Creating GIS Enabled Information Value Chains

streamlineAM

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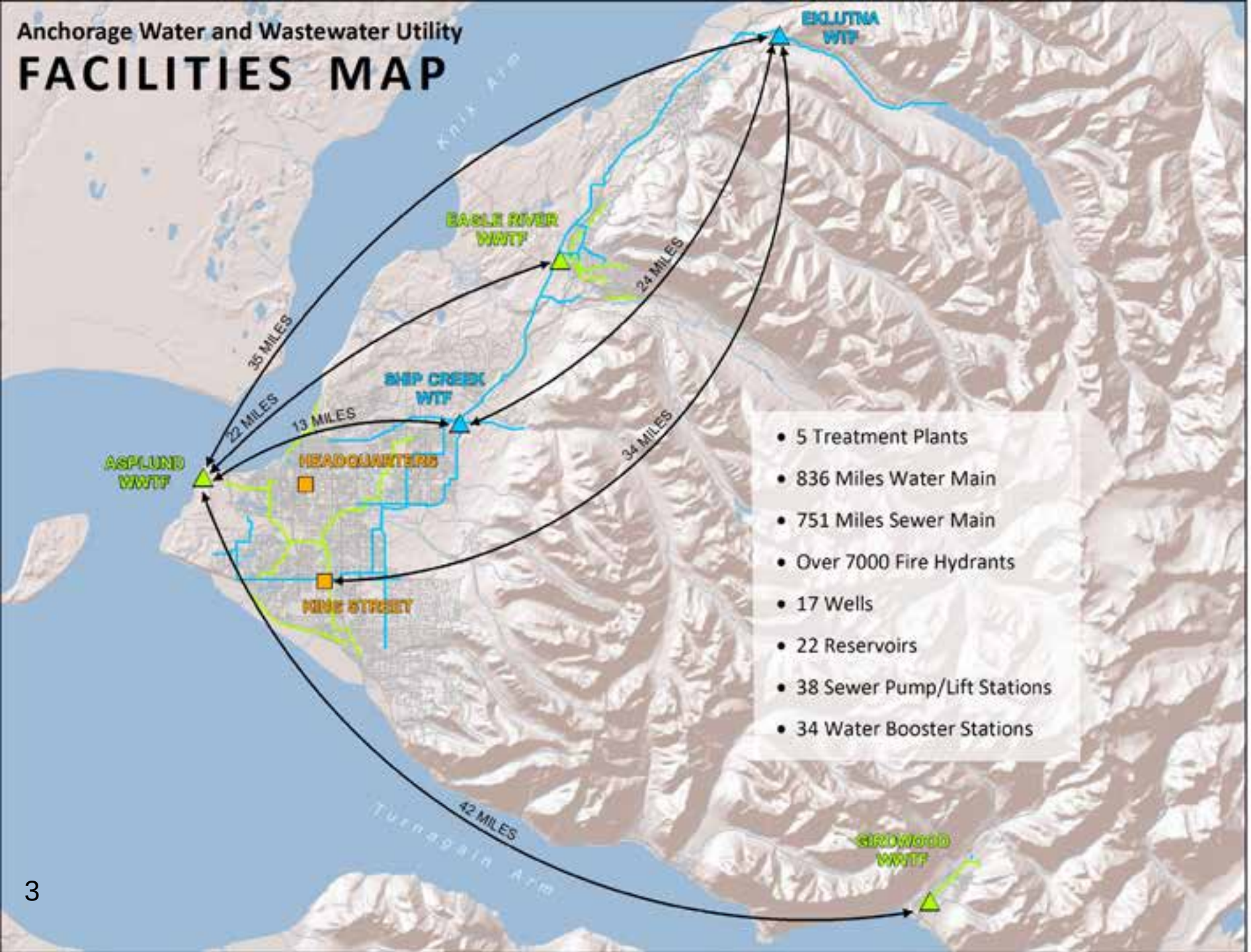

Anchorage Water and Wastewater Utility
FACILITIES MAP
EKLUTNA WTF
EAGLE RIVER WWTF
SHIP CREEK WTF
ASPLUND WWTF
HEADQUARTERS
MAIN STREET
GIRDWOOD WWTF
35 MILES
22 MILES
13 MILES
24 MILES
34 MILES
42 MILES
Knik Arm
Turnagain Arm
• 5 Treatment Plants
• 836 Miles Water Main
• 751 Miles Sewer Main
• Over 7000 Fire Hydrants
• 17 Wells
• 22 Reservoirs
• 38 Sewer Pump/Lift Stations
• 34 Water Booster Stations

Economy Forces Change

Initial Business Drivers:

- Policy makers push for CPI or less than CPI rate increases without decrease in service level
- Capital & operating budget constraints

Ongoing Considerations:

- Current Economic Conditions
- Continuation of Rate Discussion

Change is Continuous……

Policy Considerations

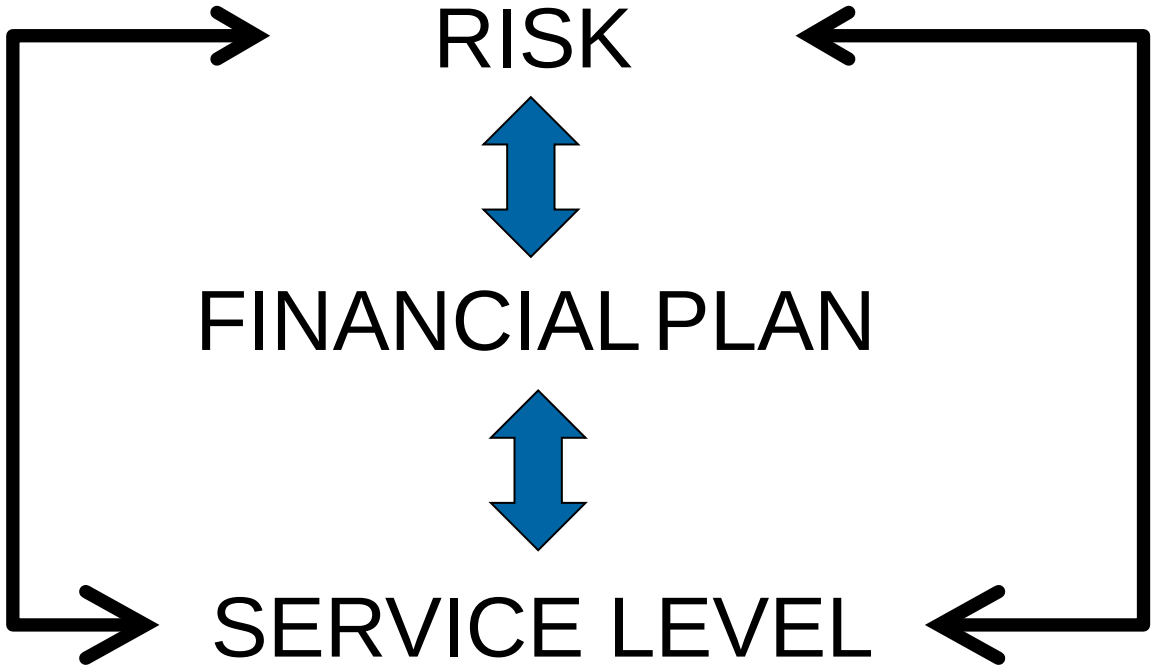
Refine Long Term Financial Policies

- Long Term Agreements with Policy Makers
- Cost Causer is Cost Payer

Service Levels / Risk Policy

- Community Input
- Elected Official Input
- Industry Practices

Policy Salsa



Moving from Policy to Approach

- Executive Team Commitment
- Organizational Development
- Define Service Levels / Risk Policy

Asset Management – Implementing Policy

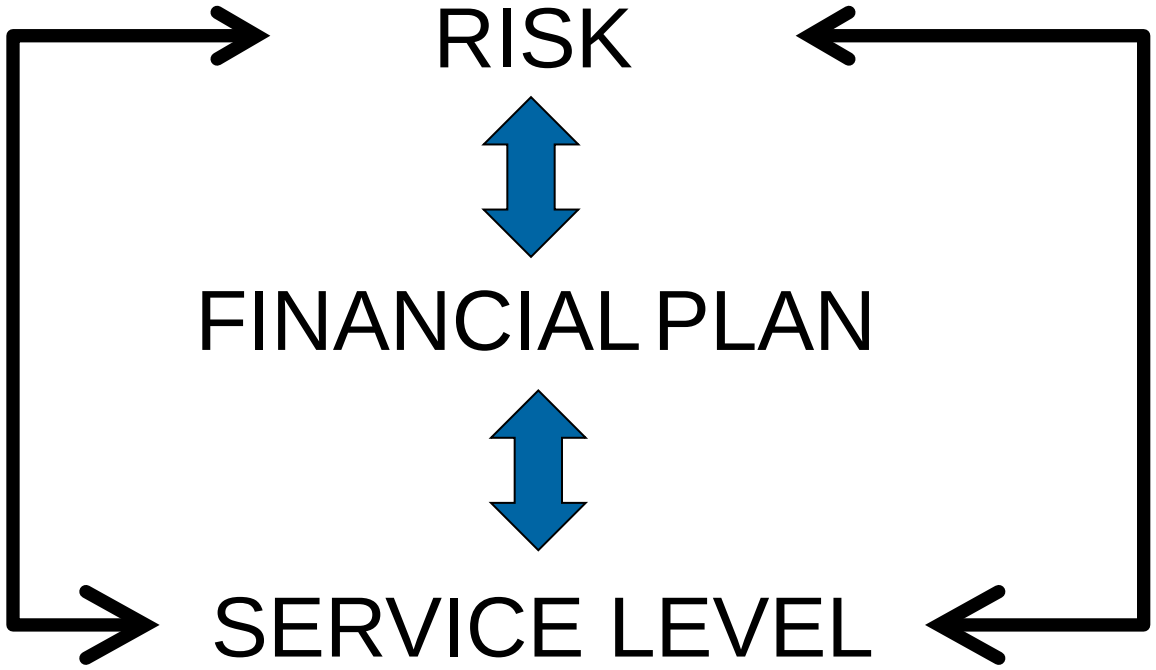
Risk Analysis

Service Levels

Operating Program

Capital Program

Policy Dance



Risk Policy – Response to Risk

RISK: Likelihood x Consequence

Quantifying Risk: Consequence

Customer Type

Location/function in pipe network

- Size
- Redundancy
- Size of population/customer base served

Surrounding Area

- Environmentally Sensitive Areas
- Traffic
- Difficulty of Access

Quantifying Risk -- Likelihood

Likelihood: Condition Assessment Types

- Field/Physical Inspection
- Data Mining/Cleanup

Likelihood: Sewer Pipe

Field Projects

- Large Diameter CCTV , Flow Evaluation and Field Inspections
- Small Diameter CCTV

Data Mining/Validation

- Large & Small Diameter Sewer Pipe– Older Inspections
- Ensured Data Archived and Validated for Use

Risk Based Approach – Sewer Results

Sewer Pipe Risk Matrix – All Sewer Main

Likelihood		1 Low		2		3		4		5 High	
		Miles	%	Miles	%	Miles	%	Miles	%	Miles	%
High	5	5.9	0.8%	2.0	0.3%	1.6	0.2%	0.2	0.0%	0.4	0.1%
	4	9.2	1.2%	1.8	0.2%	2.0	0.3%	1.4	0.2%	1.0	0.1%
	3	238.2	31.9%	40.9	5.5%	31.8	4.3%	24.6	3.3%	14.4	1.9%
	2	132.0	17.7%	24.0	3.2%	20.7	2.8%	12.0	1.6%	14.8	2.0%
Low	1	111.5	14.9%	17.2	2.3%	13.3	1.8%	11.1	1.5%	14.2	1.9%

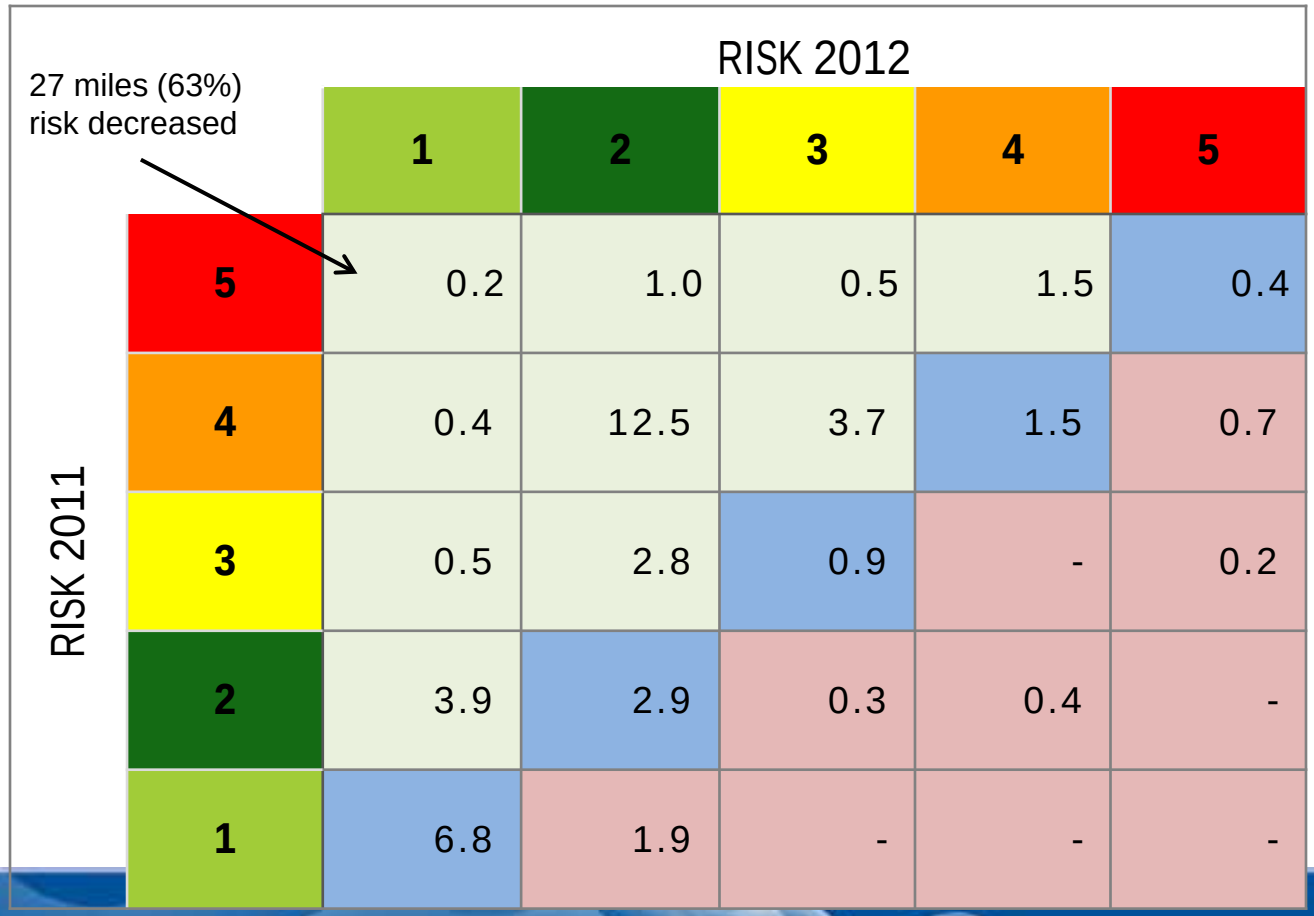
Consequence

2011 Sewer Main Risk Analysis
Mainly Desktop Approach

2012 Sewer Main Risk Analysis
Reduced Risk – Condition Assessment Results

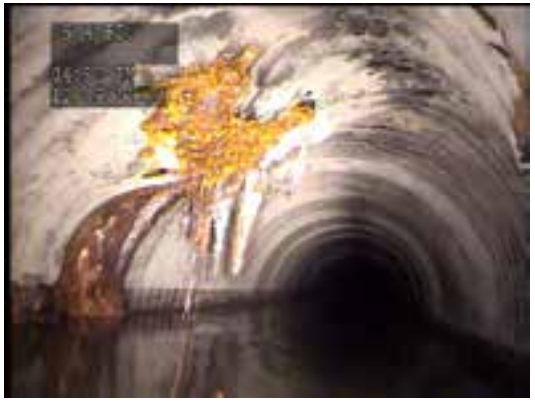
Policy Results: Knowledge is Power

Policy Results: Knowledge is Power



RISK 2011 \ RISK 2012	1	2	3	4	5
5	0.2	1.0	0.5	1.5	0.4
4	0.4	12.5	3.7	1.5	0.7
3	0.5	2.8	0.9	-	0.2
2	3.9	2.9	0.3	0.4	-
1	6.8	1.9	-	-	-

Policy Results: Knowledge is Power



Sewer Pipe (Large)

- Large Reduction in Replacement
- Able to Target Maintenance Needs
- Potential Large Failures Avoided

Sewer Pipe (Small) – Program of Inspections

Likelihood: Water Pipe

Field Projects

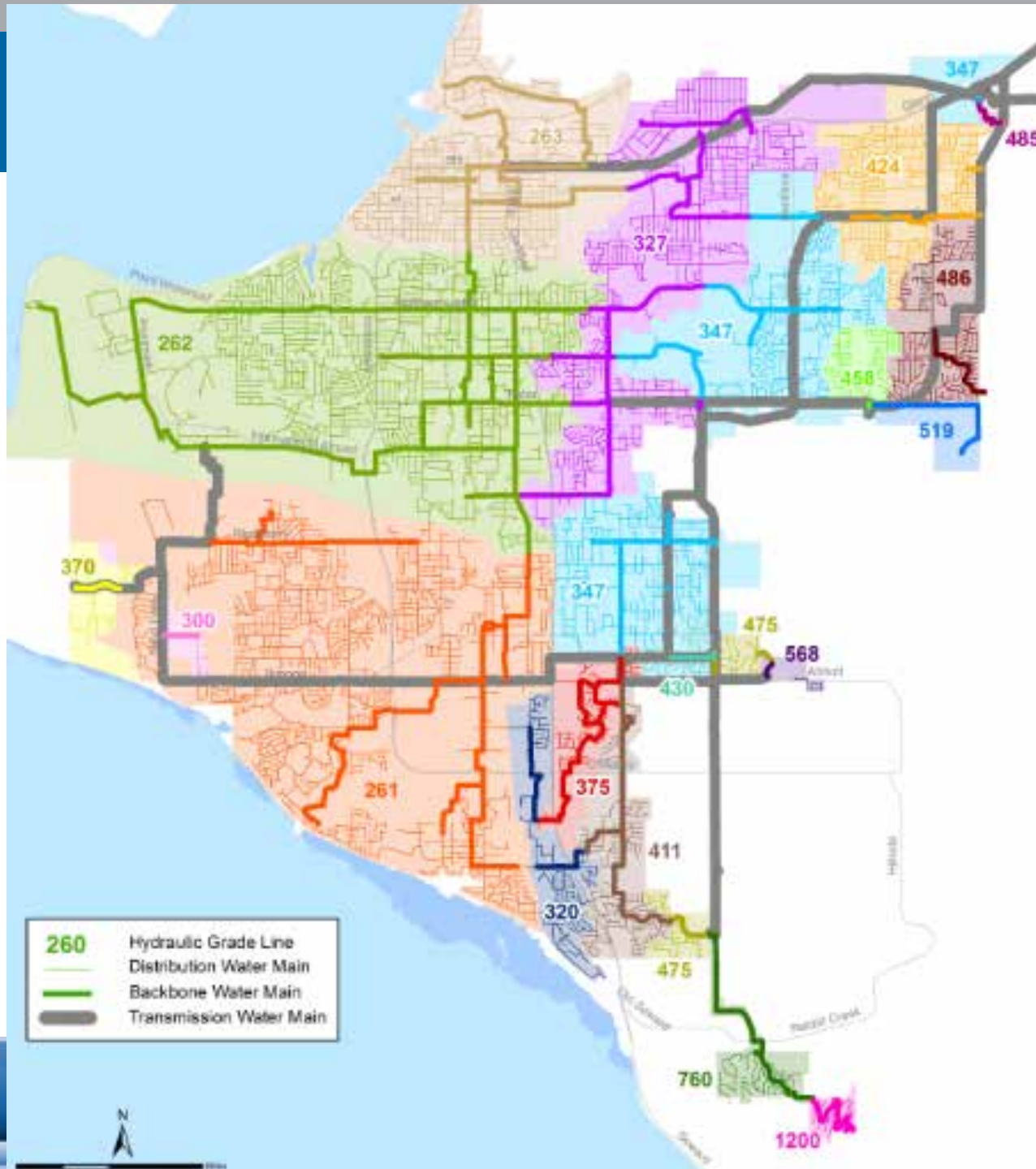
- Large Diameter Leak Detection, BEM
  - Large Diameter Pipe Class Research
- Small Diameter Echologics

Data Mining/Validation

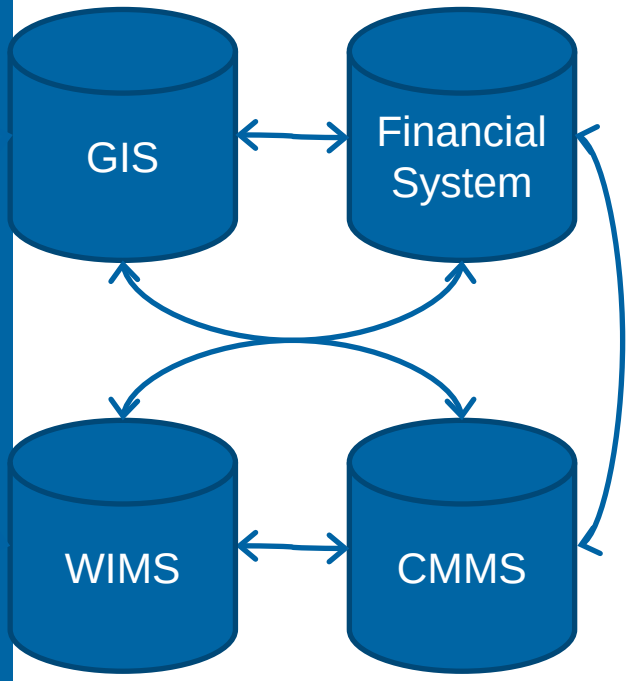
- 20 Years of Small Diameter Break Data
- Statistical Validation of Factors Influencing Failures
- Failure Curves and Live Estimates

“SEE” the need

Supply Analysis (Consequence)

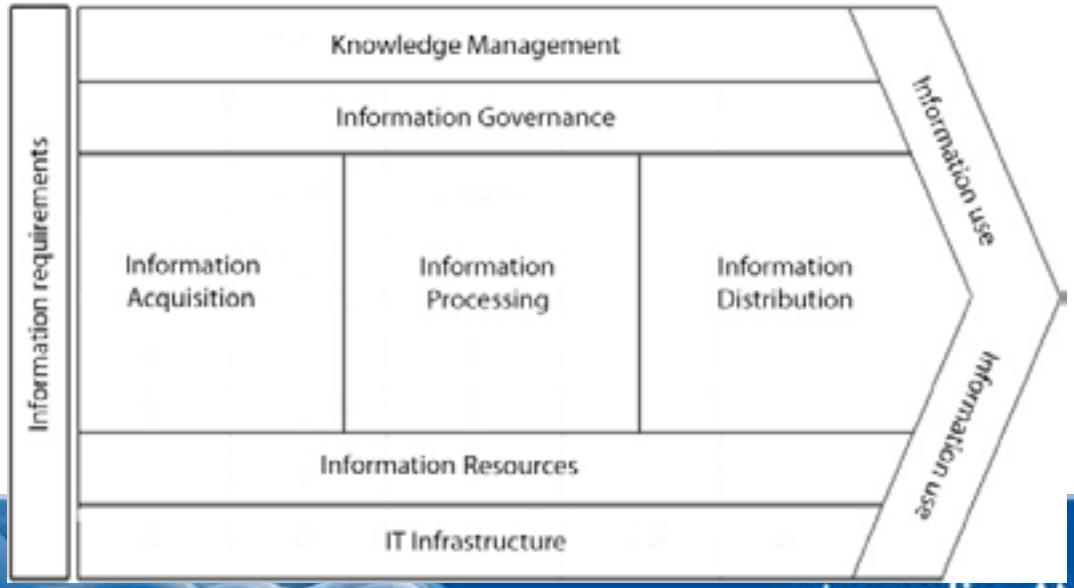


GIS Information Chain Creation : Water Pipe



Making the Change from Linking Data Systems

to Creating Information Chains



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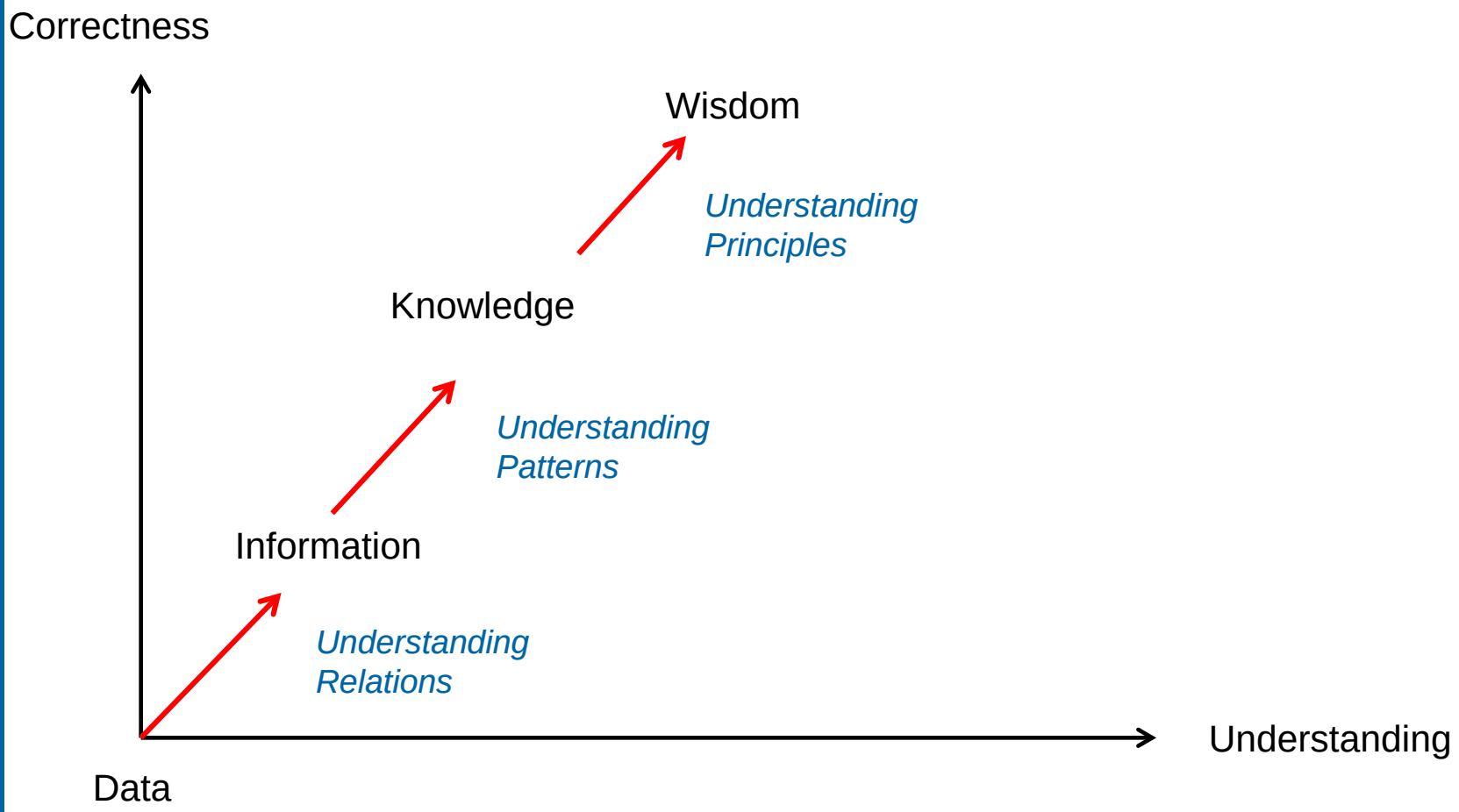
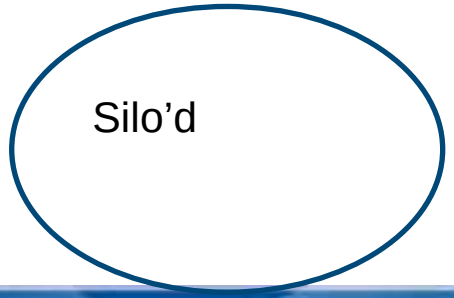


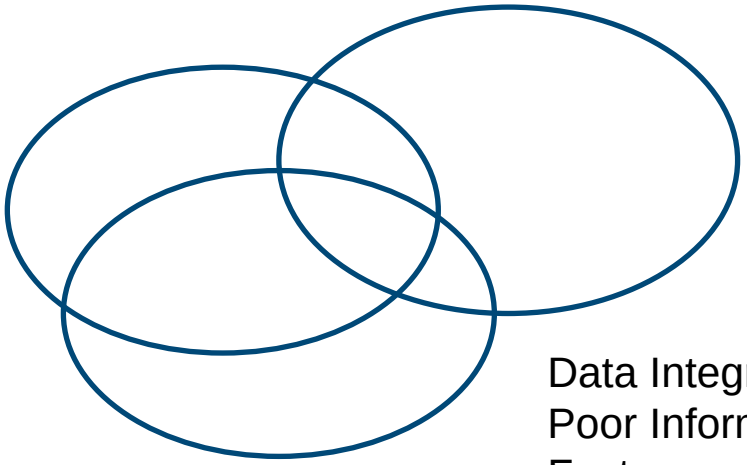
GIS Information Chain Creation : Water Pipe

Industry Standard Practice

- Siloing
- Data Integration Interrelations at a data system level
- Lack of connection from information acquisition to information distribution

No Integration:
Waste of Resources
Increase in Discrepancies





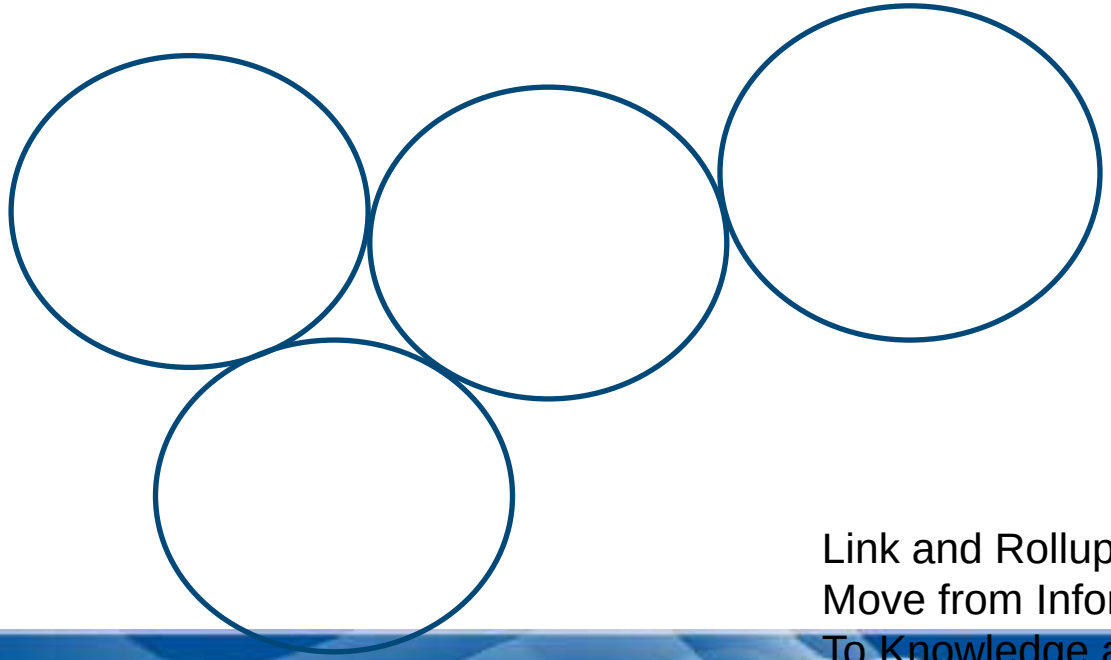
Data Integrated;
Poor Information
Factory

Overlap or Silo’d:
Waste of Resources
Increase in Discrepancies

GIS Information Chain Creation : Water Pipe

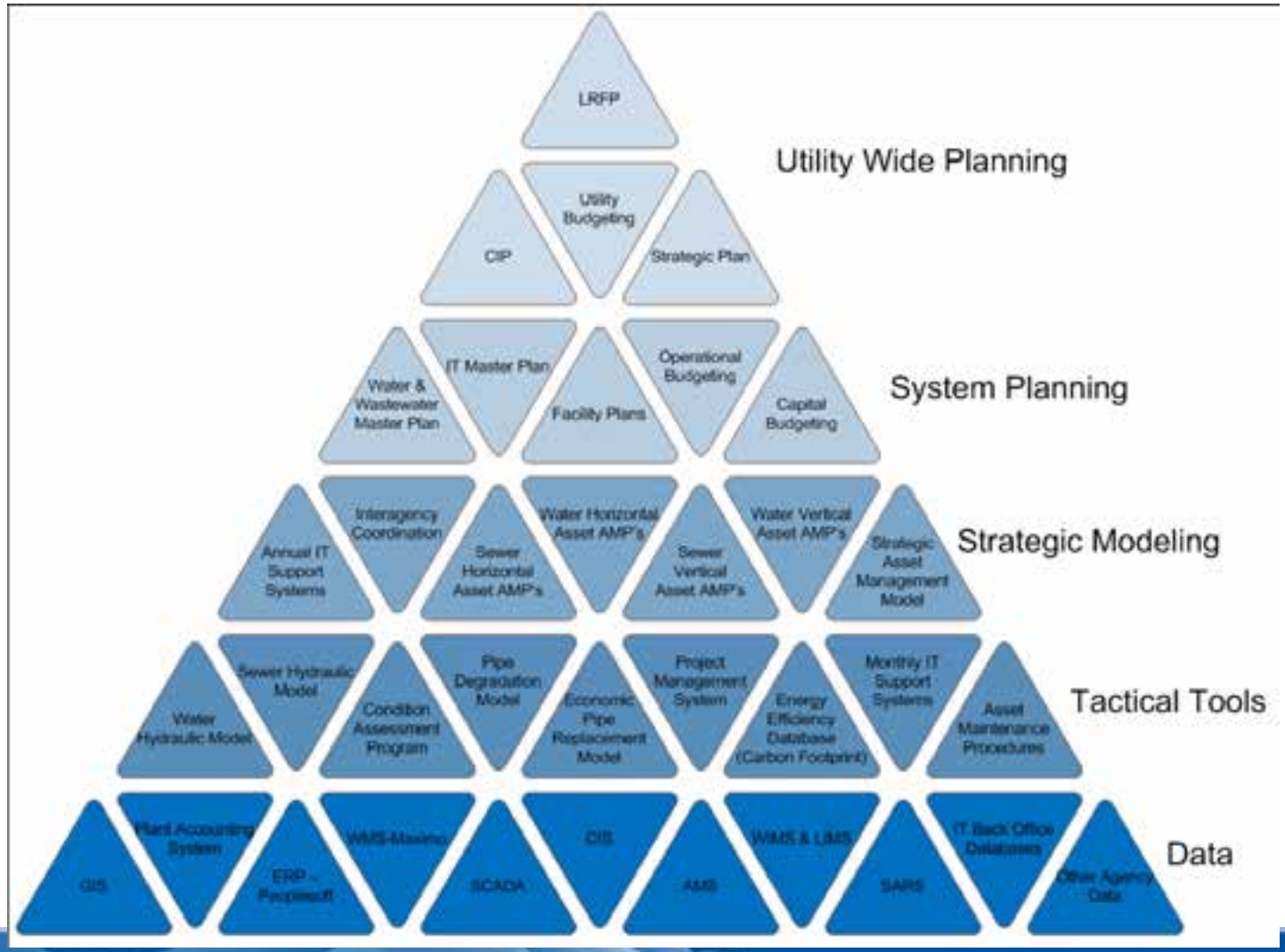
Functional Best Practice

- Treat Data and Information as a Process to Be Maintained
- Don’t Make Square Peg into Round Hole (Right Tool for Job)
- Data At Right Place at Right Time
- Part of the Entire Business – Ensure Collaboration & Accountability

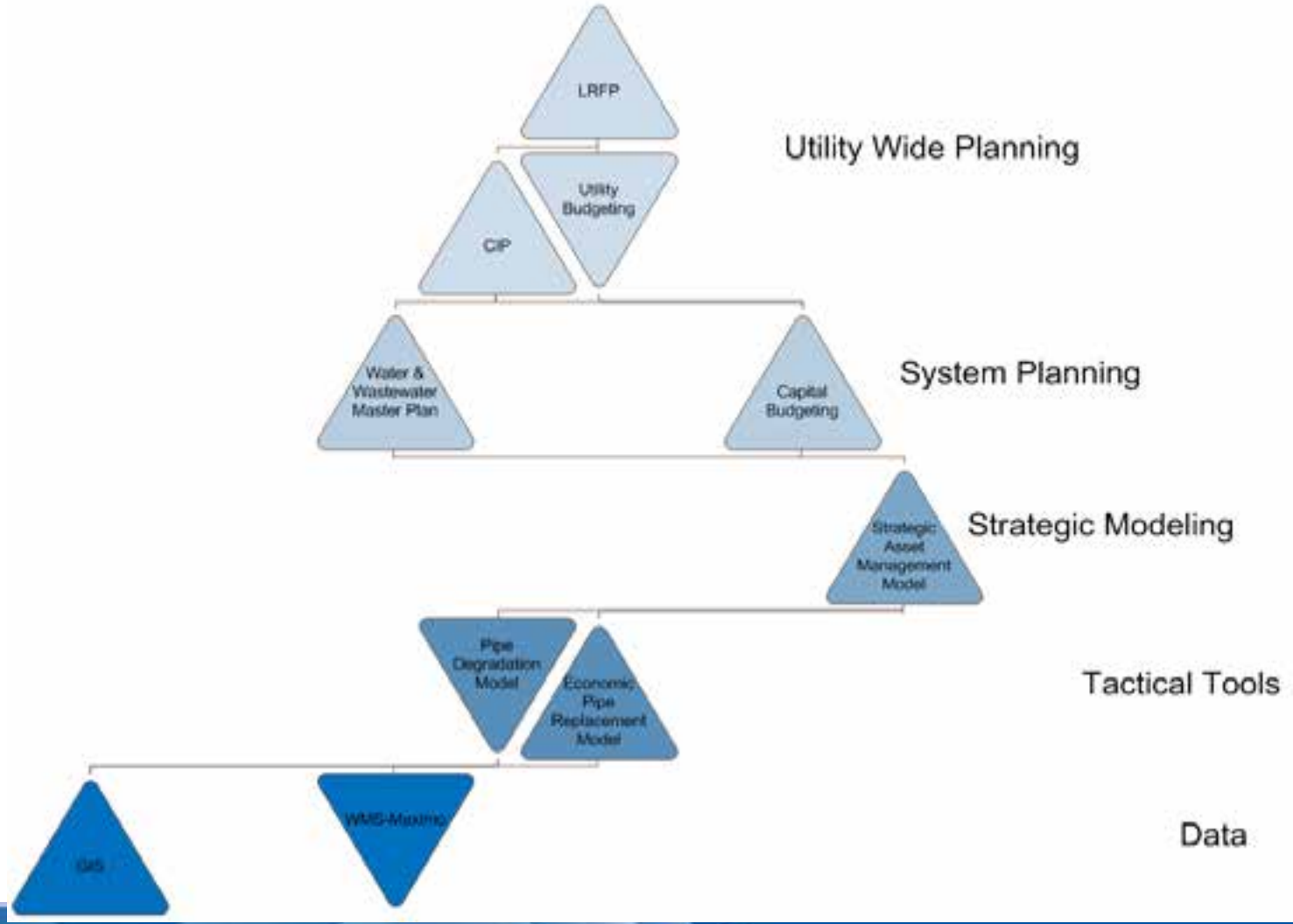


Link and Rollup:
Move from Information
To Knowledge and Wisdom

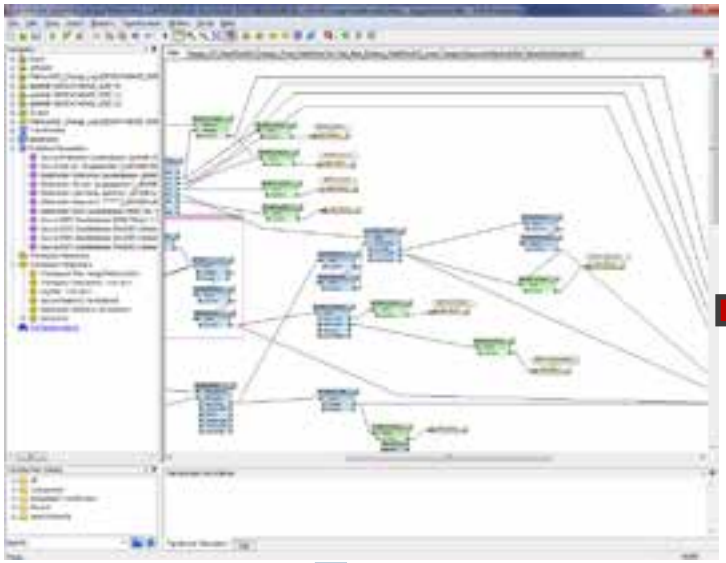
GIS Information Chain Creation : Water Pipe



GIS Information Chain Creation : Water Pipe



Likelihood: Failure Prediction and Economics

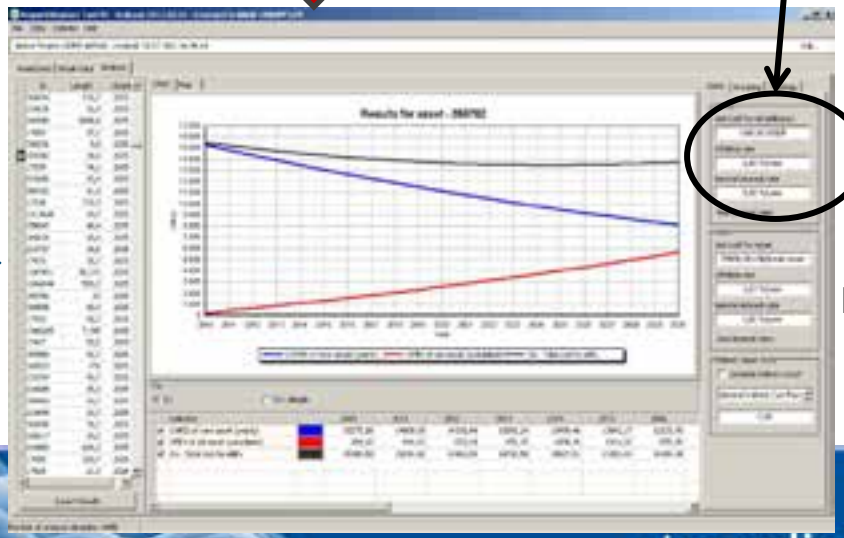


- Scripting Process Does Heavy Lifting

Triple Bottom Line Consequence of Failure

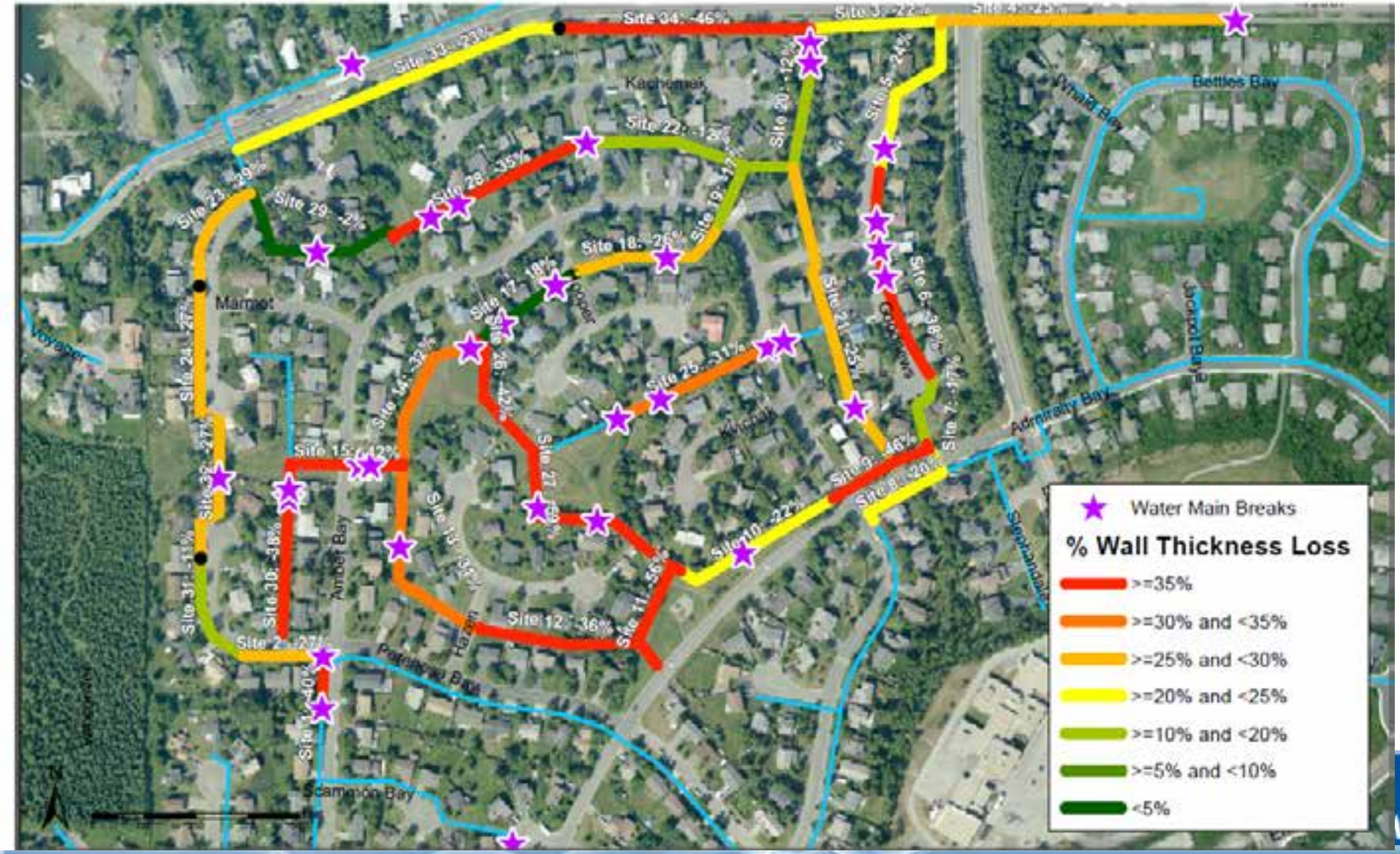
Scripting tools also generate R&R costs

Likelihood of Failure Developed through Statistical Failure Model

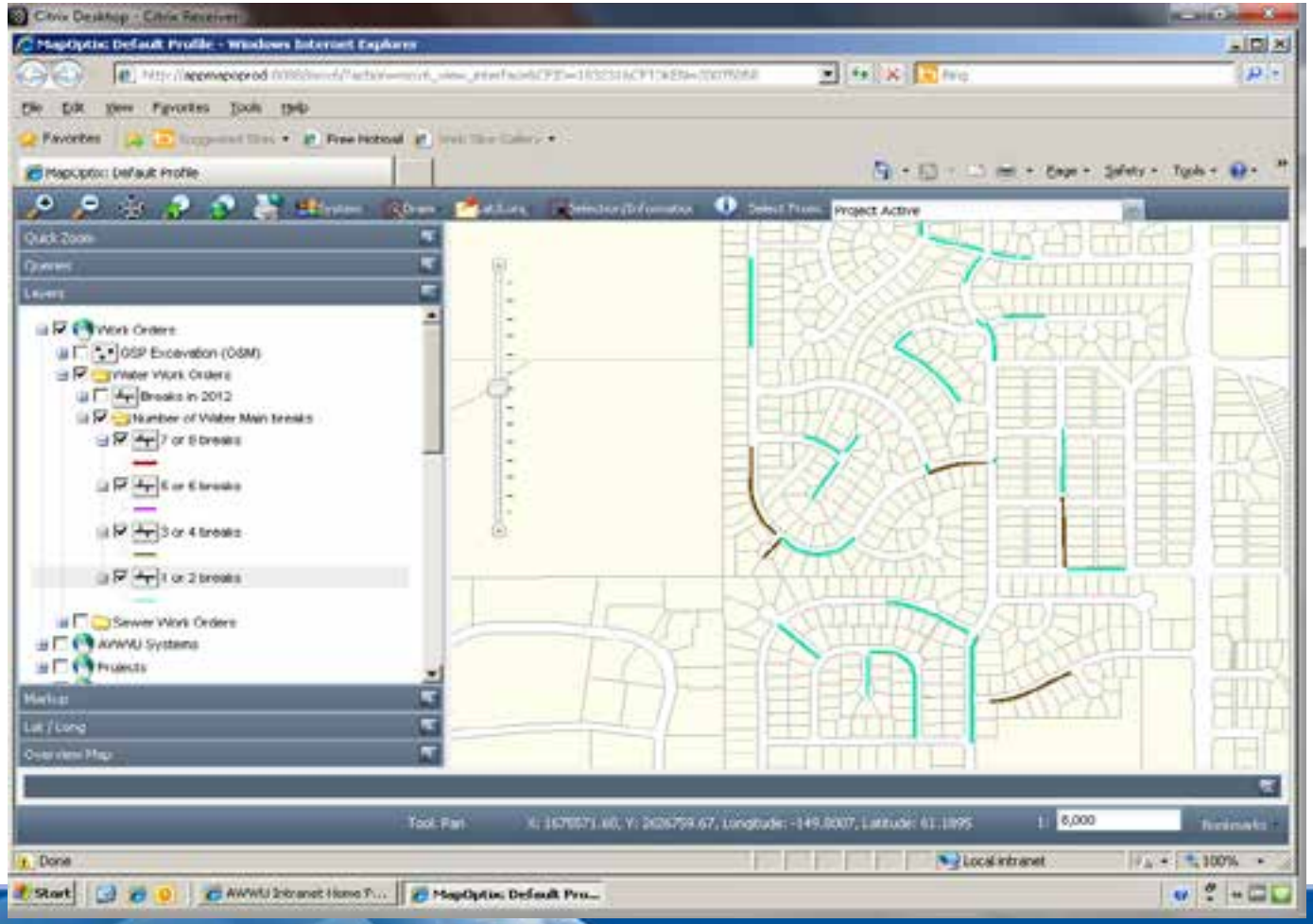


$$\lim_{h \to 0_+} \frac{P\{N(t+h) - N(t) = 1 \mid N(t) = j\}}{h} = \underbrace{(1+\alpha j)}_{\text{Yule Factor}} \underbrace{\delta t^{\delta-1}}_{\text{Weibull Factor}} \underbrace{\exp(Z^T \beta)}_{\text{Cox Factor}}$$

Likelihood: Validation of Approach



Institutionalized Results



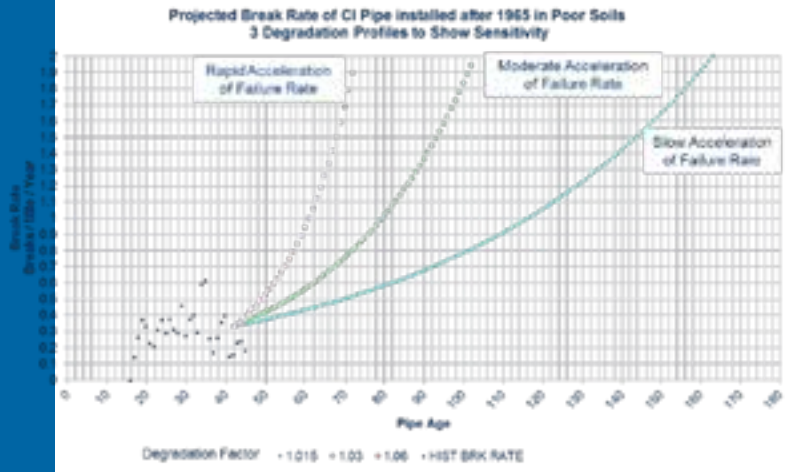
Capital Program Results

Optimal Replacement Year By Individual Pipe Segment

Final Sieve is Engineering Judgment on Final Project Scope

Execution to Policy: Service Level

Develop Break Rate Curves from Historic Break Data



Define Failure Tolerance Based on Consequence (same as previous)

Direct and Indirect Cost of Failure	Break Rate Tolerance Br/Mi/Yr
< $100,000	2
$100,001 to $200,000	1
$200,001 to $500,000	0.5
> $500,001	0.2

Service Lives should be defined in terms of Level of Service- i.e Risk Tolerance (BR's)

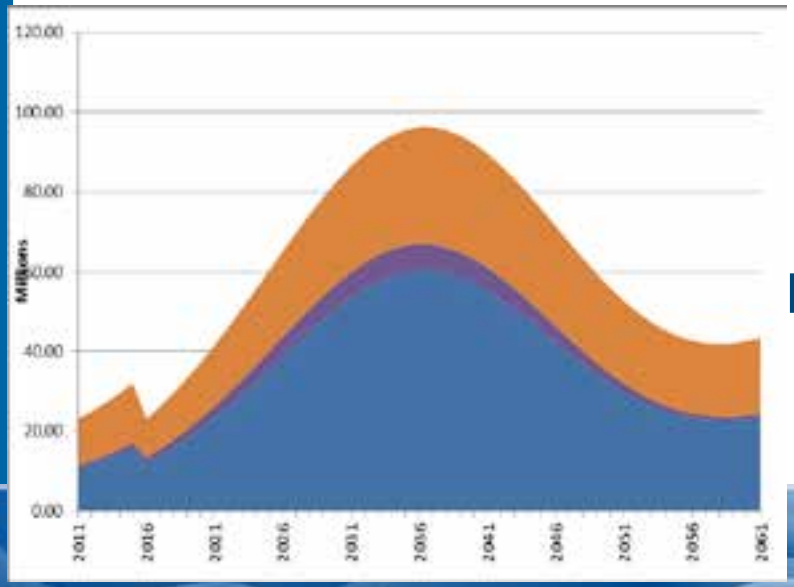
Informal Service Level:
3 breaks/3 blocks/ 3 years ~ 2 br/mi/yr

Execution to Policy: Financial Plan

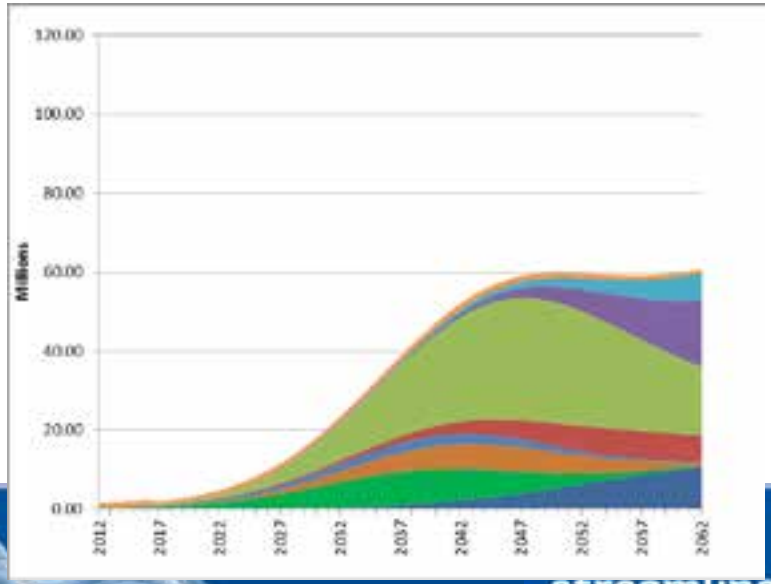
New Service Lives Based on Service Level

	Nessie	MBR 0.5	MBR 1	MBR 2
AC	75	125	150	170
CI_POST_65_BS	50-60	55	80	105
CI_POST_65_GS	60	85	110	135
CI_PRE_65_BS	50-60	75	100	125
CI_PRE_65_GS	75	100	125	150
DI_BS	50-70	105	130	150
DI_GS	60-75	135	155	180

2011 Nessie



2012 Updated Nessie



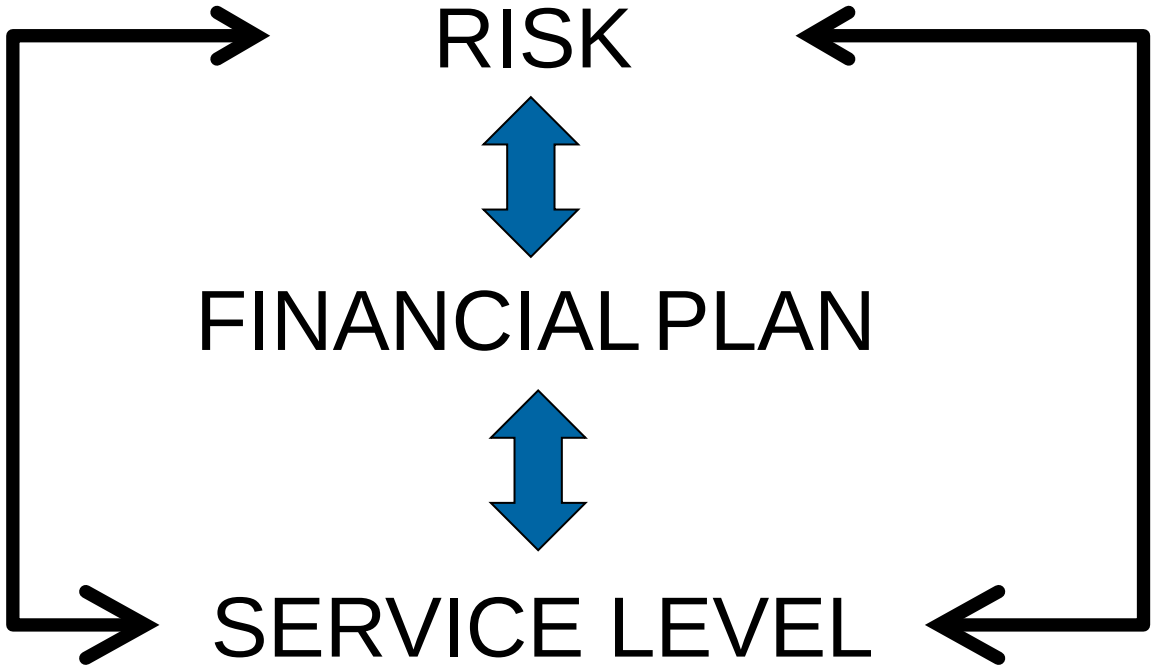
Returning Approach Back to Policy

Executive Team Commitment

Organizational Development

Define Service Levels / Risk Policy

Policy Salsa



Service Level/Risk Policy

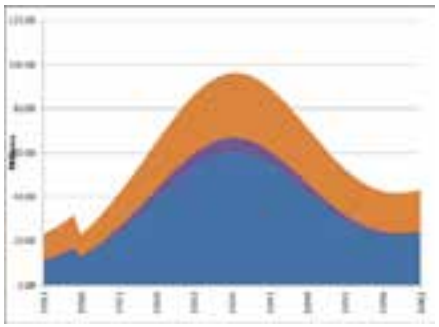
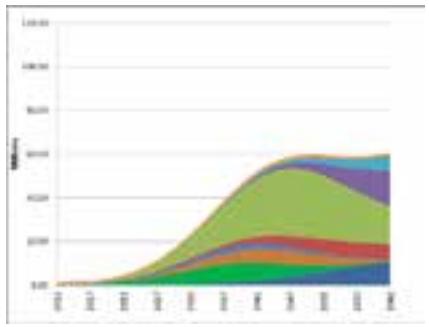
Capital Budget

- Water 17% Reduction
- Sewer Holding the Line

Operating Budget

- Able to Hold Operating Budget
- Able to Hold Service Level

No Impact to Service

Questions????

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