Unit I-B
Building Design for Homeland Security

U.S. DEPARTMENT OF HOMELAND SECURITY
FEMA

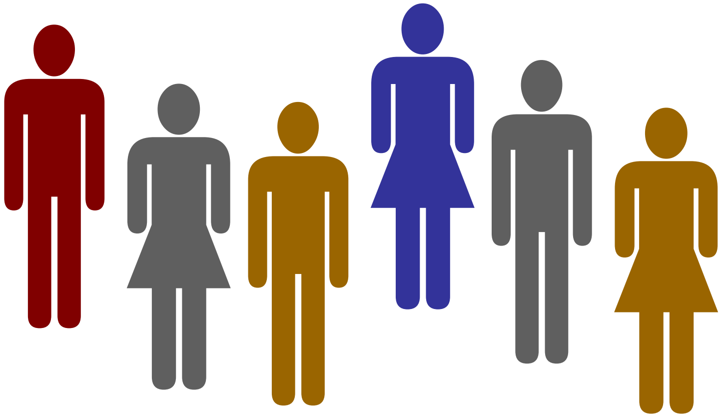
Student Introductions

Name

Affiliation

Area of Concentration

Course Expectations



Purpose of Course and FEMA 426 Manual

Provide guidance to building sciences community

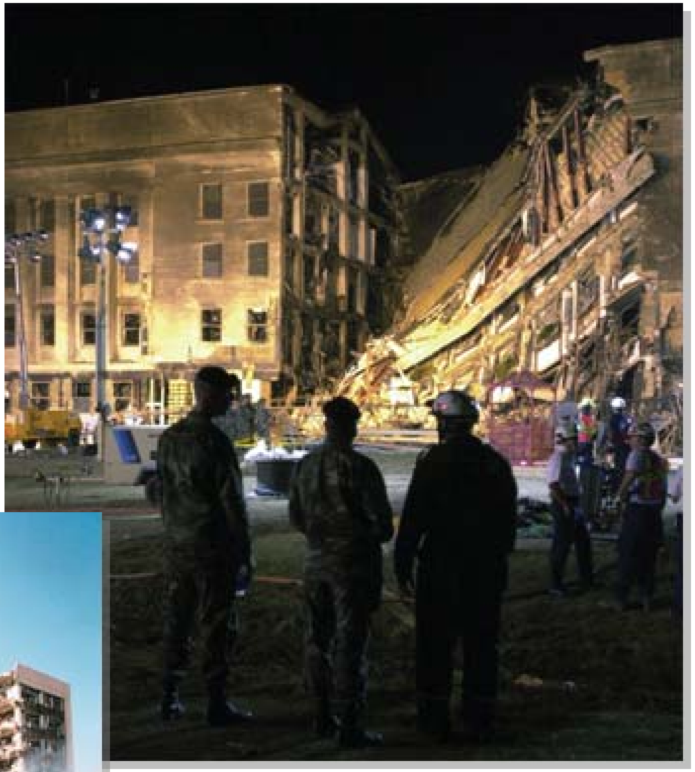
Decision-makers determine which threats and mitigation measures

Information

- Not mandatory
- Not applicable to all buildings
- Not applicable when it interferes with other hazards

Course Goal

To enhance student understanding of the measures and technology available to reduce risk from terrorist attack.



FEMA

U.S. AIR FORCE

FEMA

Course Objectives

Students will be able to:

1. **Explain** the basic components of the assessment methodology.
2. **Appreciate** the different assessment methodology approaches that can be used.
3. **Perform** an assessment for a building by identifying and prioritizing assets, threats, and vulnerabilities and calculating relative risk.

Course Objectives

4. **Identify** available mitigation measures applicable to the site and building envelope.
5. **Understand** the technology limitations and application details of mitigation measures for terrorist tactics and technological accidents.
6. **Perform** an assessment for a given building by identifying vulnerabilities using the Building Vulnerability Assessment Checklist in FEMA 426.

Course Objectives

7. **Select** applicable mitigation measures and prioritize them based upon the final assessment risk values.
8. **Appreciate** that designing a building to mitigate terrorist attacks can create conflicts with other design requirements.

Course Overview – Day 1

Unit I-B – Introduction and Course Overview
Unit II – Asset Value Assessment
Unit III – Threat / Hazard Assessment
Unit IV – Vulnerability Assessment
Unit V – Risk Assessment / Risk Management

Course Overview – Day 2

Unit VI – FEMA 452 Risk Assessment Database
Unit VII – Explosive Blast
Unit VIII – Chemical, Biological, and Radiological (CBR) Measures
Exam and Exam Review
Unit IX-B – Site and Layout Design Guidance

FEMA

Course Overview – Day 3

Unit X – Building Design Guidance
Unit XI – Electronic Security Systems
Unit XII-B – Finalization of Case Study Results
Unit XIII – Course Wrap-up

FEMA

Course Materials

FEMA Publication 426

Reference Manual
to Mitigate Potential Terrorist Attacks Against Buildings

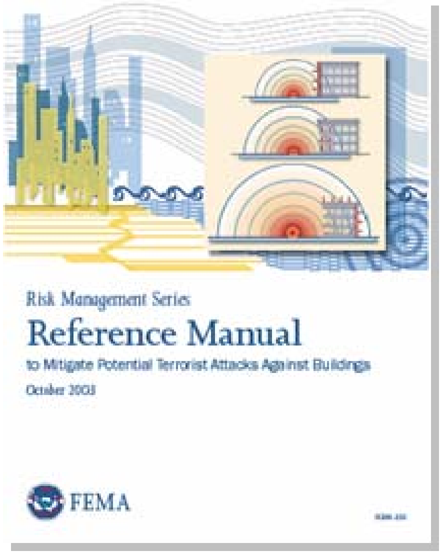
FEMA Publication 452

Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Threats Against Buildings

FEMA

FEMA 426 Reference Manual

Chapter 1 – Asset Value, Threat / Hazard, Vulnerability, and Risk



Chapter 2 – Site and Layout Design Guidance

Chapter 3 – Building Design Guidance

Chapter 4 – Explosive Blast

Chapter 5 – CBR Measures

FEMA 426 Reference Manual

Appendix A – Acronyms

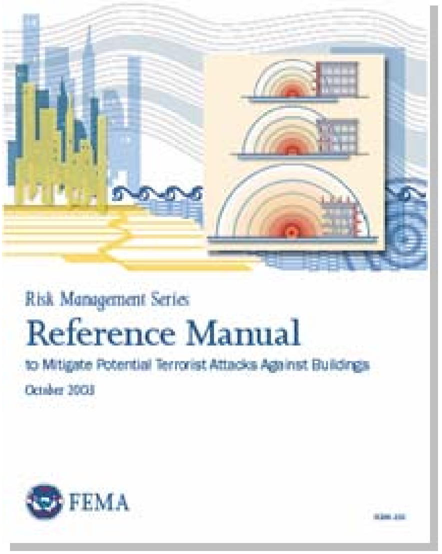
Appendix B – General Glossary

Appendix C – CBR Glossary

Appendix D – Electronic Security Systems

Appendix E – Bibliography

Appendix F – Associations and Organizations



FEMA 452 Risk Assessment How-To

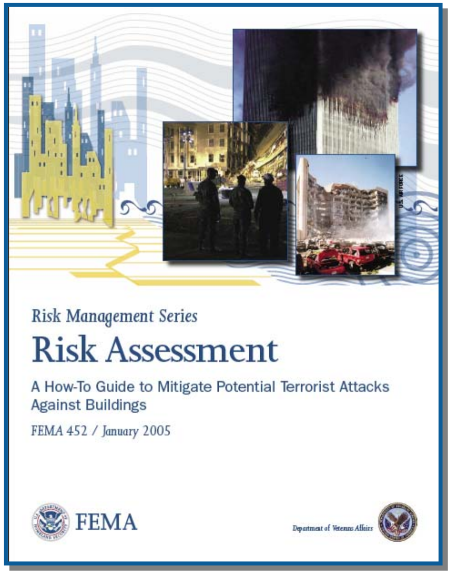
Step 1 – Threat Identification and Rating

Step 2 – Asset Value Assessment

Step 3 – Vulnerability Assessment

Step 4 – Risk Assessment

Step 5 – Consider Mitigation Options



FEMA 452 Risk Assessment How-To

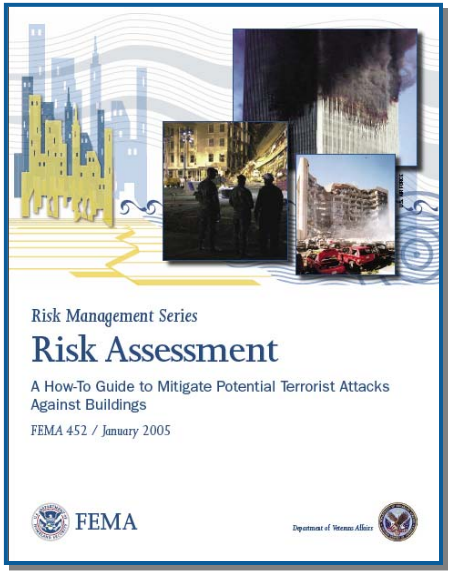
Appendix A – Building Vulnerability Assessment Checklist

Appendix B1 – Risk Management Database: Assessor's User Guide

Appendix B2 – Risk Management Database: Database Administrator's User Guide

Appendix B3 – Risk Management Database: Manager's User Guide

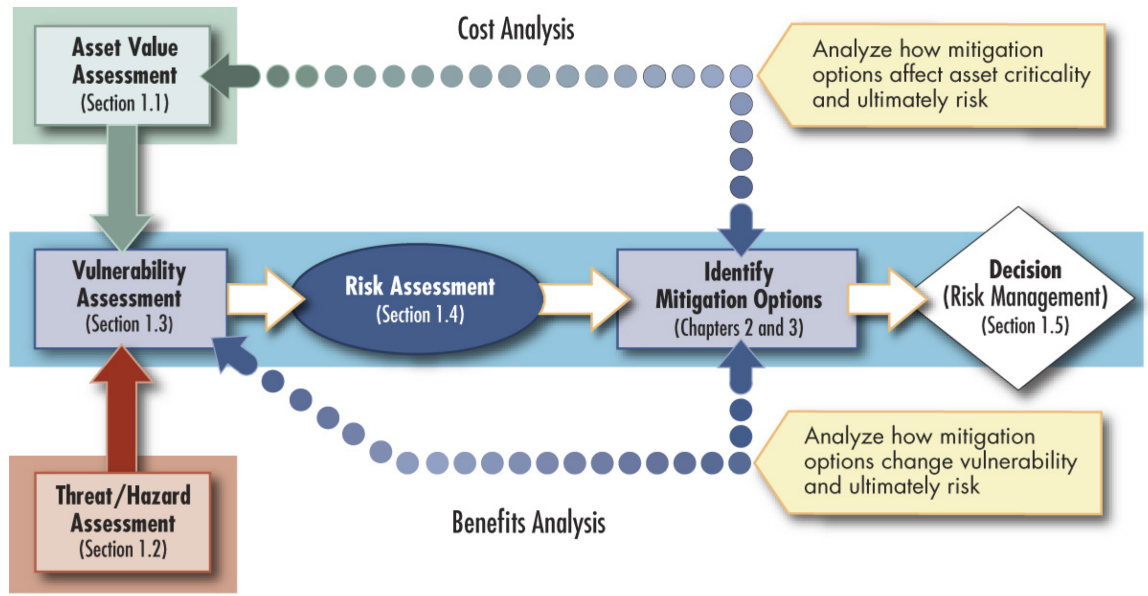
Appendix C – Acronyms and Abbreviations



FEMA

FEMA 426 – Chapter 1

- Asset Value Assessment
- Threat/Hazard Assessment
- Vulnerability Assessment
- Risk Assessment
- Risk Management
- Building Vulnerability Assessment Checklist

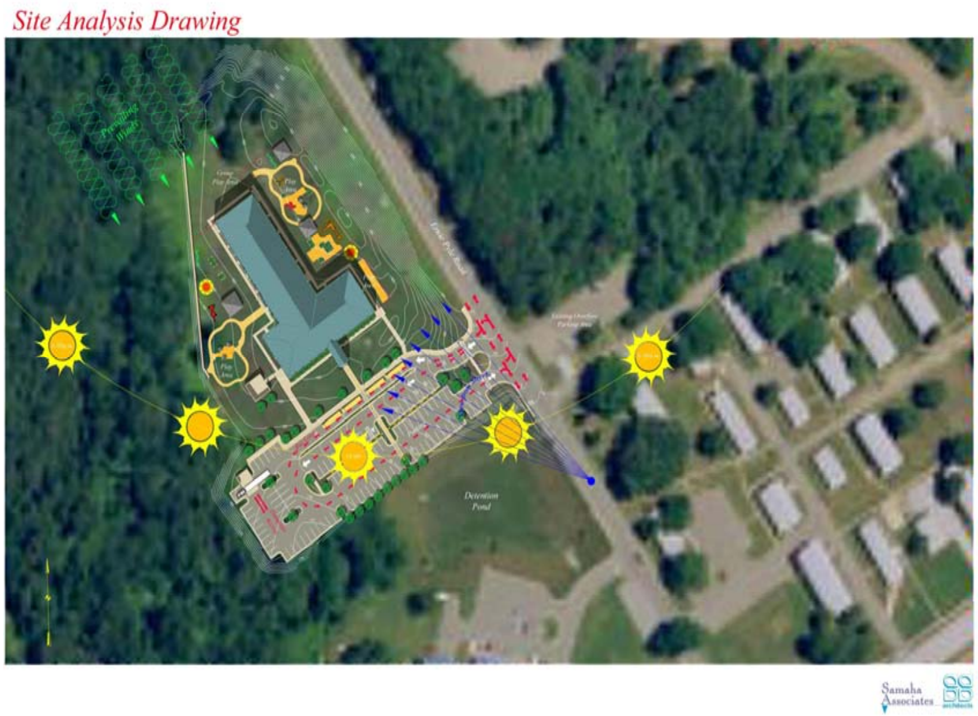


FEMA 426, Figure 1-3: The Assessment Process Model, p. 1-5

FEMA 426 – Chapter 2

Site and Layout Design

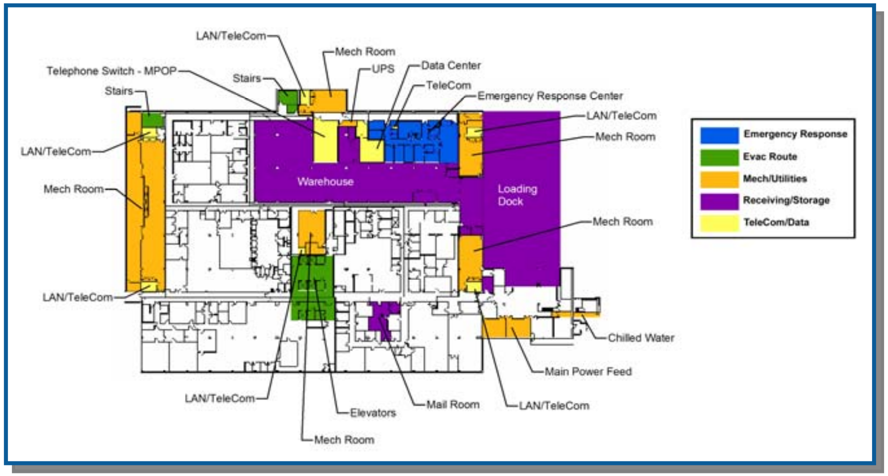
- Layout Design
- Siting
- Entry Control/Vehicle Access
- Signage
- Parking
- Loading Docks
- Physical Security Lighting
- Site Utilities



FEMA 426 – Chapter 3

Building Design Guidance

- Architectural
- Building Structural and Nonstructural Considerations
- Building Envelope considerations
- Other Building Design Issues
- Building Mitigation Measures



FEMA 426, Figure 1-10: Non-Redundant Critical Functions Collocated Near Loading Dock, p. 1-41

FEMA 426 – Chapter 4

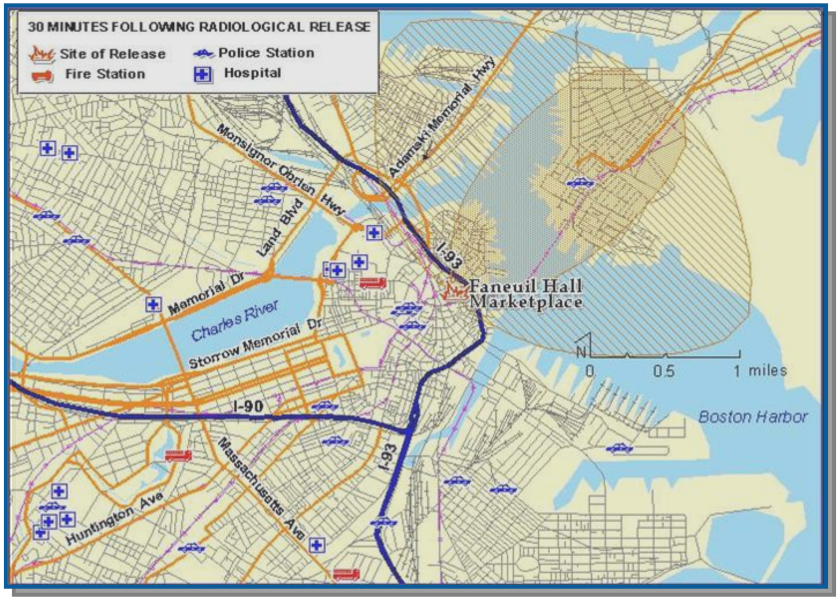
Explosive Blast

- Building Damage
- Blast Effects and Predictions
- Stand-off Distance
- Progressive Collapse

FEMA 426 – Chapter 5

CBR Measures

- Evacuation
- Sheltering in Place
- Personal Protective Equipment
- Filtering and Pressurization
- Exhausting and Purging



Summary

FEMA 426 is intended for building sciences professionals.

Manmade hazards risk assessments use a "Design Basis Threat."

Site and building systems and infrastructure protection are provided by layers of defense.

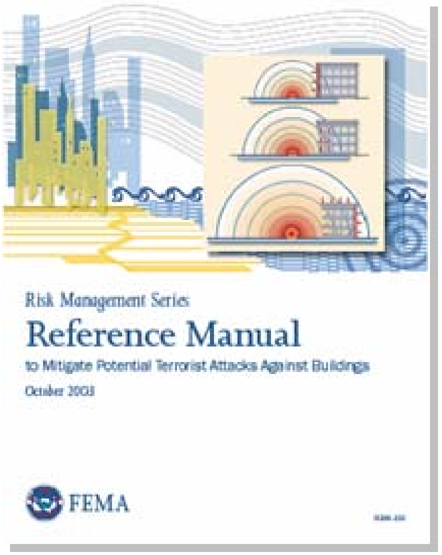
Multiple mitigation options and techniques.

Use cost-effective multihazard analysis and design.

Case Study Activities

In small group settings, apply concepts introduced in the course.

Become conversant with contents and organization of FEMA 426.



Unit I-B Case Study Activity

HazardCorp Building Urban Case Study Overview

Requirements

Briefly review Case Study materials.

As a group, complete the worksheet.

Use only the Case Study data to answer worksheet questions.

HAZARDCORP BUILDING (HZC)

Case Study

Urban Office Rental Property occupied by:

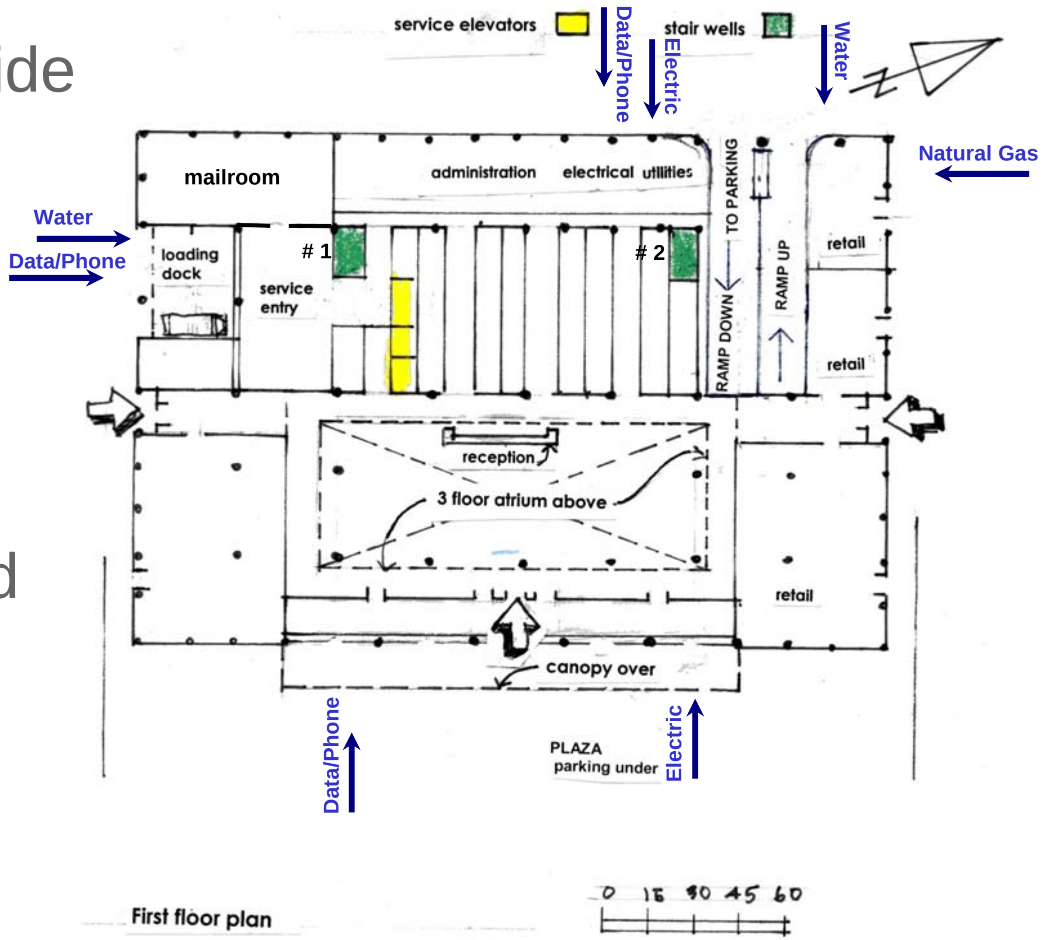
- Building Owner (Building Management)
- Tenants:
  - Retail (Restaurant, Shops)
  - Government (Federal, State, Local)
  - Banking
  - Financial
  - Insurance

HazardCorp Building

FEMA

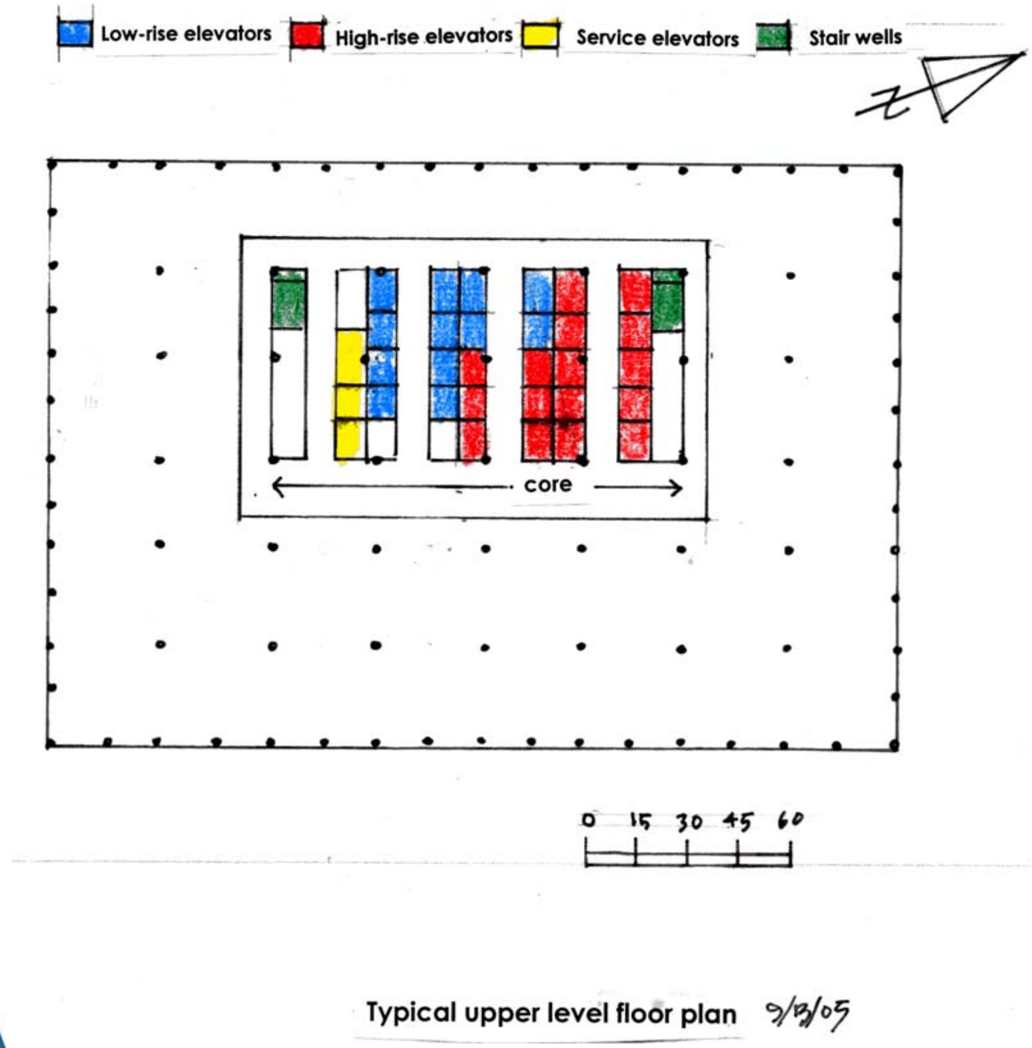
Building Data

- 50-story building completed in 1987
- Loading dock on SW side
- Retail on lower level
- 8,000 occupants
- 1,000 visitors
- 3 levels of underground parking



First floor plan

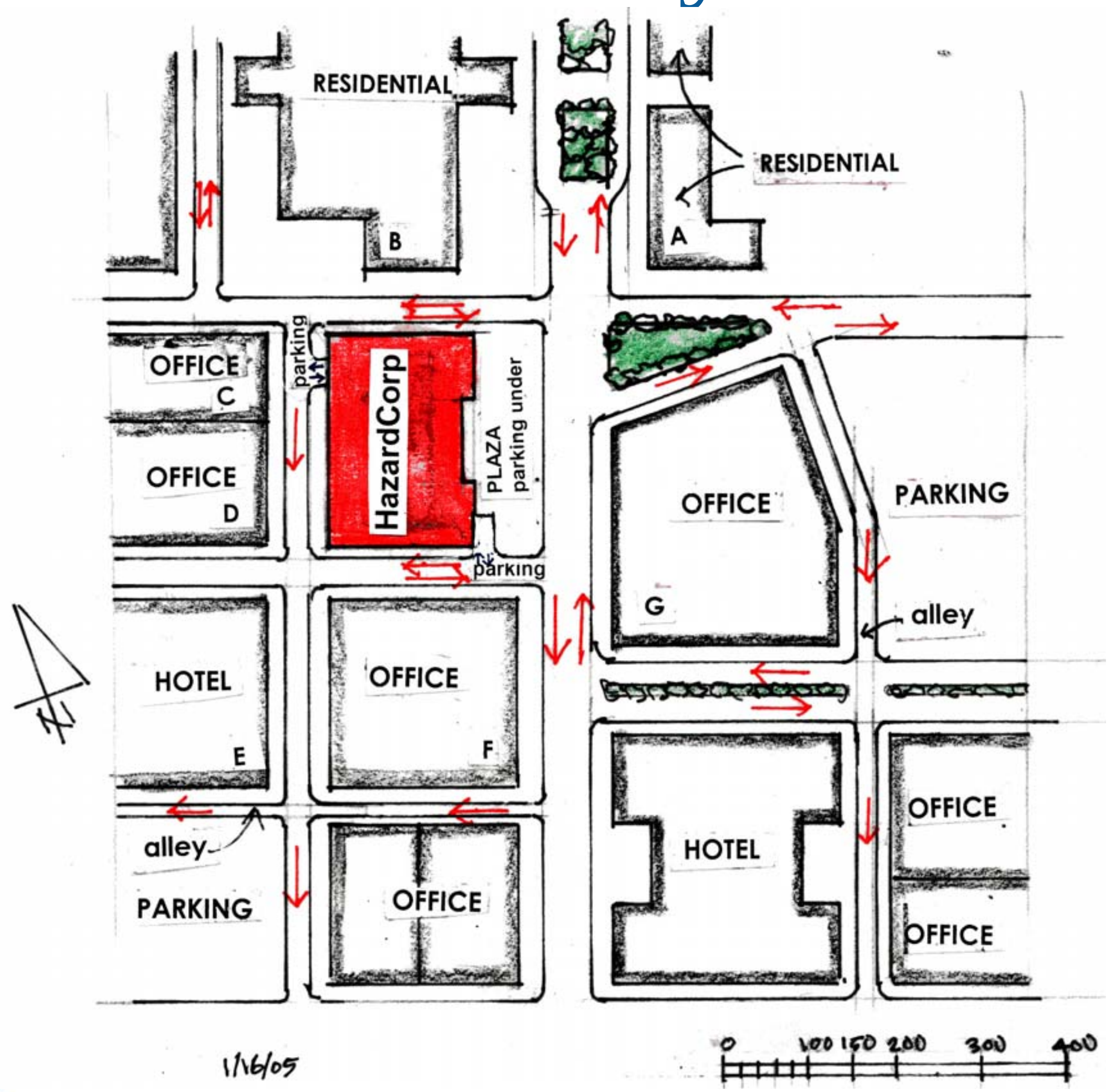
Upper Level Floor Plan



Aerial Overview

FEMA

HAZARDCORP Site Layout



FEMA

HAZARDCORP Neighbors

- A and B: 14 - 26-story residential condominiums, constructed 2001-2005.
- C: 10-story office, constructed 1925
- D: 10-story office, constructed 1934
- E: 14-story hotel, constructed 1935
- F: 20-story office, constructed 1970
- G: 20-story office, constructed 1994

HAZARDCORP Occupancy

FLOOR	TENANT OCCUPANCY
49-50	Mechanical Floors
31-48	National financial services company
29-30	Bank offices
27-28	Federal government offices (IRS, DOD, CIA)
26	Mechanical room
25	Office of Emergency Management
23-24	Financial service company
20-22	Insurance company
19	State Employment Commission
15-18	Vacant
14	Financial management company
8-13	Federal government offices (SEC, Secret Service)
6-7	Bank offices
4-5	Storage, switch gear, generators, transformers
3	Open to first floor lobby, rentable meeting space, building management
2	Open to first floor lobby, rentable meeting space
1	Lobby, retail, fuel storage, switchgear, building administration, loading dock
UG1	Parking
UG2	Parking
UG3	Parking

FEMA

Threat Analysis

Terrorist Threat

Intelligence Threat

Criminal Threat

Hazard Analysis

HazMat

- Facilities
- Highway
- Rail
- Maritime

Liquid Fuels

Chemicals

Air Traffic

Natural Hazards

Emergency Response

- Police
- Fire
- EMT
- HazMat
- Hospitals

FEMA

Design Basis Threat

Explosive Blast: Car Bomb approximately 500 lb TNT equivalent. Truck Bomb approximately 5,000 lb TNT equivalent (Murrah Federal Building class weapon)

Chemical: Large quantity gasoline spill and toxic plume from the upwind petroleum tank farm or large quantity chlorine release from the upwind chemical storage tank farm. Small quantity (tanker truck and rail car size) spills of HazMat materials (chlorine).

Biological: Anthrax delivered by mail or in packages, smallpox distributed by spray mechanism mounted on truck or aircraft in metropolitan area

Radiological: Small "dirty" bomb detonation within the 10-mile radius of the HazardCorp building

Design Basis Threat

Criminal Activity/Armed Attack: High powered rifle (sniper attack) or handgun shooting (direct assault on individuals).

Cyber Attack: Focus on IT and building systems infrastructure (SCADA, alarms, etc.) accessible via Internet access

Levels of Protection and Layers of Defense

Levels of Protection for Buildings

- GSA Interagency Security Criteria Level IV Building
- DoD Primary Gathering Building

Elements of the Layers of Defense Strategy

- Deter
- Detect
- Deny
- Devalue

Summary

FEMA Publication 426

Reference Manual
to Mitigate Potential Terrorist Attacks Against Buildings

FEMA Publication 452

Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Threats Against Buildings

Unit I-B Case Study Activity

Introduction and Overview

Background

Emphasis:

- Refamiliarize yourself with Appendix B Case Study and answer general questions
- Get acquainted with FEMA 426

Requirements

Refer to Case Study, and independently answer worksheet questions

Confer with team members on answers to normalize team information

Unit II
Asset Value Assessment

FEMA

Unit Objectives

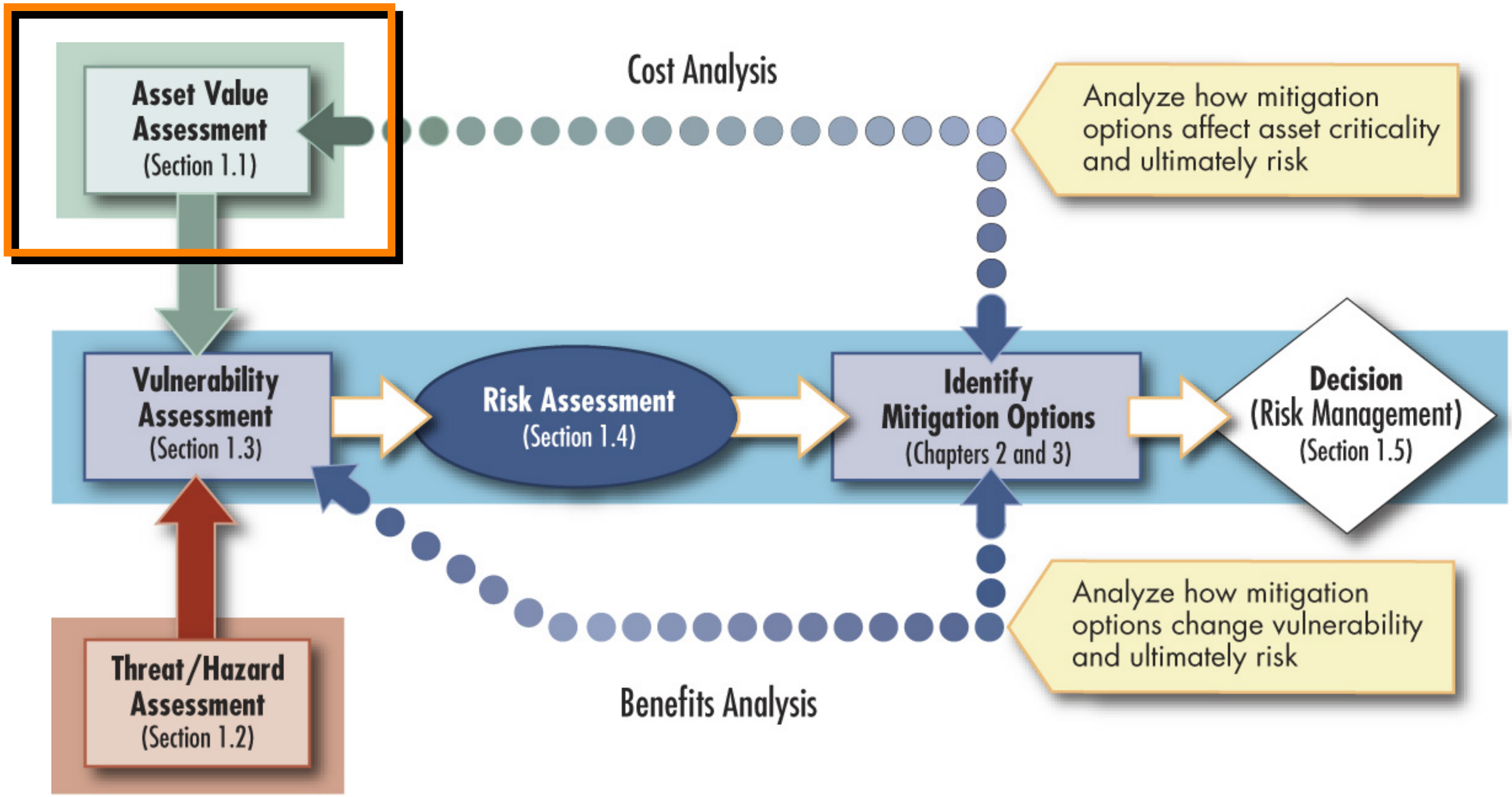
Identify the assets of a building or site that can be affected by a threat or hazard.

Explain the components used to determine the value of an asset.

Determine the critical assets of a building or site.

Provide a numerical rating for the asset and justify the basis for the rating.

Assessment Flow Chart



FEMA 426, Figure 1-3: The Assessment Process Model, p. 1-5

FEMA

Definition of Risk

Risk is a combination of:

- The probability that an event will occur, and
- The consequences of its occurrence

	Low Risk	Medium Risk	High Risk
Risk Factors Total	1-60	61-175	≥ 176

Risk = Asset Value x Threat Rating x Vulnerability Rating

Infrastructure	Function
Replacement/Repair	People
Loss of Use	

Asset - A resource of value requiring protection. An asset can be tangible, such as buildings, facilities, equipment, activities, operations, and information; or intangible, such as processes or a company's information and reputation.

FEMA 426, Table 1-19: Total Risk Color Code, p. 1-38

People and Asset Value

Asset Value - The degree of debilitating impact that would be caused by the incapacity or destruction of an asset.

Identification of a Building’s Assets

Two Step Process

Step 1: Define and understand a building’s core functions and processes

Step 2: Identify site and building infrastructure and systems

FEMA

Asset Value

Core Functions

- Primary services or outputs
- Critical activities
- Identify customers
- Inputs from external organizations

Critical Infrastructure

- Injuries or deaths related to lifelines
- Effect on core functions
- Existence of backups
- Availability of replacements
- Critical support lifelines
- Critical or sensitive information

Asset Value Rating

Asset Value		
Very High	10	Very High – Loss or damage of the building's assets would have exceptionally grave consequences, such as extensive loss of life, widespread severe injuries, or total loss of primary services core processes, and functions.
High	8-9	High – Loss or damage of the building's assets would have grave consequences, such as loss of life, severe injuries, loss primary services or major loss of core processes and functions for an extended period of time.
Medium High	7	Medium High – Loss or damage of the building's assets would have serious consequences, such as serious injuries or impairment of core processes and functions for an extended period of time.

Key elements

- Loss of assets and/or people would have grave, serious, moderate, or negligible consequences or impact

FEMA 426, Adaptation of Table 1-1: Asset Value Scale, p. 1-13

Asset Value Rating (continued)

Asset Value		
Medium	5-6	Medium – Loss or damage of the building's assets would have moderate to serious consequences, such as injuries or impairment of core functions and processes.
Medium Low	4	Medium Low – Loss or damage of the building's assets would have moderate consequences, such as minor injuries or minor impairment of core functions and processes
Low	2-3	Low – Loss or damage of the building's assets would have minor consequences or impact, such as a slight impact on core functions and processes for a short period of time.
Very Low	1	Very Low – Loss or damage of the building's assets would have negligible consequences or impact.

Key elements

- Loss of assets and/or people would have grave, serious, moderate, or negligible consequences or impact

FEMA

FEMA 426, Adaptation of Table 1-1: Asset Value Scale, p. 1-13

Asset Value Notional Example

Asset	Value	Numeric Value
Site	Medium Low	4
Architectural	Medium	5
Structural Systems	High	8
Envelope Systems	Medium High	7
Utility Systems	Medium High	7
Mechanical Systems	Medium High	7
Plumbing and Gas Systems	Medium	5
Electrical Systems	Medium High	7
Fire Alarm Systems	High	9
IT/Communications Systems	High	8

FEMA 426, Table 1-2: Nominal Building Asset Value Assessment, p. 1-14

Critical Functions

Function	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Administration				
Asset Value	**5**	**5**	**5**	**5**
Threat Rating				
Vulnerability Rating				
Engineering				
Asset Value	**8**	**8**	**8**	**8**
Threat Rating				
Vulnerability Rating				

FEMA 426, Adaptation of Table 1-20: Site Functional Pre-Assessment Screening Matrix, p. 1-38

Critical Infrastructure

Infrastructure	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Site				
Asset Value	**4**	**4**	**4**	**4**
Threat Rating				
Vulnerability Rating				
Structural Systems				
Asset Value	**8**	**8**	**8**	**8**
Threat Rating				
Vulnerability Rating				

FEMA 426, Adaptation of Table 1-21: Site Infrastructure Systems Pre-Assessment Screening Matrix, p. 1-39

Summary

Identify a building's Critical Functions and Critical Infrastructure

Assign a value to a building's assets or resources

Input values into the Critical Functions and Critical Infrastructure Matrices

FEMA

Unit II Case Study Activity

Asset Value Ratings

Background

Asset value: degree of debilitating impact that would be caused by the incapacity or destruction of a building's assets

FEMA 426: Tables 1-1 and 1-2

Requirements

Refer to Case Study and answer worksheet questions:

- Identify Core Functions
- Identify Building Assets
- Quantify Asset Values

Unit III
Threat / Hazard Assessment

FEMA

Unit Objectives

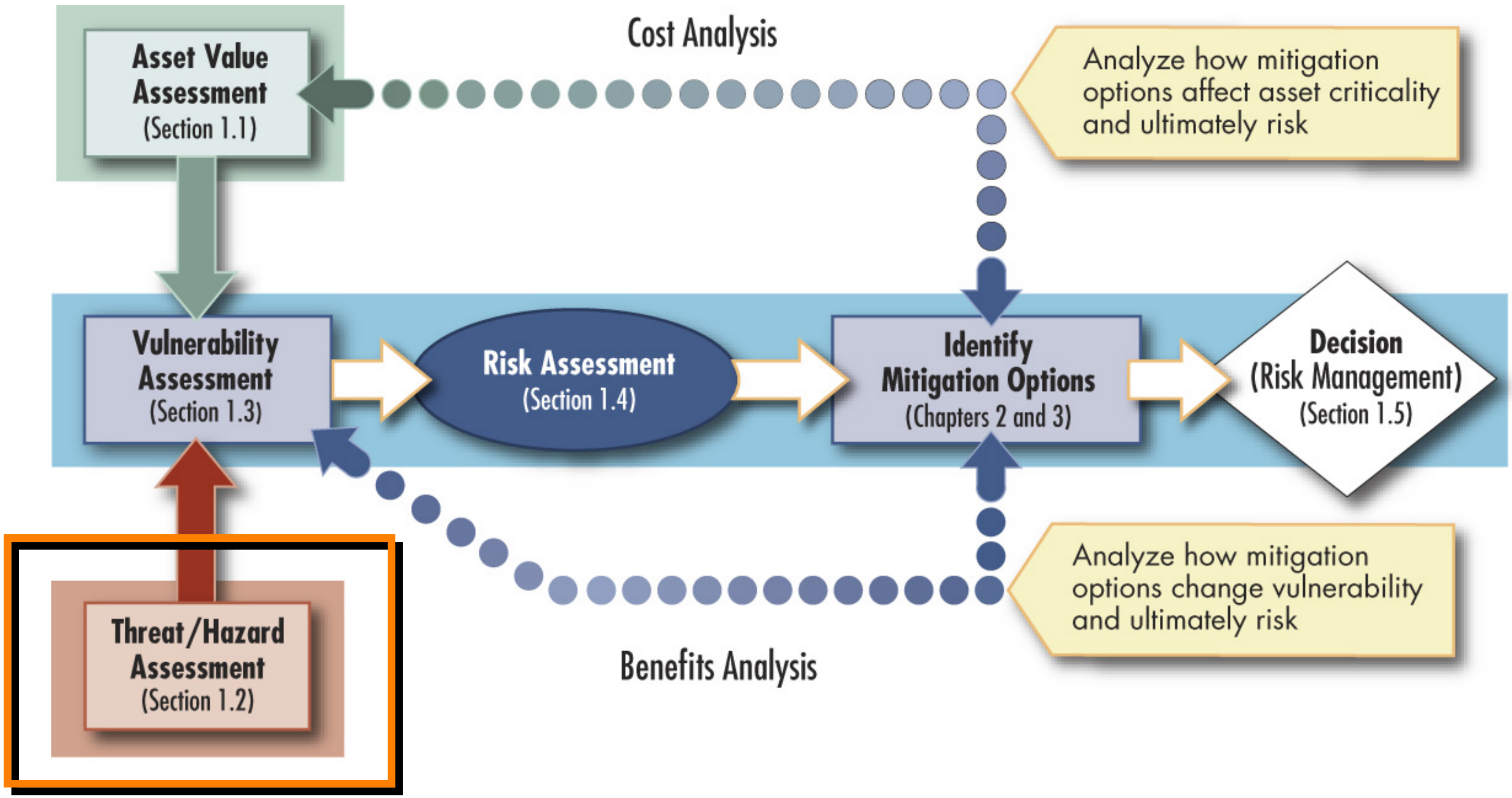
Identify the threats and hazards that may impact a building or site.

Define each threat and hazard using the FEMA 426 methodology.

Provide a numerical rating for the threat or hazard and justify the basis for the rating.

Define the Design Basis Threat, Levels of Protection, and Layers of Defense.

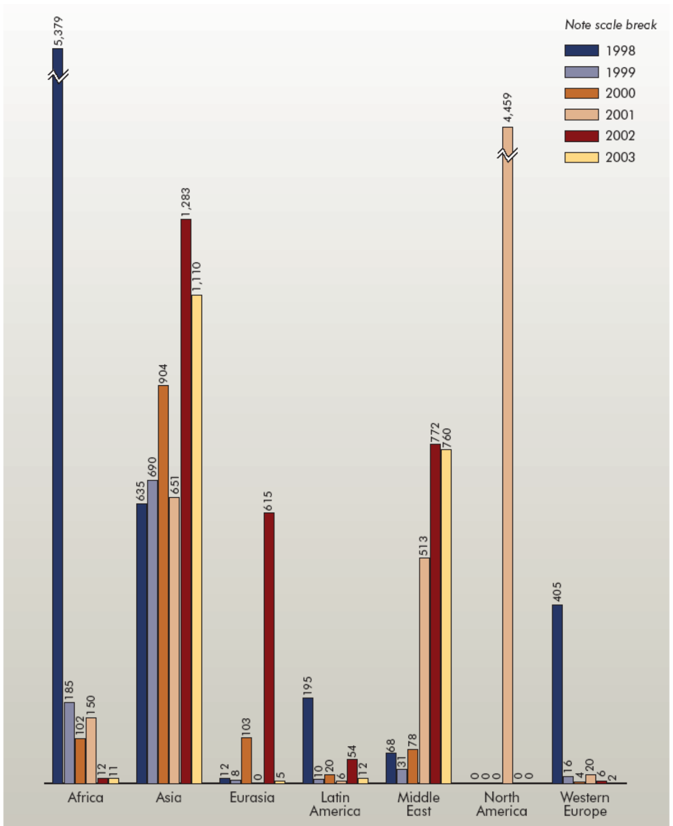
Assessment Flow Chart



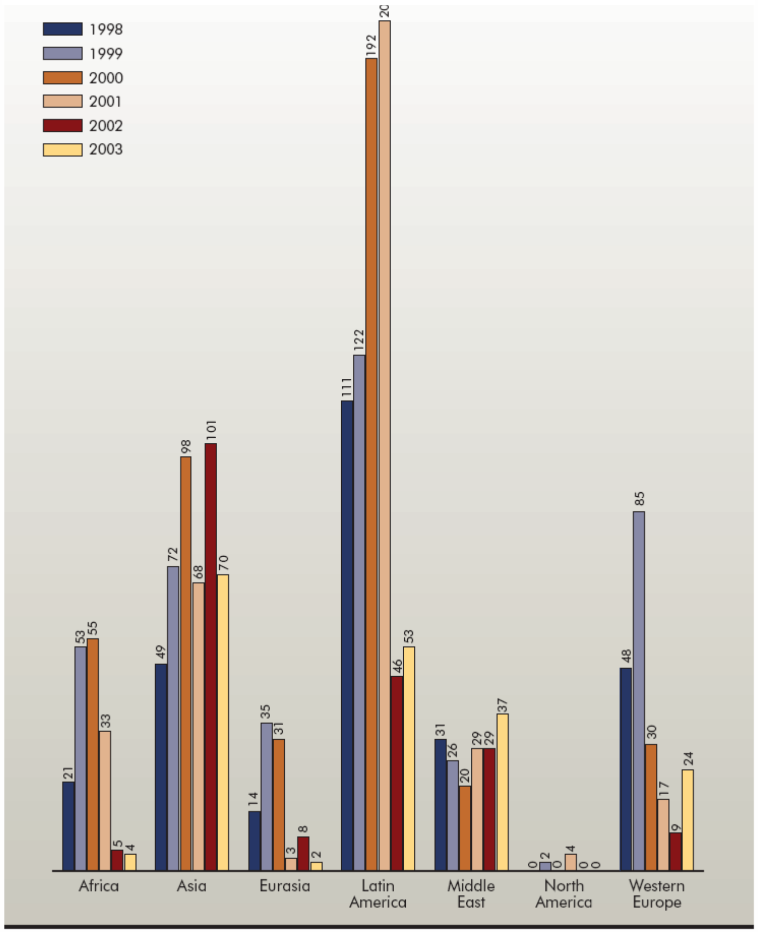
FEMA 426, Figure 1-3: The Assessment Process Model, p. 1-5

Nature of the Threat

International Casualties by Region 1998-2003



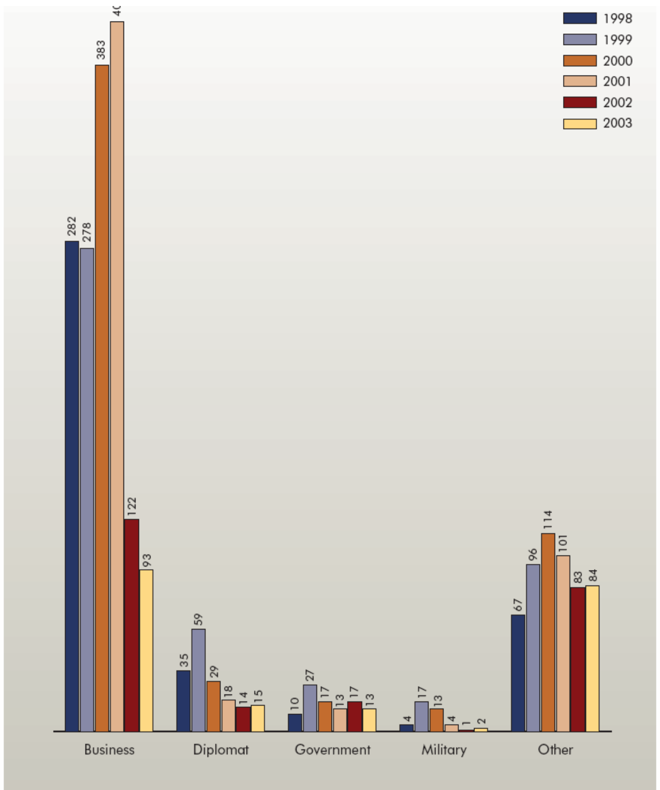
International Attacks by Region 1998-2003



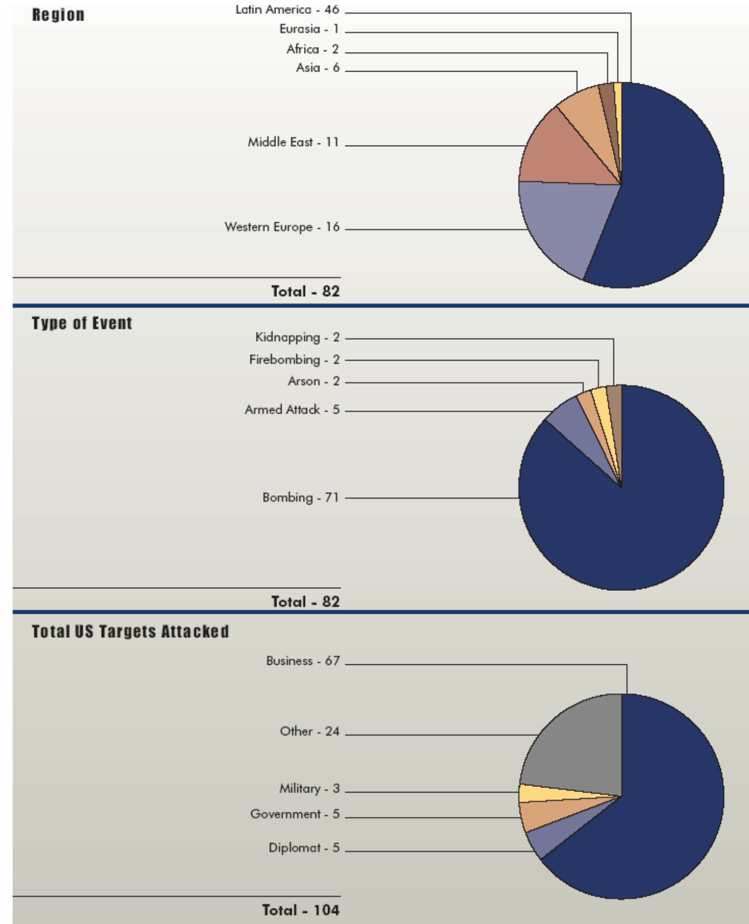
From *Patterns of Global Terrorism 2003 Department of State April* 2004

Nature of the Threat

Facilities Struck by International Attacks 1998-2003

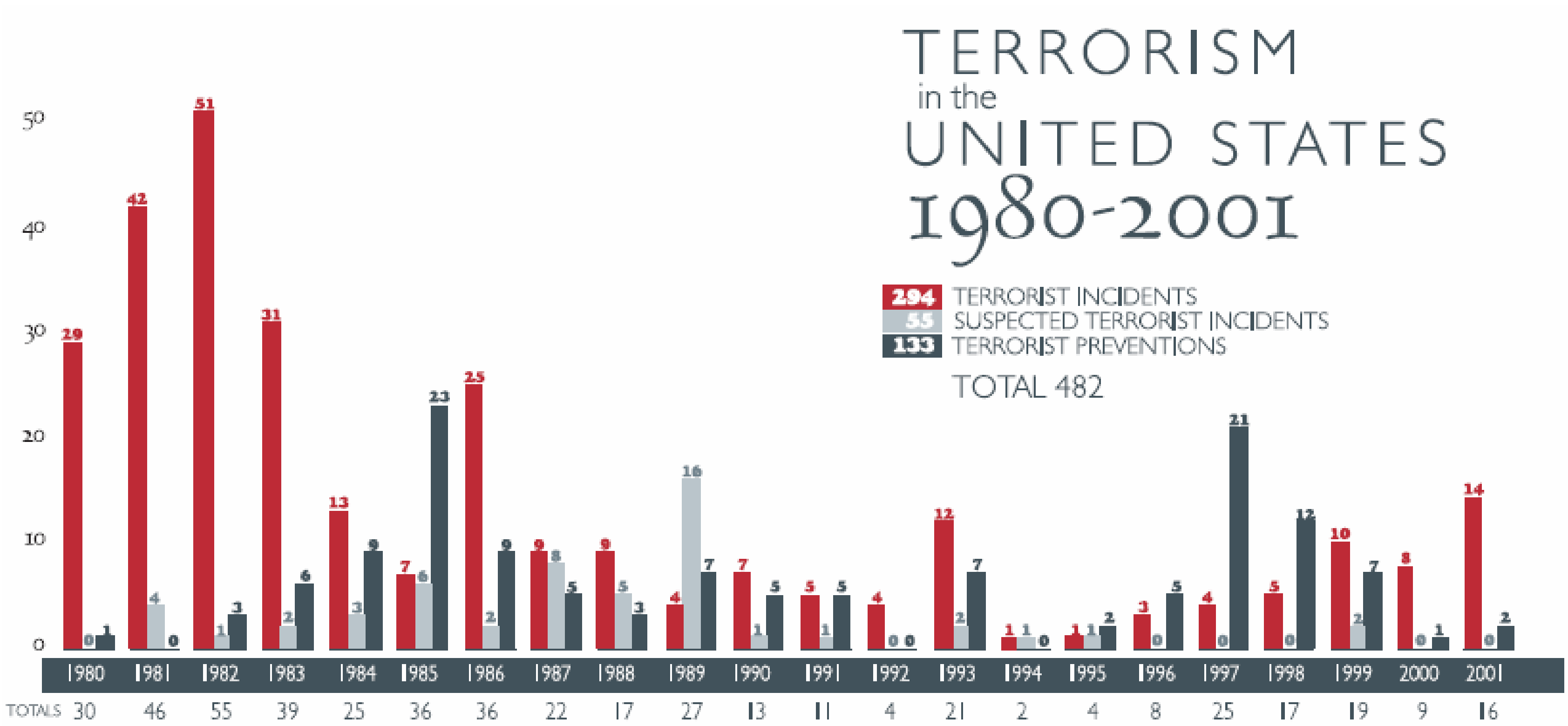


Total Anti-US Attacks 2003



From *Patterns of Global Terrorism 2003 Department of State April* 2004

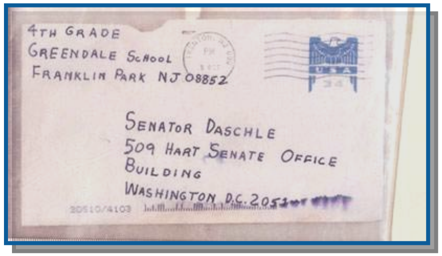
Nature of the Threat



From *Terrorism 2000/2001 FBI Publication #0308*

FEMA

CBR Terrorist Incidents Since 1970



1972 Typhoid
1984 Salmonella
200 Injured
1984 Botulinum
1985 Cyanide
1992 Cyanide
June 1994 Sarin
7 Dead, 200 Injured
March 1995 Sarin
12 Dead, 5,500 Affected
March 1995 Ricin
April 1995 Sarin
May 1995 Plague
April-June 1995 Cyanide, Phosgene, Pepper Spray
November 1995 Radioactive Cesium
December 1995 Ricin
June 1996 Uranium
February 1997 Chlorine
14 Injured, 500 Evacuated
April 1997 U235
March 1998 Cesium-137
2001 Anthrax
70
75
80
85
90
95
00

FEMA

Hazard

Hazard - A source of potential danger or adverse condition.

FEMA

- Natural Hazards are naturally-occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, hurricanes, and wildfires.

FEMA

FEMA

Manmade Threats

Threats – Any indication, circumstance, or event with the potential to cause loss of, or damage to an asset. They can be technological accidents and terrorist attacks.

Technological accident

Terrorism act

Threat Overview

Any indication, circumstance, or event with the potential to cause loss of, or damage to an asset

Involves two steps:

- **Selection of primary threats:** tools and tactics as well as people with intent to cause harm
- **Determine the threat rating:** a parameter used to quantify your losses

Weapons, tools, and tactics can change faster than a building can be modified.

Threat Overview

- Improvised Explosive Device (Bomb)
- Armed Attack
- Chemical Agent
- Biological Agent
- Radiological Agent
- Cyberterrorism

FEMA

Step 1: Selection of Primary Threats

Criteria

Criteria							
Scenario	**Access to Agent**	**Knowledge/ Expertise**	**History of Threats (Building Functions/ Tenants)**	**Asset Visibility/ Symbolic**	**Asset Accessibility**	**Site Population/ Capacity**	**Level of Defense**
9-10	Readily available	Basic knowledge/ open source	Local incident, occurred recently, caused great damage; building functions and tenants were primary targets	Existence widely known/ iconic	Open access, unrestricted parking	> 5,000	Little to no defense against threats. No security design was taken into consideration and no mitigation measures adopted.
6-8	Easy to produce	Bachelor's degree or technical school/open scientific or technical literature	Regional/State incident, occurred a few years ago, caused substantial damage; building functions and tenants were one of the primary targets	Existence locally known/ landmark	Open access, restricted parking	1,001-5,000	Minimal defense against threats. Minimal security design was taken into consideration and minimal mitigation measures adopted.
3-5	Difficult to produce or acquire	Advanced training/rare scientific or declassified literature	National incident, occurred some time in the past, caused important damage; building functions and tenants were one of the primary targets	Existence published/ well-known	Controlled access, protected entry	251-1,000	Significant defense against threats. Significant security design was taken into consideration and substantial mitigation measures adopted.
1-2	Very difficult to produce or acquire	Advanced degree or training/ classified information	International incident, occurred many years ago, caused localized damage; building functions and tenants were not the primary targets	Existence not well-known/ no symbolic importance	Remote location, secure perimeter, armed guards, tightly controlled access	1-250	Extensive defense against threats. Extensive security design was taken into consideration and extensive mitigation measures adopted.

FEMA 452, Table 1-4: Criteria to Select Primary Threats, p. 1-20

Selected Threats

- Cyber Attack
- Armed Attack
- Vehicle Bomb
- CBR Attack

Step 1: Selection of Primary Threats

Scenario	Access to Agent	Knowledge/ Expertise	History of Threats (Building Functions/ Tenants)	Asset Visibility/ Symbolic	Asset Accessibility	Site Population/ Capacity	Level of Defense	Score
	Criteria							Score
Improvised Explosive Device (Bomb)								
1-lb. Mail Bomb	9	9	3	8	3	10	3	45
5-lb. Pipe Bomb	9	9	3	8	3	10	3	45
50-lb. Satchel Bomb/Suicide Bomber	8	8	6	8	3	10	5	48
500-lb. Car Bomb	6	8	7	8	3	10		
5,000-lb. Truck Bomb	4	8	5	8	3	10		
20,000-lb. Truck Bomb	2	6	1	8	3	10		
Natural Gas	2	8	1	8	3	10		

	Scenario	Access to Agent	Knowledge/ Expertise	History of Threats (Building Functions/ Tenants)	Asset Visibility/ Symbolic	Asset Accessibility	Site Population/ Capacity	Level of Defense	Score
		Criteria							Score
Chemical Agent									
Choking	Chlorine	5	7	2	8	3	10	5	40
Choking	Phosgene	3	10	2	8	3	10	5	41
Blood	Hydrogen Cyanide	3	8	2	8	3	10	5	39
Blister	Lewisite	3	6	2	8	3	10	5	37
Nerve	Sarin	3	4	9	8	3	10	5	42

FEMA

FEMA 452, Adaptation of Table 1-5: Nominal Example to Select Primary Threats for a Specific Urban Multi-story Building, p. 1-21

Step 2: Determine the Threat Rating

Threat Rating		
Very High	10	Very High – The likelihood of a threat, weapon, and tactic being used against the site or building is imminent. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat is credible.
High	8-9	High – The likelihood of a threat, weapon, and tactic being used against the site or building is expected. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat is credible.
Medium High	7	Medium High – The likelihood of a threat, weapon, and tactic being used against the site or building is probable. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat is credible.

Key elements

- Likelihood of a threat (credible, verified, exists, unlikely, unknown)
- If the use of the weapon is considered imminent, expected, or probable

FEMA 452 Table 1-6: Threat Rating, p. 1-24

Step 2: Determine the Threat Rating
(continued)

Threat Rating		
Medium	5-6	Medium – The likelihood of a threat, weapon, and tactic being used against the site or building is possible. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat is known, but is not verified.
Medium Low	4	Medium Low – The likelihood of a threat, weapon, and tactic being used in the region is probable. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat is known, but is not likely.
Low	2-3	Low – The likelihood of a threat, weapon, and tactic being used in the region is possible. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat exists, but is not likely.
Very Low	1	Very Low – The likelihood of a threat, weapon, and tactic being used in the region or against the site or building is very negligible. Internal decision-makers and/or external law enforcement and intelligence agencies determine the threat is non-existent or extremely unlikely.

Key elements

- Likelihood of a threat (credible, verified, exists, unlikely, unknown)
- If the use of the weapon is considered imminent, expected, or probable

FEMA 452 Table 1-6: Threat Rating, p. 1-24

FEMA

Critical Functions

Function	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Administration				
Asset Value	5	5	5	5
Threat Rating	**8**	**4**	**3**	**2**
Vulnerability Rating				
Engineering				
Asset Value	8	8	8	8
Threat Rating	**8**	**5**	**6**	**2**
Vulnerability Rating				

FEMA 426, Adaptation of Table 1-20: Site Functional Pre-Assessment Screening Matrix, p. 1-38

Critical Infrastructure

Infrastructure	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Site				
Asset Value	4	4	4	4
Threat Rating	**4**	**4**	**3**	**2**
Vulnerability Rating				
Structural Systems				
Asset Value	8	8	8	8
Threat Rating	**3**	**4**	**3**	**2**
Vulnerability Rating				

FEMA 426, Adaptation of Table 1-21: Site Infrastructure Systems Pre-Assessment Screening Matrix, p. 1-39

Threat Sources

Identify Threat Statements

Identify Area Threats

Identify Facility-Specific Threats

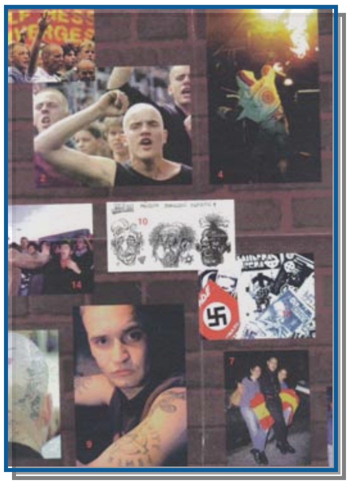
Identify Potential Threat Element Attributes

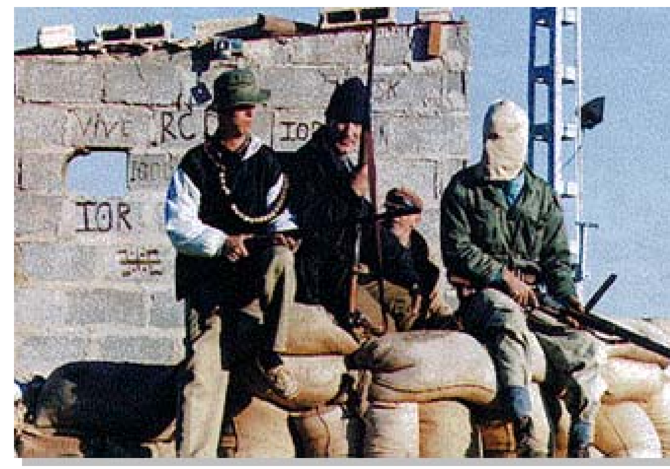
Seek information from local law enforcement, FBI, U.S. Department of Homeland Security, and Homeland Security Offices at the state level.

FEMA 426, p. 1-14 to 1-15

Design Basis Threat

The threat against which assets within a building must be protected and upon which the security engineering design of the building is based.





Levels of Protection

Layers of Defense Elements

- Deter
- Detect
- Deny
- Devalue

The strategy of Layers of Defense uses the elements and Levels of Protection to develop mitigation options to counter or defeat the tactics, weapons, and effects of an attack defined by the Design Basis Threat.

FEMA 426, p. 1-9

Levels of Protection

Deter: The process of making the target inaccessible or difficult to defeat with the weapon or tactic selected. It is usually accomplished at the site perimeter using highly visible electronic security systems, fencing, barriers, lighting and security personnel; and in the building by security access with locks and electronic monitoring devices.

Detect: The process of using intelligence sharing and security services response to monitor and identify the threat before it penetrates the site perimeter or building access points.

FEMA 426, p. 1-9

Levels of Protection

Deny: The process of minimizing or delaying the degree of site or building infrastructure damage or loss of life or protecting assets by designing or using infrastructure and equipment designed to withstand blast and chemical, biological, or radiological effects.

Devalue: The process of making the site or building of little to no value or consequence, from the terrorists' perspective, such that an attack on the facility would not yield their desired result.

FEMA 426, p. 1-9

Levels of Protection

Level**	Typical Location	Examples of Tenant Agencies***	Security Measures (based on evaluation)
I	10 Employees (Federal) 2,500 Square Feet Low Volume Public Contact Small "Store Front" Type Operation	Local Office District Office Visitor Center USDA Office Ranger Station Commercial Facilities Industrial/Manufacturing Health Care	High Security Locks Intercom Peep Hole (Wide View) Lighting w/Emergency Backup Power Controlled Utility Access Annual Employee Security Training
II	11 - 150 Employees (Federal) 2,500 - 80,000 Square Feet Moderate Volume Public Contact Routine Operations Similar to Private Sector and/or Facility Shared with Private Sector	Public Officials Park Headquarters Regional/State Offices Commercial Facilities Industrial Manufacturing Health Care	Entry Control Package w/Closed Circuit Television (CCTV) Visitor Control/Screening Shipping/Receiving Procedures Guard/Patrol Assessment Intrusion Detection w/Central Monitoring CCTV Surveillance (Pan-Tilt, Zoom System) Duress Alarm w/Central Monitoring

FEMA 426, Table 1-6: Classification Table Extracts, p. 1-26

Levels of Protection (continued)

Level**	Typical Location	Examples of Tenant Agencies***	Security Measures (based on evaluation)
III	151 - 450 Employees (Federal) Multi-Story Facility 80,000 - 150,000 Square Feet Moderate/High Volume Public Contact Agency Mix: Law Enforcement Operations Court Functions Government Records	Inspectors General Criminal Investigations Regional/State Offices GSA Field Office Local Schools Commercial Facilities Industrial Manufacturing Health Care	Guard Patrol on Site Visitor Control/Screening Shipping/Receiving Procedures Intrusion Detection w/Central Monitoring CCTV Surveillance (Pan-Tilt/Zoom System) Duress Alarm w/Central Monitoring
IV	>450 Employees (Federal) Multi-Story Facility >150,000 Square Feet High Volume Public Contact High-Risk Law Enforcement/Intelligence Agencies District Court	Significant Buildings and Some Headquarters Federal Law Enforcement Agencies Local Schools, Universities Commercial Facilities Health Care	Extend Perimeter (Concrete/Steel Barriers) 24-Hour Guard Patrol Adjacent Parking Control Backup Power System Hardened Parking Barriers
V	Level IV Profile and Agency/Mission Critical to National Security	Principal Department Headquarters	Agency-Specific

FEMA 426, Table 1-6: Classification Table Extracts, p. 1-26

Levels of Protection

DoD Minimum Antiterrorism (AT) Standards for New Buildings

Level of Protection	Potential Structural Damage	Potential Door and Glazing Hazards	Potential Injury
Below AT standards	Severely damaged. Frame collapse/ massive destruction. Little left standing.	Doors and windows fail and result in lethal hazards	Majority of personnel suffer fatalities.
Very Low	Heavily damaged - onset of structural collapse. Major deformation of primary and secondary structural members, but progressive collapse is unlikely. Collapse of non-structural elements.	Glazing will break and is likely to be propelled into the building, resulting in serious glazing fragment injuries, but fragments will be reduced. Doors may be propelled into rooms, presenting serious hazards.	Majority of personnel suffer serious injuries. There are likely to be a limited number (10 percent to 25 percent) of fatalities.

FEMA 426, Table 4-1, p. 4-9

Levels of Protection (continued)

Level of Protection	Potential Structural Damage	Potential Door and Glazing Hazards	Potential Injury
Low	Damaged – unrepairable. Major deformation of non-structural elements and secondary structural members, and minor deformation of primary structural members, but progressive collapse is unlikely.	Glazing will break, but fall within 1 meter of the wall or otherwise not present a significant fragment hazard. Doors may fail, but they will rebound out of their frames, presenting minimal hazards.	Majority of personnel suffer significant injuries. There may be a few (<10 percent) fatalities.
Medium	Damaged – repairable. Minor deformations of non-structural elements and secondary structural members and no permanent deformation in primary structural members.	Glazing will break, but will remain in the window frame. Doors will stay in frames, but will not be reusable.	Some minor injuries, but fatalities are unlikely.
High	Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural elements.	Glazing will not break. Doors will be reusable.	Only superficial injuries are likely.

DoD Minimum Standards

FEMA 426, Table 4-1, p. 4-9

FEMA

Levels of Protection

UFC 4-010-01 APPENDIX B DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS	
Standard 1	Minimum Stand-off Distances
Standard 2	Unobstructed Space
Standard 3	Drive-Up/Drop-Off Areas
Standard 4	Access Roads
Standard 5	Parking Beneath Buildings or on Rooftops
Standard 6	Progressive Collapse Avoidance
Standard 7	Structural Isolation
Standard 8	Building Overhangs
Standard 9	Exterior Masonry Walls
Standard 10	Windows, Skylights, and Glazed Doors
Standard 11	Building Entrance Layout
Standard 12	Exterior Doors

Levels of Protection

UFC 4-010-01 APPENDIX B DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS	
Standard 13	Mailrooms
Standard 14	Roof Access
Standard 15	Overhead Mounted Architectural Features
Standard 16	Air Intakes
Standard 17	Mailroom Ventilation
Standard 18	Emergency Air Distribution Shutoff
Standard 19	Utility Distribution and Installation
Standard 20	Equipment Bracing
Standard 21	Under Building Access
Standard 22	Mass Notification

Summary

Process

- Identify each threat/hazard
- Define each threat/hazard
- Determine threat level for each threat/hazard

Threat Assessment Specialist Tasks

Critical Infrastructure and Critical Function Matrix

Determine the “Design Basis Threat”

Select the “Level of Protection”

Unit III Case Study Activity

Threat Ratings

Background

Hazards categories: natural and manmade

Case Study Threats: Cyber Attack, Armed Attack, Vehicle Bomb, and CBR Attack (latter two are main focus of course)

Result of assessment: “Threat Rating,” a subjective judgment of threat

Requirements

Refer to Case Study data

Complete worksheet tables:

- Critical Function Threat Rating
- Critical Infrastructure Threat Rating

Unit IV
Vulnerability Assessment

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

Vulnerability

Any weakness that can be exploited by an aggressor or, in a non-terrorist threat environment, make an asset susceptible to hazard damage

Unit Objectives

Explain what constitutes a vulnerability.

Identify vulnerabilities using the Building Vulnerability Assessment Checklist.

Understand that an identified vulnerability may indicate that an asset:

- is vulnerable to more than one threat or hazard;
- and that mitigation measures may reduce vulnerability to one or more threats or hazards.

Provide a numerical rating for the vulnerability and justify the basis for the rating.

FEMA

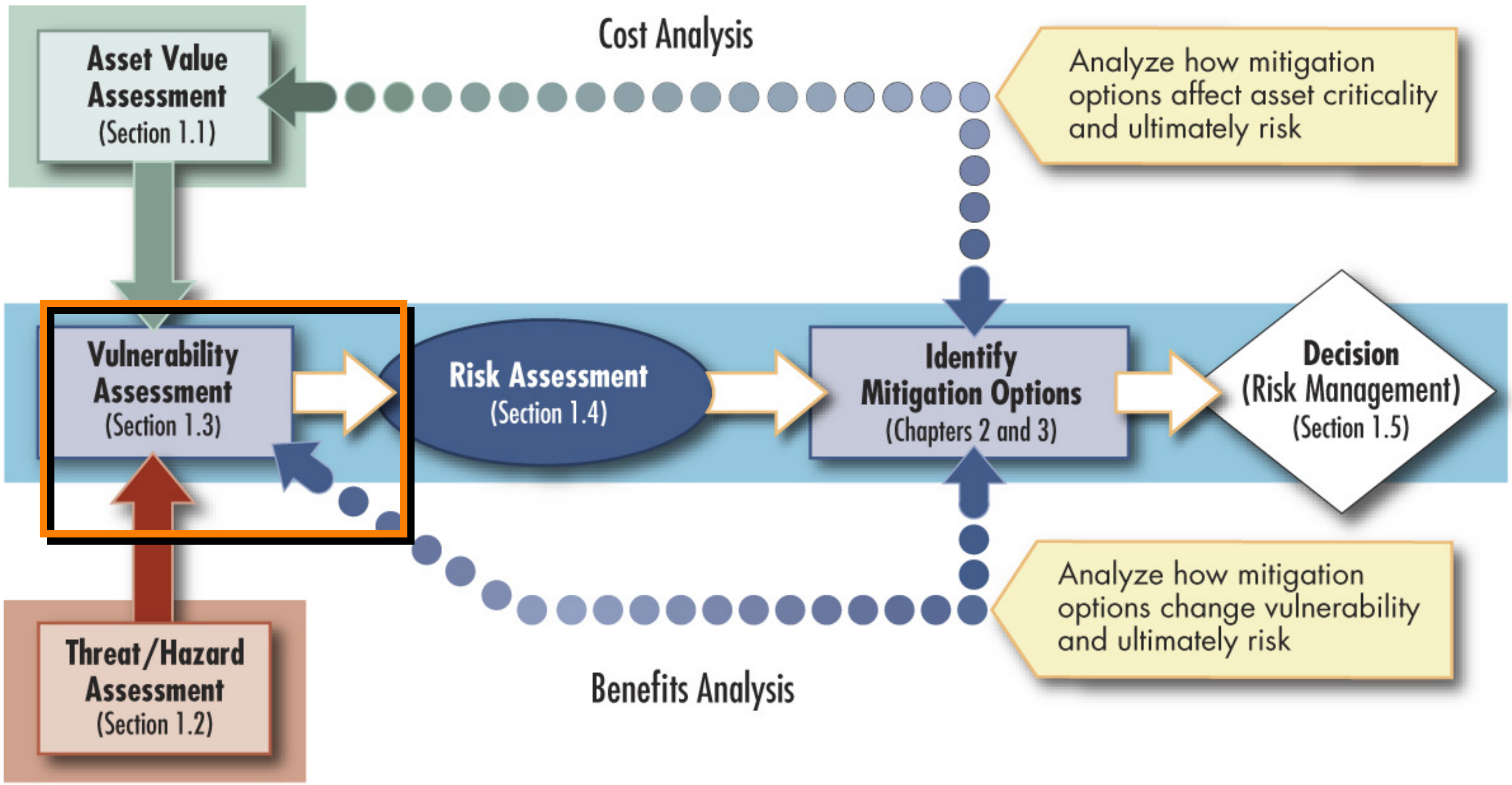
Vulnerability Assessment

Identify site and building systems design issues

Evaluate design issues against type and level of threat

Determine level of protection sought for each mitigation measure against each threat

Assessment Flow Chart



FEMA 426, Figure 1-3: The Assessment Process Model, p. 1-5

Identifying Vulnerabilities

Multidisciplinary Team

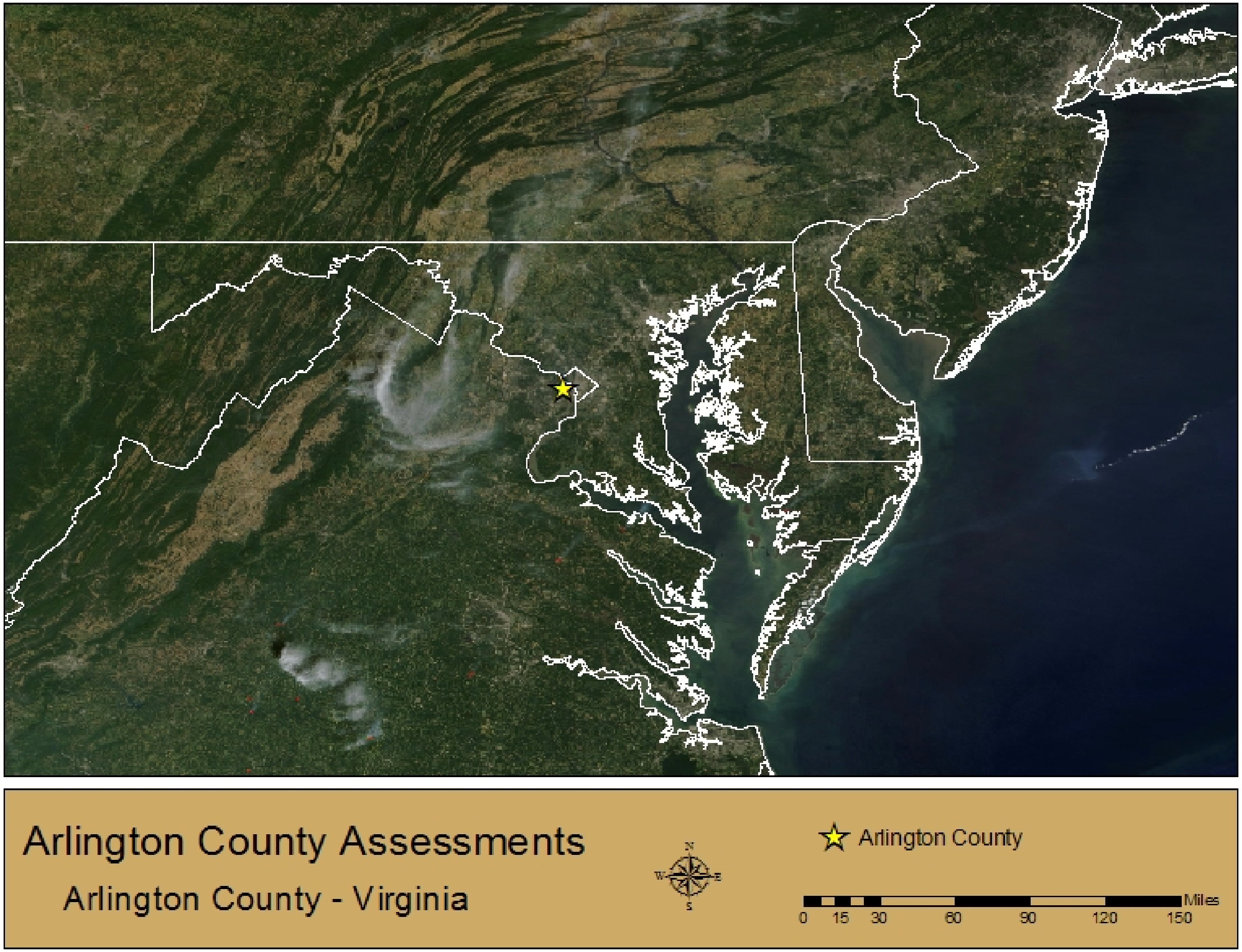
- Engineers
- Architects
- Security specialists
- Subject matter experts
- Outside experts if necessary

Vulnerability Assessment Preparation

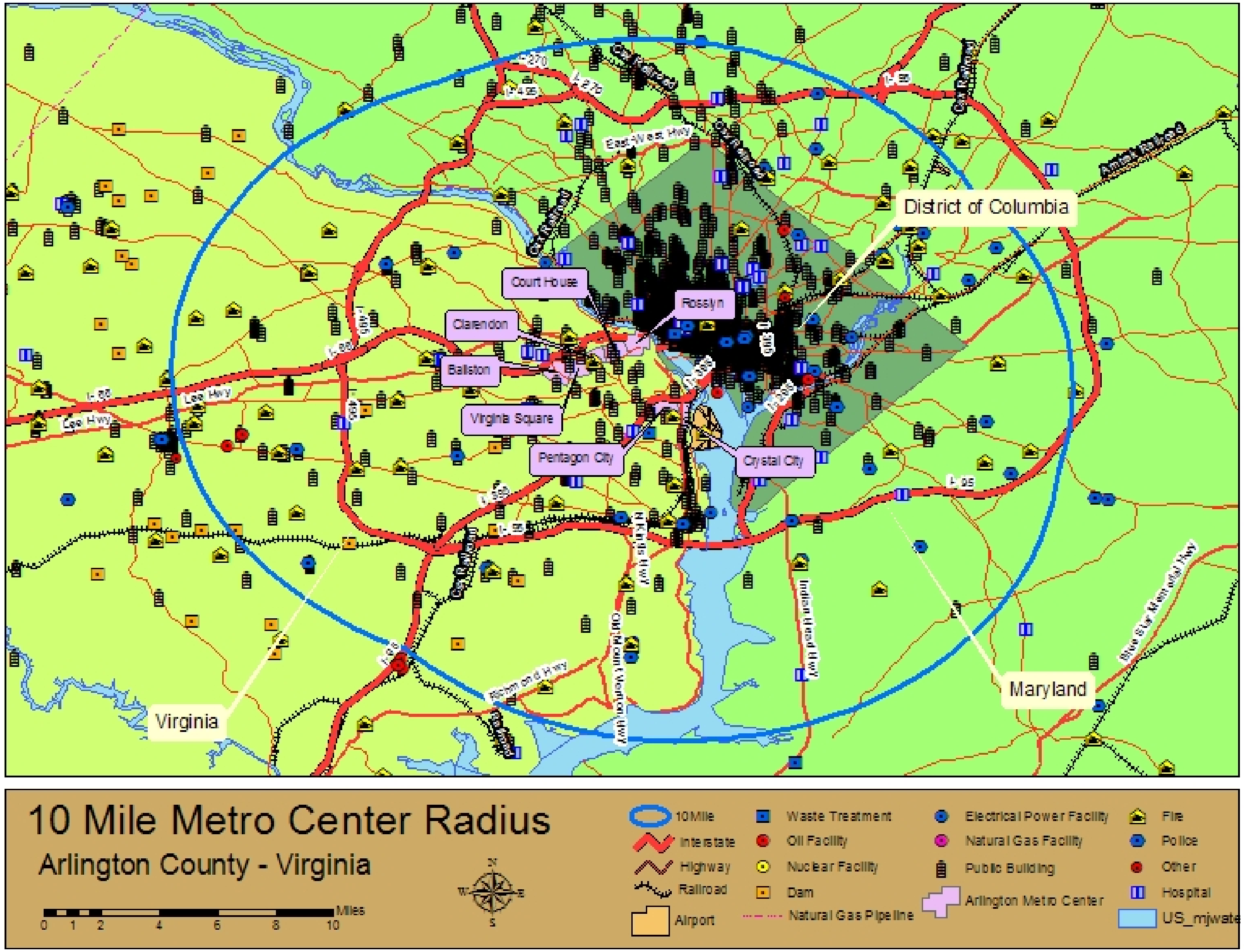
Coordinate with the building stakeholders:

- Site and Building Plans
- Utilities
- Emergency Plans (shelter, evacuation)
- Interview schedules
- Escorts for building access

Assessment GIS Portfolio

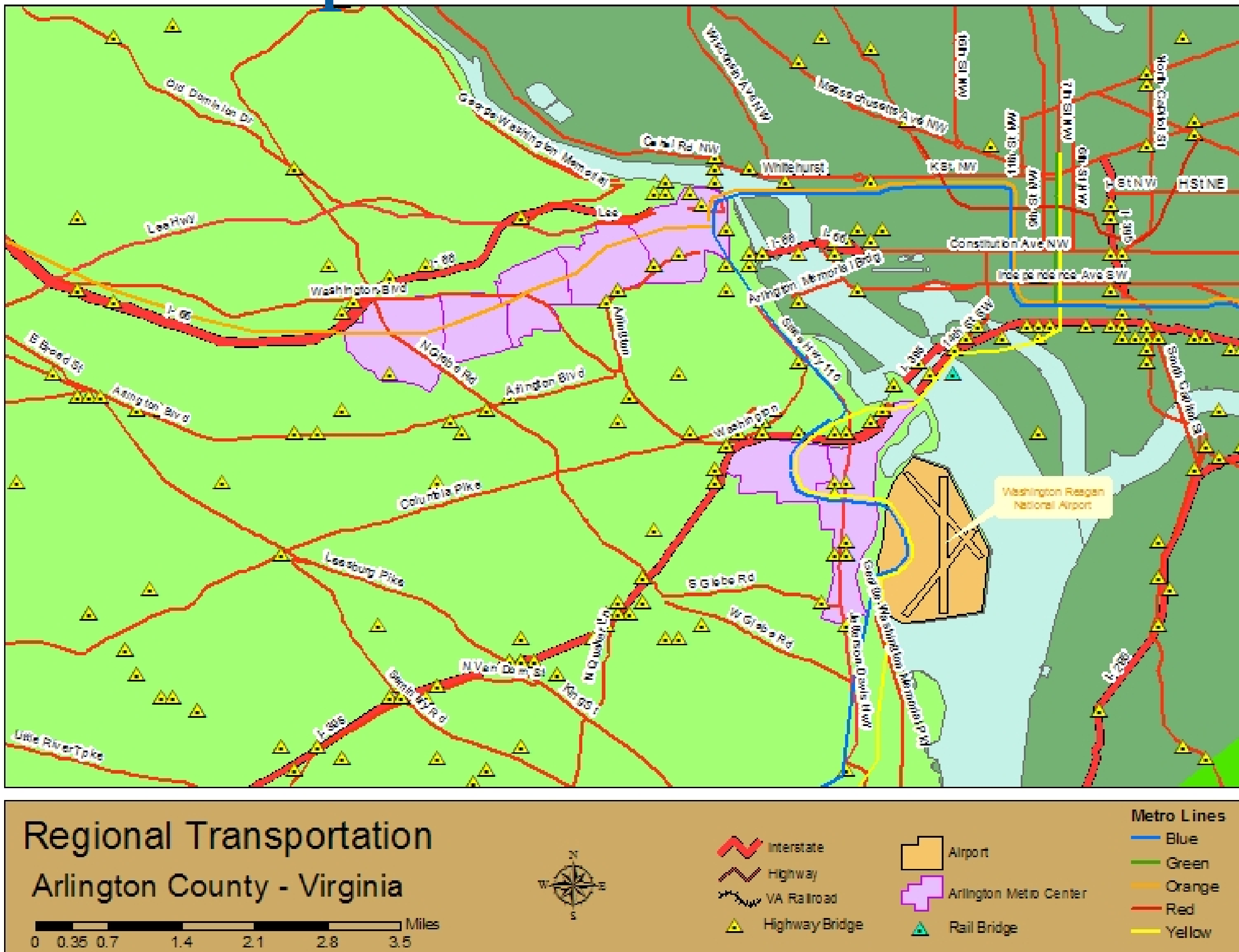


10-Mile Radius



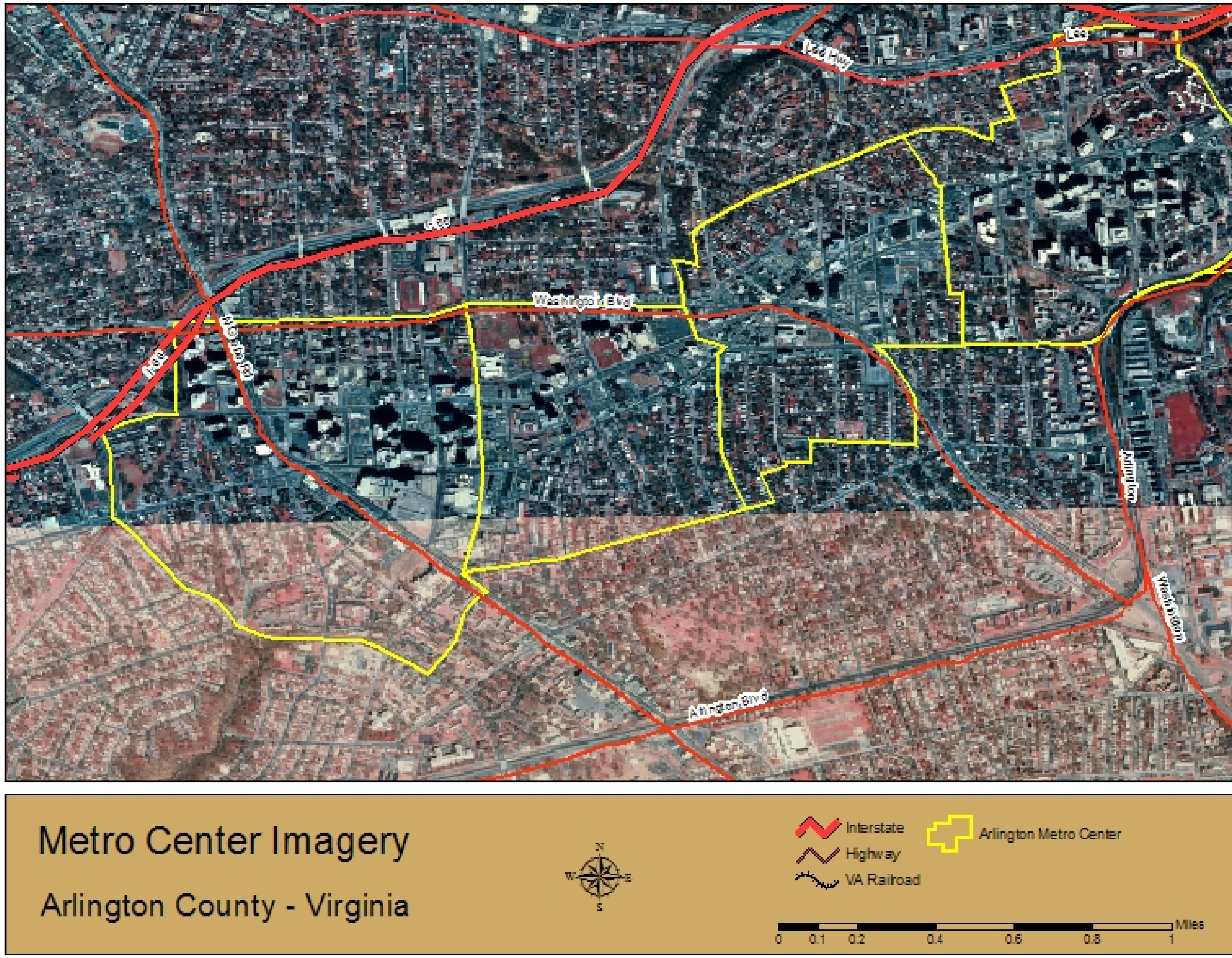
FEMA

Regional Transportation

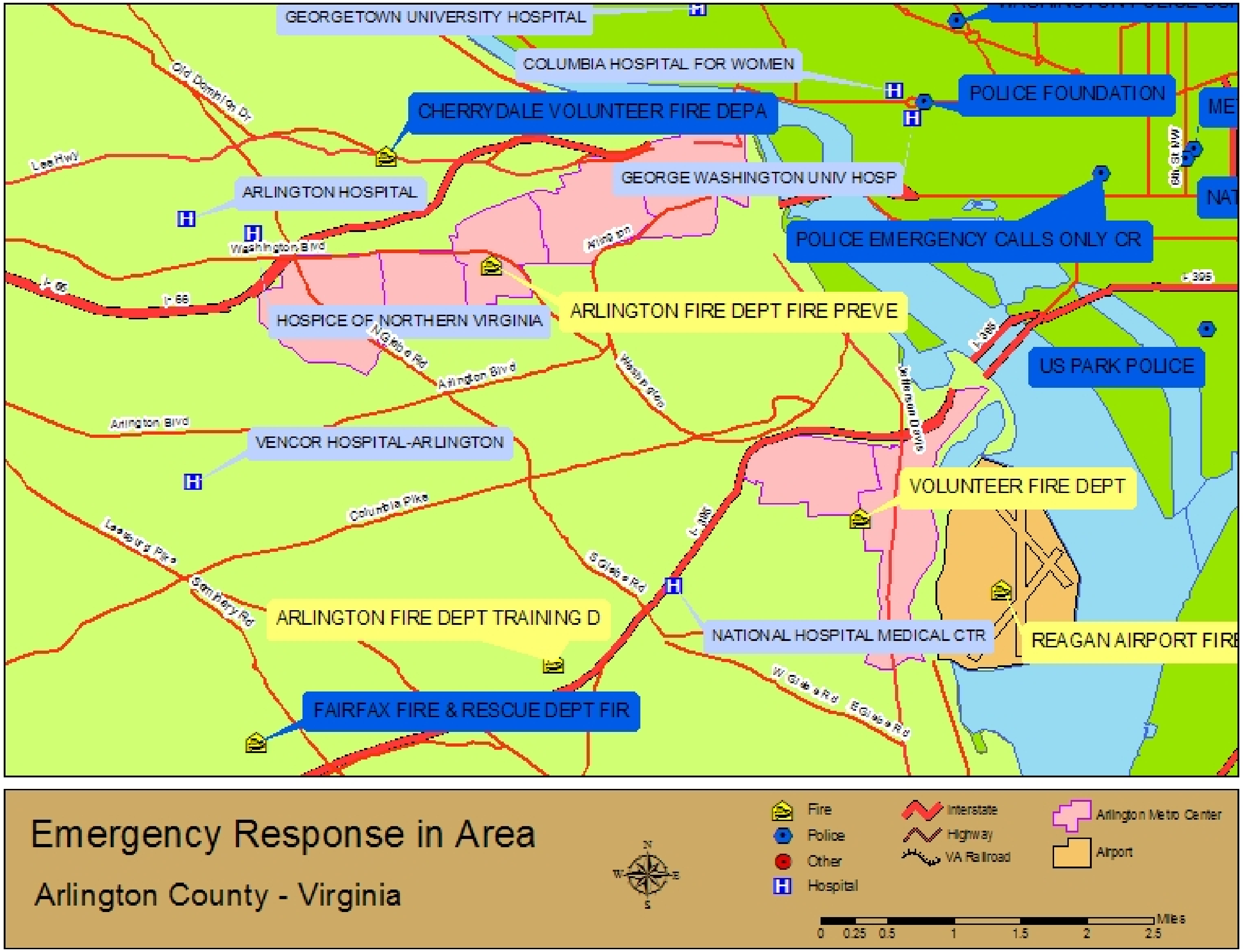


FEMA

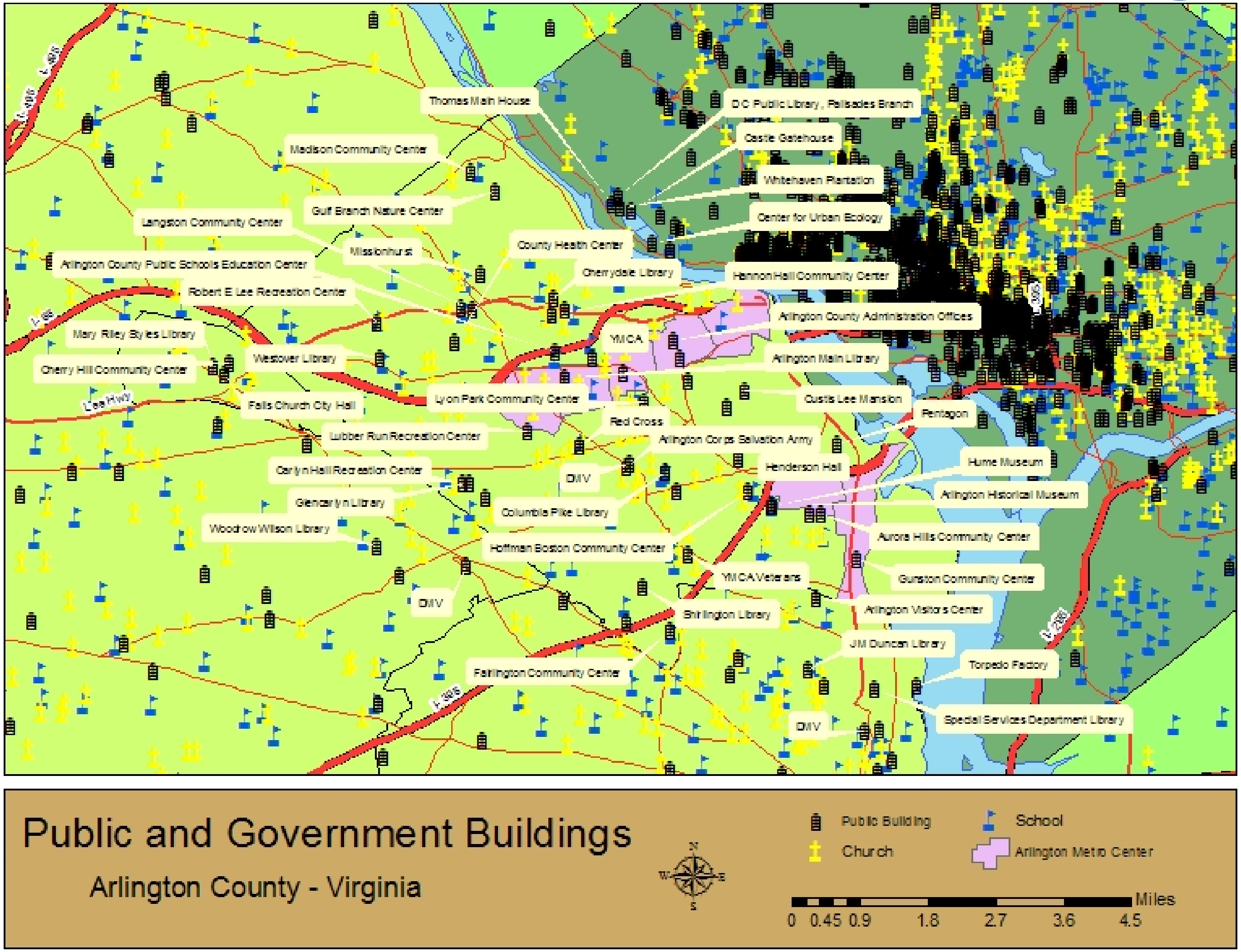
Metro Center Imagery



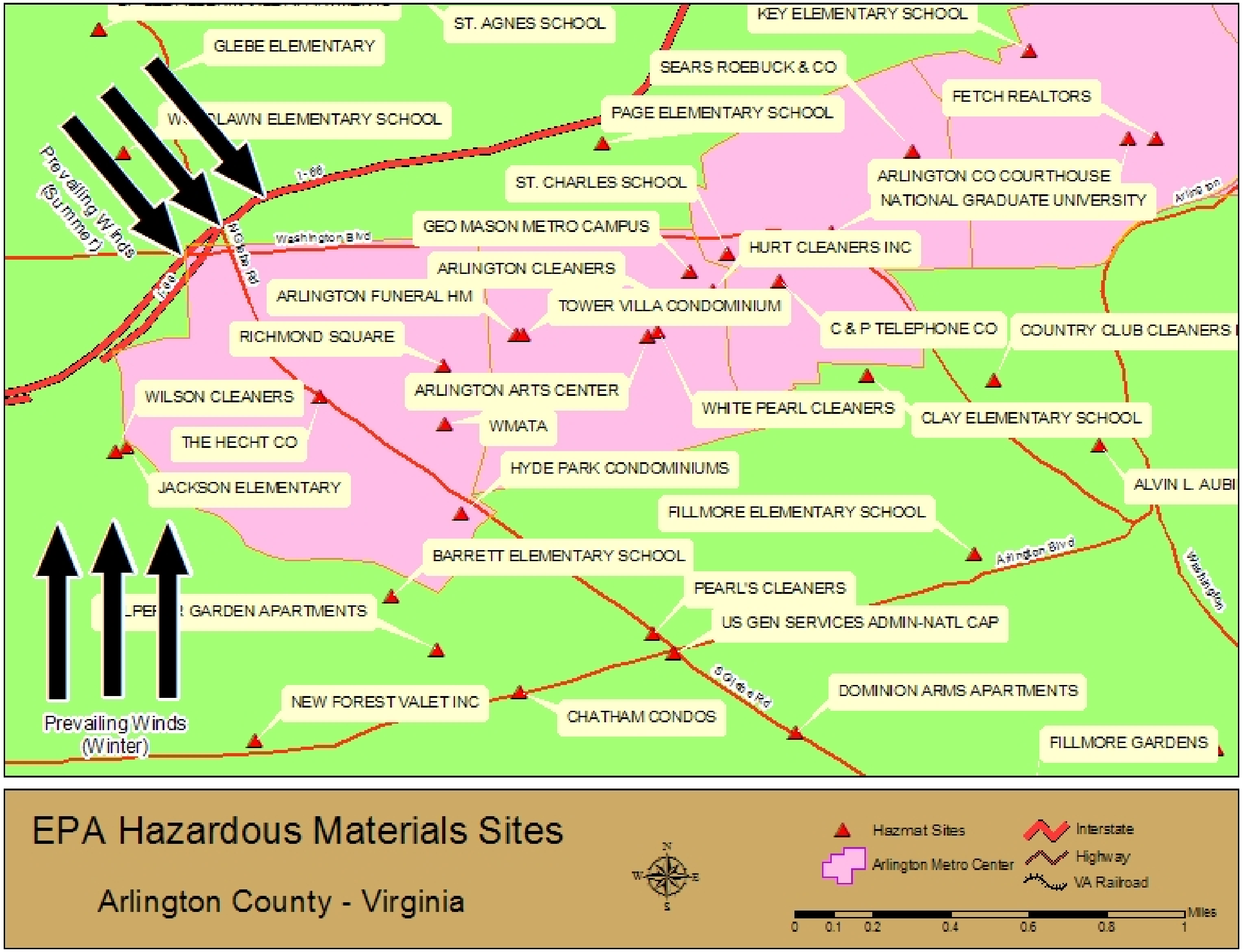
Site Emergency Response



Site Public and Government Buildings

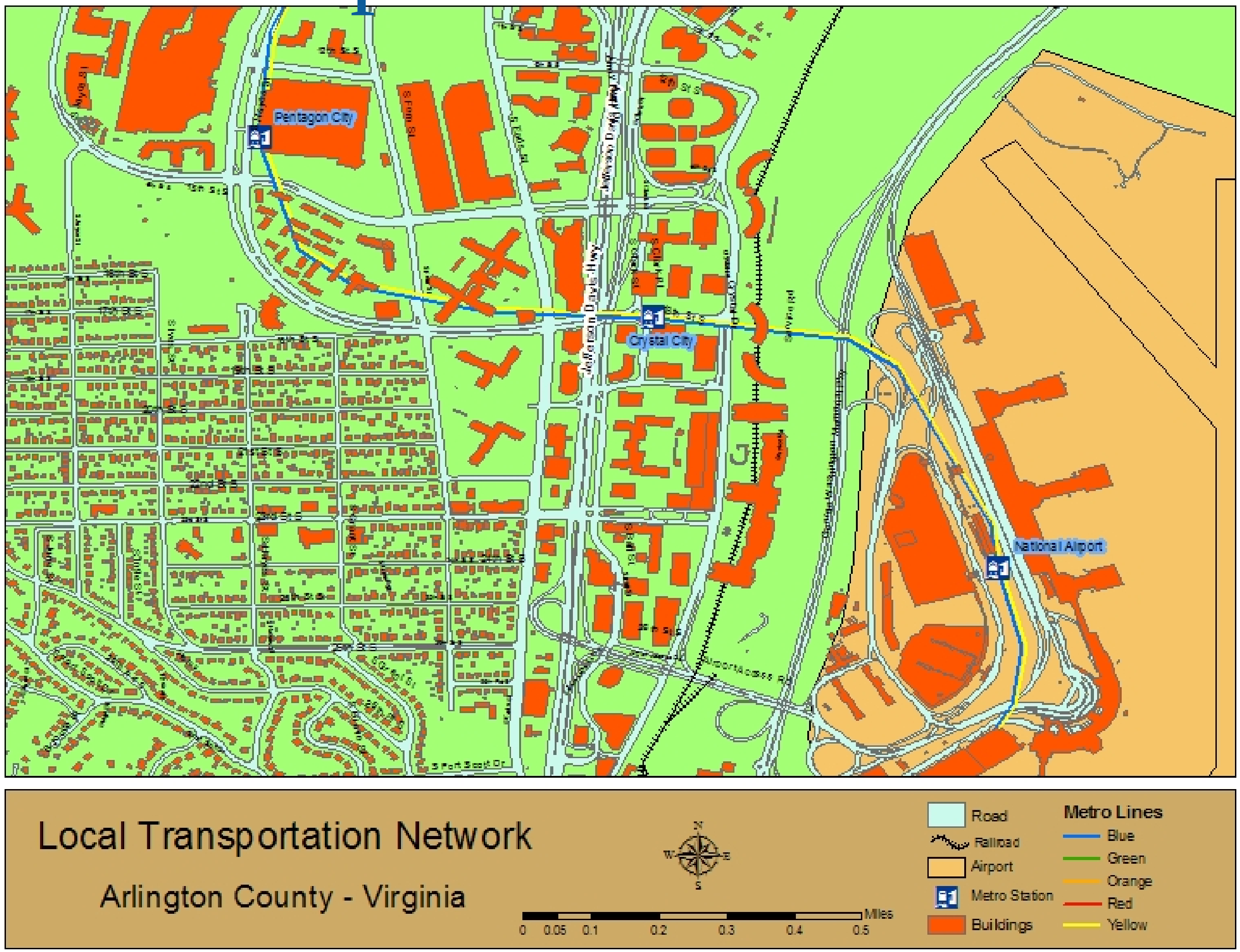


Site HazMat

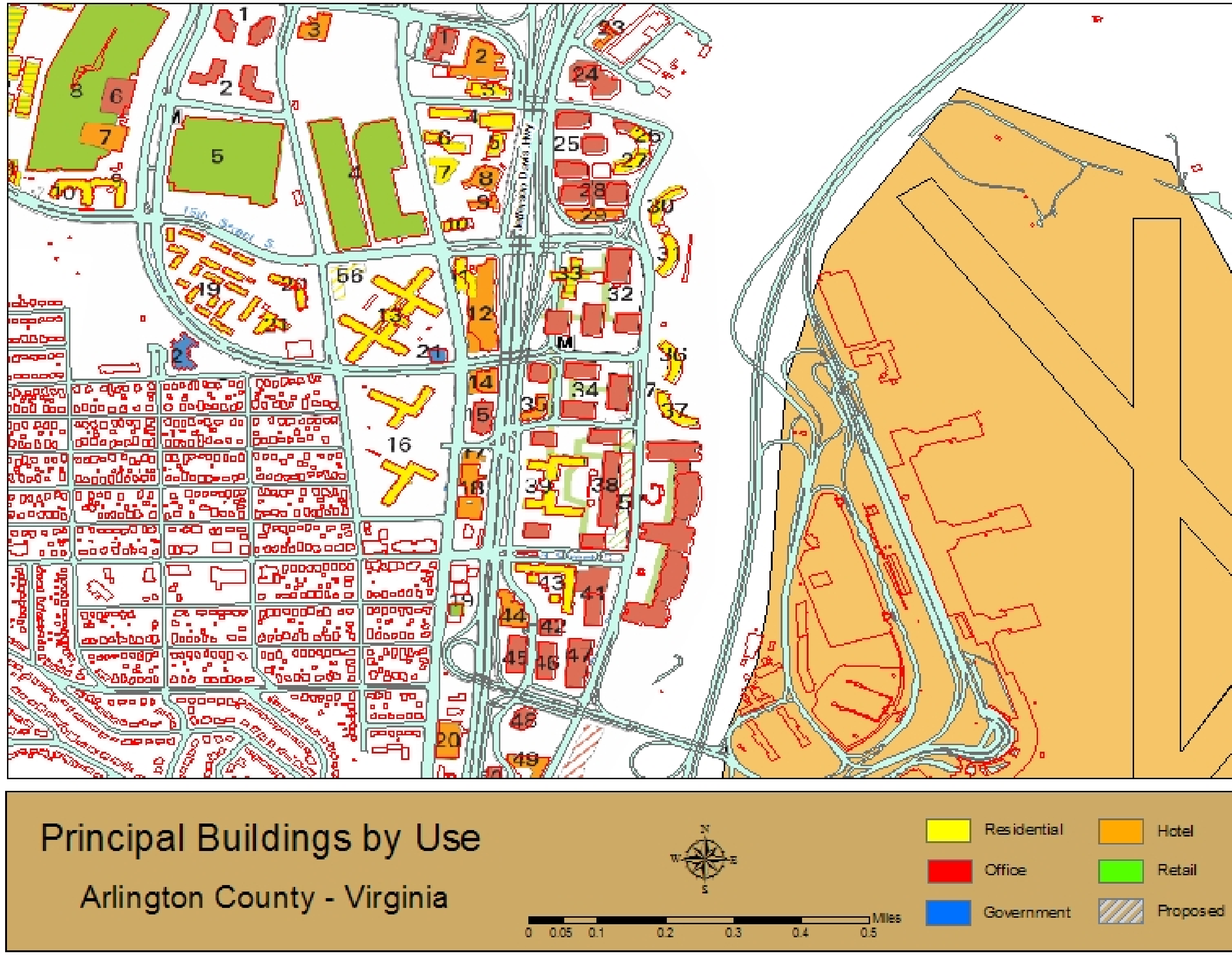


FEMA

Site Local Transportation Network



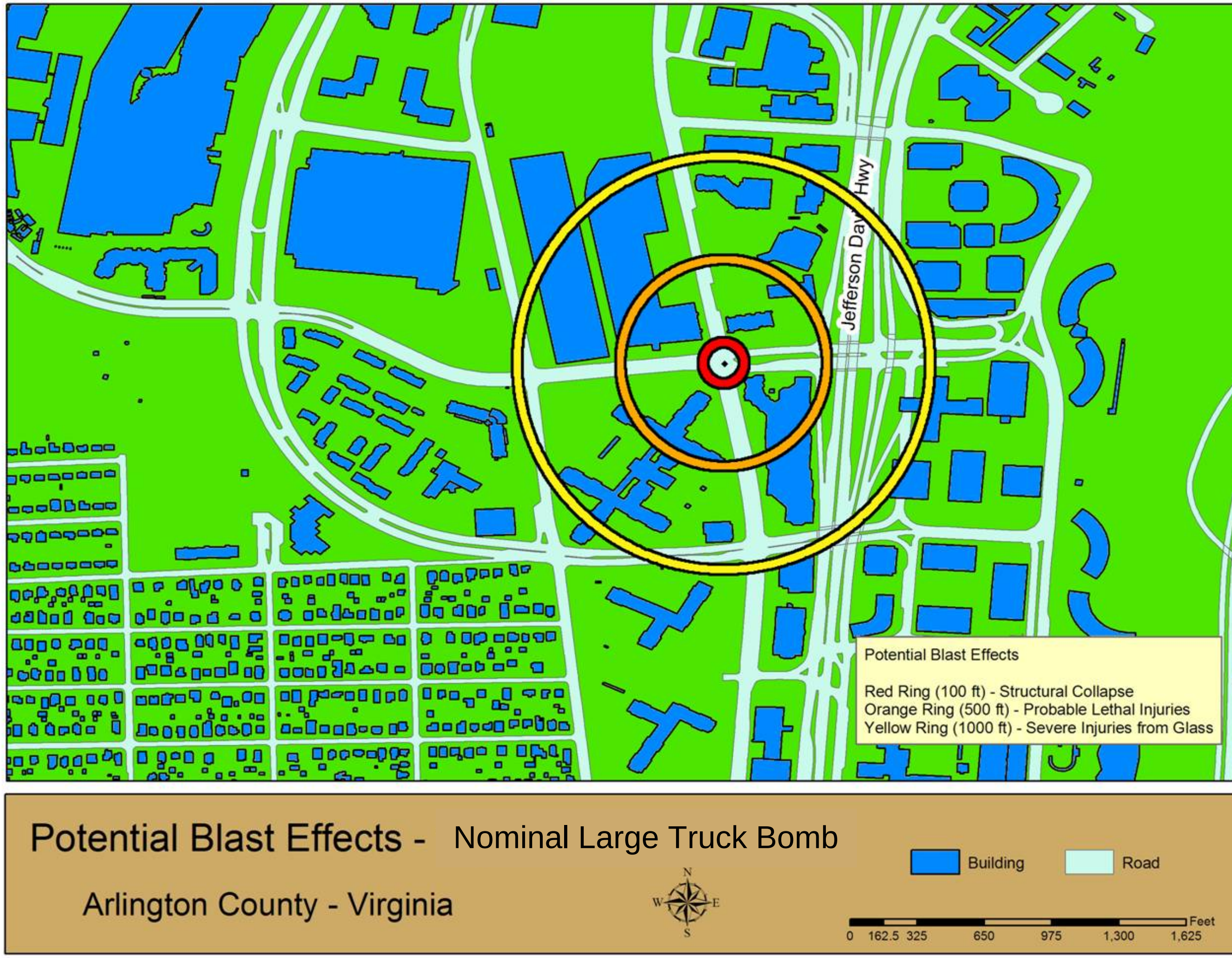
Site Principal Buildings by Use



Site Perimeter Imagery

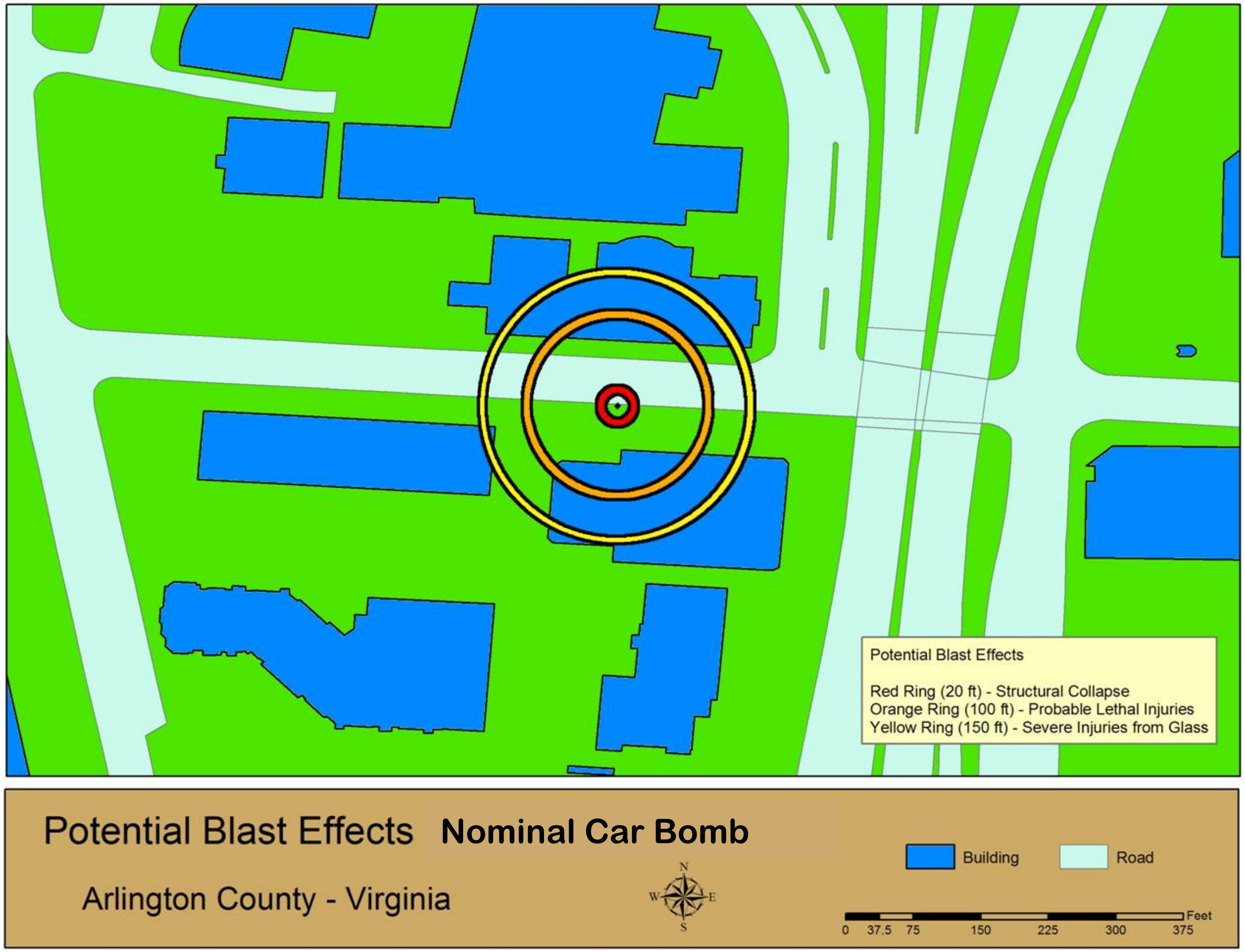
FEMA

Site Truck Bomb



FEMA

Site Car Bomb



FEMA

Options to Reduce Vulnerability

1) Define Site Functions
2) Identify Critical Systems

Interviews with Site Personnel

3) Evaluate Facility System Interactions
4) Determine Common System Vulnerabilities

Review Prints and Specs; Check with Systems Experts

5) Physically Locate Components and Lines — On-site Inspections

6) Identify Critical Components and Nodes — Apply “Vulnerability Checklist”

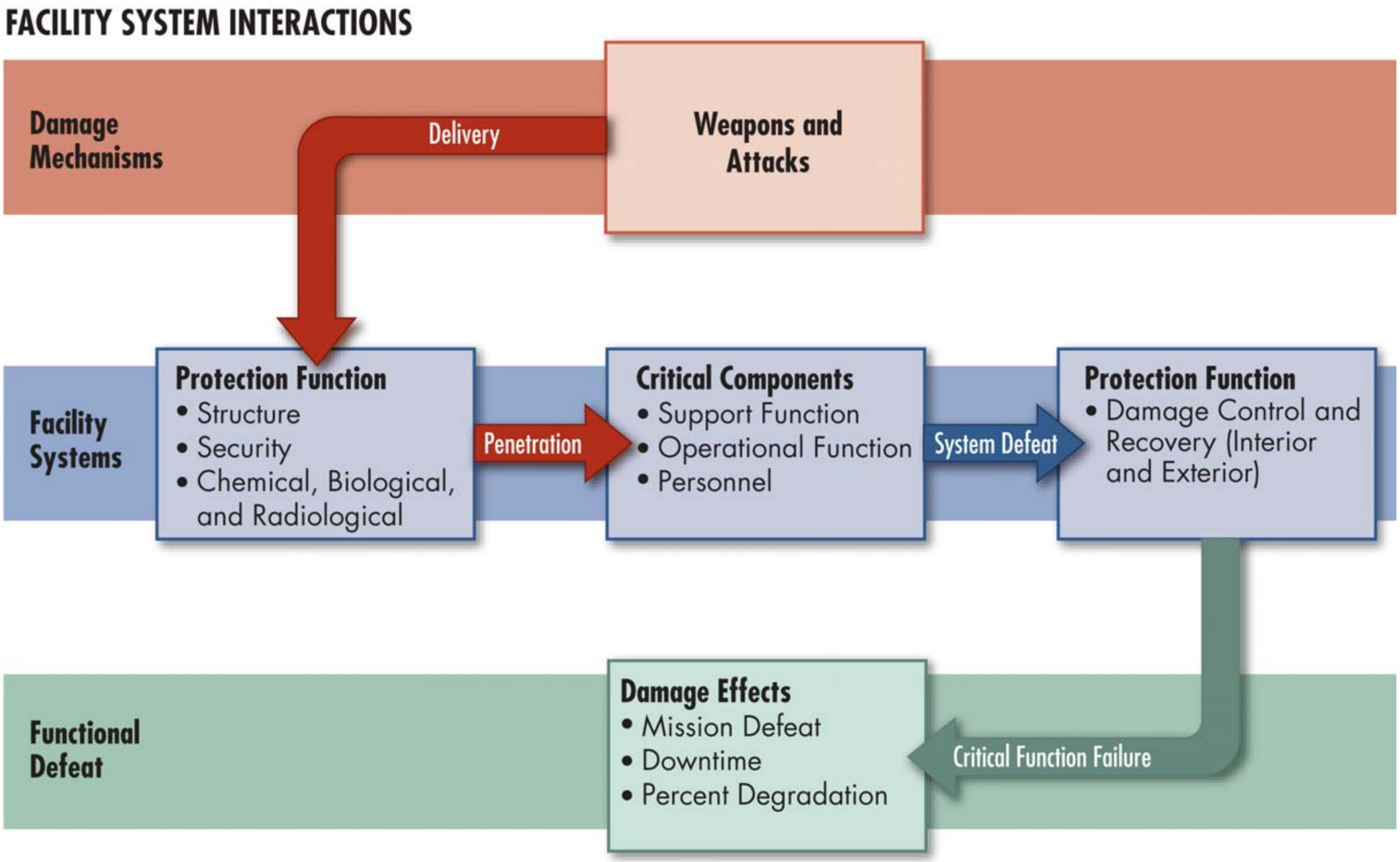
7) Assess Critical Nodes vs. Threats — Threat Spectrum Evaluation

8) Determine Survivability Enhancements — Survivability Options

9) Document Entire Analysis Process — Records

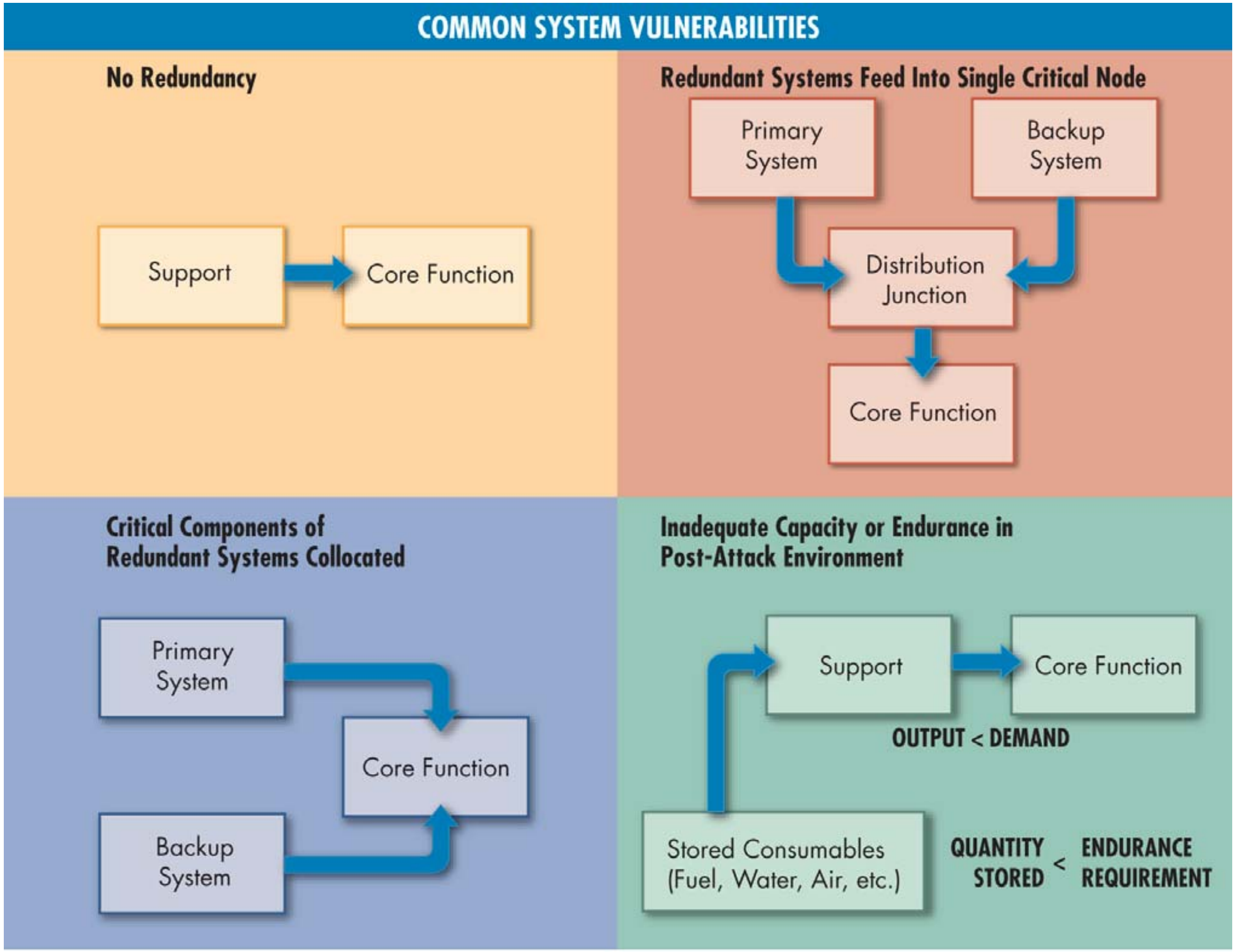
FEMA

Facility System Interactions



FEMA 426, Figure 1-8: Facility System Interactions, p. 1-23

Single-Point Vulnerabilities



FEMA 426, Figure 1-9: Common System Vulnerabilities, p. 1-35

FEMA

Functional Analysis SPVs

Standard 11	The loading dock and warehouse provide single point of entry to the interior
Standard 13 and 17	The mailroom is located within the interior and not on exterior wall or separate HVAC system
Standard 1	The telecom switch and computer data center are adjacent to the warehouse
Standard 1	The trash dumpster and emergency generator are located adjacent to the loading dock

FEMA 426, Figure 1-10: Non-Redundant Critical Functions Collocated Near Loading Dock, p. 1-41

Infrastructure SPVs

Air Intakes

Drive Through

Electrical Service

Telecom Service

FEMA 426, Figure 1-11: Vulnerability Examples, p. 1-42

FEMA

Building Vulnerability Assessment Checklist

Compiles best practices from many sources

Includes questions that determine if critical systems will continue to function during an emergency or threat event

Organized into 13 sections

- Each section should be assigned to a knowledgeable individual
- Results of all sections should be integrated into a master vulnerability assessment
- Compatible with CSI Master Format standard to facilitate cost estimates

Building Vulnerability Assessment Checklist

Site

Architectural

Structural Systems

Building Envelope

Utility Systems

Mechanical Systems (HVAC and CBR)

Plumbing and Gas Systems

Electrical Systems

Fire Alarm Systems

Communications and IT Systems

Equipment Operations and Maintenance

Security Systems

Security Master Plan

Building Vulnerability Assessment Checklist

	Vulnerability Question	Guidance	Observations
6	**Mechanical Systems (HVAC and CBR)**		
6.1	Where are the air intakes and exhaust louvers for the building? (low, high, or midpoint of the building structure) Are the intakes and exhausts accessible to the public?	*Air intakes should be located on the roof or as high as possible. Otherwise secure within CPTED-compliant fencing or enclosure. The fencing or enclosure should have a sloped roof to prevent throwing anything into the enclosure near the intakes.* *Ref: CDC/NIOSH Pub 2002-139*	
6.2	Is roof access limited to authorized personnel by means of locking mechanisms? Is access to mechanical areas similarly controlled?	*Roofs are like entrances to the building and are like mechanical rooms when HVAC is installed. Adjacent structures or landscaping should not allow access to the roof.* *Ref: GSA PBS –P100, CDC/NIOSH Pub 2002-139, and LBNL Pub 51959*	

FEMA

FEMA 426, Adapted from Table 1-22: Building Vulnerability Assessment Checklist, p. 1-46 to 1-92

Building Vulnerability Assessment Checklist

1.15	Is there minimum setback distance between the building and parked cars?
4.1	What is the designed or estimated protection level of the exterior walls against the postulated explosive threat?
4.2	Is the window system design on the exterior façade balanced to mitigate the hazardous effects of flying glazing following an explosive event? (glazing, frames, anchorage to supporting walls, etc.)?

FEMA

FEMA 426, Adapted from Table 1-22: Building Vulnerability Assessment Checklist, p. 1-46 to 1-92

Building Vulnerability Assessment Checklist

2.19	Are loading docks and receiving and shipping areas separated in any direction from utility rooms, utility mains, and service entrances, including electrical, telephone/data, fire detection/alarm systems, fire suppression water mains, cooling and heating mains, etc.?
1.16	Does adjacent surface parking on site maintain a minimum stand-off distance? ***For initial screening consider using 25 meters (82 feet) as a minimum with more distance needed for unreinforced masonry or wooden walls. Reference: GSA PBS-P100***

FEMA

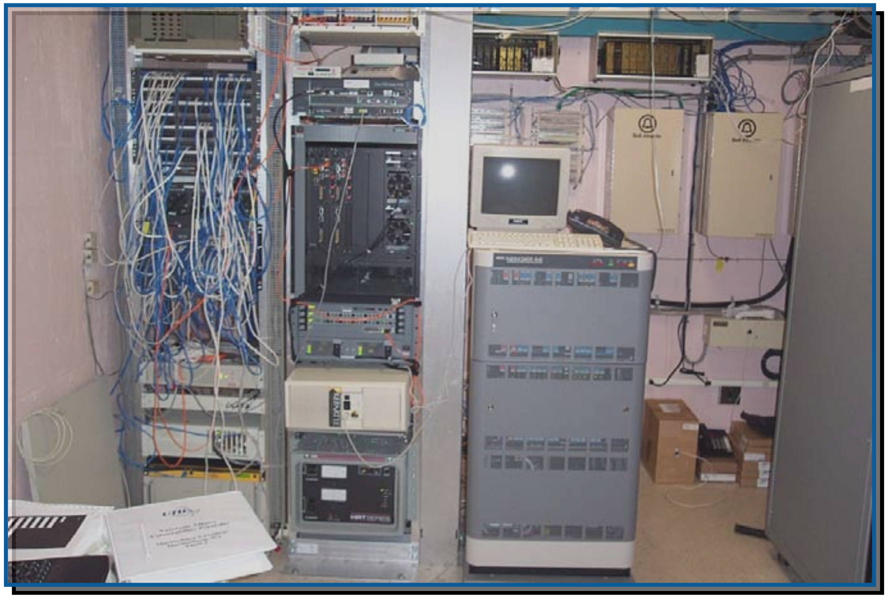
FEMA 426, Adapted from Table 1-22: Building Vulnerability Assessment Checklist, p. 1-46 to 1-92

Building Vulnerability Assessment Checklist

6.1	Where are the air intakes and exhaust louvers for the building? (low, high, or midpoint of the building structure) Are the intakes and exhausts accessible to the public?
1.9	Is there any potential access to the site or building through utility paths or water runoff? ***(Eliminate potential site access through utility tunnels, corridors, manholes, storm water runoff culverts, etc. Ensure covers to these access points are secured.)***
3.1	What type of construction? What type of concrete and reinforcing steel? What type of steel? What type of foundation?

FEMA 426, Adapted from Table 1-22: Building Vulnerability Assessment Checklist, p. 1-46 to 1-92

Building Vulnerability Assessment Checklist



5.19	By what means does the main telephone and data communications interface the site or building?
5.20	Are there multiple or redundant locations for the telephone and communication service?
5.21	Does the fire alarm system require communication with external sources? By what method is the alarm signal sent to the responding agency: telephone, radio, etc.? Is there an intermediary alarm monitoring center?

FEMA 426, Adapted from Table 1-22: Building Vulnerability Assessment Checklist, p. 1-46 to 1-92

Vulnerability Rating

Criteria		
Very High	10	Very High – One or more major weaknesses have been identified that make the asset extremely susceptible to an aggressor or hazard. The building lacks redundancies/physical protection and the entire building would be only functional again after a very long period of time after the attack.
High	8-9	High – One or more major weaknesses have been identified that make the asset highly susceptible to an aggressor or hazard. The building has poor redundancies/physical protection and most parts of the building would be only functional again after a long period of time after the attack.
Medium High	7	Medium High – An important weakness has been identified that makes the asset very susceptible to an aggressor or hazard. The building has inadequate redundancies/physical protection and most critical functions would be only operational again after a long period of time after the attack.

Key elements

- Number of weaknesses
- Aggressor potential accessibility
- Level of redundancies /physical protection
- Time frame for building to become operational again

FEMA 452, Table 3-4: Vulnerability Rating, p. 3-16

Vulnerability Rating (continued)

Criteria		
Medium	5-6	Medium – A weakness has been identified that makes the asset fairly susceptible to an aggressor or hazard. The building has insufficient redundancies/physical protection and most part of the building would be only functional again after a considerable period of time after the attack.
Medium Low	4	Medium Low – A weakness has been identified that makes the asset somewhat susceptible to an aggressor or hazard. The building has incorporated a fair level of redundancies/physical protection and most critical functions would be only operational again after a considerable period of time after the attack.
Low	2-3	Low – A minor weakness has been identified that slightly increases the susceptibility of the asset to an aggressor or hazard. The building has incorporated a good level of redundancies/physical protection and the building would be operational within a short period of time after an attack.
Very Low	1	Very Low – No weaknesses exist. The building has incorporated excellent redundancies/physical protection and the building would be operational immediately after an attack.

Key elements

- Number of weaknesses
- Aggressor potential accessibility
- Level of redundancies /physical protection
- Time frame for building to become operational again

FEMA 452, Table 3-4: Vulnerability Rating, p. 3-16

Critical Functions

Function	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Administration				
Asset Value	5	5	5	5
Threat Rating	8	4	3	2
Vulnerability Rating	**7**	**7**	**9**	**9**
Engineering				
Asset Value	8	8	8	8
Threat Rating	8	5	6	2
Vulnerability Rating	**2**	**4**	**8**	**9**

FEMA

FEMA 426, Adaptation of Table 1-20: Site Functional Pre-Assessment Screening Matrix, p. 1-38

Critical Infrastructure

Infrastructure	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Site				
Asset Value	4	4	4	4
Threat Rating	4	4	3	2
Vulnerability Rating	**1**	**7**	**9**	**9**
Structural Systems				
Asset Value	8	8	8	8
Threat Rating	3	4	3	2
Vulnerability Rating	**1**	**1**	**8**	**1**

FEMA 426, Adaptation of Table 1-21: Site Infrastructure Systems Pre-Assessment Screening Matrix, p. 1-39

Summary

Step-by-Step Analysis Process:

- Expertly performed by experienced personnel
- Determines critical systems
- Identifies vulnerabilities
- Focuses survivability mitigation measures on critical areas
- Essential component of Critical Infrastructure and Critical Function Matrices

FEMA

Unit IV Case Study Activity

Vulnerability Rating

Background

Vulnerability: any weakness that can be exploited by an aggressor or, in a non-terrorist threat environment, make an asset susceptible to hazard damage

Requirements: Vulnerability Rating Approach

Use rating scale of 1 (very low or no weakness) to 10 (one or major weaknesses)

Answer selected initial Vulnerability Assessment Checklist questions

Refer to Case Study and rate the vulnerability of asset-threat/hazard pairs:

- Critical Functions
- Critical Infrastructure

Unit V
Risk Assessment / Risk Management

U.S. DEPARTMENT OF HOMELAND SECURITY FEMA

Unit Objectives

Explain what constitutes risk.

Evaluate risk using the Threat-Vulnerability Matrix to capture assessment information.

Provide a numerical rating for risk and justify the basis for the rating.

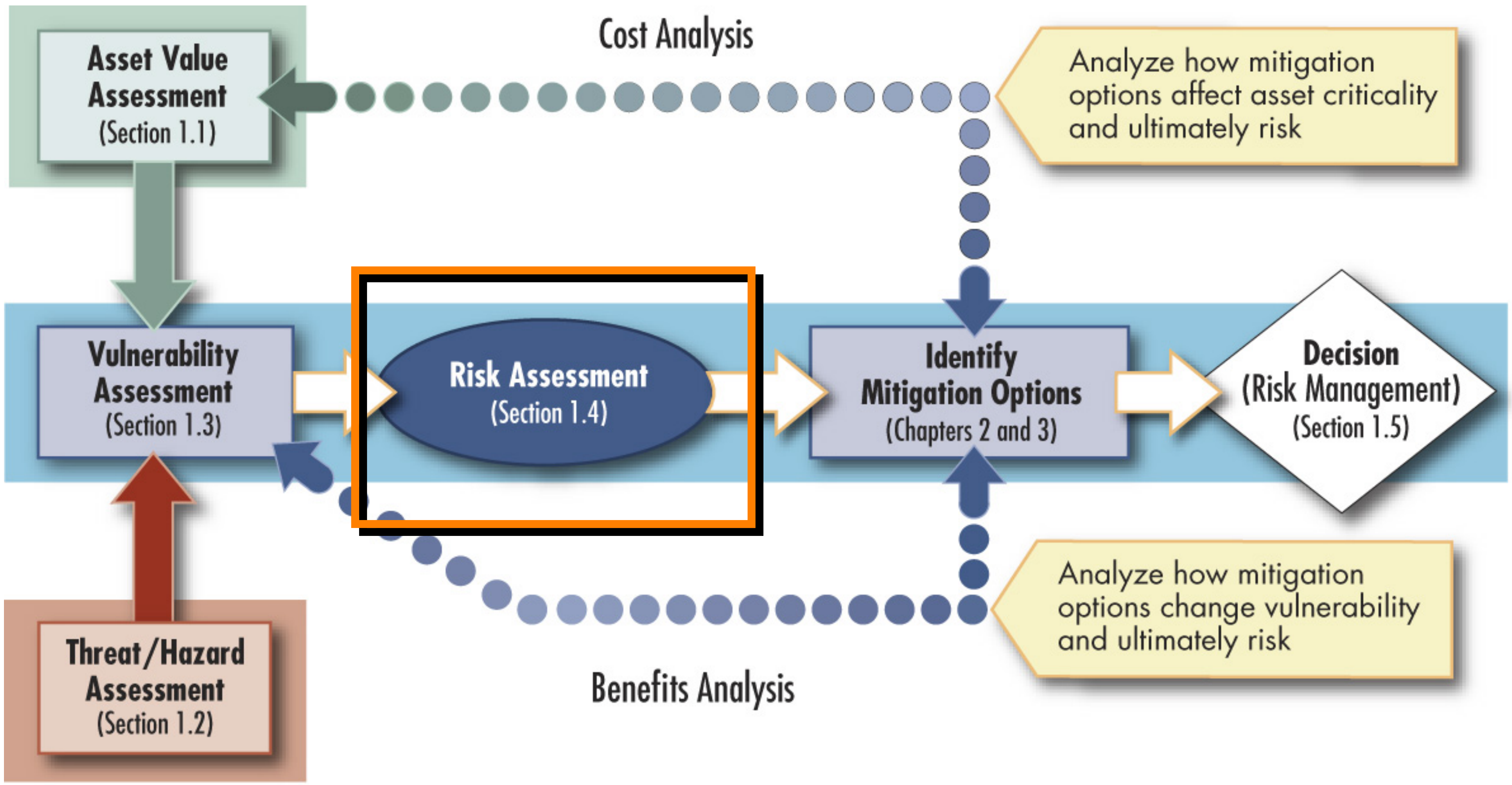
Identify top risks for asset-threat/hazard pairs that should receive measures to mitigate vulnerabilities and reduce risk.

Risk Management

Risk management is the deliberate process of understanding "risk" – the likelihood that a threat will harm an asset with some severity of consequences – and deciding on and implementing actions to reduce it.

GAO/NSIAD-98-74: Combating Terrorism – Threat and Risk Assessments Can Help Prioritize and Target Program Investments, April 1998

Assessment Flow Chart



FEMA 426, Figure 1-3: The Assessment Process Model, p. 1-5

Definition of Risk

Risk is a combination of:

- The probability that an event will occur, and
- The consequences of its occurrence

	Low Risk	Medium Risk	High Risk
Risk Factors Total	1-60	61-175	≥ 176

Risk = Asset Value x Threat Rating x Vulnerability Rating

FEMA 426, Table 1-19: Total Risk Color Code, p. 1-38

Quantifying Risk

Risk Assessment

Determine Asset Value

Determine Threat Rating Value

Determine Vulnerability Rating Value

Determine relative risk for each threat against each asset

Select mitigation measures that have the greatest benefit/cost for reducing risk

An Approach to Quantifying Risk

Risk = Asset Value x Threat Rating x Vulnerability Rating

Table 1-18: Risk Factors Definitions

Very High	10
High	8-9
Medium High	7
Medium	5-6
Medium Low	4
Low	2-3
Very Low	1

Table 1-19: Total Risk Color Code

	Low Risk	Medium Risk	High Risk
Risk Factors Total	1-60	61-175	≥ 176

FEMA 426, p. 1-38

Critical Functions

Function	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Administration	**280**	**140**	**135**	**90**
Asset Value	5	5	5	5
Threat Rating	8	4	3	2
Vulnerability Rating	7	7	9	9
Engineering	**128**	**160**	**384**	**144**
Asset Value	8	8	8	8
Threat Rating	8	5	6	2
Vulnerability Rating	2	4	8	9

FEMA 426, Adaptation of Table 1-20: Site Functional Pre-Assessment Screening Matrix, p. 1-38

Critical Infrastructure

Infrastructure	Cyber attack	Armed attack (single gunman)	Vehicle bomb	CBR attack
Site	**48**	**80**	**108**	**72**
Asset Value	4	4	4	4
Threat Rating	4	4	3	2
Vulnerability Rating	3	5	9	9
Structural Systems	**48**	**128**	**192**	**144**
Asset Value	8	8	8	8
Threat Rating	3	4	3	2
Vulnerability Rating	2	4	8	9

FEMA 426, Adaptation of Table 1-21: Site Infrastructure Systems Pre-Assessment Screening Matrix, p. 1-39

Risk Assessment Results

Function	Cyber Attack	Armed Attack (single gunman)	Vehicle Bomb	CBR Attack
Administration	280	140	135	90
Asset Value	5	5	5	5
Threat Rating	8	4	3	2
Vulnerability Rating	7	7	9	9
Engineering	128	128	192	144
Asset Value	8	8	8	8
Threat Rating	8	4	3	2
Vulnerability Rating	2	4	8	9
Warehousing	96	36	81	54
Asset Value	3	3	3	3
Threat Rating	8	4	3	2
Vulnerability Rating	4	3	9	9
Data Center	360	128	216	144
Asset Value	8	8	8	8
Threat Rating	9	4	3	2
Vulnerability Rating	5	4	9	9
Food Service	2	32	48	36
Asset Value	2	2	2	2
Threat Rating	1	4	3	2
Vulnerability Rating	1	4	8	9
Security	280	140	168	126
Asset Value	7	7	7	7
Threat Rating	8	4	3	2
Vulnerability Rating	5	5	8	9
Housekeeping	16	64	48	36
Asset Value	2	2	2	2
Threat Rating	8	4	3	2
Vulnerability Rating	1	8	8	9
Day Care	54	324	243	162
Asset Value	9	9	9	9
Threat Rating	3	4	3	2
Vulnerability Rating	2	9	9	9

* NOTIONAL DATA INSERTED FOR DEMONSTRATION PURPOSES.

FEMA

FEMA 426, Table 1-20: Site Functional Pre-Assessment Screening Matrix, p. 1-38

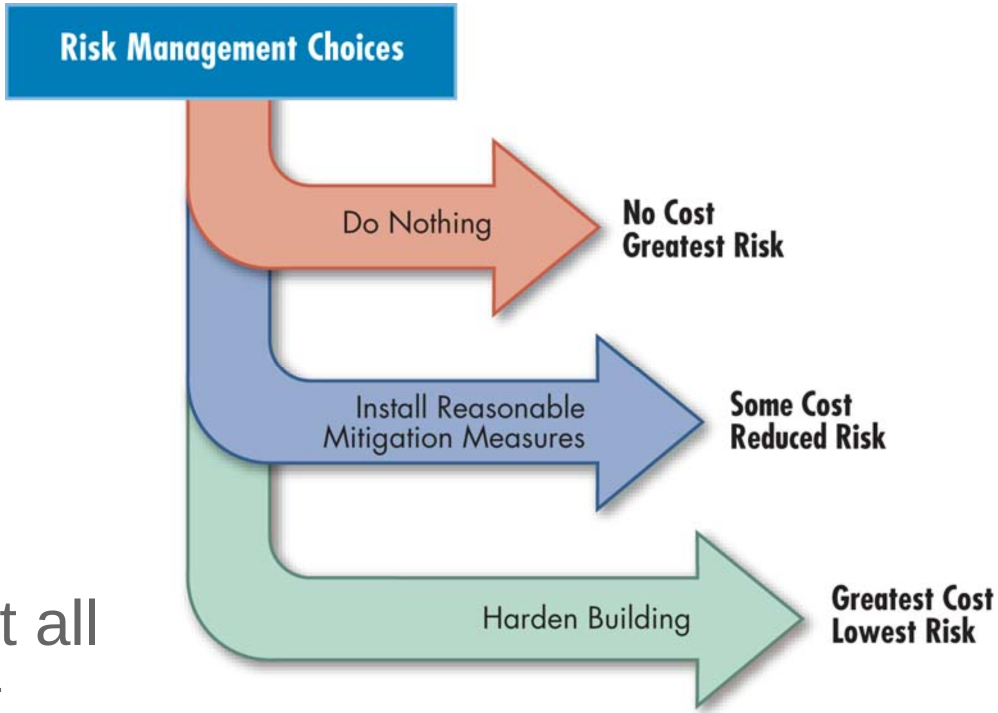
Selecting Mitigation Measures

Three Options:

Do nothing and accept the risk.

Perform a risk assessment and manage the risk by installing reasonable mitigation measures.

Harden the building against all threats to achieve the least amount of risk.



FEMA 426, Figure 1-13: Risk Management Choices, p. 1-44

FEMA

Mitigation Measures

A mitigation measure is an action, device, or system used to reduce risk by affecting an asset, threat, or vulnerability.

- Regulatory measures
- Rehabilitation of existing structures
- Protective and control structures

Mitigation Measures

- Mitigation measures can be evaluated against the following parameters

- Political Support
- Community Acceptance
- Cost and Benefit
- Financial Resources
- Legal Authority
- Adversely Affected Population
- Adversely Effects on the Built Env.
- Environmental Impact
- Technical Capacity
- Maintenance and Operations
- Ease and Speed of Implementation
- Timeframe and Urgency
- Short-term and Long-Term Solutions
- Estimated Cost

FEMA

Achieving Building Security: Planning Factors

Building security integrates multiple concepts and practices.

Objective is to achieve a balanced approach that combines aesthetics, enhanced security, and use of non-structural measures.

Process Review

Calculate the relative risk for each threat against each asset

Identify the high risk areas

Identify Mitigation Options to reduce the risk

Summary

Risk Definition

Critical Function and Critical Infrastructure Matrices

Numerical and color-coded risk scale

Identify Mitigation Options

Unit V Case Study Activity

Risk Rating

Background

Formula for determining a numeric value risk for each asset-threat/hazard pair:

Risk = Asset Value x Threat Rating x Vulnerability Rating

Requirements: Vulnerability Rating Approach

Use worksheet tables to summarize Case Study asset, threat, and vulnerability ratings conducted in the previous activities

Use the risk formula to determine the risk rating for each asset-threat/hazard pair for:

- Critical Functions
- Critical Infrastructure

Unit VI
FEMA 452
Risk Assessment Database

FEMA 452: Risk Assessment

Risk Management Series

Risk Assessment

A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings

FEMA 452 / January 2005

Available at: http://www.fema.gov/plan/prevent/rms/rmsp452.shtm

FEMA

Unit Objectives

Explain the database install process

Identify where to save photos, maps, drawings, plans, etc. to interface with the database

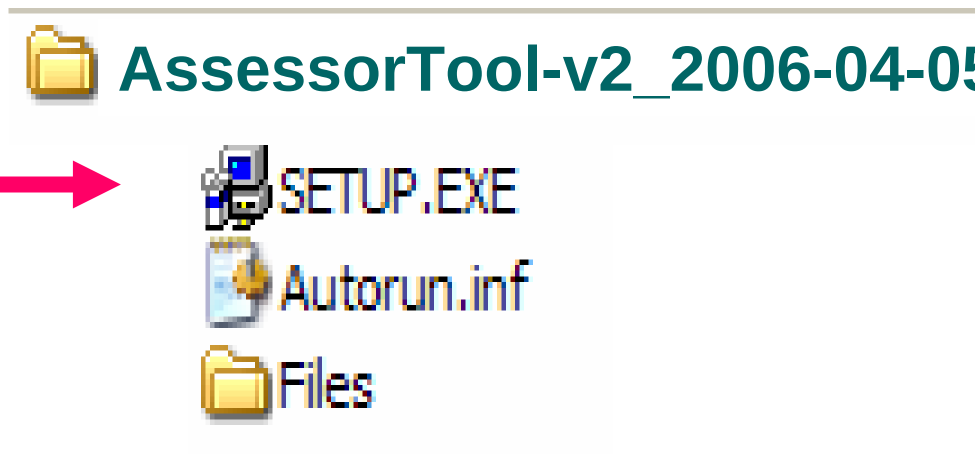
Explain the information required for the database to function within each screen, how to move between screens, and switch between the assessor's tool and the master database

Explain the benefit and approaches to setting priorities on identified vulnerabilities

Explain how to use the master database to produce standard reports and search the database for specific information

Program Installation

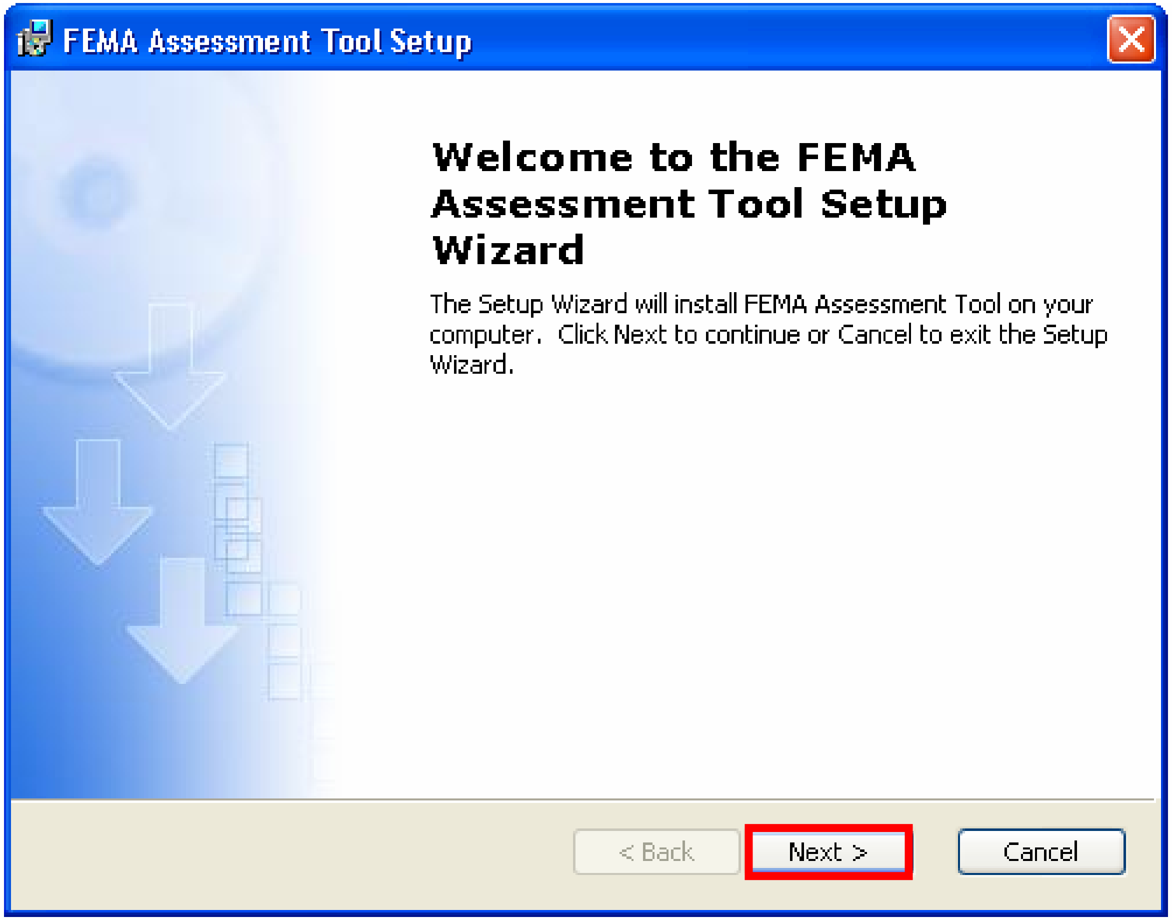
- Download self installing files from FEMA Web site or
- Install from CD provided during course
- Run SETUP.EXE for Assessor Tool



Version 2.0 is soon to be available at: http://www.fema.gov/plan/prevent/rms/rmsp452.shtm

FEMA

Program Installation

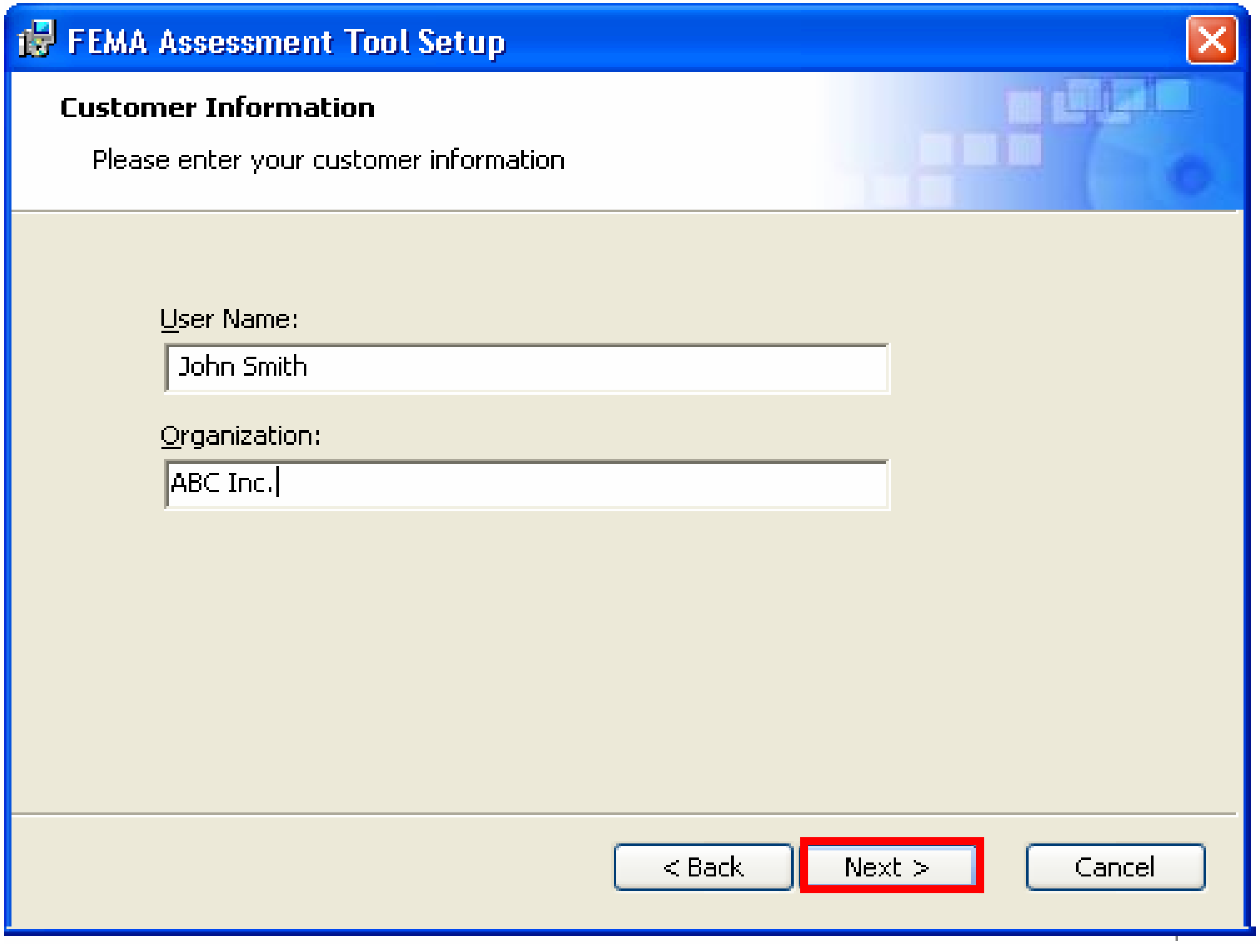


FEMA

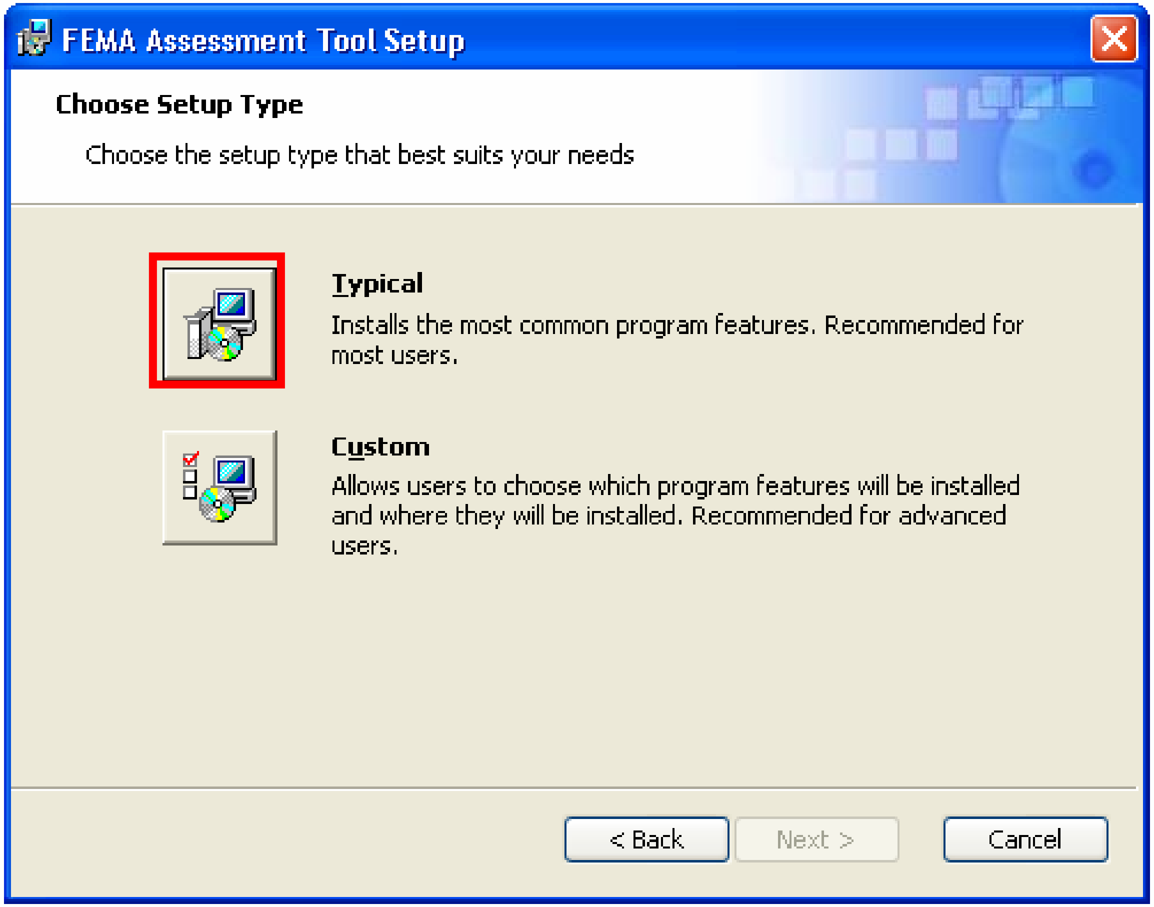
Program Installation

FEMA

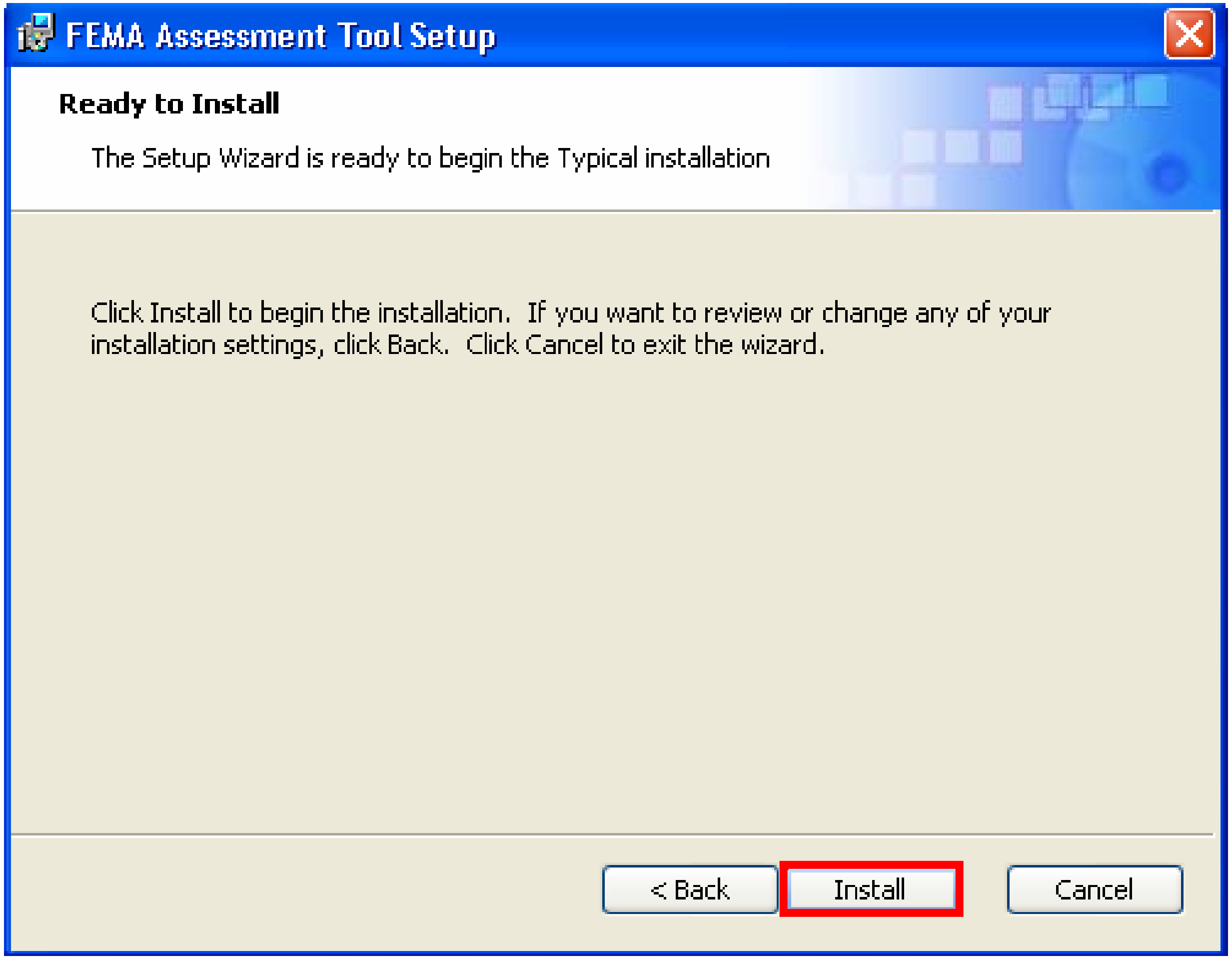
Program Installation



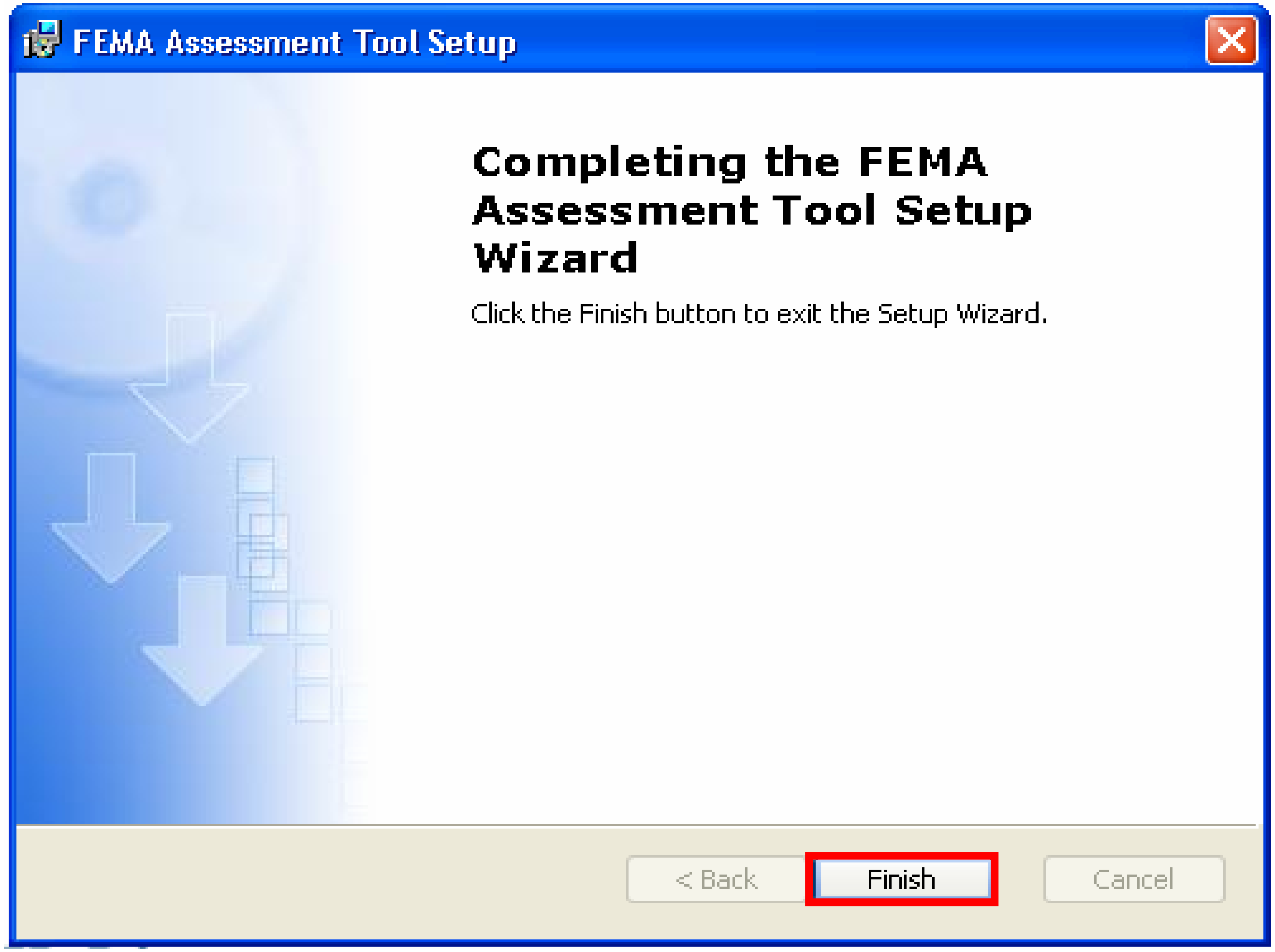
Program Installation



Program Installation



Program Installation



Program Installation

- Download self installing files from FEMA Web site or
- Install from CD provided during course
- Run SETUP.EXE for Master Database

Master Database Installation-v2_2006-04-05

SETUP.EXE

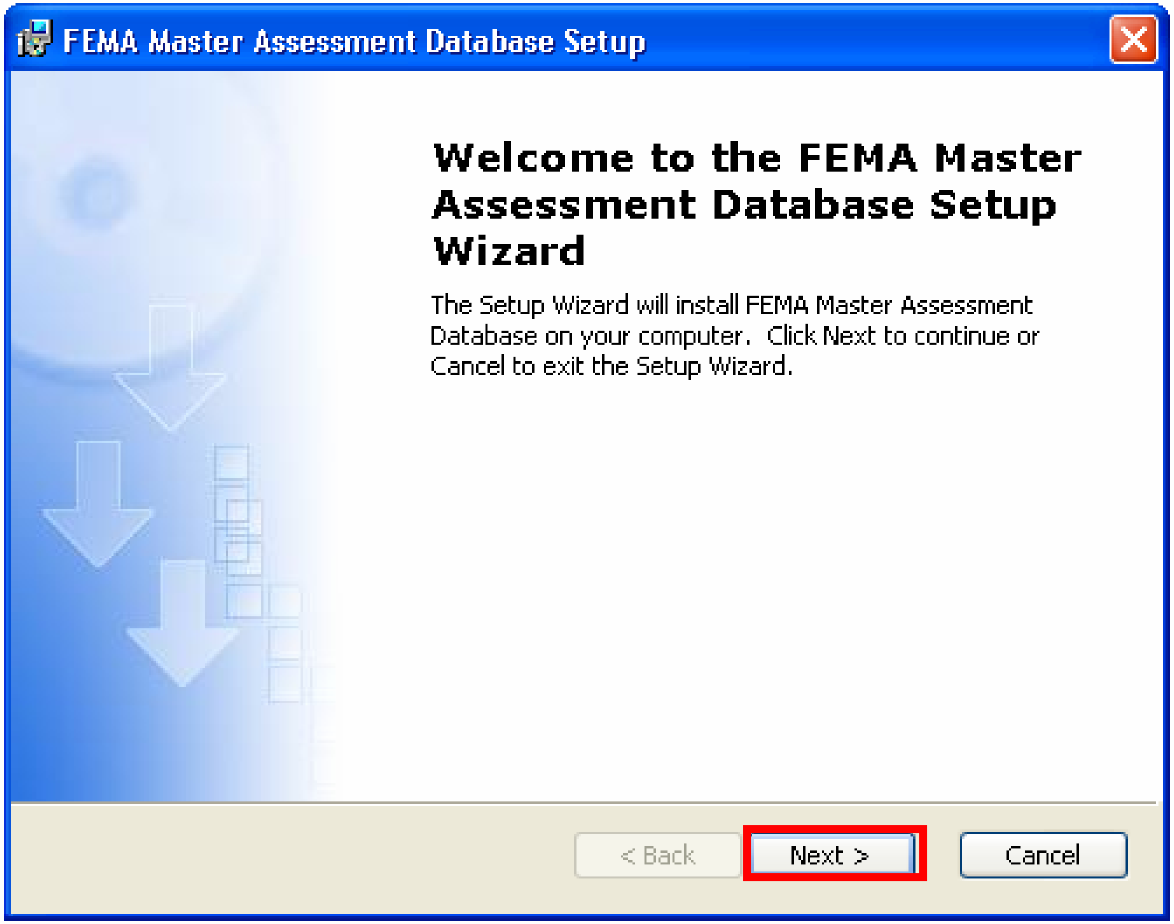
Autorun.inf

Files

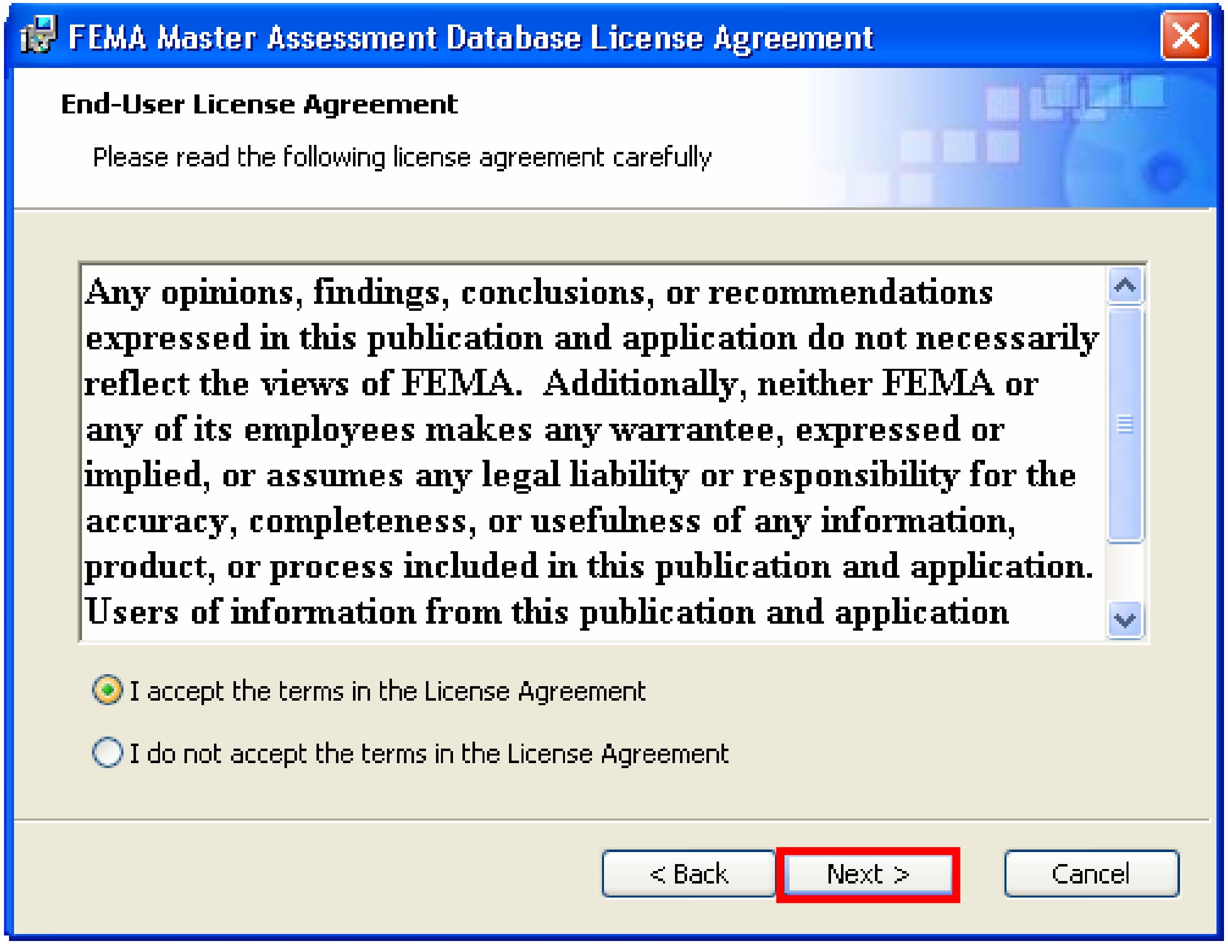
Version 2.0 is soon to be available at:
http://www.fema.gov/plan/prevent/rms/rmsp452.shtm

FEMA

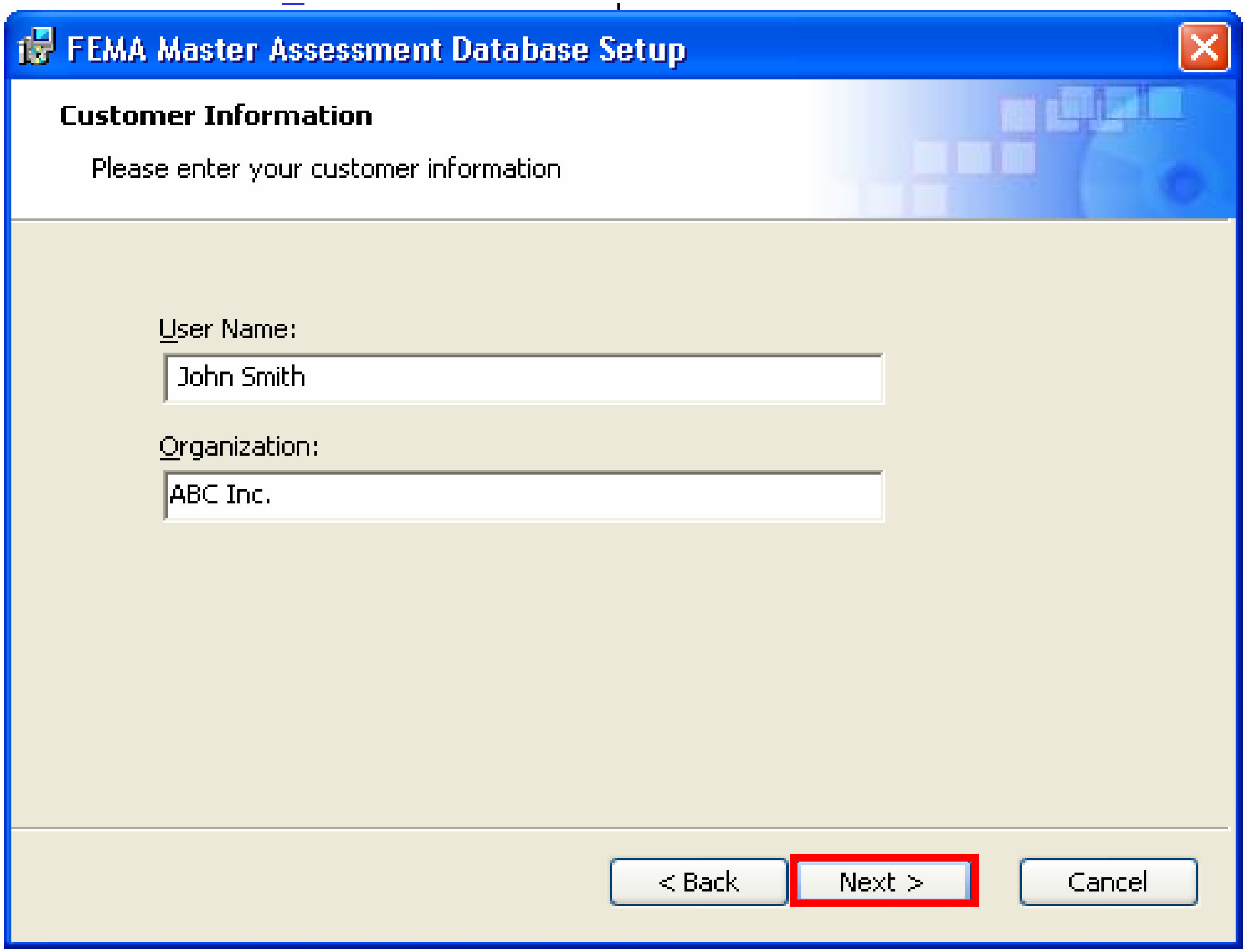
Program Installation



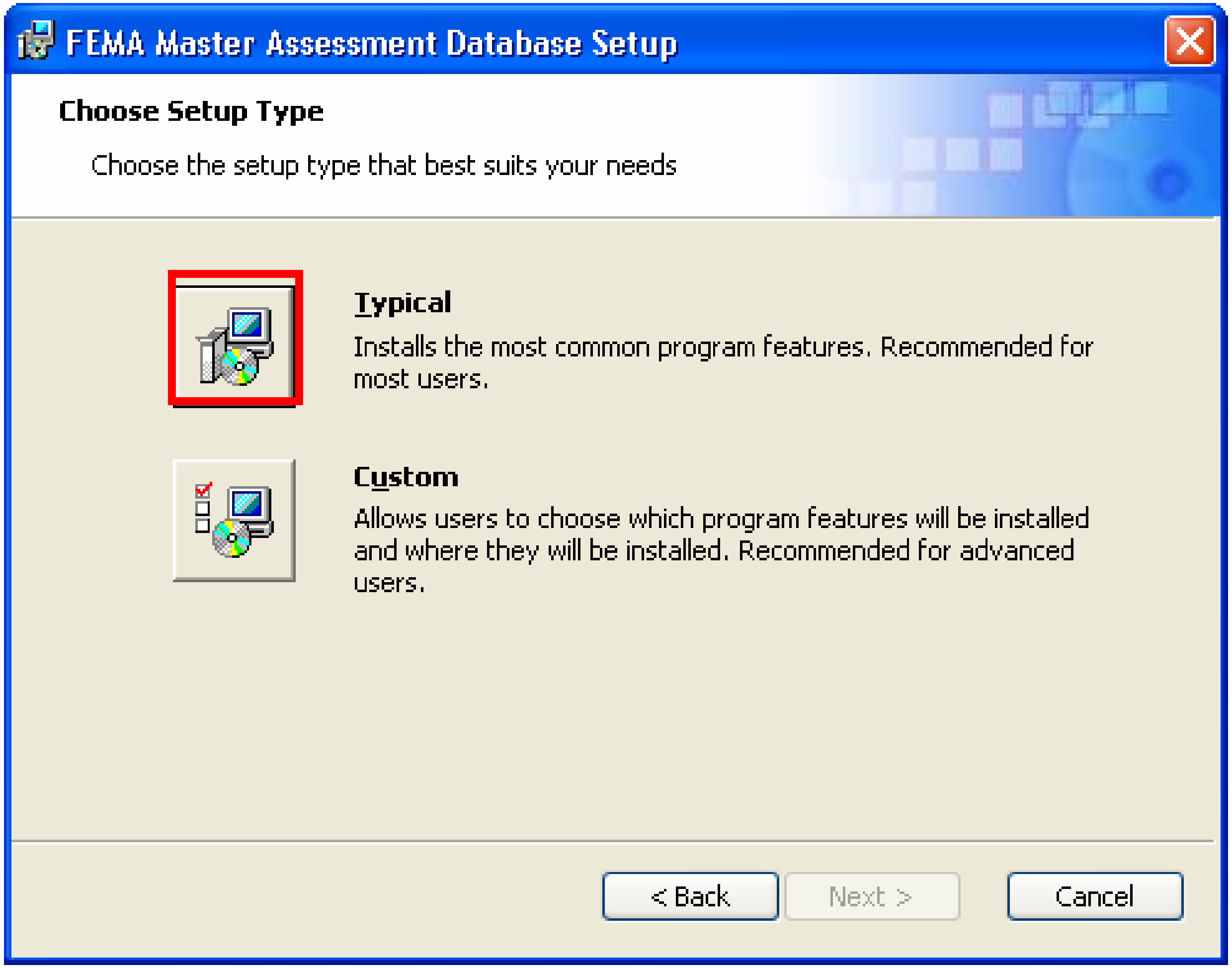
Program Installation



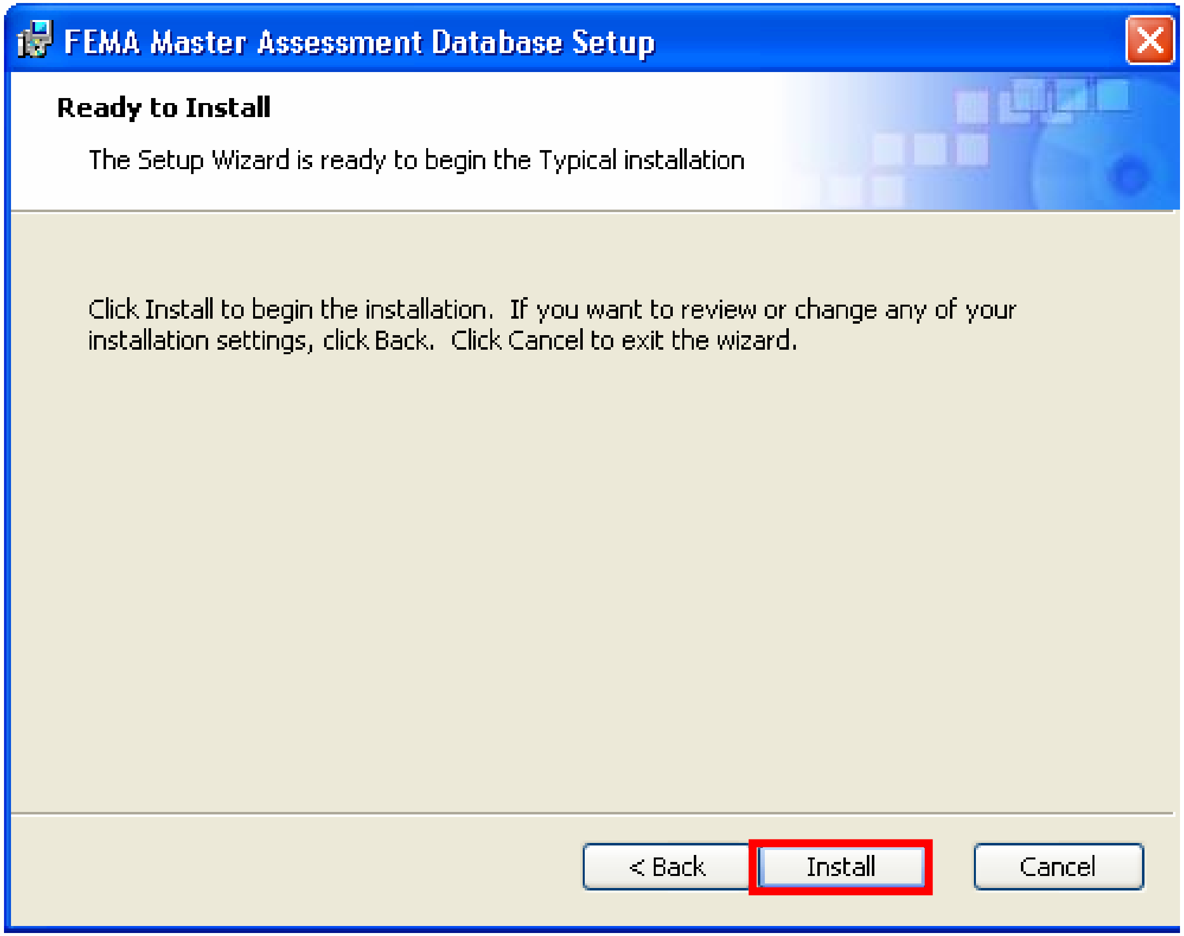
Program Installation



Program Installation

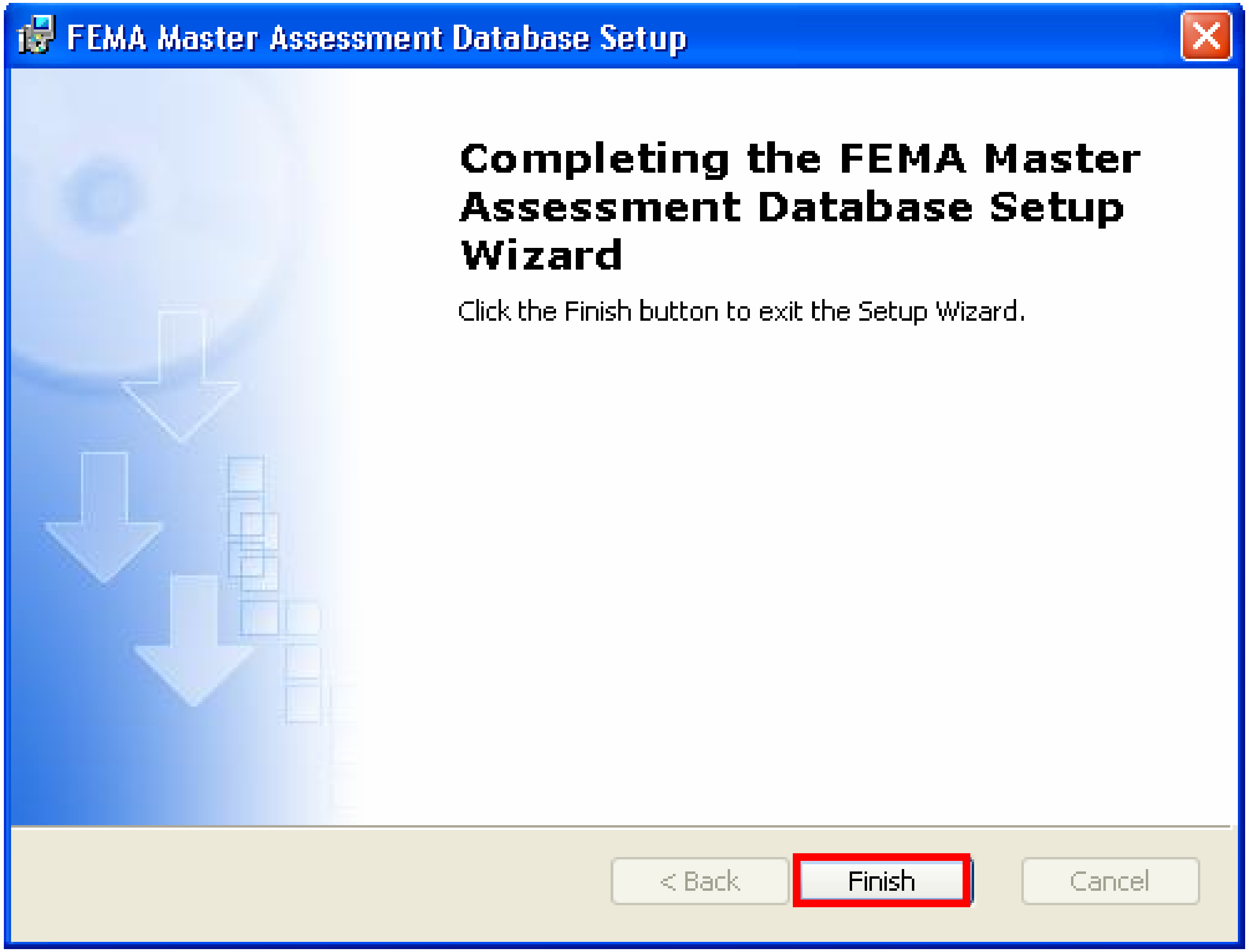


Program Installation

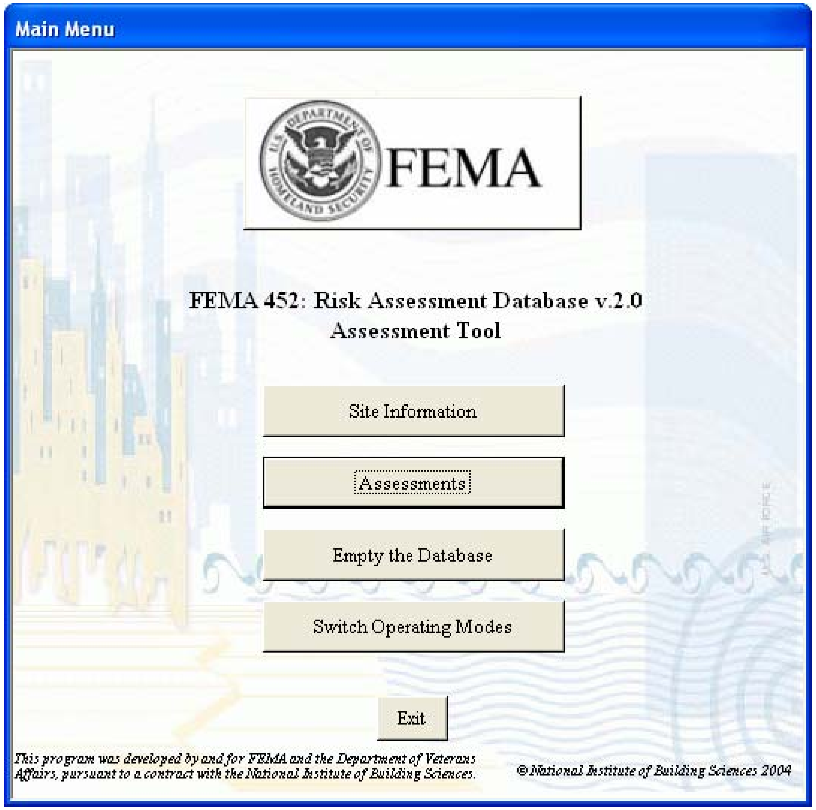


FEMA

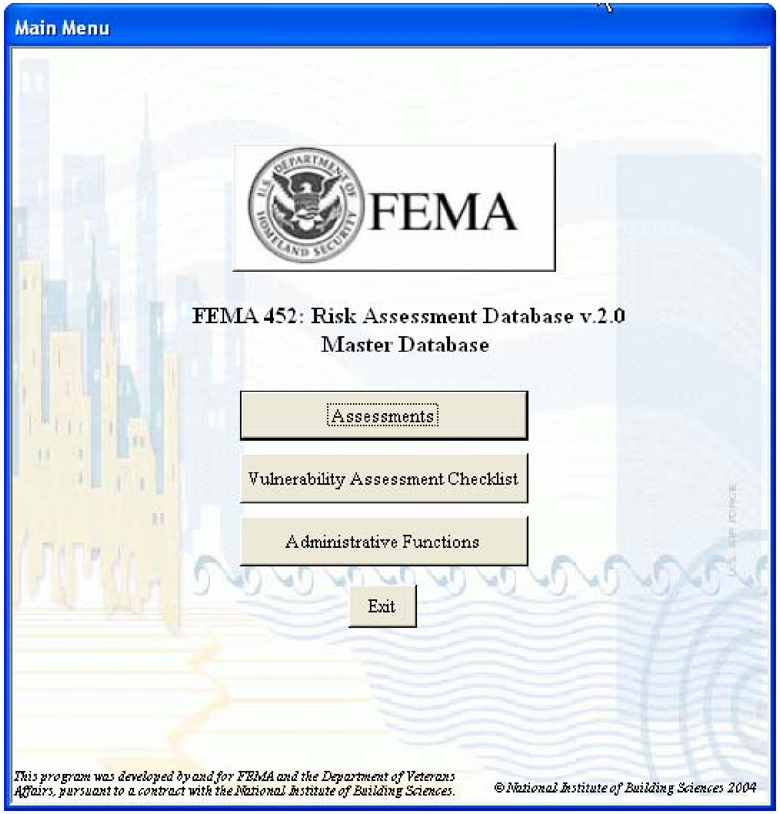
Program Installation



FEMA 452: Risk Assessment



Assessor Tool



Master Database

FEMA

Database Structure

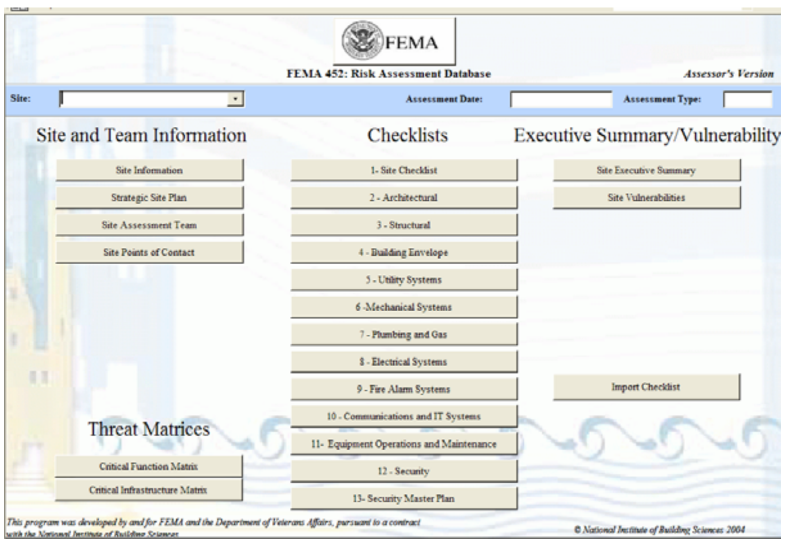
Import Assessment Data

Master Database

Analyze Data

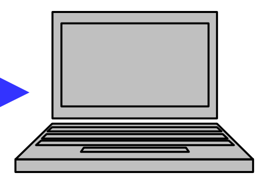
Store Data

Conduct Assessment

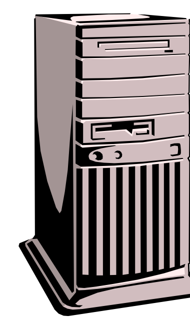


Assessor Tool (MS Access)

Return Files, Pictures, Data

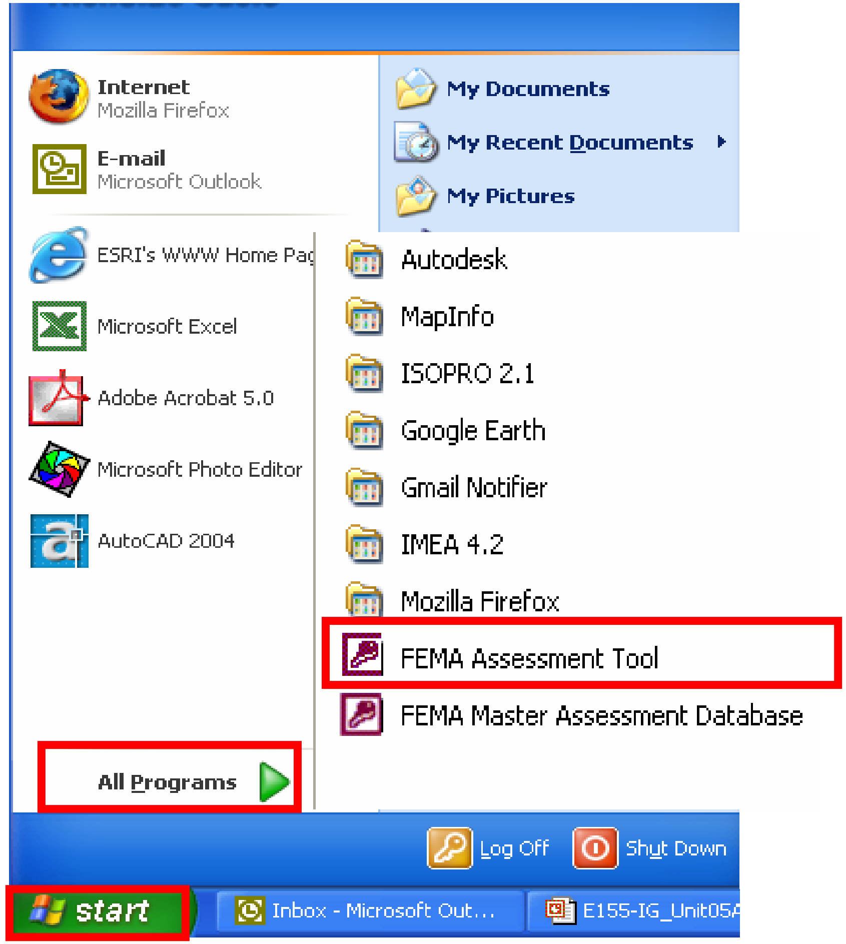


Assessor Tool



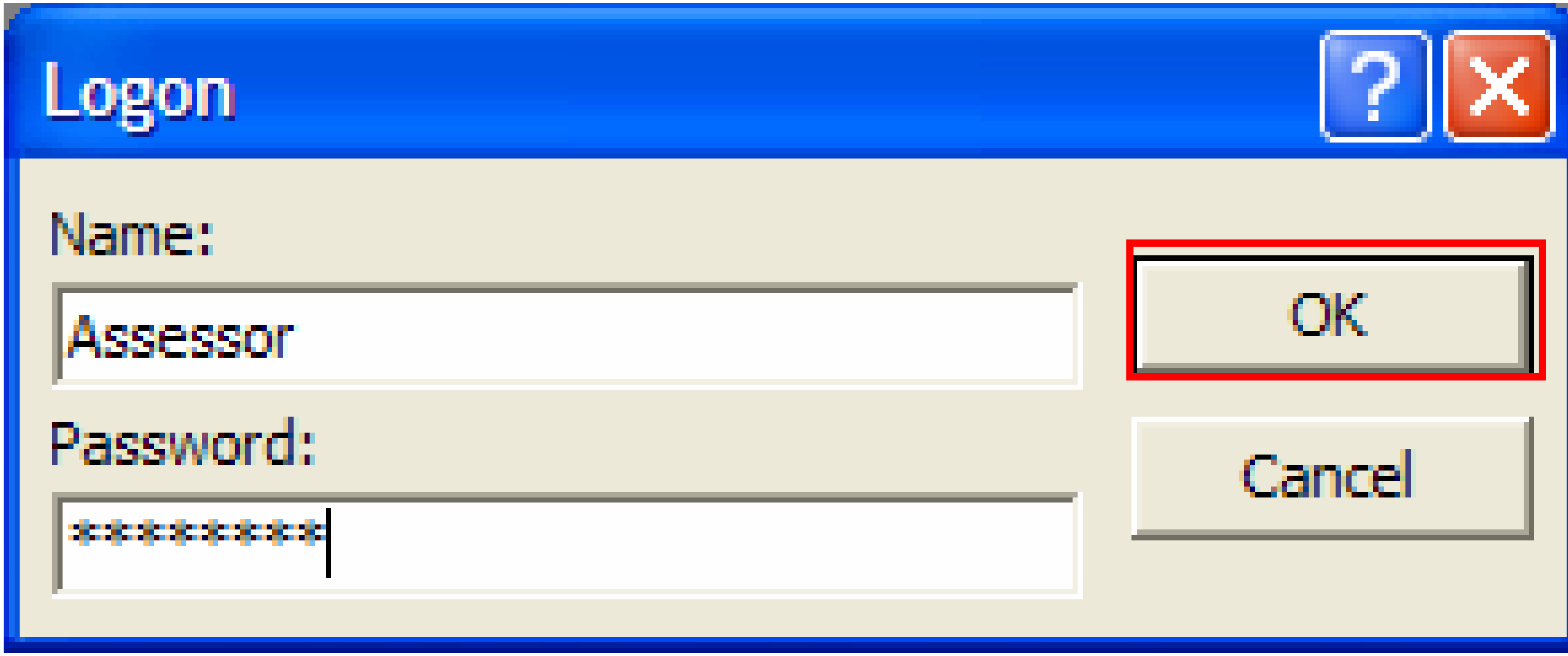
Master Database (MS Access)

Open Assessor Tool



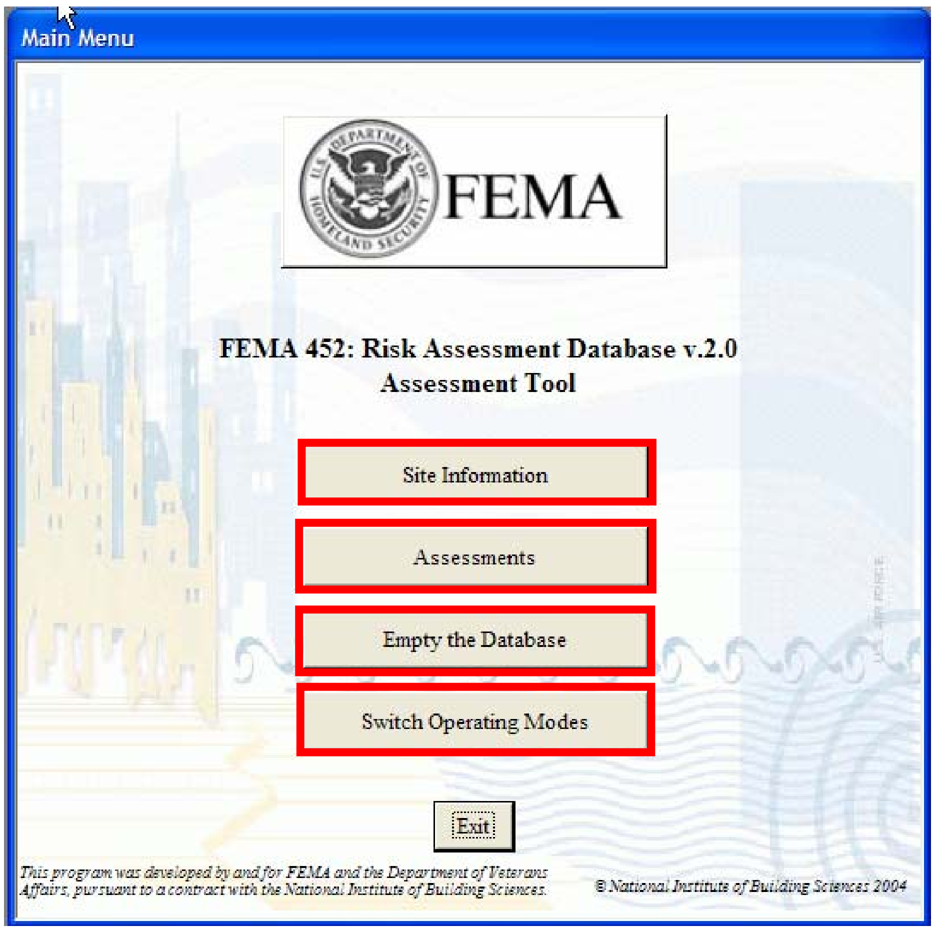
FEMA

Login to Assessor Tool



FEMA

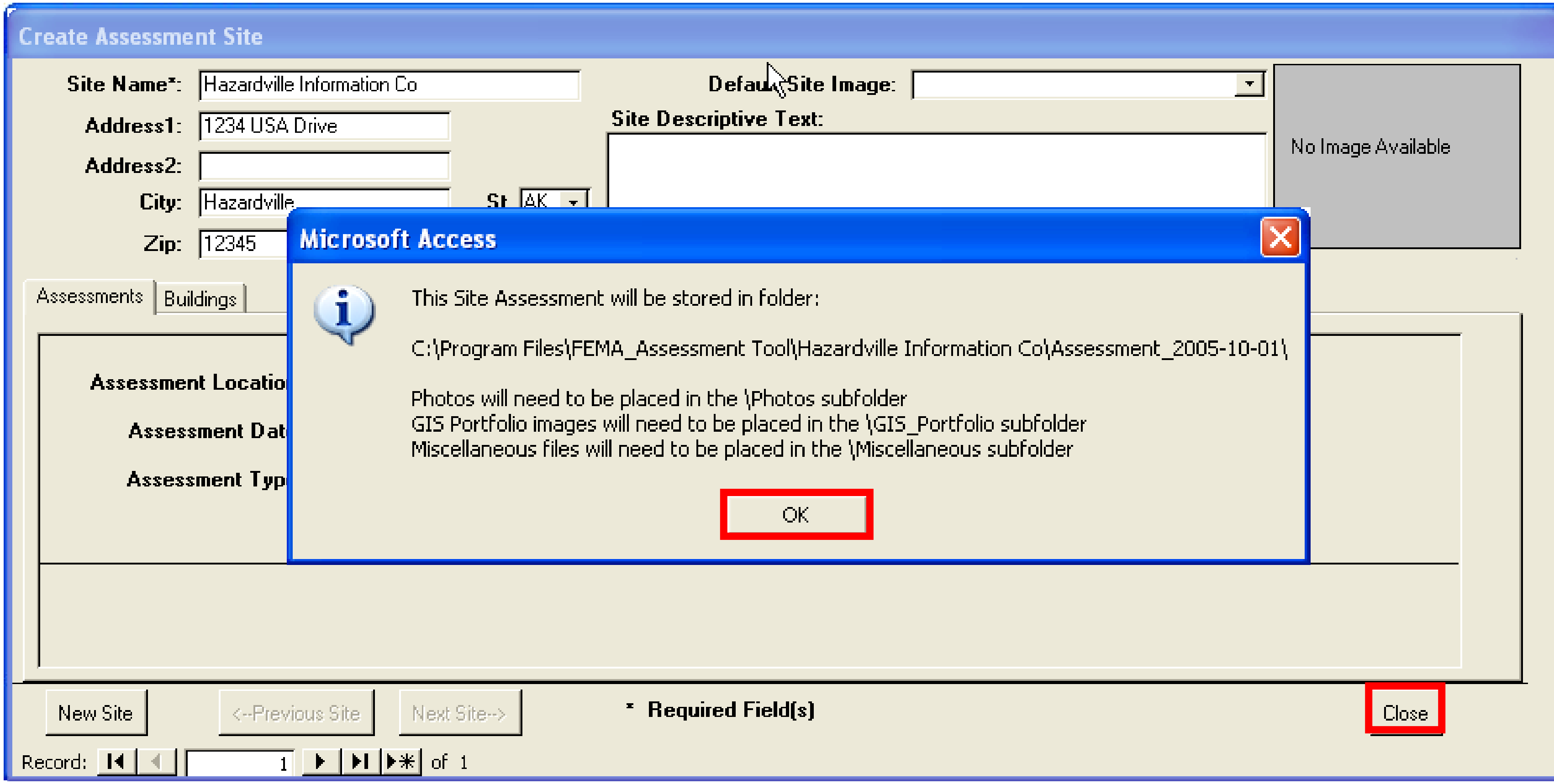
Assessor Tool



- Create and name assessment site
- Enter assessment screen
- Empty database
- Switch to Master Database Mode

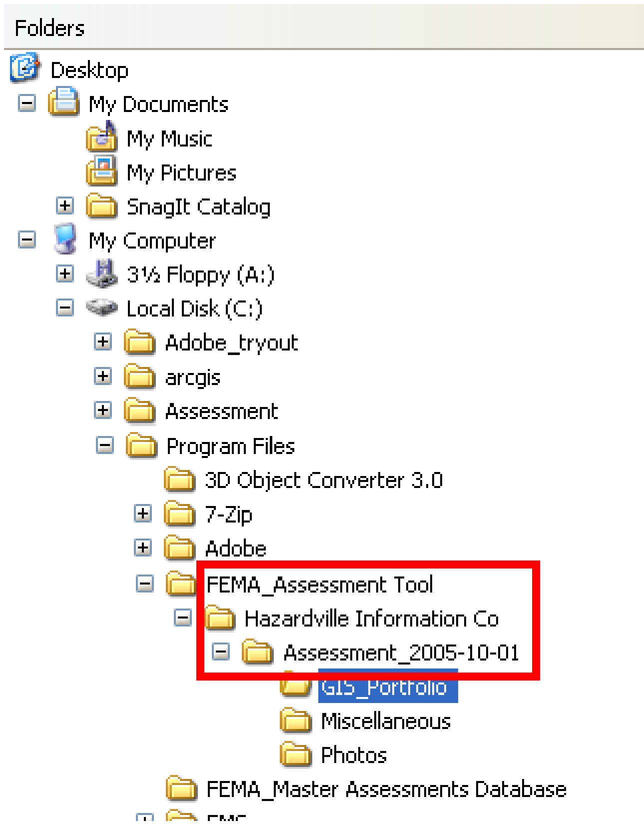
FEMA

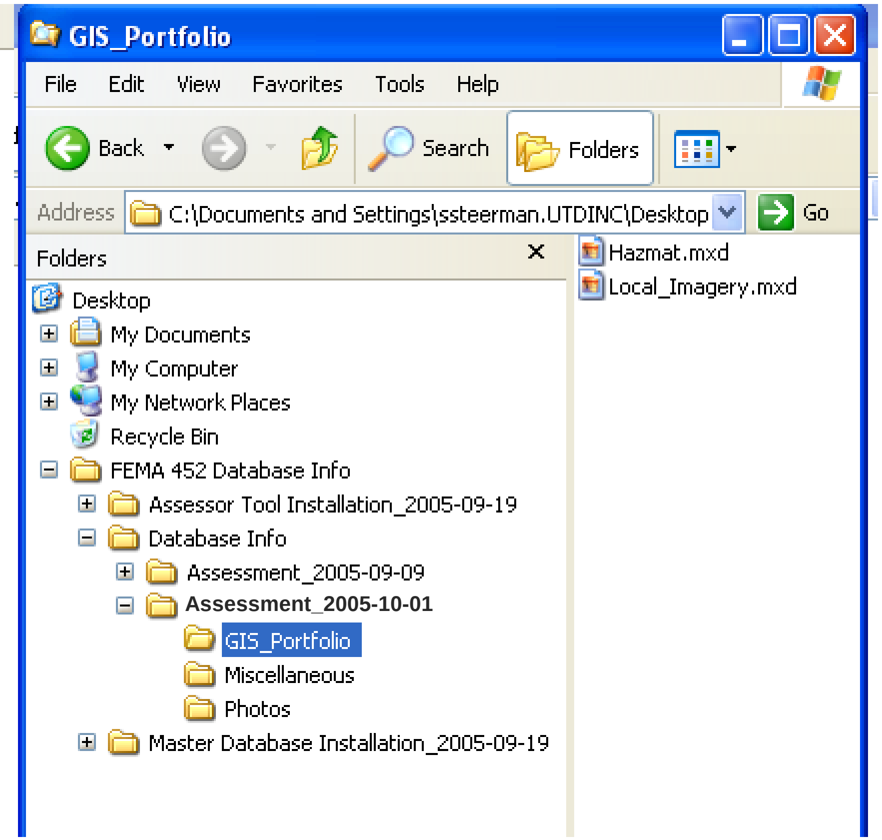
Site Information



FEMA

Load Information

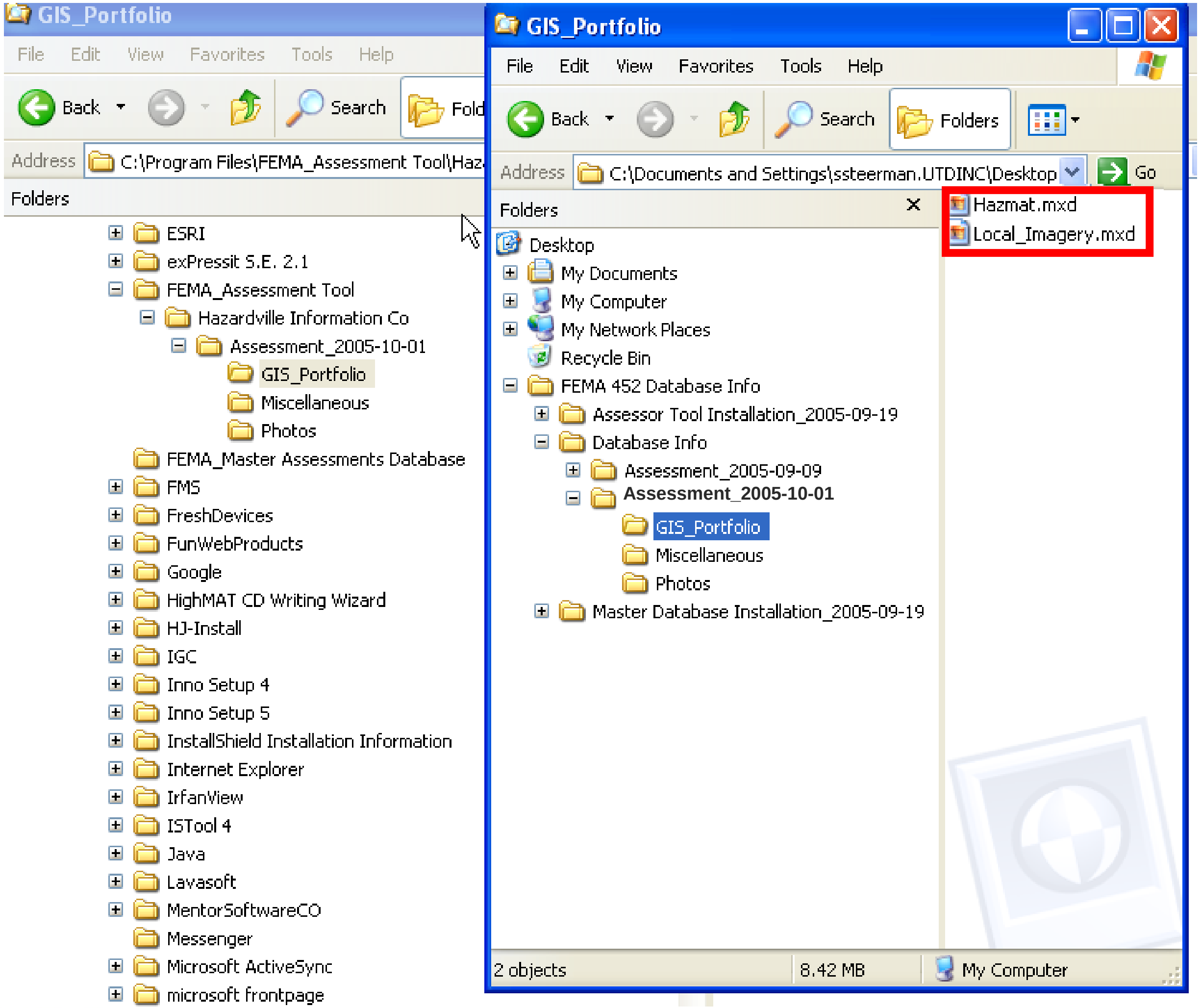




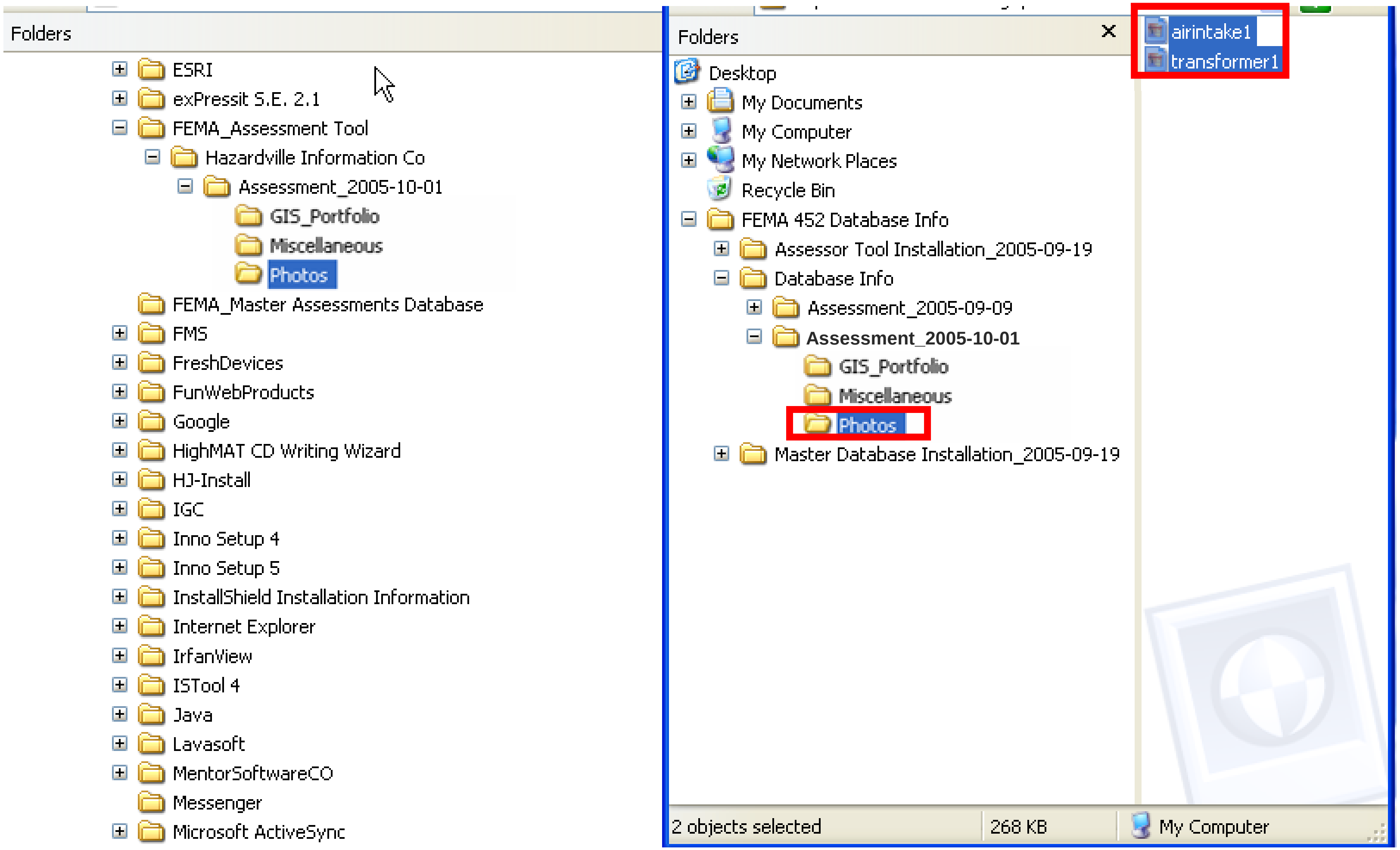
Open a second window with existing data

FEMA

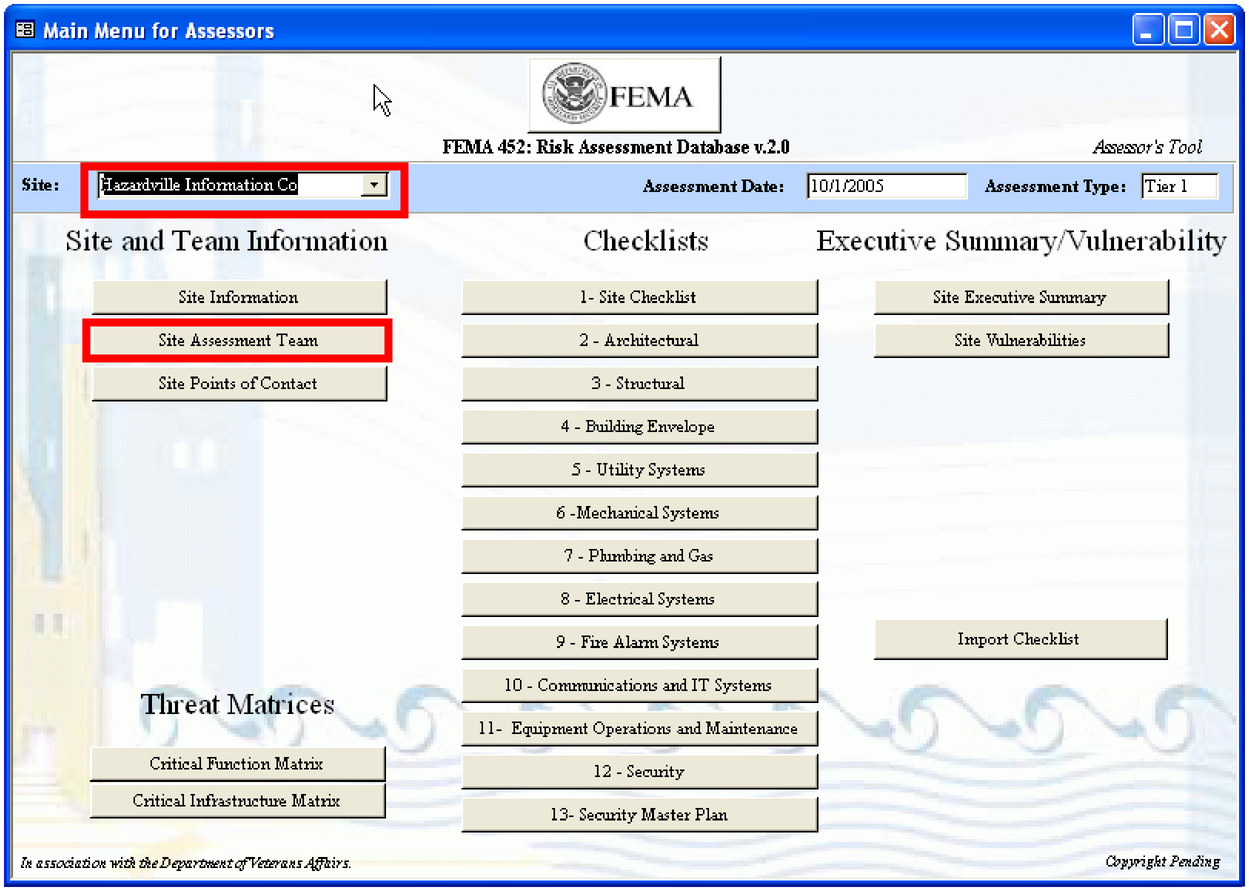
Load Information



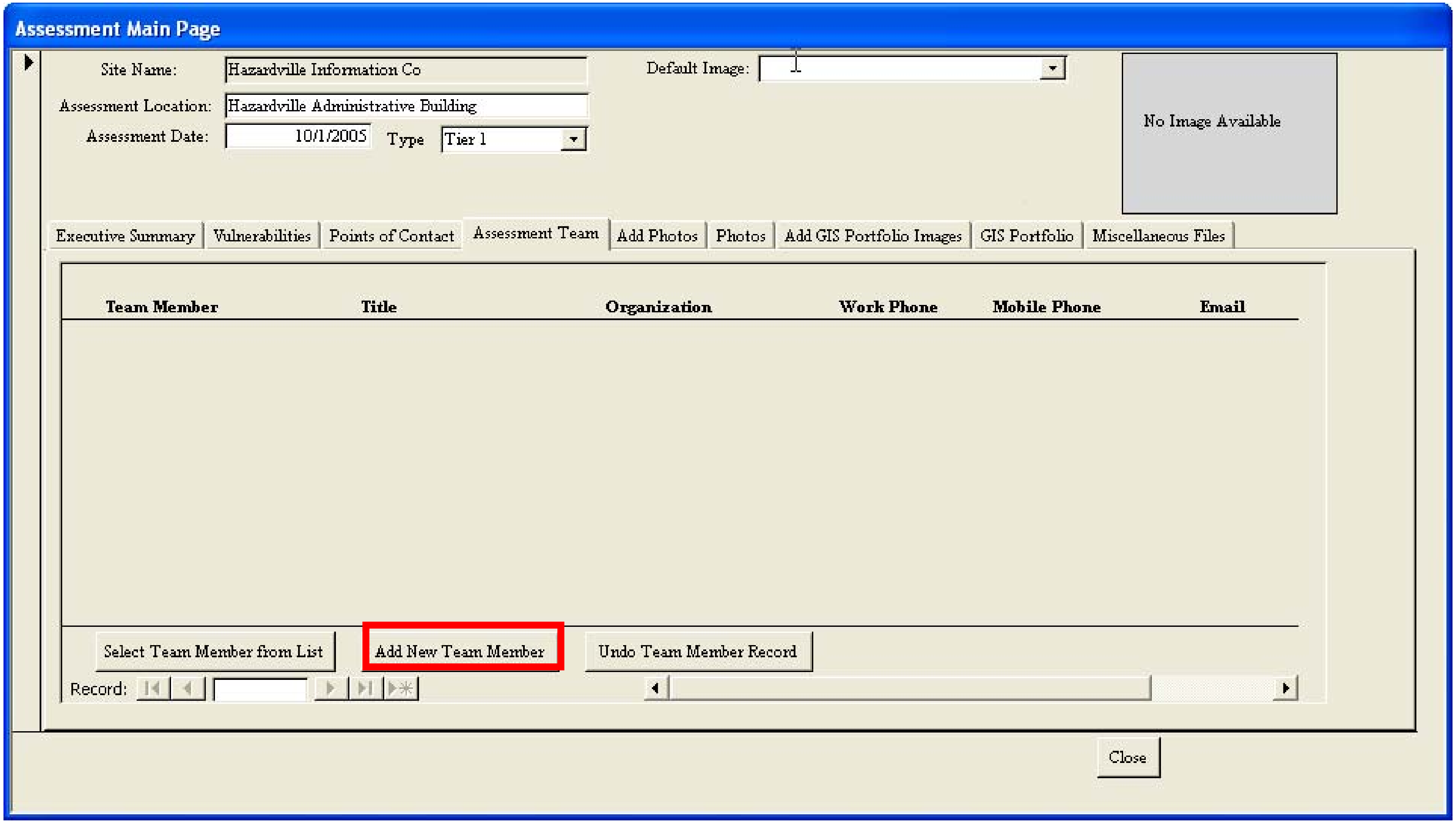
Load Information



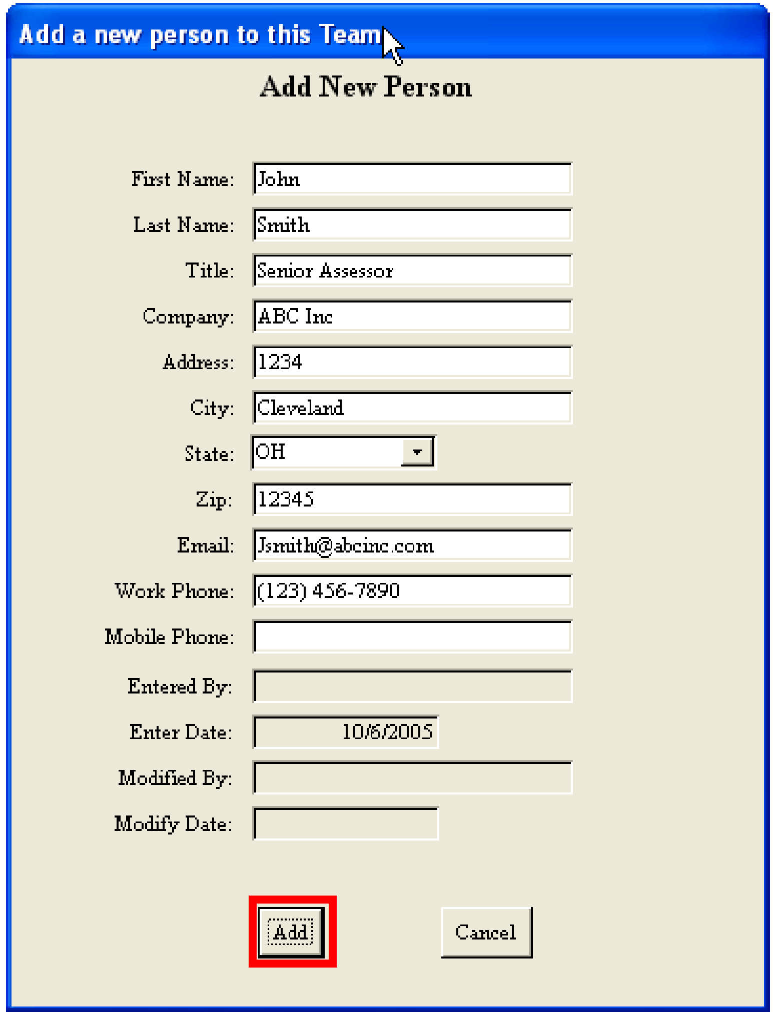
Assessor Tool



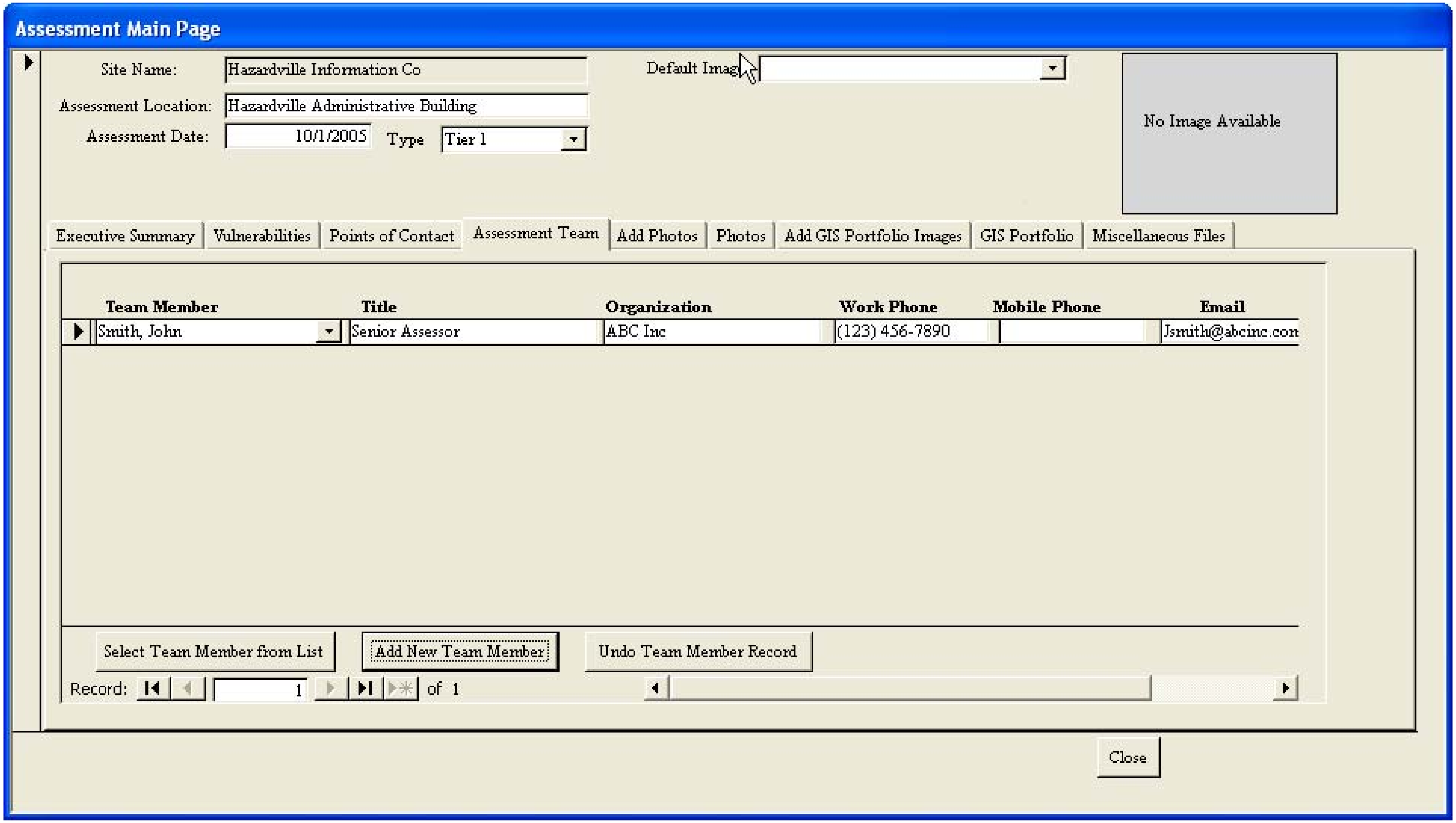
Add Team Members



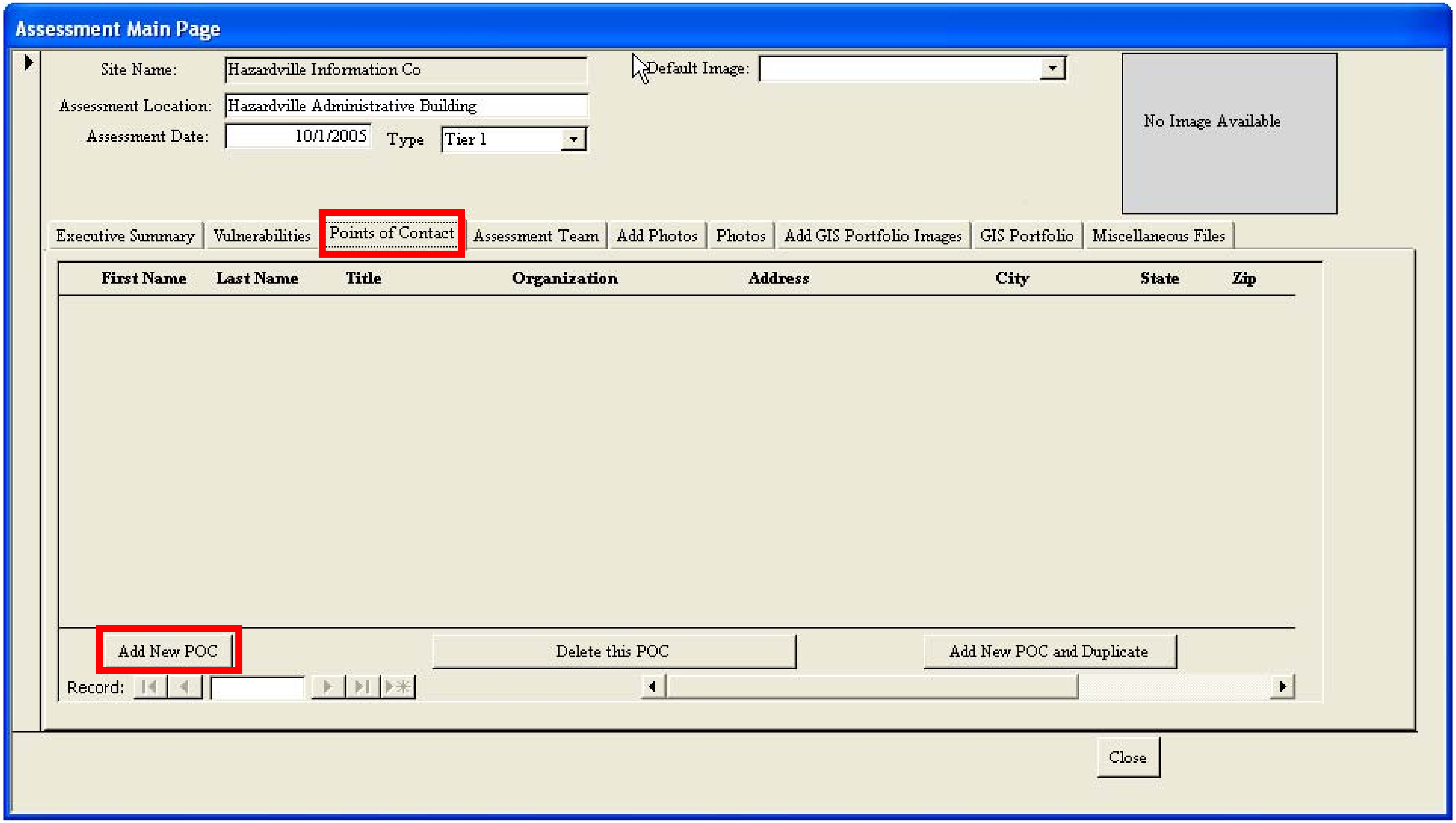
Add Team Members



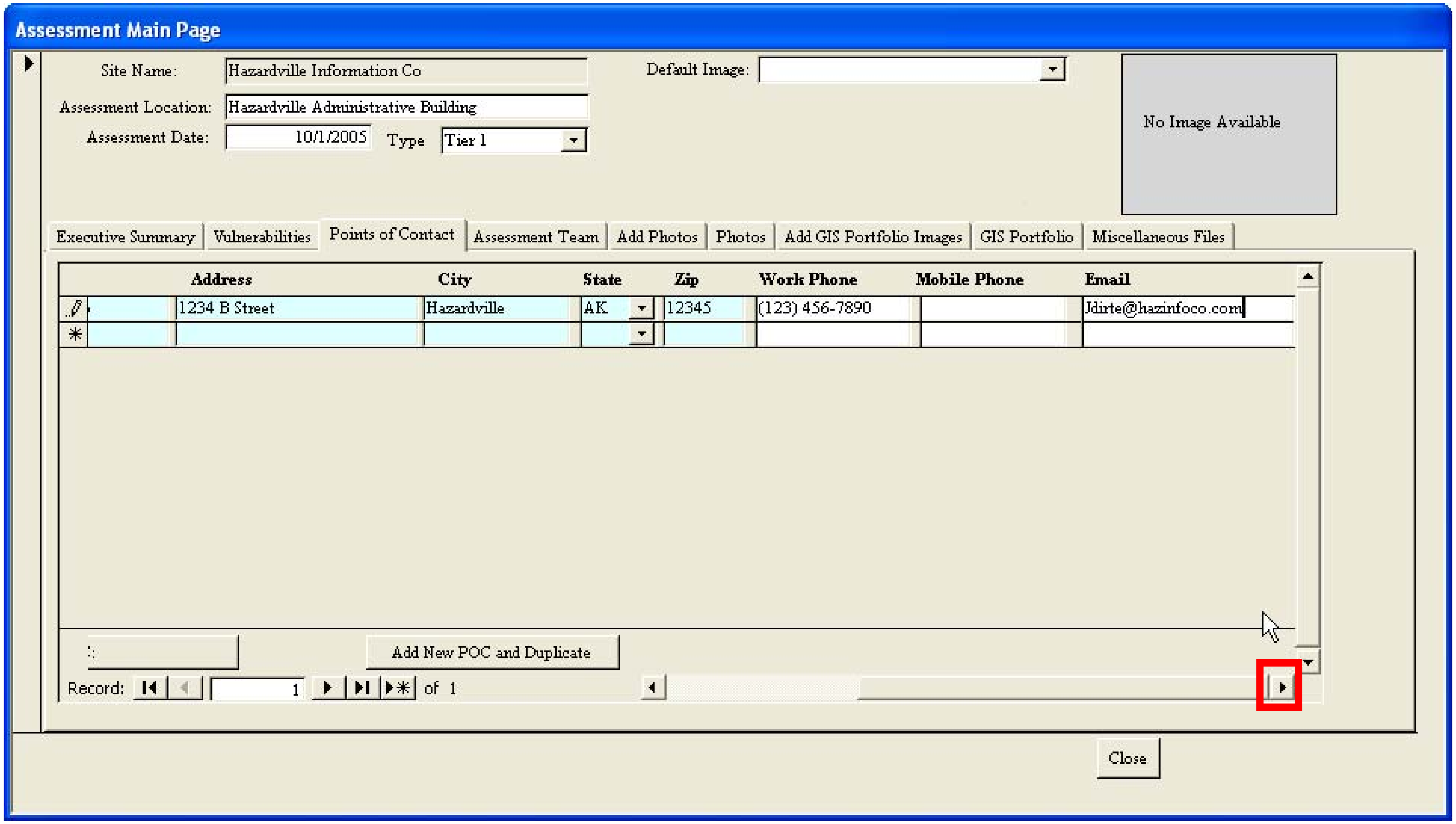
Team Members



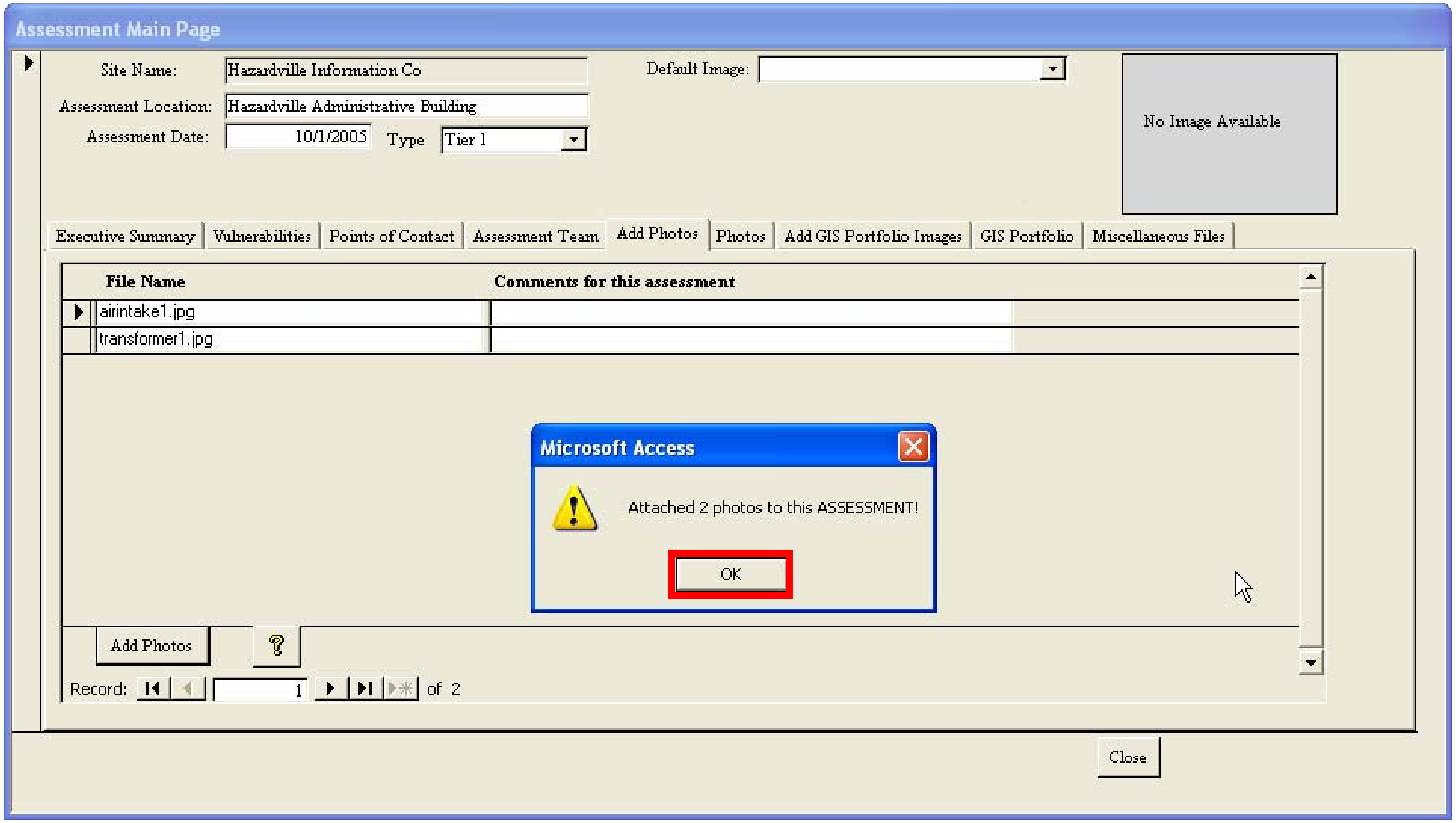
Add Point of Contact



Add Point of Contact

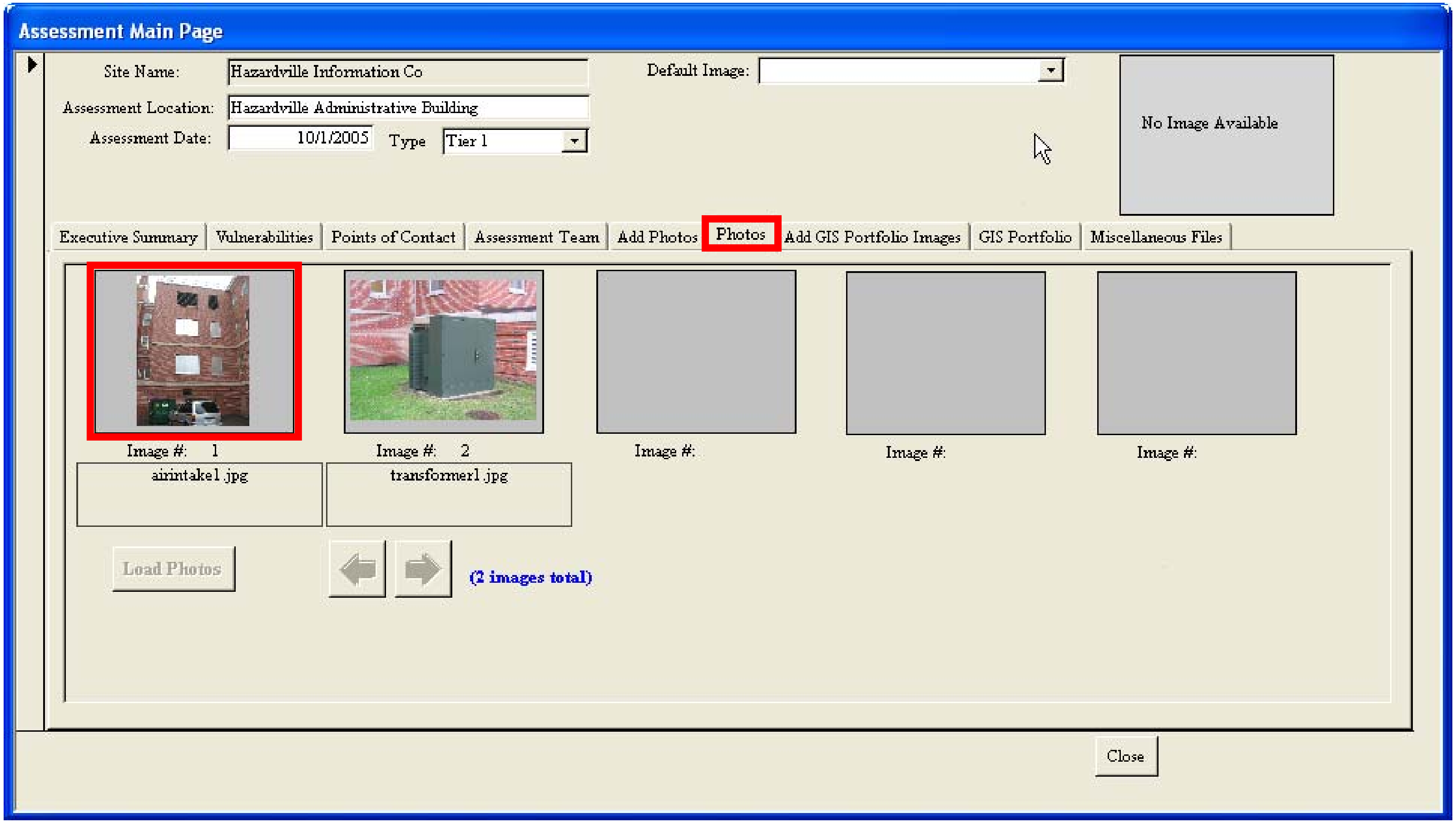


Add Photos



Assessment Main Page
Site Name: Hazardville Information Co
Assessment Location: Hazardville Administrative Building
Assessment Date: 10/1/2005
Type Tier 1
Default Image:
No Image Available
Executive Summary
Vulnerabilities
Points of Contact
Assessment Team
Add Photos
Photos
Add GIS Portfolio Images
GIS Portfolio
Miscellaneous Files
File Name
Comments for this assessment
airintake1.jpg
transformer1.jpg
Microsoft Access
Attached 2 photos to this ASSESSMENT!
OK
Add Photos
Record: 1 of 2
Close

Add Photos


Assessment Main Page
Site Name:
Hazardville Information Co
Default Image:
Assessment Location:
Hazardville Administrative Building
Assessment Date:
10/1/2005
Type
Tier 1
No Image Available
Executive Summary
Vulnerabilities
Points of Contact
Assessment Team
Add Photos
Photos
Add GIS Portfolio Images
GIS Portfolio
Miscellaneous Files
Image #: 1
airintake1.jpg
Image #: 2
transformer1.jpg
Image #:
Image #:
Image #:
Load Photos
(2 images total)
Close

Add Photos

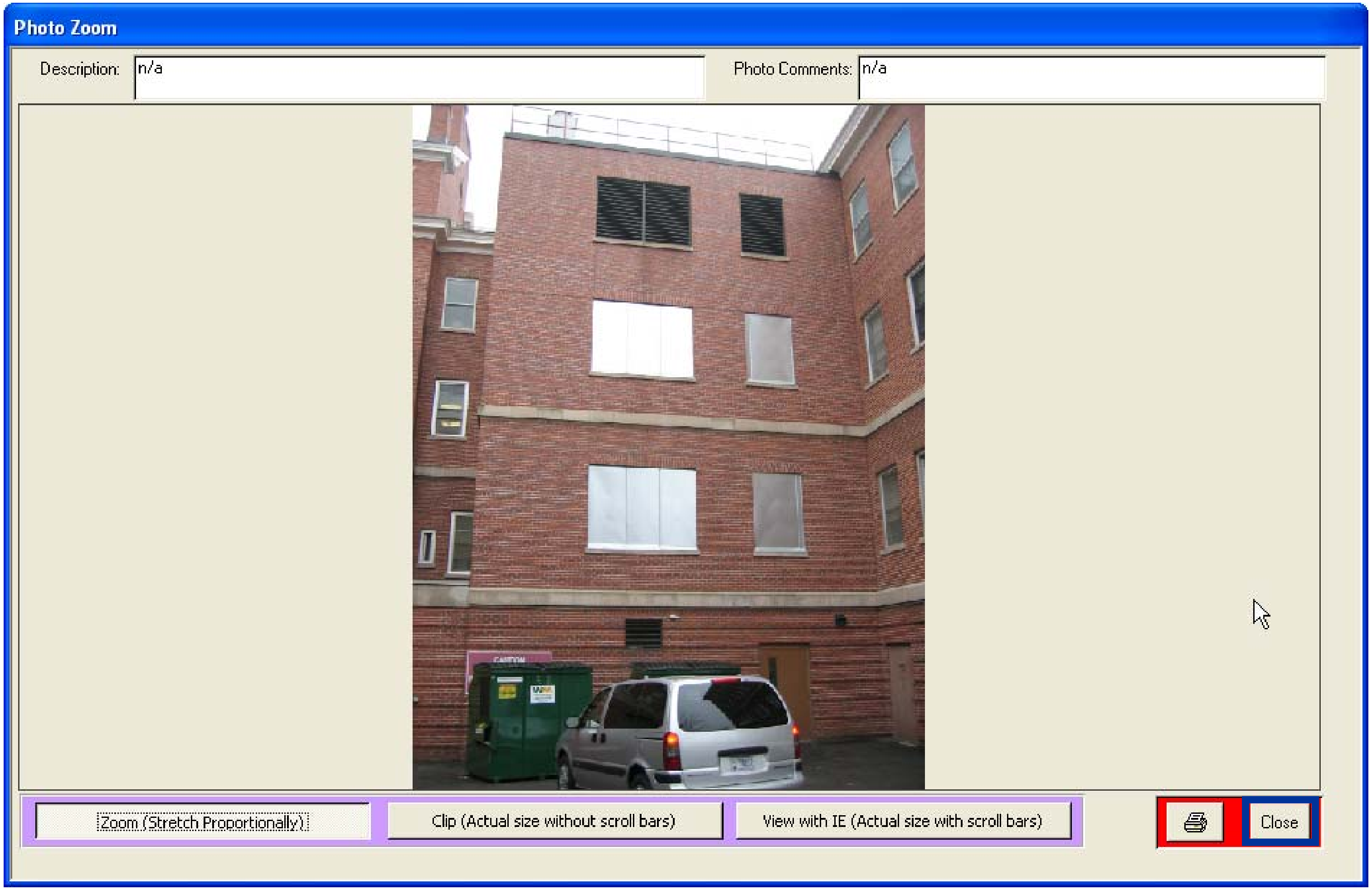
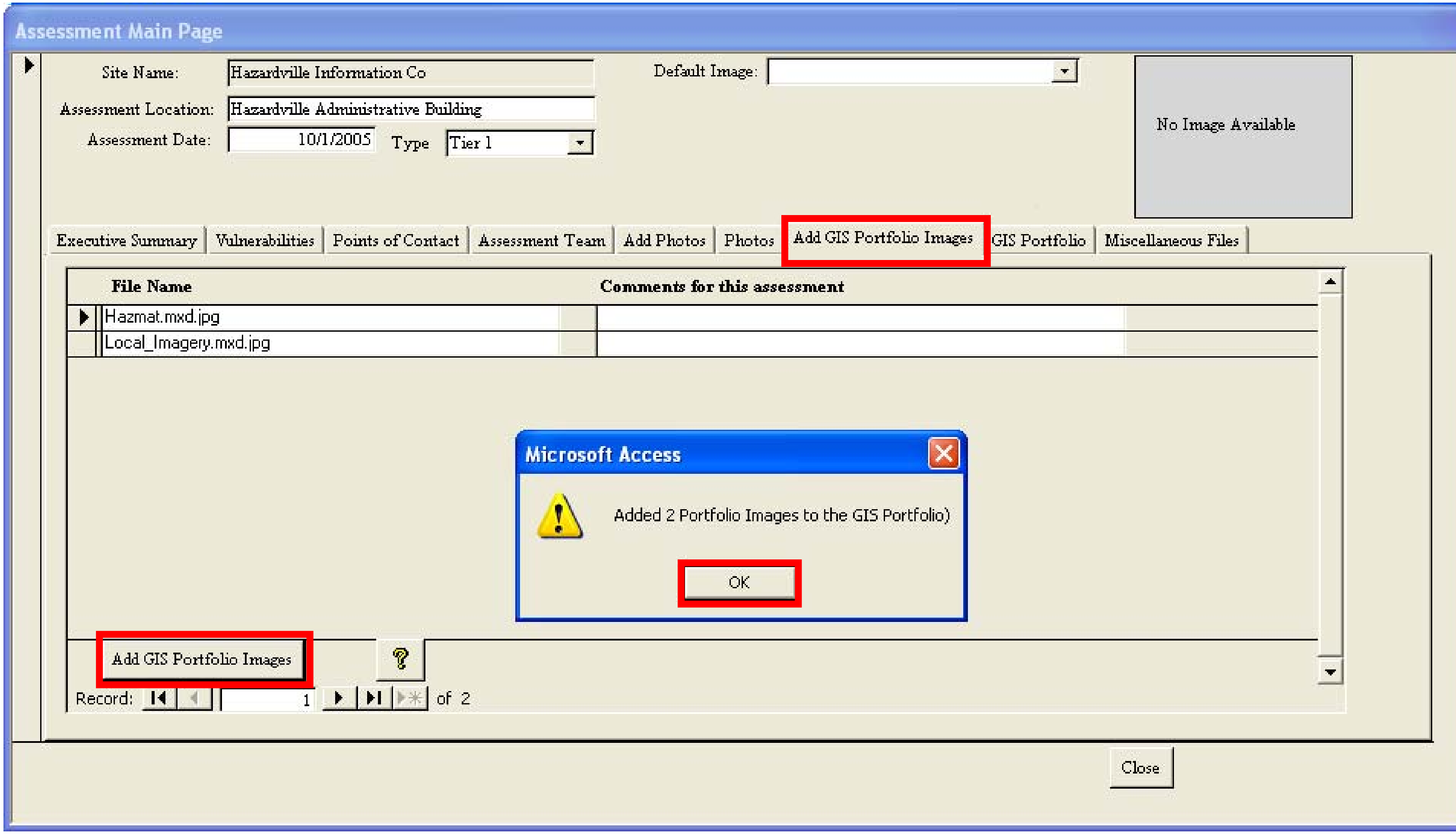
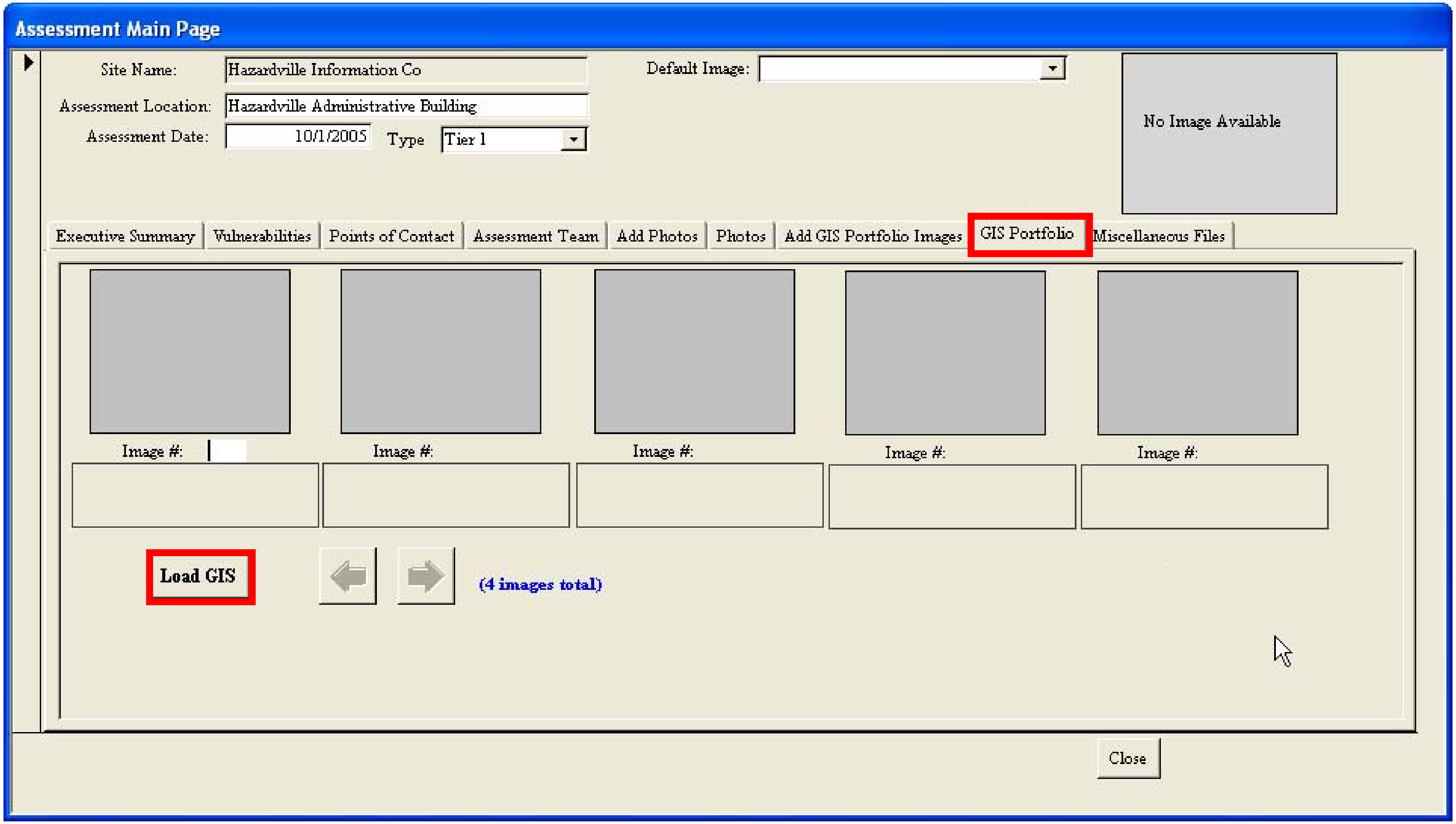


Photo Zoom
Description:
n/a
Photo Comments:
n/a
Zoom (Stretch Proportionally)
Clip (Actual size without scroll bars)
View with IE (Actual size with scroll bars)
Close

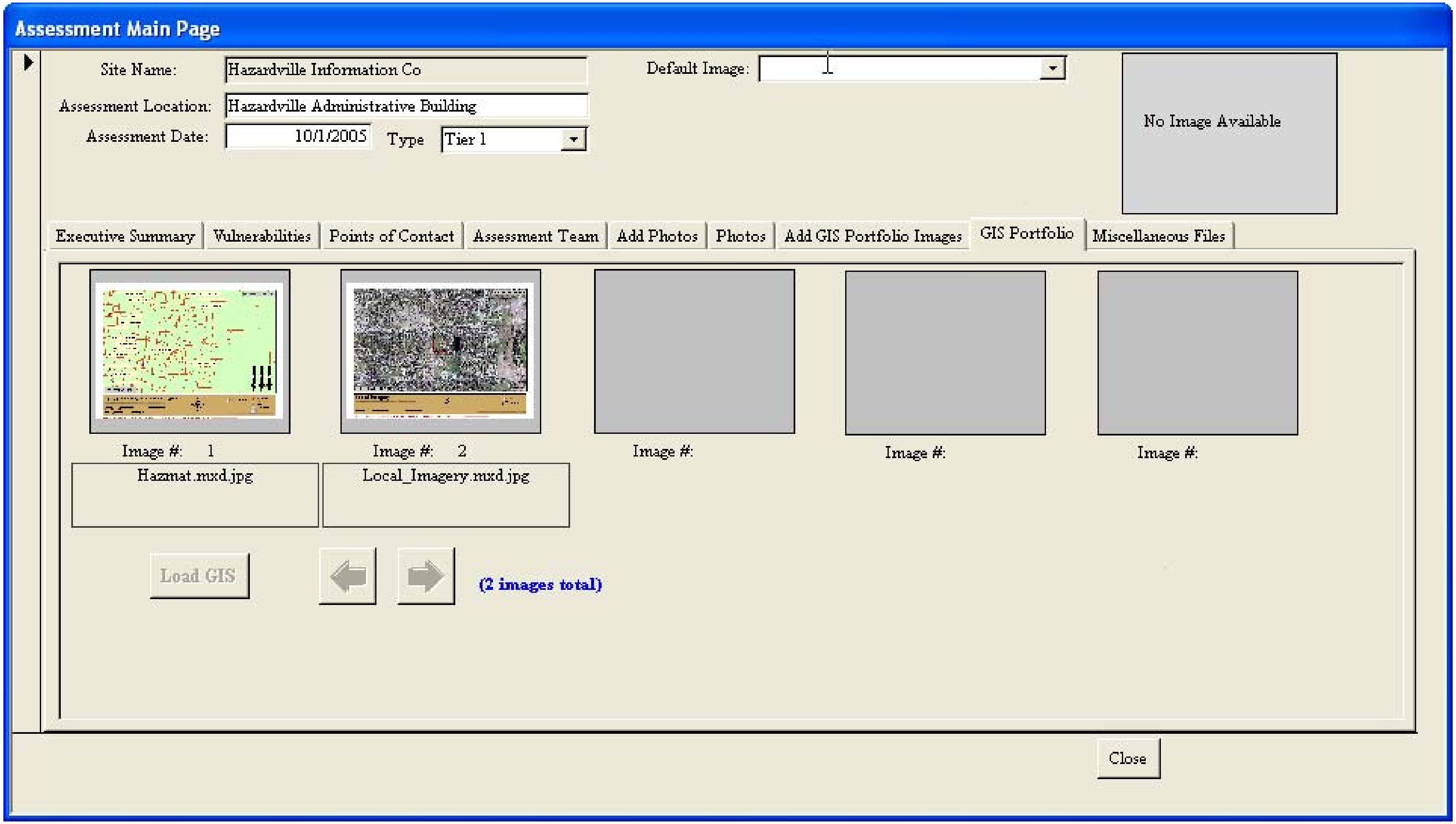
Add GIS Images



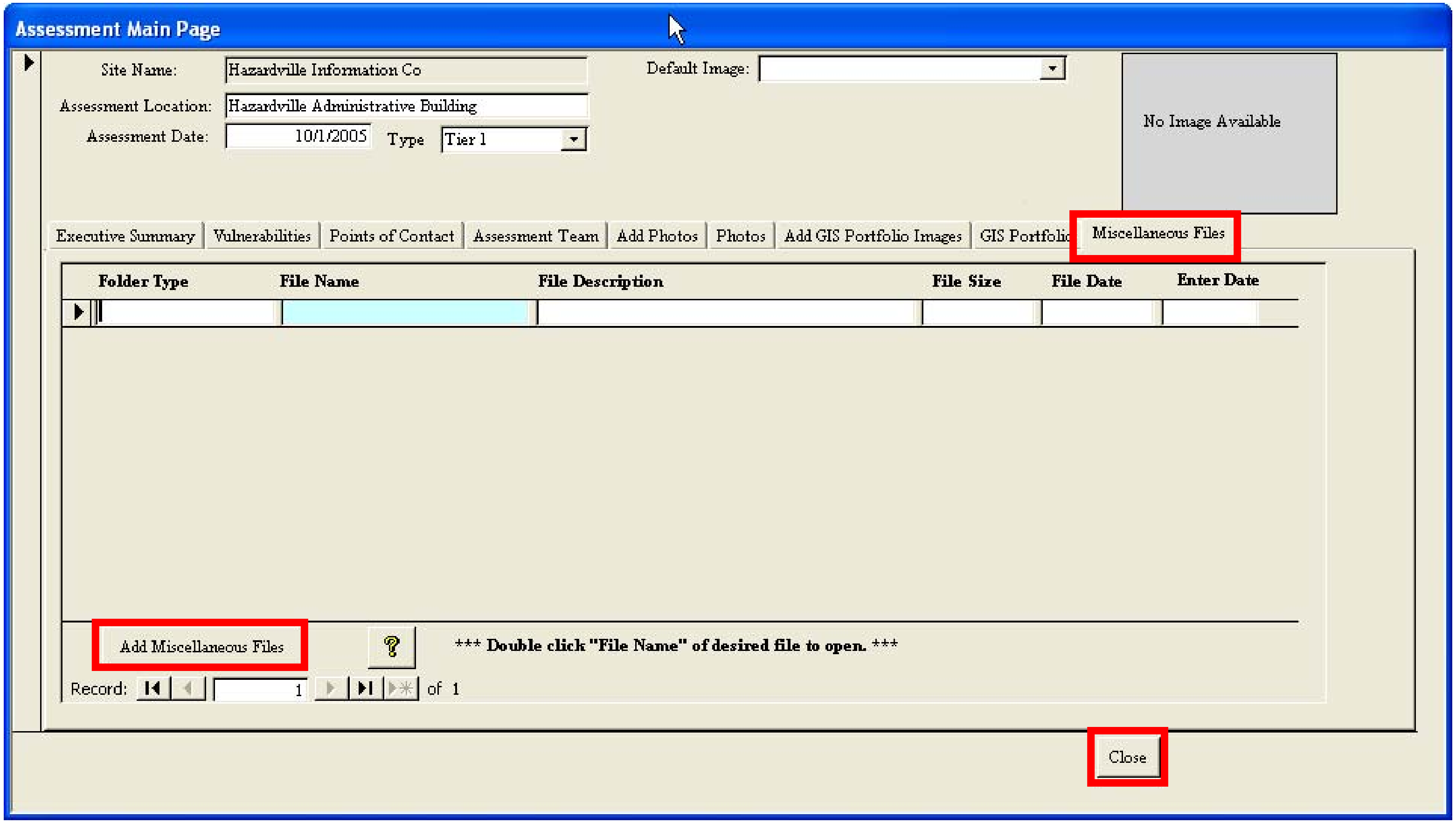
Add GIS Images



Add GIS Images

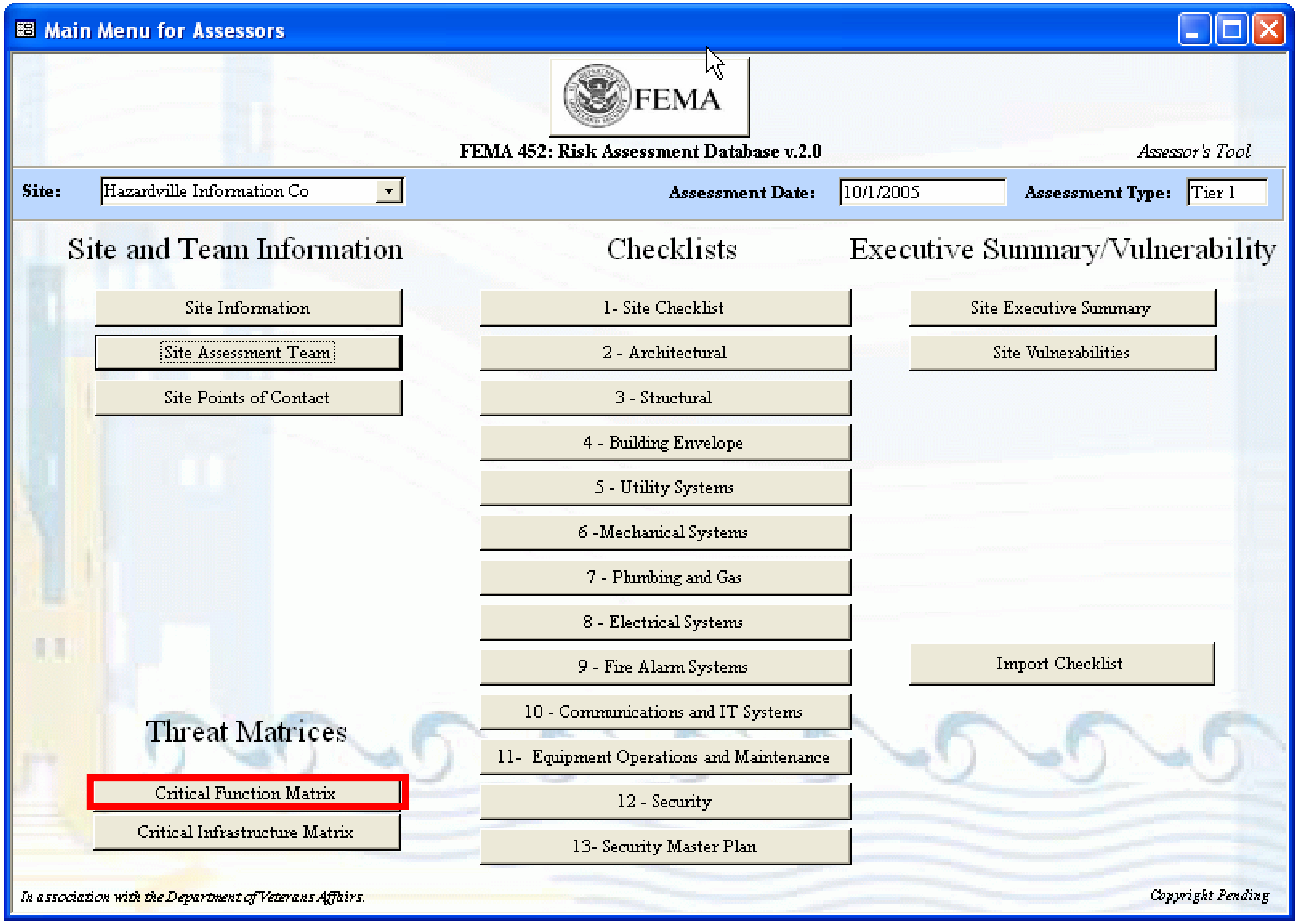


Add Miscellaneous Files



*** Same as photos and GIS images**

Threat Matrices



Critical Functions Matrix

Threats

Functions

Critical Functions Matrix

Site Name: Hazardville Information Co. AssessmentDate: 10/01/2005 AssessmentType: Tier1

Low Risk (1-6
Medium Risk
High Risk (>1

TR: Threat Rating
AV: Asset Value
VR: Vulnerability Rating

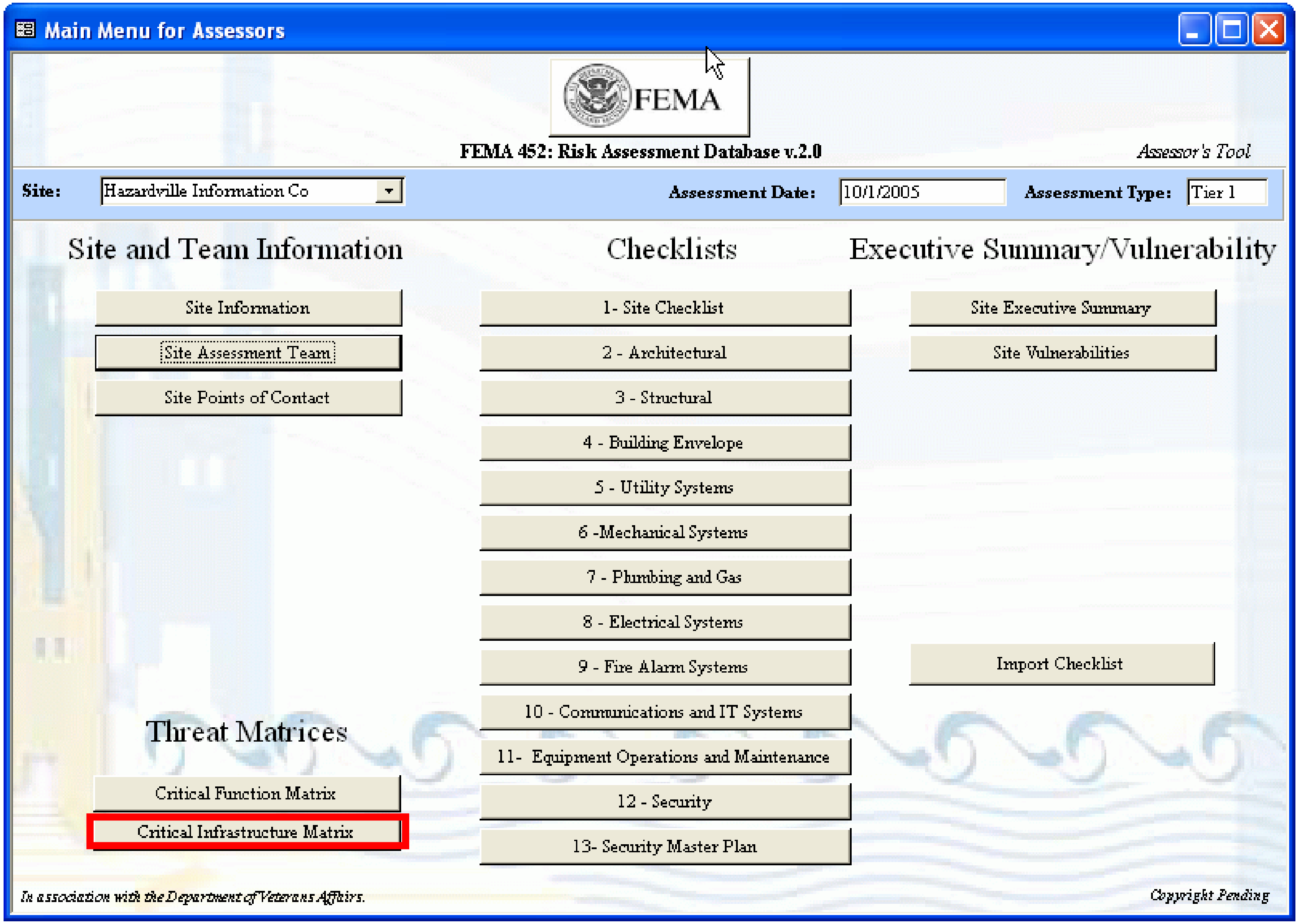
		Improvised Explosive Device (Bomb)				Chemical Agent				Arson/Incendiary Attack				Armed Attack				Biological Agent				Cyberterrorism				Agriterr		
No.	Critical Function	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VI
1	Administration	6	4	8	192	4	4	8	128	0	0	0	0	3	4	8	96	4	4	8	128	6	4	8	192	0	0	0
2	Engineering	6	5	8	240	4	5	8	160	0	0	0	0	3	5	8	120	4	5	8	160	5	5	8	200	0	0	0
3	Warehousing	6	5	8	240	4	5	8	160	0	0	0	0	3	5	3	45	4	5	8	160	5	5	2	50	0	0	0
4	Data Center	6	10	8	480	4	10	8	320	0	0	0	0	3	10	3	90	4	10	8	320	9	10	9	810	0	0	0
5	Food Service	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Security	6	7	8	336	4	7	8	224	0	0	0	0	3	7	3	63	4	7	8	224	5	7	3	105	0	0	0
7	Housekeeping	6	1	8	48	4	1	8	32	0	0	0	0	3	1	1	3	4	1	8	32	2	1	1	2	0	0	0
8	Day Care	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Other CF-1	6	8	8	384	4	8	8	256	0	0	0	0	3	8	3	72	4	8	8	256	5	8	8	320	0	0	0
10	Other CF-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Other CF-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Other CF-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Other CF-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Other CF-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Asset Value	**1- 10**
Threat Rating	**1- 10**
Vulnerability Rating	**1- 10**

Low risk (1-60)
Medium risk (61-175)
High risk (> 175)

FEMA

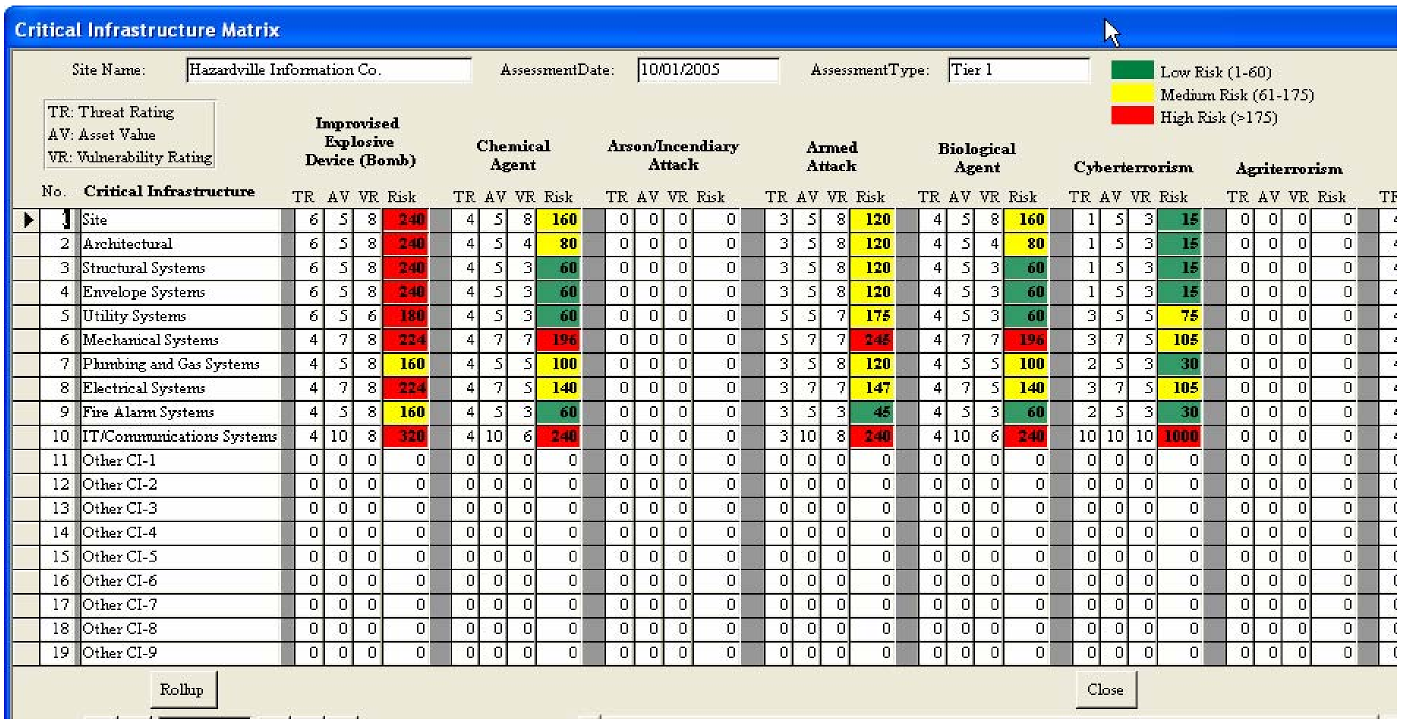
Threat Matrices



Critical Infrastructure Matrix

Threats

Infrastructure


Critical Infrastructure Matrix

Site Name: Hazardville Information Co. AssessmentDate: 10/01/2005 AssessmentType: Tier 1

Low Risk (1-60)
Medium Risk (61-175)
High Risk (>175)

TR: Threat Rating
AV: Asset Value
VR: Vulnerability Rating

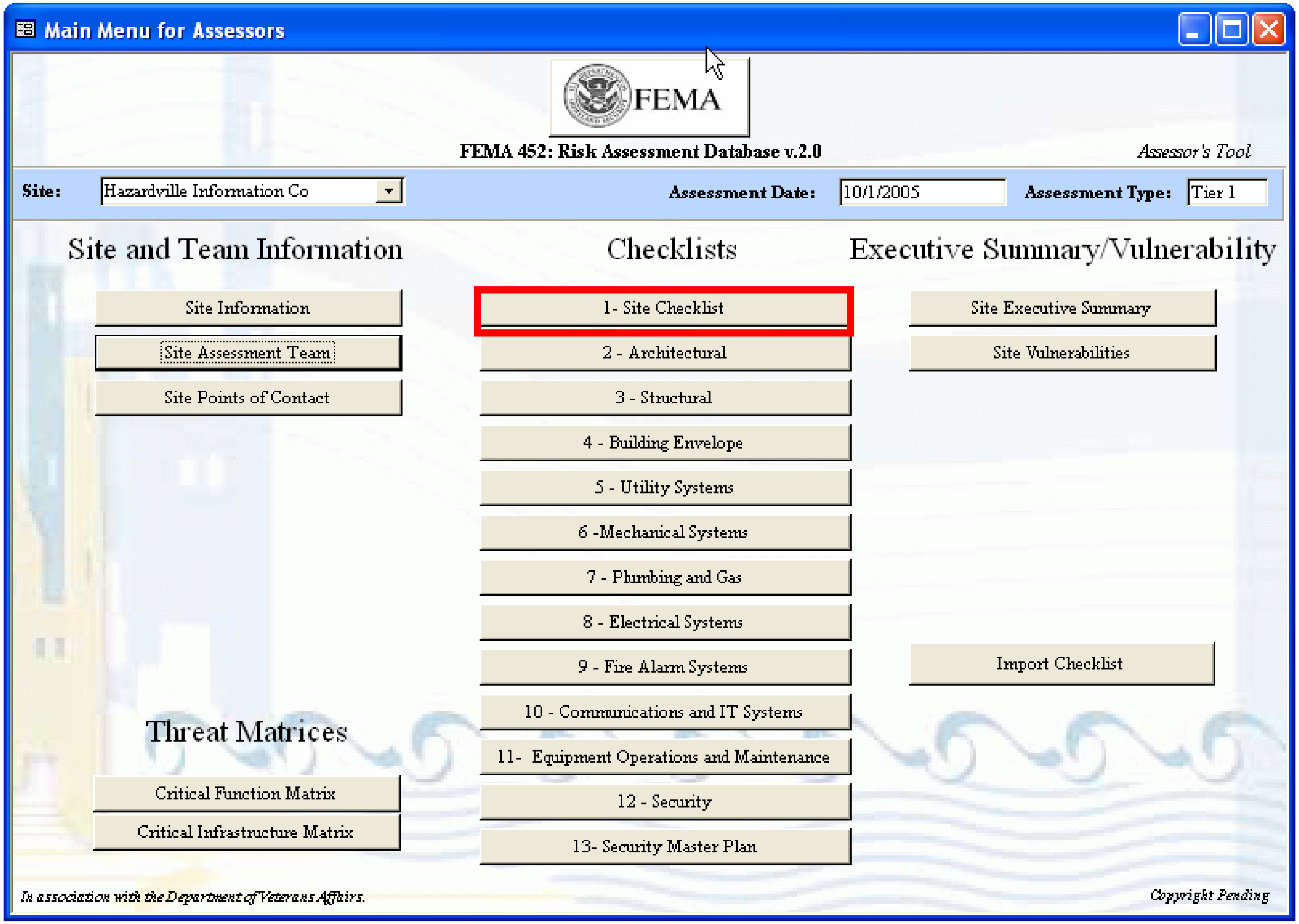
		Improvised Explosive Device (Bomb)				Chemical Agent				Arson/Incendiary Attack				Armed Attack				Biological Agent				Cyberterrorism				Agriterrorism			
No.	Critical Infrastructure	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk	TR	AV	VR	Risk
1	Site	6	5	8	240	4	5	8	160	0	0	0	0	3	5	8	120	4	5	8	160	1	5	3	15	0	0	0	0
2	Architectural	6	5	8	240	4	5	4	80	0	0	0	0	3	5	8	120	4	5	4	80	1	5	3	15	0	0	0	0
3	Structural Systems	6	5	8	240	4	5	3	60	0	0	0	0	3	5	8	120	4	5	3	60	1	5	3	15	0	0	0	0
4	Envelope Systems	6	5	8	240	4	5	3	60	0	0	0	0	3	5	8	120	4	5	3	60	1	5	3	15	0	0	0	0
5	Utility Systems	6	5	6	180	4	5	3	60	0	0	0	0	5	5	7	175	4	5	3	60	3	5	5	75	0	0	0	0
6	Mechanical Systems	4	7	8	224	4	7	7	196	0	0	0	0	5	7	7	245	4	7	7	196	3	7	5	105	0	0	0	0
7	Plumbing and Gas Systems	4	5	8	160	4	5	5	100	0	0	0	0	3	5	8	120	4	5	5	100	2	5	3	30	0	0	0	0
8	Electrical Systems	4	7	8	224	4	7	5	140	0	0	0	0	3	7	7	147	4	7	5	140	3	7	5	105	0	0	0	0
9	Fire Alarm Systems	4	5	8	160	4	5	3	60	0	0	0	0	3	5	3	45	4	5	3	60	2	5	3	30	0	0	0	0
10	IT/Communications Systems	4	10	8	320	4	10	6	240	0	0	0	0	3	10	8	240	4	10	6	240	10	10	10	1000	0	0	0	0
11	Other CI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Other CI-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Other CI-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Other CI-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Other CI-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Other CI-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Other CI-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Other CI-8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Other CI-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rollup Close

Asset Value	1- 10
Threat Rating	1- 10
Vulnerability Rating	1- 10

Low risk (1-60)
Medium risk (61-175)
High risk (> 175)

Checklists



FEMA

Site Checklist

Observations and Recommendations/Remediations for Section Heading: Site

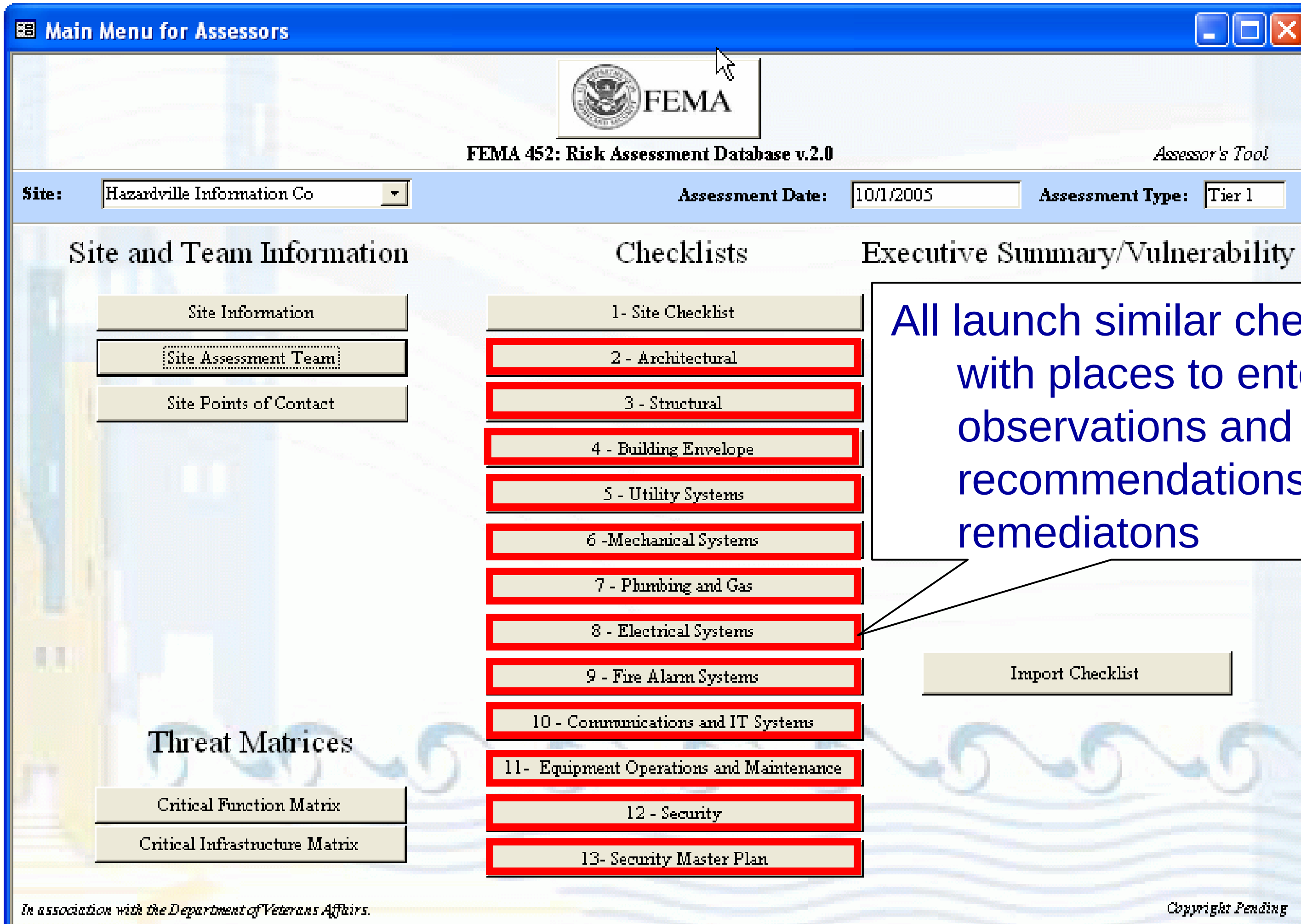
Site Name: Hazardville Information Co. **Type: Tier 1**

Q#	Observation	Recommendation/Remediation	Vuln?	Vulnerability Assessment Question	Guidance
1-1	Two Critical Hazard Facilities within 2 mile and a dozen Tier II HAZMAT Facilities within 3 miles. Major interstate highway within 1/4 mile. Two railroads have tracks within 1/2 mile with no restrictions on materials carried Four nearby buried long-distance	Collateral effects of attacks or accidents impact HIC similar to CBR attacks. See recommendations for HVAC systems.		What major structures surround the facility (site or building(s))? -- What critical infrastructure, government, military, or recreation facilities are in the local area that impact transportation, utilities, and collateral damage (attack at this facility impacting	Critical infrastructure to consider includes: - Telecommunications infrastructure - Facilities for broadcast TV, cable TV; cellular networks; newspaper offices, production, and distribution; radio stations; satellite base stations; telephone trunking and
1-2	The site is above the tank farm and the rear parking area slopes away from the building to a stream, which allows winds to pass over the structure unhindered.	None.		Does the terrain place the building in a depression or low area?	Depressions or low areas can trap heavy vapors, inhibit natural decontamination by prevailing winds, and reduce the effectiveness of in-place sheltering. - Reference: USAF Installation Force Protection Guide
1-3	With a loading dock on the west side, it is possible for vehicles to park right next to the building. Normal parking for employees is in front; the closest row is 44 feet from the front door.	Increased stand-off or increased access control is needed to reduce risk of vehicle-borne improvised explosive device. Any action will require coordination with Business Park Management and other tenants due to impacts on the overall business park	✓	In dense, urban areas, does curb lane parking place uncontrolled parked vehicles unacceptably close to a building in public rights-of-way?	Where distance from the building to the nearest curb provides insufficient setback, restrict parking in the curb lane. For typical city streets this may require negotiating to close the curb lane. Setback is common terminology for the distance between a building and

Close

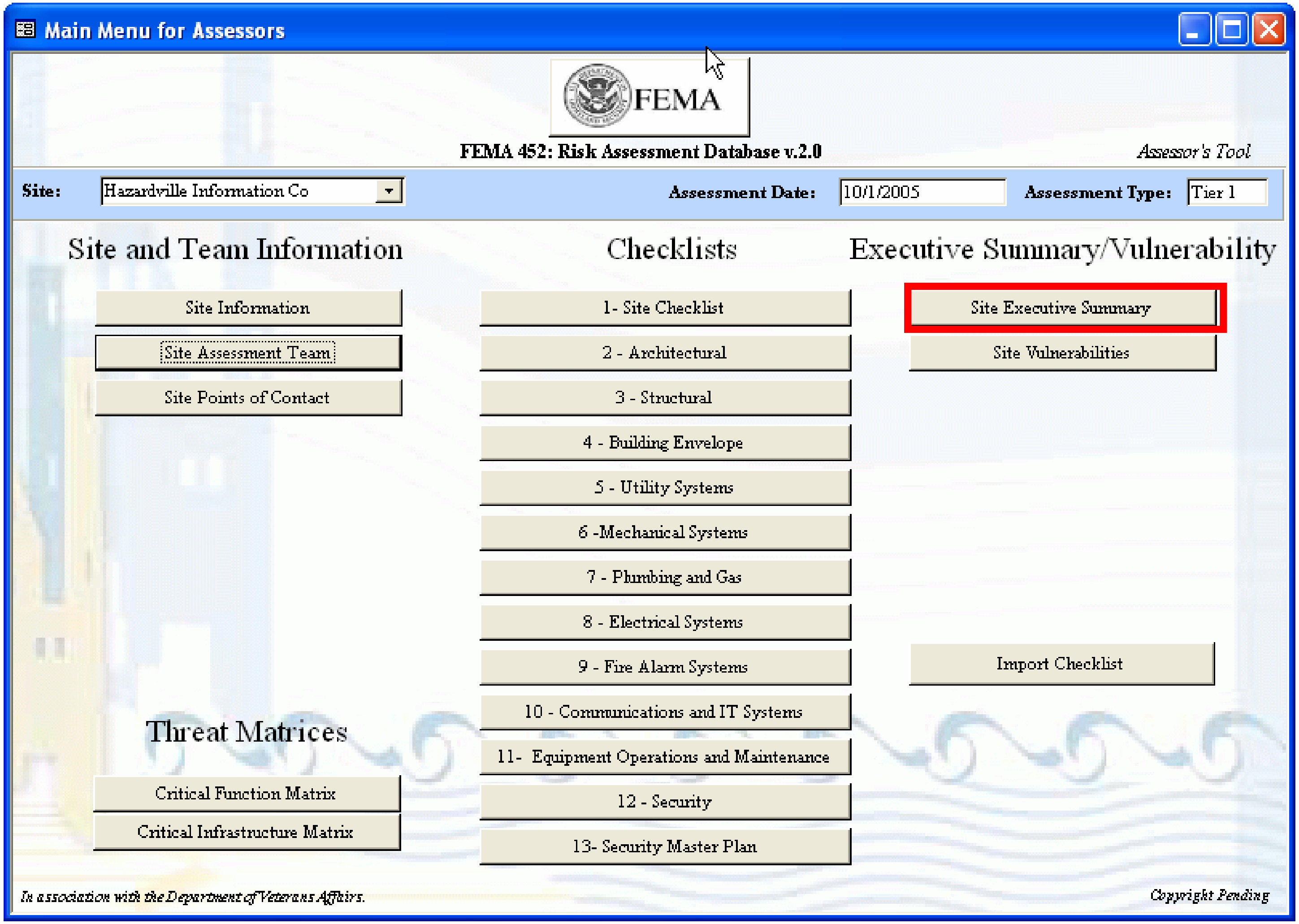
Record: 3 of 23 (Filtered)

Checklists



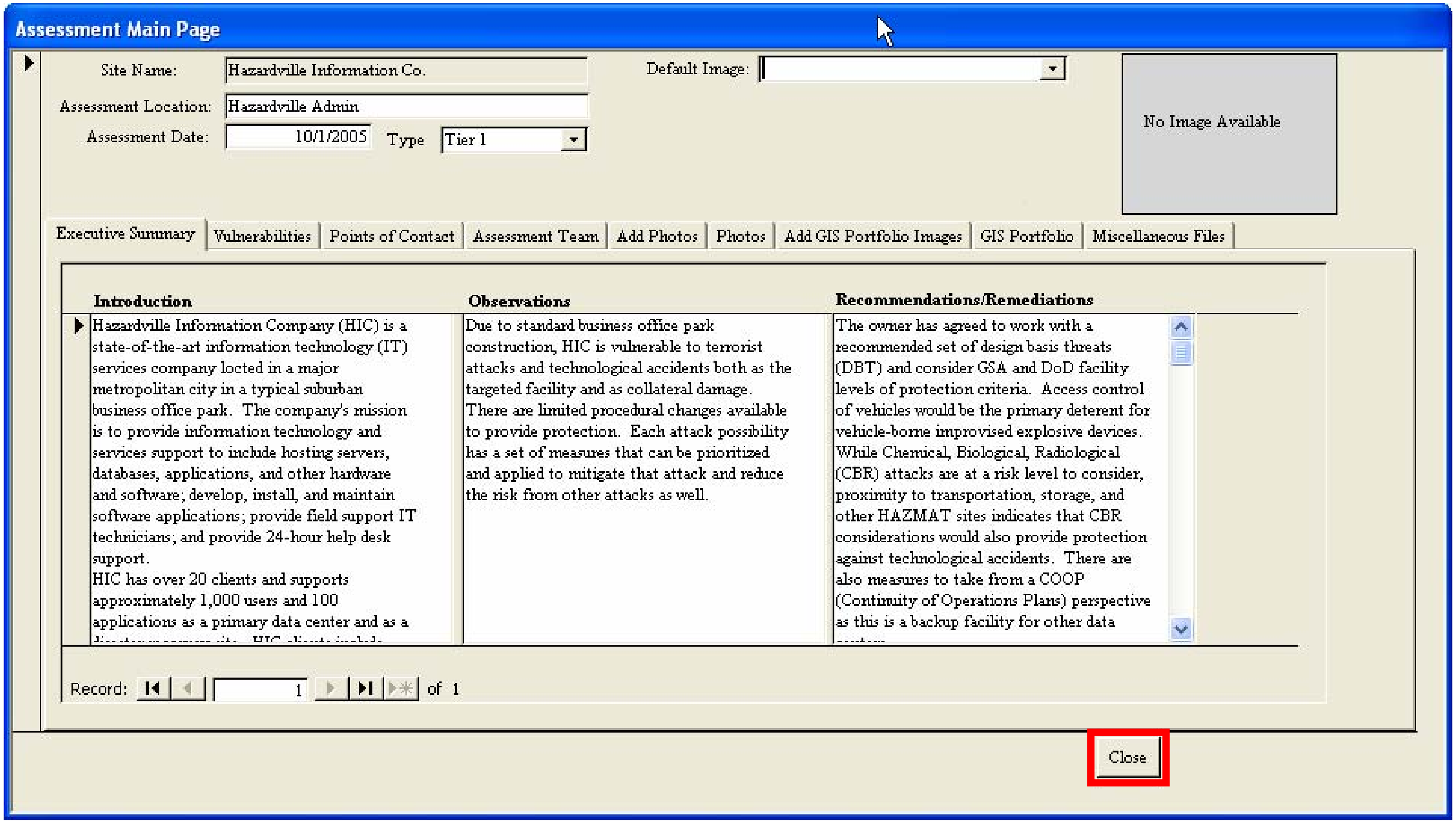
All launch similar checklists with places to enter observations and recommendations / remediatons

Executive Summary

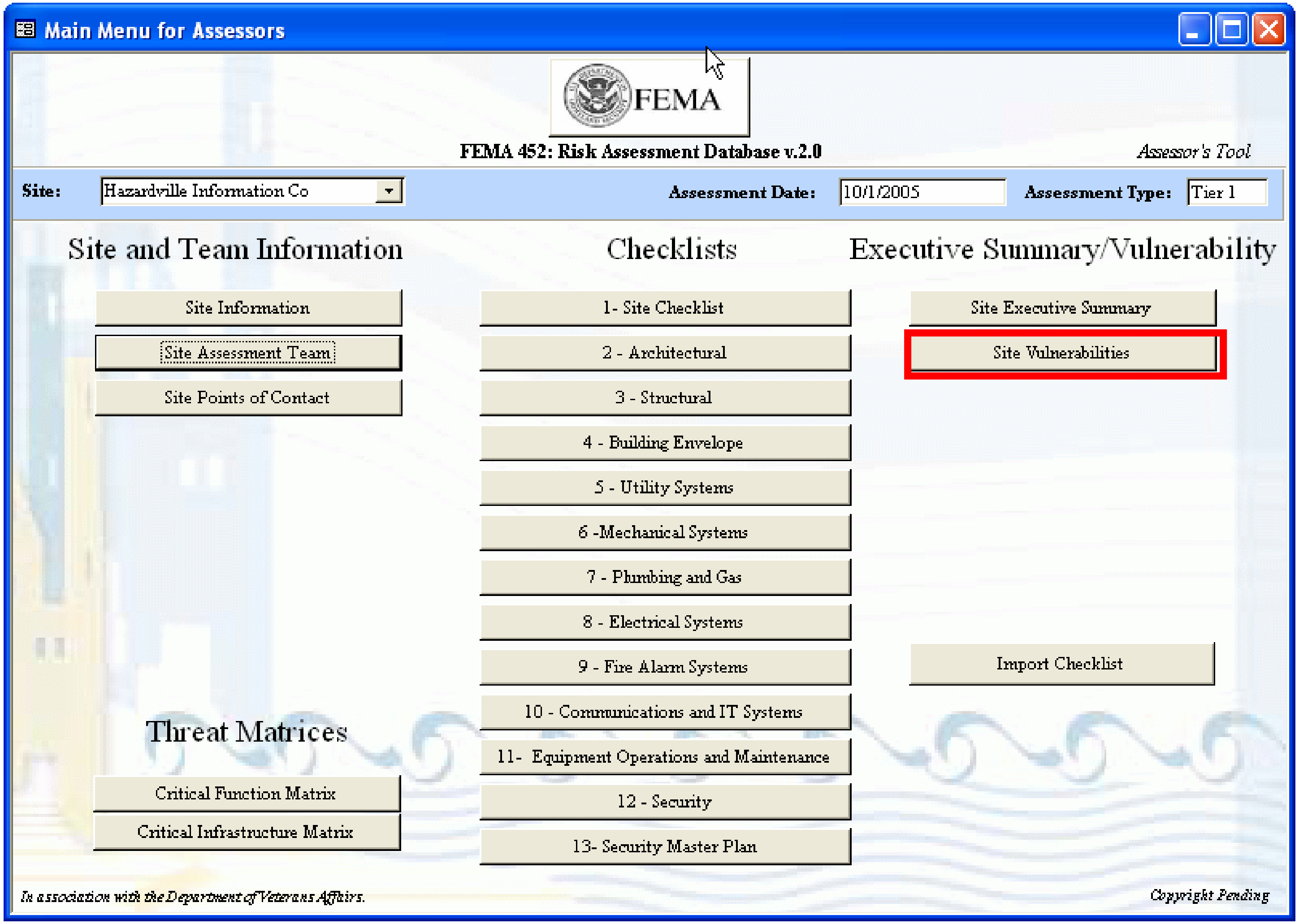


FEMA

Executive Summary Tab

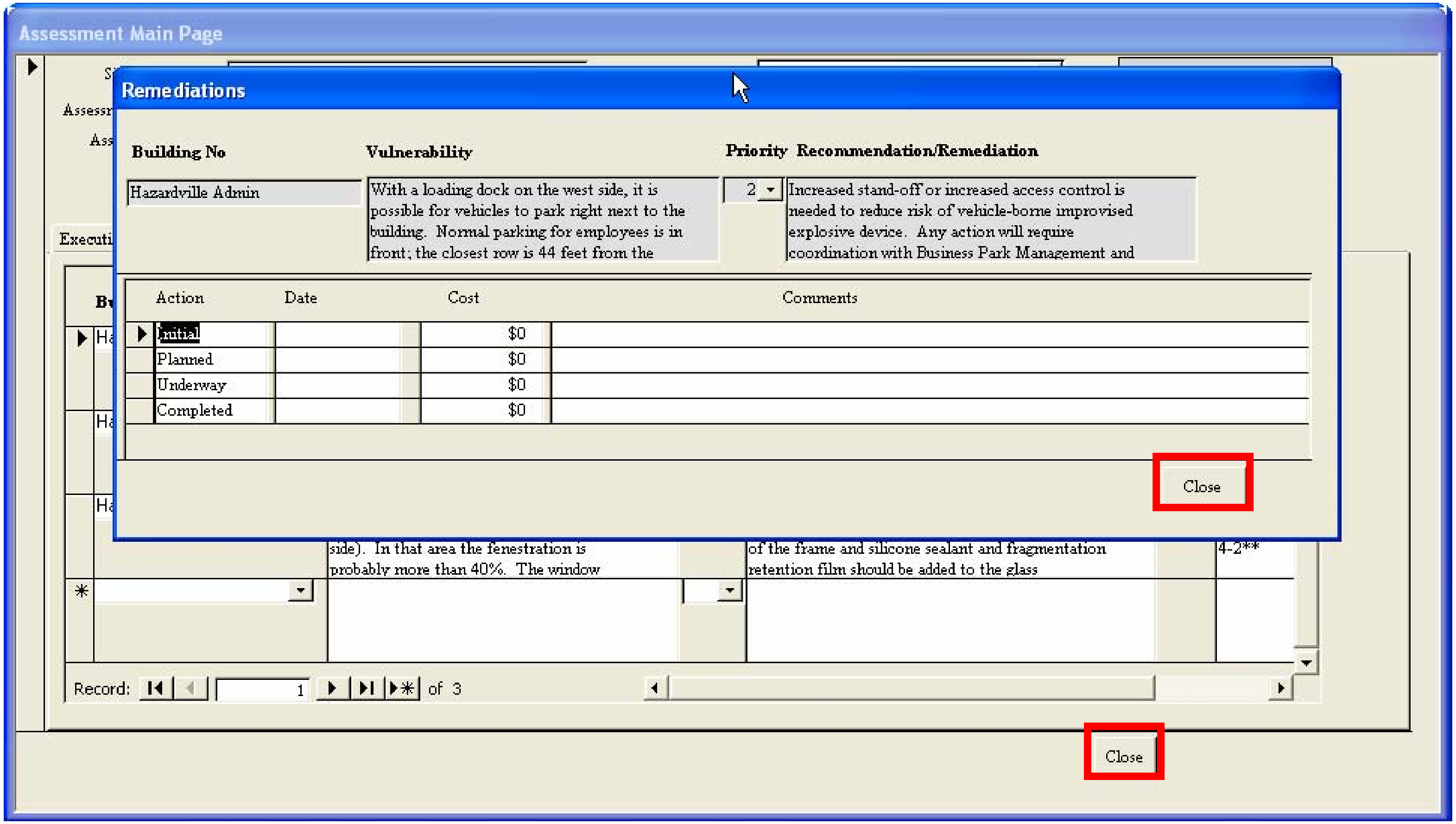


Vulnerabilities

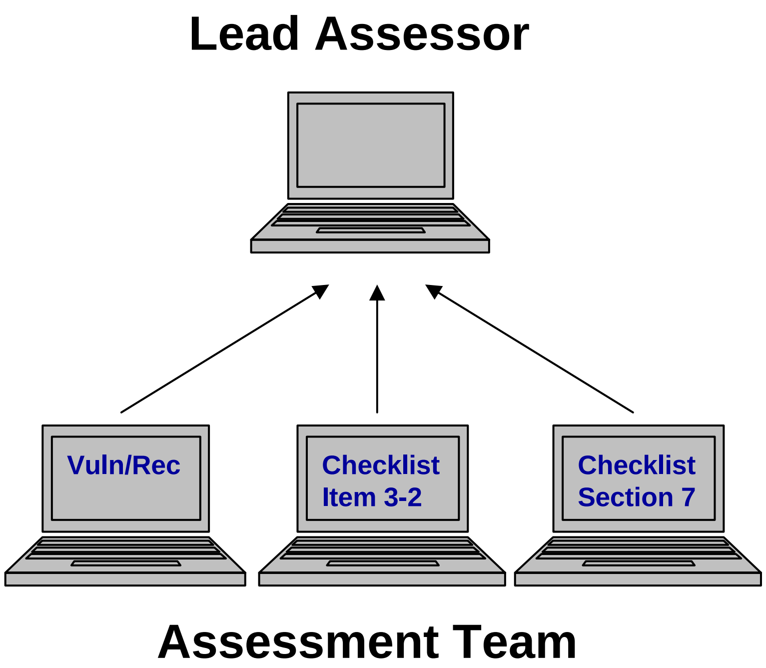


FEMA

Vulnerabilities and Recommendations



Assessment Team Import Function

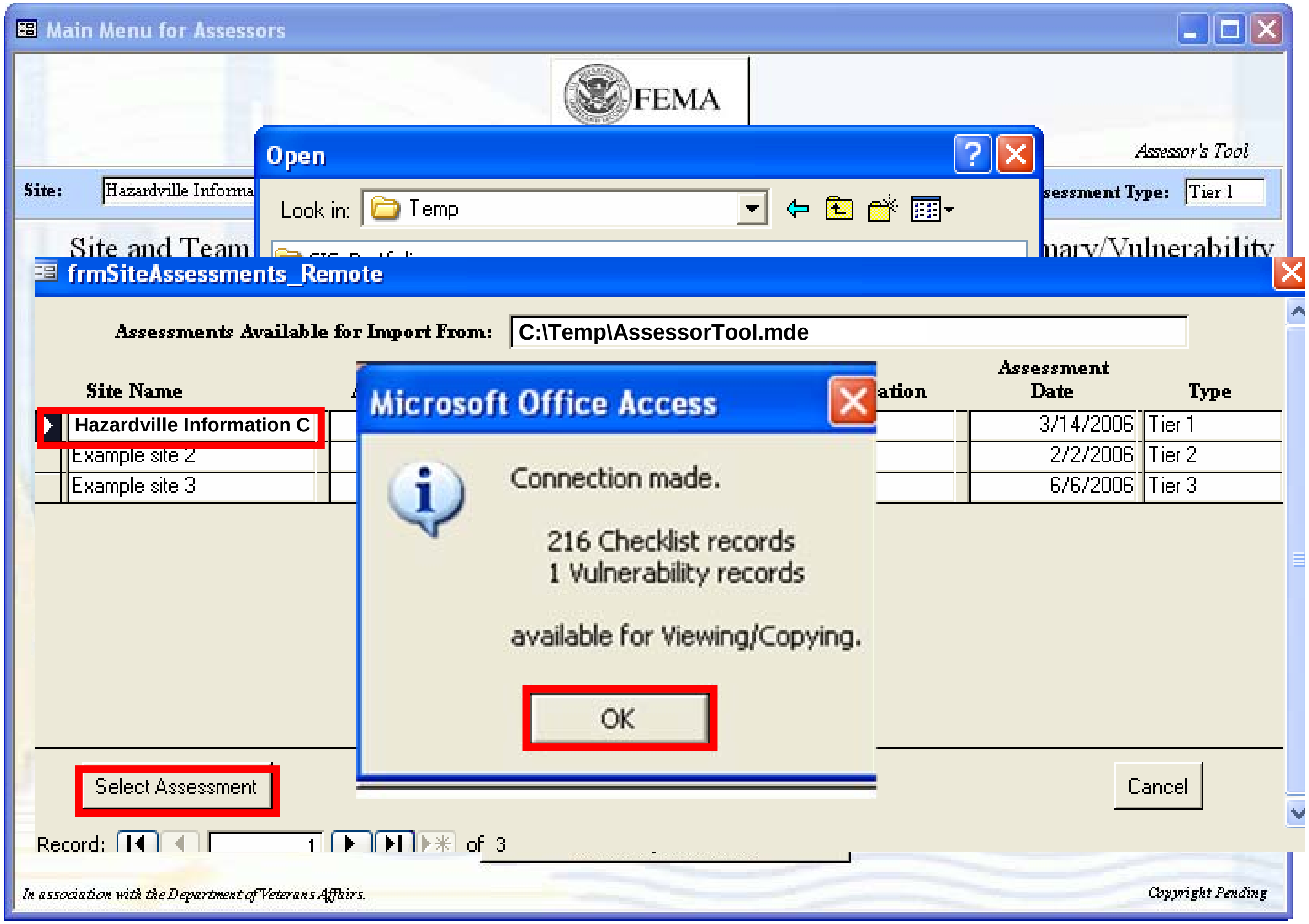


- Establish a link to a team member's database
- Open the remote database
- Import Observation, Recommendation/Remediation, or Vulnerability entries

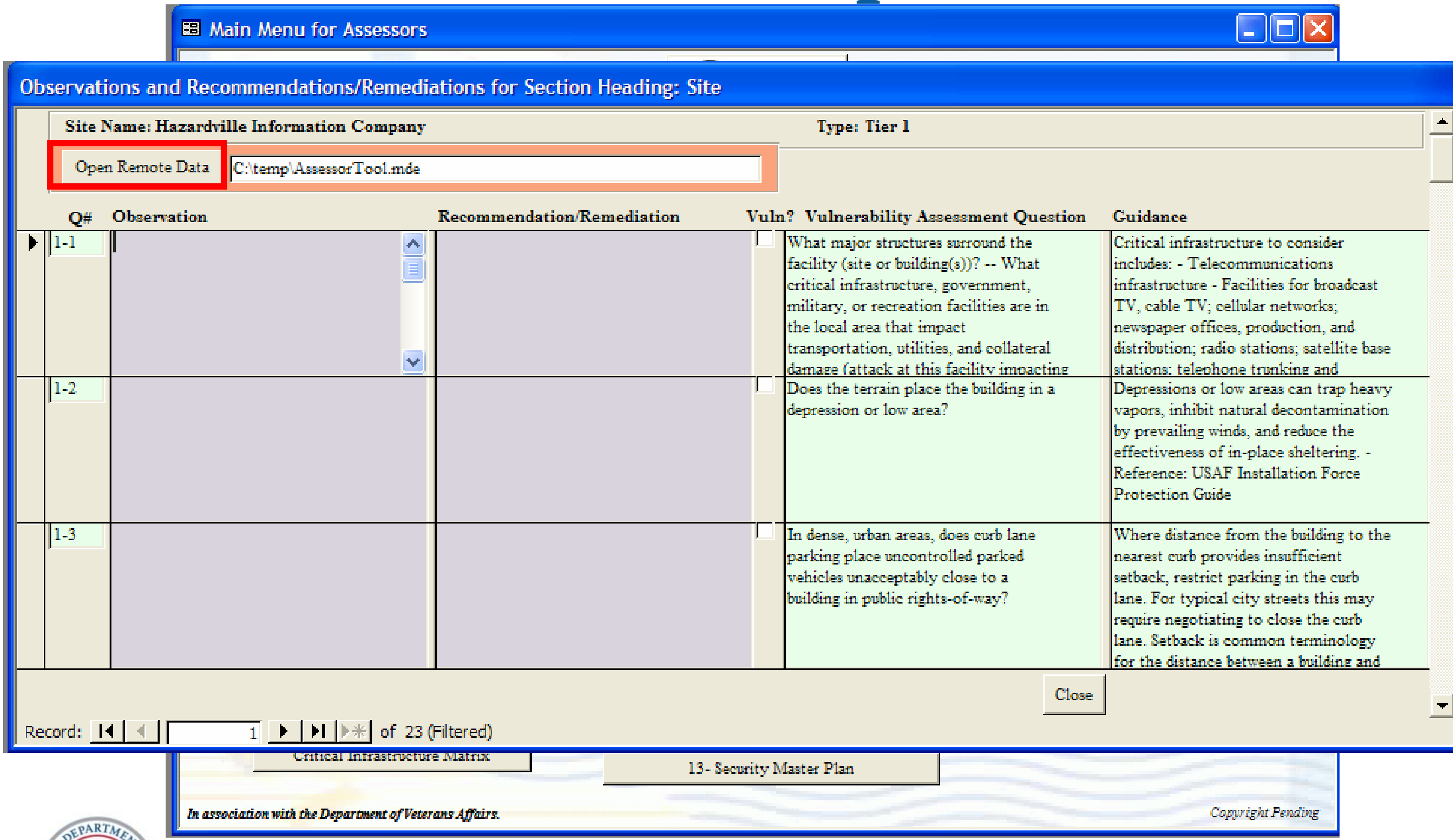
The assessment team members to combine their data into one database file on one computer at the end of the assessment.

FEMA

Import Assessments

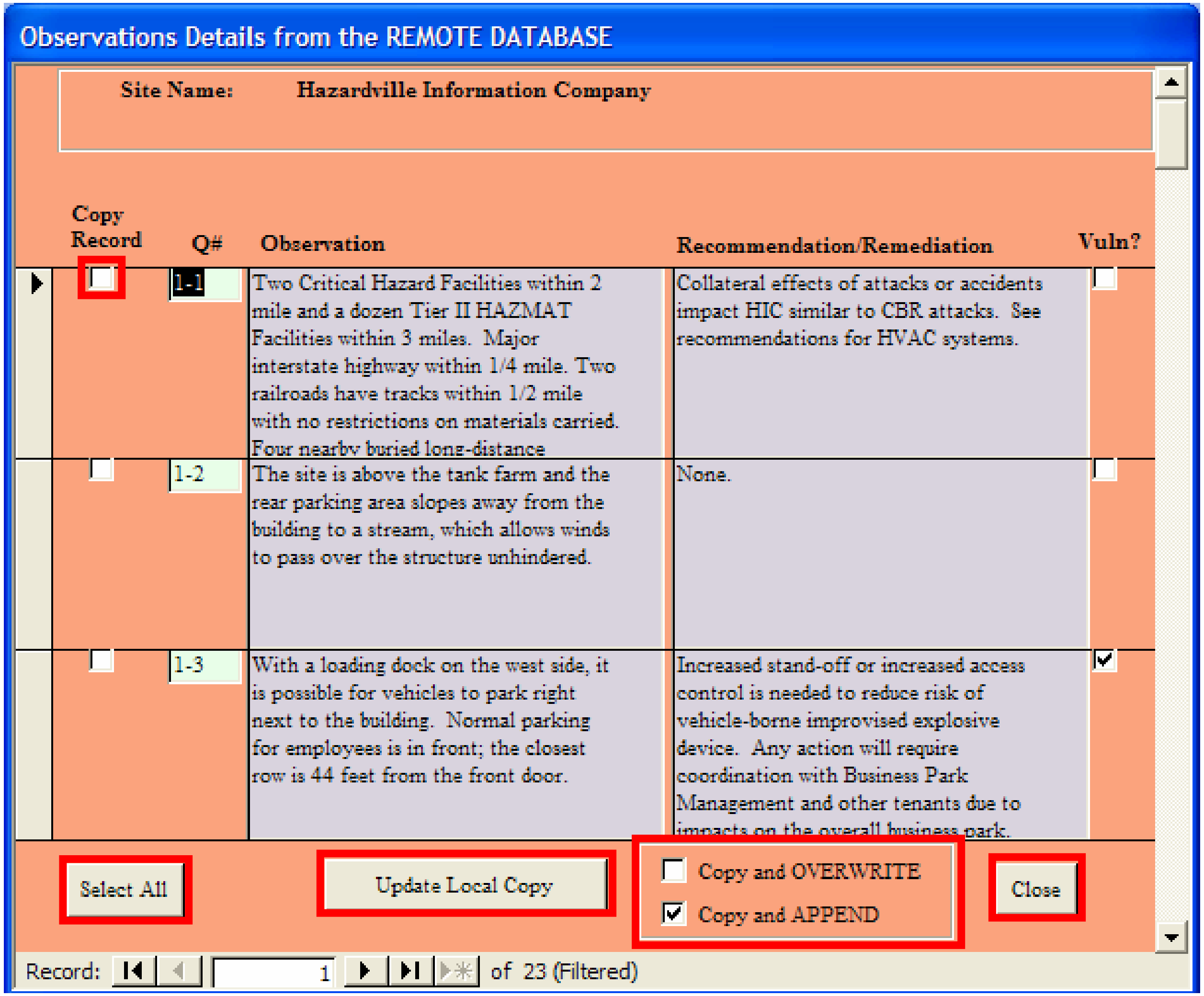


Assessment Team Import Function



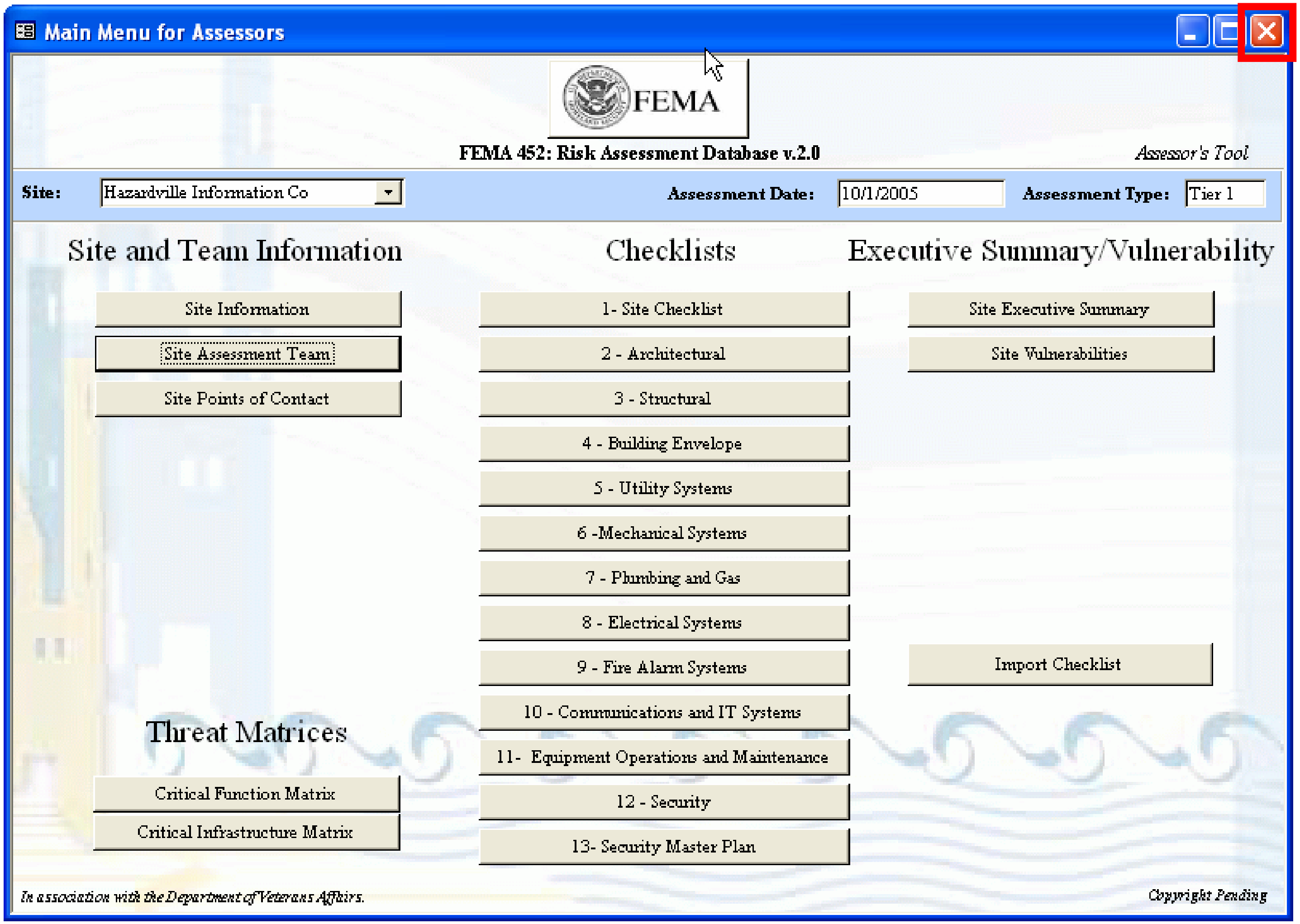
FEMA

Assessment Team Import Function



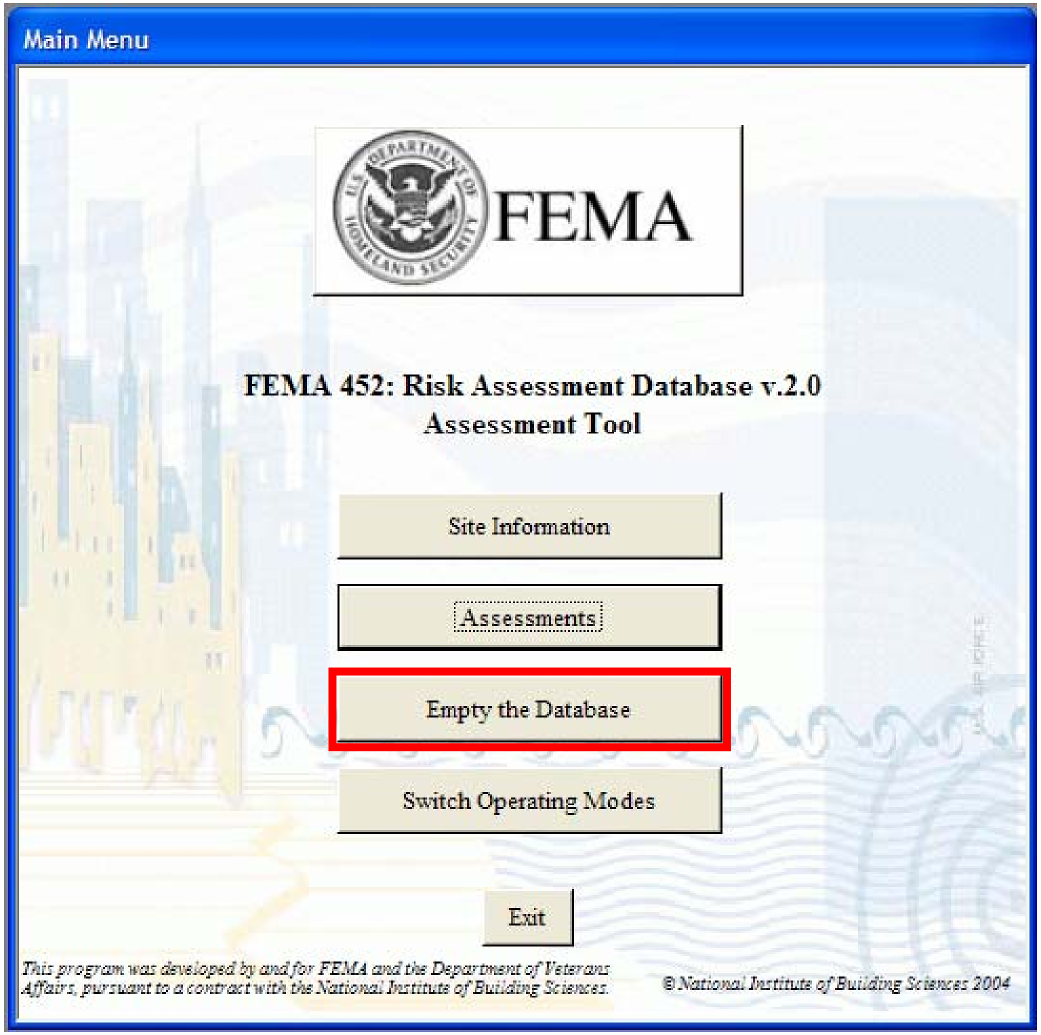
FEMA

Close Assessor Tool

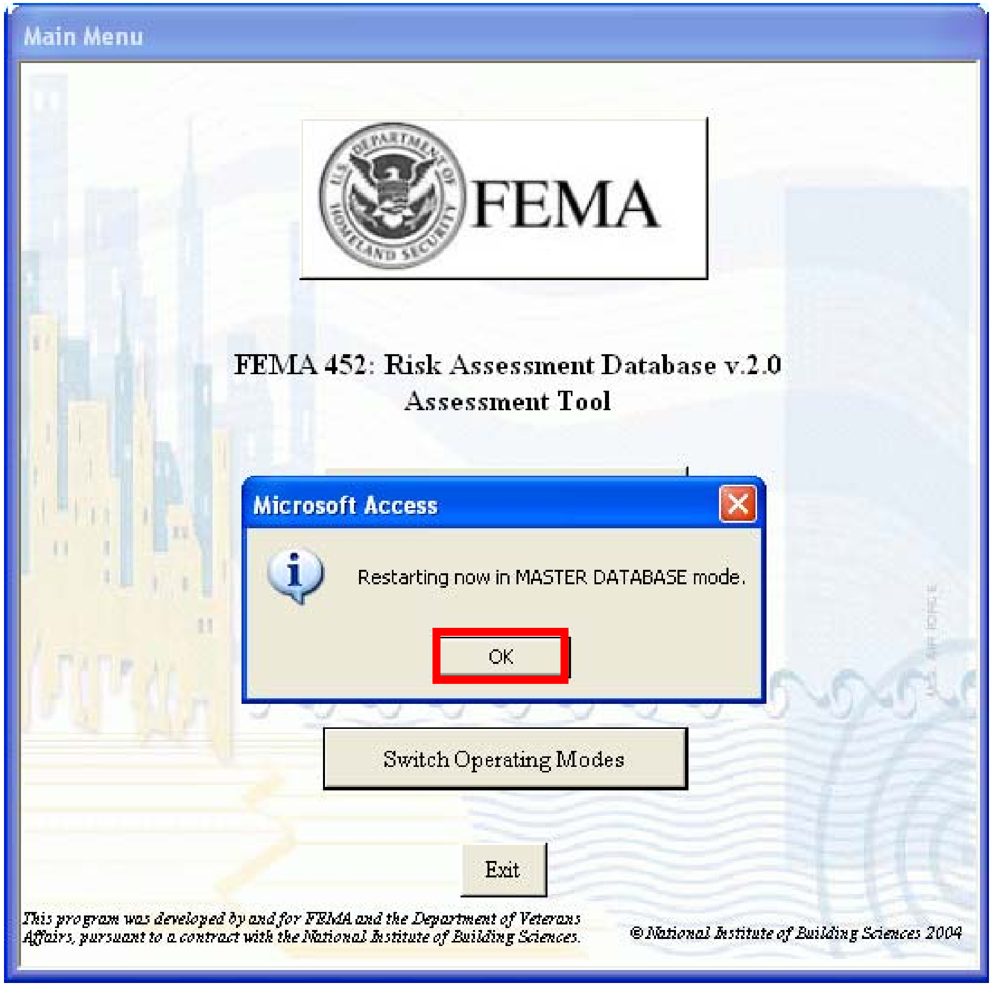


FEMA

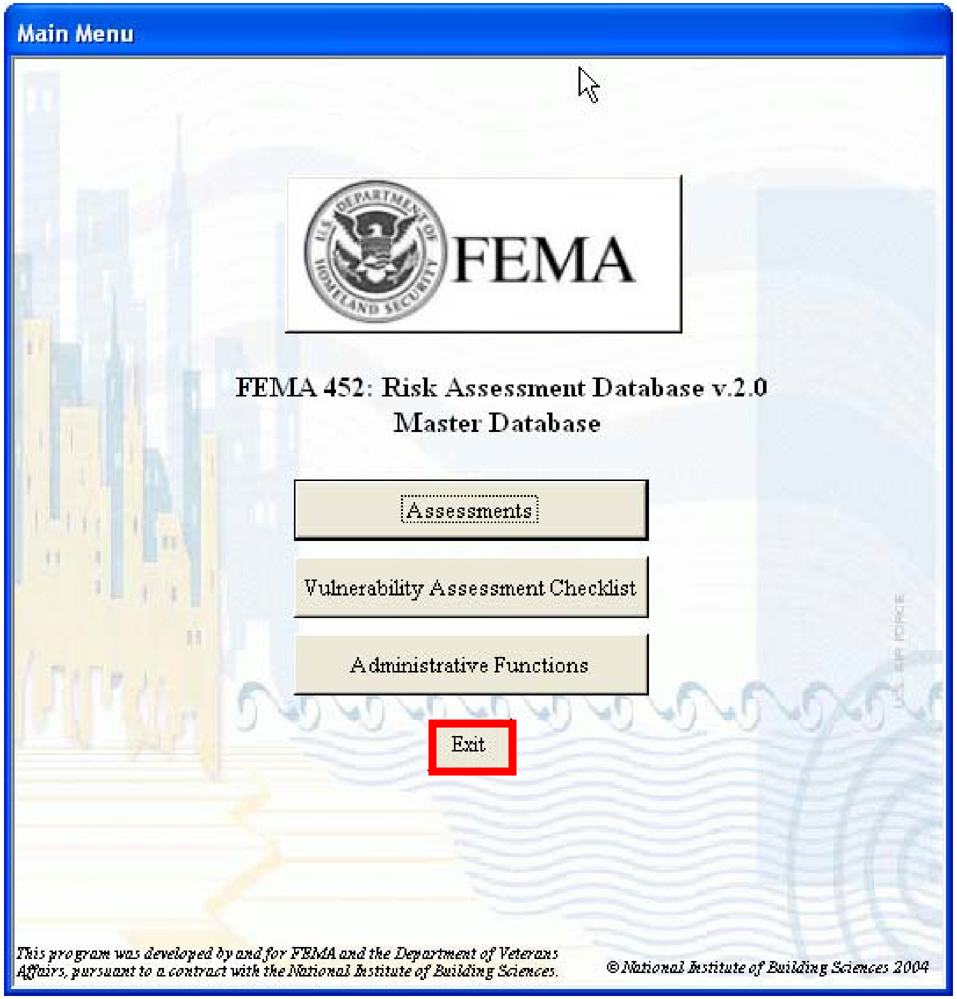
Empty Database



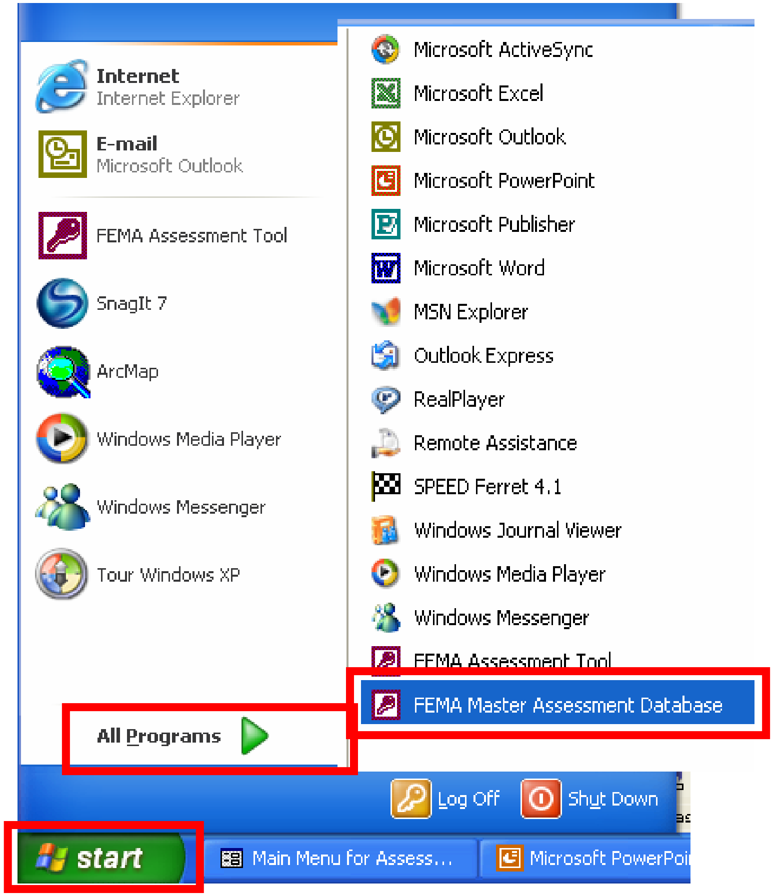
Switch to Master Database



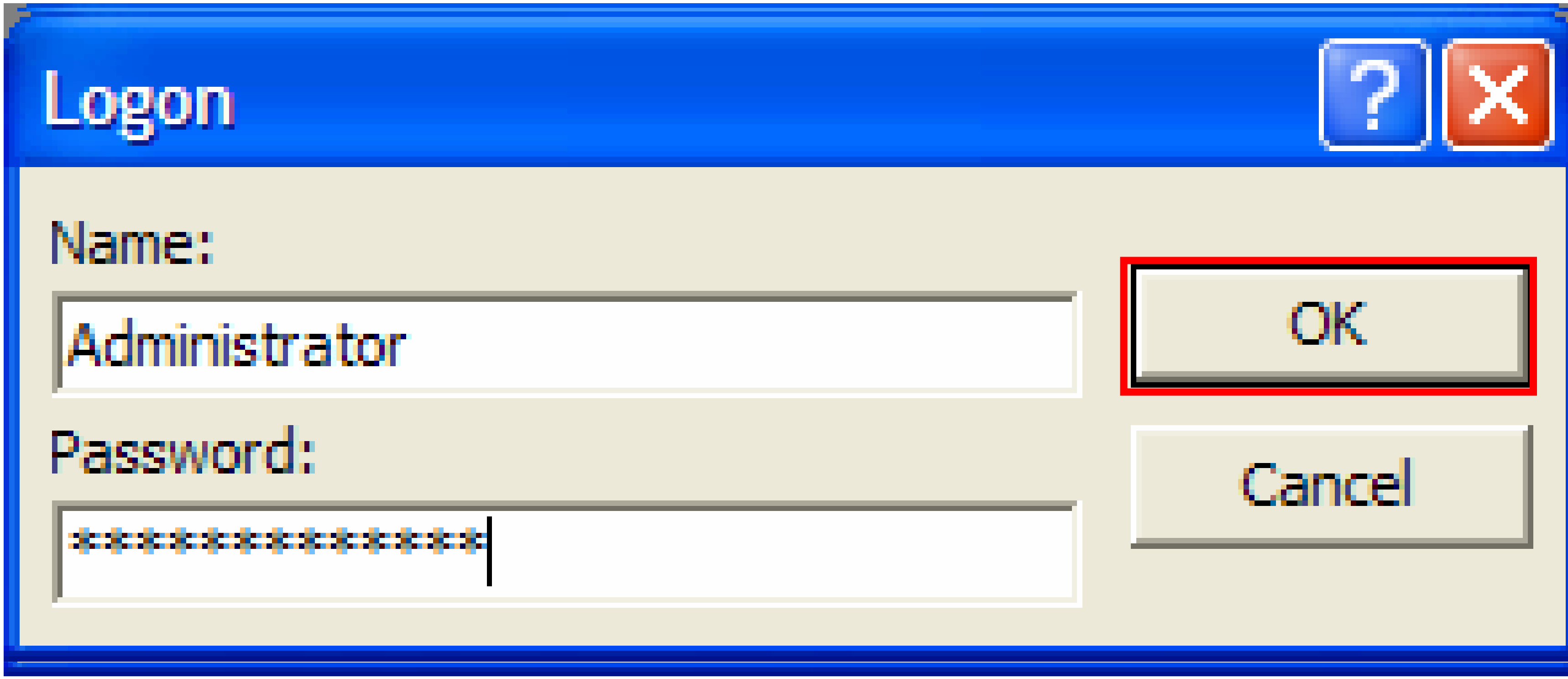
Master Database



Open Master Database

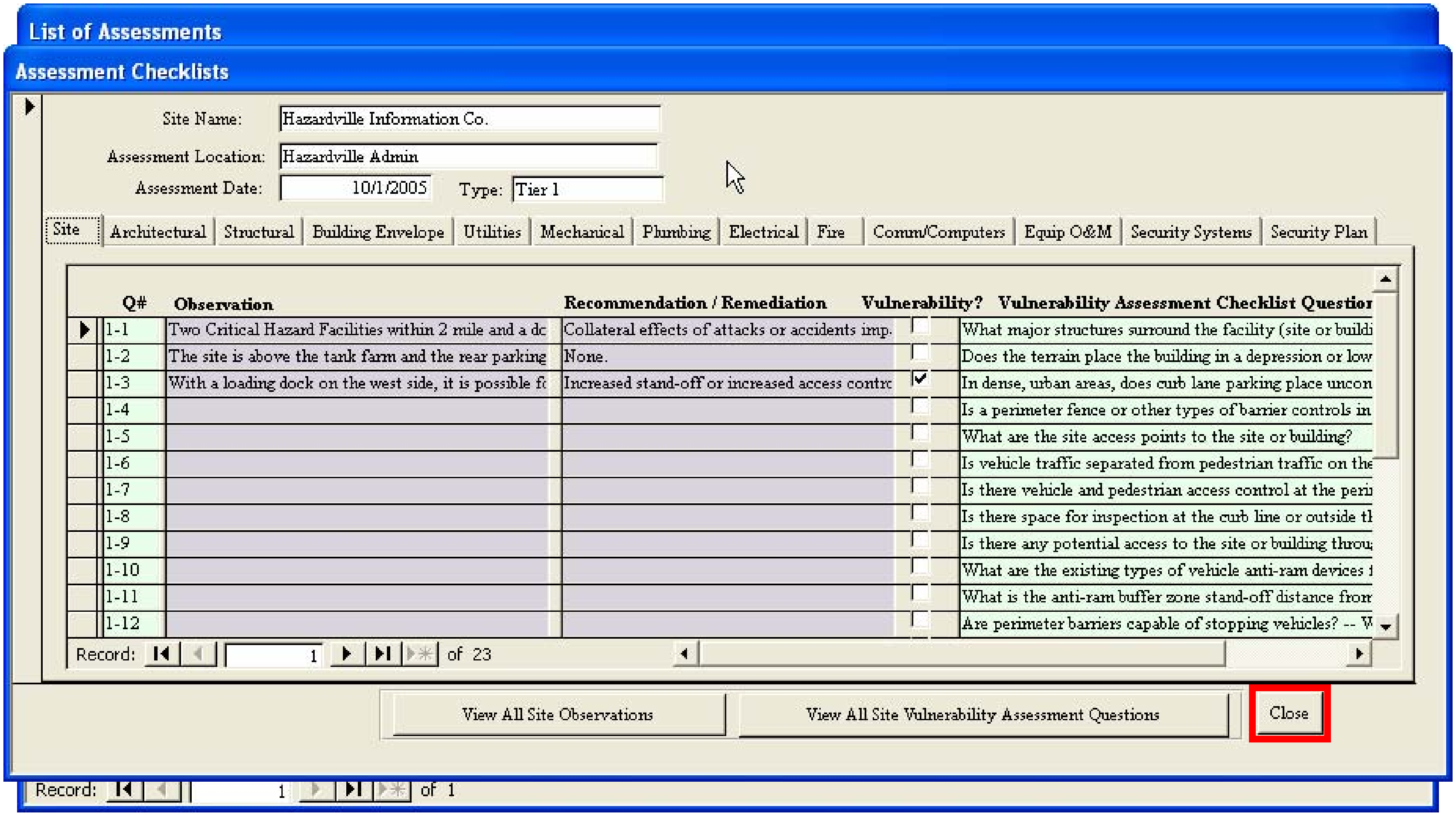


Login to Master Database



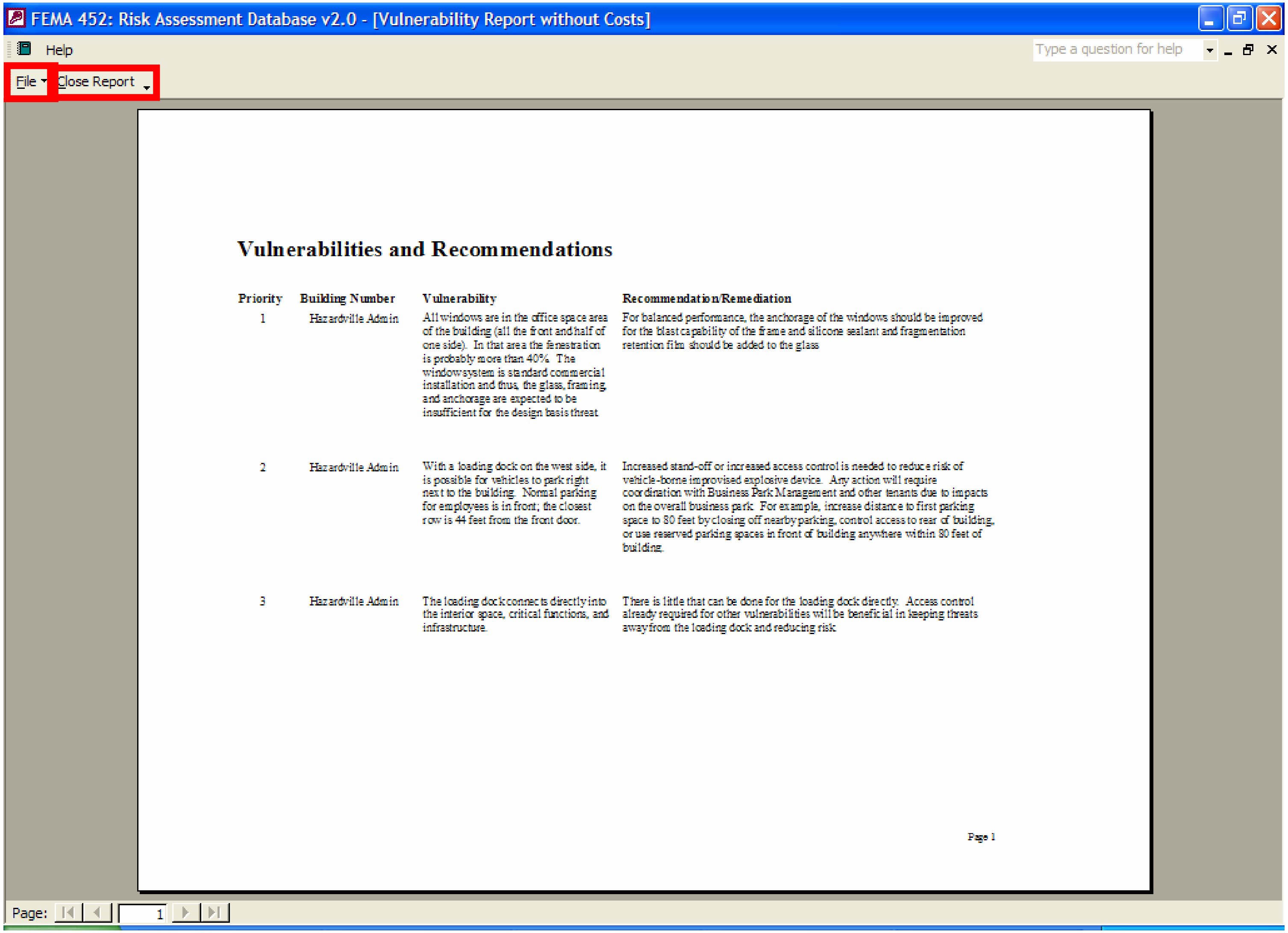
Master Database

View Checklists



FEMA

Reports



Vulnerabilities and Recommendations

Priority	Building Number	Vulnerability	Recommendation/Remediation
1	Hazardville Admin	All windows are in the office space area of the building (all the front and half of one side). In that area the fenestration is probably more than 40%. The window system is standard commercial installation and thus, the glass, framing, and anchorage are expected to be insufficient for the design basis threat	For balanced performance, the anchorage of the windows should be improved for the blast capability of the frame and silicone sealant and fragmentation retention film should be added to the glass
2	Hazardville Admin	With a loading dock on the west side, it is possible for vehicles to park right next to the building. Normal parking for employees is in front; the closest row is 44 feet from the front door.	Increased stand-off or increased access control is needed to reduce risk of vehicle-borne improvised explosive device. Any action will require coordination with Business Park Management and other tenants due to impacts on the overall business park. For example, increase distance to first parking space to 80 feet by closing off nearby parking, control access to rear of building, or use reserved parking spaces in front of building anywhere within 80 feet of building.
3	Hazardville Admin	The loading dock connects directly into the interior space, critical functions, and infrastructure.	There is little that can be done for the loading dock directly. Access control already required for other vulnerabilities will be beneficial in keeping threats away from the loading dock and reducing risk

Page 1

Reports

Executive Summary

Introduction

Hazardville Information Company (HIC) is a state-of-the-art information technology (IT) services company locted in a major metropolitan city in a typical suburban business office park. The company's mission is to provide information technology and services support to include hosting servers, databases, applications, and other hardware and software; develop, install, and maintain software applications; provide field support IT technicians; and provide 24-hour help desk support.
HIC has over 20 clients and supports approximately 1,000 users and 100 applications as a primary data center and as a disaster recovery site. HIC clients include local and regional government offices and commercial entities along with large prime defense contractors and Federal government agencies. HIC handles unclassified and classified information.

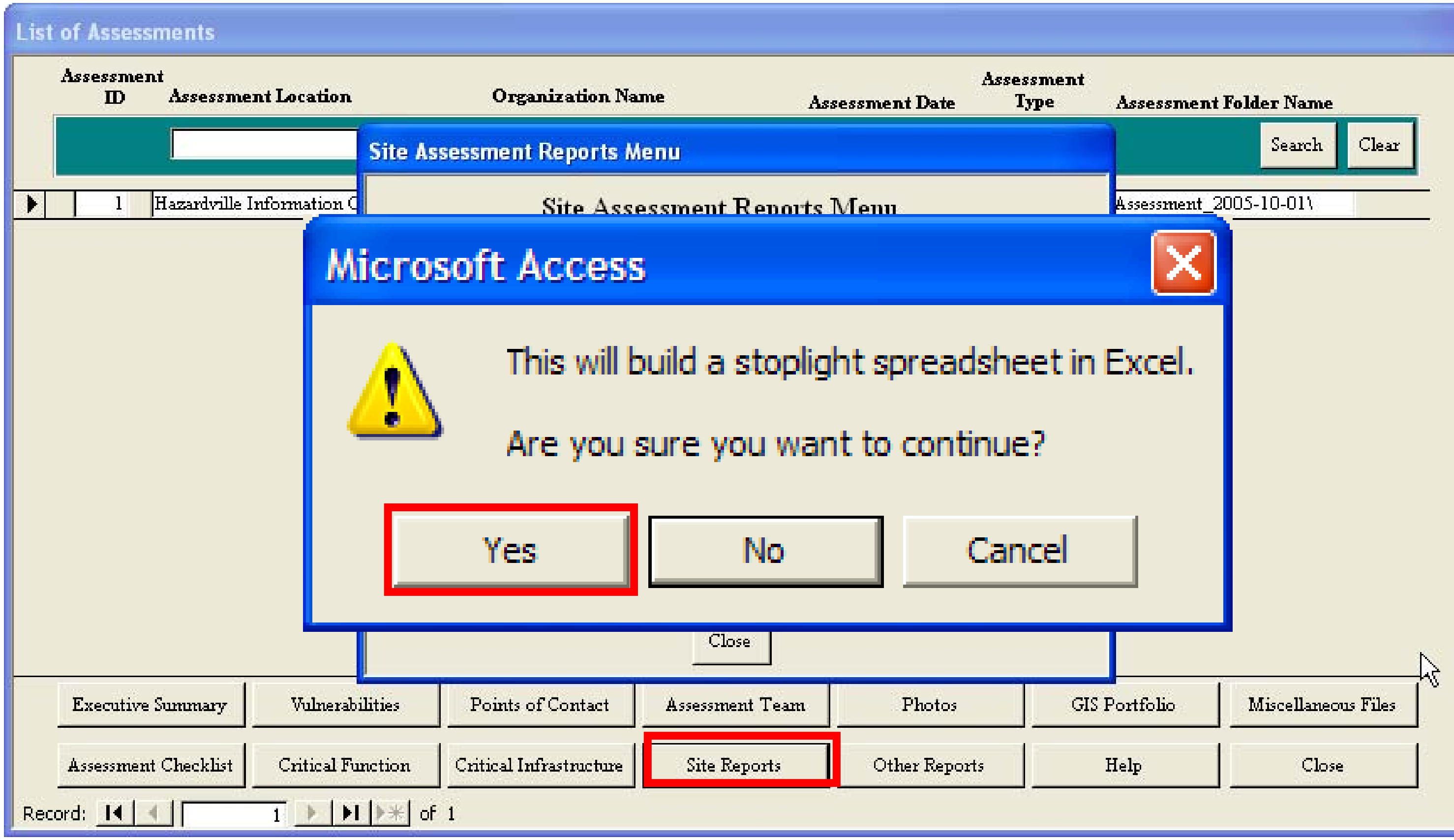
Observations

Due to standard business office park construction, HIC is vulnerable to terrorist attacks and technological accidents both as the targeted facility and as collateral damage. There are limited procedural changes available to provide protection. Each attack possibility has a set of measures that can be prioritized and applied to mitigate that attack and reduce the risk from other attacks as well.

Recommendations / Remediations

The owner has agreed to work with a recommended set of design basis threats (DBT) and consider GSA and DoD facility levels of protection criteria. Access control of vehicles would be the primary deterent for vehicle-borne improvised explosive devices. While Chemical, Biological, Radiological (CBR) attacks are at a risk level to consider, proximity to transportation, storage, and other HAZMAT sites indicates that CBR considerations would also provide protection against technological accidents. There are also measures to take from a COOP (Continuity of Operations Plans) perspective as this is a backup facility for other data centers.

Reports


List of Assessments
Assessment ID
Assessment Location
Organization Name
Assessment Date
Assessment Type
Assessment Folder Name
Search
Clear
1
Hazardville Information C
Assessment_2005-10-01\
Site Assessment Reports Menu
Microsoft Access
This will build a stoplight spreadsheet in Excel.
Are you sure you want to continue?
Yes
No
Cancel
Close
Executive Summary
Vulnerabilities
Points of Contact
Assessment Team
Photos
GIS Portfolio
Miscellaneous Files
Assessment Checklist
Critical Function
Critical Infrastructure
Site Reports
Other Reports
Help
Close
Record: 1 of 1

Threat Matrix

L54 | fx 0

	A	B	D	E	F	G	H	I	J	K
10		1 5 10								
11	**Facility**									
12			**Improvised**	**Chemical**	**Arson / Incendiary**	**Armed**	**Biological**	**Cyberterrorism**	**Agriterrorism**	**Radiological**
13	**Core Process/Function**		**Explosive Device**	**Agent**	**Attack**	**Attack**	**Agent**			**Agnet**
14										
15	Administration		192	128	0	96	128	192	0	128
16		Threat Rating	6	4	0	3	4	6	0	4
17		Asset Value	4	4	0	4	4	4	0	4
18		Vulnerability Rating	8	8	0	8	8	8	0	8
19	Engineering		240	160	0	120	160	200	0	160
20		Threat Rating	6	4	0	3	4	5	0	4
21		Asset Value	5	5	0	5	5	5	0	5
22		Vulnerability Rating	8	8	0	8	8	8	0	8
23	Warehousing		240	160	0	45	160	50	0	160
24		Threat Rating	6	4	0	3	4	5	0	4
25		Asset Value	5	5	0	5	5	5	0	5
26		Vulnerability Rating	8	8	0	3	8	2	0	8
27	Data Center		480	320	0	90	320	810	0	320
28		Threat Rating	6	4	0	3	4	9	0	4
29		Asset Value	10	10	0	10	10	10	0	10
30		Vulnerability Rating	8	8	0	3	8	9	0	8
31	Food Service		0	0	0	0	0	0	0	0
32		Threat Rating	0	0	0	0	0	0	0	0
33		Asset Value	0	0	0	0	0	0	0	0
34		Vulnerability Rating	0	0	0	0	0	0	0	0
35	Security		336	224	0	63	224	105	0	224
36		Threat Rating	6	4	0	3	4	5	0	4
37		Asset Value	7	7	0	7	7	7	0	7
38		Vulnerability Rating	8	8	0	3	8	3	0	8
39	Housekeeping		48	32	0	3	32	2	0	32
40		Threat Rating	6	4	0	3	4	2	0	4
41		Asset Value	1	1	0	1	1	1	0	1
42		Vulnerability Rating	8	8	0	1	8	1	0	8
43	Day Care		0	0	0	0	0	0	0	0
44		Threat Rating	0	0	0	0	0	0	0	0
45		Asset Value	0	0	0	0	0	0	0	0
46		Vulnerability Rating	0	0	0	0	0	0	0	0
47	Communications		384	256	0	72	256	320	0	256
48		Threat Rating	6	4	0	3	4	5	0	4
49		Asset Value	8	8	0	8	8	8	0	8
50		Vulnerability Rating	8	8	0	3	8	8	0	8
51	Other 2		0	0	0	0	0	0	0	0
52		Threat Rating	0	0	0	0	0	0	0	0
53		Asset Value	0	0	0	0	0	0	0	0
54		Vulnerability Rating	0	0	0	0	0	0	0	0

Function Vulnerability | Infrastructure Vulnerability

FEMA

Threat Matrix

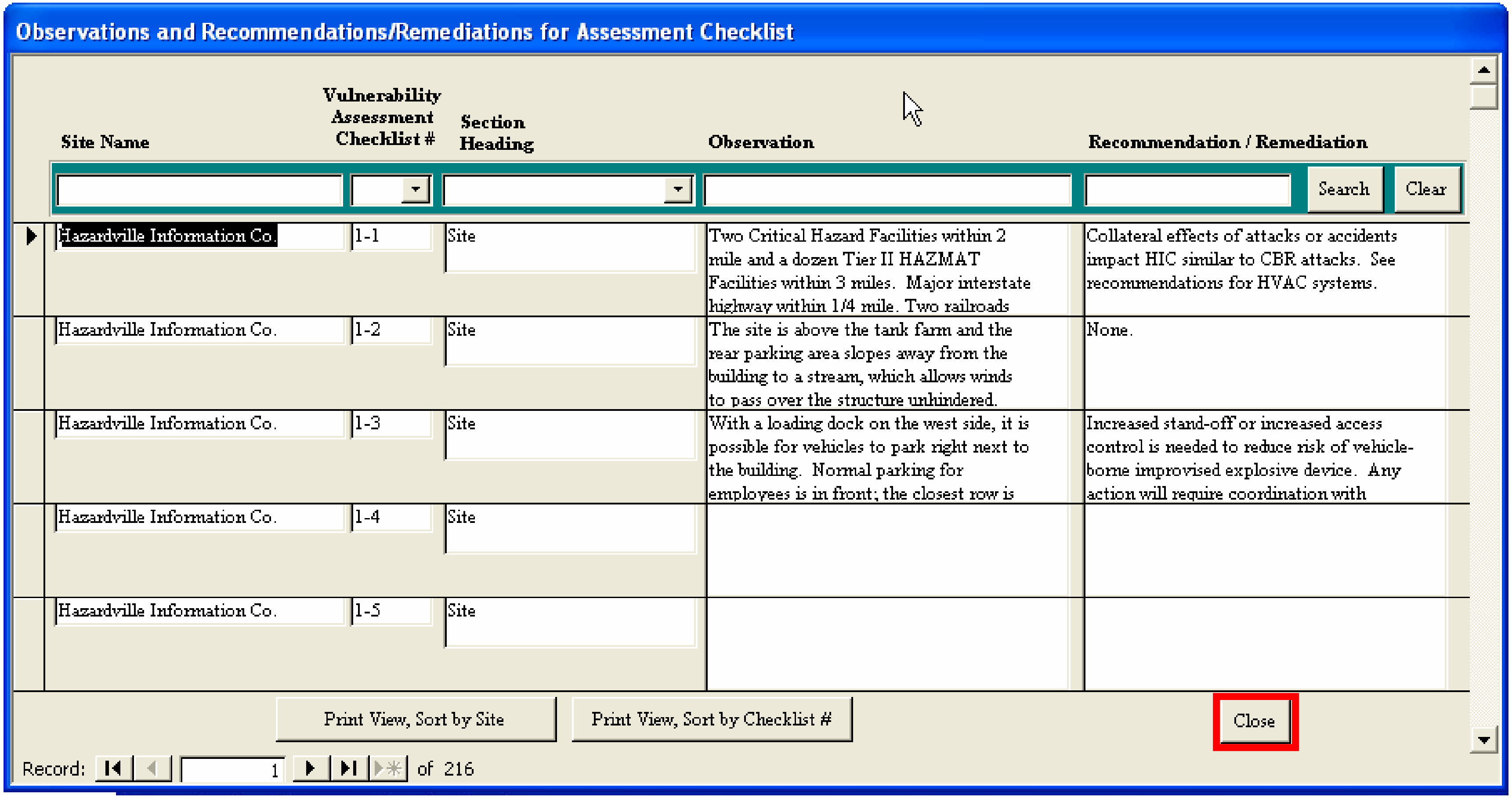
K7

	A	B	D	E	F	G	H	I	J	K
11	**Facility**									
12			Improvised	Chemical	Arson / Incendiary	Armed	Biological	Cyberterrorism	Agriterrorism	Radiological
13	Critical Infrastructure		Explosive Device	Agent	Attack	Attack	Agent			Agnet
14										
15	Site		240	160	0	120	160	15	0	160
16		Threat Rating	6	4	0	3	4	1	0	4
17		Asset Value	5	5	0	5	5	5	0	5
18		Vulnerability Rating	8	8	0	8	8	3	0	8
19	Architectural		240	80	0	120	80	15	0	80
20		Threat Rating	6	4	0	3	4	1	0	4
21		Asset Value	5	5	0	5	5	5	0	5
22		Vulnerability Rating	8	4	0	8	4	3	0	4
23	Structural Systems		240	60	0	120	60	15	0	60
24		Threat Rating	6	4	0	3	4	1	0	4
25		Asset Value	5	5	0	5	5	5	0	5
26		Vulnerability Rating	8	3	0	8	3	3	0	3
27	Envelope Systems		240	60	0	120	60	15	0	60
28		Threat Rating	6	4	0	3	4	1	0	4
29		Asset Value	5	5	0	5	5	5	0	5
30		Vulnerability Rating	8	3	0	8	3	3	0	3
31	Utility Systems		180	60	0	175	60	75	0	60
32		Threat Rating	6	4	0	5	4	3	0	4
33		Asset Value	5	5	0	5	5	5	0	5
34		Vulnerability Rating	6	3	0	7	3	5	0	3
35	Mechanical Systems		224	196	0	245	196	105	0	196
36		Threat Rating	4	4	0	5	4	3	0	4
37		Asset Value	7	7	0	7	7	7	0	7
38		Vulnerability Rating	8	7	0	7	7	5	0	7
39	Plumbing and Gas Systems		160	100	0	120	100	30	0	100
40		Threat Rating	4	4	0	3	4	2	0	4
41		Asset Value	5	5	0	5	5	5	0	5
42		Vulnerability Rating	8	5	0	8	5	3	0	5
43	Electrical Systems		224	140	0	147	140	105	0	140
44		Threat Rating	4	4	0	3	4	3	0	4
45		Asset Value	7	7	0	7	7	7	0	7
46		Vulnerability Rating	8	5	0	7	5	5	0	5
47	Fire Alarm Systems		160	60	0	45	60	30	0	60
48		Threat Rating	4	4	0	3	4	2	0	4
49		Asset Value	5	5	0	5	5	5	0	5
50		Vulnerability Rating	8	3	0	3	3	3	0	3
51	IT and Communication Systems		320	240	0	240	240	1000	0	240
52		Threat Rating	4	4	0	3	4	10	0	4
53		Asset Value	10	10	0	10	10	10	0	10
54		Vulnerability Rating	8	6	0	8	6	10	0	6
55	Other1		0	0	0	0	0	0	0	0

Function Vulnerability | **Infrastructure Vulnerability**

FEMA

Other Reports



Observations and Recommendations/Remediations for Assessment Checklist

Site Name	Vulnerability Assessment Checklist #	Section Heading	Observation	Recommendation / Remediation
Hazardville Information Co.	1-1	Site	Two Critical Hazard Facilities within 2 mile and a dozen Tier II HAZMAT Facilities within 3 miles. Major interstate highway within 1/4 mile. Two railroads	Collateral effects of attacks or accidents impact HIC similar to CBR attacks. See recommendations for HVAC systems.
Hazardville Information Co.	1-2	Site	The site is above the tank farm and the rear parking area slopes away from the building to a stream, which allows winds to pass over the structure unhindered.	None.
Hazardville Information Co.	1-3	Site	With a loading dock on the west side, it is possible for vehicles to park right next to the building. Normal parking for employees is in front; the closest row is	Increased stand-off or increased access control is needed to reduce risk of vehicle-borne improvised explosive device. Any action will require coordination with
Hazardville Information Co.	1-4	Site		
Hazardville Information Co.	1-5	Site		

Search Clear

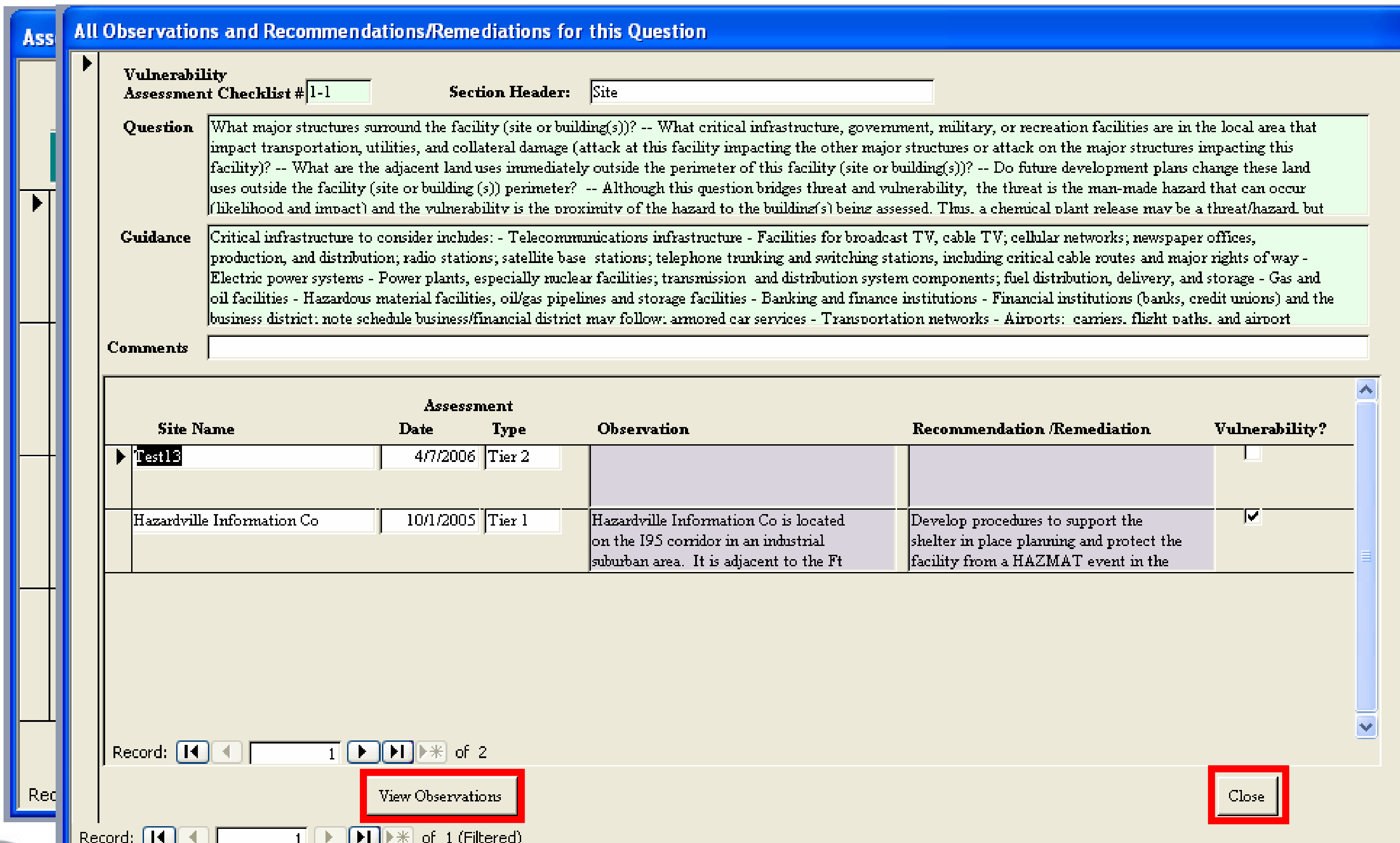
Print View, Sort by Site | Print View, Sort by Checklist # | Close

Record: 1 of 216

Master Database

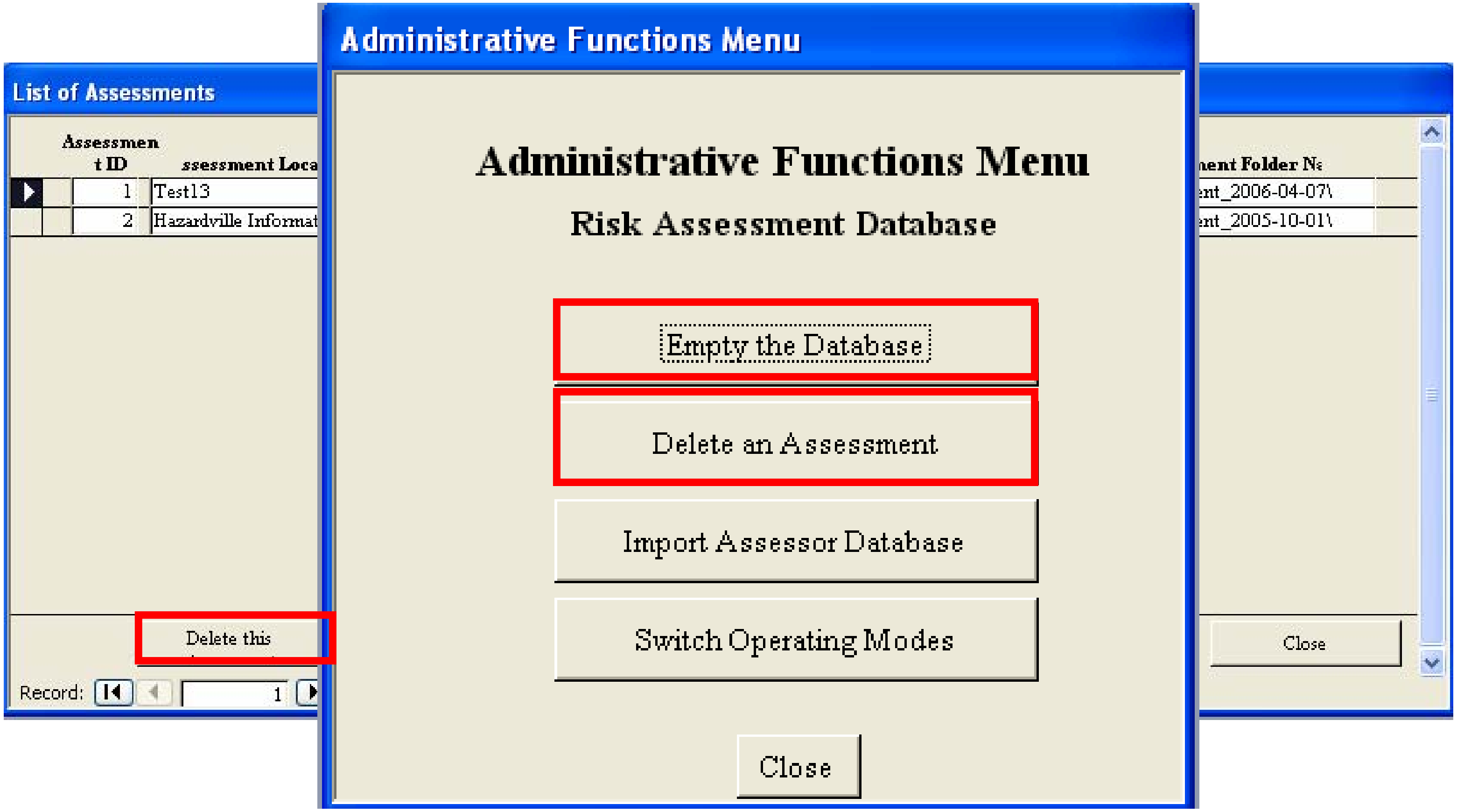
FEMA

Vulnerability Assessment Checklist Search



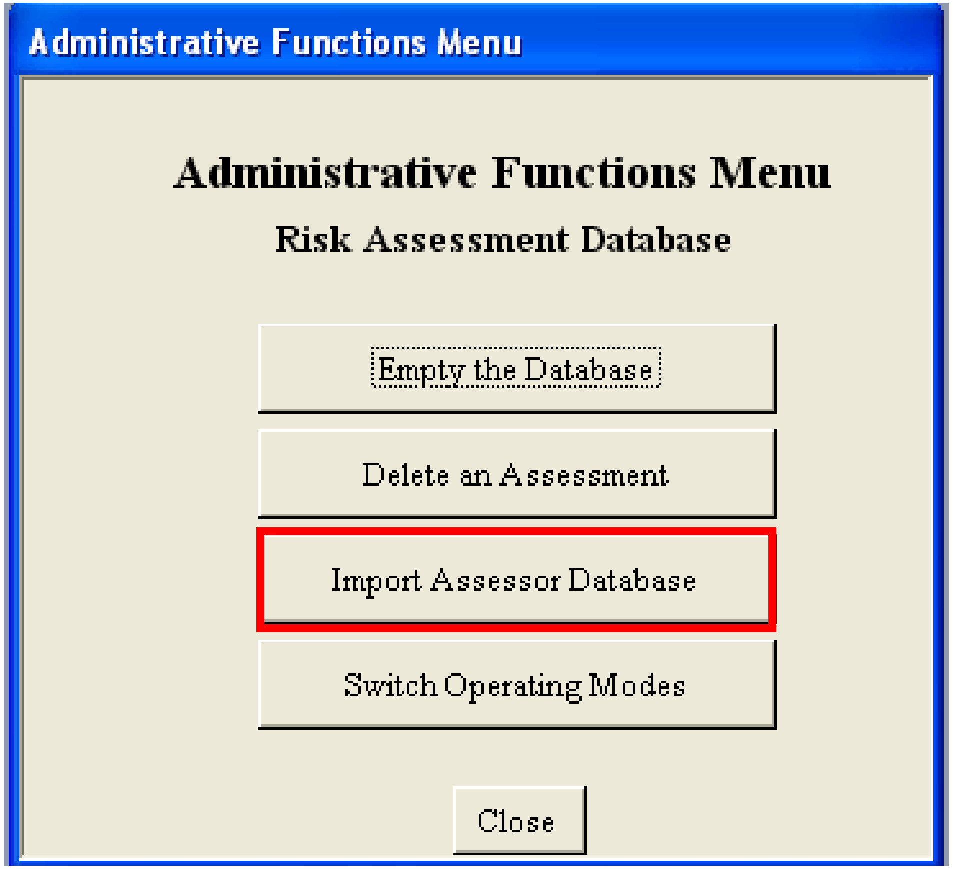
Master Database

Master Database: Erasing One or All Assessments



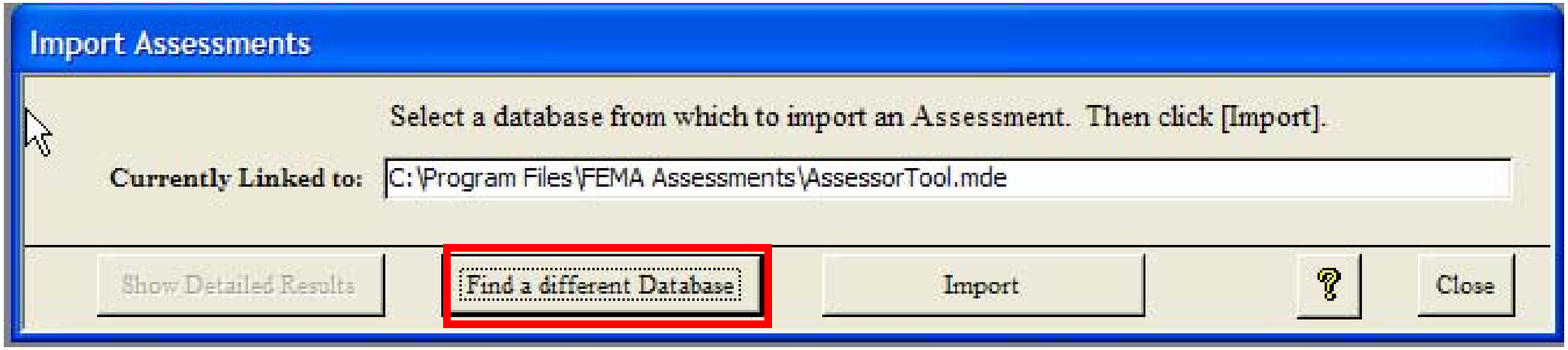
FEMA

Master Database: Import Function

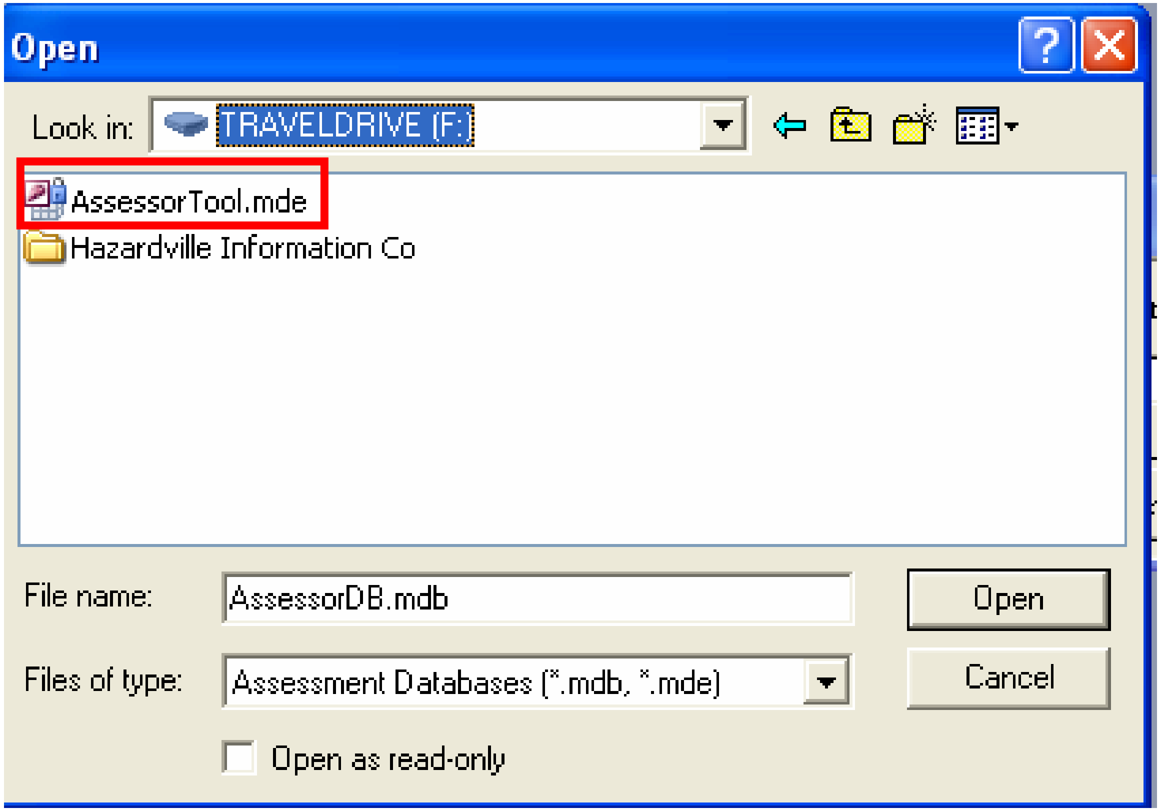


FEMA

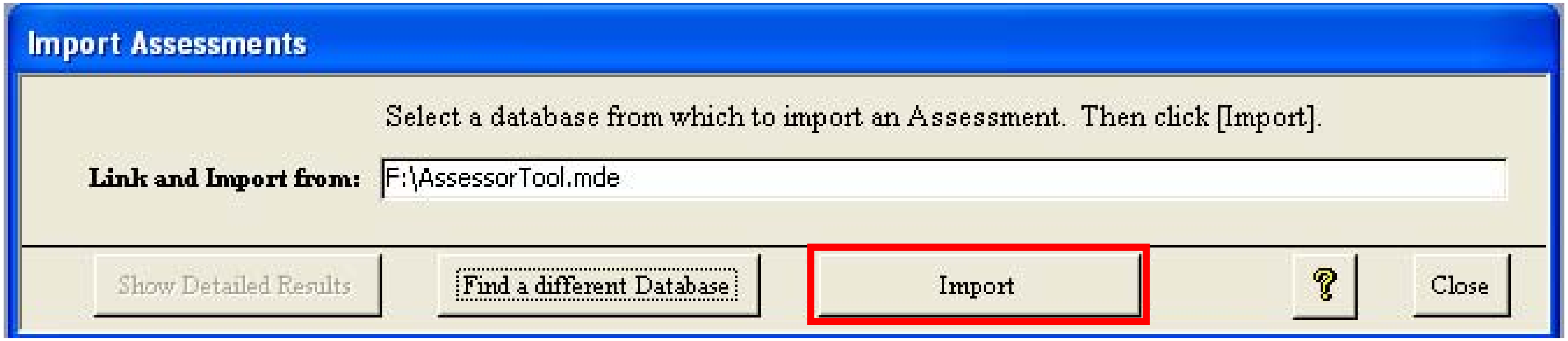
Master Database: Import Function



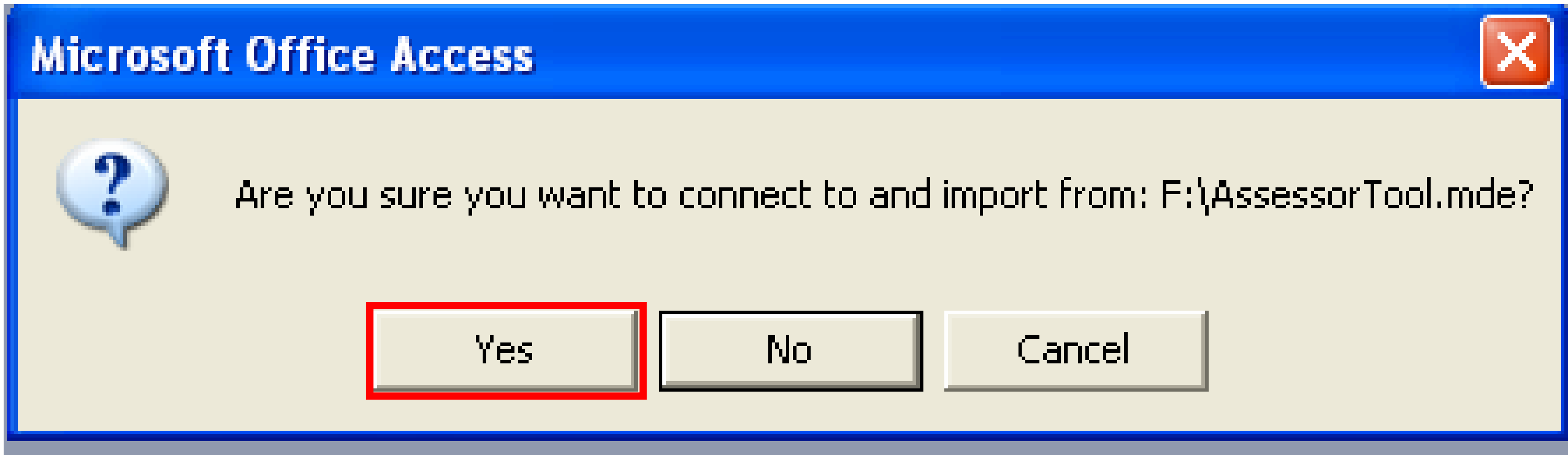
Master Database: Import Function



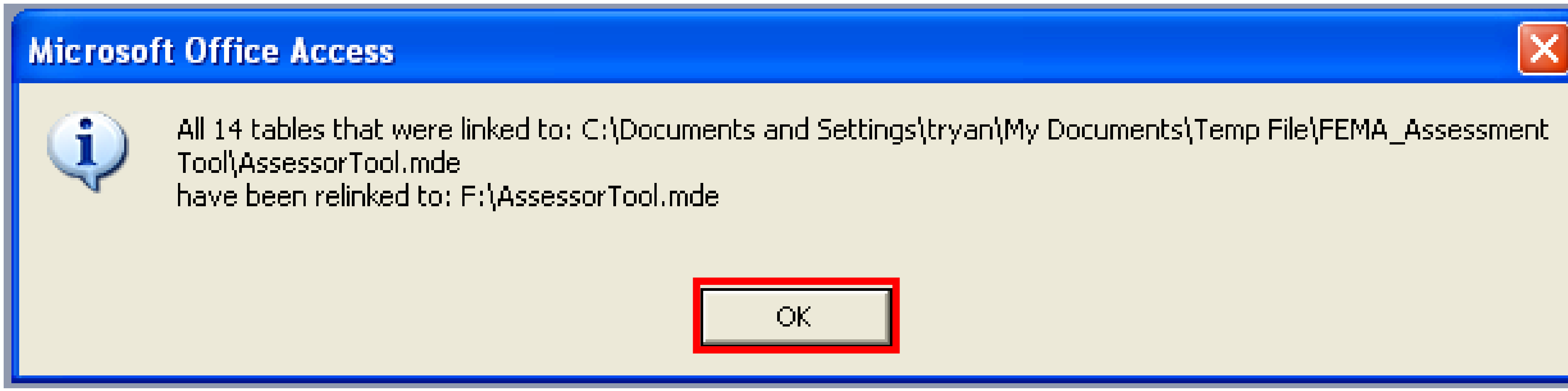
Master Database: Import Function



Master Database: Import Function

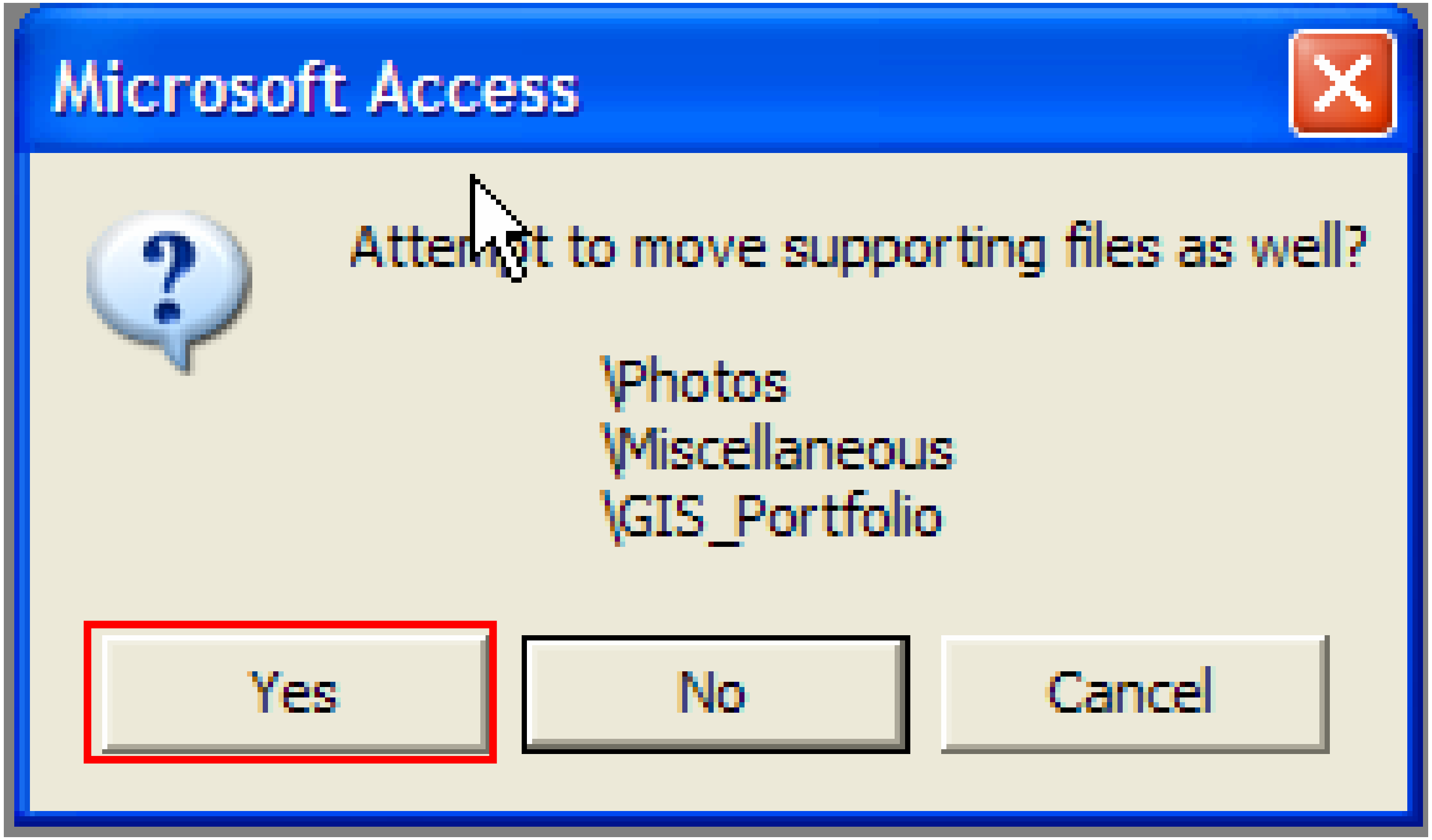


Master Database: Import Function

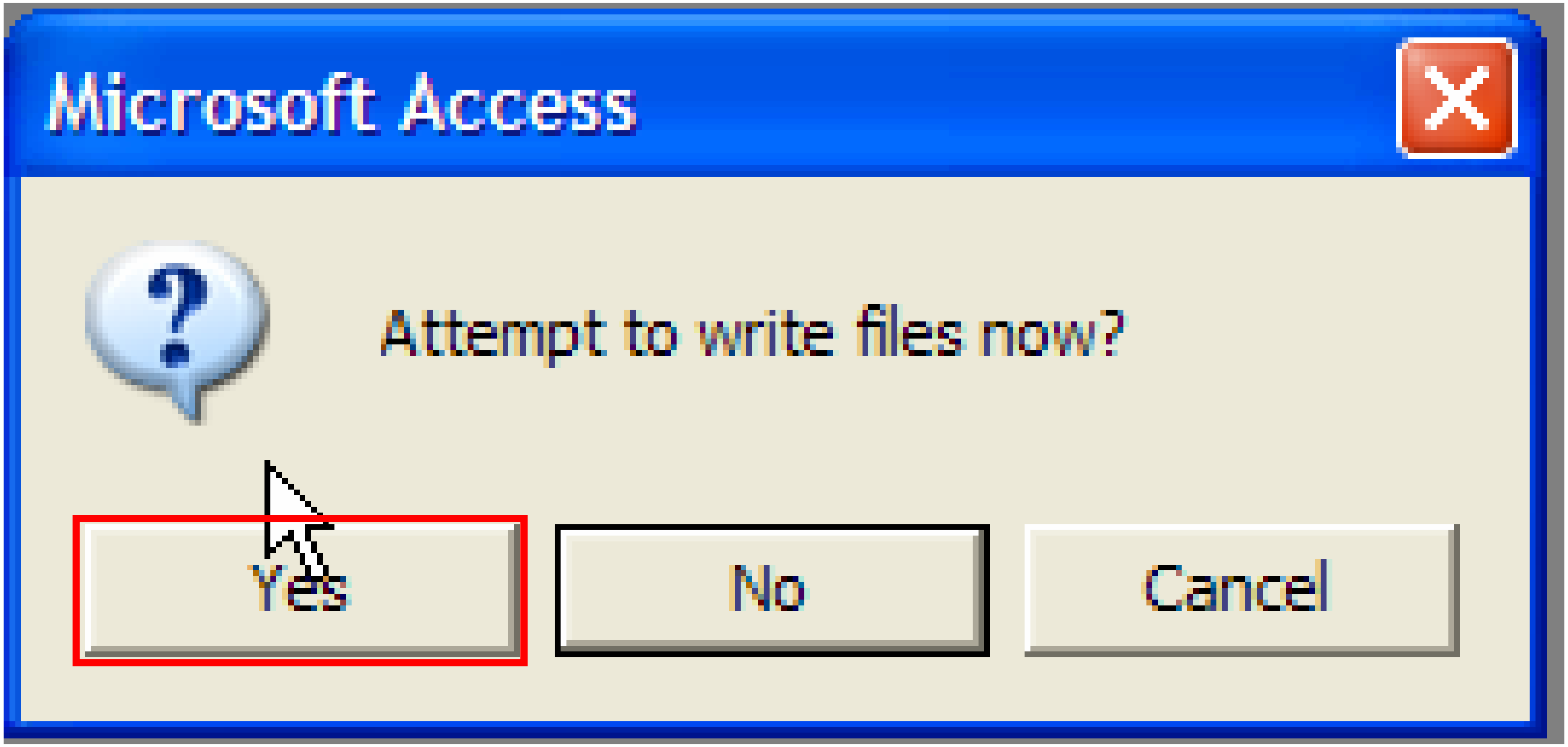


FEMA

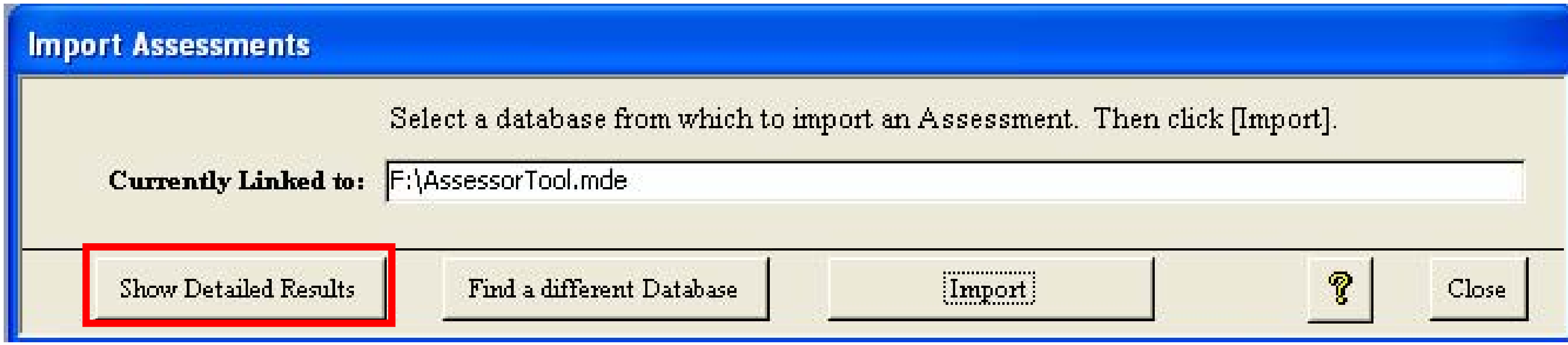
Master Database: Import Function



Master Database: Import Function



Master Database: Import Function



Master Database: Import Function

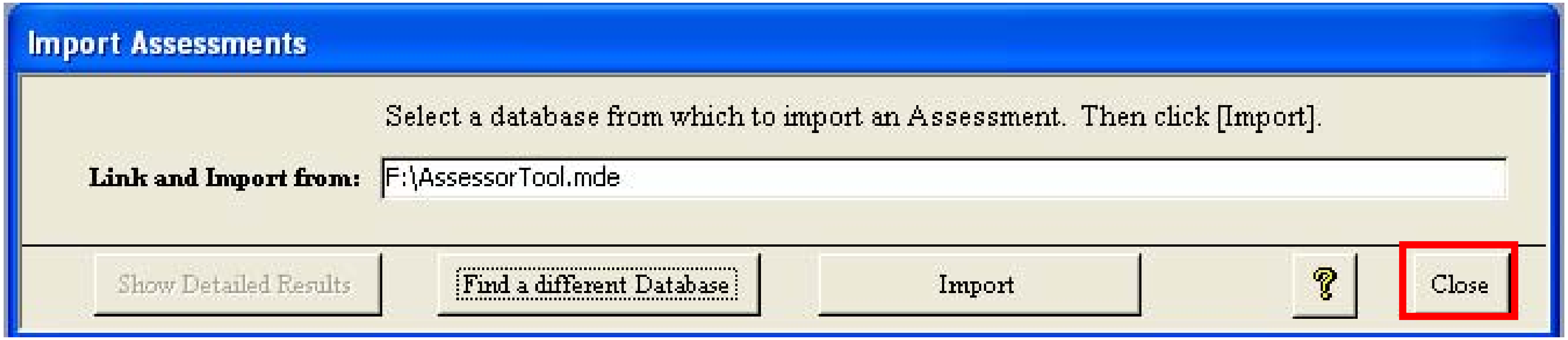
Import Detailed Diagnostics

Import Order	Importing	NumberOf RecordsBefore	NumberOf RecordsAttempted	NumberOf RecordsAfter	Successful
1	Sites	4	1	5	✓
2	Buildings (*handled differently)	0	19	19	✓
3	People	0	2	2	✓
4	Assessments	4	1	5	✓
5	Observations	216	216	432	✓
6	Vulnerabilities	0	1	1	✓
7	Executive Summary	1	1	2	✓
8	Critical Infrastructure	20	20	40	✓
9	Critical Functions	18	18	36	✓
10	Assessment Personnel	0	2	2	✓
11	GIS images this assessment	0	1	1	✓
12	Photos	0	1	1	✓
13	Assessment Photos	0	1	1	✓
14	Miscellaneous files	0	1	1	✓

Record: 1 of 14

FEMA

Master Database: Import Function



Summary

Installation and opening of databases

Filing of GIS Portfolio, Miscellaneous, and Photos to link with the databases

Moving about the database software and between the Assessor Tool and the Master Database

Setting priorities on identified vulnerabilities and how the software handles it

Production of standard reports and searching the database for specific information

Unit VII
Explosive Blast

FEMA

Unit Objectives

Explain the basic physics involved during an explosive blast event, whether by terrorism or technological accident.

Explain building damage and personnel injury resulting from the blast effects upon a building.

Perform an initial prediction of blast loading and effects based upon incident pressure.

Unit VII: Explosive Blast

Units I-VI covered the Risk Assessment Process

Units VII and VIII explain Explosive Blast, CBR Agents, and their effects

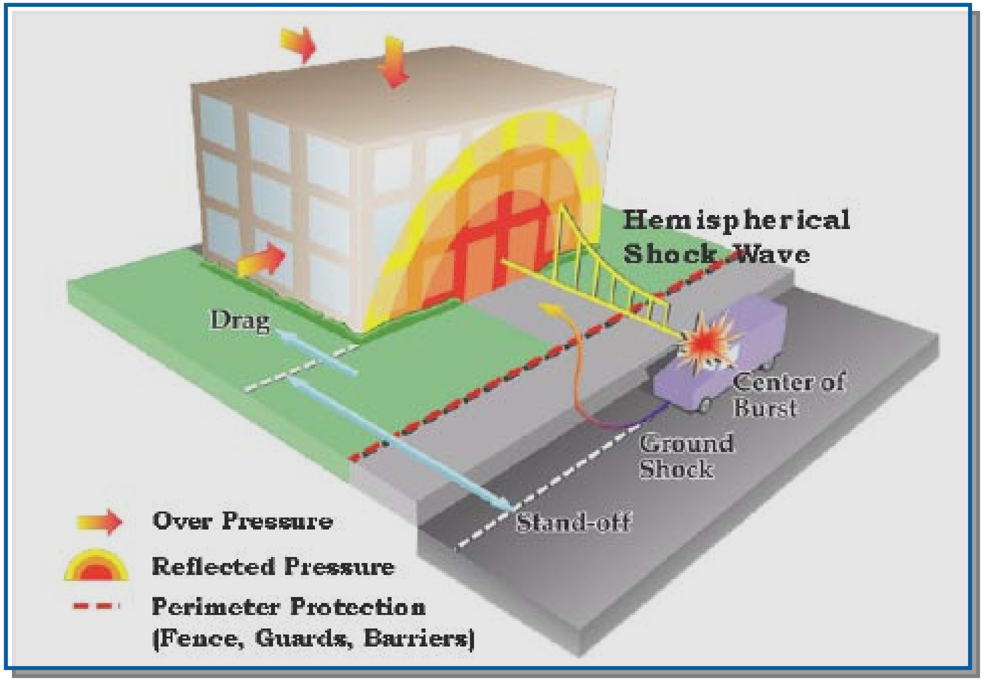
Units IX and X demonstrate techniques for site layout and building design to counter or mitigate manmade threats and similar technological hazards

FEMA

Blast Loading Factors

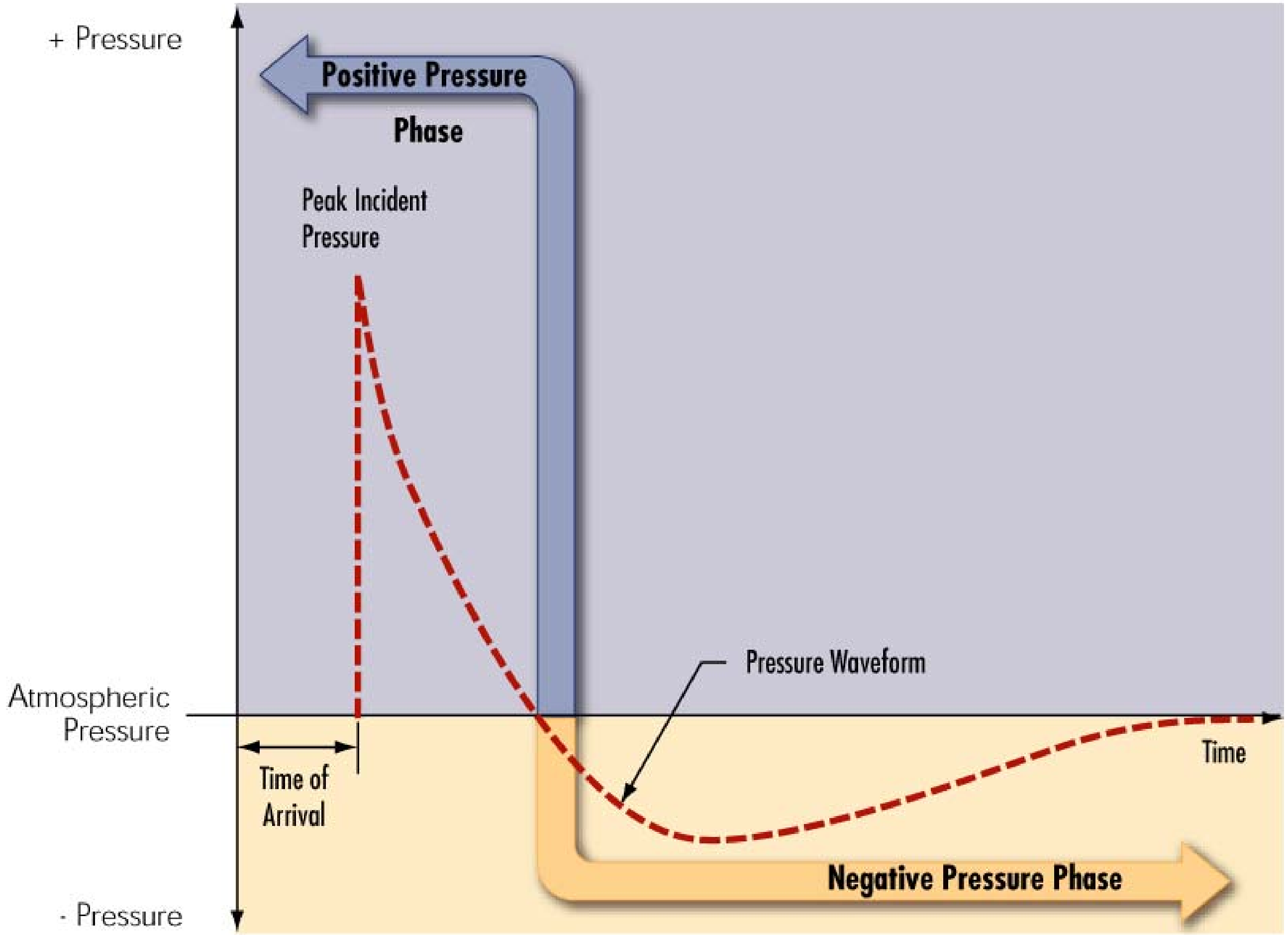
Explosive properties

- Type
- Energy output (TNT equivalency)
- Quantity



FEMA 427, Figure 2-1: Schematic of Vehicle Weapon Threat Parameters and Definitions, p. 2-2

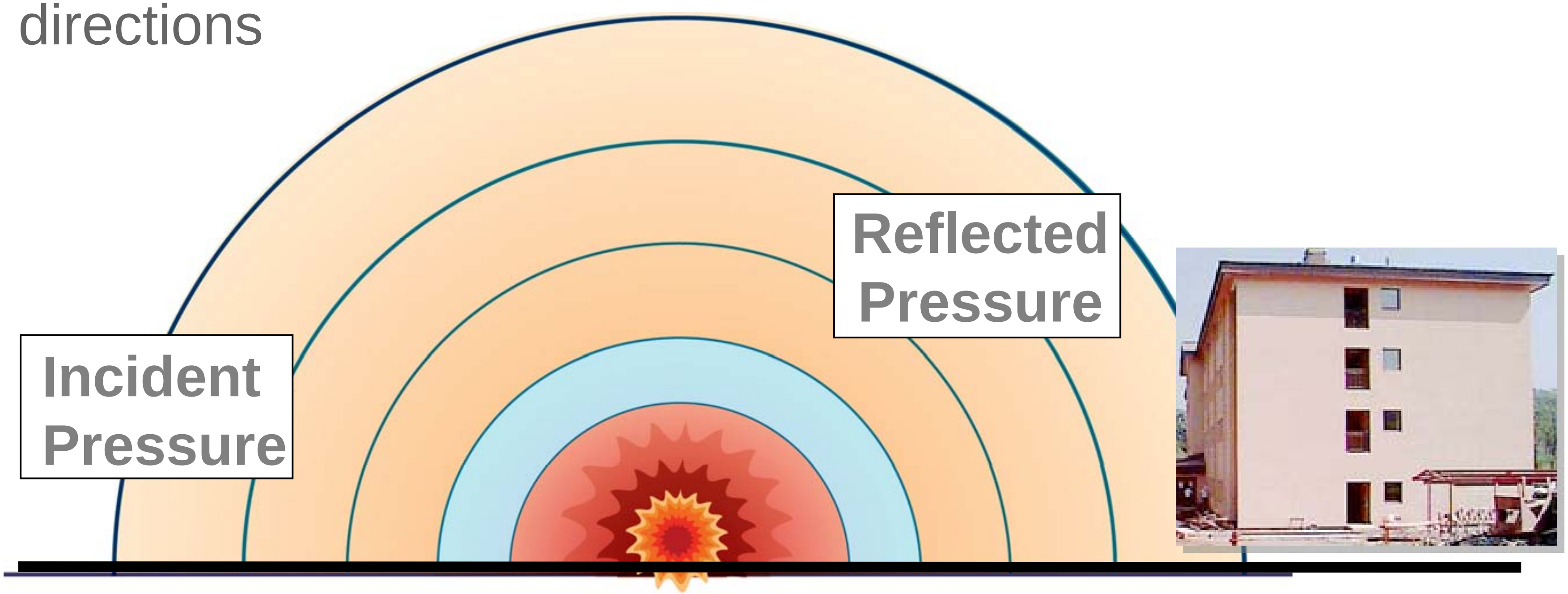
Typical Incident Pressure Waveform



FEMA 426, Figure 4-1: Typical Pressure-Time History, p. 4-2

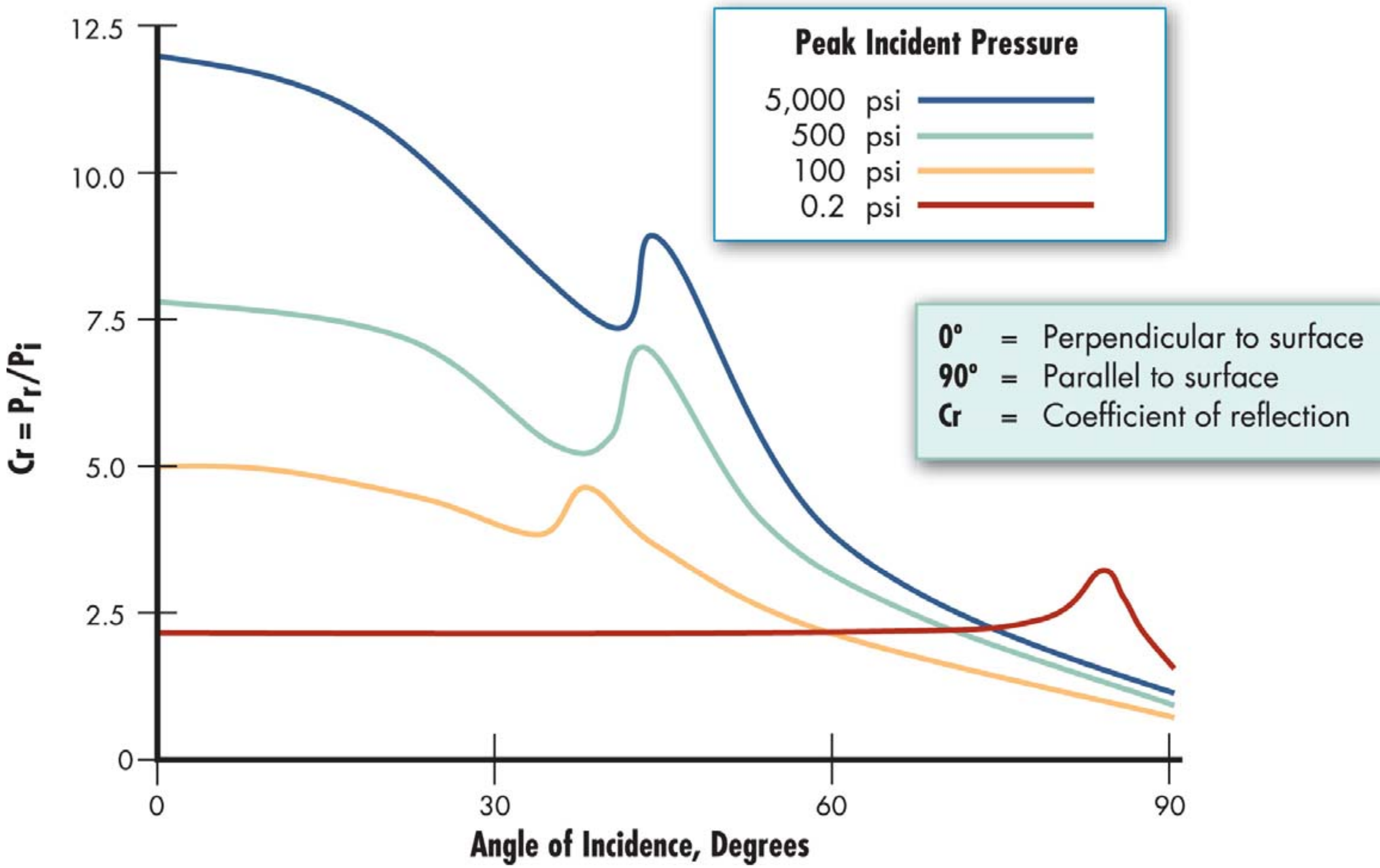
Incident and Reflected Pressure

Blast energy lost at rate of volume increase in X, Y, and Z directions



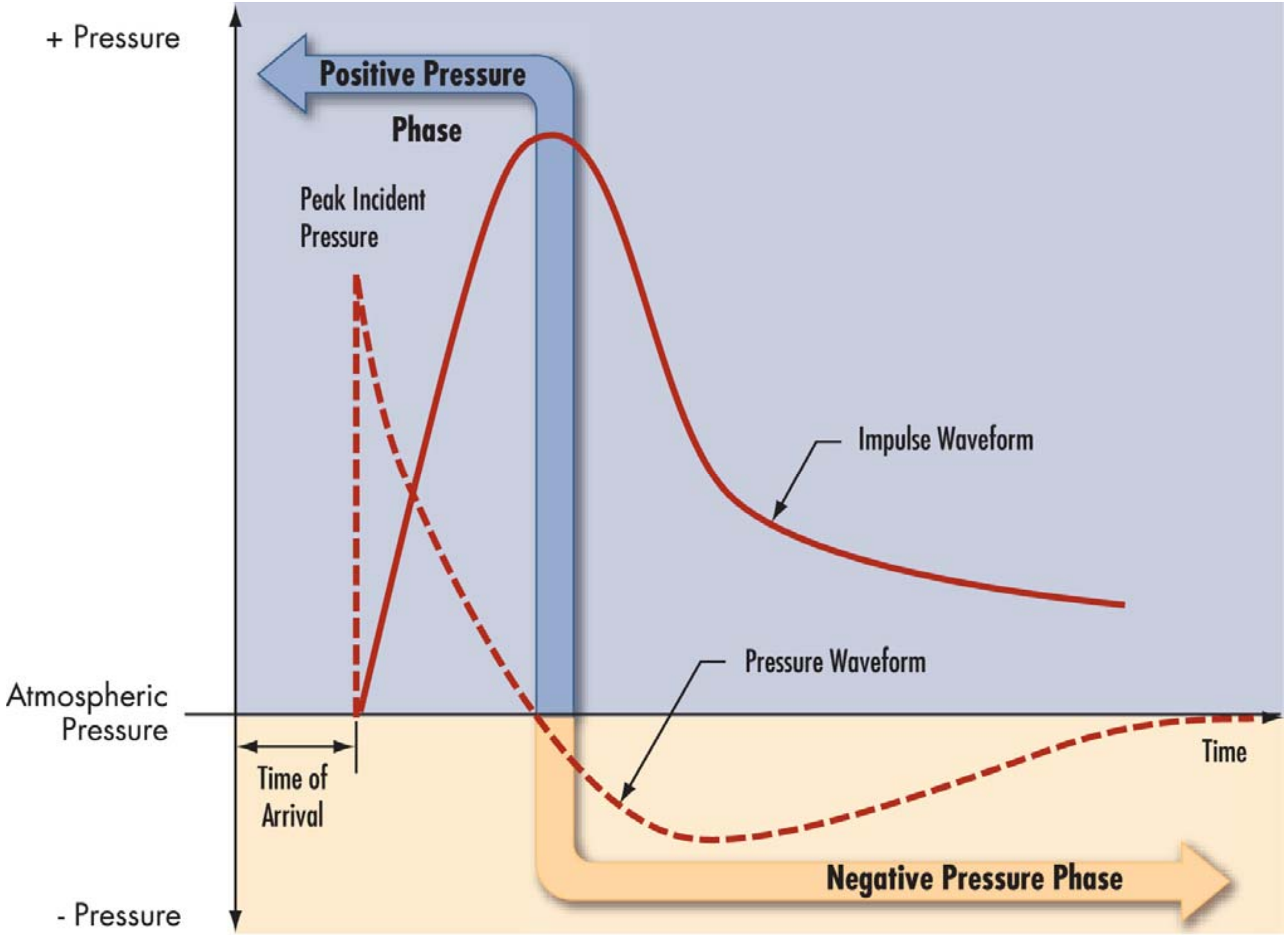
Equivalent pressure occurs at Scaled Distance = Distance / (Net Explosive Weight, TNT equivalent) $^{1/3}$

Reflected Pressure/Angle of Incidence



FEMA 426, Figure 4-2: Reflected Pressure Coefficient vs. Angle of Incidence, p. 4-3

Typical Blast Impulse Waveform

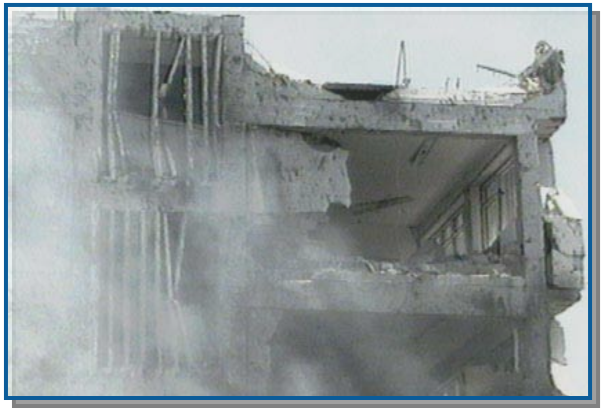


FEMA 426, Figure 4-3: Typical Impulse Waveform, p. 4-4

Blast Loading Factors

Location of explosive relative to structure

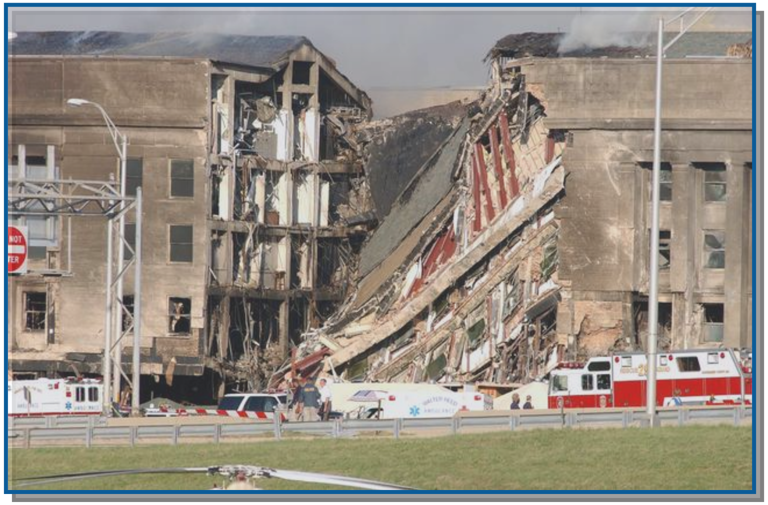
- Stand-off distance
- Reflections and reflection angle
  - Ground
  - Buildings
- Identify worst case



Blast Compared to Natural Hazards

Higher incident pressures and relatively low impulse

- High explosive (C-4)
- Medium explosive (black powder)
- Low explosive (gasoline)
- Aircraft or vehicle crash combines kinetic energy (velocity, mass), explosive loads, and fuel/fire



- 200 mph hurricane generates only 0.8 psi, but with very large impulse

Blast Compared to Natural Hazards

Direct airblast causes more localized damage

- Component breakage
- Penetration and shear
- Building's other side farther away
- Reflections can increase damage on any side

Greater mass historically used for blast protection

- Greater mass usually detrimental during earthquake due to resonance

FEMA

Factors Contributing to Building Damage

First approximations based upon:

- Quantity of explosive
- Stand-off distance between building and explosive
- Assumptions about building characteristics

Types of Building Damage

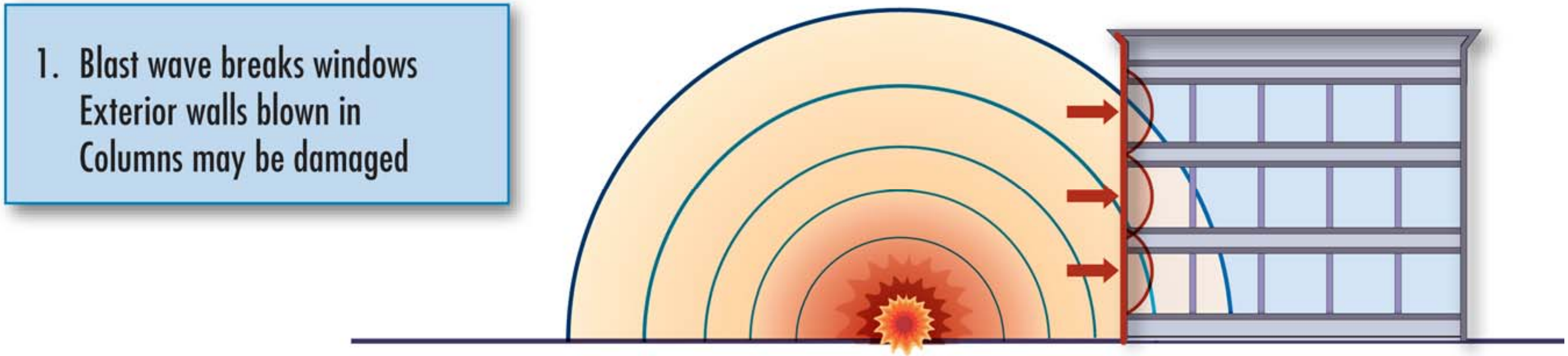
Direct Air Blast

- Component failure
- Additional damage after breaching

Collapse

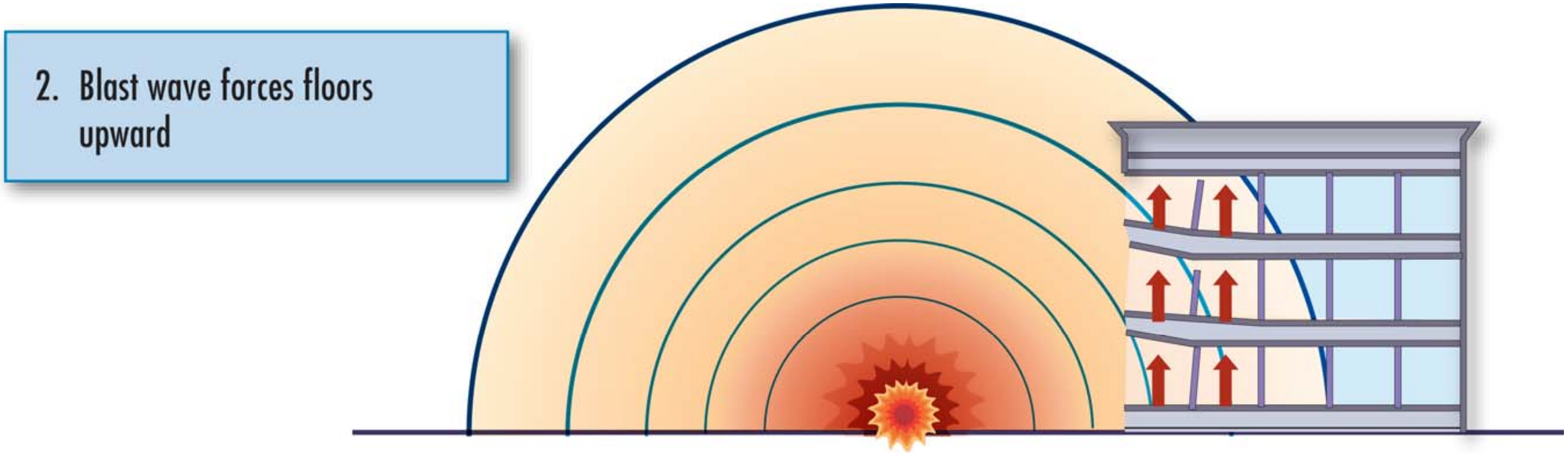
- Localized
- Progressive

Blast Pressure Effects



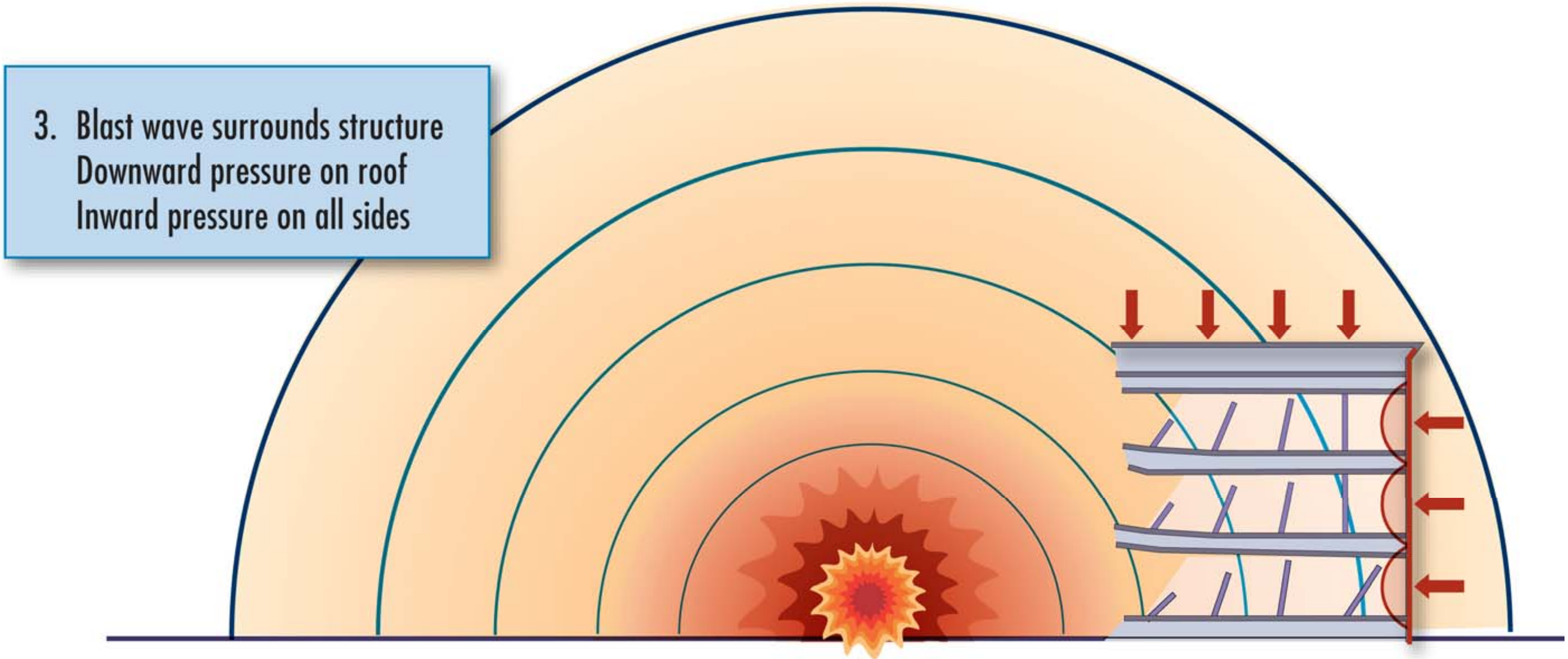
FEMA 426, Figure 4-4: Blast Pressure Effects on a Structure, p. 4-7

Blast Pressure Effects



FEMA 426, Figure 4-4: Blast Pressure Effects on a Structure, p. 4-7

Blast Pressure Effects



FEMA 426, Figure 4-4: Blast Pressure Effects on a Structure, p. 4-7

Causes of Blast Injuries

Overpressure

- Eardrum rupture
- Lung collapse/failure

Blast Wave

- Blunt trauma, lacerations, and impalement

Causes of Blast Injuries

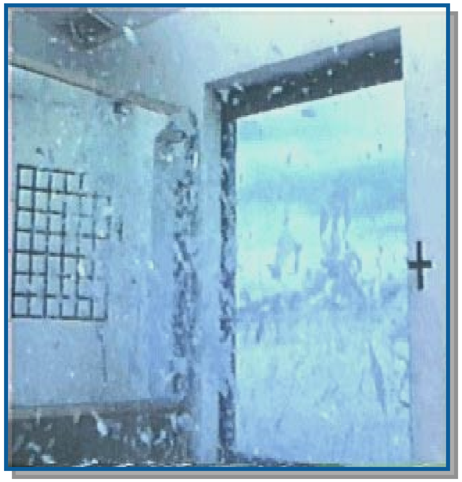
Fragmentation

Bomb or vehicle

Street furniture or jersey barriers

Building component failure

- Glass – predominant
- Walls
- Floors



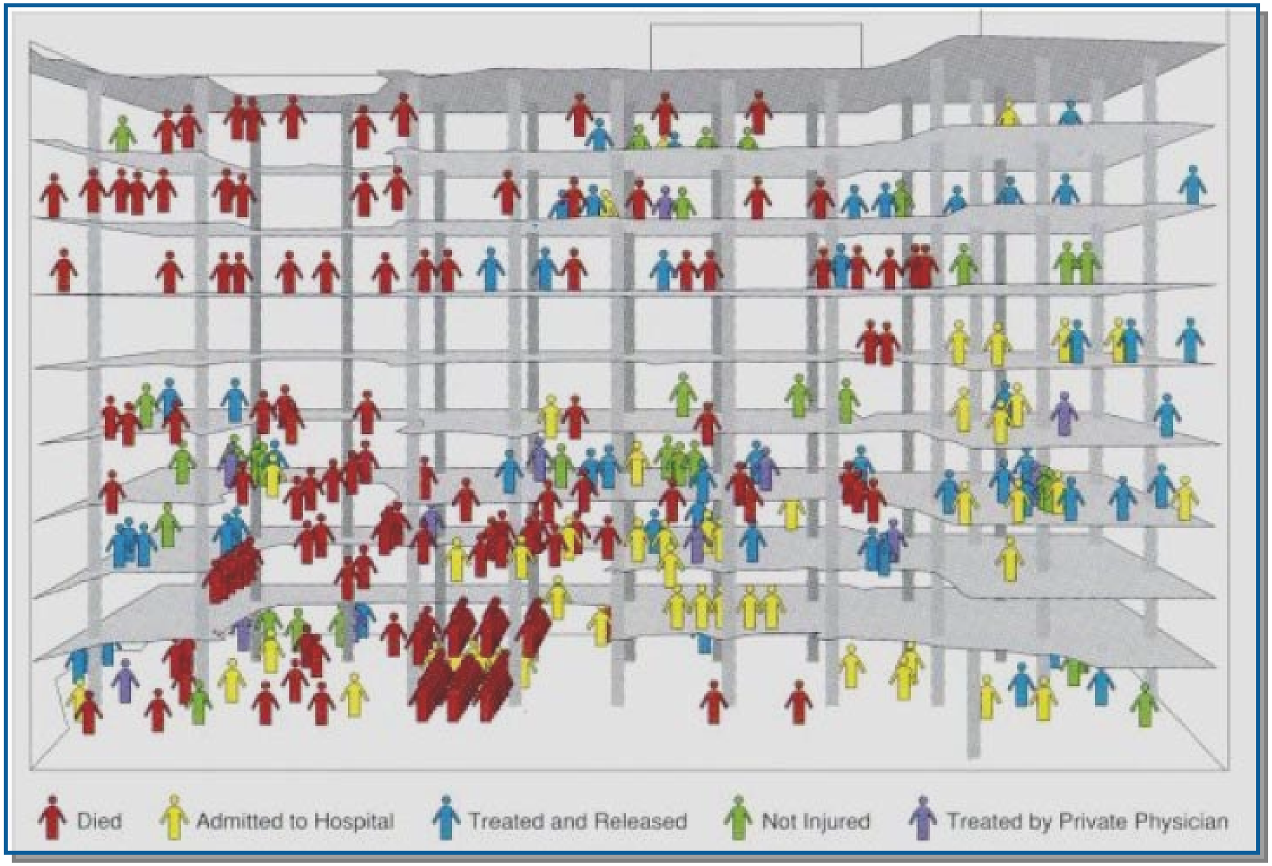
FEMA

Murrah Federal Building, Oklahoma City

FEMA

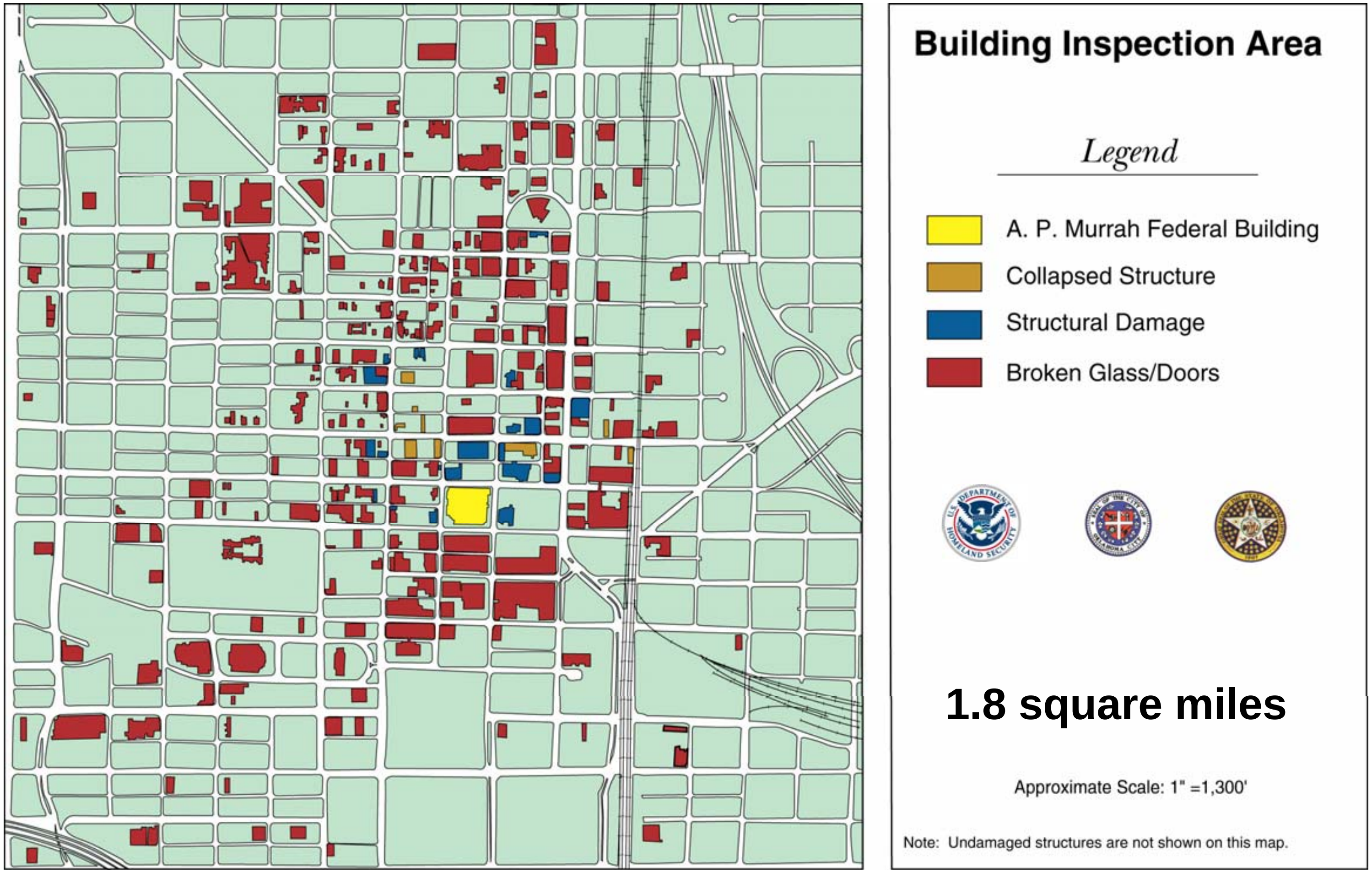
Murrah Federal Building, Oklahoma City

The majority of deaths were due to the collapsing structure



From *Journal of American Medical Association, August 7, 1996*

Murrah Federal Building, Oklahoma City



From *FEMA Oklahoma City Bombing Report 9-0300 / FEMA 277, August 1996*

Levels of Protection

CONVENTIONAL CONSTRUCTION **INCIDENT OVERPRESSURE**

Level of Protection	Potential Structural Damage	Potential Door and Glazing Hazards	Potential Injury
Below AT standards	Severely damaged. Frame collapse/massive destruction. Little left standing.	Doors and windows fail and result in lethal hazards. GSA 5	Majority of personnel suffer fatalities.
Very Low psi = 3.5	Heavily damaged - onset of structural collapse. Major deformation of primary and secondary structural members, but progressive collapse is unlikely. Collapse of non-structural elements.	Glazing will break and is likely to be propelled into the building, resulting in serious glazing fragment injuries, but fragments will be reduced. Doors may be propelled into rooms, presenting serious hazards. GSA 4	Majority of personnel suffer serious injuries. There are likely to be a limited number (10 percent to 25 percent) of fatalities.
Low psi = 2.3	Damage – unrepairable. Major deformation of non-structural elements and secondary structural members and minor deformation of primary structural members, but progressive collapse is unlikely.	Glazing will break, but fall within 1 meter of the wall or otherwise not present a significant fragment hazard. Doors may fail, but they will rebound out of their frames, presenting minimal hazards. GSA 3a	Majority of personnel suffer significant injuries. There may be a few (<10 percent) fatalities.

FEMA 426, Adapted from Table 4-1: DoD Minimum Antiterrorism Standards for New Buildings, p. 4-9

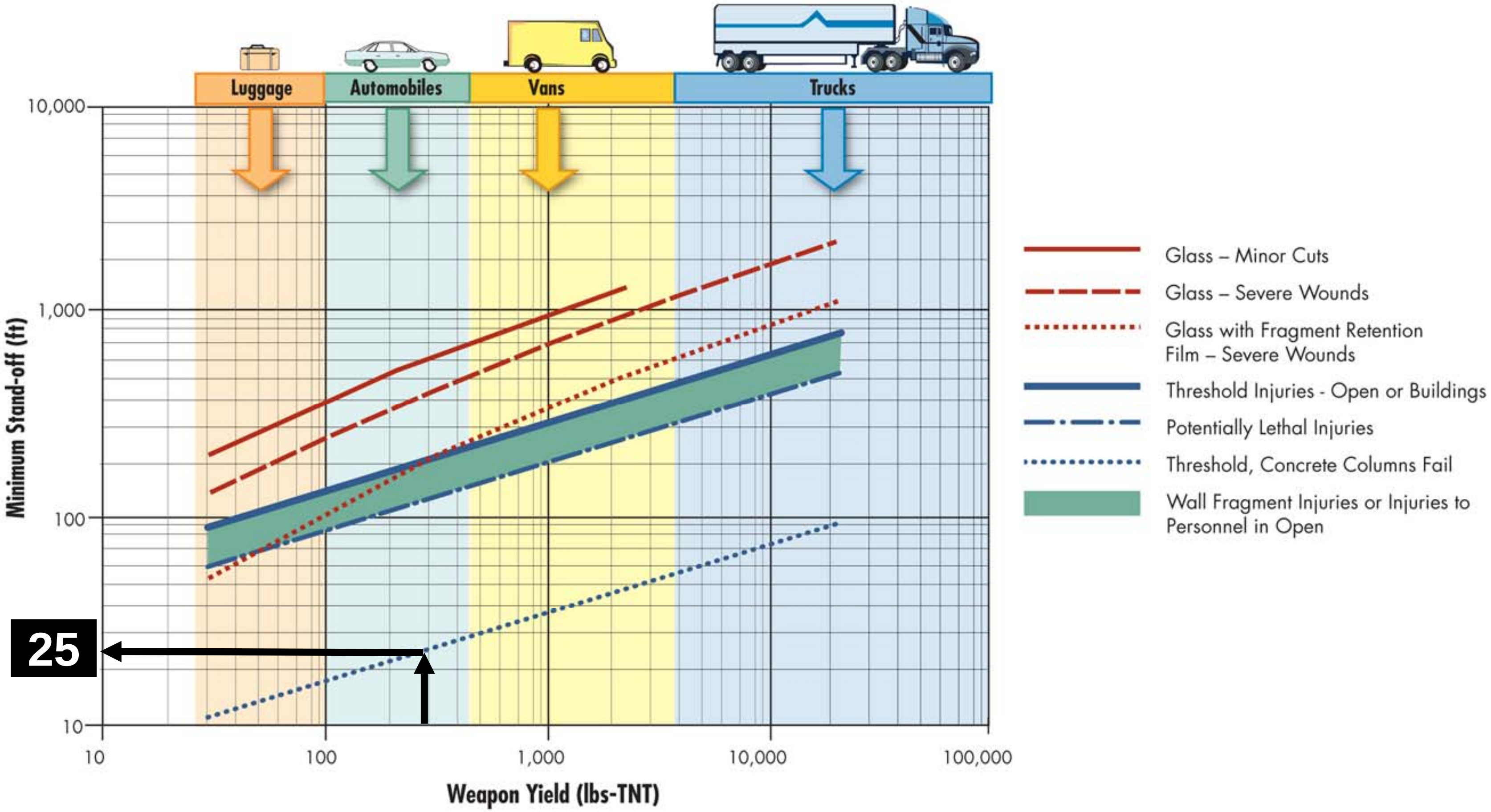
Levels of Protection

CONVENTIONAL CONSTRUCTION **INCIDENT OVERPRESSURE**

Level of Protection	Potential Structural Damage	Potential Door and Glazing Hazards	Potential Injury
Medium psi = 1.8	Damaged – repairable. Minor deformations of non-structural elements and secondary structural members and no permanent deformation in primary structural members.	Glazing will break, but will remain in the window frame. Doors will stay in frames, but will not be reusable. GSA 2	Some minor injuries, but fatalities are unlikely.
High psi = 1.1	Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural elements.	Glazing will not break. Doors will be reusable. GSA 1	Only superficial injuries are likely.

FEMA 426, Adapted from Table 4-1: DoD Minimum Antiterrorism Standards for New Buildings, p. 4-9

Nominal Range-to-Effect Chart



FEMA 426, Figure 4-5: Explosive Environments – Blast Range to Effects, p. 4-11

Comparison of Stand-off

Murrah Federal Building

YIELD (≈TNT Equiv.)	4,000 lb.
Reflected PRESSURE	9,600 psi.
Stand-off	15 feet

166 killed

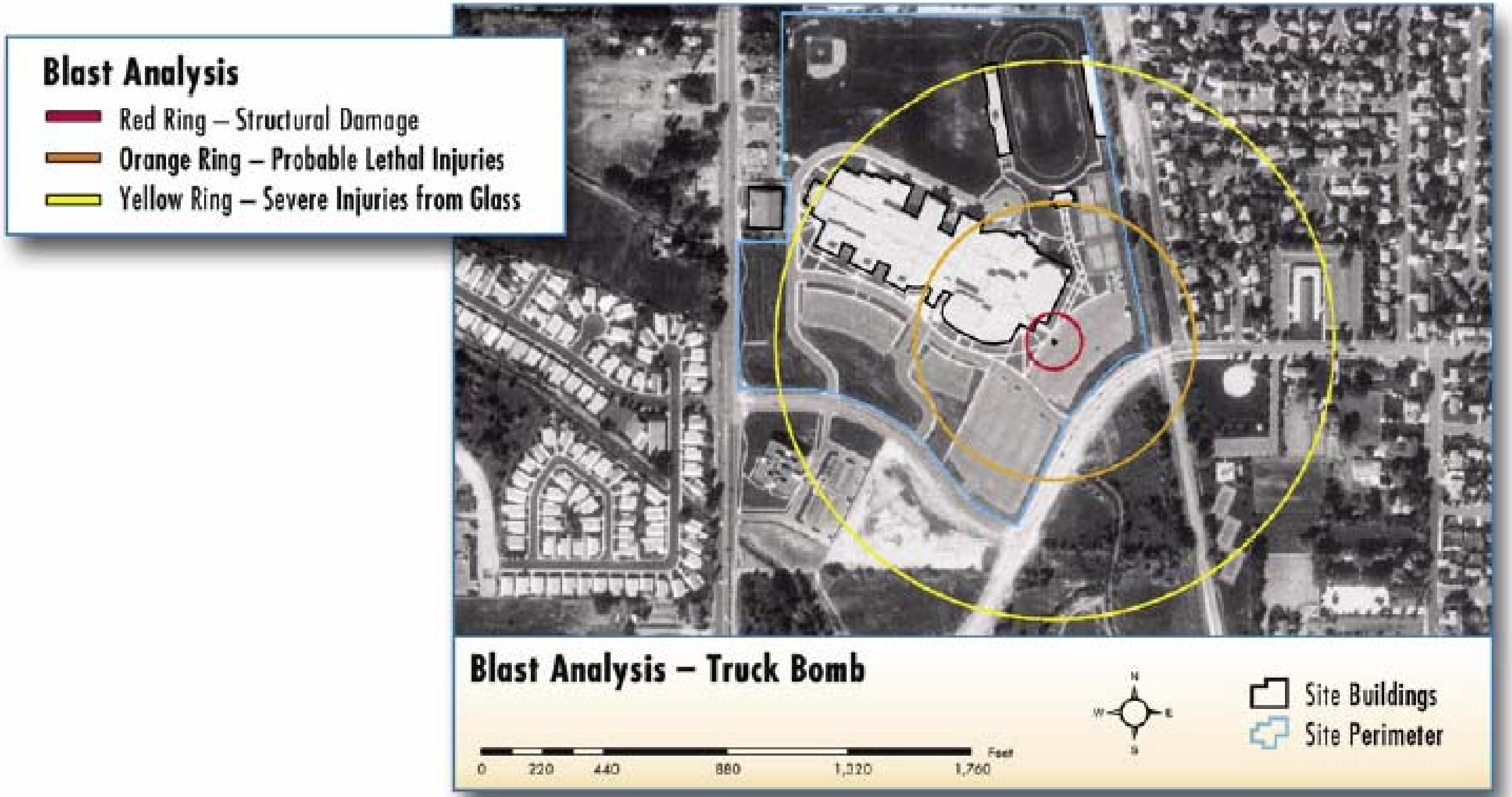
Khobar Towers

YIELD (≈TNT Equiv.)	20,000 lb.
Reflected PRESSURE	800 psi.
Stand-off	80 feet

19 killed

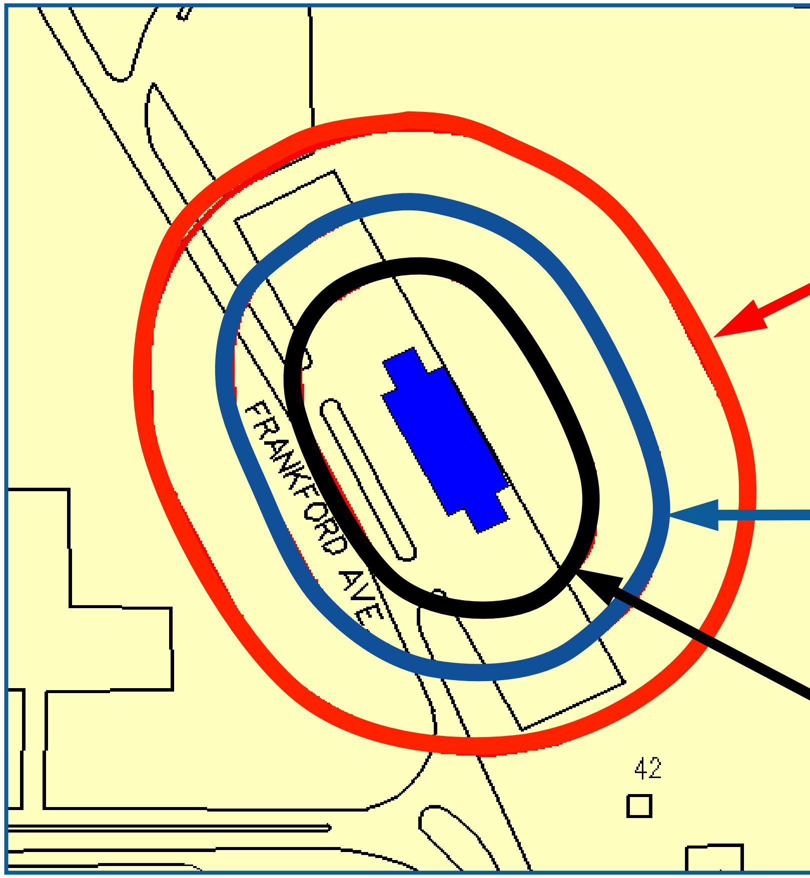
FEMA

Vulnerability Radii



FEMA 426, Figure 4-7: Blast Analysis of Building for Typical Large Truck Bomb Detonated in Building's Parking Log, p. 4-12

Iso-Damage Contours



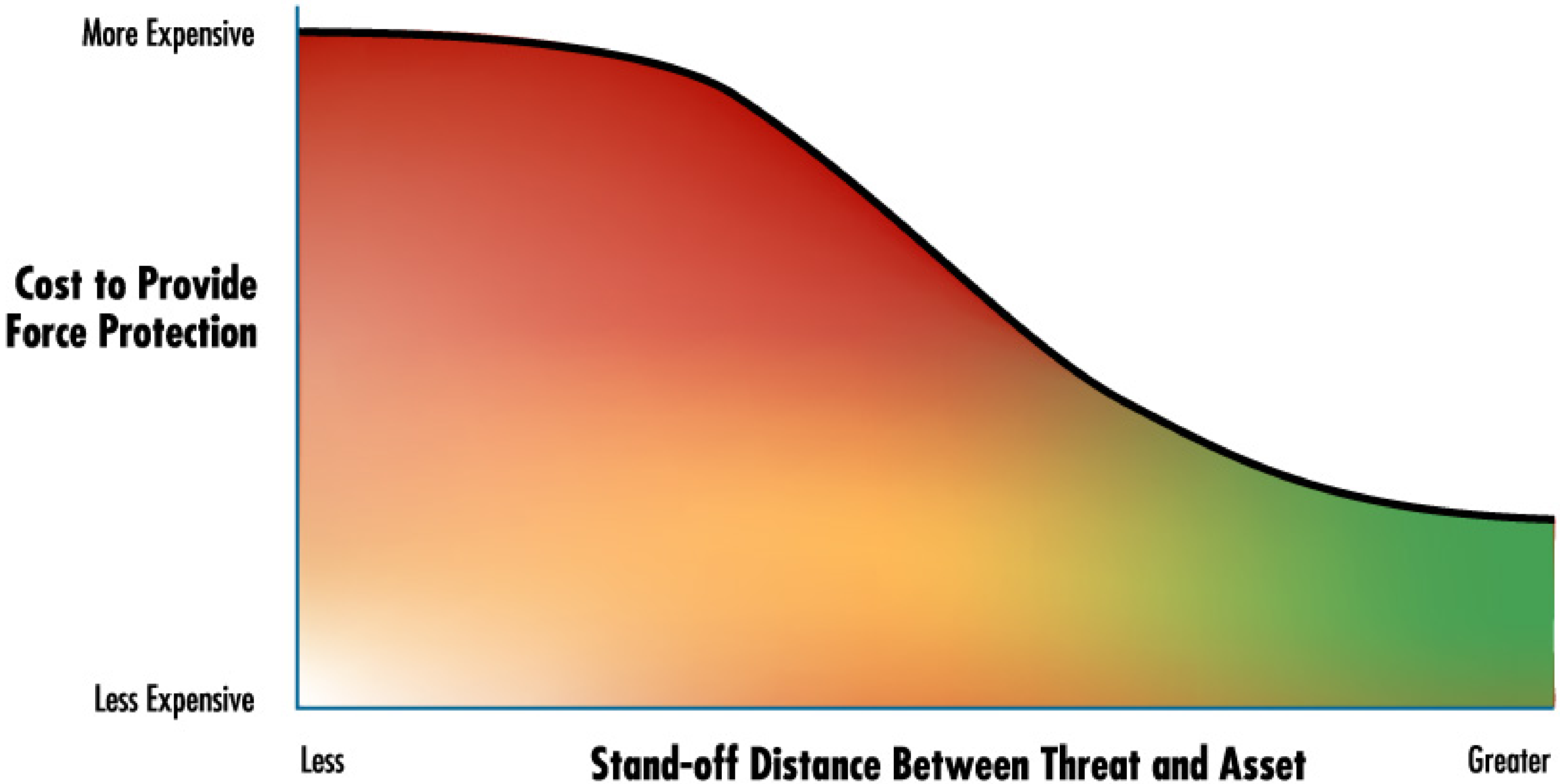
Stand-off required to prevent lethal glass injury

Stand-off required to prevent lethal wall damage

Stand-off required to prevent collapse

FEMA

Cost Versus Stand-off



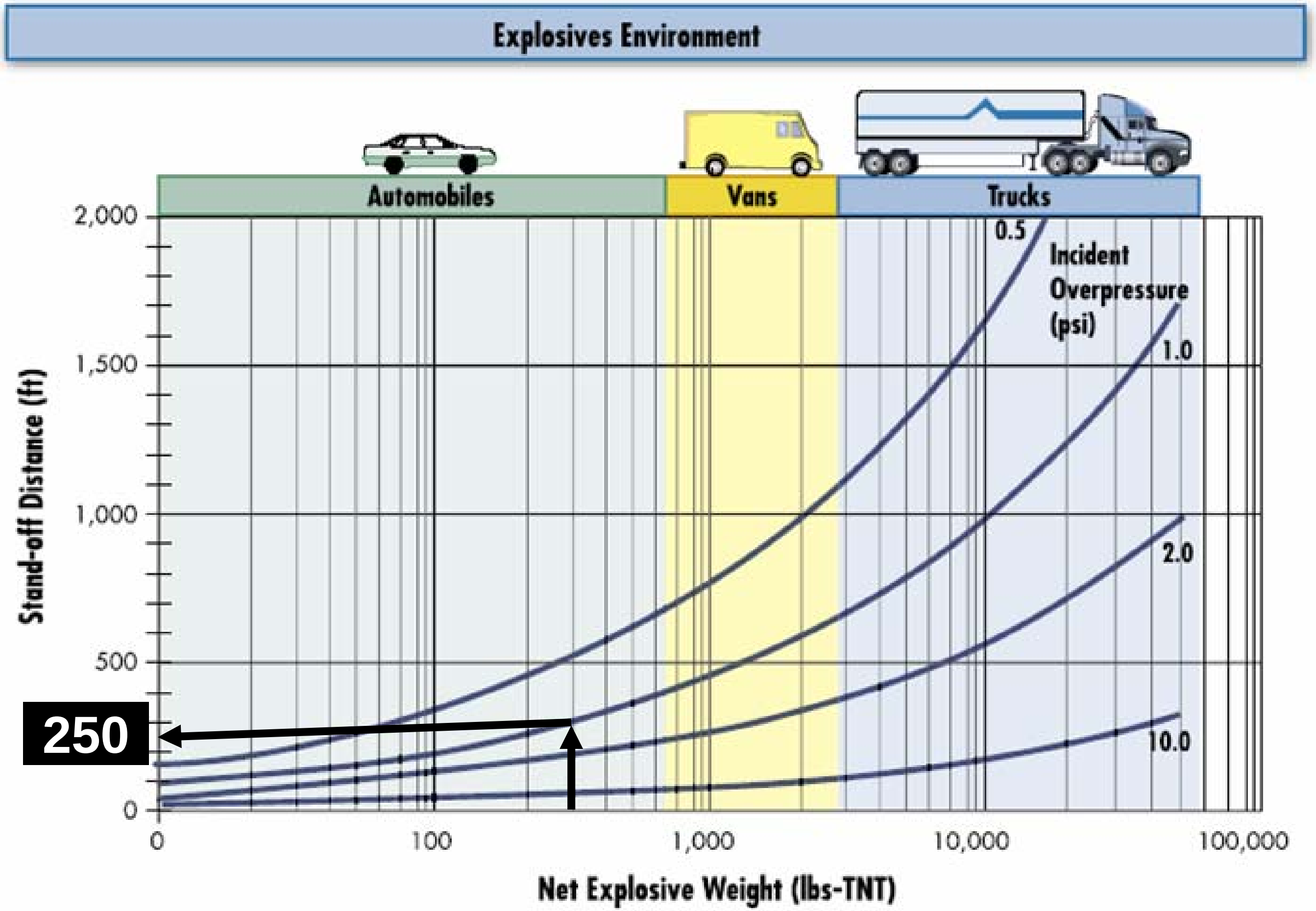
FEMA 426, Figure 4-8: Relationship of Cost to Stand-off Distance, p. 4-13

Blast Load Predictions

Incident and reflected pressure and impulse

- Software
  - Computational Fluid Dynamics
  - ATBLAST (GSA)
  - CONWEP (US Army)
- Tables and charts of predetermined values

Pressure versus Distance



FEMA 426, Figure 4-10: Incident Overpressure Measured in Pounds Per Sq. Inch, as a Function of Stand-Off Distance and Net Explosive Weight, p. 4-17

FEMA

Blast Damage Estimates

Assumptions - pressure and material

- Software - SDOF
  - AT Planner (U.S. Army)
  - BEEM (TSWG)
  - BlastFX (FAA)
- Software - FEM
- Tables and charts of predetermined values

Blast Damage Estimates

Damage	Incident Pressure (psi)
Typical window glass breakage (1)	0.15 – 0.22
Minor damage to some buildings (1)	0.5 – 1.1
Panels of sheet metal buckled (1)	1.1 – 1.8
Failure of unreinforced concrete blocks walls (1)	1.8 – 2.9
Collapse of wood frame buildings (2)	Over 5.0
Serious damage to steel framed buildings (1)	4 – 7
Severe damage to reinforced concrete structures (1)	6 – 9
Probable total destruction of most buildings (1)	10 – 12

FEMA 426, Table 4-3: Damage Approximations, p. 4-19

Level of Protection	Incident Pressure (psi)
High	1.2
Medium	1.9
Low	2.3
Very Low	3.5
Below AT Standards	> 3.5

FEMA

Manchester Bombing

Summary

Explosive blast physics

Blast damage to buildings

Injury to personnel

Prediction of loading, damage, and injury

- Range-to-effect chart
- Incident pressure chart

Unit VII Case Study Activity

Explosives Environment, Stand-off Distance, and the Effects of Blast

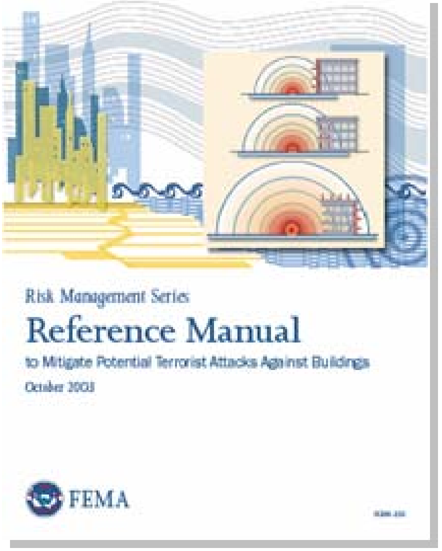
Background

Purpose of activity: check on learning about explosive blast

Requirements

Refer to Case Study and FEMA 426

Answer worksheet questions



Unit VIII
Chemical, Biological, and Radiological (CBR) Measures

FEMA

Unit Objectives

Explain the five possible protective actions for a building and its occupants.

Compare filtration system efficacy relative to the particles present in CBR agents.

Explain the key issues with CBR detection.

Identify the indications of CBR contamination.

Unit VIII: CBR Measures

Units I-VI covered the Risk Assessment Process

Units VII and VIII explain Explosive Blast, CBR Agents, and their effects

Units IX and X demonstrate techniques for site layout and building design to counter or mitigate manmade threats and similar technological hazards

FEMA

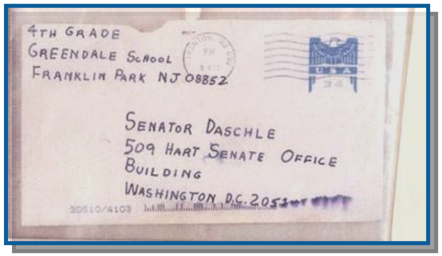
CBR Measures: An Overview

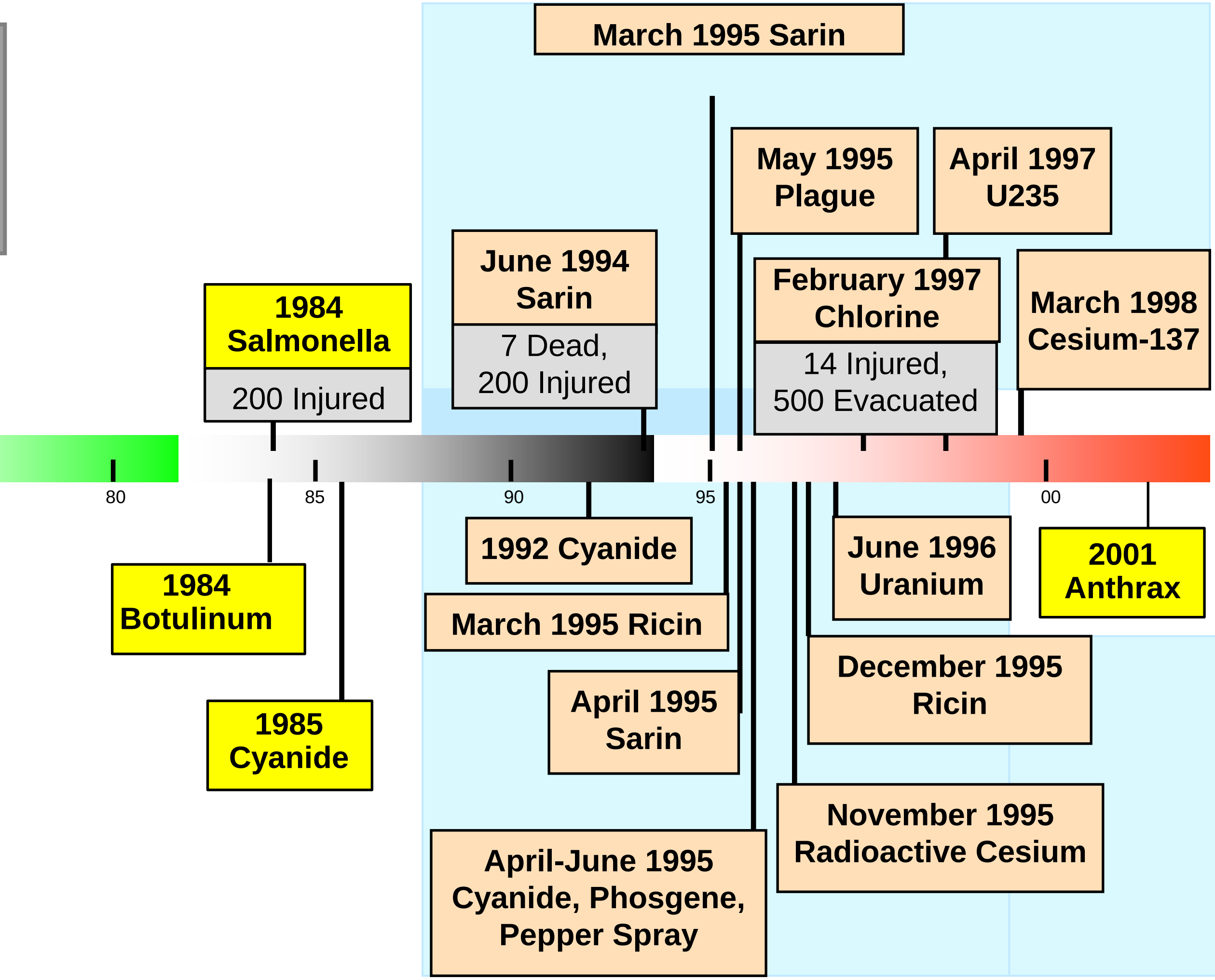
FEMA 426, Chapter 5 is based on best practices for safeguarding building occupants from CBR threats. This module is organized into four sections :

- Protective Actions for Buildings and Occupants
- Air Filtration and Cleaning Principles and Technology
- CBR Detection and Current Technology
- Non-Technology CBR Contamination Indications

SOURCE: SENSIR TECHNOLOGIES

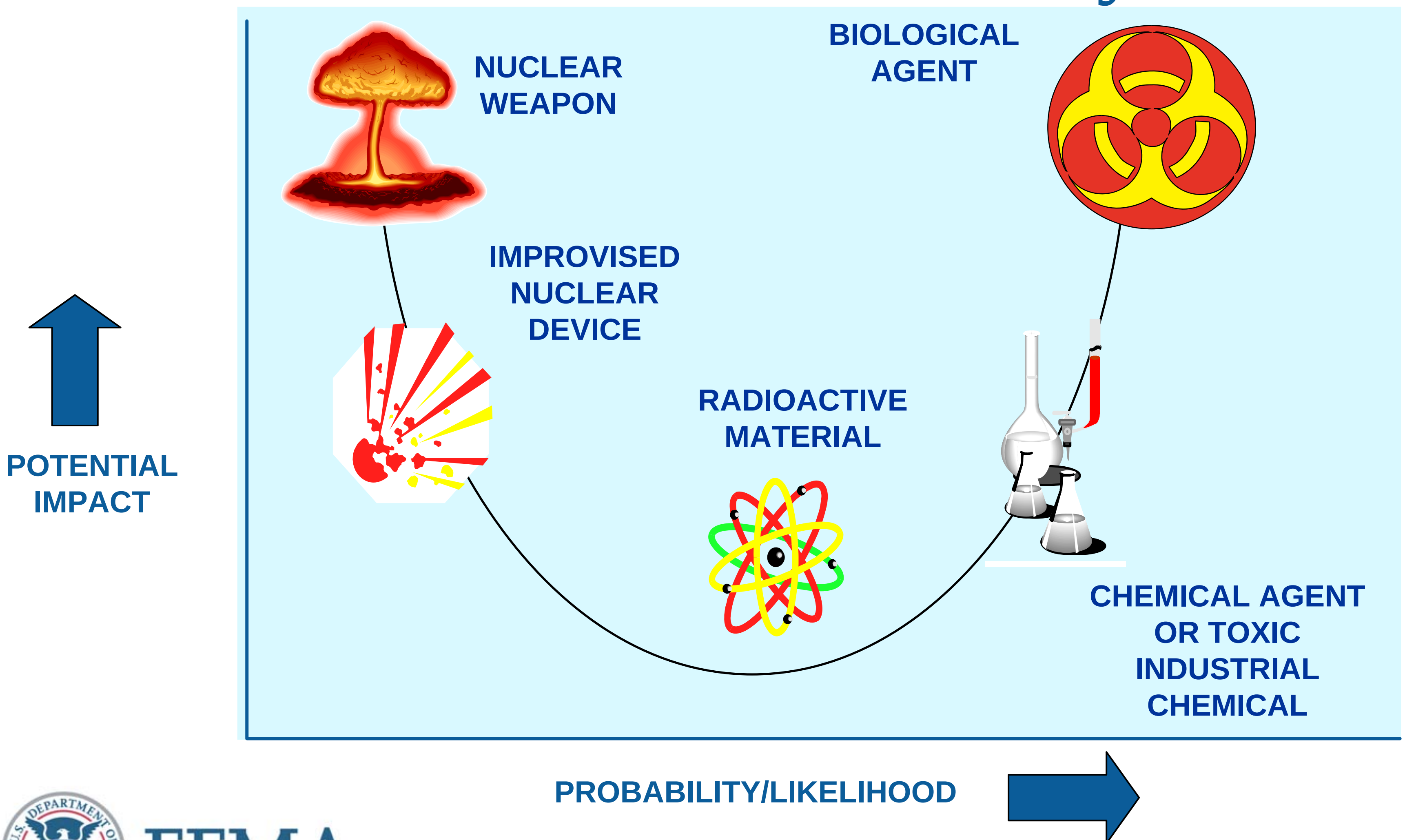
CBR Terrorist Incidents Since 1970





FEMA

What is the CBR Threat Today?



Why Would Terrorists Use CBR?

- Available and relatively easy to manufacture
- Large amounts not needed in an enclosed space
- Easily spread over large areas
- Potential for mass casualties
    - Strong psychological impact
    - Overwhelms resources
    - Difficult to recognize (contagious or spread by victims)

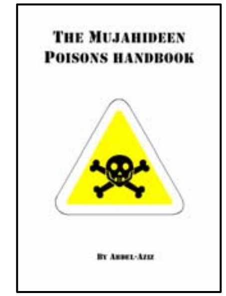
FEMA

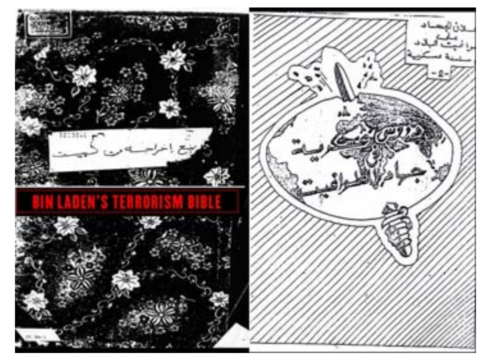
CBR Sources

- Laboratory/commercial
- Industrial facilities
- Foreign military sources
  - At least 26 countries possess chemical agents or weapons
  - 10 countries are suspected to possess biological agents or weapons
- Medical/university research facilities
- Nuclear facilities
- Home production

Limitations of CBR Materials

- Targeted dissemination is difficult
- Delayed effects can detract from impact
- Counterproductive to terrorists’ support
- Potentially hazardous to the terrorist
- Development and use require time and expertise





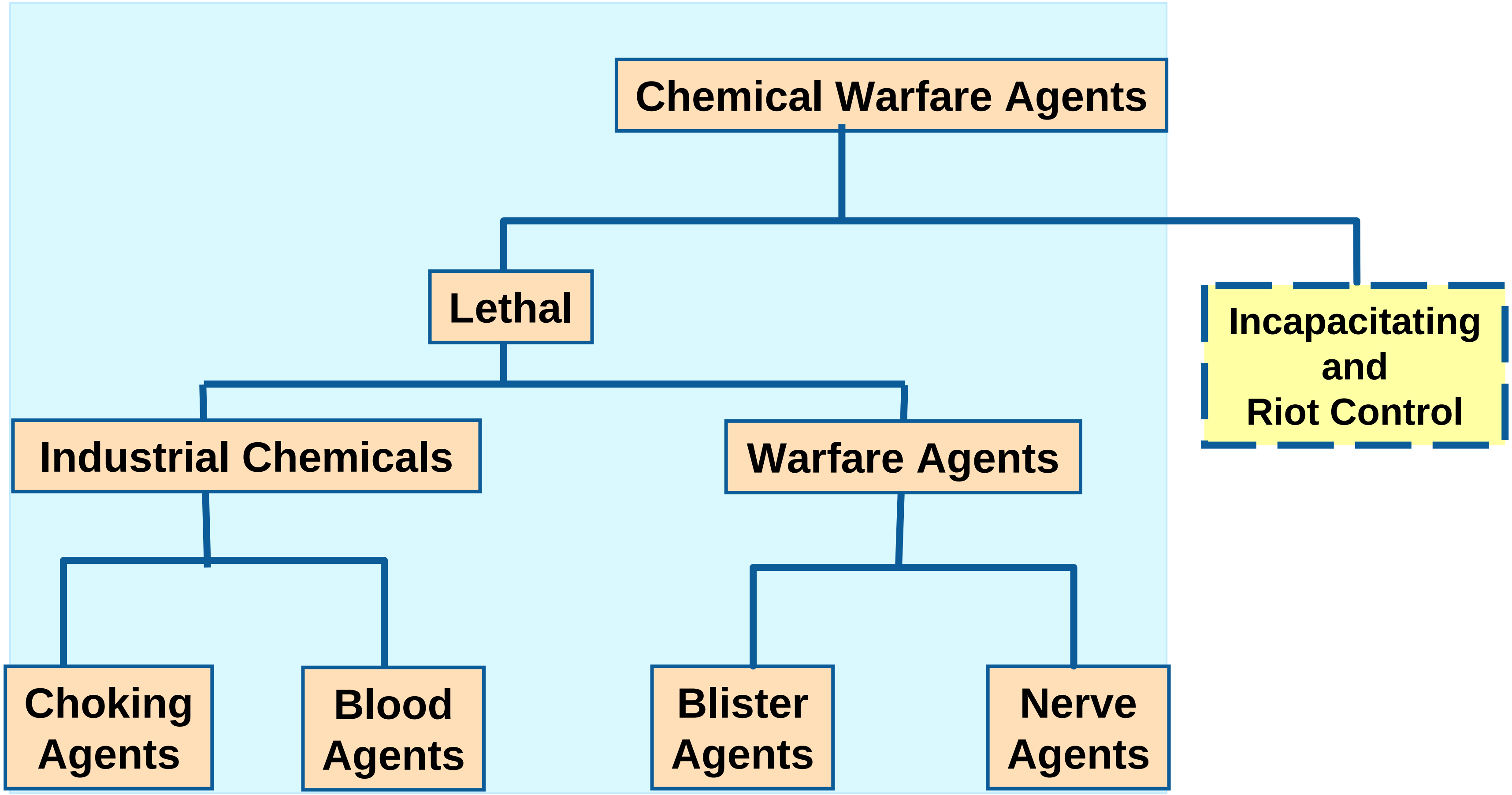
Chemical Agents: Characteristics and Behavior

- Generally liquid (when containerized)
- Normally disseminated as aerosol or gas
- Present both a respiratory and skin contact hazard
- May be detectable by the senses (especially smell)
- Influenced by weather conditions

Subway riders injured in Aum Shinrikyo sarin gas attack, Tokyo, March 20, 1995.
(AP Photo/Chikumo Chiaki)

FEMA

Classes of Chemical Agents



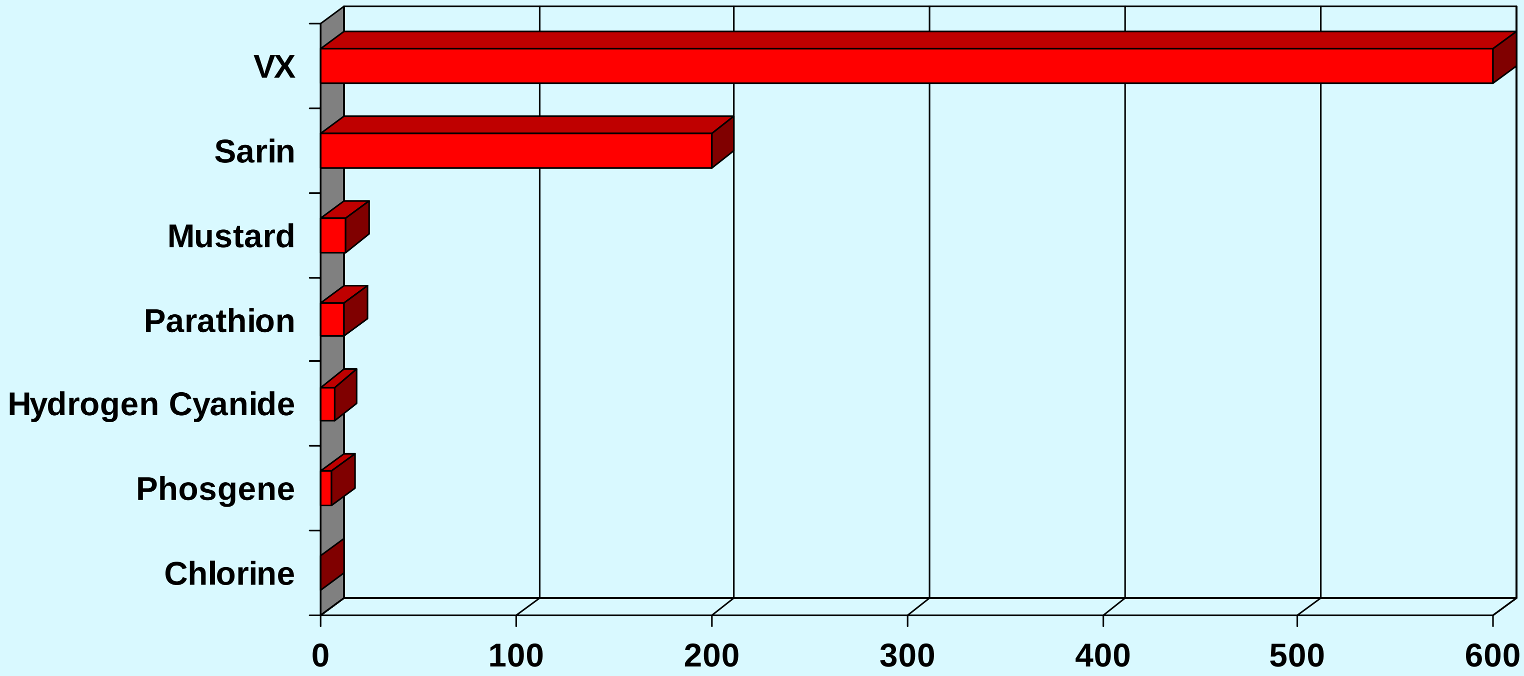
FEMA

Industrial Chemicals

Industrial chemicals previously used as chemical warfare agents	Choking Agents Chlorine/Phosgene	Blood Agents Hydrogen Cyanide/ Cyanogen Chloride
Physical Appearance	Greenish-yellow vapor/ colorless vapor	Colorless vapor
Odor	Bleach/mown hay	Bitter almonds
Signs and Symptoms	Coughing, choking, tightness in chest	Gasping for air Red eyes, lips, skin
Protection	Respiratory	Respiratory
Treatment	Aeration	Aeration, cyanide kit

Four industrial chemicals previously used as chemical warfare agents

Comparative Toxicity



How Much Sarin Does it Take?

Structure	Lethal Amount
Domed Stadium	107 kg (26 gals)
Movie Theater	1.2 kg (5 cups)
Auditorium	52 g (1/4 cup)
Conference Room (50-100 seating)	33 g (1 shot glass)

LD_{50} amounts for 1 minute exposure to Sarin aerosol

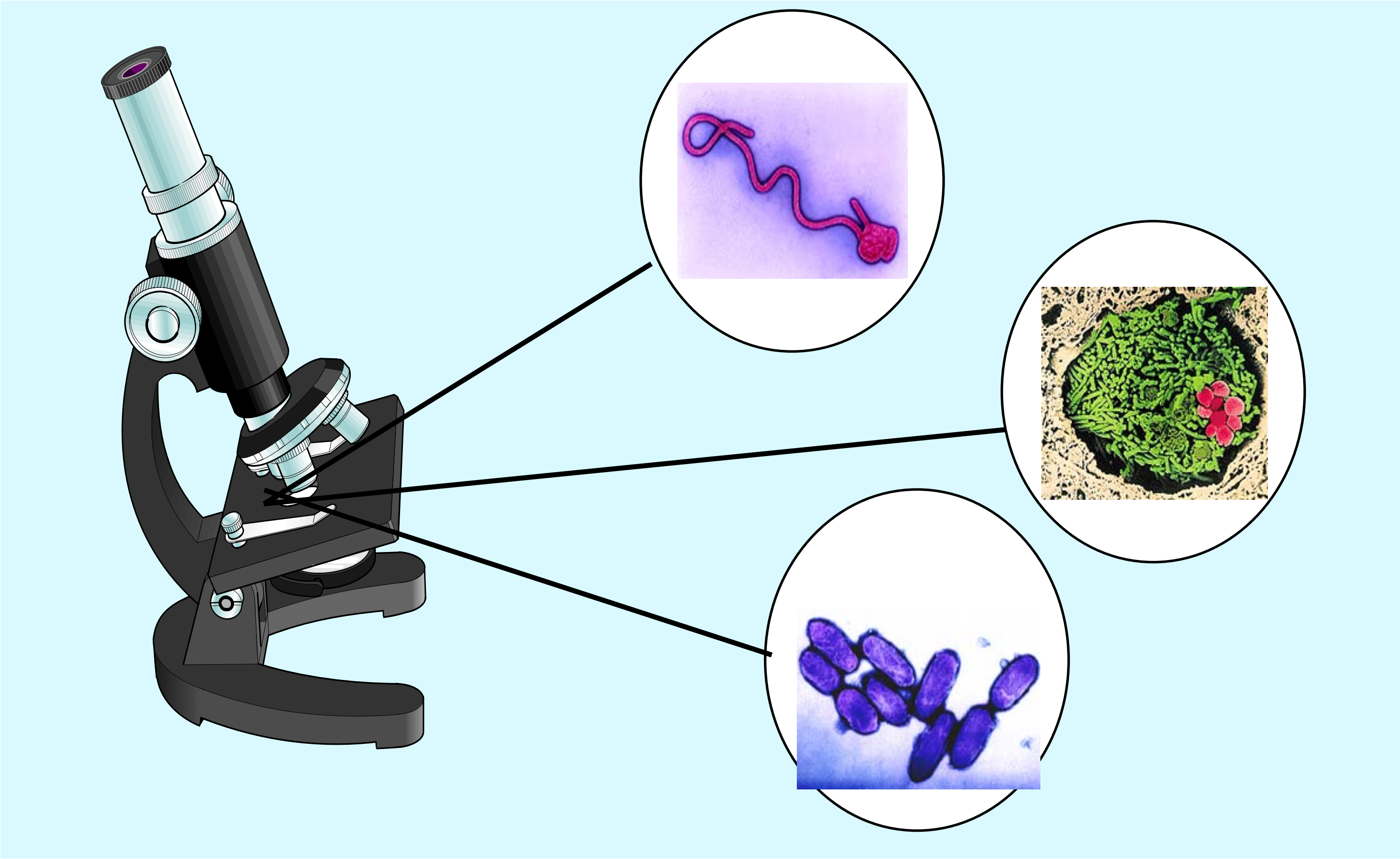
FEMA

Chemical Agents Key Points

- Chemical agents are super toxic
- Relative toxicity: industrial chemicals < mustard < nerve
- Normal states are as a liquid or a vapor
- Inhalation hazard is of greatest concern

FEMA

Biological Warfare Agents

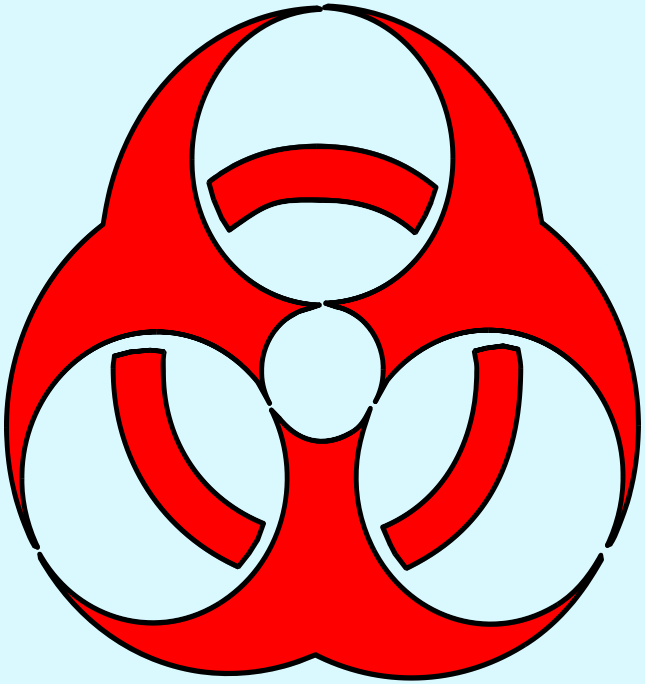


Classes of Biological Agents

Bacteria

Viruses

Toxins



FEMA 426 - Appendix C contains a CBR glossary and characteristics of biological agents

FEMA

Bacteria

	Anthrax	Plague
Incubation Period	1 to 6 days	2 to 3 days for pneumonic 2 to 10 days for bubonic
Contagious	NO	YES (pneumonic) NO (bubonic)
Signs and Symptoms	Chills, fever, nausea, swollen lymph nodes	Chills, high fever, headache, spitting up blood, shortness of breath
Protection	Standard Precautions	Standard Precautions and Droplet Precautions
Treatment	Antibiotics and vaccines	Antibiotics and vaccines

FEMA

Viruses

	Smallpox	Viral Hemorrhagic Fevers
Contagious	YES	YES
Signs and Symptoms	Fever, rigors, vomiting, headache, pustules	Fever, vomiting, diarrhea, mottled/blotchy skin
Protection	Standard Precautions + Droplet + Airborne + Contact Precautions	Standard Precautions + Droplet + Airborne + Contact Precautions
Treatment	Vaccine, supportive therapy	Vaccines available for some

FEMA

Toxins

	Neurotoxin (Botulinum)	Cytotoxin (Ricin)
Onset of Symptoms	1 to 3 days	4-8 hours after ingestion 12-24 hours after inhalation
Contagious	NO	NO
Signs and Symptoms	Weakness, dizziness, dry mouth and throat, blurred vision, paralysis	Chills, high fever, headache, spitting up blood, shortness of breath
Protection	Standard Precautions	Standard Precautions
Treatment	Supportive care, antitoxins, and vaccines	Supportive oxygenation and hydration

Note: There are numerous naturally-occurring toxins. For our purposes, we will group them into two categories.

FEMA

Biological Agents Key Points

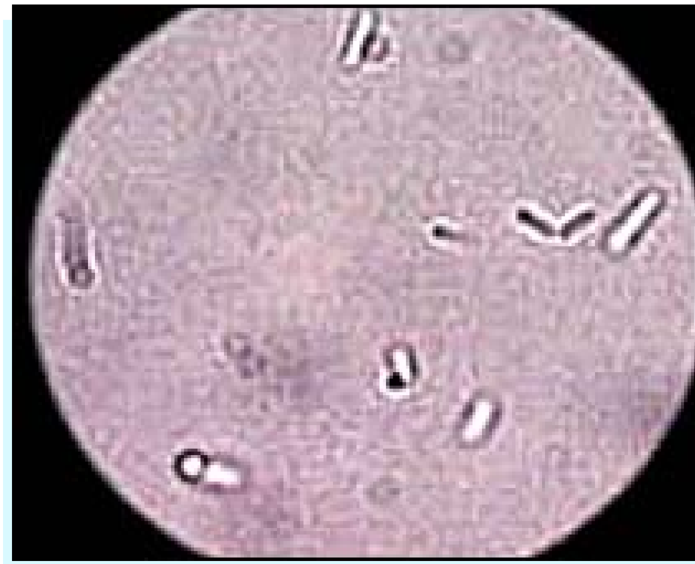
Onset of symptoms

Potentially contagious

Signs and symptoms

Protection

Treatment



(CDC)

FEMA

Biological Agent Categories

Some Biological agent(s)	Disease
Category A	**Category A**
• Variola major	• Smallpox
• Bacillus anthracis	• Anthrax
• Yersinia pestis	• Plague
• Clostridium botulinum	• Botulism
• Ebola, Marburg	• Tularemia
	• Viral hemorrhagic fevers
Category B	**Category B**
• Coxiella burnetii	• Q Fever
• Brucella spp.	• Brucellosis
• Burkholderia mallei	• Glanders
• Burkholderia pseudomallei	• Melioidosis
• Toxins	• Psittacosis
• Food/Water safety threats	• Ricin toxin
Category C	• Typhus
• Emerging threat agents	• Cholera
	• Shigellosis

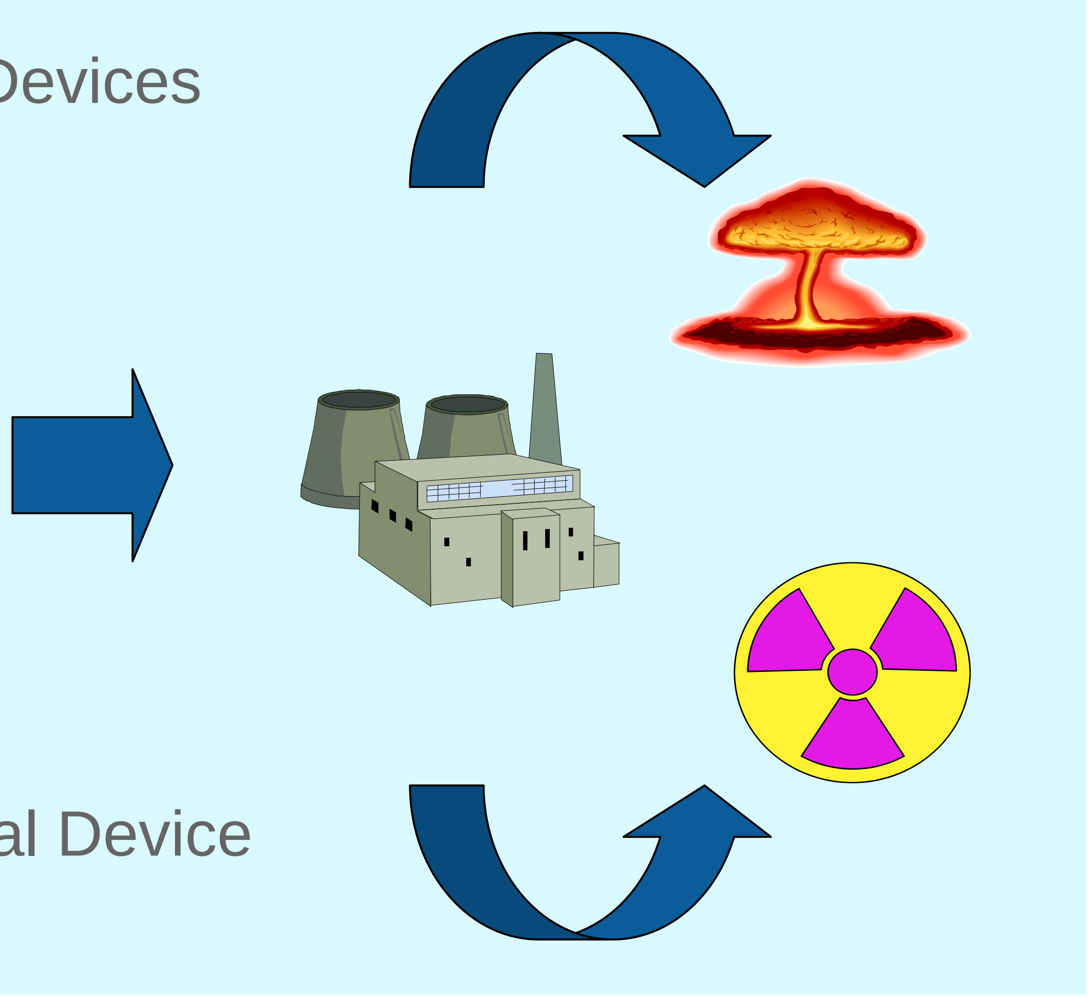
FEMA

Nuclear/Radiological Materials

Improvised Nuclear Devices

Nuclear Plants

Radiological Dispersal Device



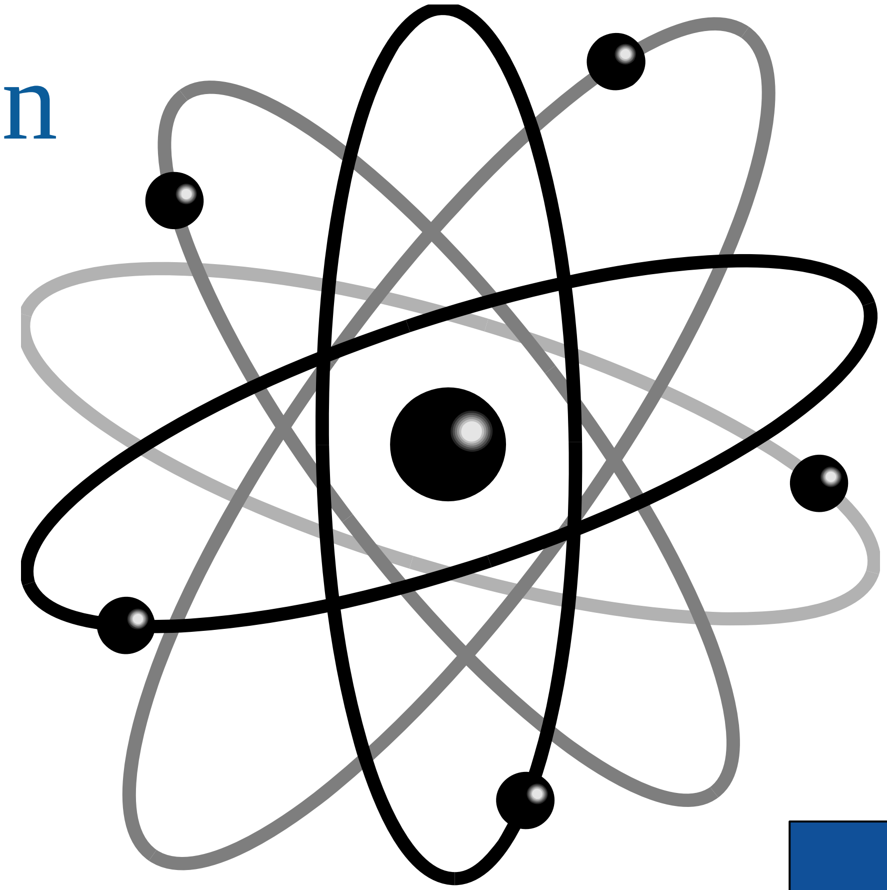
Ionizing Radiation

Alpha particles

Beta particles

Gamma rays

Neutrons



There are also non-ionizing types of radiation – fluorescent lights, lasers, and microwaves. In these examples, the radiation can cause burns, but it does not cause molecular change or ionization

FEMA

Common Radiation Exposures

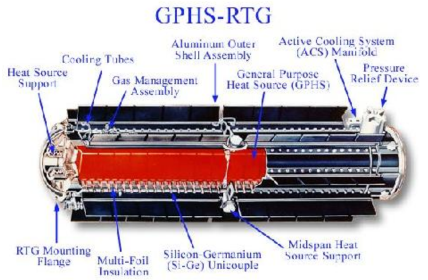
Average annual exposure	360 mrem per year	**Chronic**
Chest x-ray	10 to 30 mrem	
Flight	0.5 mrem every hour	
Smoking 1.5 packs per day	16,000 mrem per year	
Mild radiation sickness*	200,000 mrem	**Acute**
Lethal dose*	450,000 mrem	

*** single acute exposure**

FEMA

Health Hazards in an Incident

- Exposure to radiation source (external)
- Contamination (possible internal and/or external)

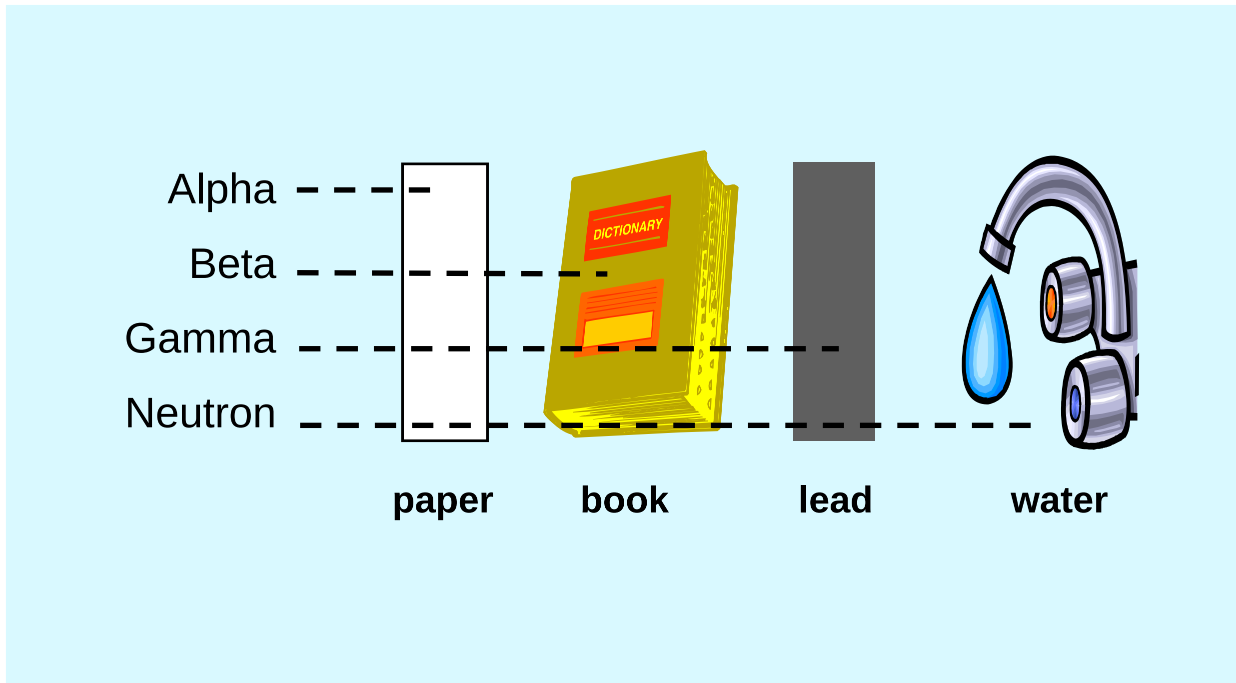


Protection from Radiation Exposure

Time

Distance

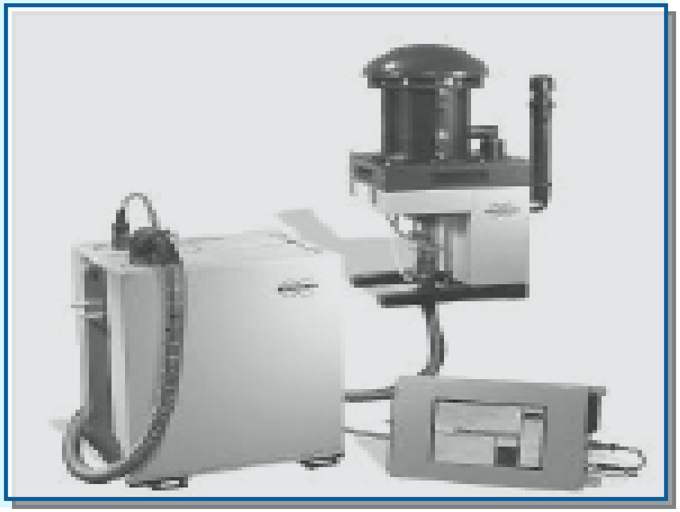
Shielding



CBR Detection

Radiological	✓
Chemical	✓
Biological	?

SOURCE: BAE SYSTEMS



SOURCE: BRUKER DALTRONICS

CBR Incident Indicators

Indicator	Chemical	Biological	Radiological
Dead Animals	✔		✔
Lack of Insect life	✔		
Physical Symptoms	✔	✔	✔
Mass Casualties	✔		✔
Unusual Liquids	✔		
Unexplained Odors	✔		
Unusual Metal Debris/Canisters	✔	✔	✔
Heat Emitting or Glowing			✔
Spray Mechanisms	✔	✔	

FEMA

Chemical Incident Indicators (1)

Dead animals, birds, fish	Not just an occasional roadkill, but numerous animals (wild and domestic, small and large), birds, and fish in the same area.
Lack of insect life	If normal insect activity (ground, air, and/or water) is missing, check the ground/water surface/shore line for dead insects. If near water, check for dead fish/aquatic birds.
Physical symptoms	Numerous individuals experiencing unexplained water-like blisters, wheals (like bee stings), pinpointed pupils, choking, respiratory ailments, and/or rashes.
Mass casualties	Numerous individuals exhibiting unexplained serious health problems ranging from nausea to disorientation to difficulty in breathing to convulsions to death.
Definite pattern of casualties	Casualties distributed in a pattern that may be associated with possible agent dissemination methods.

Chemical agents have a rapid onset of symptoms

FEMA 426, Table 5-2: Indicators of a Possible Chemical Incident, p. 5-34

Chemical Incident Indicators (2)

Illness associated with confined geographic area	Lower attack rates for people working indoors than those working outdoors, and vice versa.
Unusual liquid droplets	Numerous surfaces exhibit oily droplets film; numerous water surfaces have an oily film (No recent rain.)
Areas that look different in appearance	Not just a patch of dead weeds, but trees, shrubs, brushes, food crops, and/or lawns that are dead, discolored, or withered. (Not current drought.)
Unexplained odors	Smells may range from fruity to flowery to sharp/pungent to garlic/horseradish like to bitter almond/peach kernels to new mown hay. It is important to note that the particular odor is completely out of character with its surroundings.
Low-lying clouds	Low-lying clouds/fog-like condition that is not explained by its surroundings
Unusual metal debris	Unexplained bomb/munitions-like material, especially if it contains a liquid. (No recent rain.)

FEMA 426, Table 5-2: Indicators of a Possible Chemical Incident, p. 5-34

Biological Incident Indicators

Unusual numbers of sick or dying people or animals	Any number of symptoms may occur. As a first responder, strong consideration should be given to calling local hospitals to see if additional casualities with similar symptoms have been observed. Casualties may occur hours to days or weeks after an incident has occurred. The time required before symptoms are observed is dependent on the biological agent used and the dose received. Additional symptoms likely to occur include unexplained gastrointestinal illnesses and upper respiratory problems similar to flu/colds.
Unscheduled and unusual spray being disseminated	Especially if outdoors during periods of darkness.
Abandoned spray devices	Devices will have no distinct odors.

Biological agents will typically have a more delayed effect

FEMA 426, Table 5-3: Indicators of Possible Biological Incident, p. 5-35

Radiological Incident Indicators

Unusual numbers of sick or dying people or animals	As a first responder, strong consideration should be given to calling local hospitals to see if additional casualties with similar symptoms have been observed. Casualties may occur hours to days or weeks after an incident has occurred. The time required before symptoms are observed is dependent on the radioactive material used and the dose received. Additional symptoms likely to occur include skin reddening and, in severe cases, vomiting.
Unusual metal debris	Unexplained bomb/munitions-like material.
Radiation symbols	Containers may display a radiation symbol.
Heat emitting material	Material that seems to emit heat without any sign of an external heating source.
Glowing material/particles	If the material is strongly radioactive, it may emit a radioluminescence.

Radiological agents will typically have a more delayed effect

FEMA 426, Table 5-4: Indicators of a Possible Radiological Incident, p. 5-36

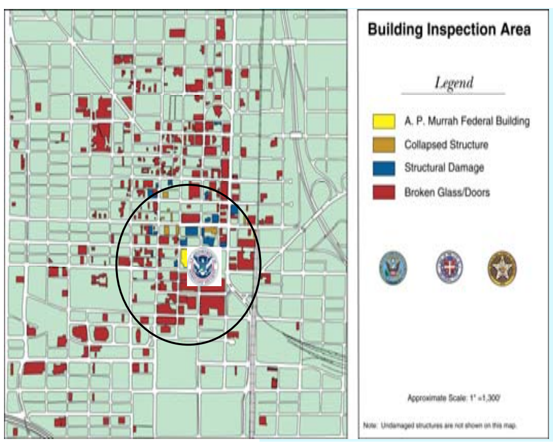
CBR Protection Strategies

Protective Actions:

- Evacuation
- Sheltering in Place
- Personal Protective Equipment
- Air Filtration, Pressurization, and Ultraviolet Light
- Exhausting and Purging

Evacuation

- Determine airborne hazard source -- internal or external
- Determine if evacuation will make things better or worse
- Assembly should be upwind, at least 1,000 feet away, and three different locations (A, B, C plan)
- In most cases, existing plans for fire evacuation apply – follow through - exercise



Sheltering in Place

A building can provide substantial protection against agents released outside if uptake of contaminated air can be halted or reduced and/or if uptake of fresh/filtered air can be increased.

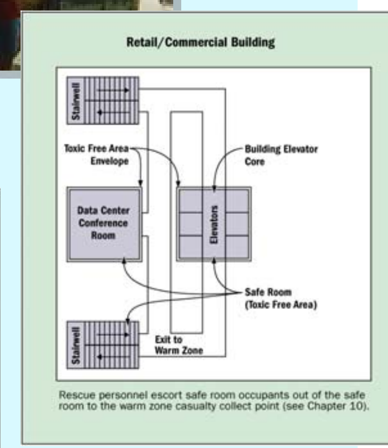
The amount of protection varies with:

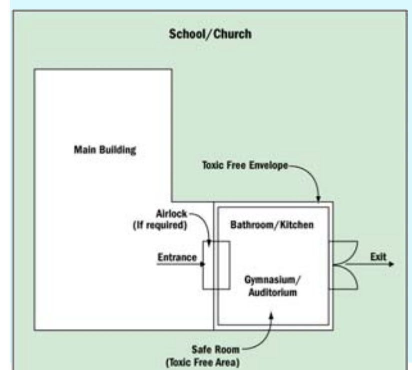
- How tight the building is
- Level of exposure (dose x time)
- Purging or period of occupancy
- Natural filtering

Sheltering in Place

Sheltering Plan should:

- Identify all air handling equipment to deactivate
- Identify cracks, seams, joints, and doors to seal (with method)
- Preposition needed supplies
- Identify safe rooms/safe havens
- Identify procedures for purging or airing out building
- Identify procedures for voluntary occupant participation
- Maintain comms - TV or radio

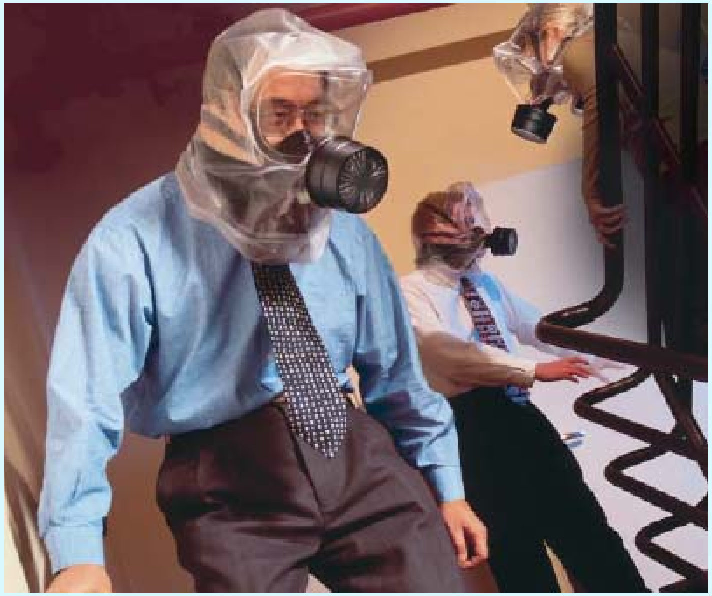




FEMA 453, Multihazard Shelter (Safe Havens) Design

Personal Protective Equipment

SOURCE: BARDAS CHILD PROTECTIVE WRAP (ISRAEL)



SOURCE: MINE SAFETY APPLIANCES COMPANY (USA)

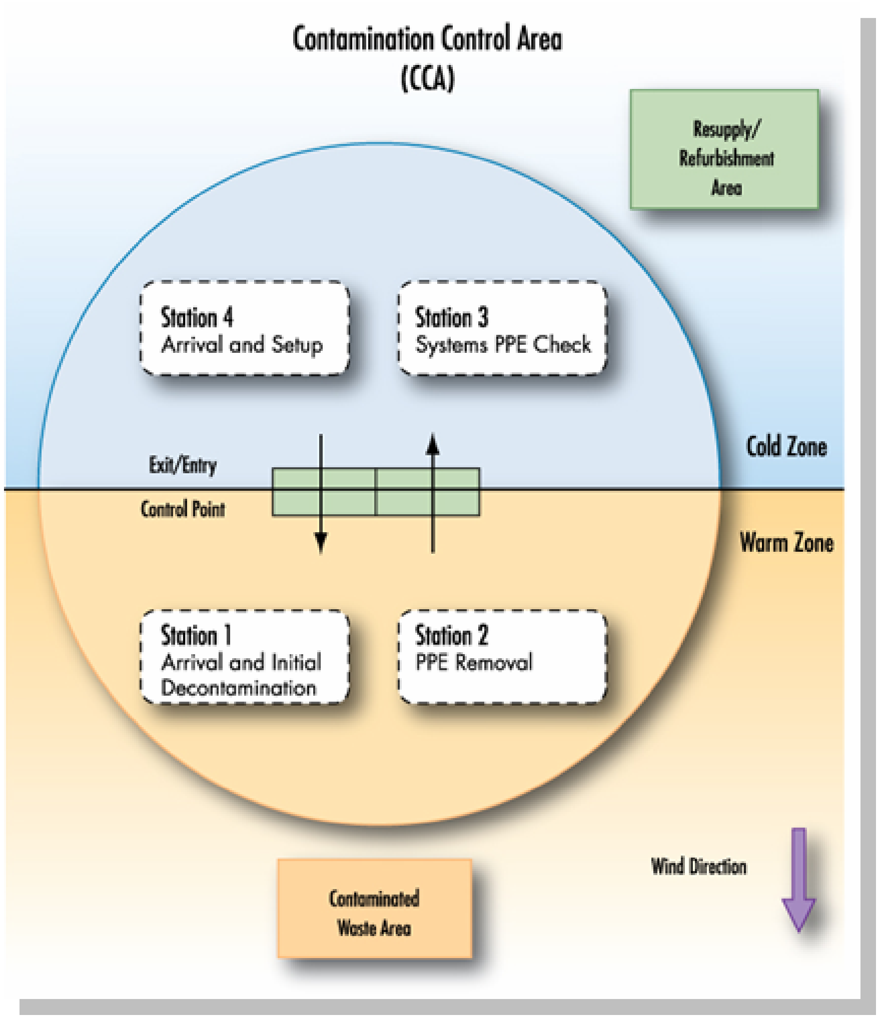
SOURCE: BROOKDALE INTERNATIONAL SYSTEMS INC (CANADA)

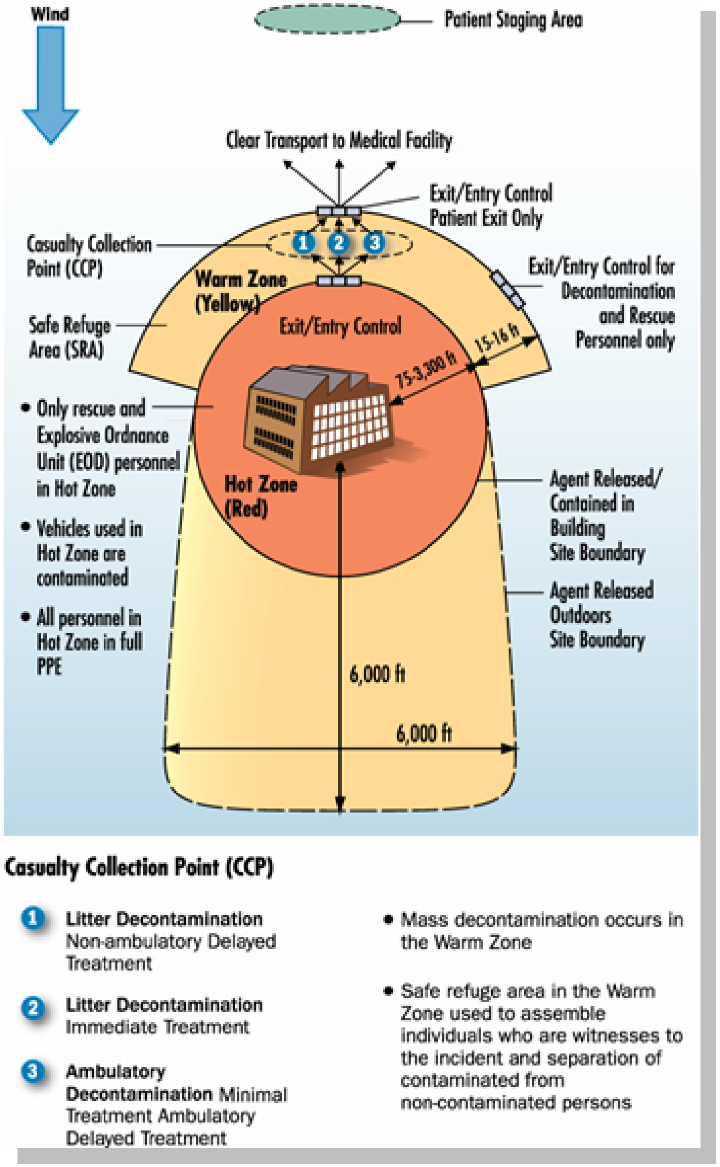
Aftermath of Tragic Events

NMRT decontamination corridor.

Assembly should be to the upwind side of the building at least 1,000 feet away since any airborne hazard escaping the building during an internal release will be carried downwind.

Casualty Collection Point



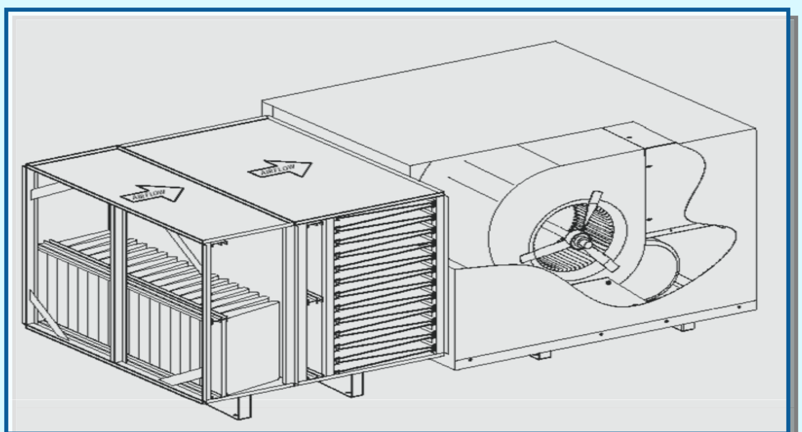


FEMA

FEMA 453, Figure 1-18, p. 1-57, and Figure 1-13, p. 1-52

Air Filtration and Pressurization

- Requires modifications to HVAC and electrical systems – significant initial and life-cycle costs
- Introduces filtered air at a rate sufficient to produce an overpressure and create an outward flow through leaks and cracks



SOURCE: TRION INCORPORATED

FEMA

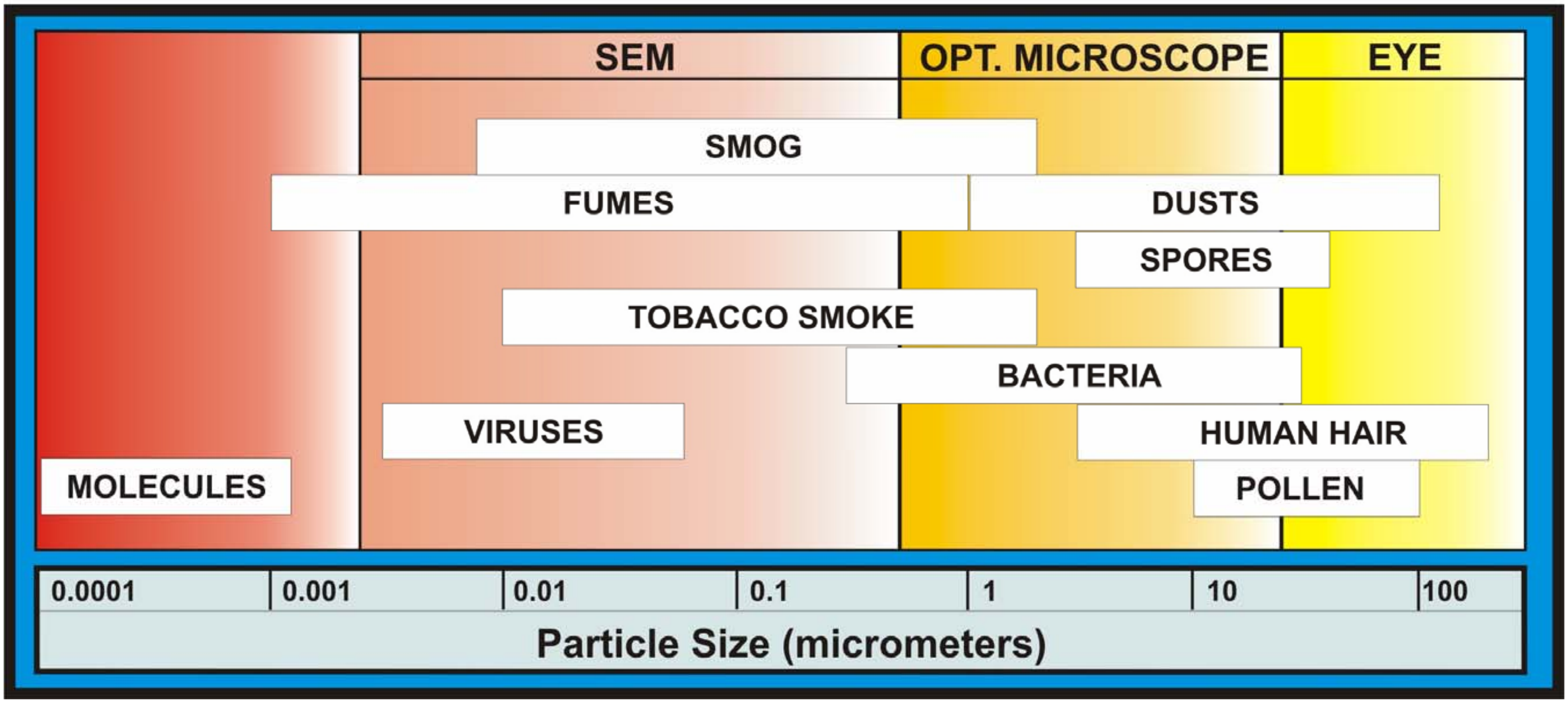
FEMA 426, Figures 5-5 and 5-12: Bag Filter and HEPA Filter; Commercial Air Filtration Unit, p. 5-12 and 5-22

Air Filtration and Cleaning

Two Types of Collection Systems:

- Particulate air filtration
  - Principles of collection
  - Types of particulate filters
  - Filter testing and efficiency ratings
- Gas-phase air filtration
  - Principles of collection
  - Types of gas-phase filters

Air Contaminant Sizes



FEMA

Various Filter Types

Pleated Panel Filters

SOURCE: AMERICAN FILTER

HEPA Filters

SOURCE: FLANDERS CORPORATION

Carbon Filters

SOURCE: FLANDERS CORPORATION

FEMA 426, Figure 5-9: Charcoal Filter Beds (center), p. 5-17

ASHRAE Standards

ASHRAE 52.2				ASHRAE 52.1		Particle Size Range, µm	Applications
MERV	Particle Size Range			Test			
	3 to 10 µm	1 to 3 µm	.3 to 1 µm	Arrestance	Dust Spot		
1	< 20%	-	-	< 65%	< 20%	> 10	Residential, light, pollen, dust mites
2	< 20%	-	-	65 - 70%	< 20%		
3	< 20%	-	-	70 - 75%	< 20%		
4	< 20%	-	-	> 75%	< 20%		
5	20 - 35%	-	-	80 - 85%	< 20%	3.0 - 10	Industrial, Dust, Molds, Spores
6	35 - 50%	-	-	> 90%	< 20%		
7	50 - 70%	-	-	> 90%	20 - 25%		
8	> 70%	-	-	> 95%	25 - 30%		

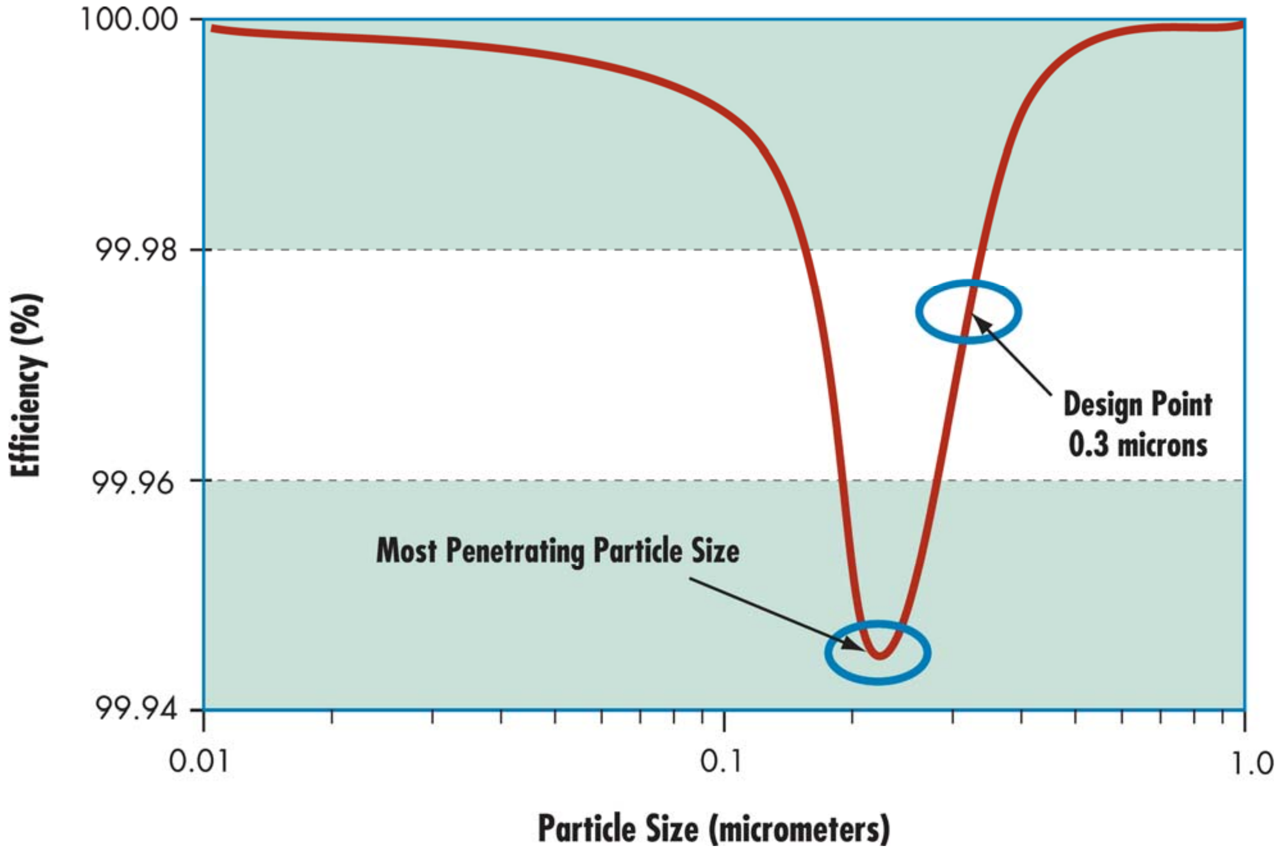
FEMA 426, Table 5-1: Comparison of ASHRAE Standards 52.1 and 52.2, p. 5-12

ASHRAE Standards

9	> 85%	< 50%	-	> 95%	40 - 45%	1.0 – 3.0	Industrial, Legionella, dust
10	> 85%	50 - 65%	-	> 95%	50 - 55%		
11	> 85%	65 - 80%	-	> 98%	60 - 65%		
12	> 90%	> 80%	-	> 98%	70 - 75%		
13	> 90%	> 90%	< 75%	> 98%	80 - 90%	0.3 – 1.0	Hospitals, Smoke removal, Bacteria
14	> 90%	> 90%	75 - 85%	> 98%	90 - 95%		
15	> 90%	> 90%	85 - 95%	> 98%	~95%		
16	> 95%	> 95%	> 95%	> 98%	> 95%		
17	-	-	≥ 99.97%	-	-	< 0.3	Clean rooms, Surgery, Chembio, Viruses
18	-	-	≥ 99.99%	-	-		
19	-	-	≥ 99.999%	-	-		
20	-	-	≥ 99.9999%	-	-		

FEMA 426, Table 5-1: Comparison of ASHRAE Standards 52.1 and 52.2, p. 5-12

Typical Performance of a HEPA Filter



FEMA 426, Figure 5-7: Typical HEPA Filter Performance p. 5-14

Inside Versus Outside Releases

Outside Release

- Keep people inside building
- Reduce indoor/outdoor air exchange – close dampers
- Shut off air handling systems and equipment that moves air – HVAC, exhausts, combustion, computers, elevators
- Close all windows and doors
- Once the outdoor hazard has dissipated
  - Open all doors and windows
  - Turn on all fans, including purging systems

Inside Versus Outside Releases

Inside Release

- Turn off all air handling equipment if no special stand-alone systems installed
- If special systems installed, i.e. mailroom
  - Place air handling system on full (or 100% outside air) to pressurize the space around release room
  - Turn off all air handling supplying release room
- Consider activating fire sprinklers in release room if toxic chemicals involved
- Evaluate evacuation routes for contamination
- Evacuate building in accordance with emergency plan

FEMA

Exhausting and Purging

Basic Principles:

- Use ventilation and smoke/purge fans to remove airborne hazards
  - Use primarily after an external release plume has passed
  - Selectively use for internal release – may spread contamination further
- Purging should be carefully applied
  - Primarily when agent has spread throughout building

FEMA

HVAC System Upgrade Issues

- What is the threat? Toxic Industrial Chemicals, particulate, gaseous, chemical, biological?
- How clean does the air need to be and what is the associated cost?
- What is the current system capacity?
- Is there filter bypass and how significant is air infiltration into the building envelope?
- Will improved indoor air quality offset upgrade costs?
- Is system maintenance addressed?

Economic Issues to Consider

Initial Costs

- Filters, housing, blowers
- Factors including flow rate, contaminant concentration

Operating Costs

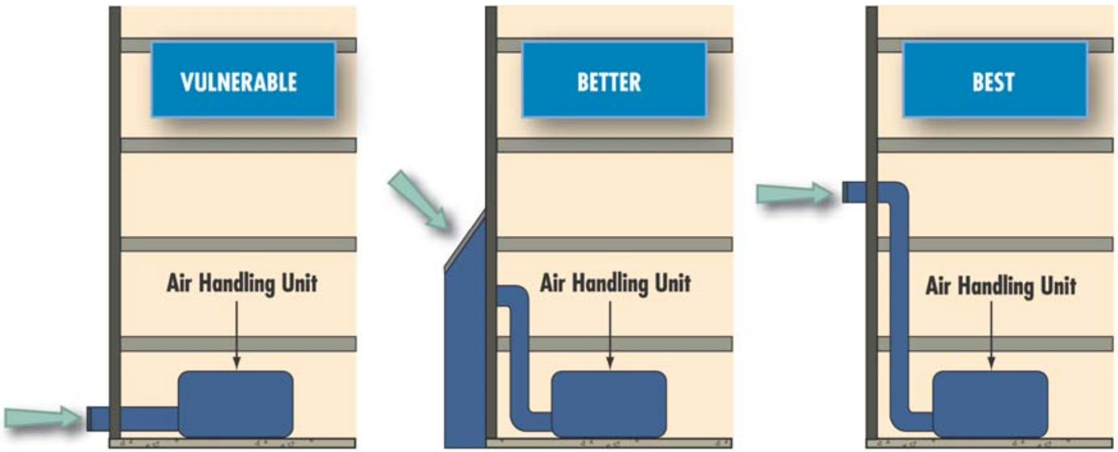
- Maintenance, replacement filters, utilities, waste disposal

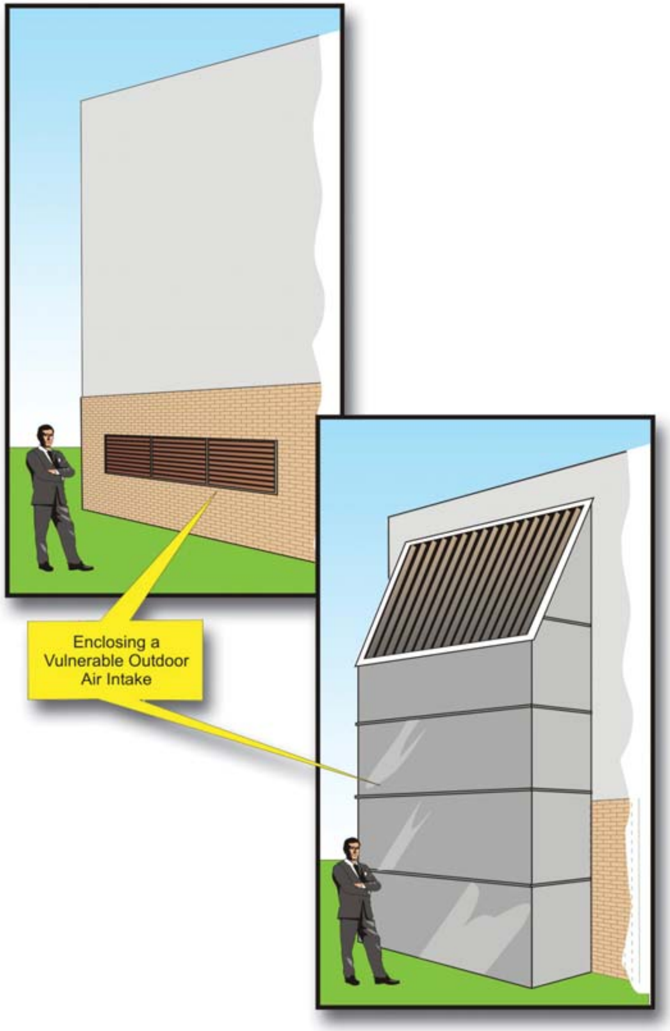
Replacement Costs

- Filter life (factors include continued concentration and particle size distribution, flow rates, etc.)

FEMA

Access to Outdoor Intakes

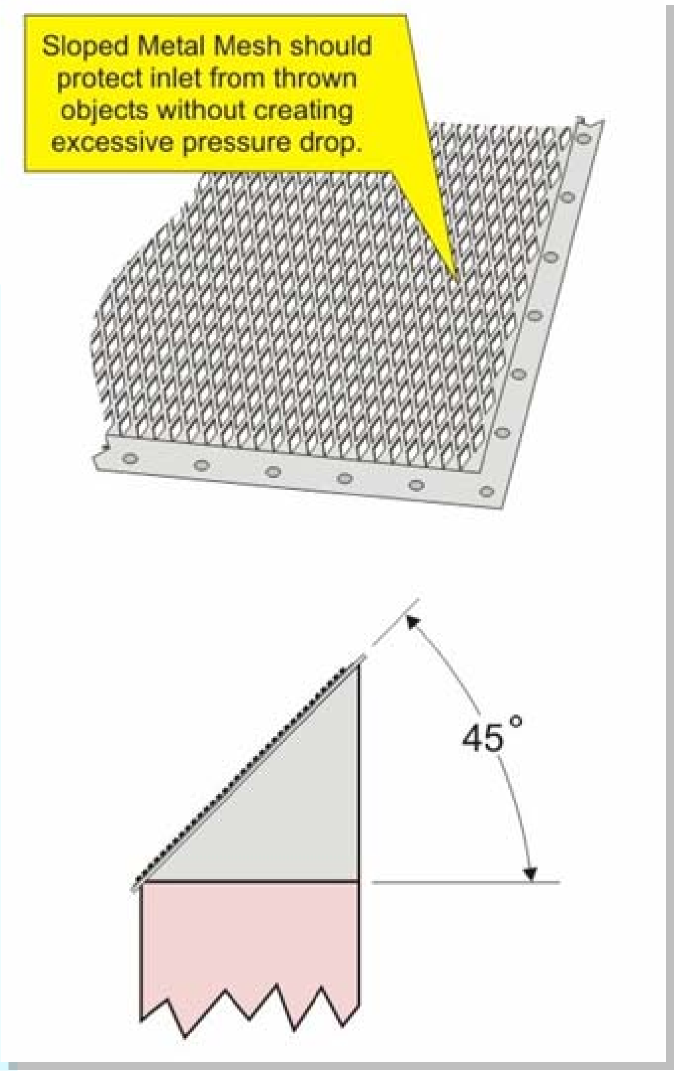




FEMA 426, Figure 3-8, Example of Protecting Outdoor Air Intakes, p. 3-36 and Figure 3-11, Example of Enclosing Existing Vulnerable Air Intake, p.3-38

Extension Design Recommendations

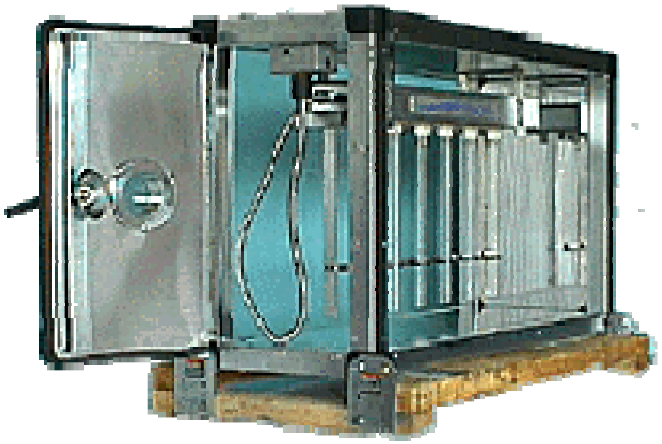
- Lowest edge as high as possible (> 12ft)
- Sloped intake (min. 45° recommended)
- Metal mesh protecting intake



From CDC/NIOSH 2002-139, Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks, p. 21

Ultraviolet Germicidal Irradiation

All viruses and almost all bacteria (excluding spores) are vulnerable to moderate levels of UVGI exposure



UV lamps resemble ordinary fluorescent lamps, but are designed to emit germicidal UV

FEMA 426, Figure 5-10: UVGI Array with Reflective Surfaces, p. 5-19

URV AND UVGI INFORMATION

URV Average Intensities and Doses			
URV (UVGI Rating Value)	Average Intensity μW/cm²	Dose at t (time) = 0.5 sec μW/s/cm²	TB (Tuberculosis) Kill Rate %
9	250	125	23.4
10	500	250	41.3
11	1,000	500	65.5
12	1,500	750	79.8
13	2,000	1,000	88.1
14	3,000	1,500	95.9

URV = **U**VGI **R**ating **V**alue

UVGI = **U**ltra**v**iolet
Germicidal
Irradiation

Simulation Results for Air Intake Release			
Predicted Performance	Anthrax	Smallpox	TB Bacilli
URV 11 - UVGI Removal Rate%	8.0	53.4	65.6
MERV 11 Filter Removal %	56.7	32.3	14.1
Combined Removal Rate %	60.2	68.5	70.4
Baseline Casualties (release over 8 hour period) %	99.0	99.0	99.0
Casualties with Filters and UVGI %	1.0	1.5	1.5

From *"Immune Building Systems Technology"*, *Kowalski 2003*

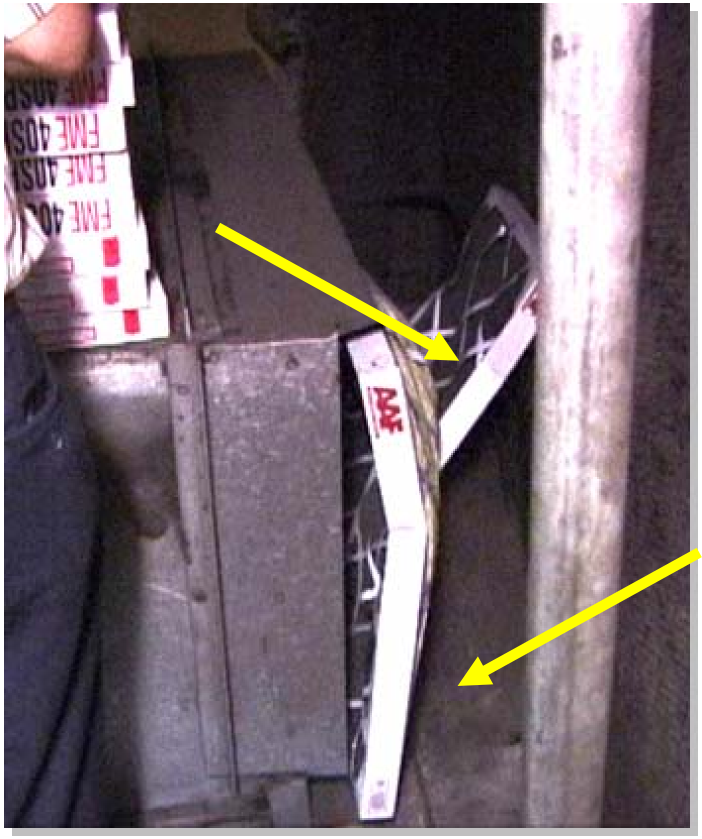
Infiltration and Bypass

Infiltration

- Building envelope tightness and ventilation control are critical

Bypass

- Filters should be airtight
- Check gaskets and seals
- Periodically check



Things Not to Do

- Outdoor air intakes should not be permanently sealed.
- HVAC systems (includes filter upgrades) should not be modified without understanding the effects on building systems or occupants.
- Fire protection and life safety systems should only be modified after careful analysis and review.

Things to Do

- Have a current emergency plan that addresses CBR concerns
  - Exercise plan
  - Revise plan based upon lessons learned
- Understand your HVAC building vulnerabilities
- Conduct periodic walk-through of the system for evidence of irregularities or tampering
- Recognize that there are fundamental differences among various CBR events

Summary

- CBR threats are real and growing.
- Industrial chemicals are readily available.
- Military chemicals require specialty expertise.
- Most buildings provide a reasonable level of protection.
- Inside versus outside building release determines evacuation and other reaction decisions.
- Develop an emergency plan and ensure it works.

FEMA

Unit VIII Case Study Activity

Chemical, Biological, and Radiological (CBR) Measures

Background

Purpose of activity: check on learning about the nature of chemical, biological, and radiological agents

Requirements

Refer to Case Study and FEMA 426

Answer worksheet questions

Unit IX-B
Site and Layout Design Guidance

Unit Objectives

Identify site planning concerns that can create, reduce, or eliminate vulnerabilities and understand the concept of “Layers of Defense.”

Recognize protective issues for urban site planning.

Compare the pros and cons of barrier mitigation measures that increase stand-off or promote the need for hardening of buildings at risks.

FEMA

Unit Objectives

Understand the following critical issues:

- Need for keeping up with the growing demand for security design
- Benefits that can be derived from appropriate security design

References

FEMA Building Vulnerability Assessment Checklist, Chapter 1, page 1-46, FEMA 426

Site and Layout Design Guidance,Chapter 2, FEMA 426

FEMA 430, Primer for Incorporating Building Security Components in Architectural Design

Unit Objectives

Understand the following critical issues (continued):

- Benefits of adopting a creative process to face current design challenges
- Benefits of including aesthetic elements compatible with security and architectural characteristics of building and surrounding environment

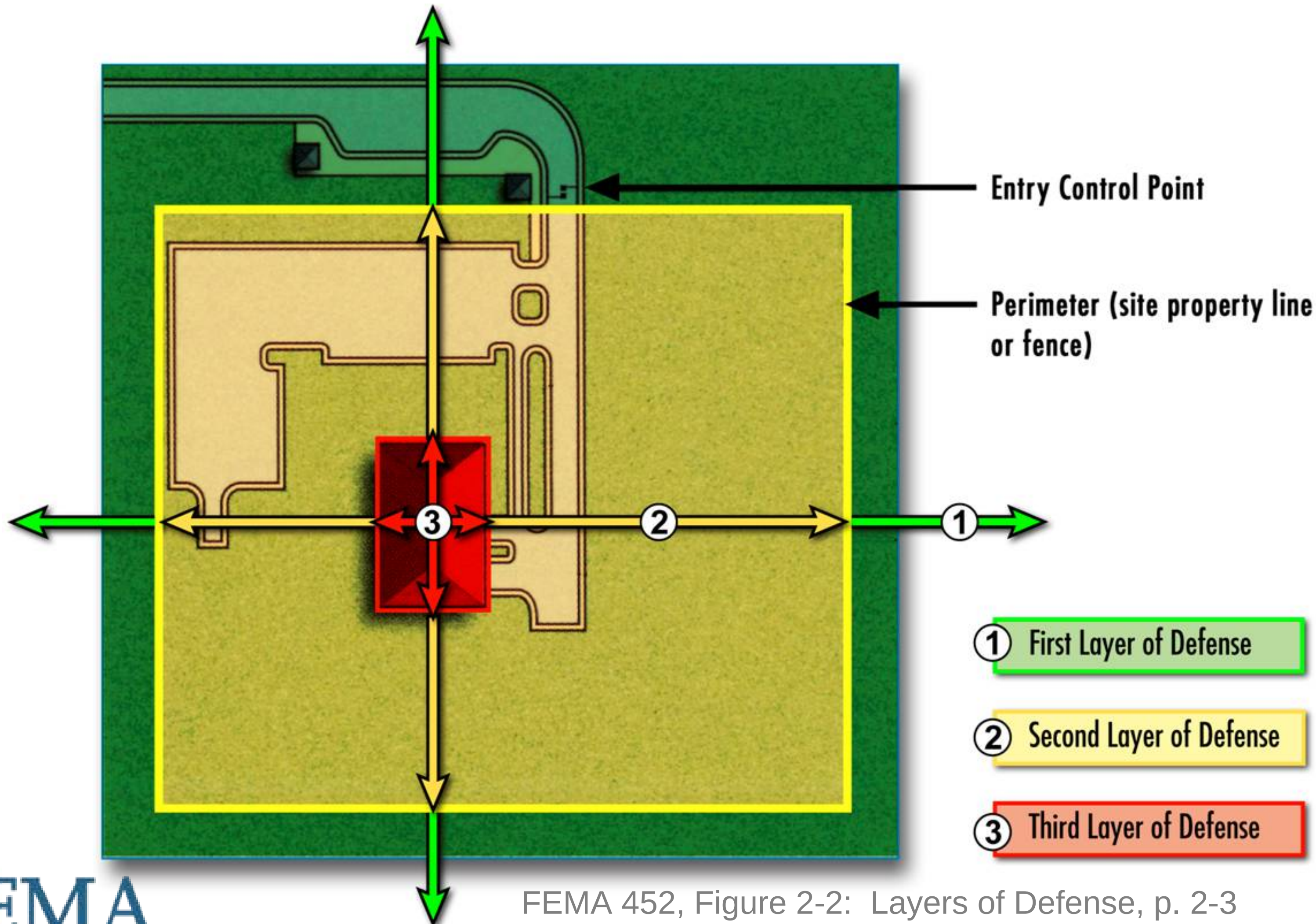
References

FEMA Building Vulnerability Assessment Checklist, Chapter 1, page 1-46, FEMA 426

Site and Layout Design Guidance,Chapter 2, FEMA 426

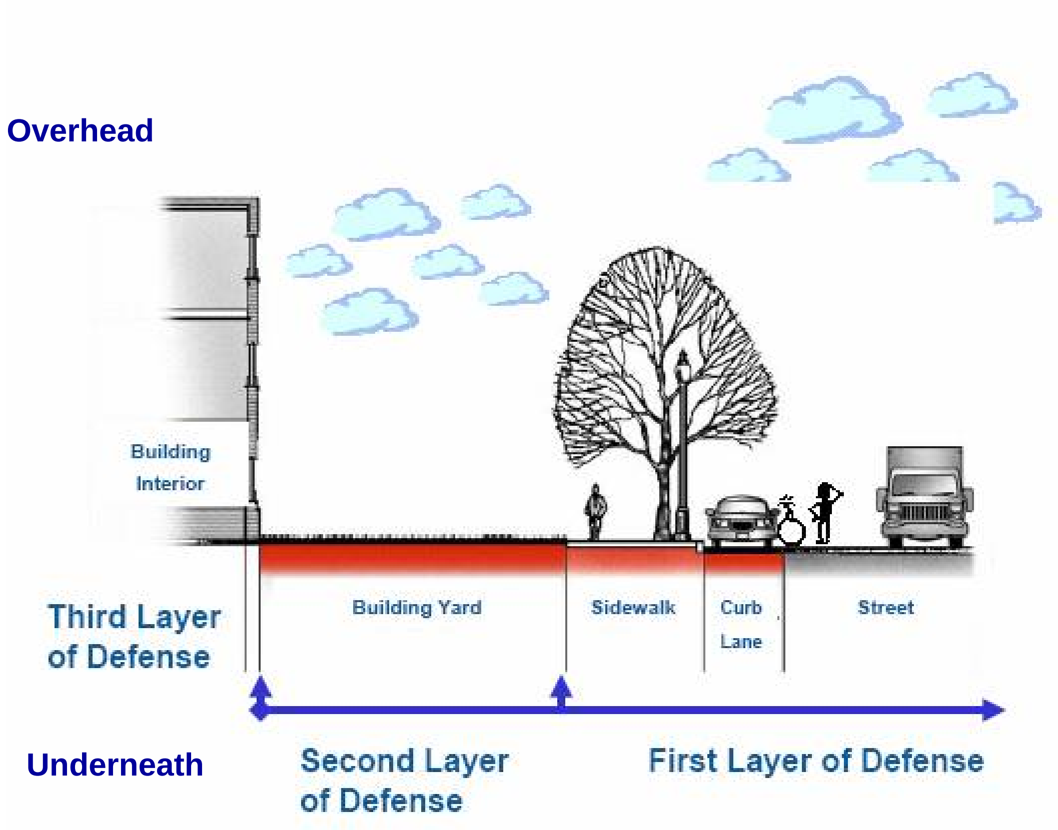
FEMA 430, Primer for Incorporating Building Security Components in Architectural Design

Layers of Defense



FEMA 452, Figure 2-2: Layers of Defense, p. 2-3

Layers of Defense



Building yards many not exist in urban areas

Layers of Defense

Layers of Defense	Survey Surroundings	Access Points	Sidewalks and Curbs	Street Furniture	Barriers and Bollards	Yards and Plazas	Gatehouses / Screening	Parking	Signage	Security Lighting	Sensors / CCTV	Site Utilities
First Layer												
Second Layer												
Third Layer												

First Layer of Defense

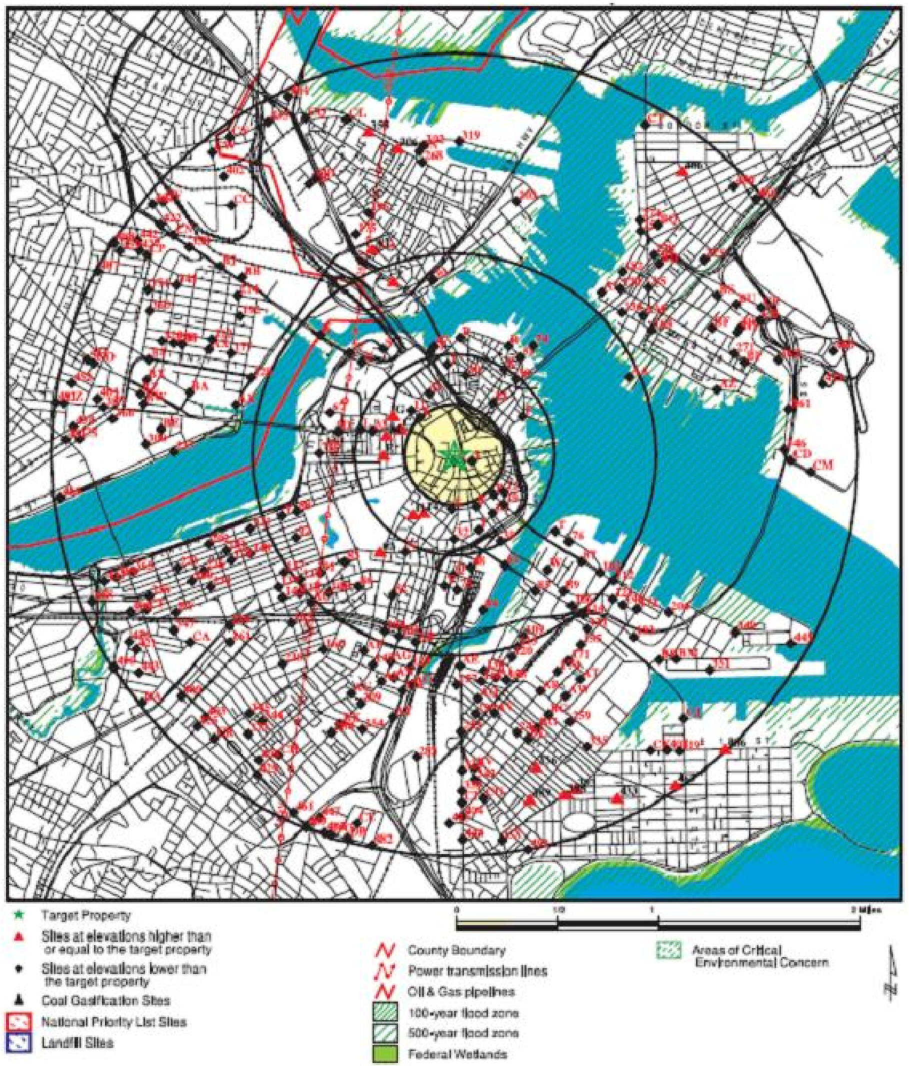
Survey Surroundings / Data Collection:

- **360 degrees - all directions**
- **Overhead – structures that can collapse and strike building of interest**
- **Underneath – subways, roadway tunnels, and utilities**

First Layer of Defense

Data Collection -- use GIS to help determine:

- Approaches to site/building
  - Personnel
  - Vehicles
- Potential collateral damage near facility
- Buildings and infrastructure of concern nearby
- Important geographic and topographic elements



FEMA

First Layer of Defense

Access Points

- Ring of steel
- Temporary stand-off
  - Road closure
  - Temporary barriers / parked vehicles
- Work with local authorities

FEMA

First Layer of Defense

Access Points

- Interruption of traffic pattern or street closure can impact a wide area

- Interruption or closure only justified when stand-off absolutely required

First Layer of Defense

Access Points

- Control angle of approach
  - Turns
  - Curves
- Slow down approaching vehicles

First Layer of Defense

Sidewalks and Curbs

- Most central business district buildings have exterior wall on the property line
- Stand-off distance is generally impossible to achieve; sidewalks provide less than 10 feet
- Low curbs do not keep vehicles away from buildings
- Hardening in lieu of stand-off can be very expensive, especially for existing buildings

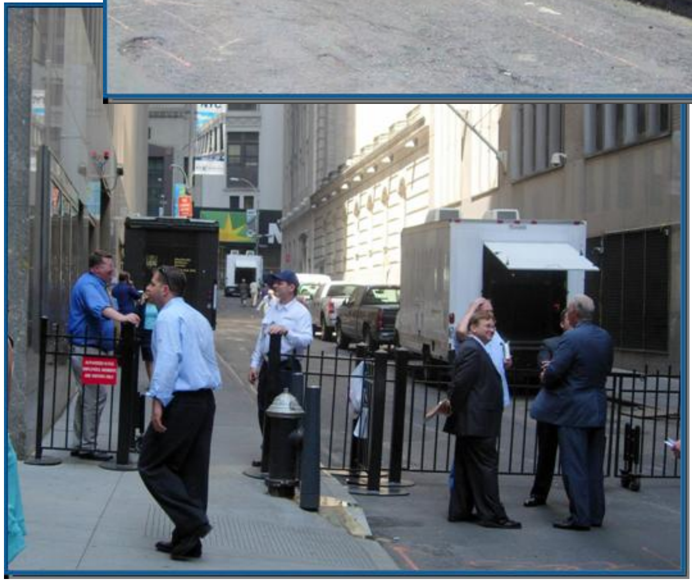
FEMA

First Layer of Defense

Sidewalks and Curbs

- Interruption of a sidewalk is only justified when stand-off is absolutely required

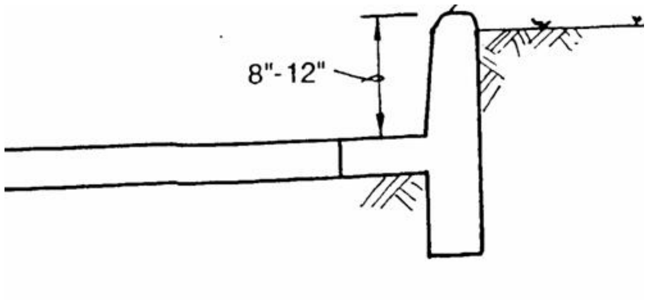
- Closure can be temporary or permanent



FEMA

First Layer of Defense

Sidewalks and Curbs



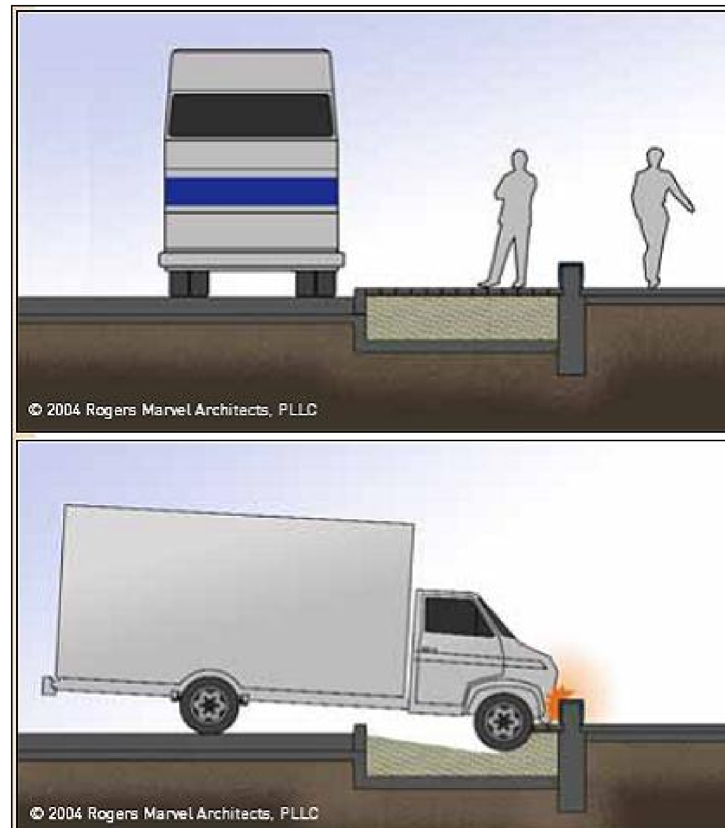
- High curbs can keep vehicles from departing roadway
- Do not remove curbside parking unless additional stand-off absolutely required

FEMA

First Layer of Defense

Sidewalks and Curbs

An alternate to visible barriers or bollards is collapsible sidewalks using low-strength concrete



A vehicle can be immobilized by the collapsible material of the Tiger Trap™ system.

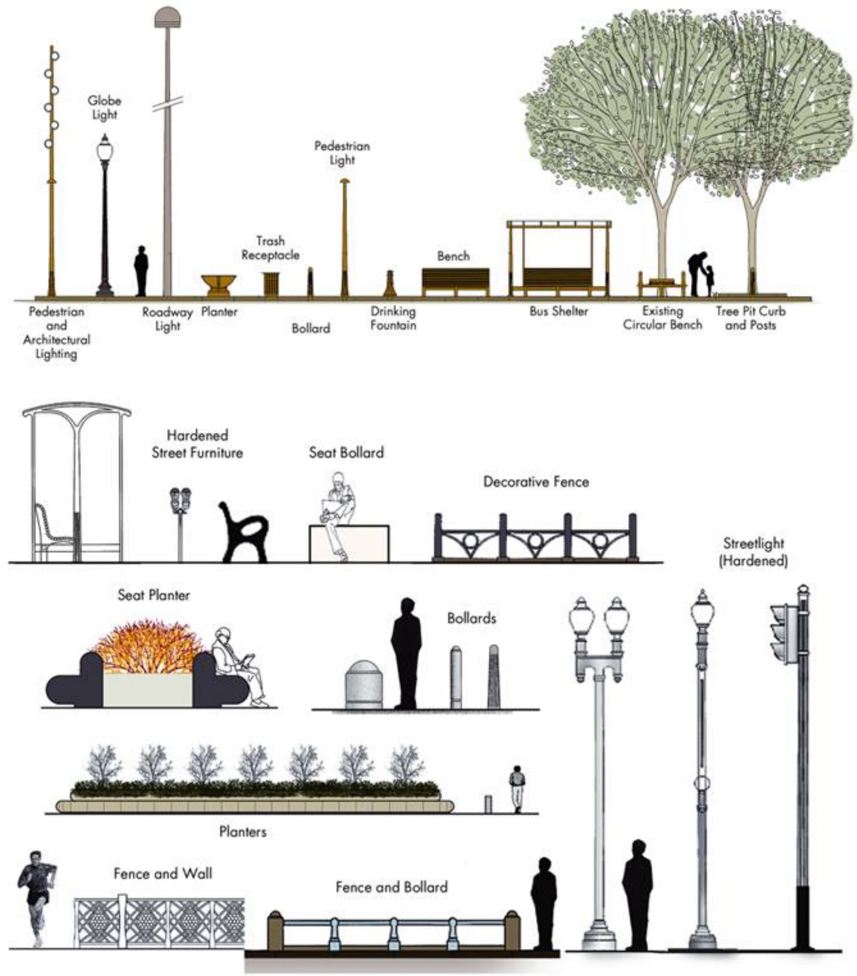
FEMA

First Layer of Defense

Street Furniture

Streetscape can be used to increase security. Hardened elements that become security elements

- Parking meters
- Streetlights
- Benches
- Planters
- Trash receptacles



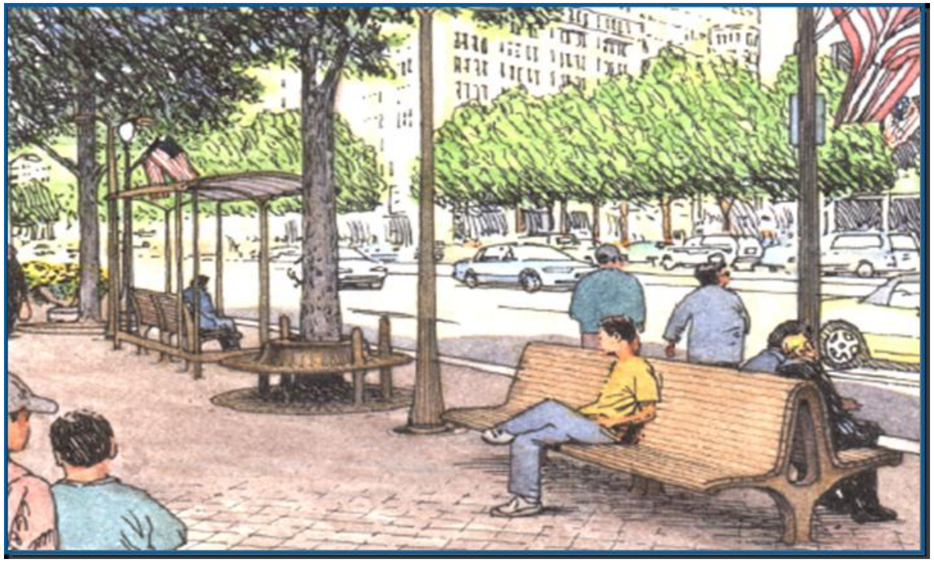
NCPC Streetscape Catalogue

First Layer of Defense

Street Furniture

Place streetscape security components at least <u>24 inches</u> from edge of curb

- Allow for opening car doors
- Allow for pedestrian movement from car to sidewalk



FEMA

First Layer of Defense

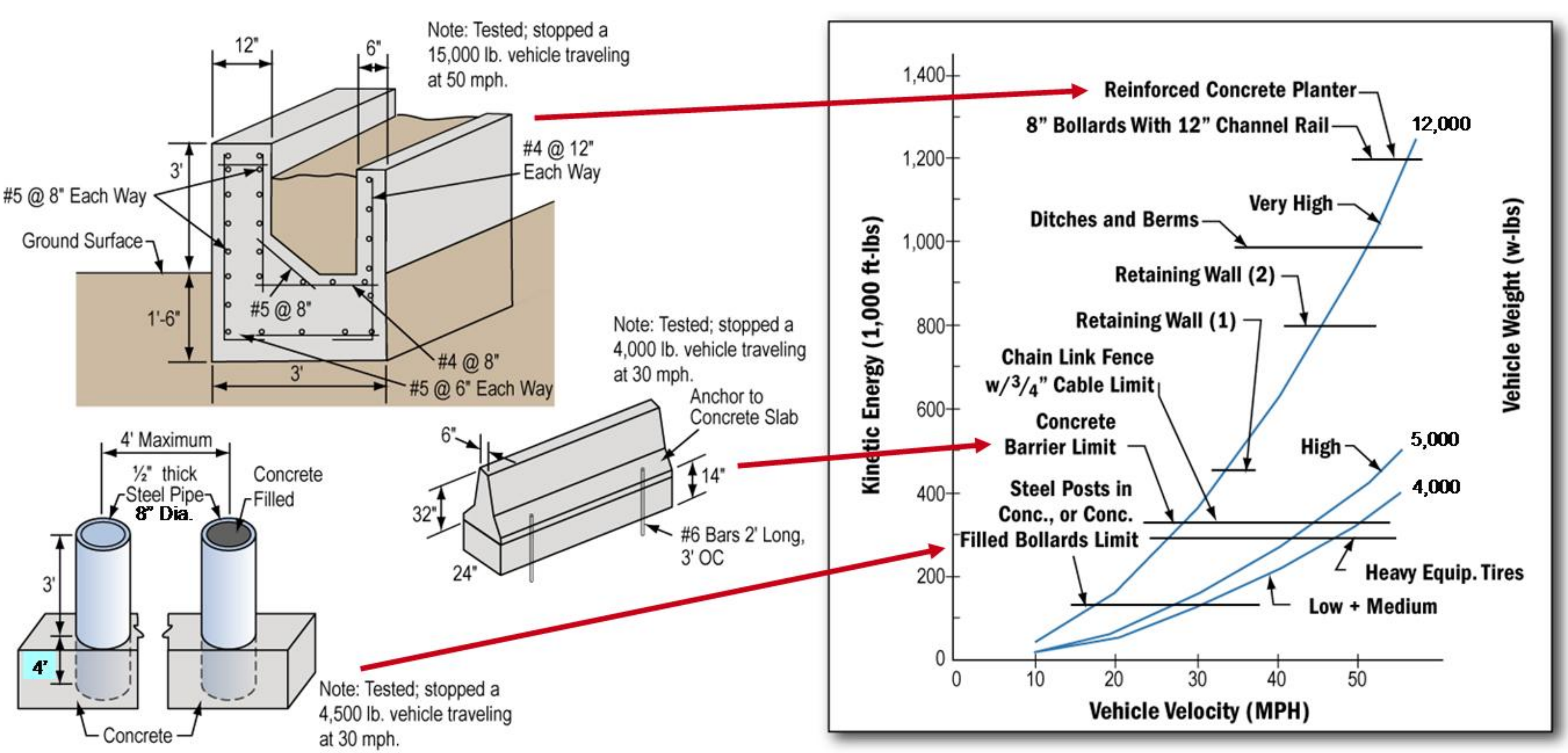
Street Furniture

- Treatment of security elements should be compatible with existing elements
- Perimeter barriers can go hand-in-hand with streetscape improvements and plantings
- Appropriate design can blend security into existing streetscape; serving as amenities for tenants and neighbors

FEMA

First Layer of Defense

Barriers and Bollards - Passive



From *US Army Field Manual 5-114, Engineer Operations Short of War, 1992*

First Layer of Defense

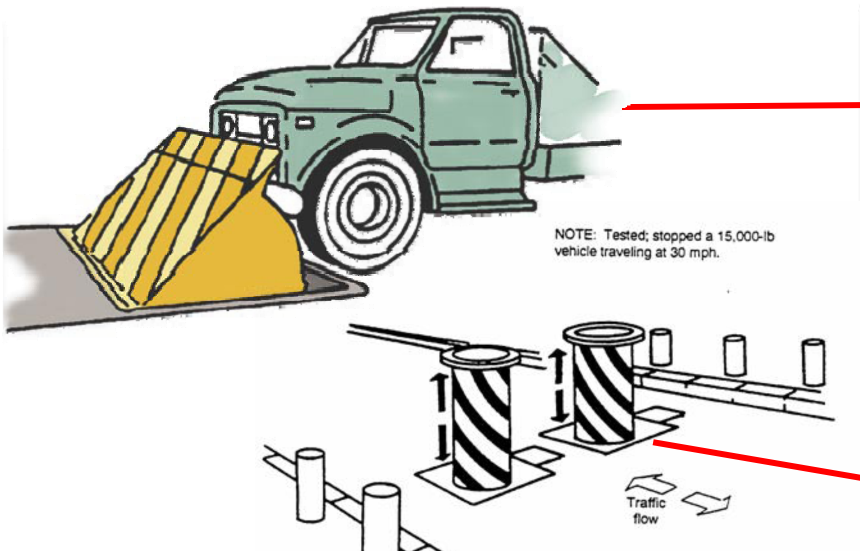
Barriers and Bollards - Passive

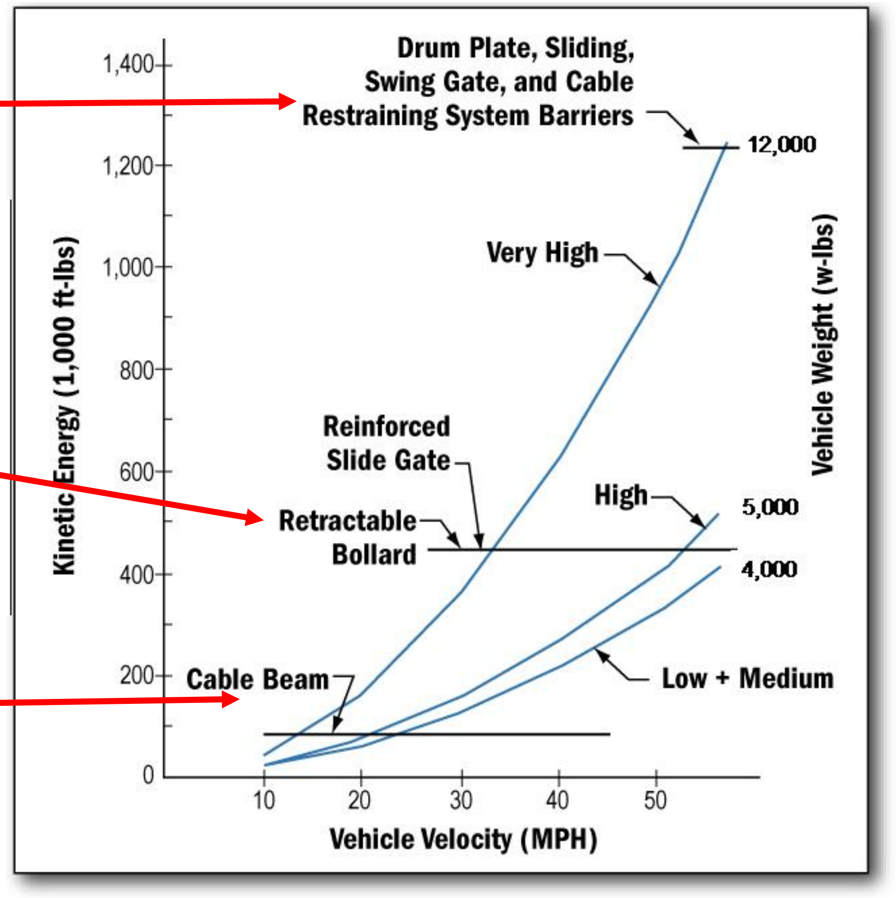
Source: Yodock Wall Company

FEMA

First Layer of Defense

Barriers and Bollards - Active





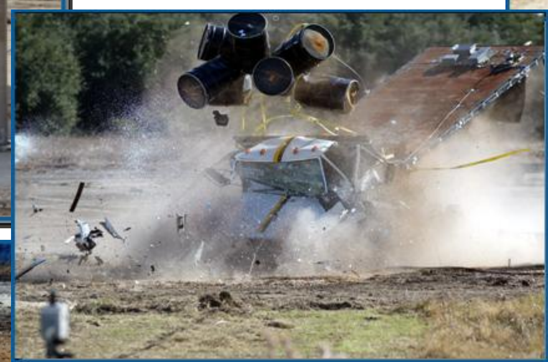
Source: Delta Scientific Corporation

FEMA

From *US Army Field Manual 5-114, Engineer Operations Short of War, 1992*

First Layer of Defense

Barriers and Bollards - Active



FEMA

First Layer of Defense

Rotating Drum, Drop Arm, and Rotating Plate Vehicle Barriers

FEMA

First Layer of Defense
Barriers and Bollards

Department of State periodically issues list of manufacturers and model numbers certified in meeting prescribed testing criteria (March 2003)

Rating	Vehicle Weight (lbs.)	Vehicle Speed (mph)	Distance Past Barrier (ft)
K4	15,000	30	<= 3.3
K8	15,000	40	<= 3.3
K12	15,000	50	<= 3.3

Check site utilities, water runoff, and other subterranean Conditions when installing bollards and barriers

FEMA

First Layer of Defense

Barriers and Bollards

Department of Defense periodically issues list of manufacturers and model numbers certified in meeting prescribed testing criteria (August 2003)

Vehicle Weight (lbs.)	Vehicle Speed (mph)	Distance Past Barrier (ft)
15,000	30	<=3(L3)/20(L2)/50(L1)
15,000	40	<=3(L3)/20(L2)/50(L1)
15,000	50	<=3(L3)/20(L2)/50(L1)
10,000	50	0 to 50
10,000	15	50 to 100

FEMA

First Layer of Defense

Barriers and Bollards

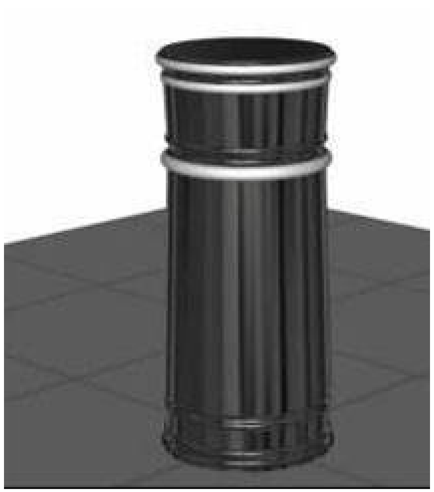
- Fixed bollards
- Retractable bollards
- Planters

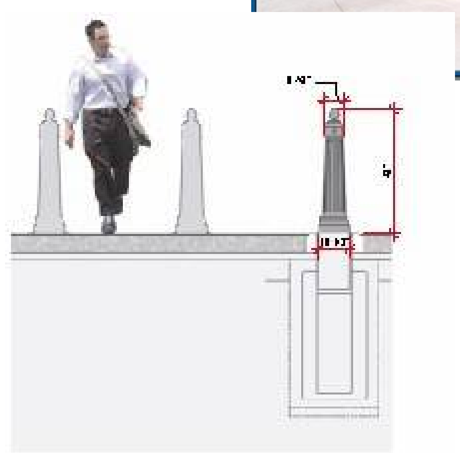
Fixed bollards

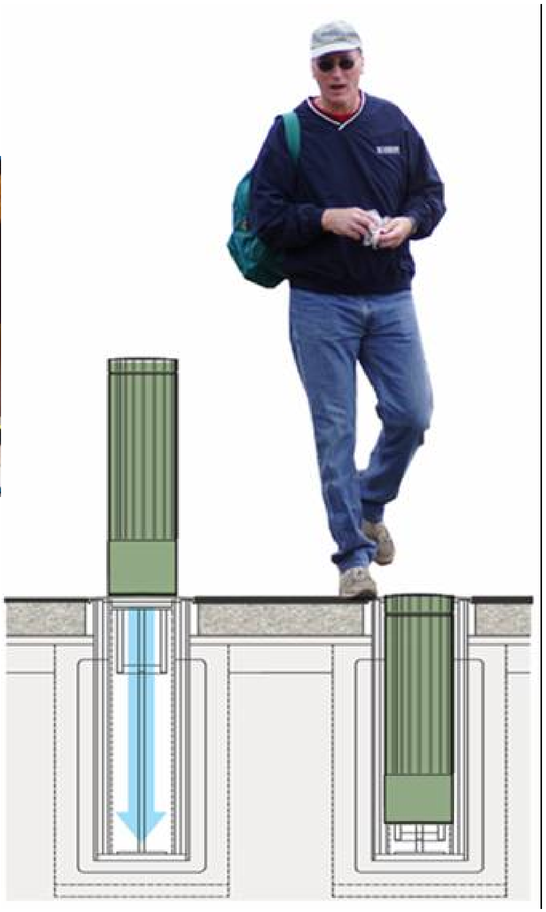
First Layer of Defense

Barriers and Bollards

Retractable







First/Second Layer of Defense

Barriers and Bollards

Planters

- If well designed, planters can be an element of beautification
- Ensure barriers are properly anchored to stop vehicles and configured to reduce fragmentation

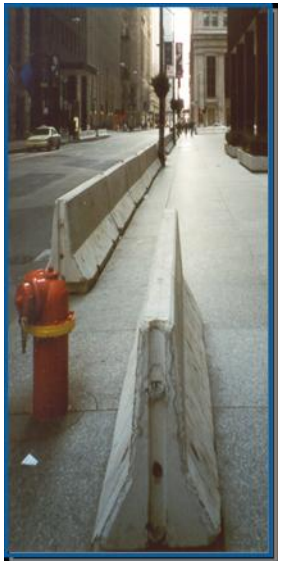
FEMA

First Layer of Defense

Barriers and Bollards

Avoid designing barriers that impair access by first responders:

- Intersection with driveways and gates
- Crossing of pedestrian paths and handicapped ramps
- Fire hydrants



First Layer of Defense

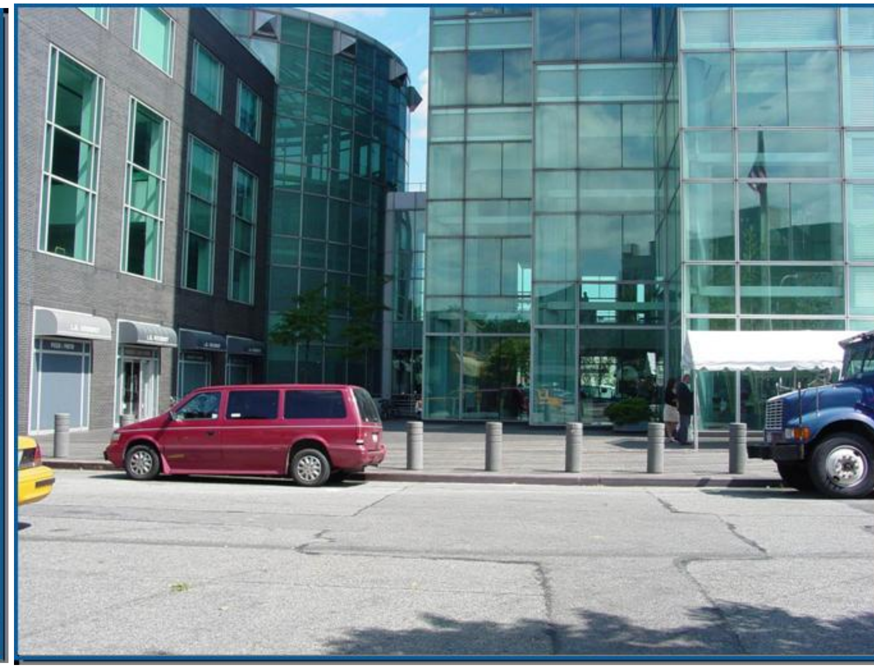
Barriers and Bollards

Ensure barriers are properly anchored to stop vehicles

FEMA

First Layer of Defense

Barriers and Bollards

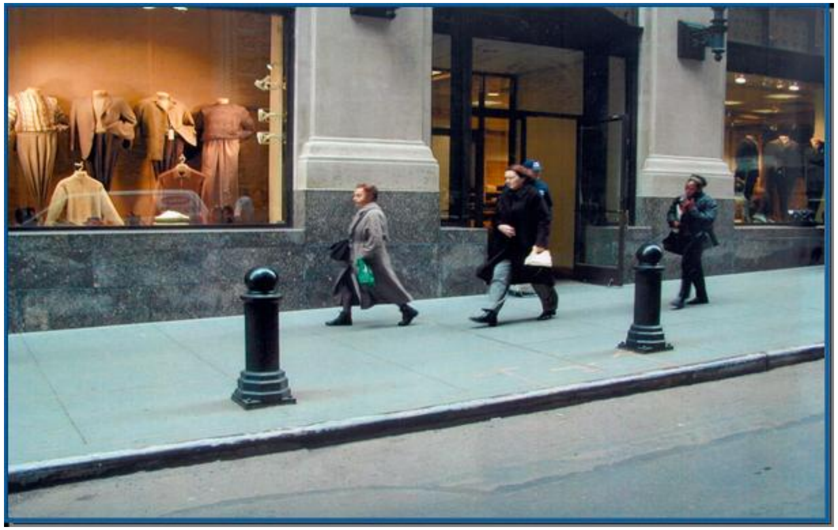



Properly anchored barriers stop vehicles and reduce fragmentation during blast

First Layer of Defense

Barriers and Bollards

Long expanses of bollards should be carefully designed and sited to avoid monotony



Bollard spacing should ensure no vehicles can get through

FEMA

Second Layer of Defense

- Buildings with front yards
- Buildings with plazas

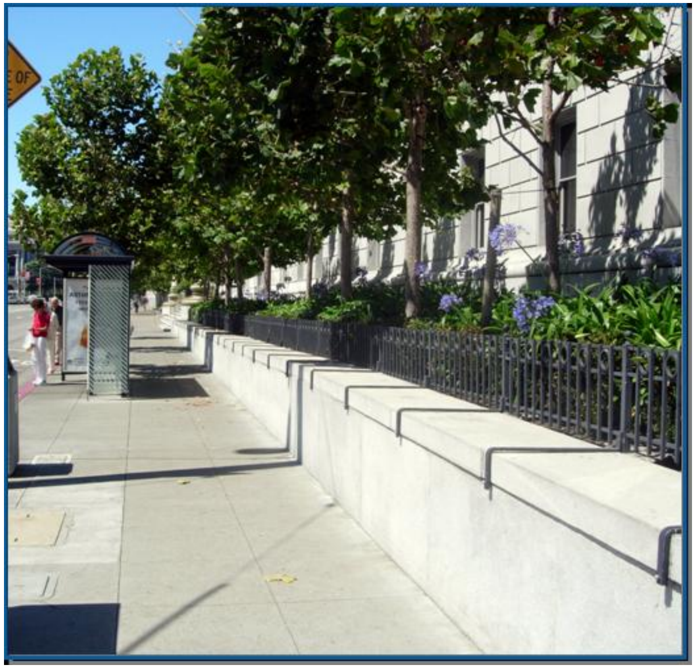
YARD

PLAZA

Second Layer of Defense

Building Yard

- Generally small
- Usually provided for governmental & institutional buildings



Narrow yard incorporating low stone wall and metal fence

Small yard with wide pavement that provide some useful stand-off

FEMA

Second Layer of Defense

Building Yard

Low planting makes a moderate barrier

High stepped yard on sloping site make a strong barrier

Second Layer of Defense

Building Yard

Monumental yards make excellent barriers and elements of beautification

Second Layer of Defense

Plaza

- An expanded building yard
- Moved out from the controlled building access
- A developer provided public space
- A well designed plaza can provide visual interest at same time providing good stand-off

Second Layer of Defense

Plaza

Plaza with sculptured barrier forms

Second Layer of Defense

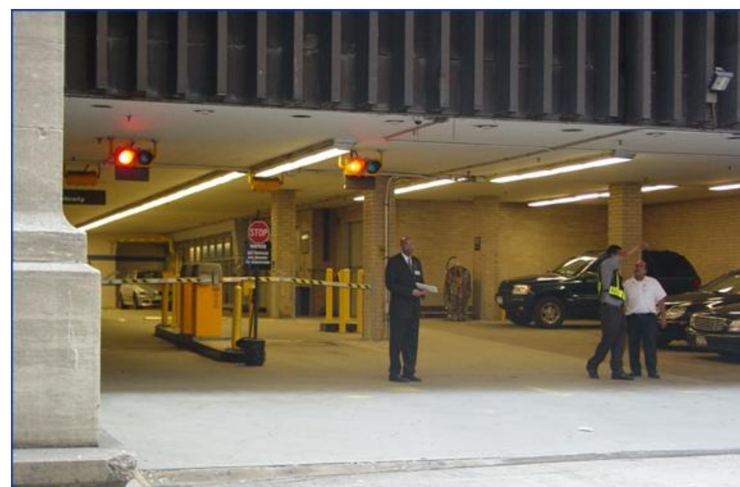
Gatehouses

- Access control with human intervention
  - Hardened as determined by threat
  - Protection from elements

FEMA

All Layers of Defense

Parking



- Parking can be applicable to all layers of defense

All Layers of Defense

Parking – Delivery / Loading Dock

- Develop plan for delivery and queuing
  - Coordinate with civic authorities as necessary
- Place barriers, guardhouse, if possible
- Avoid parking too close to building even after screening

FEMA

All Layers of Defense

Parking

- Restrict parking and access between buildings
- Consider one-way circulation in parking lots
- Well-lit, with security presence, emergency communications, and/or CCTV
- Open, observable, no hiding places
- Restrict parking underneath buildings
- Apply progressive collapse hardening to columns when parking garage is in building

All Layers of Defense

Signage

- Unless required, do not identify sensitive areas
- Minimize signs identifying critical utilities
- Warnings signs limiting access to control areas should be posted at all entrances
- Signpost may be hardened and included as part of the perimeter barrier
- The lighting of signage should enhance nighttime safety
- Warning signs should be posted in languages commonly spoken

FEMA

Second Layer of Defense

Security Lighting

Continuous lighting

- Glare projection
- Controlled lighting (avoid glare)
- Compatible with closed circuit television (CCTV)

Emergency lighting

First Layer of Defense

Sensors / CCTV

- When stand-off and hardening are not possible, security must rely upon sensors and CCTV
- Look for suspicious vehicles and people, especially those that seem to be profiling your building
- Monitor access to utilities serving the building
- Currently high tech monitoring systems need to be selected and placed by experts

FEMA

Second Layer of Defense

Site Utilities

- Concealed versus exposed
- Underground versus overhead
- Protect/secure versus accessible
- Surveillance if possible

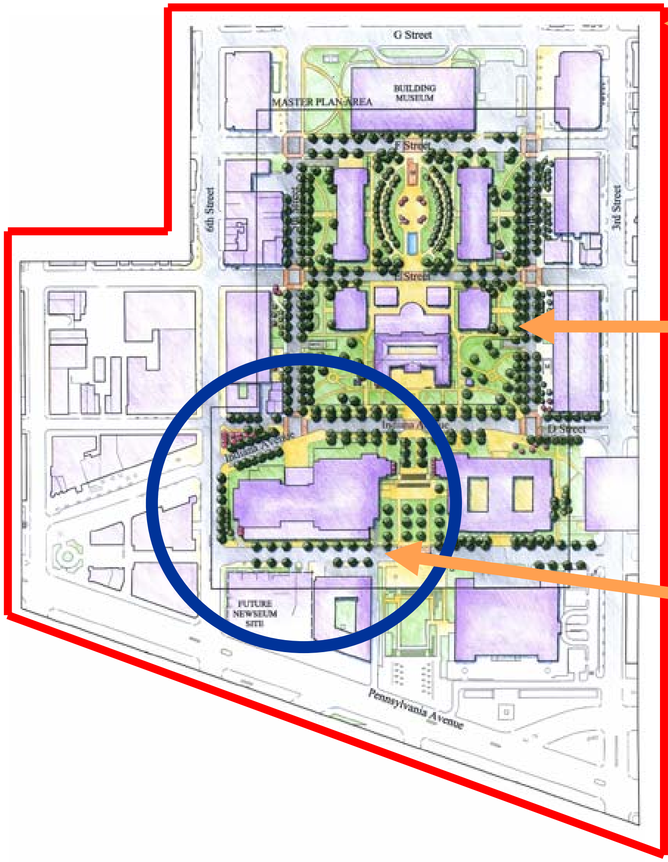
FEMA

Campus/University

The following considerations can impact the site and layout design:

- Overall size and number of structures placed on site
- Massing and placement of structures
- Access/egress points, such as visitor entries, staff entries, and loading docks

Campus/University



First Layer of Defense (Uncontrolled)
- Personnel Access Control
- Vehicle Access Control & Inspection
- Vehicle Stand-off

Second Layer of Defense (Controlled)
- Personnel Access Control
- Vehicle Access Control
- Vehicle Stand-off

High Security Building

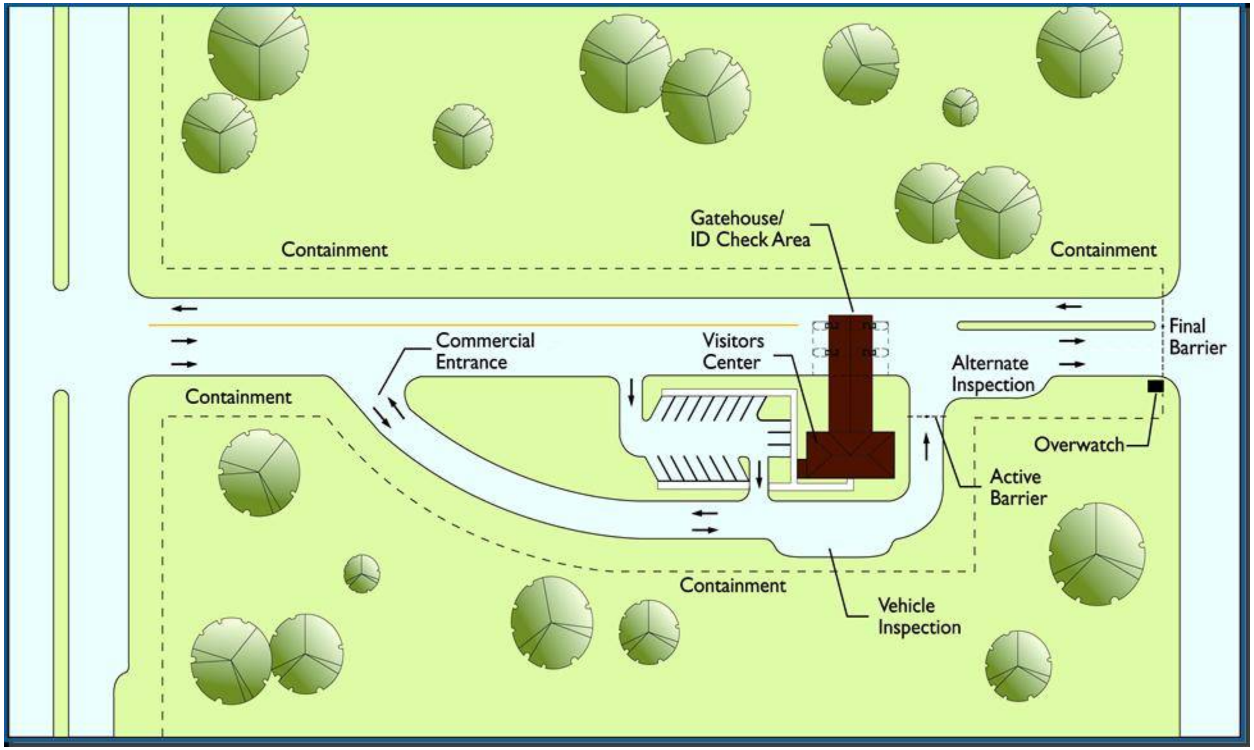
Third, Second, and First Layers of Defense (Controlled)
- Personnel Access Control
- Vehicle Access Control
- Hardening

FEMA

Campus/University

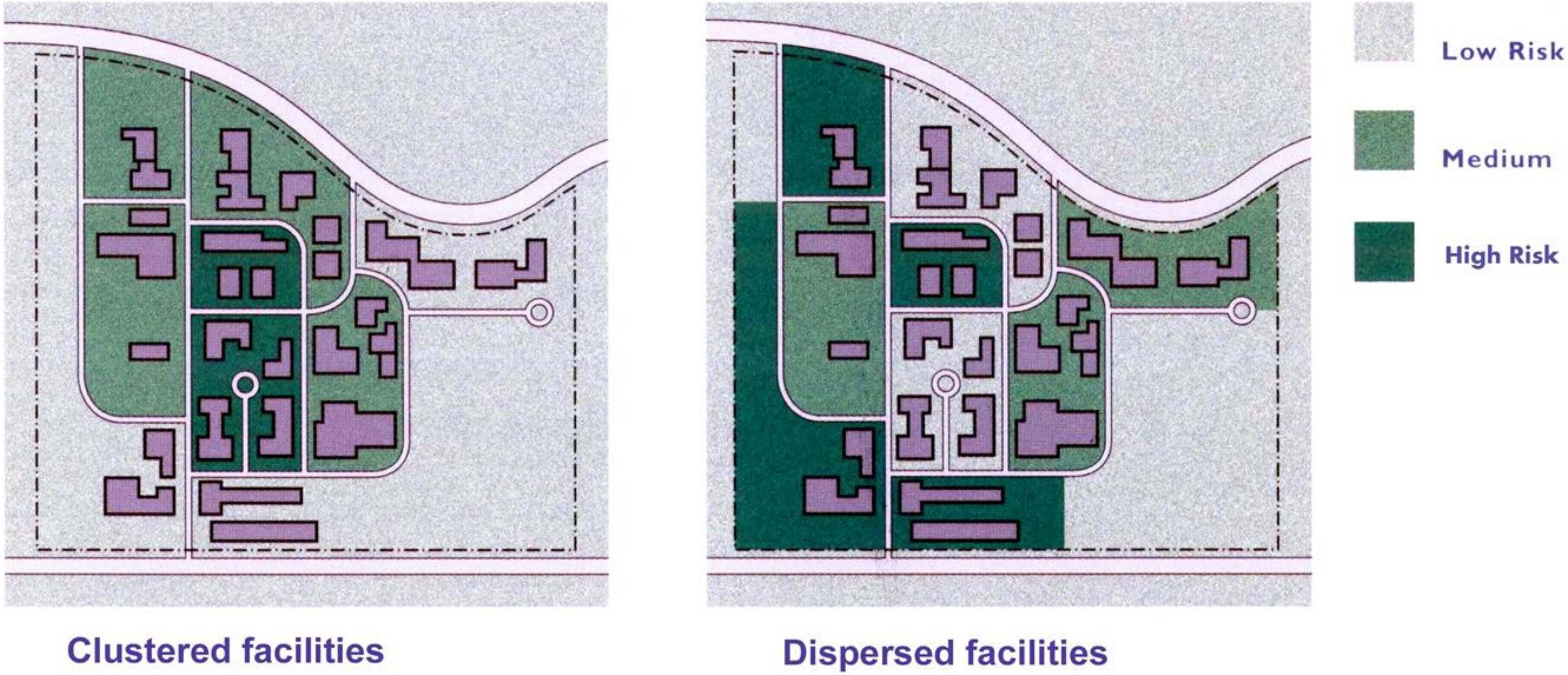
Access Points

- Reject vehicles before final barrier
- Inspection area blast effects
  - Pressure
  - Fragments
- Reaction time to activate barriers



FEMA 426, Figure 2-15: Combined Multi-User Gate, p. 2-37

Campus/University

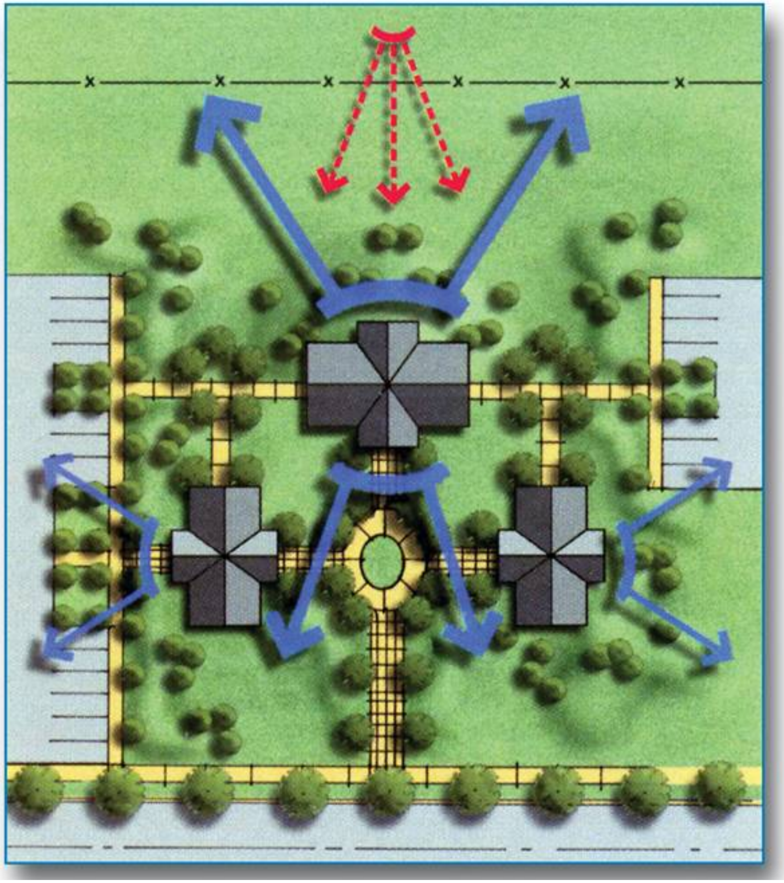


FEMA 426, Figure 2-2: Clustered versus Dispersed Site Layouts, p. 2-8

Campus/University

Orientation

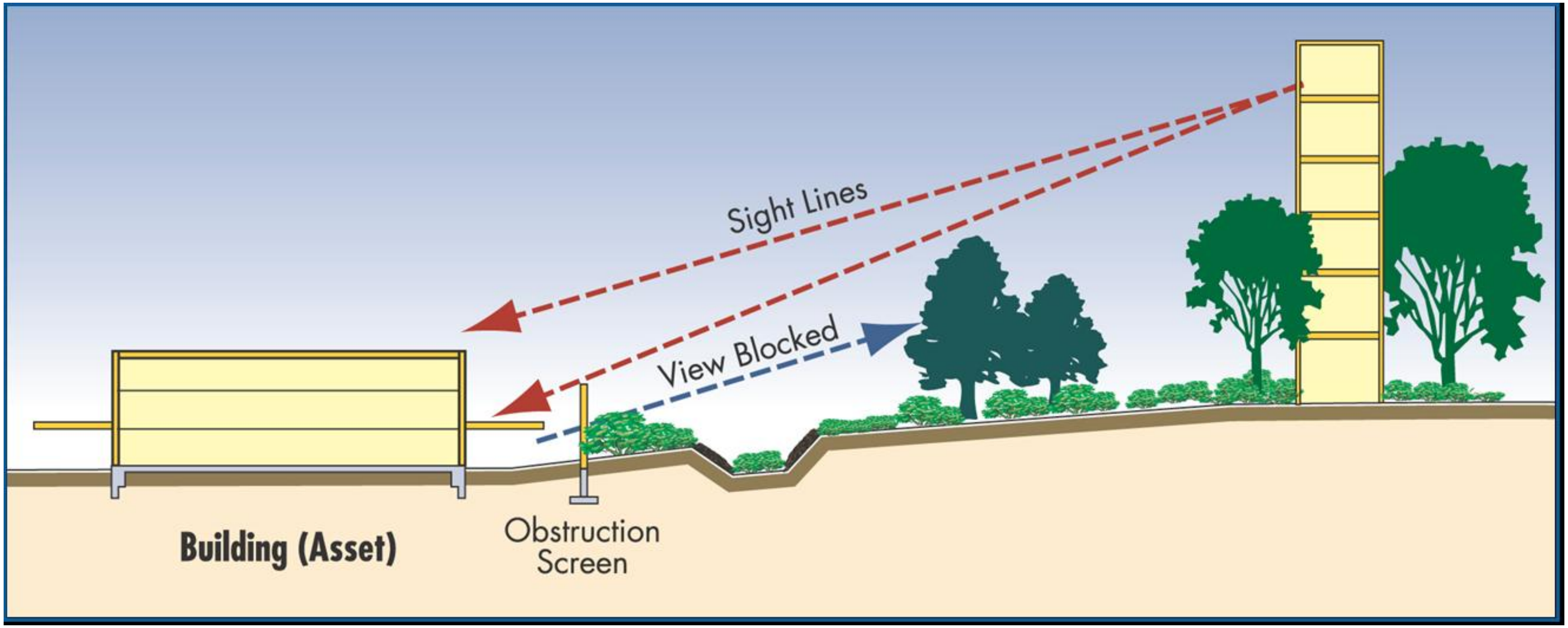
- Significant impact on making building visible or hidden to aggressors
- Enhance surveillance opportunities of approaches and parking
- Minimize views into building
- Reduce blast effects



FEMA 426, Figure 2-3: Clustering to Enhance Surveillance Opportunities While Minimizing Views into Buildings, p. 2-8

Campus/University

Siting and View Relationships



Blocking Sight Lines

FEMA 426, Figure 2-5: Blocking of Site Lines, p. 2-20

Campus/University

Parking

- Restrict parking from the interior of a group of buildings and away from restricted area
- Locate parking within view of occupied buildings
- If possible, design the parking lot with one-way circulation

Best Practices

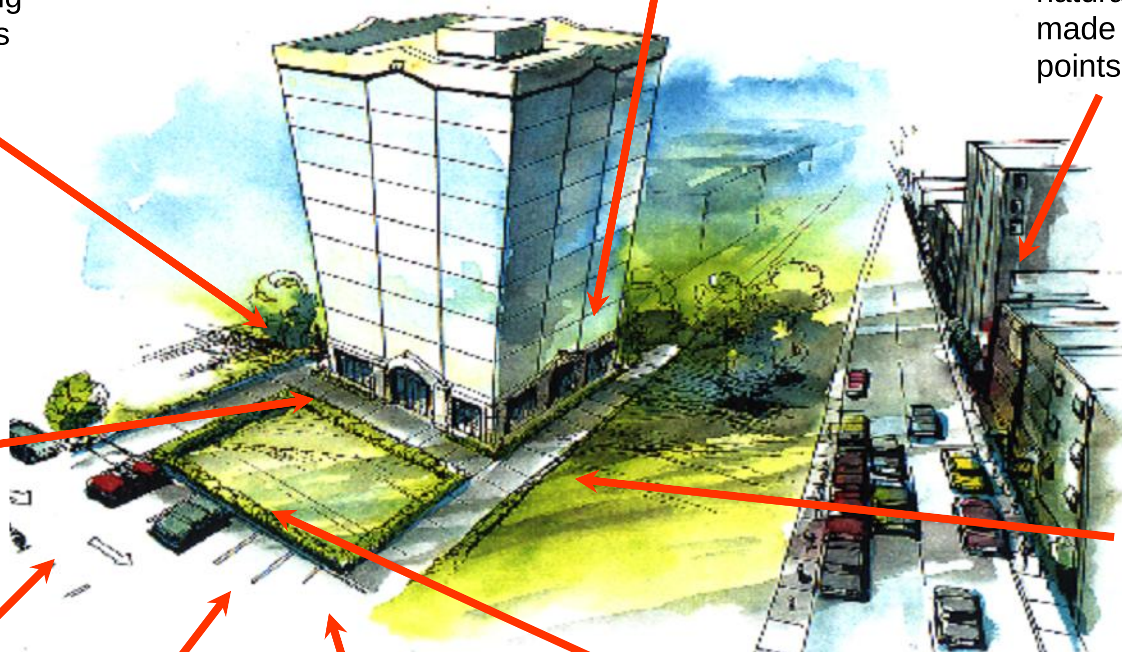
Eliminate potential hiding places near facility, provide an unobstructed view around facility

Locate facility away from natural or man-made vantage points

Eliminate parking beneath facilities

Locate trash bins as far from facility as possible

Minimize exterior signage or other indications of asset locations



Secure access to power/heat plants, gas mains, water supplies, and electrical service

Locate parking to obtain stand-off from facility

Illuminate building exteriors or sites where exposed assets are located

Minimize vehicle access points

Eliminate lines of approach perpendicular to the building

Figure 2-16, Summary of Site Mitigation Measures, p. 2-53

Unit IX Case Study Activity

Site and Layout Design Guidance

Background

FEMA 426, Building Vulnerability Assessment Checklist: screening tool for preliminary design vulnerability assessment

Requirements: Vulnerability Rating Approach

Assign sections of the checklist to qualified group members

Refer to Case Study and answer worksheet questions

Review results to identify site and layout vulnerabilities and possible mitigation measures

Unit X
Building Design Guidance

U.S. DEPARTMENT OF HOMELAND SECURITY FEMA

Unit Objectives

Explain architectural considerations to mitigate impacts from blast effects and transmission of chemical, biological, and radiological agents from exterior and interior incidents.

Identify key elements of building structural and non-structural systems for mitigation of blast effects.

References

FEMA Building Vulnerability Assessment Checklist, Chapter 1, page 1-46, FEMA 426

Building Design Guidance, Chapter 3, FEMA 426

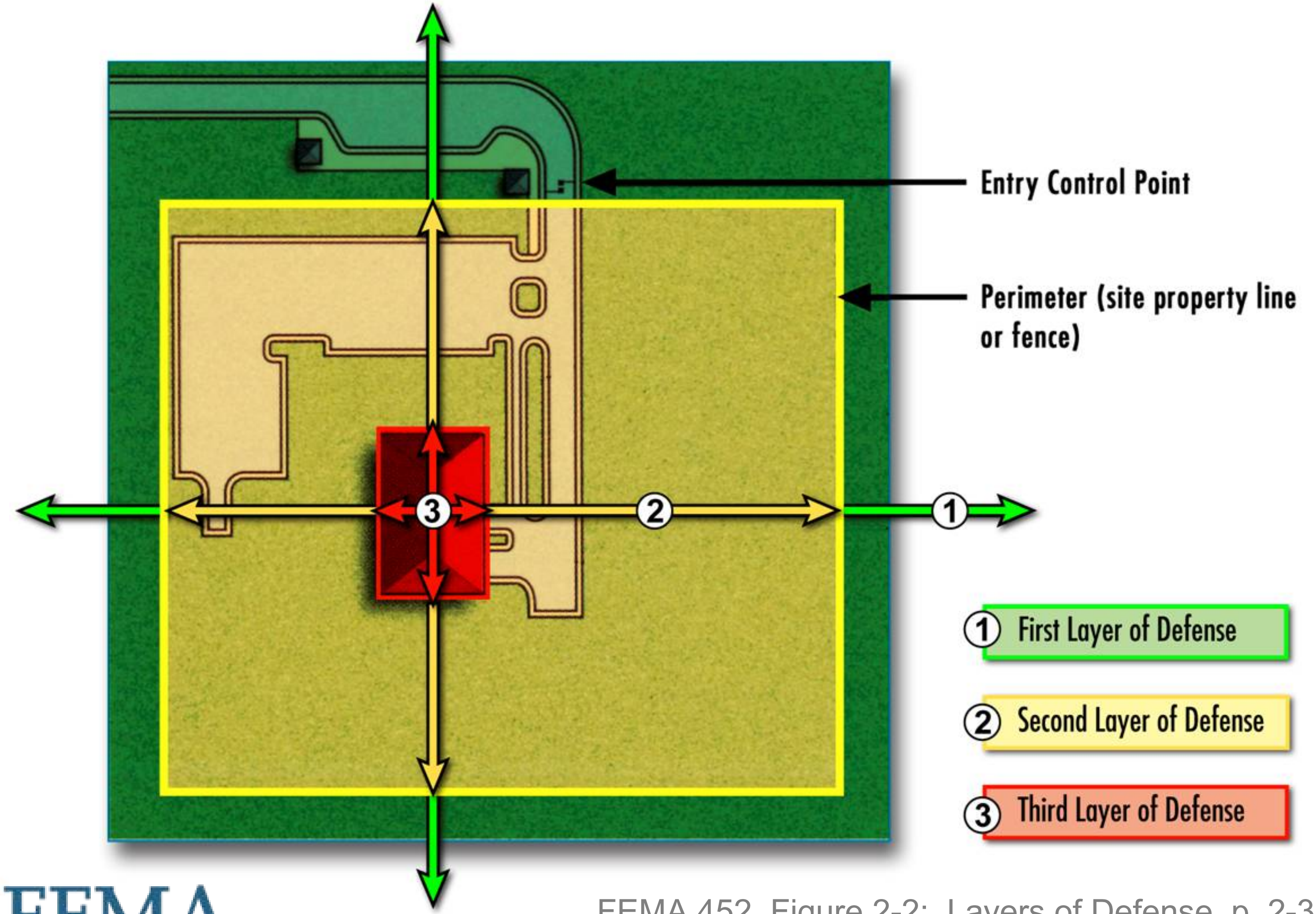
FEMA 430, Primer for Incorporating Building Security Components in Architectural Design

Unit Objectives (cont.)

Compare and contrast the benefit of building envelope, mechanical system, electrical system, fire protection system, and communication system mitigation measures, including synergies and conflicts.

Apply these concepts to an existing building or building conceptual design and identify mitigation measures needed to reduce vulnerabilities.

Layers of Defense

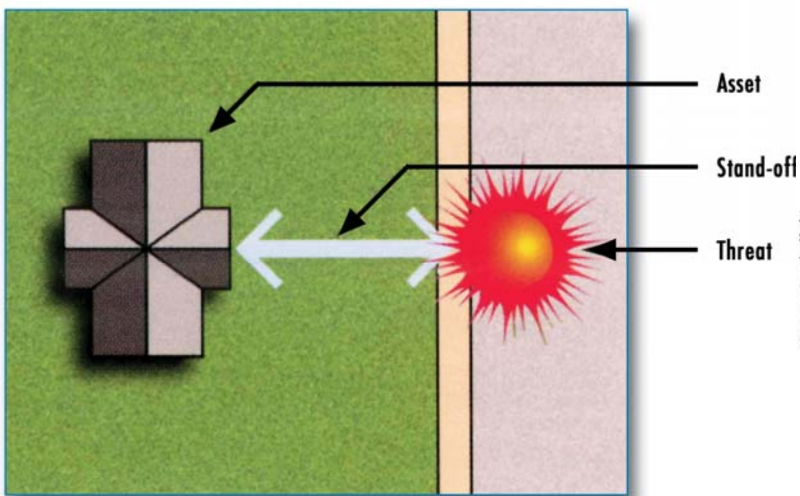


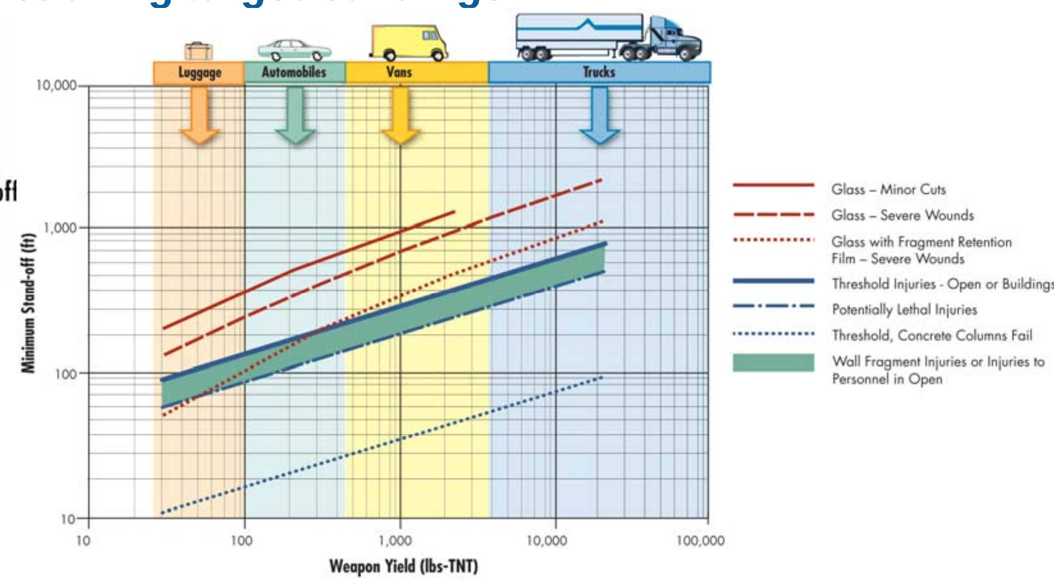
FEMA 452, Figure 2-2: Layers of Defense, p. 2-3

Third Layer of Defense

Stand-off Distance – primary impact on design and construction of building envelope and structure against design basis threat (explosives)

To protect against unauthorized vehicles approaching target buildings



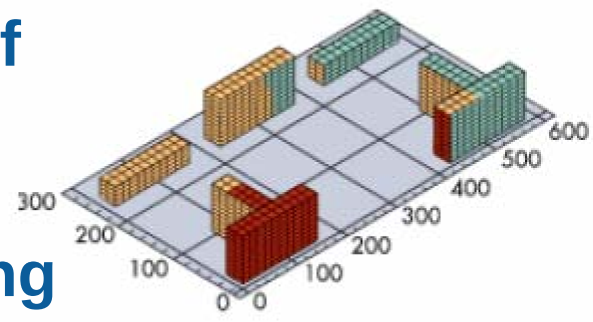


FEMA

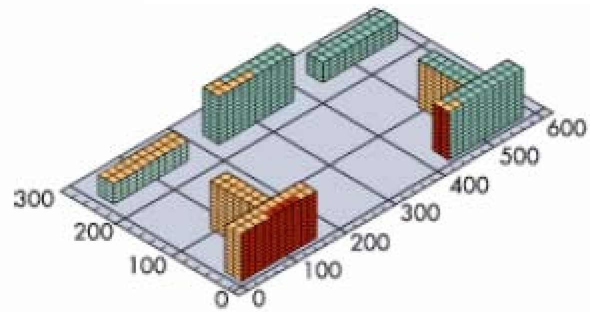
FEMA 426, Figure 2-8: Concept of stand-off distance, p. 2-22 (left)
FEMA 426, Figure 4-5: Explosive blast range to effects, p. 4-11 (right)

Third Layer of Defense

Stand-off versus Given Hardening

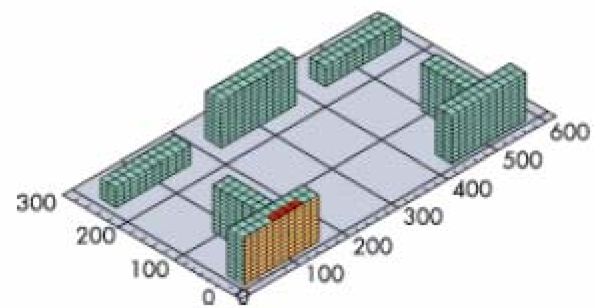


Detonation at 80 feet



Detonation at 171 feet

- Red – Very severe damage, possible collapse
- Yellow – Very unrepairable structural damage
- Green – Moderate repairable structural damage



Detonation at 400 feet

FEMA 426, Figure 4-9: Stand-off distance versus blast impact – Khobar Towers, p. 4-15

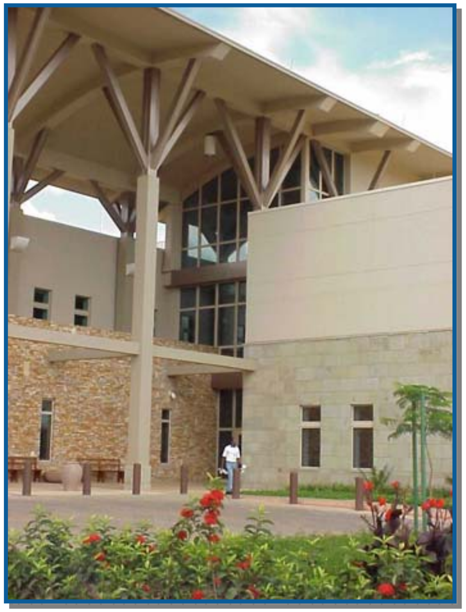
FEMA

Third Layer of Defense

Hardening

Less stand-off requires

- More mass
- More steel
- Thicker and stronger glass
- Better door and window frame connection to building/wall



FEMA

Third Layer of Defense

Layers of Defense	Architecture	Structural Systems	Building Envelope	Utility Systems	Mechanical & Electrical Sys	Plumbing & Gas Systems	Fire Alarm Systems	Comm - Info Technology Sys	Equipment Ops & Maint	Security Systems
First Layer										
Second Layer										
Third Layer										

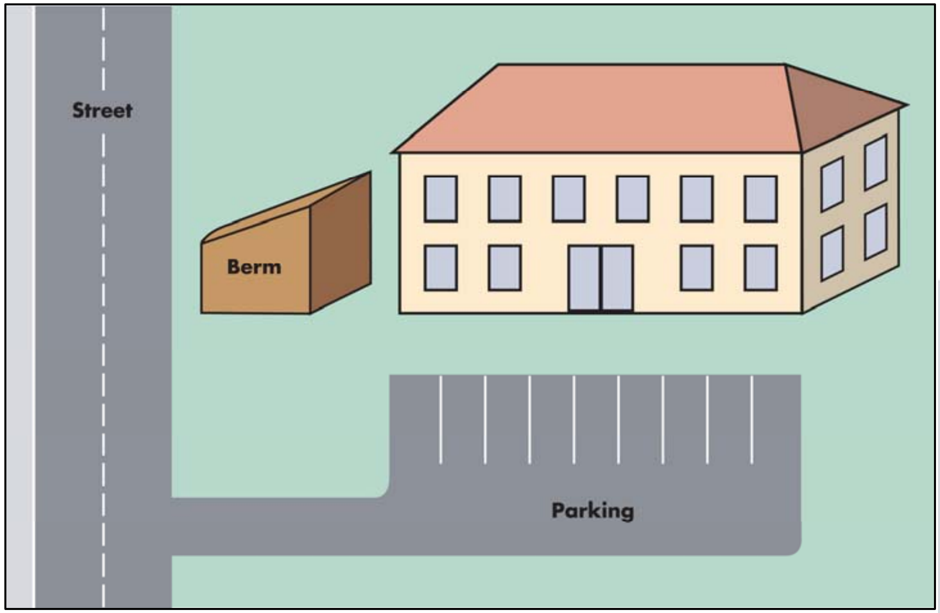
FEMA

Third Layer of Defense

When hardening a building, the following should be considered:

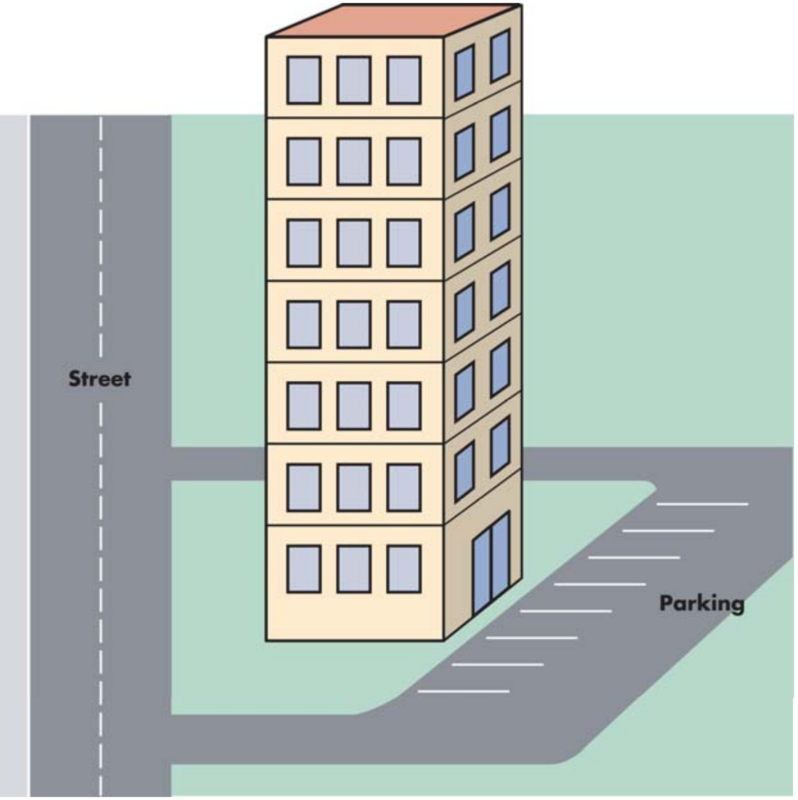
- Progressive collapse
- Appropriate security systems
- Hardening the building envelope
- Appropriate HVAC systems to mitigate CBR
- Hardening the remaining structure
- Hardening and location of utilities

Architecture – Building Configuration



Low, Large Footprint

Tall, Small Footprint

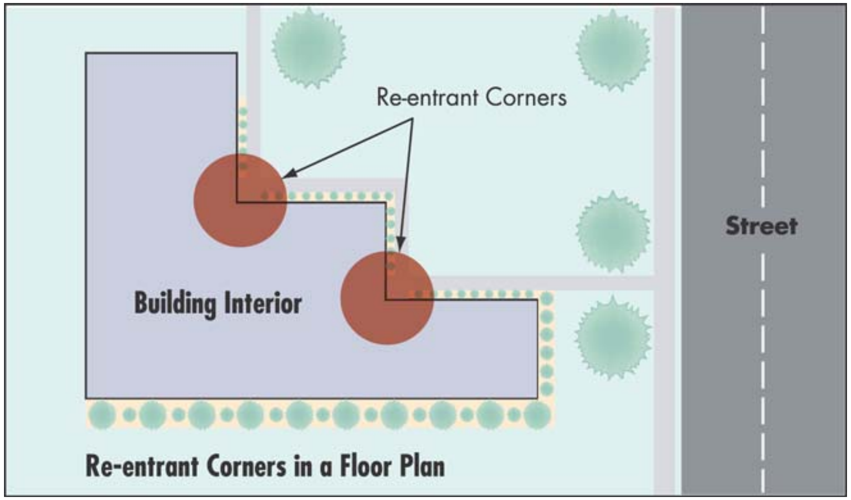


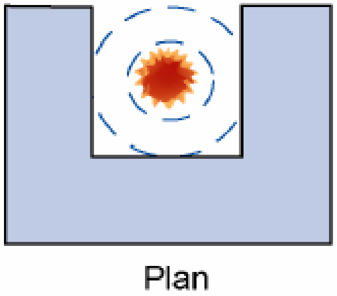
Architecture – Building Configuration

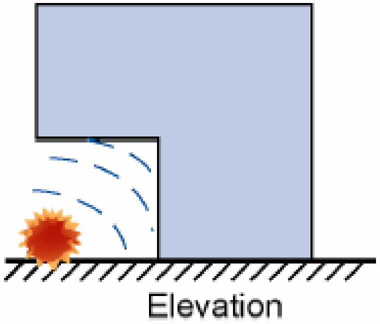
Rectangular versus
"U", "L" or "E"

Avoid re-entrant corners

Flush face versus eaves
and overhangs







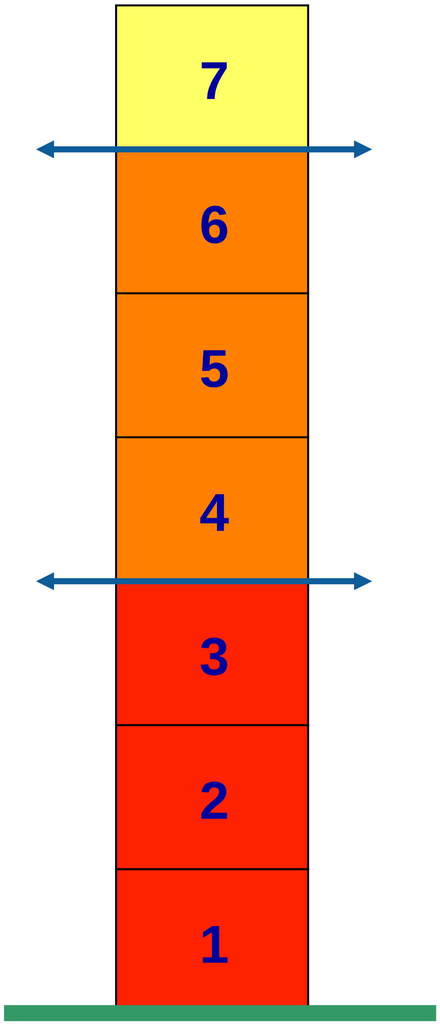
Shapes That Accentuate Blast

FEMA 426, Figure 3-2: Re-entrant corners in a floor plan, p. 3-6
FEMA 427, Figure 6-3: Effects of building shape vs. air blast, p. 6-9

Architecture – Building Configuration

Hardening – Story height vs Stand-off

- Hardening of first three floors is critical as these take brunt of blast
- At third through sixth floor, hardening can be reduced due to reflection angle
- Above the sixth floor, conventional construction may be sufficient depending upon design threat and reflections off adjacent buildings



FEMA

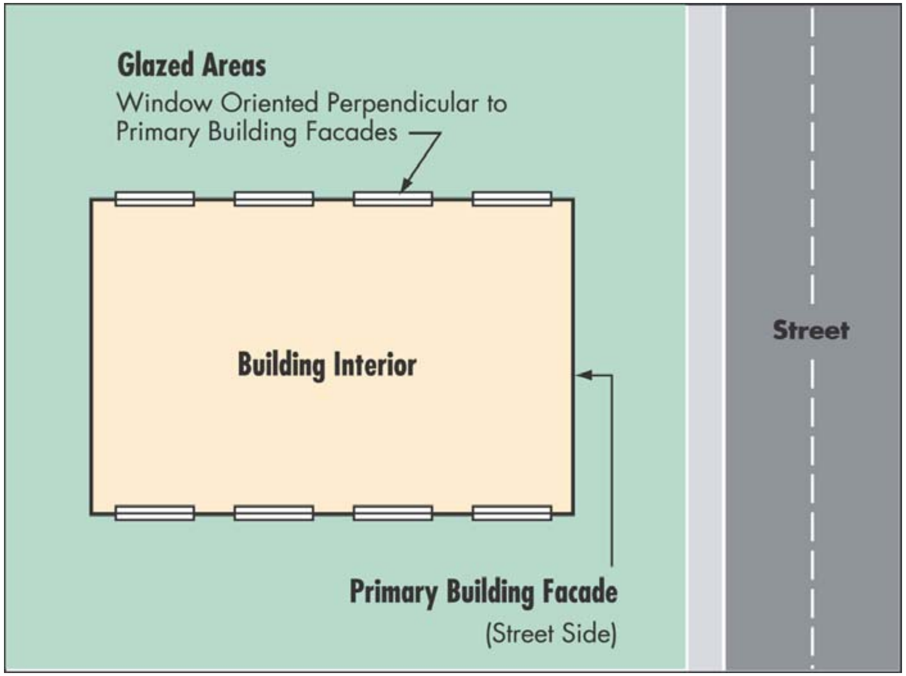
Architecture – Building Configuration

Ground floor elevation 4 feet above grade

Orient glazing perpendicular to principal threat direction

Avoid exposed structural elements

Pitched roofs and pitched window sills



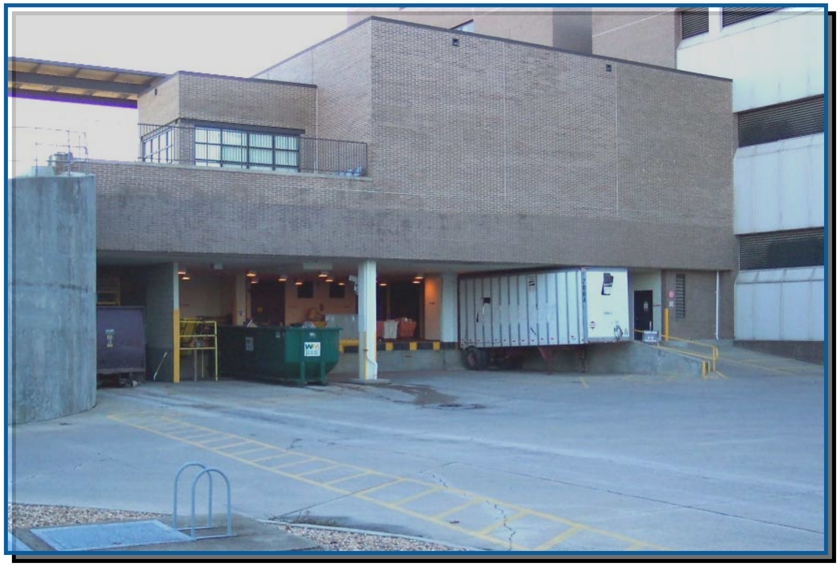
FEMA 426, Figure 3-1: Glazed areas perpendicularly oriented away from streets, p. 3-5

FEMA

Architecture – Building Configuration

Loading Docks

- Avoid trucks parking in or underneath buildings
- Design to prevent progressive collapse
- Ensure separation from critical systems, functions, and utility service entrances
- Separate loading docks from building critical functions



- Provide sufficient area for screening vehicles and packages
- Keep dumpsters away from buildings

FEMA

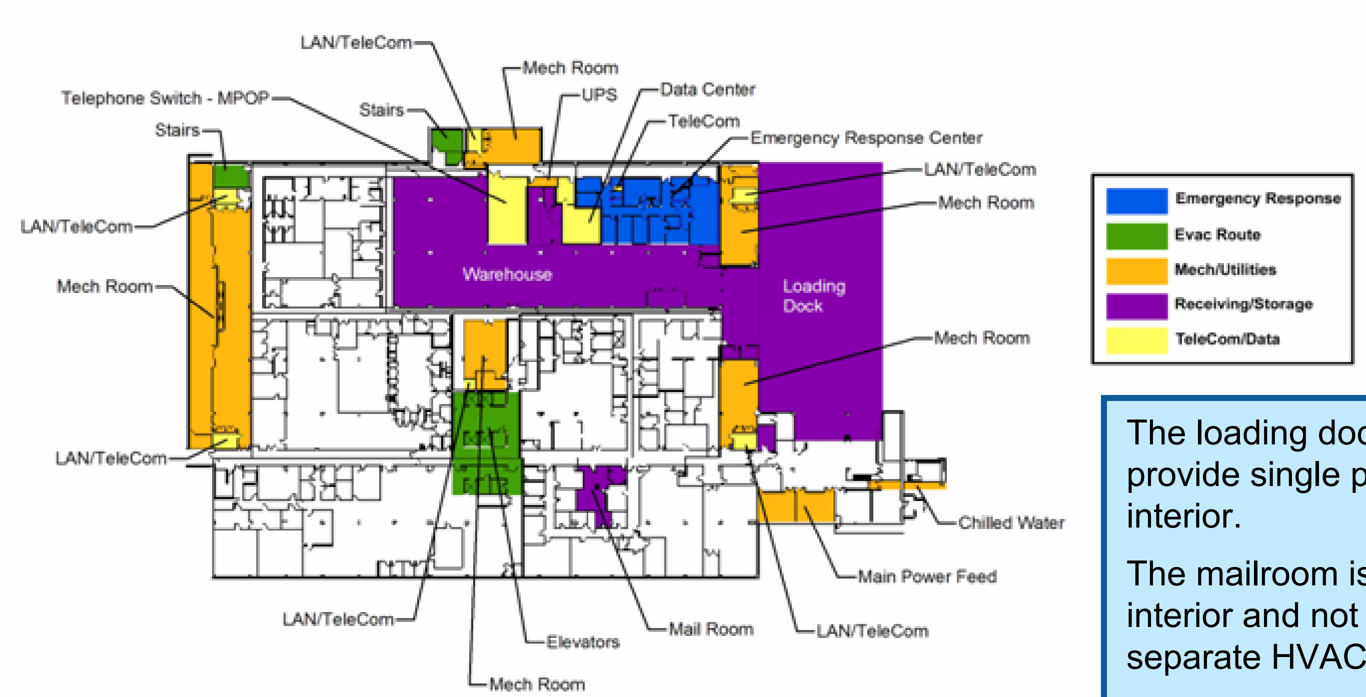
Architecture – Building Configuration

Parking Considerations

- Garage elevators service garage only to unsecured zone of lobby

- Restrict parking underneath buildings
- Well-lit, security presence, emergency communications, and/or CCTV
- Apply progressive collapse hardening to columns when parking garage is in building

Architecture – Space Design



The loading dock and warehouse provide single point of entry to the interior.

The mailroom is located within the interior and not on exterior wall or separate HVAC system.

The telecom switch and computer data center are adjacent to the warehouse.

The trash dumpster and emergency generator are located adjacent to the loading dock.

FEMA 426, Figure 1-10: Non-redundant critical functions collocated near loading dock, p. 1-41

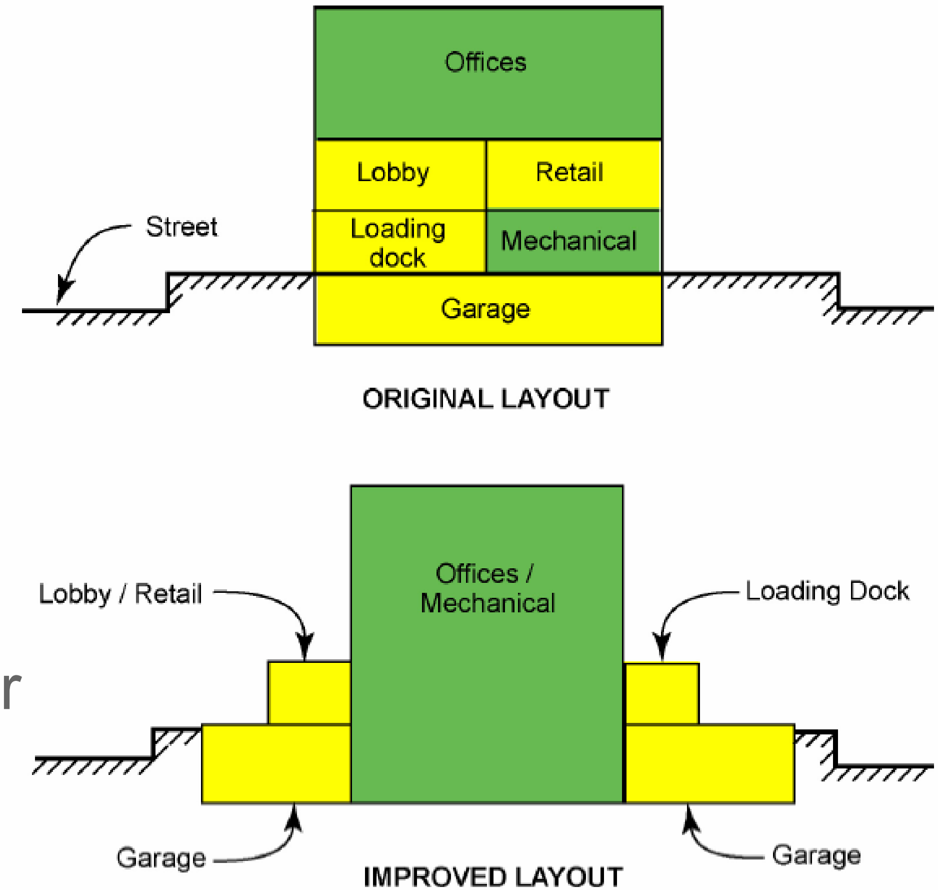
Architecture – Space Design

Place unsecured or high risk areas outside building footprint

Do not mix high risk and low risk tenants in same building

Locate critical assets into interior of building

Separate areas of high visitor activity (unsecured) from critical assets



FEMA 427, Figure 6-4: Improving layout of adjacent unsecured and secured areas, p. 6-10

Architecture – Space Design

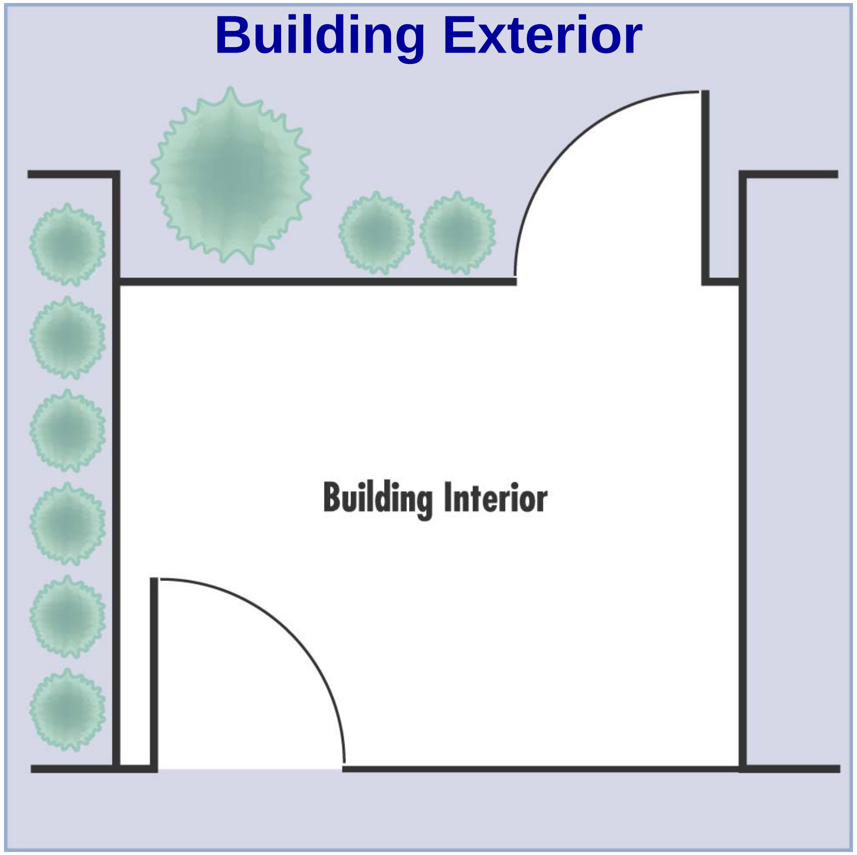
Eliminate hiding places

Interior barriers

Offset doorways

Minimize glazing, particularly interior glazing near high-risk areas

Lobby with security procedures configured to contain incidents (blast, CBR, armed attack)



FEMA 426, Figure 3-3: Offset doors through foyer, p. 3-7

Architecture – Other Location Concerns

- Safe havens / shelters
- Office locations
- Public toilets and service areas
- Retail spaces
- Stairwells
- Mailroom

Structural Systems

Progressive Collapse Design

GSA Progressive Collapse Analysis and Design Guidance for New Federal Office Buildings and Major Modernization Projects

DoD Unified Facilities Criteria - Minimum Antiterrorism Standards for Buildings

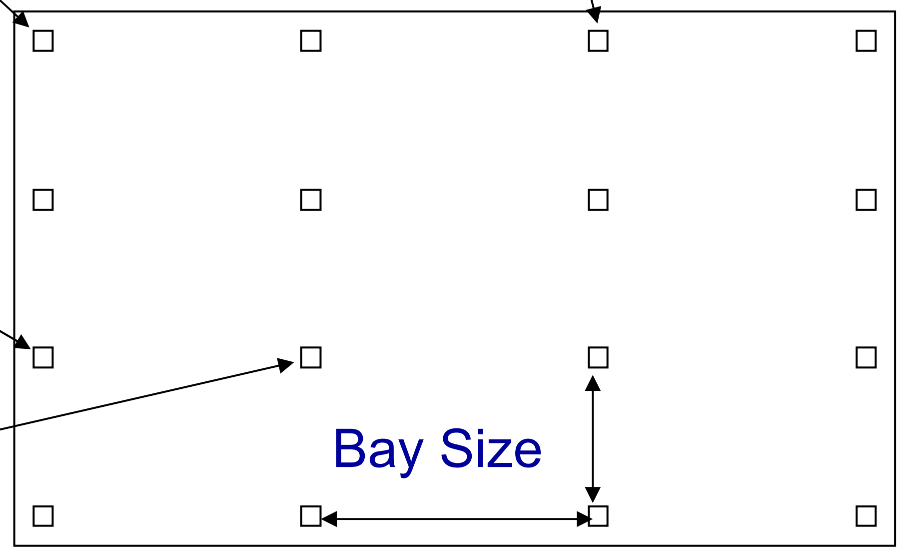
Structural Systems

Progressive Collapse Concept

Loss of column

Loss of column

Loss of column



Loss of interior column only if uncontrolled access occurs below.
(Hardening may be an acceptable alternative)

BUILDING PLAN

FEMA

Structural Systems -- Collapse

GSA and DoD criteria do not provide specific guidance for an engineering structural response model

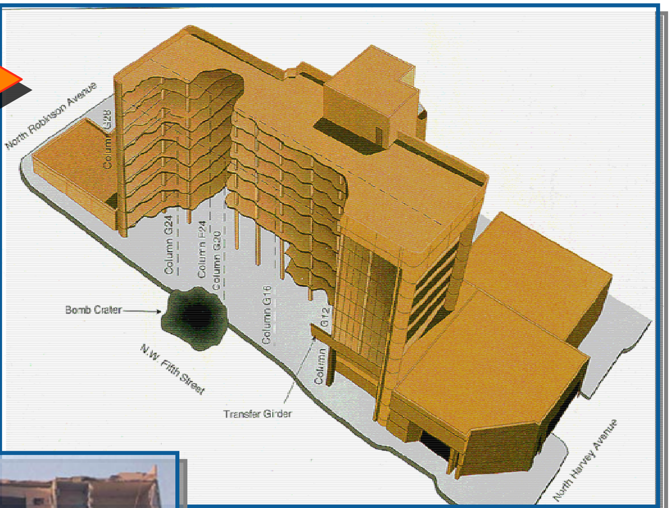
These organizations are working toward Interagency Security Committee consolidated guidance

Owner and design team should decide how much progressive collapse analysis and mitigation to incorporate into design.

Structural Systems -- Loads and Stresses

Ronan Point, London

Murrah Federal Building, Oklahoma City



Khobar Towers, Dhahran

Structural Systems – Best Practices

Consider incorporating active or passive internal damping into structural system (sway reduction in high-rise)

Use symmetric reinforcement, recognizing components might act in directions opposite to original or standard design – flooring especially

Column spacing should be minimized (<=30 feet)

Structural Systems – Best Practices (cont.)

Stagger lap splices and other discontinuities and ensure full development of reinforcement capacity or replace with more flexible connections – floors to columns especially

Protect primary load carrying members with architectural features that provide 6 inches minimum of stand-off

Use ductile detailing requirements for seismic design when possible

FEMA

Building Envelope

During actual blast or CBR event, building envelope provides some level of protection for people inside:

- Walls
- Windows
- Doors
- Roofs

Soil can be highly effective in reducing damage during an explosive event

Minimize “ornamentation” that may become flying debris in an explosion.

Building Envelope – Walls

Design should ensure a flexible failure mode

Resist actual pressures and impulses acting on exterior wall surfaces from design basis threats

Withstand dynamic reactions from windows and windows stay connected to walls

Use multiple barrier materials and construction techniques – composites can add ductility and strength at savings

As desired Level of Protection increases, additional mass and reinforcement may be required

Building Envelope – Best Wall Practices

Use symmetric reinforcement, recognizing that components might act in directions opposite to original or standard design

- Lobbies and mailrooms

Use wire mesh in plaster – reduces spalling / fragmentation

Floor to floor heights should be minimized (<=16 feet)

Building Envelope – Best Wall Practices (cont.)

Connect façade from floor slab to floor slab to avoid attachments to columns (one-way wall elements)

- Limits forces transferred to vertical structural elements

No unreinforced CMU – use fully grouted and reinforced construction

FEMA

Building Envelope – Windows

Balanced Window Design

Glass strength

Glass connection to window frame (bite)

Frame strength

Frame anchoring to building

Frame and building interaction

Building Envelope – Windows

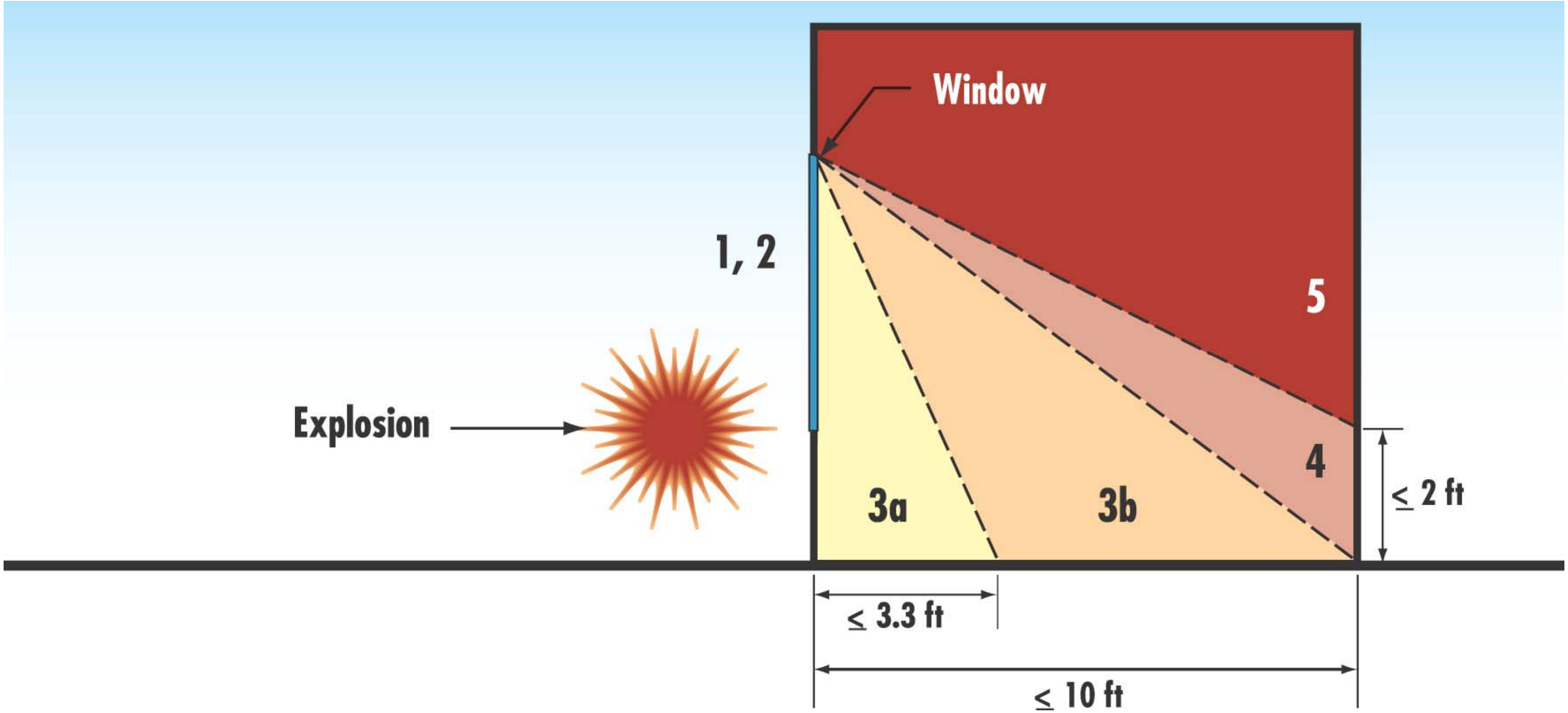
Glass (weakest to strongest)

- Annealed (shards)
- Heat Strengthened (shards)
- Fully Thermally Tempered (pellets)
- Laminated (large pieces)
- Polycarbonate (bullet-resistant)

"Balanced Design"

Building Envelope – Windows

GSA Glazing Performance Conditions



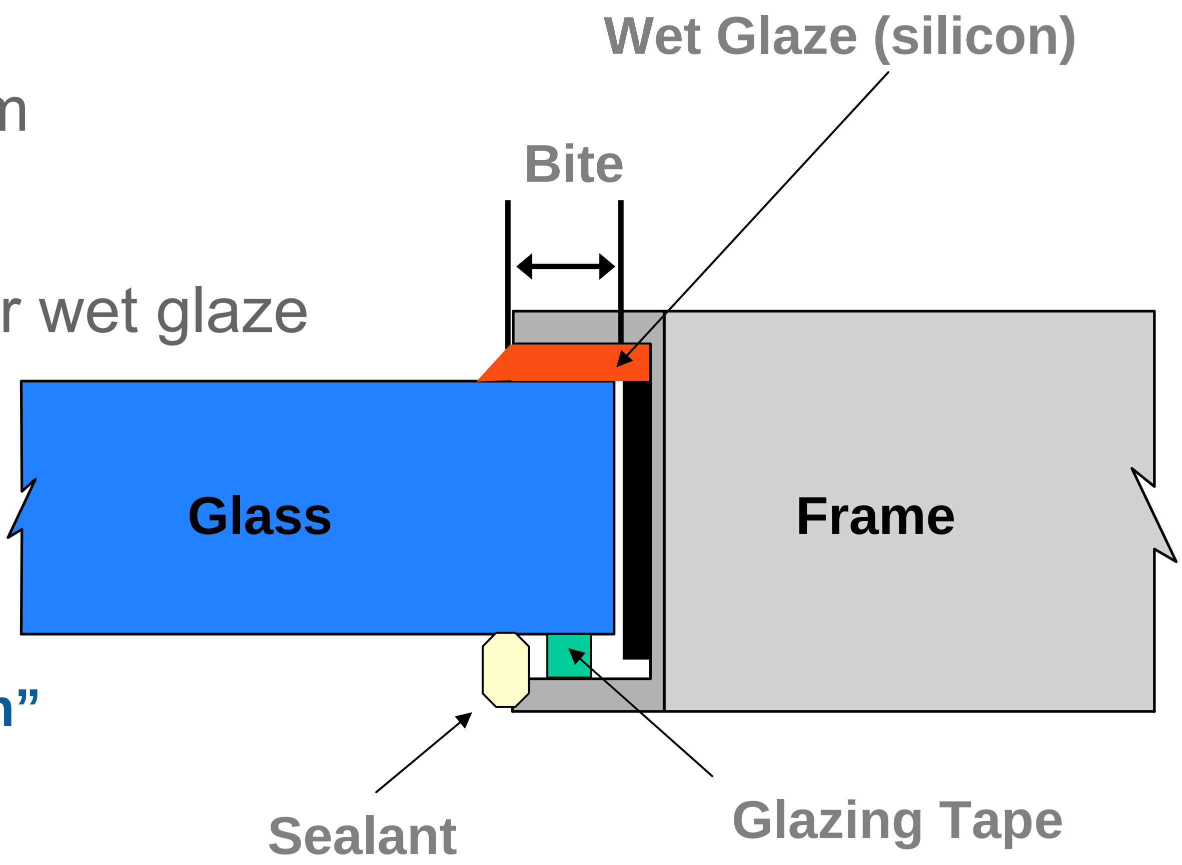
FEMA 426, Figure 3-4: Side view of a test structure illustrating performance conditions of Table 3-2, p. 3-22

Building Envelope - Window Frames

Goal: transfer load from glass to frame and retain glass in frame

Bite: ½ inch minimum

Structural sealant:
¼ inch bead or wet glaze



"Balanced Design"

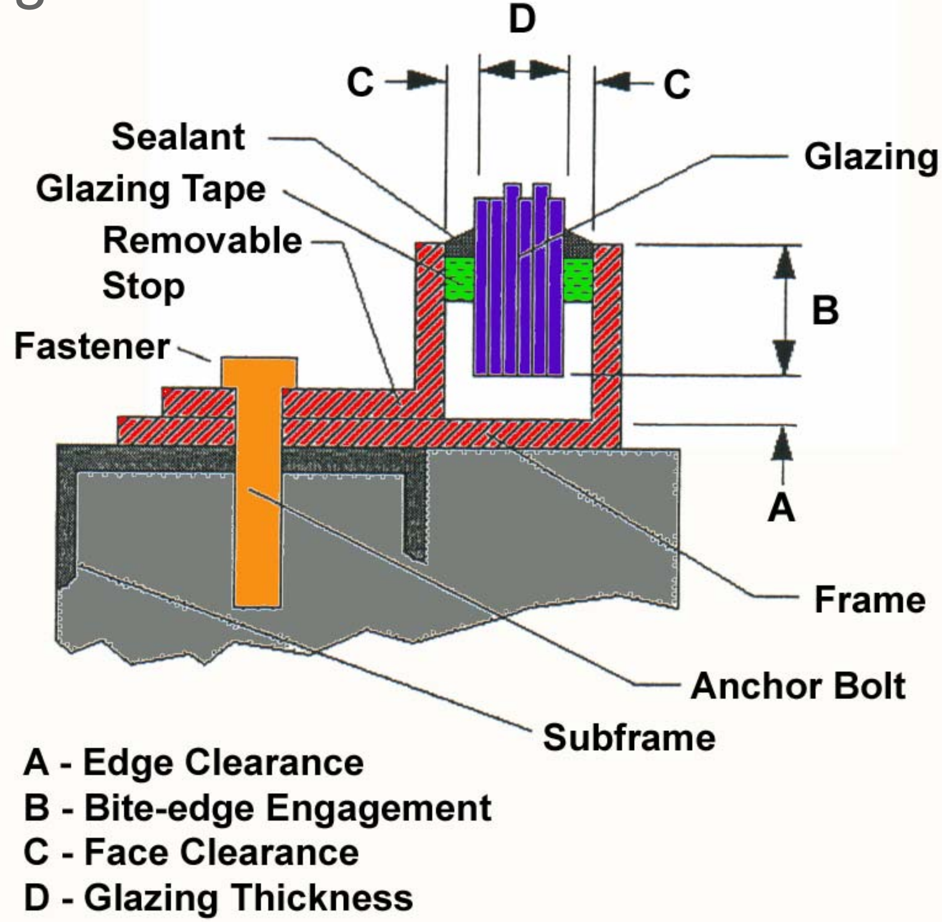
FEMA

Building Envelope - Window Frames

Goal: transfer load to building structure

Balanced strength:
glass, frame,
and connection
of frame to wall

“Balanced Design”



Building Envelope - Fragment Retention Film

Clear tough polyester film attached to inside of glass surface with strong pressure-sensitive adhesive

Also known as shatter-resistant film, safety film, or protective film

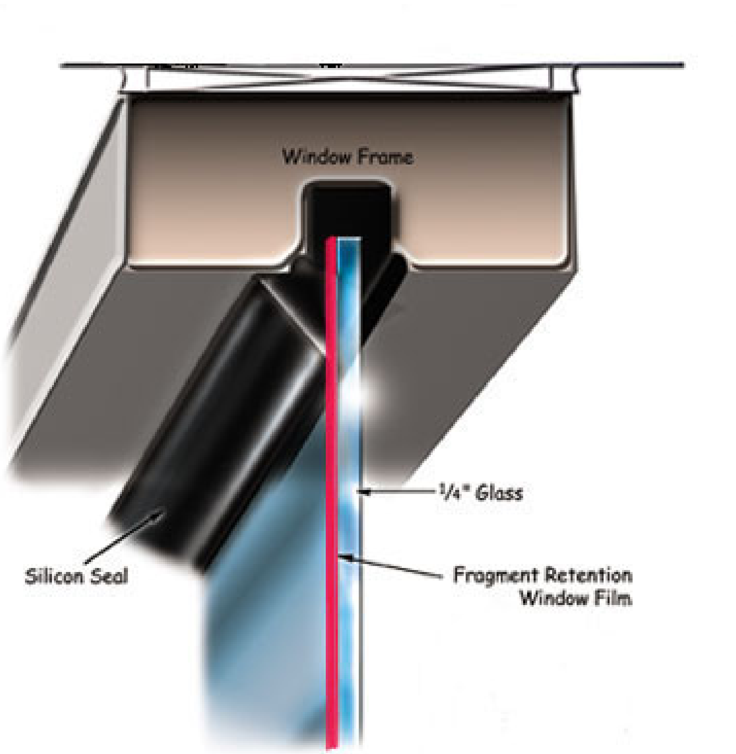
Relatively low installation costs

Level of protection varies with thickness of film and method of installation

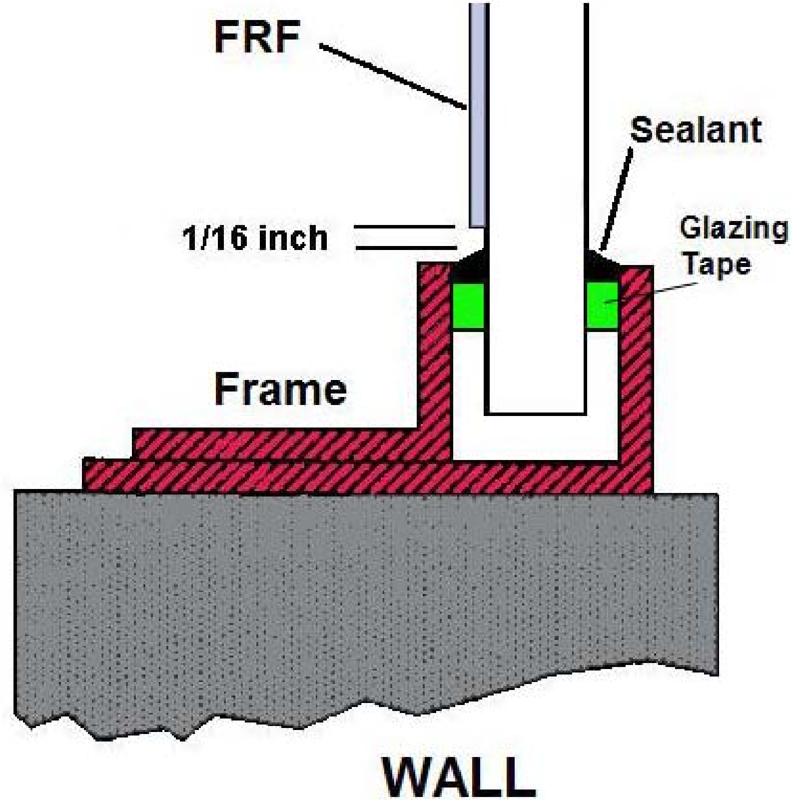
Limited life for FRF

FEMA

Building Envelope - Fragment Retention Film



"Wet Glazing" (edge to edge)



"Daylight Application"

Building Envelope - Blast Curtains

- Invented by British during WW II
- Kevlar curtains
- Allow venting of blast wave while "catching" fragments
- May be augmented with FRF

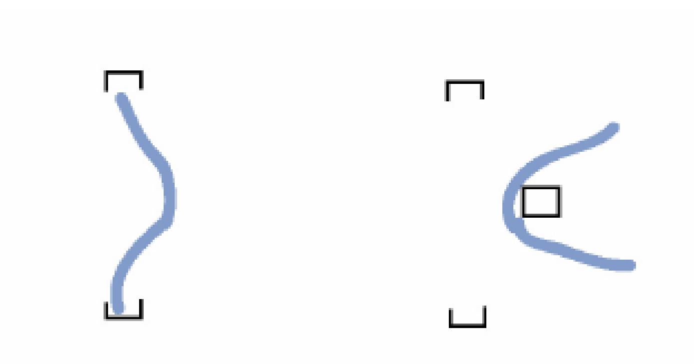
FEMA

Building Envelope - Catch Bar

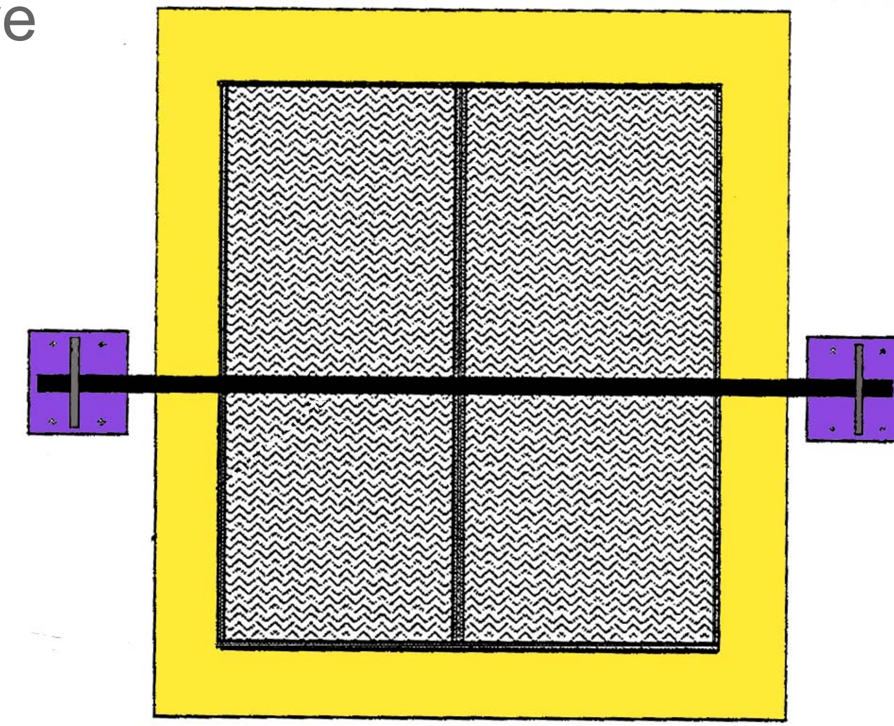
Must be centered on window and window panes

FRF must be thick enough to hold the fragments (≥ 7 mil)

Laminated glass should have 60 mil interlayer



Plan View



FEMA 427, Figure 6-7: Safe laminated glass systems and failure modes, p. 6-29

Building Envelope – Best Window Practices

No windows adjacent to doors

Minimize number and size of windows - watch building code requirements

Laminated glass for high-occupancy buildings

Stationary, non-operating windows, but operable window may be needed by building code

Steel versus aluminum window framing

Building Envelope – Doors

Balanced strength

- Door
- Frame
- Anchorage to building

Hollow steel doors or steel-clad doors

Steel door frames

Blast-resistant doors available

- Generally heavy
- Generally expensive

FEMA

Building Envelope – Roofs

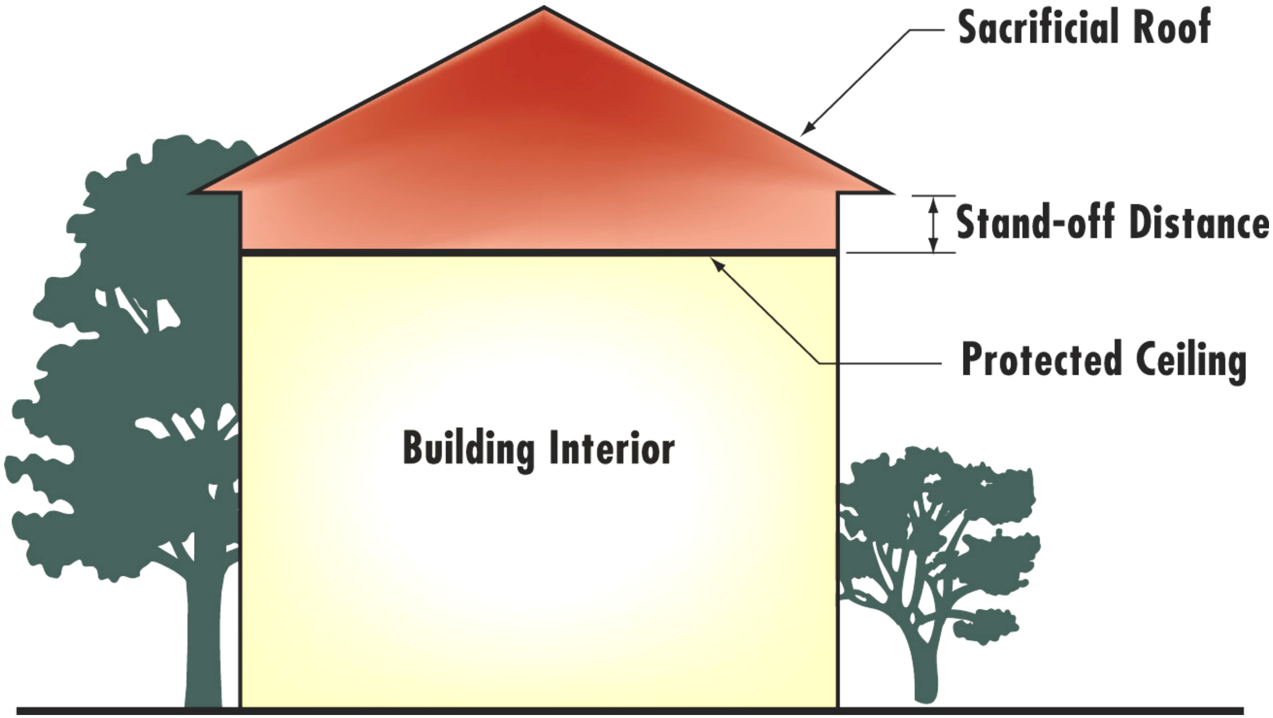
Preferred – poured in place reinforced concrete

Lower protection – steel framing with concrete and metal deck slab

Sloped sacrificial roof over protected roof/ceiling

Sandbags or dirt layer

Restrict access to roof



FEMA 426, Figure 3-7: Sacrificial roof, p. 3-33

Utility Systems

Building Service

- Electric – commercial and backup
- Domestic water
- Fire protection water
- Fuel – coal, oil, natural gas, or other
- Steam heat with or without condensate return
- Hot water heat

Utility Systems

Building Service (cont)

- Sewer – piping and sewage lift stations
- Storm drainage
- Information
- Communications
- Fire alarm
- Security systems and alarms

Utility Systems

Entrances

- Proximity to each other
- Aboveground or underground
- Accessible or secure

Delivery capacity

- Separate
- Aggregate

Storage capacity

- Outage duration
- Planned or historical

Mechanical & Electrical Systems

Functional layout – physical separation or hardening

Structural layout – systems installation

Do not mount utility equipment or fixtures on exterior walls or mailrooms

Avoid hanging utility equipment and fixtures from roof slab or ceiling

FEMA

Mechanical & Electrical Systems

Overhead components, architectural features, and other fixtures > 14 kilograms (31 pounds), especially in occupied spaces

- Mount to resist forces 0.5 x W in any direction and 1.5 x W in downward direction (DoD Unified Facilities Criteria)
- Plus any seismic requirements

Mechanical & Electrical Systems

Distribution within building

- Looped or multiple radial versus single radial
- Pipe chases – horizontal and vertical – cross impacts

Normal and emergency equipment locations

- Generators versus commercial switchboard or transfer switch
- Electric fire pumps versus diesel fire pumps

FEMA

Mechanical & Electrical Systems

Restrict access - locks / alarms / surveillance

- Utility floors / levels
- Rooms
- Closets
- Roofs
- Security locks/interlocks comply with building code
- Building information
- Also consider for other systems

FEMA

Mechanical & Electrical Systems

Building lighting and CCTV compatibility

- Intensity
- Resolution
- Angle
- Color

Exit lighting – consider floor level, like airplanes

Emergency lighting – battery packs have their place

Mechanical & Electrical Systems

Ventilation and Filtration – HVAC Control Options

- Building specific
- System shutdown – configuration and access
  - HVAC fans and dampers
  - Include 24/7 exhausts, i.e. restrooms
- Zone pressurization
  - Doors and elevator use
  - Shelter-in-place

FEMA

Mechanical & Electrical Systems

Ventilation and Filtration – HVAC Control Options

- Specialized exhaust for some areas – i.e., lobbies and mailrooms
  - Air purge (e.g., 100 percent outside air if internal release)
  - CBR filters to trap and prevent spread elsewhere
- Pressurized egress routes (may already exist)
  - Filtered air supply or shutdown if release external

FEMA

Plumbing and Gas Systems

Same considerations as electrical and mechanical systems

Added concern is fuel distribution

- Heating sources / open flames / fuel load

Interaction with other systems during an incident

- Fuel versus alarms / electric / fire protection water / structure
- Water versus electronic / electric

Fire Alarm Systems

Considerations similar to information and communications systems, but tighter building codes

- Centralized or localized
- Fire alarm panel access for responding fire fighters or fire control center
- Interaction with other building systems
  - Telephone / IT
  - Energy management
  - HVAC controls
- Off-premises reporting and when

Communications - Information Technology Systems

Looped versus radial distribution

Redundancy

- Landline, security, fire watch
  - Copper
  - Fiber optics
- Cell phones (voice, walkie-talkie, text)
- Handheld radios / repeaters
- Radio telemetry / microwave links
- Satellite

Mass notification

- Loud speakers
- Telephone hands-off speaker
- Computer pop-up
- Pager

FEMA

Communications - Information Technology Systems (cont.)

Empty conduits

- Future growth
- Speed repair

Battery and backup power for IT

- Hubs, switches, servers, switchboards, MW links, etc.
- VOIP, building ops, alarms, etc.

Fire stopping in conduits between floors

Secure dedicated lines between critical security functions

Backup control center with same capability as primary

FEMA

Equipment Operations and Maintenance

Preventive Maintenance and Procedures

- Drawings indicating locations and capacities are current?
- Maintenance critical to keep systems operational
  - Critical systems air balanced and pressurization monitored regularly?
  - Periodic recommissioning of major systems?
- Regularly test strategic equipment
  - Sensors, backup equipment and lighting, alarms, and procedures tested regularly to ensure operation when needed?
  - Backup systems periodically tested under worst case loadings?

Equipment Operations and Maintenance

Maintenance Staff Training

- System upgrades will require new training
- Specific instructions for CBR event (internal vs external release)
- Systems accessible for adjustment, maintenance, and testing

Security Systems

Electronic Security Systems

Purpose is to improve the reliability and effectiveness of life safety systems, security systems, and building functions.

- Detection
- Access control
- Duress alarms
- Primary and backup control centers – same procedures

FEMA

Security Systems

Entry Control Stations

Channel visitors entering building to access control in lobby

Signs should assist in controlling authorized entry

Have sufficient lobby space for security measures (current or future)

Avoid extensive queuing, especially outside building

Proper lighting, especially if manned 24 hours/ day

Hardened against attack based upon security needs

FEMA

Security Systems

Emergency Plans

All buildings should have current plans

- Building evacuation with signage & emergency lighting
- Accountability – rally points, call-in
- Incorporate CBR scenarios into plans
  - General occupant actions
  - Response staff actions – HVAC and control centers

Exercise the plans to ensure they work

- Coordinate with local emergency response personnel
- Test all aspects

Practical Applications

What can be done with a reasonable level of effort?

End of Chapter 3, FEMA 426 listing of mitigation measures

- Less protection, less cost, with less effort
- Greater protection, greater cost, at greater effort

Building Materials: General Guidance

All building materials and types acceptable under building codes are allowed.

Special consideration should be given to materials having inherent flexibility and ability to respond to load reversals.

Careful detailing is required for materials (such as pre-stressed concrete, pre-cast concrete, and masonry) to adequately respond to design loads.

Construction type selected must meet all performance criteria of specified protection level.

Desired Building Protection Level

Component design based on:

Design Basis Threat

Threat Independent approach

Level of Protection sought

Leverage natural hazards design/retrofit

Incorporate security design as part of normal capital or O&M program

Use existing tools/techniques, but augment with new standards/guidelines/codes

Summary

Building Design Guidance and Mitigation Options

Using the FEMA 426 Checklist will help identify vulnerabilities and provide recommended mitigation options.

There are many methods to mitigate each vulnerability.

Relatively low cost mitigations significantly reduce risk.

Unit X Case Study Activity

Building Design Guidance and Mitigation Measures

Background

Emphasis:

- Providing a balanced building envelope that is a defensive layer against the terrorist tactic of interest
- Avoiding situations where one incident affects more than one building system

FEMA 426, Building Vulnerability Assessment Checklist

Requirements

Assign sections of the checklist to qualified group members

Refer to Case Study, and answer worksheet questions

Review results to identify vulnerabilities and possible mitigation measures

FEMA

Unit XI
Electronic Security Systems

FEMA

Unit Objectives

Explain the basis concepts of electronic security system components, their capabilities, and their interaction with other systems.

Describe the electronic security system concepts and practices that warrant special attention to enhance public safety.

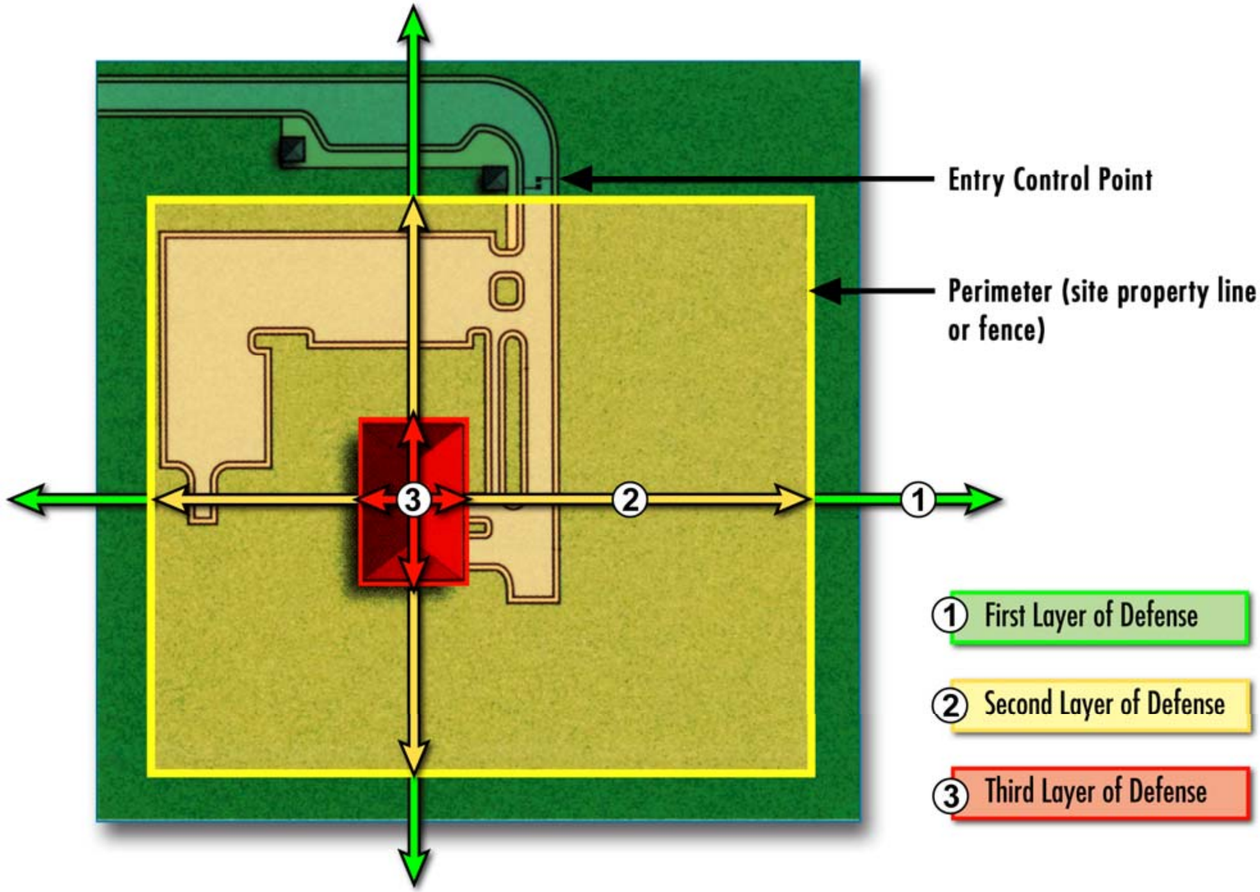
Use the Building Vulnerability Assessment Checklist to identify electronic security system requirements that can mitigate vulnerabilities.

Justify selection of electronic security systems to mitigate vulnerabilities.

Electronic Security System (ESS) Concepts

- Basic concepts of site security systems
- Use of ESS
- General ESS Description
- ESS Design Considerations

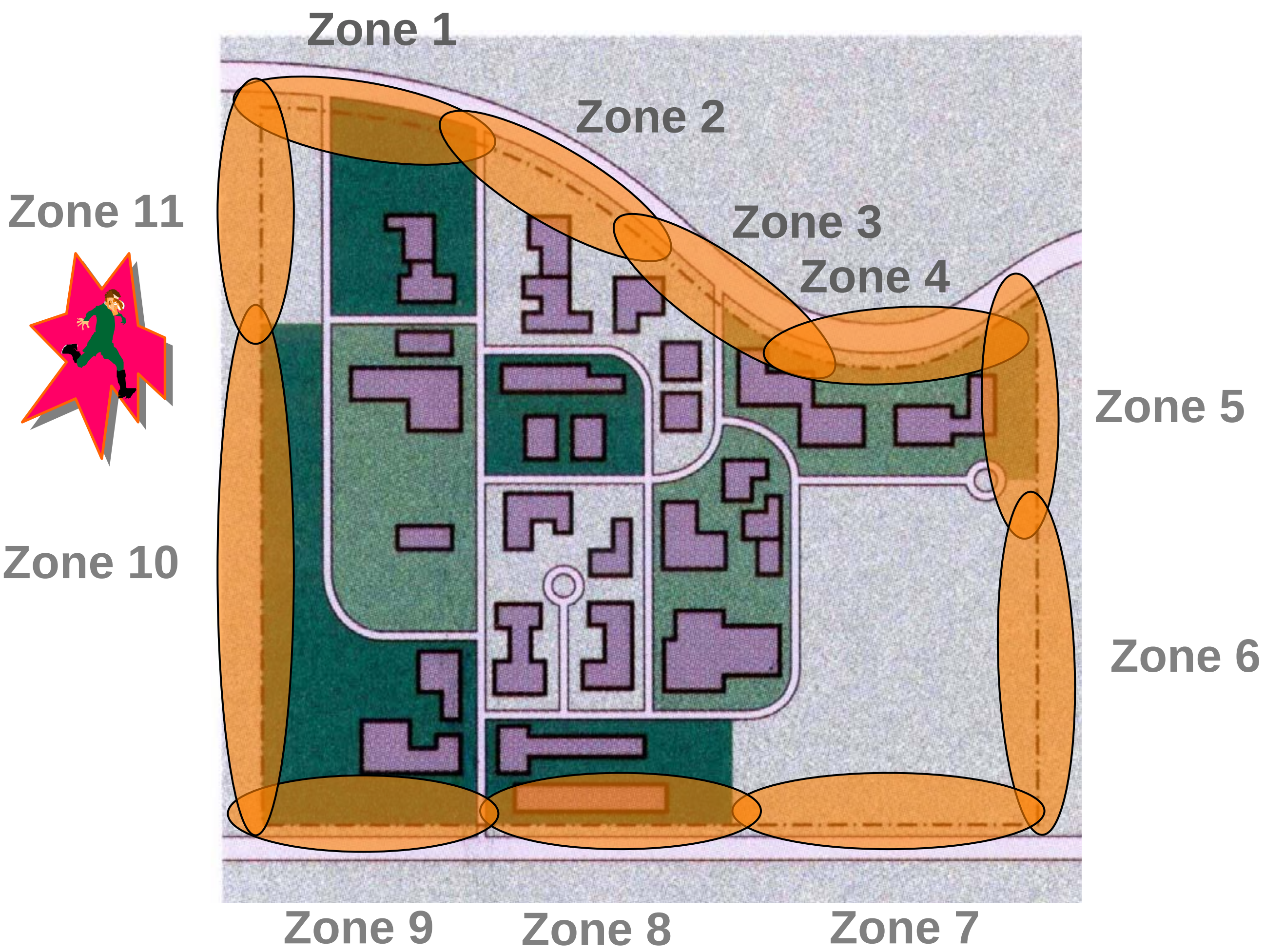
Perimeter Zone



FEMA 452, Figure 2-2: Layers of Defense, p. 2-3

FEMA

Perimeter Zone



Adapted from FEMA 426, Figure 2-2: Dispersed Facilities, p. 2-8

Intrusion Detection Systems

Old Generation

CCTV

Motion Sensors

New Generation

CCTV

Motion Sensors

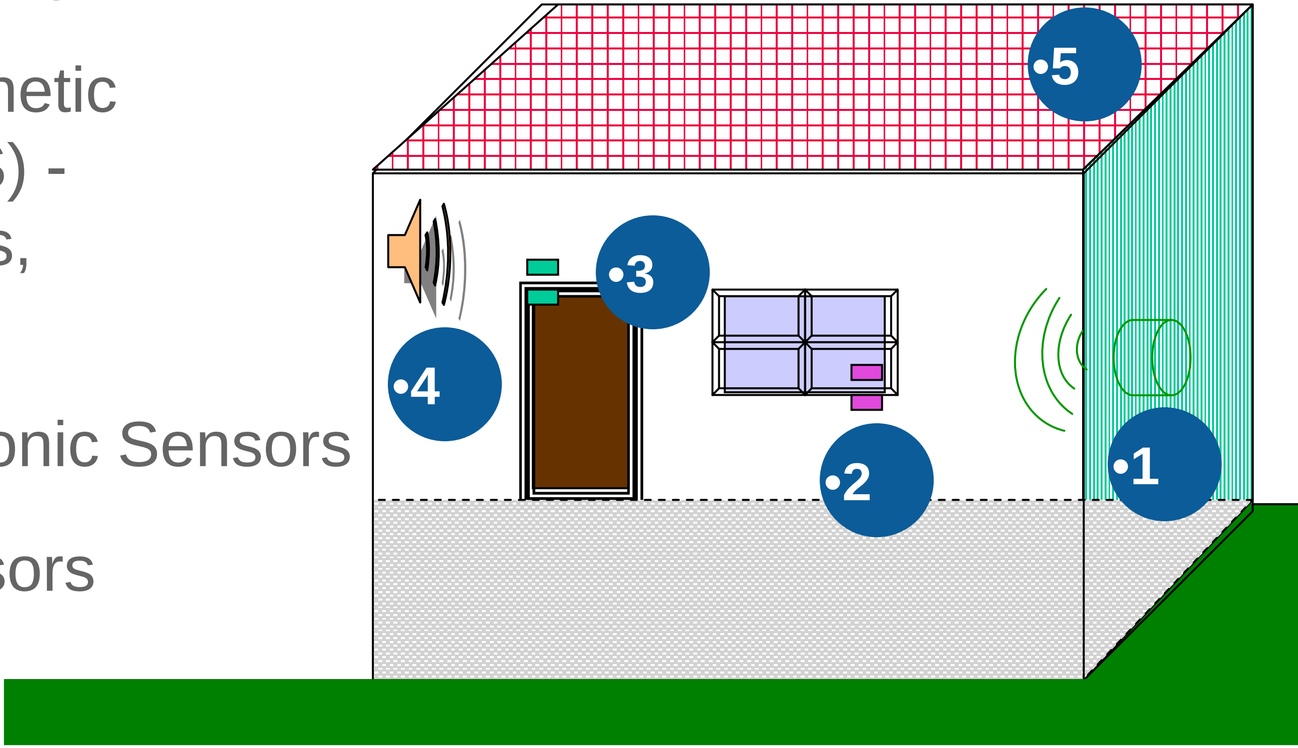
Source: Protech

Source: Protech

FEMA

Boundary Penetration Sensors

1. Structural Vibration Sensors
2. Glass Break (GB) - both acoustical and contact mount
3. Balanced Magnetic Switches (BMS) - doors, windows, and hatches
4. Passive Ultrasonic Sensors
5. Grid Wire Sensors



Adapted from DARPA Perimeter Security Sensor Technologies Handbook, July 1998, p. 1-13

Volumetric Motion Sensors

Designed to detect intruder motion within the interior of the protected volume

- Microwave Motion Sensors
- Passive Infrared (PIR) Motion Sensors
- Dual Technology Sensors
- Video Motion Sensors
- Point Sensors
- Capacitance Sensors
- Pressure Mats
- Pressure Switches

Exterior Intrusion Detection

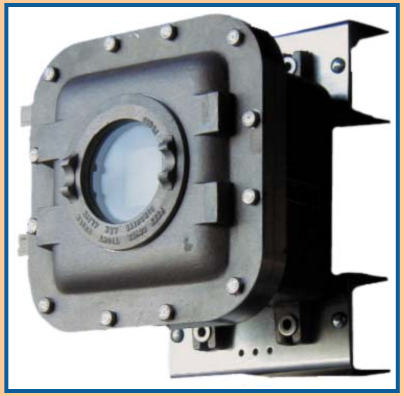
Strain Sensitive Cable

Fiber Optic Cable, Bistatic/Monostatic Microwave, Active Infrared, and Ported Coax

Dual Technology (PIR/MW)

Video Motion

Explosion Proof

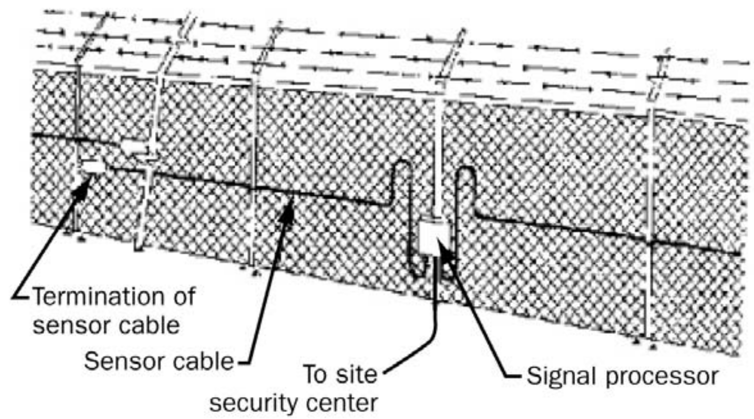


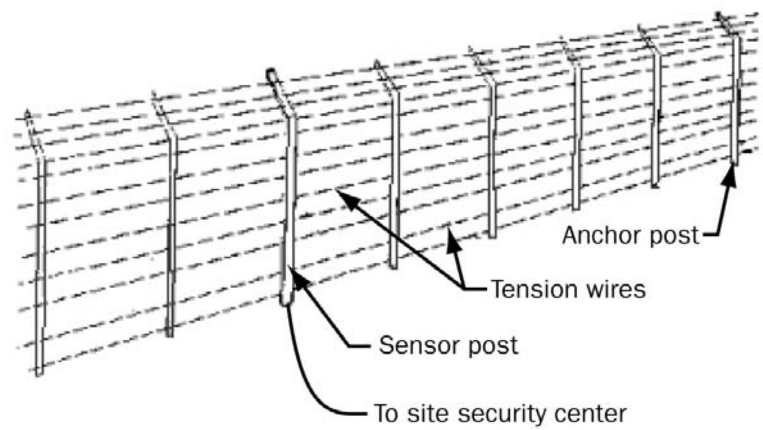
Source: Protech

First Layer of Defense

Fence Sensors

- Strain sensitive cables
- Taut wire sensors
- Fiber optic sensors
- Capacitance proximity sensors

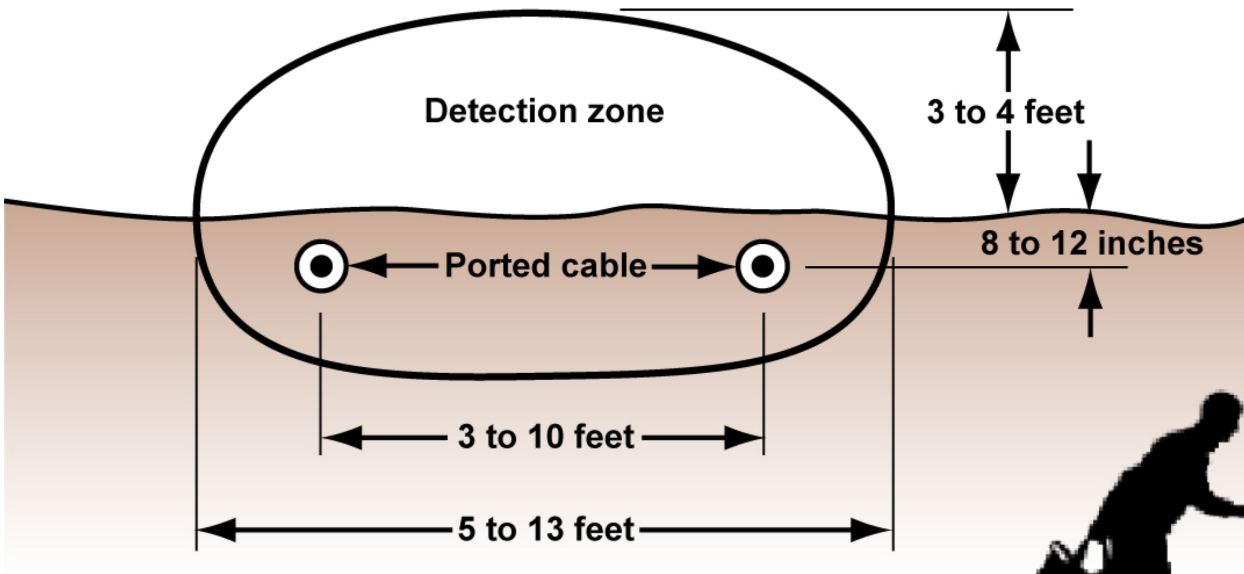


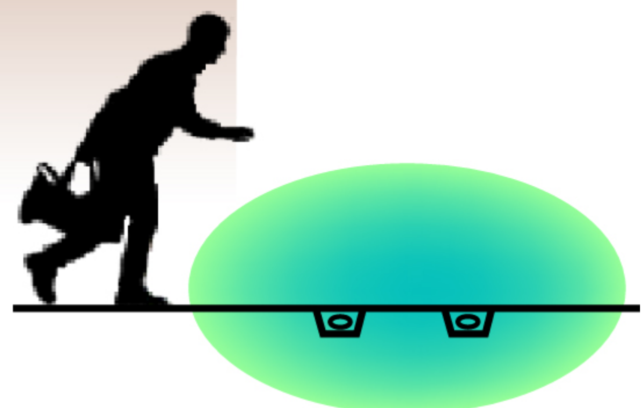


First Layer of Defense

Army TM 5-853-4, Electronic Security Systems, pgs. 5-3 and 5-4

Buried Line Sensors

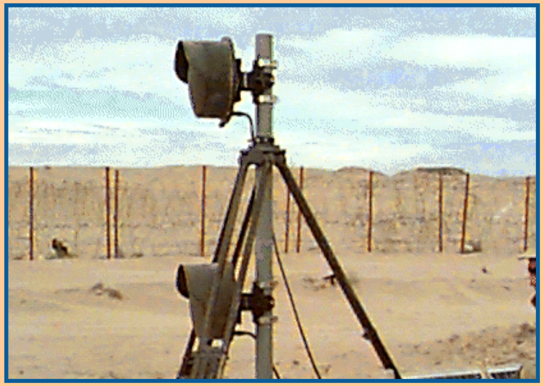




First Layer of Defense

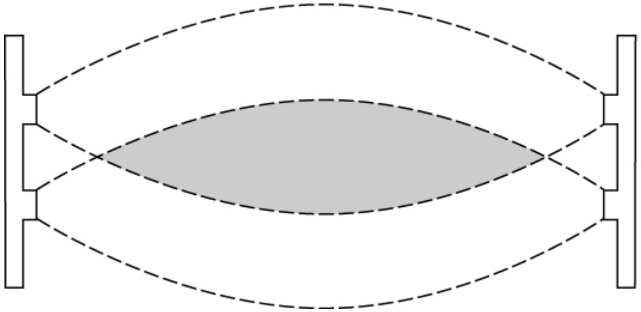
Army TM 5-853-4, Electronic Security Systems, p. 5-6

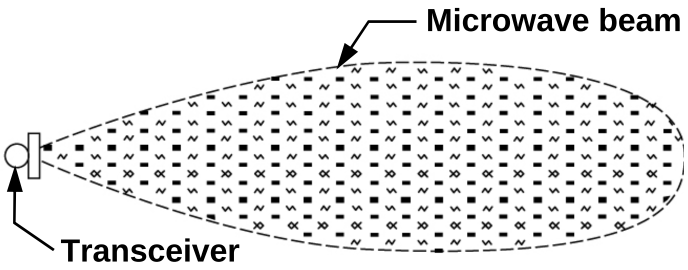
Microwave Sensors



Bistatic System

Monostatic System





First Layer of Defense

Army TM 5-853-4, Electronic Security Systems, pgs. 5-15 and 5-7

Infrared Sensors

Active

Passive

First or Second Layer of Defense

Video Motion Sensors

Old Generation

New Generation

Source: Protech

First or Second Layer of Defense

Electronic Entry Control

Coded Devices

Credential Devices

Biometric Devices

First or Second Layer of Defense

Coded Devices

Electronic Keypad Devices

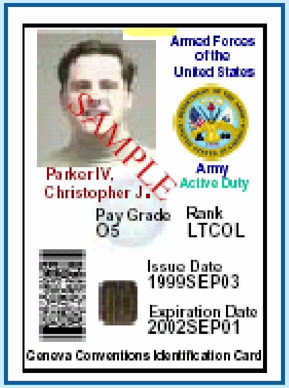
Computer Controlled Keypad Devices

First, Second, or Third Layer of Defense

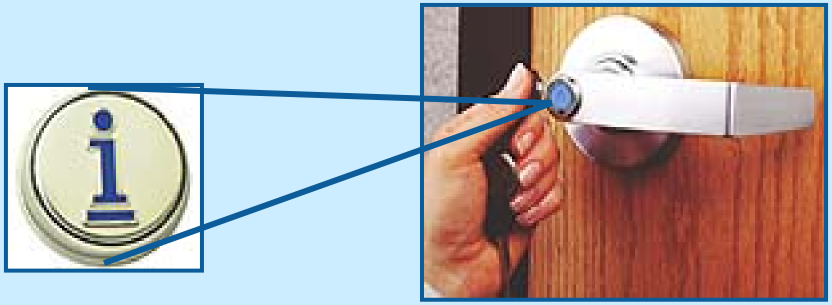
FEMA

Credential Devices

- Magnetic Stripe Card
- Wiegand-effect Card
- Proximity Card
- Smart Card
- Bar Code
- “i” Button
- Radio Frequency ID (RFID)



First, Second, or Third Layer of Defense



FEMA

Biometric Devices

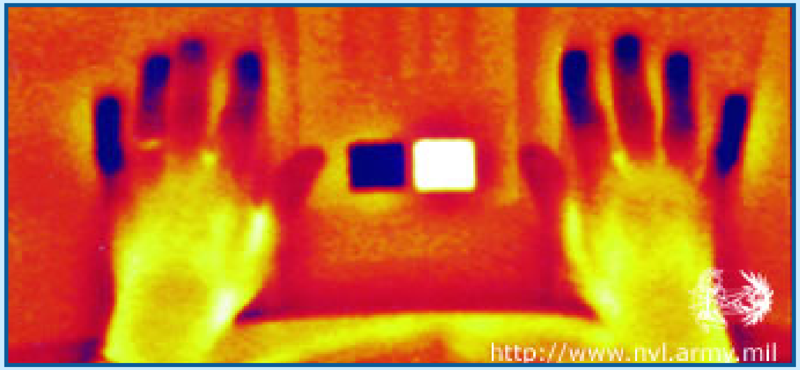
Fingerprints

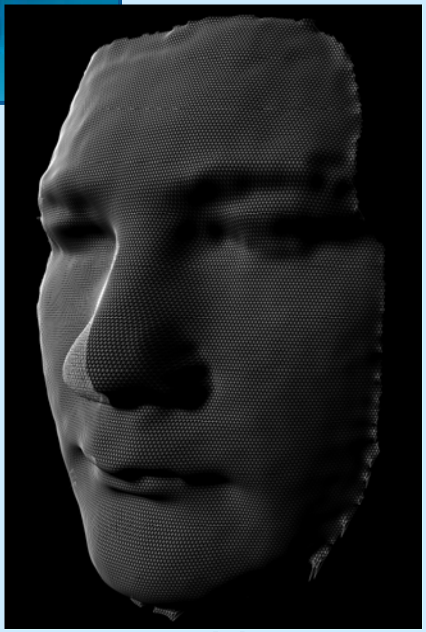
Hand Geometry

Retinal Patterns

Facial Patterns

Source: Veridt





Source: A4Vision

FEMA

First, Second, or Third Layer of Defense

Closed Circuit Television

Interior CCTV

Alarm assessment, card reader door assessment, emergency exit door assessment, and surveillance of lobbies, corridors, and open areas

Exterior CCTV

Alarm assessment, individual zones and portal assessment, specific paths and areas, exclusion areas, and surveillance of waterside activities

Source: Protech Protection Technologies, Inc.

First, Second, or Third Layer of Defense

FEMA

Security Operations Center

Enhancements to Overcome Operator/System Limitations

- Workspace / Hardening
- Alarm Recognition / Alerts
- CCTV Image Alarm - Motion Detection
- Smart CCTV Auto Pan/Tilt/Zoom on Tripped Sensor Location
- Forwarding Alarms to Pagers, PDAs, Radios
- Data Recording - DVR
- Line Supervision / Backup Feeds
- Emergency Power to System

FEMA

Summary

Use the Building Vulnerability Assessment Checklist to identify electronic security system requirements.

Public safety is enhanced by electronic security systems (deter, detect, deny, devalue).

Electronic security systems components and capabilities interact with other systems (LAN, doors, windows, lighting, etc.).

Electronic security systems can be used to mitigate vulnerabilities.

Unit XI Case Study Activity

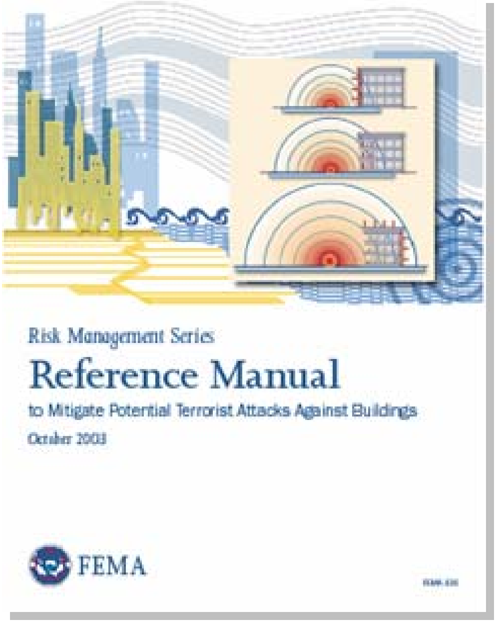
Electronic Security Systems

Background

Emphasis: Various components and technology available for use in electronic security systems

FEMA 426, Building Vulnerability Assessment Checklist

Assess Electronic Security Systems in Case Study for vulnerabilities and recommended mitigation measures



FEMA

Unit XII-B
Case Study

FEMA

Unit Objectives

Explain building security design issues to a building owner for consideration prior to a renovation or new construction.

Explain the identification process to arrive at the high risk asset-threat/hazard pairs of interest.

Justify the recommended mitigation measures, explaining the benefits in reducing the risk for the high risk situations of interest.

HAZARDCORP BUILDING

Building
- Functions
- Infrastructure

Threats/Hazards
- Design Basis Threat
- Levels of Protection

Vulnerabilities
- Impact
- Mitigation

Report

FEMA

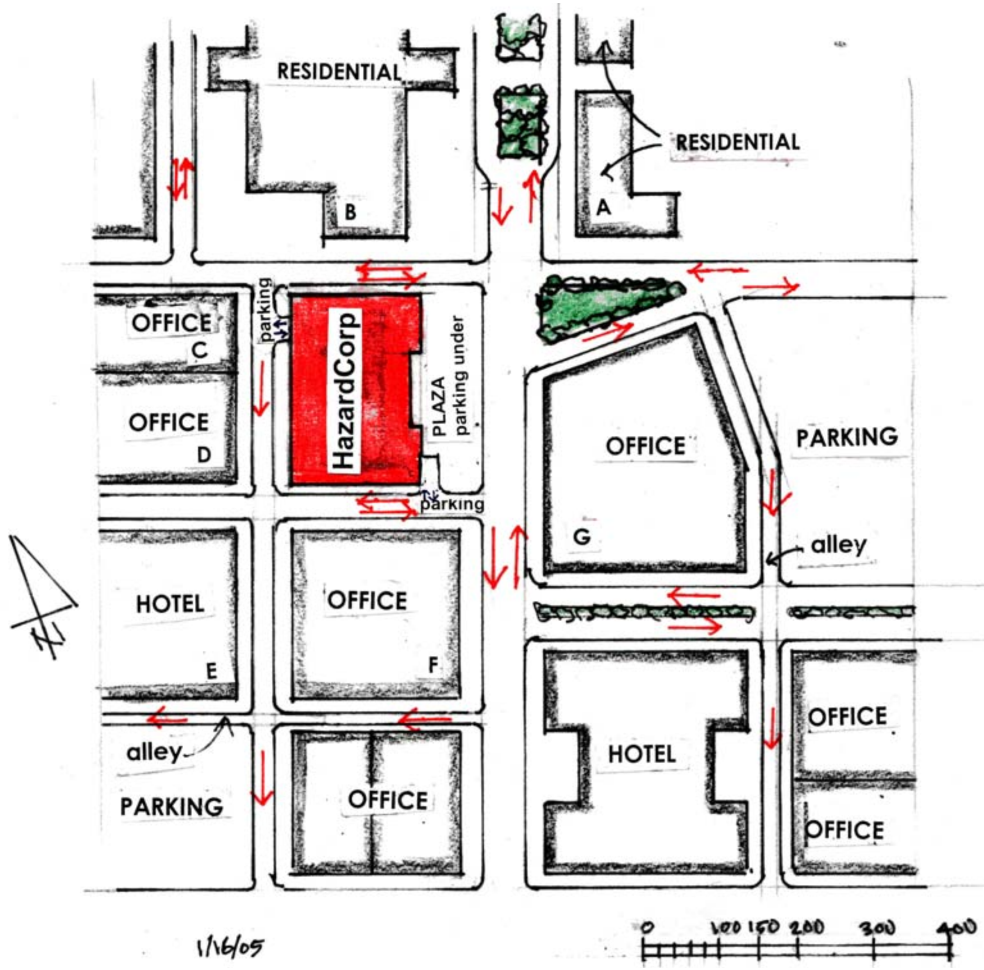
HAZARDCORP

50-story mixed use high-rise office building

- 8,000 occupants
- 1,000 visitors
- Over 2,000,0000 square feet of rentable space

"Neighbors" include:

- Offices
- Residential



5-Mile Building Radius

Local Imagery

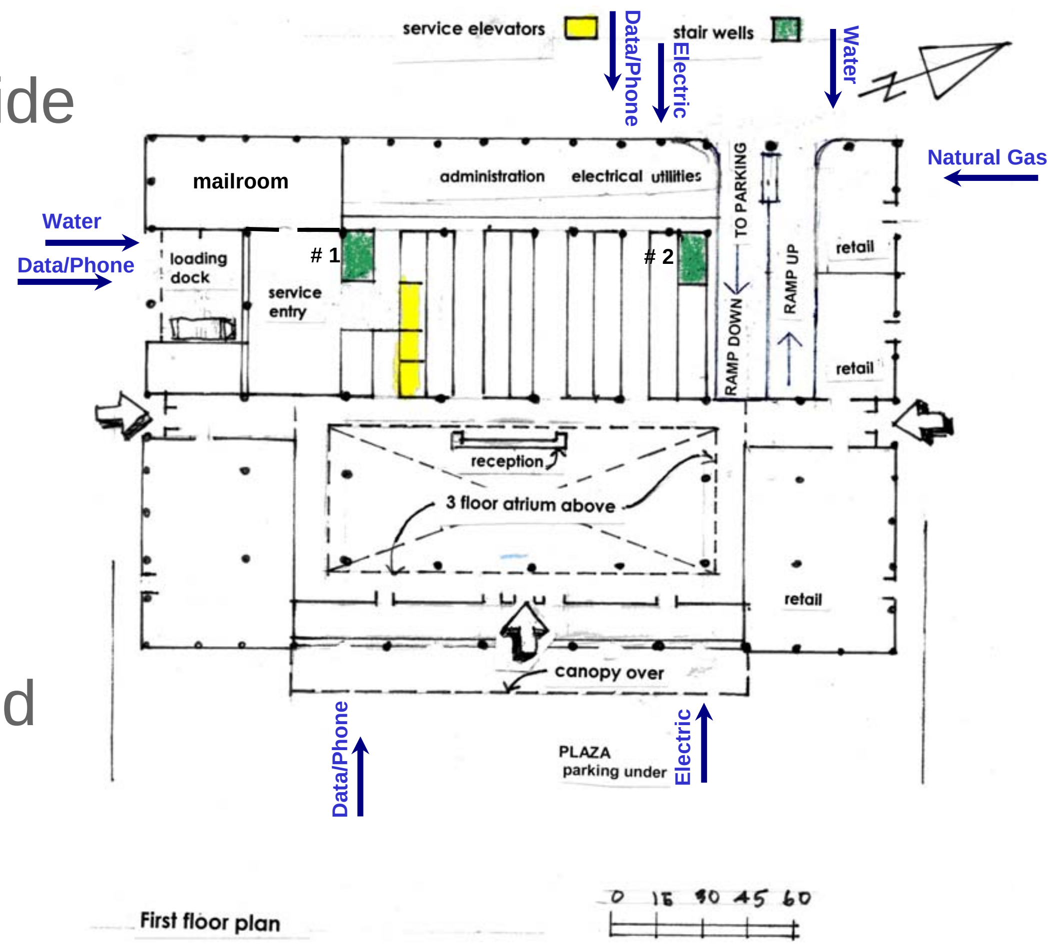
HazMat Sites

Emergency Response

FEMA

Building Data

- 50-story building completed in 1987
- Loading dock on SW side
- Retail on lower level
- 8,000 occupants
- 1,000 visitors
- 3 levels of underground parking

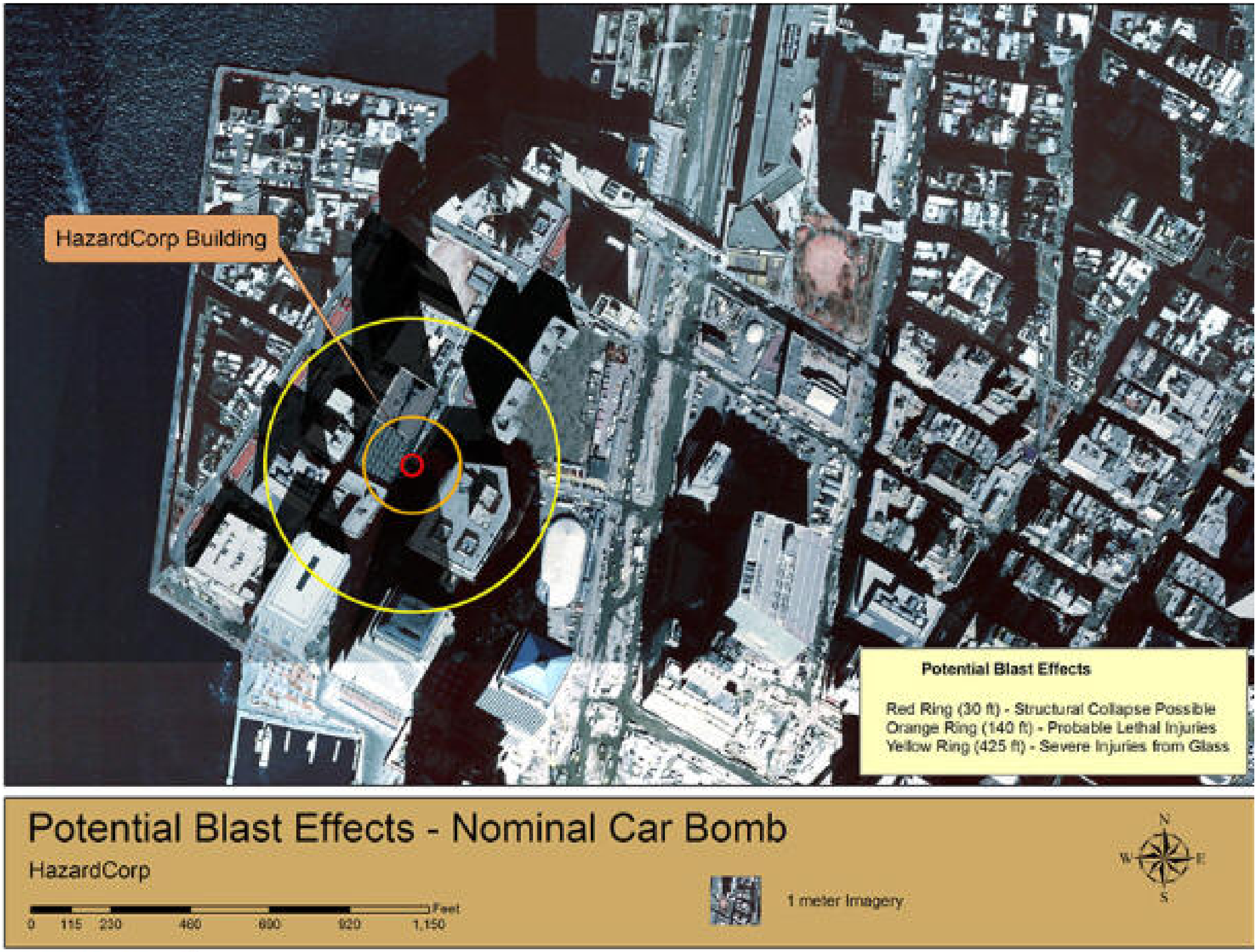


HAZARDCORP Occupancy

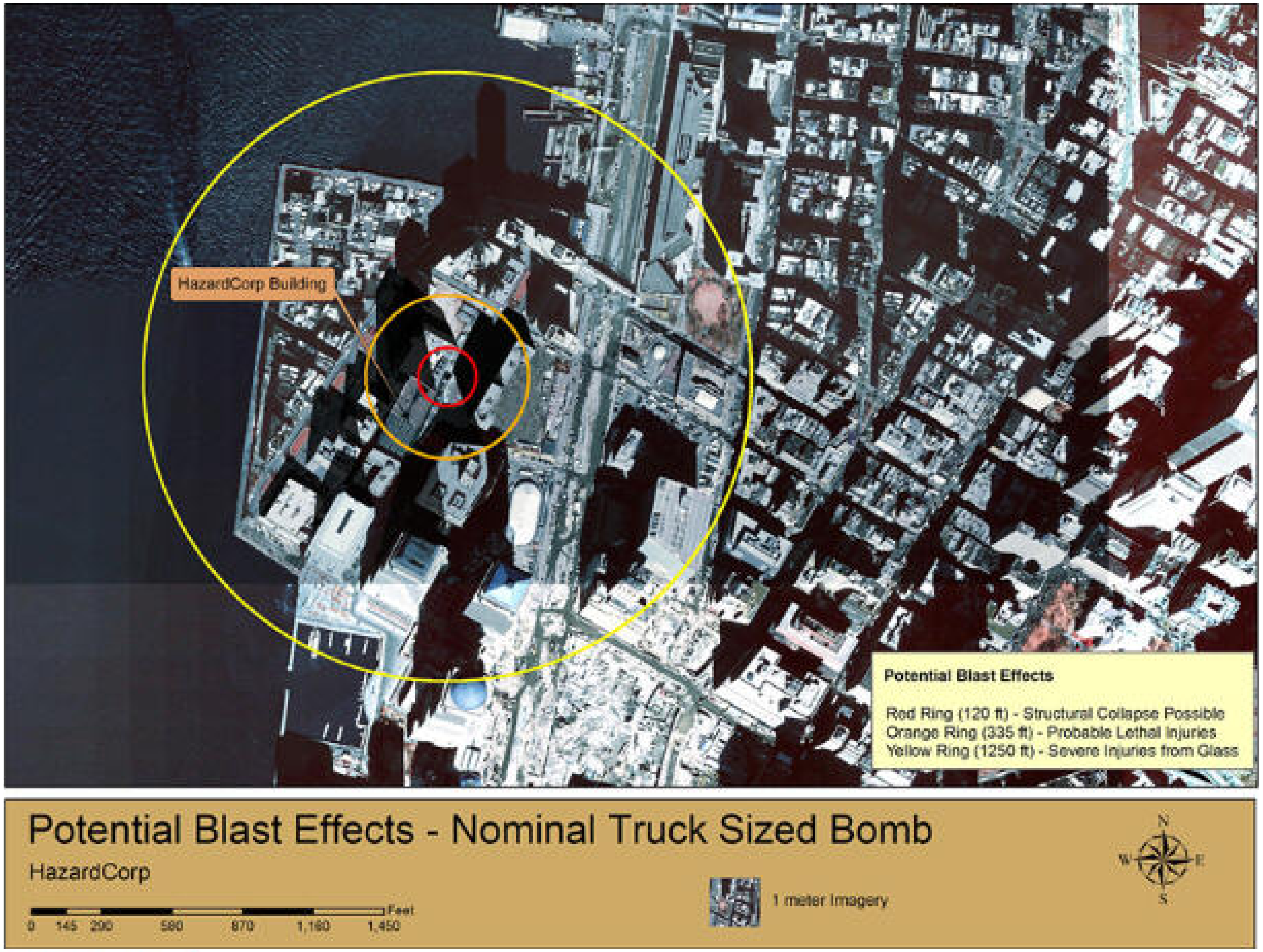
FLOOR	TENANT OCCUPANCY
49-50	Mechanical Floors
31-48	National financial services company
29-30	Bank offices
27-28	Federal government offices (IRS, DOD, CIA)
26	Mechanical room
25	Office of Emergency Management
23-24	Financial service company
20-22	Insurance company
19	State Employment Commission
15-18	Vacant
14	Financial management company
8-13	Federal government offices (SEC, Secret Service)
6-7	Bank offices
4-5	Storage, switch gear, generators, transformers
3	Open to first floor lobby, rentable meeting space, building management
2	Open to first floor lobby, rentable meeting space
1	Lobby, retail, fuel storage, switchgear, building administration, loading dock
UG1	Parking
UG2	Parking
UG3	Parking

FEMA

Car Bomb Blast Effects

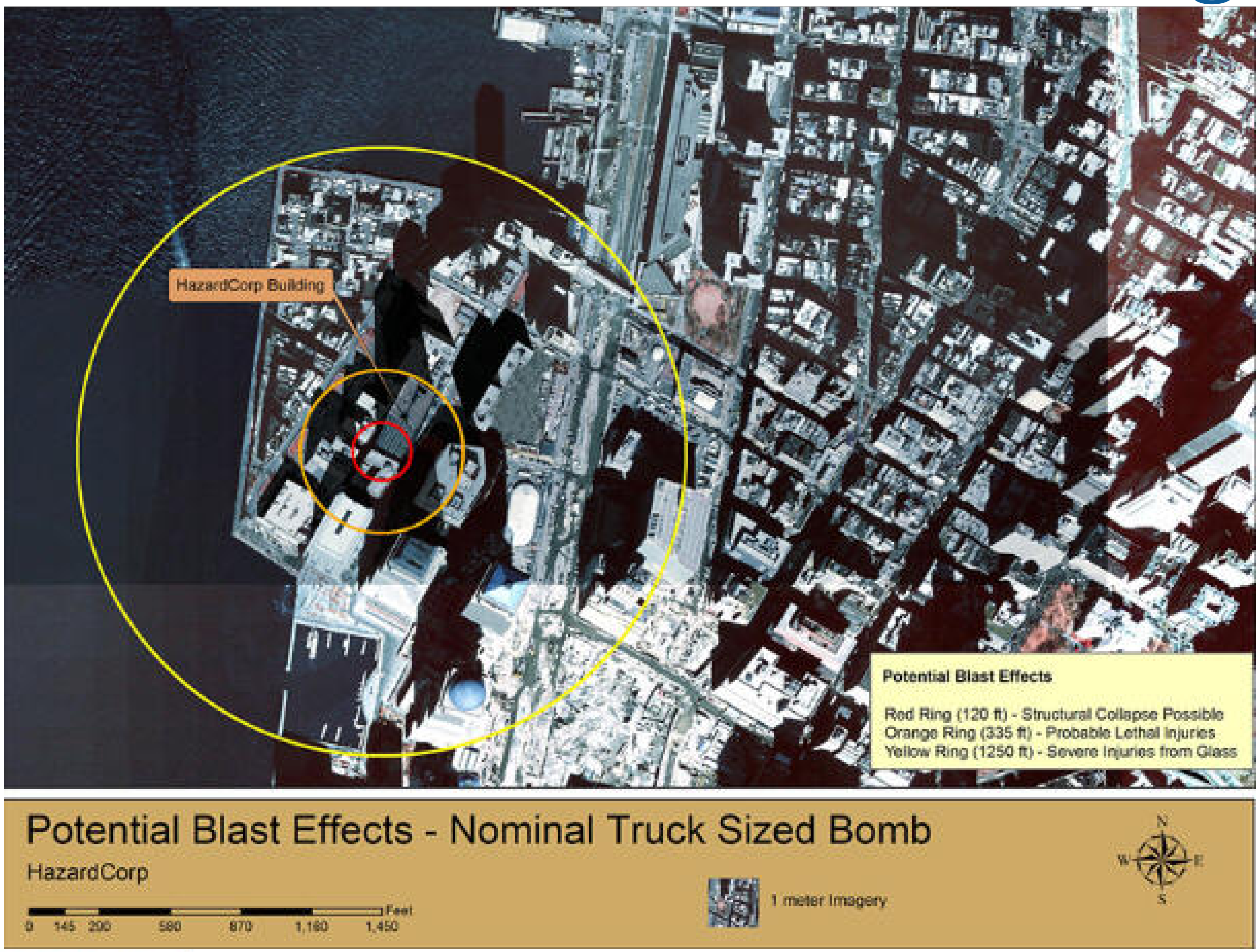


Truck Bomb Blast Effects-Collateral



FEMA

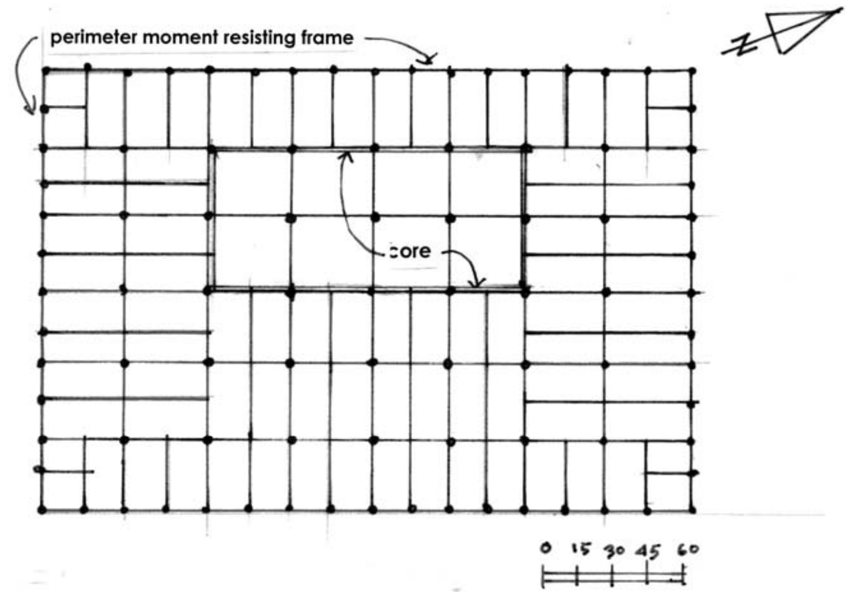
Truck Bomb Blast Effects-Loading Dock



Building Data

Structural / Envelope

- 4 perimeter moment frames
- Gravity framing composite steel beams
- Variety of framing connections
- Aluminum / Glass curtain wall exterior cladding
  - First three floors 3/8 inch thermally tempered glass
  - Other glazing ¼ inch or 3/8 inch annealed single pane glass
- Discontinuous columns through the lobby area



Typical floor framing plan, 4th through 49th floor.

FEMA

Building Infrastructure

Fire Suppression

- Sprinklers on every floor of building
- Standpipes in every stairway, including building and plaza parking
- Yard main loops all around building
- Fire department connections – west and north side of building

Electric Power

- 13,800 volt looped service feeds substation in building
- 4th floor transformers – 480/277 volt distribution

Building Infrastructure

Generators/Fuel Systems

- Building management and tenant systems
- Located in various parts of building

HVAC

- All air using heat pumps and supplemental electric heat (including lighting)
- Tied to fire suppression whereby floors above and below fire are overpressurized and fire floor is exhausted

FEMA

Building Infrastructure

Water

- Two feeds, one under loading dock
- Storage tanks on mechanical floors

Natural Gas

- 4-inch main to first floor restaurants

Building Infrastructure

Communications

- Three T-3 lines from three providers
- Empty conduits for expansion installed
- Tenants have additional services
- VOIP, satellite, and landline phones in building for outside communication
- Fire Watch phone in stairwells

Building Infrastructure

Physical Security

Security personnel

- 1 person -- Central Security
- 2 rovers

Reception staff

- 2 persons 0600-1800 on business days
- 1 person 1800-0600 on business days or all day on non-business days

Lobby – access to atrium, mailroom, meeting rooms and retail space

Threats/Hazards

Threats include:

Terrorism

- No direct threat specifically identified for HazardCorp Building
- Government, military, finance, and banking tenants in building could be targeted if perceived as soft target
- Collateral damage potential due to nearby potential targets in the area

Intelligence Collection, especially by cyber attack

- Government classified information
- Commercial information

FEMA

Threats/Hazards

Threats (continued):

Crime

- City has much higher crime rate than national averages in most categories

Natural Hazards

- Hurricanes and tornadoes – Almost 100 per year
- Evacuation zone for storm surges
- Earthquakes – Infrequent and low intensity -- old seismic zone 2A
- Lightning – 25 strikes/year on average

Threats/Hazards

Threats (continued):

HazMat

- Chemical and fuel tank farms across river
- Rail lines across river
- Shipping on river
- 2,000 trucks each day within city
- 100 spills and releases each year in city

Other Technological Hazards

- 600 water main breaks per year in city

Design Basis Threat

Explosive Blast: Car Bomb 500 lb TNT equivalent. Truck Bomb 5,000 lb TNT equivalent (Murrah Federal Building class weapon)

Chemical: Large quantity petroleum fire toxic plume from tank farm. Large and small quantity HazMat release (chlorine) from tank farm, tanker truck, and rail car.

Biological: Anthrax delivered by mail or in packages, smallpox distributed by spray mechanism mounted on truck or aircraft in metropolitan area

Radiological: Small “dirty” bomb detonation within the 10-mile radius of the HAZARDCORP building

Levels of Protection

GSA Interagency Security Criteria

Level IV Building – over 450+ employees
-- over 150,000 sq ft

- Perimeter Security
- Entry Security
- Interior Security
- Administrative Procedures
- Blast/Setback Standards

FEMA

Levels of Protection

DoD Antiterrorism Standards

Level of Protection	Potential Structural Damage	Potential Door and Glazing Hazards	Potential Injury
Low	Damage – unrepairable. Major deformation of non-structural elements and secondary structural members and minor deformation of primary structural members, but progressive collapse is unlikely.	Glazing will break, but fall within 1 meter of the wall or otherwise not present a significant fragment hazard. Doors may fail, but they will rebound out of their frames, presenting minimal hazards.	Majority of personnel suffer significant injuries. There may be a few (<10 percent) fatalities.

FEMA

FEMA 426, Adapted from Table 4-1: DoD Minimum Antiterrorism Standards for New Buildings, p. 4-9

Levels of Protection

DoD Antiterrorism Standards

Location	Building Category	Stand-off Distance or Separation Requirements			
		Applicable Level of Protection	Conventional Construction Stand-off Distance	Effective Stand-off Distance	Applicable Explosives Weight
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter	Primary Gathering Building	Low	45 m 148 ft	25 m 82 ft	Car Bomb

FEMA

Adapted from DoD Unified Facilities Criteria (UFC), *"DoD Minimum Antiterrorism Standards for New Buildings", UFC 4-010-01, 31 July 2002*

Levels of Protection

UFC 4-010-01 APPENDIX B DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS	
Standard 1	Minimum Stand-off Distances
Standard 2	Unobstructed Space
Standard 3	Drive-Up/Drop-Off Areas
Standard 4	Access Roads
Standard 5	Parking Beneath Buildings or on Rooftops
Standard 6	Progressive Collapse Avoidance
Standard 7	Structural Isolation
Standard 8	Building Overhangs
Standard 9	Exterior Masonry Walls
Standard 10	Windows, Skylights, and Glazed Doors
Standard 11	Building Entrance Layout
Standard 12	Exterior Doors

Levels of Protection (continued)

UFC 4-010-01 APPENDIX B DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS	
Standard 13	Mailrooms
Standard 14	Roof Access
Standard 15	Overhead Mounted Architectural Features
Standard 16	Air Intakes
Standard 17	Mailroom Ventilation
Standard 18	Emergency Air Distribution Shutoff
Standard 19	Utility Distribution and Installation
Standard 20	Equipment Bracing
Standard 21	Under Building Access
Standard 22	Mass Notification

Unit XII Case Study Activity

Finalization and Presentation of Group Results

Purpose

- Groups finalize their assessments
- Decide on high priority risk concerns
- Determine appropriate mitigation measures
- Present findings to class

Requirements

Based on findings from previous activities, complete the worksheet table

Prepare to present conclusions and justify decisions to class in a 5- to 7-minute presentation

FEMA

Vulnerability/Mitigation

Basis of Mitigation Measures

Recommendations ultimately require an understanding of benefit (capability) versus cost to implement

Blast Modeling

- Various scenarios run at Tier III level for comparison using Design Basis Threats
  - Truck bomb is worst case
  - Car bomb also analyzed for comparison
  - Some interesting and unexpected results
- More analysis required for final design

Vulnerability/Mitigation

Basis of Mitigation Measures

Plume Modeling (CBR or HazMat)

- Tier II / Tier III performed for selected Design Basis Threats external to building, less urban canyon effect
- Additional Tier III analysis required inside building
    - Understand internal pressure changes during building operation
    - Understand on HVAC and other changes implemented in response plans affect the building
    - Supports design of CBR measures

Vulnerability/Mitigation

Basis of Mitigation Measures

Cost Estimates are ROM (Rough Order of Magnitude)

- Assumes 10% Overhead and 10% Profit
- Assumes Area Cost Factor of 1.0 (DoD) or 100 (RS Means)
  - DoD Range: **0.84** (Huntsville AL) to **1.67** (Anchorage AK)
  - RS Means Range: **82.5** (Baton Rouge LA) to **131.9** (New York NY)
  - Adjusted for July 2006
- Anti-Terrorism / Force Protection equipment and construction costing information is still immature

Vulnerability/Mitigation

Site / Vehicle Bomb

Maximize available stand-off

- Plaza side barriers at property line to prevent direct approach into lobby – K12 rating / 408 LF
  - Planters - $ 92K
  - Plinth walls - $207K
  - Bollards - $104K

Vulnerability/Mitigation

Site / Vehicle Bomb

Maximize available stand-off

- Other three sides
  - Continue controlled parking on street
    - Signage - $10K
  - Bollards if no controlled parking
    - K12 rating – North and South 340 LF - $90K
    - K8 rating – West 248 LF - $65K

FEMA

Vulnerability/Mitigation

Site / Vehicle Bomb

Protect loading dock / building

- Hardened vehicle barriers, K12 rating, 3 each
  - Pop-Up   - $405K
  - Drop Arm - $150K

Vulnerability/Mitigation

Site / Vehicle Bomb

Reroute Traffic

- Traffic Study - $20K
- MOUs with tenants / neighbors / police
- Variable road closure or area-wide access control based upon intelligence (Ring of Steel)
- Change west side alley to north travel direction to avoid queuing on main roads for entry to UG building parking

Vulnerability/Mitigation

Site / Vehicle Bomb

Segregate UG parking for access control

- Controlled under building – tenants/vetted only
- Public under plaza (public parking is a premium in urban area)
- Hardened vehicle barriers at under building entrance / exit
  - Drop Arms K8 rating, 2 each - $96K
- Signage to denote public and tenant/staff UG parking entrances - $2K

Vulnerability/Mitigation

Architectural / Vehicle Bomb

Access control for loading dock

- Additional security at loading dock, includes screening at curb
  - 2 personnel, 8 hour shift – $188K/year
- Pre-screening away from building
  - Pre-engineered bldg – $ 36K
  - 2 personnel, 8 hour shift – $188K/year
- Time of day access (2000 to 0400)
  - 4 personnel, 8 hour shift - $376K/year
- Apply individually or collectively

FEMA

Vulnerability/Mitigation

Architectural / Vehicle Bomb

Segregate UG parking for access control

- Electronic or manned access control under building
  - Electronic (Card Scanner & PIN) – $12K
  - Manned
    - Small Shelter - $5K
    - 2 Personnel, 24/7 - $790K/year

Vulnerability/Mitigation

Architectual / Vehicle Bomb

Strengthen overhead anchorage elements

- HVAC diffusers, light fixtures, etc.
  - First three floors - $950K
- Canopy at main entrance
  - Requires additional design information
  - $950K

Vulnerability/Mitigation

Architectural + Security / Vehicle Bomb

Move Security Control to 4th floor or install backup location on 4th floor

- >> $1M
- Alarms, communications, CCTV, building operating systems (SCADA, EMCS), and Fire Control

FEMA

Vulnerability/Mitigation

Architectural / Access Control

Lobby redesign

- Channel all entrances to screening location(s) with up to 12 checkpoints for throughput
- $2.5M

Close off retail space access to Lobby

- Convert to crash bar with alarm, 3 doors - $1.5K
- Lobby redesign may overcome need

Armed guards manning screening equipment in lobby

- Up to 36 guards with 3 guards per checkpoint at peak times based upon throughput
- $8.7M/year

Vulnerability/Mitigation

Structural Systems / Vehicle Bomb

Perform blast analysis – perimeter building columns

- Existing – W14x455 steel columns, 96 total
- Upgrade on Floors 1 and 2 – Encase in 4,000 psi concrete and ¼” steel wrap - $980K

Harden loading dock to protect rest of building – below achieves low LOP

- 12” R/C, #8-4”O.C. both faces, ½” steel plate on ceiling and floor - $510K
- Adds protection of fuel tanks under loading dock, evaluate need for additional measures

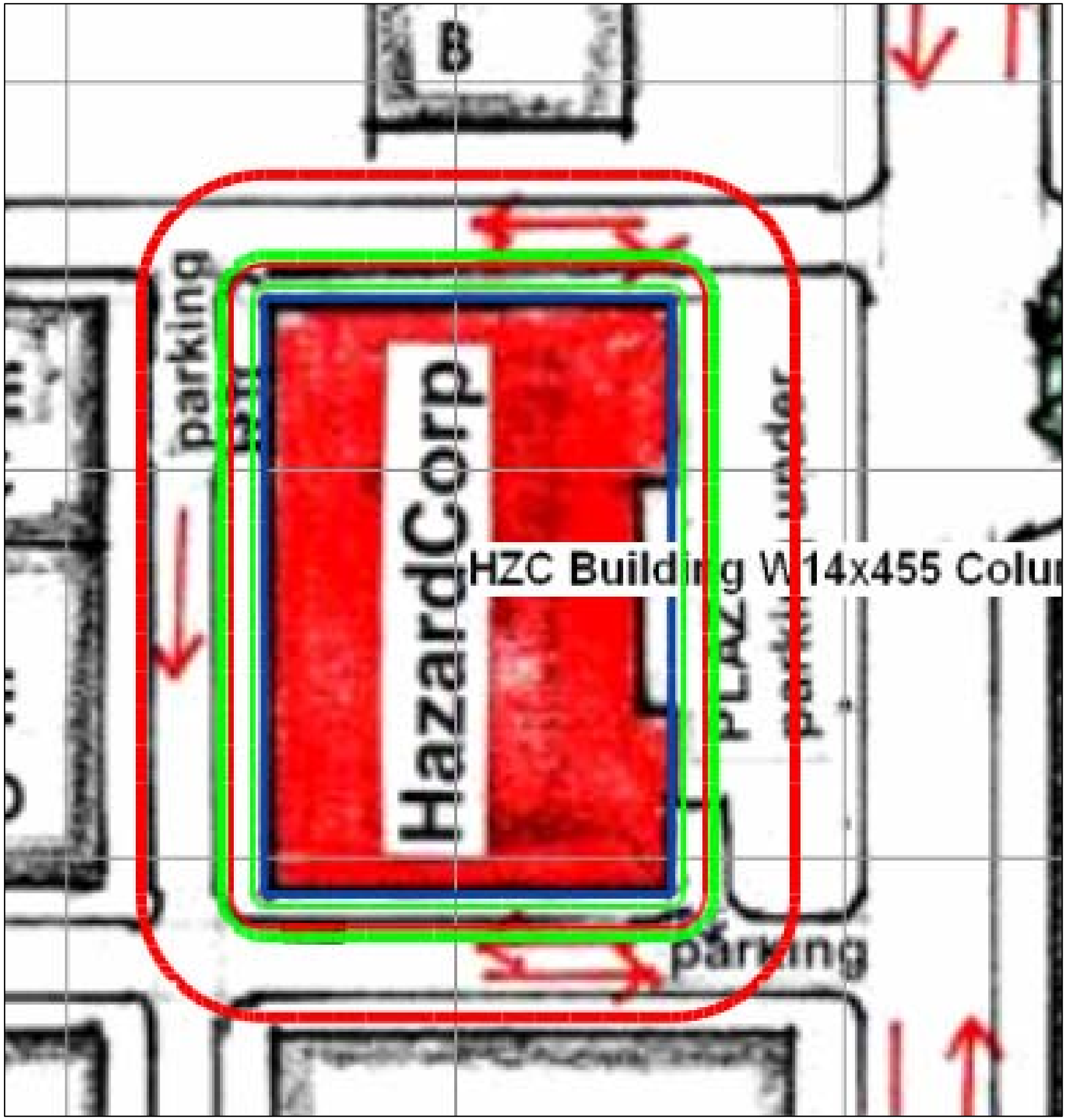
Column Hardening

Original Columns

- Large DBT – 52 ft
- Small DBT – 14 ft

Hardened Columns

- Large DBT – 18 ft
- Small DBT -- 5 ft



Vulnerability/Mitigation

Structural Systems / Vehicle Bomb

Segregate UG parking for access control

- Harden columns on all underground levels along first building line nearest public access
  - 4,000 PSI concrete and ¼" steel wrap, 21 columns
    - $635K
  - Consider all columns at all UG parking levels under building based upon progressive collapse
    - Add $2.6M to above

FEMA

Vulnerability/Mitigation

Structural Systems / Vehicle Bomb

Segregate UG parking for access control

- Hardened wall between vetted and public parking, 248 LF per level, <u>3 levels – totaled below</u>
  - 12” R/C, #8-4”O.C., both faces - $2.06M
  - One vehicle barrier per level, K8 rating - $145K

Vulnerability/Mitigation

Structural Systems / Vehicle Bomb

Perform blast analysis atrium columns – harden against progressive collapse

- Existing – W14x455 steel columns, 16 total
- Upgrade on Floor 1 only – Encase in 4,000 psi concrete and ¼" steel wrap - $467K

Provide architectural stand-off around columns

- Gypsum board on metal studs
- 1' off column (GSA 6" required)
- 16 columns, first floor only - $50K

Vulnerability/Mitigation

Building Envelope / Vehicle Bomb

Perform blast analysis – glazing and frame upgrades

- Existing 172 windows/floor, nominal 5’ x 5’
  - Floors 1-3, 3/8” TTG SP
  - Floors 4-8, ¼” DS SP
  - Floors 9-50, 3/8” DS SP
- Upgraded – Note Federal floors are 8-13 and 27-28
  - Floors 1-7, 1” TTG LAM SP – $12M
  - Floor 8, 3/8” TTG SP from Floors 1-3 with 15 mil FRF – $560K
  - Floors 9-13, 27-28 Existing with 15 mil FRF - $710K

Window Hardening – Floor 1

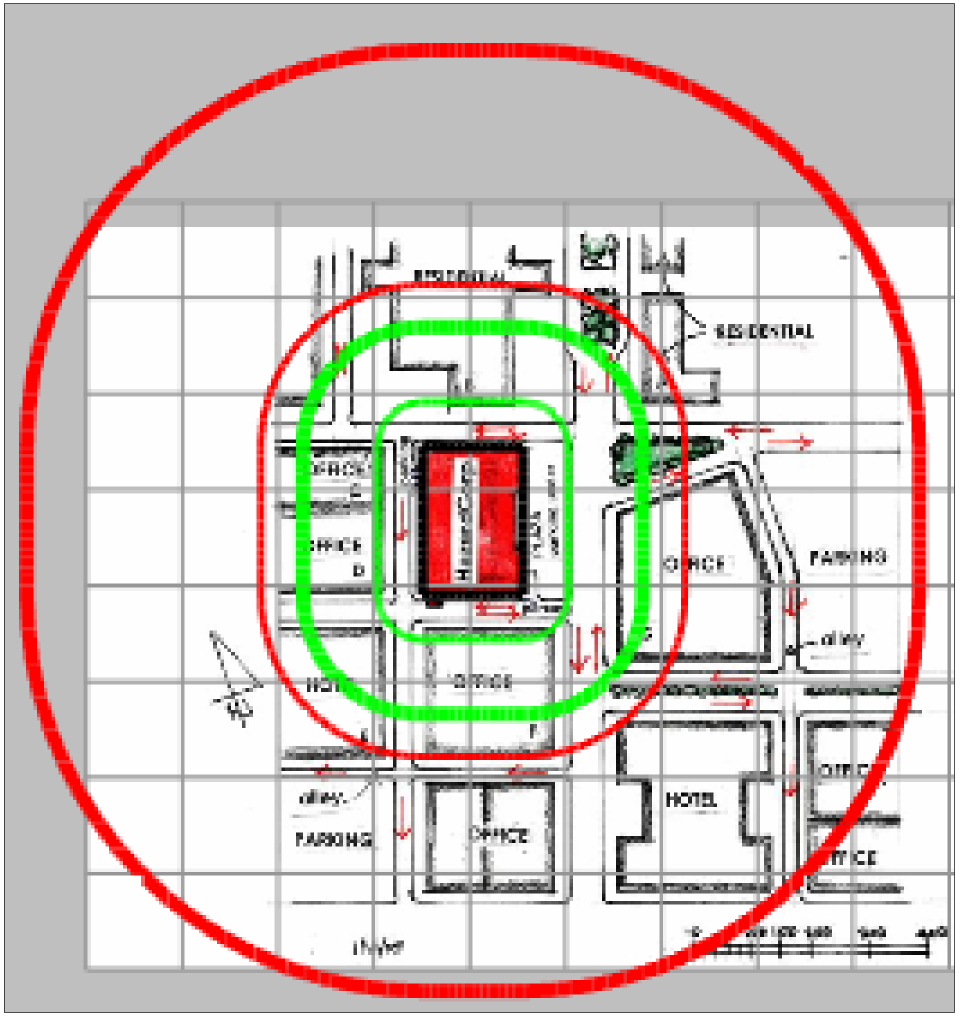
Original glazing meets GSA minimum

Original Glazing

- Large DBT– 678 ft
- Small DBT– 277 ft

Hardened Glazing

- Large DBT– 205 ft
- Small DBT– 77 ft



Window Hardening – Floor 7

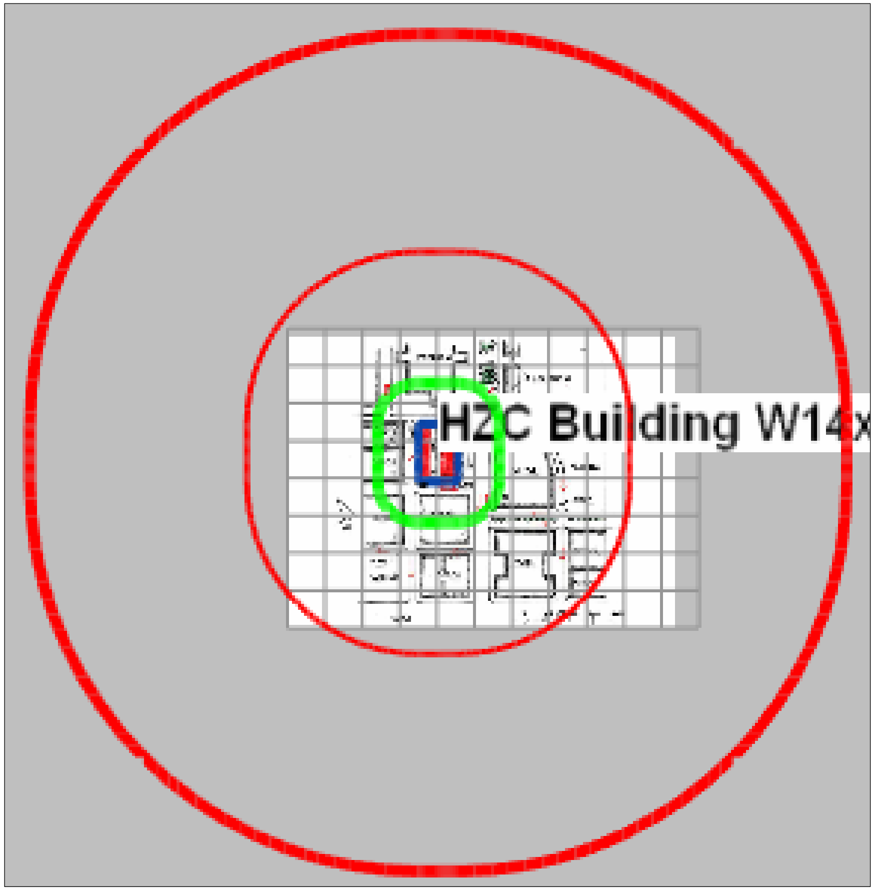
Original glazing requires 15-mil FRF to meet GSA minimum

Original Glazing

- Large DBT– 1,707+ ft
- Small DBT– 755 ft

Hardened Glazing

- Large DBT– 180 ft
- Small DBT– GSA 1 / 2



FEMA

Window Hardening – Floor 8

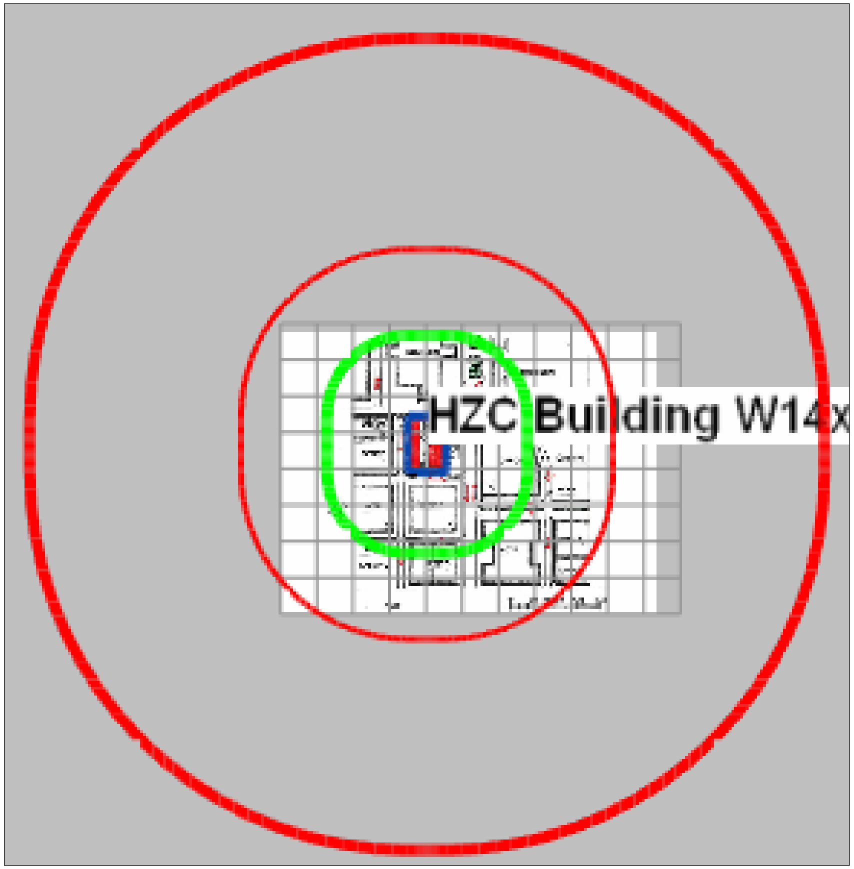
Original glazing requires 15-mil FRF w/4-sided attachment to meet GSA minimum

Original Glazing

- Large DBT–1,707+ ft
- Small DBT– 755 ft

Hardened Glazing

- Large DBT– 366 ft
- Small DBT– GSA 1 / 2



FEMA

Window Hardening – Floor 9

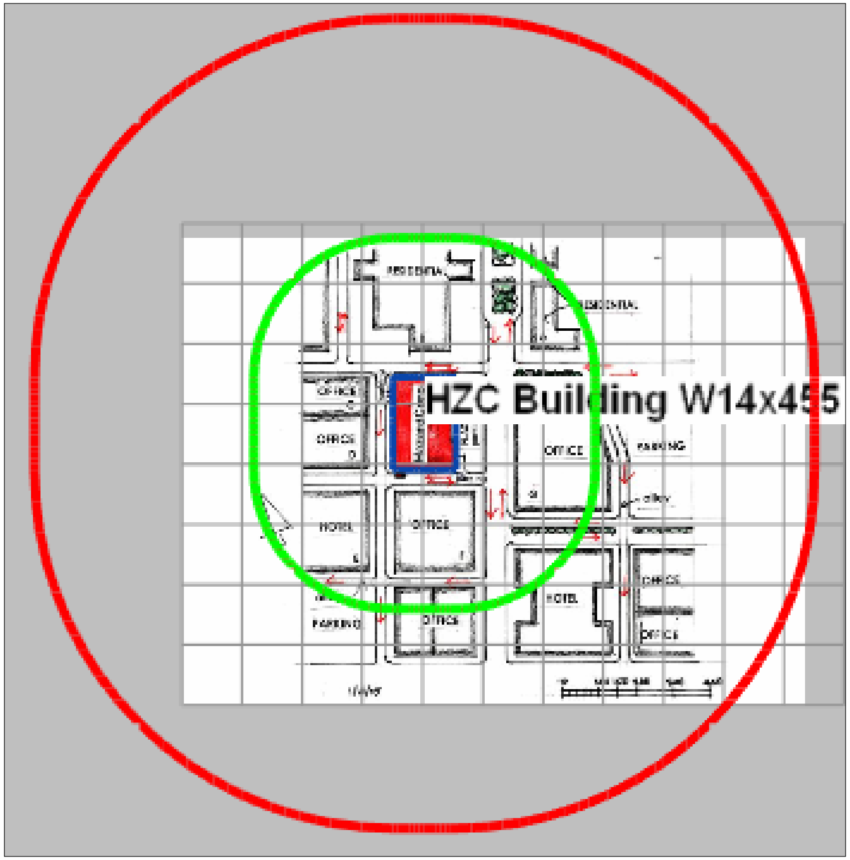
Original glazing requires 15-mil FRF w/4-sided attachment to meet GSA minimum

Original Glazing

- Large DBT– 977 ft
- Small DBT– 380 ft

Hardened Glazing

- Large DBT– 379 ft
- Small DBT– GSA 1 to 3b



FEMA

Window Hardening – Floor 13

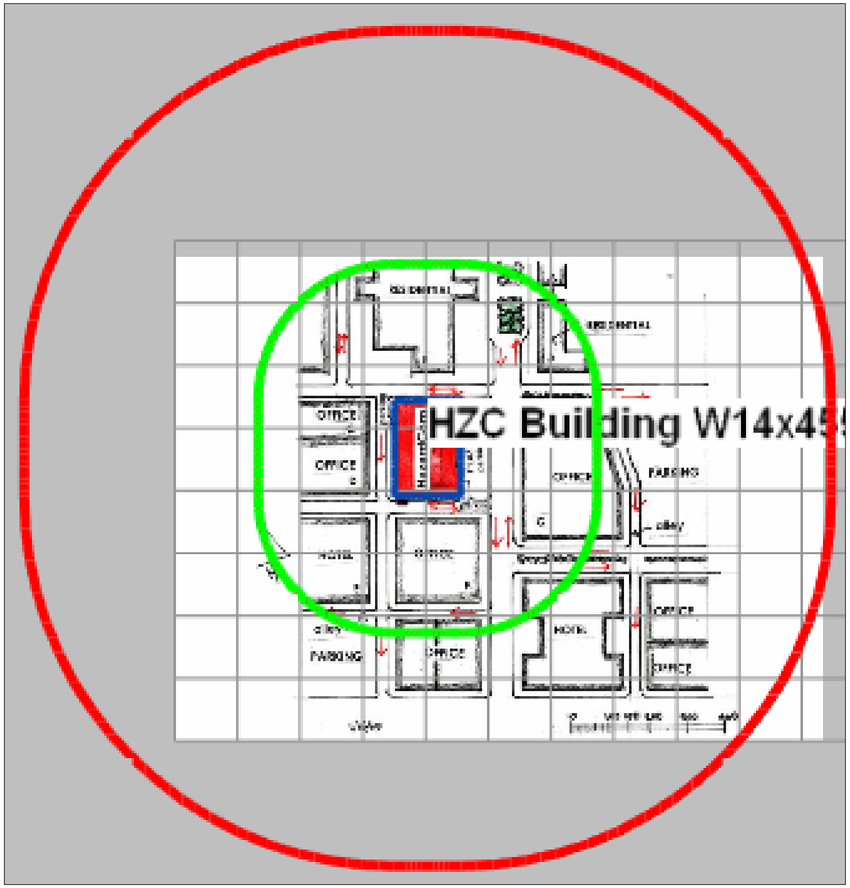
Original glazing requires 15-mil FRF w/4-sided attachment to meet GSA minimum

Original Glazing

- Large DBT– 970 ft
- Small DBT– 359 ft

Hardened Glazing

- Large DBT– 358 ft
- Small DBT– GSA 1 / 2



Window Hardening – Floor 27

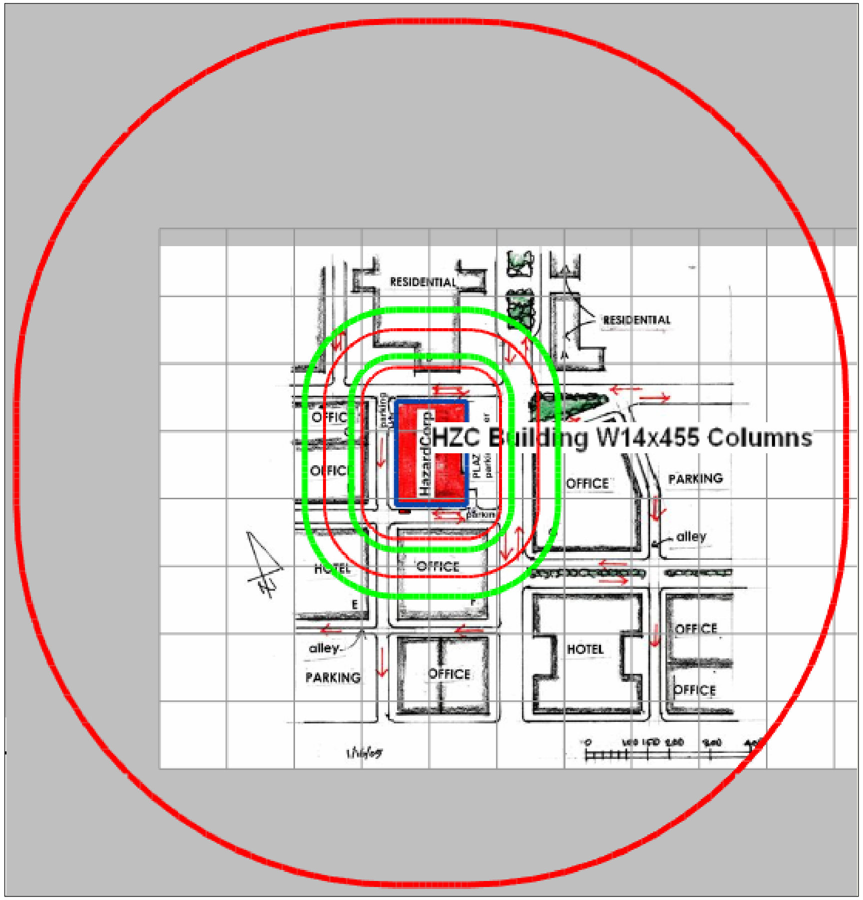
Original glazing requires 15-mil FRF w/4-sided attachment to meet GSA minimum

Original Glazing

- Large DBT– 923 ft
- Small DBT– 82/174 ft

Hardened Glazing

- Large DBT– 109/222 ft
- Small DBT– GSA 1 / 2



FEMA

Vulnerability/Mitigation

Utility Systems / Vehicle Bomb

Harden all utilities entering site as transiting UG parking, 1’ x 1’ cross section

- 3/8” steel plate welded with access panels and hangars - $250/LF

Set up preplanned contingency fuel deliveries for emergency generators with other supplier(s)

Vulnerability/Mitigation

Mechanical / CBR Attack

Install emergency shut down switches – all fans

- At each floor accessible to fire wardens - $22K per floor
- Security Control and backup location - $22K per floor in addition to fire warden capability
- Total for building: $2.2M

Vulnerability/Mitigation

Mechanical / CBR Attack

Install elevator controls in Security Control and backup location

- Evacuation support (up or down)
- Shut down to prevent pumping of contaminants throughout building
- Total for 31 elevators: $775K

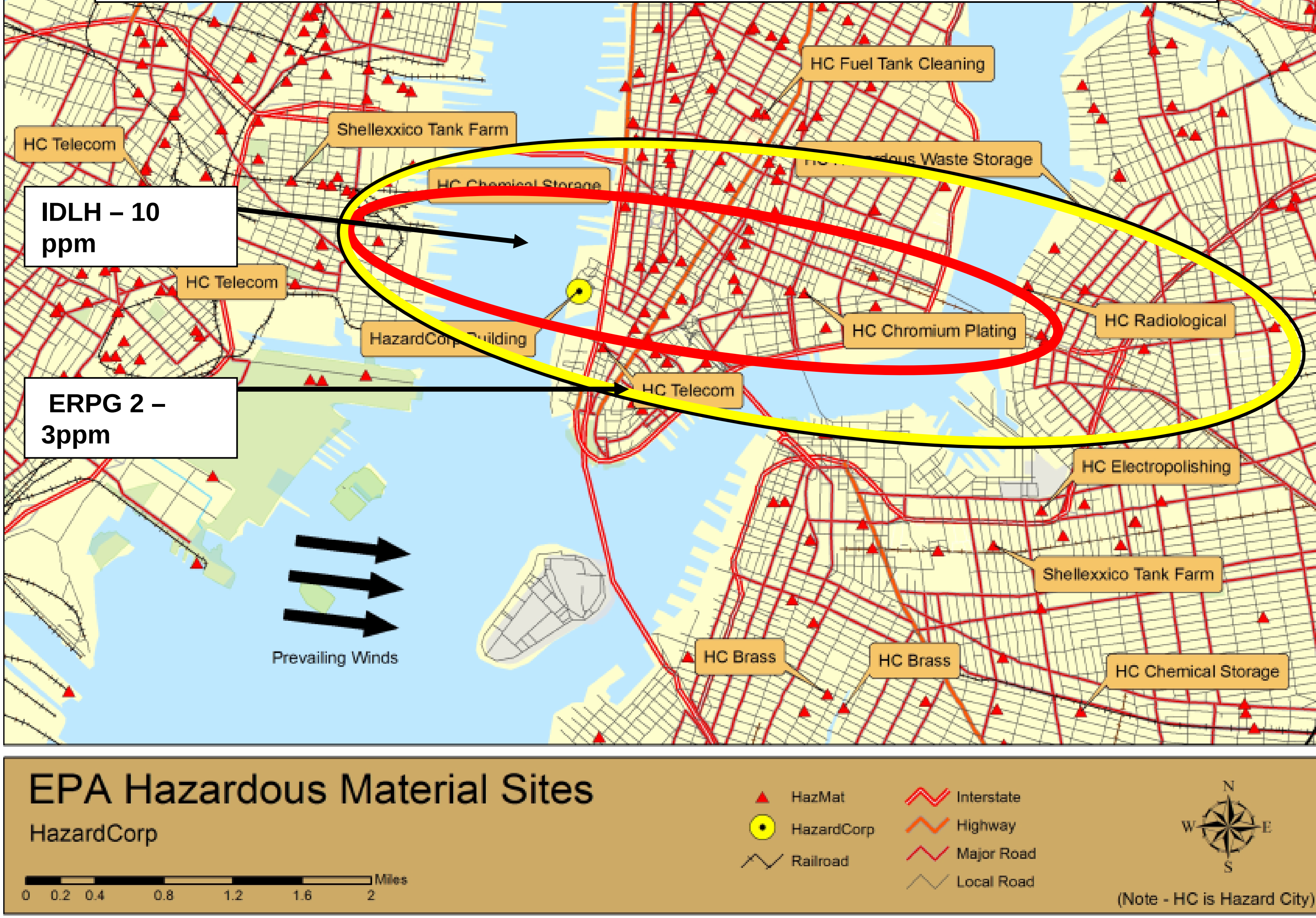
Vulnerability/Mitigation

Mechanical / CBR Attack (Chemical and Radiological)

Evaluate carbon filters for chlorine-type spills

- Analysis of heavier or lighter than air contaminants
- $135K per air handler (two to four air handlers per floor)

5,000 gallons of chlorine released 1.5 miles upwind of HZC Bldg



FEMA

HZC Chlorine Release Parameters

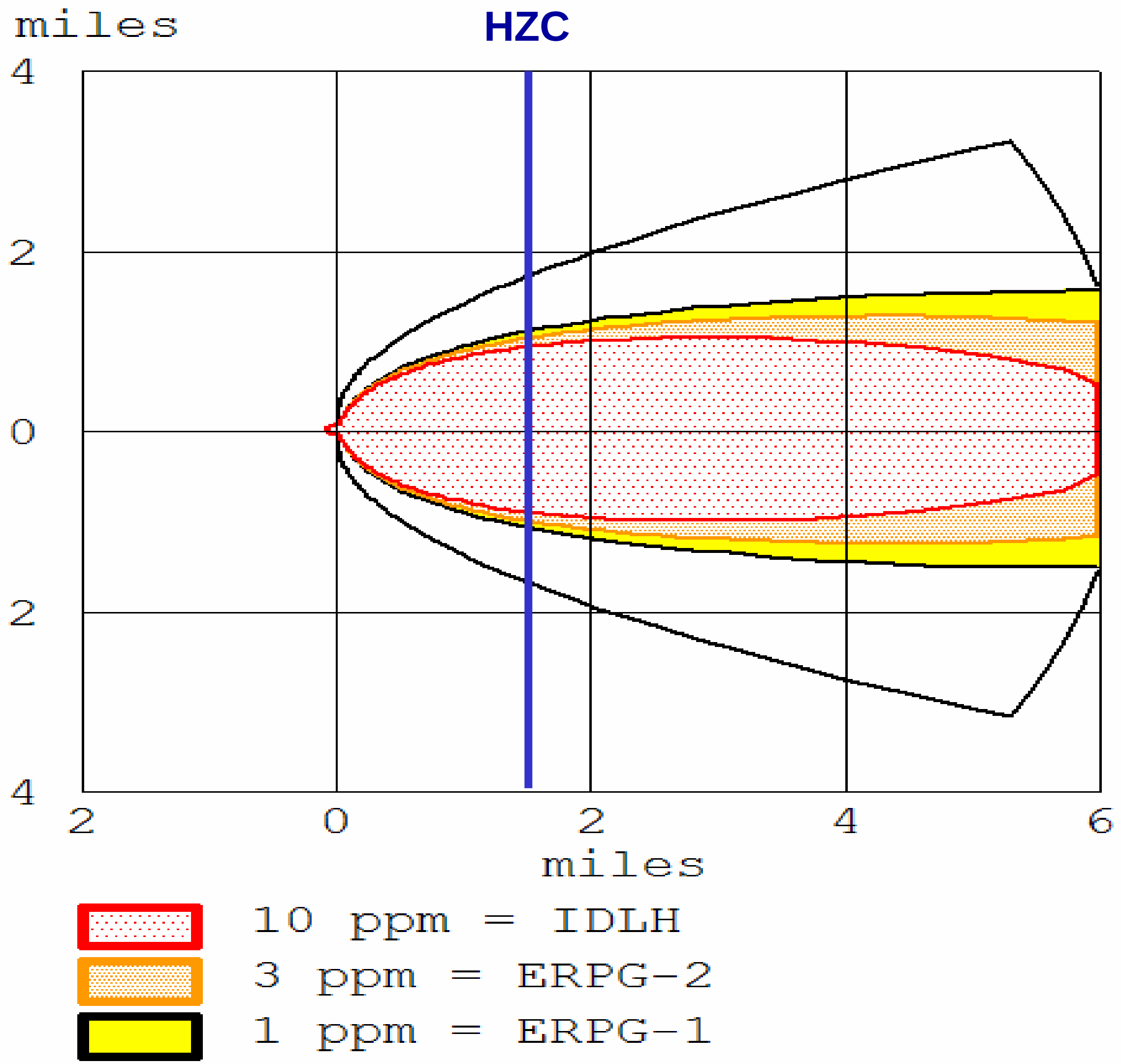
SITE DATA INFORMATION:
Location: JERSEY CITY, NEW JERSEY
Building Air Exchanges Per Hour: 0.50 (enclosed office)
Time: June 30, 2005 0937 hours EDT (user specified)

CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.91 g/mol
ERPG-3: 20 ppm ERPG-2: 3 ppm ERPG-1: 1 ppm
IDLH: 10 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: -29.3° F Ambient Boiling Point: -29.3° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

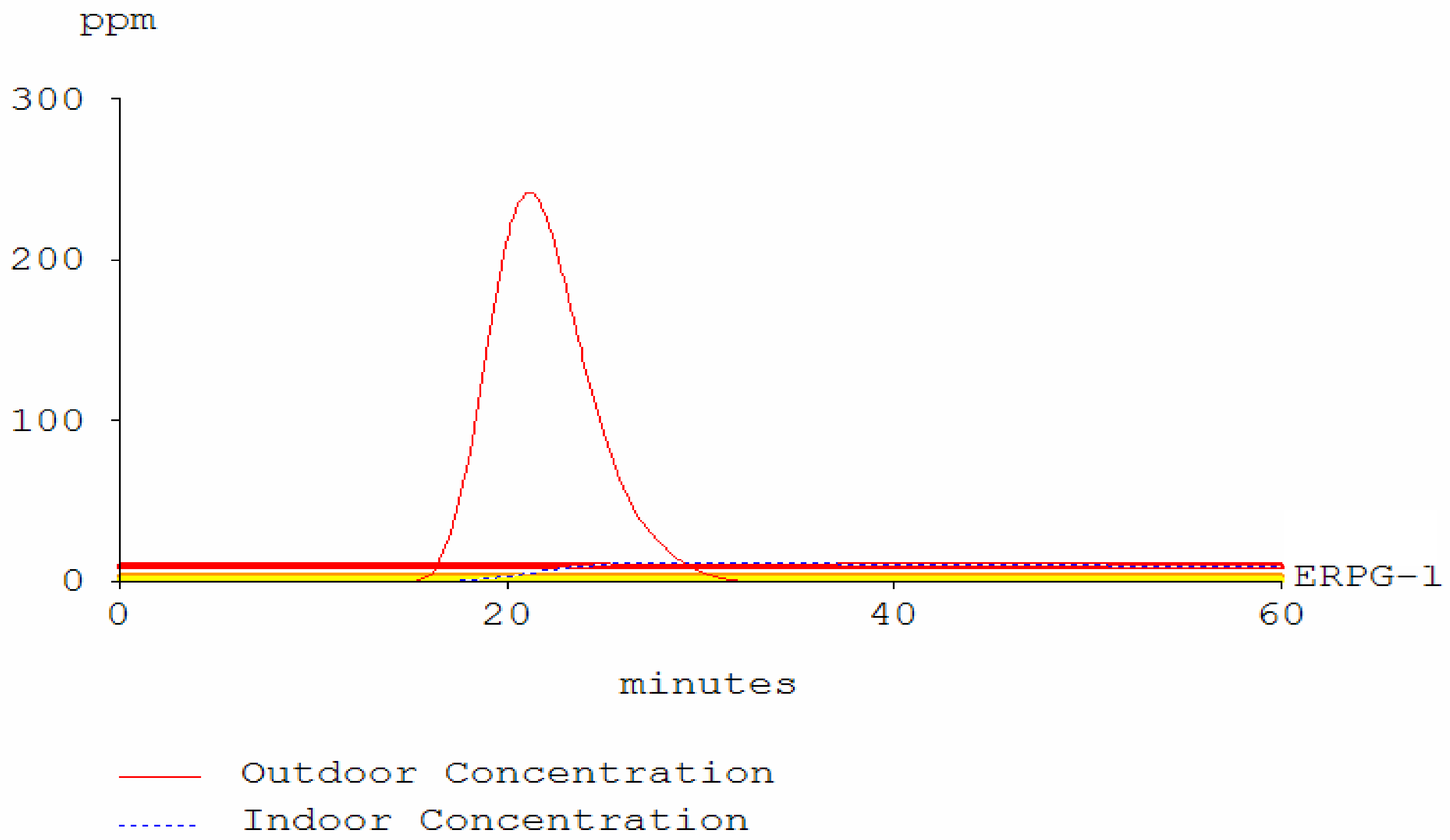
ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 7 mph from 280° true at 3 meters
No Inversion Height
Stability Class: C Air Temperature: 70° F
Relative Humidity: 50% Ground Roughness: open country
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Leak from hole in horizontal cylindrical tank
Tank Diameter: 8 feet Tank Length: 39.9 feet
Tank Volume: 15000 gallons Tank contains liquid
Internal Temperature: 70° F
Chemical Mass in Tank: 88.0 tons Tank is 100% full
Circular Opening Diameter: 6 inches
Opening is 6 inches from tank bottom
Release Duration: 5 minutes
Max Average Sustained Release Rate: 60,900 pounds/min
(averaged over a minute or more)
Total Amount Released: 174,826 pounds
Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

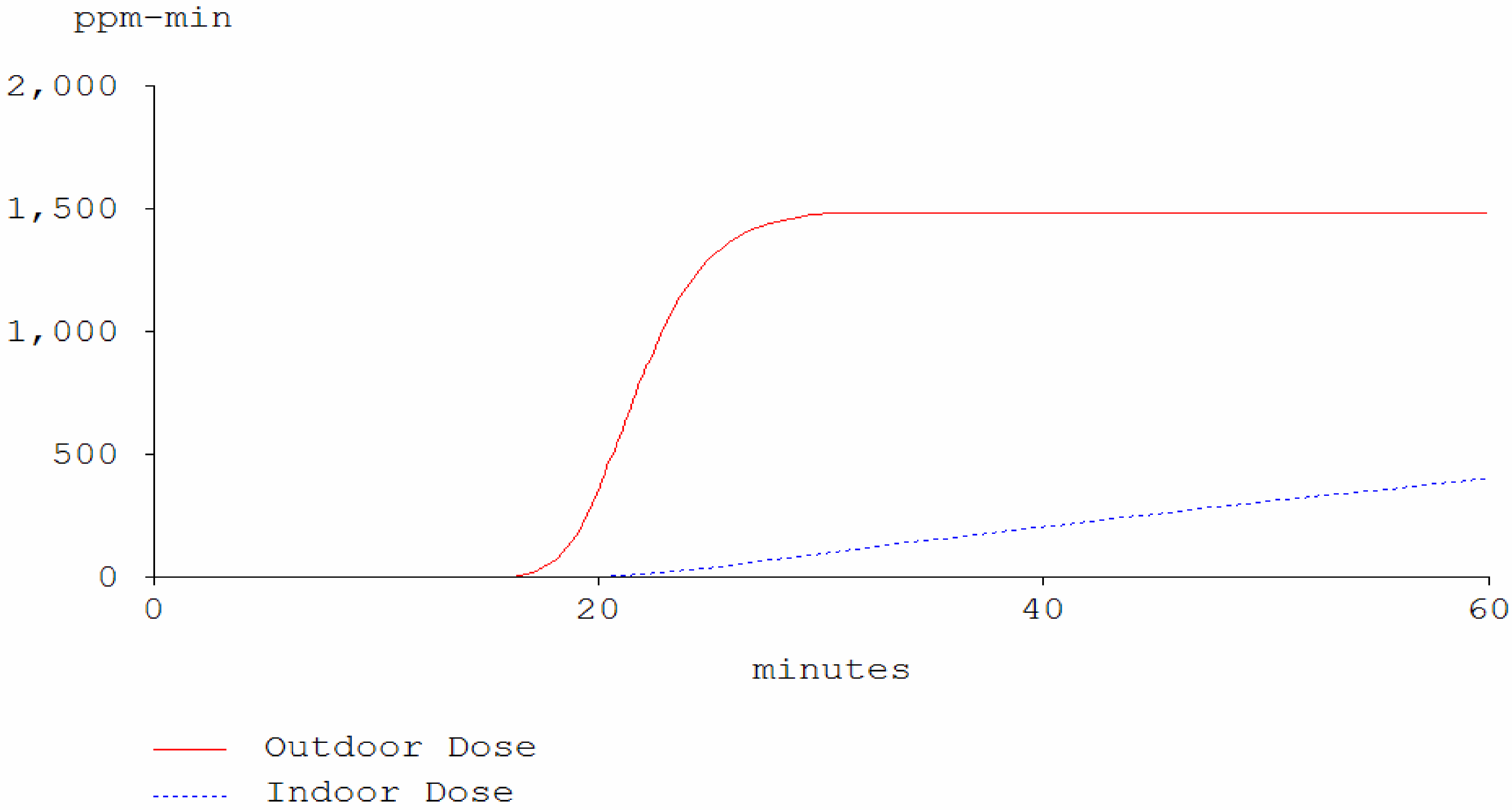
Railroad Tanker Chlorine Release



Chlorine Concentration at HZC



Chlorine Dose at HZC



Vulnerability/Mitigation

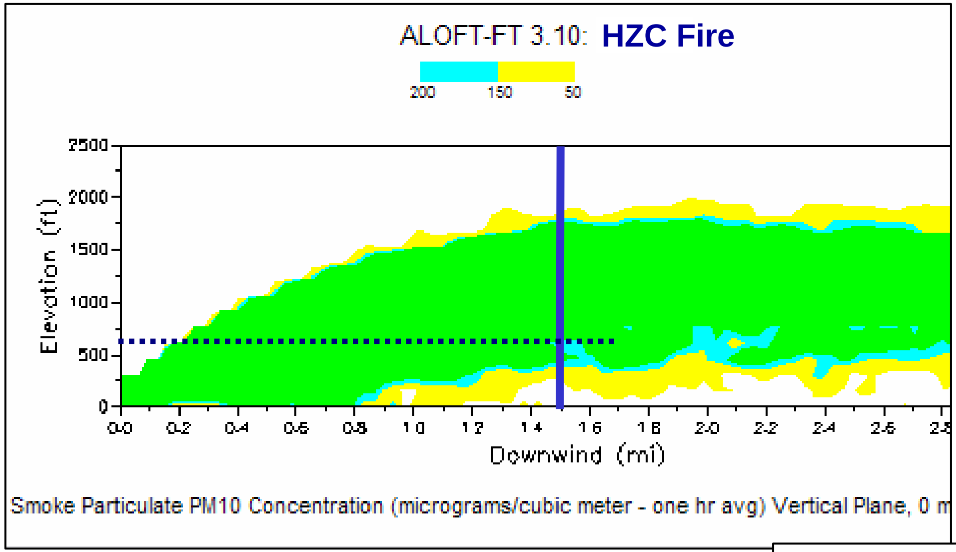
Mechanical / CBR Attack (Chemical and Radiological)

Upgrade filters to MERV 11, 12 or 13 to remove particulates / CBR

- Confirm pressure drop can be handled or upgrade fan equipment
- $50K to $1.2M+ per floor

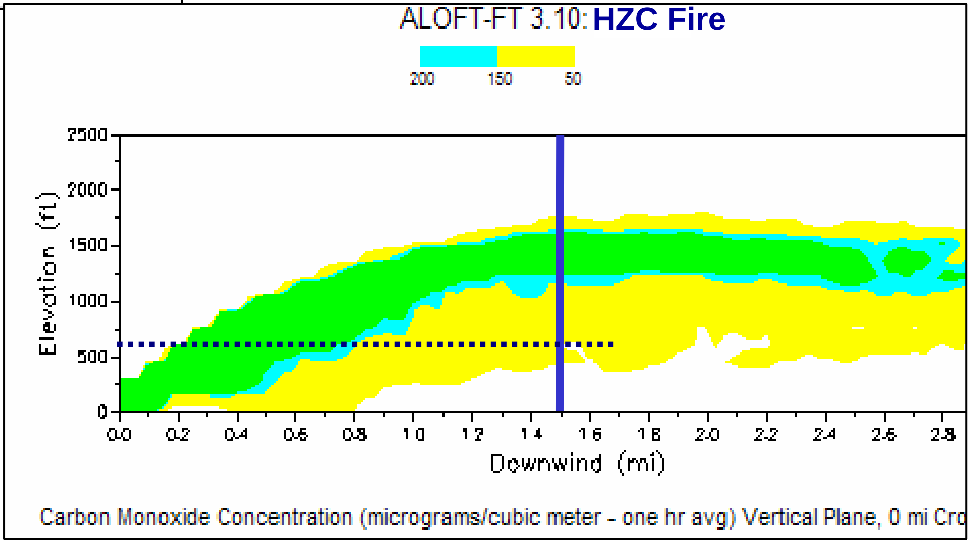
FEMA

Fire Plumes – Smoke & CO



Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Vertical Plane, 0 m

Smoke



Carbon Monoxide Concentration (micrograms/cubic meter - one hr avg) Vertical Plane, 0 mi Cro

Carbon Monoxide

IDLH for CO is 1,200 ppm

FEMA

Vulnerability/Mitigation

Mechanical / CBR Attack (Chemical and Radiological)

Install chemical/radiological detectors

- Activate HVAC shutdown and alarm
- $15K to $100K per floor for each type, with radiological less expensive

Vulnerability/Mitigation

Mechanical / CBR Attack

Redesign HVAC for lobby

- Separate system, like mailroom - $620K

Design safe rooms / shelter-in-place locations with filtered air units operated when shelter activated

- $200K per floor for 170 people

Vulnerability/Mitigation

Mechanical / CBR Attack (Biological)

Evaluate Ultraviolet Germicidal Irradiation (UVGI)

- $4.9M for complete facility

CBR General

Establish Occupant Emergency Plans for CBR external and internal releases

- Part of Building Management overhead

Vulnerability/Mitigation

Security Systems / Generic Measures

Expanded and upgraded CCTV coverage

- Perimeter - $415K
- Stairwells (not pan/tilt/zoom) - $800K
  - UG Parking, Lobby, Federal Floors
  - Include coverage of access keypads
- UG parking - $555K
- With appropriate sensors (motion, noise, door contact) to aid monitoring

Vulnerability/Mitigation

Security Systems / Generic Measures

Panic / duress alarms – for general public

- Place sign at each keypad
- Reprogram system to indicate duress/problem by pressing 911*
- Keypads linked to CCTV monitoring system for alarm
- Keypads added to plaza UG parking levels with CCTV coverage

Vulnerability/Mitigation

Equipment Ops and Maintenance / Vehicle Bomb or Armed attack

Confirm sufficient fuel capacity for emergency generators to cover longest historical outage

- Starting estimate: 0.08 gal/KW/hr
- Once per year measure consumption at normal to high load
- Coordinate timely resupply