

*BUILDING DESIGN FOR HOMELAND SECURITY COOP T-t-T*

# Unit IV

# Vulnerability Assessment



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# Vulnerability

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



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# 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.



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# Vulnerability Assessment

**Identify** site and building systems design issues

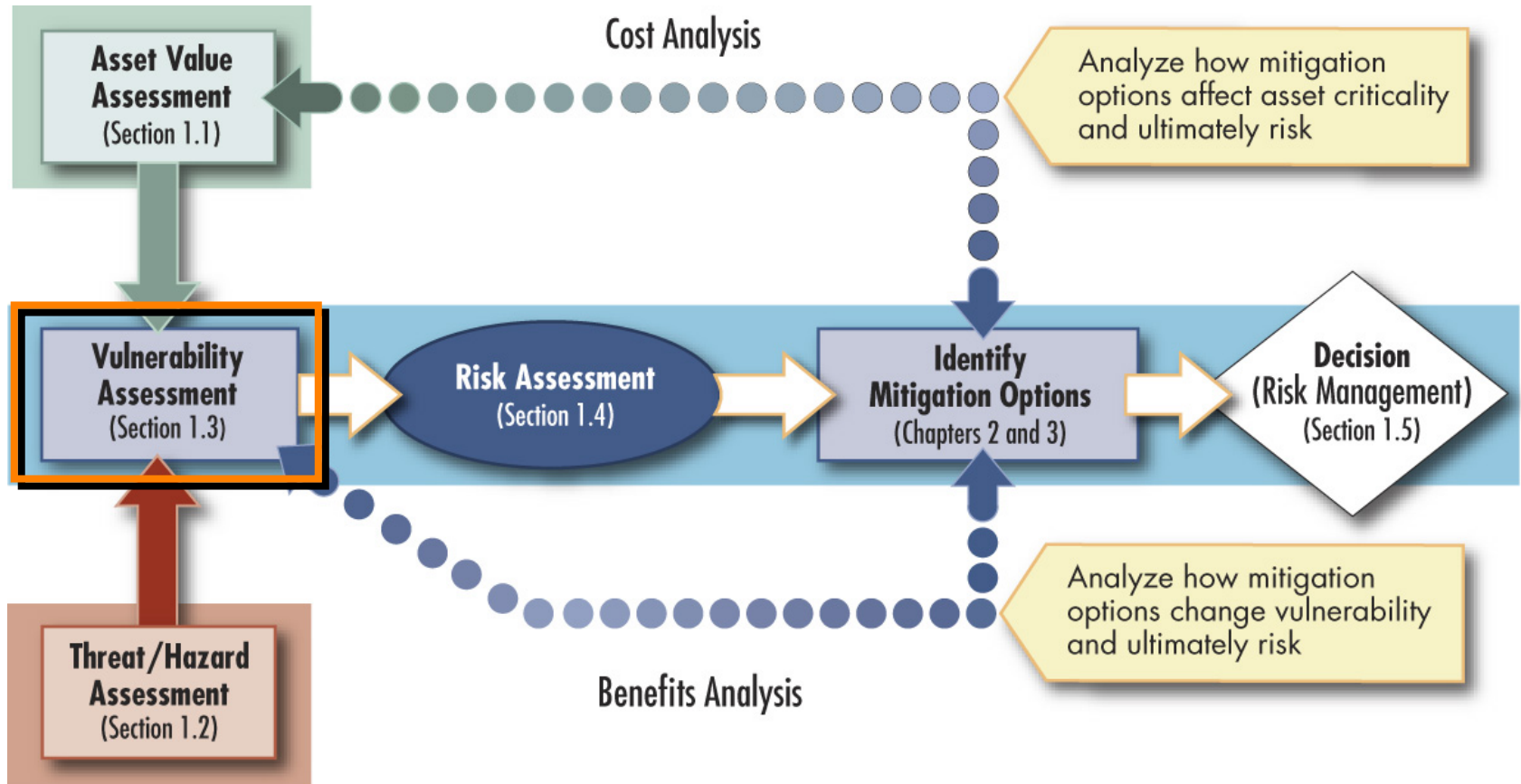
**Evaluate** design issues against type and level of threat

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



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# Assessment Flow Chart



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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



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# Vulnerability Assessment Preparation

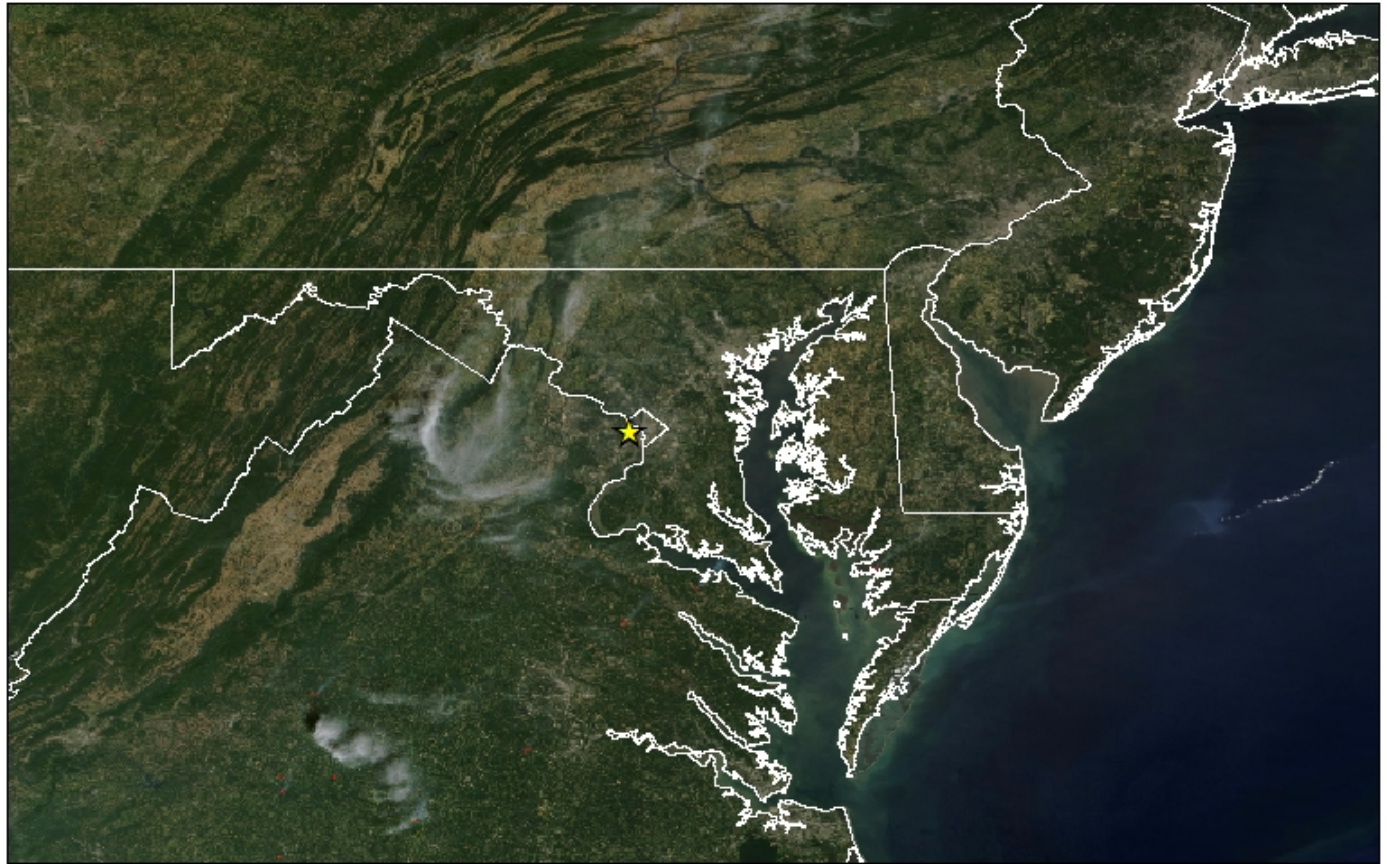
Coordinate with the building stakeholders:

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



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# Assessment GIS Portfolio



Arlington County Assessments  
Arlington County - Virginia



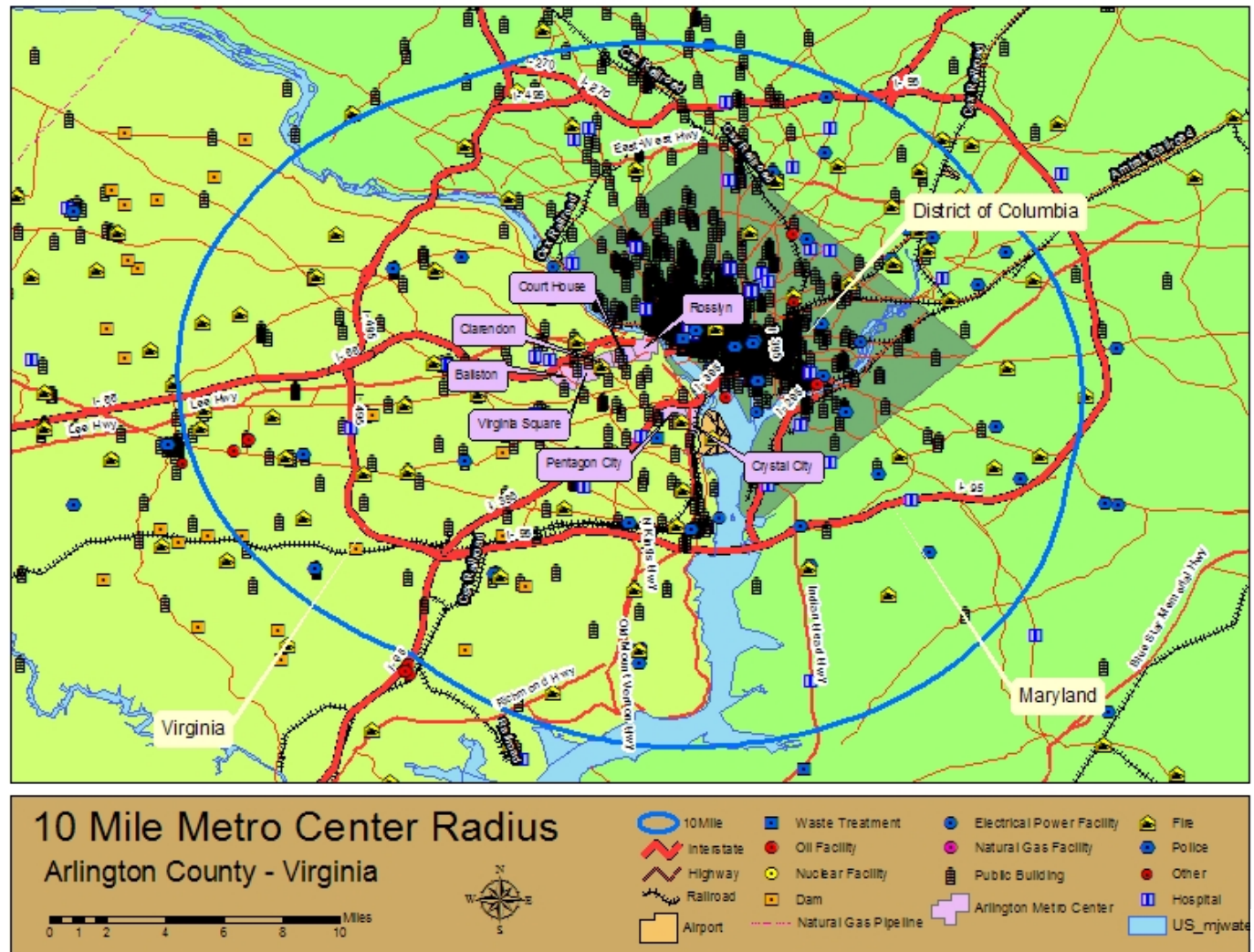
★ Arlington County



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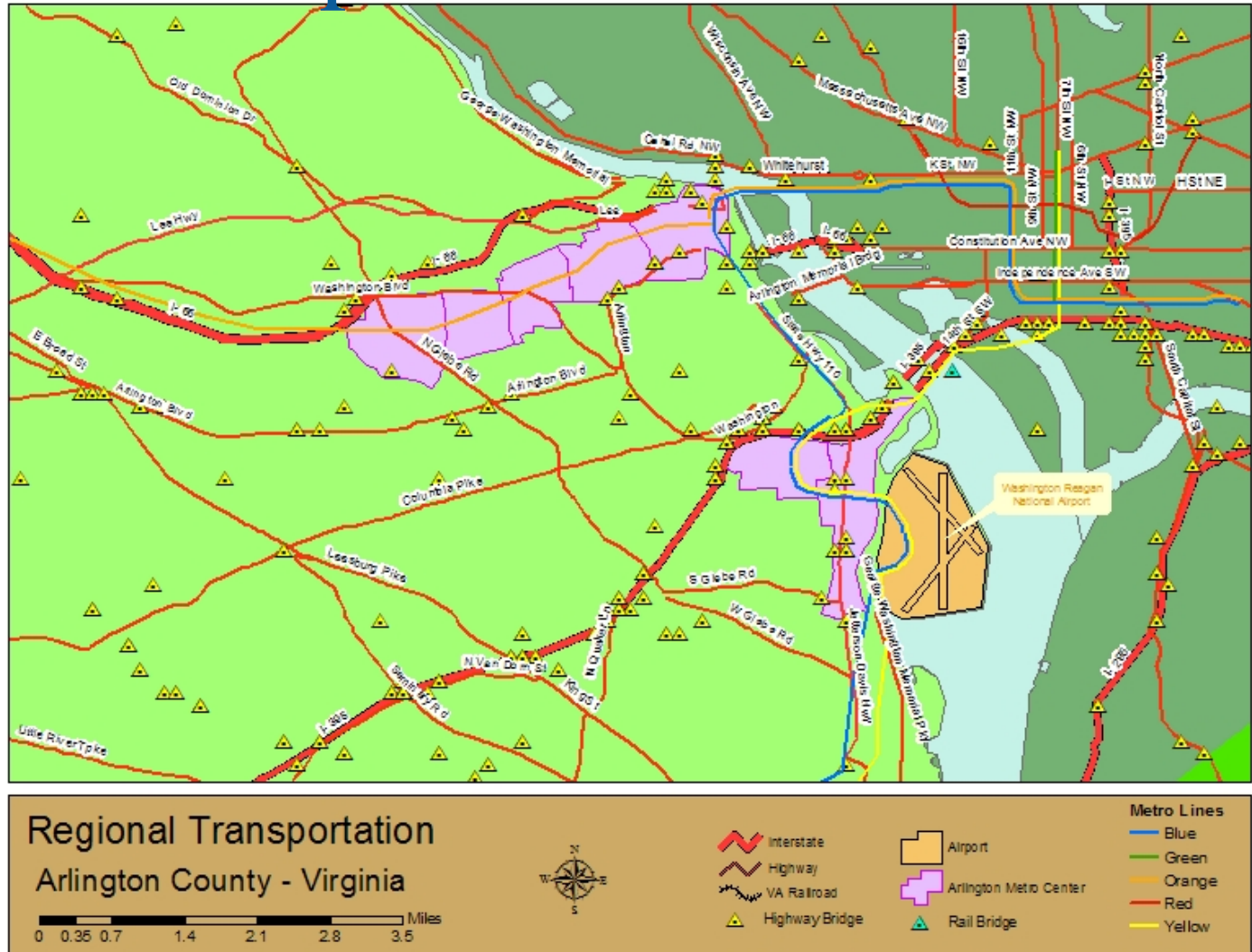


# 10-Mile Radius



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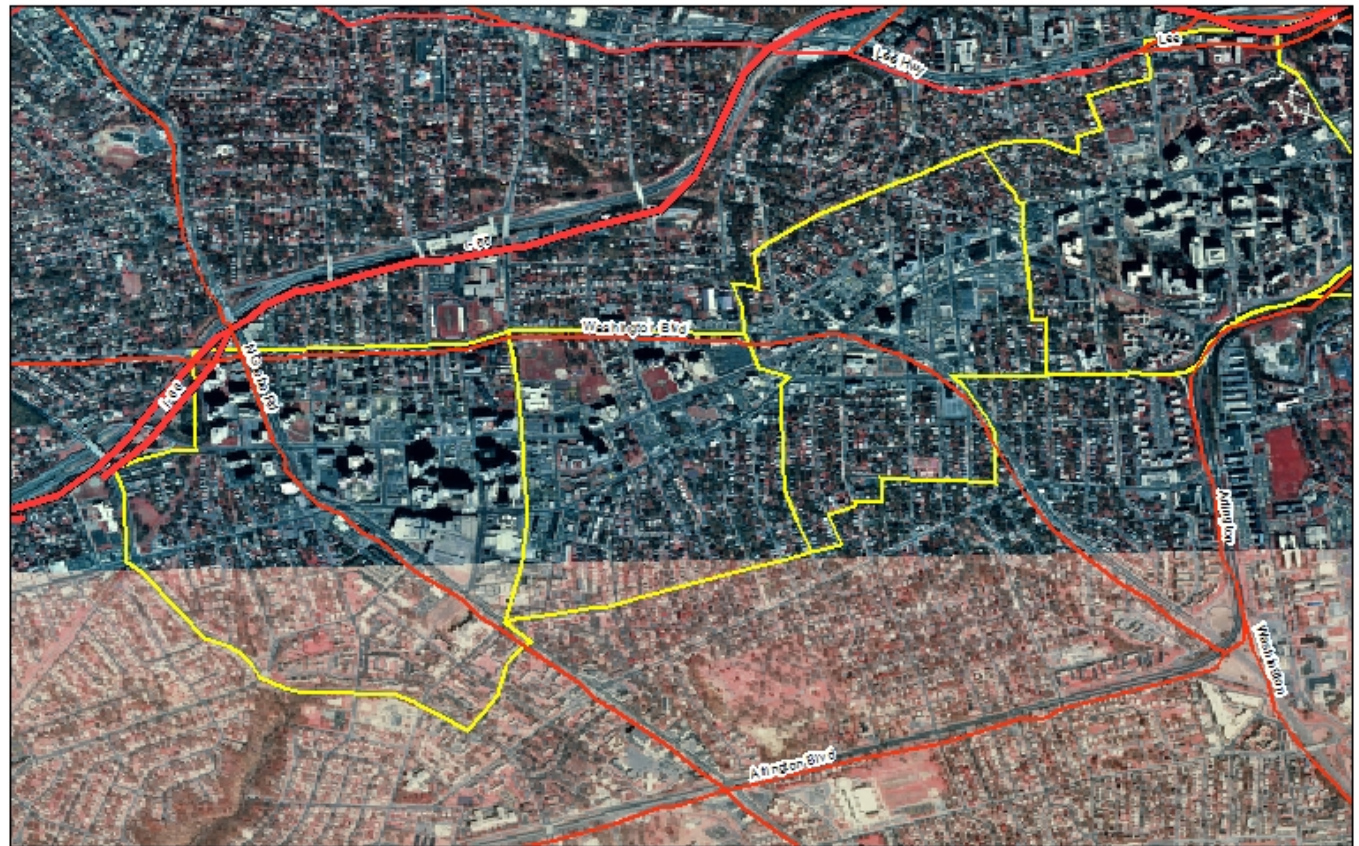
# Regional Transportation



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# Metro Center Imagery



Metro Center Imagery

Arlington County - Virginia

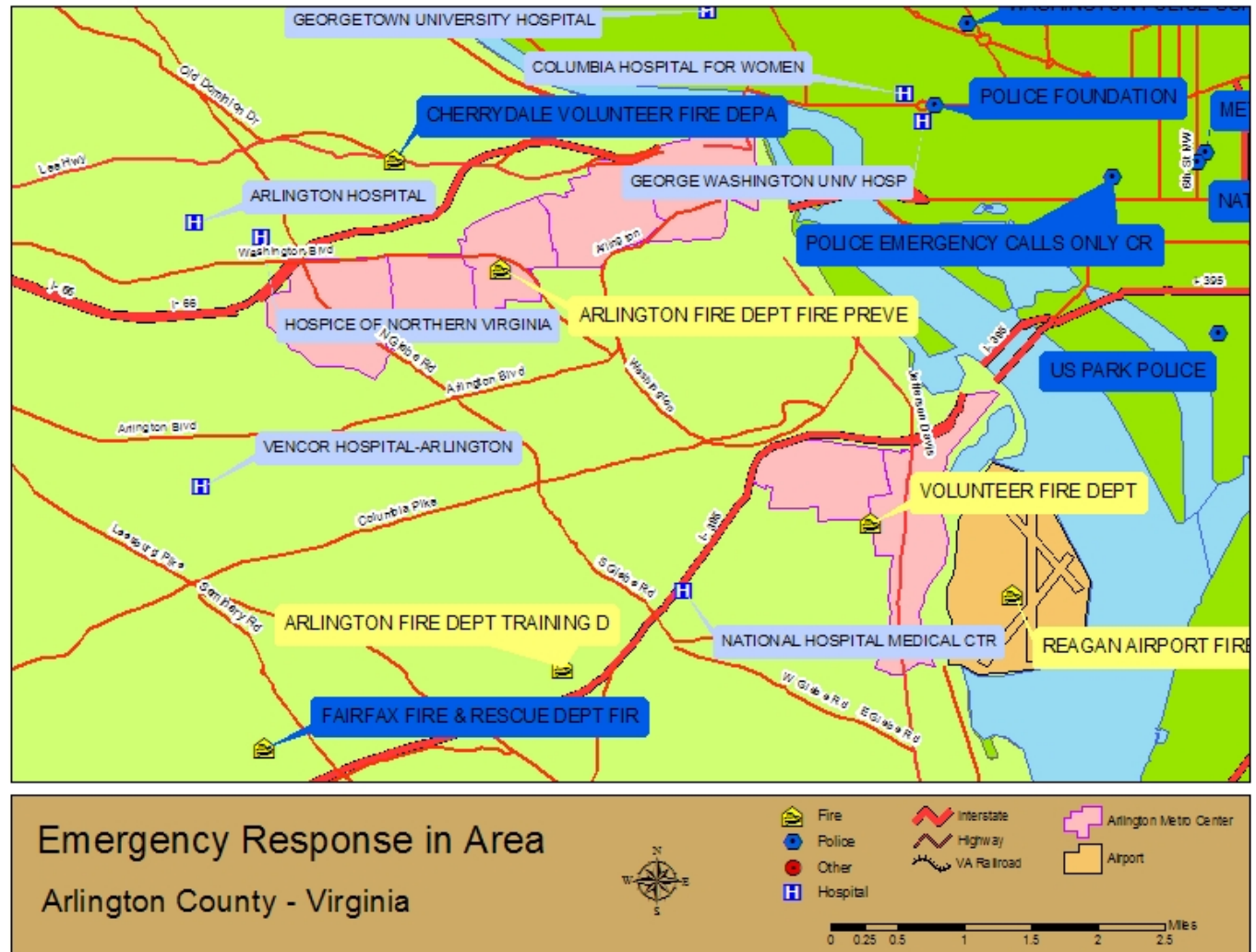


-  Interstate
-  Highway
-  VA Railroad
-  Arlington Metro Center



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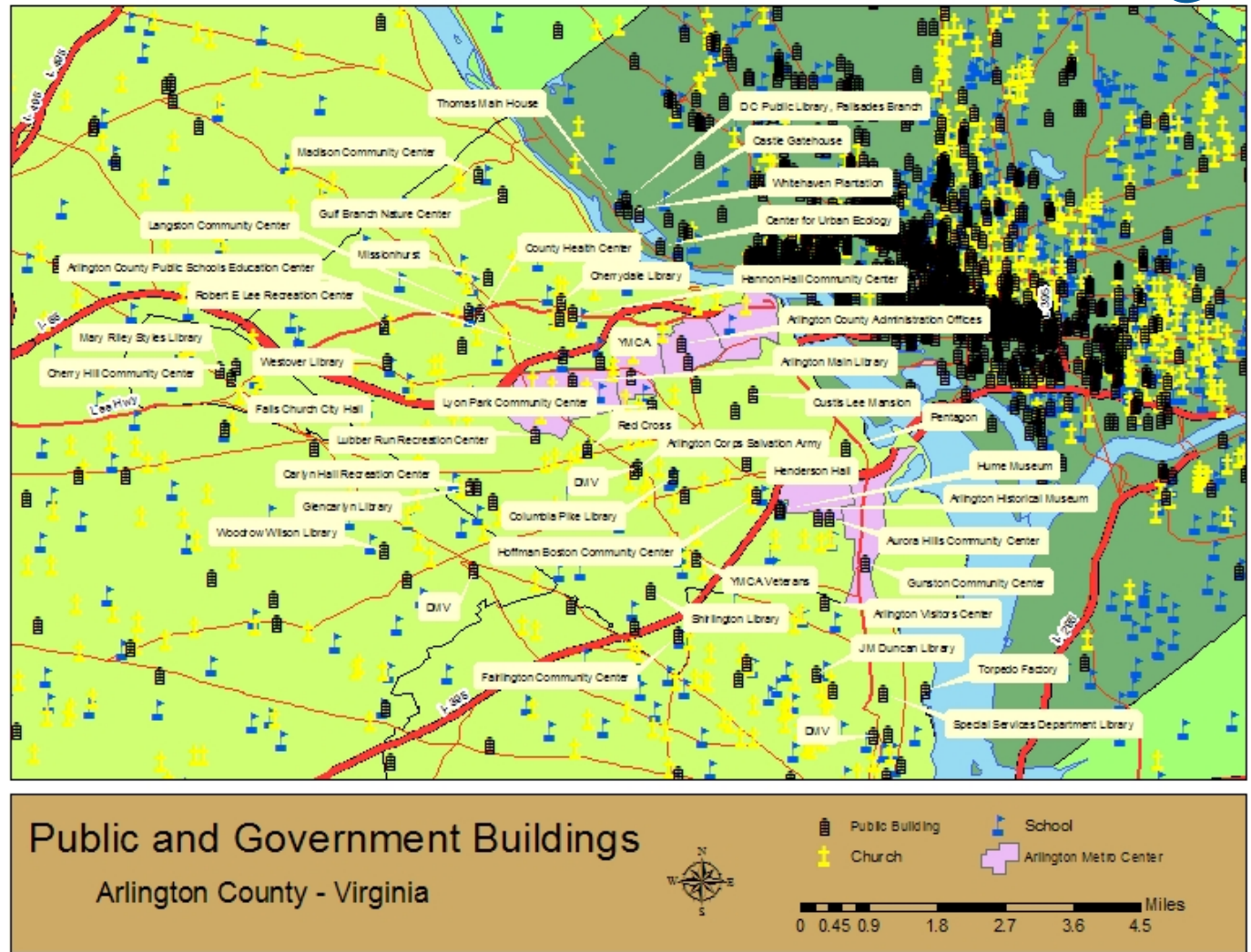
# Site Emergency Response



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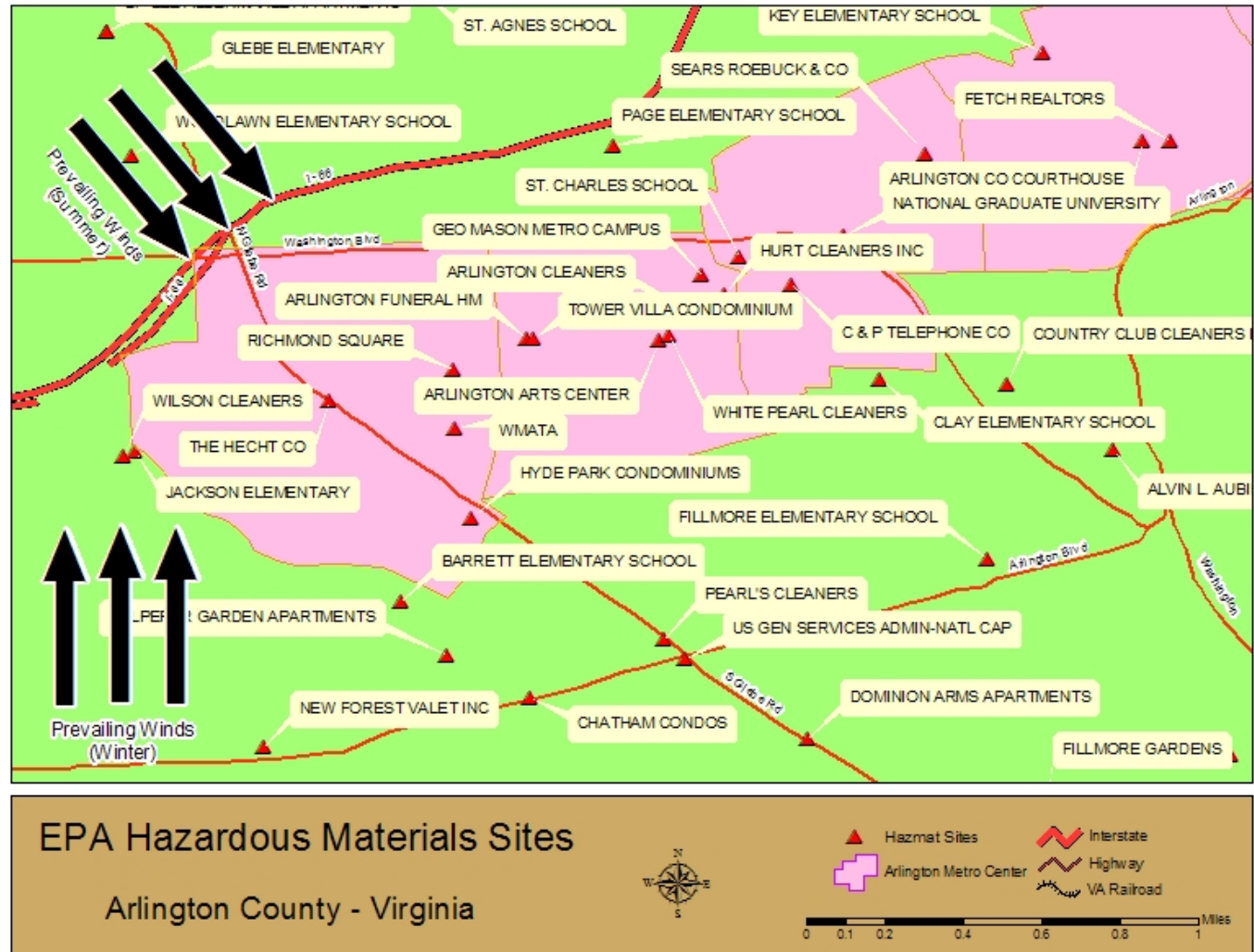


# Site Public and Government Buildings



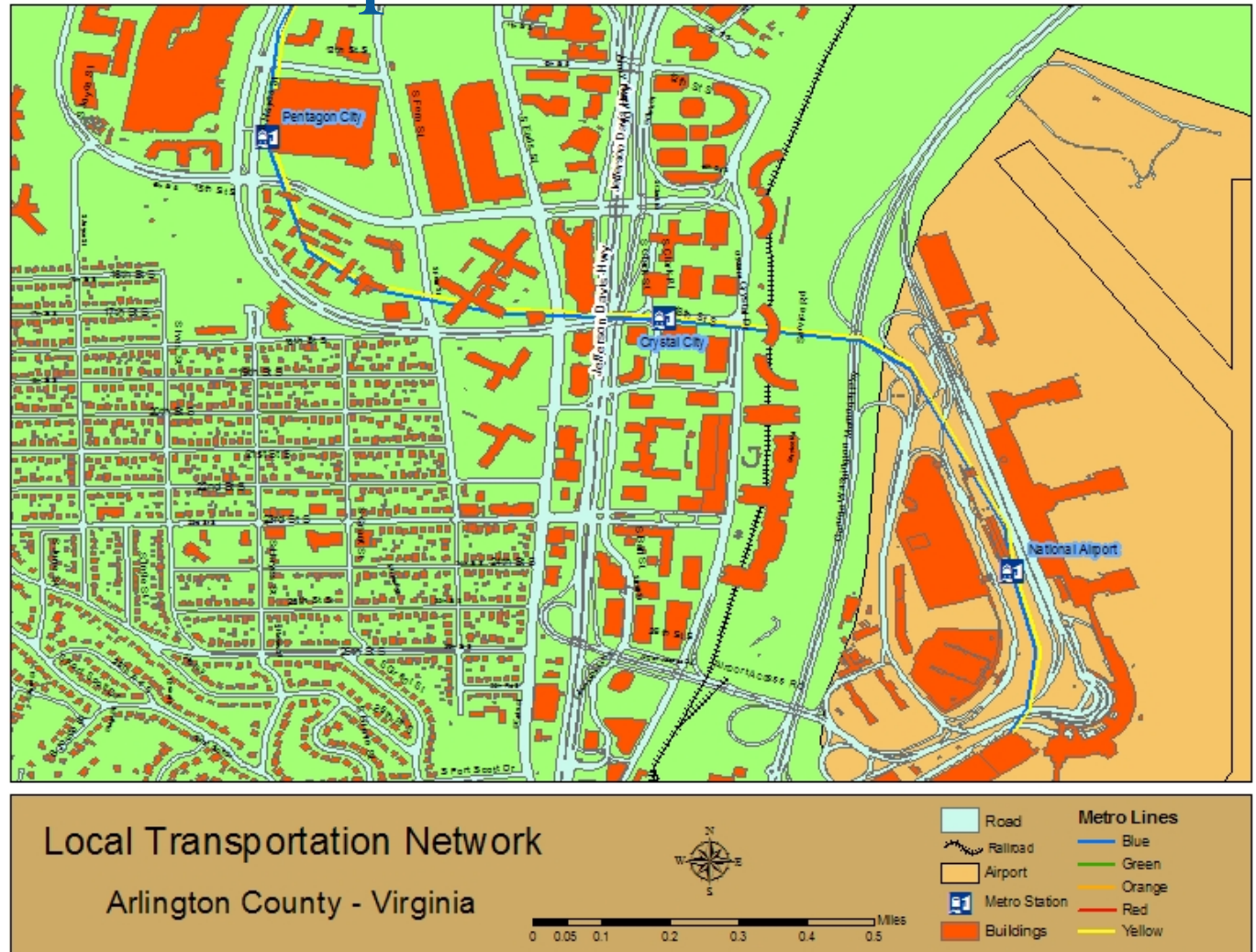
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# Site HazMat



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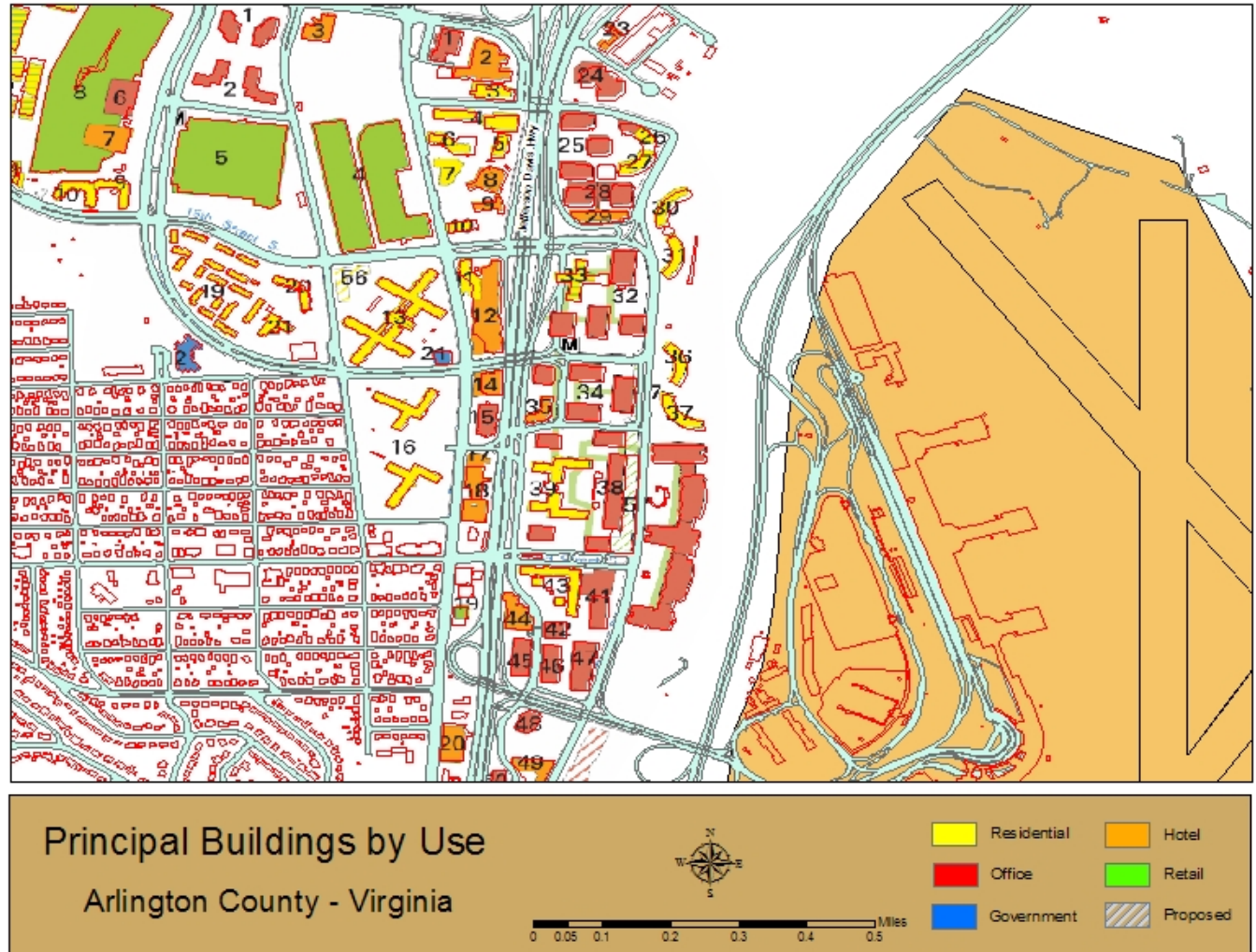
# Site Local Transportation Network



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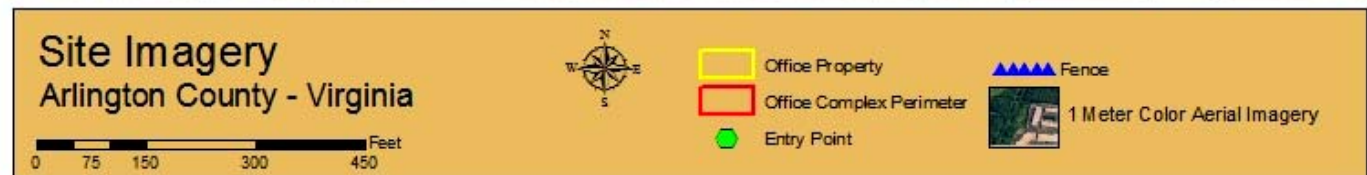
# Site Principal Buildings by Use



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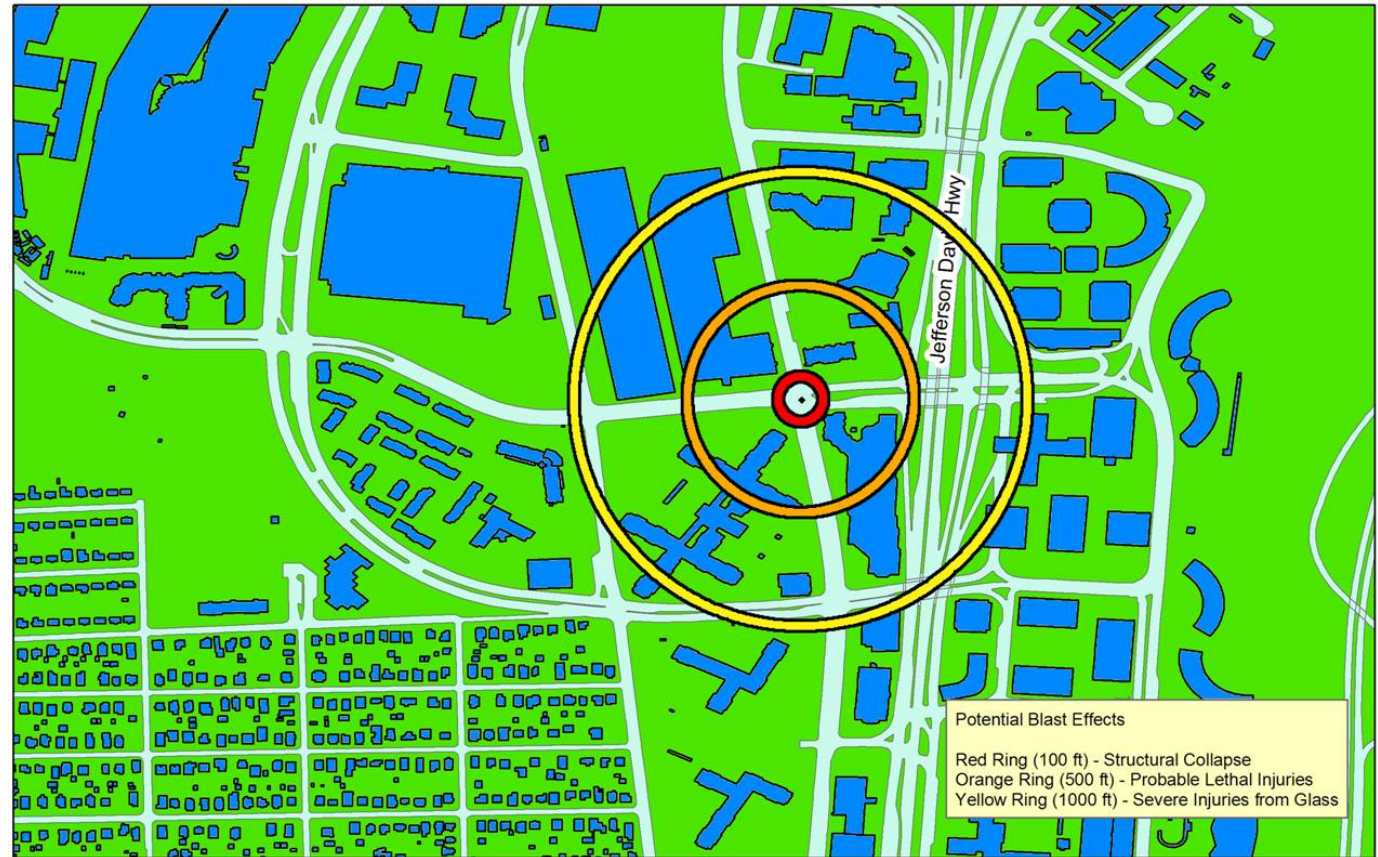


# Site Perimeter Imagery



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# Site Truck Bomb



Potential Blast Effects - Nominal Large Truck Bomb

Arlington County - Virginia



Building

Road

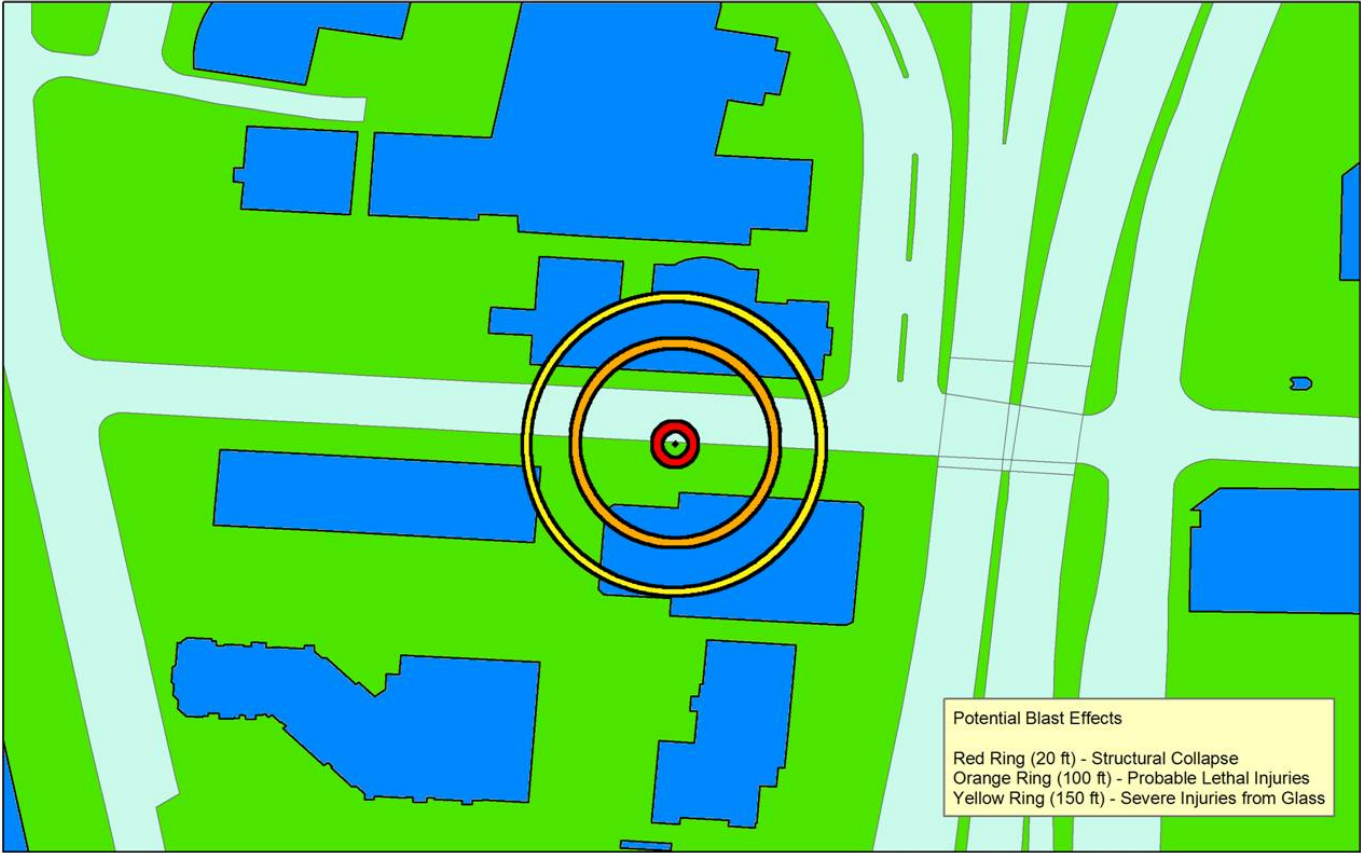
0 162.5 325 650 975 1,300 1,625 Feet



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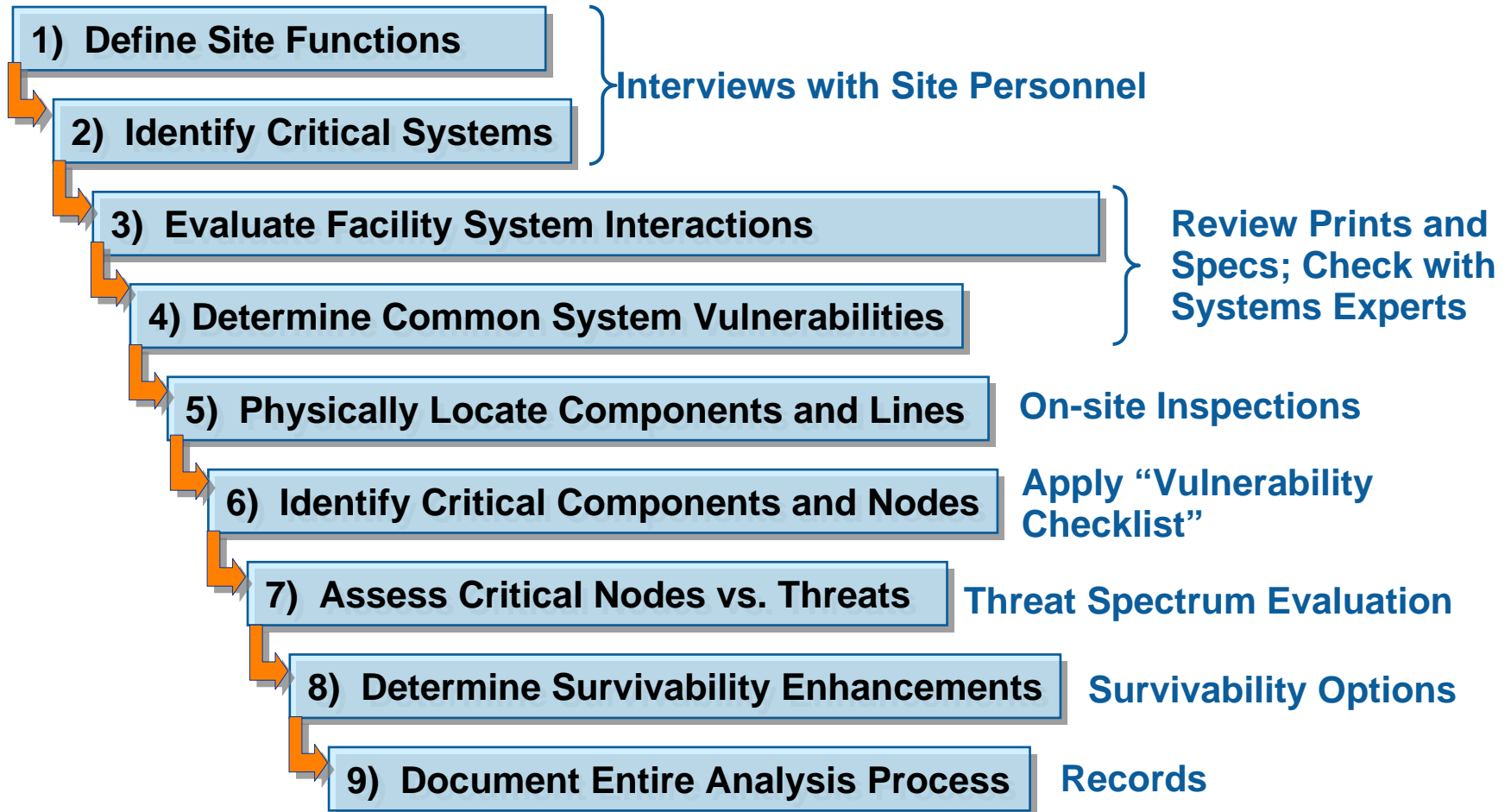


# Site Car Bomb



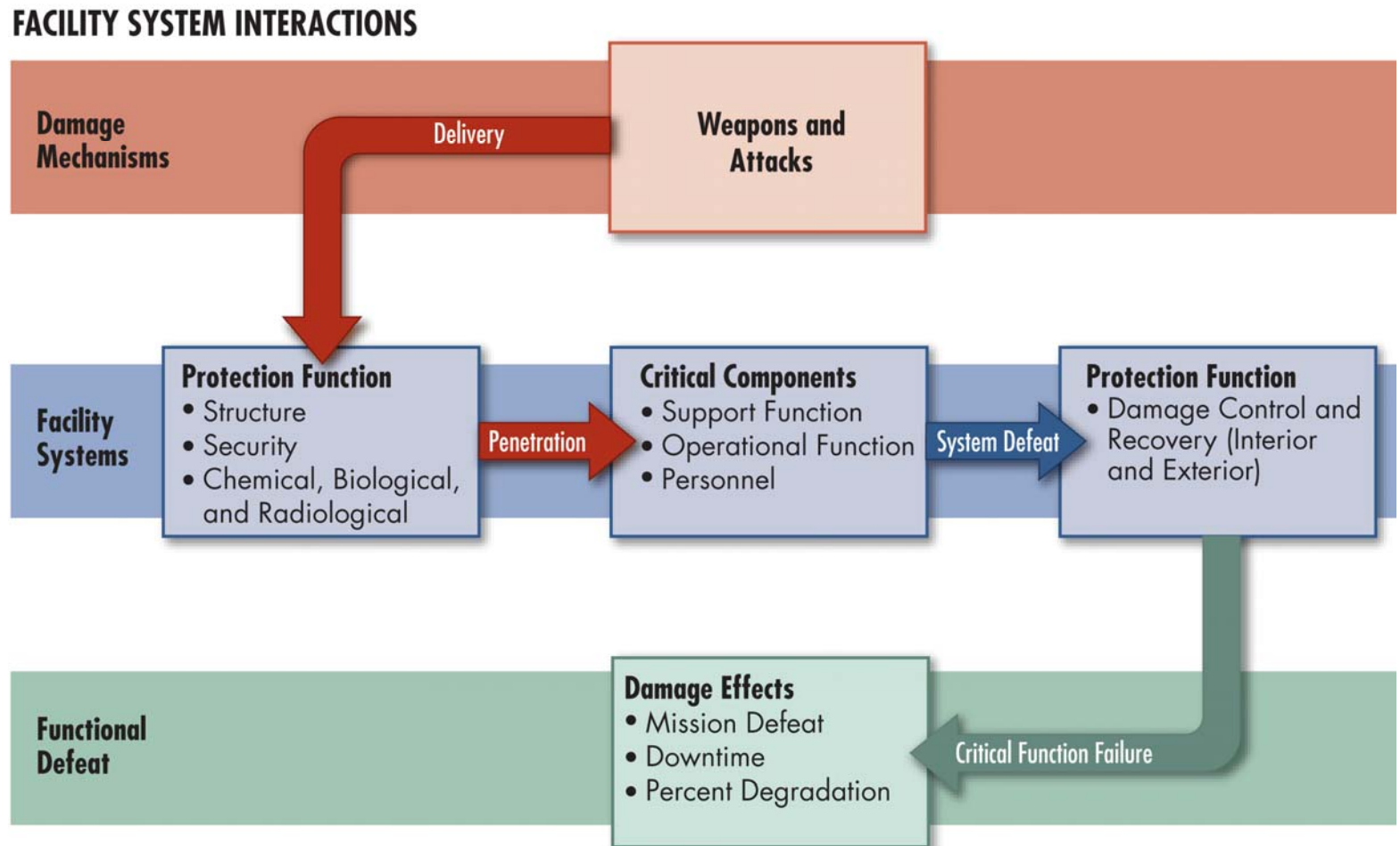
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# Options to Reduce Vulnerability



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# Facility System Interactions

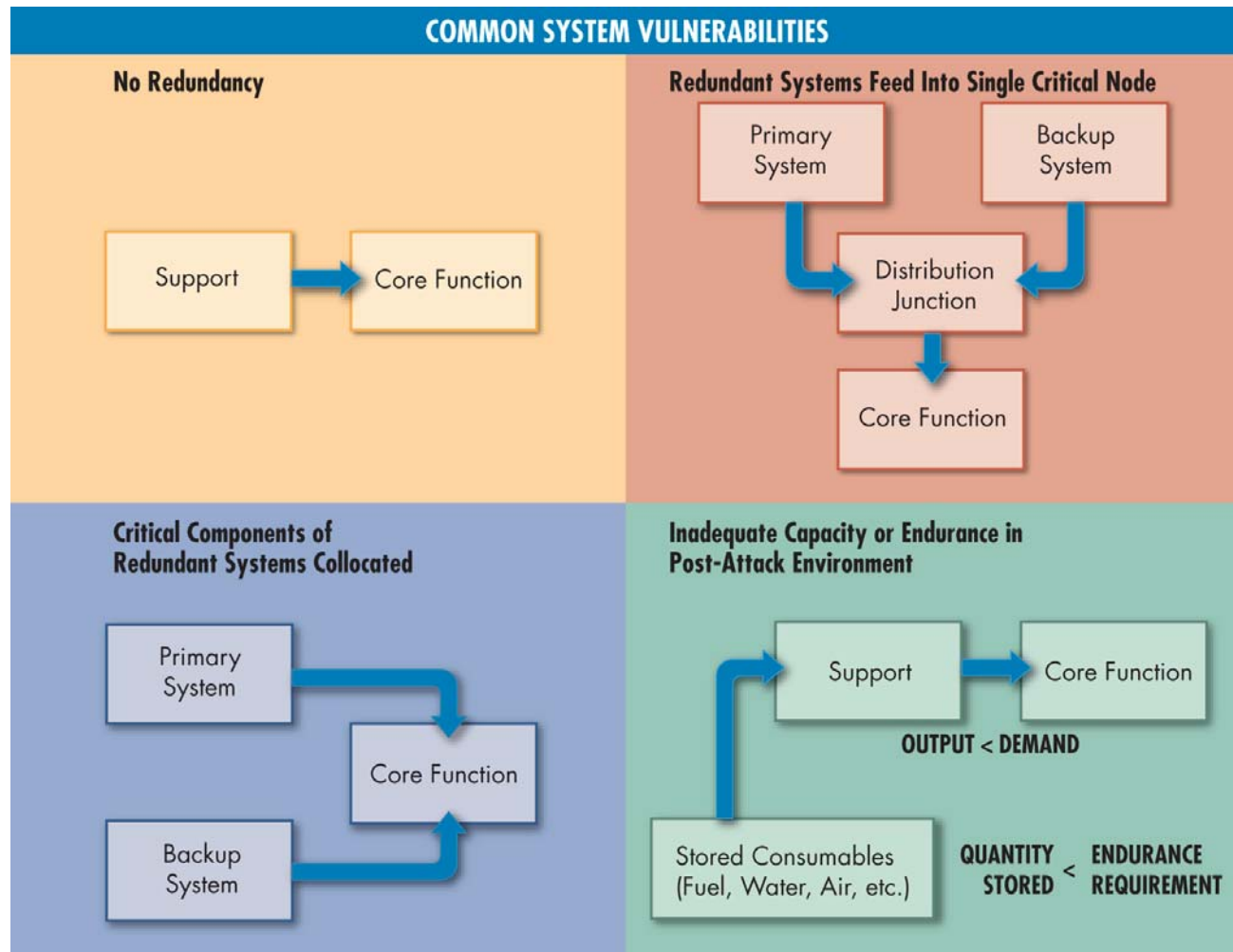


FEMA 426, Figure 1-8: Facility System Interactions, p. 1-23



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# Single-Point Vulnerabilities



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

# Functional Analysis SPVs



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



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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



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# 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



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# 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



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# Building Vulnerability Assessment Checklist

Vulnerability Question	Guidance	Observations	
<b>6</b>	<b>Mechanical Systems (HVAC and CBR)</b>		
<b>6.1</b>	<p>Where are the air intakes and exhaust louvers for the building? (low, high, or midpoint of the building structure)</p> <p>Are the intakes and exhausts accessible to the public?</p>	<p><i>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.</i></p> <p><i>Ref: CDC/NIOSH Pub 2002-139</i></p>	
<b>6.2</b>	<p>Is roof access limited to authorized personnel by means of locking mechanisms?</p> <p>Is access to mechanical areas similarly controlled?</p>	<p><i>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.</i></p> <p><i>Ref: GSA PBS -P100, CDC/NIOSH Pub 2002-139, and LBNL Pub 51959</i></p>	



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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.)?



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

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**Unit IV-C-28**

# 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*



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

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Unit IV-C-29

# Building Vulnerability Assessment Checklist



<b>6.1</b>	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?
<b>1.9</b>	Is there any potential access to the site or building through utility paths or water runoff? <i>(Eliminate potential site access through utility tunnels, corridors, manholes, storm water runoff culverts, etc. Ensure covers to these access points are secured.)</i>
<b>3.1</b>	What type of construction?  What type of concrete and reinforcing steel?  What type of steel?  What type of foundation?

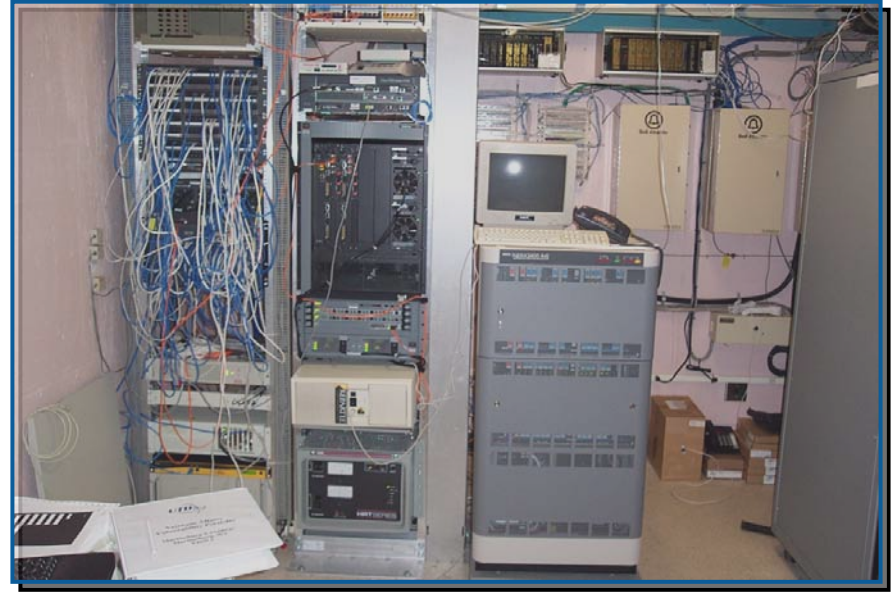


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FEMA 426, Adapted from Table 1-22: Building Vulnerability Assessment Checklist, p. 1-46 to 1-92



# Building Vulnerability Assessment Checklist



<b>5.19</b>	By what means does the main telephone and data communications interface the site or building?
<b>5.20</b>	Are there multiple or redundant locations for the telephone and communication service?
<b>5.21</b>	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?



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

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**Unit IV-C-31**

# 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



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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



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

# Critical Functions

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



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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
<b>Site</b>				
Asset Value	4	4	4	4
Threat Rating	4	4	3	2
<b>Vulnerability Rating</b>	<b>1</b>	<b>7</b>	<b>9</b>	<b>9</b>
<b>Structural Systems</b>				
Asset Value	8	8	8	8
Threat Rating	3	4	3	2
<b>Vulnerability Rating</b>	<b>1</b>	<b>1</b>	<b>8</b>	<b>1</b>



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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 Functions and Critical Infrastructure Matrices



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# Vulnerability Rating Considerations

\*Go to Page SM IV-C-2 in your Student Manual\*

1. Effectiveness of threat tactic / hazard against asset
2. Redundancy
3. Layers of Defense and depth of layers
4. Cyber



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# 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)

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

- Critical Functions
- Critical Infrastructure



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