



What's Going On And What's Coming Up?

Pennsylvania's climate is changing, and these changes are predicted to affect Bristol Township. The earth has warmed by about one degree Fahrenheit (°F) in the last century. If today's trends in greenhouse gas emissions continue, by the middle of the 21st century, Pennsylvania is predicted to warm by between 5.4-6.0°F from current temperatures.¹

Increases in temperature are predicted to cause higher sea levels and more frequent heavy storms, both of which will introduce new vulnerabilities in Bristol that the community will need to address.

The following chart shows tide gauge heights above high tide (the "mean higher high water" measurement used by NOAA) at the Philadelphia tide gauge in the Delaware River. The chart lists flood height measurements from some of the most recent strong storms (the "Current" column) and how those **flood heights are predicted to increase in a likely sea level rise scenario** (the "2030," "2050," and "2100" columns). These measurements and calculations form the basis for the map of flood extents and depths in Bristol on the reverse side of this poster.

Flooding Estimates at Philadelphia Tide Gauge

	Current (ft)	2030 (ft)	2050 (ft)	2100 (ft)
1%/100-year flood	4.13	4.93	5.53	7.53
Flood of April 2005 (~April 4, 2005)	3.06	3.86	4.46	6.46
Hurricane Irene (~August 28, 2011)	3.23	4.03	4.63	6.63
Hurricane Lee (~September 3, 2011)	1.65	2.45	3.05	5.05
Superstorm Sandy (~October 30, 2012)	3.94	4.74	5.34	7.34
10%/10-year flood	3.05	3.85	4.45	6.45
99%/1-year flood	1.12	1.92	2.52	4.52
Permanent inundation at high tide (mean higher high water)	0	0.8	1.4	3.4

Sources: NOAA, central estimate from Kopp et. al 2016.

¹Pennsylvania Climate Impacts Assessment Update, Shortle et. al, May 2015, 41

What Does It Mean for Your Community?

Bristol's location in the Delaware Estuary Coastal Zone already makes it vulnerable to flooding from several sources. Regular tides along the Delaware River as well as riverine flooding and coastal storm surge from extreme storms already cause damage to property in Bristol. Future flooding may cause additional problems. In general, **some of the greatest flooding problems for Bristol Township and other communities along the Delaware River include:**

- Flooding of private property (especially homes, businesses, and cars)
- Flooding of roadways
- Stress on aging water-related infrastructure (sewer lines, storm drains, inlets, dikes, and levees)
- Secondary effects of flooding: siltation, erosion, pollution
- Destruction of tidal wetland habitat
- Insufficient flood monitoring systems

What Can You Do About It?

The problems listed above can be addressed using a variety of strategies, including the following:

Plans, Regulations, and Ordinances

- Incorporate flood information into municipal plans, ordinances, and building codes.
- Use the zoning ordinance to regulate setbacks from rivers and streams, increase base flood elevations for buildings, and set requirements for managing stormwater.
- Begin a community-wide planning process to prepare for the long-term effects of storm surge and sea level rise beyond the standard 20- or 25-year planning horizon.
- Add flood mitigation projects into a capital improvements plan or hazard mitigation plan.
- Develop a post-disaster recovery plan.

Projects

- Participate in National Flood Insurance Program's Community Rating System program to reduce insurance premiums for residents in the FEMA 100-year/1-percent floodplain.
- Work with property owners in repeat flood areas to buy out properties, converting them into parks or other open space.
- Work with local environmental organizations to educate residents about the benefits of natural floodplains and riverine wetland habitat in order to achieve long-term support for preserving these areas.
- Preserve existing natural floodplains and riverine wetland habitat.
- Use living plants (green stormwater infrastructure) to reduce stormwater runoff in areas that get flooded by more regular, smaller storms.

- Conduct regular outreach to the residents living in floodprone areas on flood preparedness and disaster assistance.
- Create an evacuation plan that includes multiple routes out of the municipality, and share that information with residents.

Other coastal flooding preparation and response strategies can be found at <https://www.dvrpc.org/Resiliency/Coastal>.

What's Available?

Funding (\$) and technical assistance (TA) resources are available to better plan for and respond to flooding impacts:

Federal

- FEMA: Pre-Disaster Mitigation Grant and Hazard Mitigation Grant Programs (\$)
- HUD: Community Development Block Grants (\$)
- NOAA: Digital Coast (TA)

State

- DCNR: Community Conservation Partnerships Program (\$)
- PennVest (Pennsylvania Infrastructure Investment Authority) (\$)
- PA DEP: Coastal Zone Management and Growing Greener Grants (\$)

Other

- Bucks County Municipal Open Space Program (\$)
- DVRPC: TCDI and TAP (\$)
- Natural Lands and PECO: Green Region Open Space Program (\$)
- NFWF and Wells Fargo: Resilient Communities Program (\$)

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Bristol Township Waterfront Communities, south of the Delaware River Bridge | Source: PADEP.

3 FEET
FLOODING SCENARIOS:
 Historic flood of April 2005 or sea level rise in 2100 (5% chance)

5 FEET
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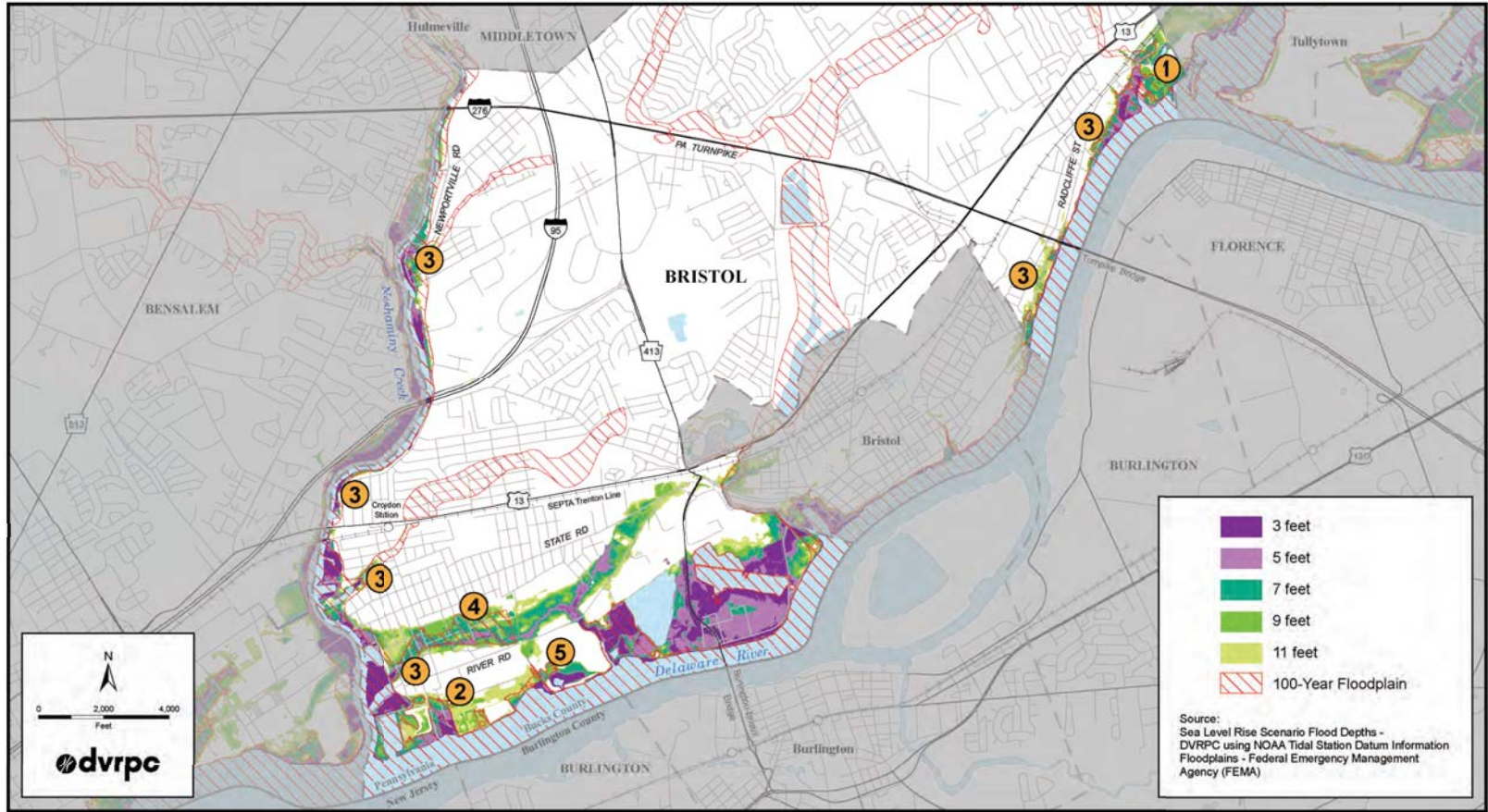
DELAWARE VALLEY REGIONAL PLANNING COMMISSION

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The map shows five possible flooding levels in two-foot increments. Coastal storms could produce any of these flood heights today, but all of the heights will be more likely to occur in the future due to sea level rise. Additionally, in 2100, the three or five foot increments could represent permanent inundation. The FEMA 1-percent chance floodplain has been added for comparison, though it does not consider the future impacts of sea level rise.

Flooding Effects at the County Level

In Bucks County, the following assets are predicted to flood or have restricted access with nine feet of floodwater (a worst-case scenario):

- 2,902.6 acres of land
- 21.2 miles of roads
- 1 EPA-designated Superfund Site (Croydon)
- 5 public and private schools
- 18 PennDOT bridges
- 5 SEPTA bus routes
- 5 major roads (Routes 1, 13, I-95, 276, 413)
- 1 rail line (Northeast Corridor, shared by Conrail, CSX, Norfolk Southern, Amtrak, SEPTA)
- 2 ports

In Bristol Township, the following assets (see map above) are at risk of being flooded and may have the highest consequences to the township if they are flooded:

- ① Riverside Industrial Complex
- ② Industrial facilities along River Road
- ③ Residential communities with potentially vulnerable populations
- ④ Cul-de-sac residential streets
- ⑤ Croydon TCE Superfund site



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Increases in temperature are predicted to cause higher sea levels and more frequent heavy storms, both of which will introduce new vulnerabilities in Middletown that the community will need to address.

The following chart shows tide gauge heights above high tide (the "mean higher high water" measurement used by NOAA) at the Philadelphia tide gauge in the Delaware River. The chart lists flood height measurements from some of the most recent strong storms (the "Current" column) and how those **flood heights are predicted to increase in a likely sea level rise scenario** (the "2030," "2050," and "2100" columns). These measurements and calculations form the basis for the map of flood extents and depths in Middletown on the reverse side of this poster.

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Sources: NOAA, central estimate from Kopp et. al 2016.

¹Pennsylvania Climate Impacts Assessment Update, Shortle et. al, May 2015, 41

What Does It Mean for Your Community?

Middletown is located in the Delaware Estuary Coastal Zone, a region that is already vulnerable to flooding from several sources. Regular tides along the Delaware River and its tributaries, as well as riverine flooding along Neshaminy Creek, already cause damage to property in the area. Future flooding may cause additional problems. In general, **some of the greatest flooding problems for Middletown Township and other communities along the Delaware River include:**

- Flooding of private property (especially homes, businesses, and cars)
- Flooding of roadways
- Stress on aging water-related infrastructure (sewer lines, storm drains, inlets, dikes, and levees)
- Secondary effects of flooding: siltation, erosion, pollution
- Destruction of tidal wetland habitat
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What Can You Do About It?

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Projects

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Lake Luxembourg, Middletown Township, PA | Source: Wikimedia Commons User Pif0407.




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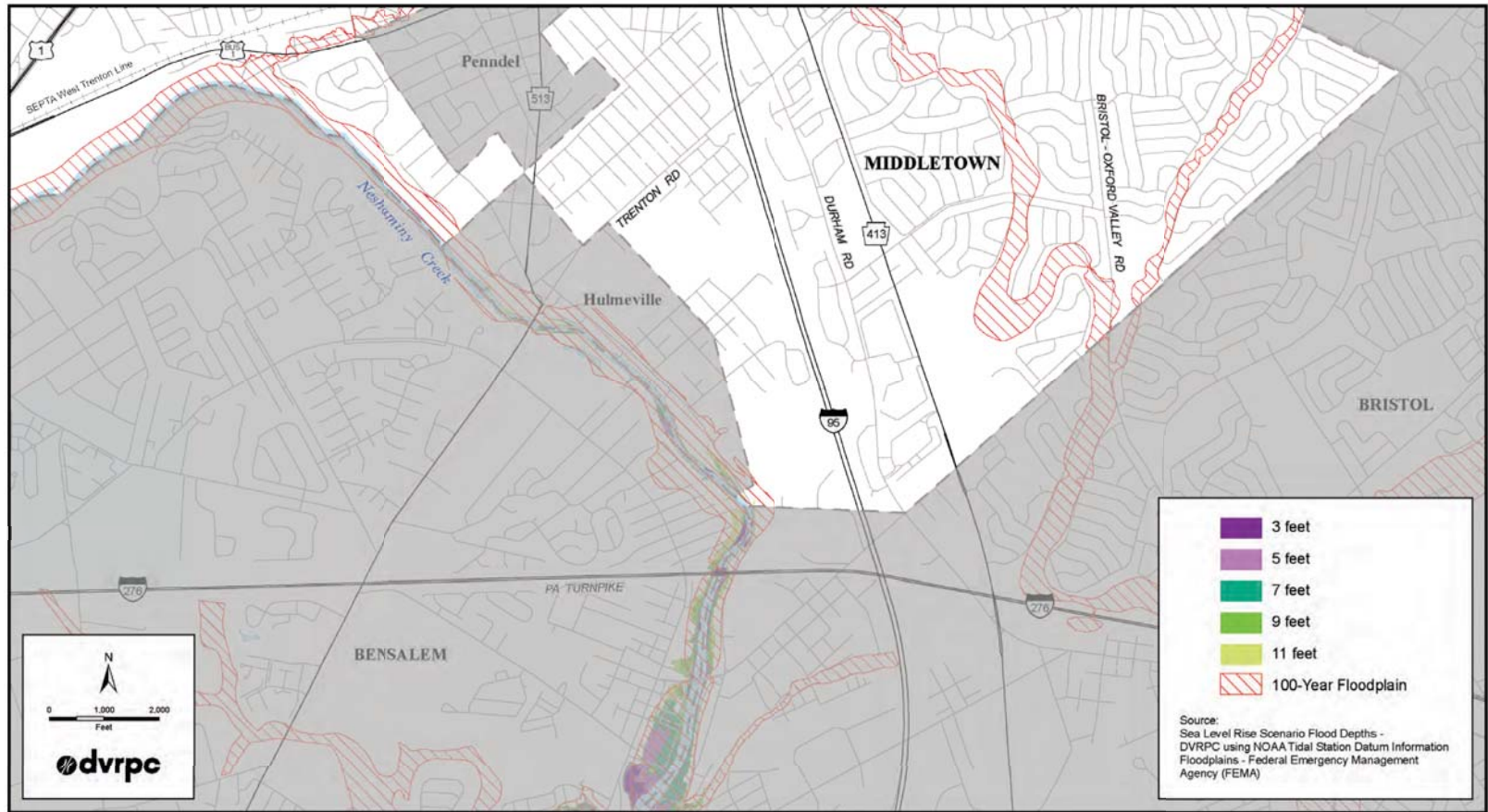
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Flooding Effects at the County Level

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Middletown Township is not predicted to face flooding from the combined effects of sea level rise and storm surge studied in this project; i.e., up to 11 feet of coastal flooding. Inland stormwater runoff from strong storms may present greater risks for the township.



What's Going On And What's Coming Up?

Pennsylvania's climate is changing, and these changes are predicted to affect Morrisville Borough. The earth has warmed by about one degree Fahrenheit (°F) in the last century. If today's trends in greenhouse gas emissions continue, by the middle of the 21st century, Pennsylvania is predicted to warm by between 5.4-6.0°F from current temperatures.¹

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What Does It Mean for Your Community?

Morrisville's location in the Delaware Estuary Coastal Zone already makes it vulnerable to flooding from several sources. Riverine flooding and coastal storm surge from extreme storms already cause damage to property in Morrisville. Future flooding may cause additional problems. In general, **some of the greatest flooding problems for Morrisville Borough and other communities along the Delaware River include:**

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Other

- DVRPC: TCDI and TAP (\$)
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Morrisville Borough Waterfront | Source: PADEP



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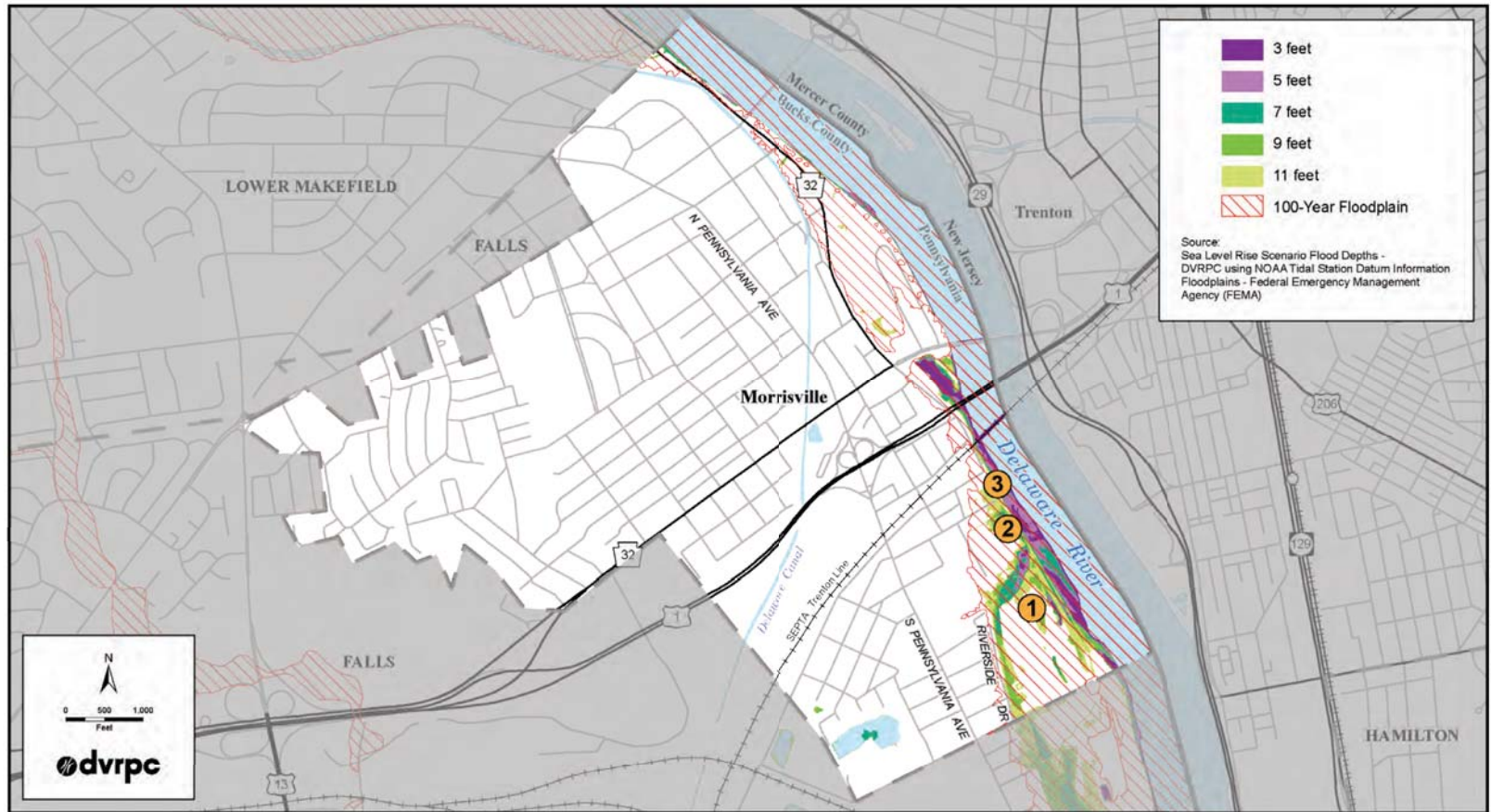
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- 2 ports

In Morrisville Borough, the following assets (see map above) are at risk of being flooded and may have the highest consequences to the Borough if they are flooded:

- ① Industrial facility adjacent to Riverside Drive (Tate & Lyle)
- ② Borough Sewer plant
- ③ South Delmar Avenue/rail line



What's Going On And What's Coming Up?

Pennsylvania's climate is changing, and these changes are predicted to affect Falls Township. The earth has warmed by about one degree Fahrenheit (°F) in the last century. If today's trends in greenhouse gas emissions continue, by the middle of the 21st century, Pennsylvania is predicted to warm by between 5.4-6.0°F from current temperatures.¹

Increases in temperature are predicted to cause higher sea levels and more frequent heavy storms, both of which will introduce new vulnerabilities in Falls that the community will need to address.

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Twilight Lake, Falls Township | Source: Falls Township




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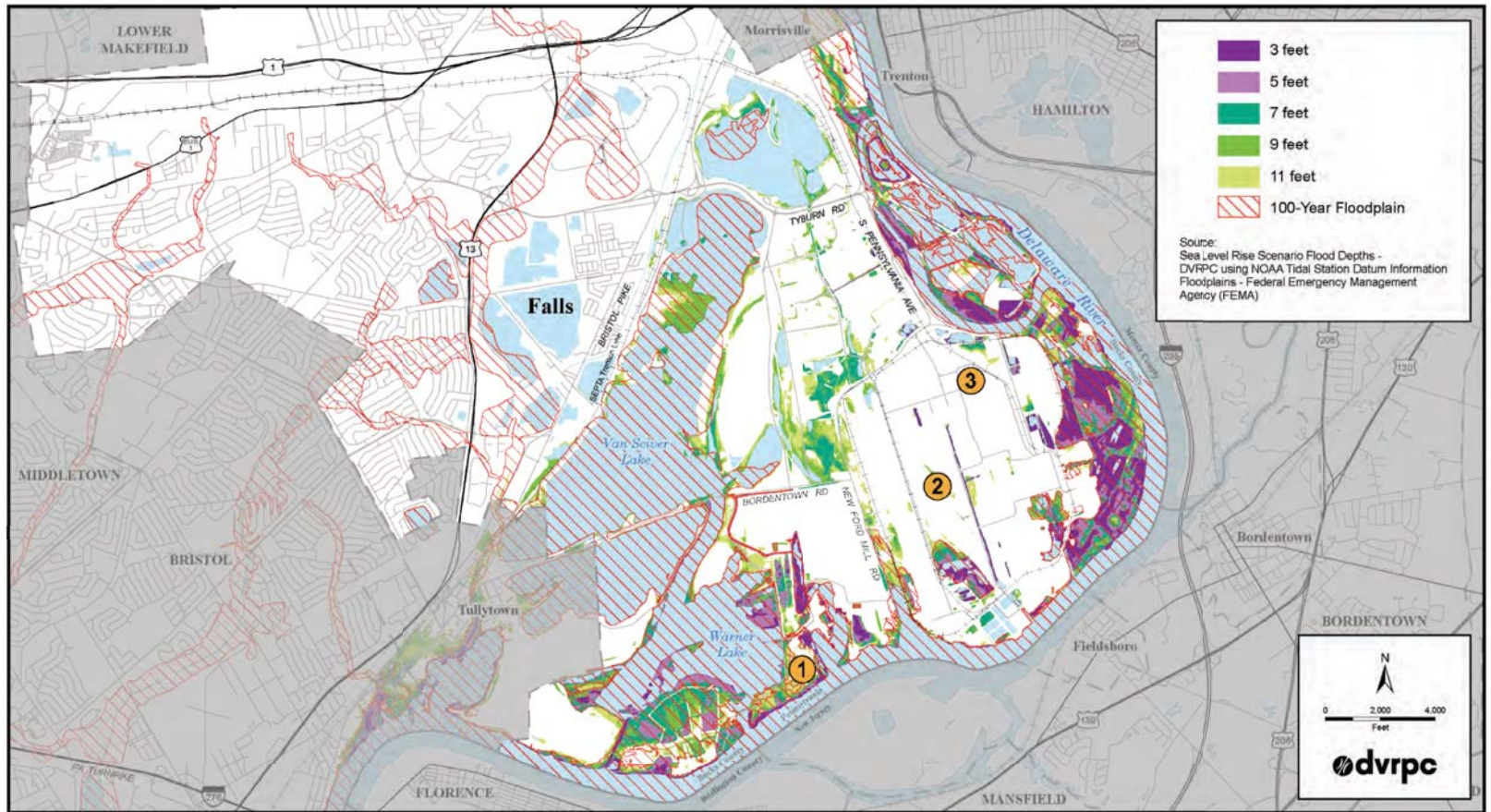
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 **The map shows five possible flooding levels in two-foot increments. Coastal storms could produce any of these flood heights today, but all of the heights will be more likely to occur in the future due to sea level rise. Additionally, in 2100, the three or five foot increments could represent permanent inundation. The FEMA 1-percent chance floodplain has been added for comparison, though it does not consider the future impacts of sea level rise.**

Flooding Effects at the County Level

In Bucks County, the following assets are predicted to flood or have restricted access with nine feet of floodwater (a worst-case scenario):

- 2,902.6 acres of land
- 21.2 miles of roads
- 1 EPA-designated Superfund Site (Croydon)
- 5 public and private schools
- 18 PennDOT bridges
- 5 SEPTA bus routes
- 5 major roads (Routes 1, 13, I-95, 276, 413)
- 1 rail line (Northeast Corridor, shared by Conrail, CSX, Norfolk Southern, Amtrak, SEPTA)
- 2 ports

In Falls Township, the following assets (see map above) are at risk of being flooded and may have the highest consequences to the Township if they are flooded:

- ① Pennsbury Manor
- ② Industrial area along the Delaware River
- ③ U.S. Steel Wastewater and Industrial Wastewater Treatment Plant



What's Going On And What's Coming Up?

Pennsylvania's climate is changing, and these changes are predicted to affect Marcus Hook Borough. The earth has warmed by about one degree Fahrenheit (°F) in the last century. If today's trends in greenhouse gas emissions continue, by the middle of the 21st century, Pennsylvania is predicted to warm by between 5.4-6.0°F from current temperatures.¹

Increases in temperature are predicted to cause higher sea levels and more frequent heavy storms, both of which will introduce new vulnerabilities in Marcus Hook that the community will need to address.

The following chart shows tide gauge heights above high tide (the "mean higher high water" measurement used by NOAA) at the Philadelphia tide gauge in the Delaware River. The chart lists flood height measurements from some of the most recent strong storms (the "Current" column) and how those **flood heights are predicted to increase in a likely sea level rise scenario** (the "2030," "2050," and "2100" columns). These measurements and calculations form the basis for the map of flood extents and depths in Marcus Hook on the reverse side of this poster.

Flooding Estimates at Philadelphia Tide Gauge

	Current (ft)	2030 (ft)	2050 (ft)	2100 (ft)
1%/100-year flood	4.13	4.93	5.53	7.53
Flood of April 2005 (~April 4, 2005)	3.06	3.86	4.46	6.46
Hurricane Irene (~August 28, 2011)	3.23	4.03	4.63	6.63
Hurricane Lee (~September 3, 2011)	1.65	2.45	3.05	5.05
Superstorm Sandy (~October 30, 2012)	3.94	4.74	5.34	7.34
10%/10-year flood	3.05	3.85	4.45	6.45
99%/1-year flood	1.12	1.92	2.52	4.52
Permanent inundation at high tide (mean higher high water)	0	0.8	1.4	3.4

Sources: NOAA, central estimate from Kopp et. al 2016.

¹Pennsylvania Climate Impacts Assessment Update, Shortle et. al, May 2015, 41

What Does It Mean for Your Community?

Marcus Hook's location in the Delaware Estuary Coastal Zone already makes it vulnerable to flooding from several sources. Regular tides along the Delaware River as well as riverine flooding and coastal storm surge from extreme storms already cause damage to property in Marcus Hook Borough. Future flooding may cause additional problems. In general, **some of the greatest flooding problems for Marcus Hook Borough and other communities along the Delaware River include:**

- Flooding of private property (especially homes, businesses, and cars)
- Flooding of roadways
- Stress on aging water-related infrastructure (sewer lines, storm drains, inlets, dikes, and levees)
- Secondary effects of flooding: siltation, erosion, pollution
- Destruction of tidal wetland habitat
- Insufficient flood monitoring systems

What Can You Do About It?

The problems listed above can be addressed using a variety of strategies, including the following:

Plans, Regulations, and Ordinances

- Incorporate flood information into municipal plans, ordinances, and building codes.
- Use the zoning ordinance to regulate setbacks from rivers and streams, increase base flood elevations for buildings, and set requirements for managing stormwater.
- Begin a community-wide planning process to prepare for the long-term effects of storm surge and sea level rise beyond the standard 20- or 25-year planning horizon.
- Add flood mitigation projects into a capital improvements plan or hazard mitigation plan.
- Develop a post-disaster recovery plan.

Projects

- Participate in National Flood Insurance Program's Community Rating System program to reduce insurance premiums for residents in the FEMA 100-year/1-percent floodplain.
- Work with property owners in repeat flood areas to buy out properties, converting them into parks or other open space.
- Work with local environmental organizations to educate residents about the benefits of natural floodplains and riverine wetland habitat in order to achieve long-term support for preserving these areas.
- Preserve existing natural floodplains and riverine wetland habitat.
- Use living plants (green stormwater infrastructure) to reduce stormwater runoff in areas that get flooded by more regular, smaller storms.

- Conduct regular outreach to the residents living in floodprone areas on flood preparedness and disaster assistance.
- Create an evacuation plan that includes multiple routes out of the municipality, and share that information with residents.

Other coastal flooding preparation and response strategies can be found at <https://www.dvrpc.org/Resiliency/Coastal>.

What's Available?

Funding (\$) and technical assistance (TA) resources are available to better plan for and respond to flooding impacts:

Federal

- FEMA: Pre-Disaster Mitigation Grant and Hazard Mitigation Grant Programs (\$)
- HUD: Community Development Block Grants (\$)
- NOAA: Digital Coast (TA)

State

- DCNR: Community Conservation Partnerships Program (\$)
- PennVest (Pennsylvania Infrastructure Investment Authority) (\$)
- PA DEP: Coastal Zone Management and Growing Greener Grants (\$)

Other


- DVRPC: TCDI and TAP (\$)
- Natural Lands and PECO: Green Region Open Space Program (\$)
- NFWF and Wells Fargo: Resilient Communities Program (\$)
- Schuylkill River Heritage Area: Schuylkill River Restoration Fund (\$)

Other resources can be found at


<https://www.dvrpc.org/Resiliency/Coastal>.




Marcus Hook Waterfront at Market Square Memorial Park | Source: DVRPC




3 FEET
FLOODING SCENARIOS:
 Historic flood of April 2005 or sea level rise in 2100 (5% chance)



5 FEET
FLOODING SCENARIOS:
 Hurricane Irene (2011) or sea level rise in 2100 (5% chance)



9 FEET
FLOODING SCENARIOS:
 Superstorm Sandy with 2100 sea level rise (5% chance)




DELAWARE VALLEY REGIONAL PLANNING COMMISSION
 The Delaware Valley Regional Commission is the federally designated Metropolitan Planning Organization for a diverse nine-county region in two states: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey.

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Flooding Effects at the County Level

In Delaware County, the following assets are predicted to flood or have restricted access with nine feet of floodwater (a worst-case scenario):

- 4,508.2 acres of land
- 50.2 miles of roads
- 3 EPA-designated brownfields
- 9 municipal buildings, fire departments, and police stations
- 7 public and private schools
- 49 PennDOT bridges
- 7 SEPTA bus routes
- 5 major roads (I-95, 476, 291, 13, 322, 291, 420)
- 4 freight rail lines

In Marcus Hook Borough, the following assets (see map above) are at risk of being flooded and may have the highest consequences to the Borough if they are flooded:

- ① Industrial facilities and ports
- ② Neighborhood between Green Street and Church Street south of West 6th Street
- ③ Bridge at Marcus Hook Creek
- ④ Chester Secondary Conrail Line
- ⑤ Marcus Hook Community Center