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# Spatial Data Mining Presents a New Wave of O&M and Capital Cost Optimization Opportunities to Upstream Producers

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QM4 Engineering Ltd.

*``Aligning Corporate Data to Impact Performance``*

Thank you ....



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<http://www.nacecalgary.ca>

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The goal of NACE Calgary is to protect people, assets and the environment in Western Canada from the affects of corrosion.

We do this primarily through seminars, training and networking opportunities for people who are involved in corrosion prevention and control.



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## Spatial Data Mining Presents New Wave of O&M and Capital Cost Optimization Opportunities to Upstream Producers

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### AGENDA -- ``Getting More from Your Assets``

1. Industry Pipeline Performance - Alberta
2. Causal Issues Related to Data Quality
3. Impact of Data Quality to O&M Work Processes
4. Use of Spatial Data as “New Starting Point” for Field, Operations
5. Use of Spatial Data to Support Pipeline Integrity Management
  - Case Study – Smart Network to Support PIM
6. Project Design & Execution



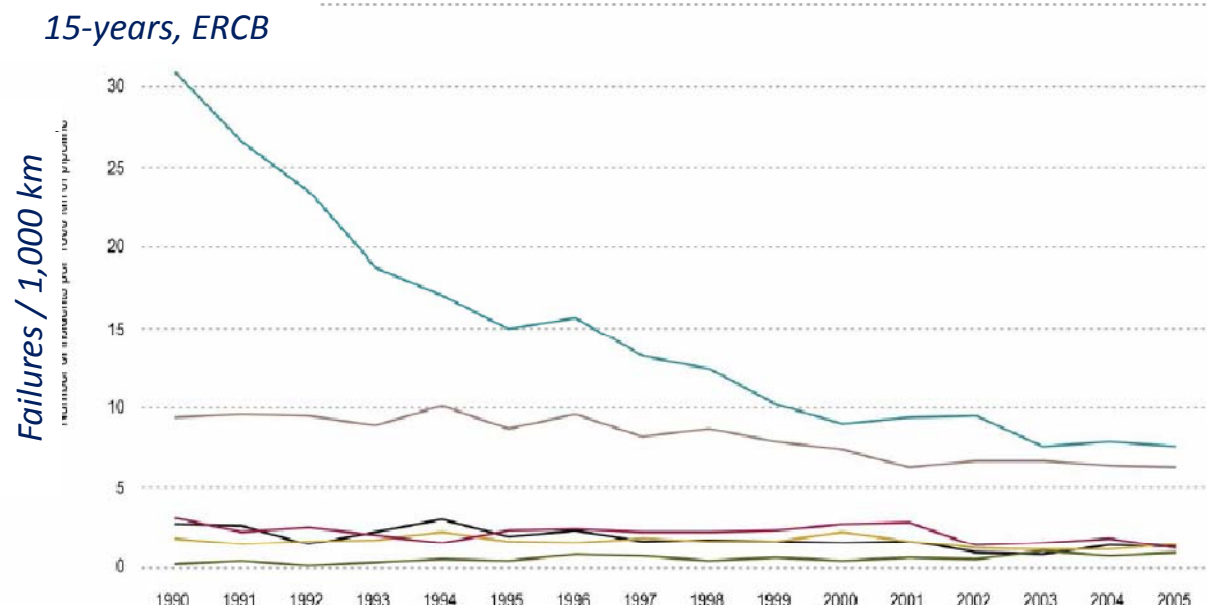
# 1. PIPELINE PERFORMANCE

*“Pipeline performance continues to be unacceptable from owner & public p.o.v.”*



## *``Getting More from Your Assets``*

### 1. Industry Pipeline Performance - Alberta

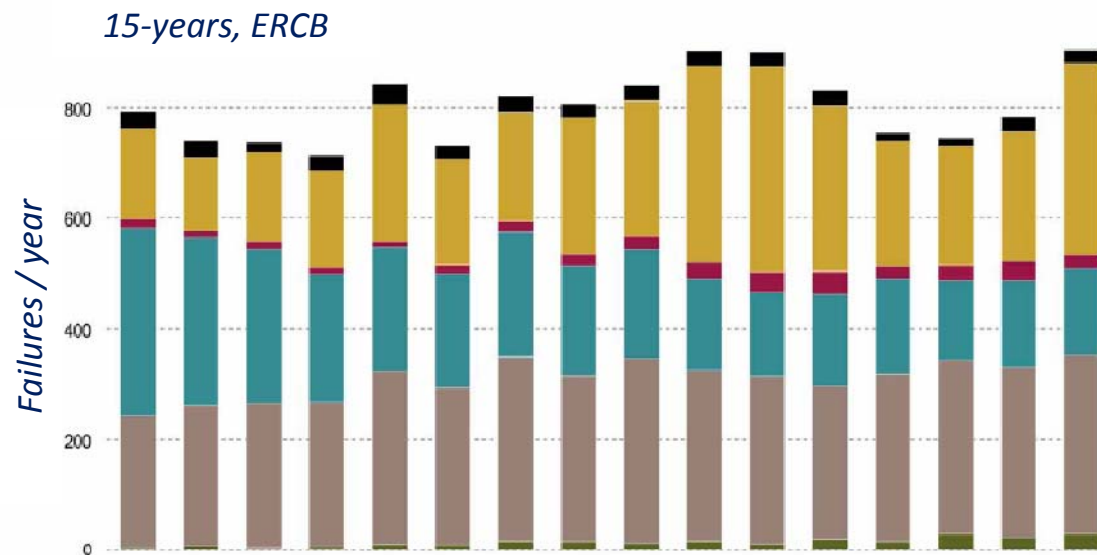


***``Pipeline Failure Frequency is Falling  
for all Substances in Alberta``***



## *``Getting More from Your Assets``*

### 1. Industry Pipeline Performance - Alberta



***``Annual Pipeline Failure Events Remain Steady, and Increasing for Natural Gas & Oil Emulsion. Failure Events for 2008 Established new Historical Maximum``***

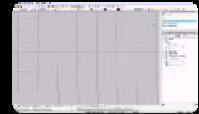


## 2. CAUSAL ISSUES RELATED TO DATA QUALITY

*“There continues to be a need to better understand the asset as the basis for O&M decisions”*

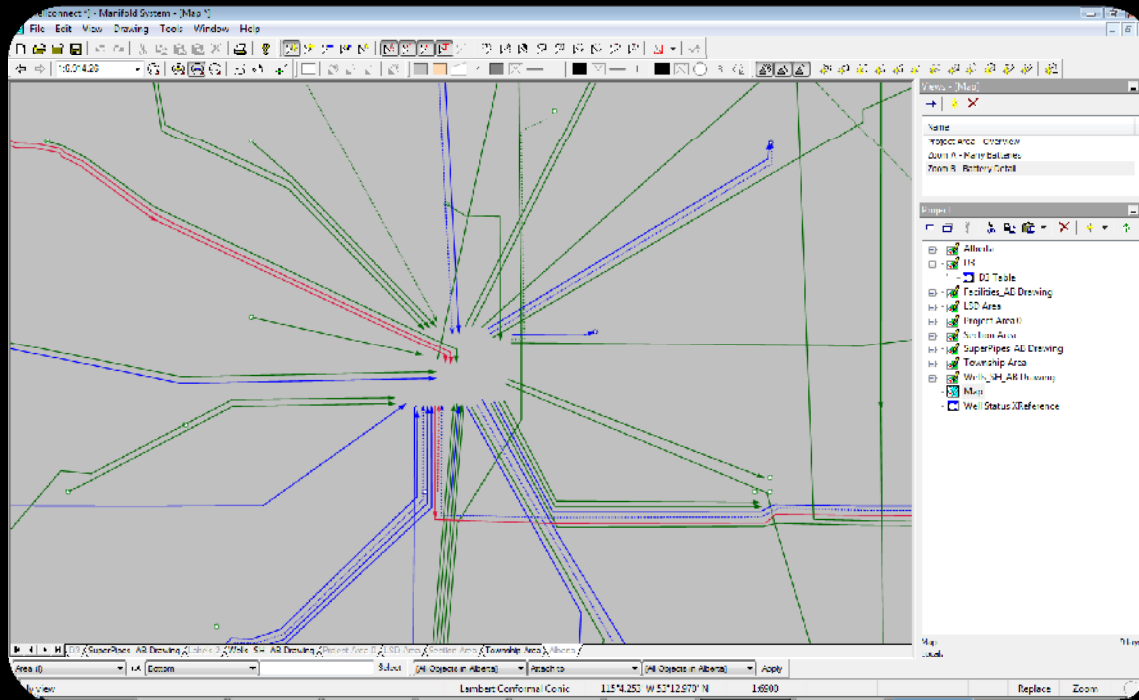


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### 2. Causal Issues are Related to Data Quality –

- Networks are not Connected
- Content of each Segment is Unknown
- No Ability to React to Changes (*22% annual decline*)







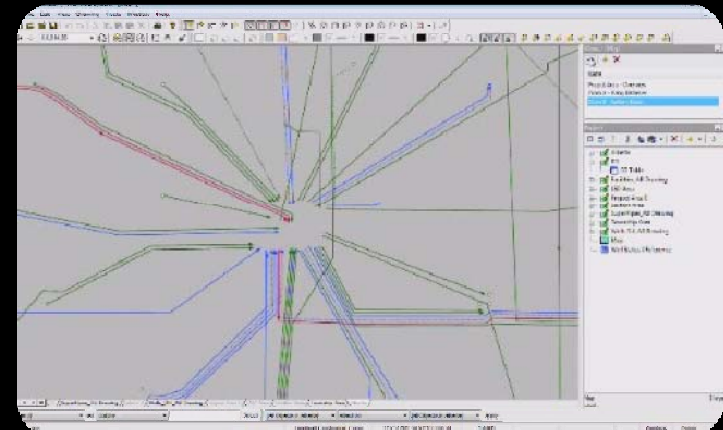
## *“Getting More from Your Assets”*

### 2. Causal Issues Related to Data Quality –

- Networks are not Connected
- Content of each Segment is Unknown
- No Ability to React to Changes

#### **SUMMARY OF AS-IS:**

- Present Data Standard is not Serving the Owner Business Model
- No Knowledge of Network Connections
  - W-P / P-P / P-F / F-P
- No Knowledge of Content within Each Pipeline Segment
  - Oil / Gas / Water



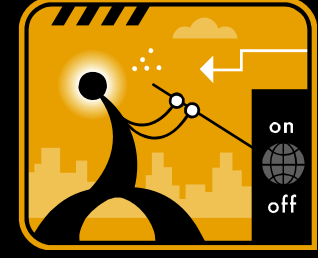


### 3. IMPACT OF QUALITY SPATIAL DATA TO O&M WORK

*“Oil and gas operations needs SMART networks to support SMART decisions – the time is NOW”*



*“Getting More from Your Assets”*



### 3. Impact of Quality Spatial Data to O&M Work Process Portfolio

IC Risk Assessment & Management

IC Mitigation Scheduling & Execution

EC Risk Assessment & Management

ERCB D-066 Pipeline Compliance

ERCB D-013 Suspended Well Surveillance

ILI Data Assessment

Chemical Program Management

CP Data Management

ERCB D-071 Sour Gas Buffers

Public Awareness

Incident Command

Hydrate Assessment & Control

Drilling Program / Capacity Optimization

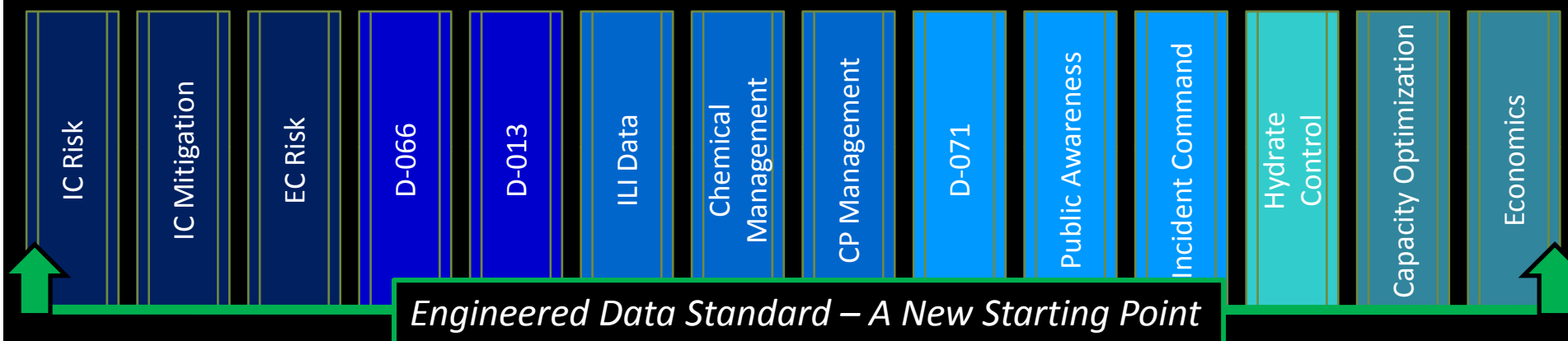
Cashflow Forecasting & Economic Model



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### 3. Impact of Quality Spatial Data to O&M Work Process Portfolio



**Industry Standard Practice  
(reactive)**



Unacceptable Industry  
Performance Based Upon  
Insufficient Operational Asset  
Characterization

**Enhanced Data  
(predictive)**

Enhanced Pipeline Asset  
Characterization Positions Owner to  
be Complaint, Improve Reliability,  
Optimize OPEX and Achieve  
Incremental Production Volumes



## 4. USE OF SPATIAL DATA AS BASIS FOR A “NEW STARTING POINT” FOR FIELD, OPERATIONS

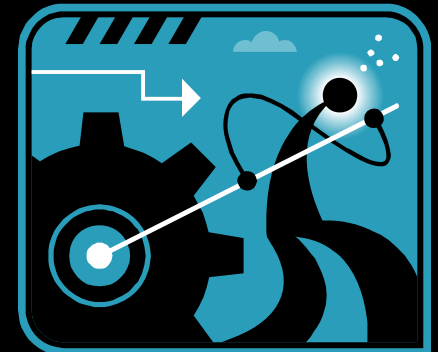
*“Smart Networks can now be CREATED and  
MAINTAINED – efficiently and economically”*



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### 4. Use of Spatial (GIS) Tools to Support Business Requirements

- GIS / Spatial Data Technology has Evolved
  - Accessible and affordable at desktop
  - Compatible with Existing IT
    - MSSQL / Oracle
- Supports Data Collection from Field, Operations
  - confirm / create / edit network connections
  - confirm operational data (P / T / fluids)
- Field, Operations Owns and Controls the Data
  - “the folks who are in the know have control”
  - no more repeatedly red-lining maps with no return benefit to Field, Operations
- Smart Networks Support Smart Decisions
  - Visualize and assess data
  - Identify data trends to support enhanced troubleshooting





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### 4. Use of Spatial (GIS) Tools to Support Business Requirements

- Spatial data technology offers Field, Operations **MORE THAN JUST A VIEWER:**
  - Network Connectivity & Connectivity Editing
  - O / G / W apportionment through Smart Network
    - Knowledge of well / pipeline / facility attributes
    - Consideration of pipeline substance / status
  - Pipeline physical attribute editing
  - Pipeline operational data editing / validation
  - Spatial interaction with surface DEM to create accurate elevations
  - Spatial location editing direct to database
  - Interaction with waterways
    - crossings & down-dip proximity
  - Interaction with roadways and pipelines
    - crossings / signage / traffic frequency for assessment of leak detection



## 5. USE OF SPATIAL DATA TO SUPPORT PIPELINE INTEGRITY MANAGEMENT –

- Internal Corrosion (IC)
- Case Study

*“Investing in a SMART network transformed a sour gas field PIM strategy – and saved money”*





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## CASE STUDY

### SITUATION:

Significant Sour Gas Gathering System Under Threat of Production Shut-in

- History of extensive corrosion mitigation
  - chemical injection / pigging / batching (\$2,500,000 / yr)
- History of extensive In-Line Inspections
  - 104 ILI Projects in previous 36 months (\$6,000,000 direct costs)
- History of IC pipeline failures on relatively short-life pipeline segments
- ERCB Issues a High-Risk Enforcement Memo Subsequent to Inadequate Failure Event Response:

#### — Challenge from ERCB --

- Demonstrate a “Systems Understanding” as the basis for future operational competency
- Develop a strategy to shift from a reactive mode to a forward-looking / proactive pipeline management mode
- 30-day completion window



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## CASE STUDY

### RESPONSE:

Commission a 20-day Project designed to integrate all historical operational, mitigation, and inspection data into a **SPATIAL DATA MODEL** to support enhanced ability to examine data trends, and to identify relationship of potential contributing factors to internal corrosion activity

- Completion of an internal corrosion risk assessment model incorporating characterization of water film transport properties
- Publish Integrity Management Plans for each pipeline based upon assessment
- Upload risk assessment results into spatial database
- Integrate historical ILI inspection data into spatial database
- Upload daily well production data from FieldView into spatial database
- Load historical mitigation activities into spatial database
  - chemical injection / pigging / batch inhibition with pigs





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## CASE STUDY



### RESPONSE:

### Internal Corrosion Risk Assessment Incorporating Spatial Data



{Flow loop video clip}

- Critical inclination angle not exceeded
- Stratified water film
- Good film movement
- Relatively easy to mitigate
  - continuous inhibition is effective



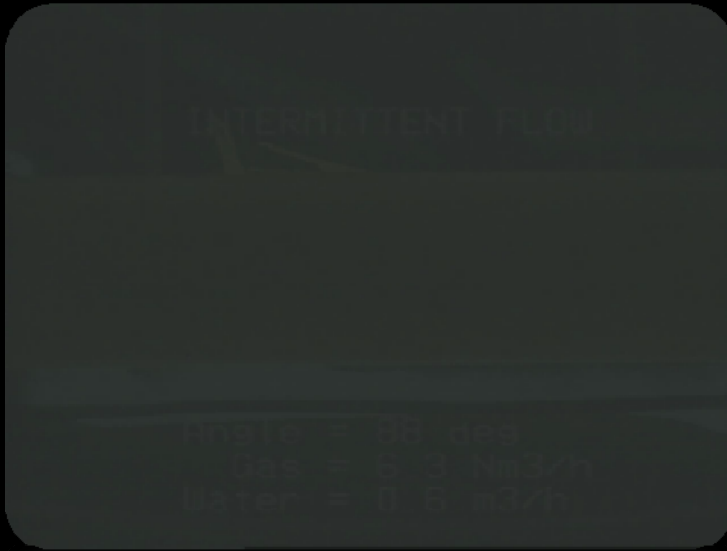
## *“Getting More from Your Assets”*

## CASE STUDY



### RESPONSE:

### Internal Corrosion Risk Assessment Incorporating Spatial Data



{Flow loop video clip}

- Critical inclination angle exceeded
- Onset of high liquid fraction to 50%
- Higher likelihood of reduced localized pH
- Severe stagnant pools can allow bacteria / solids to settle
- Potential for onset of steady-state slugging & increase in water film shear stress
- Can disrupt naturally protective FeS scales
- More difficult to mitigate
  - pigging / batch inhibition required
- Conditions prevail at locations of pipeline failure incidents

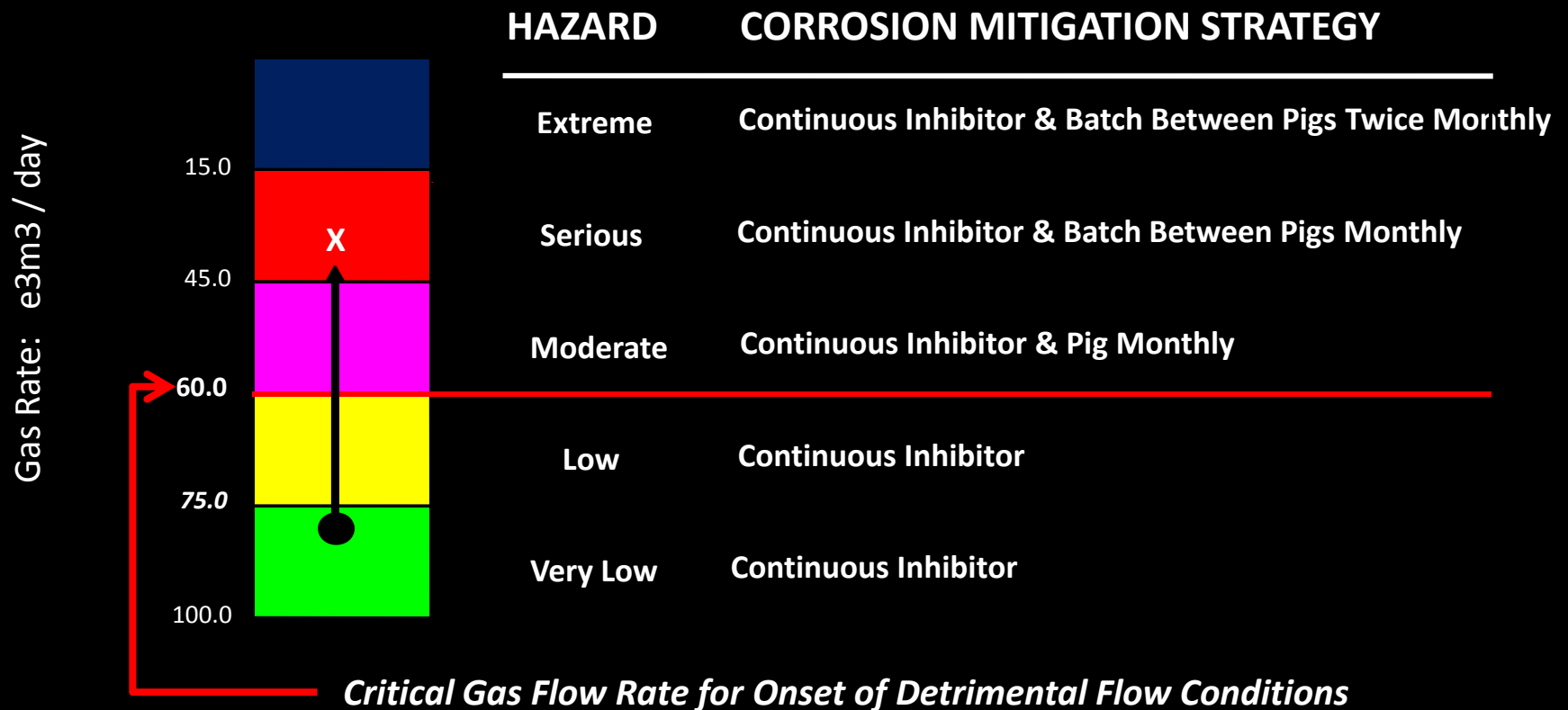


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## CASE STUDY

IMP

### PUBLICATION OF INTEGRITY MANAGEMENT PLANS (IMP):



*Implication of changing conditions can be identified by Field, Operations and corrective action taken to reduce likelihood of IC corrosion failure event*

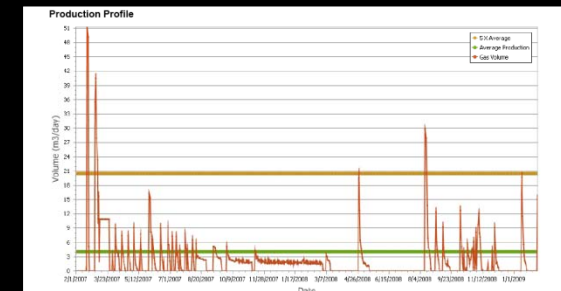
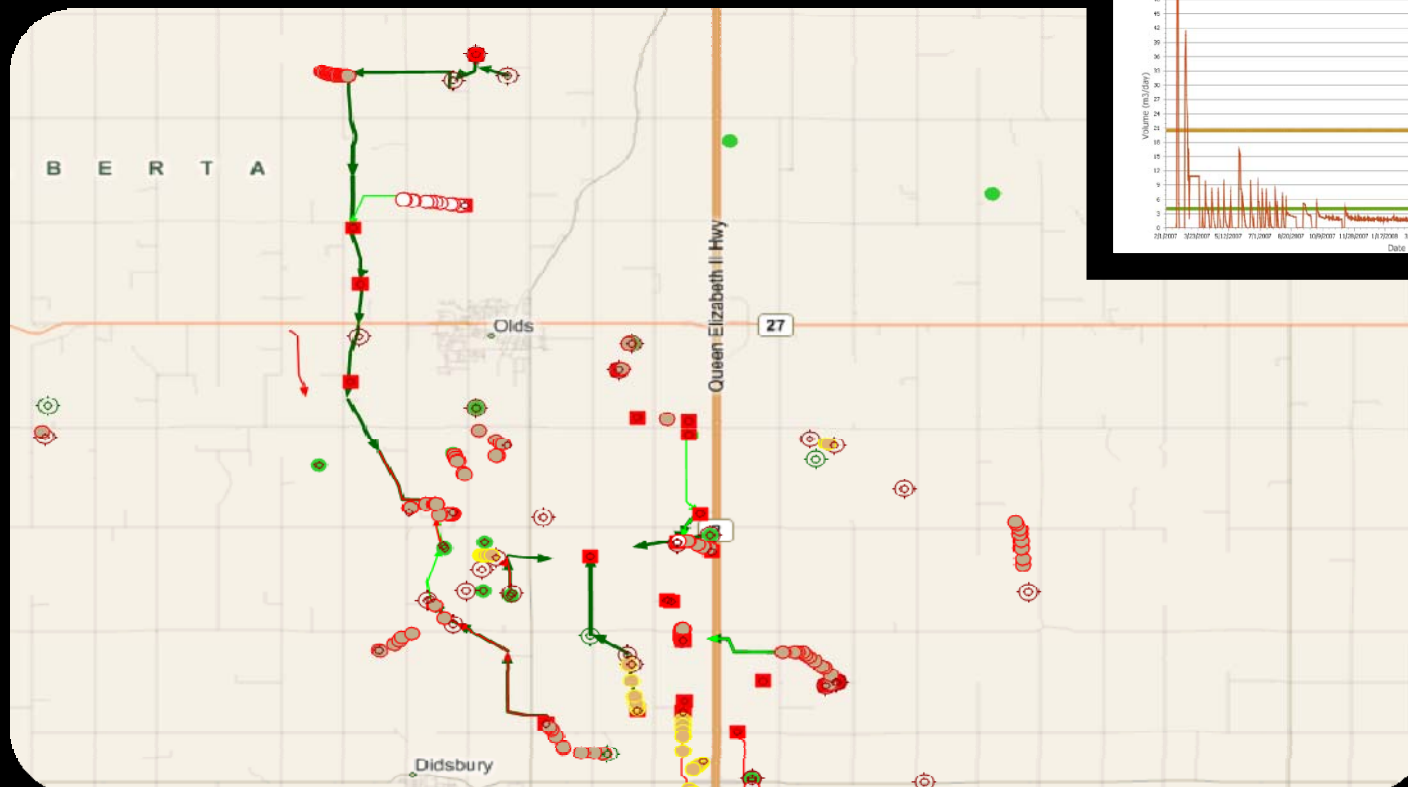


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## CASE STUDY

### RESPONSE:

Creation of a **Spatial Data Model** for all production, risk assessment, historical mitigation, and inspection data





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## CASE STUDY

### RESULTS:

#### Creation of a “System Assessment” as Basis for Future PIM

- IC Risk Assessment model resulted in re-alignment of pigging & batch inhibition schedules (*\$500,000 savings for 2009 +++*)
- IC predictions aligned with actual ILI data
  - no corrosion predicted on “clean” ILI projects
- IC predictions within average of 1.7 metre of actual ILI defects
- IC Risk Assessment identified five (5) candidates for immediate ILI inspection based upon common history with failed pipeline segments (*\$2,000,000 savings for 2009 +++*)
- Correlation between corrosion failures and high-cycling wells upstream of segments susceptible to stagnant water hold-up (“red” pipelines)
- Existing mitigation strategy is effective for “red” pipeline segments, provided they are not directly fed with high cycling wells





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## CASE STUDY

### RECOMMENDATIONS:

#### Creation of a “System Assessment” as Basis for Future PIM

- Modify well operations practices to eliminate production spikes during well start-up periods
- Install shut-down control limits within the SCADA system to eliminate the spiking of wells to a level  $< 3X$  Average Gas Production Rate
- If excessive production spiking occurs upstream of a “red” segment, Field, Operations must immediately execute a batch inhibition application
- Field, Operations must adhere to safe pipeline suspension practices
  - apply suspension procedure within seven days of shutting-in a pipeline
  - suspension procedure to include volatile vapour-phase inhibitor designed to elevate remaining in-situ waters to a non-corrosive condition
    - $pH > 7.0$



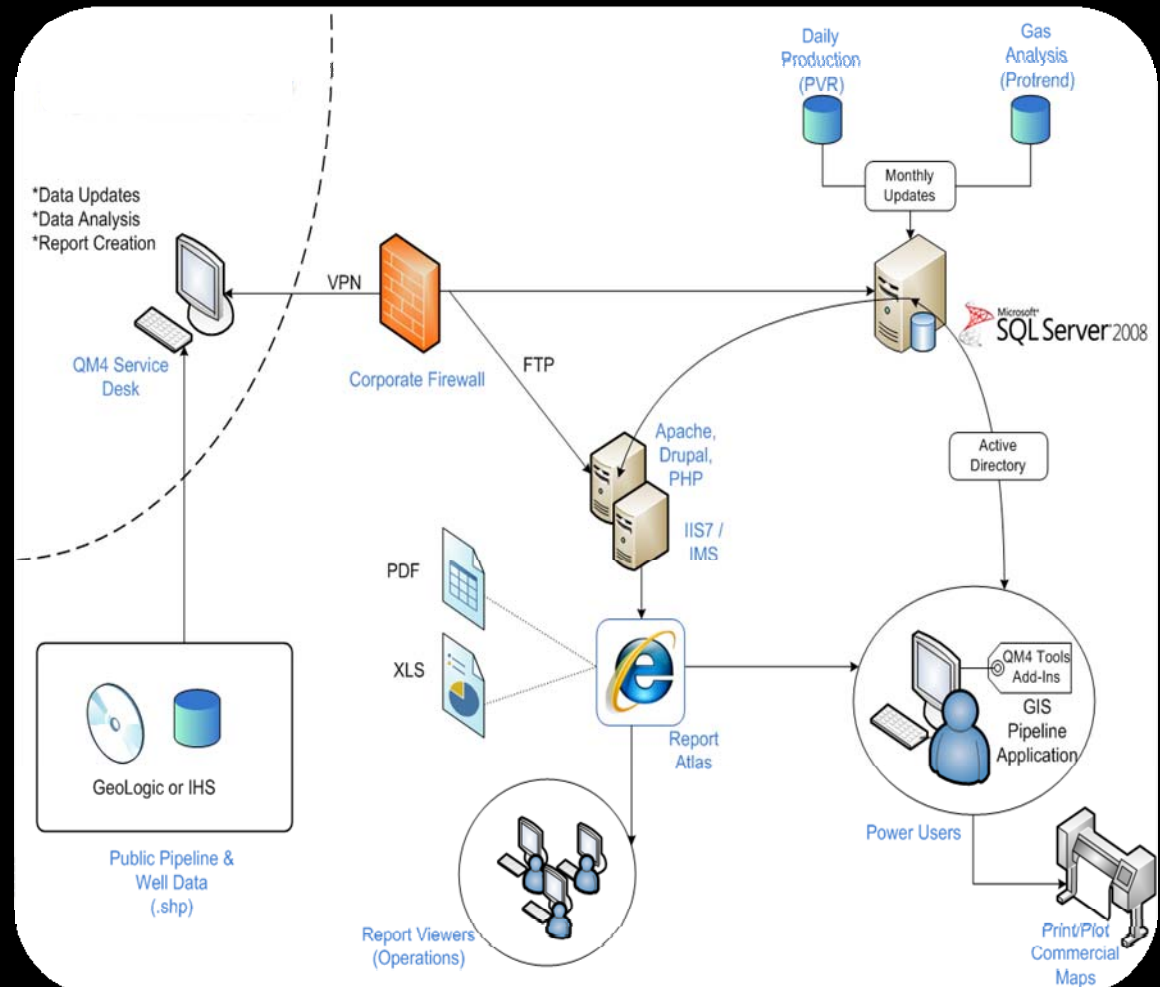
## 6. PROJECT DESIGN & EXECUTION



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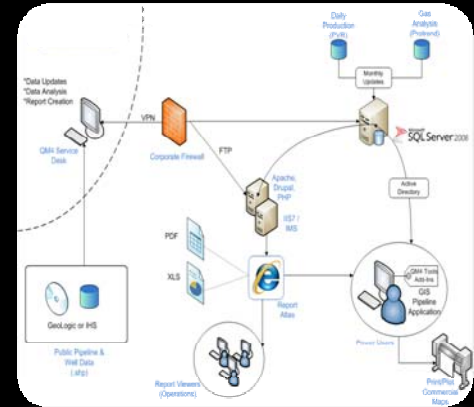
### Project Design & Execution

- Database installed into existing IT – MSSQL
- Desktop GIS supports data editing / viewing / map plotting
- Report Atlas provides access to corporation to pre-published reports & maps
- QM4 provides monthly data updates, and data analysis via secure connection to MSSQL database





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- **Software-and-Service Model (SAAS)**
  - Project-based model with Client
    - database configuration for identified Area / District / Field(s)
  - Monthly Update & Assessment Service
    - pipeline inventory update
      - New builds / spatial changes / operational data changes
    - risk assessment, compliance status, reports & maps
  - Project Costs are Typical of Single ILI Project
  - Monthly data and assessment update costs are nominal
    - coffee / copiers / janitorial / parking lot maintenance