Using ArcGIS for Spatial Risk Assessment

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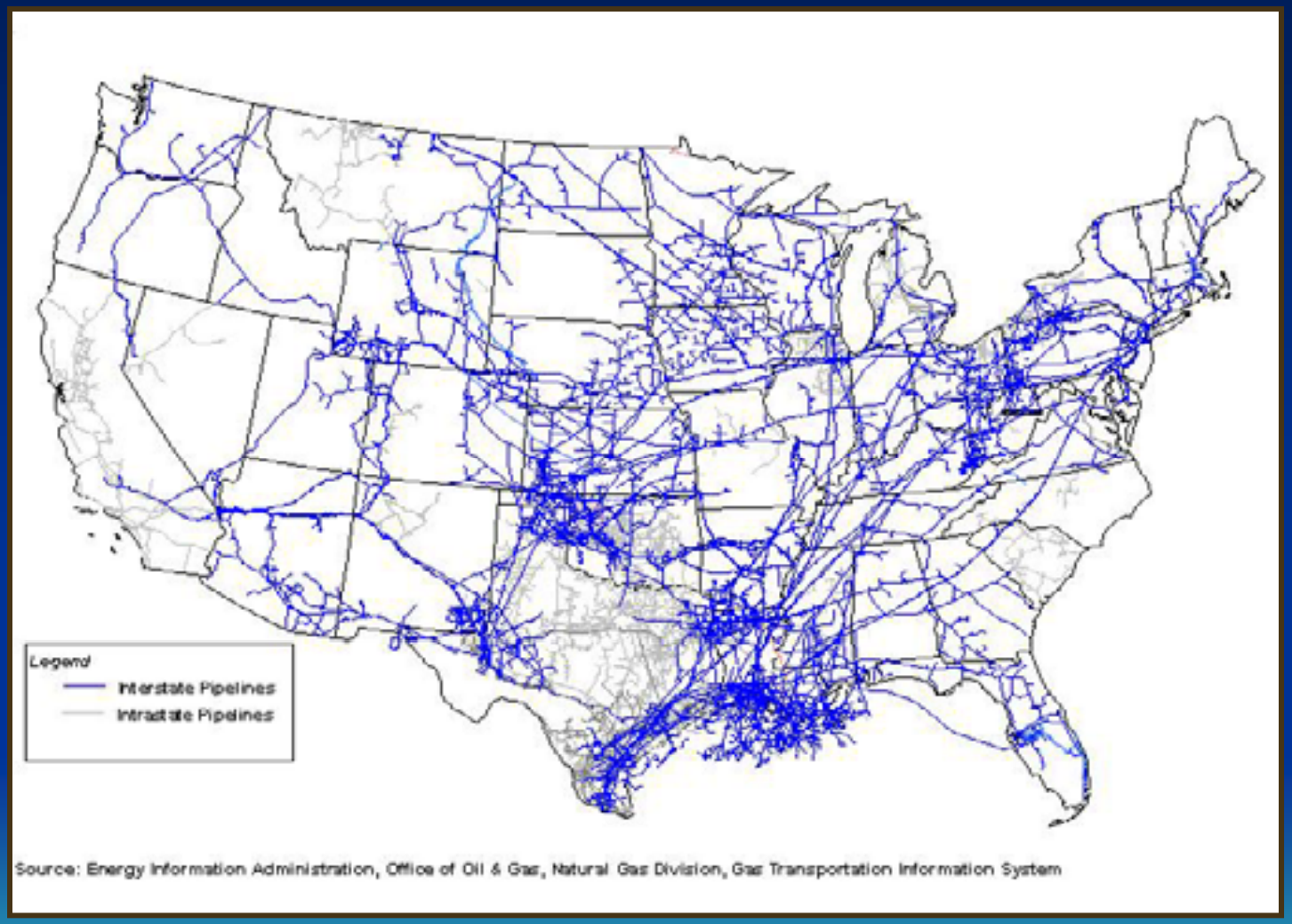
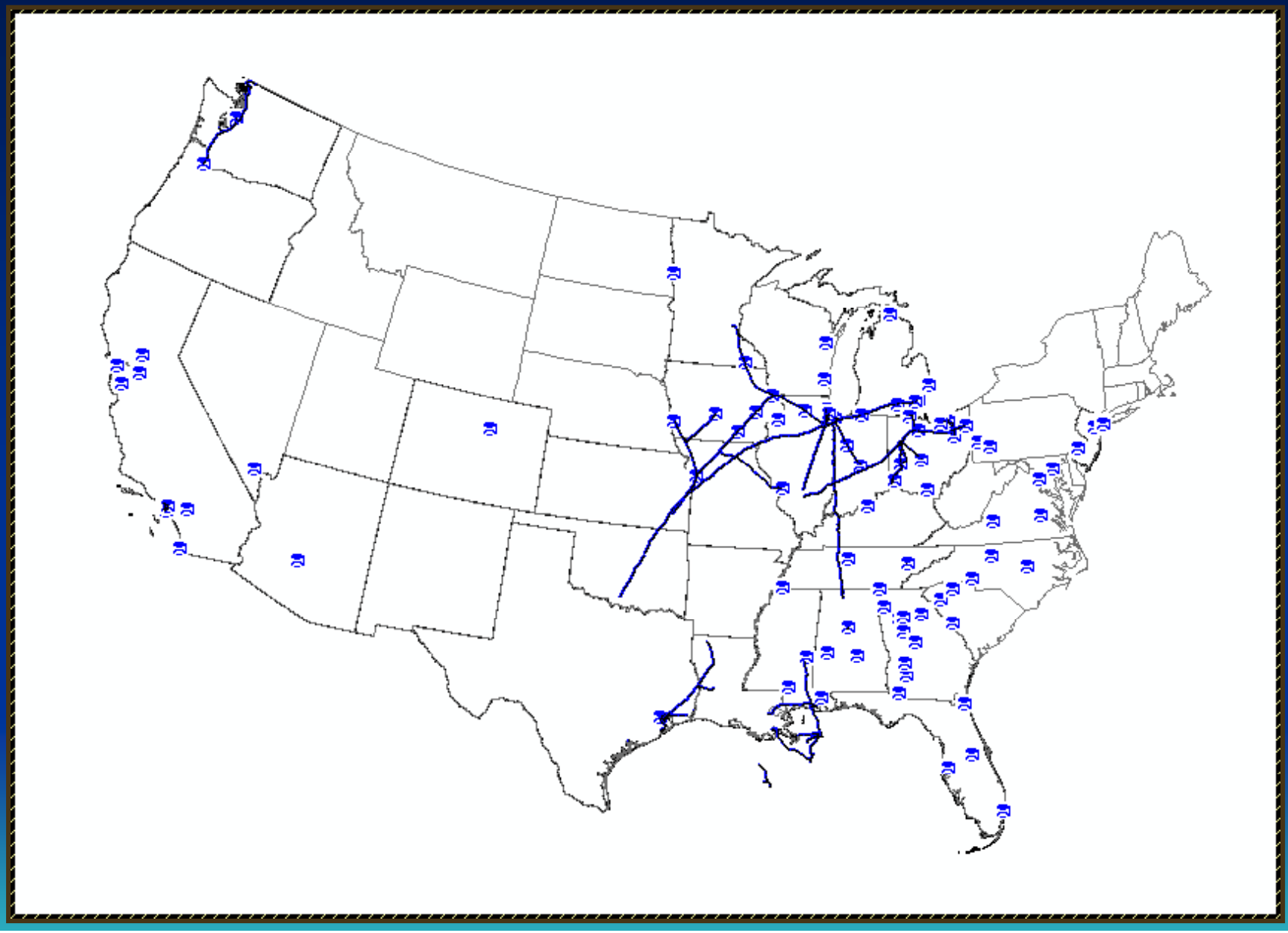
US Pipeline Network



BP Pipeline System Overview



BP System Overview (Cont'd)

- The business unit operates and maintains over 9000 miles of onshore and offshore pipelines.
- Employs more than 2000 people throughout the country.
- Pipeline network transports approximately 2.5 million barrels/day of oil, refined products, natural gas liquids, natural gas, carbon dioxide and chemicals.
- Located primarily in the Midwest, Gulf Coast, West Coast and Gulf of Mexico regions.
- Terminal facilities consist of 70 light oil terminals located in 38 states.
- Terminals are supported by a fleet of over 500 transport trucks that deliver refined product daily.

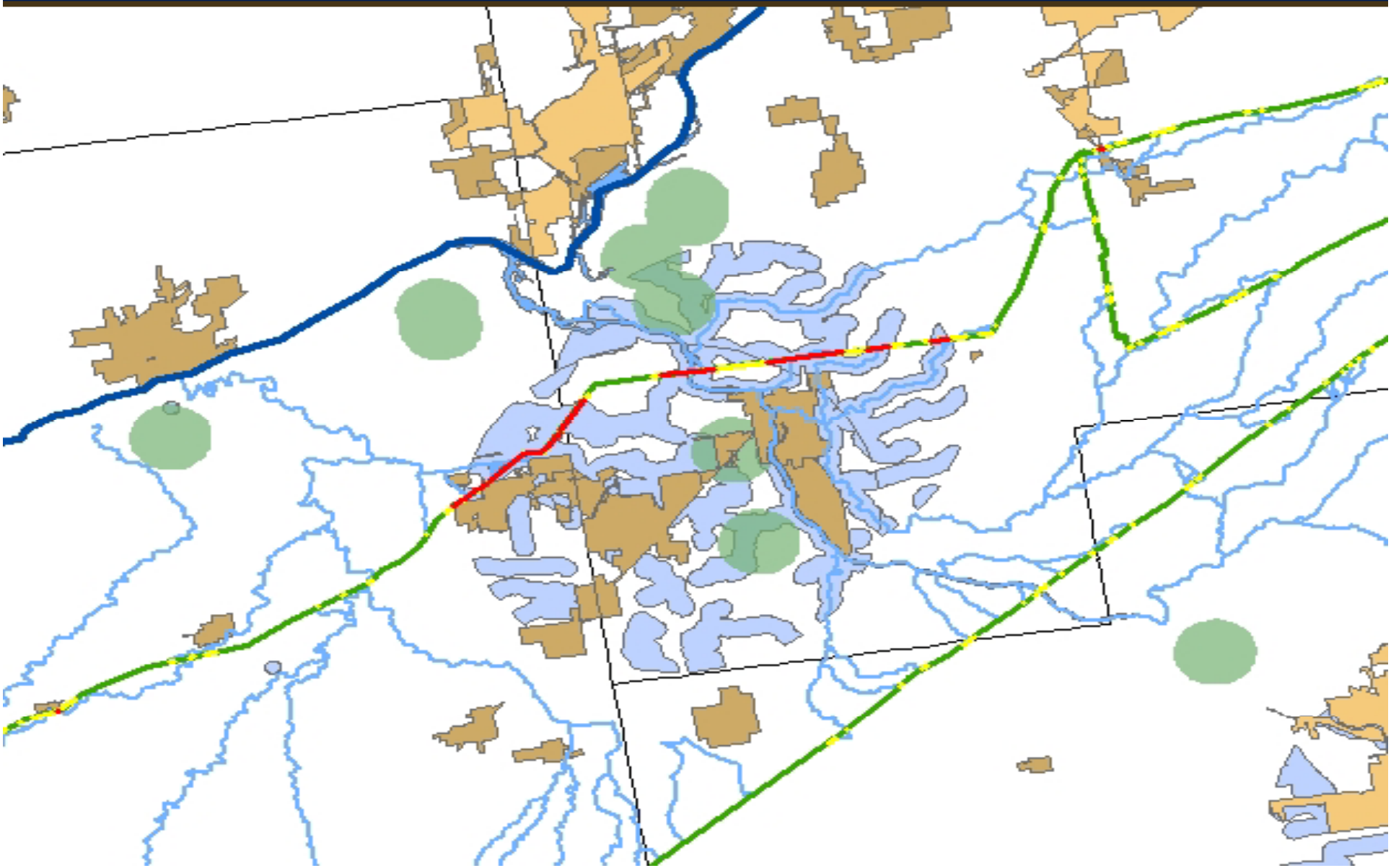
Key Business Drivers for Risk Assessment

- Assure pipeline safety, integrity and reliable operation
  - Identify unacceptable risk conditions along pipeline
- Compliance with Federal and State regulations
- Compliance with company policies and standards
- Establish priority
  - Risk ranking of pipeline segments for inspection and repair
- Provide for better allocation of resources
  - Enable the development of a multi year schedule and budget for pipeline assessments

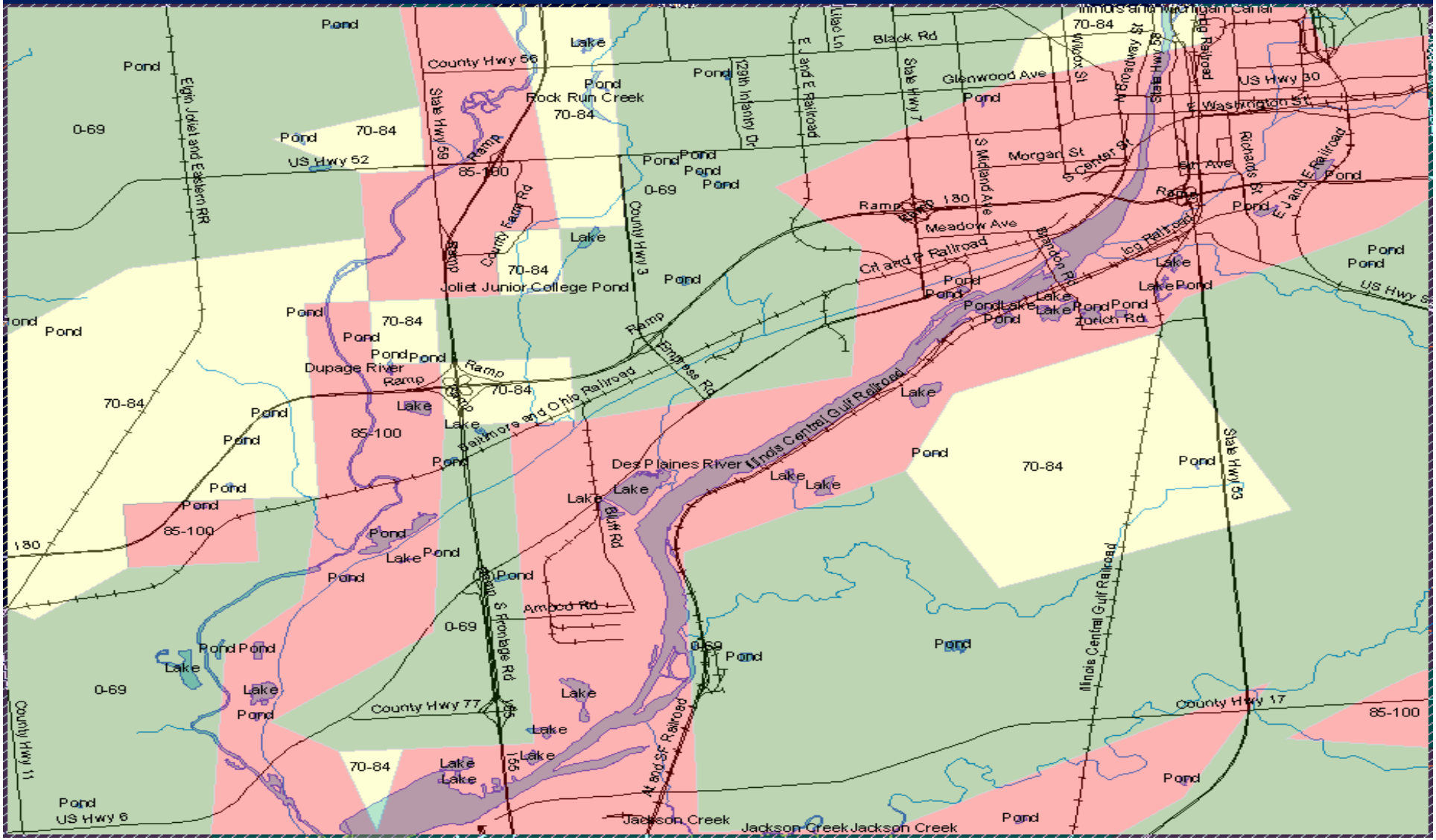
Pipeline Integrity Management Rule

- Enacted by Congress in 2001 with oversight by PHMSA (Pipeline Hazardous Materials Safety Authority).
- Requires operators to develop, execute and maintain a comprehensive Integrity Management Plan for all regulated lines.
- Identify pipeline segments that have potential to impact High Consequence Areas (HCA).
- Identify pipeline segments of higher risk and the subsequent factors driving those risks
- Develop a plan to reduce those risks.

Examples of HCA Locations

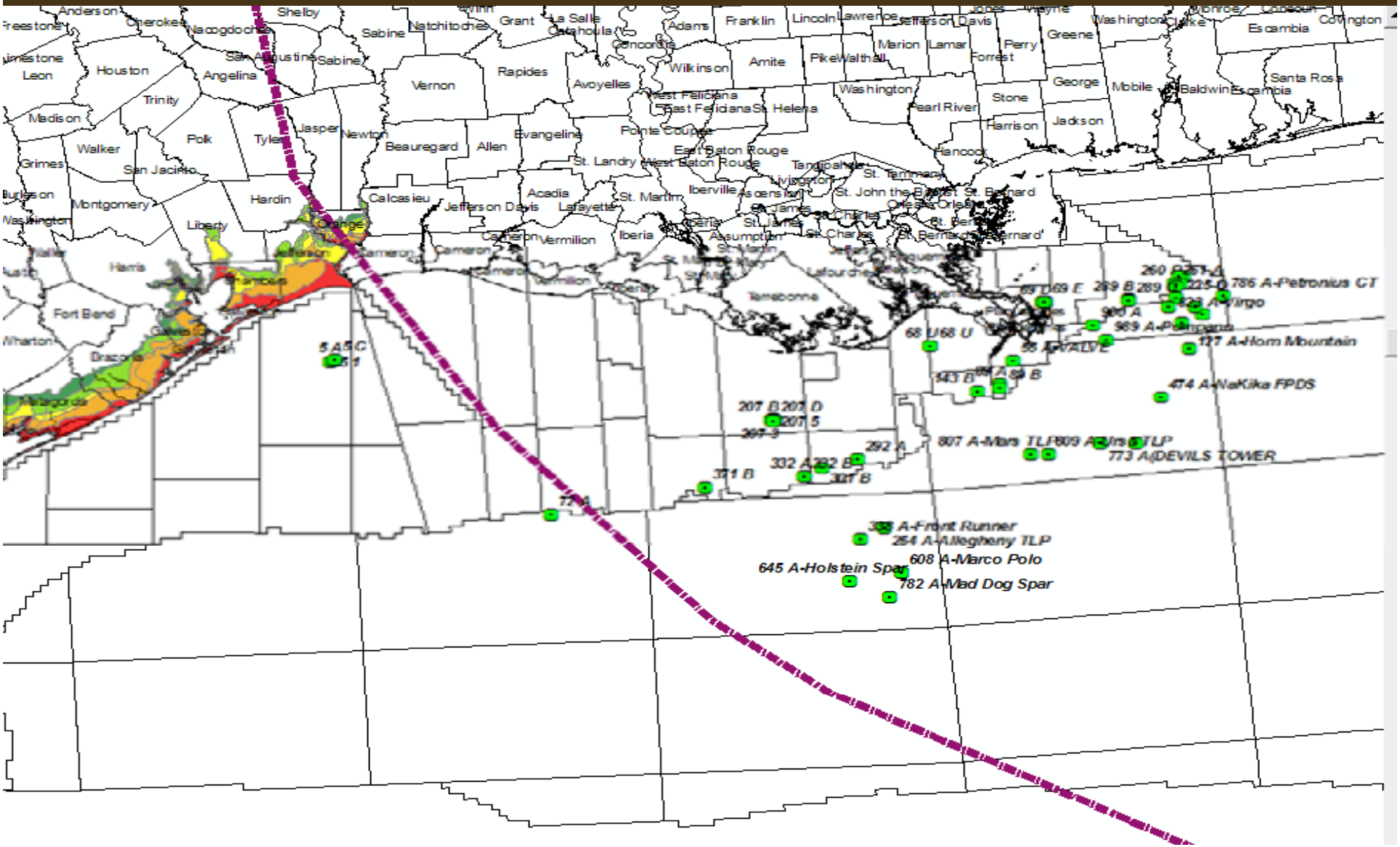


Flood Hazard Example

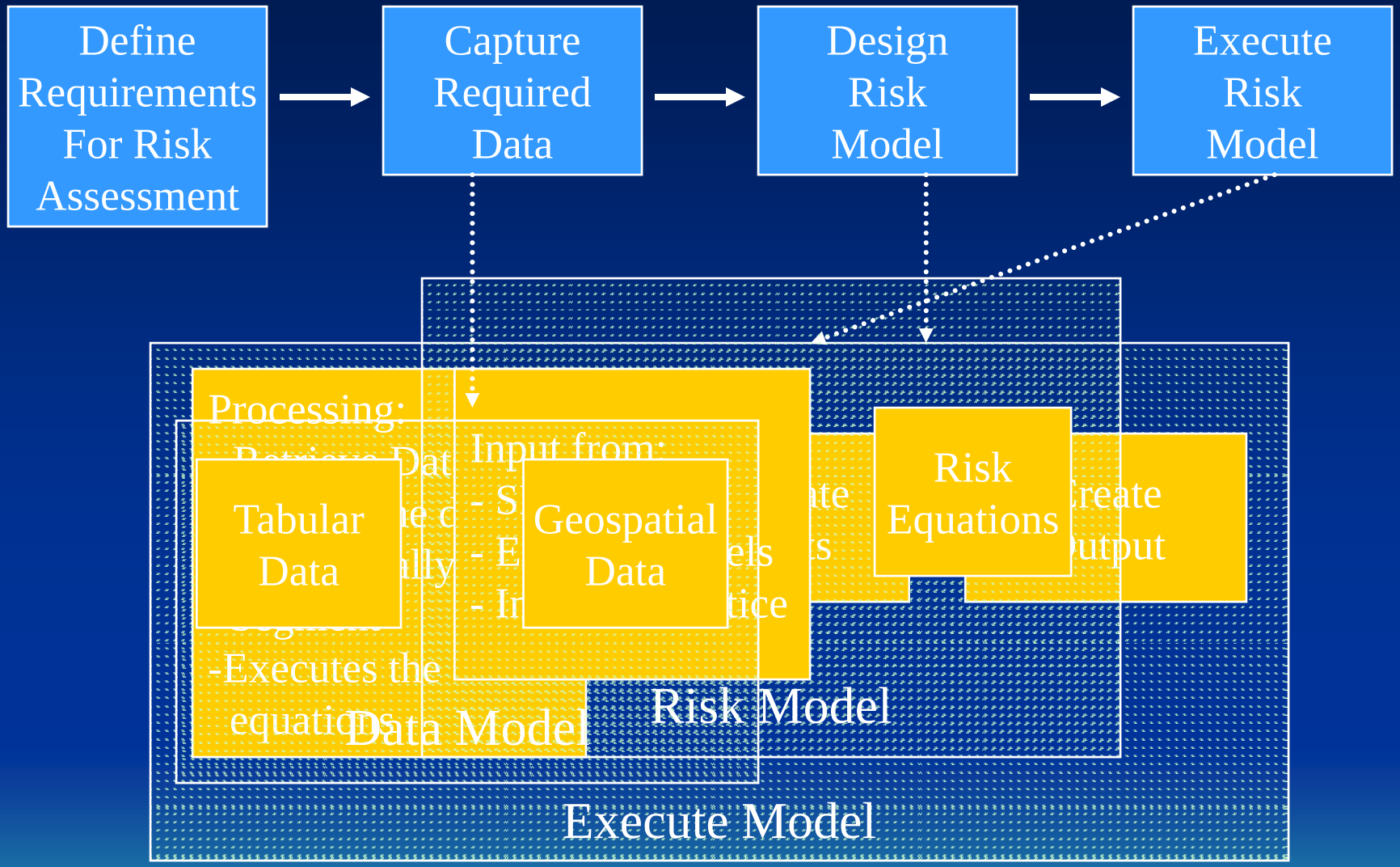


Spill Impact Analysis

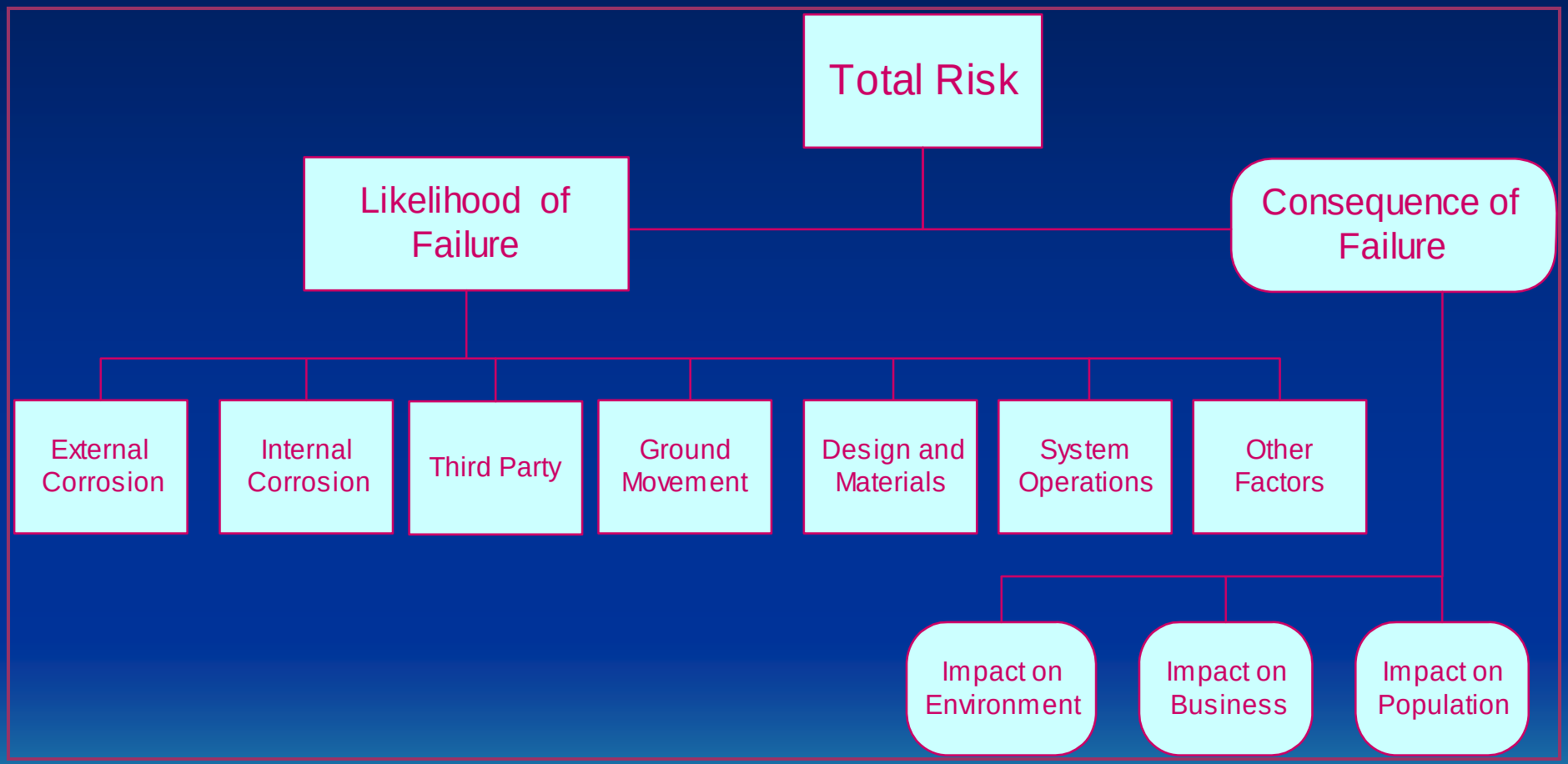
Hurricane Rita Response



Process


Define Requirements For Risk Assessment
Capture Required Data
Design Risk Model
Execute Risk Model
Processing:
-Executes the
Input from:
Tabular Data
Geospatial Data
Risk Equations
Data Model
Risk Model
Execute Model

Risk Profile Review



Risk Formula

Risk Formula	Likelihood of Failure (LOF)	X	Consequence of Failure (COF)	=	Risk of Failure (ROF)

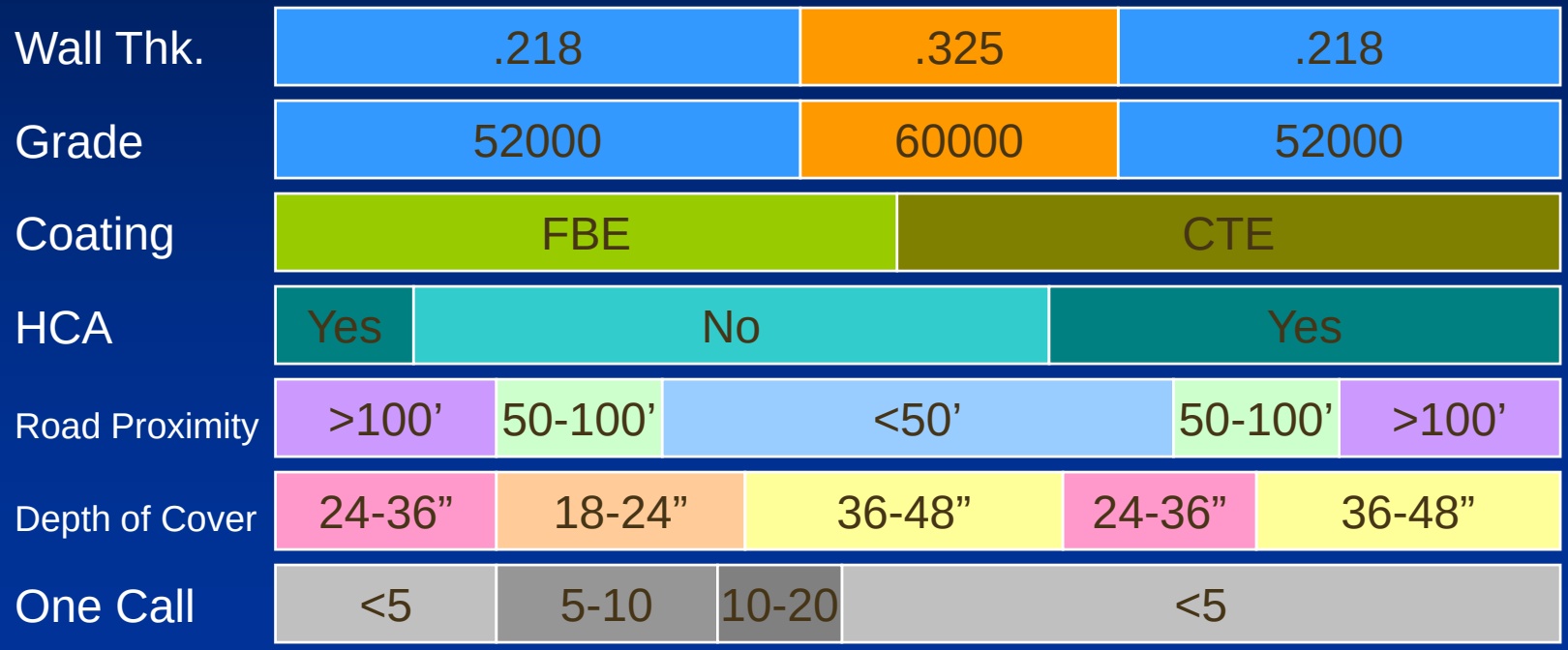
Attributes		
	pipeline specs. (diameter, wall thickness, grade, seam, girth weld, coating) installation date operating pressure flow rate product type pipe spans leak history CP history One Call Effectiveness last internal inspection date last hydrotest date natural hazard potential (earthquake, flood, landslide, hurricane)	product type rupture volume loss dispersion potential population impact potential environmental impact potential

Spatial Risk Analysis

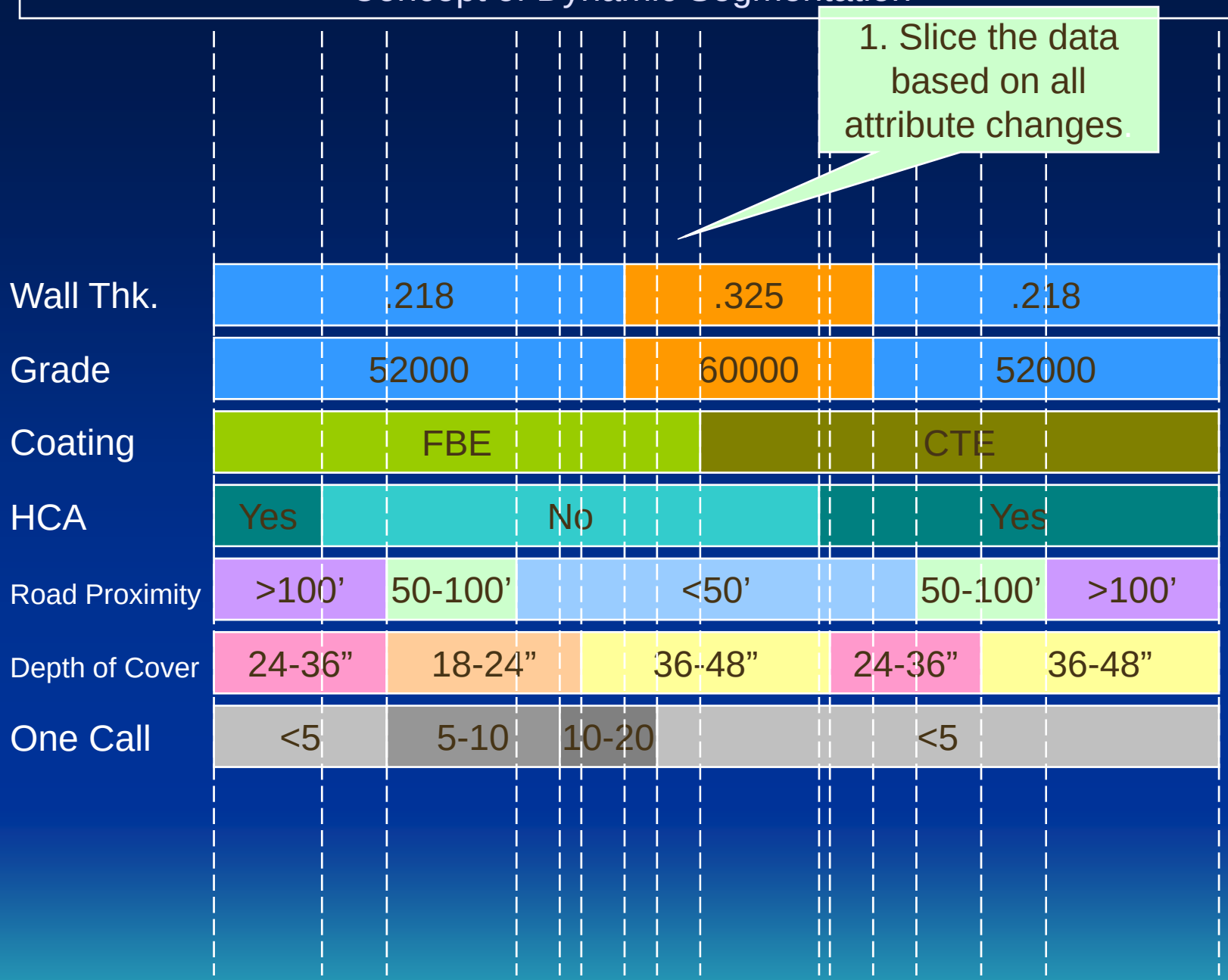
Demonstration

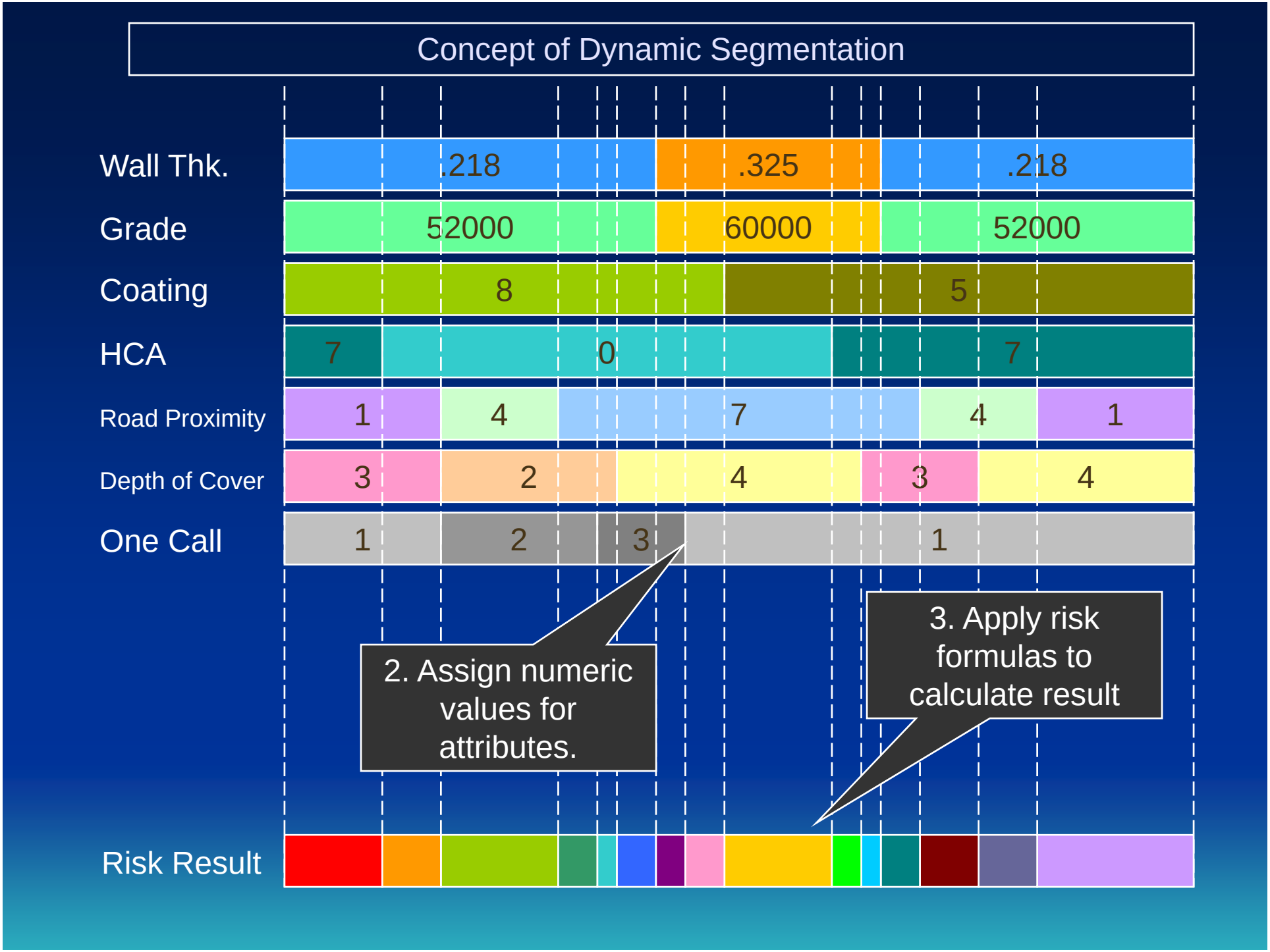
Dynamic Segmentation

Concept



Concept of Dynamic Segmentation




Concept of Dynamic Segmentation
Wall Thk.
.218
.325
.218
Grade
52000
60000
52000
Coating
8
5
HCA
7
0
7
Road Proximity
1
4
7
4
1
Depth of Cover
3
2
4
3
4
One Call
1
2
3
1
2. Assign numeric values for attributes.
3. Apply risk formulas to calculate result
Risk Result

Related Business Uses

- Insurance Risk Assessment
- New Construction
  - Roads, Railroads, Fiber Cable, Utilities
- Real Estate Site Selection
  - Road Segmentation
  - Address ranges with score

Summary

- Spatial risk assessment techniques are used in the pipeline industry
- GIS data is very useful for risk assessment
- Demonstrated examples
  - Multiple data sources – tabular & spatial
  - User-defined risk model
  - Output – map, tabular, chart, etc.
- Technique can be applied in other industries

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