NEW YORK STATE | Department of Environmental Conservation

New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act

ESTIMATING GUIDELINE ELEVATIONS

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Introduction

In 2014, Governor Andrew Cuomo signed the Community Risk and Resiliency Act (CRRA) to build New York's resilience to rising sea levels and extreme flooding. The Climate Leadership and Community Protection Act made modifications to the CRRA, expanding the scope of climate hazards and projects for consideration. These modifications became effective January 1, 2020. As part of the implementation of the CRRA, the Department of Environmental Conservation, in consultation with the New York State Department of State (DOS) and other stakeholders, developed the New York State Flood Risk Management Guidance (SFRMG) [1] to help ensure the health, safety and well-being of New Yorkers now and in the future. This companion document to the SFRMG is intended to provide professionals such as engineers, architects, designers and planners assistance in incorporating SFRMG principles into project design.

A key factor in designing for resilience to future floods is establishing an appropriate guideline elevation. The guideline elevation indicates the water surface elevation to be considered in project siting and design. The SFRMG provides descriptions of guideline elevations appropriate to various types of structures in tidal and nontidal areas. These guideline elevations incorporate projections of future flooding based on climate science or are based on proxies for such projections. In this document you will find eight methods for establishing one or more of the guideline elevations described in the SFRMG.

Once an appropriate guideline elevation is identified for the particular project, the designer should determine whether any portion of the project site is at an elevation that is lower than the guideline elevation and, thus, within the horizontal extent of potential future flooding. That information, as defined by the applicable guideline elevation, should be considered in siting and design decisions to reduce risk of flood damage under both current and future conditions. See the SFRMG (pp. 11-12) for additional discussion of siting considerations.

Estimating Guideline Elevations

To the extent feasible, development in currently mapped special flood hazard areas (SFHA)[2] and areas likely to be flood-prone in the future due to sea-level rise or more frequent extreme precipitation events should be avoided. The SFRMG recommends adoption of one or more site-specific guideline elevations that can be used to define the elevation and corresponding horizontal extent of projected future floodplains. These projected floodplains are generally deeper and have a larger horizontal extent than the associated mapped SFHAs.

The SFRMG describes guideline elevations applicable to specific types of structures, in lacustrine, riverine, and tidal areas. Application of a guideline elevation informed by climate science is generally preferred (Fig. 1).

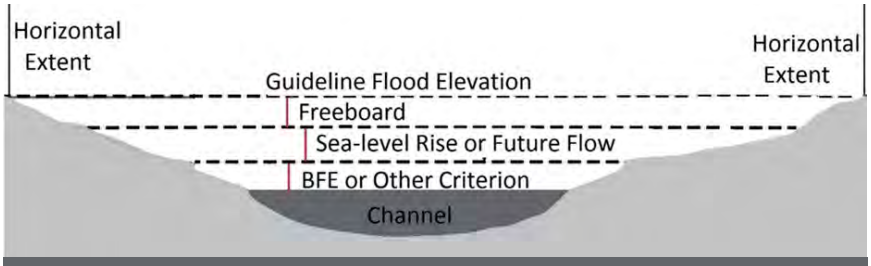

Fig. 1. New York State climate informed science flood risk management guideline elevation.

[1] New York State Department of Environmental Conservation. 2020. New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act. Albany. 100 pp.

[2] Special flood hazard areas are areas designated on FEMA flood insurance rate maps as being subject to inundation by the flood with a one-percent chance of being equaled or exceeded in any given year.

The procedures outlined below are intended as a reference for use by design professionals and related staff in siting and designing structures in mapped SFHAs and future flood hazard areas. These procedures assume familiarity with the use of topographic maps, flood insurance rate maps, and concepts of floodplain management. The SFRMG provides an introduction to use of such maps and concepts.

Although projected flood elevations are key considerations in project siting and design, the type of resilience measures employed is also important. Protection of natural resilience features and the use of natural resources and nature-based features are highly preferred as risk-reduction measures. Refer to the Department of Environmental Conservation's guidance on use of natural resilience measures for more information.[3]

There are eight primary ways to determine the guideline elevation for a project. The appropriate method is based upon the project type and the site location. Once you have determined your project type, if the site location is in a tidal or non-tidal area, and project elevation, you can use Tables 1-4 to identify the appropriate method to calculate the guideline elevation for the project.

Mapping Resources

The following mapping resources allow overlays of numerous data layers and may facilitate estimation of guideline elevations and estimation of flood risk at project sites.

Flood insurance rate maps (FIRMS) are accessible at the FEMA Flood Map Service Center (https://msc.fema.gov/portal). FEMA FIRMS indicate only current SFHAs. Various digital mappers display projected floodplains based on projected sea-level rise. However, similar maps of projected lacustrine and riverine areas are not generally available. Until such maps can be made available, alternative techniques for determining whether a project site is located in the projected floodplain are necessary. The New York State Energy Research and Development Authority has produced a guide on consideration of community flood risk that describes procedures for making this determination that can be adapted for site-specific determinations.[4]

- New York Climate Change Science Clearinghouse: https://www.nyclimatescience.org/
- New York State Department of State Geographic Information Gateway: http://opdgig.dos.ny.gov/#/home
- The Nature Conservancy Natural Resource Navigator: http://www.naturalresourcenavigator.org
- DEC Environmental Assessment Form Mapper: http://www.dec.ny.gov/eafmapper
- NOAA Lake Level Viewer: https://www.coast.noaa.gov/llv/
- USGS Flood Inundation Mapping Program: https://www.usgs.gov/mission-areas/water-resources/science/flood-inundation-mapping-fim-program

Additional information on these resources is provided in SFRMG Appendix C.

[3] New York State Department of Environmental Conservation. 2020. Using Natural Measures to Reduce the Risk of Flooding and Erosion. Albany. 339 pp.
[4] New York State Energy Research and Development Authority. 2019. Considering Current and Future Inland Flood Risk: A consumers' guide to flooding tools for communities in New York State. Albany. 78pp.

Determining Site and Structure Specific Guideline Elevations

Tables 1 through 4 below indicate the estimation method to be used to determine the guideline elevation for each of the structure and environment types described in the SFRMG.

Refer to the SFRMG for additional information and for definitions of guideline elevations and their applicability according to structure type and environment (SFRMG Tables 4 and 5).

Table 1. Methods to estimate guideline elevations for transportation structures in non tidal areas, including lakeshores and riverine areas.

Category	Flood Risk Management Guideline	Estimation Method
Critical linear transportation infrastructure	The vertical flood elevation and corresponding horizontal floodplain that result from increasing current, relevant peak flows, e.g., Q_{50}, Q_{100}, to account for projected peak flows for the full, expected service life of the infrastructure, adding freeboard per current applicable engineering requirements or recommendations (three feet preferred), and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.	3
	The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2-percent annual chance flood (Q_{500}).	7
Non-critical linear transportation infrastructure	The vertical flood elevation and corresponding horizontal floodplain that result from increasing current, relevant peak flows, e.g., Q_{50}, Q_{100}, to account for projected peak flows for the full, expected service life of the infrastructure, adding freeboard per current requirements or recommendations, and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.	3
Critical bridges	The vertical flood elevation and corresponding flows that result from increasing current, relevant peak flows, e.g., Q_{50}, to account for projected peak flows for the full, expected service life of the bridge, and adding two feet of bridge freeboard. An additional foot of bridge freeboard should be considered for critical bridges. The projected Q_{100} flow should pass below the lowest chord without going into pressure flow.	3
	The vertical flood elevation and corresponding flows resulting from the 0.2-percent annual chance flood (Q_{500}).	7
Non-critical bridges	The vertical flood elevation and corresponding flows that result from increasing current, relevant peak flows, e.g., Q_{50}, to account for projected peak flows for the full, expected service life of the bridge, and adding two feet of bridge freeboard. The projected Q_{100} flow should pass below the lowest chord without going into pressure flow.	3
Critical culverts	The vertical flood elevation and corresponding flows that result from increasing current, relevant peak flows, e.g., Q_{50}, to account for projected peak flows for the full, expected service life of the culvert, and that allow the culvert to fully pass the design flood without increasing headwater and that provide at least two feet of roadway freeboard above the projected checkflow. An additional foot of roadway freeboard should be considered for culverts on critical roadways.	3
	The vertical flood elevation and corresponding flows resulting from the 0.2-percent annual chance flood (Q_{500}).	7
Non-critical culverts	The vertical flood elevation and corresponding flows that result from increasing current, relevant peak flows, e.g., Q_{50}, to account for projected peak flows for the full, expected service life of the culvert, and that provide at least two feet of roadway freeboard above the projected checkflow.	3

Table 2. Methods to estimate guideline elevations for non transportation structures in non tidal areas, including lakeshores and riverine areas.			
Category	**Flood Risk Management Guideline**		**Estimation Method**
Lakes: All structures	The vertical flood elevation and corresponding horizontal floodplain that result from adding two feet of freeboard to the BFE and extending this level to its intersection with the ground.		1
	The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2-percent annual chance flood (Q_{500}).		7
	The vertical flood elevation and corresponding horizontal floodplain associated with the flood of record.		8
One- and two-family residential, and small nonresidential structures	The vertical flood elevation and corresponding horizontal floodplain that result from adding two feet of freeboard to the BFE and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.		1
	The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2-percent annual chance flood (Q_{500}).		7
	If no BFE is available: The vertical flood elevation and corresponding horizontal floodplain that result from adding three feet to the elevation of the highest adjacent grade and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.		6
Multi-family and large non-residential structures	The vertical flood elevation and corresponding horizontal floodplain that result from increasing the current 1-percent annual chance peak flow (Q_{100}) to account for projected future flows, adding two feet of freeboard to the resultant flood level, and extending this level to its intersection with the ground.		2
	The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2-percent annual chance flood (Q_{500}).		7
Critical facilities and critical non-transportation infrastructure, designed to be functional during flooding	The vertical flood elevation and corresponding horizontal floodplain that result from increasing the current 1-percent annual chance peak flow (Q_{100}) to account for projected future flows, adding three feet of freeboard to the resultant flood level, and extending this level to its intersection with the ground.		2
	The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2-percent annual chance flood (Q_{500}).		7
Non-critical facilities and non-critical non-transportation infrastructure designed to survive flooding and regain functionality within an acceptable period	The vertical flood elevation and corresponding horizontal floodplain that result from increasing the current 1-percent annual chance peak flow (Q_{100}) to account for projected future flows, adding two feet of freeboard to the resultant flood level, and extending this level to its intersection with the ground.		2
Water supply and wastewater treatment plants, and pump stations	**Non-critical equipment**	The vertical flood elevation and corresponding horizontal floodplain that result from adding two feet of freeboard to the BFE and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.	1
	Critical equipment	The vertical flood elevation and corresponding horizontal floodplain that result from increasing current, relevant peak flow parameters, e.g., Q_{100}, to account for projected peak flows, adding three feet of freeboard, and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.	3
		The vertical flood elevation and corresponding horizontal floodplain subject to flooding from the 0.2-percent annual chance flood (Q_{500}).	7

Table 3. Methods to estimate guideline elevations for non transportation structures in tidal areas.			
Category	**Flood Risk Management Guideline**		**Estimation Method**
One- and two-family residential, and small nonresidential structures	The vertical flood elevation and corresponding horizontal floodplain that result from adding the medium sea-level rise projection over the expected service life of the structure, plus two feet of freeboard, to the BFE and extending this level to its intersection with the ground.		4
	V and Coastal A Zones - elevated on and adequately anchored to pilings or columns so that the lowest horizontal portion of the structural members of the lowest floor is elevated to or above the elevation resulting from adding the medium sea-level rise projection plus two feet to the BFE.		4
Multi-family and large non-residential structures	The vertical flood elevation and corresponding horizontal floodplain that result from adding the medium sea-level rise projection over the expected service life of the structure, plus two feet of freeboard, to the BFE and extending this level to its intersection with the ground.		4
	V and Coastal A Zones - elevated on and adequately anchored to pilings or columns so that the lowest horizontal portion of the structural members of the lowest floor is elevated to or above the elevation resulting from adding the medium sea-level rise projection plus two feet to the BFE.		4
Critical facilities and critical non-transportation infrastructure, designed to be functional during flooding	The vertical flood elevation and corresponding horizontal floodplain that result from adding the high sea-level rise projection applicable for the full, expected service life of the facility, plus three feet of freeboard, to the BFE and extending this level to its intersection with the ground.		4
Non-critical facilities and non-critical non-transportation infrastructure designed to survive flooding and regain functionality within an acceptable period	The elevation and special flood hazard area that result from adding the medium sea-level rise projection applicable for the full, expected service life of the facility, plus two feet of freeboard, to the BFE and extending this level to its intersection with the ground.		4
Water supply and wastewater treatment plants, and pump stations	**Non-critical equipment**	The vertical flood elevation and corresponding horizontal floodplain that result from adding two feet of freeboard to the BFE and extending this level (transversely to the direction of flow in riverine situations) to its intersection with the ground.	1
	Critical equipment	The vertical flood elevation and corresponding horizontal floodplain that result from adding the high sea-level rise projection applicable for the full, expected service life of the infrastructure to the BFE, adding three feet of freeboard, and extending this level to its intersection with the ground.	4

Table 4. Methods to estimate guideline elevations for transportation infrastructure tidal areas.		
Category	**Flood Risk Management Guideline**	**Estimation Method**
Critical linear transportation infrastructure	Applicable coastal design criteria that incorporate the higher of the 0.2-percent annual chance flood (Q_{500}) or a range of sea-level rise projections, up to and including the high sea-level rise projection, applicable for the full, expected service life of the infrastructure.	5
Non-critical linear transportation infrastructure	Applicable coastal design criteria that incorporate a range of sea-level rise projections, up to and including the medium sea-level rise projection, applicable for the full, expected service life of the infrastructure.	4
Critical bridges	Applicable coastal design criteria that incorporate a range of sea-level rise projections, up to and including the high sea-level rise projection, applicable for the full, expected service life of the bridge, and the 0.2-percent annual chance flood (Q_{500}).	5
Non-critical bridges	Applicable coastal design criteria that incorporate a range of sea-level rise projections, up to and including the medium sea-level rise projection, applicable for the full, expected service life of the bridge.	4
Critical culverts	Applicable coastal design criteria that incorporate a range of sea-level rise projections, up to and including the high sea-level rise projection, applicable for the full, expected service life of the culvert, and the 0.2-percent annual chance flood (Q_{500}).	5, 7
Non-critical culverts	Applicable coastal design criteria that incorporate a range of sea-level rise projections, up to and including the medium sea-level rise projection, and projected peak flows applicable for the full, expected service life of the culvert.	3, 5

Estimation Methods

Extending mapped nontidal hazard area

1. Horizontal Extension of Base Flood Elevation plus Freeboard (Fig. 2)

Applicability: Method is applicable for all structures on lakes, non-critical equipment at water plants, and one- and two-family residential and small nonresidential structures in non-tidal areas.

Project site located in a mapped special flood hazard area (SFHA)

- Project site located in a zone for which the FIRM provides the BFE, i.e., AE, A1-A30, AH or zones
  - Read the BFE directly from the map. If necessary, the associated FIS may be consulted to determine the BFE to a tenth of a foot.
- Project site located in a zone for which the FIRM does not provide the BFE, e.g., zones A, AO, A99, AR
  - Consult the SFRMG and FEMA's Zone A Manual (https://www.fema.gov/zone-manual-managing-floodplain-development-approximate-zone-areas) for guidance on determining BFEs in SFHAs for which BFEs have not been published.
  - Add the recommended freeboard to the BFE to determine the site guideline elevation.

Project site not located in a mapped SFHA

- Estimate the likely flow path from site to hydrologically closest Zone AE or Zone A1-30, visually or using GIS tools, and determine BFE of that zone.
- Add the recommended freeboard to the BFE to determine the site guideline elevation.
- Compare site elevation to guideline elevation.
- If necessary, model a projected floodplain using hydrologic and hydraulic modeling, or cartographic methods (See NYSERDA 2019, pages 14-15).

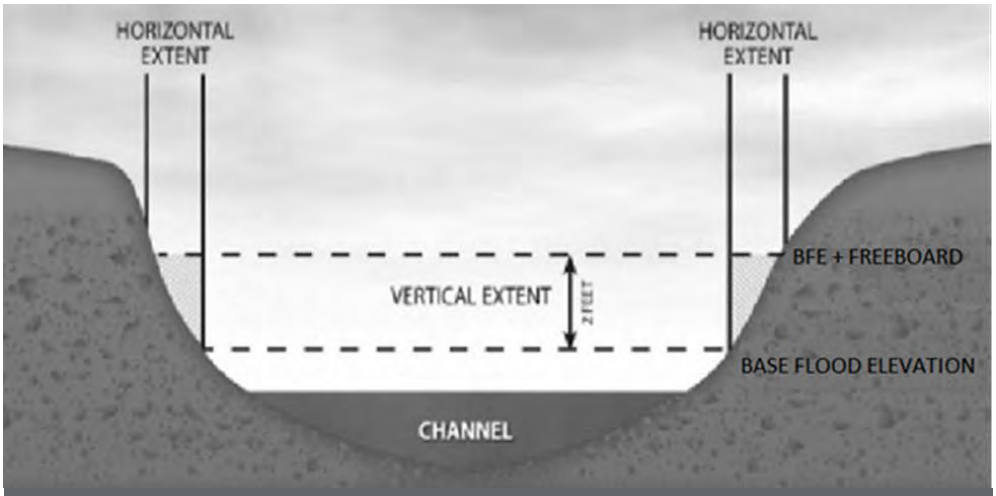

Fig. 2. Determination of horizontal extent of floodplain based on 1) base flood elevation and 2) base flood elevation plus freeboard.

Projecting future riverine flows

2. Projected Q_{100} [5] (Fig. 3)

Applicability: Method is applicable for multi-family and large non-residential structures in nontidal areas, and critical facilities and critical non-transportation infrastructure in nontidal areas.

- Consult StreamStats (https://water.usgs.gov/osw/streamstats/index.html) or other source for project site flow characteristics (Fig. 4).
- Multiply design flow criterion by design flow multiplier (western New York: 110 percent, eastern New York: 120 percent) to calculate projected Q_{100}. (See SFRMG pages 15 and for discussion of design flow multipliers.)
- Alternatively, consult Future Flow Explorer (https://ny.water.usgs.gov/maps/floodfreq-climate/) to estimate projected flows, but review discussion on use of this tool in the SFRMG (Appendix D).
- Estimate future BFE based on projected Q_{100}.

Flow models (e.g., HEC-RAS, HEC-2) available

- Apply model to estimate future BFE.

Flow models not available

- Consult flood insurance study to estimate future BFE as elevation associated with flow closest to the projected Q_{100}.
- Add the recommended freeboard (two or three feet) to the estimated future BFE to determine the site guideline elevation.
- Compare site elevation to guideline elevation
- If necessary, model projected floodplain using hydrologic and hydraulic modeling, or cartographic methods (See NYSERDA 2019, pages 14-15).

3. Projected Design Flows

Applicability: Method is applicable in non-tidal areas for critical equipment at water plants and transportation infrastructure, and non-critical culverts in tidal areas.

- Identify relevant design flow criterion, e.g., Q_{50}, Q_{100}, for project type. Follow procedure outlined in method 2.
- Confirm and adjust design criteria per applicable engineering requirements or recommendations.

[5] Q_{100}:the peak discharge of streamflow that would occur during the 1-percent annual chance flood.

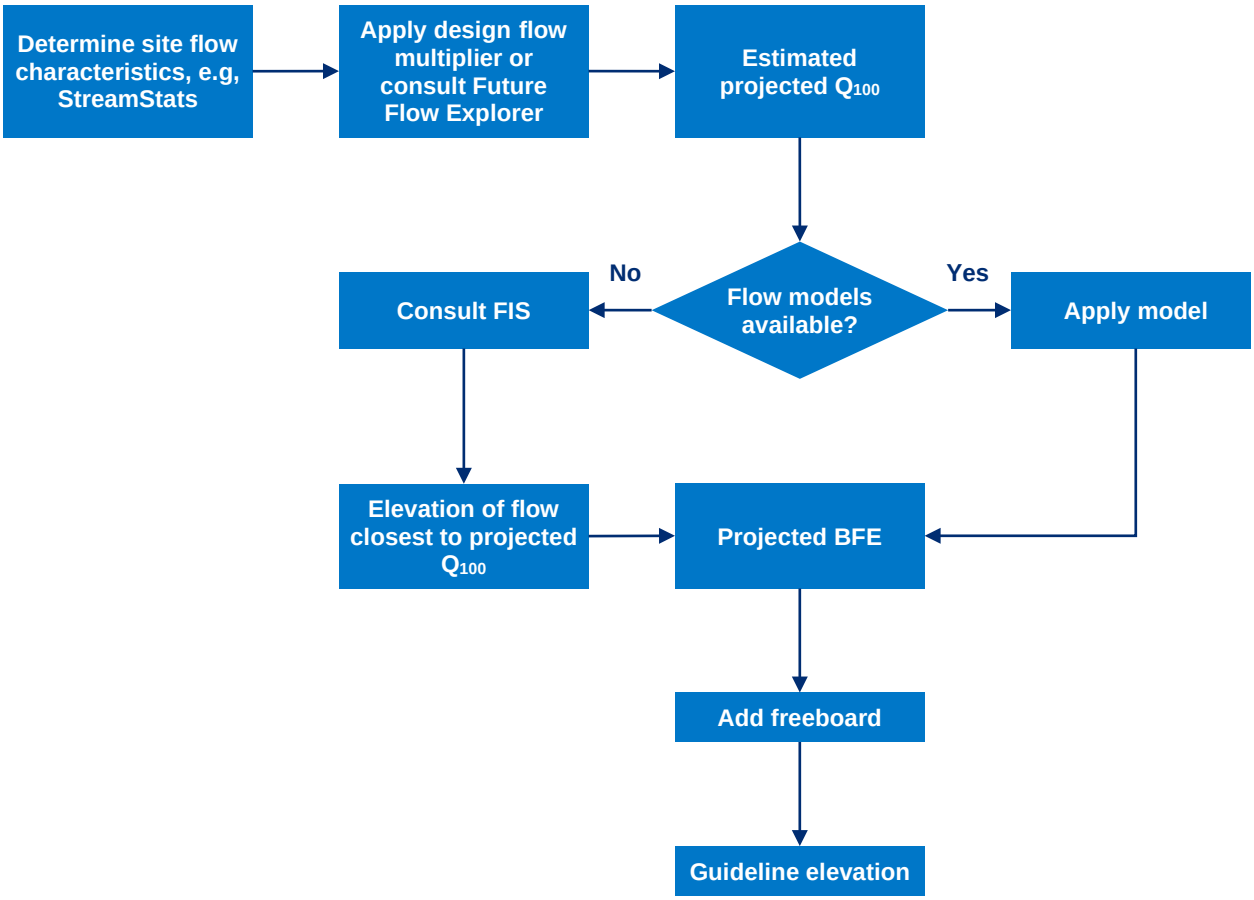

Fig. 3. Flow chart for estimation of guideline elevation using method 2, Projected Q_{100}.

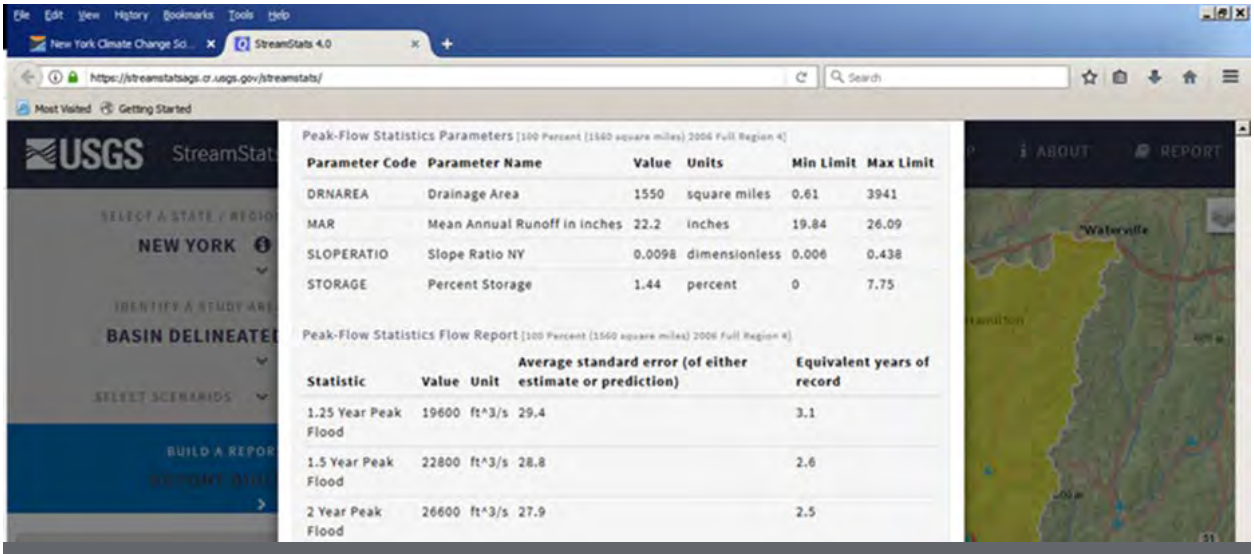

Fig. 4. The StreamStats peak flow statistics report includes flow volumes for various return intervals that can be used to estimate extent of future floods.

Adjusting for sea-level rise

4. Sea-level Rise Adjustment – Nontransportation Structures (Fig. 5).

Applicability: Method is applicable in tidal areas for residential and nonresidential structures, facilities, non-critical transportation infrastructure, and critical equipment at water plants.

- Follow applicable sea-level rise mapper instructions to display projected SFHA with six feet of sea-level rise by the year 2100 (Fig. 6):
  - Nassau and Suffolk counties: *Coastal New York Future Floodplain Mapper* https://services.nyserda.ny.gov/SLR_Viewer/
  - New York City: *NYC Flood Hazard Mapper* https://www.nyc.gov/site/planning/data-maps/flood-hazard-mapper.page
  - Hudson River (north of New York City): *Hudson River Flood Hazard Decision Support System* http://www.ciesin.columbia.edu/hudson-river-flood-map/
- Locate project site on sea-level rise mapper.

Project site not located within projected SFHA with six feet of sea-level rise by 2100

- No further consideration required

Project site located within projected SFHA with six feet of sea-level rise by 2100

- Locate project site on relevant FIRM.

Project site located in a mapped SFHA

Project site located in a zone for which the FIRM provides the BFE, i.e., AE, A1-A30 and AH zones

- Read the BFE directly from the map. If necessary, the associated FIS may be consulted to determine the BFE to a tenth of a foot.

Project site not located in a zone for which the FIRM provides the BFE, i.e. A, AO, A99, and AR zones

- Consult the SFRMG for guidance on determining BFEs in SFHAs for which BFEs have not been published.
- Consult SFRMG tables 4 and 5, and 6 NYCRR Part 490, Projected Sea-level Rise to determine applicable sea-level rise projection.
- Add applicable sea-level rise projection to current BFE to calculate projected BFE.
- Add the required or recommended freeboard to the projected BFE to determine the site guideline elevation.

Project site not located in mapped SFHA (but within projected SFHA)

- Estimate the likely flow path from site to hydrologically closest Zone AE, Zone AH, or Zone A1-30 visually or using GIS tools, and determine BFE of that zone.
- Consult SFRMG tables 4 and 5, and 6 NYCRR Part 490, Projected Sea-level Rise to determine applicable sea-level rise projection.
- Add the applicable sea-level rise projection to the BFE to calculate projected BFE.
- Add the required or recommended freeboard to the projected BFE to determine the site guideline elevation.

5. Sea-level Rise Adjustment – Transportation Infrastructure

Applicability: Method is applicable in tidal areas for critical transportation infrastructure.

- Follow procedures outlined in methods 3 and 7 to determine higher of Q_{500} flood or projected SFHA.
- Confirm and adjust design criteria per applicable engineering requirements or recommendations.

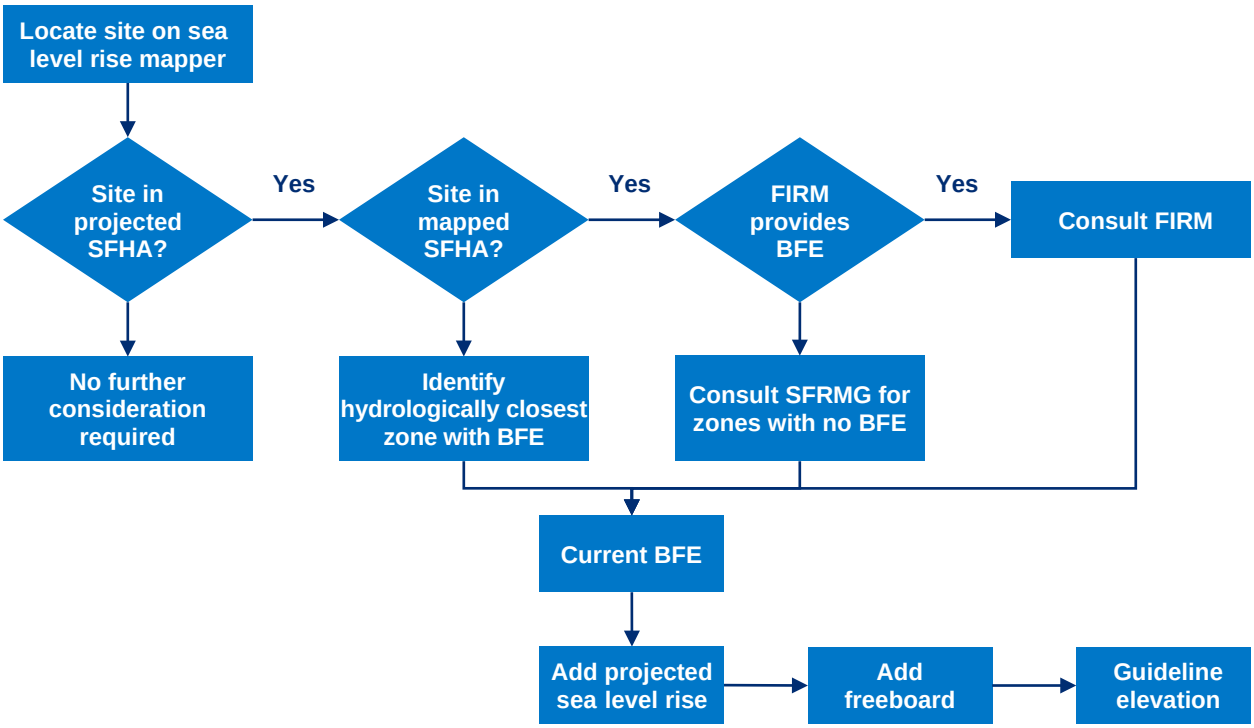

Fig. 5. Flow chart for estimation of guideline elevation using method 4, Sea level Rise Adjustment Nontransportation Structures.

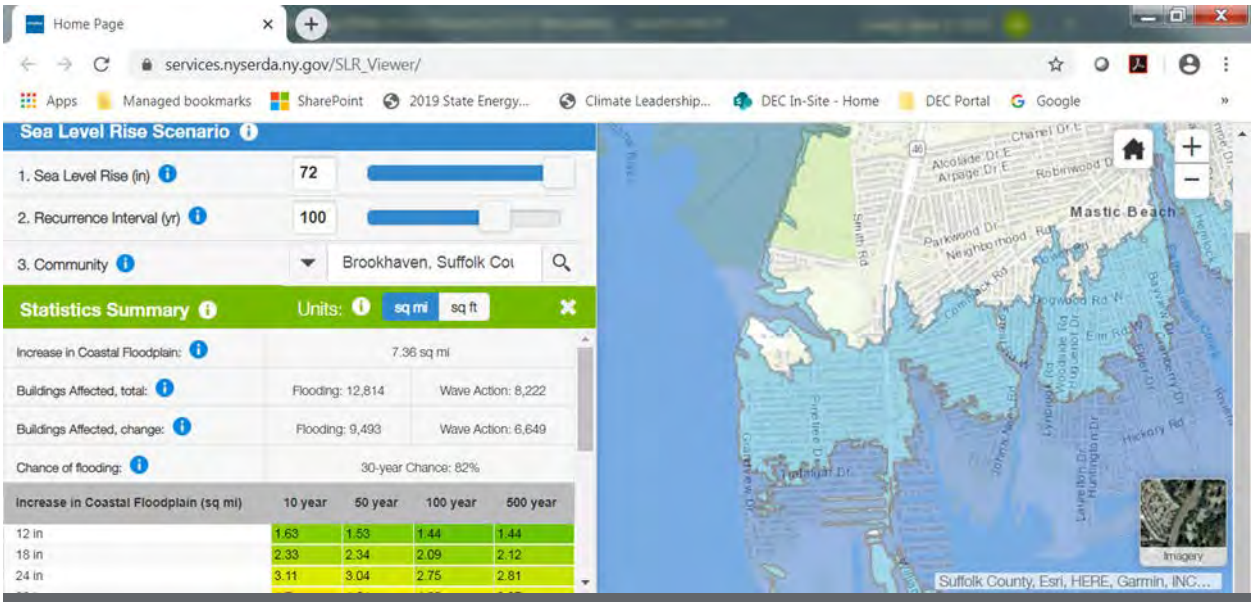

Fig. 6. Sea level rise mappers can be used to screen projects for future coastal flood risk.

Other methods

6. No Base Flood Elevation Available

Applicability: Method is applicable for one- and two-family residential, and small nonresidential structures in nontidal areas.

- If BFE not available, consult SFRMG page 17 for alternative methods to estimate BFE.
- If BFE cannot be determined, for residential and small non-residential buildings, the lowest floors of the building must be elevated at least three feet above the highest grade adjacent to any wall of the building.

7. Mapped 0.2% Floodplain

Applicability: Method is applicable for all structures on lakes, and in non-tidal areas for residential and non-residential structures, and critical facilities and infrastructure, including transportation infrastructure in non-tidal areas.

- Refer to the relevant FEMA FIRM.
  - The 0.2% flood guideline comprises the vertical flood elevation and corresponding horizontal floodplain of the 0.2-percent annual-chance flood, commonly known as the 500-year flood. FIRMS often depict the horizontal extent of the 0.2-percent annual-chance flood as areas of moderate flood risk, but the corresponding vertical flood elevation is not shown on FIRMs. Some flood insurance studies (FIS) include 0.2-percent annual-chance elevations.

8. Floods of Record

Applicability: Method is applicable for all structures on lakes

- Information on floods of record may be available in FEMA flood insurance studies and historical sources.

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