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A Proactive Approach to Distribution Integrity

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Presentation Overview

- Distribution Integrity Status
  - Business Challenges
  - Regulation Status
  - Basic Program Elements
- Start With a Roadmap
- Know Your Infrastructure and Mitigate System Risks
  - Capture the Threats and Assess the Risks
  - Focus On Enhancing Data Collection and Accessibility
- Continuous System-Wide Evaluation
- Measure Performance

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Business Challenges

- What **risks** are associated with operating my network?
  - What can I do about them?
- How do I know I'm getting the most "bang for my buck"?
  - Where should I **focus** my attention?
  - How can I **prove it** to my regulators, investors & customers?
- How do I know I'm **not missing something critical**?
- How do I **maximize my bottom line** & **stay out of the papers**?
- How do I stay ahead of the evolving **Distribution Integrity regulations**?

Why Distribution Integrity Management?

- **High-consequence, high-profile incidents** (mid to late 90's)
- **Congressional Directives & Federal Initiatives**
  - Led by DOT/Pipeline & Hazardous Materials Safety Administration (PHMSA) Office of Pipeline Safety (OPS)
  - Pipeline Safety Act of 2002
- **Distribution Integrity Management Program** (http://www.cycla.com/dimp)
  - Proactive response by industry, PHMSA, & regulators
  - **Apply principles** from pipeline integrity, but **recognize the differences**
  - Phase 1: Understand goals & status, id gaps (complete Dec '05)
  - Phase 2: Implement legislation, rules, education, …? (start Jan '06)
- **Current Expectations**
  - Flexible & performance-based rules … with accountability
  - Responsible leak mgt, consistent risk assessment, useful measures
  - Mitigation options based on local situation
  - More than just "repair vs. replace"

Congress Wants Action on Distribution

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Distribution Integrity Best Practices

- While the term "Distribution Integrity" is new, risk management programs are not:
  - Leak and Corrosion Management Programs (1970s)
  - Call Before You Dig Programs (1980s)
  - Main Risk Assessment and Repair/Replace (1990s)
- A number of "Best Practices" have evolved
- Many are being incorporated into the new Distribution Integrity rules

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Basic Elements of a Distribution Integrity Management Program

Written Plan

Understand Your Infrastructure

Identify the Threats

Address the Risks

Monitor Performance and Adjust Approach

Report Results

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From Roadmap to Written Plan

- **Develop A DI Roadmap to Envision the Future**

  Questions and Topics that Shape the Roadmap
  - How Does DI Fit Into Corporate Goals and Objectives?
  - Who in the Organization is Responsible?
  - How is the Infrastructure Documented?
  - Are Existing Business Processes & IT Systems Adequate:
    - Is Infrastructure Knowledge Readily Accessible?
    - Monitoring Threats?
    - Continuous System-wide Risk Assessment?
  - What Is Unacceptable Risk – How Will It Be Mitigated?
  - How Will Results be Reported ?

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Distribution Integrity Threat matrix

Threat Class	Threat Mechanism	Pipe Class Affected	Business Processes	Analytical Processes
Corrosion	Natural Corrosion / Deterioration	Bare Steel	- Leak Surveys - Leak Management Programs	Failure-mode analysis and Failure Forecasting by pipe type
		Copper		
		Protected Steel		
	Graphitization	Cast Iron		
	Joint Leakage	Cast Iron		
	Slow/Brittle-Like Cracking	Plastic (PE)		
Natural Forces	Freeze - Thaw Cycles Ground Settlement	Cast Iron	- Leak Surveys - Leak Management Programs	Customer / Location specific failure-mode analysis and forecasting
		Plastic		
Excavation	Immediate Pipe Damage	All	- Locate Programs - Damage Prevent Programs - Area/Contractor Monitoring - Enforcement	Statistical Analysis: - Locates to Direct - Locates to Delayed - Area Risk Flagging Forecasting: - by Locate Request
	Immediate Coating Damage	Protected Steel		
	Delayed - Mechanical	Cast Iron		
		Plastic		
	Delayed - Corrosion	All Steel		
	Delayed - Disturbance	Cast Iron		
Other Outside Forces	Traffic Loads	All	- Traffic Area Monitoring	Failure-mode analysis to identify areas affected
Materials/ welds/ construction	Construction and/or material defects	All Steel	Legacy Materials: - "Vintage" and Lot Monitoring - Procedures Reviews New Construction: - Materials Management - Training/Qualification	Failure analysis by material/vintage. Material/vintage flagging.
		Plastic		
Equipment	Customer specific equipment threats as identified			
Operations	Customer specific Operations issues/threats as identified			
Other	Other customer specific threats as identified			

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Excavation Damage

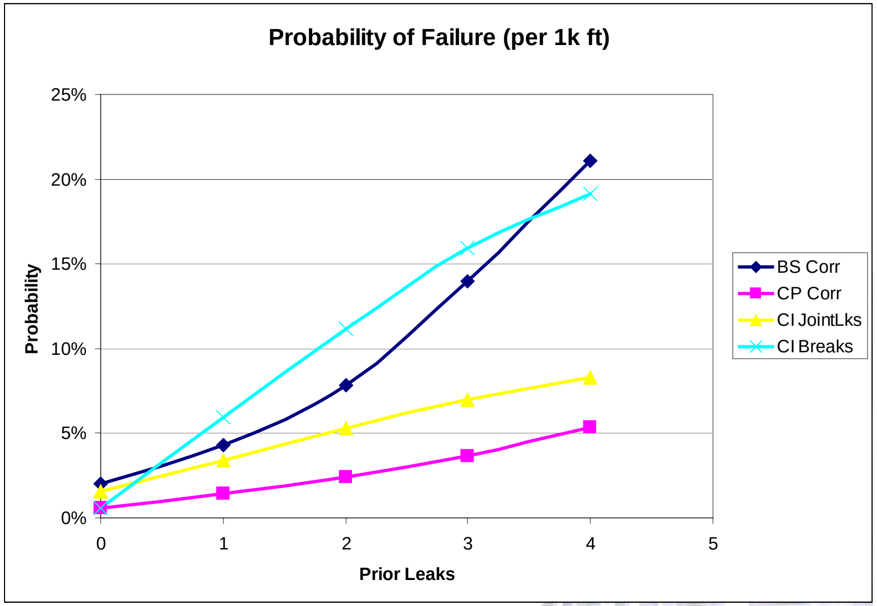
Source: OPS DIMP Excavation Damage Prevention Work Group Presentation, 9/21/05

- #1 cause of reportable incidents
- #2 cause of repaired leaks
- Data shows that comprehensive damage prevention programs can significantly reduce leaks per 1000 locates
- Spatial Application (research in progress at Opvantek)
  - Can density of recent locate requests provide usable prediction of likely damage?
  - What about the likelihood of unreported damage that leads to future pipe failure?
  - If so, what can be done with the prediction?
    - Increase leak surveys after significant locate density
    - Coordinate & focus damage prevention team activities

Spatial Analysis May Be Productive

Threat Matrix - Conclusions

- Distribution systems are a mix of pipe types
- Each threat affects each pipe type differently
- A number of business process are needed, in addition to systems
- Integrity Programs should handle the most pervasive threat/pipe type combinations



- The Distribution Integrity program should integrate the business processes and systems to meet each LDCs unique environment.

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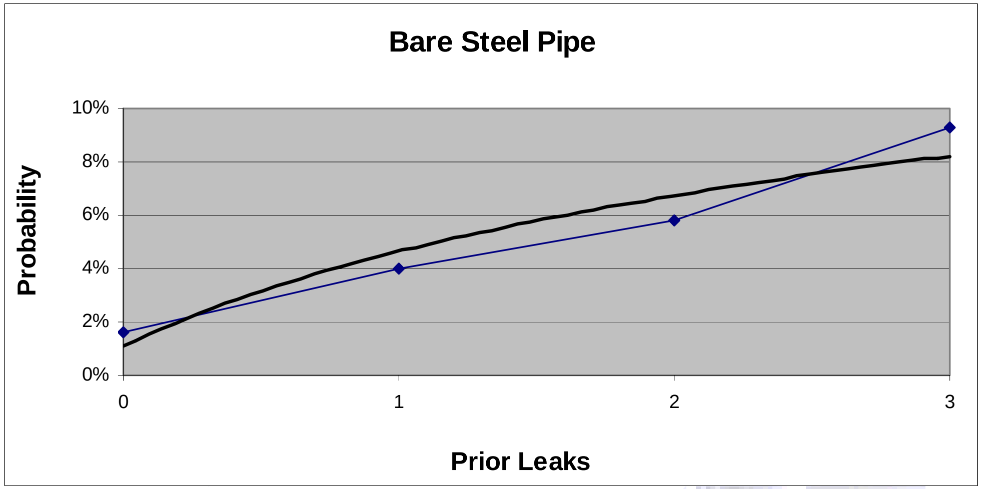
Industry Definition of Risk

Risk = **Probability of Failure** x **Consequence of Failure**

Probability of Failure

- base curves by failure mechanism and class of pipe
- influenced by other available failure factors (reported pipe conditions, joint type, soil type)



Consequence of Failure (Risk Profile)

- what happens when a pipe fails? (customer outages, cost to restore service, property damage, injuries, loss of life, etc.)
- Example Factors: cover type, service length, building use, population density, other conduit, pipe size & pressure, and failure mode (joint, break, rust-thru)

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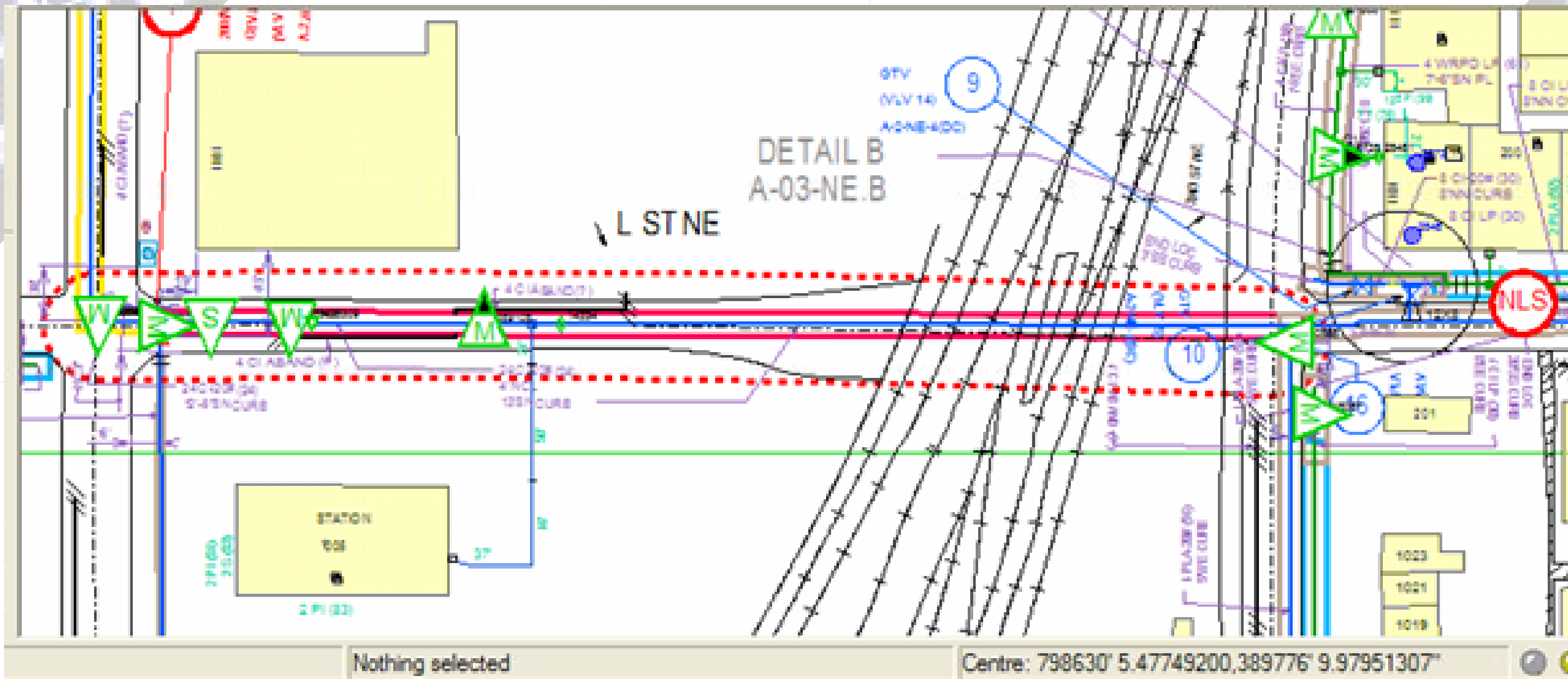
Project Definition

Evaluating distribution networks is more difficult without the benefits of GIS and automated analysis systems. Best Practices are to create discrete “Evaluation Projects”

- An “envelope” around one or more pipe segments
- Basis for collecting physical facility attributes, plus maintenance, operating, cost, and location-specific factors
- Repeated for the entire network



Risk Profile and Failure Factor Examples

Common Risk Profile Factors

- Gas Volume Migration (combined size, pressure, mode of failure)
- Cover Type
- Service Length (infiltration)
- Building Use (hospital, etc.)
- Population Density
- Other Conduit (sewer, joint trench)
- Pipe Depth
- 3rd Party Construction

Common Failure Factors

- Pipe Material, Size, Pressure
- Leak History
- Year Installed
- Corrosion Extent
- Leak Cause (eg., corrosion, 3rd Party, etc)
- Coating Condition
- Coating Type
- Joint Type
- Soil Type
- CP Faults
- Locate Requests

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Improve Pipe Condition Data Collection

- Recognize that Exposed Pipe is a Rare Opportunity to Capture Pipe Data
  - Accurate and Detailed Pipe Condition and Leak Reporting Requires an Organizational Commitment
  - Reporting External Pipe Condition Should Be More Than:
    - Local, General, and None (unless clearly defined)
    - Values such as “scattered deep” and “close shallow” with specified parameters such as “observed >12” = scattered combined with training will improve data quality and future pipe analysis and stratification
  - Reporting on Pipe Coating Condition Values Should Be Reviewed and Tested With Field Technician Responses

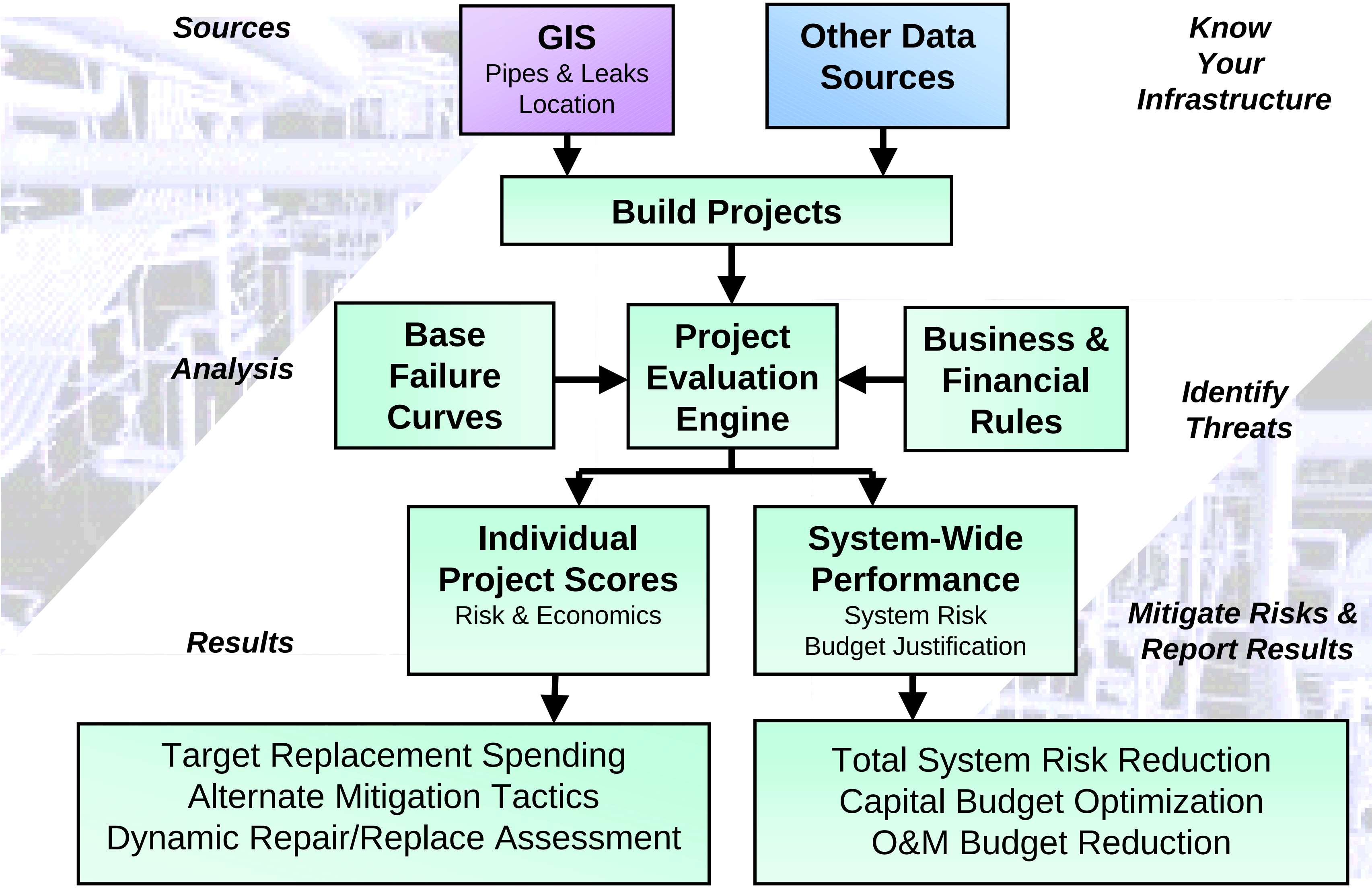
Improve Leak Data Collection

- Leak and Leak Repair Data Collection Varies Significantly Across LDCs
  - Leak Repairs Should Be Associated with Main and Service Pipes Preferably Geocoded In a GIS
  - For Analysis Open Leaks Should Be Associated with Both Surrounding Main and Service Pipes If Not Pinpointed
  - A Distinct Break/Crack Value Should be Available for CI Pipe Leak Repairs
  - Counting/Reporting the Number of Clamps Used Helps Measure Severity of Leak As Does the Number of Excavations
  - Making Leak Repair Field Comments Electronically Available Adds Value when Interpreting Leak Severity and Pipe Condition

Improve Environmental Data Collection

- With or Without A GIS Start Collecting Missing Environmental Data on Leak Repair/Pipe Condition Reports
  - Cover and Street Type
  - Other Conduit – Sewer, Electric, Water, telephone
  - Proximity to Building and Building Usage (Hospitals, etc)
  - Use internal Subject Matter Experts to Identify Other Conditions Impacting Risk Consequences and Incorporate Them on a Go Forward Basis

Turning Data into System-wide Information



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System-wide Spatial Overview

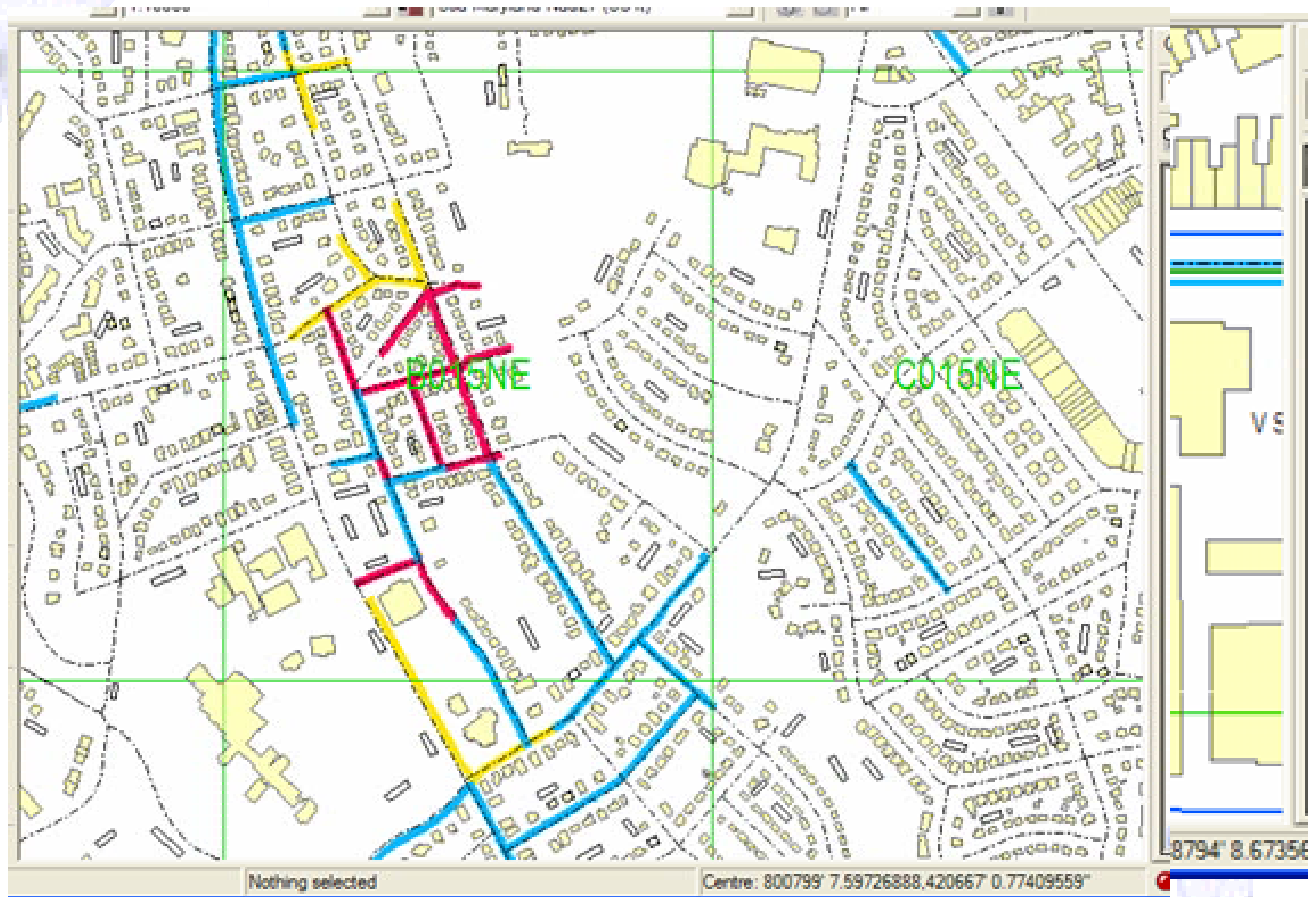
- Visualize project envelopes and high risk areas on the map
- Basis for project coordination (“notice it on the map”)

- Color-code based on relative risk

HIGH

MEDIUM

LOW



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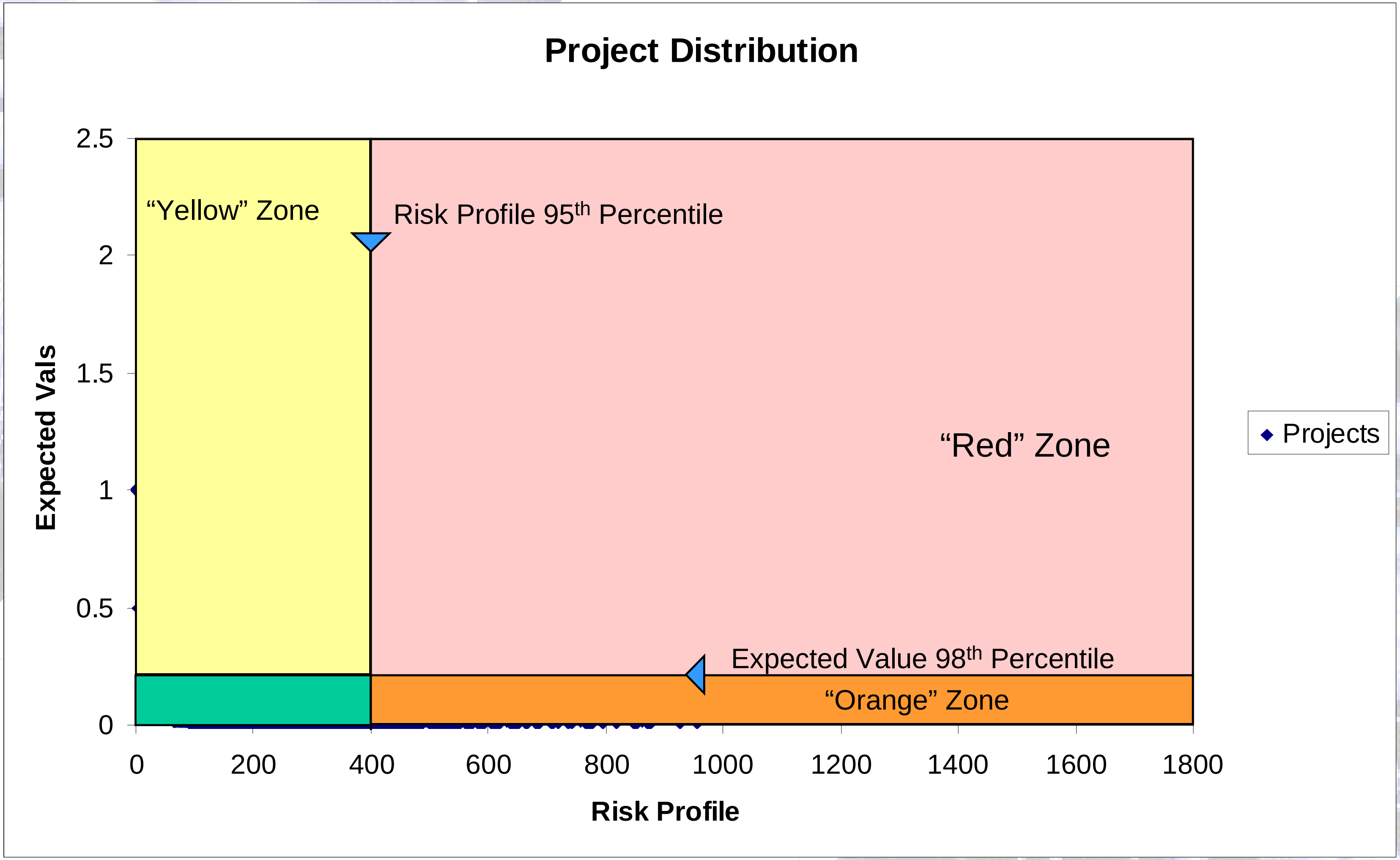
System-Wide Risk Assessment Example 1



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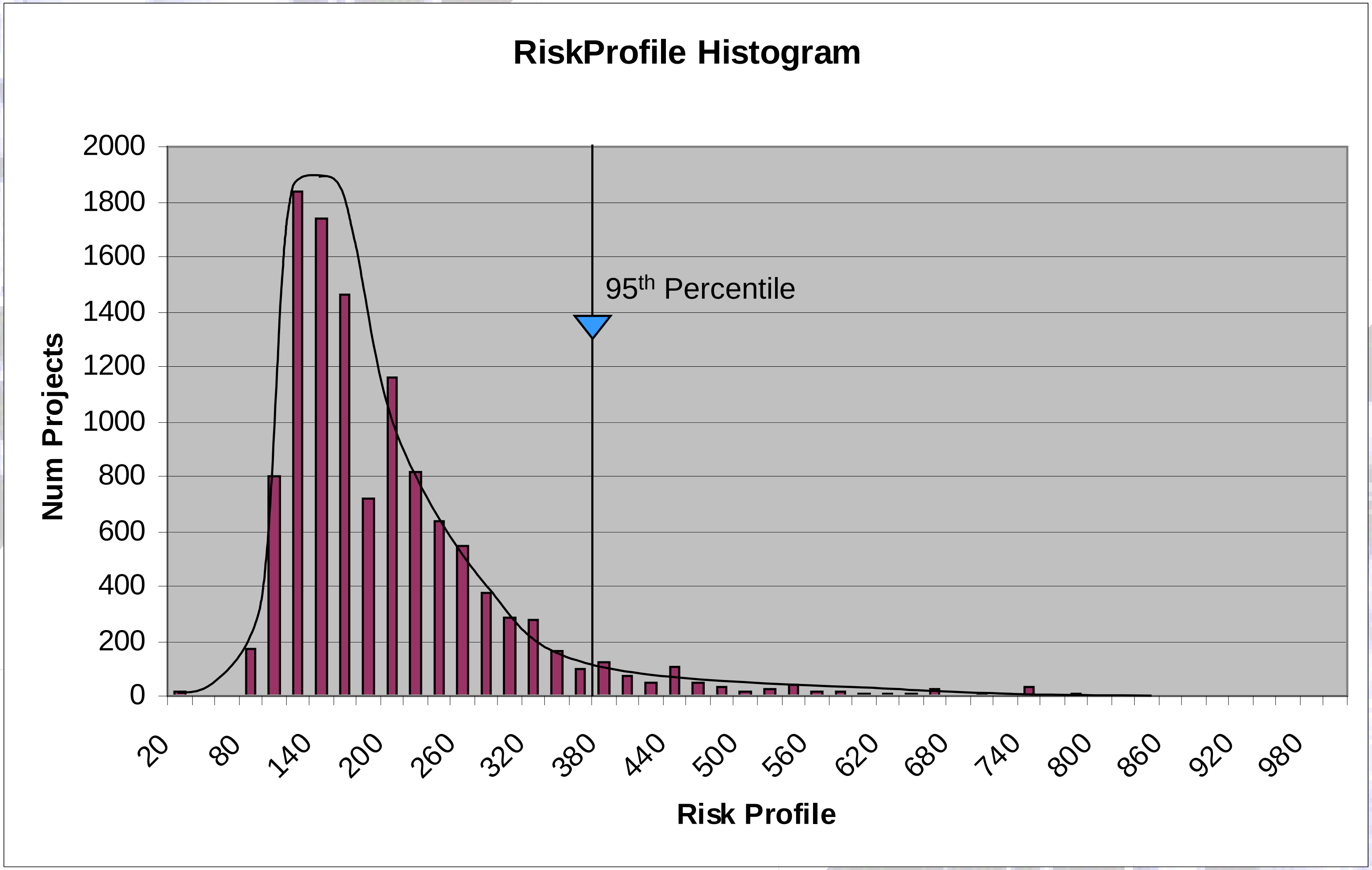
System-Wide Risk Assessment Example 2



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Develop Mitigation Strategies

- GPTC Taking Industry Lead in Defining an Approach
- Opvantek Customers are Performing the Following
  - – Increased Surveillance to Decrease Consequence of Failure
  - – Pipe Rehabilitation including:
    - Joint Sealing
    - Install Liners
    - Rebuilding CP Structures
  - – Service-Only Replacement (bare steel and copper)
  - – Main and Service Replacement
  - – Abandonment

Measure Performance

- One Dimension - Total System Risk Metrics
  - Concept of relative project risk score enables system risk measurement
  - Each “risk point” from one project is comparable to a “risk point” of another project
  - If evaluation projects are created for entire system then the sum of all project risk points represent the total risk for the system
  - System risk scores can be divided by footage to provide such average measures as:
    - Risk/ft by Division
    - Risk/ft by Pipe Material; etc.
    - Highest Risk Projects Compared to Average
    - Potential Reduction in Risk for Pipes Targeted for Risk Mitigation

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