RESILIENTMASS ACTION TEAM (RMAT)

CLIMATE RESILIENCE DESIGN STANDARDS & GUIDANCE

SECTION 3: PRELIMINARY CLIMATE HAZARD EXPOSURE & RISK SCREENING

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VERSION 1.4

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ENV 19 CC 02
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3. PRELIMINARY CLIMATE HAZARD EXPOSURE & RISK SCREENING

This section describes the Preliminary Climate Hazard Exposure and Risk Ratings outputs provided by the Climate Resilience Design Standards Tool ("the Tool"), and the relationships that inform those outputs.

3.1 GOALS/OBJECTIVES

The main objective of the Preliminary Climate Hazard Exposure and Risk Ratings is to inform project development and capital planning decision-making across various projects in the Commonwealth considering the following climate parameters: sea level rise/storm surge, extreme precipitation (stormwater and riverine flooding), and extreme heat. This is a preliminary screening and does not replace a site-specific vulnerability and risk assessment.

3.2 OUTPUT OVERVIEW

The Preliminary Climate Hazard Exposure and Risk Ratings are one of the two main outputs of the Tool (the other main output of the Tool is the Climate Resilience Design Standards, described in **Section 4**). Upon users completing the information as described in **Section 2**, the four preliminary Climate Hazard Exposure and Risk Screening outputs are automated in the Tool as listed in Table 3.1.

Table 3.1. Preliminary Climate Hazard Exposure and Risk Rating Outputs

Output	Project or Asset Specific	Climate Parameter Specific	Possible Score
Environmental Justice	Overall Project	N/A	Yes or No
Ecosystem Service Benefits (ESB) Score	Overall Project	N/A	Low ESB Score, Moderate ESB Score, or High ESB Score
Preliminary Climate Hazard Exposure Score	Overall Project	• Sea Level Rise/ Storm Surge • Extreme Precipitation (Riverine) • Extreme Precipitation (Stormwater) • Extreme Heat	Not Exposed, Low Exposure, Moderate Exposure, or High Exposure
Preliminary Climate Risk Ratings	Building Assets and/or Infrastructure Assets	• Sea Level Rise/ Storm Surge • Extreme Precipitation (Riverine) • Extreme Precipitation (Stormwater) • Extreme Heat	Low Risk, Moderate Risk, or High Risk

3.2.1 ENVIRONMENTAL JUSTICE

The evaluation of whether a project is within a mapped Environmental Justice neighborhood is the first overall project output in the Tool. In Massachusetts, an Environmental Justice (EJ) neighborhood (census block group) is defined as meeting one or more criteria linked to the size of a census block group's minority populations, median household income, and language isolation. EJ neighborhoods typically include climate vulnerable populations, who may have lower adaptive capacity or higher exposure and sensitivity to climate hazards like flooding or heat stress due to factors such as access to transportation, income level, disability, racial inequity, health status, or age.

This output (yes or no) is enabled by spatial analyses of whether the project polygon as drawn by the user intersects with the Massachusetts 2020 Environmental Justice Populations obtained from **https://www.mass.gov/info-details/massgis-data-2020-us-census-environmental-justice-populations**. This does not reflect if the user answered asset questions related to if the building/facility or infrastructure provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations. The answer to that question appears in the Preliminary Climate Risk Screening output as described in **Section 3.2.4**. The EJ project level score is not tied to the recommend design standards.

Stakeholder Engagement: Project Managers should engage with stakeholders across sectors of infrastructure, environment, and society, to establish a more integrated plan of action for community resilience.

This may also include a social vulnerability assessment, which is recommended for projects that provide services to populations that reside within mapped Environmental Justice neighborhoods or climate vulnerable populations. By incorporating knowledge and insights from a variety of stakeholders throughout design and implementation phases, the overall process becomes more inclusive and ultimately drives toward more equitable outcomes.

For additional guidance associated with integrating climate resilience into projects that serve Environmental Justice neighborhoods, please refer to the **Climate Resilience Design Guidance Document.**

This document includes regional coordination (RC) best practices, such as ***RC-4: Prioritize services and assets that serve populations in Environmental Justice neighborhoods and climate vulnerable populations.*** This consideration includes a description of this best practice, relevant examples, and questions for users to consider.

3.2.2 PROJECT ECOSYSTEM SERVICE BENEFITS (ESB) SCORE

The purpose of this output is to provide an overall indication of the ecosystem services and benefits to ecosystems that a project may provide through protection of natural resources and nature-based solutions above and beyond existing regulatory requirements.

The Ecosystem Service Benefits (ESB) Score is provided on a scale of low, moderate, and high. As described in **Section 2.4**, users indicate if their project provides the benefit (yes), benefit will not be provided in the project (no), or benefit may be integrated into project if possible (maybe). Each response is assigned a relative point, as indicated in Table 3.2, below.

Table 3.2. Ecosystem Service Benefits Assigned Points

Types of Ecosystem Benefits	Points assigned if "YES"
Is the primary purpose of this project ecological restoration?	60*
Provides flood protection through nature-based solutions	12
Reduces storm damage	8
Recharges groundwater	6
Protects public water supply	8
Filters stormwater using green infrastructure	6
Improves water quality	6
Promotes decarbonization	8
Enables carbon sequestration	6
Provides oxygen production	3
Improves air quality	3
Prevents pollution	3
Remediates existing sources of pollution	5
Protects fisheries, wildlife, and plant habitat	6
Protects land containing shellfish	6
Provides pollinator habitat	6
Provides recreation	5
Provides cultural resources/education	3

* This is an override question—answering yes automatically will result in a High ESB score.

The ESB score is determined by summing the points for all "Yes" responses provided during the Project Inputs. A response of "No" or "Maybe" to the ecosystem service benefits results in zero points. The total possible points equal 100 (except for the override question) and the thresholds for low, moderate, and high are provided below:

- Low ESB Score (Less than or equal to 30 points)
- Moderate ESB Score (31 to 59 points)
- High ESB Score (Greater than or equal to 60 points)

Natural systems and ecosystem services provide great economic value and social benefit, often untapped in non-resilient projects. Nature-based solutions may cost less than traditional gray approaches through reduced upfront investment, maintenance costs, or both, and as living systems, some can become self-sustaining over time. Nature-based solutions also provide many co-benefits for the environment and society. Low ESB scores indicate projects do not provide

substantial ecosystem benefits or ecosystem services and suggests that nature-based solutions are not part of project design. High ESB scores indicate that projects significantly benefit ecosystems and/or ecosystem services and suggests nature-based solutions are a central part of the overall project. The ESB project level score is not tied to the recommend design standards.

Users are encouraged to evaluate how their project may provide ecosystem benefits in design to increase this score. The expanded output with rationale for *Factors Influencing Output* and *Factors to Improve Output* is available by clicking the gray question mark icon next to the score. *Factors Influencing Output* query the "yes" responses provided by the user of top 12 ecosystem benefits with the most points. *Factors to Improve Output* query the "maybe" responses provided by the user because not every project will have all ecosystem benefits possible. For example—projects in Western Massachusetts will likely not include elements that protect lands containing shellfish.

The Nature Conservancy has created a set of maps that help communities identify where nature-based solutions can most effectively address natural hazards and contribute to resilience planning at a local level. This project leverages existing statewide datasets and analyses to create easily understandable layers that highlight a range of potential actions and next steps. The results are intended as a high-level screening tool to identify places where conservation and restoration can help combat drought susceptibility, inland and coastal flooding hazards, and contribute to ecosystem co-benefits. https://maps.coastalresilience.org/massachusetts/

3.2.3 PRELIMINARY CLIMATE HAZARD EXPOSURE SCORE

The purpose of this output is to provide a preliminary assessment of whether the project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change for each of the following climate parameters: sea level rise/storm surge, extreme precipitation (stormwater and riverine flooding), and extreme heat. The Tool will calculate one of the following exposure outputs for each climate parameter: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. Preliminary Climate Hazard Exposure Score is calculated based on GIS-spatial analysis of the project location and responses to questions (refer to **Section 2.3**).

The Preliminary Climate Hazard Exposure Score does not substitute a formal site-specific vulnerability assessment.

The relationship between GIS Datasets and user responses to questions for each climate parameter is shown in Table 3.2. Each question/filter has a score, which is summed to drive the overall Preliminary Climate Hazard Exposure Score for that climate parameter.

Planning Horizon Filter: The Preliminary Climate Hazard Exposure Scores are based on the overall project location, not location of individual assets. The Tool will query the GIS datasets as defined in Table 3.3 based on the extent of the project polygon as drawn by the user and the longest useful life and/or monitoring frequency of the assets entered into the Tool. For example, if there is only one asset entered for the project, the planning horizon queried for exposure scores will be the planning horizon of that asset (see Section 4). If there are several assets entered, the Tool will search for the asset with the longest useful life (calculated by useful life or monitoring

frequency in years added to the construction start year). That will determine the planning horizon queried for GIS-based analyses.

Table 3.3. Exposure Scoring Derived from Project Inputs for the Tool

Climate Parameter	GIS Dataset (if applicable)	Question/Filter	Response/Score	Total Score (Calculated)	Exposure Score (Calculated)
Sea Level Rise/Storm Surge	Massachusetts Coast Flood Risk Model (MC-FRM) (Filter: 2030 mean high water shoreline shapefile, probability maps, planning horizon)	Is any part of the project located within the projected mean high-water shoreline by 2030?	Yes = 4 No = 0	Total score determined by summing the values of all responses.	**Not Exposed (Total Score 0)** **Low Exposure (1)** **Moderate Exposure (2-3)** **High Exposure (≥4)**
	N/A - user question	Is any part of the project in the projected 1% annual coastal flood exceedance probability (ACFEP) extent within the overall project's useful life?	Yes = 2 No = 0		
	MC-FRM (Filter: probability maps, planning horizon)	Does the project site have a history of coastal flooding?	Yes = 2 No/Unsure = 0		
		Is any part of the project within the projected 0.1% annual coastal flood exceedance probability (ACFEP) extent within the overall project's useful life?	Yes = 1 No = 0		
Extreme Precipitation *Stormwater Flooding*	N/A - user question	Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Yes = 3 No/Unsure = 0	Total score determined by summing the values of all responses.	**Low Exposure (1)** **Moderate Exposure (2-3)** **High Exposure (>3)**
	N/A - user question	Does the project result in a net increase in impervious area of the site?	Yes = 1 No/Unsure = 0		
	MassGIS (National Land Cover Database [NLDC], 2016)	What is the existing percentage of impervious area of the project site?	< 10% = 0 10 - 50% =1 > 50% = 2		
	EEA's Climate and Hydrologic Risk Project (Phase 1) Projected Max Annual Rainfall (Filter: RCP 8.5, 50th percentile, Basin Scale, Planning Horizon)	What is the projected maximum annual daily rainfall within the overall project's useful life?	< 6 in = 1 6 - 10 in = 2 > 10 in = 3		
Extreme Precipitation *Riverine Flooding*	FEMA flood zones (excluding areas mapped by MC-FRM)	Is any part of the project located within the "future riverine environment" (which includes areas outside the MC-FRM projected 0.1% annual coastal flood exceedance probability extent within the overall project's useful life, and within the current FEMA 0.2% annual chance (500-year floodplain)) within the overall project's useful life?	Yes = 3 No = 0	Total score determined by summing the values of all responses.	**Not Exposed (Total Score 0)** **Low Exposure (1)** **Moderate Exposure (2)** **High Exposure (≥3)**
	N/A - user question	Does the project site have a history of riverine flooding?	Yes = 2 No/Unsure = 0		
	LiDAR rasters; MassGIS data layer MassDEP Hydrography and polycodes 1, 6 and arccodes 4, 5; MassDEP waterbodies 500 ft buffers; waterbodies 100 ft buffers	Is the lowest elevation point on the project site located outside of the MC-FRM projected 0.1% annual coastal flooding exceedance probability extent within the overall project's useful life, AND: within 100 ft of a waterbody? OR Between 101 – 200 ft away from a waterbody AND less than 30 ft above the waterbody? OR Between 201 – 500 ft away from a waterbody AND less than 20 ft above the waterbody?	Yes = 2 No = 0		
	MassDEP waterbodies 100 ft buffer; LiDAR rasters	Is any part of the project located outside of the MC-FRM projected 0.1% annual coastal flood exceedance probability extent within the overall project's useful life, not within a body of water, and within 100 ft of a waterbody with a 15% or greater slope between the project and waterbody?	Yes = 1 No = 0		
Extreme Heat	EEA's Climate and Hydrologic Risk Project (Phase 1) Projected Days over 90 degrees (Filter: RCP 8.5, Basin Scale, Planning Horizon)	How many days of projected increase in days over 90 degrees Fahrenheit are there within the asset's useful life?	< 10 days = 1 10 to 30 days = 2 30+ days = 3	Total score determined by summing the values of all responses; *except in the case of existing impervious and existing canopy choose the higher score between the two and use that value in the scoring calculation.	**Low Exposure (1)** **Moderate Exposure (2 - 3)** **High Exposure (≥4)**
	GIS Map	Is any part of the project within 100 ft. of an existing water body?	Yes = 0 No = 1		
	MassGIS (NLCD, 2016)* **OR*** MassGIS (NLCD, 2016)*	What is the existing percentage of impervious area of the project site?* **OR*** What is the existing percentage of canopy area of the project site?*	< 10% = 0 10 - 50% =1 > 50% = 2 < 10% = 2 10 - 40% =1 > 40% = 0		
	N/A - user question	Does the project result in a net increase in impervious area of the site?	Yes = 1 No/Unsure = 0		
	N/A - user question	Are existing trees being removed as part of the proposed project?	Yes = 2 No/Unsure = 0		

Expanded Exposure Score Output

The expanded output with rationale for *Primary Factors Influencing the associated score* is available by clicking the gray question mark icon next to the score.

For project locations exposed to sea level rise/storm surge (within the projected 0.1% annual exceedance probability extent of the Massachusetts Coast Flood Risk Model (MC-FRM) over the project's useful life), users will also receive the first planning horizon (2030, 2050, or 2070) that the site is exposed to coastal flooding for the 100-year or 1% annual exceedance probability (AEP) flood event within its useful life.

Figure 3.1 shows an example of a preliminary project exposure rating output the user will receive from the Tool. Indicated in Figure 3.2, below, is an example of an expanded exposure rating a user would receive for the sea-level rise/storm surge climate parameter.

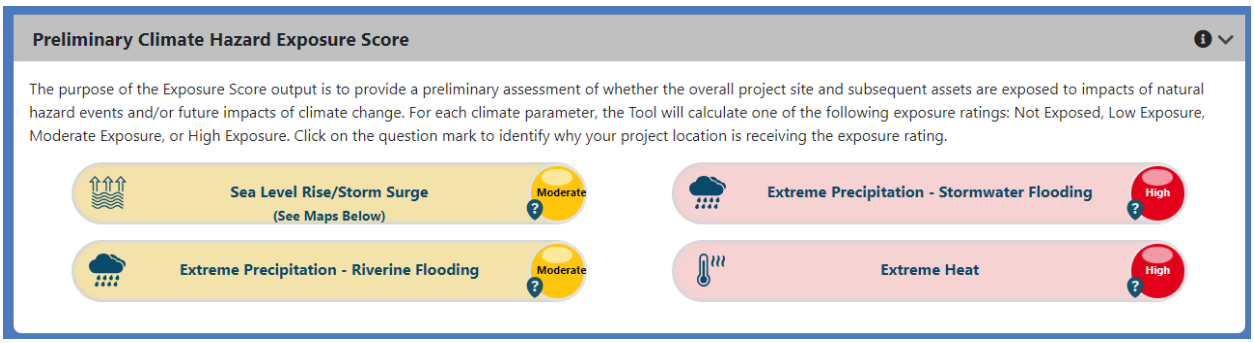

Figure 3.1. Example of Preliminary Project Exposure Score Output

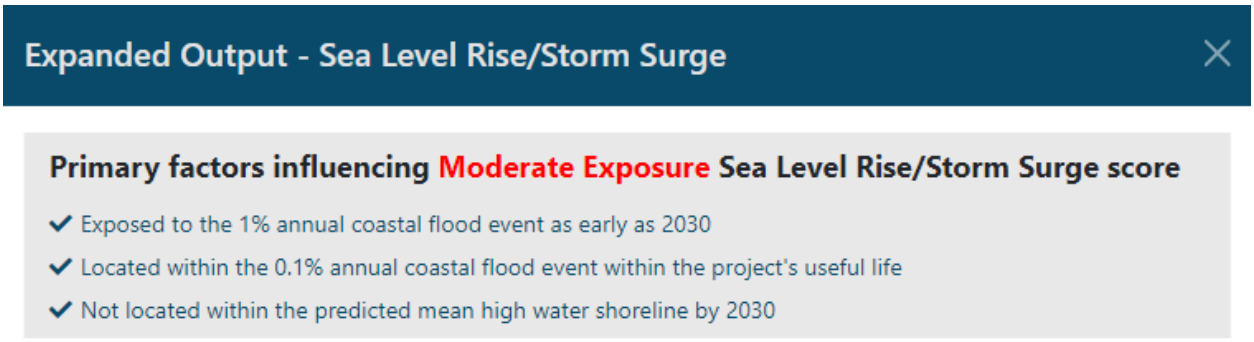

Figure 3.2. Example of Expanded Output for Moderate Exposure for the Sea Level Rise/Storm Surge

The Climate Hazard Exposure is one of many factors that may influence project planning and design. For additional guidance associated with the Preliminary Climate Hazard Exposure Score, please refer to the **Climate Resilience Design Guidance Document** for site suitability and opportunities for regional coordination considerations.

- Site suitability evaluates how geographic location, existing conditions, and asset placement impact a sites' ability to serve its intended function, before, during, and after an extreme event. The associated best practices and related forms provide examples and questions to consider relocating the project to a site with a lower climate hazard exposure

score. There may be opportunities to mitigate climate impacts through the proposed project, such as designing a flood barrier or using green infrastructure to reduce extreme precipitation and extreme heat impacts.

- Regional coordination considerations seek to understand how collaboration across regions, state agencies, and jurisdictions can help strengthen resilient design and implementation. The associated best practices and related forms provide examples to consider existing regional plans and vulnerability assessments to identify regional projects that may provide on-site and off-site benefits such as flood protection or upland stormwater storage. If no existing studies are available, users are encouraged to consider conducting a formal risk and vulnerability assessment.

3.2.4 PRELIMINARY CLIMATE RISK RATING

The purpose of this output is to serve as an initial screening to identify projects with a "High Risk" designation, which may warrant additional siting review and/or design considerations.

A Preliminary Climate Risk Rating Output is provided for building and infrastructure assets for each of the following climate parameters: sea level rise/storm surge, extreme precipitation (stormwater and riverine flooding), and extreme heat. The Tool will calculate one of the following risk outputs for each climate parameter: Low Risk, Moderate Risk, or High Risk. Preliminary Climate Risk Rating is calculated based on the preliminary exposure score of the overall project and the individual asset's criticality score (refer to **Section 2.5.7**) as illustrated by the matrix shown in Table 3.4. *Note: all applicable assets will receive at a minimum, a Low Risk Rating; where as for the Climate Hazard Exposure, it is possible to receive a "Not Exposed" for coastal or riverine flooding parameters.*

Natural resource assets will not receive a preliminary risk rating. The Preliminary Climate Risk Rating does not substitute a formal risk assessment.

Table 3.4. Preliminary Climate Risk Rating Relationship Matrix (based on Overall Project Preliminary Climate Hazard Exposure Score & Asset Criticality Score)

		Preliminary Exposure Score			
		Not Exposed	**Low Exposure**	**Moderate Exposure**	**High Exposure**
Criticality	**High**	Low Risk	Moderate Risk	High Risk	High Risk
	Medium	Low Risk	Low Risk	Moderate Risk	High Risk
	Low	Low Risk	Low Risk	Moderate Risk	High Risk

Table 3.5 shows an example of how multiple assets in a project could receive different risk ratings from the Tool with the same overall project exposure.

Table 3.5. Example of Preliminary Asset Risk Rating Output from the Tool

	SEA LEVEL RISE /STORM SURGE	EXTREME PRECIPITATION - RIVERINE	EXTREME PRECIPITATION - STORMWATER	EXTREME HEAT
Overall Project Exposure	***High Exposure***	***Not Exposed***	***Moderate Exposure***	***Moderate Exposure***
Asset 1: High Criticality	High Risk	Low Risk	High Risk	High Risk
Asset 2: Medium Criticality	High Risk	Low Risk	Moderate Risk	Moderate Risk
Asset 3: Low Criticality	High Risk	Low Risk	Moderate Risk	Moderate Risk

A high risk score does not necessarily indicate a "risky" investment. For example, a coastal flood barrier may receive a high risk score, but that is based on the exposure of the project and impact if that asset fails. Users should consider if their project can incorporate assets that mitigate climate risks or if they should consider relocating their assets to a less exposed location (please refer to the **Climate Resilience Design Guidance Document** for site suitability considerations) especially if the asset has significant impacts to public health and safety or other significant consequences if inoperable or inaccessible.

Expanded Climate Risk Rating Output

The expanded output with rationale for *Primary project exposure and asset criticality factors influencing the associated risk rating* is available by clicking the gray question mark icon next to the score. These expanded details are meant to provide a general overview of important areas for the user to be aware of and evaluate more but does not replace a detailed vulnerability and risk assessment of the project or asset.

This dashboard output will highlight factors that are more severe in consequence and are more likely to cause High Risk ratings. An example of a detailed dashboard output users would receive with the Preliminary Risk Rating for a sample asset is shown in Figure 3.3, below.

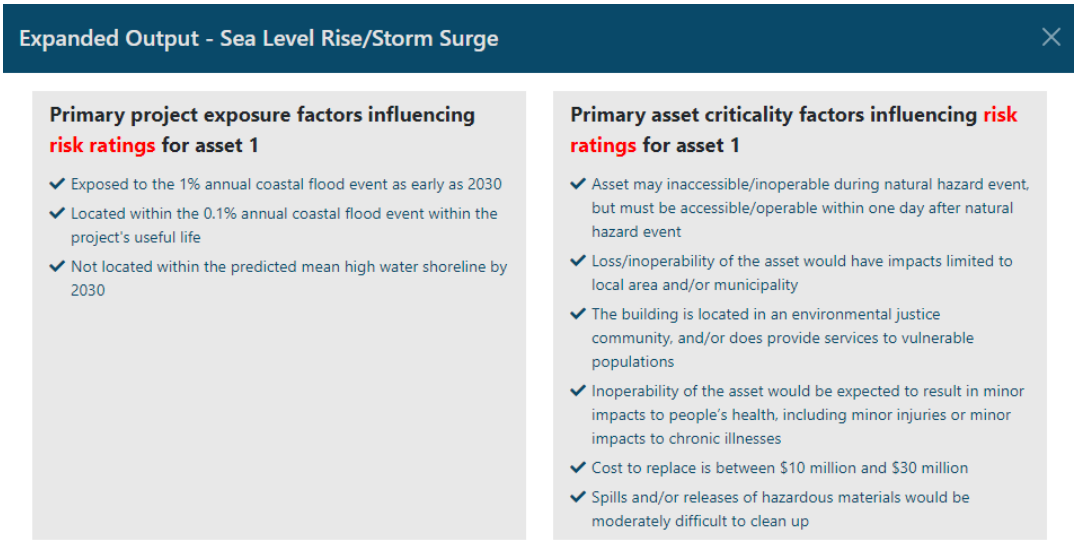

Figure 3.3. Example of the Expanded Risk Rating Output from the Climate Design Standards Tool for a Moderate Risk asset (Sea Level Rise/Storm Surge Climate Parameter)

3.3 LIMITATIONS

The climate projections and GIS datasets referenced within are based on the published data available for the region at this time. The climate projections provided by others and underlying assumptions and uncertainties have not been independently reviewed by the project team that developed the Climate Resilience Design Standards and Guidance. The limitations provided in the GIS datasets and climate projections by others also apply to the Tool.

Actual climate conditions will vary and may be more or less extreme than the projections used for the Climate Resilience Design Standards Tool. The Commonwealth of Massachusetts plans to update their climate projections at least every five years through the State Hazard Mitigation and Climate Adaptation Plan process.

Statewide flood models have not been developed to project riverine and pluvial (stormwater) flood exposure yet. The riverine flood exposure screening methodology described within does not distinguish between near-term and longer-term riverine flood risks, but does exclude areas mapped as future coastal flooding extents through 2070 by the Massachusetts Coast Flood Risk Model. Waterbodies MassGIS hydrography/DEP wetlands site are not explicitly categorized as coastal/inland or major/minor. The current screening methodology does not identify projects/areas that may experience combined flood exposure from both riverine and coastal flooding, which may affect exposure as well the recommended Climate Resilience Design Standards described in **Section 4**.

The user provided information that informs the relationships described within (including ecosystem service benefits, exposure scores, and risk ratings) is inherently subject to unintentional or intentional misrepresentation of conditions. The GIS datasets queried are based on the extent of the polygon and useful life of asset(s) as provided by the user. Actual conditions may vary.

The Preliminary Climate Hazard Exposure and Risk Screening outputs are not intended for final opinions for site suitability, regional coordination, capital planning, permitting and/or construction and should continue to be vetted with site-specific information, updated climate projections, design alternatives and regulatory requirements. Within the limitations of scope, schedule, and budget, the relationships informing the Preliminary Climate Hazard Exposure and Risk Screening outputs been executed in accordance with the generally accepted practices in this area at this time based on iterative stakeholder feedback as presented in **Section 1**. No warranty, expressed or implied, is given.

Additional limitations regarding the Massachusetts Coast Flood Risk Model (MC-FRM):

The MC-FRM is a physics-based approach to water level increases, wave dynamics, and flooding progression using climate projections described in the 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), which includes sea level rise projections under RCP8.5 emissions scenarios. The MC-FRM is a high-resolution hydrodynamic model, with data results provided in overland areas on the order of 5-10 meters (16-33 feet), and as resolved as 2-3 meters (5-10 feet) in highly populated and developed areas. The model dynamically includes the impacts of tides, waves, wave set-up, wave run-up and overtopping, storm surge, winds, and currents over a range of storm conditions.

The MC-FRM represents the "Level 3" approach, as described by Federal Highway Administration's Highways in the Coastal Environment, Hydraulic Engineering Circular Number 25 (HEC-25), third edition (FHWA, 2020). The MC-FRM is the result of over 1,000 simulations of storms, including both extra-tropical (i.e., nor-easters) and tropical (i.e., hurricanes) cyclones, and was calibrated to historical and contemporary storm events. This statistically robust approach provides information corresponding to an annual exceedance probability, such as the 1% annual chance event or 100-yr return period.

The landscape of the model is based on topography and bathymetry conditions at the time of model mesh creation (2016-2017), but anthropogenic features are constantly changing and evolving. As such, if a flood protection project was constructed after the model mesh creation, it is unlikely that it is included in the MC-FRM, and therefore inaccurate flooding risk may be represented within the model for that area.

The MC-FRM does not model topographic landscape or shoreline changes over time, so the topographic features, landscape elevations, and spatial extents do not erode, accrete or undergo any type of morphologic changes between planning horizons. For example, the ground surface elevations and shorelines within the model grid are the same in 2030 as they are in 2070. In reality it is likely that coastal landscapes will change as a result of increasing sea levels and ongoing storm conditions over time. Exactly how these coastal resources are expected to change in the future is tied to sea level rise projections and the quantity, type, and intensity of coastal storms for various areas, both of which are highly uncertain.

Larger precipitation events may result in localized flooding due to poor drainage and/or undersized capacity of stormwater systems, and in coastal rivers higher than normal discharge flowing downstream can cause overbank flooding in the river itself. The MC-FRM does not include localized precipitation-based flooding beyond changes to increased interactions between discharge and coastal flooding at major rivers. Coastal-based flooding advances upstream in rivers, estuaries, and other connected water bodies and systems. There were three types of freshwater boundary conditions applied in the MC-FRM based on available data. For the Mystic and Charles Rivers, the MC-FRM models backwater effects that propagate upstream and the dynamics of discharge interacting with storm tides because of better data available. Average discharge under current and future climate conditions were assumed for the Taunton, Neponset, and Merrimack rivers. Minor rivers and estuaries did not have freshwater discharges modeled in the MC-FRM.

Section 3 Attachment

Attachment 3-A – GIS Component Table for Version 1.4

Attachment 3-A– GIS Component Table for Version 1.4

	GIS Component	Feature Class / Raster Name(s)	Additional Note on Names	Source	Provided by	Planning Horizons	Question(s) Answered/Purpose(s)	Hosting	GIS Methods used
Version 1.2, July 2022	***Project Area***	N/A	N/A	User	N/A	N/A	Project spatial extent used to answer questions		Intersection with query layers
Precipitation Design Standards	***Precipitation Depth from Cornell IDF Raster***	Mean_Annual_Temp_2030	N/A	Cornell SWGEN Dataset	EEA GIS	2030	Located within recommended planning horizon		1) Intersect project polygon with "Mean_Annual_Temp_20XX" for recommended planning horizon 2030, 2050, 2070, or 2090 corresponding to overall project useful life. 2) Read the intersected value from "RCP8.5 50th pctl" column for the recommended planning horizon 2030, 2050, 2070, or 2090 corresponding to overall project useful life. 3) Convert the value to degC by dividing it with 1.8
		Mean_Annual_Temp_2050				2050			
		Mean_Annual_Temp_2070				2070			
		Mean_Annual_Temp_2090				2090			
		neXXyr24hr_2degC	XX stands for recurrence interval in yr corresponding to 2yr, 5yr, 10yr, 25yr, 50yr, 100yr, 200yr, and 500yr	Cornell IDF Dataset	EEA GIS	Based on degree warming for that planning horizon obtained from Mean_Annual_Temp: 2 degC	Located within recommended recurrence interval for degree warming based on recommended planning horizon	EEA Web Map Service	4) Use the degC value from Step 3 to look up the corresponding precipitation depth (in) from Cornell IDF dataset for the recommended recurrence interval 5a) If the project polygon size is less than the precipitation depth grid size, read the precipitation depth for the corresponding grid for that degree warming scenario for the recommended recurrence interval 5b) If the project polygon size is more than the precipitation depth grid size OR the project polygon intersects multiple precipitation depth grids, run zonal statistics for the project polygon using the precipitation depth dataset for that degree warming scenario for the recommended recurrence interval to get the weighted average precipitation depth 6) **For natural resource assets, use the 4% (25-yr) AEP to generate values.** Follow steps 5a OR 5b to generate the precipitation depth values
		neXXyr24hr_3degC				3 degC			
		neXXyr24hr_3_5degC				3.5 degC			
		neXXyr24hr_4degC				4 degC			
		neXXyr24hr_4_5degC				4.5 degC			
		neXXyr24hr_5degC				5 degC			
		neXXyr24hr_5_5degC				5.5 degC			
		neXXyr24hr_6degC				6 degC			
		neXXyr24hr_6_5degC				6.5 degC			
		neXXyr24hr_7degC				7 degC			
		neXXyr24hr_7_5degC				7.5 degC			
Hatch Zones (Sea Level Rise/Storm Surge Design Criteria) **- For Stillwater Elevation, for Wave Heights, for DFE**	***MC-FRM recommended recurrence interval for recommended planning horizon***	Hatchzones_2030_DXX_Merged	XX stands for recurrence interval corresponding to the following annual exceedance percent probabilities: "D1" = 1% "D2" = 2% "D5" = 5% "Dpt1" = 0.1% "Dpt2" = 0.2% "Dpt5" = 0.5%	MC-FRM	WHG and merged by WSE	2030	Located within MC-FRM recommended recurrence interval for recommended planning horizon		1) Check if project polygon intersects with the Hatch Zone extents for the recommended planning horizon (2030, 2050 or 2070) for the recommended recurrence interval (TRUE = within). **For natural resource assets, use the 5% AEP to generate values.** 2) If the project polygon intersects the Hatch Zone extents, display the extent of the hatch zones in the map output for the project and flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6 & slide 7). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch type (as determined from the attribute Hatch_Type of 9997, 9998, 9999) should be displayed.
		Hatchzones_2050_DXX_Merged				2050			
		Hatchzones_2070_DXX_Merged				2070			
Water Surface Elevation (Sea Level Rise/Storm Surge Design Criteria)	***MC-FRM recommended recurrence interval for recommended planning horizon***	**WSE_2030_DXYY =** The 1% annual probability Stillwater Elevation (ft-NAVD88) raster for Zone XX in the 2030 planning horizon	YY stands for the corresponding region name XX stands for recurrence interval corresponding to the following annual exceedance percent probabilities: "D1" = 1% "D2" = 2% "D5" = 5% "Dpt1" = 0.1% "Dpt2" = 0.2% "Dpt5" = 0.5%	MC-FRM	WHG and retiled by BSC Group	2030	Located within MC-FRM recommended recurrence interval for recommended planning horizon	WHG	1) Check if project polygon intersects with the Stillwater Elevation extents for recommended planning horizon (2030, 2050 or 2070) and for the recommended recurrence interval (TRUE = within). **For natural resource assets, use the 5% AEP to generate values.** 2) If the project polygon intersects the Stillwater extents there could be four scenarios: i) intersected area contains data and there is no hatch zones associated ii) intersected area is completely/partially overlayed by hatch zone with underlying data iii) intersected area is partially overlayed by hatch zone with no underlying data iv) intersected area is completely overlayed by hatch zone with no underlying data 3) In case of i), run zonal statistics for the project polygon and the raster data for the recommended planning horizon for the recommended recurrence interval. Report the Max, Min, and Weighted Average values 4) In case of ii), there are 2 steps: a) Run zonal statistics for the project polygon and the raster data for the recommended planning horizon for the recommended recurrence interval as mentioned in step 3); Report the Max, Min, and Weighted Average values b) flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch zone should be displayed. 5) In case of iii), there are 3 steps: a) Reclassify the region/tile without the hatch zone value (9997, 9998, 9999) that has no valid data underneath b) Run zonal statistics for the project polygon and the reclassified raster data for the recommended planning horizon for the recommended recurrence interval. Report the Max, Min, and Weighted Average values c) Flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch zone should be displayed. 6) In case of iv) no calculation is needed but flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch type (as determined from the attribute Hatch_Type of 9997, 9998, 9999) should be displayed.
		WSE_2050_DXYY = The 1% annual probability Stillwater Elevation (ft-NAVD88) raster for Zone XX in the 2050 planning				2050			
		WSE_2070_DXYY = The 1% annual probability Stillwater Elevation (ft-NAVD88) raster for Zone XX in the 2070 planning				2070			
Wave Height (Sea Level Rise/Storm Surge Design Criteria)	***MC-FRM recommended recurrence interval for recommended planning horizon***	**WH_2030_DXYY =** The 0.1% annual probability Wave Height (ft) raster for Zone XX in the 2030 planning	YY stands for the corresponding region name XX stands for recurrence interval corresponding to the following annual exceedance percent probabilities: "D1" = 1% "D2" = 2% "D5" = 5% "Dpt1" = 0.1% "Dpt2" = 0.2% "Dpt5" = 0.5%	MC-FRM	WHG and retiled by BSC Group	2030	Located within MC-FRM recommended recurrence interval for recommended planning horizon	WHG	1) Check if project polygon intersects with the Wave Height extents for recommended planning horizon (2030, 2050 or 2070) and for the recommended recurrence interval (TRUE = within). **For natural resource assets, use the 5% AEP to generate values.** 2) If the project polygon intersects the Wave Height extents there could be four scenarios: i) intersected area contains data and there is no hatch zones associated ii) intersected area is completely/partially overlayed by hatch zone with underlying data iii) intersected area is partially overlayed by hatch zone with no underlying data iv) intersected area is completely overlayed by hatch zone with no underlying data 3) In case of i), run zonal statistics for the project polygon and the raster data for the recommended planning horizon for the recommended recurrence interval. Report the Max, Min, and Weighted Average values 4) In case of ii), there are 2 steps: a) Run zonal statistics for the project polygon and the raster data for the recommended planning horizon for the recommended recurrence interval as mentioned in step 3); Report the Max, Min, and Weighted Average values b) flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch zone should be displayed. 5) In case of iii), there are 3 steps: a) Reclassify the region/tile without the hatch zone value (9997, 9998, 9999) that has no valid data underneath b) Run zonal statistics for the project polygon and the reclassified raster data for the recommended planning horizon for the recommended recurrence interval. Report the Max, Min, and Weighted Average values c) Flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch zone should be displayed. 6) In case of iv) no calculation is needed but flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch type (as determined from the attribute Hatch_Type of 9997, 9998, 9999) should be displayed.
		WH_2050_DXYY = The 0.1% annual probability Wave Height (ft) raster for Zone XX in the 2050 planning				2050			
		WH_2070_DXYY = The 0.1% annual probability Wave Height (ft) raster for Zone XX in the 2070 planning				2070			
Wave Action Water Elevation (Sea Level Rise/Storm Surge Design Criteria)	***MC-FRM recommended recurrence interval for recommended planning horizon***	**DFE_2030_DXYY =** The 0.1% annual probability Design Flood Elevation (ft-NAVD88) raster for Zone XX in the 2030 planning	YY stands for the corresponding region name XX stands for recurrence interval corresponding to the following annual exceedance percent probabilities: "D1" = 1% "D2" = 2% "D5" = 5% "Dpt1" = 0.1% "Dpt2" = 0.2% "Dpt5" = 0.5%	MC-FRM	WHG and retiled by BSC Group	2030	Located within MC-FRM recommended recurrence interval for recommended planning horizon	WHG	1) Check if project polygon intersects with the Design Flood Elevation extents for recommended planning horizon (2030, 2050 or 2070) and for the recommended recurrence interval (TRUE = within). **For natural resource assets, use the 5% AEP to generate values.** 2) If the project polygon intersects the Design Flood extents there could be four scenarios: i) intersected area contains data and there is no hatch zones associated ii) intersected area is completely/partially overlayed by hatch zone with underlying data iii) intersected area is partially overlayed by hatch zone with no underlying data iv) intersected area is completely overlayed by hatch zone with no underlying data 3) In case of i), run zonal statistics for the project polygon and the raster data for the recommended planning horizon for the recommended recurrence interval. Report the Max, Min, and Weighted Average values 4) In case of ii), there are 2 steps: a) Run zonal statistics for the project polygon and the raster data for the recommended planning horizon for the recommended recurrence interval as mentioned in step 3); Report the Max, Min, and Weighted Average values b) flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch zone should be displayed. 5) In case of iii), there are 3 steps: a) Reclassify the region/tile without the hatch zone value (9997, 9998, 9999) that has no valid data underneath b) Run zonal statistics for the project polygon and the reclassified raster data for the recommended planning horizon for the recommended recurrence interval. Report the Max, Min, and Weighted Average values c) Flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch zone should be displayed. 6) In case of iv) no calculation is needed but flag message/note with the output based on the type of hatch zone (See business requirements powerpoint "RMAT Beta Tool FY22 Updates DRAFT – Build 2 Mockup.pptx", slide 6). Note if multiple hatch zone types intersect the project polygon, corresponding messages for each hatch type (as determined from the attribute Hatch_Type of 9997, 9998, 9999) should be displayed.
		DFE_2050_DXYY = The 0.1% annual probability Design Flood Elevation (ft-NAVD88) raster for Zone XX in the 2050 planning				2050			
		DFE_2070_DXYY = The 0.1% annual probability Design Flood Elevation (ft-NAVD88) raster for Zone XX in the 2070 planning				2070			
Tidal Datums (Sea Level Rise/Storm Surge Design Criteria)	***MC-FRM future tidal datums for recommended planning horizon***	North_2030_Datum_Polys.shp South_2030_Datum_Polys.shp	N/A	MC-FRM	WHG	2030	Located along the coast and/or within MC-FRM mean highwater shoreline for recommended planning horizon		1) Check if a project polygon intersects the future tidal datum polygon layer. 2) Read the numbers (MHHW, MHW, MTL, MLW, MLLW) for the recommended planning horizon 3) If project polygon intersects multiple future tidal datum polygon layers, compare the numbers and report the maximum number for each of the tidal datums (MHHW, MHW, MTL, MLW, MLLW) for the recommended planning horizon 4) Check if the project polygon intersects the Hatch Zone extents (Hatch = 1 in the attribute table). Zones with a Hatch value = 1 may or may not contain tidal datum information. 4a) If the project polygon intersects an area with "Hatch = 1" WITH underlying values, provide dynamic table output, and provide the following note below the the table output: "This project is located in an area with uncertainty for future tidal datums. These uncertain zones are either dynamic in terms of geomorphology or are restricted by manmade features (i.e. culverts, tide gates, etc.) that should be evaluated in more detail at the site-scale." 4b) If the project polygon intersects an area with "Hatch = 1" with NO underlying value, don't provide any table output instead provide following text: "This project is located in an area with uncertainty for future tidal datums. These uncertain zones are either dynamic in terms of geomorphology or are restricted by manmade features (i.e. culverts, tide gates, etc.) that should be evaluated in more detail at the site-scale."
		North_2050_Datum_Polys.shp South_2050_Datum_Polys.shp				2050			
		North_2070_Datum_Polys.shp South_2070_Datum_Polys.shp				2070			
	Basemap*	https://tiles.arcgis.com/tiles/hGdibHYSPO59RG1h/arcgis/rest/services/MassGISBasemap_Topo_Detailed_L3/MapServer		MassGIS	EEA IT		Aid user in drawing project area	MassGIS ArcServer	Reference Only
	Geocoder			ESRI	N/A		Aid user in drawing project area	ESRI ArcServer	Reference Only

Attachment 3-A (continued) – GIS Component Table for Version 1.4

	GIS Component	Feature Class / Raster Name(s)	Source	Update for Build One	Provided by	Planning Horizons	Question(s) Answered/Purpose(s)	Hosting	GIS Methods used	EEA ArcGIS Online URL
	Project Area	N/A	User	Unchanged	N/A	N/A	Project spatial extent used to answer questions	SQL Server	Intersection with query layers	
Version 1.2, July 2022	***Environmental Justice***	EJ_2020	MassGIS	New	EEA IT	Present	Is the project in an EJ zone?	EEA Web Map Service	Check if project polygon intersects with "EJ_2020" (TRUE = within)	https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/MA_2010_Environmenta_Justice_Blockgroups/FeatureServer
Sea Level Rise / Storm Surge	***Mean High Water Shoreline***	MA_MHW_2030	MC-FRM	Unchanged	Woods Hole Group	2030	Is any part of the project located within the predicted mean high water shoreline by 2030?	EEA Web Map Service	Check if project polygon intersects with "MA_MHW_2030" (TRUE = within)	https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/MHW_2030/VectorTileServer
	1% ACFEP Exceedance Probability	MA_2030_1Perc_v11	MC-FRM	Unchanged	Woods Hole Group	2030	Is any part of the project in the 1% annual coastal flood exceedance probability (ACFEP) within the overall project's useful life?	EEA Web Map Service	Check if project polygon intersects with "MA_20XX_1Perc_v11" for the recommended planning horizon of 2030, 2050 or 2070 corresponding to overall project useful life (TRUE = within)	https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/MA_2030_1Perc_v11/FeatureServer
		MA_2050_1Perc_v11		Unchanged		2050				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/MA_2050_1Perc_v11/FeatureServer
		MA_2070_1Perc_v11		Unchanged		2070				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/ArcGIS/rest/services/MA_2070_1Perc_v11/FeatureServer
	0.1% ACFEP Exceedance Probability	MA_2030_Pt1Perc	MC-FRM	Unchanged	Woods Hole Group	2030	Is any part of the project in the 0.1% annual coastal flood exceedance probability (ACFEP) within the overall project's useful life?	EEA Web Map Service	Check if project polygon intersects with "MA_20XX_Pt1Perc" for recommended planning horizon of 2030, 2050 or 2070 to overall project useful life (TRUE = within)	https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/MA_2030_Pt1Perc/FeatureServer
		MA_2050_Pt1Perc		Unchanged		2050				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/MA_2050_Pt1Perc/FeatureServer
		MA_2070_Pt1Perc		Unchanged		2070				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/MA_2070_Pt1Perc/FeatureServer
Extreme Precipitation - Urban Flooding	***Max Annual Rainfall***	Max_Annual_Precip_in_2030	Cornell Dataset	New	EEA GIS	2030	What is the maximum annual daily rainfall within the overall project's useful life?		1) Intersect project polygon with "Max_Annual_Precip_in_20XX" for recommended planning horizon 2030, 2050, 2070, or 2090 corresponding to overall project useful life. 2) Read the the intersected value from "RCP8.5 50th pctl" column for the recommended planning horizon 2030, 2050, 2070, or 2090 corresponding to overall project useful life. 3) Check the value from Step 2 against Exposure Score in the "Revised Exposure Rating" tab to determine exposure score. 4) If project polygon intersects with multiple basin polygons, return the max of the values among the basins for the attribute in Step 2.	https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/Max_Annual_Precip_2030/FeatureServer
		Max_Annual_Precip_in_2050		New		2050				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/Max_Annual_Precip_2050/FeatureServer
		Max_Annual_Precip_in_2070		New		2070				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/Max_Annual_Precip_2070/FeatureServer
		Max_Annual_Precip_in_2090		New		2090				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/Max_Annual_Precip_2090/FeatureServer
	Existing impervious area	impervious_WebMercAux	MassGIS (NLCD, 2016)	New	EEA GIS	Present	What is the percent of existing impervious area of the project site?		1) Intersect project polygon with "impervious_WebMercAux" (more vertices) or "impervious_WebMercAux_Diss" (less vertices). 2) Divide intersected shape area by the project polygon shape area 3) Multiply by 100 to get the percent impervious area of the project site 4) Check against Exposure Table in the "Revised Exposure Rating" tab to determine exposure score.	
		impervious_webMercAux_Diss		New						https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/Impervious_BSCsimplified/VectorTileServer
Extreme Precipitation - Riverine Flooding	***Riverine Environment***	FEMA_500yr_nopt1pct_2030	MassGIS, FEMA, and processed by EEA GIS	New	EEA GIS	2030	Is any part of the project located within the "FEMA riverine environment" (which includes areas outside the 0.1% annual coastal flood exceedance probability within the overall project's useful life and within the current 0.2% annual chance (500-year floodplain)) within the overall project's useful life?	EEA Web Map Service	Project polygon intersected with "FEMA_500yr_noPt1pct_20XX" for recommended planning horizon either 2030, 2050 or 2070, respectively (TRUE = within) Future riverine flooding exposure is considered in the Tool using areas outside the 0.1% annual coastal flood exceedance probability (determined from the Massachusetts Coast Flood Risk Model MC-FRM) within the project's useful life, and within the current 0.2% annual chance (500-year) FEMA floodplain.	https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/FEMA_2030/VectorTileServer
		FEMA_500yr_nopt1pct_2050		New		2050				https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/FEMA_2050/VectorTileServer
		FEMA_500yr_nopt1pct_2070		New		2070				https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/FEMA_2070/VectorTileServer
		lidar_DEM	MassGIS, processed by EEA GIS	New	EEA GIS	Present	Is the lowest elevation point on the project site located:		1) Intersect project polygon boundary with LiDAR DEM 2) Determine minimum elevation within project polygon boundary	
		hydro_buff0ft_noPt1pct_2030_v4	MassGIS, processed by EEA GIS	New	EEA GIS	2030	Within 100 ft of a "riverine waterbody" (which includes water bodies outside of the 0.1% annual coastal flood exceedance probability within the overall project's useful life)? OR		Check if any part of the project polygon is within 100 ft of the "hydro_buff0ft_noPt1pct_20XX_v4" (TRUE=within).	https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/hydro_buff0ft_noPt1pct_2030/FeatureServer
		hydro_buff0ft_noPt1pct_2050_v4		New		2050				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/hydro_buff0ft_noPt1pct_2050/FeatureServer
		hydro_buff0ft_noPt1pct_2070_v4		New		2070				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/hydro_buff0ft_noPt1pct_2070/FeatureServer
		hydro_buff0ft_noPt1pct_2030_v4	MassGIS, processed by EEA GIS	New	EEA GIS	2030	Between 100 - 200 ft away from a "riverine waterbody" (which includes water bodies outside of the 0.1% annual coastal flood exceedance probability within the overall project's useful life) AND less than 30 ft above the nearest location to that "riverine waterbody"?		1) Determine the lowest elevation point within the project polygon using the LiDAR DEM 2) Use "near" (or equivalent) function to determine the shortest distance between the lowest elevation point in the project polygon and the nearest edge of the riverine waterbody "hydro_buff0ft_noPt1pct_20XX_v4" polygon	
		hydro_buff0ft_noPt1pct_2050_v4	MassGIS, processed by EEA GIS	New	EEA GIS	2050	OR Between 200 - 500 ft away from a "riverine waterbody" (which includes water bodies outside of the 0.1% annual coastal flood exceedance probability within the overall project's useful life) AND less than 20 ft above the nearest location to that "riverine waterbody"?		3) Read the distance between the lowest elevation point in the project polygon and the nearest edge of the riverine waterbody ""hydro_buff0ft_noPt1pct_20XX_v4" 4) Read the elevation of that nearest point along the edge of the riverine waterbody "hydro_buff0ft_noPt1pct_20XX_v4" using LiDAR DEM 5) Compare values from Steps 3 and 4 agianst Exposure Score in the "Revised Exposure Rating" tab to determine Exposure score	
		hydro_buff0ft_noPt1pct_2070_v4	MassGIS, processed by EEA GIS	New	EEA GIS	2070				
	Riverine Erosion	lidar_DEM	MassGIS, processed by EEA GIS	New	EEA GIS	Present	Is any part of the project not within a "riverine waterbody" (which includes water bodies outside of the 0.1% annual coastal flood exceedance probability within the overall project's useful life), AND within 100 ft of a "riverine waterbody" with a 15% or greater slope between that part of the project and the nearest location to that "riverine waterbody"?		1) Determine area of intersection between project polygon and within 100-ft buffer of riverine waterbody "hydro_buff0ft_noPt1pct_20XX_v4" 2) Indentify all LiDAR DEM cells within this area (SET A) 3) Identify all LiDAR cells along the edge of the riverine waterbody "hydro_buff0ft_noPt1pct_20XX" (SET B) [Note: SET B can be created in advance, irrespective of project polygons] 4) For every cell in SET A, find the nearest cell in SET B 5) Use the elevation values and the corresponding distances between the respective cells in SET A and SET B, to calculate the slope (Caution: please use always [elev(SET A) - elev(SET B)]/[dist(SETA) - dist(SETB)]. do not use absolute values for slope) 6) Check if slope from Step 5 is >= 15%	
		hydro_buff0ft_noPt1pct_2030_v4		New		2030				
		hydro_buff0ft_noPt1pct_2050_v4		New		2050				
		hydro_buff0ft_noPt1pct_2070_v4		New		2070				
Extreme Heat	***Days > = 90 deg. F***	DaysAbove90_Annual_2030	Cornell Dataset	Replace	EEA GIS	2030	How many days increase in days over 90 degrees Fahrenheit are there within the overall project's useful life?	EEA Web Map Service	1) Intersect project polygon with "DaysAbove90_Annual_20XX" for recommended planning horizon 2030, 2050, 2070, or 2090 corresponding to overall project useful life. 2) Read the the intersected value from "RCP8.5 50th pctl" column for the recommended planning horizon 2030, 2050, 2070, or 2090 corresponding to overall project useful life. 3) Check the value from Step 2 against Exposure Score in the "Revised Exposure Rating" tab to determine exposure score. 4) If project polygon intersects with multiple basin polygons, return the max of the values among the basins for the attribute in Step 2.	https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/DaysAbove90_Annual_2030/FeatureServer
		DaysAbove90_Annual_2050		Replace		2050				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/DaysAbove90_Annual_2050/FeatureServer
		DaysAbove90_Annual_2070		Replace		2070				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/DaysAbove90_Annual_2070/FeatureServer
		DaysAbove90_Annual_2090		Replace		2090				https://services1.arcgis.com/7iJyYTjCtKsZS1LR/arcgis/rest/services/DaysAbove90_Annual_2090/FeatureServer
	MassGIS Hydrography	waterbodies_100ftbuffer	MassGIS	Unchanged	EEA GIS	Present	Is any part of the project within 100 ft. of an existing water body?	EEA Web Map Service	Check if project polygon intersects with "waterbodies_100ftbuffer" polygon (TRUE = within)	https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/Waterbodies_100ft_buffer/VectorTileServer
	Existing impervious area	impervious_WebMercAux	MassGIS (NLCD, 2016)	New		Present	What is the percent of existing impervious area of the project site?		1) Intersect project polygon with "impervious_WebMercAux" (more vertices) or "impervious_WebMercAux_Diss" (less vertices). 2) Divide intersected shape area by the project polygon shape area 3) Multiply by 100 to get the percent impervious area of the project site 4) Check against Exposure Table in the "Revised Exposure Rating" tab to determine exposure score.	
		impervious_webMercAux_Diss		New						
	Existing canopy area	tree_canopy_WebMercAux	MassGIS (NLCD, 2016)	New		Present	What is the percent of existing canopy area of the project site?		1) Intersect project polygon with "tree_canopy_WebMercAux" (more vertices) or "tree_canopy_WebMercAux_Diss" (less vertices). 2) Divide intersected shape area by the project polygon shape area 3) Multiply by 100 to get the percent impervious area of the project site 4) Check against Exposure Table in the "Revised Exposure Rating" tab to determine exposure score.	
		tree_canopy_WebMercAux_Diss		New						https://tiles.arcgis.com/tiles/7iJyYTjCtKsZS1LR/arcgis/rest/services/Existing_canopy/VectorTileServer
	Basemap*	https://tiles.arcgis.com/tiles/hGdibHYSPO59RG1h/arcgis/rest/services/MassGISBasemap_Topo_Detailed_L3/MapServer	MassGIS	Unchanged	EEA IT		Aid user in drawing project area	MassGIS ArcServer	Reference Only	
	Geocoder		ESRI		N/A		Aid user in drawing project area	ESRI ArcServer	Reference Only	