Participant workbook for Game of Floods

Princeton, San Mateo County

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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

1 INTRODUCTION

This workbook contains instructions and worksheets to support the Game of Floods exercise for Princeton, a hands-on, interactive game that allows community participants to immerse themselves in a climate change assessment and adaptation plan[1]. The purpose of the game is to help participants:

- 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!

REVIEW CLIMATE SCIENCE

Adaptation to sea level rise begins with an understanding of the current state-of-the-science. Climate science is continually being updated, revised, and strengthened. Although there is no doubt that climate change has occurred and will continue to occur, it is difficult to predict with certainty what amount of sea level rise will occur at any given time in the future. Given these uncertainties, climate change planning must rely on the best available science. During adaptation planning, the selection of an appropriate project planning horizon often influences the selection of climate change projections.

Sea Level Rise Projections

The gameboard shows two sea level rise exposure zones, each with storm surge from a 1% annual chance storm. The sea level rise amounts shown on the game board are for 3.3 and 6.6 feet, taken from USGS's Coastal Storm Modeling System data. These amounts are used for the game because they align with San Mateo County's Sea Level Rise Policy for County-Owned Assets and the County's 2018 Sea Level Rise Vulnerability Assessment. The data aligns with (but is not identical to) the projections from the State of California Sea Level Rise Guidance released in 2024 by the Ocean Protection Council. Your team will have one scenario to keep in mind when assessing the vulnerability and consequences for assets in Princeton.

- **Intermediate Scenario: sea levels may rise 3.3 feet by 2100, and 6.6 feet by 2150.**
- **High Scenario: sea levels may rise 3.3 feet by 2070, and 6.6 feet by 2100.**

Your Allocated Sea Level Rise Scenario: _____

[1] The Game of Floods was originally developed for Marin County, California as a planning tool to allow stakeholders to better understand and prioritize adaptation strategies for responding to sea level rise and coastal flood hazards. This interactive tool was leveraged and expanded by Kris May and Rebecca Verity at AECOM with permission from Marin County. USDN further developed the game, incorporating extreme heat into a version called The Game of Extremes. Additional refinements were made for San Mateo County.

Game of Floods Activity:

- Review the *Game of Floods – Princeton* game board
- Review your assigned climate scenario card
- Choose/be assigned and review a role to adopt for the purposes of the game
- Introduce yourself to your team (including your actual role in life as well as your assumed role for the game!)

Roles

• Harbormaster	• Fishing Association President
• Surfer	• Supervisor
• Local Resident	• County Planner
• Business Owner	• Chief Engineer

2 ASSET INVENTORY

The development of the asset inventory is an important initial step in climate adaptation planning. Key assets are identified and catalogued. This is the full list of information that would be ideally collected for a vulnerability assessment to help understand its sensitivity to flooding:

- Year constructed / age
- Location and Elevation (lowest adjacent grade and elevation of electrical components)
- Condition
- Materials
- Redundancy
- Maintenance history
- Prior damage or repair history related to climate variables (e.g., flooding)
- Future planned upgrades or repairs (if any)

Note: *All asset descriptions are developed for the purpose of the game only. Where possible, they are derived from reports, maps, and observed conditions. They may not accurately reflect the asset.*

Game of Floods Activity:

- Facilitators will provide the team with Asset Cards describing the assets shown on the game board. Select 10 of the 19 infrastructure and community assets for further evaluation in the game, that your team considers most important for the community. Each team member should consider their assigned role when selecting assets – make the case for your assets!
- Complete the Asset Inventory columns in the separate Asset Tracking Table Worksheet.

Asset List*	
Central Industrial Zone	Highway 1
Waterfront Industrial Zone	Capistrano Road
West Point Avenue Residential Zone	Prospect Way
Princeton/Columbia Mixed-Use Zone	West Point Avenue
Pillar Point Harbor	Princeton Avenue
Half Moon Bay Yacht Club	Airport Street / Vassar Avenue
Marsh	West Point Parking Lot
Princeton Beach	Airport Street Bus Stop
West Shoreline Access Path	Public Works Corporation Yard
Princeton Pump Station	

*Selected for the purposes of the game. Exclusion is not an indication of the importance of the asset to Princeton. The 'Zones' have been made up for the purpose of the game and are not formal zones in real life.

3 VULNERABILITY AND CONSEQUENCE

ASSESSING VULNERABILITY

The vulnerability assessment utilizes the results of the asset inventory, sea level rise scenario selection, and inundation mapping, to assess vulnerability to sea level rise. Vulnerability is the degree to which an asset may be physically or functionally impacted by a climate hazard. Vulnerability is assessed through evaluating the exposure and sensitivity of an asset. *Exposure* is the degree to which an asset may physically interact with flooding and *sensitivity* is the degree to which an asset is adversely affected by flooding.

Vulnerability = Exposure + Sensitivity

Note: *All asset descriptions and sensitivity scores are developed for the purpose of the game only. Where possible, they are derived from reports, maps, and observed conditions. They may not accurately reflect the asset.*

Game of Floods Activity:

- Complete the Vulnerability Assessment columns in the separate Asset Tracking Table worksheet.

Vulnerability Assessment

Each team should review the Asset Cards for the assets selected in the Asset Tracking table. Your completed Asset Inventory columns provide information about each asset that is useful in completing the Vulnerability Assessment columns. The Total Vulnerability Score can be used to prioritize assets for adaptation strategy selection.

Hint: Each team should refer to the scoring definition tables below for determining the appropriate number of points for each asset, for both Exposure and Sensitivity. Remember, *exposure* is the degree to which an asset may physically interact with flooding and *sensitivity* is the degree to which an asset is adversely affected by flooding. Exposure can be identified on the gameboard for each asset. Sensitivity ratings are provided for each asset. If the team has a better understanding of an asset and therefore its likely sensitivity to flooding, they can adjust the provided sensitivity score.

Score		Exposure Definition:
5	**High**	Floods with 3.3 ft of SLR.
4	**High-Medium**	Floods with 3.3 ft of SLR + 1% Annual Chance Storm.
3	**Medium**	Floods with 6.6 ft of SLR.
2	**Medium-Low**	Floods with 6.6 ft of SLR + 1% Annual Chance Storm.
0	**Not Exposed**	Not in an exposure zone.

Score		Sensitivity Definition:
5	**High**	Irreversible change to asset/natural resource and permanent loss of function.
3	**Medium**	Substantial but reversible change to asset/natural resource or function.
1	**Low**	Short-term, minor, or reversible change to asset/natural resource or function.
0	**Not Sensitive**	No change to asset or natural resource function.

Assessing Consequences

Consequence considers the magnitude of the impact that would occur under the selected sea level rise scenario. Information about the asset, such as how it would be damaged by flooding, what disruption would be caused and how much it would cost to replace or repair are often informative when considering the consequences. The questions below can be useful in framing the consequences of sea level rise related impacts.

- **Damage:**
  - What is the level of damage to the asset?
  - Can the asset be repaired, or would the asset require complete replacement?
- **Disruption:**
  - Is there a disruption in service?
  - What is the length of disruption, i.e., hours, days, weeks? Does the disruption threaten public health and safety?
  - Will disruption at this asset have cumulative effects throughout an interconnected system (e.g. could the failure of a pump station cause wastewater backups upstream)?
- **Cost:**
  - Would it be costly to repair or replace the asset?
  - What are the economic (or health and safety) costs associated with the disruption?
  - Are there secondary impacts that need to be considered (i.e., potential impacts to human health and safety, or costs to other sectors, such as the environment and public recreation)?

Consequences Assessment

The intent of the consequence assessment is to develop a means to prioritize assets for adaptation planning and implementation.

Think about the potential *consequence* of the climate change impact on each asset in terms of damage, disruption, and overall relative cost (consider both direct and indirect consequences and short-term vs. long-term costs). You can then re-rank the assets based on these potential consequences using the final column in worksheet.

Game of Floods Activity:

- Complete the Consequence columns in the separate Asset Tracking Table worksheet.
- Re-rank the priority order of the assets if necessary, based on the consequence of inundation.

4 DEVELOPING ADAPTATION STRATEGIES

During this phase, potential adaptation strategies are developed for assets that are identified as vulnerable. Adaptation strategies can be either structural (such as levees and seawalls) that may address multiple assets, asset specific (such as flood proofing or elevation) or non-structural (such as policy) solutions. If a consequences assessment was also completed, the strategy selection may prioritize adaptation planning for assets, facilities, or features whose vulnerability poses high risks. Together, understanding vulnerability and consequence can help develop a prioritized list of assets for adaptation strategy development and implementation.

In many instances, it is not feasible or cost effective to design and build for long-term potential sea level rise scenarios of a highly uncertain nature, such as at the upper end estimates for the year 2100. In this case, a project could be designed and constructed to account for mid-century sea level rise conditions (for example, 1 foot of sea level rise by 2050), while also designing the facility with the ability to adapt to more severe sea level rise conditions over time. Adaptation strategies can therefore include both near-term and long-term solutions.

While only estimated capital costs have been included in the Game of Floods for simplicity, a full assessment would consider the costs of inaction and repeated repair and replacements. In order to successfully adapt in the future, it is likely that new ways of funding and/or new ways of local governments budgeting may be needed.

Game of Floods Activity:

- Review your budget, strategy cards and strategy cost sheet
- Complete the separate Adaptation Strategy Selection Table worksheet

Budget: _____

Adaptation Strategy Selection

Step 1. Facilitators will provide your team with cards of potential Adaptation Strategies and their associated costs, and a strategy selection table. Review the completed Asset Tracking Table and identify a range of adaptation strategies that can protect the selected infrastructure and community assets to a 2100 sea level rise scenario. Review the scenario card to see if that means adapting to 3.3ft or 6.6ft of sea level rise. The total cost of the adaptation strategies selected must not exceed your team's allocated budget. Think of innovative ways to achieve your adaptation goals!

Step 2. Each team will report out on their selected adaptation strategies and the associated cost of implementation. Each team should also consider the following three questions:

- Think about outreach and engaging the community, what activities would you need to complete as you finalize your strategies and during implementation?
- Are there long-term operations and maintenance costs that have not been considered?
- If there is one more thing you wanted to do to increase the adaptability of the area, but you could not afford, what would it be and why?

KEY TERMS AND DEFINITIONS

The following key terms are used throughout the workshop and within this workbook.

Adaptation	The practice of planning for anticipated climate change and developing strategies to address potential impacts.
Asset	Property, often a facility or structure (or a component of the facility or structure) regarded as having value. In this context, an asset is typically a physical component of an interrelated system that is essential to enable, sustain or enhance societal living conditions, such roads, trails, buildings, pump stations, etc. Natural resources, including open space, parks, and habitat, are also assets which may be considered in adaptation planning.
Climate	Climate is often defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities (such as temperature, air pressure, humidity, precipitation, and wind) over a period of time ranging from months to thousands of years. The traditionally accepted time period is 3 decades, as defined by the World Meteorological Organization (WMO). Climate in a wider sense is the state, including a statistical description, of the climate system.
Climate Change	Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, wind patterns, or sea level rise, among others, that occurs over several decades or longer.
Climate Impact	The physical manifestation of a short- or long-term climate stressor, such as flooding, degradation, damage, or destruction.
Climate Hazard	The component of climate (e.g., sea level rise, storm surge, precipitation, temperature) or event (e.g., extreme storm) that causes short- or long-term stress or impact to an asset, system, or community over time. Also referred to as a climate *stressor*.
Consequence	Something that happens to an asset or facility as a result of a particular climate impact or a combination of climate stressors. In a practical sense, consequence often considers damage, disruption, and/or costs to repair or replace. Also includes indirect consequences, such as impacts to supply chain or economic losses due to loss of function of an asset.
Exposure	The exposure of an asset is the degree to which an asset is susceptible to hazards (i.e., depth of flooding due to sea level rise, storm surge and wave run up).
FEMA	Federal Emergency Management Agency.
Flooding	The temporary inundation of a normally dry area as a result of abnormally highwater levels. *Coastal* flooding is caused by the combination of high tides and waves. *Riverine* flooding is caused by prolonged or intense precipitation within a watershed that causes a river or creek to overtop its banks and inundate its floodplain. *Urban* flooding is caused by intense precipitation in developed areas that overwhelms the stormwater collection system. One type of flooding may be exacerbated by another – for example, urban flooding may be worsened during high tides due to back-up of the stormwater system.

H:V	A slope ratio commonly used in engineering and construction to describe the steepness of a slope. It means that for every number of horizontal units (H), there is a rise or fall of a certain number of vertical units (V).
Levee	A man-made embankment.
Mitigation	The process of reducing the severity or impacts of climate change.
Overtopping	The amount of water over the crest of a coastal structure such as a seawall, due to wave action.
Planning Horizon	The timeframe that should be considered when planning for and adapting to climate change (e.g., 2050, 2100, 2100+)
Public Trust Boundary	The boundary between public and private land, usually along a natural resource that is held by the government for public use.
Sediment	Sediment is the sand, mud, and pebbles that were once solid rock.
Sensitivity	The degree to which an asset is, or could be, affected (i.e., temporary flooding causes minimal impact, or results in complete loss of asset or shut-down of operation) by a climate stressor, if exposed to that stressor.
Submarine Canyon	Channel incised into the seafloor, with shapes varying from straight, narrow cuts to meandering valleys.
Useful Life	The actual period of time the asset or facility will be in use at the given location (including regular repair and maintenance). The functional lifespan is typically longer than the engineering design life.
Vulnerability	The degree to which an asset may be physically or functionally impacted by a climate hazard. Vulnerability is a combination of exposure and sensitivity.
Wave Reflection	The phenomenon where a wave encounters a boundary or interface and is turned back into its original medium.
Wave Runup	The elevation of the sea level produced by waves at the shoreline.

Photo Credits

- **Front Page:** Pathways Climate Institute

For Powerpoint and Strategy Cards:

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- **Structure Relocation:** San Mateo County