INLAND FLOOD PROTECTION RULE

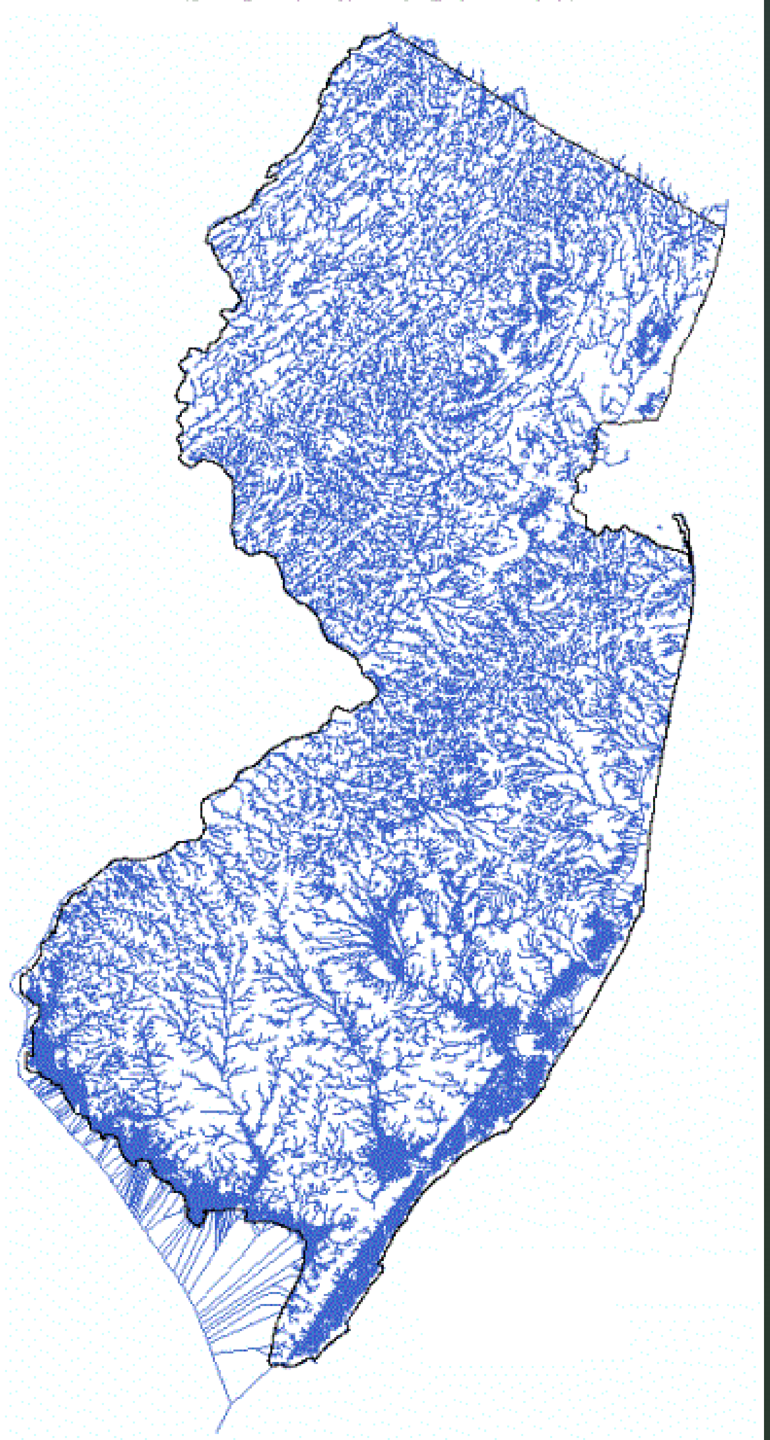
Resilient Environments and Landscapes
NJPACT Update

NJ Department of Environmental Protection
19 October 2022

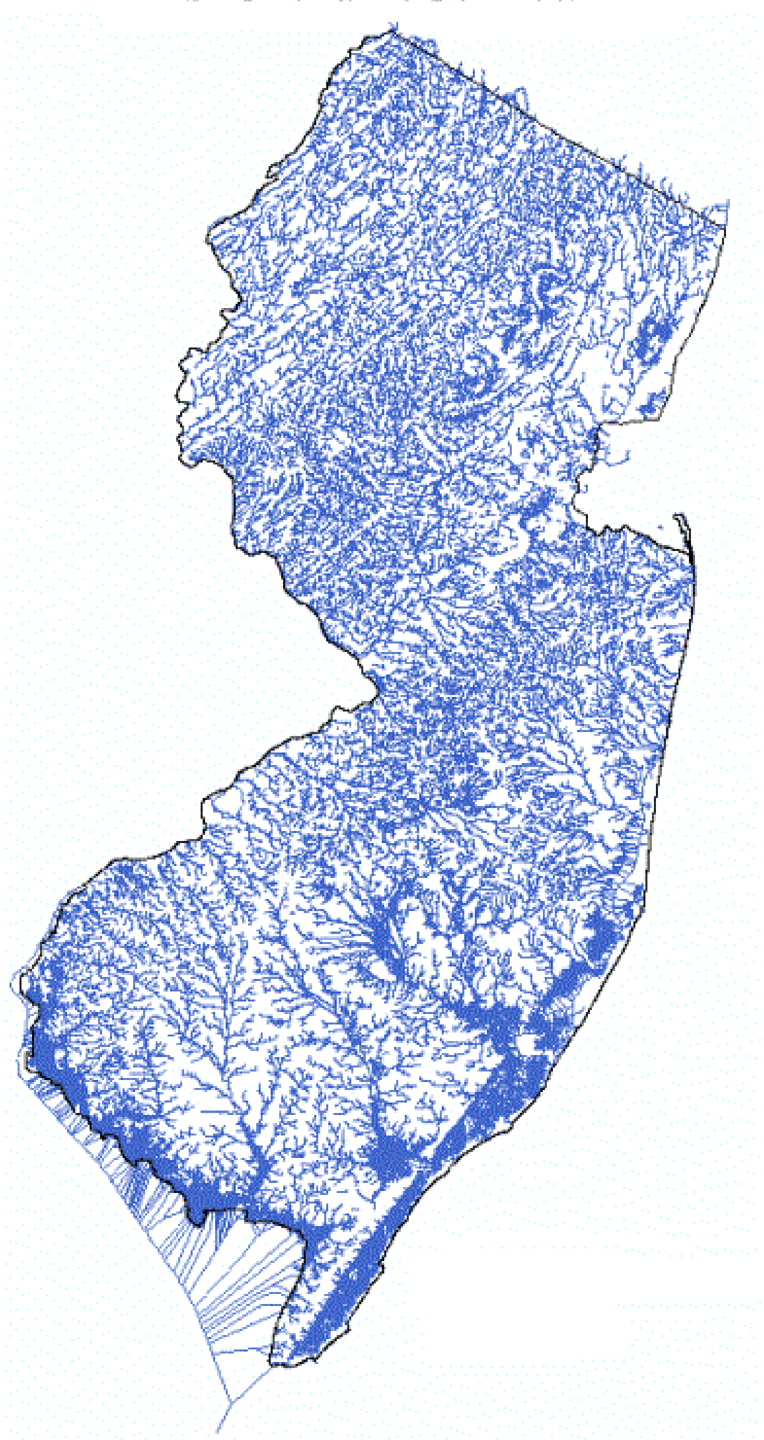
QUICK FACTS ON FLOODING

- NJ currently ranks as the third highest state in the nation for NFIP claims
- Over 15% of the State lies within a mapped floodplain
- Publicly available flood mapping is incomplete and often underestimates actual flood risk
- NJ endures both riverine (fluvial) and coastal (tidal) flooding, which have different causes and result in different flood dynamics and safety concerns

- New Jersey's original settlements were along navigable waterways
- As a result, many of the State's population centers are located within flood hazard areas today
- Older development was often built without regard for potential flood risk



- **Flood mapping is based on what has happened in the past, using data collected over the past 50 years**
- **Mapping was never a truly accurate predictor of flood risk**
- **No longer a sound methodology for estimating flood risk due to climate change**



TERMINOLOGY

What is a 100-Year Flood?

- More accurately described as a 1% flood
- Within a given year, this flood has a 1% probability of occurring
- On average, a flood of this magnitude occurs about once a century

What is a 500-Year Flood?

- More accurately described as a 0.2% flood
- Within a given year, this flood has a 0.2% probability of occurring
- On average, a flood of this magnitude occurs about once every 500 years

For general discussion purposes only. Information provided is pre-decisional and does not constitute a final agency decision or action.

RISK ASSESSMENT

- There is nothing particularly special about these two flood probabilities
- The 100-year flood became common in the 1960s as a means of determining the worst flooding that a structure would likely endure during its lifetime
- Mapping is a good starting point to assess risk but flooding often exceeds mapped floodplain limits
- Floods don't stop at a line on a map

RISK ASSESSMENT

- People need to be aware of flood risks when buying, renting, occupying or developing property
- Often difficult to determine risk due to incomplete or inaccurate flood mapping

FLUVIAL vs. TIDAL FLOODING

FLUVIAL (RIVERINE)

- Caused by stormwater runoff from extreme precipitation events
- Floodwaters are moving through the watershed down to the ocean
- Can happen quickly (flash flooding) and cause significant damage and loss of life

TIDAL (COASTAL)

- Caused by tidal surge during coastal storms
- Significant damage caused by wave action
- Generally does not happen quickly so there is time to prepare and evacuate

FLUVIAL FLOOD RISK

- Most State and FEMA flood maps are based on past hydrology
- Mapping is incomplete - does not cover all floodplains
- Mapping generally underestimates today's flood potential
- Mapping does not account for increasing precipitation due to climate change

EFFECTS OF INCREASING EXTREME PRECIPITATION

- Added stress on already overtaxed infrastructure
- Overwhelmed stormwater management systems
- Increased fluvial flood depths
- Increased risk to life and property

NEW JERSEY'S INCREASING TEMPERATURES & PRECIPITATION

- Higher temperatures increase the energy in storms and allow the atmosphere to hold more water, which increases the potential for more intense precipitation and flooding
- By the end of the 21st century, heavy storm events are projected to occur 200 to 500% more often and with more intensity than in the 20th century
- Major flood events hit New Jersey in 2000, 2004, 2005, 2006, 2007, 2010, 2011, 2012, 2016, and 2021

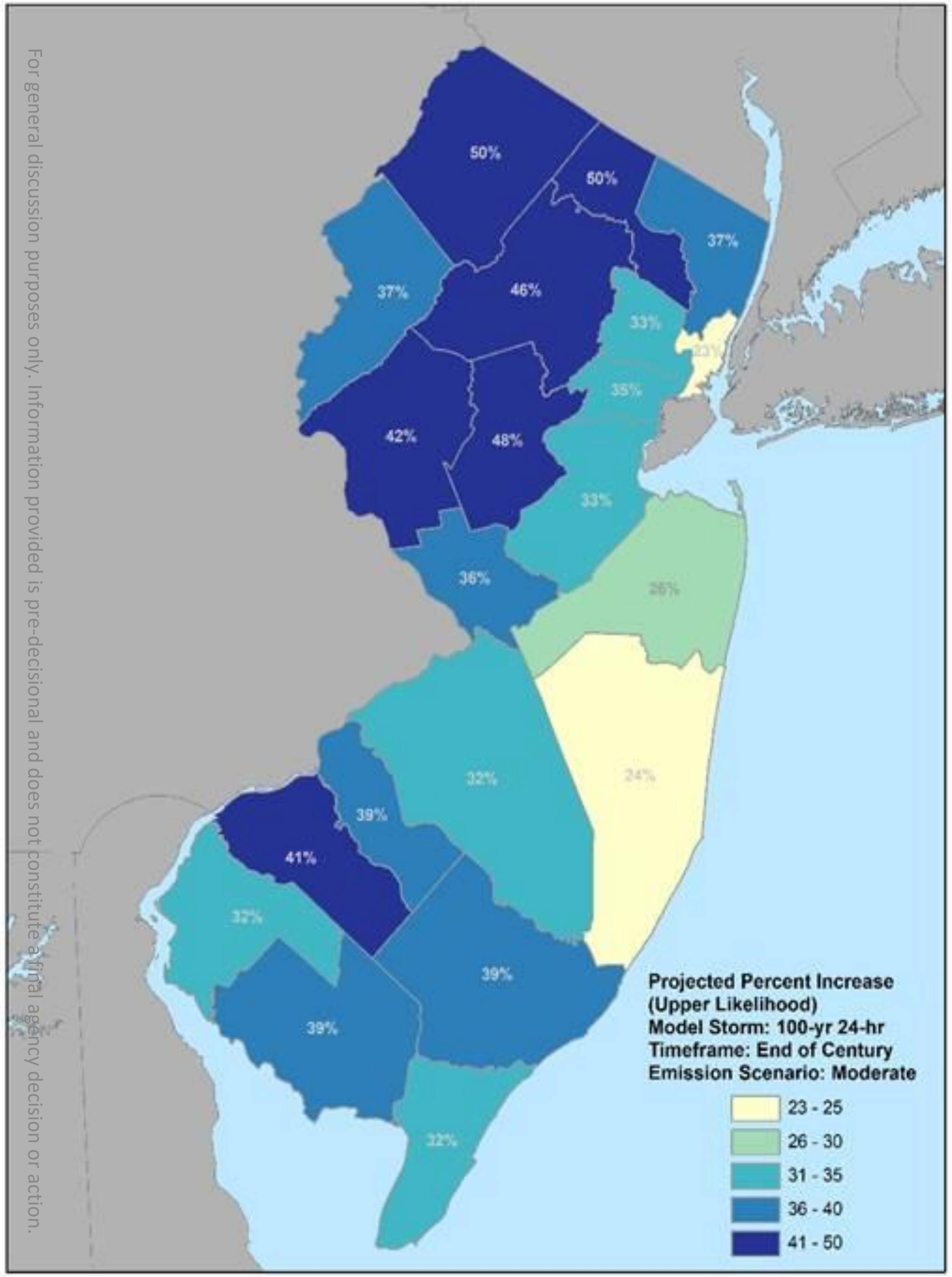
▸INTENSIFYING RAINFALL & FLOODING IN NEW JERSEY

NJDEP and the Northeast Regional Climate Center, a National Oceanic and Atmospheric Administration (NOAA) partner, released studies in November 2021, which:

- **Confirm increases in extreme precipitation across New Jersey over the last 20 years**
- **Project further increases in precipitation intensity over coming decades**

INTENSIFYING RAINFALL & FLOODING IN NEW JERSEY

- The data presently used to analyze flood potential in waterways and in the design of stormwater infrastructure is outdated—it includes data only through 1999
- The precipitation expectations that presently guide state policy, planning and development criteria, and which rely upon data obtained through 1999, do not accurately reflect current precipitation intensity conditions



More Rain = More Stormwater Runoff → **More Runoff =** Increased Riverine Flow → **More Flow =** Higher Flood Elevations

CURRENT PRECIPITATION

Since 1999:

- **The 2-year storm has increased as much as 5%**
- **The 10-year storm has increased as much as 7%**
- **The 100-year storm has increased as much as 15%**

FUTURE PRECIPITATION

Over the coming decades:

- **The 2-year storm is likely to increase by as much as 24%**
- **The 10-year storm likely to increased as much as 27%**
- **The 100-year storm likely to increased as much as 50%**

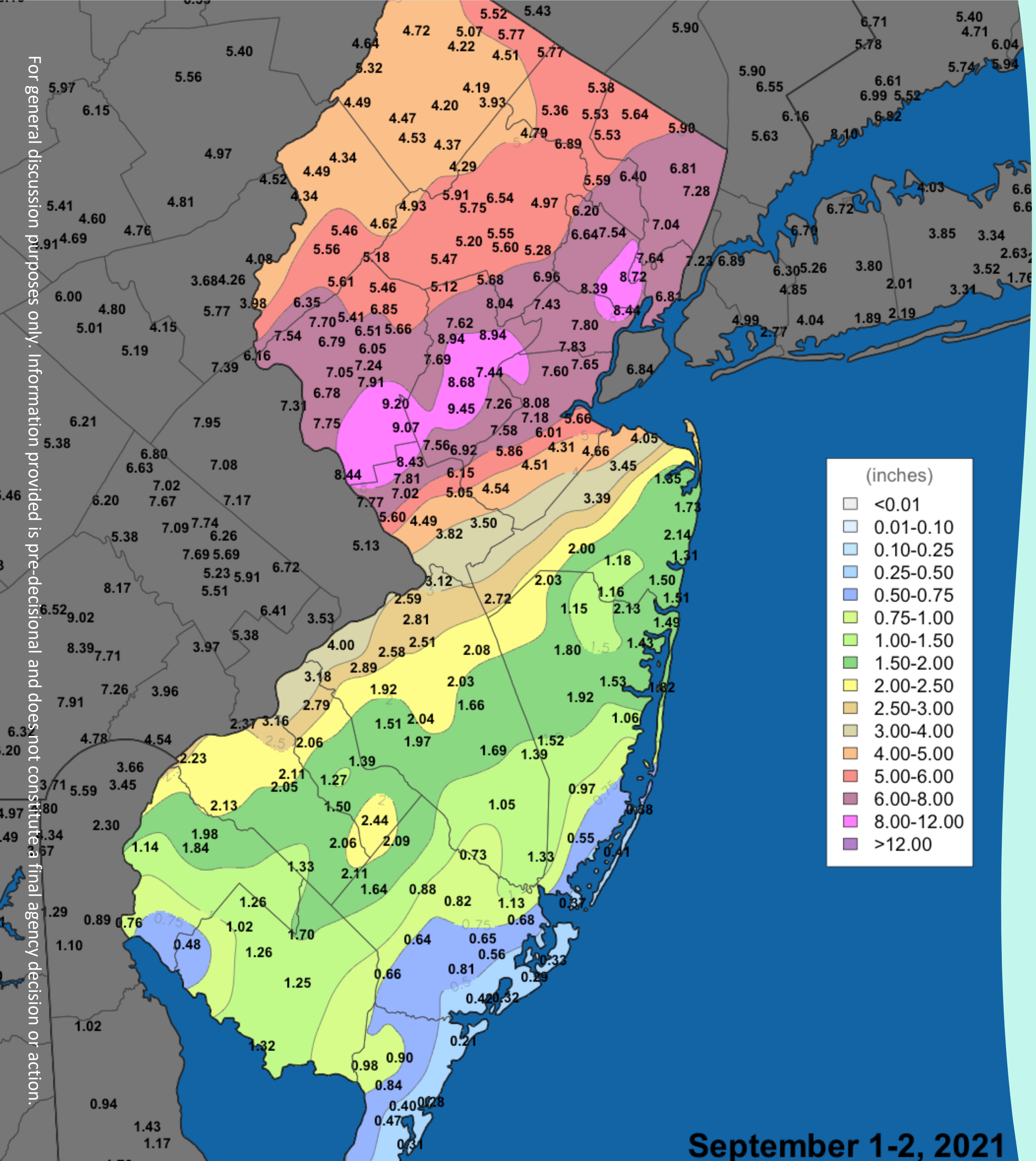
To make the data more user-friendly, DEP developed a weighted county-by-county average of adjustment factors for publication in its rules.

ADJUSTING 1999 RAINFALL TO 2019

Current Precipitation Adjustment Factors			
County	2-year Design Storm	10-year Design Storm	100-year Design Storm
Atlantic	1.01	1.02	1.03
Bergen	1.01	1.03	1.06
Burlington	0.99	1.01	1.04
Camden	1.03	1.04	1.05
Cape May	1.03	1.03	1.04
Cumberland	1.03	1.03	1.01
Essex	1.01	1.03	1.06
Gloucester	1.05	1.06	1.06
Hudson	1.03	1.05	1.09
Hunterdon	1.02	1.05	1.13
Mercer	1.01	1.02	1.04
Middlesex	1.00	1.01	1.03
Monmouth	1.00	1.01	1.02
Morris	1.01	1.03	1.06
Ocean	1.00	1.01	1.03
Passaic	1.00	1.02	1.05
Salem	1.02	1.03	1.03
Somerset	1.00	1.03	1.09
Sussex	1.03	1.04	1.07
Union	1.01	1.03	1.06
Warren	1.02	1.07	1.15

ADJUSTING 1999 RAINFALL FOR 2100 PROJECTIONS

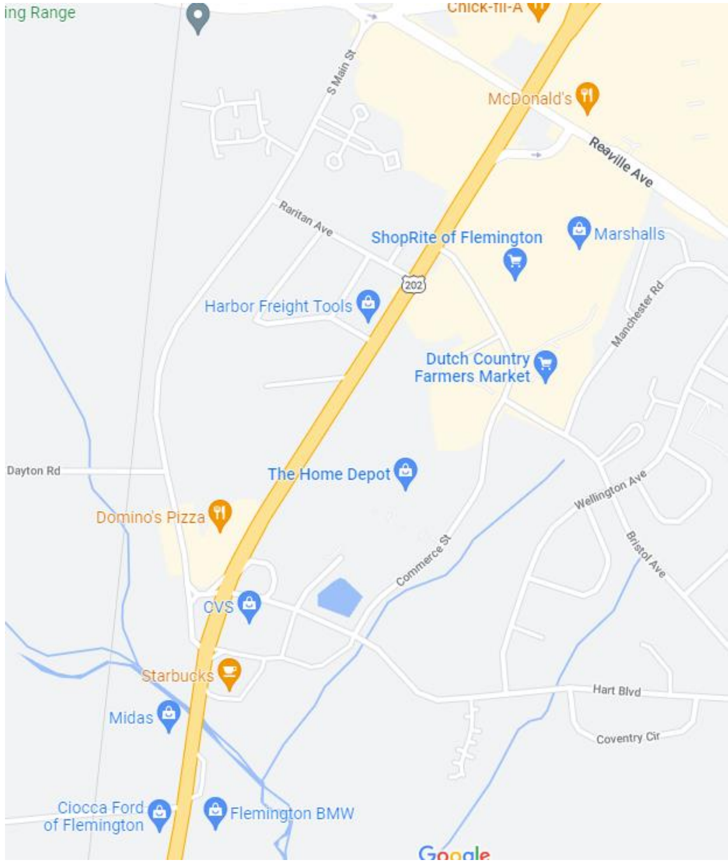
Future Precipitation Change Factors			
County	2-year Design Storm	10-year Design Storm	100-year Design Storm
Atlantic	1.22	1.24	1.39
Bergen	1.20	1.23	1.37
Burlington	1.17	1.18	1.32
Camden	1.18	1.22	1.39
Cape May	1.21	1.24	1.32
Cumberland	1.20	1.21	1.39
Essex	1.19	1.22	1.33
Gloucester	1.19	1.23	1.41
Hudson	1.19	1.19	1.23
Hunterdon	1.19	1.23	1.42
Mercer	1.16	1.17	1.36
Middlesex	1.19	1.21	1.33
Monmouth	1.19	1.19	1.26
Morris	1.23	1.28	1.46
Ocean	1.18	1.19	1.24
Passaic	1.21	1.27	1.50
Salem	1.20	1.23	1.32
Somerset	1.19	1.24	1.48
Sussex	1.24	1.29	1.50
Union	1.20	1.23	1.35
Warren	1.20	1.25	1.37



REMNANTS OF TROPICAL STORM IDA

- **Record rainfalls**
  - Newark experienced an all-time record for highest one-hour rainfall total (3.65 inches)
  - Documented 10+ inches of rainfall in parts of Hunterdon, Essex, Middlesex and Union Counties
- **Severe flash flooding due to intense precipitation**
  - Storm sewers were overwhelmed
  - Streams and rivers couldn’t convey so much water in such a short time
  - More than 12 rivers exceeded their 100-year flood levels
- **Directly resulted in the loss of thirty lives**
  - Second deadliest natural disaster event to impact New Jersey in a century

REMNANTS OF TROPICAL STORM IDA



The extreme rainfall overwhelmed existing storm sewer systems resulting in flooding along roadways far from any streams

IDA COMPARED WITH FLOOD HAZARD RULES: CASE STUDIES

The current FHACA Rules set the design flood elevation (DFE) as the higher of:

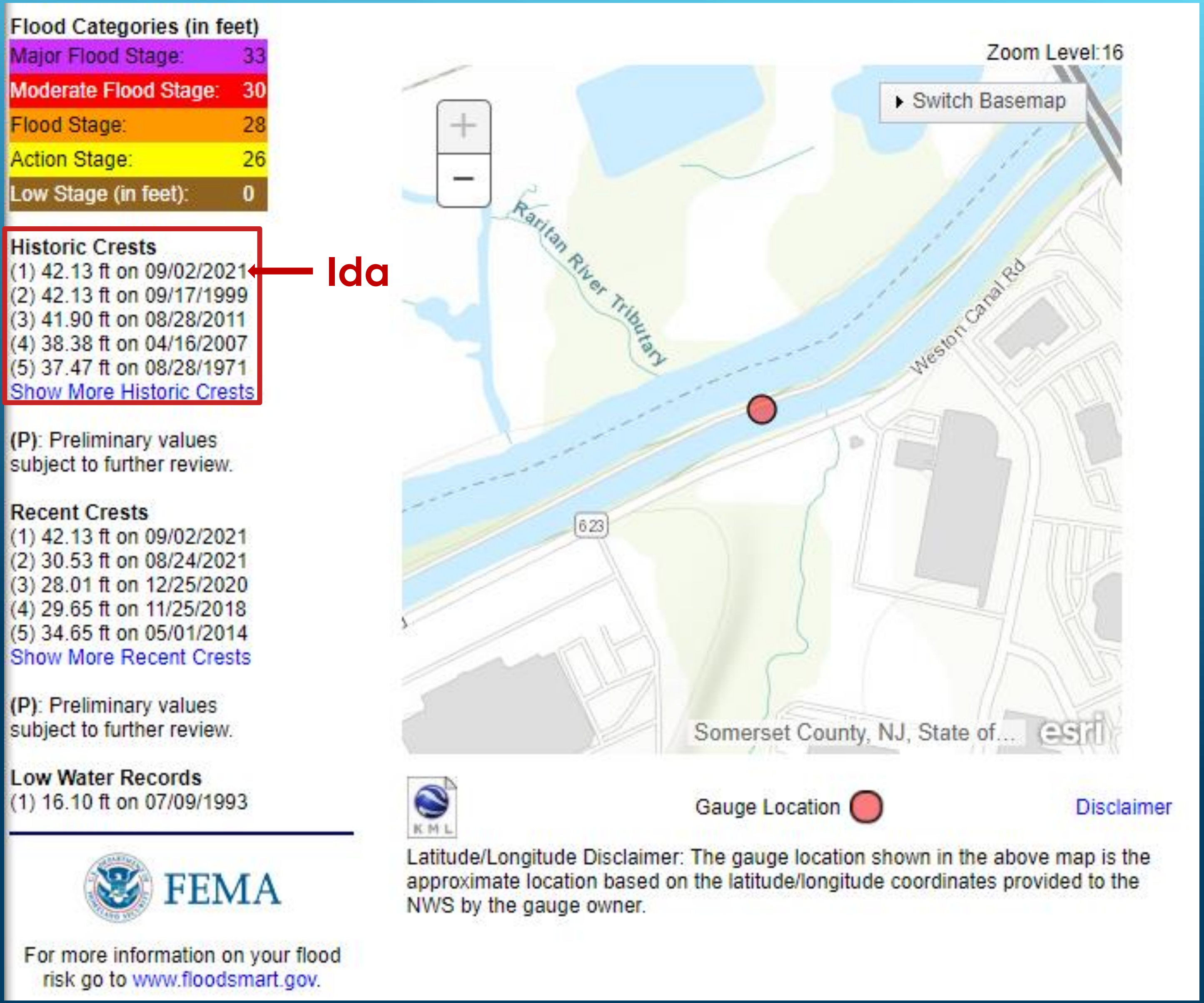
- Flood elevation mapped by NJDEP (where available)
- FEMA 100-year elevation plus 1 ft

Ida case studies show average elevations of 3.1 feet above FEMA's 100-year flood elevation.

- This is 2.1 ft higher than the current DFE

RARITAN RIVER AT BOUND BROOK

RARITAN RIVER AT BOUND BROOK



- Flooding during Ida equaled 1999's Hurricane Floyd, which was the highest elevation ever recorded at Bound Brook.
- IDA peaked at 42.13 ft NGVD (41.21 NAVD) which is:
  - 3.01 feet above FEMA 100-year elevation (38.2 ft NAVD)
  - 0.21 ft above FEMA's 500-year flood elevation (41.0 ft NAVD)
- The 500-year flood elevation at this location has been exceeded three times since 1999.

NESHANIC RIVER AT REAVILLE

NESHANIC RIVER AT REAVILLE

Flood Categories (in feet)

Flood Stage:	6.5
Action Stage:	5.5

Historic Crests
(1) 19.47 ft on 09/02/2021 ← **Ida**
(2) 15.33 ft on 09/16/1999
(3) 14.66 ft on 08/28/2011
(4) 13.84 ft on 01/28/1971
(5) 13.57 ft on 07/18/2021
Show More Historic Crests

(P): Preliminary values subject to further review.

Recent Crests
(1) 19.47 ft on 09/02/2021
(2) 11.81 ft on 08/22/2021
(3) 13.57 ft on 07/18/2021
(4) 7.24 ft on 03/25/2021
(5) 9.28 ft on 12/25/2020
Show More Recent Crests

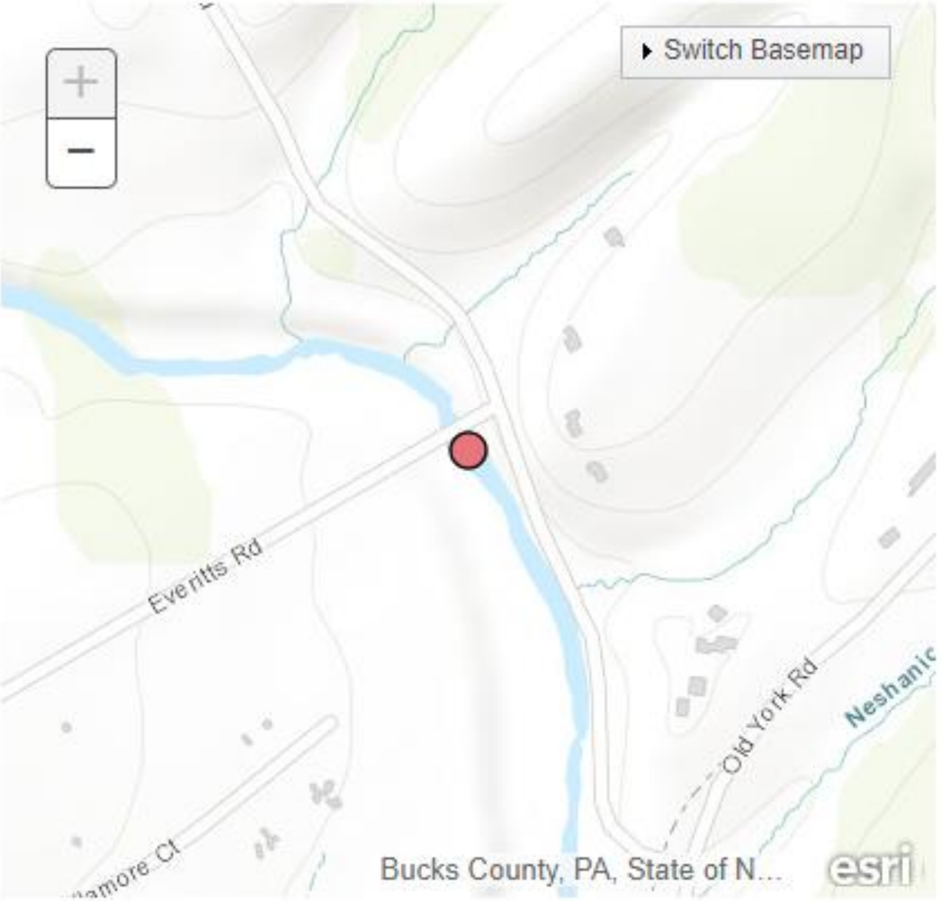
(P): Preliminary values subject to further review.

Low Water Records
Currently none available.

FEMA

For more information on your flood risk go to www.floodsmart.gov.

Zoom Level:16



Gauge Location

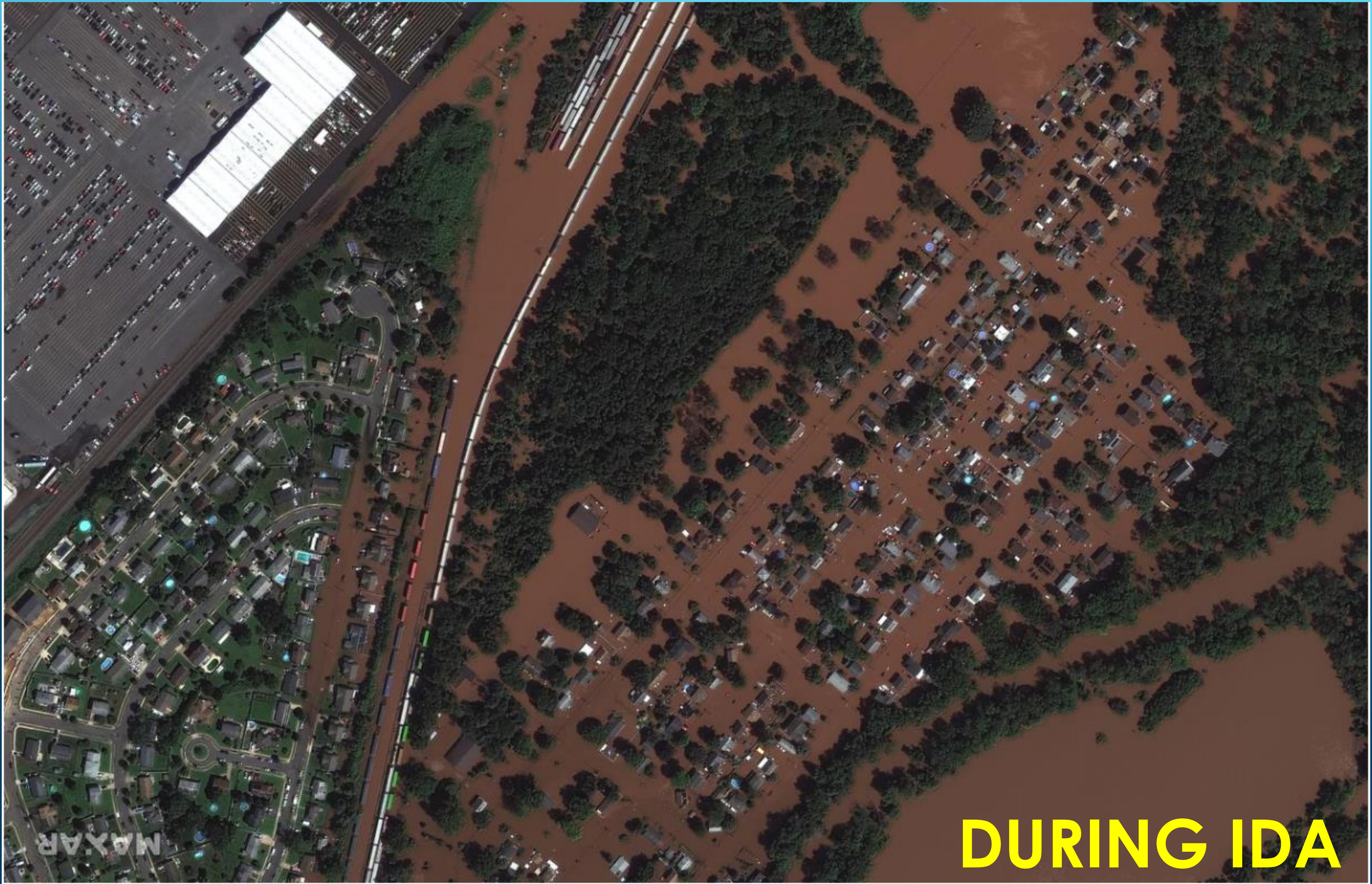
Disclaimer

Latitude/Longitude Disclaimer: The gauge location shown in the above map is the approximate location based on the latitude/longitude coordinates provided to the NWS by the gauge owner.

- Flooding during Tropical Storm Ida was more than 4.14 feet above 1999's Hurricane Floyd, which had previously been the highest elevation ever recorded at this location.

MILLSTONE RIVER AT MANVILLE

MILLSTONE RIVER AT MANVILLE



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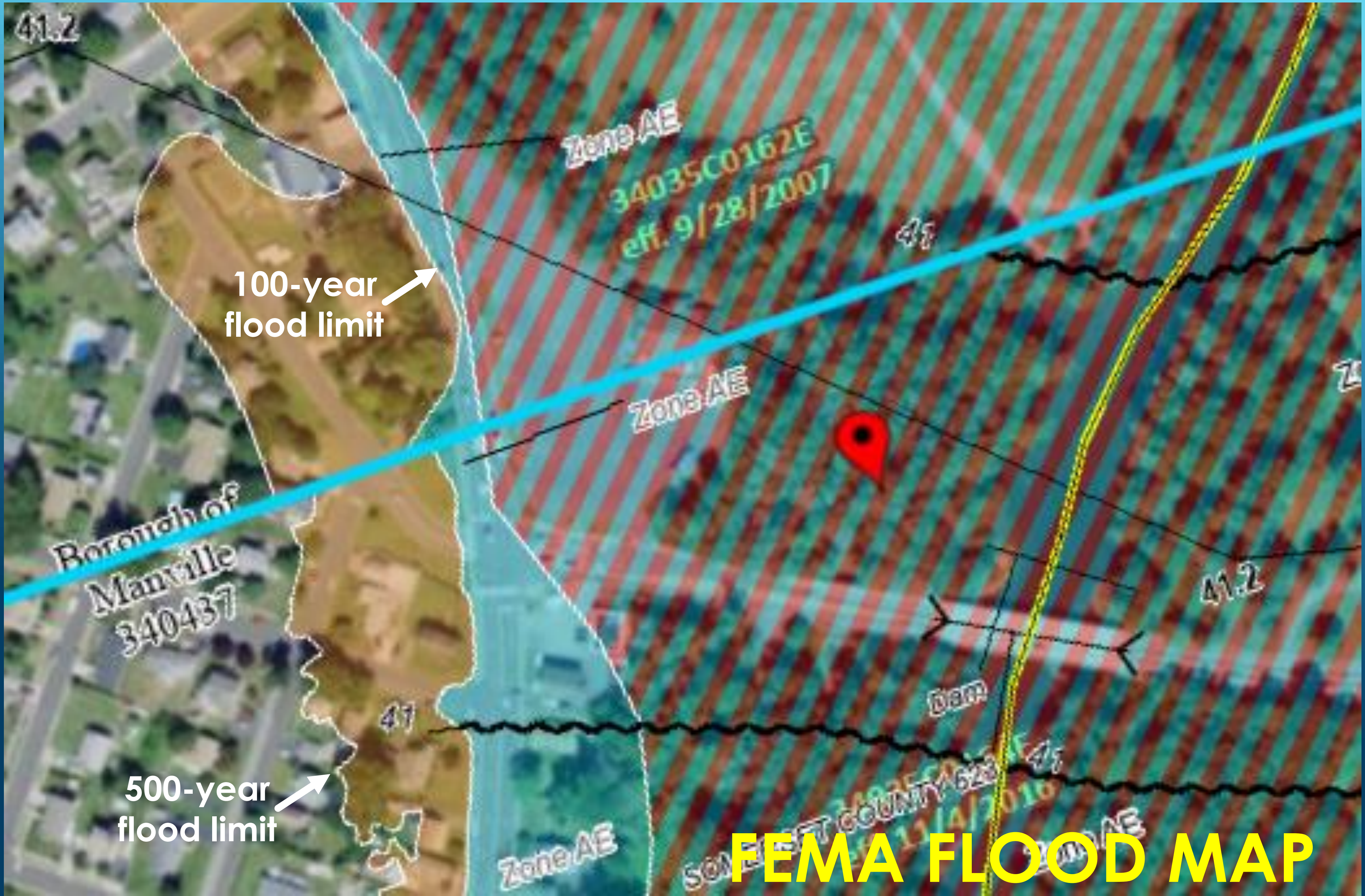
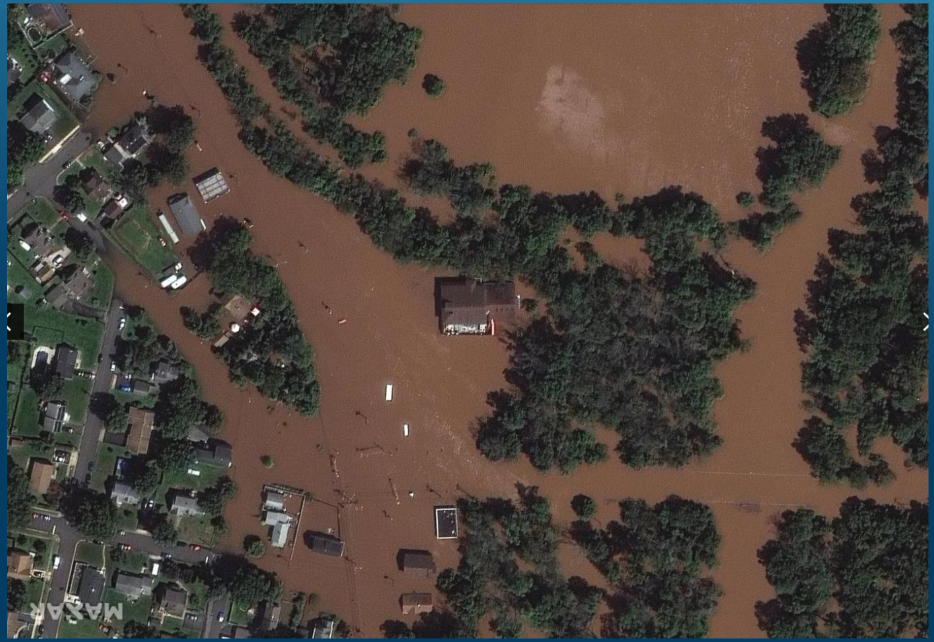


MILLSTONE RIVER AT MANVILLE

- Flooding peaked at roughly one foot above FEMA's 500-year flood elevation (43.5 ft NAVD) which is 2.5 ft above FEMA's 100-year flood elevation (41.0 ft NAVD).

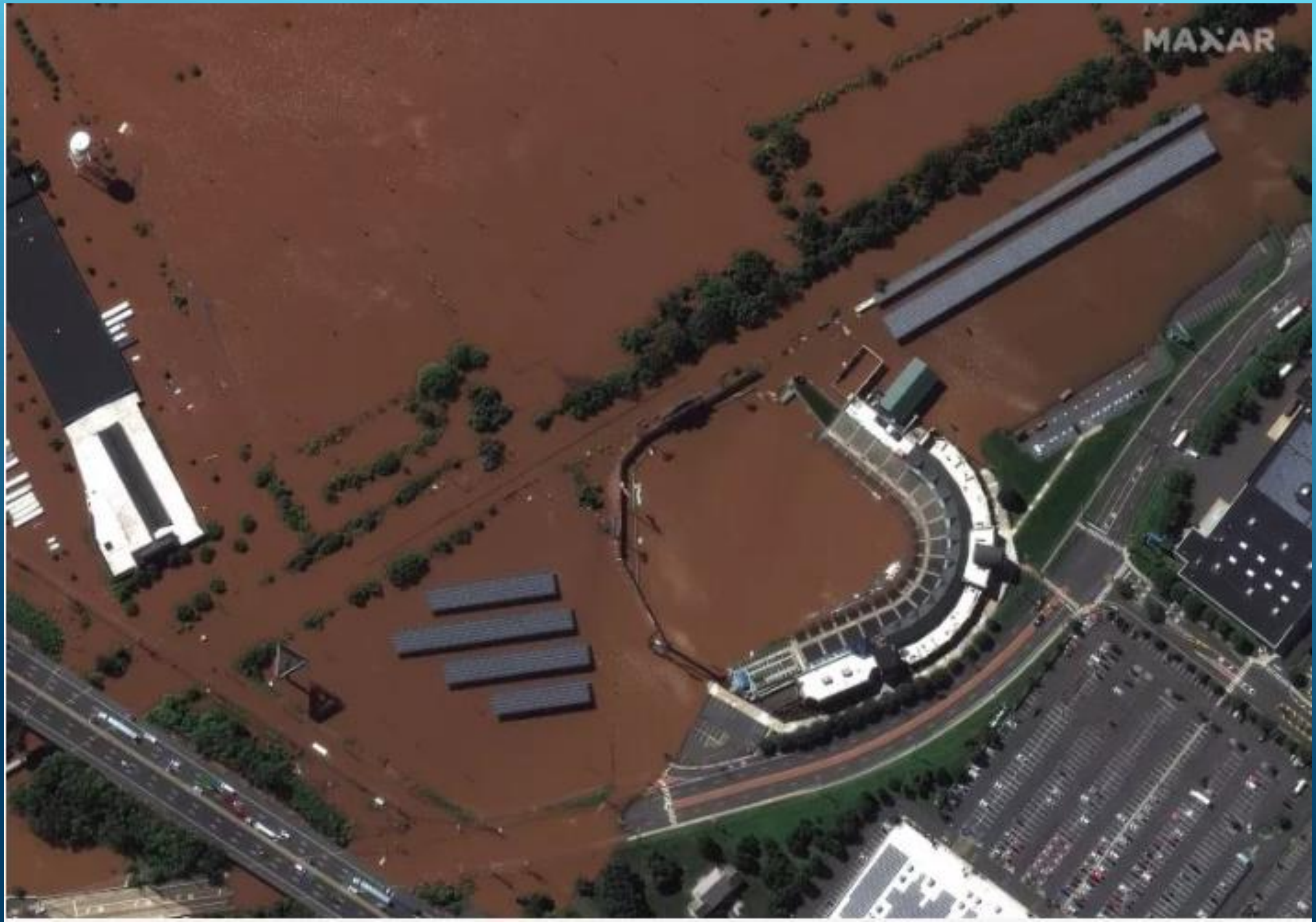
- Flooding in Manville therefore peaked at approximately 3.5 feet above FEMA's 100-year flood elevation.



RARITAN RIVER AT BRIDGEWATER

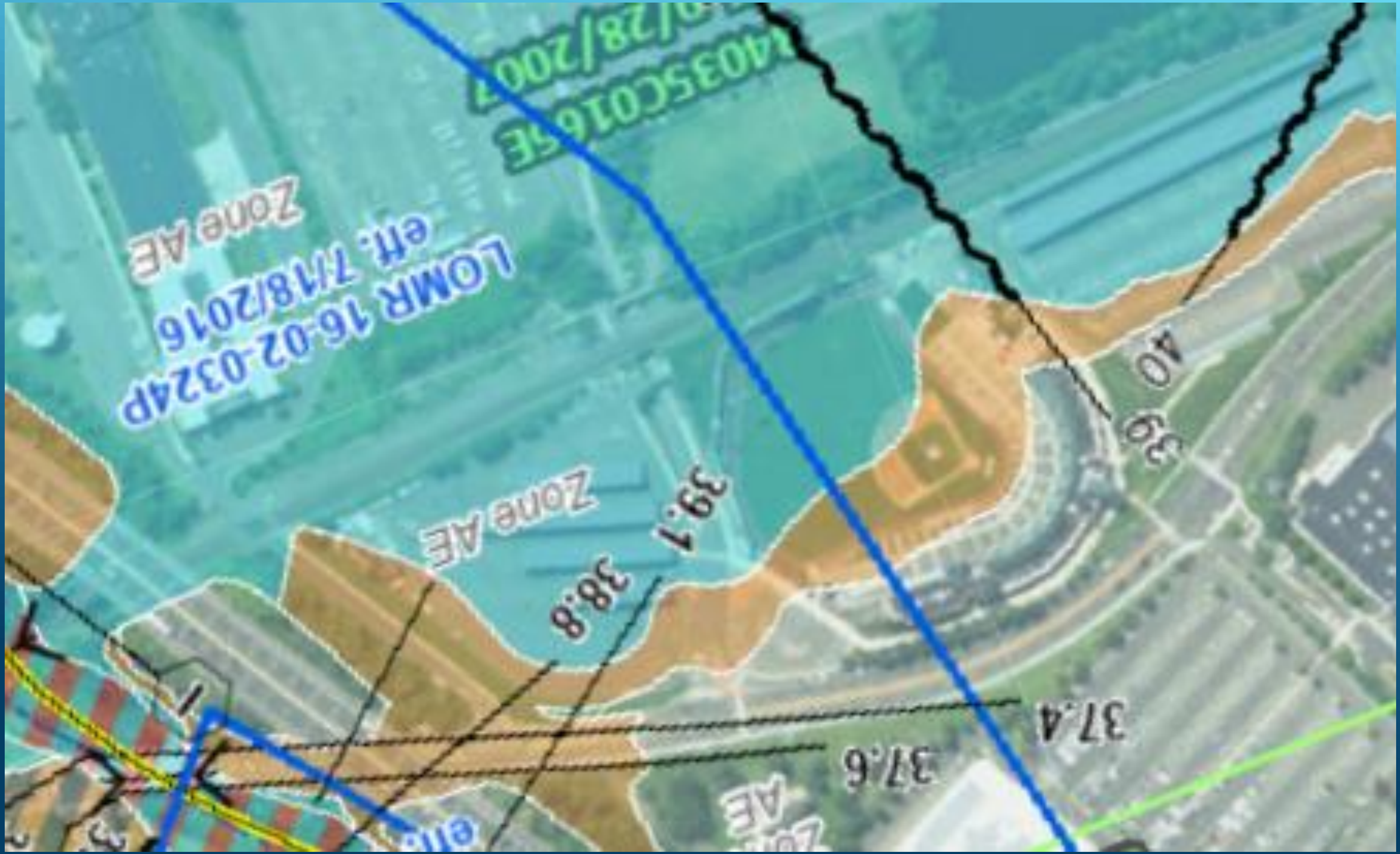
BEFORE IDA

RARITAN RIVER AT BRIDGEWATER



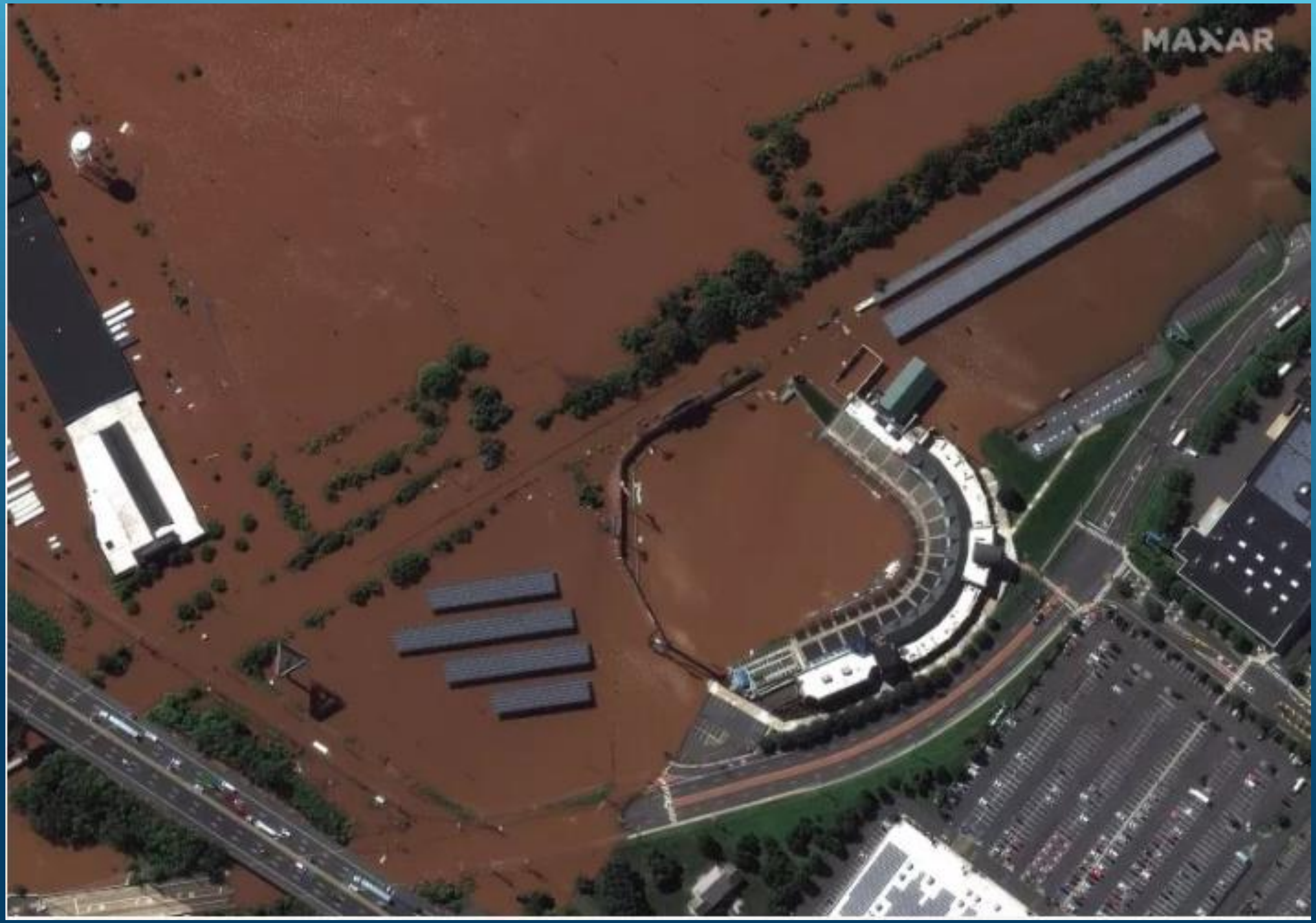
DURING IDA

RARITAN RIVER AT BRIDGEWATER



FEMA FLOOD MAP

RARITAN RIVER AT BRIDGEWATER



- Flooding peaked roughly at FEMA's 500-year flood elevation (41.0 ft NAVD) which is 2.8 ft above FEMA's 100-year flood elevation (38.2 ft NAVD).

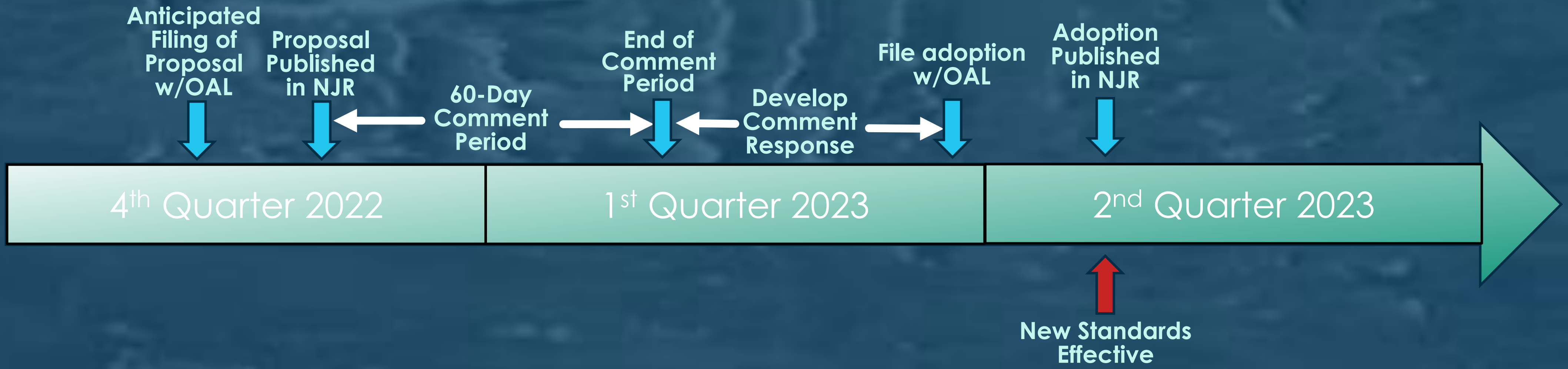
PROPOSED INLAND FLOOD PROTECTION RULEMAKING

SCOPE

Addresses three issues related to increased precipitation due to climate change:

1. "Current" rainfall data used by our rules was computed only through 1999
2. Rules do not account for future increases in precipitation due to climate change
3. Designs based on current flood mapping are not protective for future conditions:
   - Mapping reflects prior flooding patterns
   - Does not reflect changes due to climate change

PROPOSED INLAND FLOOD PROTECTION RULEMAKING



PROPOSED INLAND FLOOD PROTECTION RULEMAKING

KEY POINTS

1. Raises fluvial (non-tidal) design flood elevations by two feet
2. Requires use of future projected precipitation when calculating design flood elevation
3. Ensures that permits and authorizations under the FHACA rules meet minimum NFIP standards and relevant sections of the UCC
4. Requires stormwater BMPs to be designed to manage runoff for both today’s storms and future storms
5. Removes use of Rational and Modified Rational methods for stormwater calculations

PROPOSED INLAND FLOOD PROTECTION RULEMAKING

PURPOSE

- To ensure that new investments are suited to:
  - Manage today's rainfall, runoff and flooding
  - The likely future conditions over the life of an asset
- Supports the wise deployment of Ida recovery and water infrastructure investments
- Informs new development and reconstruction; does not apply to existing development

APPLICATION OF NEW FLOOD HAZARD AREA STANDARDS

To help protect communities from future flood damage, the DFE along streams and rivers will be raised by 2 feet above current standard:

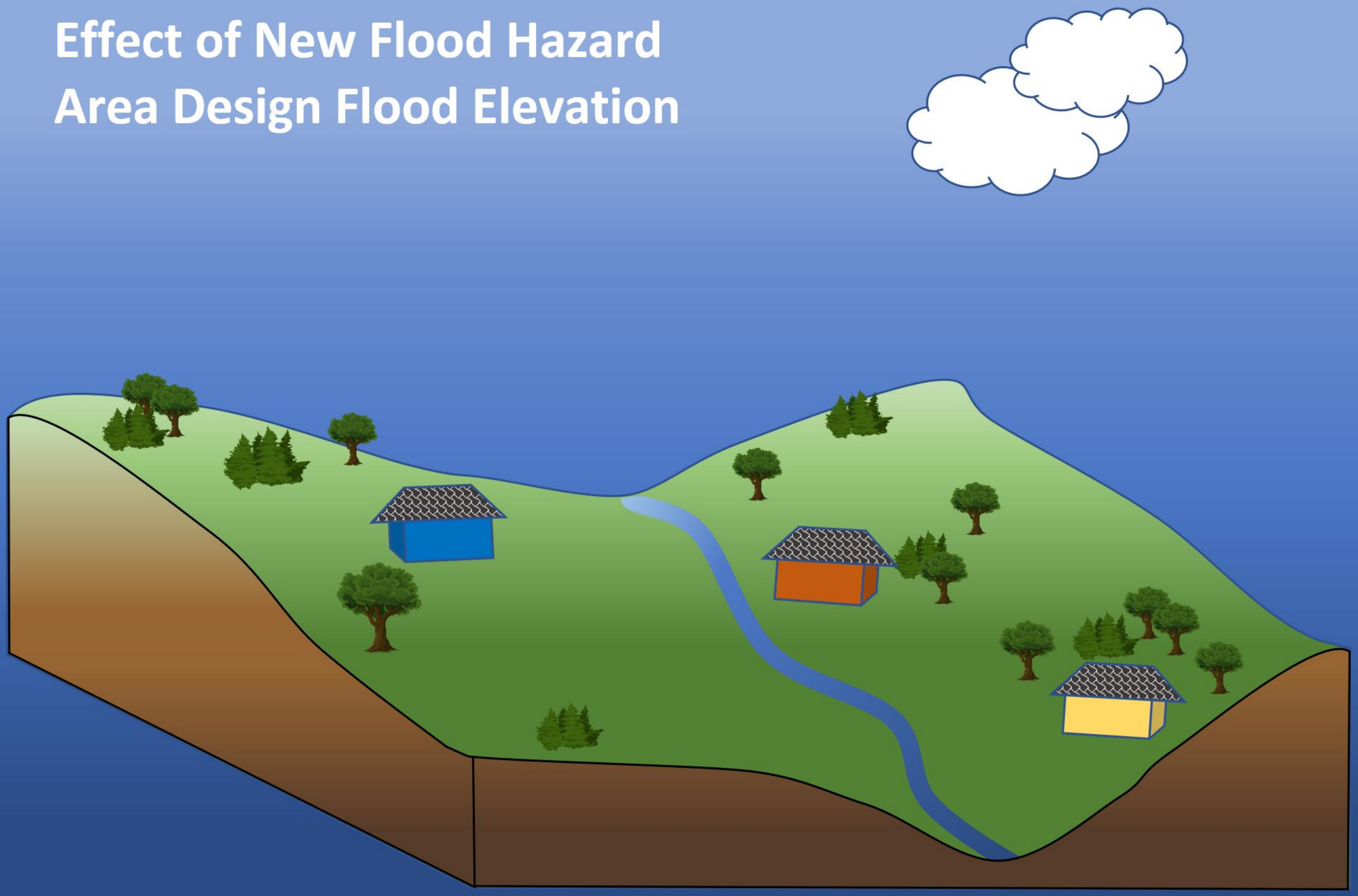
When using maps, new DFE is the higher of:

- Flood elevation mapped by NJDEP (where available) plus 2 feet
- FEMA 100-year elevation plus 3 feet

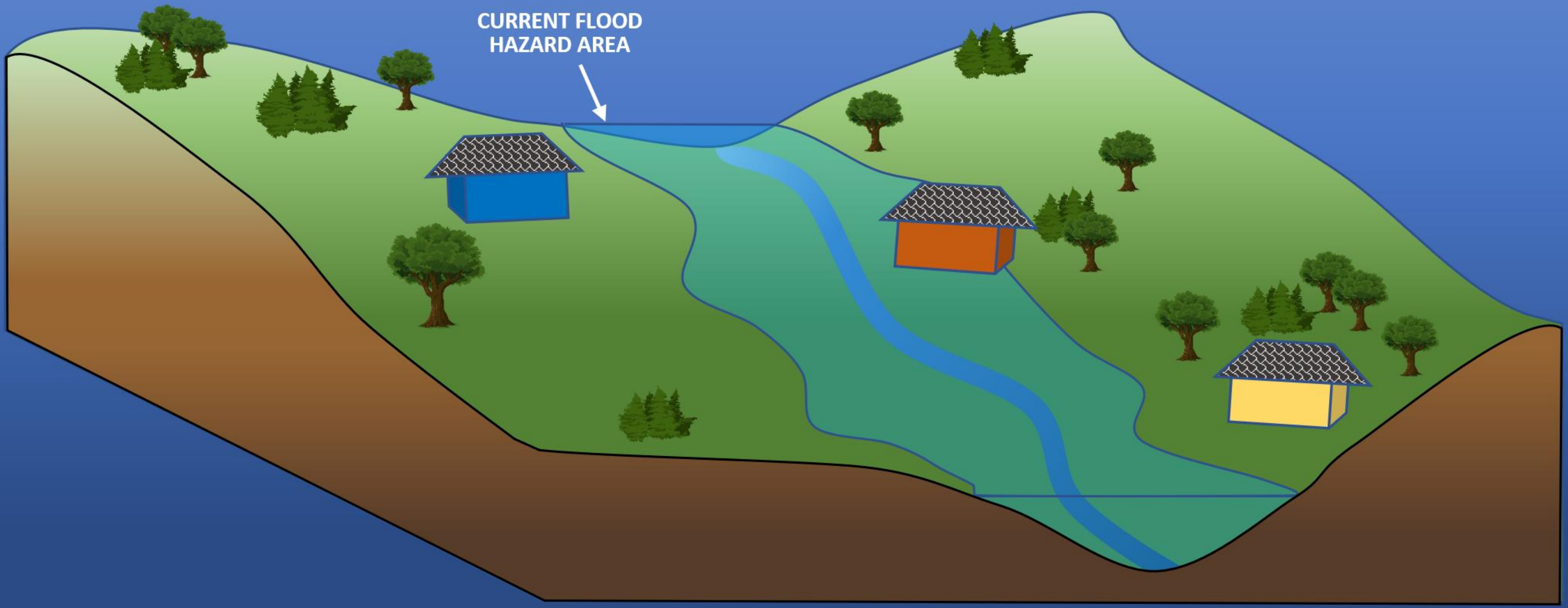
When calculating flow rates to determine DFE:

- Compute flow rates based on future anticipated 100-year precipitation
- Model design flood based on 125% of the computed flow rates

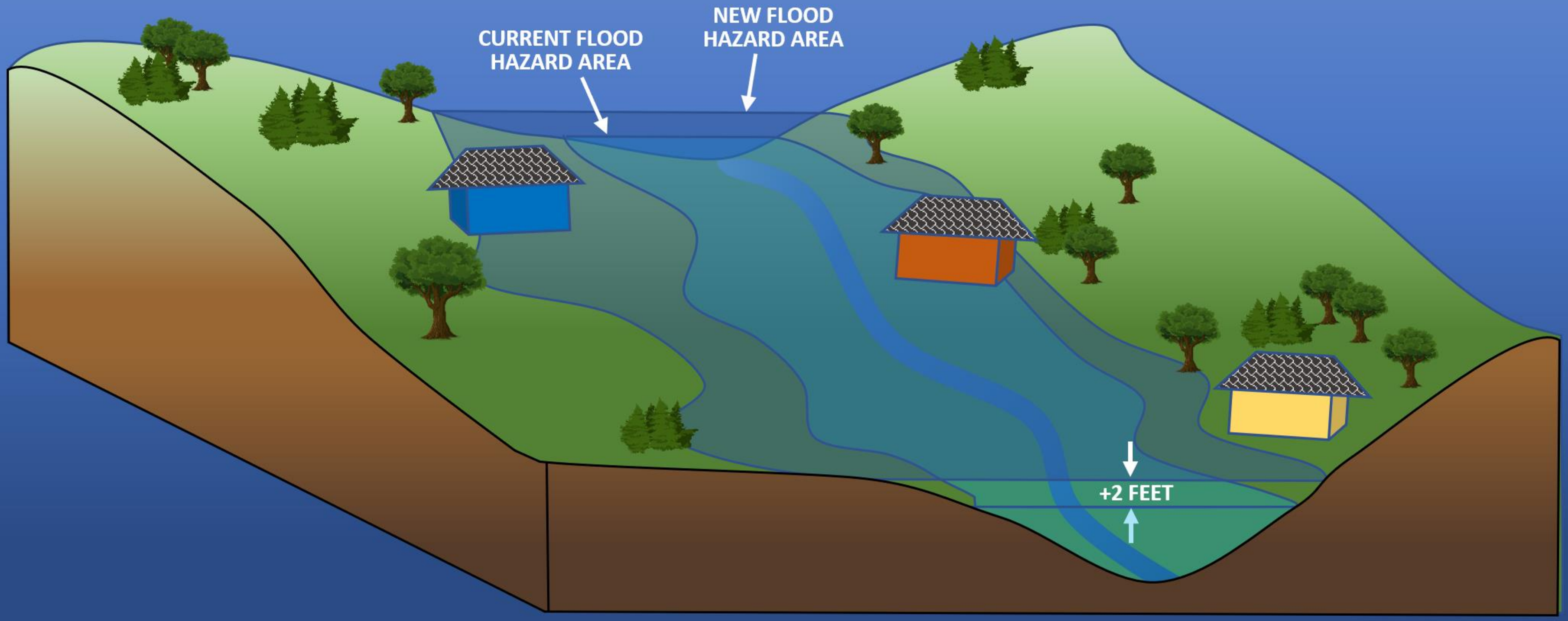
Effect of New Flood Hazard Area Design Flood Elevation



Effect of New Flood Hazard Area Design Flood Elevation



Effect of New Flood Hazard Area Design Flood Elevation



APPLICATION OF NEW FLOOD HAZARD AREA STANDARDS

All regulated activities are subject to the new standards upon adoption unless:

1. The regulated activity is part of a project that has a valid FHA permit

   OR

2. The regulated activity is part of a project that needs an FHA permit and a complete application for such was submitted to NJDEP prior to adoption

   OR

3. The regulated activity is part of a project that did not need an FHA permit prior to rulemaking where:
   - The project received all necessary Federal, State and local approvals prior to rulemaking and
   - Construction commenced prior to rulemaking

APPLICATION OF NEW STORMWATER MANAGEMENT STANDARDS

All Major Developments are subject to the new standards upon adoption unless:

- The project needs an FHA, CZM, FWW or Highlands approval and a complete application for such was submitted to NJDEP prior to adoption

OR

- The project does not need NJDEP approval and has received certain local approvals pursuant to the MLUL prior to adoption

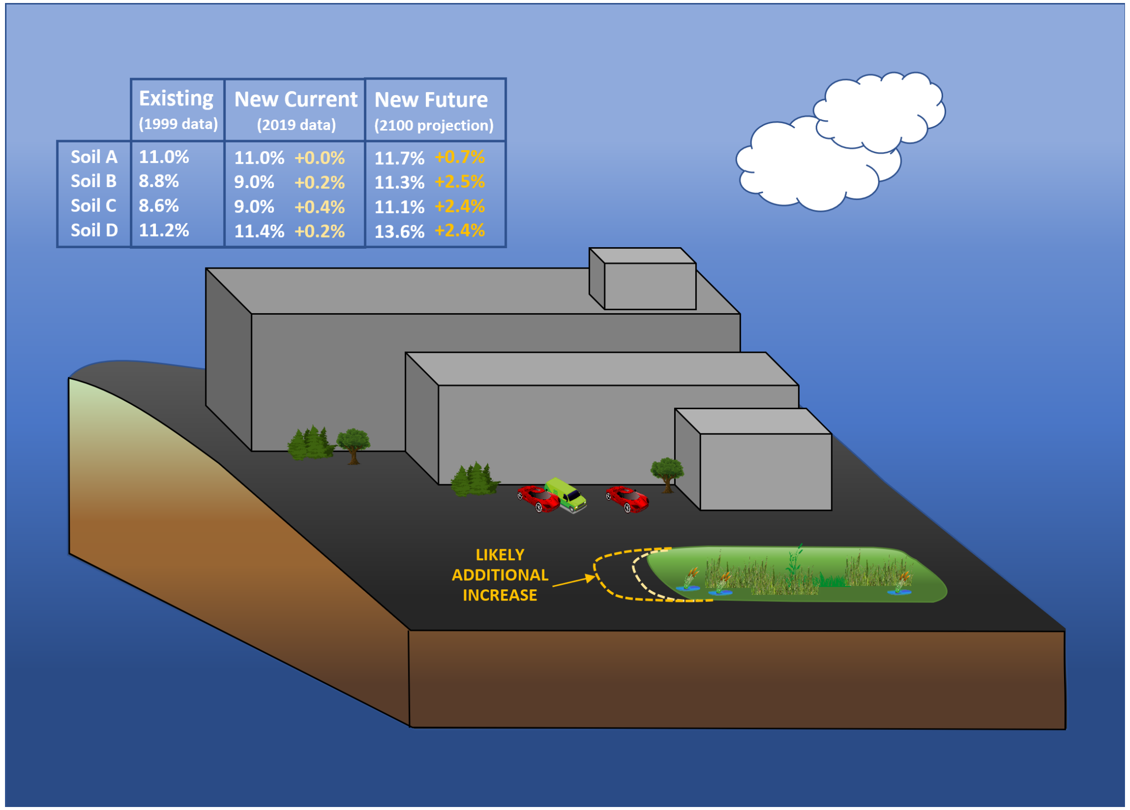
Municipalities must amend their municipal stormwater ordinance within one year of adoption

- Projects covered by RSIS must meet new standards immediately (unless covered above)

IMPACT OF PROPOSED RULE ON STORMWATER MANAGEMENT

- Accounting for existing increased rainfall and preparing for likely further increases results in nominal additional effort or cost during development
- Greater runoff and flood control can be achieved, for example, with a small increase in the amount of property required for stormwater controls
- Regulation would be deployed consistent with Governor EO 100 approach of utilizing flexible standards commensurate with risk recognizing that no one-size fits all

	Existing (1999 data)	New Current (2019 data)	New Future (2100 projection)
Soil A	11.0%	11.0% +0.0%	11.7% +0.7%
Soil B	8.8%	9.0% +0.2%	11.3% +2.5%
Soil C	8.6%	9.0% +0.4%	11.1% +2.4%
Soil D	11.2%	11.4% +0.2%	13.6% +2.4%

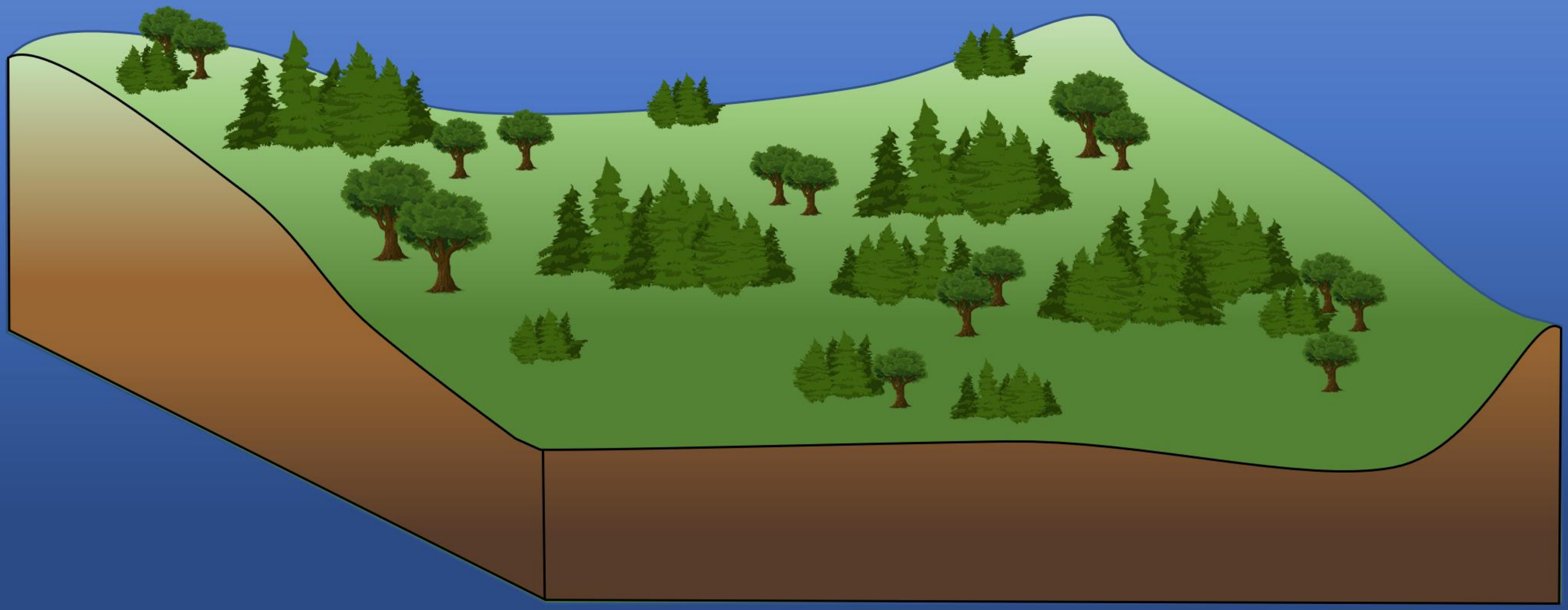


EXAMPLE:

2.5 Acre Site

Existing Conditions: Forested and Undeveloped

Sussex County

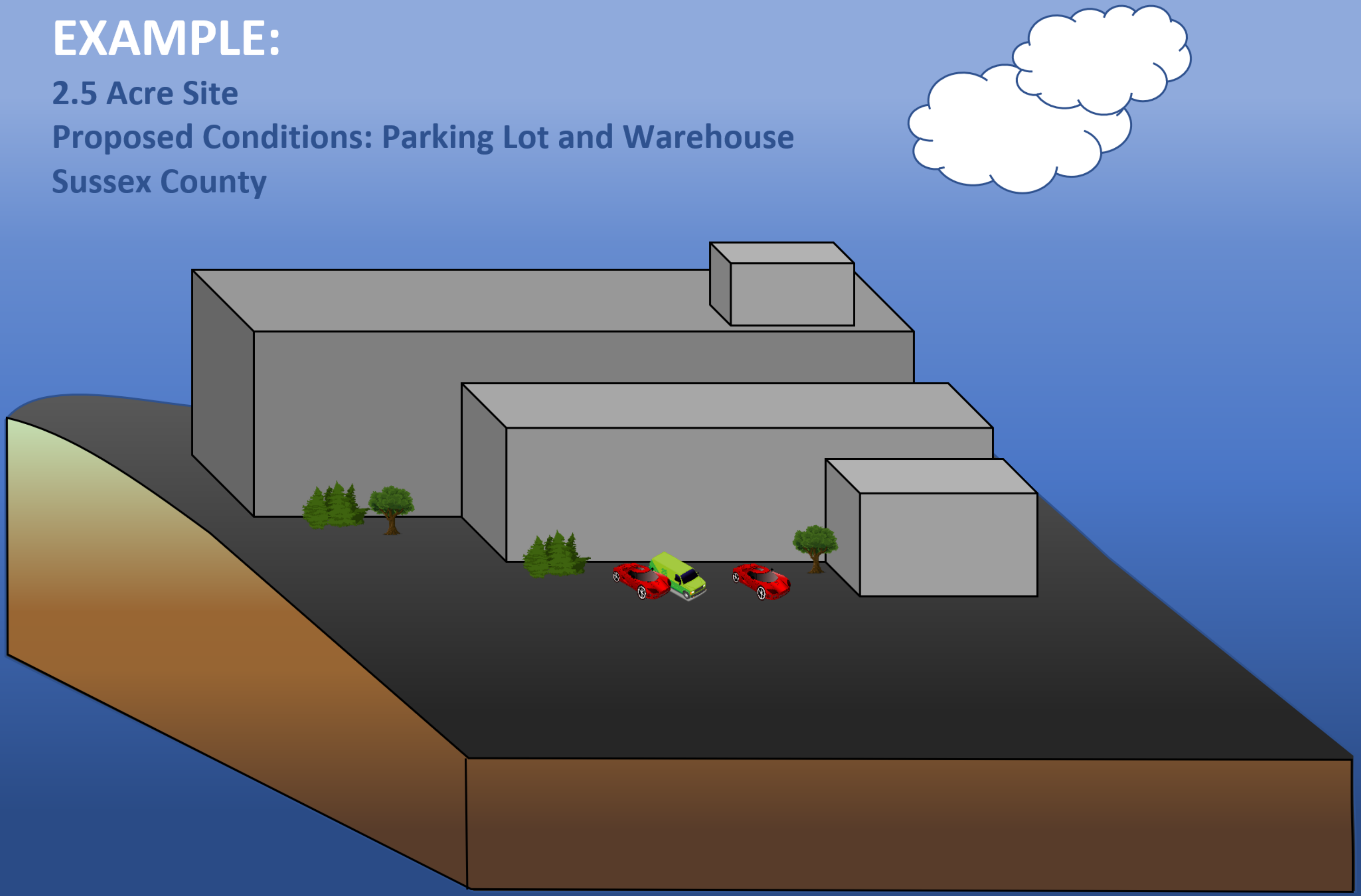


EXAMPLE:

2.5 Acre Site

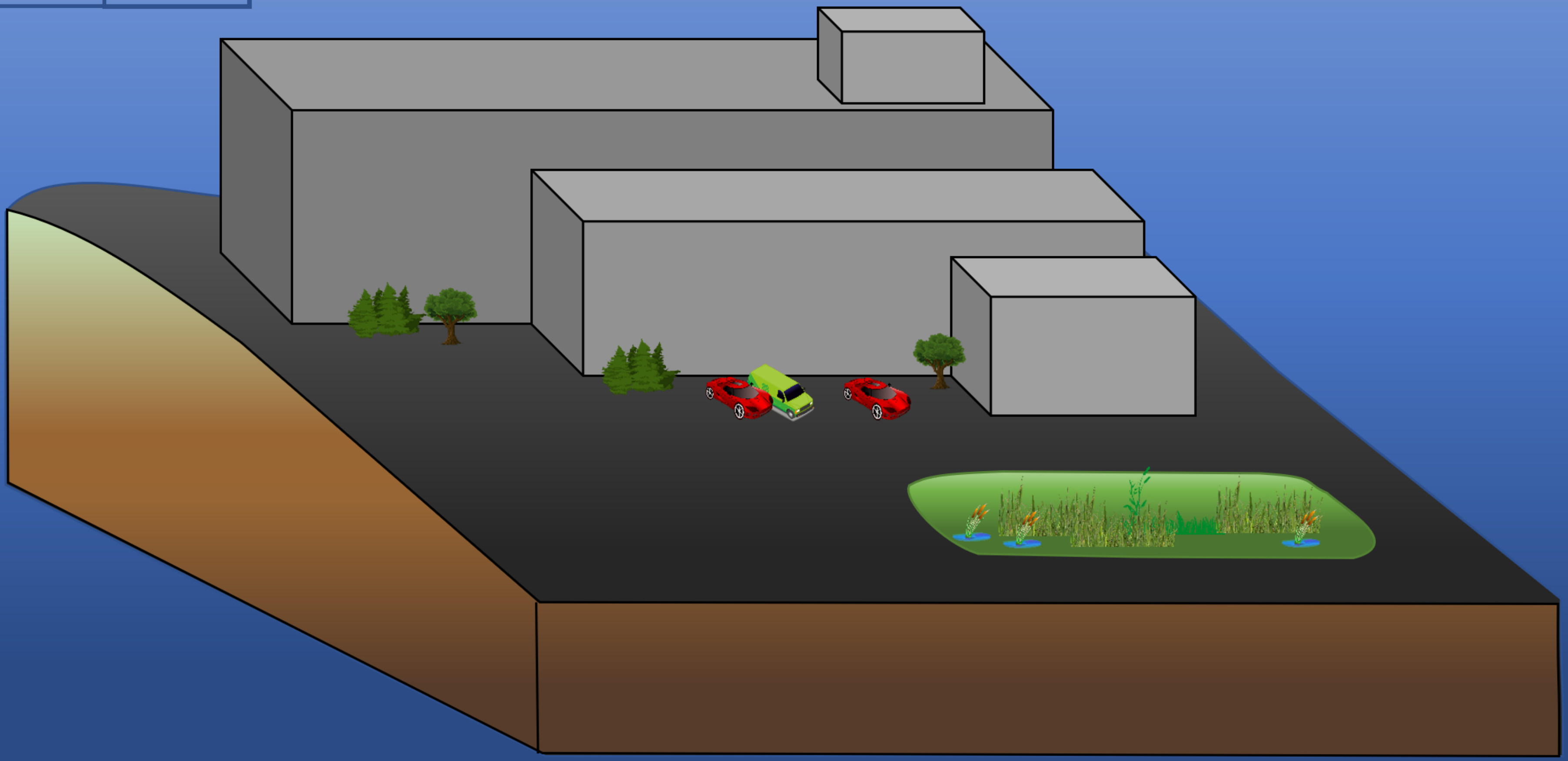
Proposed Conditions: Parking Lot and Warehouse

Sussex County



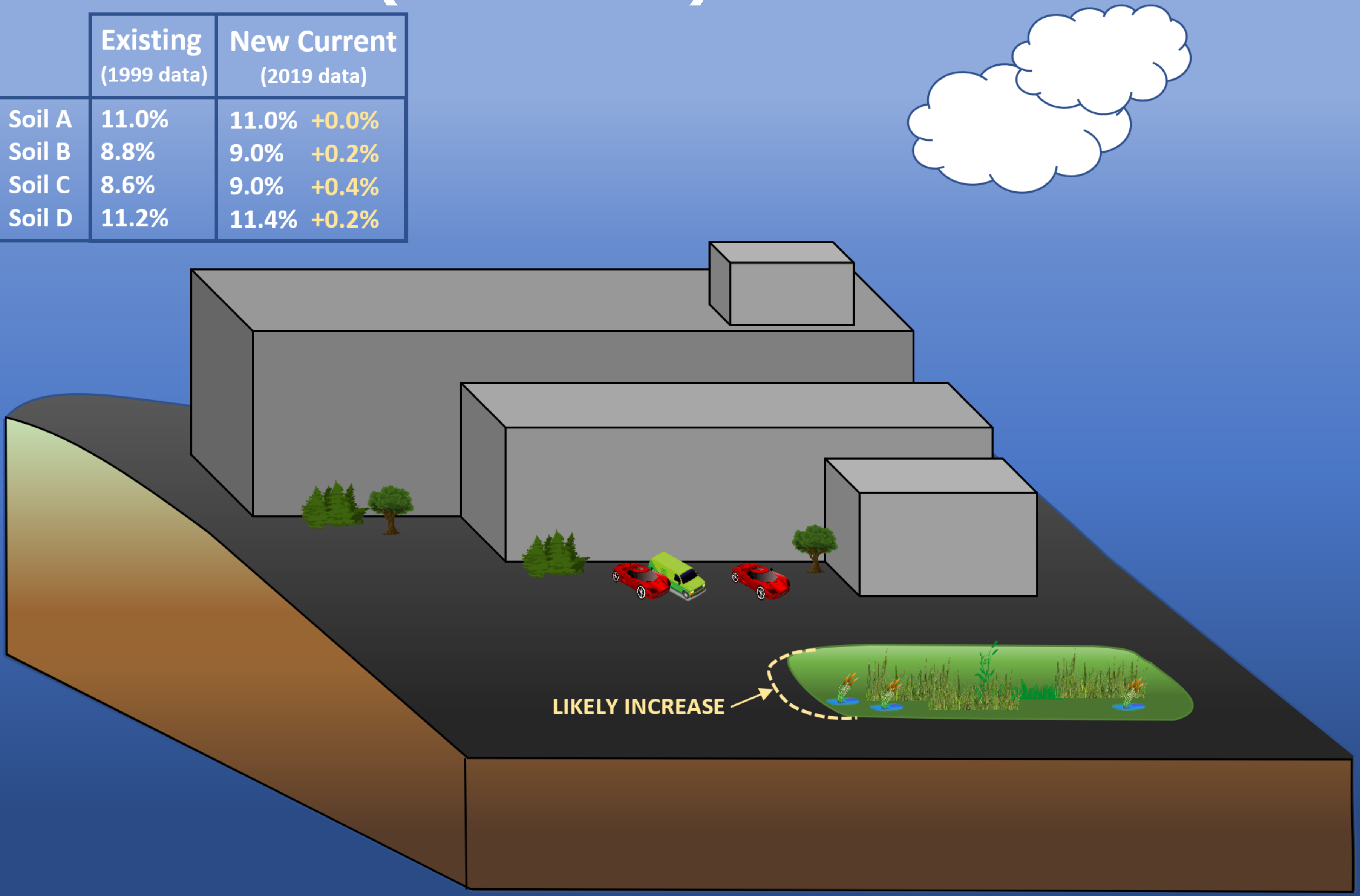
SIZE OF BMP (% OF SITE)

	Existing (1999 data)
Soil A	11.0%
Soil B	8.8%
Soil C	8.6%
Soil D	11.2%



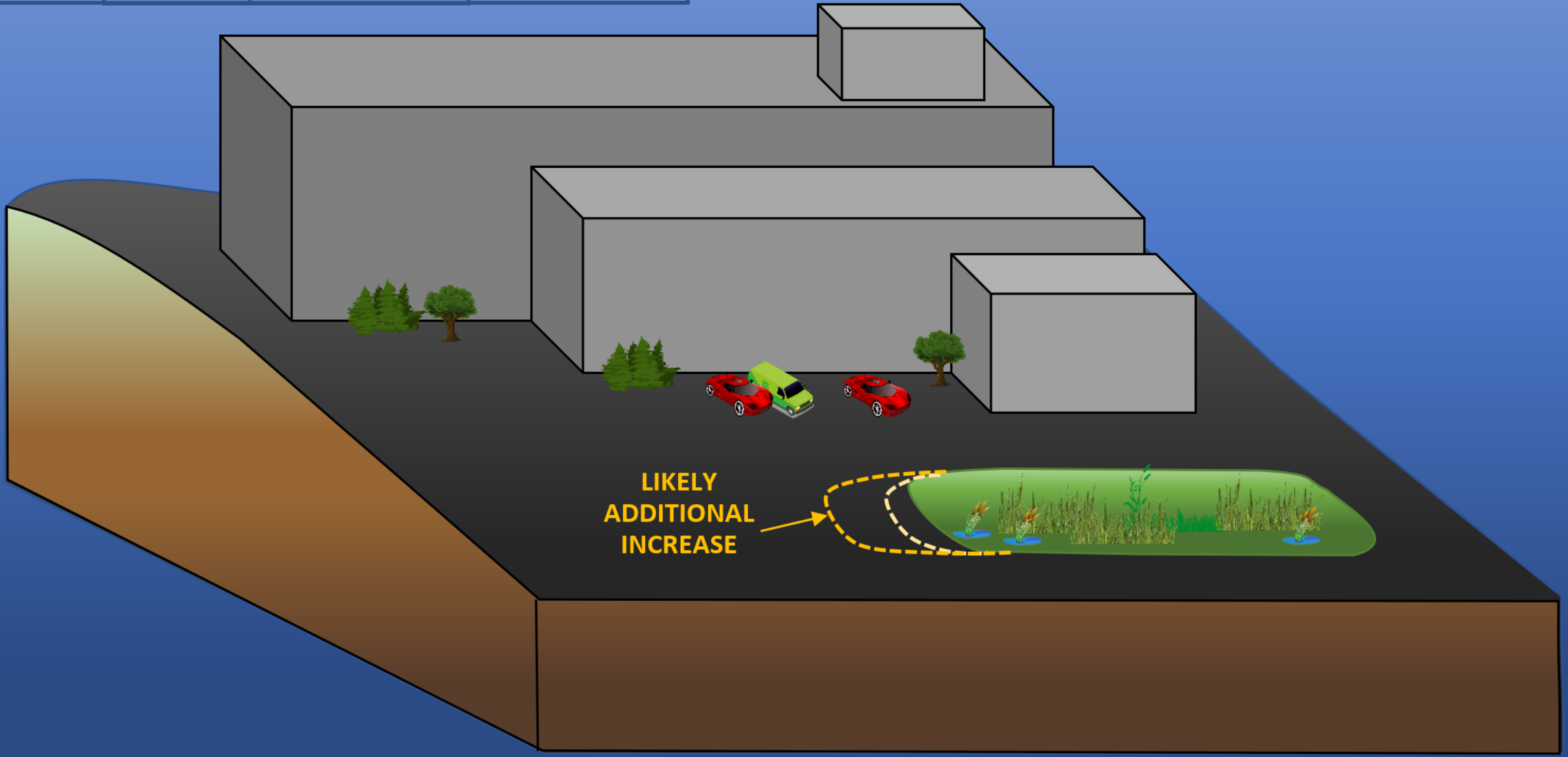
SIZE OF BMP (% OF SITE)

	Existing (1999 data)	New Current (2019 data)	
Soil A	11.0%	11.0%	+0.0%
Soil B	8.8%	9.0%	+0.2%
Soil C	8.6%	9.0%	+0.4%
Soil D	11.2%	11.4%	+0.2%



SIZE OF BMP (% OF SITE)

	Existing (1999 data)	New Current (2019 data)	New Future (2100 projection)
Soil A	11.0%	11.0% +0.0%	11.7% +0.7%
Soil B	8.8%	9.0% +0.2%	11.3% +2.5%
Soil C	8.6%	9.0% +0.4%	11.1% +2.4%
Soil D	11.2%	11.4% +0.2%	13.6% +2.4%

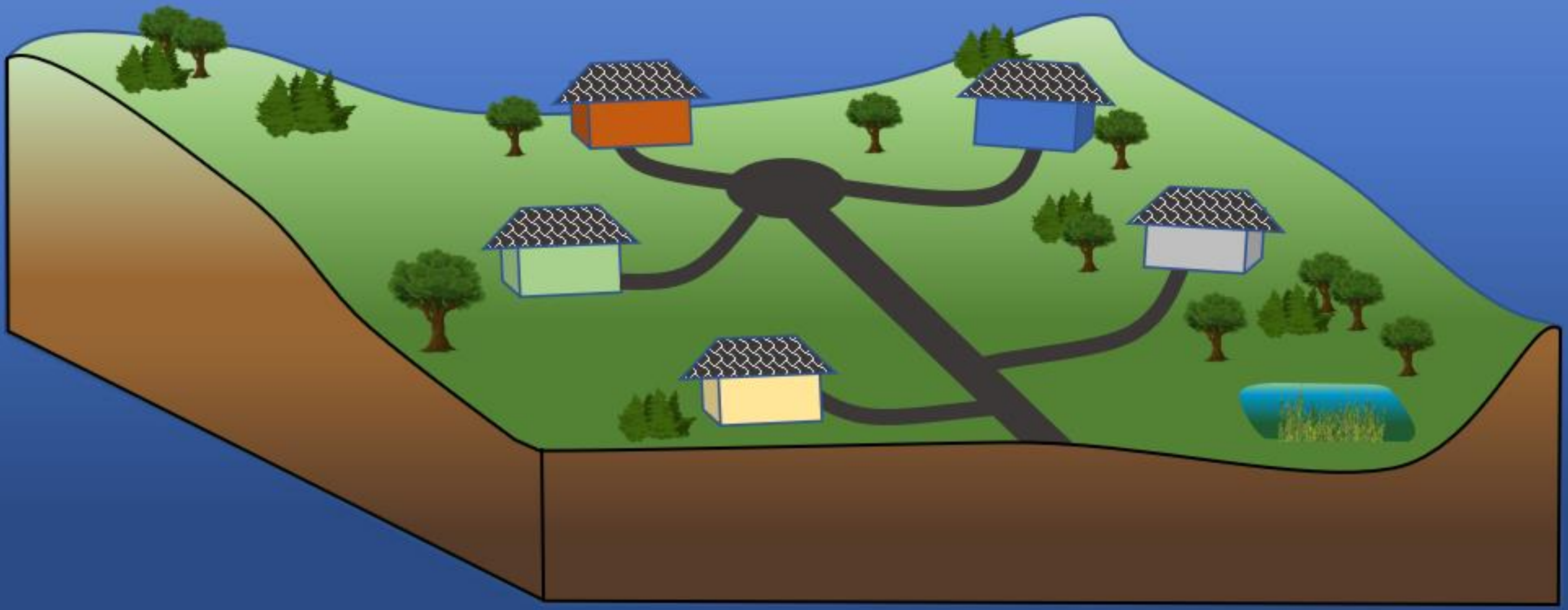


EXAMPLE:

2.5 Acre Site

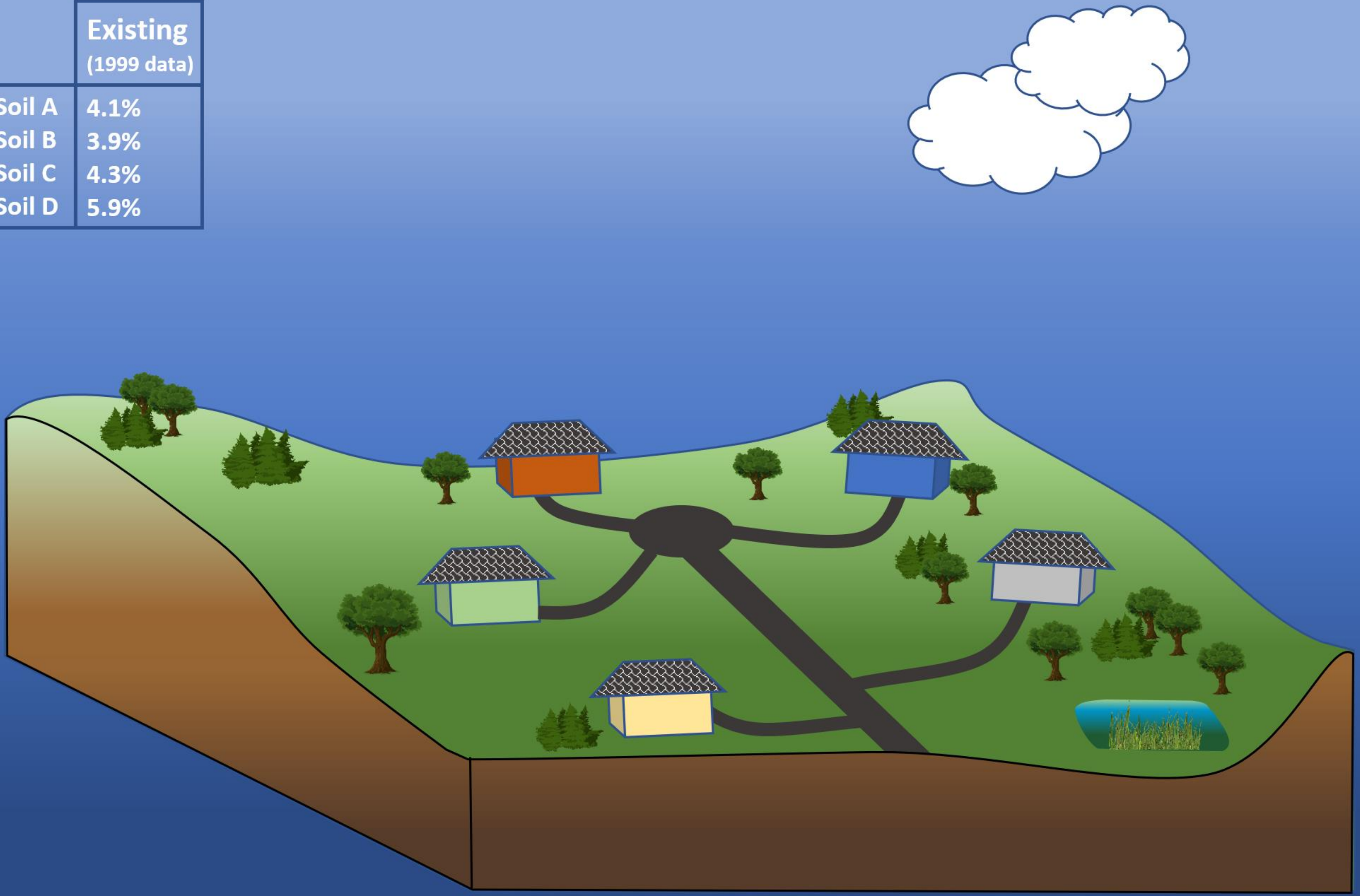
Proposed Conditions: Residential Subdivision (½ acre zoning)

Sussex County



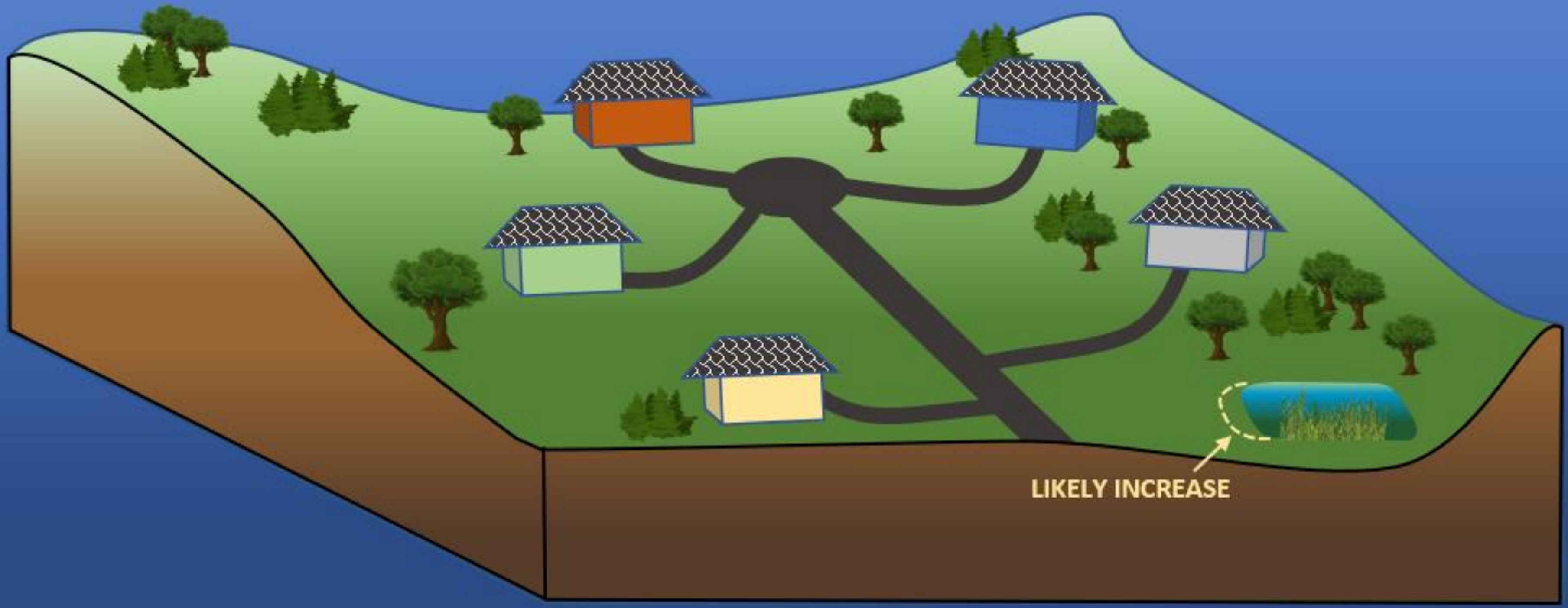
SIZE OF BMP (% OF SITE)

	Existing (1999 data)
Soil A	4.1%
Soil B	3.9%
Soil C	4.3%
Soil D	5.9%



SIZE OF BMP (% OF SITE)

	Existing (1999 data)	New Current (2019 data)	
Soil A	4.1%	4.1%	+0.0%
Soil B	3.9%	4.1%	+0.2%
Soil C	4.3%	4.5%	+0.2%
Soil D	5.9%	6.1%	+0.3%



SIZE OF BMP (% OF SITE)

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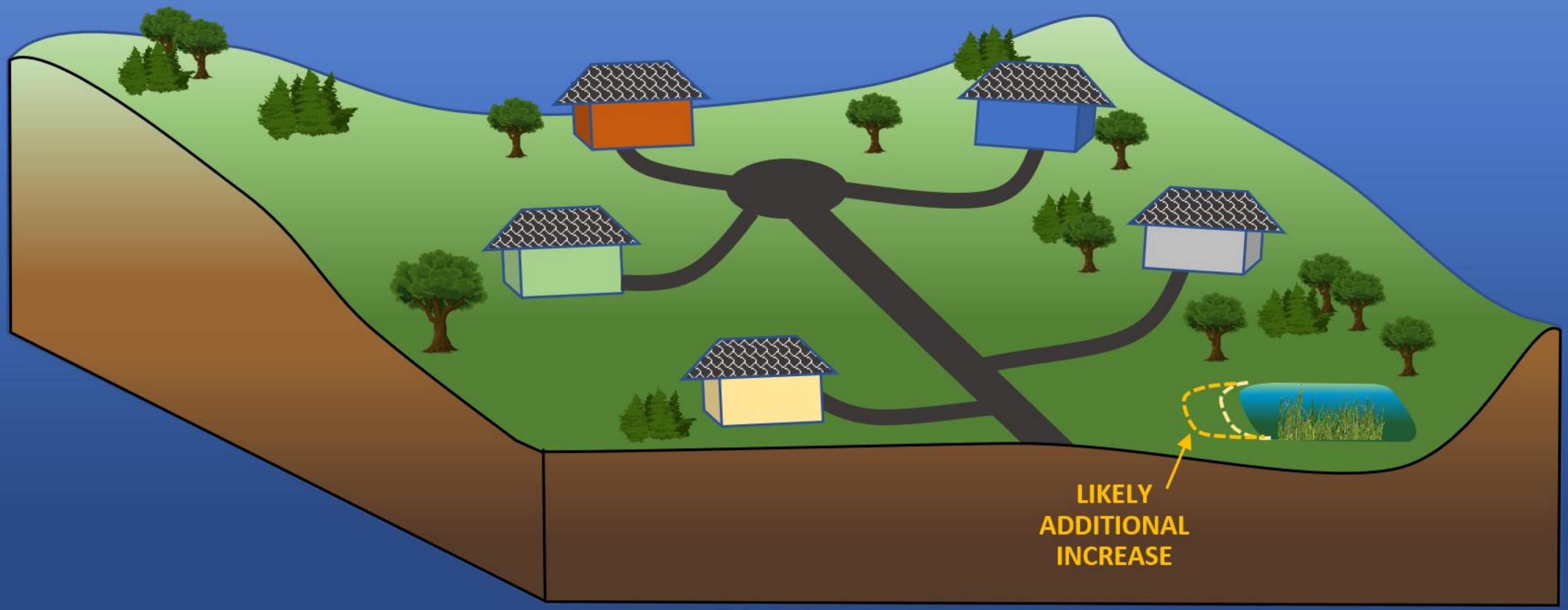
Soil B	3.9%	4.1%	+0.2%	5.5%	+1.6%
Soil C	4.3%	4.5%	+0.2%	5.8%	+1.6%
Soil D	5.9%	6.1%	+0.3%	7.9%	+2.1%



Questions or Comments?

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