

Kingston Tidal Waterfront Flood Task Force

Risk Evaluation using New York State Department of State process

Last Revision: 7/31/13

Two risk assessments for flood impacts were completed for the Task Force. The first risk assessment evaluated potential impacts from predicted water levels that could occur during the 1% annual risk flood (100 year storm) and the 10% annual risk flood (10 year storm), with current assets and land uses. The estimated water level for the 1% (100 year) annual risk flood = 8 feet, and for the 10% annual risk (10 year) flood = 6 feet. These water levels are rounded off from the current Flood Insurance Study (FIS) by FEMA for Kingston. Notes 1 through 8 below describe the process used and assumptions for completing the first (current conditions) risk assessment. Notes 9 through 14 describe how the results were modified to assess additional risk due to an assumed increase in sea level of three (3) feet. Notes 15 through 24 present an interpretation comparing the results of the first (current conditions) and second (sea level rise) risk assessments.

These risk assessments are planning level evaluations based on information collected by the Task Force. They are not predictions of any specific events and they are not intended for any regulatory purpose. They may be used along with other appropriate information in weighing community-level actions to address the potential effects of elevated water levels due to flooding and sea level rise.

Results of the first (current conditions) risk assessment and scoring criteria for the risk factors (Hazard, Exposure, Vulnerability) were posted to a spreadsheet workbook file: Kingston_Risk_Assess_3-6-13.xlsx.

A second risk assessment was completed to examine potential flood impacts compounded by sea level rise. Notes 9 through 14 below describe the assumptions, process and interpretation of results for the second (three foot sea level rise scenario) risk assessment.

Comments by NYS-DOS (Barry Pendergrass) interpreting the results of the sea level rise risk assessment are contained in notes 15 through 24 below.

1. The first (current conditions) assessment utilized the map contained in file Risk Areas_11-17_handout_Scenic Hud.pdf. This basemap is an image derived from GIS data produced by Scenic Hudson. Land areas were classed for risk of flood impacts in descending order of intensity as Extreme, High and Moderate (medium) using the following information:

- a. DEM derived from 2012 LiDAR topography.

b. MHHW shoreline by Scenic Hudson for the Hudson River, with tidal elevation adjustment based on local tide gage station data.

c. Extreme Risk Area: Land areas up to highest annual elevation of MHHW.

d. High Risk Area: Areas above the Extreme Risk Area up to 3 feet above local elevation of MHHW, plus the remainder of the NFIP-A zone.

e. Moderate (Medium) Risk Area: Areas above the Extreme and High Risk Areas up to 3 feet above the local elevation of the upper extent of the NFIP-A zone.

2. A DOS objective to define the potential area of increased flooding from the Rondout Creek due to climate change induced increases in extreme precipitation events (the 1% annual risk flood discharge has increased approximately 67% per findings of a recent study) was abandoned due to the difficulty of estimating the increased creek elevations associated with the extra water volume. This work could be investigated further at a later date.

3. A list of community assets was compiled from comments received at the first Task Force meeting in December 2012, with asset positions identified as dots on the Scenic Hudson risk area map. The dots were color coded to represent the Risk Zone where the corresponding asset is located. The dot color reflects the highest-risk zone a significant portion of the asset/property is located in.

4. A risk assessment for the compiled list of assets was completed by two work teams at Kingston City Hall on March 6, 2013. The teams included Mark Lowery (NYS-DEC), Kristin Marcel (NYS-DEC), Patrick McDonough (Hudson River Maritime Museum), Julie Noble (City of Kingston), Jennifer Schwartz-Berky (Kingston resident), Sacha Spector (Scenic Hudson), Susan Spencer-Crowe (Kingston resident), and Gregg Swanzey (City of Kingston). Barry Pendergrass (NYS-DOS) provided guidance on the risk assessment process. The asset list was divided in half, with two subgroups assigning scores for Hazard, Exposure and Vulnerability.

5. The Risk Area map was used to determine the Hazard Score as follows:

Red dot/Extreme Risk, 100 year risk = 5 and 10 year risk = 5;

Orange dot/High Risk, 100 year risk = 4 and 10 year risk = 3;

Yellow dot/Medium (Moderate) Risk, 100 year risk = 3 and 10 year risk = 1.

Green dot (outside mapped risk areas) no scores.

6. Exposure scores were based on the condition of applicable site attributes as described in the Exposure evaluation file: Risk_Assess_Mtg_2_2-12-13.xlsx. The Exposure value of site attributes are weighted

differently for each Risk Area (Extreme, High, Medium). The weights are designed to reflect the relative increase or decrease in protective capacity of each site attribute due to proximity of the asset to the shoreline flood source. The site attributes used in the Exposure evaluation and their relative weights were adjusted following consultation with Hudson River Estuary Program regional staff (Dan Miller and others.)

7. Vulnerability scores were determined based on the estimated loss of service each asset would experience during the modeled flood events (100 year/8 foot and 10 year/6 foot elevation floods). The affect/score is determined from the Vulnerability chart in the file Risk_Assess_Mtg_2_2-12-13.xlsx.

Notes on the nature of flood vulnerability to some assets were compiled by the evaluation team, see Comments_Assets_1-56_3-6-13.xlsx.

8. DOS compiled the risk score results using the Hazard, Exposure and Vulnerability scores described above and emailed copies to small group participants.

Comments returned by participants resulted in revisions to some scores for the following reasons:

- a. Some asset locations shown on the Risk Map were corrected and dot color was revised;
- b. Representatives from Kingston provided personal knowledge of impacts from Hurricane Irene (2011, approximated 10 year flood water level) or Hurricane Sandy (2012, approximated 100 year flood water level).
- c. Additional information on impacts to individual assets was provided by some owners after the initial evaluation by the team.
- d. In a few cases Exposurce scores were interpolated where definitive information was not available from the team in the first evaluation. Interpolation was based on Exposure scores for adjacent assets.
- e. Scores adjusted for the above reasons are noted in the summary spreadsheet file with an asterisk (*) and explanatory note.

Second Risk Assessment: Three foot sea level rise with 10 year and 100 year flood water levels.

9. The second (sea level rise) assessment utilized the risk area map contained in file RiskAreas_3ftSLR.jpg. This map is an image derived from GIS data produced by Scenic Hudson including shapefiles for each of three risk classification zones and a point file of the numbered assets from the first (current conditions) risk assessment. The sea level rise risk zones include three feet of sea level rise added to the zone classes created in the first (current conditions) risk assessment. The data sets used

for the sea level rise risk zones are described below. NYS-DOS assembled the shapefiles into a single reference map resulting in reclassified risk areas (Extreme, High and Moderate). NYS-DOS revised the color of some of the asset markers (dots) for assets that extend into or occupy higher classification risk areas than the specific geographic point where the representative dot/number was originally placed. The Extreme, High and Moderate medium) flood risk areas were defined using the following base map information:

- a. DEM derived from 2012 LiDAR topography.
- b. MHHW shoreline by Scenic Hudson for the Hudson River, corrected to local tide gage stations.
- c. Extreme Risk Area: Land areas up to highest elevation of MHHW plus 3 feet.
- d. High Risk Area: Areas above the Extreme Risk Area above, plus the additional area encompassed by raising the Base Flood Elevation of the NFIP-A zone by three feet and extending this elevation landward to intersection with the DEM surface.
- e. Moderate Risk Area: Areas above the Extreme and High Risk Areas above, plus the additional area encompassed by raising the Base Flood Elevation of the NFIP-A zone by six feet and extending this elevation landward to intersection with the DEM surface.

Using the sea level rise-revised risk zone map DOS reinterpreted scores for Hazard, Exposure and Vulnerability, resulting in new scores for Risk for the listed assets.

Results and scoring criteria for the risk factors were posted to a spreadsheet workbook file:
Kingston_DOS_Risk_Assess_w-3ft-SLR_07-30-13.xlsx

All scores in the second (sea level rise) assessment that were changed from the first (current conditions) assessment are indicated by tinted boxes in the spreadsheet. Yellow tinted boxes are used to indicate assets for which the overall risk for flood impacts during the 10 year and/or 100 year flood event increased in the sea level rise assessment.

10. The same list of community assets derived from comments received at the first public meeting in December 2012 was used. Asset locations are identified as dots on the waterfront risk area map. The dots are color coded to represent the Risk Zone in which the assets are located: Red = Extreme; Orange = High; Yellow = Moderate; Green = Outside the defined risk zones. The dot color is based on the highest class risk zone in which a significant portion of the asset/property is located.

11. The same return interval water levels were used in the sea level rise risk assessment as were used for the current conditions assessment, ie.: 10 year return interval flood = six feet increase in water level; 100 year return interval flood = 8 feet increase in water level (both above MHHW).

12. A risk assessment for the composite list of assets was completed by NYS-DOS (Barry Pendergrass) by revising the Hazard, Exposure and/or Vulnerability scores from the first risk assessment. The revisions were completed between July 18 and 23, 2013. Scores were updated using the following criteria:

Hazard: This score was updated from the first assessment based on highest risk class zone in which a significant portion of an asset is located. If the updated risk zones (with sea level rise) did not change with respect to a significant portion of an asset the Hazard score remained as determined in the first risk assessment. 21 assets received updated Hazard scores (of a total of 61 assets scored).

Exposure: This score was updated from the first risk assessment only if significant changes in site conditions were apparent with three feet of sea level rise. In many cases the factors used to weigh Exposure did not change significantly due to sea level rise, and consequently the scores from the first risk assessment were maintained. Eight assets received updated Exposure scores.

Vulnerability: The "Sea Level Rise Mapper" produced by Scenic Hudson (<http://www.scenichudson.org/slr/mapper>) was used extensively to review the areal extent of routine inundation associated with three feet of sea level rise. If routine inundation was estimated to significantly affect existing uses of the assets, the Vulnerability Score was updated per the criteria established in the Vulnerability scoring sheet in the workbook. 47 assets received updated Vulnerability scores for either the 10 year or 100 year (return period) flood event.

13. In the criteria for evaluating the Vulnerability score, a slight change in language was inserted in the Severe and Major loss categories for Commercial assets. The purpose was to help discriminate the boundary between these two categories. This change should have no effect on the original scoring for current conditions.

14. The sea level rise assessment assumes no adaptive, protective or preventive measures are taken to avoid damages other than those currently existing. Estimated impacts reflect current conditions, sea level rise and flood water levels only.

Results of Sea Level Rise Risk Assessment:

15. Vulnerability scores that increased to 5 under the sea level rise scenario (in comparison with the current conditions assessment) indicate assets that would experience permanent or routine inundation due to sea level rise alone (without additional flooding due to storms). Absent other adaptive measures these locations are likely to be under water at least part of the time with three feet of sea level rise.

16. The many assets with increased risk due to sea level rise (yellow tinted risk scores in the spreadsheet) indicate the need for adaptive measures. It also reflects Task Force knowledge and experience with assets known or estimated to be vulnerable to flood effects.

17. Potentially effective adaptive measures include elevating, flood proofing, relocating, protecting or otherwise adapting the use so it is resilient to the future water level and storm conditions. No particular adaptive measure is suggested or prioritized on the basis of the risk assessment.

18. Projections of the time at which three feet of sea level rise will occur are changing as new climate research is completed. At the present time three feet of sea level rise approximates the mid-range of estimates for increase between 2000 and 2100. Likewise changes in precipitation patterns may result in revisions to estimates of 10 year and 100 year return interval water levels. Risk assessments should be updated periodically with new information about climate patterns, water levels, asset vulnerability and adaptive actions.

19. Assets with the maximum Hazard score for both the 10 year and 100 year flood event are in the highest risk area for flood impacts. To be sustainable these assets must currently have or must achieve one or more of the following conditions:

- a. Recovers quickly from flood waters or is specially adapted to accommodate periodic flooding.
- b. Built to resist flood waters with minimal negative effects.
- c. Are protected from flood waters including redundant measures so that if one protective method fails backup measures provide adequate protection.

20. The maximum Exposure score possible in this assessment is 4. Exposure scores above 2.5 indicate opportunities to reduce exposure through protective measures, elevation or improvement of natural protective features may effectively reduce overall risk. Exposure scores above 3 are only sustainable by assets that can accommodate periodic flooding.

21. The maximum Vulnerability score possible in this assessment is 5. Assets with vulnerability scores of 5 indicate opportunities to improve the asset may help reduce risk. Flood proofing, elevation or other adaptive measures may be effective.

22. Assets with high Hazard and high Exposure scores, but low overall Risk Scores have low overall vulnerability. These assets are little affected by flooding, resume functioning quickly after flooding, or are well protected from floods. If these assets are critical to the community then managers and decision makers should consider whether the reasons for low Risk Scores constitute acceptable risk

management. If there is a possibility of loss of a critical facility due to flooding then additional management measures may be desirable even if the Risk Score is low.

23. The overall Risk Scores do not reflect the value of any asset to the community. Additional consideration of critical assets, community value, community vision for the future, regional importance and non-monetary values may be helpful in determining priorities for risk management.

24. Assets with the same overall Risk Score for both the 10 year and 100 year flood water levels are likely to have site factors that result in loss of service during many flood events. If the overall Risk Score is high it suggests periodic flooding may incapacitate the asset. In this case either temporary loss of the asset must be tolerated or some adaptive measures are necessary to preserve functions.