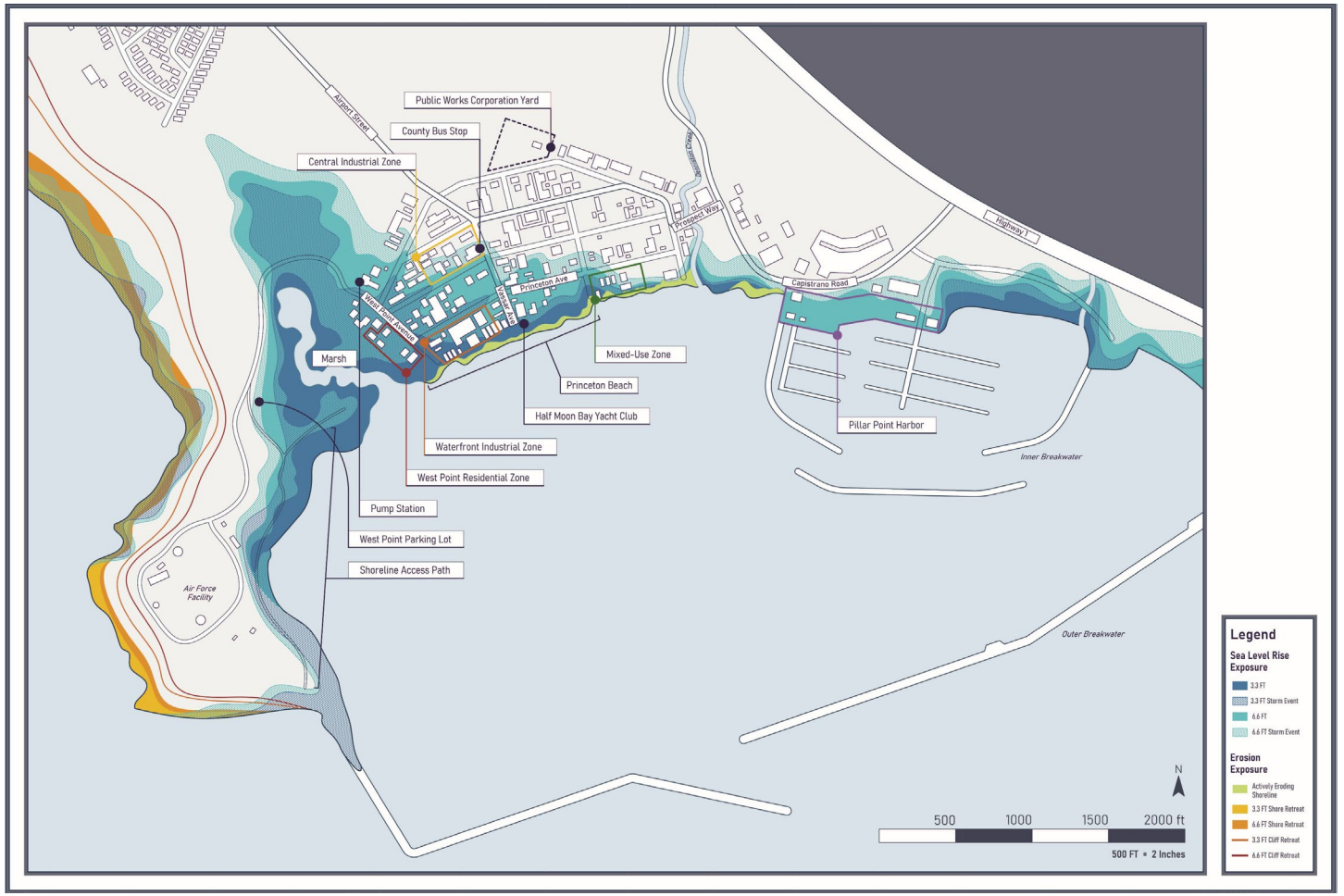
Review exposure and sensitivity

Discuss consequences

Choose strategies

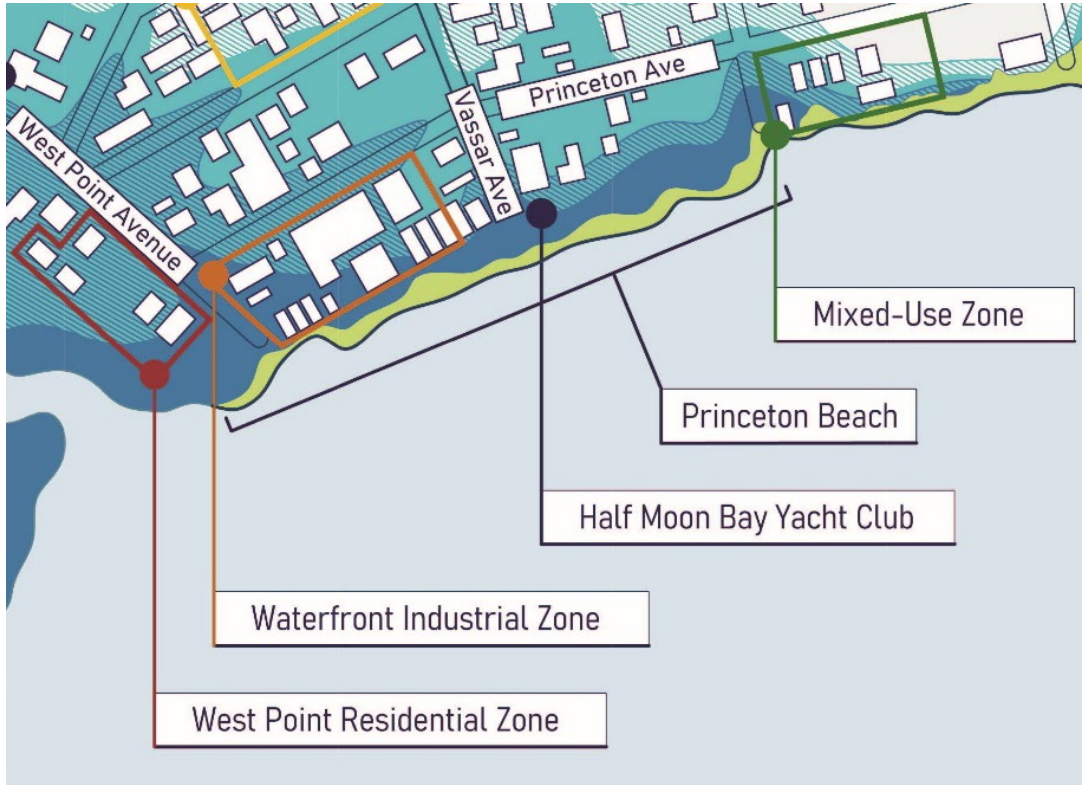
Game play – setting the scene

- Introduce yourself and your organization to the group – and your facilitator will assign you a role
- Review the game board to see what assets are part of game play
- Familiarize yourself with the board
- Select a scribe/ spokesperson



Game play – choosing assets

- Choose 10 of 19 assets to include
- What categories of assets are important for the functioning of the community?
- Make the case for assets that affect your role!
- List the assets in your inventory table



Game play – assessing vulnerability

Identify which sea level rise zone the assets are in (**exposure**)

- High (5): Floods with 3.3ft SLR
- High-Medium (4): Floods with 3.3ft SLR + 1% annual storm
- Medium (3): Floods with 6.6ft SLR
- Medium-Low (2): Floods with 6.6ft SLR + 1% annual storm
- Not exposed (0): Not in an exposure zone

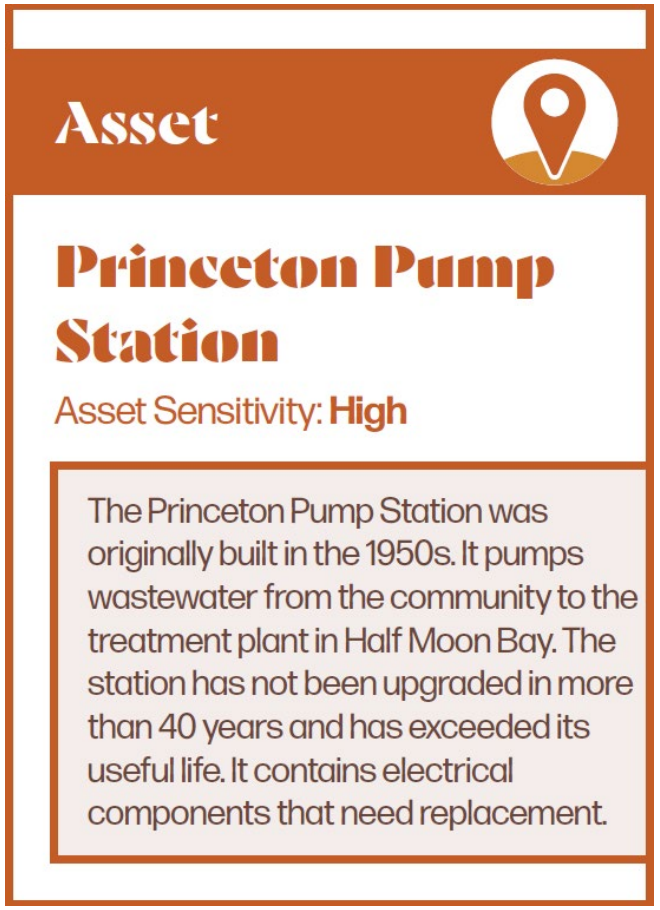
Game play – assessing vulnerability

Review the **sensitivity** of the asset to flooding

- High (5): Irreversible change and permanent loss of function
- Medium (3): Substantial but reversible change to asset or function
- Low (1): Short term or minor change to asset or function

Calculate the vulnerability score in your inventory table. What is most vulnerable?

- **Exposure + sensitivity**



Game play – assessing consequences

Discuss what the consequences could be if each of your selected vulnerable assets are inundated. Consider:

- how it would be **damaged** by flooding
- what **disruption** would be caused – in terms of service or impacts on other systems
- how much it would **cost** to replace or repair? What is the **economic impact** associated with the disruption?

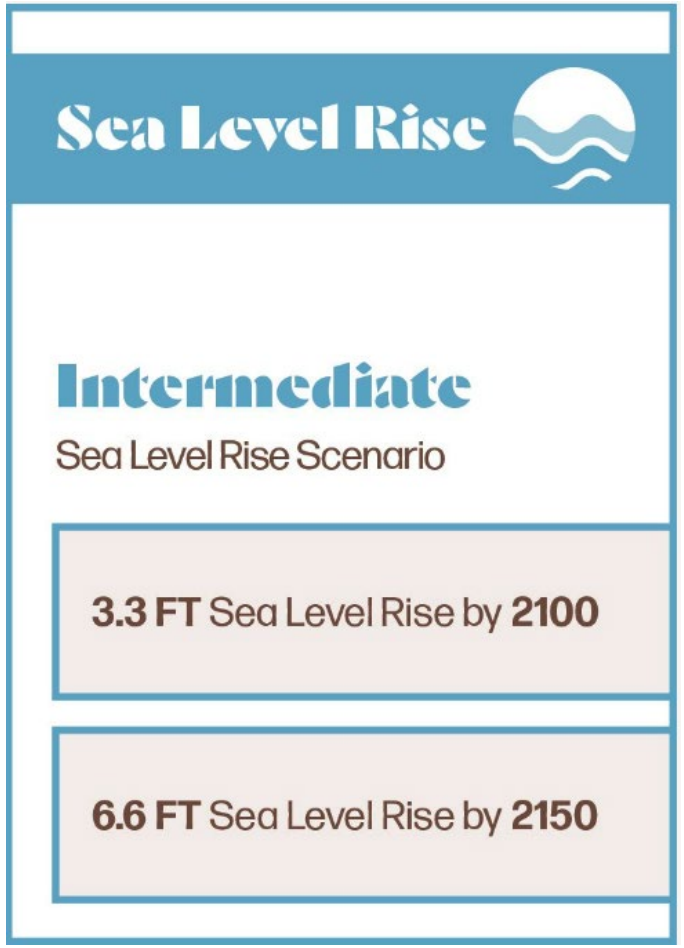
Does this change your priority order?

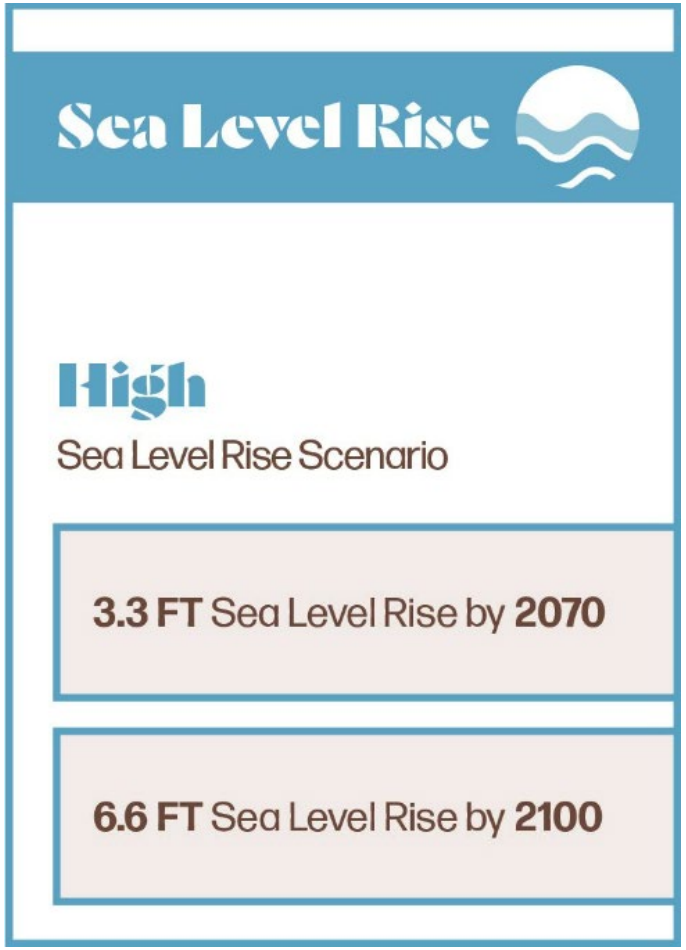
LUNCH BREAK!

Game play – Strategy selection and planning

Consider:

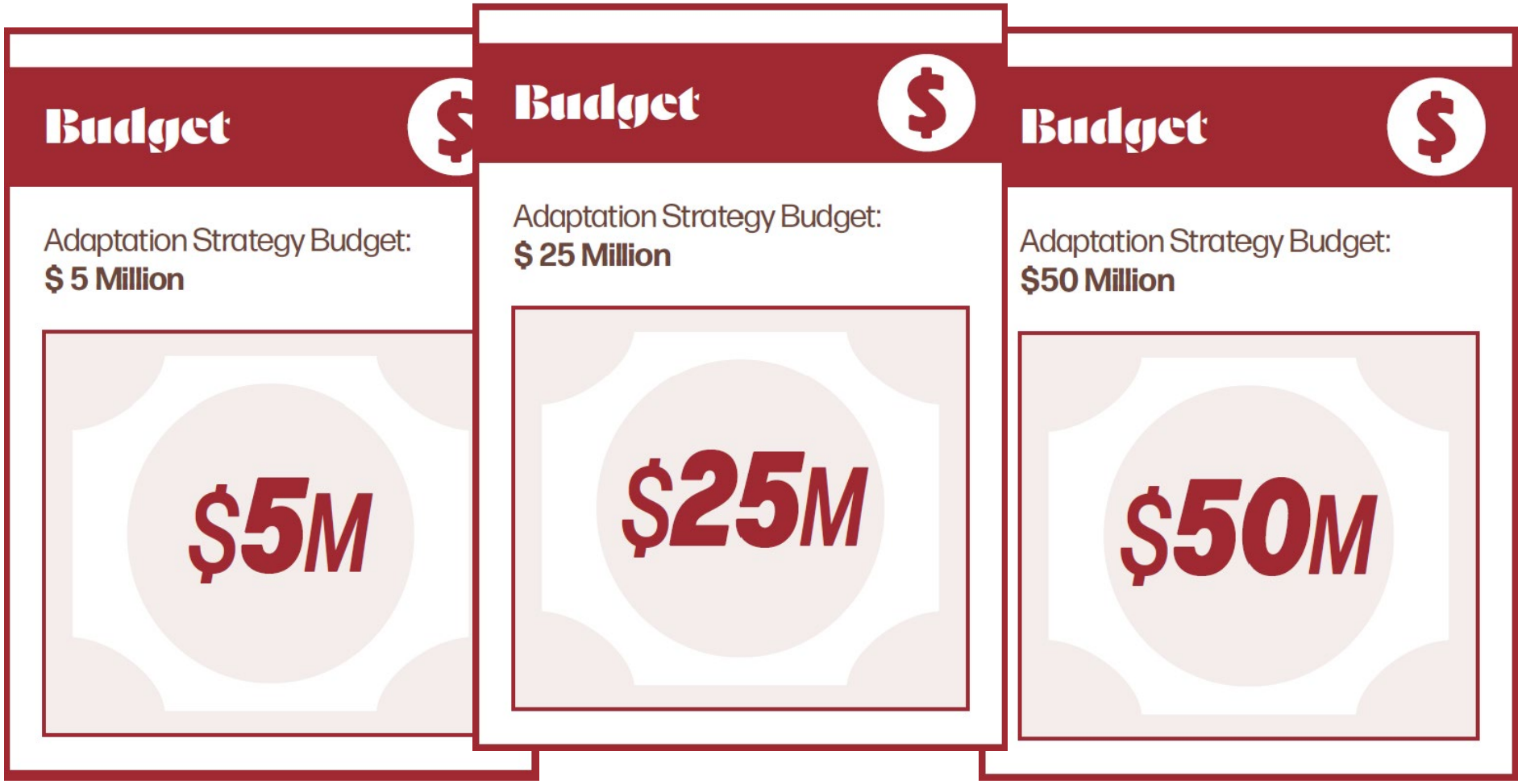
- Think about what strategies you might need for the **2100 scenario**.
- What amount of SLR rise does that mean for your priority assets?





Game play – Strategy selection and planning

Budget card – what is your budget?



Game play – Strategy selection and planning

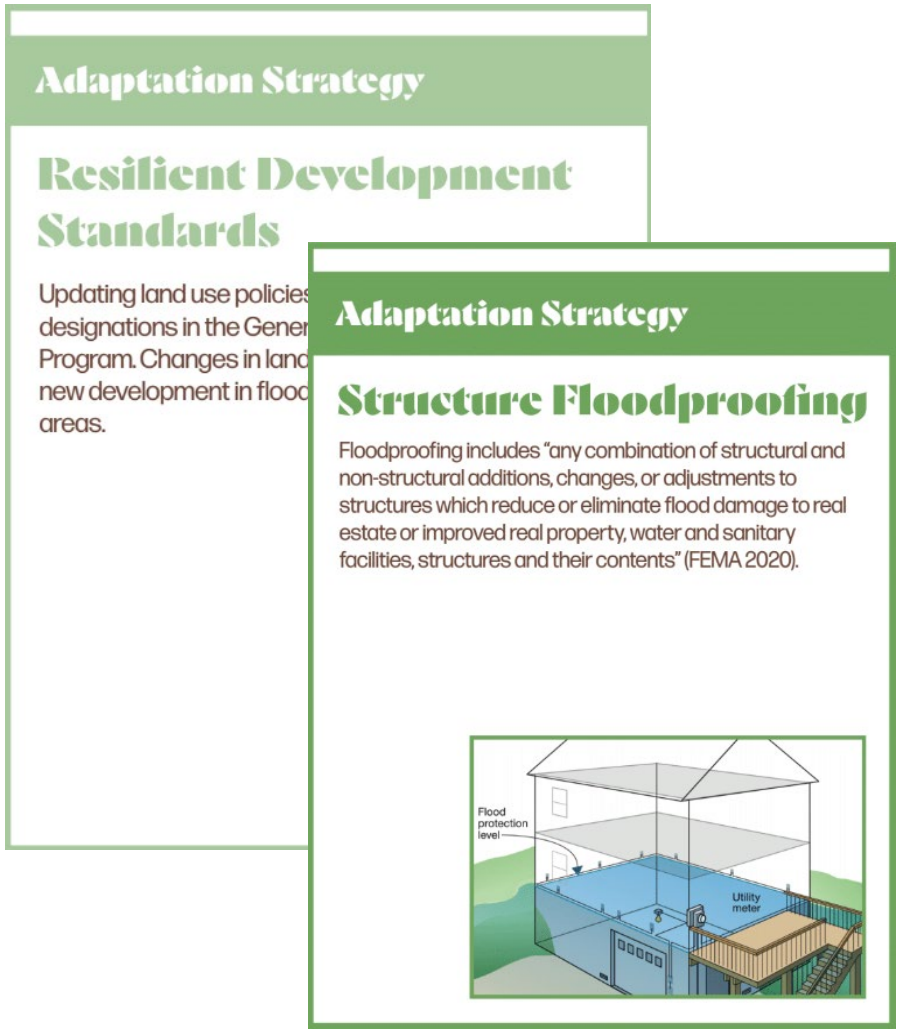
Consider types of strategy based on the asset/assets:

Realign: policy strategies

- Help ensure that over time assets can move out of harm's way.
- Need to get in place early
- Ensure your plan has some of these
- Lower cost and big impact

Accommodate: asset specific strategies

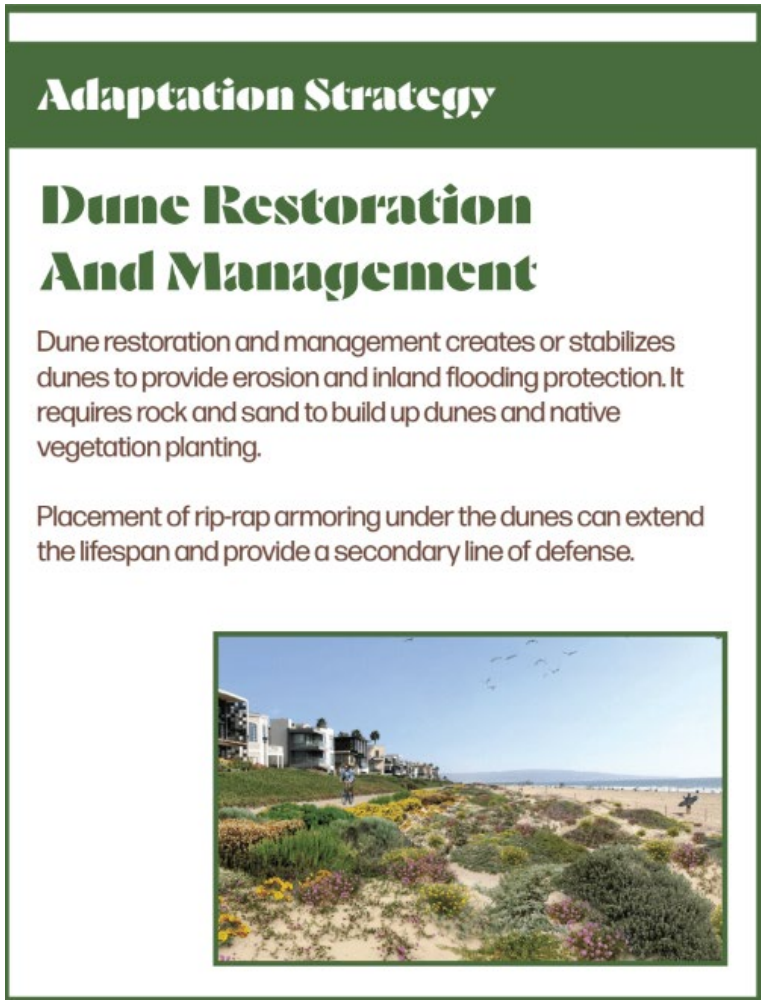
- Helps protect against periodic storm surge in the short term before permanent inundation
- Lower cost



Game play – Strategy selection and planning

Protect: constructed strategies

- Takes time to consult, design, permit, fund
- Feasibility is dependent on existing shoreline
- Some strategies may negatively impact habitat and other parts of the shoreline
- Some require extensive maintenance esp. after big storms
- Expensive



Zoning and Land Use Policies

(Realign)

Resilient Development Standards

- Require new development and major remodels to analyze potential SLR impacts within the building's proposed lifespan and implement mitigation strategies to withstand temporary flooding.
- Could restrict or limit future expansion or intensification of development in high-risk areas.
- Could include updating building and zoning ordinances or implement as part of a Sea Level Rise Overlay Zone.

Pros:

- Provides options for new development and redevelopment
- Reduces costs to recover from a flood

Cons:

- Harder to implement for existing development

Update Land Use Regulations

- Only allow uses that are more compatible with flooding because they either have a high ability to adapt or are less sensitive if flooded.
- May include limiting sensitive uses such as new housing and new critical infrastructure and services (wastewater treatment plants, fire stations, etc.).
- Includes updating the General Plan, the Local Coastal Program, and the Zoning Ordinance.

Pros:

- Long term solution
- Could preserve or create new open space

Cons:

- Could change existing community character

Acquisition and Buyout Programs

- Buyout program can reduce flood risks in existing or future high-risk areas.

- For a leaseback program, County could purchase at-risk properties, floodproof them at the County's cost, and rent them out as an interim strategy, including to the same renters to avoid displacement. Most floodproofing can be completed without relocating tenants.

Pros:

- Long term solution
- Could preserve or create new open (or floodable) space

Cons:

- Public opposition
- Potential equity concerns (potential for bias towards less expensive properties, which may lead to displacement)

Transfer of Development Rights

- The program allows unused development potential from a property at risk to be transferred to another property out of the sea level rise exposure zone to increase the allowable gross floor area of development above what would otherwise be allowed.
- Any TDR would happen within the Princeton community boundary.

Pros:

- Long term solution
- Could preserve or create new open (or floodable) space

Cons:

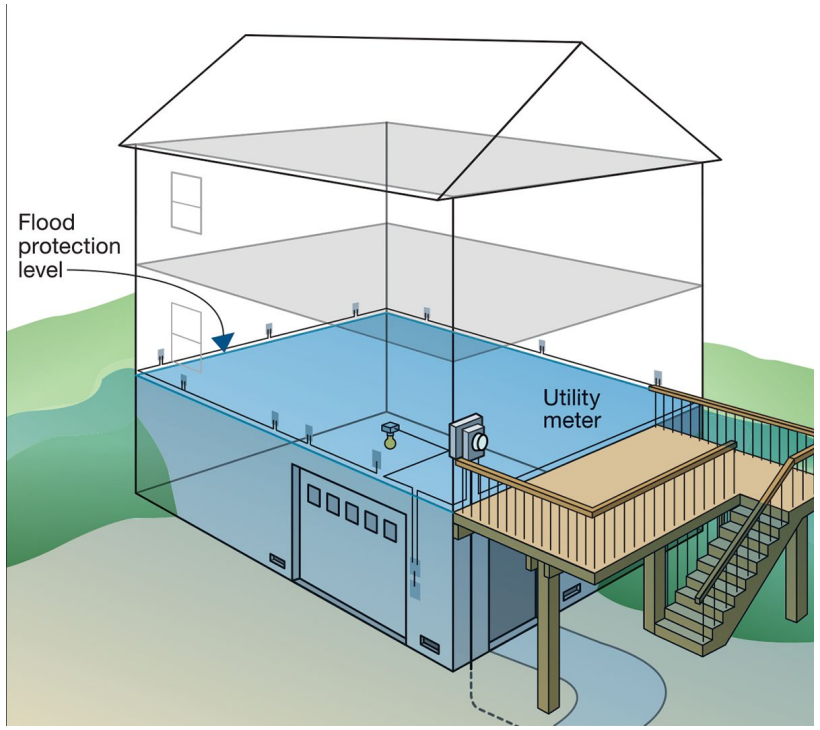
- Could impact existing community character

Asset-Based Strategies

(Accommodate)

Structure Floodproofing

- "Any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents" (FEMA 2020).



Pros:

- Reduces flood risk damage
- Less costly than other interventions

Cons:

- Can require active deployment of closure structures prior to a flood event

Structure Elevation

- For new construction, structure elevation can be achieved by raising grades with fill material, or elevating structures on piles.
- For existing structures, structures are physically raised, including elevating on: continuous foundation walls; open foundations, such as piles, piers, posts or columns; fill; and removing first occupancy and converting the second story.

Pros:

- Can reduce or eliminate flood insurance premiums
- Raising structure can be coupled with seismic retrofits

Cons:

- Access may be impacted during flood events (e.g., flooded roadways)
- Addresses temporary flooding, not permanent sea level rise inundation

Structure Relocation

- Structures can be relocated outside of areas of existing and future flood risk.

Pros:

- Reduces flood risk

Cons:

- Identifying receiving location can be challenging
- Potential loss of community

Nature-based and Engineered Strategies

(Protect)

Dune Restoration and Management

- Dune restoration and management creates or stabilizes dunes to provide erosion and inland flooding protection. It requires sand to build up dunes and native vegetation planting.
- Placement of rip-rap armoring under the dunes can extend the lifespan and provide a secondary line of defense.

Pros:

- Reduces wave energy and mitigates erosion
- Enhances habitat biodiversity

Cons:

- Requires substantial fill material

Beach Nourishment

- Beach nourishment is the engineered process of pumping or dumping sand on a beach to replace eroded sand and provide temporary erosion protection of inland areas.

Pros:

- Temporarily reduces wave energy and mitigates erosion
- Improves public access, tourism, and recreation

Cons:

- Local sand sources can be limited, increasing costs

Marsh Enhancement

- Many tidal marshes cannot build vertically naturally to keep pace with sea level rise due to limited sediment supplies. As sea level rise accelerates, these marshes will drown and disappear. Strategic placement of a thin layer of sediment at regular intervals can enhance marsh resilience to sea level rise.

Pros:

- Maintains wetland flood risk reduction capacity
- Supports endangered species and biodiversity

Cons:

- Long-term benefits may be limited if marshes cannot migrate inland

Riprap Revetment

- Riprap revetments consist of an armor layer of stone with stone underlayers and/or geotechnical fabric to prevent loss of soil material due to wave action. Revetments are built at 2H:1V or shallower slopes and achieve stability through the armor stone weight some interlocking between stones.

Pros:

- Reduces wave energy and mitigates erosion
- Can provide habitat for mollusks and aquatic vegetation

Cons:

- Accelerates erosion of adjacent unprotected shorelines
- Regulations discourage hard armoring

Traditional Levee

- Traditional Levees provide flood risk reduction and reduce shoreline erosion. Levee slopes are typically 3H:1V or 4H:1V, with riprap armoring to reduce wave energy.

Pros:

- Reduces wave energy and mitigates erosion
- Can reduce flood insurance premiums for inland structures

Cons:

- Accelerates erosion of adjacent unprotected shorelines
- Regulations discourage hard armoring

Seawall

- Seawalls harden the shoreline and limit inland flooding and reduce erosion behind the seawall. The slope of the structure is generally vertical or near vertical. The vertical slope of seawalls can increase the potential for wave hazards and wave runup, requiring higher structure heights than a traditional or living levee.

Pros:

- Reduces inland erosion and flooding
- Can reduce flood insurance premiums for inland structures

Cons:

- Increases erosion due to wave reflection
- Challenging to maintain if property ownership is complex (multiple properties with property-based seawalls)

Raising Breakwaters

- Raising and enhancing existing breakwaters to accommodate future sea level rise and increased wave activity.
- Design can include nature-based features like integrating tide pools for rock dwelling flora and fauna and fish, and/or integrating shellfish reefs to improve water quality.

Pros:

- Reduces wave energy and mitigates erosion
- Protects maritime and recreation areas

Cons:

- Impacts to natural sediment movement within protected areas

New Inner Breakwater

- Breakwaters protect coastal areas from strong wave hazards. Most used to protect harbors and anchorages, helping to isolate vessels from wave hazards. Breakwaters installed parallel to the shore can minimize wave-induced erosion and beach loss.

Pros:

- Reduces wave energy and mitigates erosion
- Protects maritime and recreation areas

Cons:

- May impact existing harbor use or boating access

Elevated Roadway

- Elevated roadways (on fill) raise the street above an expected flood elevation. The elevated roadway becomes the levee, providing flood risk reduction for inland assets and infrastructure.

Pros:

- Reduces inland flooding
- Increased initial capital costs but may reduce long-term costs when coupled with utility improvements

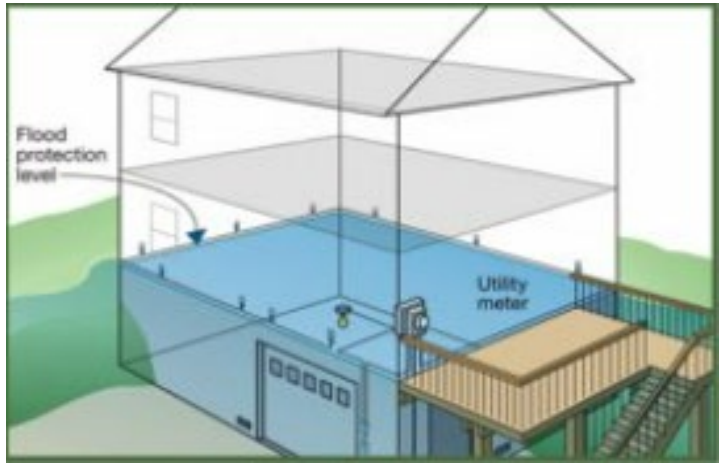
Cons:

- Liability for flood protection may fall on transportation agency

Game play – Strategy selection and planning

Example for Waterfront Industrial Zone:

- Put in place a Resilience Development Standard
- Flood proof buildings as needed/possible
- Add dunes to the Princeton beach to help protect against storm surge and sea level rise. May need rebuild multiple times to address 2100 SLR.
- Add beach nourishment if you want the beach maintained



Game play – Strategy selection and planning

Consider:

- Think about what strategies you might need for the **2100 scenario**.
- What amount of SLR rise does that mean for your priority assets?
- Consider types of strategy based on the asset/assets:
  - **Realign: policy strategies**
  - **Accommodate: asset specific strategies**
  - **Protect: physical strategies**
- Document your team's chosen strategies in the worksheet

Press Conference – Sharing your plan!

Take 3 minutes to share your plan.
Highlight:

- Your Sea Level Rise Scenario
- Your top 3-5 priority assets
- Your budget
- Your main strategy pathways

Thank you!

To learn more about Plan Princeton, scan the QR code or look up the following URL for the County's webpage:

https://www.smcgov.org/planning/plan-princeton

Photo Credits

- **Riprap Revetment:** https://econcretetech.com/projects/port-of-san-diego/
- **Seawall:** David Hubbard, https://www.audubon.org/news/the-best-defense-against-sea-level-rise-leaves-little-room-birds
- **Traditional Levee:** Brett Walton, https://www.circleofblue.org/2020/world/building-bigger-walls-in-san-francisco-bay-to-hold-back-rising-waters/attachment/2020-02-california-marin-bwalton-img_5506-cr2-edit-edit-2500/
- **Beach Nourishment**: https://www.dredgingtoday.com/2013/01/10/sandag-beach-replenishment-completed-usa/
- **Marsh Enhancement:** Pathways Climate Institute
- **Dune Restoration and Management:** https://www.manhattanbeach.gov/departments/environmental-sustainability/climate-ready-manhattan-beach/beach-dune-enhancement-project
- **Breakwaters:** SCAPE, https://www.archdaily.com/1006533/living-breakwaters-by-scape-landscape-architecture-wins-the-2023-obel-award
- **Elevated Roadway**: https://napavalleyregister.com/news/local/stretch-of-highway-37-in-novato-gets-gas-tax-fund-to-study-flooding/article_c876caf9-c551-54be-b586-b9b5aba3aac2.html
- **Structure Floodproofing**: FEMA, https://basc.pnnl.gov/images/placing-both-interior-and-exterior-hvac-units-elevated-surface-provides-greater-protection
- **Structure Elevation:** Google Maps
- **Structure Relocation:** San Mateo County
- **Game play picture:** Pathways Climate Institute