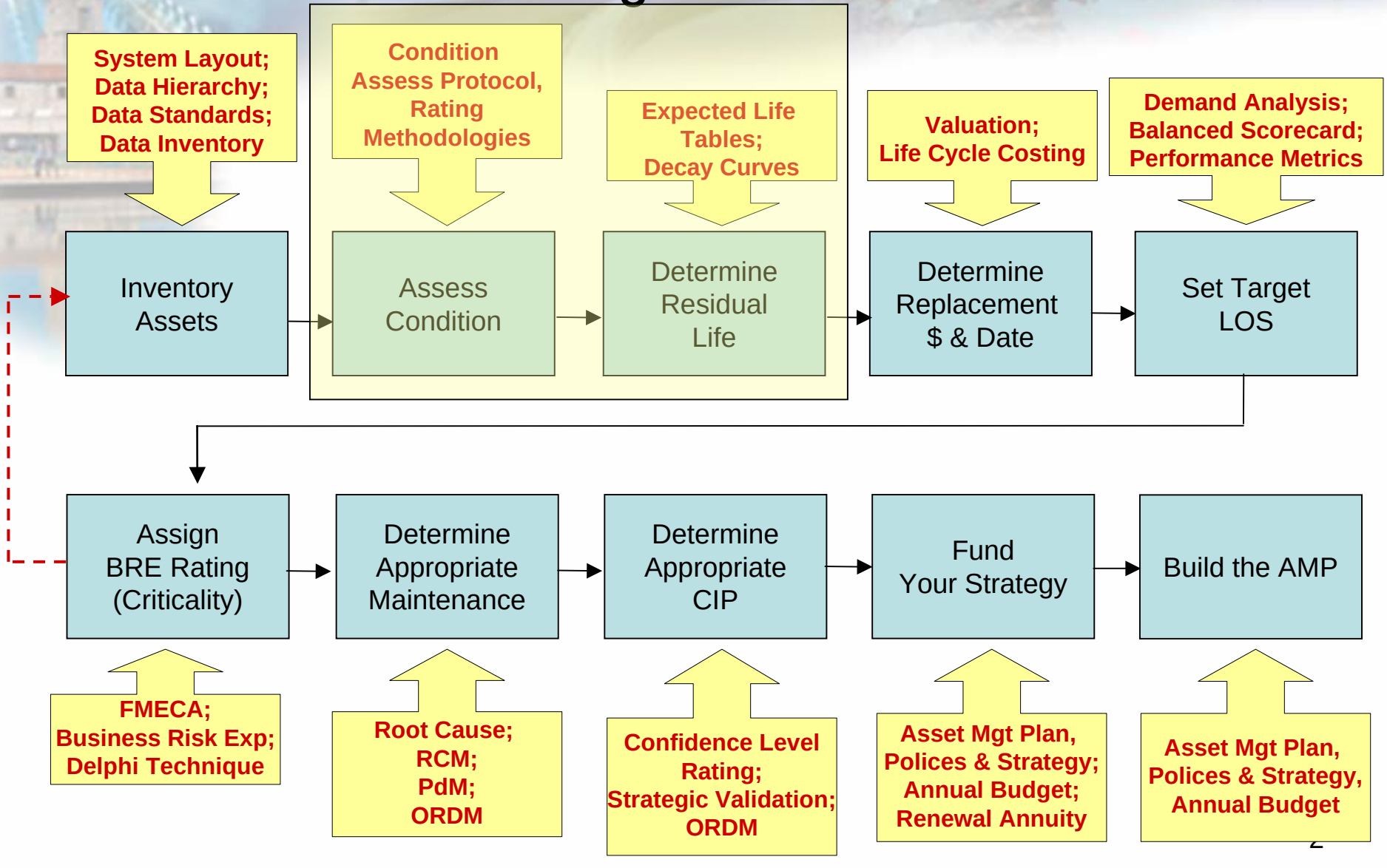
Q1b. What Condition Is It In And What Is Its Remaining Physical Life?

AMPLE

Asset Management Program
Learning Environment

Core AAM Program Process Tools



BAP Condition / Performance Assessment

- We thoroughly understand and have recorded the current levels of service in terms of quantity and quality of service including :
  - Condition
  - Function / size /type (fit for use)
  - Regulatory requirements
  - Reliability
  - Repair response times
- We report this performance against our required levels of service annually …

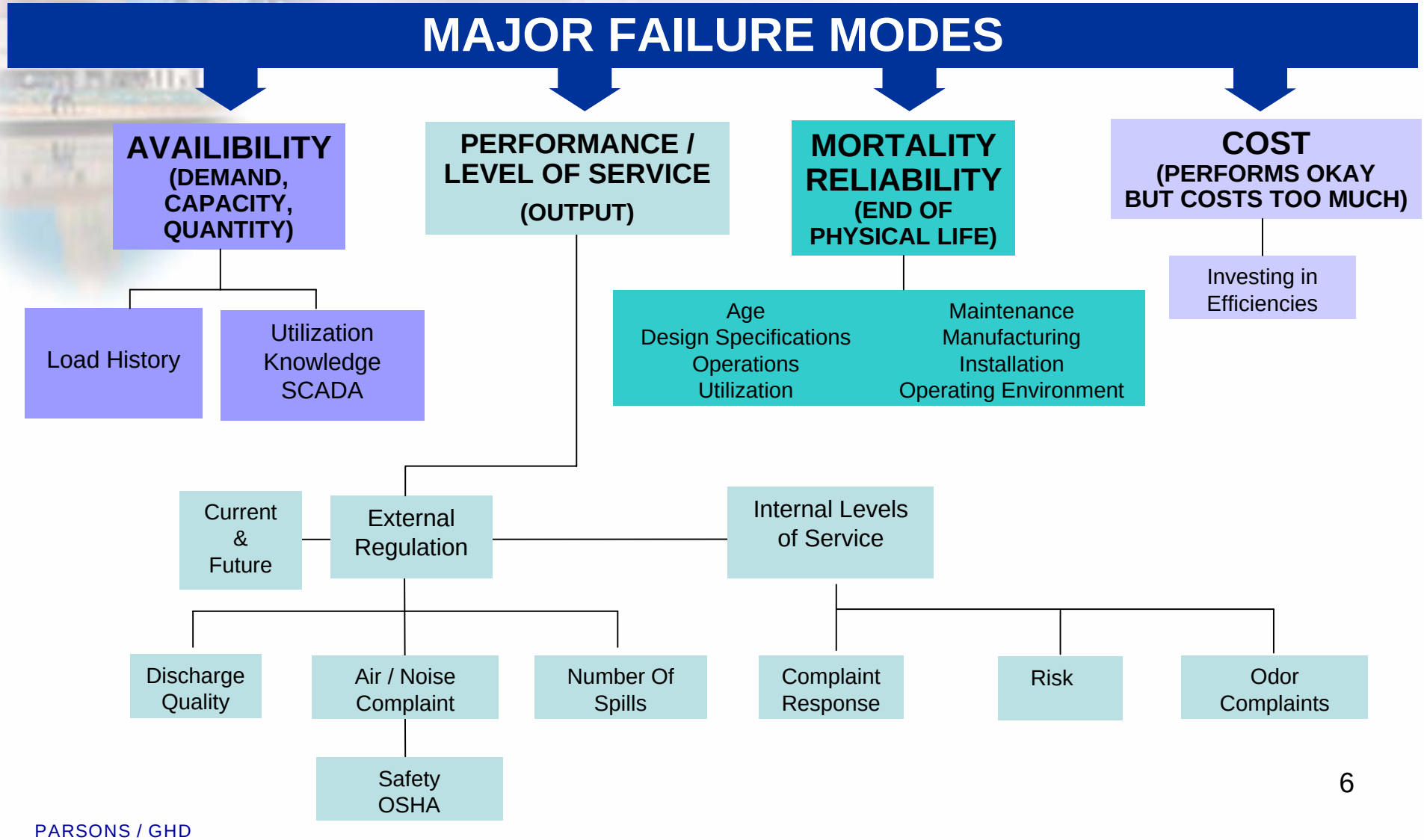
BAP Condition / Performance Assessment

- We monitor condition, performance and cost to enable us to predict the failure mode by which the asset will fail to (or cause to) deliver the service level required from the asset.

Definitions

- Renewal:
  - Repair – normal periodic maintenance, minor in nature, anticipated in the normal operation of the asset; no enhancement of capabilities
  - Refurbish/Rehabilitation– replacement of a component part or parts or equivalent intervention sufficient to return the asset to level of performance above minimum acceptable level; may include minor enhancement of capabilities; typically funded out of capital budgets
  - Replace
    - Without enhancement – substitution of an entire asset with a new or equivalent asset without enhancement of capabilities
    - With enhancement - substitution of an entire asset with a new or equivalent asset with enhanced capabilities
- Non-Asset Solutions

The Four Core "Failure Modes"

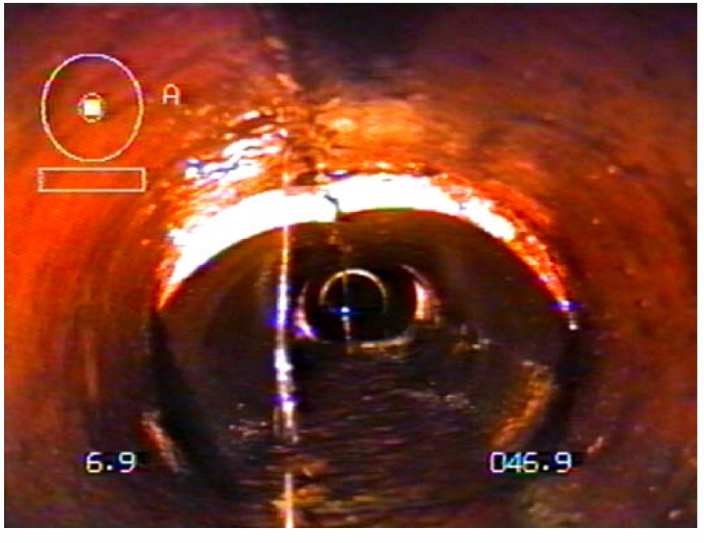


Typical Condition Assessment Techniques

1. Visual inspection
2. Non-destructive testing
3. Wear products/contaminants testing
4. Vibration analysis
5. Performance analysis
6. Current & temperature analysis

Methods to Inventory and Document Structural Conditions:

- Pump Station Inspection
- Manhole Inspection
- Smoke Testing
- Dye Testing
- Video Inspection (CCTV)
- Lamping
- Sonar
- Global Positioning System
- Building Inspection
- Ground Penetrating Radar



Example: Early Forms of Condition Definitions and Ranking Criteria

Condition Class 1:	Damage to be repaired immediately
Condition Class 2:	Damage to be repaired within 1 year
Condition Class 3:	Damage to be repaired within 3 years
Condition Class 4:	Damage to be repaired within 7 years
Condition Class 5:	Damage to be repaired in the course of other construction work
Condition Class 6:	No damage

A. Urgent repairs
   - To meet emergency situations
   - To meet legal requirements

B. Necessary repairs
   - To eliminate safety hazards and code violations
   - To meet contractual obligations
   - To perform required renovations or repair

C. Desired repairs
   - To replace equipment
   - To extend or enhance service
   - To match funds

D. Ongoing repairs
   - To continue work in progress

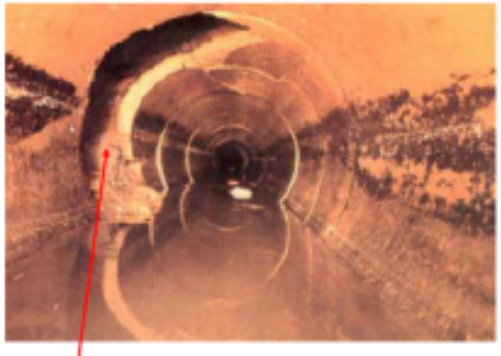
E. Deferrable repairs
   - To perform non-essential renovations/improvements
   - To perform projects with questionable need or with timing problems

Example: Collection System Rating Structure

- Pipe Rise/Joint Offset
  1. Minor – not critical
  2. Moderate – not critical to flow pattern
  3. Significant – possible infiltration source
  4. Severe – pipe offset impeded/obstructed flow, probable infiltration source
- Pipe Dip
  1. Length 0-10 feet – not critical
  2. Length 11-20 feet – causes minor velocity reductions
  3. Length 21-30 feet – causes solids to settle in pipe
  4. Length >31 feet – can cause significant solids buildup
- Joint Infiltration
  1. Slow drip
  2. Steady drip
  3. Continuous flow – moderate
  4. Continuous flow – severe
- Mineral Buildup (at joint)
  1. Deposit on wall without any noticeable flow restriction – not critical
  2. 0.25 Reduction in pipe diameter, some flow restriction
  3. 0.25-0.5 Reduction in pipe diameter, significant flow restriction
  4. >0.5 Reduction in pipe diameter, camera unable pass – severe flow Reduction
- Laterals with Roots (house lateral)
  1. Some root penetration – no blockage
  2. More established root presence – minimal blockage
  3. 0.5 of lateral is blocked – possible infiltration and flow restriction
  4. Near total blockage – probable infiltration and flow restriction
- Joints with Roots
  1. Some root penetration – no blockage
  2. More established root presence – minimal blockage
  3. 0.5 of pipe blocked – possible infiltration and flow restriction
  4. Near total blockage – probable infiltration and flow restriction
- Pipe Break
  1. Minor Break – no structural impairment
  2. Break with separation – structural impairment not immanent
  3. Break with separation/partial collapse immanent structural failure
  4. Severe breakage requiring immediate attention to maintain flow
- Debris Blocking Pipe
  1. Minor debris – minimal flow restriction
  2. Moderate debris – minor flow restriction
  3. Significant debris – moderate flow restriction
  4. Severe debris – near total flow restriction
- Pipe Cracks
  1. Hairline no structural impairment
  2. Crack with separation structural impairment not immanent
  3. Crack with separation/partial collapse immanent structural failure
  4. Severe crack requiring immediate attention to maintain flow
- Lateral protrusion
  1. <1" minimal flow restriction
  2. >1" moderate but not critical to flow pattern
  3. 0.5-0.75 full pipe blocked – severe flow restriction
  4. 0.75 full pipe blocked – severe flow restriction

Emergent “National” Standards

Hole (H)



Distance (feet)	Video Ref	Code Group / Descrip	Code Modifier / severity	Continuous defect	Value S/M/L	Value Inches 1st	Value Inches 2nd	Value %	Value Joint	Circumferential location At / from	Circumferential location To
309.4		H								07	12
312.0		FC								12	04
312.0		FL								12	
312.0		FL								08	

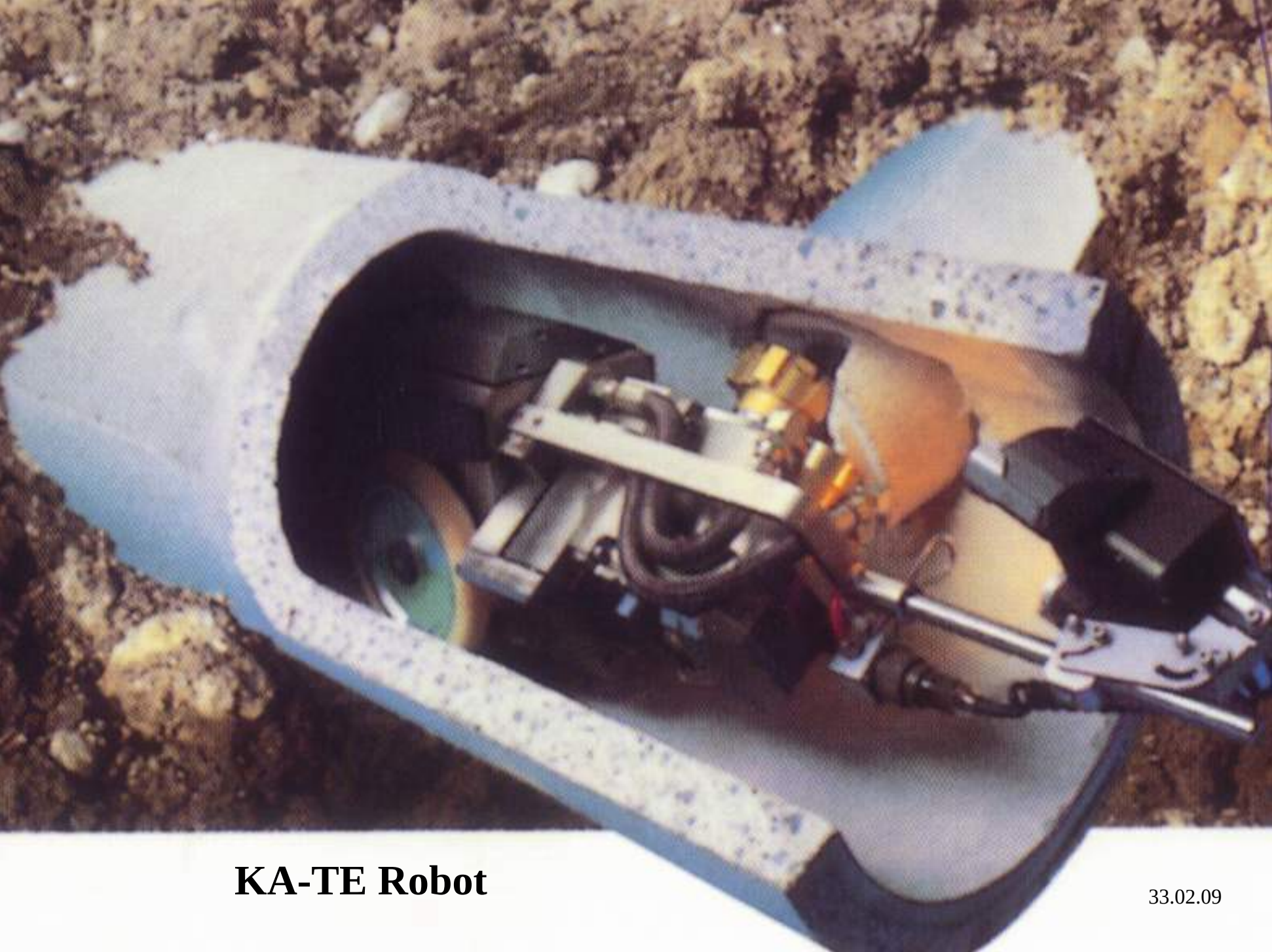
“PACP” - Pipe Assessment Certification Program

*Structural defect scores - Pipe sewers

Defect	MSCC Code	Description	Score
Longitudinally displaced joint / Open joint	OJM	Medium < 1*pipe thickness	1
	OJL	Large > * pipe thickness	2
		if soil visible grade as a hole	165
Radially displaced joint	JDM	Medium < 1* pipe thickness	1
	JDL	Large > 1* pipe thickness	2
		> 10% diameter & soil visible	80
Cracked	CC	Circumferential	10
	CL	Longitudinal*	10
		Complex*	40
		Helical*	40
	CM		
Fractured	FC	Circumferential	40
	FL	Longitudinal*	40
		Complex*	80
		Helical*	80
	FM		
Broken	B		80
Hole	H	Radial extent <¼	80
		Radial extent ¼+	165
Collapsed	X		165

*Abstract from Sewerage Rehabilitation Manual (Fourth Edition)

National Association of Sewer Service Companies (NASSCO)
Water Research Centre (WRc), Manual of Defect Classification



KA-TE Robot

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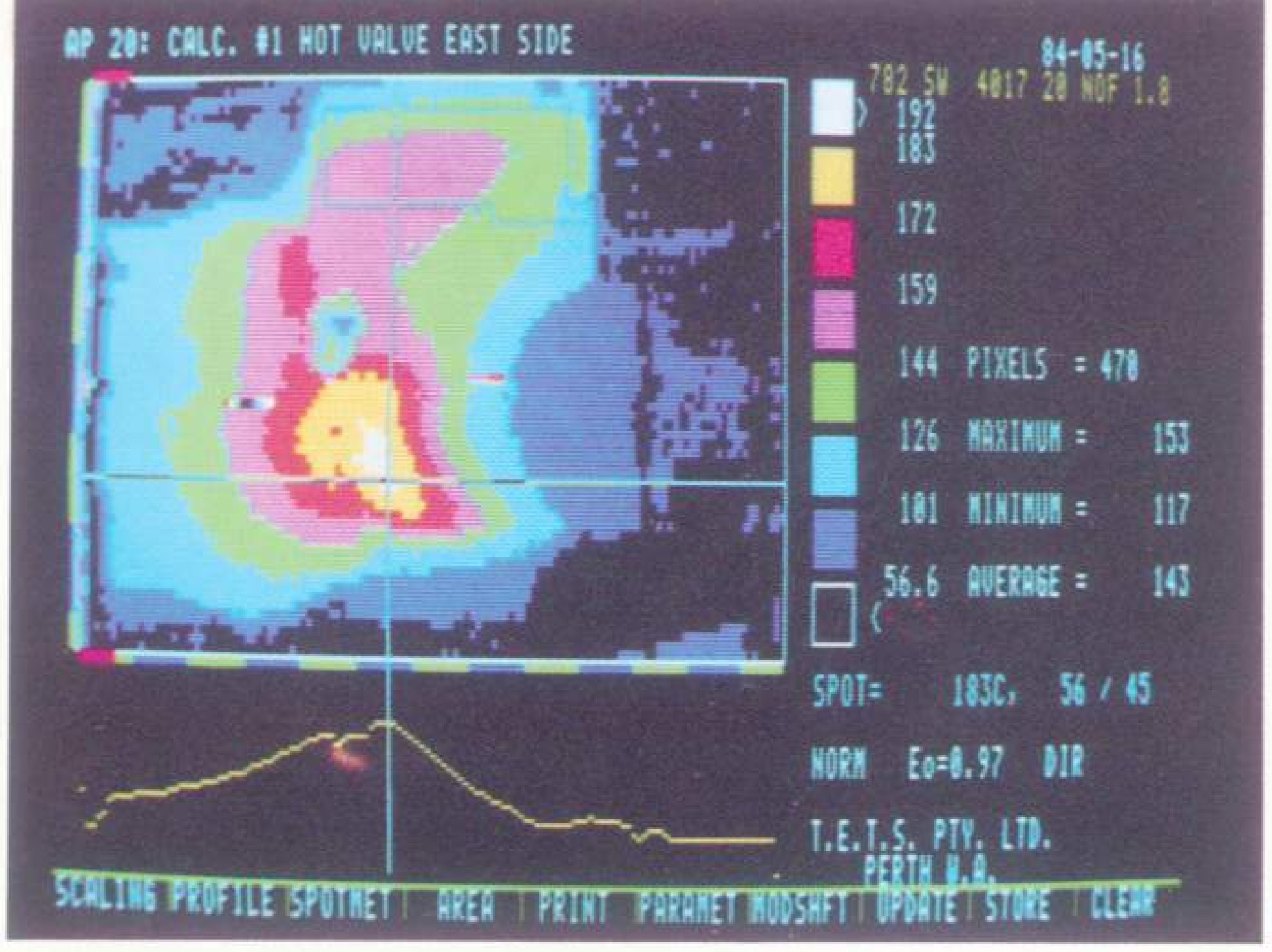
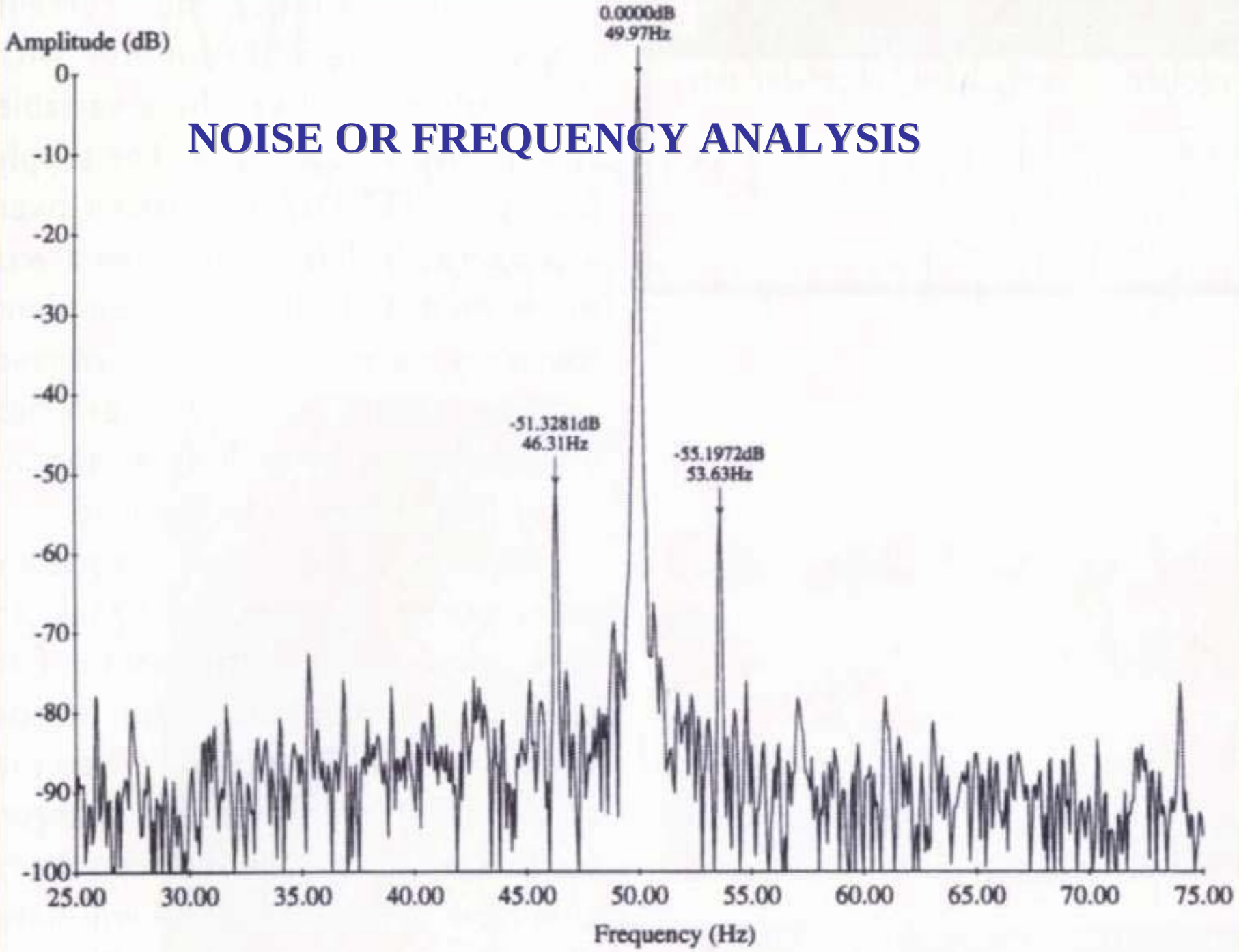
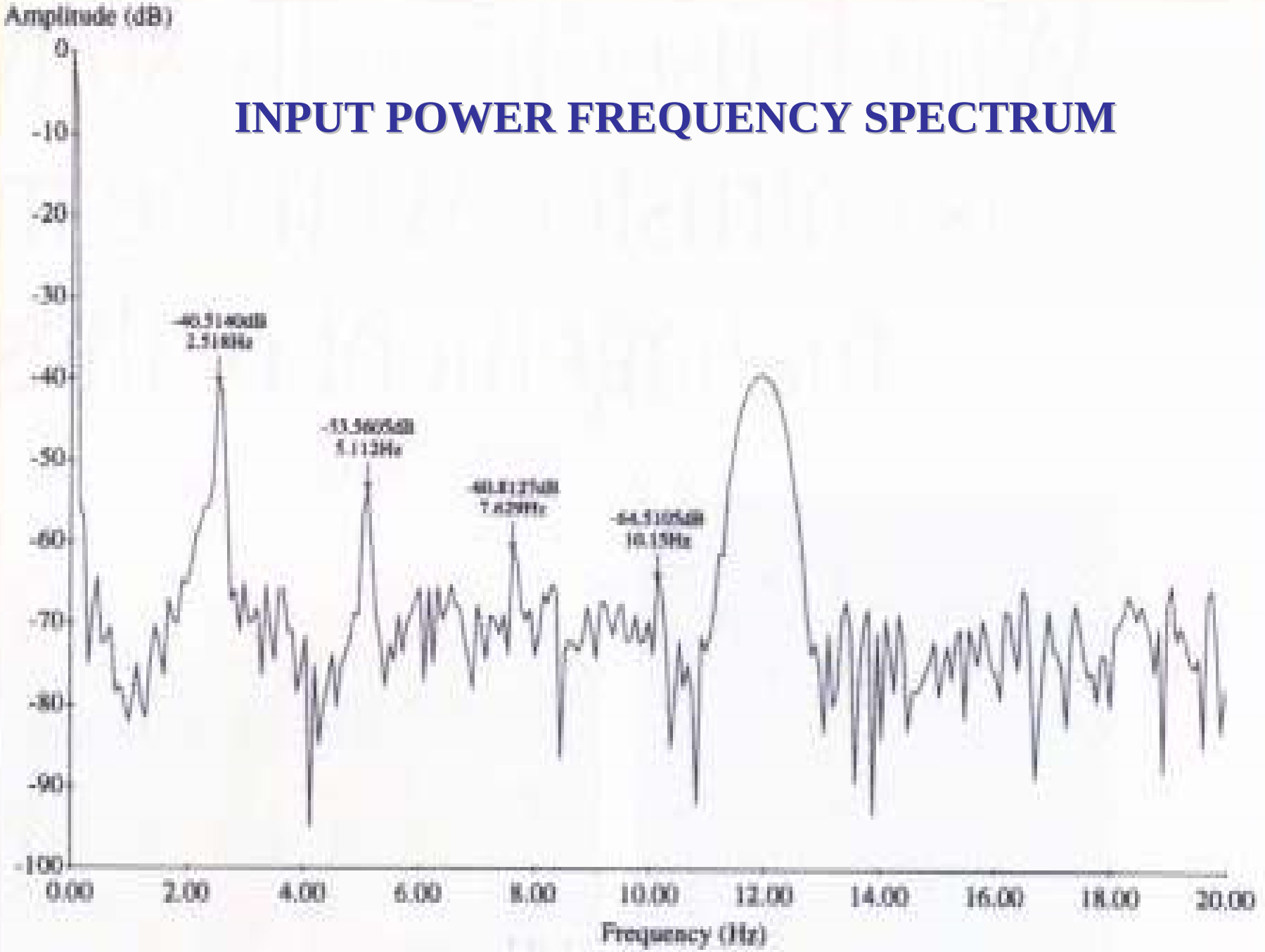

AP 20: CALC. #1 HOT VALUE EAST SIDE
84-05-16
782 SW 4017 20 NOF 1.8
192
183
172
159
144 PIXELS = 470
126 MAXIMUM = 153
101 MINIMUM = 117
56.6 AVERAGE = 143
SPOT= 183C, 56 / 45
NORM Eo=0.97 DIR
T.E.T.S. PTY. LTD.
PERTH W.A.
SCALING PROFILE SPOTMET AREA PRINT PARAMET MODSHFT UPDATE STORE CLEAR

NOISE OR FREQUENCY ANALYSIS

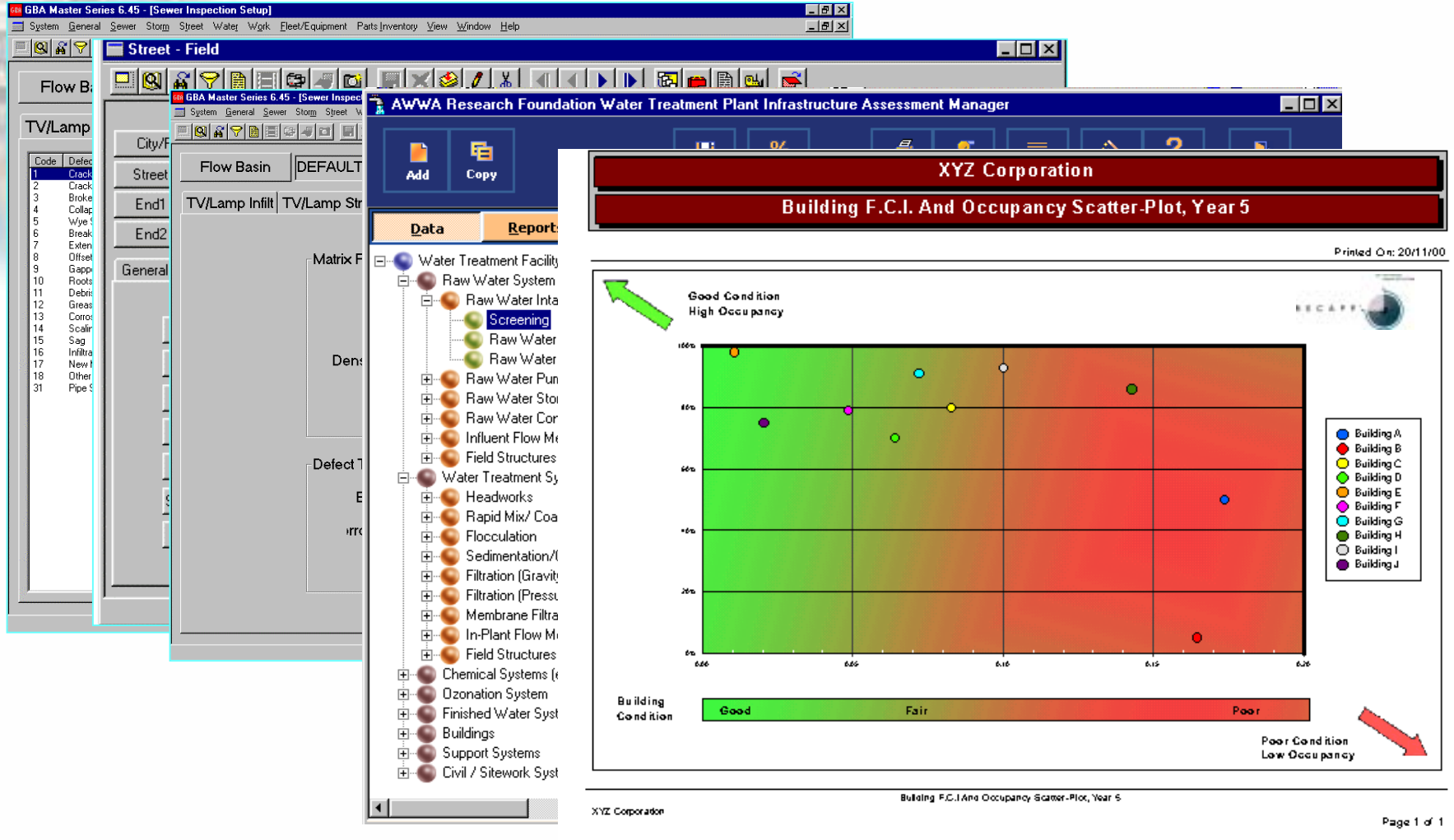


INPUT POWER FREQUENCY SPECTRUM



SHOCK PULSE ANALYSIS

Condition Assessment



Condition Rating Example

Condition Assessment

Condition Rating	Description	Maintenance Level	Degree of Replacement
0	NEW	Normal	0%
1	PERFECT/EXCELLENT CONDITION	Normal	0%
2	MINOR DEFECTS ONLY	Minor	5%
3	BACKLOG MAINTENANCE REQUIRED	Significant	10-20%
4	REQUIRES MAJOR RENEWAL	Renew	20-40%
5	ASSET ALMOST UNSERVICEABLE	Replace	>50%

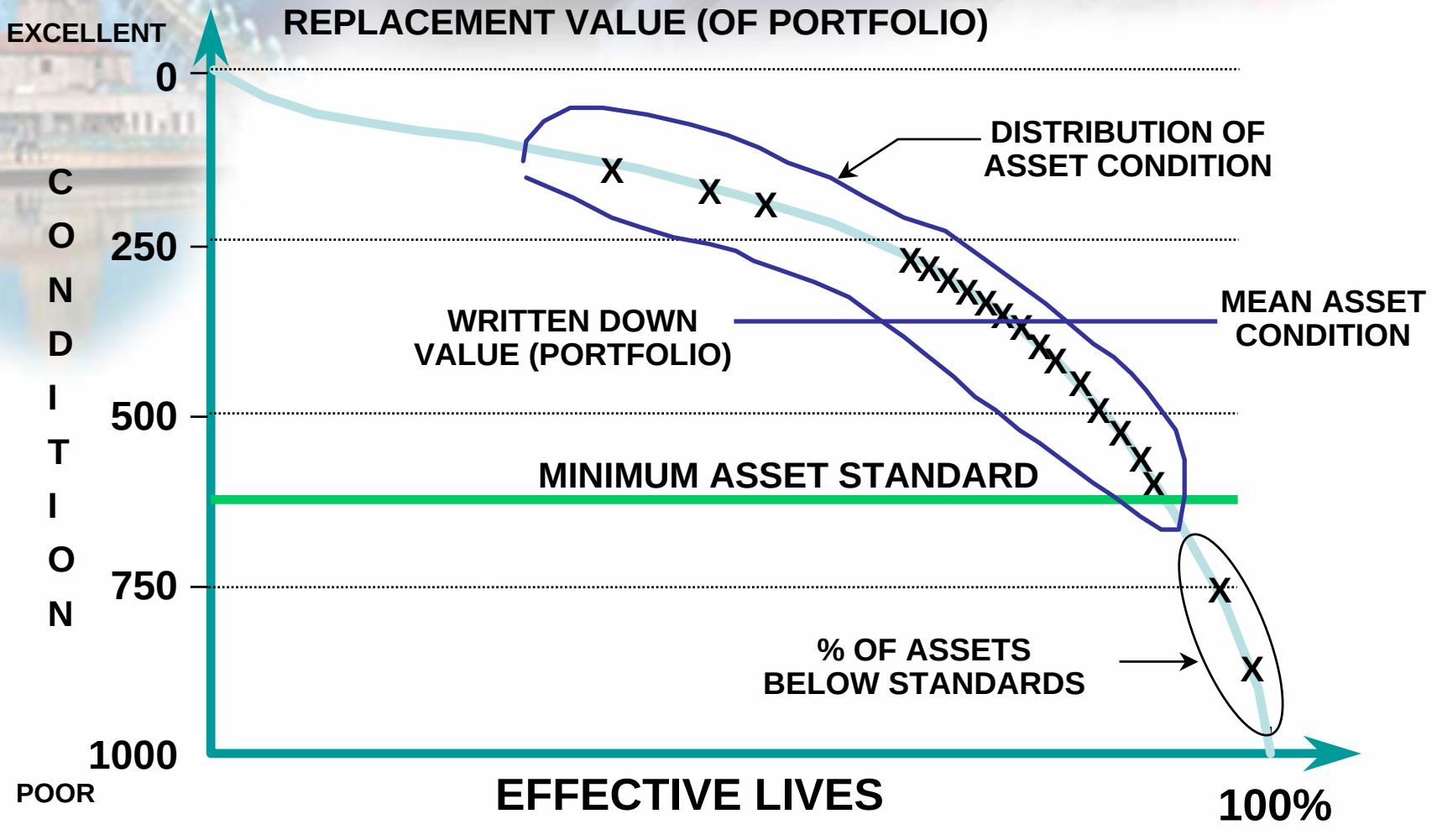
Condition Assessment

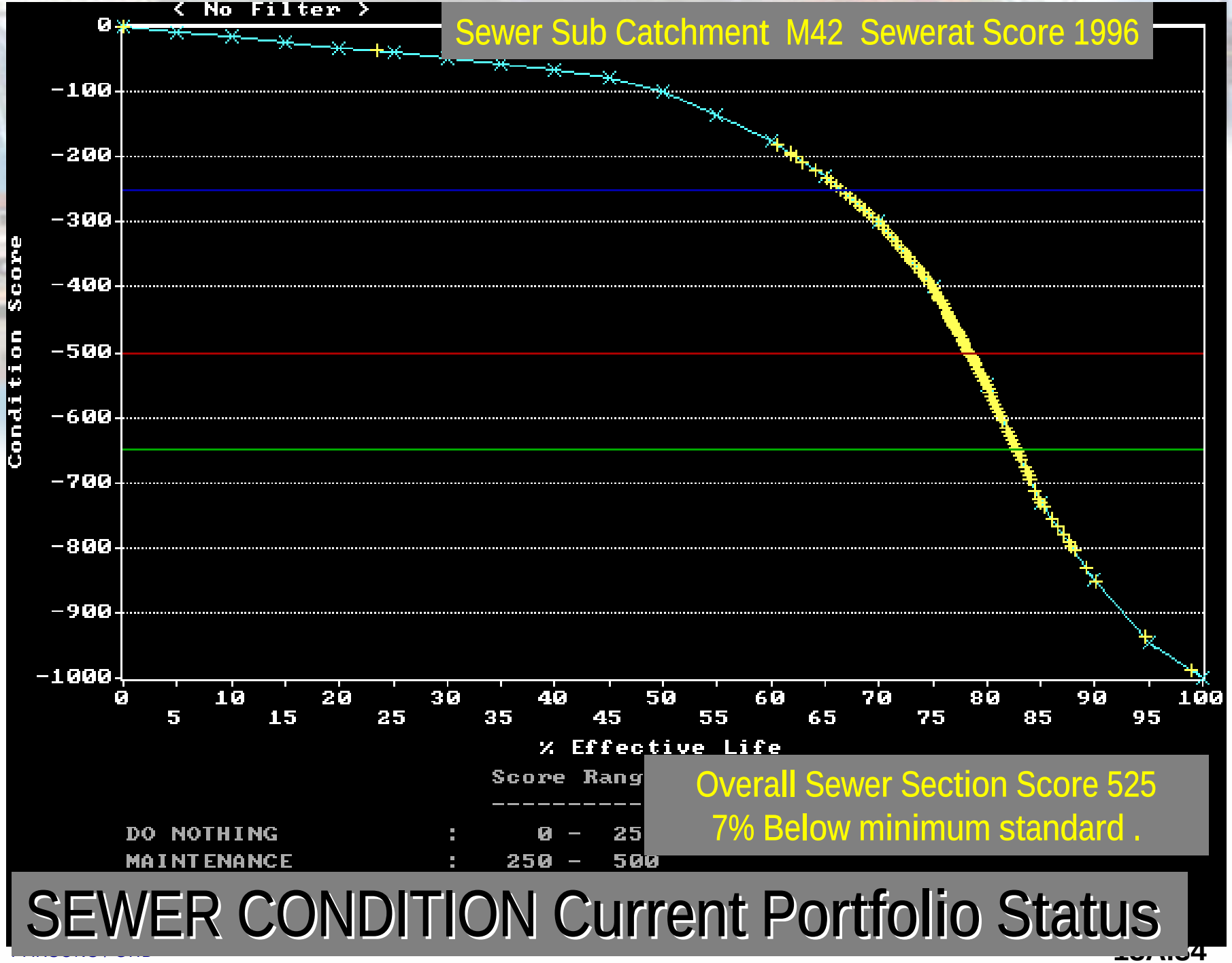
Intermediate Method

4.1
4.3
4.5
4.7
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.6
5.7
5.8
5.9

Develop Method
Related To
Distress
Of Assets

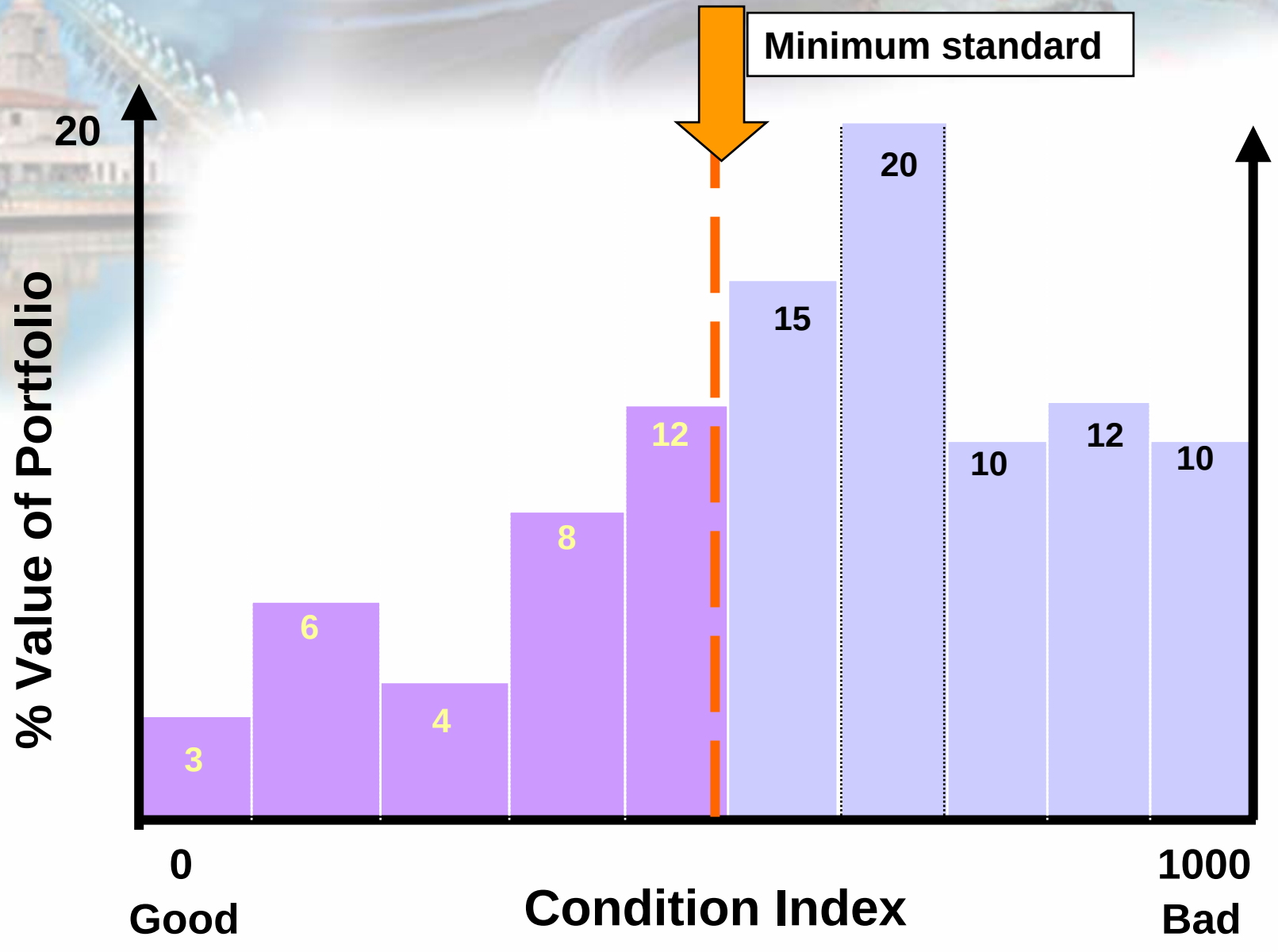
Reporting on Asset Portfolios





SEWER CONDITION Current Portfolio Status

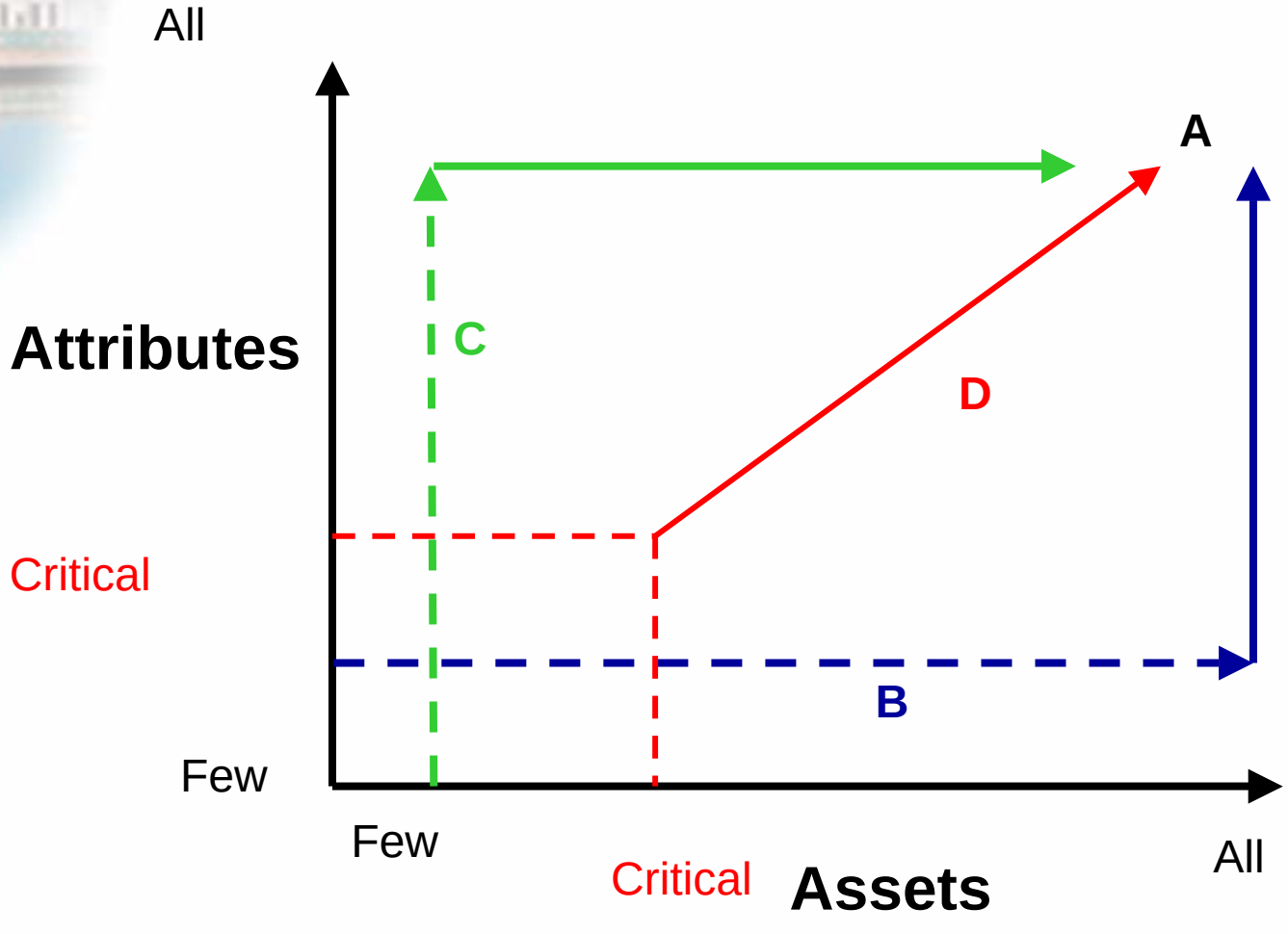
Portfolio Condition



Expanding This To The Whole Asset System Cost Effectively

- "We cannot *afford* to understand the condition of all our assets!"
- "Do we *really* need to understand this ?"
- Yes , we need to be confident in what we tell our Board and stakeholders .
- "Can't we do it smarter?"
- Yes we can …

Data Collection Strategies



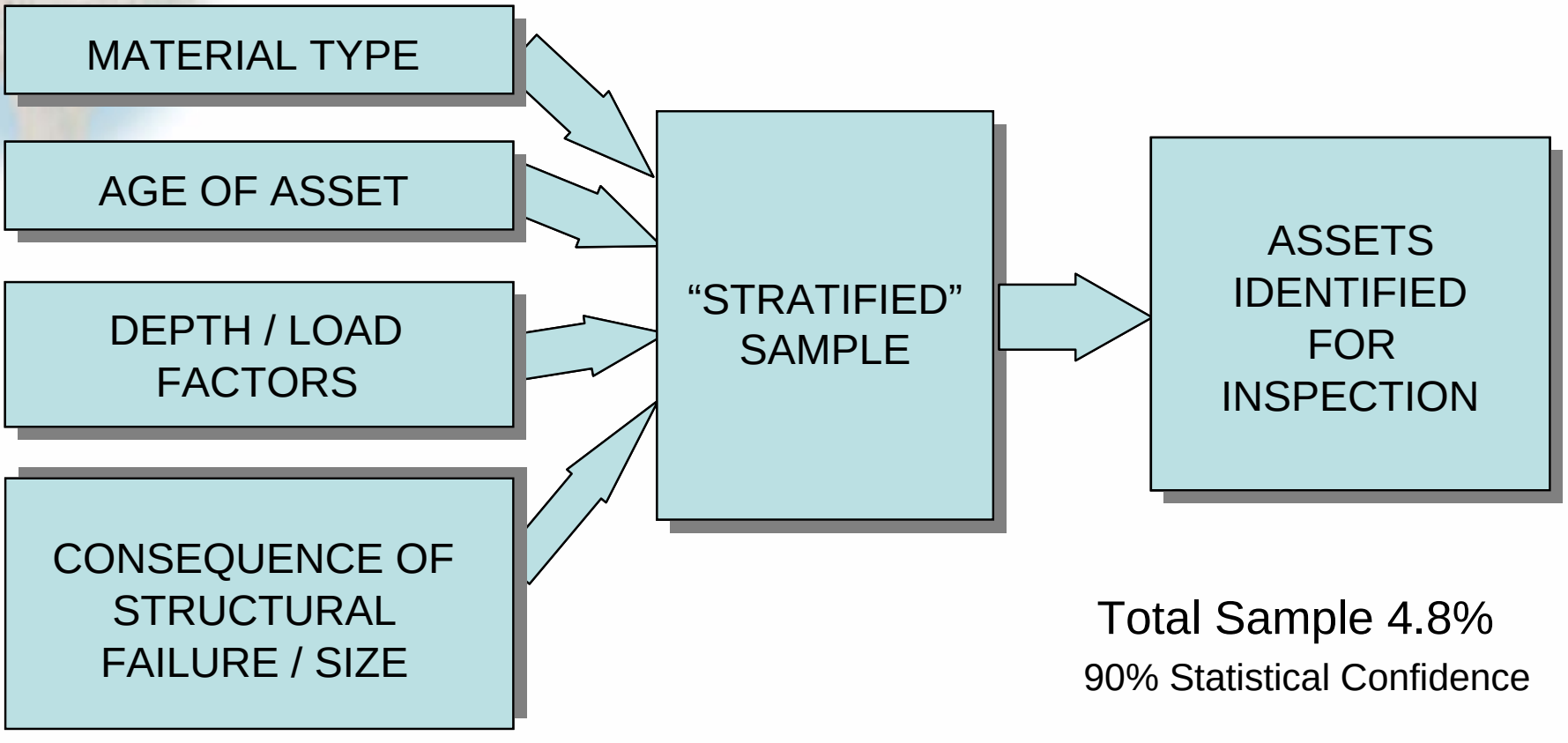
Actuarial / Risk Based Condition Assessment Program

- Understand causes of decay
- Understand risk (criticality) of assets
- Determine risk drivers
- Rank assets against drivers
- Use actuarial sampling techniques to determine sample needed to derive necessary confidence level
- Complete sample till confidence level is confirmed

Advanced CAP: Actuarial Sampling

Key Variables (4 No.):

Sewer asset profile consists of 20,000 pipelines (manhole lengths)



Total Sample 4.8%

90% Statistical Confidence

Actual Savings Achieved

OPTION	COSTS / SAVINGS ACHIEVED
1. ORIGINAL PRACTICE	$ 4.48 Million
3. ACTUARIALLY BASED	$ 0.74 Million

Note!

- Condition assessment is not an end in itself, but is a *means* to an end
- The “end” is to determine “remaining useful life”
- “Good”, “Fair”, “Poor” type ratings have little utility unless they lead to an effective estimate of remaining useful life

The remaining useful life of an asset is what we have left to try to manage

Exercise Number 1b

Help Tom develop an understanding of the physical condition of the assets and components in the pump station :

- Use your asset register
- First, let's add data about the date the assets were acquired, their original cost and the "class" of the asset …

Exercise Number 1b

Help Tom develop an understanding of the physical condition of the assets and components in the pump station :

- use your asset register
- rate their condition using the assessment table shown in the handout …
- *The spreadsheet will then calculate the residual life and the % asset consumed…*

Sheet B on the Exercise Spreadsheet

Effective Lives (Years)

Asset Type	Effective Lives
Civil	75
Pressure Pipework	60
Sewers	100
Pumps	40
Motors	35
Electrical	30
Controls	25
Building Assets	60

This is calculated based on class of asset you assign – you need to modify if it is not a reasonable estimate

Sheet B on the Exercise Spreadsheet

Effective Lives (Years)		Condition Rating / Residual Life				
Asset Type	**Effective Lives**	1	2	3	4	5
Civil	75	75	60	45	30	15
Pressure Pipework	60	60	48	36	24	12
Sewers	100	100	80	60	40	20
Pumps	40	40	32	24	16	8
Motors	35	35	28	21	14	7
Electrical	30	30	24	18	12	6
Controls	25	25	20	15	10	5
Building Assets	60	60	48	36	24	12

This is calculated – you only have to rate condition