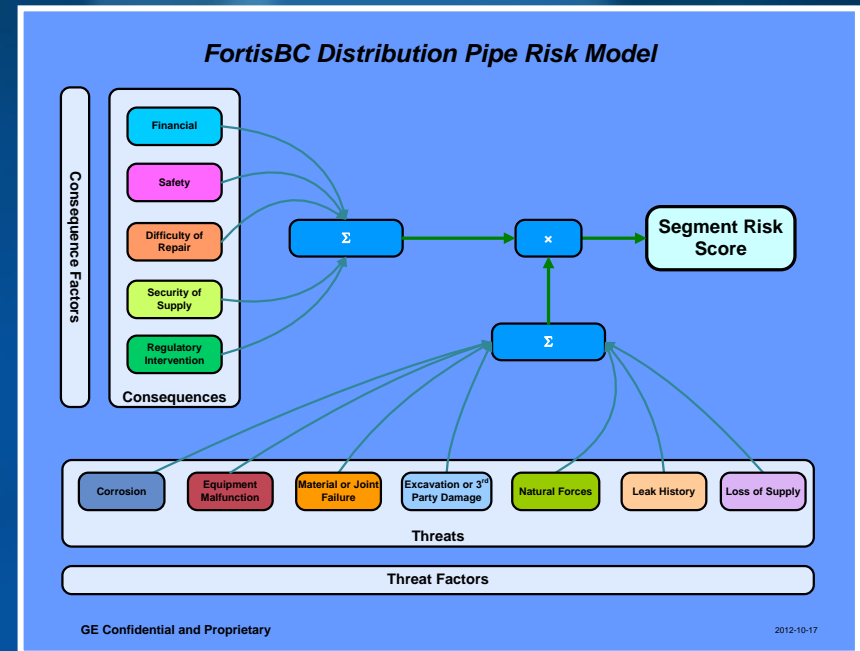# Implementing a Gas Distribution Risk Model using Smallworld GeoSpatial Analysis for Distribution Main Replacement Programs

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FortisBC Distribution Pipe Risk Model

FORTIS BC

Introduction

- FortisBC has implemented a **Gas Distribution Risk Model** to analyze 30,000 km of its gas distribution system and prioritize replacement.

- The **Risk Model** is driven by data in FortisBC's GE Smallworld GIS Database and lookup tables containing risk values for object attributes. i.e. material, diameter and age

- The risk model calculates a **relative risk score** for each pipe segment and thematically maps the distribution mains according to the level of risk.

- These maps can be overlaid with **municipal infrastructure projects**, **pavement plans**, and FortisBC's own system improvements.

- **This presentation will discuss the development of the risk model, the results and lessons learned.**
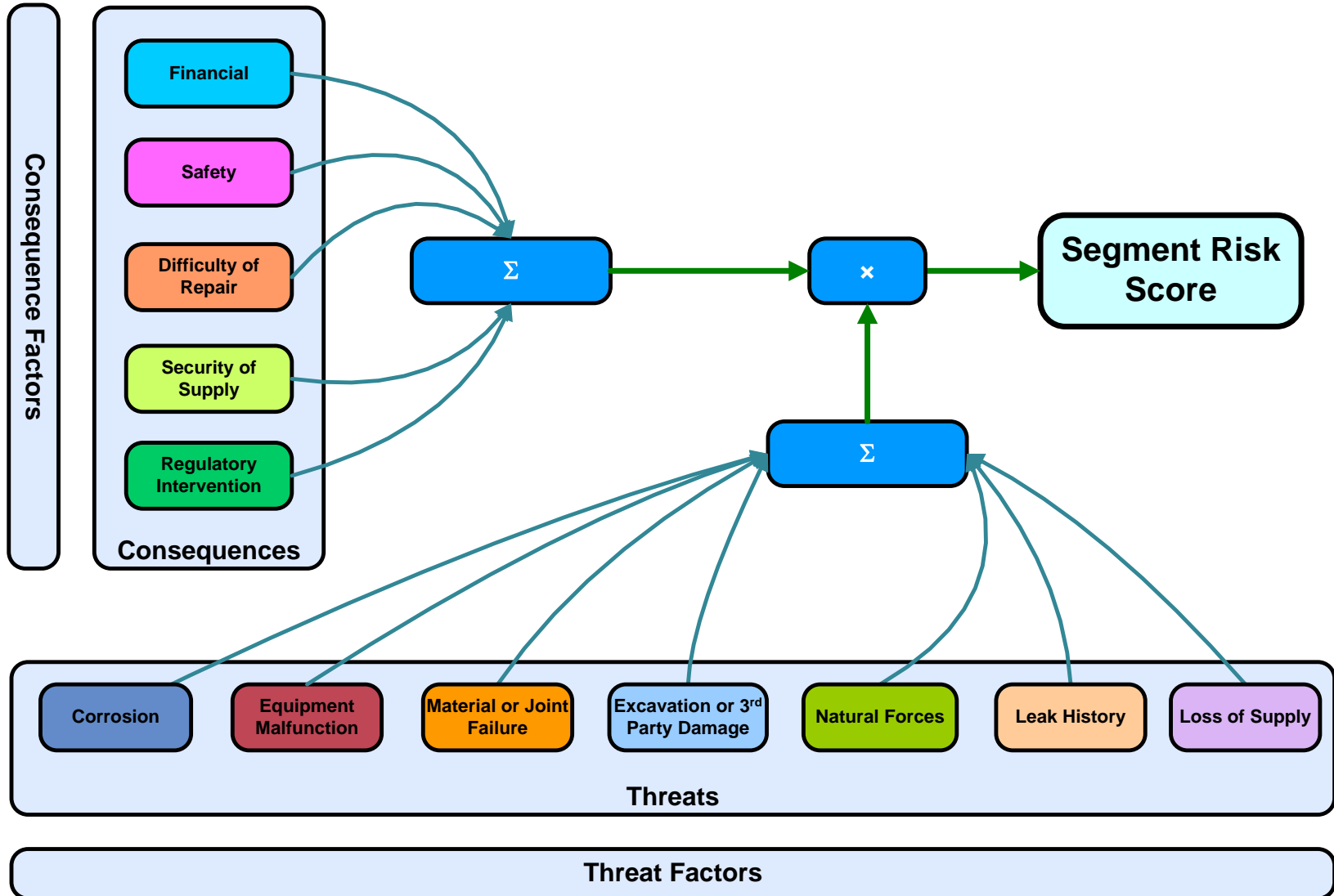
Smallworld is the propriety GIS database of General Electric
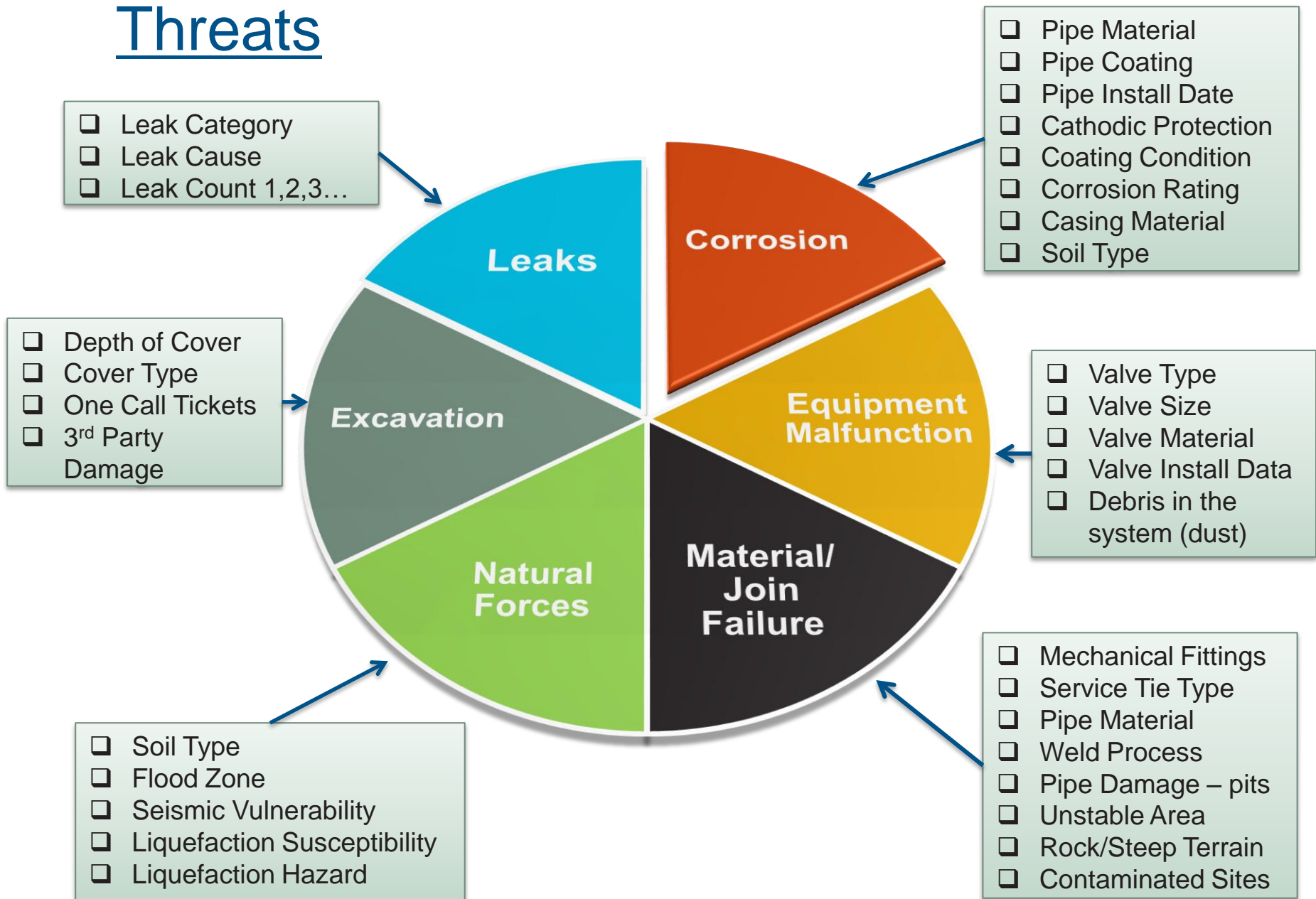
Risk

- Predicting the Probability of Failure

- Predicting the Consequences of Failure

- Calculating the Relative Risk and Weightings

- Reports and Thematic Maps

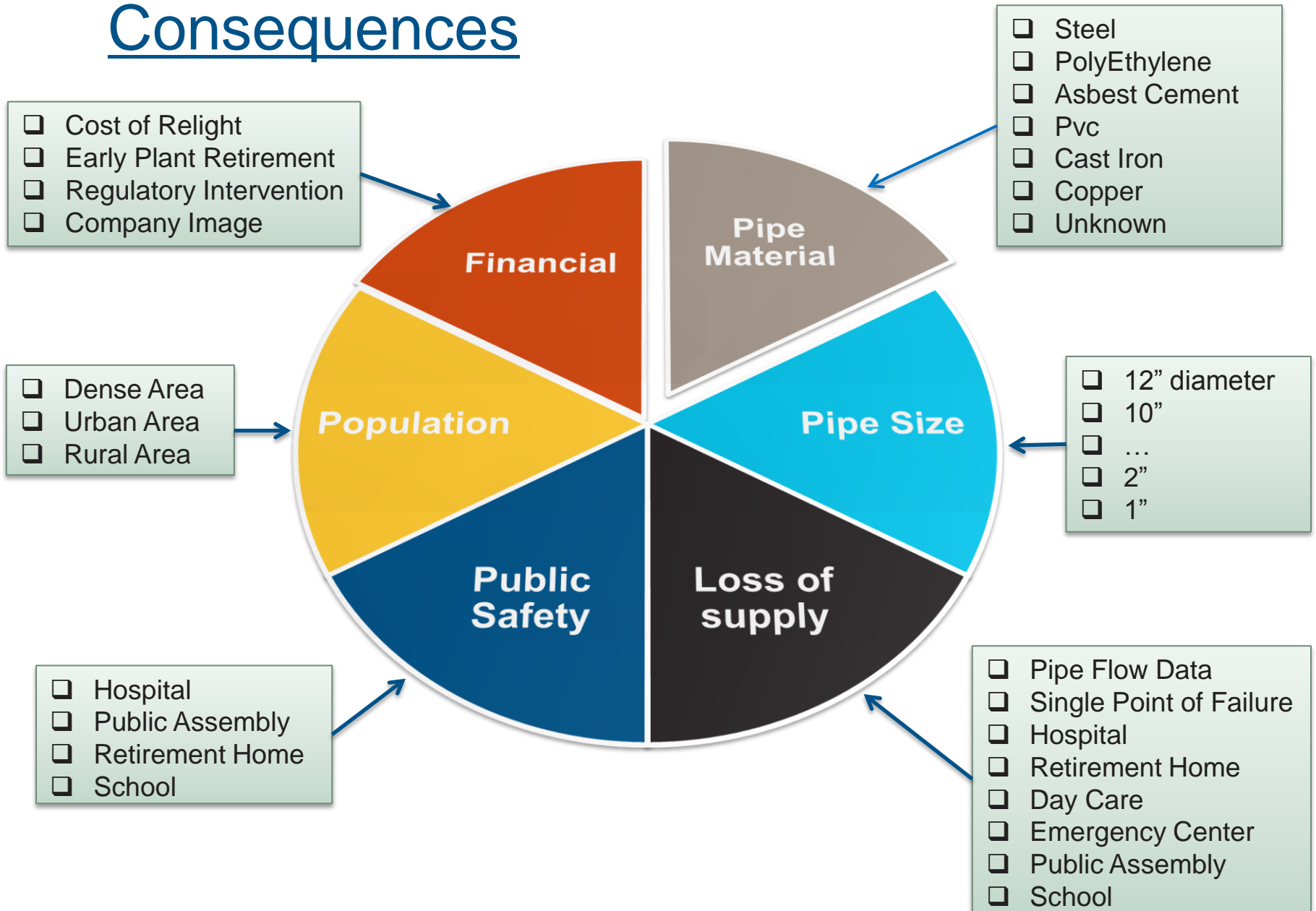- Decision Making for replacement

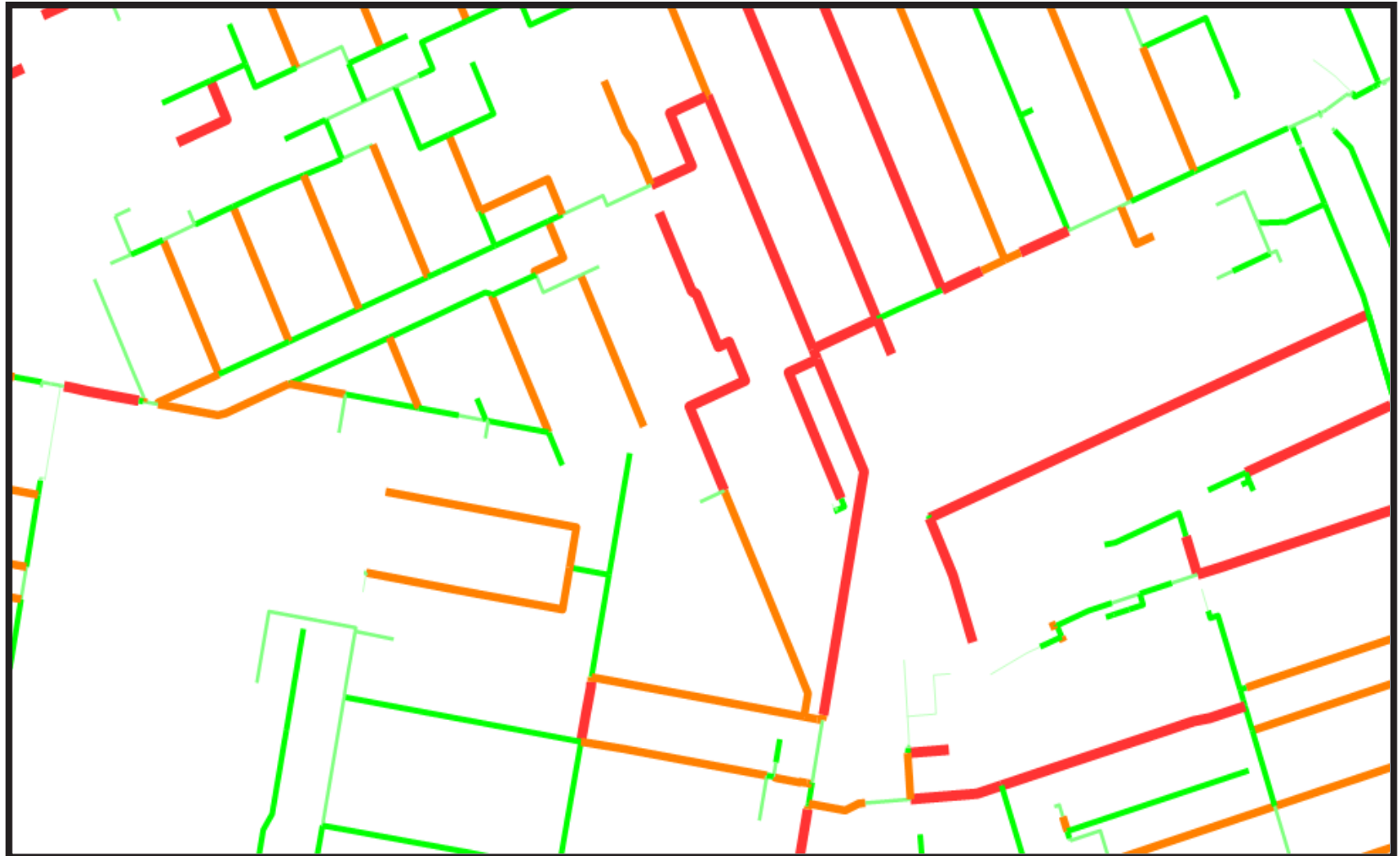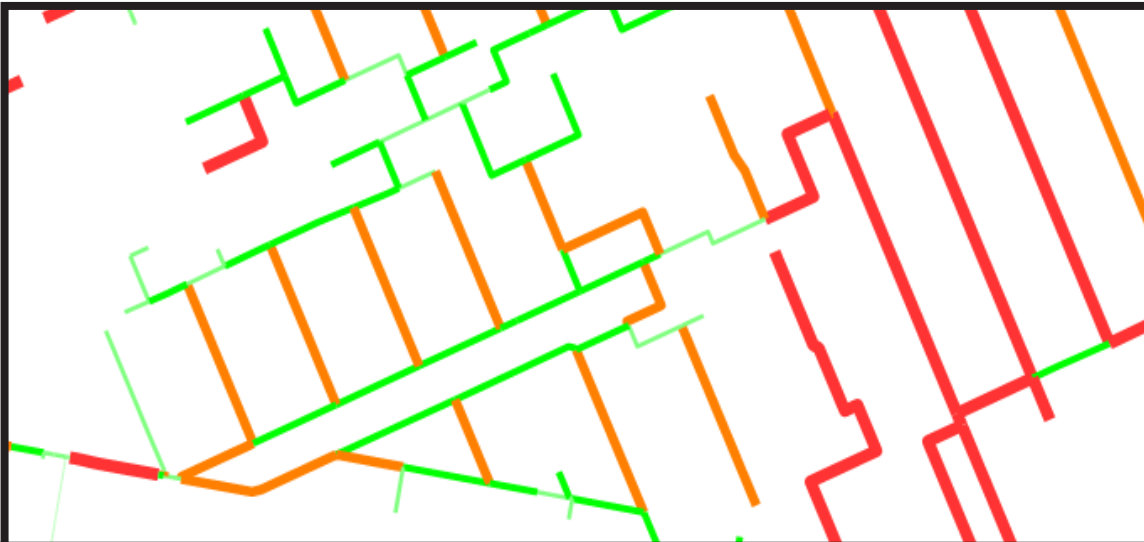# FortisBC Distribution Pipe Risk Model

Threats

Leaks:
- ☐ Leak Category
- ☐ Leak Cause
- ☐ Leak Count 1,2,3…

Corrosion:
- ☐ Pipe Material
- ☐ Pipe Coating
- ☐ Pipe Install Date
- ☐ Cathodic Protection
- ☐ Coating Condition
- ☐ Corrosion Rating
- ☐ Casing Material
- ☐ Soil Type

Excavation:
- ☐ Depth of Cover
- ☐ Cover Type
- ☐ One Call Tickets
- ☐ 3rd Party Damage

Equipment Malfunction:
- ☐ Valve Type
- ☐ Valve Size
- ☐ Valve Material
- ☐ Valve Install Data
- ☐ Debris in the system (dust)

Natural Forces:
- ☐ Soil Type
- ☐ Flood Zone
- ☐ Seismic Vulnerability
- ☐ Liquefaction Susceptibility
- ☐ Liquefaction Hazard

Material/ Join Failure:
- ☐ Mechanical Fittings
- ☐ Service Tie Type
- ☐ Pipe Material
- ☐ Weld Process
- ☐ Pipe Damage – pits
- ☐ Unstable Area
- ☐ Rock/Steep Terrain
- ☐ Contaminated Sites

Consequences

- ☐ Cost of Relight
- ☐ Early Plant Retirement
- ☐ Regulatory Intervention
- ☐ Company Image

- ☐ Steel
- ☐ PolyEthylene
- ☐ Asbest Cement
- ☐ Pvc
- ☐ Cast Iron
- ☐ Copper
- ☐ Unknown

- ☐ Dense Area
- ☐ Urban Area
- ☐ Rural Area

- ☐ 12" diameter
- ☐ 10"
- ☐ …
- ☐ 2"
- ☐ 1"

- ☐ Hospital
- ☐ Public Assembly
- ☐ Retirement Home
- ☐ School

- ☐ Pipe Flow Data
- ☐ Single Point of Failure
- ☐ Hospital
- ☐ Retirement Home
- ☐ Day Care
- ☐ Emergency Center
- ☐ Public Assembly
- ☐ School

Financial

Pipe Material

Population

Pipe Size

Public Safety

Loss of supply

Pipelines by Risk Score - Low to High

Risk Score in Detail

Properties

DP Main w/ Risk Score

Valve Normalized	
Installed to Stand	0.75
Weld Process/Me	1
Service Ties per 1	6.48586231110168
Leaks per 100m	0
Limited Access Dif	0.6
Customers at Risk	0
GTH Long Natural	
GTH Short Natural	
Maximum Operati	0
Modeled Flow Rat	0.2
Obsolete or Non-	0
Pipe Install Date (	1
Pipeline Class Reg	1
Resource Availab	0.4
System Redundar	0.6
Urbanization Safe	0.5
Financial Factor	0.25
Leak Count Leak I	0
Service Ties per 1	0.45

Result List

DP Main w/ Risk Score · Go To ▾ Select ▾ · Export · Create Report · Objects: 149 · Re-Run

Geotechni...	Corrosion ...	Equipmen...	Material o...	Excavatio...	Natural Fo...	Leak Histo...	Loss of Su...	Financial C...	Safety Co...	Difficulty ...	Security o...	Regulator...	Threat Sc...	Conseque...	Risk Score
0.2	3.125	0	0	3.75	0.5	0	0	3.5	1.2142857...	2.6666666...	4.5	4	1.49375	2.7857142...	4.1611607...
0.2	3.125	0	0	3.75	0.5	0	0	3.5	3.3571428...	3.7777777...	4.5	6	1.49375	3.9095238...	5.8398511...
0.2	2.625	0	0	3.75	0.5	0	0	4.5	4.0714285...	3.3333333...	4.5	10	1.31875	4.4285714...	5.8401785...
0.2	2.625	0	0	3.75	0.5	0	0	4.5	4.0714285...	3.3333333...	5.3333333...	10	1.31875	4.6785714...	6.1698660...
0.2	2.625	0	0	3.75	0.5	0	0	5.5	4.0714285...	3.3333333...	4.5	10	1.31875	4.5285714...	5.9720535...
0.2	2.625	0	0	3.75	0.5	0	0	5.5	3.3571428...	3.3333333...	4.5	6	1.31875	4.0428571...	5.3315178...
0.2	3.125	0	0	3.75	0.5	0	0	3.5	3.3571428...	3.3333333...	4.5	6	1.49375	3.8428571...	5.7402678...
0.2	2.625	0	0	3.75	0.5	0	0	5.5	2.2857142...	2.6666666...	4.5	4	1.31875	3.4142857...	4.5025892...
0.2	3.125	0	6.875	3.75	0.5	0	0	3.5	1.7714285...	2.6666666...	4.5	2	2.525	2.9085714...	7.3441428...

Disclaimer: Data is for illustration purposes only.

Threat Gas Station Contaminated Site

Draw a buffer around stations for analysis of the potential area of contamination

Gas Station

Leaking fuel tanks, leaking piping and spills, which could impact gas pipes

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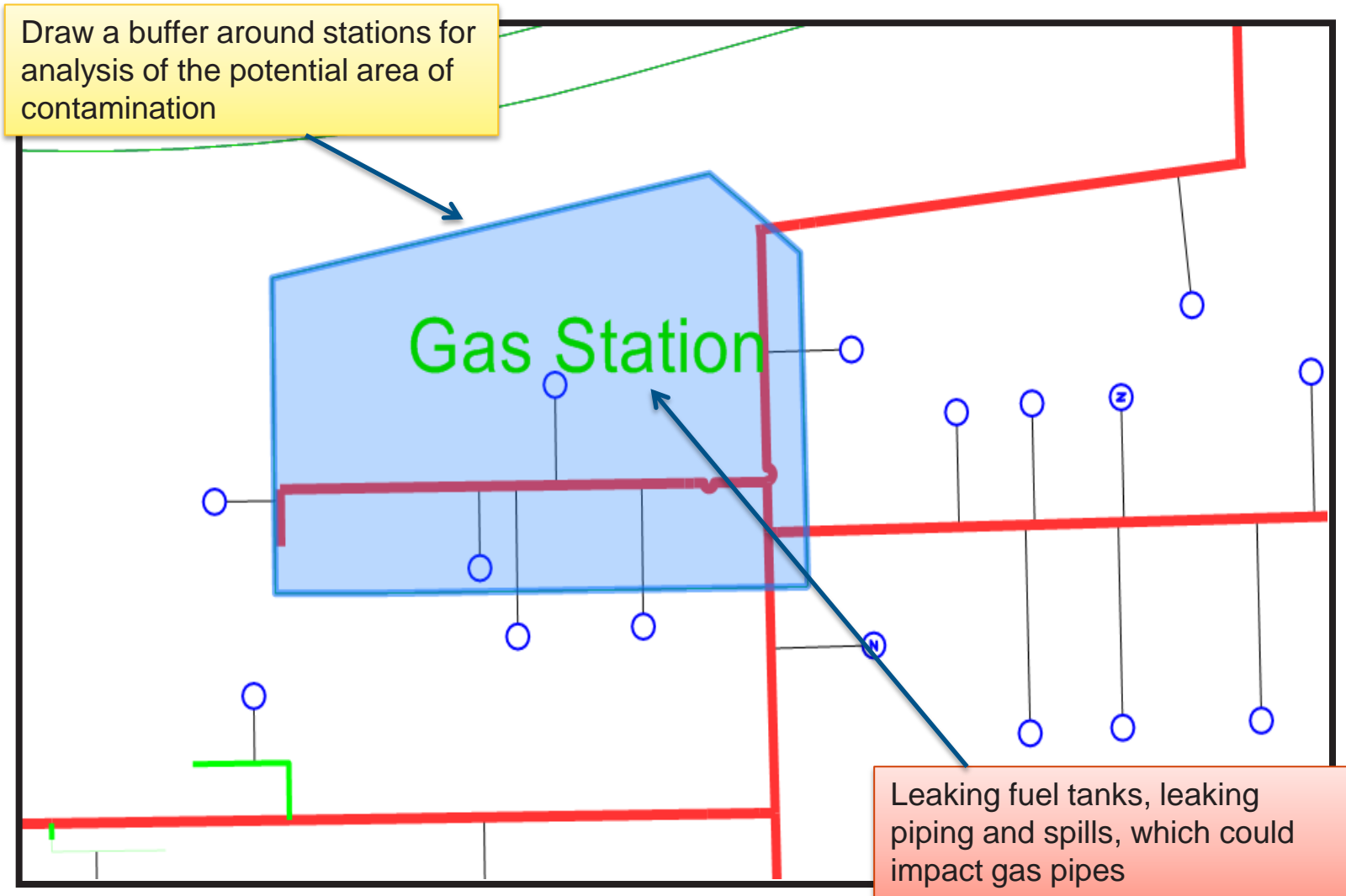
Threat Third Party Damage & One Call
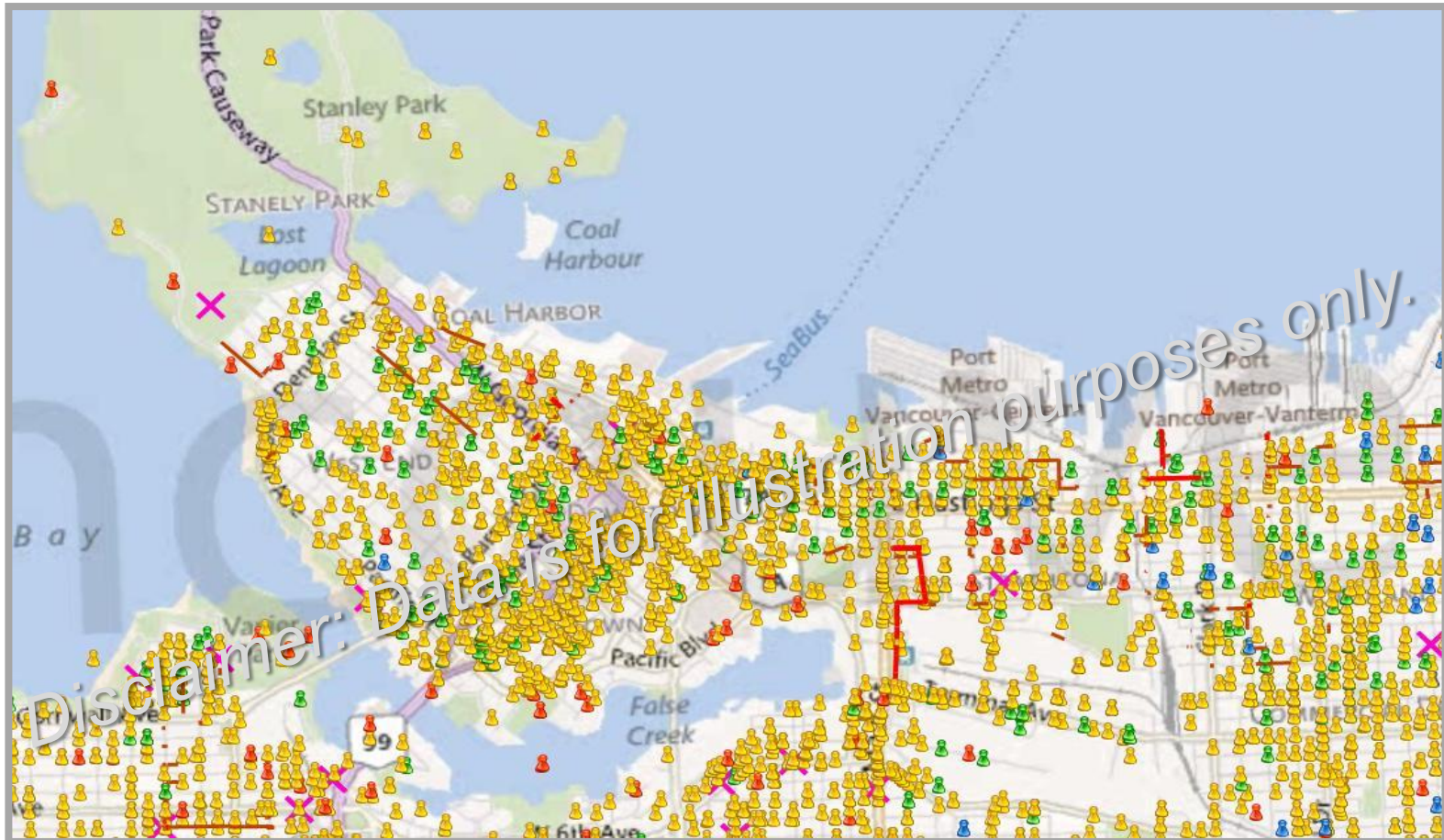
CONTRACTOR
HOMEOWNER
MEMBER, MUNICIPALITY, UTILITY
OTHER

X ☐ FEI 3 Party Damage
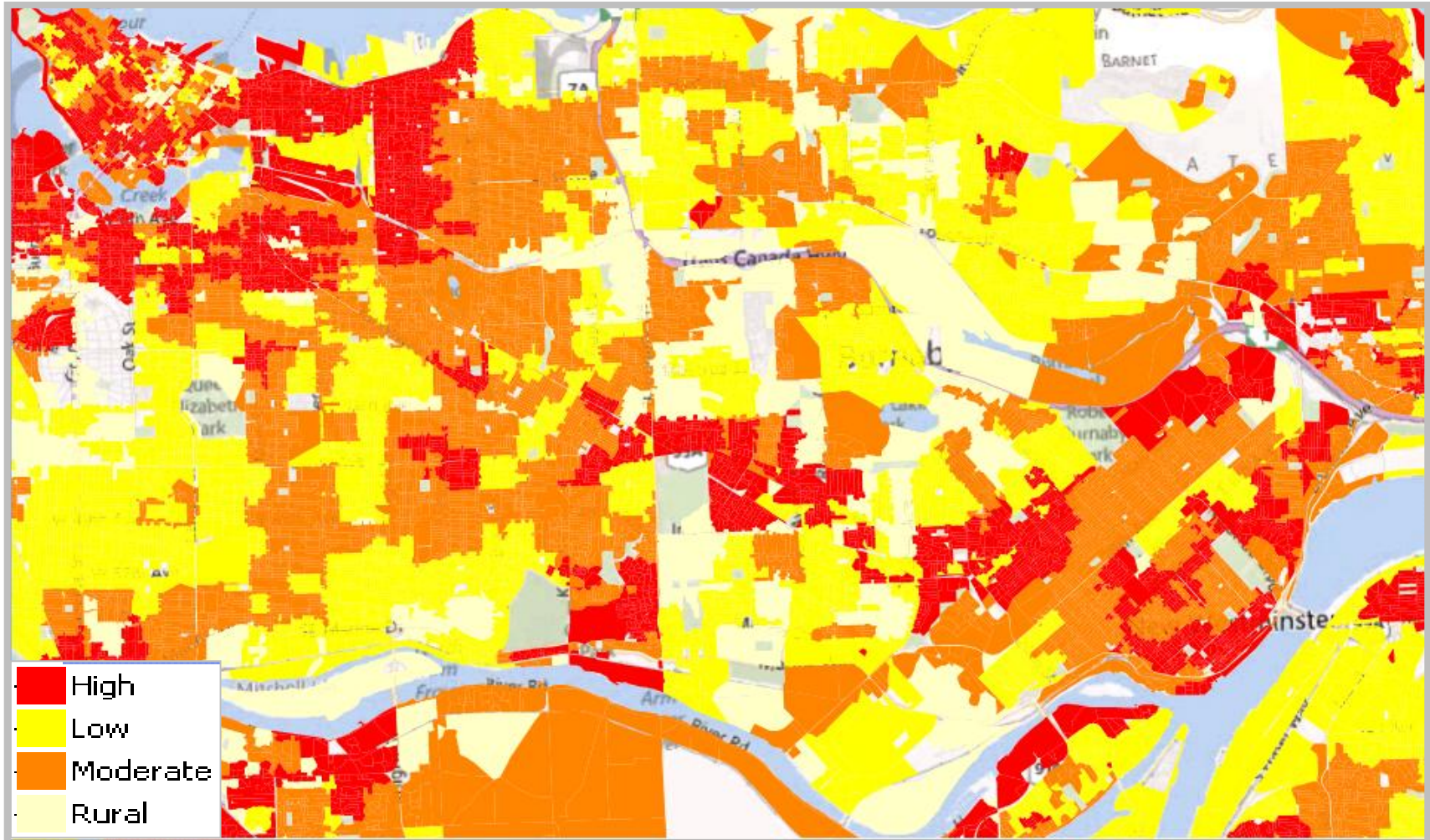
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Consequence – Nearby Critical Facilities

Hospital   Care Homes   School

Consequence – Population Density

Legend:
- **High** (red)
- **Low** (yellow)
- **Moderate** (orange)
- **Rural** (pale yellow)

Disclaimer: Data is for illustration purposes only.

Analyzing Station Location

Disclaimer: Data is for illustration purposes only.

Using the Results

Long Range Plans - Develop long range plans; standard rule: mains with higher risk scores have to be replaced sooner than mains with lower risk scores.

Budgets - Create financial models for multi year replacement projects.

Alignment – Take your multi year plan and overlay with third party projects such as highway projects, railway projects and municipal infrastructure projects.

Detail planning – Develop replacement plans, attach spreadsheets, create themes and pie charts.

Alignment – Infrastructure Projects

Sewer Project 2015

Evergreen Line 2012-2016

Road Widening 2013-2014

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Alignment – Gas Main/Municipal Projects

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Alignment – Gas Main/Municipal Projects

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Lessons Learned

- **Asset Data –** Accuracy and completeness of your facilities data is critical – when you start connecting your data sources, missing information needs to be addressed with high priority - **Historical and current asset condition data is critical.**

- **External Data Sets -** There are numerous data sets you can analyze: internal and external, shape, kmz, dwg, spreadsheets, photo's. Each data sets has to be reviewed on its merits and before you can utilize it in your risk model - **Quality and accuracy of data is key.**

- **Maintenance Risk Model** – Based on quality of data an annual review of the risk model, it may be appropriate to adjust the risk factors and weightings. With lookup tables this is easily accomplished.

Contact Information

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