EMPOWERED BY ROSEN TECHNOLOGY

GIS im Kontext der Risikobewertung von Öl- und Gas-Hochdruckleitungen

ROSEN Technology & Research Center GmbH
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30-Nov-2012

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ROSEN

ROSEN develops and manufactures equipment, software and methods for the inspection and diagnosis of engineering structures.

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ROSEN

- ROSEN products & services are sold worldwide in over 100 countries
- ROSEN employs over 1900 people worldwide representing 40 nationalities

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ROSEN Integrity Solutions

- Engineering & Consultancy Company (ENCO) within the ROSEN Group
- Integrity Software provision & implementation
- Engineering Services provision (Integrity Assessments, Risk-based Inspection Plans, GIS analysis and processing)
- Project Management
- Secured Data and Software Hosting Services

PODS™ Pipeline Open Data Standard

esri Partner Network Silver

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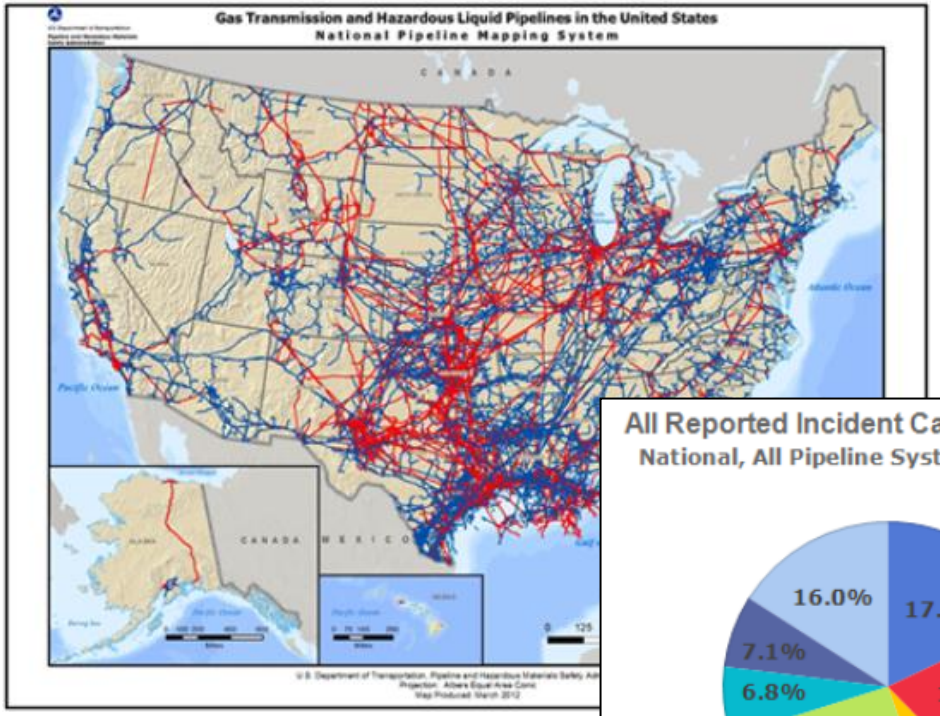
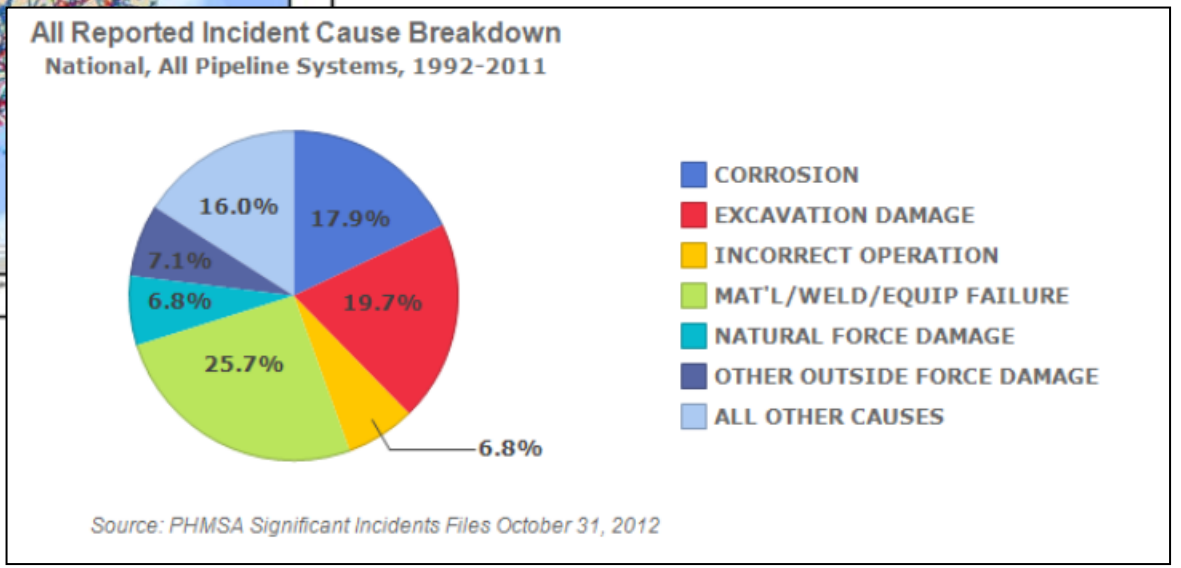
Risk & Integrity Management

Gas pipelines USA: approx. 500.000 km (2009)

Oil pipelines USA: approx. 240.000 km (2009)





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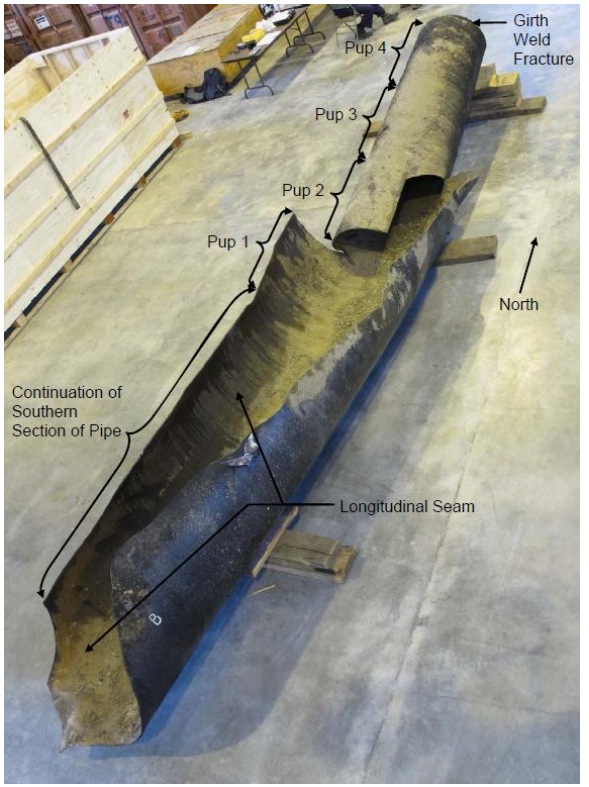
San Bruno Pipeline Incident (September 9, 2010)

A 30-inch (76 cm) diameter natural gas transmission pipeline ruptured in a residential area in San Bruno, California. The resulting explosion created a crater approximately 50 m long by 8 m wide. The subsequent fire destroyed 37 homes and damaged 18 more. Eight people were killed, numerous individuals were injured, and many more were evacuated from the area



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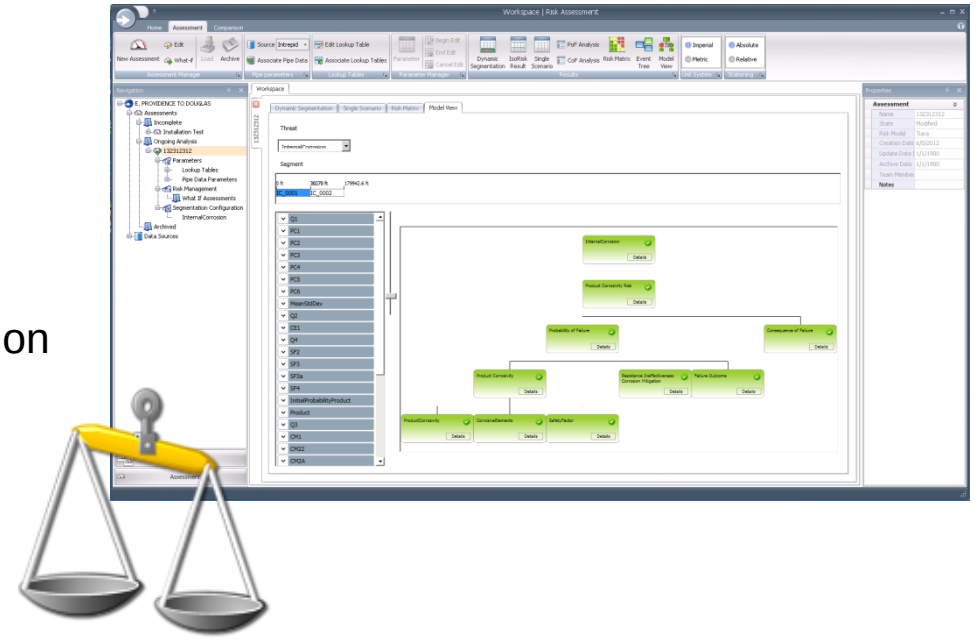
Risk & Integrity Management

A Risk Assessment model is structured to answer three basic questions:

- Which threats are active?
- Will the active threat result in a leak or a rupture?
- What is the company liability in the event of a failure?

To prioritize the system for maintenance and inspection activities an assessment has to be carried out both for active threats and for the consequences of a failure.

- **Dynamic Segmentation**
- Threat assessment based on rules derived from applicable codes and industry best practice, e.g. ASME B31.8s
- Suggestion of verification and mitigation procedures for all identified threats



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Risk Assessment Principles

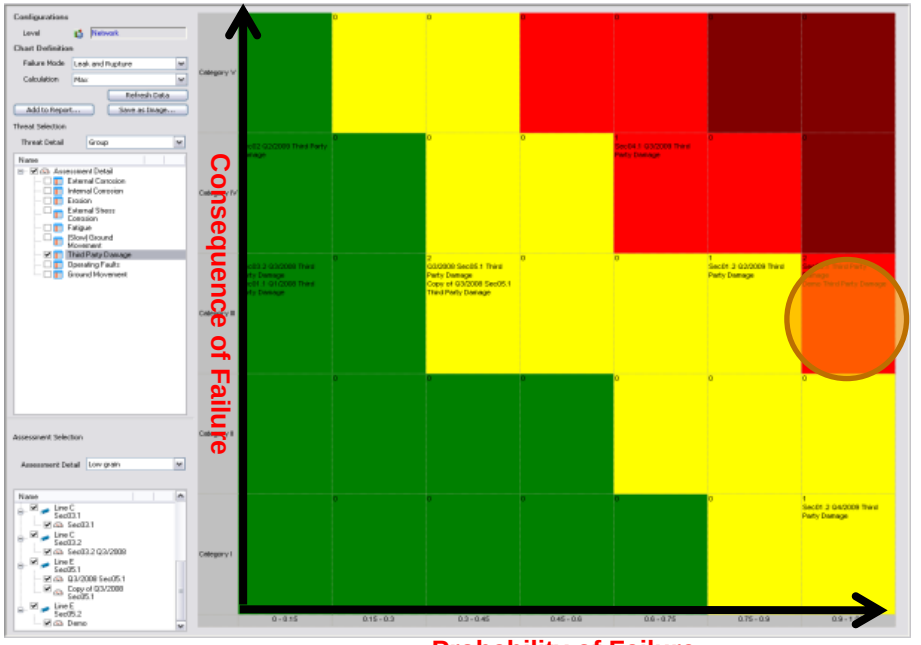
- Susceptibility assessment to identify active threats (What can go wrong?)
- Severity of the expected failure mode for active threat (Will it leak or rupture?)
- Consequence assessment in the event of a failure (What will be the impact on the operator?)

Probability of failure

Susceptibility x Severity

Risk

Probab. of failure x Conseq.



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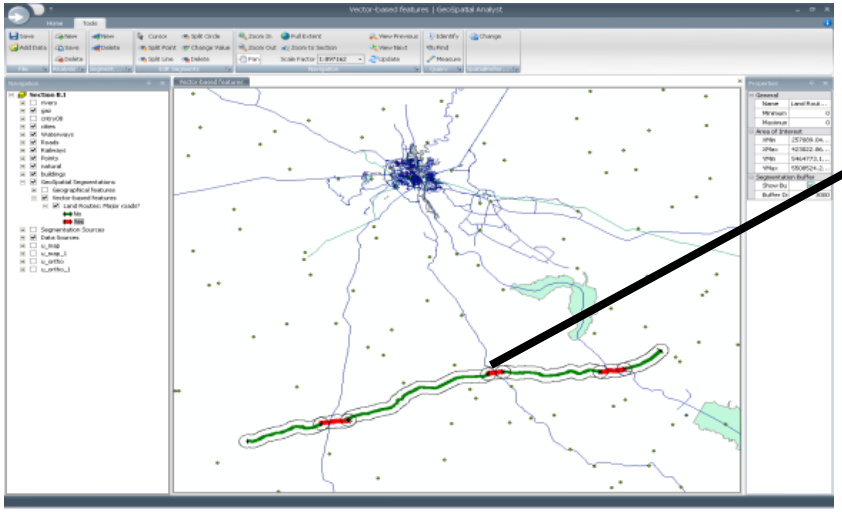
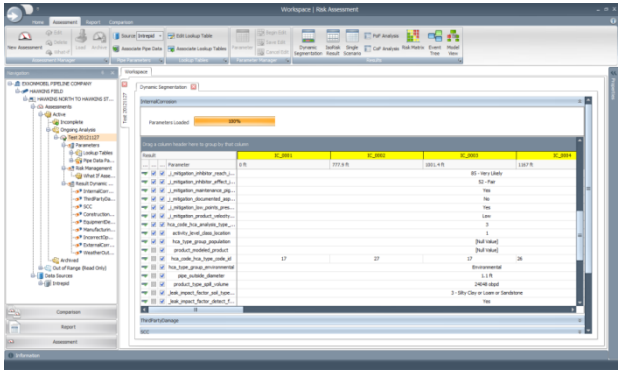
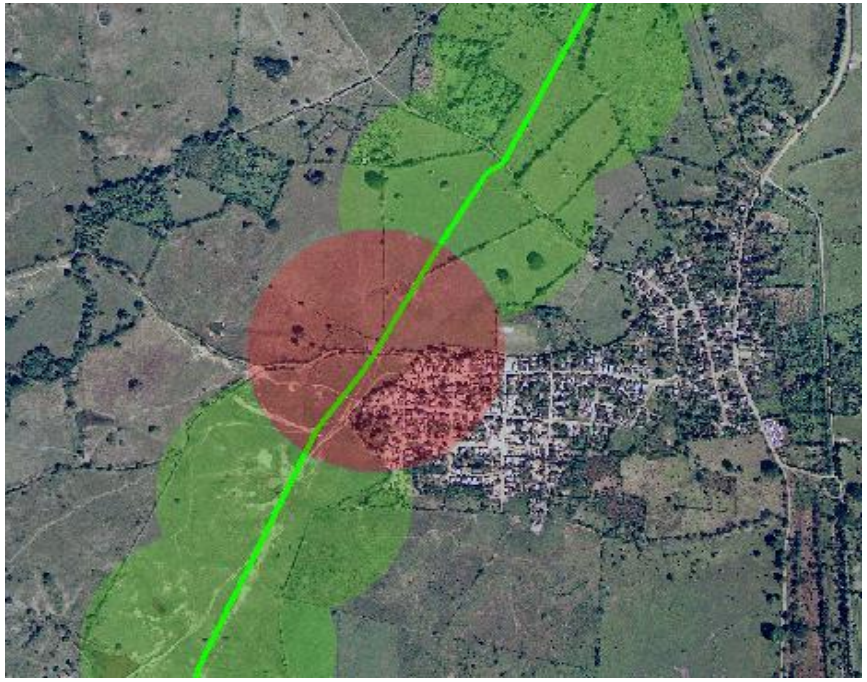
Risk & Integrity Management

- Pipelines/Sections/Segments are evaluated by Probability of Failure (Matrix X-Axis) and Consequence of Failure (Matrix Y-Axis)







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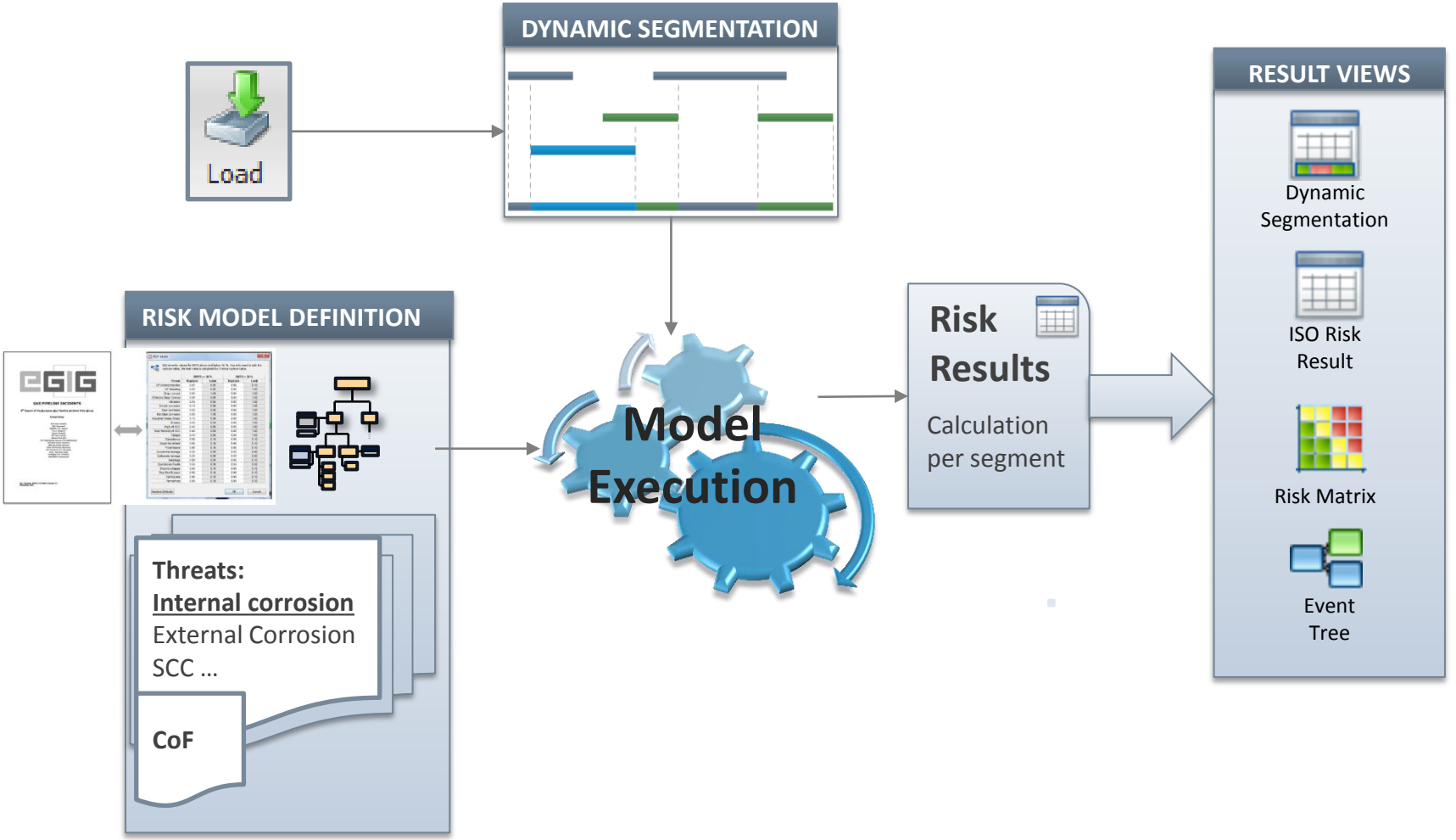
Risk & Integrity Management

Based on client HSE Risk Management Document a Risk Assessment model is being designed



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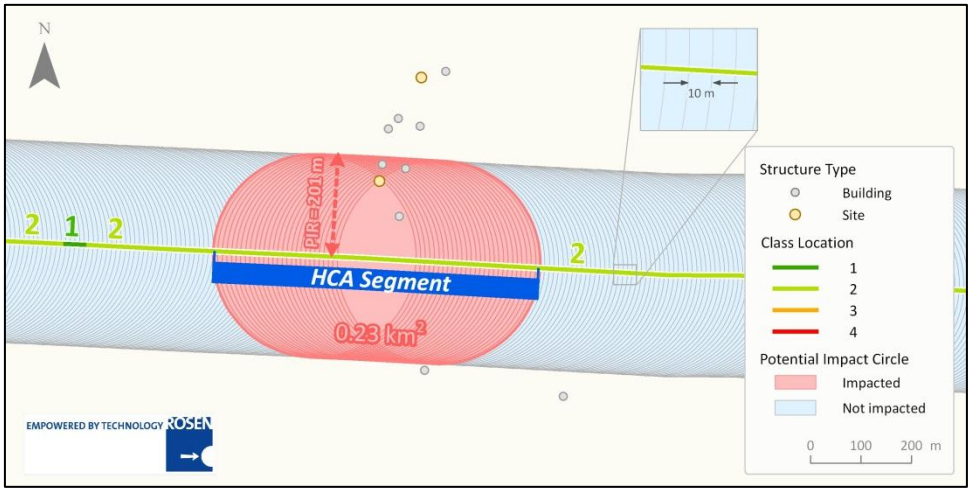
How does GIS help?

Gas Pipeline Analysis – Class Location



- Class Locations are calculated based on CFR Title 49 Part 192 Subpart A §192.5
- Class Locations segment the pipeline into 4 categories according to a potential impact on population
- Class Location serve as input e.g. for Gas HCA analysis

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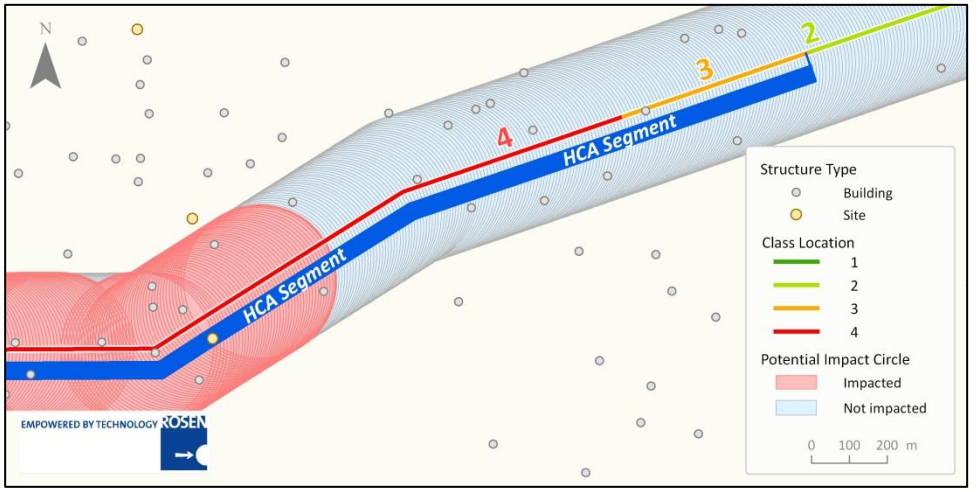
Gas Pipeline Analysis – Gas HCA



- Gas HCAs are calculated based on CFR Title 49 Part 192 Subpart O §192.903
- Gas HCAs segment the pipeline according to a potential impact on population
- Class Location can serve as input for Gas HCA analysis

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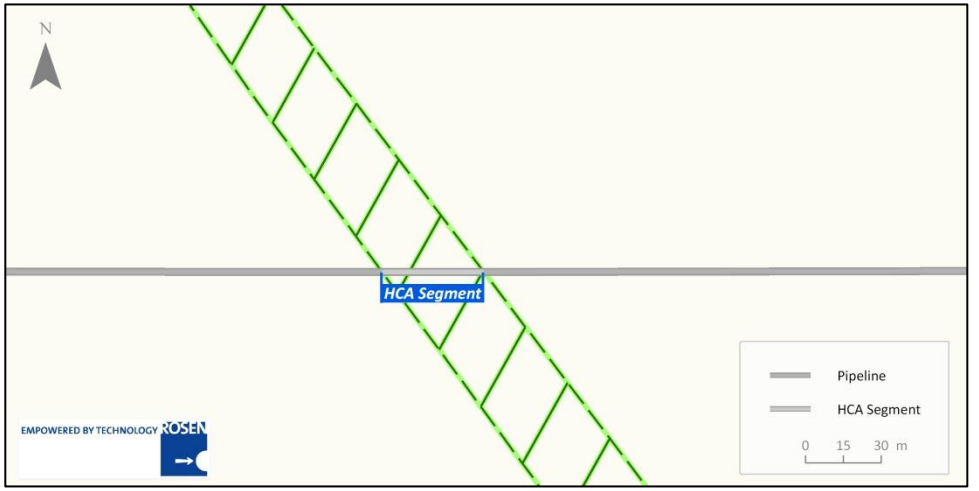
How does GIS help?

Liquid Pipeline Analysis – Direct



- Pipeline is directly intersected with High Consequence Areas (HCA)
- Typical High Consequence Areas are among others: Population, Environmental Sensitive Areas, Drinking Water, Commercially Navigable Waterways
- Each intersection results into a High Consequence Segment having general information about the impacted HCA

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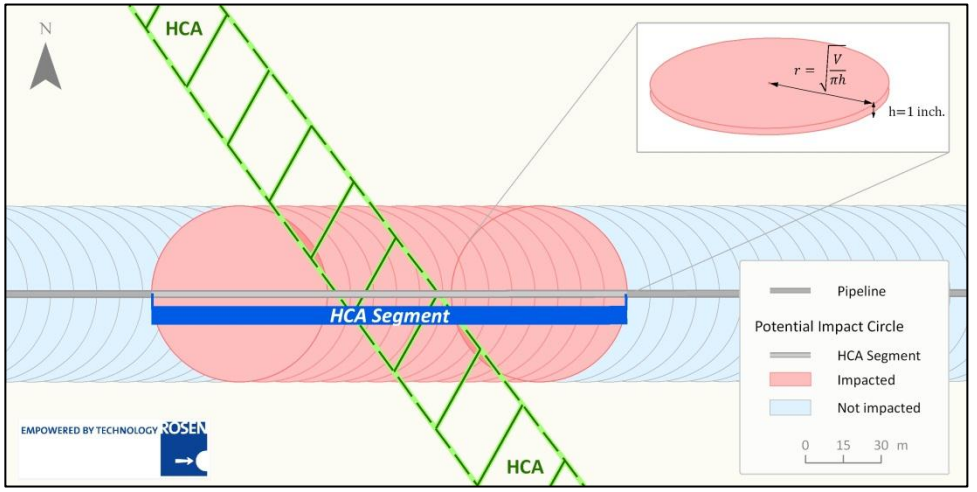
Liquid Pipeline Analysis – Indirect



- Spill volumes are calculated continuously along the pipeline
- Spills are modeled as pools
- Depth of a pool simulates the absorption of the ground
- Resulting HCA Segment has its extend based on the “Spill Pools” that intersect the pipeline

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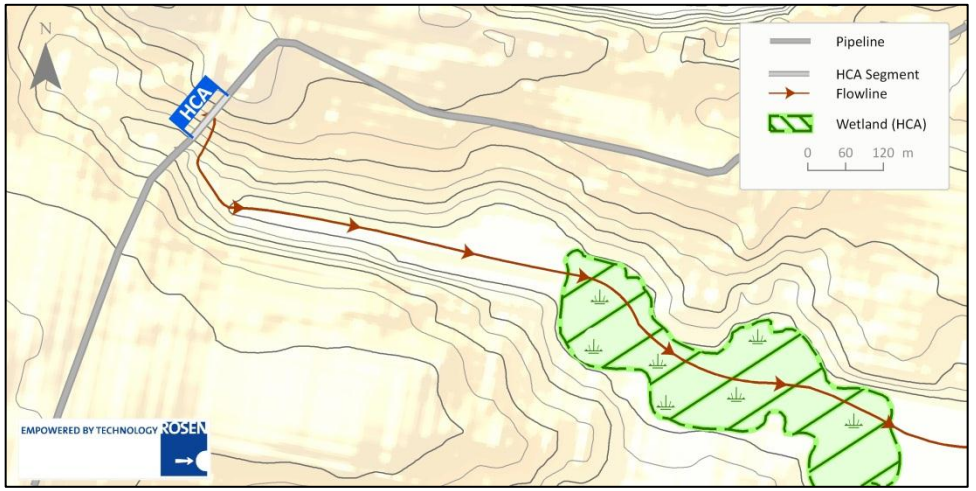
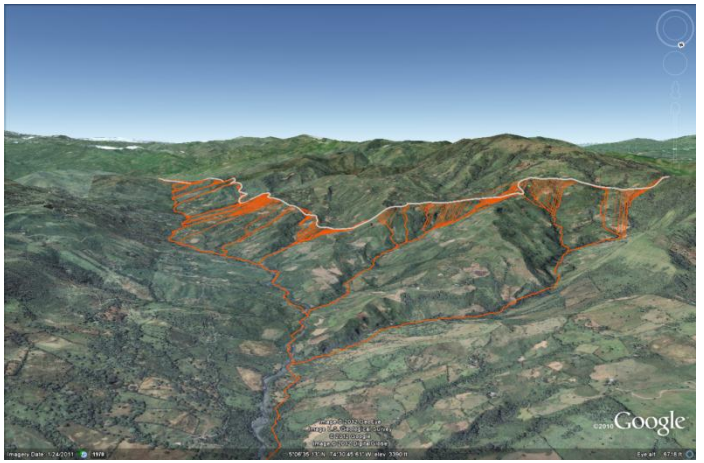
Liquid Pipeline Analysis – Terrain Flowline





- ROW of a pipeline is analyzed for its slope
- Spilling product will result into flow whenever a certain slope limit is reached (e.g. 3%)
- Overland flowline is determined following the steepest path downslope.
- Flowline is checked against High Consequence Areas

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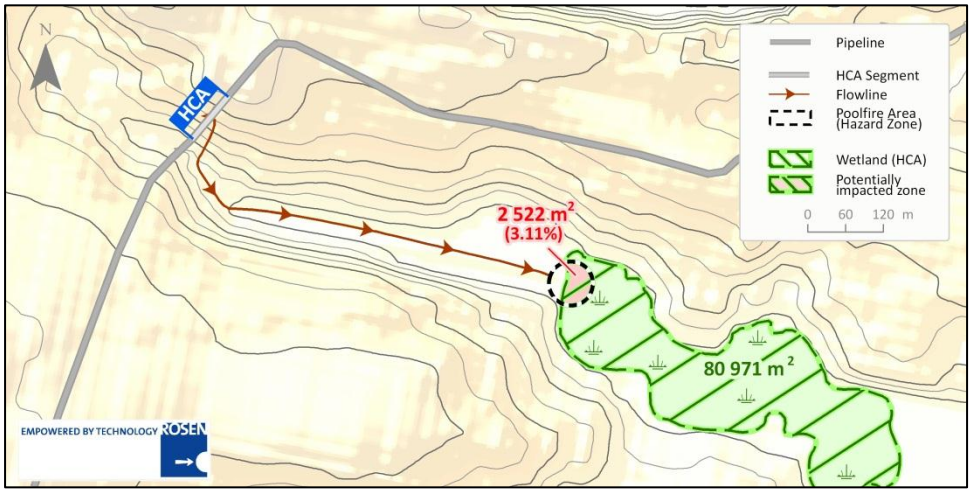
Liquid Pipeline Analysis – Poolfire



- Overland flowline is traced downhill until a sink or area without slope in which the pipeline product will accumulate
- Pool size depends on spill volume
- Area of the pool is intersected with close by High Consequence Areas

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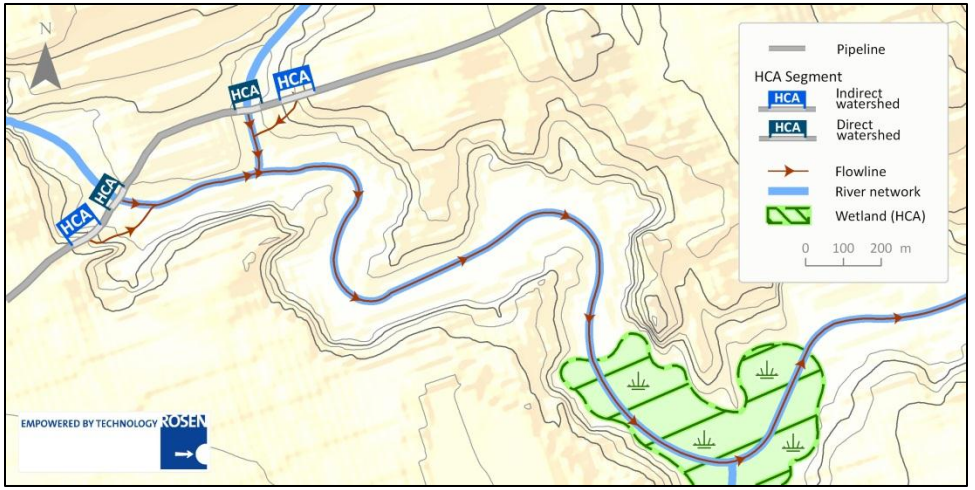
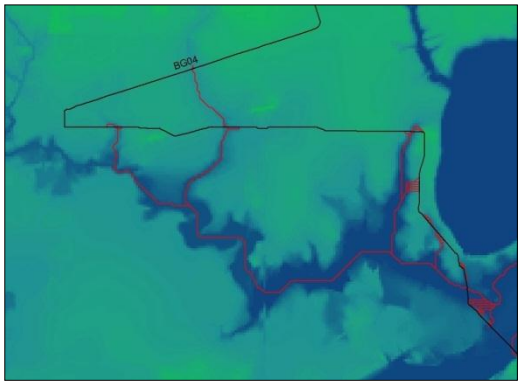
Liquid Pipeline Analysis – Watershed





- Pipeline product spills directly or indirectly (overland flowline) into a flowing waterbody
- Water network is traced downstream using flow direction information of each network segment
- A HCA segment is created whenever e.g. a river – that carries the released pipeline product – crosses a High Consequence Area

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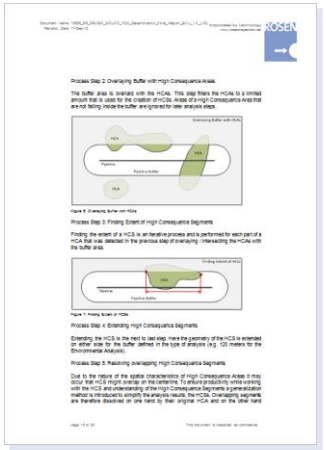
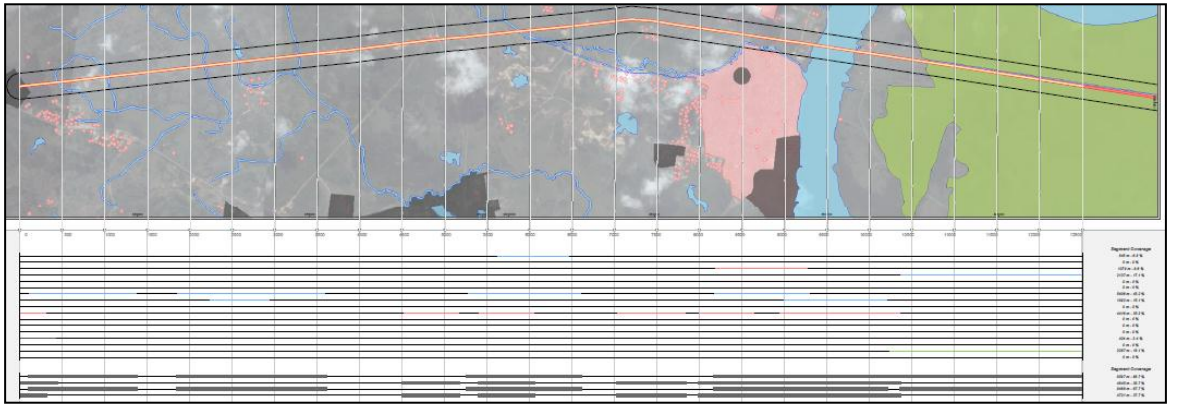
How does GIS help?

Summary

- GIS technology is an essential part of a Risk Assessment process for pipelines and the Oil & Gas industry in general
- Standardized database models and geodata structures help to speed up Integrity Management activities
- Integrated systems (GIS/Assessment/DMS/WMS) demanded
- GIS technology brings additional value with regards to reporting requirements





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