

Climate Change Adaptation and the MTA

FTA Climate Change
Adaptation Webinar

August 8, 2011

Projjal K. Dutta, AIA, LEED AP
Director, Sustainability Initiatives

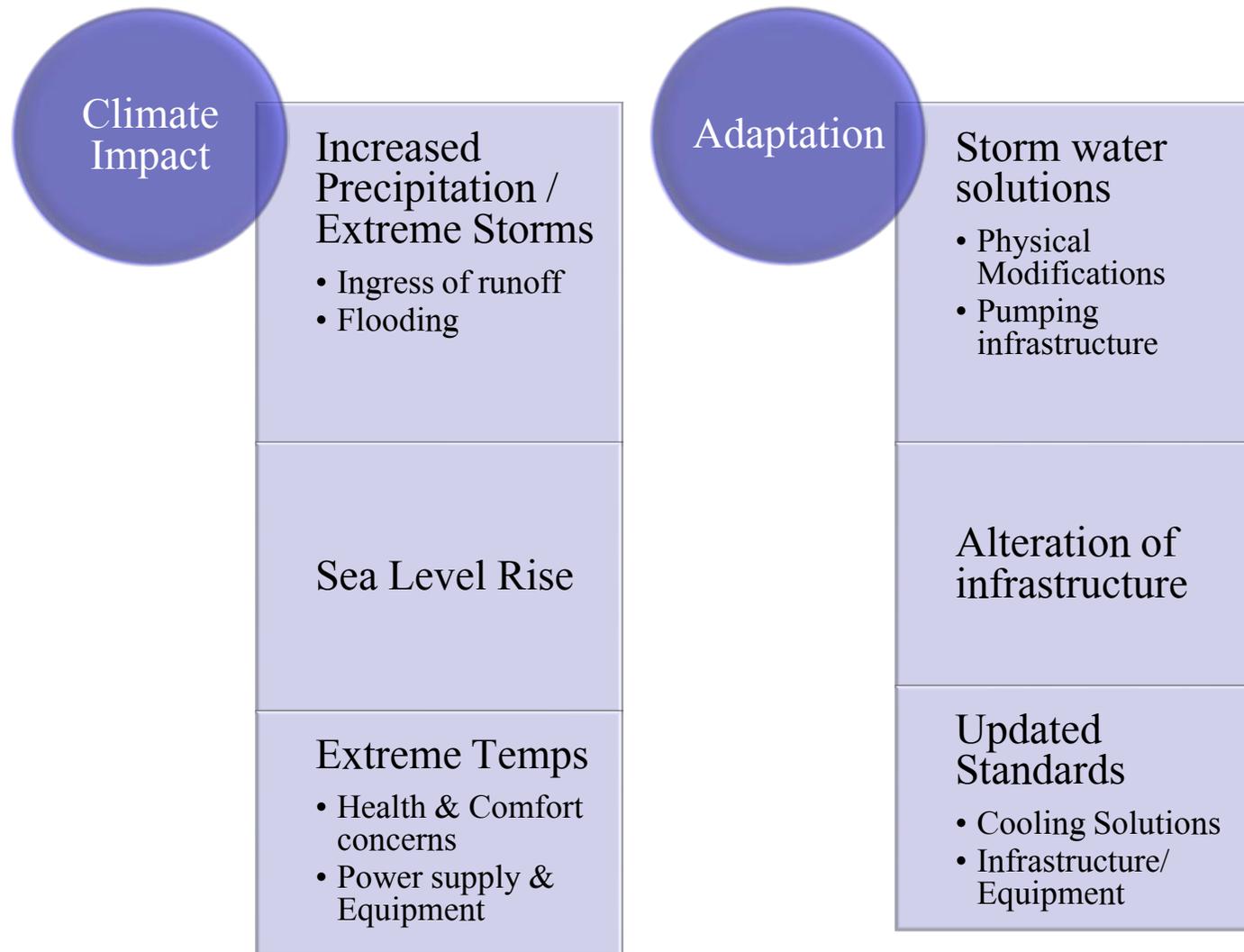
pdutta@mtahq.org

(212) 878 1065

www.mta.info/sustainability



Climate Impacts & Adaptive Needs



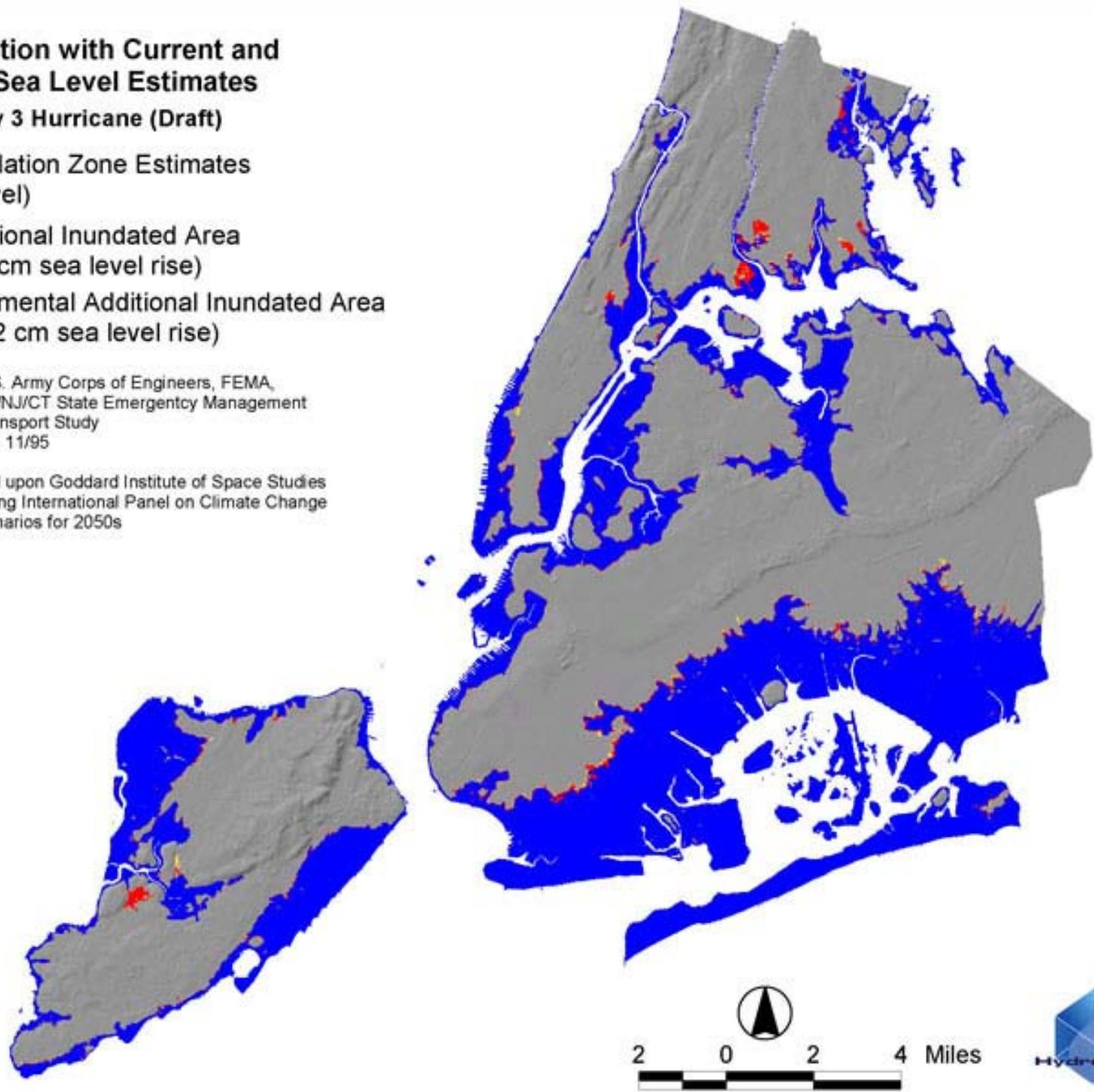
Comparing Inundation with Current and Projected (2050s) Sea Level Estimates

Case Study: Category 3 Hurricane (Draft)

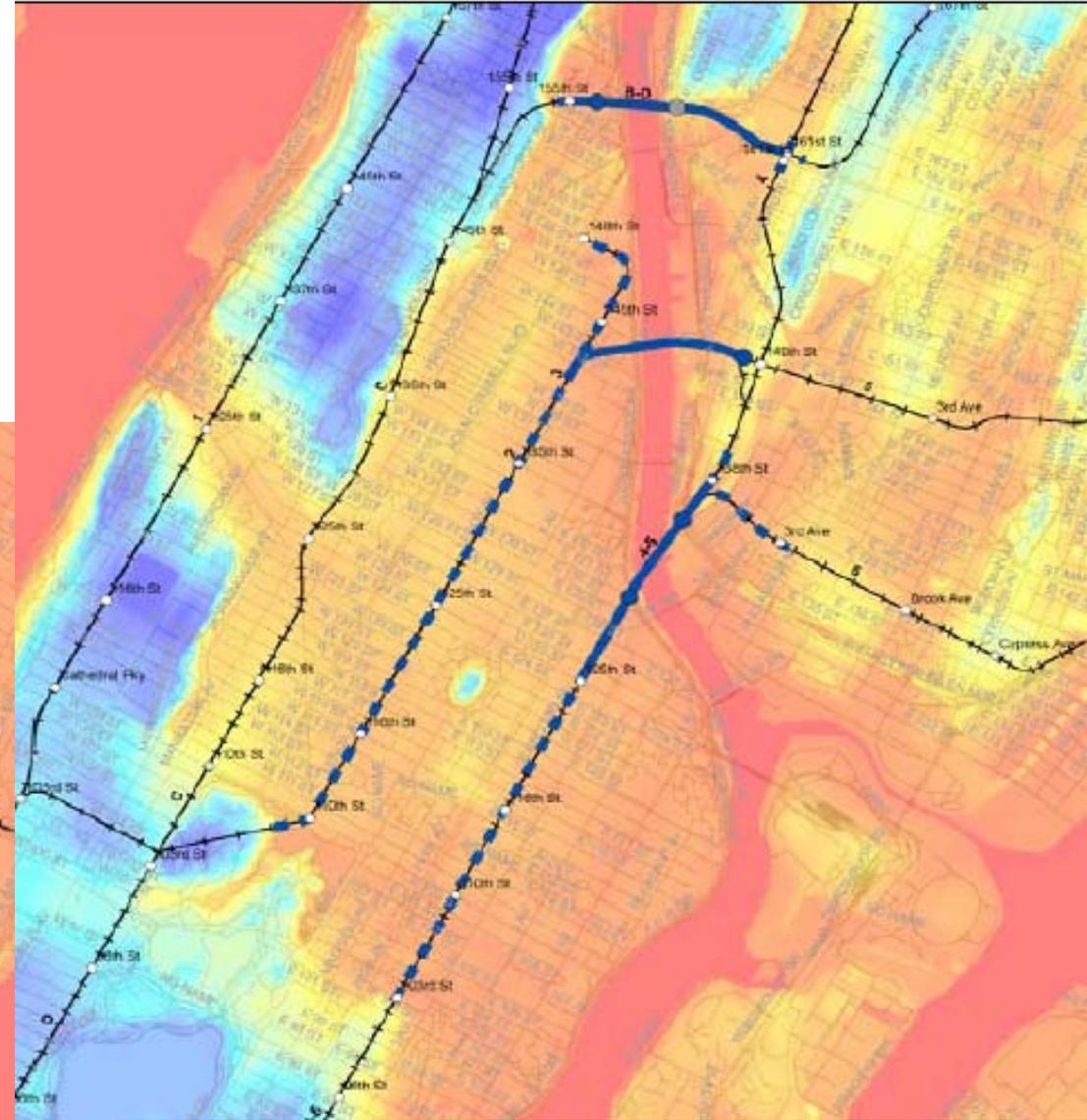
- Projected Inundation Zone Estimates (current sea level)
- Projected Additional Inundated Area IPCC B1 (37.5 cm sea level rise)
- Projected Incremental Additional Inundated Area IPCC A1B (47.2 cm sea level rise)

Storm Surge Data Source: U.S. Army Corps of Engineers, FEMA, National Weather Service, NY/NJ/CT State Emergency Management Metro New York Hurricane Transport Study Interim Technical Data Report, 11/95

Sea level rise estimates based upon Goddard Institute of Space Studies Atmospheric-Ocean Model using International Panel on Climate Change greenhouse gas emission scenarios for 2050s



100-year flood with 4ft sea level rise



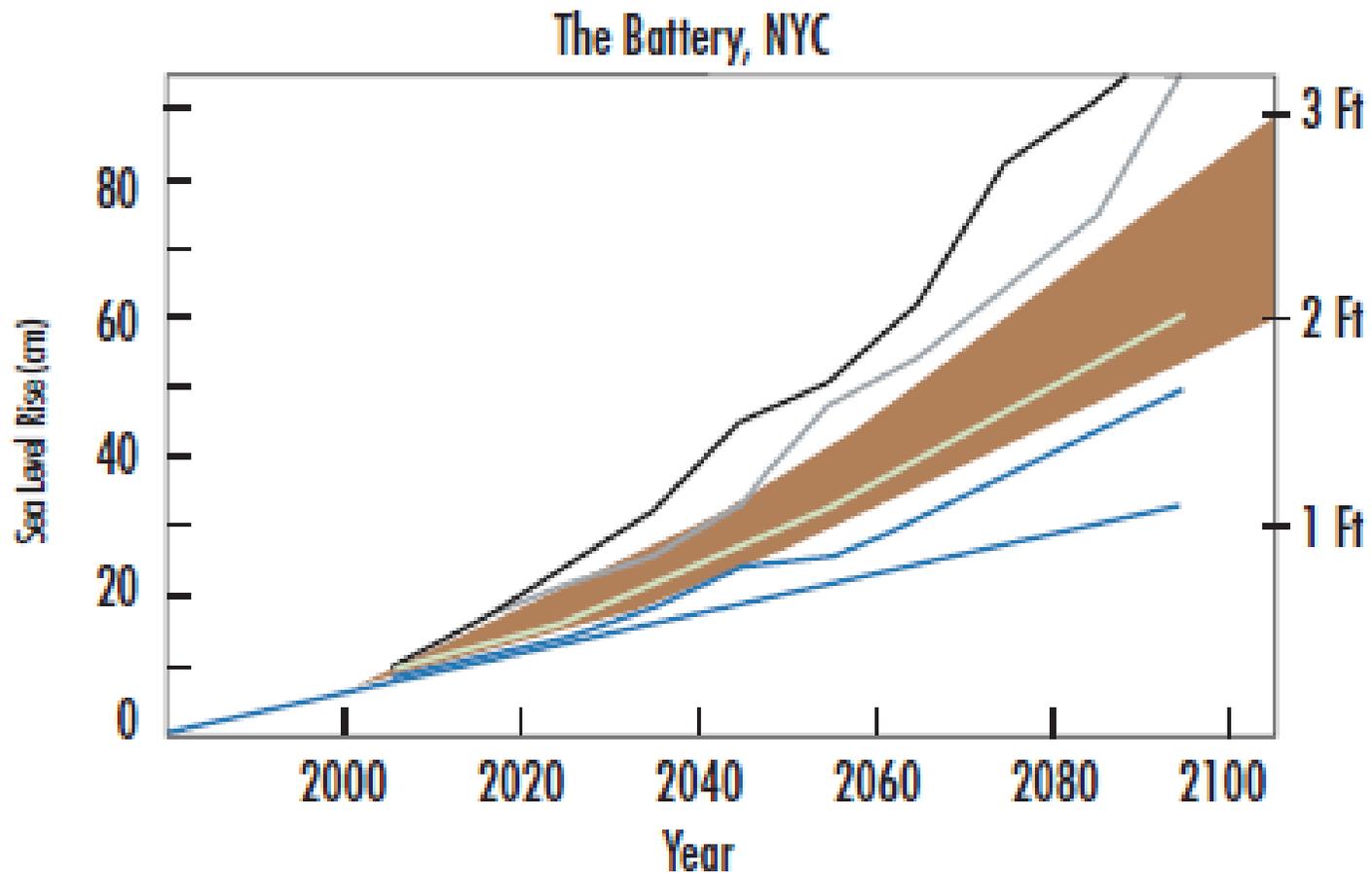
Lowest critical elevations

- The lowest points of entry to tunnels, subways or ventilation shafts.

MTA Subway Lines Lowest Critical Elevations(LCEs)	
A C Lines	7.0 feet
M N R Lines	7.5 feet
1 Line	9.1 feet
2 3 Lines	9.1 feet
4 5 6 Lines	9.9 feet
E F Lines	10.0 feet
B Q Lines	12.7 feet

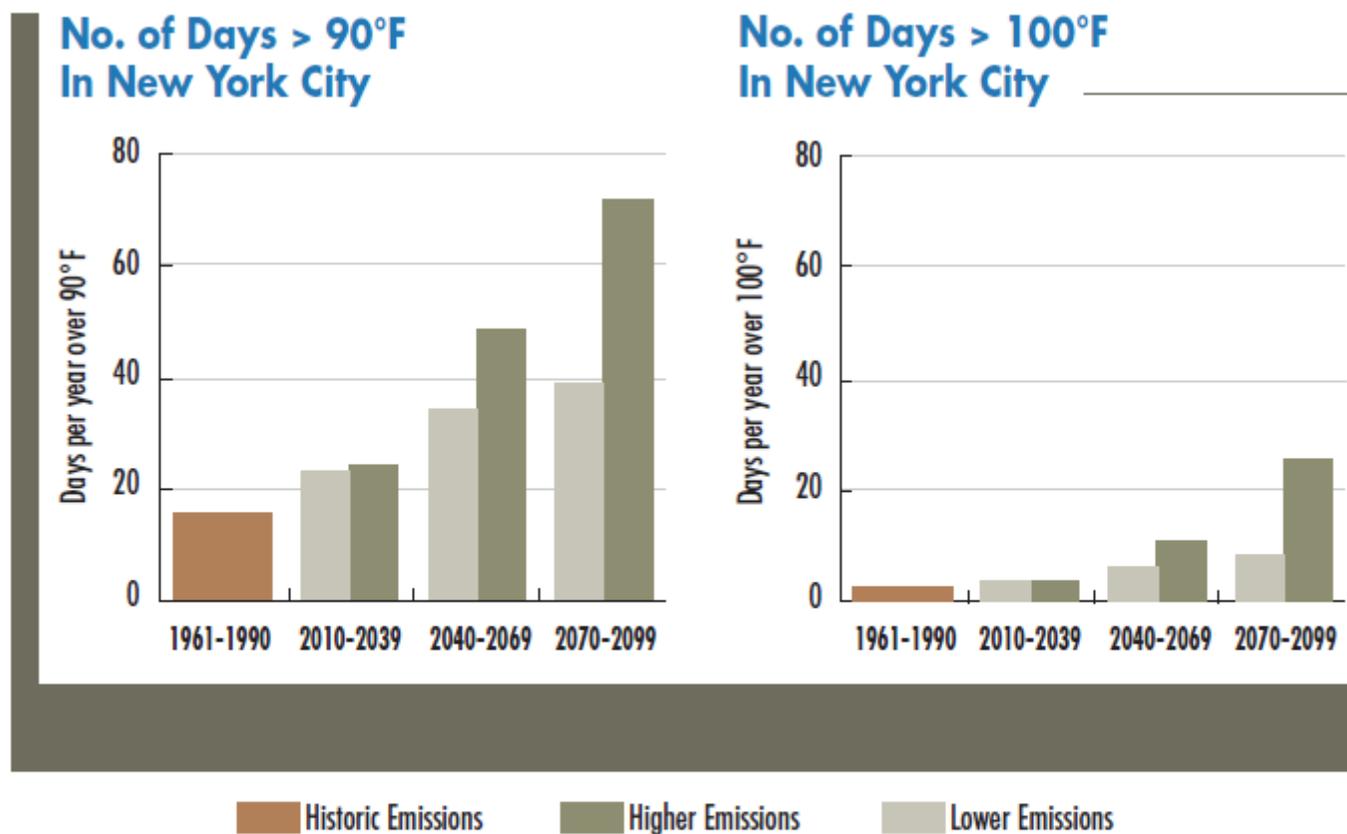
Elevations measured in feet above the National Geodetic Vertical Datum of 1929 – NGVD'29.
Source: Jacob et al. (2000)²

Potential Future Sea Level Rise



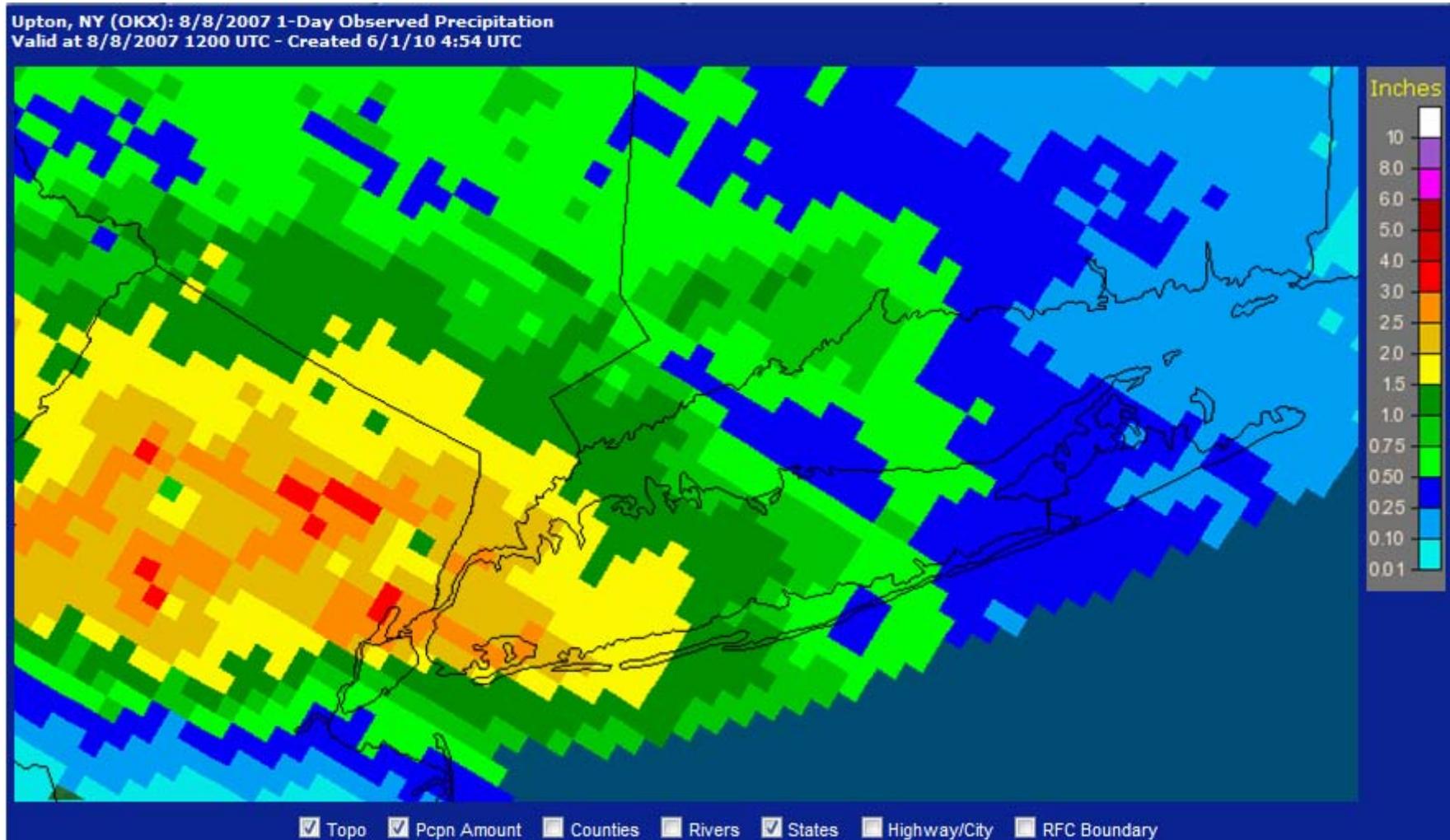
Range of projected local sea level rise (SLR) for New York City as optional input for precautionary planning purposes. The different lines represent projections for various atmospheric greenhouse gas scenarios and climate models. The orange band depicts a range of optional SLR planning scenarios during this century, implying 2ft SLR as a minimum scenario, and 3 ft by the end of this century as precautionary target planning scenario. (Source: Modified from Jacob et al, 2007).

Extreme Temperatures



Forecast of number of days/year in New York City with temperatures exceeding 90°F (left) and 100°F (right) for different decadal periods and for two GHG emissions scenarios. The orange bar represents observed occurrences prior to 1990. (Source: NECA, 2006)

Anatomy of a Storm



Case Study:

Lessons from August 8, 2007

- 1.4 to 3.5 inches of rainfall in two-hour period
- Pockets of intense, sustained rain overwhelms regional drainage systems
- First tornados to hit Brooklyn in over 100 years
- Storm coincides with morning rush hour
- Reports of flooding throughout system begin just before 6am

Progression of the Worst Flooding

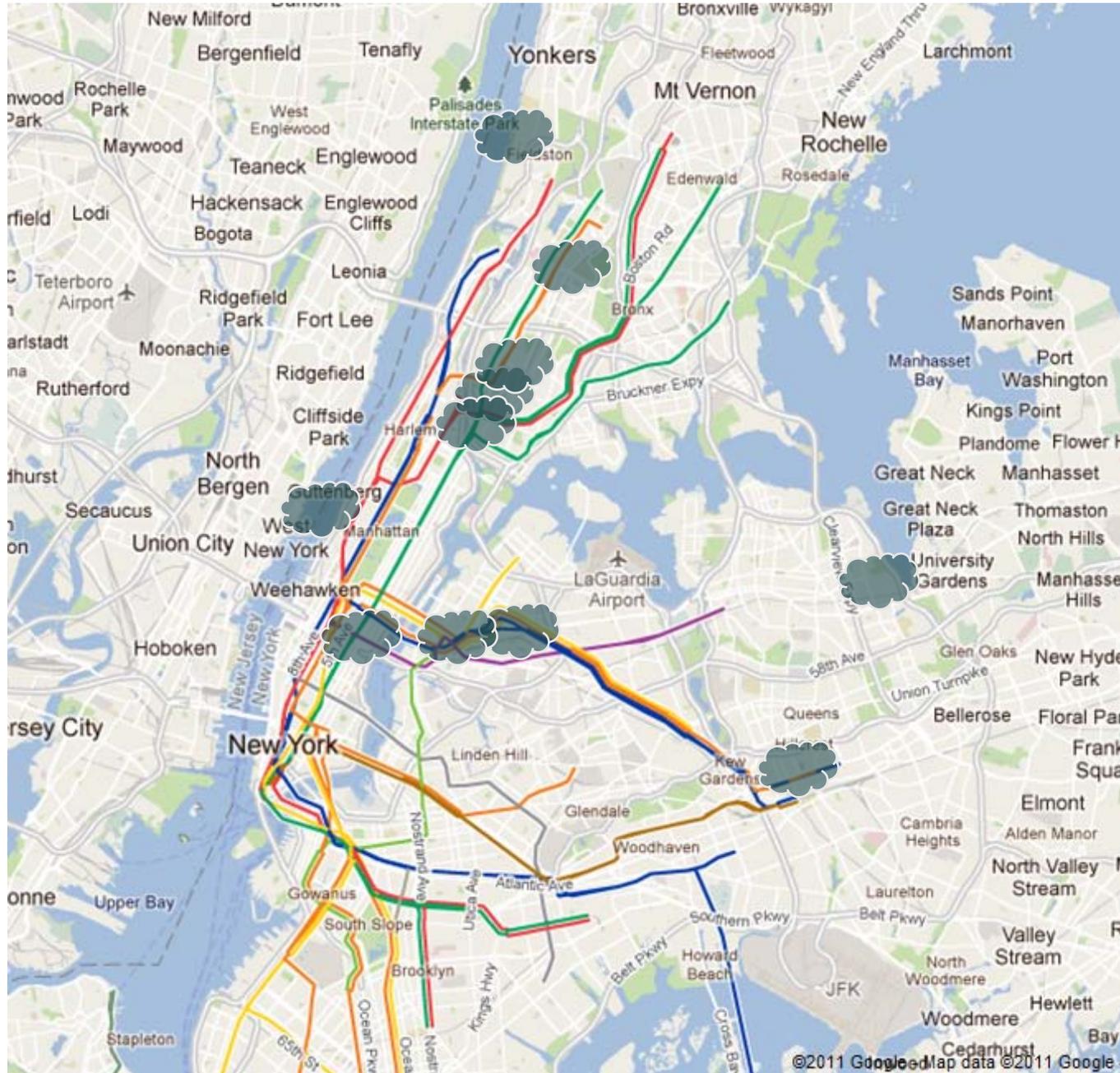
6:10 am

6:31 am

6:46 am

7:11 am

7:20 am



Most Flood-prone Subway locations

Local service only
 All trains stop (local and express service)
 Normal service
 Additional express service
 Free subway transfer
 Free out-of-system subway transfer (excluding angle-side ticket)
 Bus to airport
 Commuter rail service

Accessible station
 Station Name
 Bus or AIRTRAIN to airport
 Full time service
 Part time service
 Terminal

visit www.mta.info

This service is shown clearly, geographically as the map has been modified.
 © 2011 Metropolitan Transportation Authority
 March 2011

Service Note

The subway map depicts weekday service. Service differs by time of day and is sometimes affected by construction. Overhead directional signs on platforms show weekend, evening, and late night service. This information is also available on mta.info click on "Maps" in the top menu bar, then select "Individual Subway Line Maps."

For construction-related service changes, click on "Planned Service Changes" in the top menu bar. This information is also at station entrances and on platform columns of affected lines.









3602

23
Ely

Exit 21 St
44 St

23
Ely





Storms on the Railroad





Most Flood-prone Railroad locations



MTA Bridges and Tunnels

E-ZPass
 E-ZPass Bridges and Tunnels Facility
 E-ZPass Information
 800-333-TOLL
 (800-333-8655)

MTA Long Island Bus in Nassau, western Suffolk, and eastern Queens counties

MTA New York City Transit Subway in four boroughs. Station in five boroughs and the MTA Staten Island Railway (see resource and MTA Bridges and Tunnels Sewer bridges and two tunnels in New York City (see inset map above))

Abbreviations of Other Transit Services

AD	Adirondack Trailways	HL	Huntington Area Rapid Transit
AM	Amtrak	MTA	MTA Long Island Bus
CB	Capital Bus	MTA	MTA New York City Transit
CM	Connecticut Transit	MTA	MTA Staten Island Railway
CTA	Connecticut Transit	MTA	MTA Westchester County Transit
CTD	Connecticut Transit	MTA	MTA Westchester County Transit
CTF	Connecticut Transit	MTA	MTA Westchester County Transit
CTG	Connecticut Transit	MTA	MTA Westchester County Transit
CTH	Connecticut Transit	MTA	MTA Westchester County Transit
CTI	Connecticut Transit	MTA	MTA Westchester County Transit
CTJ	Connecticut Transit	MTA	MTA Westchester County Transit
CTK	Connecticut Transit	MTA	MTA Westchester County Transit
CTL	Connecticut Transit	MTA	MTA Westchester County Transit
CTM	Connecticut Transit	MTA	MTA Westchester County Transit
CTN	Connecticut Transit	MTA	MTA Westchester County Transit
CTO	Connecticut Transit	MTA	MTA Westchester County Transit
CTP	Connecticut Transit	MTA	MTA Westchester County Transit
CTQ	Connecticut Transit	MTA	MTA Westchester County Transit
CTR	Connecticut Transit	MTA	MTA Westchester County Transit
CTS	Connecticut Transit	MTA	MTA Westchester County Transit
CTT	Connecticut Transit	MTA	MTA Westchester County Transit
CTU	Connecticut Transit	MTA	MTA Westchester County Transit
CTV	Connecticut Transit	MTA	MTA Westchester County Transit
CTW	Connecticut Transit	MTA	MTA Westchester County Transit
CTX	Connecticut Transit	MTA	MTA Westchester County Transit
CTY	Connecticut Transit	MTA	MTA Westchester County Transit
CTZ	Connecticut Transit	MTA	MTA Westchester County Transit

visit www.mta.info

Bridge and Tunnel Flooding

- Impacts resulting from flooding adjacent to B&T property
- i.e. Flooding on local roads and approaches



Adaptation Responses





NEW YORK HOTEL

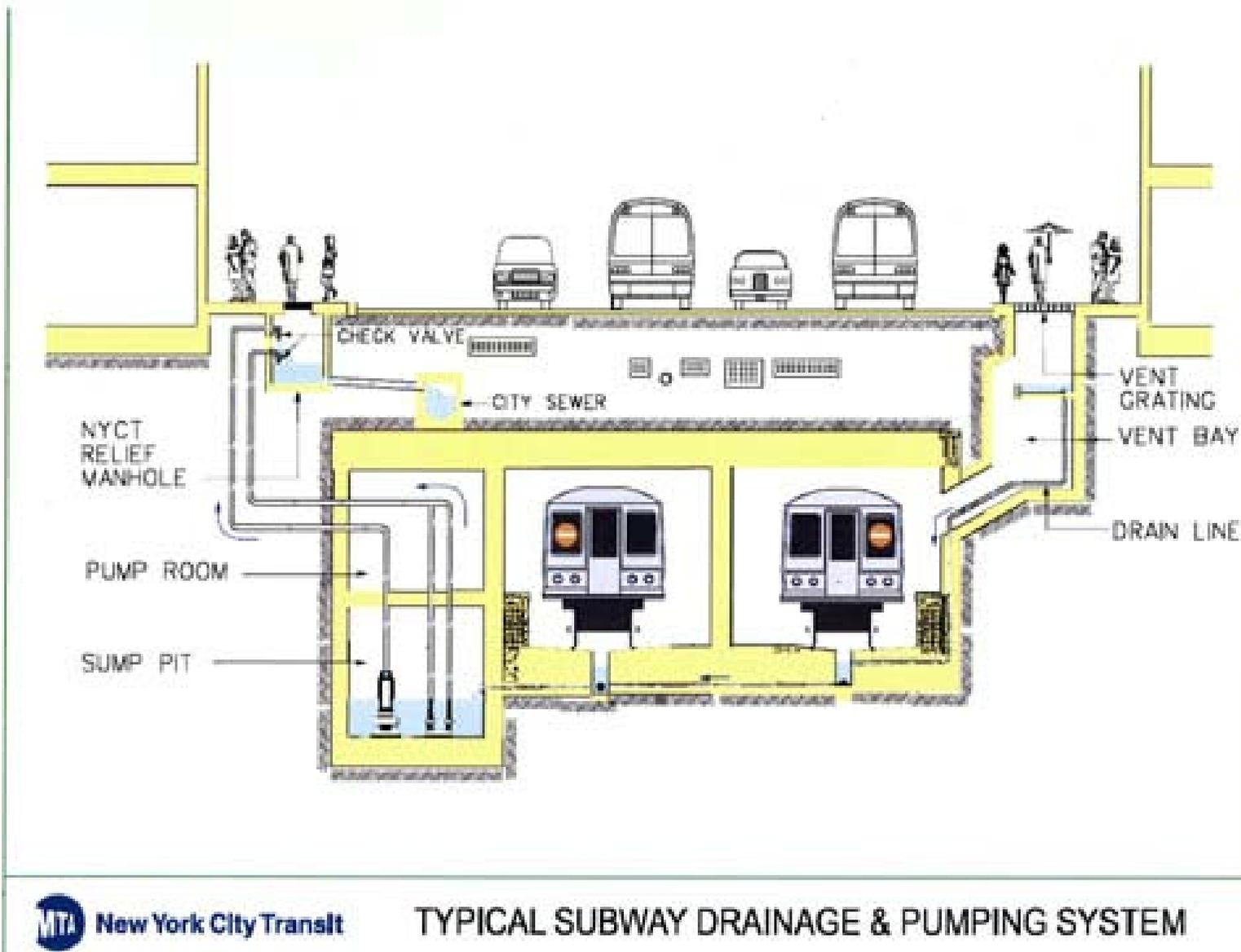
CAUTION

CAUTION





Subway Drainage System



Mitigation



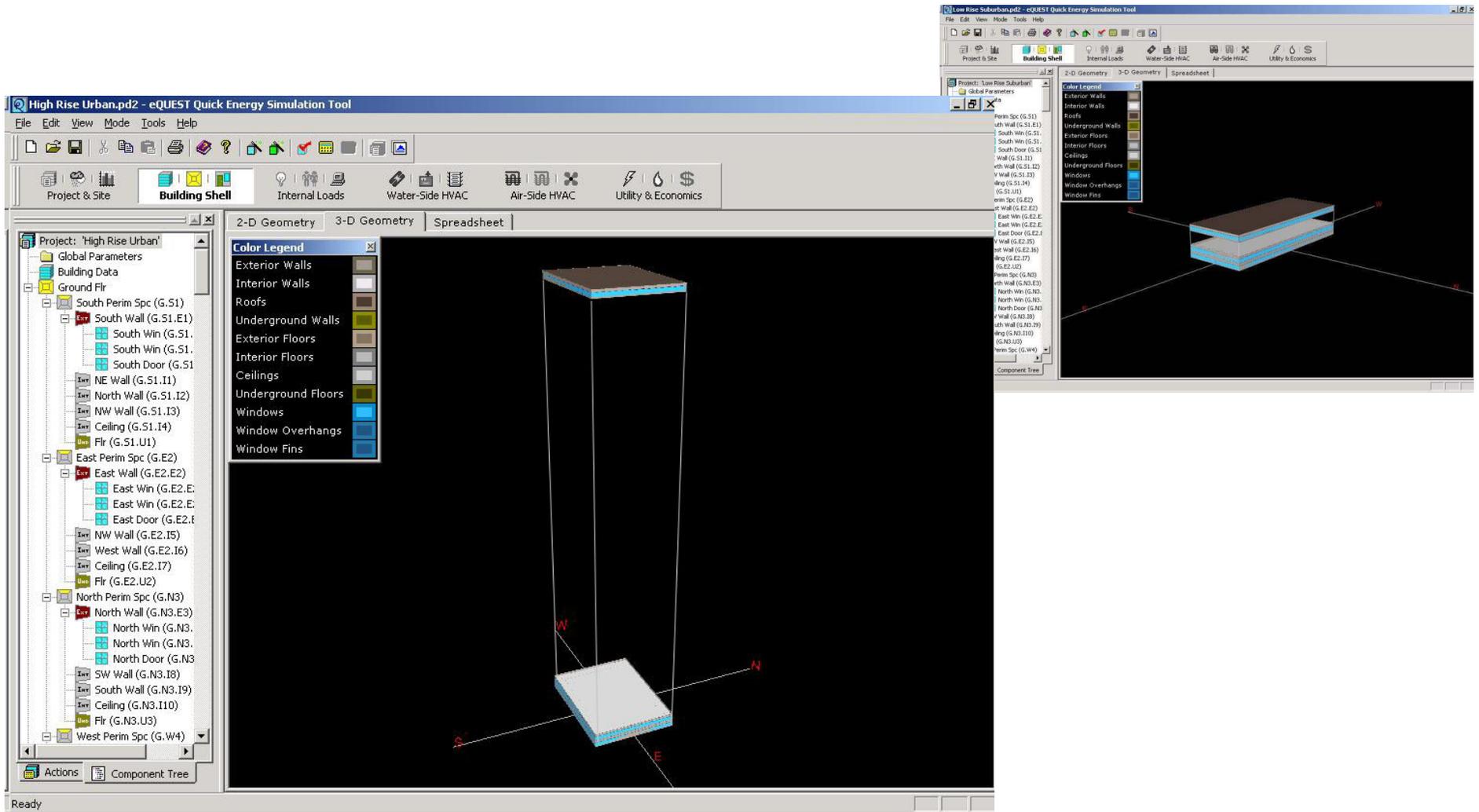
Energy Use: High-Rise vs. Low-Rise Development



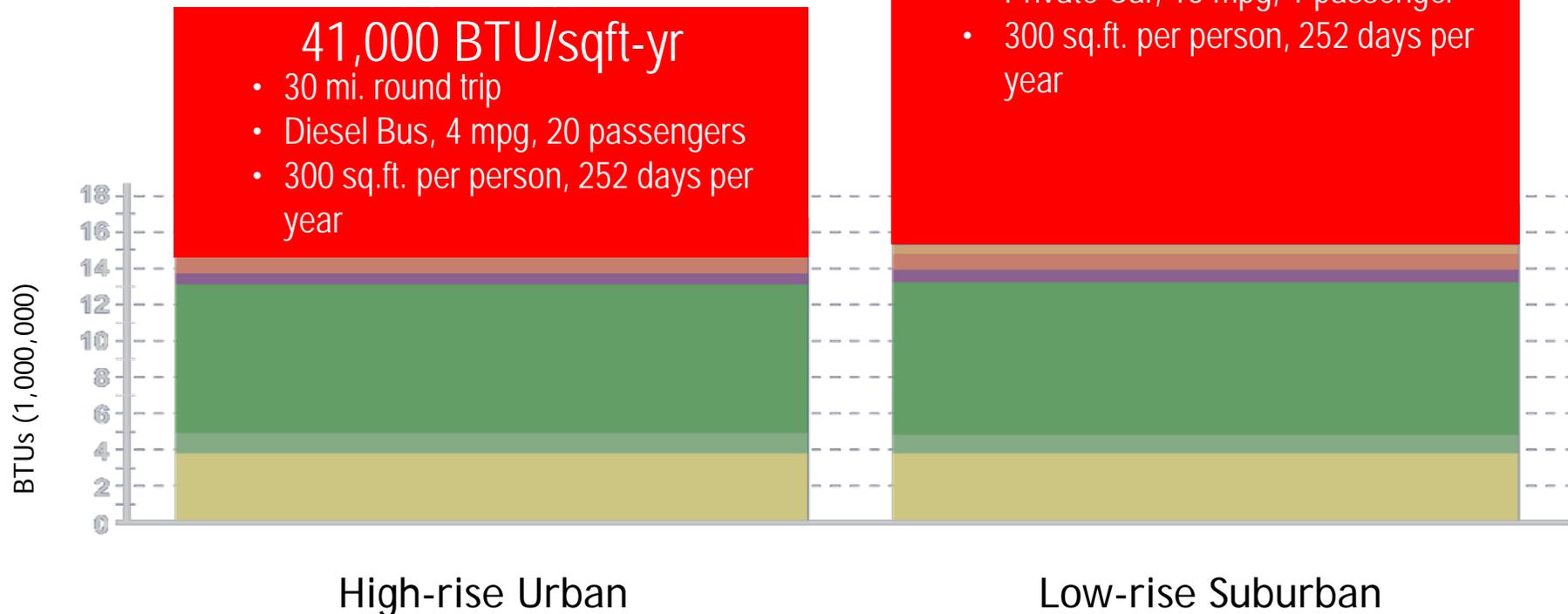
	High-Rise	Low-Rise
Number of buildings	1	10
Average floor size	30,612 sf	36,000 sf
Area of roof	88,000 sf	375,000 sf
Area of ext wall	343,000 sf	385,000 sf
Area of parking	0 sf	1,837,500 sf



Energy Consumption: Low-Rise Office Park vs. Tall Urban Building



Energy Use: high-Rise vs. Low-Rise Development



2.3 million metric tons



Climate Adaptation Matrix

Climate-Adaptation Decision-Making Matrix

		High
	Medium	
Low		

↑ Value
Risk →

Identify options for protection vulnerable rapid transit infrastructure, considering both the level of risk and the value of facilities/components. i.e. Elevated subway station vs. Train yard/Maintenance Shop in low-lying area near the coast.

Recommendations

- Implement Operational Climate Change Database
- Complete Quantitative Vulnerability and Risk Assessment
- Develop Climate Change Adaptation Master Plan
- Climate Adaptation Resilience Evaluation Procedure



CH THE GAP

WATCH THE