Chapter 3
Hazard Identification and Risk Assessment (HIRA)

Section 3.4 – State, Critical Facility, and Energy Pipeline Analysis
SECTION 3.4

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Section 3.4: State, Critical Facility, and Energy Pipeline Analysis

In addition to examining vulnerability to jurisdictions, the HIRA also considered state facility and critical facility vulnerability. The HIRA does not include local assessment information; local plan data was evaluated, but was not included due to inconsistencies between the plans. See Section 3.6 for detailed information about the local plans and future mitigation action items to increase the usability of local plan data.

The HIRA examined three major sources of facility data: the Virginia Agency Property System (VAPS) for state owned, leased, or managed facilities; the federal HSIP Freedom geodatabase for critical facilities data; and transmission pipeline data from the National Pipeline Mapping System (NPMS). Many of the buildings in the VAPS database are critical to disaster preparedness and response, although not all critical facilities are in the VAPS database. For example, many privately owned buildings and structures (hospitals, power plants, certain industrial facilities, etc.) may be considered critical during certain natural disasters. As such, the critical facilities data collection has been used to represent a broader array of critical facilities than would be available through VAPS. However, as will be discussed, the critical facilities data collection is currently a work-in-progress.

Additional types of linear infrastructure may also qualify as critical facilities, but were not assessed in this plan due to data and scope limitations. Historical road closure and condition reports were evaluated for use in this plan, but the format of the data posed challenges that limited its use. See Appendix 3.4b for examples of the types of analysis that may be possible with this data in the future.

VAPS Database

The most comprehensive source of state facility information was the VAPS database, maintained by the Division of Risk Management in the Virginia Department of the Treasury. VAPS contains information for over 13,800 locations for 247 state agencies, which includes public universities and colleges in Virginia. For the purposes of the risk assessment, the term State-owned facilities is used to refer to both State-owned and State-operated facilities. The VAPS database is non-spatial; that is, geographic coordinates (or more advanced geographic data types) are not included for all of the records in the database. The VAPS database does contain extensive attributes about each building or structure, such as basic structural information, construction type, building value, square footage, number of floors, year built, and sprinkler systems.

The 2010 version of the plan used the VAPS database. This version of the HMP updated the data used in 2010 with a new export of VAPS records from the Department of Treasury, and expanded the geocoding effort to relate more of the VAPS records to geographic locations in the form of building footprints, campus footprints, or geocoded points.
As in the previous versions of this plan, several methods were used to spatially locate the VAPS facility records. Three geo-locating methods were used, from least to most complex:

1. Buffered Address Point
2. Individual Building Polygon
3. Building Group Polygon

The lack of locational information (or the presence of inaccurate information) in the database resulted in some facilities not being tied to a geographic location. Some of the VAPS address fields were incomplete, or not in a format that could be used by a geocoding service (i.e. E911 format). Approximately 6.5% of the VAPS facilities were not geo-located, these facilities account for 0.39% of the total building value in the entire database. Table 3.4-1 shows the breakdown of the location method used and building value of the state facilities in each group.

Table 3.4-1: VAPS database summary of location method, percentage mapped, and building value

<table>
<thead>
<tr>
<th>Location Method</th>
<th>Number of Locations</th>
<th>Percent of Facilities</th>
<th>Total Value</th>
<th>Percent of Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffered Address Point</td>
<td>8,348</td>
<td>60.1%</td>
<td>$2,413,956,533</td>
<td>10.6%</td>
</tr>
<tr>
<td>Individual Building</td>
<td>1,851</td>
<td>13.3%</td>
<td>$13,605,595,857</td>
<td>59.9%</td>
</tr>
<tr>
<td>Building Group Polygons</td>
<td>2,794</td>
<td>20.1%</td>
<td>$6,609,818,485</td>
<td>29%</td>
</tr>
<tr>
<td>Not Found</td>
<td>904</td>
<td>6.5%</td>
<td>$87,753,365</td>
<td>0.39%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13,897</strong></td>
<td><strong>100%</strong></td>
<td><strong>$22,717,124,240</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Buffered Address Point

Geocoding or “address matching” uses non-spatial information describing a location (i.e. VAPS database addresses) and converts this information into a spatial address in terms of latitude and longitude (i.e. the geocoded point). In geocoding, addresses from the VAPS database were compared against the addresses in ESRI’s “StreetMap” dataset. When an address match was found between the two databases, a geographic point location was assigned to the particular record in the VAPS database. After geocoding, each point was buffered to create a polygon approximating the size of the building. The approximate size of each building was determined by dividing the total square footage of the building by the number of floors, as reported in VAPS. Overall, this geocoding and buffering method yields an approximate location and area for geocoded VAPS facilities. The majority of facilities were mapped with buffered address points. This method is the least accurate of the methods used, as the geocoding process does not usually yield points that fall precisely on the buildings. Approximately 60% of the VAPS facilities buildings, or 8% of the total building value, were located using this technique. Figure 3.4-1 shows an example of a buffered address point.

Individual Building Polygon

The most desirable geospatial representation of a building is a polygon representing its footprint. This representation was used for the higher building value locations. First, the VAPS database was sorted by building contents and fine arts values. Locations that could be considered “institutions”, such as hospitals, correctional facilities, community colleges and state colleges and universities, were spatially located to an appropriate location using various methods (such as ESRI data, web searches, and online campus maps). Editing tools were then used to draw a “polygon” around the perimeter of the buildings. In addition to creating the building footprints manually, some universities provided GIS data that already included building footprint polygons. This provided data was incorporated into the geodatabase. Figure 3.4-2 shows an example of an individual building polygon.

Building Group Polygon

The same technique used for individual building polygons was used to create building group polygons (or “campus” polygons). A building group polygon was used when only general information about the facility location was found, without enough specifics to support the creation of individual building polygons. In some cases building groups would enclose individual buildings; in these cases the area of the individual building would be clipped out (forming a donut hole) so the area would not be double-counted. The resulting building group polygons were then used in analyses to represent all of the related buildings listed in the VAPS database. Figure 3.4-3 shows an example of a building group and Figure 3.4-4 shows an example of a building group with individual buildings enclosed inside.
Figure 3.4-1: Buffered address point.
Figure 3.4-2: Individual building polygon.

Figure 3.4-3: Building group polygon.
Critical Facilities

There is currently no standard critical facility dataset for the Commonwealth; various plans have used different datasets, based upon the geographic and subject-matter scope of each plan. All critical facilities data for this plan update was acquired from FEMA through their HSIP database. This version of the plan identifies the following broad types of critical facilities:

- Law Enforcement Facilities
- Educational Facilities
- Emergency Response
- Transportation
- Public Health

Although not a complete representation of all the possible types of critical facilities, this data is a good representation of facility locations in the state. The database contains over 7,500 critical facilities within the six categories. The available critical facility data is not as comprehensive as the VAPS database; it only contains the general location of each of the facilities, with no attribute information such as building value, size, etc. In addition, facilities are represented only as geographic points, and so the full spatial extent of larger facilities is not considered. Table 3.4-2 shows the number of facilities located in each critical facility category. The facilities data that was used in the analysis is available through VDEM.
Table 3.4-2: Critical facility type and number of mapped facilities

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Number of Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law Enforcement</td>
<td>662</td>
</tr>
<tr>
<td>Educational Facilities</td>
<td>3,041</td>
</tr>
<tr>
<td>Public Health</td>
<td>1,075</td>
</tr>
<tr>
<td>Transportation</td>
<td>56</td>
</tr>
<tr>
<td>Emergency Response</td>
<td>2,840</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,673</strong></td>
</tr>
</tbody>
</table>

**Energy Pipelines**

Transmission and distribution pipelines are used to transport liquids and gases such as petroleum products, natural gas, and other chemicals across long distances. Virginia’s economy and security benefits from the products transported via pipeline; this includes refined petroleum to fuel transportation systems, and natural gas to heat homes and generate power. However, these fluids are often hazardous to human health and/or to the environment, and so the operation of transmission pipelines is regulated in an effort to ensure public safety. Applicable federal laws are found in U.S. Code, Title 49, Subtitle VIII, Chapter 601; regulatory activity occurs in accordance with Title 49 of the Code of Federal Regulations (CFR), Parts 190-199, and is carried out by the U.S. Department of Transportation’s Pipeline and Hazardous Materials Safety Administration (PHMSA). In Virginia, the State Corporation Commission’s Division of Utility and Railroad Safety is also responsible for regulating certain operators, in coordination with PHMSA.

There are essentially three major types of pipelines along the transportation route: gathering systems, transmission systems, and distribution systems. They carry either natural gas or hazardous liquids. They are also categorized as either onshore or offshore. The following table shows the mileage of each type by product transported.
Table 3.4-3: Types of Pipelines and Mileage in Virginia

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Product Transported</th>
<th>Description</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHMSA regulated gathering pipelines 1</td>
<td>Natural Gas or Hazardous Liquid</td>
<td>Gather raw natural gas from production wells to point of production or</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>transmission pipelines</td>
<td></td>
</tr>
<tr>
<td>Onshore transmission pipelines</td>
<td>Natural Gas</td>
<td>Move natural gas long distances across the country, often at high pressures</td>
<td>3,000</td>
</tr>
<tr>
<td>Onshore transmission pipelines</td>
<td>Hazardous Liquid</td>
<td>Carry crude oil and refined petroleum products such as gasoline, diesel and</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>jet fuel</td>
<td></td>
</tr>
<tr>
<td>Natural gas distribution pipelines</td>
<td>Natural Gas</td>
<td>Transport natural gas from transmission pipelines and deliver it to individual</td>
<td>20,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>homes and businesses</td>
<td></td>
</tr>
</tbody>
</table>

Risks associated with transmission pipelines result from accidental releases of the transported products, which can impact public safety, the environment, national security and our economy. Accidental releases can result in injuries or fatalities from fires or explosions caused by ignition of the released product, as well as from possible toxicity and asphyxiation effects. Economic impacts may result from business interruptions, damaged infrastructure, and loss of fuel supplies.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains the National Pipeline Mapping System (NPMS), a nationwide GIS database of transmission energy pipelines with attribute information such as the pipeline operator (typically a private business) and the type of material transported. The database does not include detailed valve, facility, or operational details, nor does it include distribution or gathering pipelines. Map features in the NPMS typically have an accuracy of +/- 500 feet, so the database is useful for a general assessment of pipelines, but not for engineering work like excavation planning. The Pipeline Safety Improvement Act of 2002 required pipeline operators to begin submitting geospatial data to the NPMS. Due to security concerns, the distribution of NPMS data is limited to federal, state, and local government agencies. An export of the PHMSA pipeline data was made available for this hazard mitigation planning activity. The NPMS Public Map Viewer allows the general public to view maps of transmission pipelines, LNG plants, and breakout tanks in one selected county. 2

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1 PHMSA regulates only a small portion of gathering pipelines and does not currently collect data or maps for unregulated gathering pipelines.

2 NPMS Public Map Viewer is available at: https://www.npms.phmsa.dot.gov/PublicViewer/
PHMSA also tracks pipeline incidents such as breaks or spills; PHMSA defines Significant Incidents as those incidents reported by pipeline operators when any of the following specifically defined consequences occur:

1. fatality or injury requiring in-patient hospitalization
2. $50,000 or more in total costs, measured in 1984 dollars
3. highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more
4. liquid releases resulting in an unintentional fire or explosion

Table 3.4-4: Significant Pipeline Incidents Caused by Natural Hazards in Virginia (2001-2012)

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Operator</th>
<th>Property Damage</th>
<th>Sub-Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>City of Richmond</td>
<td>Richmond Dept. of Public Utilities</td>
<td>$124,418</td>
<td>Earth Movement</td>
</tr>
<tr>
<td>2007</td>
<td>City of Richmond</td>
<td>Transmontaigne Product Services Inc.</td>
<td>$1,086</td>
<td>Lightning</td>
</tr>
<tr>
<td>2010</td>
<td>Charlotte Courthouse</td>
<td>Colonial Pipeline Co.</td>
<td>$123,396</td>
<td>Temperature</td>
</tr>
</tbody>
</table>

According to PHMSA database, there are about 4,126 miles of active or idle transmission pipelines in Virginia, carrying natural gas, petroleum-based fuels, and other gases. Figure 3.4-5 shows the mileage of active or idle transmission pipelines by jurisdiction.

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Figure 3.4-5: Mileage of Transmission Pipelines

DATA SOURCES:
National Pipeline Mapping System
VGIN Jurisdictional Boundaries
ESRI State Boundaries

PROJECTION:
VA Lambert Conformal Conic
North American Datum 1983

LEGEND:
Linear Miles of Pipeline
- None
- 10.00 or less
- 10.01 - 50.00
- 50.01 - 150.00
- more than 150.00

HAZARD IDENTIFICATION:
National Pipeline Mapping System (NPMS) data contains gas transmission pipelines and hazardous liquid trunklines. Collection and distribution pipelines, including those which deliver substances to end users, are not included. This map shows the mileage of pipelines listed as in-service or idle; abandoned and retired pipelines are omitted.

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards. In order to identify potential risk in the Commonwealth available data has been used beyond the original intent.
Analysis

The results of the risk assessment for state, critical facilities, and energy pipelines are included in the risk assessment section of each individual natural hazard. Facilities were intersected with the hazard’s Geographic Extent (GE) layer to determine the buildings risk zone. The analysis methodology is described in full detail in the individual hazard sections; tables are used to represent the number of facilities in each risk category.

Potential dollar loss to state facilities was completed for some of the hazards. Total exposed building value has been denoted for all of the addressed hazards. Annualized loss and the total building value at risk has been calculated for state facilities within special flood hazard areas (section 3.7). Agencies with a large quantity of structures or building value in the high risk hazard areas are noted in each of the sections. These agencies and buildings are an excellent starting point for assessing the need for specific mitigation action items.

In depth analysis could not be completed for the critical facilities because of the lack of building specific details, as previously discussed.

Pipelines may be impacted by natural hazards in direct and indirect ways. An example of a direct impact would be erosion or shifts in the supporting soils resulting in pipeline collapse. Indirect impacts are those that affect the infrastructure that supports pipeline operations. An example of an indirect impact would be severe storms causing a general power or communication systems failure which, while not impacting the structural integrity of the pipeline, could disrupt the pipeline operator’s ability to operate the pipeline safely and the pipeline may be required to be shutdown. Hazard-specific summaries of pipeline impacts are included in the individual hazard sections, where applicable.

Future Mitigation Actions

Proposed mitigation actions address the need for a more complete critical facility database, an enhanced state facility database, and an energy gathering pipeline facility database.

VDEM will need to consider standardizing the definition of a critical facility for local plan revisions, and provide advice on the essential attributes to be collected. This would act as a template for local plans to follow in the future. An option could include the FEMA HAZUS software which is currently evolving into the Comprehensive Data Management System (CDMS) that could be used as a template for this data collection process.