

# Manchester-by-the-Sea

## Comprehensive Watershed Planning for Climate Change



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# The Community





**Historical Development**  
**Aging Infrastructure**  
**Coastal Development**  
**Climate Change**



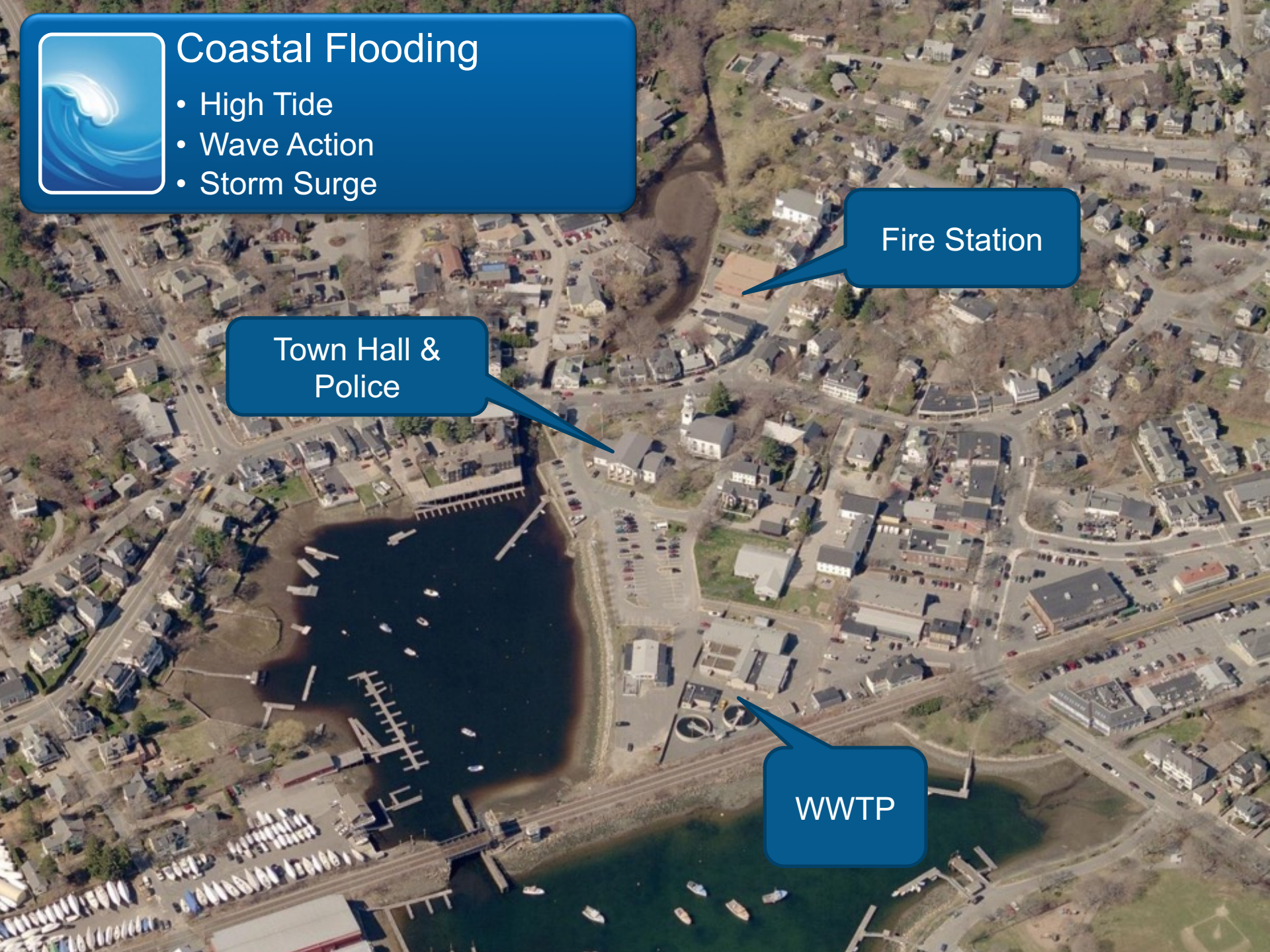
# Coastal Flooding

- High Tide
- Wave Action
- Storm Surge

Fire Station

Town Hall &  
Police

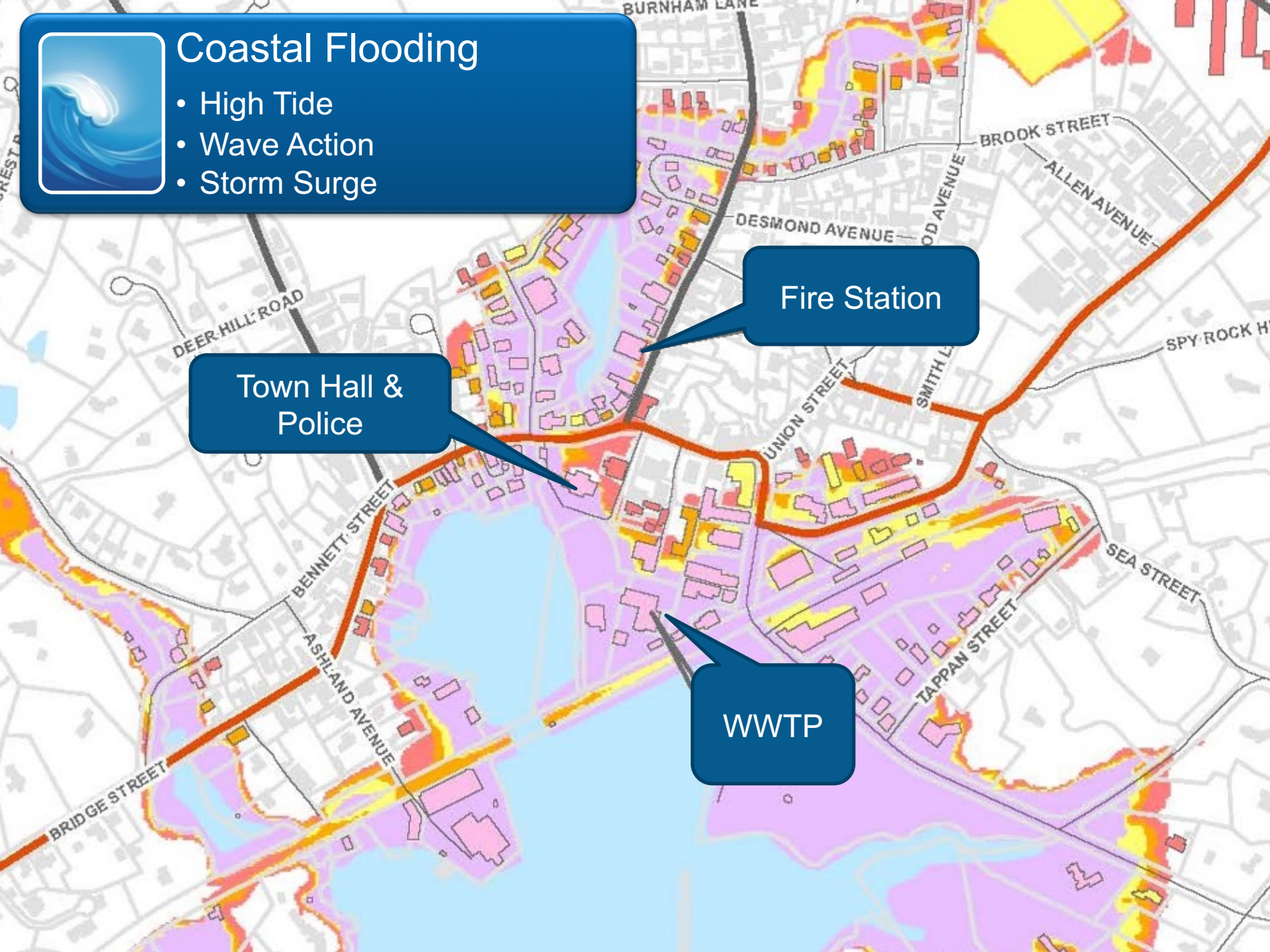
WWTP





## Coastal Flooding

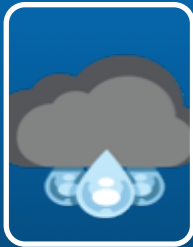
- High Tide
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## Coastal Flooding

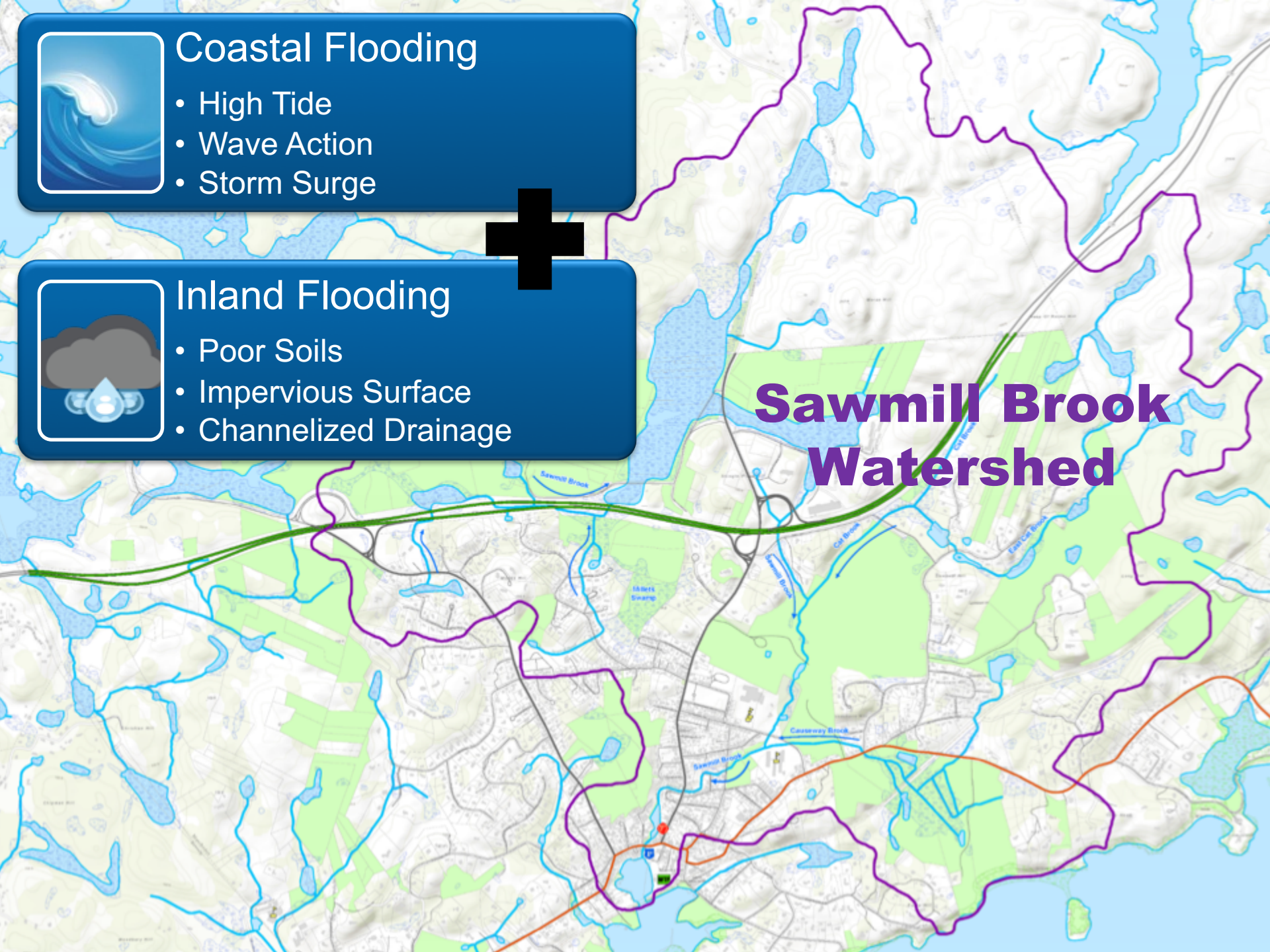
- High Tide
- Wave Action
- Storm Surge



## Inland Flooding

- Poor Soils
- Impervious Surface
- Channelized Drainage

# Sawmill Brook Watershed

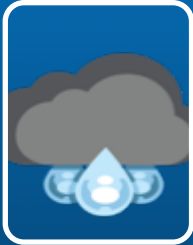






## Coastal Flooding

- High Tide
- Wave Action
- Storm Surge



## Inland Flooding

- Poor Soils
- Impervious Surface
- Channelized Drainage



## Water Quality Issues

- Bacteria
- Low pH
- Sedimentation





**Where do you even start....**



# Big Picture View ... Strategic Funding Plan

- Town Administrator wanted to understand future impacts of climate change on the town.
- Watershed issues, infrastructure capacity, mitigation solutions.
- Applied for 2 CZM Grants to study the impacts of climate change in the Sawmill Brook Watershed and LID opportunities.
- Applied for 2 FEMA PDM Grants to “enhance” and update the town’s Hazard Mitigation Plan to include the impacts of climate change.

**YES!**

**YES!**



# Engage the Community

## Develop a core Advisory Group

- *Town Administrator*
- *Grants Administrator*
- *Fire Captain*
- *Police Representative*
- *DPW Director*
- *Town Planner*



- *Salem Sound Coast Watch*
- *Manchester Coastal Stream Team*
- *Downtown Improvement Committee*
- *Citizen Advisors*
- *Coastal Zone Management*
- *MEMA*



# Engage the Community



# Three key questions

1. **Where does it flood and when?**
2. **What is the impact on critical community assets?**
3. **How can we mitigate the impacts?**

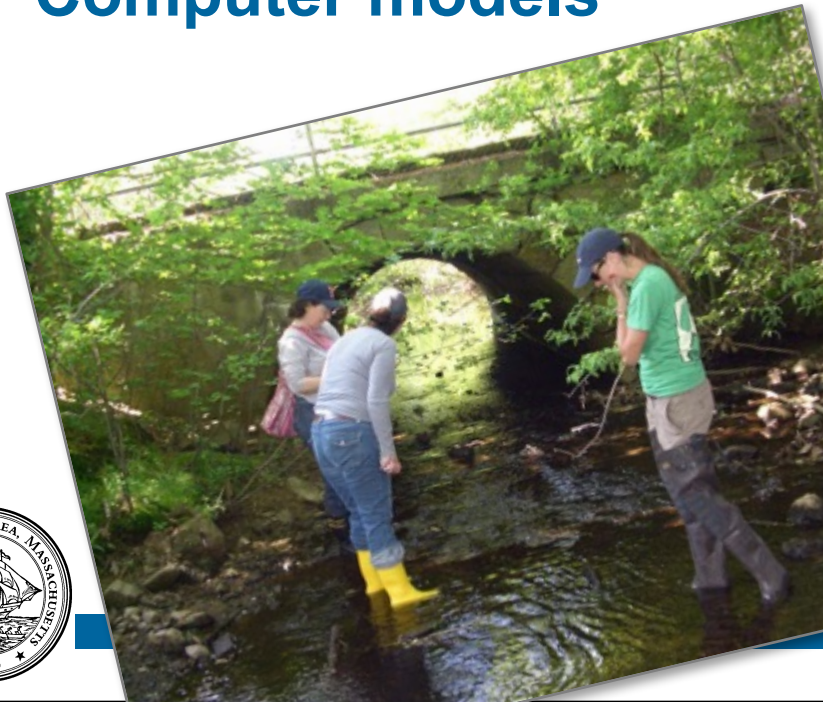


**Where does it flood and when....**



# Where does it flood and when?

- Interviews and public meetings
- Review of archives and available information
- Field work
- Computer models

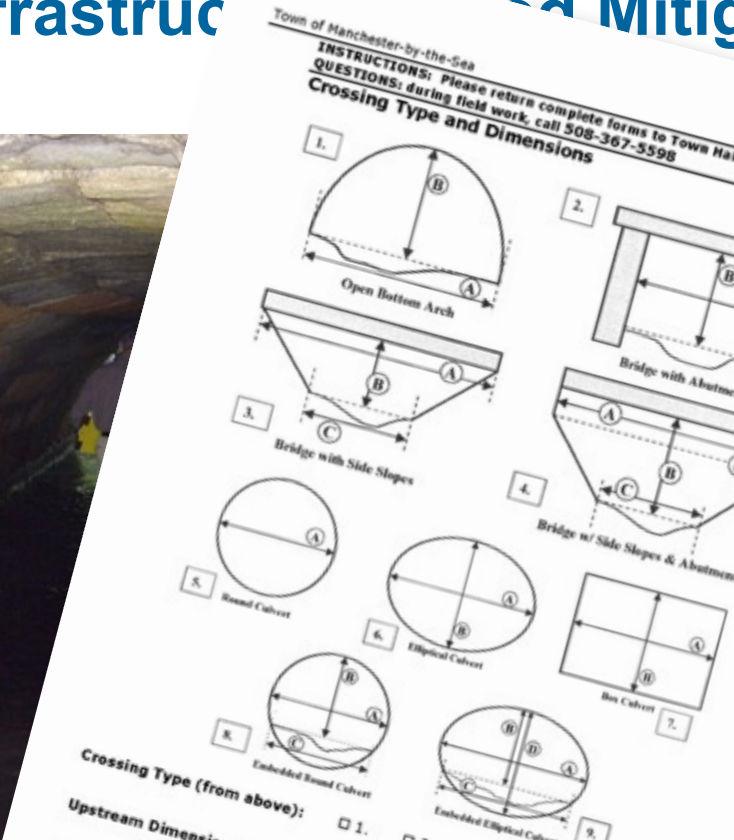


# Where does it flood and when?

## Field Work

### Assessment of:

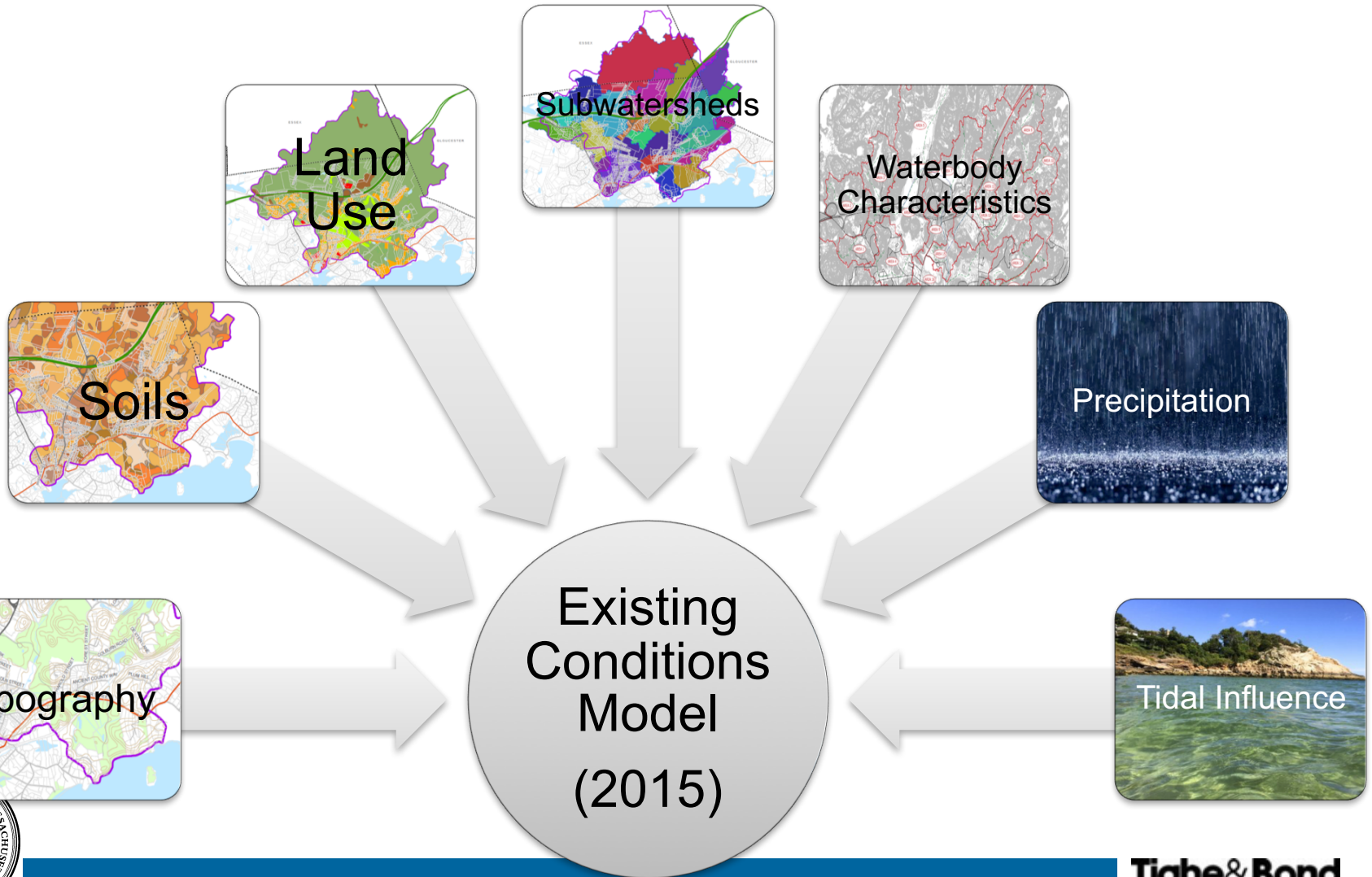
- Existing structures (23 culverts and tide gate)
- Potential structural solutions (15 sites for Green Infrastructure and Mitigation)



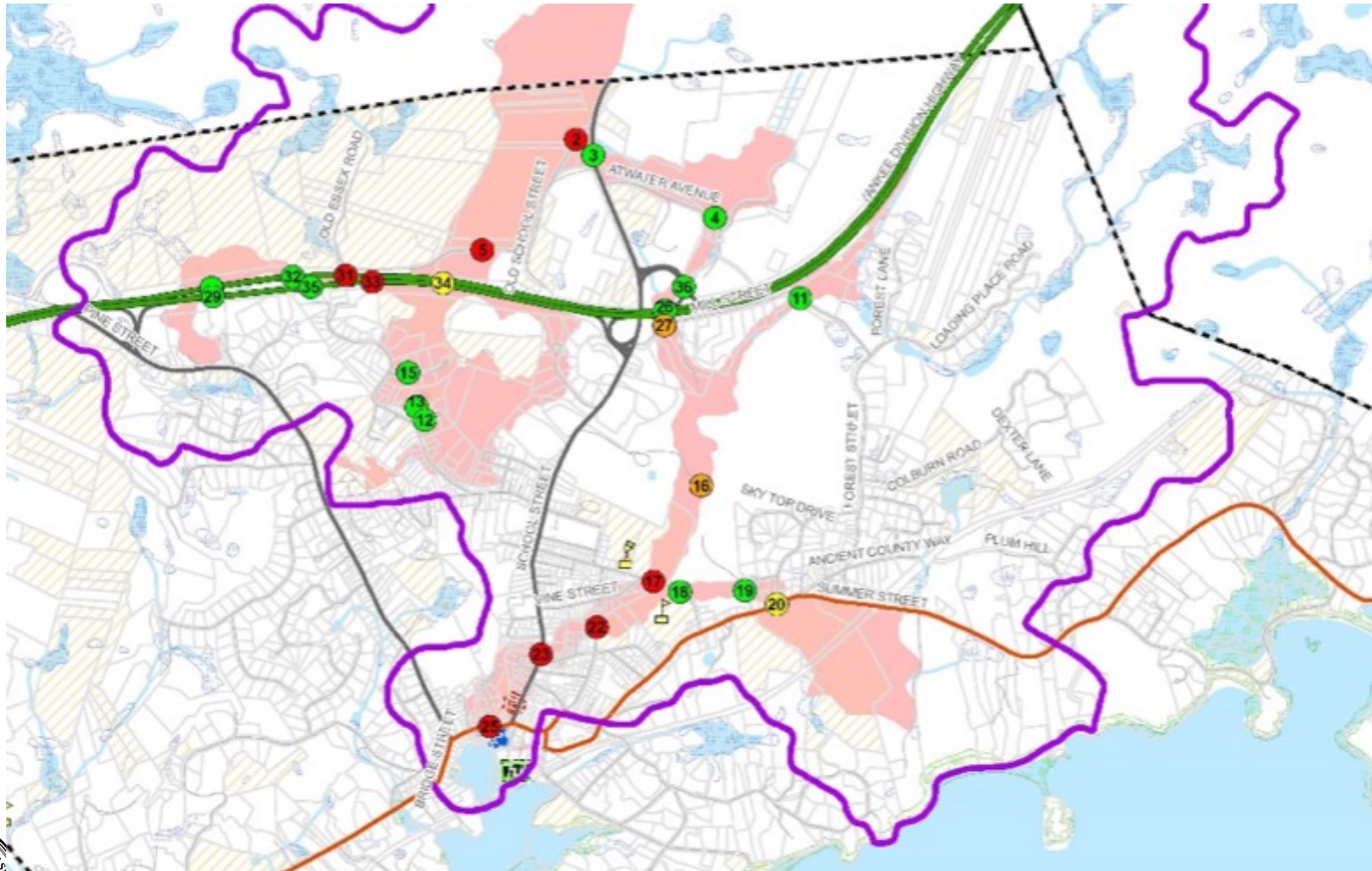


# Where does it flood and when?

## Existing Conditions Model

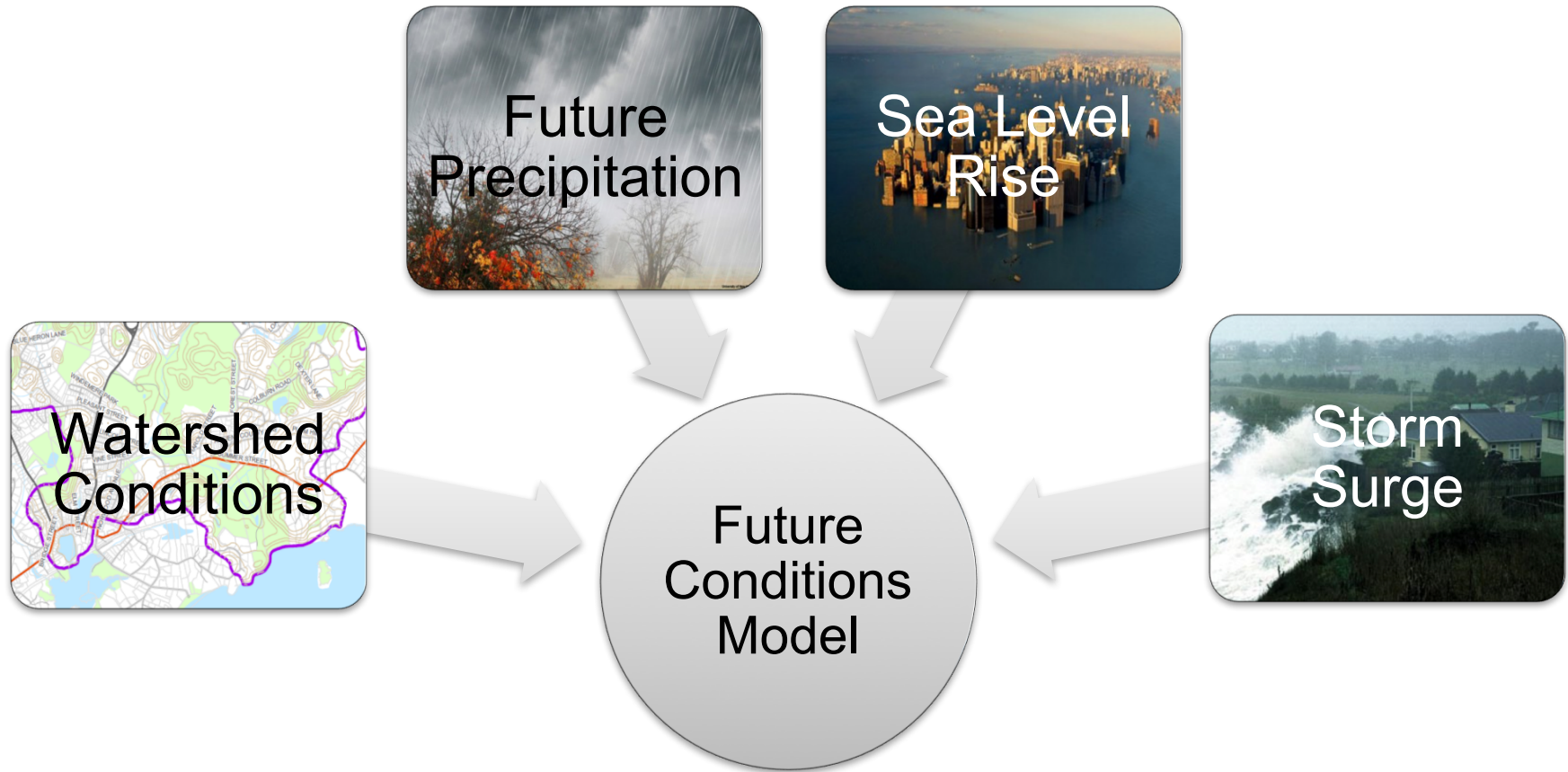


# Where does it flood and when? Existing Conditions Model Results



# Where does it flood and when?

## Future Conditions Model



**2025**      **2050**      **2100**



# Where does it flood and when? Future Conditions Model – Coastal Influence



<http://www.geosciconsultants.com/projects/2015/5/27/coastal-risk-mapping-in-salem-sound>



# Where does it flood and when? Future Conditions Model – Precipitation

## UNH Oyster River Culvert Analysis Rainfall depths for 2025, 2050, 2100

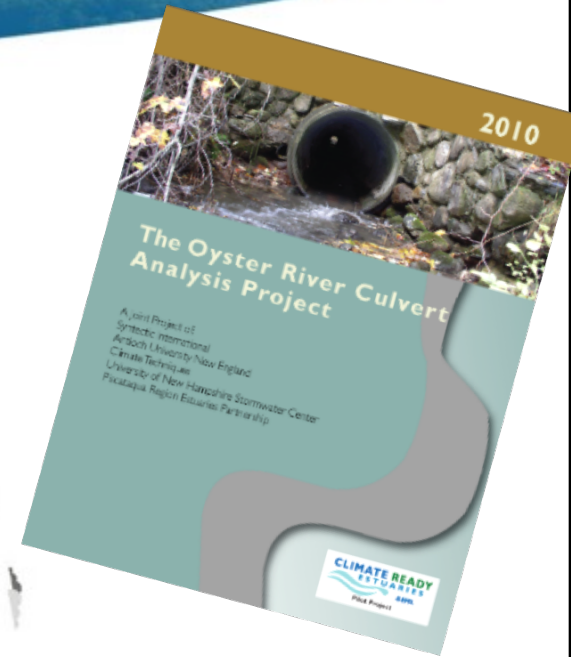
Two scenarios:



**Balanced  
Energy Use**



**Fossil Intensive  
Energy Use**



**What is the impact on the community....**



# What is the impact on the Community

## Location of Assets

People

Built  
Environment

Economy

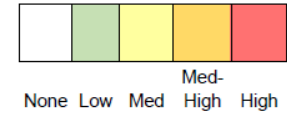
Natural  
Environment



# What is the Impact on the Community Where and When will Impacts Occur

Table 8 - Community Asset: Built Environment (Critical Buildings, Infrastructure and Transportation Corridors)

RISK KEY:

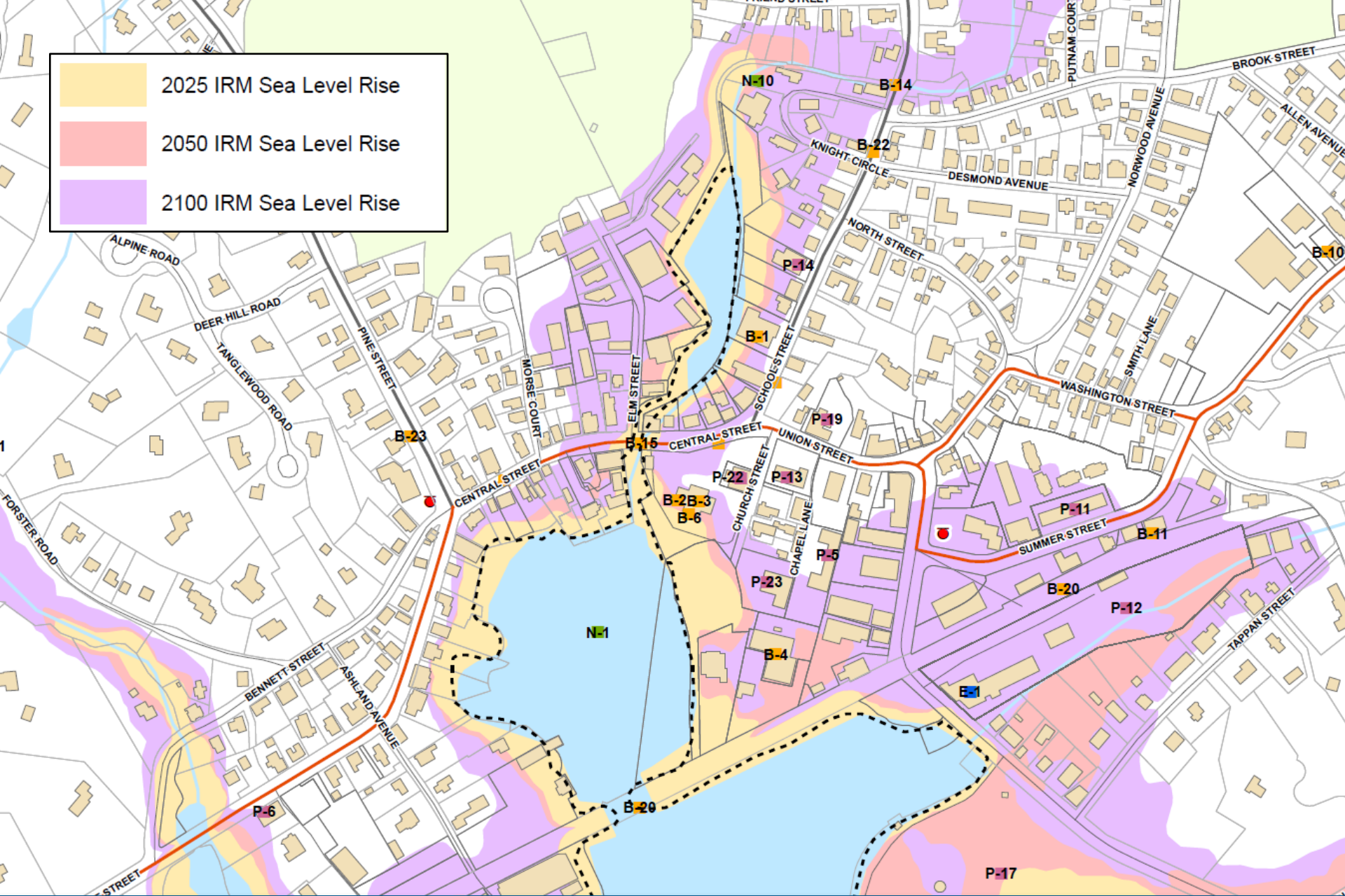


Risk of Flooding for 2015, 2025, 2050 and 2100 scenarios

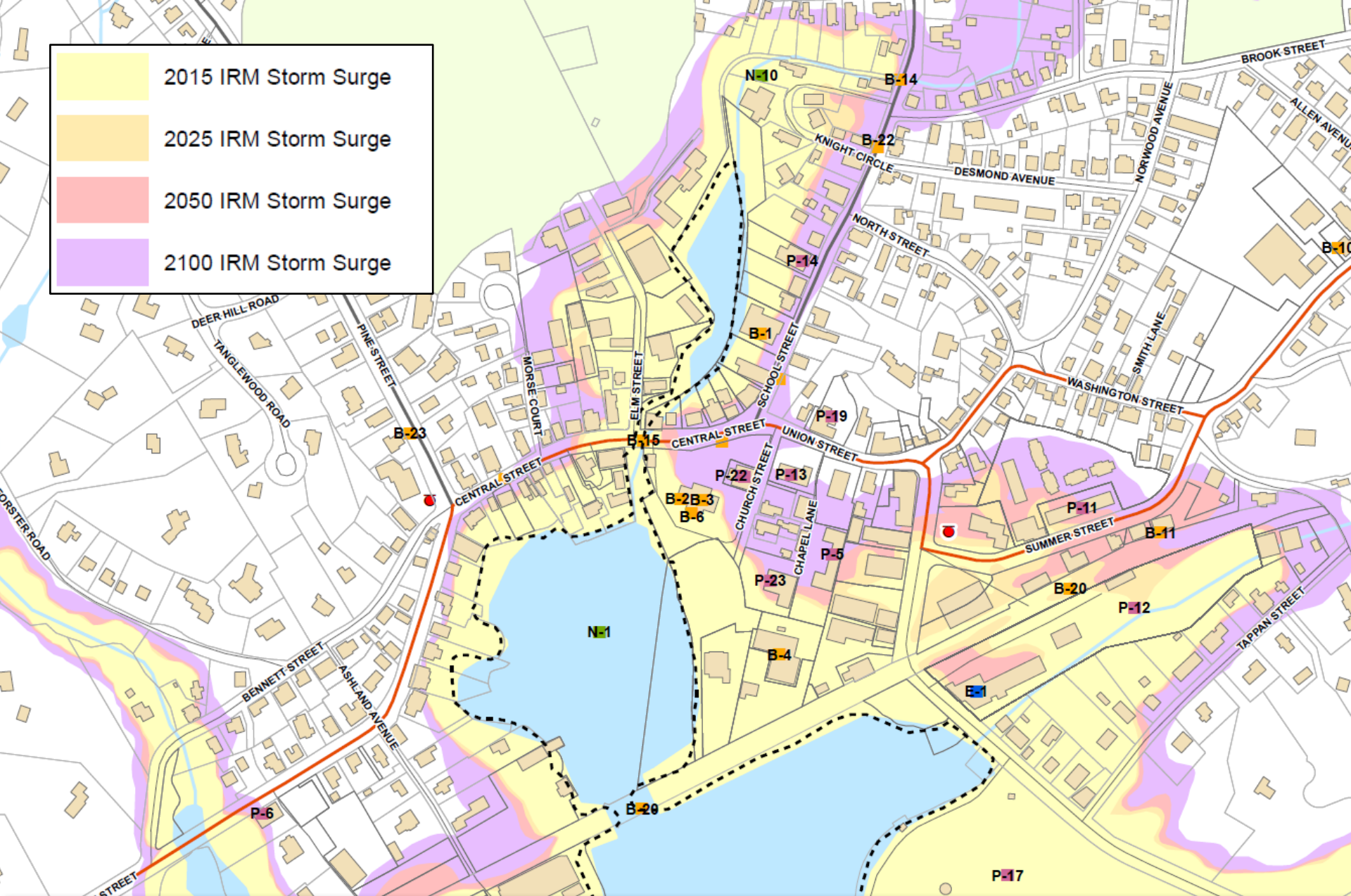
ID	NAME	ADDRESS	Sector Code	Flood Zone Elevation NAVD-88 (ft)	IRM Sea Level Rise				IRM Shallow Coastal Flooding				IRM Storm Surge				IRM Hurricane/ Cat 1				Upland Flooding Impacts			
					2015	2025	2050	2100	2015	2025	2050	2100	2015	2025	2050	2100	2015	2025	2050	2100	2015	2025	2050	2100
B-1	Manchester Fire Department	12 School Street	CB-F	11	N/A	Low	Med	High	Med	Med	High	High	Med	Med	Med	N/A	N/A	N/A	High	High	High	High		
B-2	Manchester Police Headquarters	10 Central Street	CB-F	11	N/A	Med	Med	High	High	High	High	High	High	High	Med	N/A	N/A	N/A	High	High	High	High		
B-3	Manchester-by-the-Sea Town Hall	10 Central Street	CB-F	11	N/A	Low	Med	Med	High	High	High	High	High	High	Med	N/A	N/A	N/A	High	High	High	High		
B-4	Manchester Wastewater Treatment	12 Church Street	CB-F	11	N/A		Low	Med	Low	Low	Low	Med	Med	Med	Med	N/A	N/A	N/A						
B-5	DPW Garage	85 Pleasant Street	CB-F		N/A										N/A	N/A	N/A	High	High	High	High			
B-6	Emergency Operation Center Town Hall	10 Central Street	CB-F	11	N/A	Med	Med	High	High	High	High	High	High	High	Med	N/A	N/A	N/A	High	High	High	High		
B-7	Manchester Wastewater Treatment Plant Parcel #2	12 Church Street	CB-W	11	N/A	Low	Low	Med		Low	Med	Med	Med	Med	Med	N/A	N/A	N/A						
B-8	Lincoln Street Well & Pumping Station	40 Lincoln Street	CB-W	15	N/A						Low			Low	N/A	N/A	N/A	High	High	High	High			
B-9	Manchester Water Tower (tank)	139 Pine Street	CB-W		N/A										N/A	N/A	N/A							







Sea level rise affects 23% of community assets in the near term (2025)  
 Affects almost 37% of the community assets by 2100



Storm Surge affects 33% of community assets in the near term (2025).  
 Affects over 50% of the community assets by 2100

# What is the Impact on the Community Flood Risk Present and Future

## ■ All Developed Parcels- Present Risk

- 25% are either in A, AE or VE flood zone
- \$120 million dollars (building value)

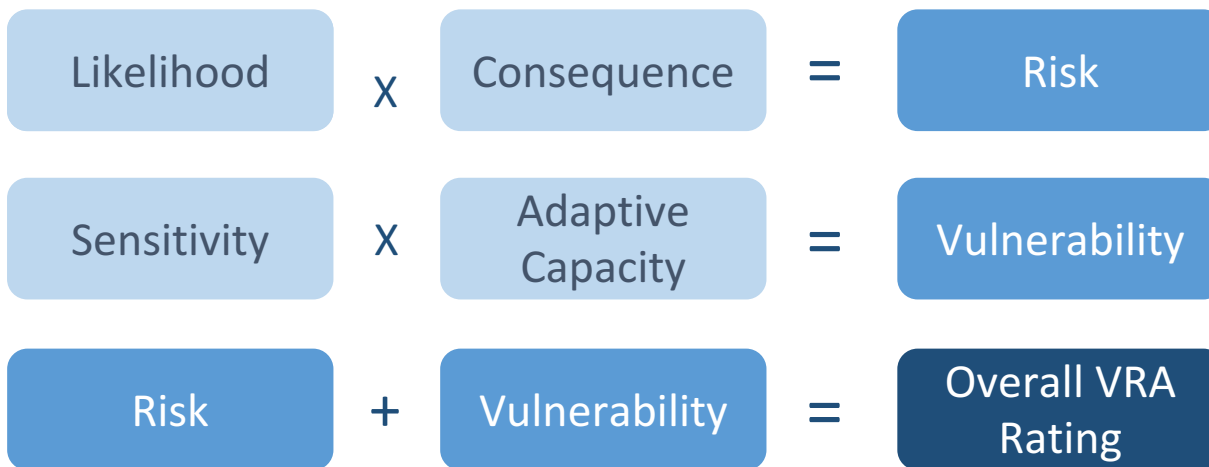
## ■ All Developed Parcels- Future Risk

- 15% impacted if Base Flood Elevation expands 4 feet (SLR)
- \$200 million dollars (building value)



# What is the Impact on the Community

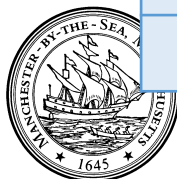
## Determining VRA Rating



# What is the Impact on the Community

## Assets with highest VRA score

Category	Community Asset	Overall Rating 2025	Overall Rating 2050	Overall Rating 2100
Built Environment	Central Street Dam	15	18	18
Built Environment	Manchester Wastewater Treatment	12	15	15
Built Environment	Downtown Stormwater Drainage System	15	15	15
Built Environment	Town Hall / Police Headquarters / Emergency Operations Center	13	13	13
Built Environment	Manchester Fire Department	10	13	13
Built Environment	Route 127	12	12	12
Economy	Downtown Businesses	13	13	13
Natural Resources	Sawmill Brook	12	12	12
Natural Resources	Manchester Harbor	12	12	12
Natural Resources	Singing Beach	12	12	12



# What is the Impact on the Community

## VRA Results: Central Street Dam



Central Street Dam

2050 Sea Level Rise

2050 Storm Surge

Category	Component	2050 Rating	2050 Category Total	2050 Overall Rating
Risk	Likelihood	High = 3	9	18
	Consequence	High = 3		
Vulnerability	Sensitivity	High = 3	9	
	Adaptive Capacity	Low = 3		



**How can impacts be mitigated....**



# How can impacts be mitigated?

## Develop Adaptation Actions

### ■ Buildings

- Flood Proof Openings
- Upgrade Equipment
- Elevate Generators
- Elevate Power Sources
- Elevate Buildings
- Adopt Emergency Operations



### ■ Infrastructure

- Widen Culverts
- Dredge and Restore Channels
- Improve Drainage
- Elevate Roadways
- Protect with Seawalls
- Research Hurricane Barrier





# How can impacts be mitigated?

## Develop Adaptation Actions

### ■ Economy

- Flood Insurance
- Public Education
- Elevate Power Sources
- Adopt Emergency Operations

### ■ Natural Resources

- Tide Gate Removal
- Dredge and Restore Channels
- Improve Drainage
- Beach Nourishments
- Eel Grass Restoration
- Harbor Management



# How can impacts be mitigated? Prioritize Projects

- Save lives, property?
- Fit multiple planning objectives?

Screening Criteria													
Flood Mitigation / Health & Safety													
	Coordination with Other Town Projects												
Habitat Improvement													
Additional Community Benefit													
Water Quality Improvement													
Permitting Difficulty													
Long-term Maintenance													

Project	Ranking	Opinion of Probable Cost
Old School Street	9	\$ 220,000
Golf Course	8	\$ 1,180,000
Hurricane Barrier	7	\$ 26,000,000
Norwood Avenue Culvert	6	\$ 910,000
Coach Field Parking Lot	5	\$ 430,000
Lincoln Street Culvert	4	\$ 400,000
School Street Culvert	3	\$ 1,040,000
Central Street Tide Gate (#1)	2	\$ 860,000
Central Street Tide Gate (#2)	1	\$ 1,910,000

147	1.00	100.0%
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# How can impacts be mitigated?

## Prioritize Projects

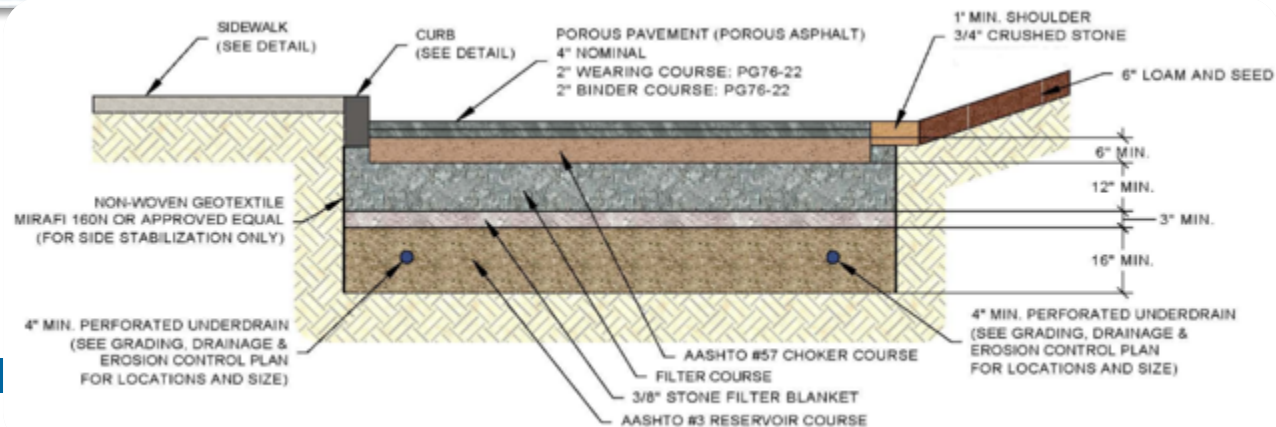






# How can impacts be mitigated?

## Prioritize Projects



**How do you keep moving forward....**



# Update Hazard Mitigation Plan

## Mitigation Actions and Adaptation Strategy





# Manchester is moving forward in these ways...

- **Updating Town Master Plan to identify climate change risks, vulnerability to community assets and mitigation solutions**
- **Formalizing actions in an approved FEMA Hazard Mitigation Plan**
- **Keeping the public informed and engaged through public workshops, web site update and news articles**



# Summary

- 1. Develop a vision for future resilience**
- 2. Understand past and future flooding causes and effects**
- 3. Complete VRA and target most vulnerable sites**
- 4. Make sure mitigation projects are defensible, cost effective, and consistent with other planning**
- 5. Develop funding strategy with big picture goals and short term objectives**



# Questions?

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Documents can be found the Manchester town website at:

[www.manchester.ma.us/354/Sawmill-Brook-Watershed-Project](http://www.manchester.ma.us/354/Sawmill-Brook-Watershed-Project)

and

[www.manchester.ma.us/355/FEMA-PDM-Grant-Projects](http://www.manchester.ma.us/355/FEMA-PDM-Grant-Projects)

