Project Checklist

Purpose:

The Project Checklist is a tool jurisdictions can use to evaluate infrastructure improvements', and other physical projects', resilience to climate change impacts based on the expected lifespan of the infrastructure, projected hazards, and community vulnerabilities. The Project Checklist then presents adaptation measures to ensure infrastructure improvements are designed to be resilient to conditions intensified by climate change, including the potential for hazards of extreme heat, wildfire, inland flooding, and coastal flooding/sea level rise.

When to use:

The Project Checklist should be used during the planning phase of physical infrastructure projects to assess projects' vulnerability to damage and disruption of service, and identify adaptation measures to mitigate risk. The information gained from using this Project Checklist may inform many aspects of project design, including building and construction materials, building and equipment location, plantings/vegetation, emergency route access, utilization of buffers and easements, among others. As such, this Project Checklist should be used early in project planning and development to allow for design changes that may impact cost and timeframe.

Pre-Checklist: Project screening for climate hazards

The first step is to determine if the project is potentially at risk from climate hazards based on project location. If a project does not yet have an identified location, it is likely too early in the project development process to complete this checklist.

Table 1 provides questions for determining potential vulnerability to each of the primary climate hazards of concern. **Answering "Yes" to any of the screening questions means that the project proponent should complete the full checklist for that climate hazard.** Questions within each climate hazard checklist will characterize the nature of the project's vulnerability, but this first step is to identify the climate hazards the project could be exposed to.

Table 1: Project Screening for Climate Hazards

Climate Hazard	Screening Threshold Questions *(If the answer to any of the following questions is "Yes", then the checklist for that hazard must be completed.)*	Data sources for assessing past and potential future exposure (check all that apply)
 Extreme Heat	• Is the project located in a census tract with a heat wave vulnerability index score in the top quartile of the county (42.38)? Yes No	Maps based on California Heat Assessment Tool (CHAT): cal-heat.org/download
 Wildfire	• Is the project located in a high or very high fire hazard zone? Yes No	CalFIRE Maps - https://gis.data.ca.gov/maps/31219c833eb54598ba83d09fa0adb346/explore
 Inland Flooding	• Is the project located in a floodplain or flood-prone, low-lying area? Yes No	FEMA "FEMA Flood Hazard Zone" at: https://msc.fema.gov/portal/home Historic flooding, e.g., nuisance flooding, damage caused by large storms, etc. Site Specific Modeling (please provide date and source of information): ____
 Coastal Flooding/ Sea Level Rise	• Is the project located in a coastal floodplain or sea level rise hazard area, or will any infrastructure or resources that the project relies upon be affected by sea level rise? Yes No	FEMA "FEMA Flood Hazard Zone" at: https://msc.fema.gov/portal/home Historic erosion/flooding, e.g., overtopping during King Tides, damage caused by large storms, etc. Our Coast Our Future (OCOF) Hazard Map: https://ourcoastourfuture.org/hazard-map/ Site Specific Modeling (please provide date and source of information):

Section 1. Project Information

Date Prepared:

Project Contact:

Contact Email:

Project Name:

Project Number:

Project Location (attach map, if appropriate):

Brief Project Description:

Project Need/Benefit:

Table 2: Project Lifespan

Functional Lifespan	Project Category	Examples
< 20 years	Assets requiring regular maintenance/ replacement	Asphalt roadways; green infrastructure; green streets, permeable paving, rain gardens, bioswales; active transportation infrastructure
20-50 years	Maintenance/industrial facilities; traditional shoreline armoring devices	Maintenance facilities; industrial buildings; mechanical equipment; railyards; piers/docks; concrete sidewalks
50-75 years	Buildings and infrastructure (site-scale)	Multi-modal stations; buildings (public and private); galvanized steel culverts

Construction start year:

Time to complete construction:

Using Table 2, what is the functional lifespan of the project: approximately

Planning horizon: (time of construction + functional lifespan)

Extreme Heat Checklist

Temperature is projected to increase substantially, by 5˚F to 10 ˚F by the end of the 21st century. Along with mean temperature, heat wave frequency will increase, with more intensity and longer duration. Marine layer clouds can help to mitigate the impacts of temperature change in the coastal regions, though these clouds are not well represented in climate models requiring further research.[1] Extreme heat and heat waves will disproportionately affect vulnerable communities with fewer trees and parks as well as community members who lack access to air conditioning or cannot afford to use it. Heat waves can lead to increased demand for power and potential brown and blackouts.

Vulnerability Assessment to Guide Project Adaptation

In this section, the following questions determine the overall sensitivity of the constructed or modified asset[2] to the climate hazard (i.e., to what extent would the climate hazard affect the asset?) and assess the potential consequences of exposure to the climate hazard (i.e., what is the estimated damage, disruption, and potential cost to replace and/or repair the asset over its lifespan from being exposed to the climate hazard).

1. How would the climate hazard **damage** the asset? List what would be damaged. This includes what functions would be temporarily inoperable as a result of power loss.

2. What are the costs to replace or repair the asset?

3. Where would the funds come from?

4. Based on the previous three questions, what is the level of damage to the asset from the climate hazard?

Low Damage: Asset could be easily repaired and/or partially replaced

Moderate Damage: Asset would require complete replacement and/or very costly repairs, but it would be possible to repair/replace

High Damage: Asset would not repairable or completely inoperable

1 Kalansky, Julie, Dan Cayan, Kate Barba, Laura Walsh, Kimberly Brouwer, Dani Boudreau. (University of California, San Diego). 2018. San Diego Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-009.

2 Here "asset" refers to the newly constructed or modified structure(s) or infrastructure components that result from the project. If the project represents multiple asset types that vary in their vulnerability to climate hazards, a separate checklist should be prepared for each asset. For example, a project that includes a school and a public park represents two assets with very different considerations for climate change vulnerability and resilience.

5. If Moderate or High Damage, what adaptation strategies are being used to prevent damage?[3] (See Table 3 below)

6. How would the climate hazard **disrupt** the asset service or function? List what would be disrupted.

7. What would be the effects of this disruption?

8. How critical is this service? *(Note to Preparer: Some facilities or components are classified as critical either because of the public health and safety services they provide (e.g., hospitals and key transportation assets) or their importance during an emergency (e.g., designated shelters and back-up energy generators). Specifically for extreme heat, designated Cool Zones are also critical facilities.)*

9. Based on the previous questions, what is the level of disruption to the asset from the climate hazard?

Low: No or little disruption in service or function as there is low anticipated damage.

Moderate: There are alternative facilities that would not be damaged or otherwise offline during an extreme heat event.

High: If this asset is damaged or offline during an extreme heat event, there are not alternative facilities, and community members and people who depend on this asset may be in danger.

10. If Moderate or High Disruption, what adaptation strategies are being used to maintain this service/function? (See Table 3 below)

3 Kalansky, Julie, Dan Cayan, Kate Barba, Laura Walsh, Kimberly Brouwer, Dani Boudreau. (University of California, San Diego). 2018. San Diego Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-009.

Table 3: Sample Extreme Heat Adaptation Strategies

Note to Preparer: the adaptations strategies listed below are not exhaustive, but a few examples of possible strategies.

Strategy #	Hazard	Adaptation Strategy
1		Expand and maintain urban tree canopy, especially in communities vulnerable to extreme heat.
2		Expand the use of cool roofs and reflective building materials.
3		Use alternative vegetative solutions such as green walls and green roofs.
4		Expand the use of cool, porous, high-reflectivity pavement?
5		Use alternative air conditioning, such as propane air conditioners, fans, and cold-water systems.
6		Expand access to cooling centers during heat health events
7		Ensure at least two routes for emergency vehicle access.

Wildfire Checklist

The risk for large catastrophic wildfires driven by Santa Ana wind events likely increase as a result of a drier autumns leading to low antecedent precipitation before the height of the Santa Ana wind season.[4]

Vulnerability Assessment to Guide Project Adaptation

In this section, the following questions determine the overall sensitivity of the constructed or modified asset[5] to the climate hazard (i.e., to what extent would the climate hazard affect the asset?) and assess the potential consequences of exposure to the climate hazard (i.e., what is the estimated damage, disruption, and potential cost to replace and/or repair the asset over its lifespan from being exposed to the climate hazard).

1. How would the climate hazard **damage** the asset? List what would be damaged.

2. What are the costs to replace or repair the asset?

3. Where would the funds come from?

4. Based on the previous questions, what is the level of damage to the asset from the climate hazard?

Low Damage: Asset could be easily repaired and/or partially replaced

Moderate Damage: Asset would require complete replacement and/or very costly repairs, but it would be possible to repair/replace

High Damage: Asset would not repairable or replaceable in the existing location

4 Here,"asset" refers to the newly constructed or modified structure(s) or infrastructure components that result from the project. If the project represents multiple asset types that vary in their vulnerability to climate hazards, a separate checklist should be prepared for each asset. For example, a project that includes a school and a public park represents two assets with very different considerations for climate change vulnerability and resilience.

5. If Moderate or High Damage, what adaptation strategies are being used to prevent damage? (See Table 4 below)

6. How would the climate hazard **disrupt** the asset service or function? List what would be disrupted.

7. What would be the effects of this disruption?

8. How critical is this service? *(**Note to Preparer**: Some facilities or components are classified as critical either because of the public health and safety services they provide (e.g., hospitals and key transportation assets) or their importance during an emergency (e.g., designated shelters and back-up energy generators)).*

9. Based on the previous three questions, what is the level of disruption to the asset from the climate hazard?

Low: No or little disruption in service or function

Moderate: Disruption in service or function that doesn't threaten public health & safety (non-critical), e.g., alternate routes, redundancy in the system, etc.

High: Disruption of service and/or function that threatens public health & safety (critical), e.g., no alternate routes, redundancy in the system, etc.

10. If Moderate or High Disruption, what adaptation strategies are being used to maintain this service/function? (See Table 4 below)

Table 4: Sample Wildfire Adaptation Strategies

Note to Preparer: the adaptations strategies listed below are not exhaustive, but a few examples of possible strategies.

Strategy #	Hazard	Adaptation Strategy
1		Implement a layered fire hazard approach using structure and fuel hardening, change of fuel types to buffer development, etc..
2		Fire Department inspection of constructed/modified project to assess safety of structures and potential enhancements to improve survivability and accessibility for firefighters.
3		Use building materials, especially roofing, that resist ignition from wildfire.
4		Plant tree and shrub species, and implement forestry practices, that have reduced vulnerability to fires.
5		Ensure redundancy of critical transportation and evacuation routes.
6		If parcel development is no community water system, provide 5000 gallons or greater of water storage.
7		Comply with defensible space laws (100 feet of clearance around structures) and establish non-ignition zone for structures.
8		Create shaded fuel breaks in transition zones between residential and open space areas.
9		Reduce fuel/vegetation along key evacuation routes with ingress/egress into neighborhoods.

Inland Flooding Checklist 

Precipitation will remain highly variable but will change in character, with wetter winters, drier springs, and more frequent and severe droughts punctuated by more intense individual precipitation events, creating new challenges for stormwater management systems and exacerbating flood risks.[5]

Vulnerability Assessment to Guide Project Adaptation

In this section, the following questions determine the overall sensitivity of the constructed or modified asset[6] to the climate hazard (i.e., to what extent would the climate hazard affect the asset?) and assess the potential consequences of exposure to the climate hazard (i.e., what is the estimated damage, disruption, and potential cost to replace and/or repair the asset over its lifespan from being exposed to the climate hazard).

1. How would the climate hazard **damage** the asset? List what would be damaged.

2. What are the costs to replace or repair the asset?

3. Where would the funds come from?

4. Based on the previous three questions, what is the level of damage to the asset from the climate hazard?

Low Damage: Asset could be easily repaired and/or partially replaced

Moderate Damage: Asset would require complete replacement and/or very costly repairs, but it would be possible to repair/replace

High Damage: Asset would not repairable or replaceable in the existing location

5 Here "asset" refers to the newly constructed or modified structure(s) or infrastructure components that result from the project. If the project represents multiple asset types that vary in their vulnerability to climate hazards, a separate checklist should be prepared for each asset. For example, a project that includes a school and a public park represents two assets with very different considerations for climate change vulnerability and resilience.

5. If Moderate or High Damage, what adaptation strategies are being used to prevent damage? (See Table 5 below)

6. How would the climate hazard **disrupt** the asset service or function? List what would be disrupted.

7. What would be the effects of this disruption?

8. How critical is this service? *(**Note to Preparer**: Some facilities or components are classified as critical either because of the public health and safety services they provide (e.g., hospitals and key transportation assets) or their importance during an emergency (e.g., designated shelters and back-up energy generators).*

9. Based on the previous three questions, what is the level of disruption to the asset from the climate hazard?

Low: No or little disruption in service or function

Moderate: Disruption in service or function that doesn't threaten public health & safety (non-critical), e.g., alternate routes, redundancy in the system, etc.

High: Disruption of service and/or function that threatens public health & safety (critical), e.g., no alternate routes, redundancy in the system, etc.

10. If Moderate or High Disruption, what adaptation strategies are being used to maintain this service/function? (See Table 5 below)

Table 5: Sample Inland Flooding Adaptation Strate-

Note to Preparer: the adaptations strategies listed below are not exhaustive, but a few examples of possible strategies.

Strategy #	Hazard	Adaptation Strategy
1		Utilize pervious pavement for bicycle and pedestrian pathways to facilitate stormwater capture.
2		Create higher land to build on by adding fill to raise existing land surface elevations.
3		Upgrade flood control channels, pumping systems, overflow areas, and drains to accomodate larger rainstorms.
4		Ensure critical equipment, such as emergency generators, are located above target flood levels.
5		Construct grey/green on-site stormwater management.
6		Reserve land for a conservation easement to protect floodplains and other open space types.
7		Relocate buildings, utilities, or other infrastructure at risk of flooding from severe precipitation events.
8		Ensure redundancy of critical transportation, emergency vehicle access, and evacuation routes.
9		Use flood-resistant building materials in construction and renovation.

Coastal Flooding/Sea Level Rise Checklist

Sea level along the San Diego County coast is expected to rise approximately 1 ft. by mid-century, and 3 ft. or potentially much higher by 2100.[6] Sea level rise increases the risk of coastal erosion and flooding. For the next several decades, coastal impacts should be intermittent as extreme events occur due to high tides and storms, usually during winters having El Niño conditions. However, as sea levels rise, current thresholds of extremes will occur more frequently and with longer durations because they will occur on top of higher water levels, imperiling existing infrastructure and ecosystems.

Additional Coastal Hazard Information

*(**Note to Preparer**: Specify the elevation baseline for all questions (NAVD88 or City Datum.) Assess if the project would be subject to temporary coastal flooding, wave hazards, or sea level rise inundation.)*

1. What is the lowest ground elevation in the project location (in feet)?

a) existing grade: _____ft NAVD88 City Datum

b) proposed grade (e.g., with fill): _____ ft NAVD88 City Datum

2. What is the Mean Higher High Water (MHHW) elevation closest to your project location[7]?

MHHW: _____ ft NAVD88 City Datum

3. What is 100-year extreme tide (storm surge) elevation closest to your project location?

100-year extreme tide: _____ ft NAVD88 City Datum

*(**Note to Preparer**: If the 100-year extreme water level elevation minus the lowest ground elevation is negative, the project could be vulnerable to temporary flooding by extreme high tides under existing conditions.)*

4. For projects located on the shoreline, what is the 100-year total water level elevation (FEMA 100-year base flood elevation, which is the 100-year extreme tide elevation plus wave runup[7])?

100-year total water level elevation: _____ ft NAVD88 City Datum

*(**Note to Preparer**: If the 100-year total water level elevation minus the lowest ground elevation is negative, the project could be vulnerable to wave hazards under existing conditions.)*

6 See La Jolla datum here: https://tidesandcurrents.noaa.gov/datums.html?id=9410230 and San Diego datum here: https://tidesandcurrents.noaa.gov/datums.html?id=9410170

7 https://www.fema.gov/sites/default/files/documents/fema_coastal-glossary.pdf

5. During the project's functional lifespan, would its lowest ground elevation be at risk from sea level rise according to the local jurisdiction's criteria for acceptable risk, e.g., MHHW plus 3 feet of sea level rise[8]?

*(**Note to Preparer**: If the lowest ground elevation is less than MHHW plus projected sea level rise at the end of the planning horizon year, the project could be vulnerable to permanent inundation.)*

Yes No

Vulnerability Assessment to Guide Project Adaptation

In this section, the following questions determine the overall sensitivity of the constructed or modified asset[9] to the climate hazard (i.e., to what extent would the climate hazard affect the asset?) and assess the potential consequences of exposure to the climate hazard (i.e., what is the estimated damage, disruption, and potential cost to replace and/or repair the asset over its lifespan from being exposed to the climate hazard).

6. How would the climate hazard **damage** the asset? List what would be damaged.

7. What are the costs to replace or repair the asset?

8. Where would the funds come from?

9. Based on the previous three questions, what is the level of damage to the asset from the climate hazard?

Low Damage: Asset could be easily repaired and/or partially replaced

Moderate Damage: Asset would require complete replacement and/or very costly repairs, but it would be possible to repair/replace

High Damage: Asset would not repairable or replaceable in the existing location

8 See La Jolla and San Diego Projected Sea Level Rise (pgs. 75 and 78, respectively): https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

9 Here "asset" refers to the newly constructed or modified structure(s) or infrastructure components that result from the project. If the project represents multiple asset types that vary in their vulnerability to climate hazards, a separate checklist should be prepared for each asset. For example, a project that includes a school and a public park represents two assets with very different considerations for climate change vulnerability and resilience.

10. If Moderate or High Damage, what adaptation strategies are being used to prevent damage? (See Table 6 below)

11. How would the climate hazard **disrupt** the asset service or function? List what would be disrupted.

12. What would be the effects of this disruption?

13. How critical is this service? *(**Note to Preparer**: Some facilities or components are classified as critical either because of the public health and safety services they provide (e.g., hospitals and key transportation assets) or their importance during an emergency (e.g., designated shelters and back-up energy generators))*

14. Based on the previous three questions, what is the level of disruption to the asset from the climate hazard?

Low: No or little disruption in service or function

Moderate: Disruption in service or function that doesn't threaten public health & safety (non-critical), e.g., alternate routes, redundancy in the system, etc.

High: Disruption of service and/or function that threatens public health & safety (critical), e.g., no alternate routes, redundancy in the system, etc.

15. If Moderate or High Disruption, what adaptation strategies are being used to maintain this service/function? (See Table 6 below)

Table 6: Sample Coastal Flooding/Sea Level Rise Adaptation Strategies

Note to Preparer: the adaptations strategies listed below are not exhaustive, but a few examples of possible strategies.

Strategy #	Hazard	Adaptation Strategy
1		Create higher land to build on by adding fill to raise existing land surface elevations.
2		Implement nature-based shoreline management strategies to preserve beaches, dunes, and wetlands, as applicable, to protect structures and infrastructure.
3		Elevate first floor of buildings to elevations above projected sea level rise levels.
4		Develop adaptation pathway to maintain functions as sea level rises (e.g., managed retreat).
5		Ensure critical equipment, such as emergency generators, are located above projected sea level rise levels.
6		Build seawall/floodwall to protect structures and infrastructure against wave erosion and flooding.
7		Locate project at appropriate distance from shoreline consistent with CCC policy.