PIPELINE INTEGRITY FOR HIGH CONSEQUENCE AREAS: A CASE STUDY FOR MANAGING URBAN INFRASTRUCTURE

3RD CGD O&M WORKSHOP

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ALLIED ENGINEERS

31-JULY-2014, KAOHSIUNG, TAIWAN: a “watershed” moment

31-JULY-2014, KAOHSIUNG, TAIWAN: a “watershed” moment

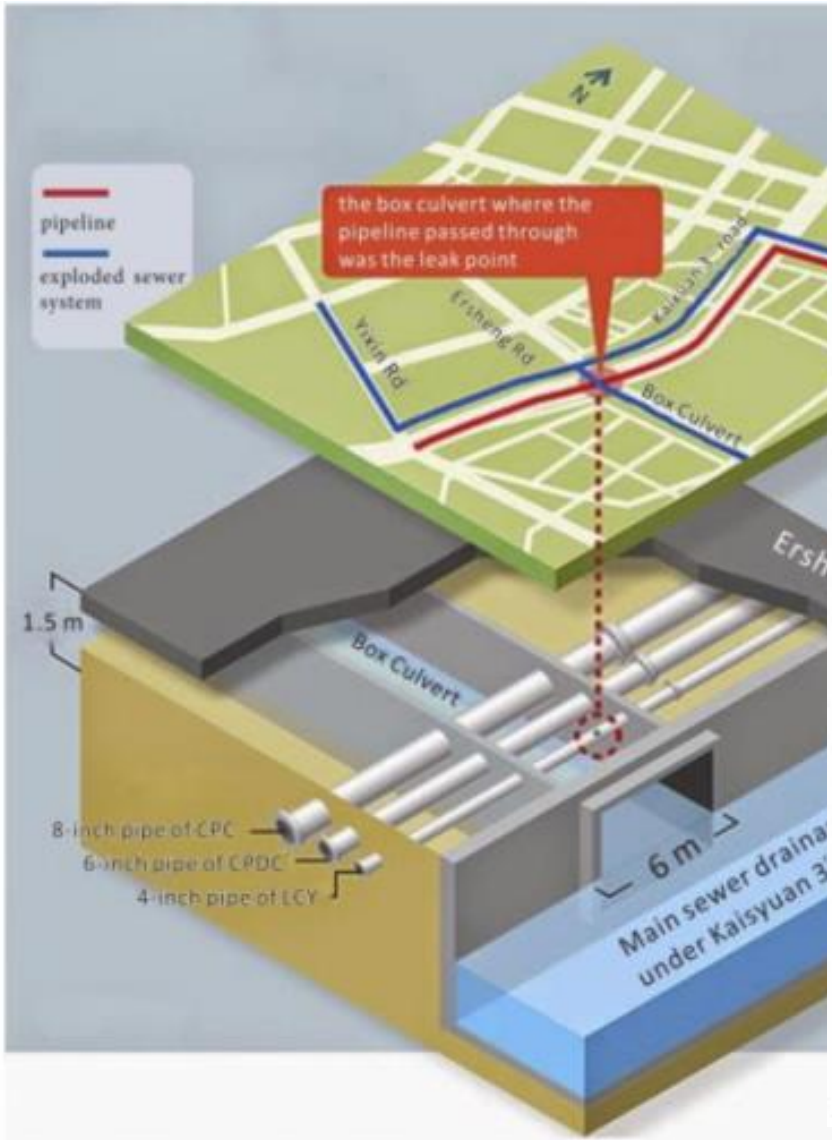
- 24 year old un-piggable pipeline that had never been inspected
- Unknown utilities in the vicinity of the non-piggable pipelines
- Unknown responsibilities between civic authorities and the pipeline owner etc.

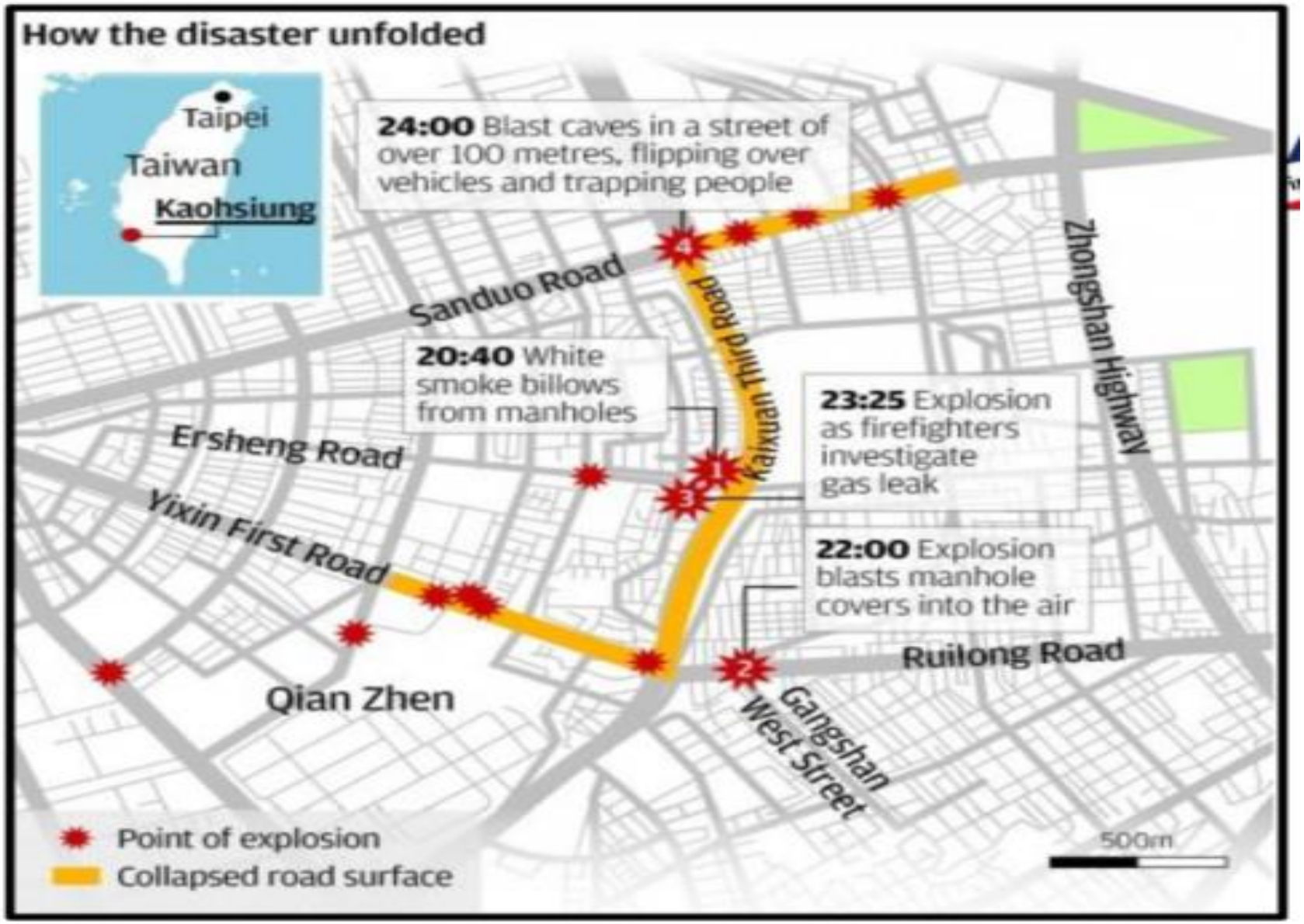
The “How” and the “Why”…

- During an upgradation work on a nearby utility, contact was created on the petroleum pipeline that went un-reported or undiscovered
- Did not result in failure immediately, but the mechanism of failure was set into motion.
- The so-called motion was set for the worldwide number one pipeline failure cause element, i.e. 3rd party damage*
- For the un-enforced, unregulated, un-inspected integrity management circumstances, it was only a matter of time before failure would occur
- The pipeline being situated within an underground tunnel system consisting of free flowing sewage water only further exacerbated the situation

**Excavation damage (34%), outside force (33%) combine to create approx. 2/3 of reportable pipeline accidents as per PHMSA (Pipeline & Hazardous Materials Safety Administration)*

The “How” and the “Why”…





Statistical Comparison to New Delhi, India

Kaohsiung, Taiwan

- Area: 2,951 km^2
- Population Density: 941 persons/km^2

New Delhi, India

- Area: 1,484 km^2
- Population Density: 11,297 persons/km^2

If the question is put forward, in terms of the bigger consequence is everybody's guess…

The Repercussion

- 18-December-2014:

  - CEO and five (5) employees of the Pipeline Owner were indicted

  - Three (3) employees of the city municipal authorities + three (3) employees from an independent terminals facility were also indicted

- 18-May-2017:

  - 2-year study conducted for all critical pipelines under the city jurisdictional area.

  - Regulation was passed. Law was enforced.

  - In the first phase, 89 pipelines owned by different Operators were mandated to undergo immediate inspection

RESULTANT: Action taken by one of the Pipeline Owners based on the Regulation

- Upgraded from a hydrostatic pressure testing programme to a full ultrasonic (UT) based in-line inspection programme for non-piggable pipelines
- It was decided by their management to obtain “direct” condition of the pipeline along with accurate XYZ datum
- The $10.3 billion USD Company that operates few of the city pipelines took it upon themselves that safety of public and reputation of company is greater than any other objective
- Four (4) pipelines were selected for the purpose of UT-ILI

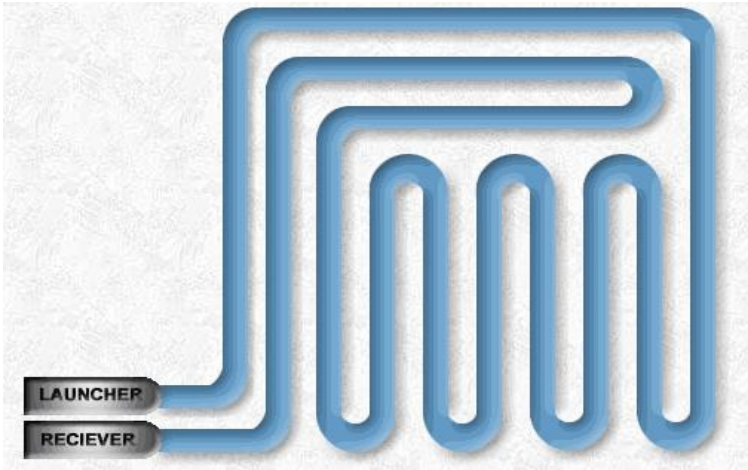
RESULTANT: Turnkey Solutions (Unpiggable, Low Risk, Low Pressure) in order to deliver the lines “ready for product” delivery service mode

PIPELINES

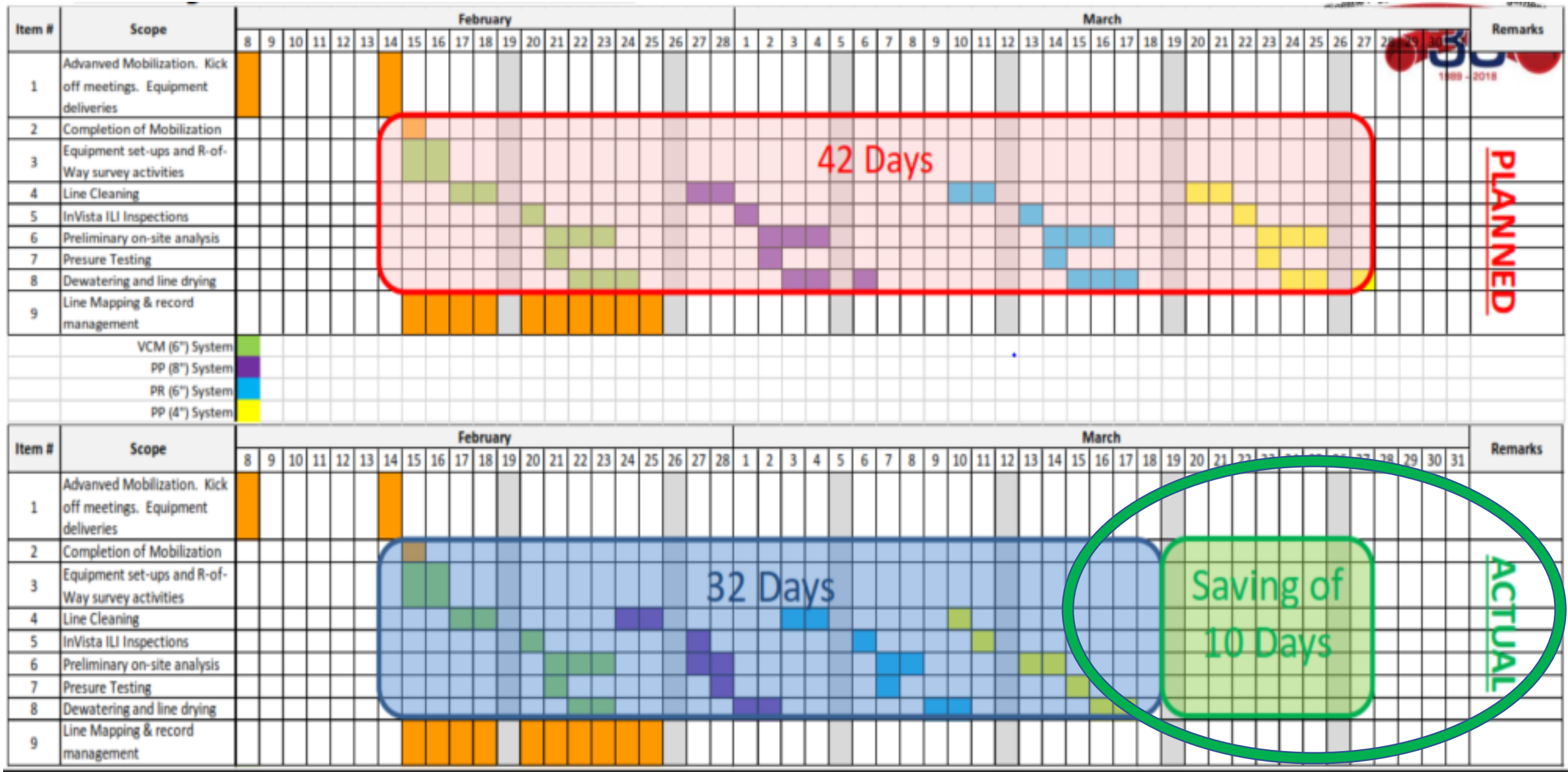
- 6” Ethylene
- 4/6” Propylene
- 6/8” Ethylene
- 8” Propylene

Turnkey Solution (Unpiggable, Low Risk, Low Pressure)

- Supply launchers / receivers and temporary flow lines.
- Pumping and water management.
- Pipeline Cleaning.
- Pipeline inspection. Deformation and wall loss.
- **Pipeline Mapping** (+/- 1 M accuracy) and isometric drawing supply.
- Hydro static pressure testing.
- Dewatering and drying (-40°C).
- Expedited Reporting



UT-ILI Project Schedule

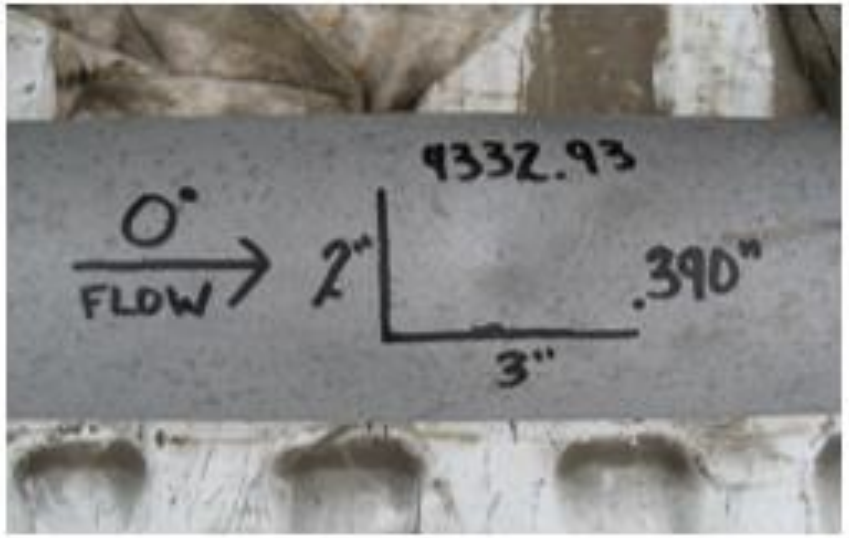


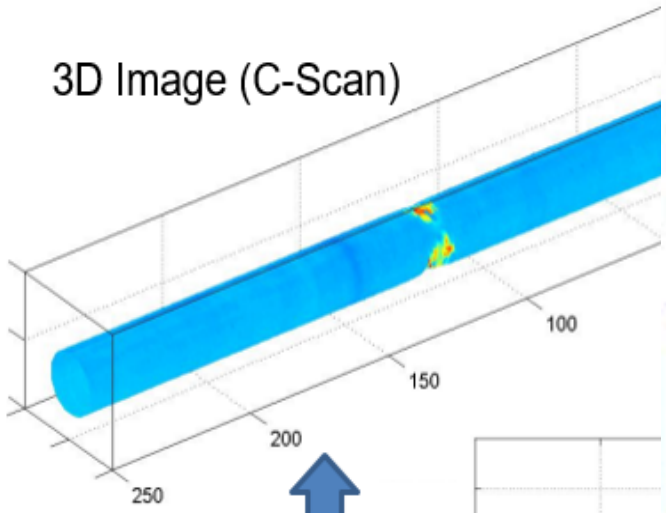
Results of the ILI Program

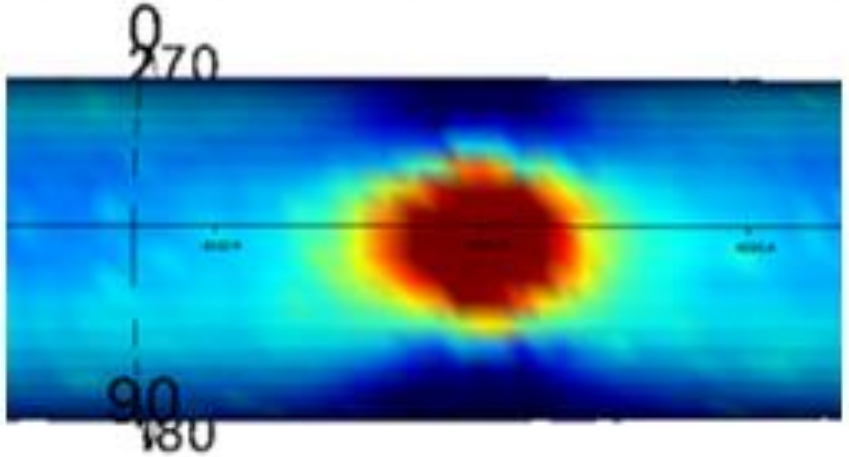
- Internal & external metal loss (worst reported was 58.6% wall loss)
- Dents (worst reported 5.5% of pipe OD)
- Mill and/or non-time dependent mechanical defects were also measured by the UT-ILI tool
- Because inspection was conducted with a high resolution UT-ILI tool, a confirmation of the “fit for service” (FFS) as per API 579 Level-II certificate was provided all four (4) pipelines inspected (complete length vs limited locations). It is to be noted that proper API 579 Level-II assessment cannot be conducted based on indirect inspection (MFL-ILI technology) data
- Although all four (4) pipelines had similar service and were in the same right-of-way, there were not in equivalent condition. Based on the UT-ILI data, two (2) of the four (4) were confirmed to have little or no integrity threats. Therefore, a blanket assumption cannot be made for pipelines – similar to a human body!

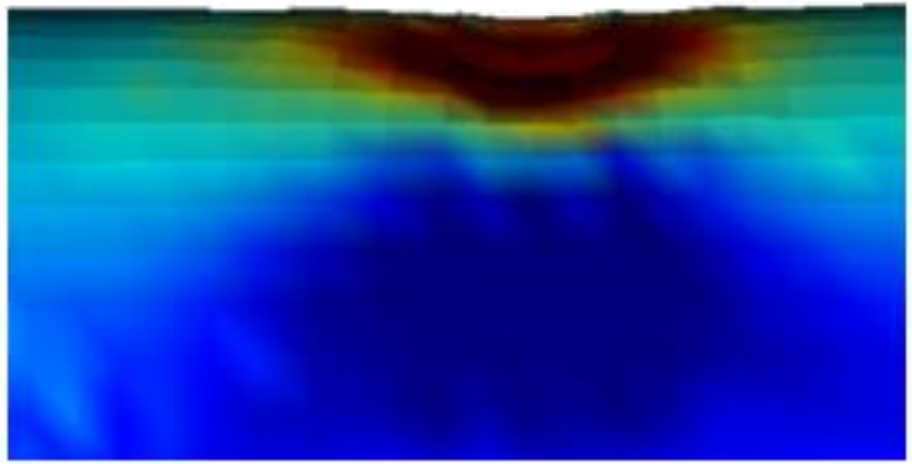
Sample UT-ILI Outputs

Ultras





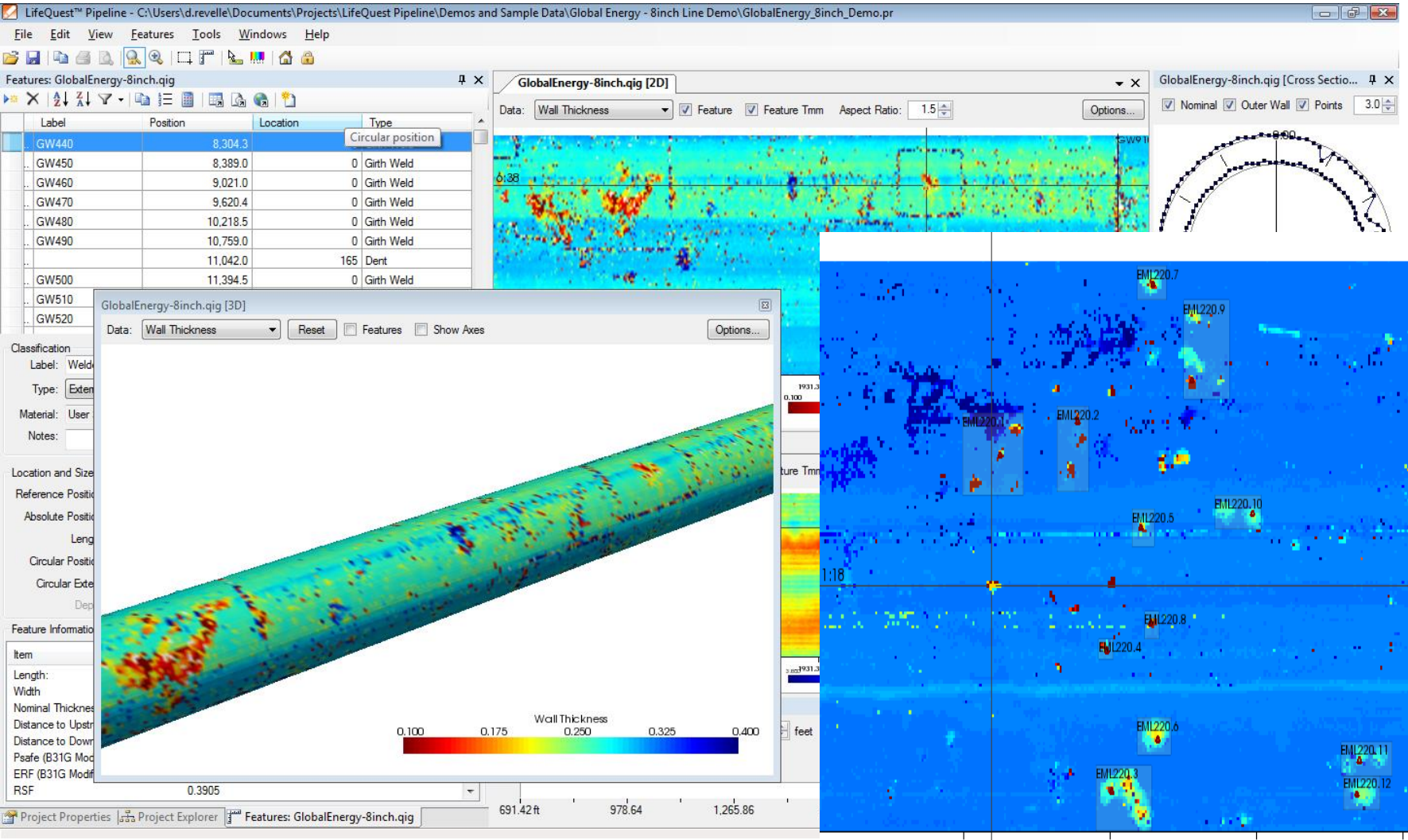




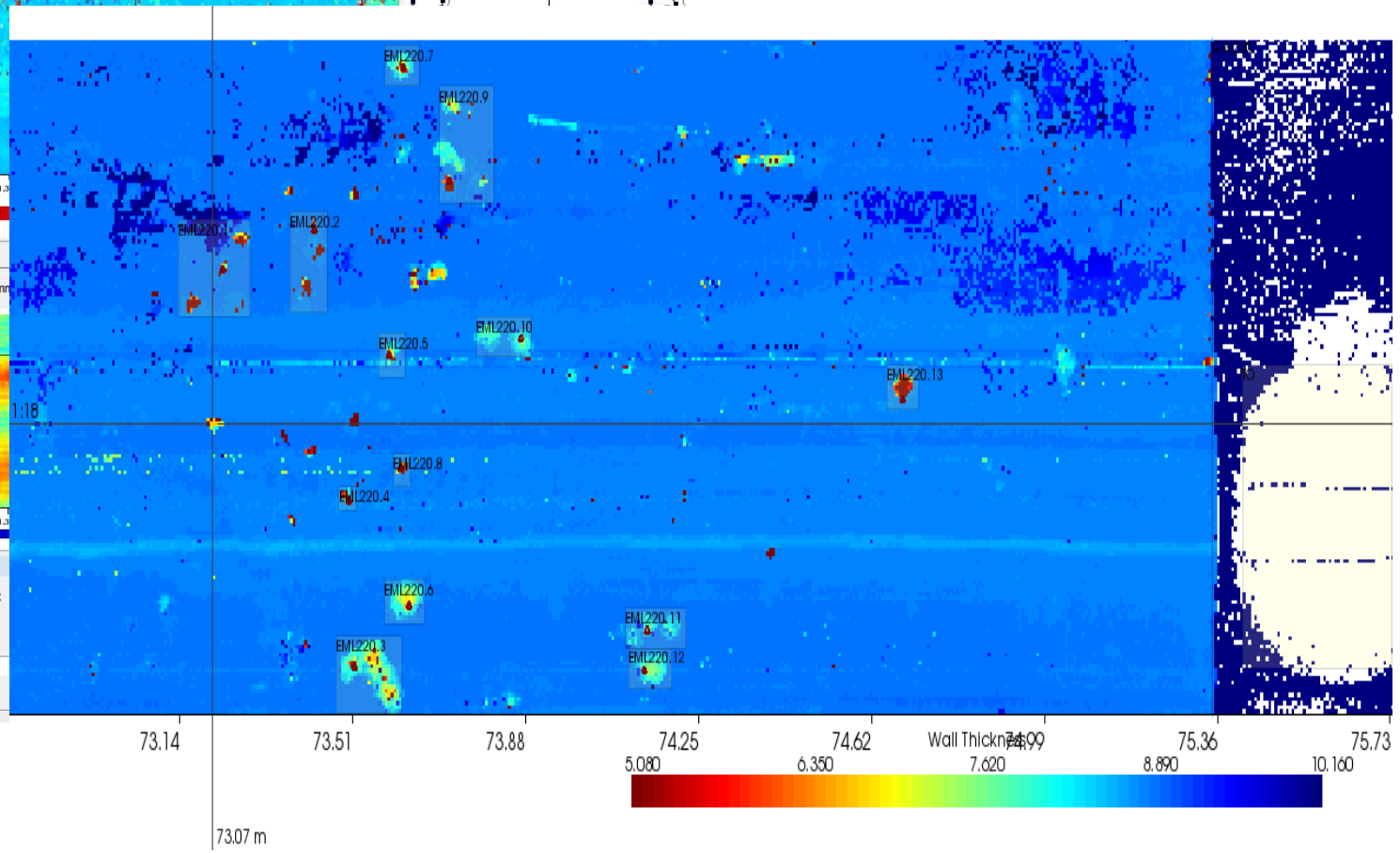
2D Image (C-Scan)

Pipeline Dent and its orientation

Sample UT-ILI Outputs

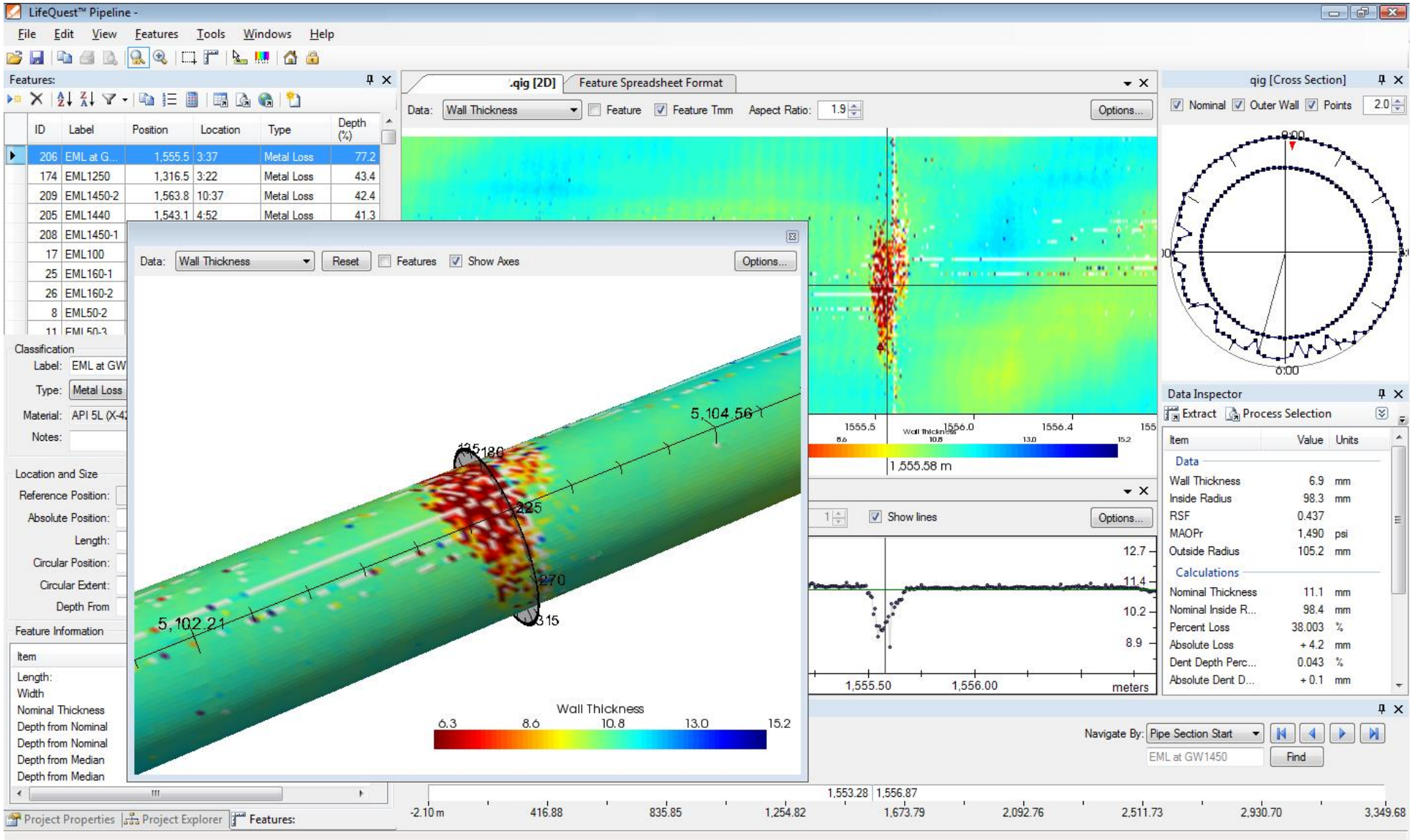


Metal loss with previously conducted repairs / unknown repairs



Pin-hole type multiple localized internal corrosion spread

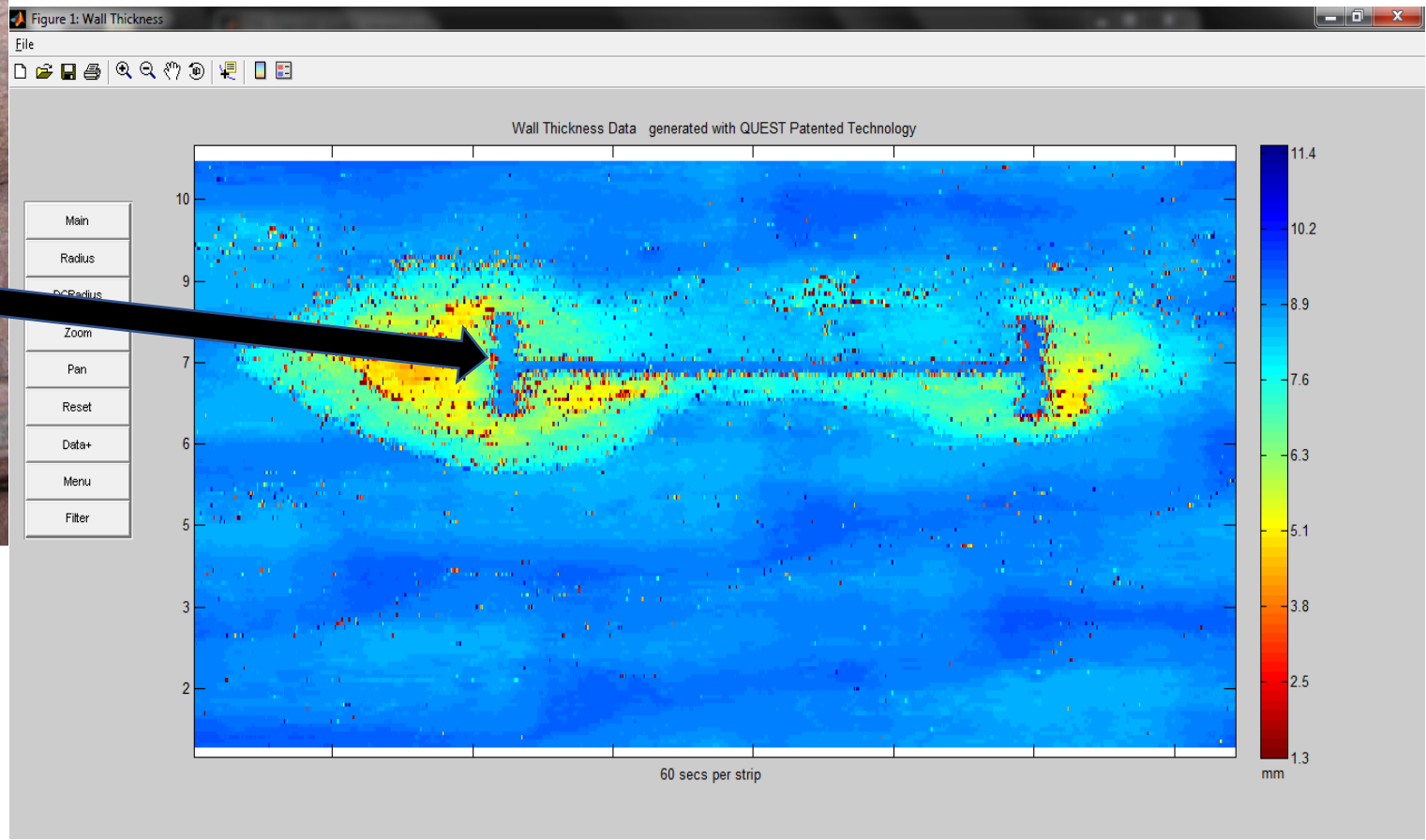
Sample UT-ILI Outputs



Localized corrosion near HAZ (girth weld)

Sample UT-ILI Outputs

Corrosion on pipe support areas



The Effect of Urbanization in High Consequence Area (Urban Areas)

- Infrastructure development is the basic catalyst of economic growth
- Infrastructure supports growth, but growth demands improvement in infrastructure
- Cost management and space limitations force the need for shared RoW's, but this comes not without risk
- Ex: 71% of the existing pipeline infrastructure in USA were constructed before 1980 – imagine how the surrounding infrastructure has grown around it!

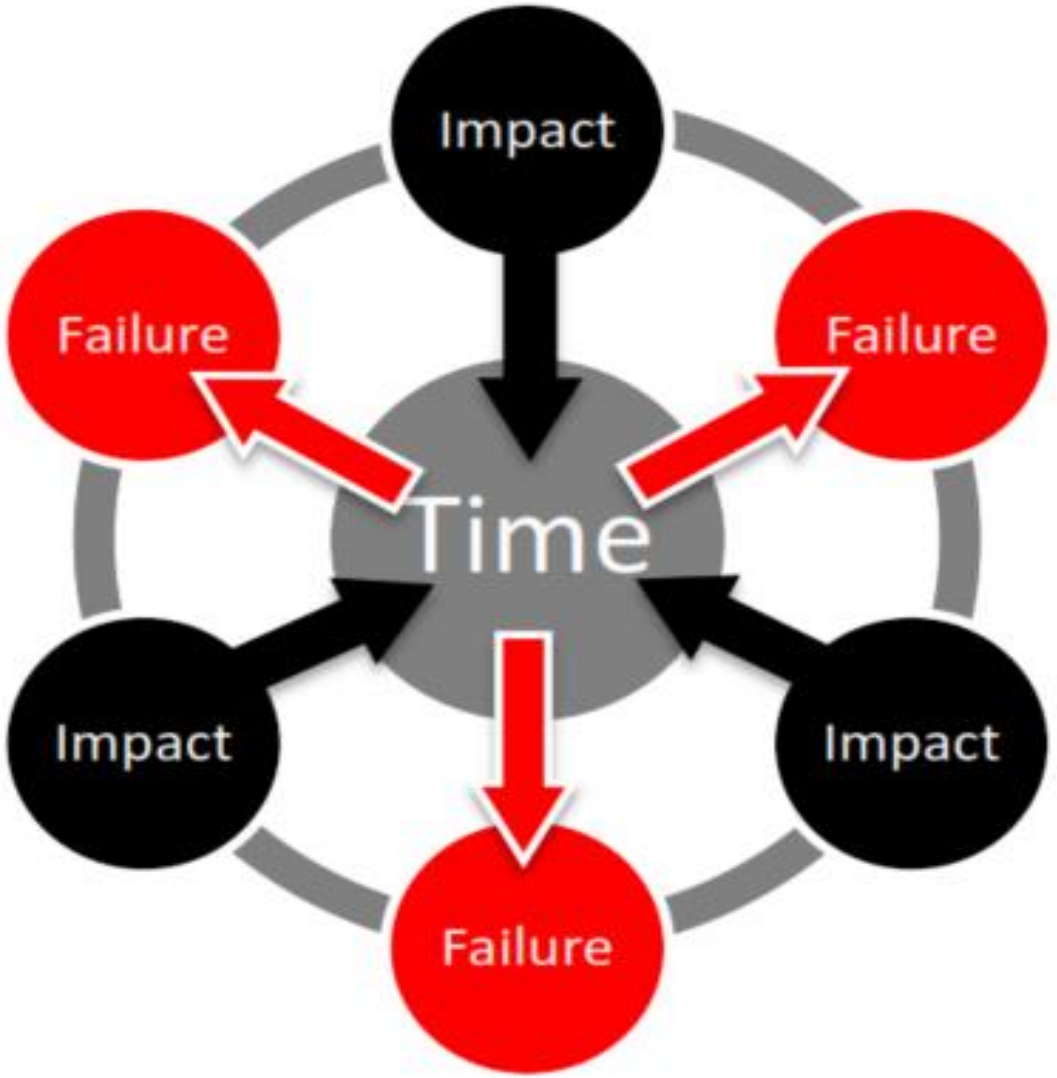
The Effect of Urbanization in High Consequence Area (Urban Areas) – A GeoSpatial Overview of the inspected pipelines RoW in Kaohsiung, Taiwan

2003

2017

Conclusion

"To build infrastructure is to build a nation; to maintain infrastructure is to love a nation"



"That what man builds; time will destroy" [if uncared for]