Section III: Natural Hazard Risk Assessment

1) INTRODUCTION 6

A) RISK ASSESSMENT APPROACH 6
B) FEMA REQUIREMENTS ADDRESSED IN THIS SECTION 6

2) HAZARD IDENTIFICATION 8

A) HAZARDS IN NEW YORK STATE 8
B) HAZARD SELECTION PROCESS 9
i) Existing Plans and Procedures 9
ii) Hazard Selection Worksheet 9
C) ELIMINATED HAZARDS 10
D) FINAL LIST OF NEW YORK CITY HAZARDS 11

3) NEW YORK CITY'S HAZARD ENVIRONMENT 12

A) THE NATURAL ENVIRONMENT 12
i) Geography 12
ii) Climate 14
iii) Topography 14
B) THE SOCIAL ENVIRONMENT 16
i) Demographics 16
ii) Neighborhoods 25
iii) Economy 30
C) THE BUILT ENVIRONMENT 33
i) Rail Transportation 33
ii) Roadway Transportation 35
iii) Air and Water Transportation 37
iv) Emergency Services 39
v) Hospitals and Healthcare 41
vi) Education 42
vii) Cultural Facilities 43
viii) Energy 45
ix) Telecommunications 45
x) Water Supply and Wastewater Treatment 46
xi) New York City's Building Stock 50
(1) Building Age 51
(2) Building Value 52
(3) Construction Type 55
xii) Structural Vulnerability to Natural Hazards 57
xiii) New York City Construction Code 57
(1) Drought 57
(2) Earthquakes 57
(3) Extreme Temperatures 57
(4) Flooding 58
(5) Wind 58
(6) Winter Storms 58

4) POPULATION AND DEVELOPMENT TRENDS 59

A) POPULATION TRENDS 59
i) Age Trends 62
B) LAND USE AND DEVELOPMENT TRENDS 62
i) PlaNYC 68
ii) Large-scale Planning Initiatives 68

5) VULNERABILITY ASSESSMENT METHODOLOGY 70

A) HAZUS-MH METHODOLOGY 70
i) HAZUS-MH for Earthquakes 70
ii) HAZUS-MH for Hurricane Winds (Coastal Storms) 71
iii) HAZUS-MH for Floods 71
iv) HAZUS-MH for Coastal Erosion 71
v) Data Limitations 71
vi) Role of HAZUS-MH in Future Hazard Mitigation Planning 71
B) METHODOLOGY FOR ASSESSING HAZARDS NOT COVERED BY HAZUS-MH 72
i) Approach 72
ii) Limitations 72

HAZARD ANALYSIS 73

6) COASTAL EROSION HAZARD ANALYSIS FOR NEW YORK CITY 74

A) HAZARD PROFILE 74
i) Hazard Description 74
ii) Severity 74
iii) Probability 74
iv) Location 74
v) Historic Occurrences 77
B) VULNERABILITY ASSESSMENT 77
i) Impact to New York City 77
ii) Structural Vulnerability 78
iii) Potential Loss Estimate 78

7) COASTAL STORMS: MULTI-HAZARD ANALYSIS FOR NEW YORK CITY 80

A) HAZARD PROFILE 80
i) Hazard Description 80
ii) Severity 82
iii) Probability 82
iv) Location 83
v) Historic Occurrences 89
B) VULNERABILITY ASSESSMENT 91
i) Impact to New York City 91
ii) Structural Vulnerability 92
iii) Potential Loss Estimate 94

8) DROUGHT HAZARD ANALYSIS FOR NEW YORK CITY 96

A) HAZARD PROFILE 96
i) Hazard Description 96
ii) Severity 96
iii) Probability 97
iv) Location 97
v) Historic Occurrences 98
B) VULNERABILITY ASSESSMENT 100
i) Impact to New York City 100
ii) Structural Vulnerability 101
iii) Potential Loss Estimate 101

9) EARTHQUAKES HAZARD ANALYSIS FOR NEW YORK CITY 102

A) HAZARD PROFILE 102
i) Hazard Description 102
ii) Severity 102
iii) Probability 108
iv) Location 109
v) Historic Occurrences 109

B) VULNERABILITY ASSESSMENT 110
i) Impact to New York City 110
ii) Structural Vulnerability 112
iii) Potential Loss Estimate 114

10) EXTREME TEMPERATURES HAZARD ANALYSIS FOR NEW YORK CITY 116

A) HAZARD PROFILE 116
i) Hazard Description 116
ii) Severity 117
iii) Probability 120
iv) Location 120
v) Historic Occurrences 123
B) VULNERABILITY ASSESSMENT 125
i) Impact to New York City 125
ii) Structural Vulnerability 126
iii) Potential Loss Estimate 126

11) FLOODING HAZARD ANALYSIS FOR NEW YORK CITY 127

A) HAZARD PROFILE 127
i) Hazard Description 127
ii) Severity 128
iii) Probability 128
iv) Location 129
v) Historic Occurrences 140
B) VULNERABILITY ASSESSMENT 147
i) Impact on New York City 147
ii) Structural Vulnerability 147
iii) Potential Loss Estimate 148

12) WINDSTORMS AND TORNADOES HAZARD ANALYSIS FOR NEW YORK CITY ... 154

A) HAZARD PROFILE 154
i) Hazard Description 154
ii) Severity 154
iii) Probability 156
iv) Location 156
v) Historic Occurrences 157
B) VULNERABILITY ASSESSMENT 160
i) Impact to New York City 160
ii) Structural Vulnerability 160
iii) Potential Loss Estimate 161

13) WINTER STORMS HAZARD ANALYSIS FOR NEW YORK CITY 162

A) HAZARD PROFILE 162
i) Hazard Description 162
ii) Severity 162
iii) Probability 163
iv) Location 163
v) Historic Occurrences 163
B) VULNERABILITY ASSESSMENT 165
i) Impact on New York City 165
ii) Structural Vulnerability 165
iii) Potential Loss Estimate 166

BIBLIOGRAPHY 167

14) LIST OF FIGURES 176

15) LIST OF TABLES 178